Generator SPECTRA Update

Issue 8

Data to 30 June 2010

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Prepared By

Sheryl Paine
Water Resource Scientist

Reviewed By

Jack McConchie
Principal Water Resource Scientist

Opus International Consultants Limited
Environmental
Level 9, Majestic Centre, 100 Willis Street
PO Box 12 003, Wellington 6144,
New Zealand

Telephone: +64 4 471 7000
Facsimile: +64 4 499 3699

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Executive Summary

This SPECTRA update was requested by the Electricity Authority and includes data from 1 July 1931 to 30 June 2010. The report provides a description of how each dataset is derived. Explanations are included for any differences between successive datasets, changes to mean flows, any new SPECTRA datasets, and any negative inflows in the datasets.

Contents

1 SPECTRA update

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SPECTRA flow routines are re-run for each update and new datasets created. These datasets are then compared with previous SPECTRA data to ensure continuity and accuracy. Monthly data (PCAL) listings and daily flow distribution tables (PDIST) are included in Appendix A. These listings and tables enable the new output to be checked and any substantial changes in these data to be identified.

The following companies have provided data for this update:

- Contact Energy Ltd
- Genesis Energy Ltd
- Joint Venture (Todd Energy/King Country Power Company).
- Meridian Energy Ltd
- Mighty River Power Ltd
- Pioneer Generation
- TrustPower

This report, and the analyses it contains, also relies heavily on data supplied by the National Institute of Water and Atmospheric Research (NIWA) from the Water Resources Archive (and funded by PGSF). Flow series from a number of rivers form a fundamental component of the datasets presented. Their use in this report is consistent with the purpose for which Government funding is provided for their collection.

Additional river flow series were provided by number of Regional Councils. Their assistance with this project is gratefully acknowledged.

All input data records have been checked for gaps and, where necessary, these have been filled to provide continuous time series.

2 Data

2.1 Datasets and mean flows

Table 2.1 Flow dataset names and mean values derived from previous SPECTRA updates and this update

Flow	Model flow name	Site number	Description	Mean flow (m^3/s) 1931 to 30 June 2008	Mean flow (m^3/s) 1931 to 30 June 2010	Type
Arapuni Tributaries	Arapuni	92724 (1)	Waikato tributary flow between Taupo and Arapuni PS	78.2	80.9	T
Benmore	Benmore	98614 (4)	Waitaki tributary flow between Lakes Pukaki & Tekapo and Benmore (Separate Tekapo simulation)	125.3	125.4	T
	Ben_tp	98615 (2)	Waitaki tributary flow between Lakes Pukaki & Tekapo and Benmore (Combined lakes Tekapo - Pukaki simulation)	123.5	123.5	T
Cobb	Cobb	97904 (2)	Cobb inflows	5.5	5.4	C
Coleridge	Coleridge	97904 (1)	Coleridge inlfows	24.5	24.5	C
Grey + Taramakau - Taipo	Grey_tara	77106(1)	Grey River at Dobson including Taramakau but not Taipo	435.1	435.5	T
Hawea	Hawea	9170 (1)	Hawea Inflows	64.9	64.9	C
Karapiro tribs	Karapiro	92714 (1)	Waikato tributary flow between Taupo and Karapiro PS	91.0	92.9	T
Mangahao	Mangahao	97502(1)	Local inflows	8.5	8.6	T
Manapouri	Manawmara	99551 (1)	Manapouri local with Mararoa dirty water spill	136.2	137.1	T
	Manapouri	99550 (1)	Manapouri local flows with no Mararoa	121.3	122.2	T
	Manareduced	99552 (1)	Manapouri with 12, 14 and 16m^3/s min flow + Mararoa dirty water spill, flushing and recreational releases	120.0	120.8	T
Matahina	Matahina	93254 (1)	Matahina Inflows	64.9	64.6	T
Ohau (separate Tekapo model)	OhauRes	98614 (6)	Ohau A only, minimum flows of 12m^3/s May to Oct and 8m^3/s Nov to Apr	70.5	70.5	T
	Ohau	98614 (3)	Ohau B and C only	80.5	80.5	T
Pukaki, Tekapo	Tek_puk	98615 (1)	No Tekapo - Pukaki simulation, one combined flow for both Pukaki and Tekapo	207.1	207.5	C

Flow	Model flow name	Site number	Description	Mean flow (m³/s) 1931 to 30 June 2008	Mean flow (m³/s) 1931 to 30 June 2010	Type
Pukaki	Pukaki	98614 (2)	Pukaki + Tekapo for separate Tekapo simulation	205.7	206.0	C
Natural Pukaki	Nat_Puk	98770 (1)	Natural Lake Pukaki Inflow	126.3	126.4	T
Rangipo	RangipoTPD	92790 (2)	Sub-catchment inflows are based on non-linear function of Taupo inflows. Incorporates latest water right discharges.	35.7	35.8	T
Rangipo	Rangi_linear	22790 (2)	Linear correlations of Taupo natural inflows used	29.1	29.0	C
Roxburgh	Roxburgh	99110 (1)	Tributary flows – but excluding Hawea outflows	443.9	444.4	T
TeAnau	Teanau	9570 (1)	Te Anau Inflows	283.0	283.5	C
Tekapo	Tekapo	98614 (1)	Separate Tekapo simulation	79.4	79.6	T
Natural Tekapo	Nat_Tek	98770 (2)	Natural Lake Tekapo Inflow	80.8	81.1	T
Tokaanu	TokaanuTPD	92790 (3)	Non linear correlations of Taupo natural inflows used	53.8	53.9	T
Tokaanu	Toka_Linear	22790 (3)	Linear correlations of Taupo natural inflows used	53.9	53.9	C
Taupo	TaupoTPD	92790 (1)	Sub catchment inflows non linear functions of Taupo inflows	158.6	158.7	C
Taupo	Taupo_Linear	22790 (1)	Linear correlations of Taupo natural inflows used	154.9	154.9	C
Taupo	Taupo_Oper	42790 (1)	Rating distribution correlates TPD flow and Taupo inflow, from 1993 to 2005. Reflects the current operating regime.	152.7	152.8	C
Waikaremoana	Waikaremoana	3650 (1)	Waikaremoana Inflows	17.7	17.7	C
Waitaki P.S. Tribs	Waitaki	98714 (2)	Waitaki Tributary flows between Lakes Pukaki & Tekapo and Waitaki Power Station	151.7	152.0	T
Wanaka	Wanaka	9154 (1)	Wanaka outflows	196.7	196.5	T

T denotes a tributary, uncontrolled flow.
C denotes a controllable, lake inflow.
(*) Denotes item number of Tideda file

Table 2.2 Flow dataset names and mean values derived from previous SPECTRA updates and this update

Flow	Model flow name	Site number	Description	Mean flow (m^3/s)		Type
				1931 to 30 June 2008	1931 to 30 June 2010	
Waiau	Clarence	162105 (1)	Waiau River flow at Clarence at Jollies recorder	14.5	14.5	T
	Glenhope	164604 (1)	Waiau River flow at Waiau at Glenhope recorder	33.1	33.2	T
	Marble	164602 (1)	Waiau River flow at Waiau at Marble Point recorder	94.5	94.5	T
Ngaruroro	WhanaWhana	123103 (1)	Ngaruroro River flow at Ngaruroro at Whanawhana recorder	35.2	35.2	T
	Kuripapango	123104 (1)	Ngaruroro River flow at Ngaruroro at Kuripapango recorder	17.6	17.7	T
	Chesterhope	123150 (1)	Ngaruroro River flow at Ngaruroro at Chesterhope recorder	43.8	43.8	T
Wairau	DipFlat	160114 (1)	Wairau River flow at Wairau at Dip Flat recorder	26.4	26.4	T
Hurunui	Mandamus	165104 (1)	Hurunui River flow at Hurunui at Mandamus recorder	51.2	51.3	T
	SH1	165101 (1)	Hurunui River flow at SH1 Bridge	66.0	66.3	T
Mohaka	Raupunga	121801 (1)	Mohaka River flow at Mohaka at Raupunga	78.9	78.8	T
Monowai	Mono_Inflow	199540 (1)	Monowai Power Station inflow	13.0	13.0	C
Wheao	Wheao	15462(1)	Wheao/Flaxy Power Station outflow	13.0	13.0	C
Patea	Patea	34300(1)	Patea Power Station outflow	18.6	18.7	C
Highbank	Highbank	7968(1)	Highbank Power Station outflow	13.4	13.4	C
Kaimai	Wairoa	14130(1)	Wairoa River flows above Ruahihi	11.8	11.8	C
Waipori	Waipori	174395(1)	Waipori Power Station outflow	7.2	7.2	C

T denotes a tributary, uncontrolled flow.
C denotes a controllable, lake inflow.
(*) Denotes item number of Tideda file

3 Dataset construction

3.1 Data sources

The SPECTRA data record for any particular site is often a composite record derived using different methods for different periods. Table 3.1 lists the source of the record for each site and period. Three basic methods are identified, although there may be variations:

1. Correlation - data are synthesised based on correlation with another site, the source site is noted in brackets.

2. Simulation - data is calculated by a model of the scheme. Sometimes the model may be very complex (e.g. Tongariro Power Development). In other cases it may simply involve adding or subtracting one site from another. In the later case an "(A)" is used to indicate essentially "Actual" data.

3. Actual - actual recorded data are used for the site.

As indicated above, where records are not available or a scheme component was not commissioned for the early part of the period, such as the Ahuriri River at Benmore prior to 1949, synthetic flows are often used based on correlation with some other flow record.

This procedure can ensure that statistics, including the mean and standard deviation, of the simulated flows are as accurate as statistical methods allow. However, the record has the unavoidable feature that the high and low flows in the simulated flow follow those of the site to which they are correlated. This can result in more extreme events in the overall generation system than would actually have occurred. Alternatively it may result in a slightly compressed record with fewer extremes. As most of the simulated flows are relatively small, this is unlikely to have a major effect except when there is a focus on a specific flow event.

Table 3.1 Source of SPECTRA data records at each site

Site	Period	Source
Matahina	01/07/31 - 09/06/48	Correlation (Taupo)
	09/06/48 - 01/06/67	(Rangitaiki @ Te Teko)
	01/06/67 - 19/07/98	Actual
	19/07/98 – 1/1/2005	Synthetic
	1/1/2005 – 30/06/08	Actual
	01/07/08 – 30/06/10	Synthesised from GWh; assumes no spill
Karapiro tributaries	01/07/31 - 07/07/47	Correlation (Arapuni)
	07/07/47 - 30/06/10	Simulation (A)
Arapuni tributaries	01/07/31 - 30/06/10	Simulation (A)
Taupo	01/07/31 - 30/06/10	Simulation (A)
Rangipo	01/07/31 - 30/06/10	Simulation
Tokaanu	01/07/31 - 30/06/10	Simulation
Waikaremoana	01/07/31 - 30/06/10	Actual

Site	Period	Source
Mangahao	01/07/31 - 28/03/34	Simulation
	28/03/34 - 22/11/45	Actual
	22/11/45 - 01/07/97	Simulation (rainfall)
	01/07/97 - 01/01/05	Synthetic
	01/01/05 – 30/06/10	Actual
Cobb	01/07/31 - 28/03/34	Correlation (Coleridge)
	28/03/34 - 22/11/45	Correlation (Gowan)
	22/11/45 - 30/06/08	Actual
	01/07/08 – 30/06/10	Correlation (Trilobite)
Coleridge	01/07/31 - 01/07/97	Actual
	01/07/97 – 1/1/2005	Synthetic
	01/01/05 – 30/06/08	Actual
	01/07/08 – 30/06/10	Synthesised from a water balance
Grey + Taramakau (no Taipo)	01/07/31 – 1/1/78	Correlation (Te Anau)
	1/1/78 -30/06/10	Actual Data
Pukaki + Tekapo (S)	01/07/31 - 30/06/10	Simulation (A)
Tekapo A (S)	01/07/31 - 30/06/10	Simulation
Pukaki + Tekapo (C)	01/07/31 - 30/06/10	Simulation
Natural Pukaki	01/07/31 - 30/06/10	Simulation (A)
Natural Tekapo	01/07/31 - 30/06/10	Actual
Ohau (S)	01/07/31 - 30/06/10	Actual
OhauRes (S)	01/07/31 - 30/06/10	Simulation (A)
Benmore tributaries (S)	01/07/31 - 30/06/10	Simulation
Benmore tributaries (C)	01/07/31 - 30/06/10	Simulation (A)
Waitaki tributaries (C)	01/07/31 - 30/06/10	Simulation (A)
Roxburgh tributaries (Roxburgh.sim)	01/07/31 - 30/06/10	Simulation (A)
Hawea	01/07/31 - 30/06/10	Actual
Wanaka	01/07/31 - 30/06/10	Actual
Manapouri (with Mararoa)	01/07/31 - 30/06/10	Simulation
Manapouri (without Mararoa)	01/07/31 - 30/06/10	Simulation (A)
Manapouri (water right reduction)	01/07/31 - 30/06/10	Simulation
Te Anau	01/07/31 - 30/06/10	Actual
Clarence at Jollies	01/07/31 - 27/03/34	Synthetic
	28/03/34 - 31/12/59	Correlation (Gowan)
	01/01/60 - 30/06/10	Actual
Waiau at Glenhope	01/07/31 - 31/01/74	Correlation (Clarence)
	31/01/74 -06/07/99	Actual
	09/07/99 - 27/09/03	Correlation (Clarence)
	27/09/03 - 08/07/08	Actual
	09/07/08 – 30/06/10	Correlation
Waiau at Marble Point	01/07/31 - 06/10/67	Correlation (Clarence)
	06/10/67 - 30/06/10	Actual
Ngaruroro at Whanawhana	01/07/31 - 31/08/60	Correlation (Lake Waikaremoana inflow)
	01/09/60 - 30/06/10	Actual
Ngaruroro at Kuripapango	01/07/31 - 19/09/63	Correlation (Whanawhana)

Site	Period	Source
	20/09/63 - 30/06/10	Actual
Ngaruroro at Chesterhope	01/07/31 - 25/11/76 25/11/76 - 30/06/10	Correlation (Whanawhana) Actual
Wairau at Dip Flat	01/07/31 - 29/03/34 30/03/34 - 31/05/51 01/06/51 - 30/06/10	Synthetic Correlation (Gowan) Actual
Hurunui at Mandamus	01/07/31 - 29/03/34 30/03/34 - 25/10/56 26/10/56 - 30/06/10	Synthetic Correlation (Gowan) Actual
Hurunui at SH1 Bridge	01/07/31 - 13/12/74 13/12/74 - 18/06/99 18/06/99 – 01/07/07 01/07/07 – 30/06/10	Correlation (Mandamus) Actual Correlation (Mandamus) Actual
Mohaka at Raupunga	01/07/31 - 28/02/57 01/03/57 - 30/06/10	Correlation (L Waikaremoana Inflow) Actual
Monowai Inflow	01/07/31- 30/06/10	Synthetic
Wheao	1/07/1931 - 1/01/99 2/01/99 - 30/06/08 01/07/08 – 30/06/10	Synthetic Actual Synthesised from GWh; assumes no spill
Patea	1/07/1931 - 1/04/99 2/04/99 - 30/06/08 01/07/08 – 30/06/10	Synthetic Actual Synthesised from GWh; assumes no spill
Highbank	01/07/31 - 30/04/51 1/05/51 - 19/05/98 20/05/98 - 05/06/02 6/06/02 - 30/06/08 01/07/08 – 30/06/10	Synthetic Actual Synthetic Actual Synthesised from GWh; assumes no spill
Kaimai	01/07/31 – 10/07/93 11/07/93 – 30/06/08 01/07/08 – 30/06/10	Synthetic Actual Synthesised from GWh; assumes no spill
Waipori	01/07/31 - 1988 1988 - 1997 1997 – 30/06/10	Synthetic Correlation (Berwick) Actual

Key: (S) **S**eparate Tekapo simulation (C) **C**ombined Pukaki and Tekapo simulation
(A) Essentially **A**ctual data with minor simulation

The various data sets necessary to produce a record of daily inflows were not available for the 2010 Spectra update from the majority of stations owned by TrustPower Ltd. Therefore, daily inflows had to be estimated from the metered generation data provided to the Electricity Authority.

Rather than relying on published average station efficiency information, an empirical relationship between daily inflows and daily generation was developed using data from the previous Spectra Update. During this period the average daily inflows had been calculated.

The potential impact of various resource consent conditions on station flow were not considered beyond establishing any residual flows and the maximum station capacity. Having developed the empirical relationship, it was used to 'predict' the average daily inflows for the period from 2008 to 2010.

Obviously such an approach has a number of assumptions and limitations. These include:

- That daily inflow equals daily outflow and therefore the station functions essentially as a run-of-the-river scheme. Since most of the dams owned by TrustPower have a small storage capacity this assumption is likely to be valid.

- That there is no spill flow, or any other flow that does not pass through the turbines. While generally this is the case, it is possible that the inflow series slightly under-estimates inflows during any major flow event which cannot be contained behind the dam.

- It assumes that all electricity is generated at the 'average efficiency' of the station. This will not be the case, but the resulting errors are likely to be small.

- It ignores the requirement of some stations to provide residual flow downstream of the station.

- It ignores the potential impact of flood rules and other operational and management decisions that can affect either station operation or spill.

To confirm that the inflow data generated in the above manner accurately reflects the inflows calculated in previous Spectra updates, the two sets of data were compared over a common period (Figure 4.1). In general, the two approaches produce very similar daily inflow records e.g., Matahina, Whaeo, and Highbank. Stations in catchments subject to highly variable flow, or with a range of consent conditions relating to maintenance of the flow regime, have greater uncertainty e.g., Patea and Kaimai.

The average daily inflow record in the 2010 Spectra Update is likely to be slightly conservative i.e., estimated inflows are slightly less than actual inflows. This is because any spill flows have not been considered and added to the flows used to generate electricity. However, spill magnitudes and durations are small so the overall effect on synthesised flow regime is likely to be minor. Also, since the energy generation potential of the rivers is most strongly related to average flow conditions any error is likely to be of little significance.

4 Description of historical SPECTRA datasets

4.1 Matahina

Scheme Description

Matahina is the largest dam and furthest downstream of the three hydro stations in the Rangitaiki catchment (Figure 4.2). This earth dam which retains a relatively small storage reservoir was commissioned in 1967; and extensively refurbished between 1987 and 1988 after the Edgcombe earthquake. The lake was drawn down again in June 1996 and refurbished in 1997 to comply with international performance standards for a 7.2 Richter scale, or a 1 in 3800 year seismic event.

Historical Flow Records

Flows are available for the Matahina Power Station since it's commissioning in 1967. From 1948 to 1967 flows are simulated from the Rangitaiki River at Te Teko and prior to 1948 from Lake Taupo outflow.

Feedback has highlighted that the synthetic data prior to 1948 appears to be inconsistent with the later record i.e., the standard deviation for this period is 50% lower. This difference is most likely caused by the inability of the simulation process to accurately model flood events. The resulting apparent reduction in the magnitude of floods has a significant influence on the standard deviation. Since the energy generation potential of the river is most strongly related to the 'average' flow conditions, this inconsistency for a period of the data record is not regarded as significant.

The various datasets required to produce the average daily inflow record were not available for this site. Therefore, averge daily inflows had to be estimated from the metered generation data provided to the Electricity Authority (Section 3). The metered generation data was compared with Spectra flows (2004-2006) to obtain an empirical relationship between flow and generation (Figure 4.1). Flows were removed if they were above the maximum generation available from the machines; in this case 150m^3/s. Only 24 flow points were removed from the dataset (2.2%).

The apparent time-shift between 1-Jul-2007 and 30-Jun-2008 has been removed in this update.

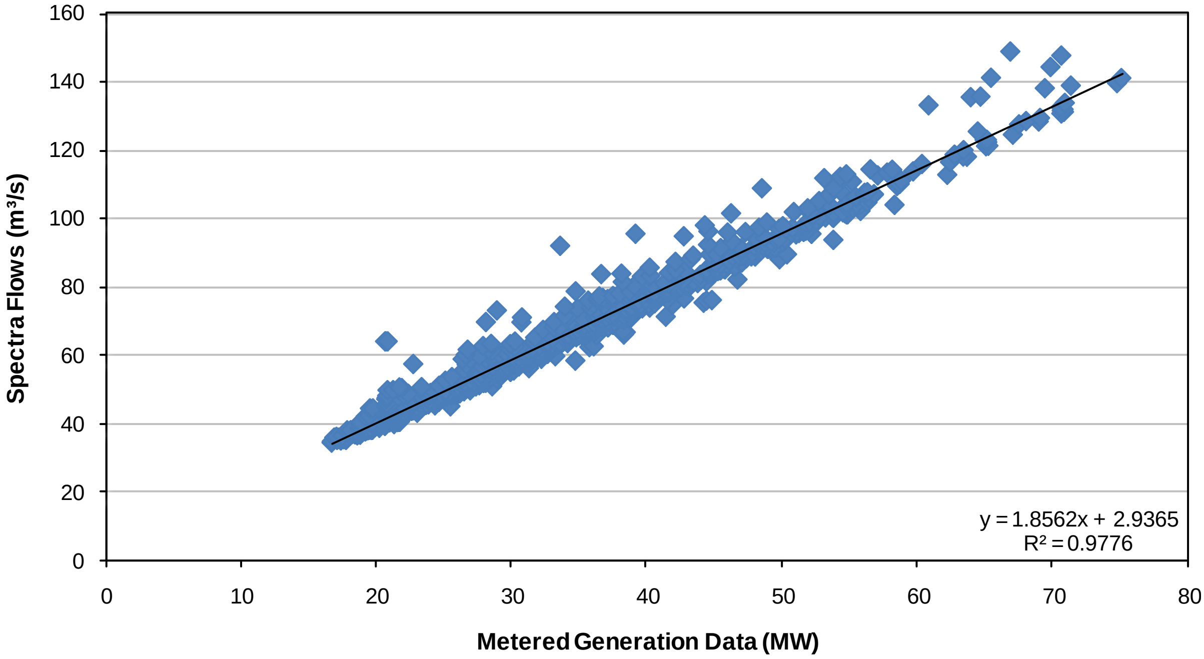

Figure 4.1 Comparison between the generation data and the Spectra flows

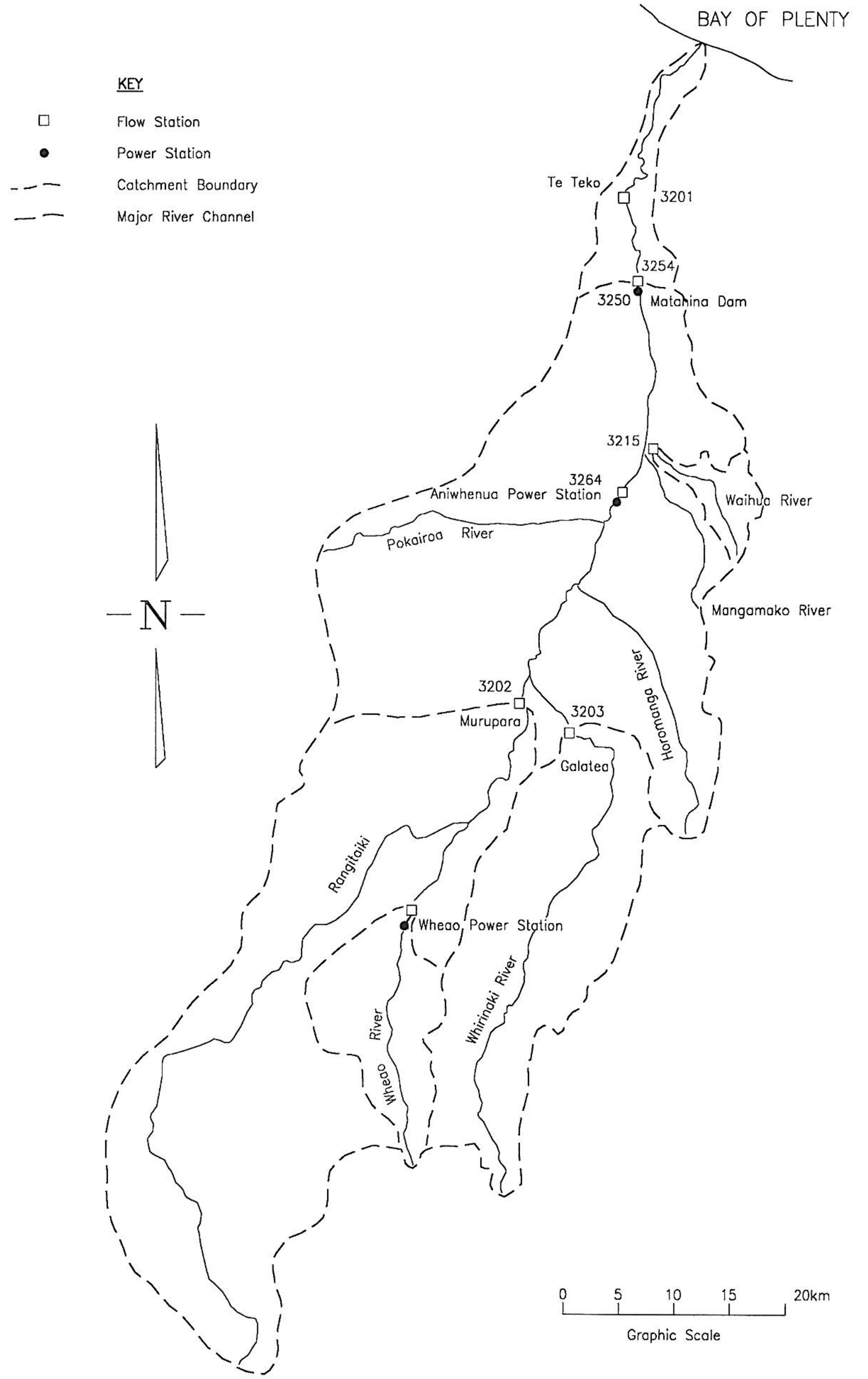

Figure 4.2 Rangitaiki catchment and Matahina Dam

4.2 Waikato (Arapuni and Karapiro)

Scheme description

Water is discharged from Lake Taupo through a series of eight hydro-electric dams along the Waikato River. These are (in order downstream of the Huka Falls): Aratiatia; Ohakuri; Atiamuri; Whakamaru; Maraetai; Waipapa; Arapuni; and Karapiro (Figure 4.3).

The flow that each dam receives can be broken down into two components:

- the controllable flow released from the Lake Taupo gates; and
- the tributary flow which enters the Waikato between Lake Taupo and the dam.

SPECTRA flow records

For the SPECTRA flow files, tributary flow is calculated at Arapuni and Karapiro. Flow records at Karapiro do not begin until 1947 but the earlier record has been simulated from the Arapuni record.

Tributary flows at Arapuni are calculated simply by subtracting the Taupo outflows from the outflows at Arapuni. Karapiro tributary flows are calculated similarly for the period of actual record (470707 - 970701) and are simulated from Arapuni tributary flows, scaled up by 20%, for the period before 1947 (Halliburton, December 1993).

The Karapiro outflows have recently been recalculated and updated back to 1995. This was because analysis showed that PI data from Karapiro Power Station using unit flow efficiency curves provided a better match. This recalculation and resulting differences are further explained in Section 6.4.

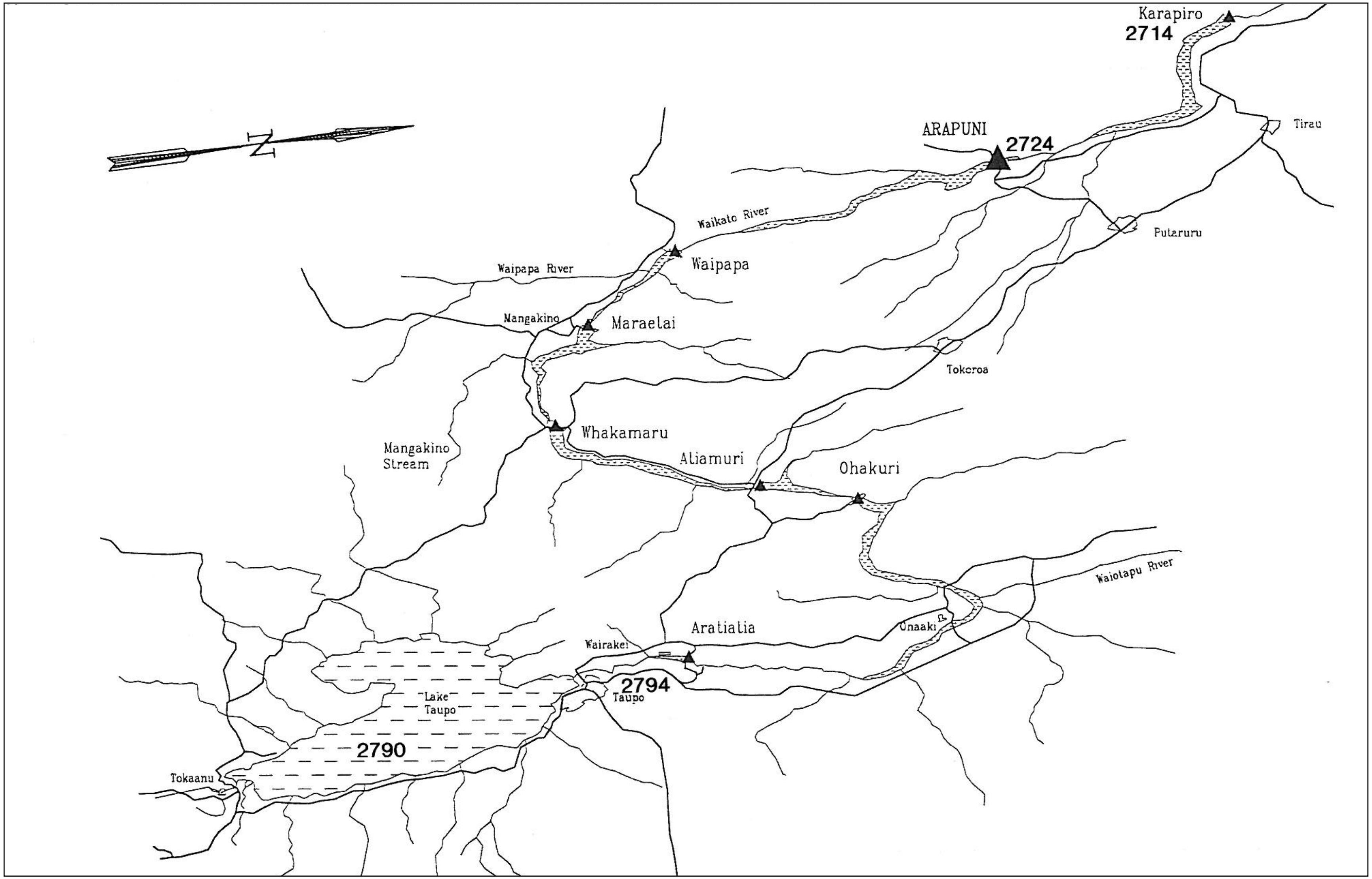

Figure 4.3 Waikato Power Development

4.3 Tokaanu, Rangipo and Taupo

Preface

The Tongariro Power Development simulation has been extensively revised (Henderson, 1996) to incorporate new minimum flow rules at Te Maire on the Whanganui River, at Turangi and Poutu Intake on the Tongariro River, and new rules about spill at Rangipo Intake and flows at Waikato Falls. Several logical errors in the previous simulation have also been corrected. Consequences of the changes introduced are:

2.5m³/s increase in Taupo inflows
6.2m³/s increase in Rangipo flows
2.1m³/s decrease in Tokaanu flows
1.2m³/s increase in Western Diversion flows

These average flow changes are for the 63 years from 1 July 1931 to 30 June 1994. The previous simulation has been retained within the modelling process but operates independently of the modified simulation. The outputs from the two simulations are kept separate. Output from the original simulation is stored as site 22790 and output from the new simulation is stored as site 92790.

Scheme description

The Tongariro Power Scheme is a complex system of tunnels and canals diverting water from several rivers and streams through the Tokaanu and Rangipo Power Stations. The schematic diagram (Figure 4.4) indicates the layout and water flow through the scheme, while Figure 4.5 lists the mean recorded flows.

There are two principal groups of diversion within the scheme, the Western and Eastern diversions. The Western Diversion collects water from five small rivers, all tributaries of the Whanganui River. The majority of the water in the Western Diversion comes from the Whakapapa River (about 63% when the diversion was operated with a 0.6m³/s release to the Whakapapa River). Water from the Western Diversion passes through a system of tunnels, canals and small storage lakes and is measured by a recorder on the Wairehu Canal before it passes in to Lake Rotoaira.

The Eastern Diversion diverts water through the Poutu intake from the Tongariro River just downstream of the Rangipo Power Station tailrace, and includes water from Lake Moawhango and the Wahianoa Aqueduct which has passed through the power station via the Moawhango and Rangipo Tunnels. From the Poutu intake on the Tongariro River, the water passes through the Poutu tunnel and canal, and flows into Lake Rotoaira via the Poutu/Rotoaira channel.

From Lake Rotoaira the water from the Eastern and Western Diversions passes through the Tokaanu Power Station before being discharged into Lake Taupo. From there it then passes through the nine power stations on the Waikato River.

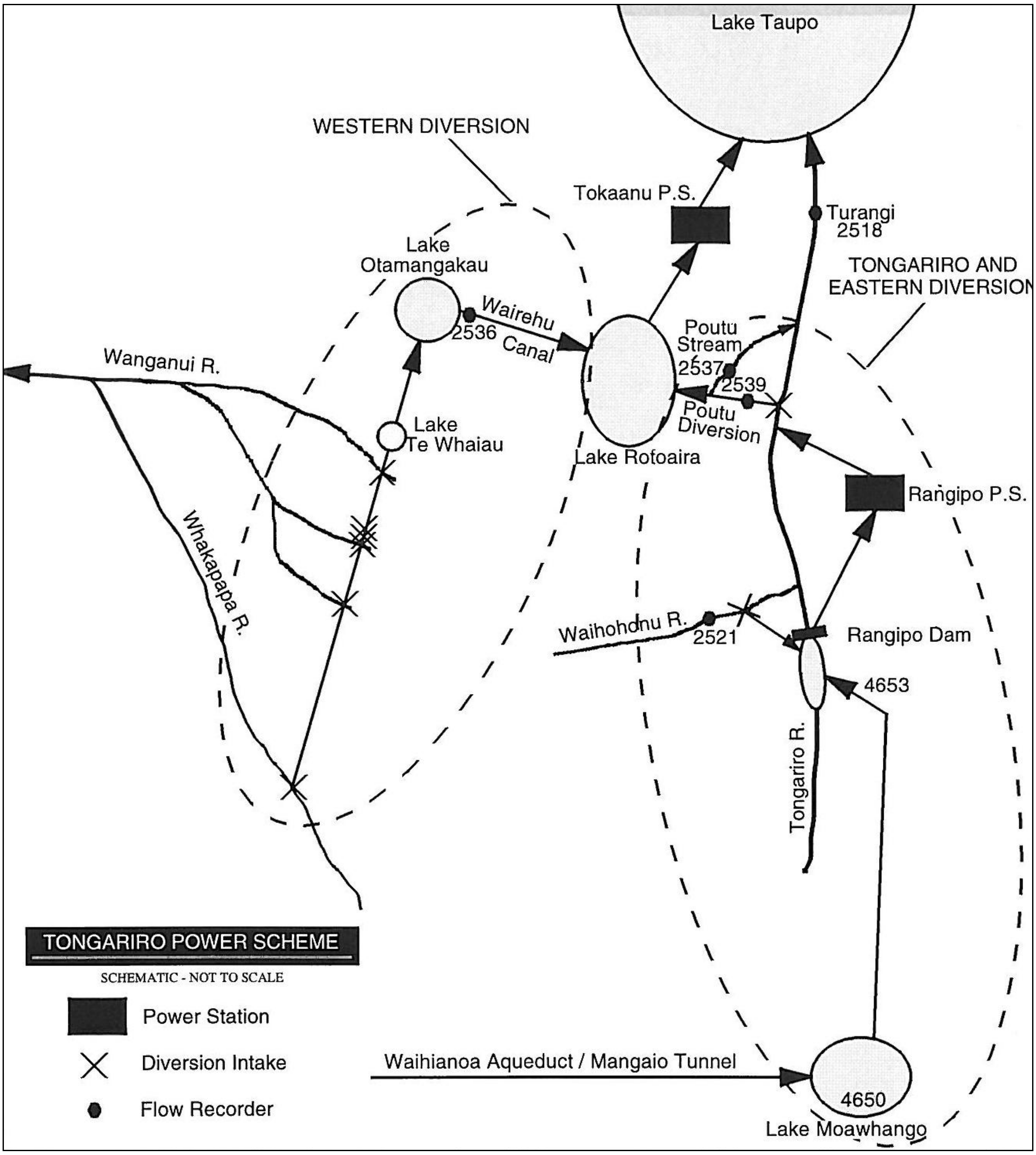

Figure 4.4 Schematic layout of Tongariro Power Scheme

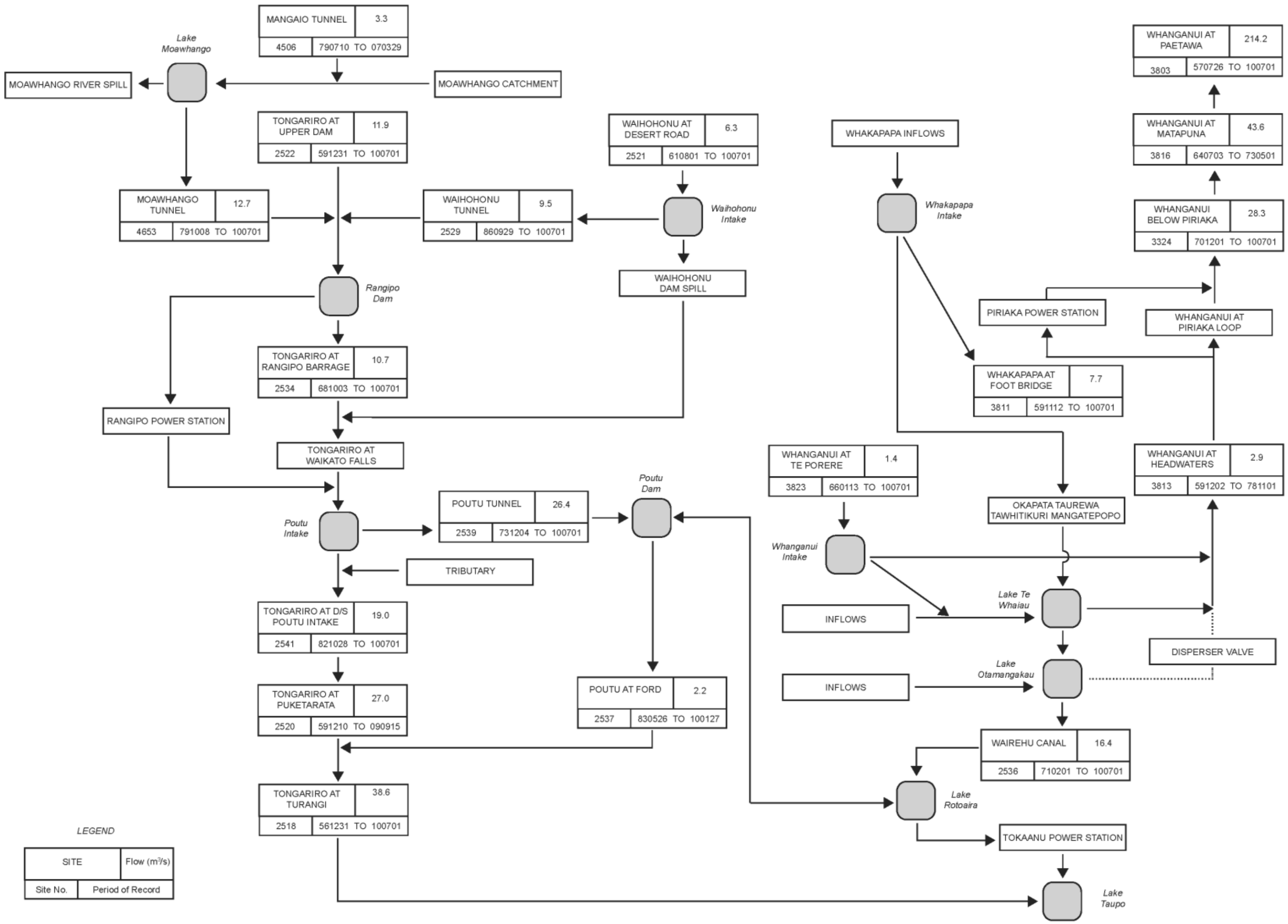

Figure 4.5 Mean flows for available periods of record at Tongariro Power Development sites

SPECTRA flow records

For the SPECTRA modelling, the required flows associated with the Tongariro Power Development (TPD) are those inflows available for generation at Tokaanu and Rangipo Power Stations and the inflows to Lake Taupo. In order to determine these flows however, several component flows at diversion points must first be determined. A series of operations using recorded data from the rivers, reservoirs and diversion canals of the TPD culminate in two TIDEDA simulation programs called “TAUPOFUN.SIM” and “TAUPOTPD.SIM” which model the river flows and current scheme operation respectively. These two simulation programs supersede the original simulation program TAUPO.SIM

The linear dataset (site number 22790) was the original dataset for TPD flow calculation. It has now been superseded by the TPD datasets (site number 92790) but is still included for historic reference. For SPECTRA the 92790 TPD datasets should be used.

An additional TPD dataset has been created in this SPECTRA update. This operational inflow dataset (site number 42790) more accurately represents the true TPD operating regime, as specified in the 1992 Waikato River consent hearing. An outcome from this hearing was a decrease in the diversion take as residual flow in the Whakapapa Stream was increased to $3m^3/s$. This site differs from the 92790 TPD dataset which also adjusts for post 1992 hearing conditions, but does not optimise diversion flows. It is based on the actual operating regime of the TPD diversion from 1993 to 2005.

Net Taupo outflows

Subtract recorded diversion flows (Wairehu Canal and Moawhango Tunnel) from Taupo outflows to give net Taupo outflows.

Taupo natural inflows

Use TAUPOIN.EXE to calculate natural inflows to Lake Taupo from net outflows and lake levels.

Outline of TAUPOFUN.SIM

Use full record of Taupo Natural Inflows as input to TAUPOFUN.SIM.

Apply non-linear transformations to Taupo natural inflows, to simulate flows at the following locations in the scheme:

- Western Diversion with no minimum flow rules
- Tongariro at Turangi natural flows
- Natural inflow to Lake Rotoaira
- Natural inflows to the lower Tongariro above Turangi and downstream of Poutu Dam and Poutu Intake.
- Natural inflows to the middle Tongariro between Rangipo Dam and Poutu Intake

- Natural flows in the Tongariro River at Rangipo Dam
- Natural flows in the Waihohonu Stream at Waihohonu Tunnel
- Natural inflows to Lake Moawhango
- Flows in the Wahianoa Aqueduct at Mangaio Tunnel
- Natural flows in the Whanganui River at Te Maire
- Write results to an intermediate TIDEDA file.

Merge modelled natural flows

Overwrite modelled flows in the intermediate file at all locations listed above (except Wahianoa Aqueduct) with simulated natural flows based on recorded data.

Outline of TAUPOTPD.SIM

- Model effect of Te Maire minimum flows to reduce Western Diversion flows
- Add Waihohonu tunnel flows to Rangipo and subtract from mid Tongariro
- Add Wahianoa flow to Moawhango inflow
- Model Lake Moawhango operation and Moawhango Tunnel flows
- Determine Poutu spill required
- Determine Rangipo spill required
- Determine if Rangipo (and Moawhango) should be shut down because flows too high
- Calculate total available flow at Rangipo
- Calculate total available flow at Tokaanu
- Calculate Taupo inflow including diversion flows for full record

More detail is given for the various components below:

Net Taupo outflows - Because the next step uses an algorithm based on the idea of natural river flow recessions, the net outflows are needed rather than the total outflows as recorded. Taupo net outflows are those that would have occurred if no additional water was diverted into the catchment.

Taupo natural inflows - A lake inflow algorithm that takes lake levels and net outflows and calculates inflows that have realistic recession shapes is also used, so that the resulting inflow time series is useable for simulation of natural flows at other locations. Previous inflows have had erratic behaviour especially at low flows, caused by fluctuations in recorded levels because of atmospheric effects on the lake, and fluctuations in outflows caused by generation requirements. Taupo natural inflows are those, which would have flowed into Lake Taupo anyway; so no adjustment is necessary here. It is the Taupo Natural inflow record which is used to extend shorter low flow records, and to simulate the flows that would have occurred at various sites, had they been as they are today back in 1931.

Flow transformations - Data recorded in the rivers and diversions of the scheme has been used to model natural flows at various locations since 1960 when data recording began. The result of this work, done mostly as part of resource consent studies and for the

Whanganui Minimum Flows Appeal, has been used to derive a set of non-linear transformations. These quasi-quadratic functions allow the transformation of Taupo natural inflows into time series that preserve the flow distribution of the modelled series. This means that not only the mean, but also higher order moments of the modelled series, are preserved. Linear regressions would only preserve the mean if the relationship modelled is in fact linear. These considerations are particularly important when using the modelled series to simulate rules that involve minimum flows and flood flows.

Merge modelled natural flows - Application of the flow transformations is for the full length of record (1931 to present). A better estimate of natural flow at each location since approximately 1960 can be gained by using the model data that was used to derive the transformations. This has the advantage that during extreme events flows at all sites will be independently measured, rather than a scaled version of Taupo inflows. The true magnitude of extremes will thus be better estimated.

Western Diversion - The flow in the Western Diversion, as if it were run with no releases down the Whakapapa River, is modelled by transforming Taupo natural inflows. The result is a 'natural' looking hydrograph with a maximum value of 41.6m³/s. Flow in the Whanganui River at Te Maire is also modelled by transforming Taupo natural inflows. The Western Diversion flow is subtracted from The Te Maire flow, and the result tested against the new minimum flow rule (29m³/s from 1 December to 31 May each year, no rule at other times). If the rule is violated, water is released from the Western Diversion to meet it. At times this means there is no diversion of water.

Eastern Diversion and Tongariro - Inflows to various parts of the Tongariro River are determined. Flows above Rangipo are derived by subtracting modelled flows there from modelled flows at Turangi. Waihohonu River diversion flows and Moawhango inflows (including Wahianoa Aqueduct flows) are calculated and the total flows at Rangipo (RangipoTPD) are then determined by adding these to the Tongariro flow at Rangipo.

The contribution to flow at Tokaanu from the Tongariro River is calculated by adding Rangipo inflows to the Tongariro inflows between Rangipo and Poutu and subtracting Poutu spill (Moawhango Tunnel contribution is included at each step so that the tunnel capacities are properly dealt with).

Rotoaira local inflows are calculated and the minimum release (0.6m³/s) down Poutu Stream is subtracted. Finally the Western Diversion flows and Poutu Tunnel flows are added to the Rotoaira local inflows and water diverted from the Tongariro River to establish the total flow available at Tokaanu Power Station (TokaanuTPD).

Taupo Inflow - The total inflow to Lake Taupo (TaupoTPD), incorporating diverted water, is the last to be determined. This is achieved by subtracting the diverted component of the natural Tongariro flows from the Taupo Natural inflows and then adding the total flow diverted into Lake Rotoaira.

Operational Taupo Inflow - TPD flows were subtracted from the Taupo inflow record then rated against the recorded TPD inflows, for the period between 1993 and 2005. The very strong linear correlation (r^2 = 0.9911) was used to extend the TPD flows back to 1931. Actual TPD flows since 1 September 1992 are used.

The dataset should be used if water balance modelling is done. However, the Taupo TPD dataset is more similar to inflow datasets because optimal water table (within consents etc) is included in the dataset.

Proceedure to create TPD flow files

Creating the SPECTRA input data files involves a considerable amount of computer processing. The modified Taupo and TPD simulation requires preliminary datasets containing actual and simulated flow and lake level data. These datasets are constructed by running seven script files. These are script files contain various TIDEDA procedures and simulation programs.

Once all seven script files have been executed in the appropriate order, the basic data from the Power Archive is assembled into one extended directory file using MERGE.SCR. The data are then read from the extended directory and merged into multi-item sites which can be read by TIDEDA PSIM programmes. The PSIMs perform the necessary simulations and the resulting data is then transformed to weekly averages and converted into SPECTRA format.

Pre-Requisites for Running the Process

Prior to running the process the following sequential steps need to be undertaken for the model operates correctly:

1. Obtain up to date gauging station data for the following NIWA sites:

    - Taramakau at Greenstone (site 7304/91104)
    - Whanganui at Paetawa (site 3803/33301)
    - Whanganui at Te Porere (site 3823/33347)

    It is also necessary to add this data to the Power Archive and therefore when obtaining the data from NIWA also request the comment files (in addition to the stage data, gaugings and ratings). Note that ratings for these sites need to be copied to the W: drive for the extended directories to access this data.

2. Retrieve from the project archive the script files necessary to run the processes from the previous update. Note that in addition to the data on the Power Archive the following *. Tideda files are required:

    - BARRMOD.MTD
    - RATSHIFT.MTD
    - ROTOINF2.MTD
    - UDAMRAT.MTD

These four files are not created when you run the processes and are available from the previous SPECTRA update. These files are required for the MAKEWANG.TSF, ROTONAT.TSF and WAIOURU.TSF script files.

How to Run the Process

The procedure for running the SPECTRA flow files updating process consists of three steps:

Period of Data (and location)

The end date (e.g. 990702) of the data may need to be one day past the period you want to cover, because of the rounding effect of TIDEDA (i.e. a lunar week is 606876.92 seconds and in the program we enter 606877 seconds. An explanation is given below.

The error in intervals amounts to +4 seconds per year (cumulative) so that every four years the Date and Time (in the WEEKFLOW.MTD TIDEDA file) catches up 16 seconds and appears to stretch ahead in time e.g.

310630	240000	1 year (52 lunar weeks)
320630	60004	1 year (52 lunar weeks)
330630	120008	1 year (52 lunar weeks)
340630	180012	1 year (52 lunar weeks)
350701	16	1 year (52 lunar weeks)

The implications of this when running SPECTRA are that if you are running it over a period that is not a multiple of 4 (e.g. for this update 1031-1997=66 years) you do not have to have an extra days data in MERGE.MTDD and you can set your dates in DATE.PAR as even years, e.g.

310701 0 - 970701 0

However, when SPECTRA is updated in 1999, data will need to cover the period (68years)

310701 0 - 990701 000432

Hence dates in DATE.PAR will have to be advanced for say 1 day to cover this period:

310701 0 - 990702 0

Note: 4’32’’ = 68 x 52 (606877 – 606876.92) seconds

= 4’32”

Note: 0.08 x 52 = 4.16 seconds but TIDEDA must round this to 4 seconds/year.

Hence for years 1999, 2003, 2007 etc the end dates in DATE.PAR will need to be advanced one day past the even number of years.

1. Taupo TPD data preparation (script files)

There are seven script files that require execution in order for the TAUPOFUN.SIM and TAUPOTPD.SIM simulation programs to function correctly. These contain standard script file commands and are required to be run in precise order.

An example of the syntax for initiation of the script files presented below;

LGO MAKETONG.TSF

The order for running the TSF files is as below.

MAKETONG.TSF – makes an extended directory TONG.MTD for use in simulating flows in the Tongariro Catchment.

MAKEWANG.TSF – makes an extended directory WANG.MTD for use in simulating flows in the Whanganui catchment. Uses MATARAT.MTD which contains ratings to convert Matapuna flows to flows at Piriaka.

WAIOURU.TSF – simulates natural flows into Lake Moawhango using Moawhango at Waiouru and a rating that converts Tongariro at Upper Dam to Moawhango inflows. Creates WAIOURU.MTD.

ROTONAT.TSF – Uses a number of sites in the vicinity of Rotoaira and Whanganui at Te Porere to simulate natural Rotoaira inflows. Writes results to ROTONAT.MTD.

TONGTOT.TSF – Creates a 10 item site for use in TONGNAT3.SIM. Also corrects early Barrage data.

WANGTOT.TSF – Creates a large merged site for use in a series of simulations. Adjusts early behaviour of the western diversion, distributes diversion flows with the timing of Te Porere hydrographs, and produces natural flows at four sites in the Whanganui.

Data preparation (MERGE.SCR)

This stage of the process assembles the data from the Power Archive into a format ready for the processing routines used by the rest of the modelled systems. This involves creating an extended directory file of all the relevant data sets and then merging them onto multi-item sites so that the TIDEDA PSIM programs can read several data sets as necessary for the simulations. To execute this stage, run MERGE.TSF in TIDEDA.

Upon completion of this step the PC will “beep” to notify that the script file has finished running and prompt you to begin the next step.

Data processing

The final stage is data processing. For sites where simulation is necessary TIDEDA PSIM programs retrieve the raw data and perform the calculations. The simulated records and appropriate raw data records are then transformed to weekly averages before being converted by a Basic program (TDTOSPEC) from TIDEDA format to the format ready for input to MV 40000 for SPECTRA. To begin the processing run PROCESS.TSF in TIDEDA

This script file now contains PSIM (COUNTWKS.SIM) to check the number of weeks in the *.DAT output datasets. The simulation is carried out on the WEEKFLOW.MTD dataset and counts the number of values for each site and then prints these out. An example is shown below for site 93254 Matahina.

~~~Tideda~~~ Ver 4.6 Works Power Engineering – Hydrology 08-Dec-97
~~~PSIM COMIPLER~~~ VER 3.4
Name of Simulation File: COUNTWKS.SIM

NO ERRORS
~~~Tideda~~~ Ver 4.6 Works Power Engineering – Hydrology 08-Dec-97
~~~PSIM ~~~ VER 3.4
Name of Simulation File: COUNTWKS.SIM
Source is WEEKFLOW.MTD Site 93254 Matahina

number of weeks
N = 3433.000

End of process

Note that the number of weeks is shown as 3433, which is one more than 667 yrs x 52 wks (=3432). This is because the first value in WEEKFLOW.MTD is an instantaneous value and is not included when TIDEDA files are transformed into SPECTRA files (TDTOSPEC.EXE).

A "beeping" sound will signify the completion of the process.

Process output

There are four types of files created by the updating process, these are as follows:

- *.DAT files which contain the data ready for transfer to MV 40000 (e.g. RANGIPO.DAT)
- *.PRN files are text files containing summary print-outs of the data, e.g. PCAL.PRN, PDIST.PRN, and PSCAN.PRN
- TIDEDA data files;
  DATA.EXT Extended directory file which accesses all raw data
  MERGE.MTD contains raw data in multi-item sites for input to simulations
  DAYFLOW.MTD contains simulation data – daily averages
  WEEKFLOW.MTD contains simulation data – weekly averages
  TONG.MTD)
  TONGMERG.MTD)
  WANG.MTD)
  ROTONAT.MTD)
  TONGNAT.MTD)Datasets created for use in Taupo and TPD simulations
  WANGMERG.MTD) Output from these simulations are in DAYFLOW.MTD
  ADJUST.MTD) and WEEKFLOW.MTD
  WANGNAT.MTD)

WANGNORL.MTD)
TAUPOFUN.MTD)
WAIOURU.MTD)
UDAM.MTD)

- LGO.TMP a temporary file created by TIDEDA which may be deleted
  TEMP.DOC a temporary file produced by the Taupo simulation routines.

Summary

Input	Process	Output
Power Archive + Supplementary Datasets	TSF script files	Files called by TAUPOTPD.SIM and TAUPOFUN.SIM
Power Archive	MERGE.TSF	File for input to TIDEDA PSIMs (MERGE.MTD)
MERGE.MTD	PROCESS.TSF	WEEKFLOW.MTD + *.DAT file for each flow set + statistical summaries

4.4 Waikaremoana

Scheme description

The Waikaremoana Power Scheme includes three storage lakes and three power stations (Figure 4.6). Water passes from Lake Waikaremoana to the Kaitawa Power Station which discharges into Lake Kaitawa. The Tuai Power Station is fed from Lake Kaitawa and discharges into Lake Whakamarino. Additional water is diverted into Lake Whakamarino from the Mangaone Diversion. From Whakamarino the water flows through the Piripaua Power Station and discharges into the Waikaretaheke River. Spill from either Lake Waikaremoana or Lake Kaitawa only by-passes the station immediately downstream and is not lost from the system entirely.

SPECTRA flow records

Inflow records for Lake Waikaremoana go back to 1929 and for the purposes of the SPECTRA flow files these are simply reduced to average weekly values. Inflows to individual scheme components are not available and so inflows are based on flows at Tuai Power Station. These include leakage but do not include water spilt at the Kaitawa gates which is not recaptured at the Whakamarino canal intake.

Waikaremoana inflow data has been revised and improved and the methods used to recalculate inflows can be found in Works Consultancy Services Ltd “Hydrological Data Reference Manual; Lake Waikaremoana Inflow Data 1929 to 1995” (April 1996).

From June 2001 onwards Genesis has calculated Waikaremoana inflows. Data supplied for this and the previous update suffered from negative inflows because of leakage associated with Lake Waikaremoana. Negative inflows supplied in the previous dataset were set to zero but as this is an ongoing problem data are presented as supplied.

Until this problem is rectified negative inflows will exist in the Waikaremoana dataset. Genesis are working on ways to solve this negative inflow issue.

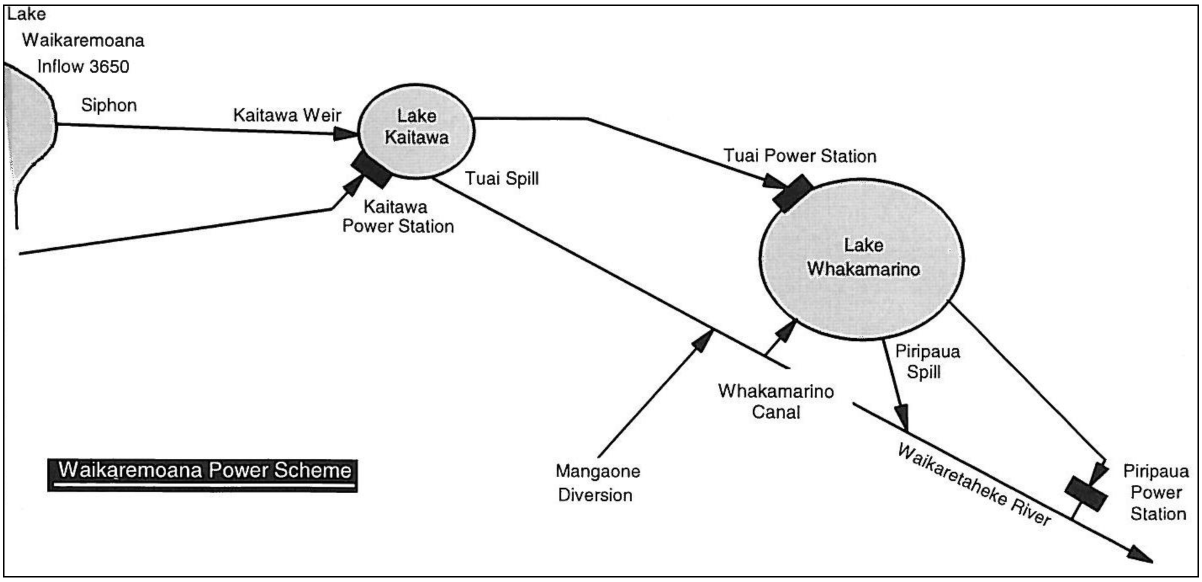

Figure 4.6 Schematic flow diagram for Waikaremoana Power Scheme

4.5 Mangahao

Scheme description

The Mangahao River is a tributary of the Manawatu River. It flows from its headwaters high in the Tararua Range north-east to the Wairarapa Plains to its confluence with the Manawatu near Woodville.

The Mangahao Power Scheme was commissioned in 1924 and at 20MW installed capacity was the largest power station in the country at the time. In 1994 the station underwent major refurbishment and from July 1994 has had an installed capacity of 37.2MW (ref. Mangahao Power Station Operator). It incorporates these storage reservoirs, two of which are on the Mangahao River (Figure 4.7). The third reservoir is on the Tokomaru stream, which is also a tributary of the Manawatu River, but joins it on the western side of the Tararua Range. Water flows from the first two reservoirs to the third along a 1.6 kilometre long tunnel and then through a 2.2km tunnel to a surge chamber and penstocks. The tailrace from the Mangahao Power Station discharges into the Mangaore Stream.

SPECTRA flow records

Because of the limited data available for the Mangahao Power Scheme a simulated No.2 reservoir inflow record has been produced (Freestone & Maslin, October 1991). The No.2 inflow record represents 97% of the total scheme inflow; the remaining 3% comes from the Arapeti (No.3) catchment. The synthetic record is based on a series of different methods each considered appropriate for a particular period of the scheme's history. A trend is apparent when the cumulative deviation from the mean is examined for the synthetic record. However, this has been compared with the Manawatu River record and is considered to be real.

The composite flow record is filed on the Power Archive and the only processing required for SPECTRA flows is a simple scaling to allow for inflows from the Arapeti (No.3) catchment.

Mangahao PS machine flows (site 5028) have been recalculated from 20 September 1994 since the previous SPECTRA update. Machine flows have been calculated using a modified cumecs per megawatt ratio based on analysis of individual machine loads (G1, G2 and G3) and accusonic data over the 1996 period. Revised cumecs/MW ratios of 0.431 (G1 Francis) and 0.503 (G2 and G3 Peltons) have been calculated.

Mangahao data from 8 October 1997 to 30 June 2010 are actual data. Inflow data are based on spill from the number 2 dam and machine generation.

In 2008 the Mangahao dataset was reviewed, including both the historic synthetic data, and the actual data over the more recent period of record. This review suggests that a reasonable level of confidence can be placed in the modelling of synthetic data; although a mean of $8m^3/s$ may be too low when compared to more recent measured data. However, the measured data covers a very short period giving a comparable record of only 3 years. Therefore, even though recent data suggests that $12m^3/s$ may be the correct mean flow for the scheme, it would not be advisable to change data based on such a short flow record.

As a result of the review, it would appear that although there is some uncertainty relating to the data from the Mangahao scheme it is believed to provide a good indication of the overall energy situation.

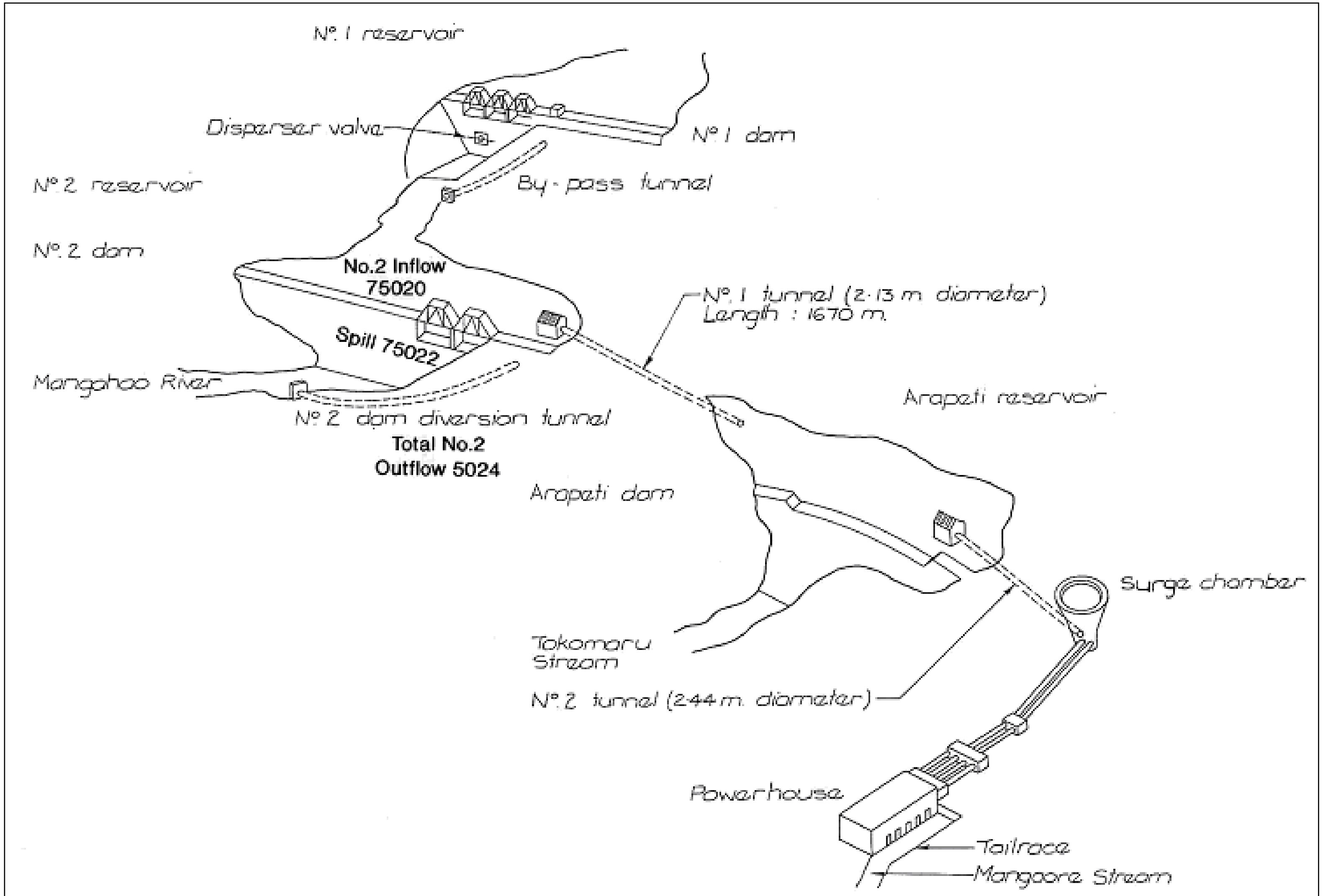

Figure 4.7 Schematic layout of Mangahao Power Scheme

4.6 Cobb

Scheme description

The Cobb power scheme utilises a high head system. Water flows from the storage reservoir through a tunnel to the penstocks and a fall of some 600 metres to the power house. Inflows to the reservoir are solely from the natural catchment.

The high head available at the Cobb Power Station makes it the most water efficient station run by TrustPower in New Zealand. One megawatt of power is generated using only 0.227m^3/s of water. This is approximately twice as productive per unit of water than other high head stations such as Rangipo (0.51m^3/s/MW) and Mangahao (0.435m^3/s/MW). Because of this high water efficiency any errors in the extrapolated inflows will result in a magnified error in the estimated potential generation.

SPECTRA flow records

Prior to 1945, inflow to the Cobb reservoir was not recorded. Initially inflows were simulated back to 1931 using a correlation with Lake Coleridge inflows. The 1993 SPECTRA Update used an improved method, utilising a correlation with Lake Rotoroa outflows since 1934 (Palmer, January 1992 and Maslin et al, February 1993). The first few years of inflows, however, are still based on Coleridge inflows.

This correlation was reassessed for the 1996 Spectra Update and an unsatisfactory r^2 value was obtained. After discussion with Lennie Palmer, ECNZ Generation (1996), it was decided to continue with the value (0.224) in the existing PSIM. This is based on the correlation of mean inflows at Coleridge and Cobb. From March 1934 to November 1945 the inflows are based on a correlation with Gowan at Rotoroa. From November 1945 to present, the inflows are calculated from actual outflow records with an allowance for change in lake storage.

Inflows were not available from TrustPower Ltd for the 2010 update. Flows were therefore derived using a correlation between the Cobb at Trilobite flows and the Cobb inflows from previous Spectra updates. Daily average flows from both sites were used to obtain flow duration curves. These were then correlated using both linear and polynomial regressions (Figure 4.8).

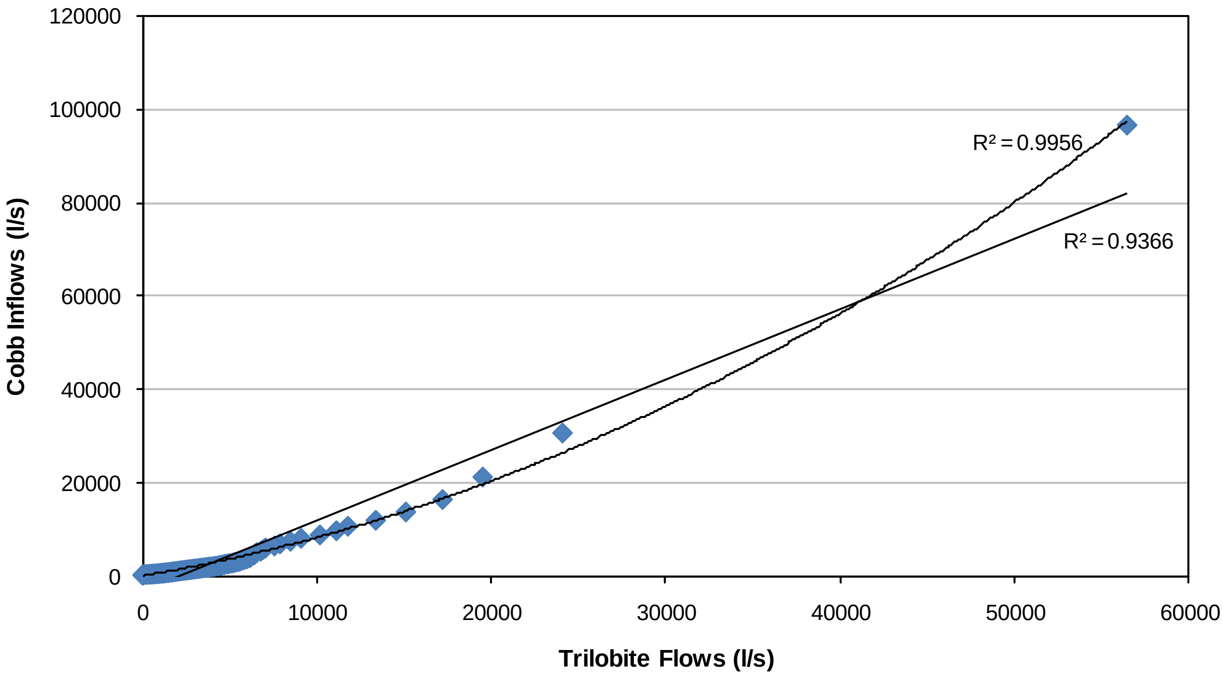

Figure 4.8 Regression lines for the Trilobite and Cobb Inflows (1-Jan-2000 to 30-Jun-2008).

The polynomial regression fits the data better and was therefore used to create a synthetic inflow series for Cobb for Jun 2008 to Jun 2010. Data was also synthesised using the polymomial equation for the Cobb inflow series between Jan 2000 and Jun 2008. This was then correlated with the Cobb inflows estimated form station records for the same period (Figure 4.9). The r^2 value is quite low but these data are the best available at this time.

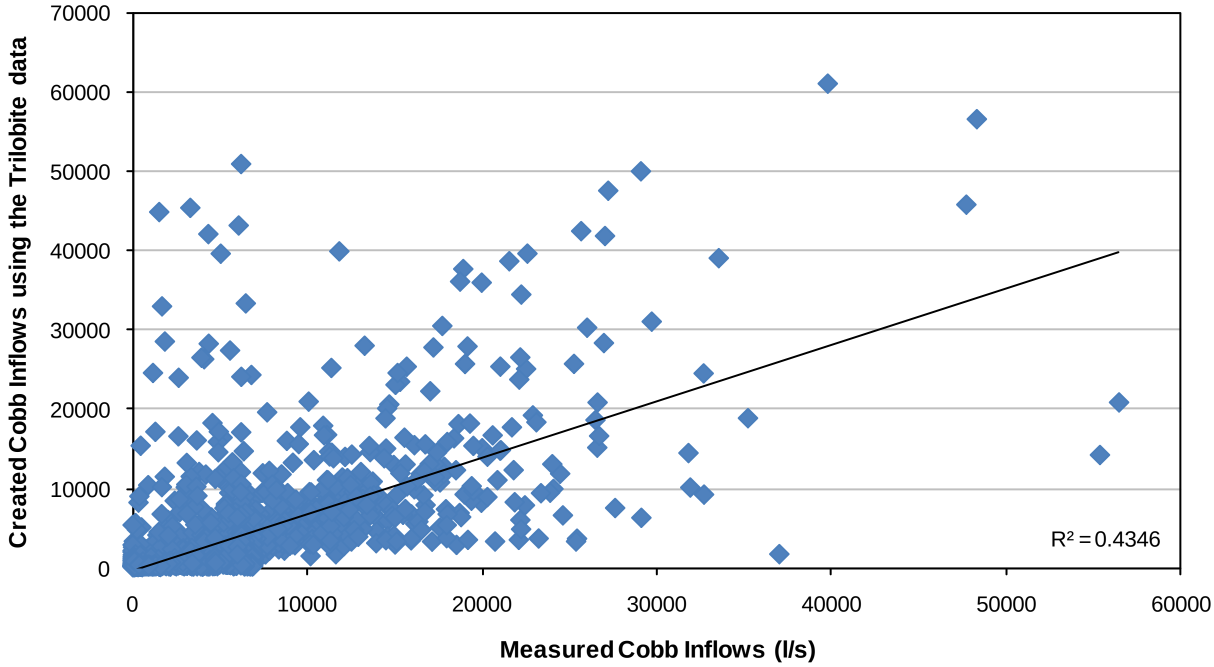

Figure 4.9 Linear regression line for the measeured and calculated Cobb Inflow series (1-Jan-2000 to 30-Jun-2008)

4.7 Grey River

Scheme description

Data for the Grey River is used for investigative work on the feasibility of a power station on the river. A proposed scheme involves diverting water from the Taramakau River into the Grey, via a canal and the Arnold River (Figure 4.10). Other proposals have also included diversion of the Taipo River; however, data here does not include Taipo.

The recording site used on the Grey River is located at Dobson at the downstream end of the Brunner Gorge. The site is approximately 10km upstream of the mouth, and has a catchment area of 3830km^2. Data for the Taramakau River is from the Taramakau at Greenstone Bridge water level recording site, which is downstream of the Taramakau/Taipo confluence. It has a catchment area of 863km^2.

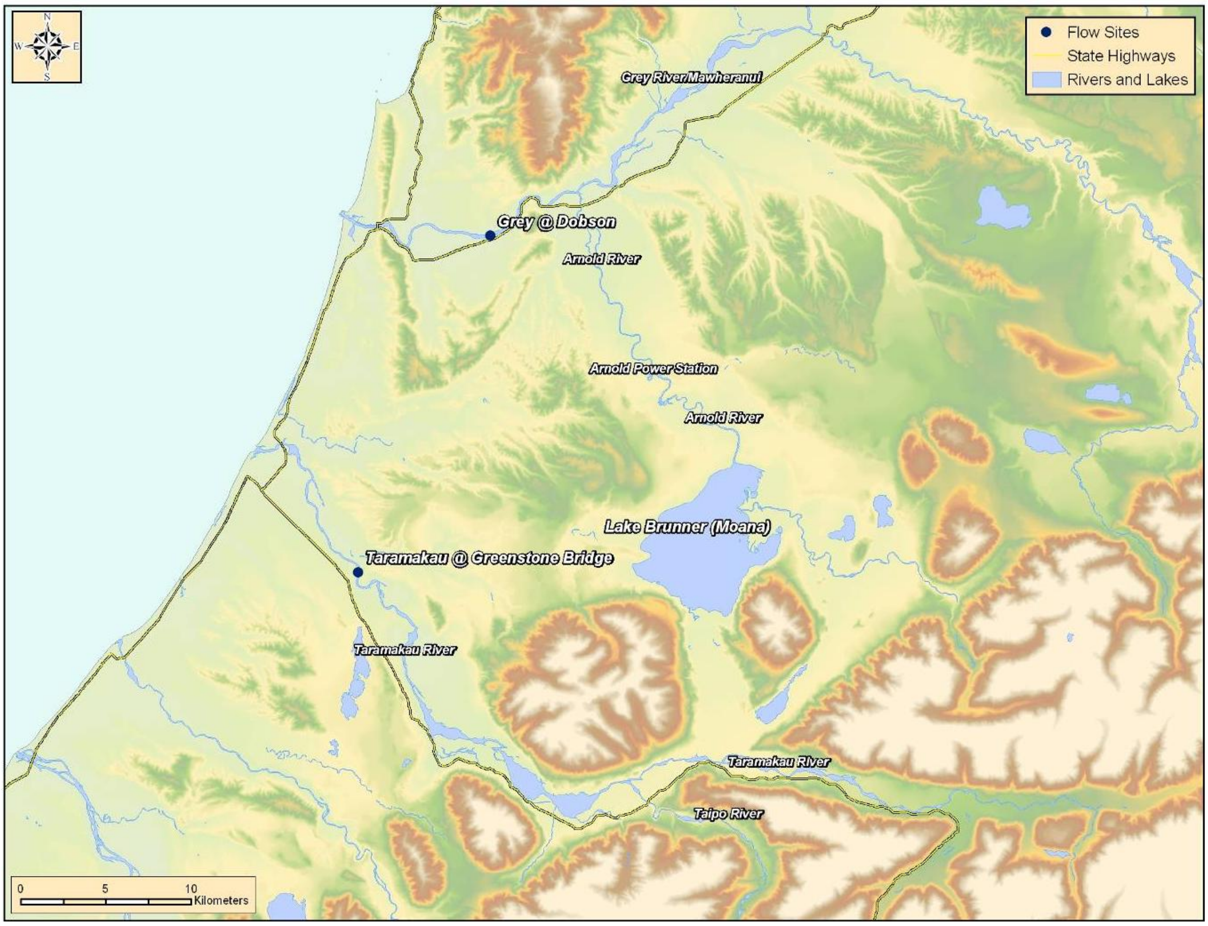

Figure 4.10 Location map for Grey, Taramakau and Taipo rivers

SPECTRA flow records

A flow record for the Grey River at Dobson is available from July 1968 until present. An earlier record is synthesised from the Buller River at "Berlins" from 1952 to 1968, and from Lake Te Anau inflow prior to 1952. Lake Te Anau gave the best results of the few records available for the early period from 1930 (Freestone & Mills, June 1990).

The dataset used in SPECTRA is the flow in the Grey River at Dobson, including water diverted from the Taramakau River. This is derived from another dataset that also includes water diverted from the Taipo River. This is because the Taramakau at Greenstone Bridge recorder includes Taipo River flow, as it is downstream of the Taipo confluence. The calculation of the combined Grey-Taramakau-Taipo data is outlined below.

To determine the flows available for diversion into the Grey some assumptions must be made, as there are currently no firm scheme details. These are summarised as follows:

- Residual flows are required in the Taramakau and Taipo Rivers of 15m³/s and 5m³/s respectively
- Maximum canal flow is 230m³/s (twice the mean)
- Shut down of diversion structure intake during floods is not considered
- Utilisation of the water available for diversion is assumed to be 70%.

Based on these assumptions the diverted water is calculated. This is then added to the Grey at Dobson record. For the period before February 1979, when the Taramakau at Greenstone record begins, the total flow set is synthesised from the extended Grey record, based on the correlation between the two, post-1979.

The data set including Taramakau only is then derived from the Grey-Taramakau-Taipo record by scaling down by 0.93, i.e. assuming that 7% of the total water is diverted from the Taipo River.

4.8 Coleridge

Scheme description

The Coleridge Power Scheme takes water from Lake Coleridge through two parallel tunnels to nine machines in the power house and then releases the water into the Rakaia River (Figure 4.12). The power scheme was commissioned in 1914 and is the oldest in New Zealand. The natural inflows to Lake Coleridge are supplemented by three diversions from adjacent rivers. The Harper River diversion was completed in 1922, the Acheron Diversion in 1932, and the Wilberforce Diversion in 1977.

The natural lake outlet was through a small stream at the northern end of the lake. Outflows are now regulated by a control gate at the outlet. However, because of the ability to control inflows to the lake through the diversions, and the comparatively large capacity of the station, spill flows seldom occur. Some spill flows have occurred as reverse flows through the Oakden canal.

SPECTRA flow records

The inflows into Lake Coleridge are from the local catchment together with diversions from the Wilberforce, Harper, and Acheron Rivers. Diversions from the Harper and Wilberforce rivers cease during floods when the diversion bunds are washed away. During the floods the only inflows are therefore from the local catchment and the Acheron Diversion. There are also turbidity constraints imposed on lake inflows.

The inflows are calculated using the equation:

Inflow = outflow ± change in storage

Where: outflows include machine discharge, spill flow and the Oakden diversion outflow. The change in storage volume is calculated from measured lake levels (at the Power Station intake) and a lake level-volume relationship.

Lake Coleridge inflows prior to 1951 initially synthesised from the Harper River flows but these were genrally of poor quality. In late 1993 some historic weekly power station reports from 1928 to 1951 were located in the station archives. From these several data items were loaded to computer which enabled the calculation of actual lake inflows. The resulting inflow record was a substantial improvement over the previously synthesised flows. This record replaced the synthetic record in the 1994 Spectra.

When the Coleridge “Hydrological Data Reference Manual” (Greer, Sept. 1994) was compiled, the inflows were again scrutinised. A further period of record, recalculated with the pre-1951 data, was replaced on the archive. This involved only a relatively minor change to the way in which the inflows were calculated from April 1951 to September 1963. It has not significantly affected the mean flow. Note that the efficiency of the diversion works varies and this may affect flow trends. Data from 26 January 1998 to 31 December 2002 is synthetic record.

Data was unavailable for the Lake Coleridge inflows. Instead, TrustPower provided daily inflows derived from a water balance. Figure 4.11 shows the Coleridge Inflows over a common period calculated using both methods. The relationship between the two different methods is generally poor, although the two patterns are similar. Despite this apparent anomaly these are the only inflow data available for the update.

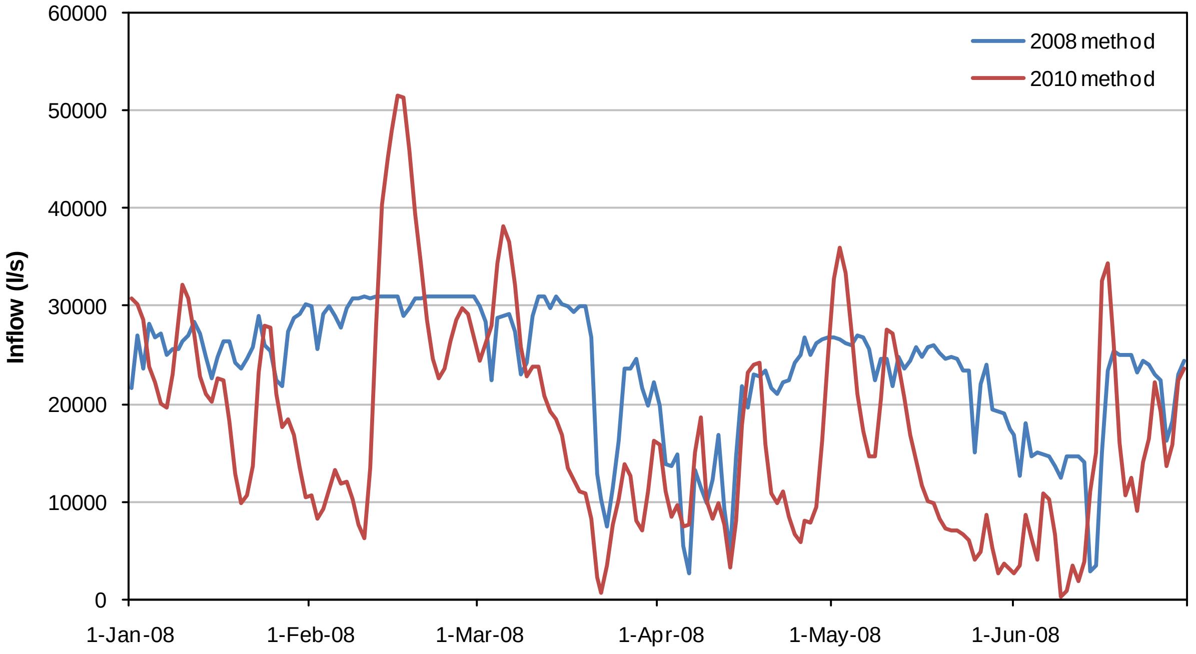

Figure 4.11 Coleridge Inflows created using two different methods (1-Jan to 1-Jul 2008). The 2008 method uses the outflows and change in storage measured at the Power Station Intake. The 2010 method is a water balance.

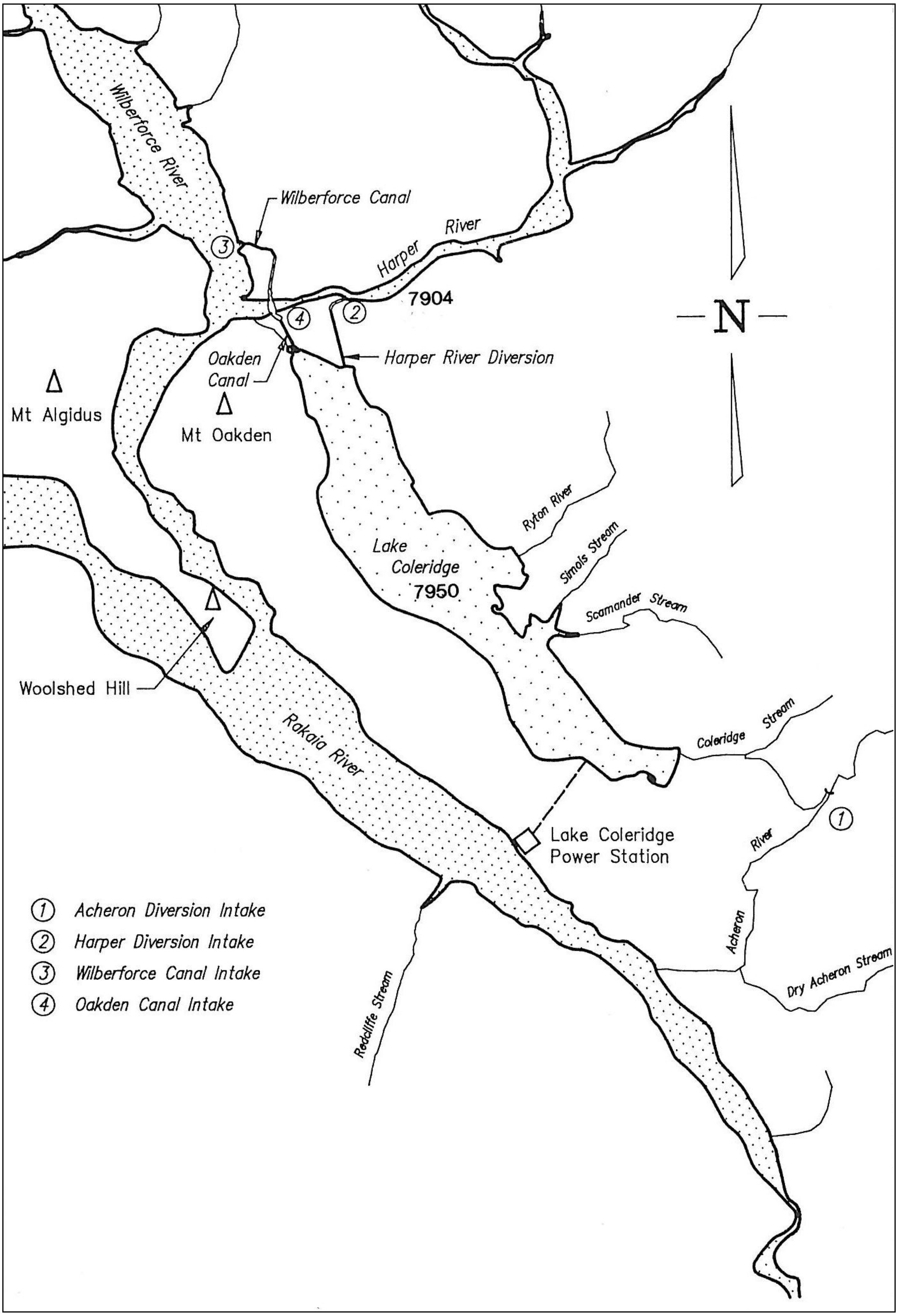

Figure 4.12 Layout of Coleridge Power Scheme

4.9 Waitaki

Scheme description

Based on mean flow the Waitaki River is the fourth largest river in New Zealand and as such is of major importance for hydro-electric power generation. This is reflected by the presence of eight power stations within the catchment (Figure 4.13). Lakes Pukaki and Tekapo at the top of the catchment provide the primary storage for the system. Water passes from Lake Tekapo through the Tekapo A Power Station along the Tekapo canal to Tekapo B and is discharged into Lake Pukaki. From Pukaki water flows down the Pukaki canal and is joined by water from Lake Ohau before passing through Ohau A Power Station into Lake Ruataniwha and then Ohau B and C and into Lake Benmore. Downstream of Lake Benmore is the Benmore Power Station followed by Aviemore and Waitaki Power Stations and their associated storage lakes.

SPECTRA flow records

For SPECTRA modelling, the flows in the Waitaki River are considered in two components, inflow to Lakes Pukaki and Tekapo; and tributary inflows below the lakes at Benmore and Waitaki Power Stations.

Pukaki and Tekapo inflows - Three options are available:

- Aggregate both lakes into one, and scale Tekapo A and B cumecs/MW factors by the ratio of the mean flows to ensure the correct mean generation from the combined flow. Flow set: Tek_Puk (Total inflows to both lakes) (controllable)

- Two-lake simulation of Tekapo-Pukaki system (i.e. separate Tekapo simulation). Lake Tekapo treated separately with a stand-alone TIDEDA simulation of its operation. This accounts for bottleneck effect of the canal. Flow sets: Tekapo (trib), Pukaki (including Tekapo outflow) (controllable).

- Natural Inflows to each lake separately. Flow sets: Tek_nat and Puk_nat (Tributary).

Ohau - Ohau A is affected by residual flows in the Upper Ohau River.

Two simulations are run for Ohau based on a separate Tekapo simulation of Tekapo - Pukaki system:

- Ohau - Ohau B & C only, no loss of water

- OhauRes - Residual flows diverted to the Upper Ohau River of $8m^3/s$ (Nov to Apr) and $12m^3/s$ (May to Oct).

Benmore Tributary - includes Ahuriri, Ohau, and tributaries between Tekapo, Pukaki, and Ohau outfalls. Prior to 1949 the Ahuriri was not measured, so it is simulated from Ohau inflows. After 1964 the flow gauging site was inundated by Lake Benmore, so a site further up the river at South Diadem is used, with a scaling factor to account for additional inflows. Small tributary flows in the areas between the major lakes and Benmore are accounted for by adding 33% to the Ahuriri flow.

There are two flows sets for Benmore tributaries:

- BENMORE.DAT (mean of 125.4m^3/s) is based on the separate Tekapo simulation and includes Tekapo spill.

- BEN_TP.DAT (mean of 123.5m^3/s) is based on the combined lakes Tekapo-Pukaki simulation and is simply Ohau inflow plus Ahuriri scaled up by 1.33.

Waitaki Tributary - A separate tributary flow has also been produced for Waitaki power station (Halliburton, December 1993). Previously, Waitaki and Aviemore tributaries were scaled off Benmore. Waitaki tributary equals total Waitaki flow minus the outflow from lakes Tekapo and Pukaki. Prior to 22 August 1977 this was calculated from the total discharge from each lake, whereas after that date it is calculated from total Pukaki discharge minus Tekapo spill only.

There are a number of gaps in the early Pukaki outflow record. A simulation has been incorporated into the updating routines, which fills these gaps with synthetic data based on Tekapo outflows.

Feedback from the draft SPECTRA (2007) report highlighted poor Waitaki flow data when compared to Benmore. Measurement inaccuracies produce negative flows when compared to Benmore power station tributaries. However, the effect tributaries have on lake levels is complicated and require assumptions that do not nessesarily work well for long term records. Meridian suggests that work on these inaccuracies should be addressed on a project by project basis for shorter data sets.

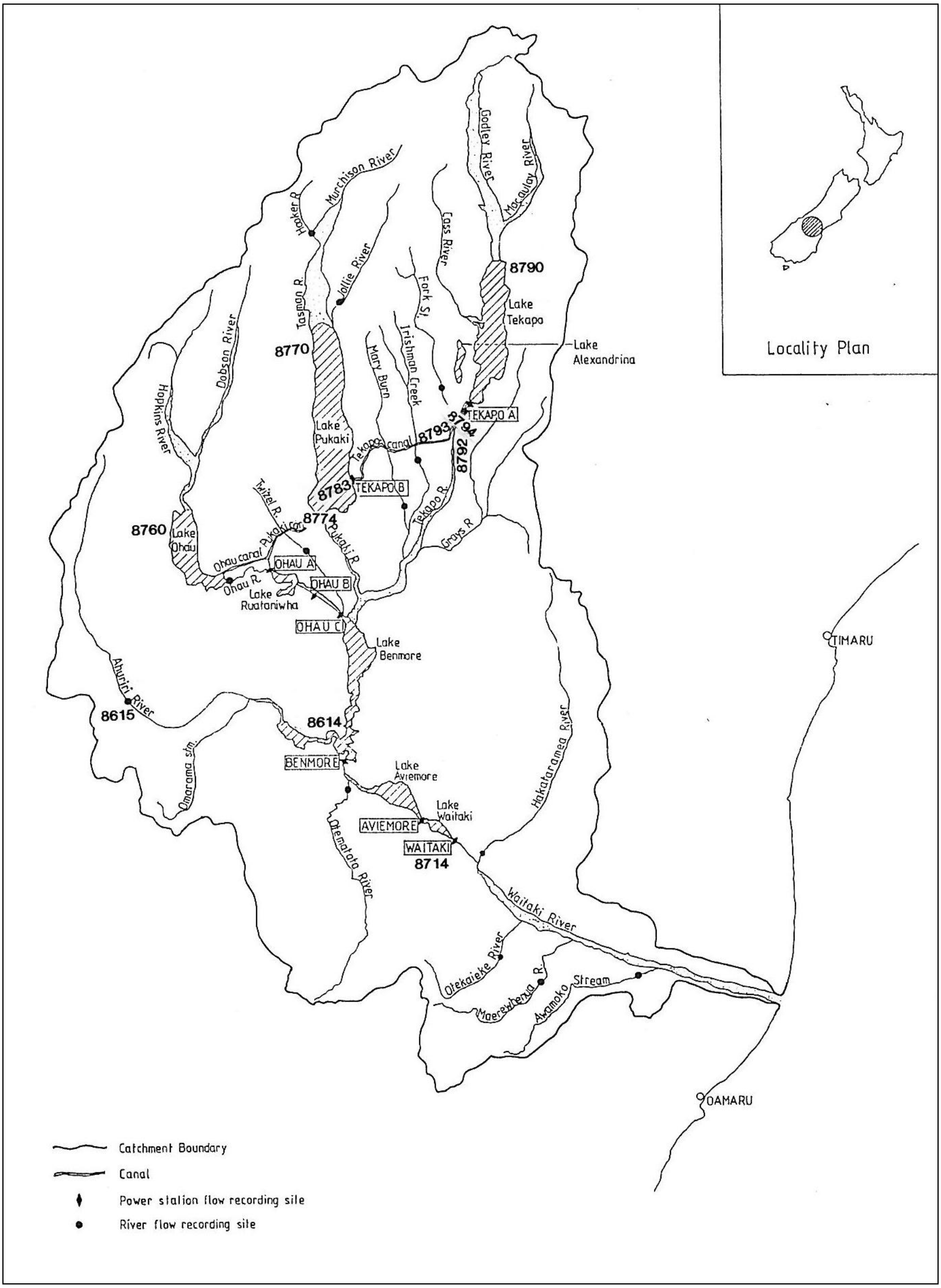

Figure 4.13 Waitaki Power Development

4.10 Clutha

Scheme description

The Roxburgh Power Station is situated on the Clutha River just upstream of its confluence with the Teviot River (Figure 4.14). Much of the flow at Roxburgh comprises outflow from three lakes; the Clutha River flows from Lake Wanaka while two of its main tributaries, the Hawea and Kawarau Rivers, drain Lakes Hawea and Wakatipu respectively. Outflows from Wanaka are natural and while Lake Wakatipu has control gates at its outlet, these were built for mining purposes and are very seldom used. Therefore only Hawea is considered to be controlled and outflows from the other two lakes are classed as tributary flows.

SPECTRA flow records

Hawea – Flow from Lake Hawea are read directly from the Power Archive.

Wanaka outflows - from Lake Wanaka are read directly from the Power Archive.

Roxburgh inflows - Roxburgh inflows are read directly from the Power Archive and Hawea outflows are subtracted.

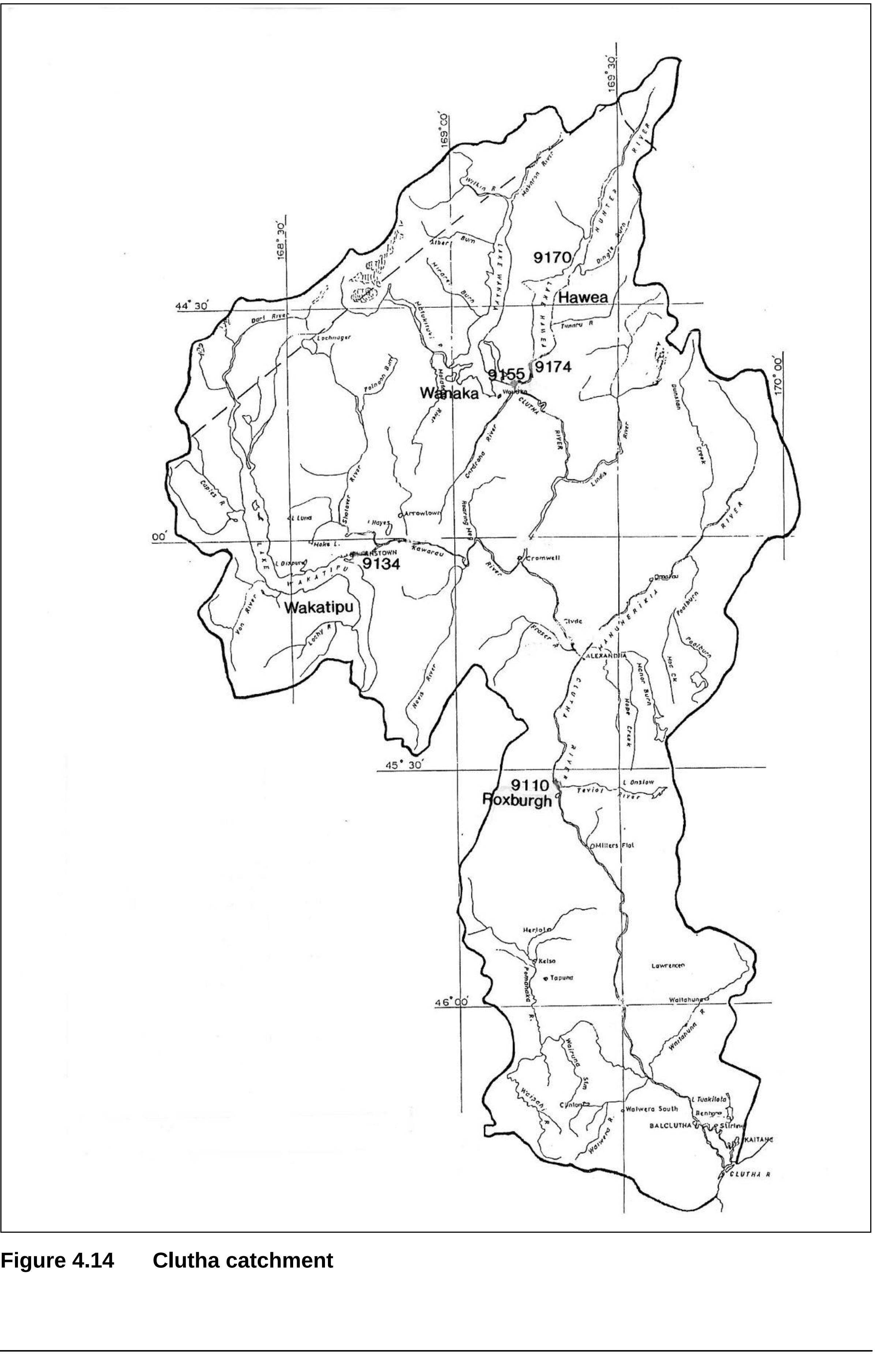

Figure 4.14 Clutha catchment

4.11 Manapouri

Scheme description

The Manapouri Power Development is based around two large storage lakes. Lake Te Anau is the second largest lake in New Zealand (after Lake Taupo) with an area of 352km² (Figure 4.15). It receives the majority of its inflow from the Fiordland National Park portion of its catchment (Riddell et al, April 1993) which has much higher rainfall than the adjacent Southland region. Outflow from Lake Te Anau is via the Upper Waiau River which feeds Lake Manapouri. Prior to control the only outflow from Lake Manapouri was via the Lower Waiau River. The Manapouri Power Development involved the construction of a power house at West Arm which discharges into Deep Cove in Doubtful Sound via a 10km long tailrace tunnel. The power station utilises the storage capacity of both lakes via the Te Anau and Manapouri control structures.

Prior to control about 67% of the water entering Lake Manapouri was from Lake Te Anau via the Upper Waiau River. The remainder was inflow from the local catchment. Since 1969 the natural inflows have been augmented by water from the Mararoa River. This was achieved by construction of a rock weir until 1976 when the Manapouri Lake Control (MLC) structure was completed.

A residual flow regime has been proposed to be released from the MLC for the lower Waiau River. The regime is comprised of a seasonally adjusted minimum flow with recreational and gravel flushing discharges within stipulated periods. The residual flow regime is outlined below.

- A continuous flow of not less than 12 cumecs in the months of 1 May to 30 September, 14 cumecs in April and October, and 16 cumecs at all other times.

- Two flushing flows of not less than 35 cumecs for 24 hours released during the winter months of June and August.

- One flow of not less than 150 cumecs for 24 hours will be provided during each of the periods March to May and September to November in any one year.

- Seven recreational flows of not less than 35 cumecs, for 24 hours, released on the fourth Sunday of each month between October and April. Two of these flows may be increased to 45 cumecs subject to compliance with lake level guidelines.

SPECTRA flow records

SPECTRA Manapouri data is intended to be used as a tributary flow, whereas Te Anau is a controllable flow. Hence two separate files are required for SPECTRA. Inflows and outflows for Lake Te Anau are available from 1926 and for Lake Manapouri from May 1932. The local catchment, or tributary, contribution to Manapouri inflow is determined by subtracting the Te Anau outflows from the total Manapouri inflows. For the period before

30th April 1932 when the record at Manapouri began, the local inflows are simulated from Te Anau outflow.

For the purposes of SPECTRA modelling a record of Manapouri local inflows is required upon which future predictions of inflows can be based. To achieve this records are synthesised which either include or exclude the Mararoa River for the entire record. The Mararoa has been included in the Archive inflows since the commissioning of the Manapouri Power Station in August 1969. Outflow was first measured downstream of the Mararoa confluence (with power station flows added) (Duffy et al, October 1993).

Prior to the availability of actual Mararoa River records, and for filling gaps, synthetic flows are simulated from Te Anau outflows. The equations used were derived by Robertson et al (April 1989) and later confirmed by Maslin et al (February 1993).

Several options are available for the Manapouri flows:

1. With Mararoa diversion. Note that when Mararoa flows are above 40 cumecs, the Mararoa is spilled. This only approximates the actual operation of the Mararoa control structure. Also when Mararoa water is being spilled, it is not possible to avoid some clean water spill from Lake Manapouri.

2. Without Mararoa, which represents the view of a possible extreme outcome of water rights application.

3. With the minimum flow regime implemented and Mararoa dirty water spill.

Distribution plots are included at the end of this report that illustrates the results of the simulations and the effects on potential generation available.

The minimum flow regime was introduced to the model. Previously, the minimum flow was assumed to be a constant 15 cumecs throughout the year, although to date, there has not been a regular minimum flow except for a nominal minor flow through the fish pass. The 15 cumec figure was hypothetical only subject to pending consent hearings.

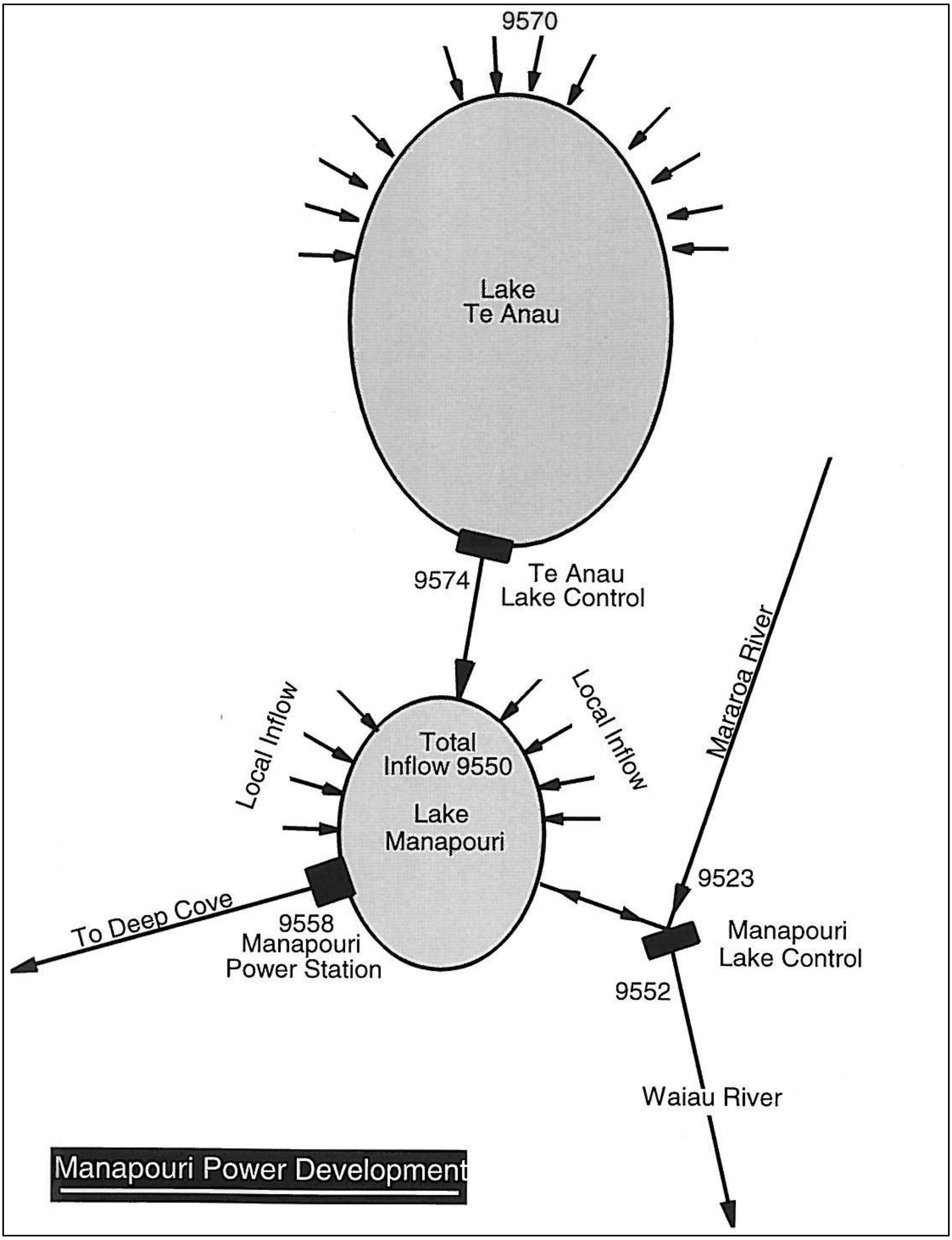

Figure 4.15 Schematic layout of the Manapouri Power Development

4.12 Waiau River, Canterbury

Four possible hydro-power scheme sites have been identified along the Waiau River. These are the Clarence to Waiau Diversion, Upper Waiau, Mid Waiau and Lower Waiau. SPECTRA records have been developed at three sites within the catchment; these are: Clarence at Jollies (Clarence diversion), Waiau at Glenhope (Upper Waiau), and Waiau at Marble Point (Mid Waiau).

The Clarence diversion is important to a Waiau power scheme as flow from the Clarence catchment could be diverted into the Waiau catchment near Hamner Springs to maximise generation. Figure 4.16 shows the possible Waiau River schemes.

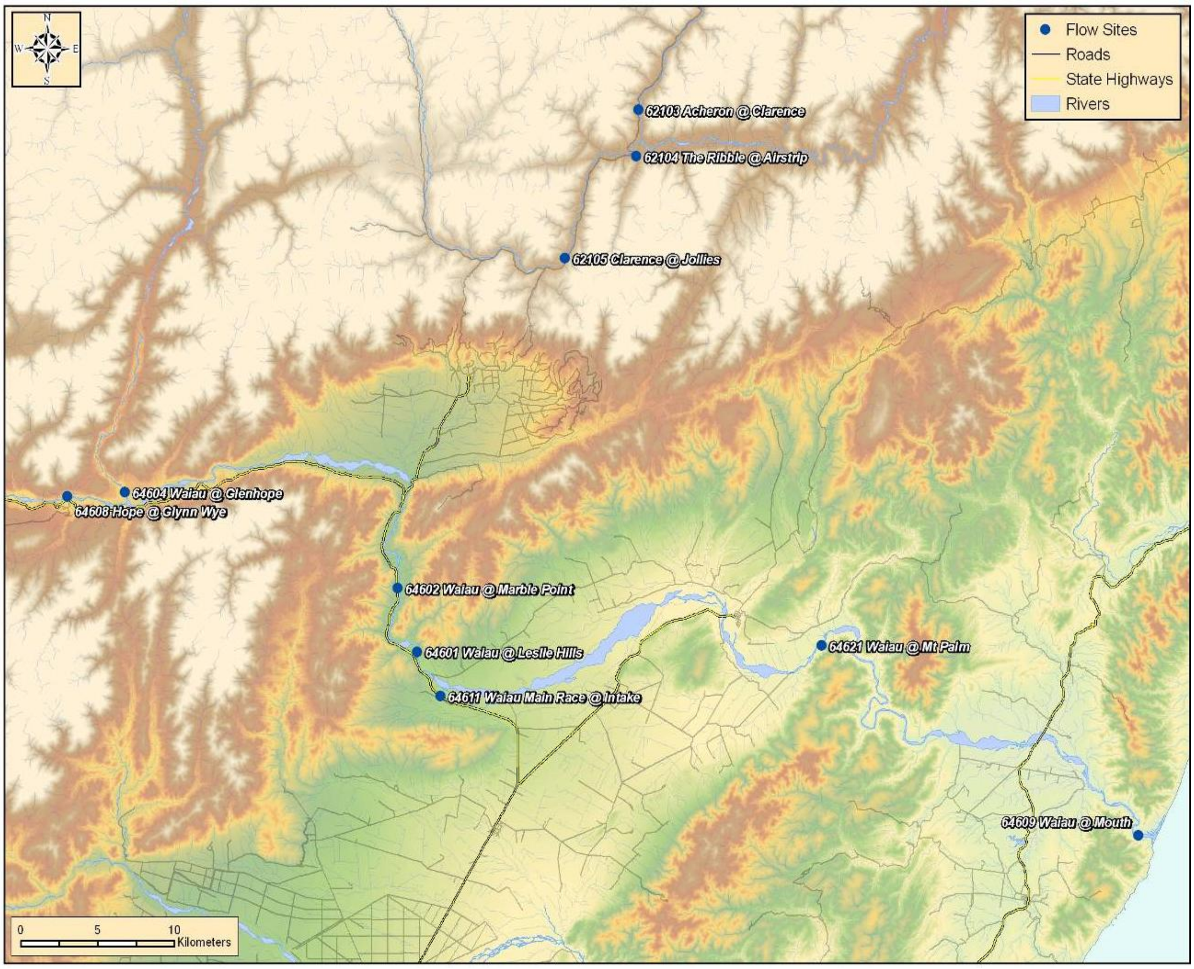

Figure 4.16 Waiau River location diagram

4.12.1 Clarence at Jollies

The longest flow record in the vicinity of the Waiau River is the Clarence at Jollies recorder. Data extends back to 1960. The Clarence at Jollies recorder was correlated with the longer Gowan at Lake Rotoroa flow record to extend the SPECTRA series back to April 1934.

The best correlation was obtained through a flow distribution rating of the Gowan record (1934-1991). The distribution of flow in the resulting dataset is similar to the actual distribution of flow. However, the Gowan record is based on lake inflows so many flood peaks have been reduced. Actual data from the Clarence at Jollies record (1960-2006) replaces the rated data.

The first four years of record (1931-1934) were selected from average flows. The Works Consultancy Services Ltd produced a report in 1993 titled “Trends in Flow Data for Manapouri Local Inflows, Mangahao, Cobb, Coleridge Inflows and Waikato Tributary Flows”. Appendix III of the report specified ratios from sites throughout New Zealand of the mean annual inflow to the mean total record, since 1932. Ratios less than one indicated inflows to the site were less than average and hence a dryer year; ratios greater than one indicated inflows to the site were greater than average and hence a wetter year. The mean annual ratios at Lake Coleridge, which is the nearest site to the Waiau River, were 0.77, 0.65, and 1.05 during 1932, 1933, and 1934 respectively. 1932 and 1933 were therefore dryer years than average.

The ratios were then applied to the total mean flow of the rated Clarence at Jollies record. Mean annual flows were determined for the three years, and compared to annual flows from the entire record. Flows from years that had similar mean annual flows were replicated in the earlier record. Flows from 1956 are repeated in 1932, flows from 1969 are repeated in 1933, and flows in the first three months of 1953 are repeated in 1934.

The six months from 1 July 1931 to 31 December 1931 were replicated from the year 1936 with the mean annual flow nearest to the total record mean flow of 14.7m³/s. 1936 has a mean flow of 14.8m³/s.

Care was taken to maintain the water balance in the river. Table 4.1 details the mean flows during the record correlation phases. This flow has remained constant. Mean monthly flow values, and the distribution of flow are displayed in Appendix A.

Table 4.1 Clarence at Jollies mean flow

Record	Record Length	Mean Flow (m³/s)
Clarence at Jollies	1960-1999	14.9
Rated Clarence at Jollies*	1960-1999	15.0
Rated Clarence at Jollies	1931-2010	14.5

*Prior to superimposing the actual Clarence at Jollies record over the SPECTRA series

Although the mean flows compare well there is less flood peak amplitude in the correlated record 1931 to 1960. However, the overall water balance is good.

4.12.2 Waiau at Glenhope

The Waiau at Glenhope record begins in 1974. This record was extended back to 1931 through a distribution correlation with the extended Clarence at Jollies record. The distribution rating compared flow data over the period 1974 to 1999. The Glenhope site was not rated between July 1999 and September 2003. The correlated data from Clarence at Jollies filled this period. Actual data from the Waiau at Glenhope record is used when present. The Waiau at Glenhope site is not rated any longer (Jul 2008). The location is too dangerous at guage at low flows in the jetboat and too difficult to wade.

Care was taken to maintain the water balance in the river. Table 4.2 details the mean flows during the record correlation phases. This flow has remained fairly constant. Mean monthly flow values, and the distribution of flow are displayed in Appendix A.

Table 4.2 Waiau at Glenhope mean flow

Record	Record Length	Mean Flow (m^3/s)
Waiau at Glenhope	1974-1999	35.8
Rated Waiau at Glenhope*	1974-1999	35.7
Rated Waiau at Glenhope	1931-2010	33.2

*Prior to superimposing the actual Waiau at Glenhope record over the SPECTRA series

There is less flood activity in the synthetic record (pre 1974) and this may, when combined with the low flow period in the 1930's, produce an overall slightly lower long-term mean flow (2.3m^3/s (6%) lower). The monthly flows (Appendix A) contain annual flows that are very similar over the actual and synthetic record periods.

4.12.3 Waiau at Marble Point

The Waiau at Marble Point record begins in 1967. This record was extended back to 1931 through a distribution correlation with the extended Clarence at Jollies record. The distribution rating compared flow data over the period 1967 to 2002. Data from February 2003 at the Marble Point site is provisional and was therefore not used in the distribution rating. Actual data from the Waiau at Marble Point record (1967 – 2006) is applied to the rated data.

Care was taken to maintain the water balance in the river. Table 4.3 details the mean flows during the record correlation phases. This flow has remained fairly constant. Mean monthly flow values, and the distribution of flow are displayed in Appendix A.

Table 4.3 Waiau at Marble Point mean flow

Record	Record Length	Mean Flow (m^3/s)
Waiau at Marble Point	1967-2002	98.7
Rated Waiau at Marble Point*	1967-2002	98.8
Rated Waiau at Marble Point	1931-2010	94.5

*Prior to superimposing the actual Waiau at Marble Point record over the SPECTRA series

The slightly lower mean flow for the longer record (1931 to 2006) is because of a dry period in the 1930's, and the reduced flood activity in the synthetic record. The monthly summary table (Appendix A) shows the annual maxima and minima for the actual and synthetic record periods are very similar.

4.13 Ngaruroro River, Hawke's Bay

In a previous Opus report Additional SPECTRA Investigations (September 2005), five possible hydro-power schemes were identified along the Ngaruroro River. SPECTRA series have been developed at three of the flow recording sites to represent flows at these schemes. SPECTRA series have been created at Ngaruroro at Whanawhana, Ngaruroro at Kuripapango and Ngaruroro at Chesterhope Bridge. These sites are shown in Figure 4.17.

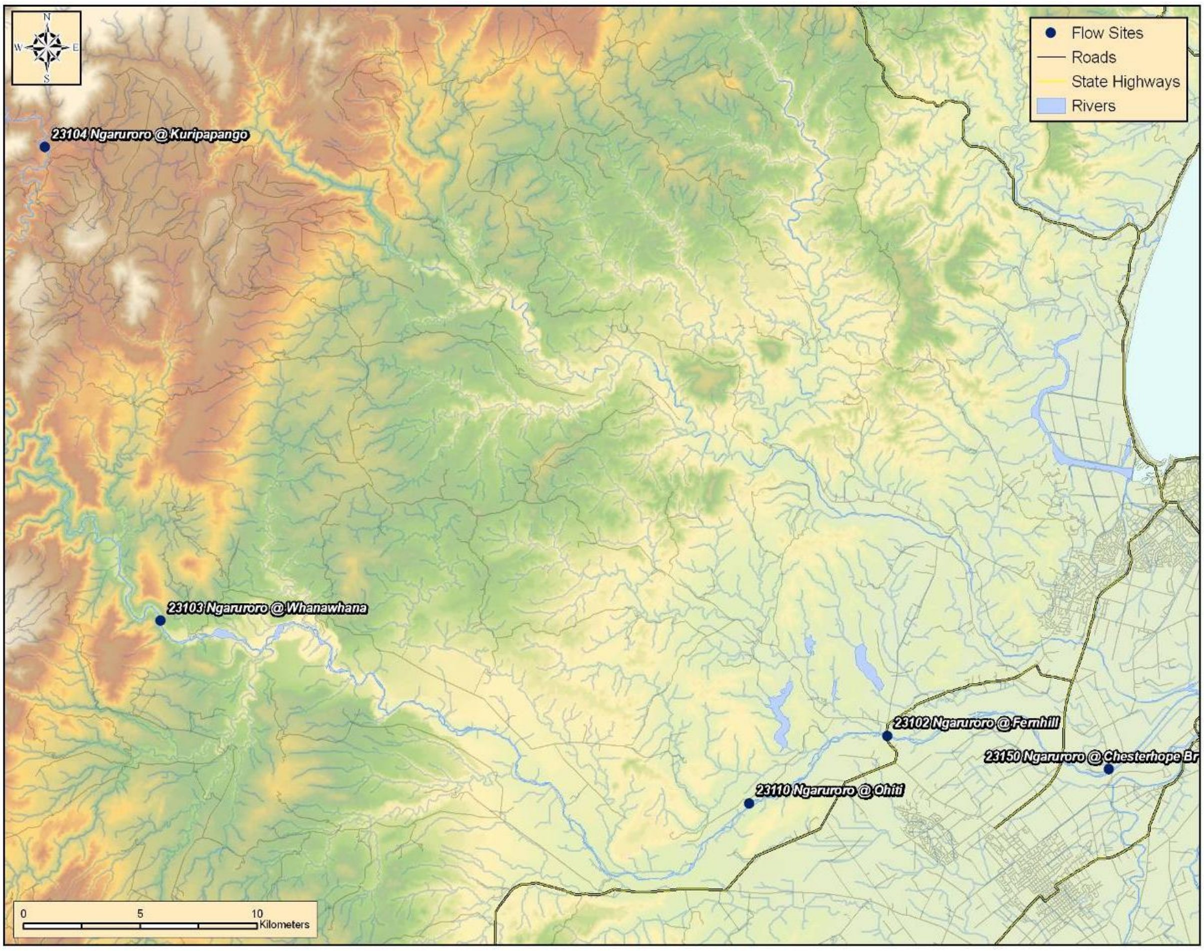

Figure 4.17 Ngaruroro River location diagram

4.13.1 Ngaruroro at Whanawhana

The longest flow record in the vicinity of the Ngaruroro River is the Ngaruroro at Fernhill data. This record extends back to 1953. Unfortunately, no gaugings were available at this site between 1974 and 2005 resulting in unrealistic flows. Consequently, data from this period could not be used. The Ngaruroro at Whanawhana record, which extends back to 1960, is used instead. The Ngaruroro at Whanawhana recorder was correlated with the longer Lake Waikaremoana inflow record to extend the SPECTRA series back to July 1931.

The best correlation was obtained through a distribution rating of the Lake Waikaremoana record (1960-2001). The distribution of flow in the resulting dataset is similar to the actual distribution of flow. The Ngaruroro at Whanawhana record is used from 1960 to present.

Inflow to Lake Waikaremoana is calculated from lake level and outflow data. The resulting Ngaruroro at Whanawhana rated record between 1931 and 1960 has some lake level characteristics, including a greater number of flood events.

Care was taken to maintain the water balance in the river. Table 4.4 details the mean flows during the record correlation phases. This flow has remained constant. Mean monthly flow values, and the distribution of flow are displayed in Appendix A.

Table 4.4 Ngaruroro at Whanawhana mean flow

Record	Record Length	Mean Flow (m^3/s)
Ngaruroro at Whanawhana	1960-2001	35.2
Rated Ngaruroro at Whanawhana*	1960-2001	34.9
Rated Ngaruroro at Whanawhana	1931-2010	35.2

*Prior to superimposing the actual Ngaruroro at Whanawhana record over the SPECTRA series

The monthly data displayed in Appendix A shows that there is slightly more variation in annual totals for the period of actual record. Also, summer flows in 1948 and 1954 are very low. In general the water balance (Table 4.4) is good.

4.13.2 Ngaruroro at Kuripapango

The Ngaruroro at Kuripapango record begins in 1963. This record was extended back to 1931 through a distribution correlation with the extended Ngaruroro at Whanawhana record. The distribution rating compared flow data over the period 1963 to 2006. Actual data from the Ngaruroro at Kuripapango record is applied to the rated data.

Care was taken to maintain the water balance in the river. Table 4.5 details the mean flows during the record correlation phases. Mean monthly flow values and the distribution of flow are displayed in Appendix A.

The monthly data in (Appendix A) confirmed the longer duration similarity between the synthetic and recorded data.

Table 4.5 Ngaruroro at Kuripapango mean flow

Record	Record Length	Mean Flow (m^3/s)
Ngaruroro at Kuripapango	1963-2005	17.2
Rated Ngaruroro at Kuripapango*	1963-2005	17.1
Rated Ngaruroro at Kuripapango	1931-2010	17.7

*Prior to superimposing the actual Ngaruroro at Kuripapango record over the SPECTRA series

4.13.3 Ngaruroro at Chesterhope Bridge

The Ngaruroro at Chesterhope Bridge record begins in 1976. This record was extended back to 1931 through a distribution correlation with the extended Ngaruroro at Whanawhana record. The distribution rating compared flow data over the period 1976 to 2006. Actual data from the Ngaruroro at Chesterhope Bridge record is applied to the rated data. Gaps in the Chesterhope Bridge record are filled from the synthetic data.

Care was taken to maintain the water balance in the river. Table 4.6 details the mean flows during the record correlation phases. Mean monthly flow values, and the distribution of flow are displayed in Appendix A.

Table 4.6 Ngaruroro at Chesterhope Bridge mean flow

Record	Record Length	Mean Flow (m^3/s)
Ngaruroro at Chesterhope Br	1976-2005	41.8
Rated Ngaruroro at Chesterhope Br*	1976-2005	41.3
Rated Ngaruroro at Chesterhope Br	1931-2010	43.8

*Prior to superimposing the actual Ngaruroro at Chesterhope Br record over the SPECTRA series

The data showed very low summer flows in 1948 and 1954. The rest of the synthetic data is reasonable.

4.14 Wairau River, Marlborough

The proposed scheme in the Wairau River is an extension of Trustpower's Branch River hydro-electric scheme. It would involve diverting water from the Wairau River into the existing Branch scheme through interconnecting canals and penstocks to new power stations. The tailrace of the last station would be approximately 25km southwest of Blenheim. The Wairau at Dip Flat record is important for this scheme. Figure 4.18 is a location map of possible power schemes for the Wairau River.

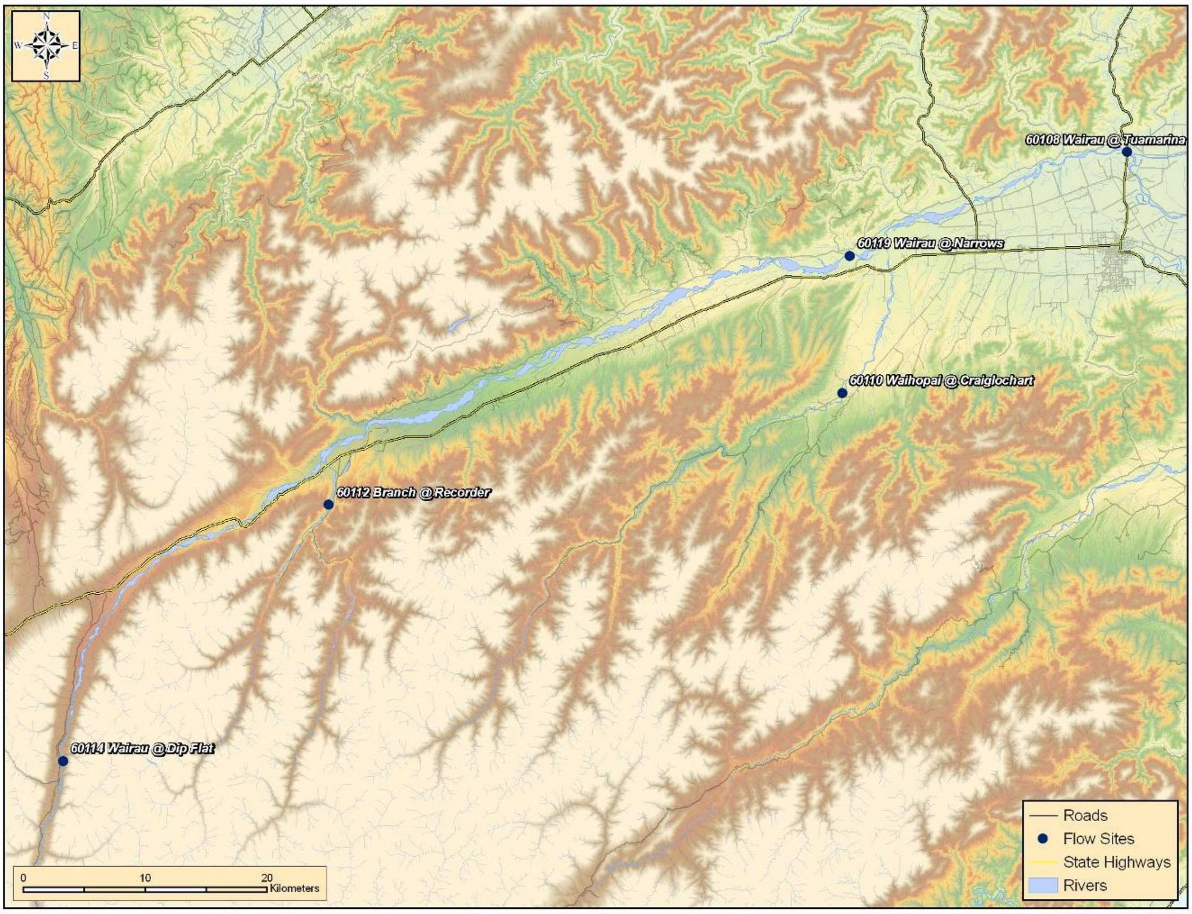

Figure 4.18 Wairau River location diagram

4.14.1 Wairau at Dip Flat

The longest flow record in the vicinity of the Wairau River is from the Wairau at Dip Flat recorder. This record extends back to 1951. The Wairau at Dip Flat recorder was correlated with the Gowan at Lake Rotoroa flow record to extend the SPECTRA series back to April 1934.

The best correlation was obtained through a distribution rating of the Gowan record comparing flow data over the period 1934-1991. The distribution of flow in the resulting dataset is similar to the actual distribution of flow. Actual data from the Wairau at Dip Flat record (1951-2006) is used.

As with the Waiau extension, the first four years of record were selected from average flows from the Works Consultancy Services Ltd report titled “Trends in Flow Data for Manapouri Local Inflows, Mangahao, Cobb, Coleridge Inflows and Waikato Tributary Flows (1993)”. The mean annual inflow ratios (averaging ratios from Mangahao and Coleridge) were 0.805, 0.795, and 0.995 in 1932, 1933, and 1934 respectively. This period was dryer than average.

The ratios were applied to the total mean flow of the correlated Gowan record (1934-2006, including actual data from the Wairau at Dip Flat record from 1951). Mean annual flows were determined for the three years and compared to annual flows from the entire record. Flows from years that had similar mean annual flows were replicated in the earlier record. Flows from 1941 are replicated in 1932 and 1933, and flows in 1954 are replicated in the initial three months of 1934.

The six months from 1 July 1931 to 31 December 1931 were replicated from the year with the nearest mean annual flow to the total mean flow of 26.6m³/s (1934-2006). 1976 has a mean flow of 26.7m³/s. The six months of record from 1 July 1976 to 31 December 1976 are replicated in 1931.

Gaps in the record were filled from correlation with the Wairau at Hells Gate record (1965-1975) and the Wairau at Tuamarina site (1989-1999) which was replaced with the Barnett's Bank recorder 390m upstream (1999-2006).

Care was taken to maintain the water balance in the river. Table 4.7 details the mean flows during the record correlation phases. Mean monthly flow values, and the distribution of flow are displayed in Appendix A.

Table 4.7 Wairau at Dip Flat mean flow

Record	Record Length	Mean Flow (m³/s)
Wairau at Dip Flat	1951-1991	26.7
Rated Wairau at Dip Flat*	1951-1991	27.0
Rated Wairau at Dip Flat	1931-2010	26.4

*Prior to superimposing the actual Wairau at Dip Flat record over the SPECTRA series

The monthly and annual data in Appendix A shows that the synthetic and actual segments of the record have similar patterns and extremes, although the synthetic low flows may be slightly higher at times.

4.15 Hurunui River, Canterbury

There are two options for a proposed hydro-power scheme along the Hurunui River. The first is upstream of State Highway 1 bridge near the mouth of the river. The second possible site is upstream of the Hurunui at Mandamus site. These sites are shown in Figure 4.19.

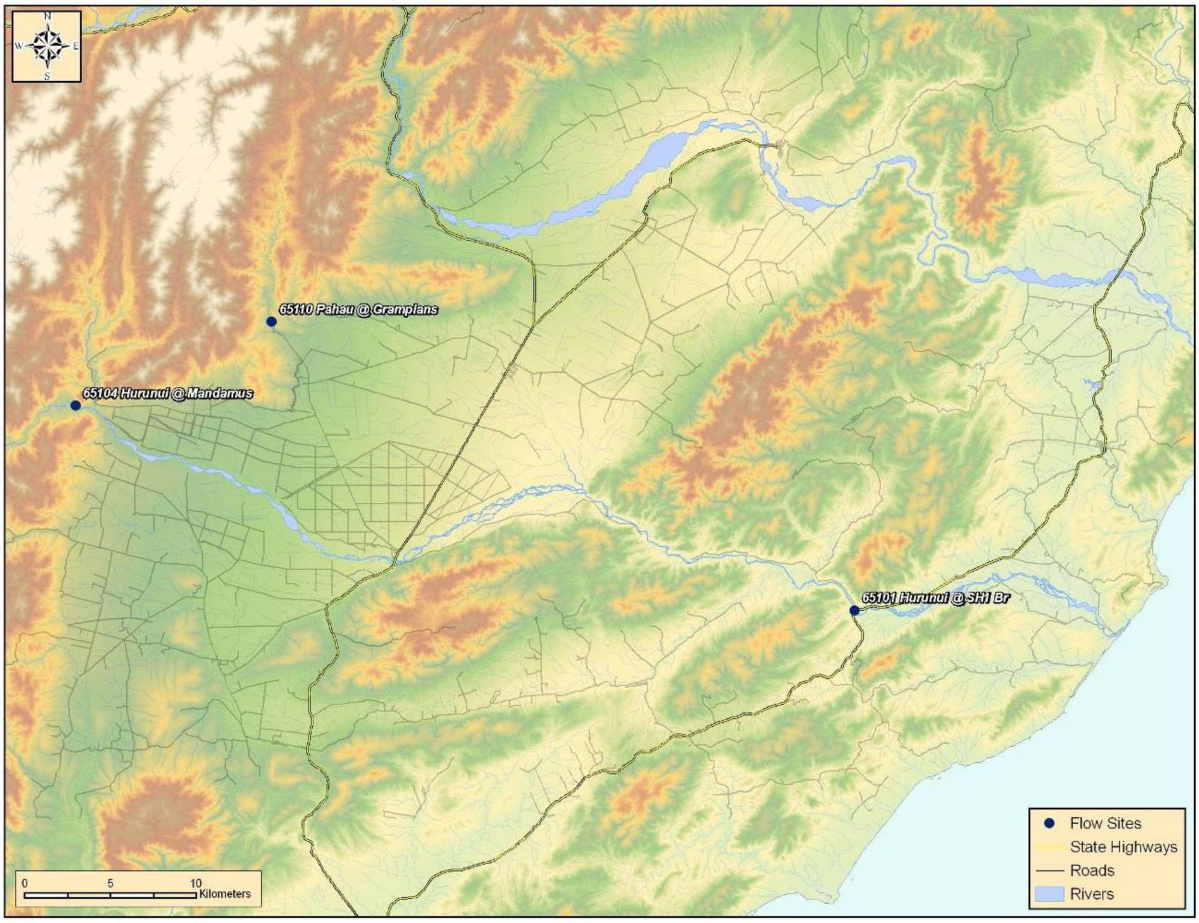

Figure 4.19 Hurunui River location diagram

4.15.1 Hurunui at Mandamus

The longest flow record on the Hurunui River is the Hurunui at Mandamus recorder. This record extends back to 1956. The Hurunui at Mandamus record was correlated with the longer Gowan at Lake Rotoroa flow record to extend the SPECTRA series back to 1934.

The best correlation was obtained through a distribution rating of the Gowan record comparing flow data over the period 1934 to 1991. The distribution of flow in the resulting dataset is similar to the actual distribution of flow. However, the Gowan record is based on lake inflows so flood peaks are often smoothed. The Hurunui at Mandamus record is used from 1956 to present.

As with the Waiau extension, the first four years of record were selected from average flows from the Works Consultancy Services Ltd report titled “Trends in Flow Data for Manapouri Local Inflows, Mangahao, Cobb, Coleridge Inflows and Waikato Tributary Flows (1993)”. The mean annual inflow ratios at Coleridge were 0.77 in 1932, 0.65 in 1933, and 1.05 in 1934.

The ratios are applied to the total mean flow of the correlated Gowan at Lake Rotoroa record (1934-2006, including actual Hurunui at Mandamus data from 1956). Mean annual flows were determined for the three years and compared to annual flows from the entire record. Flows from years that had similar mean annual flows were replicated in the earlier record. Flows from 1989 are replicated in 1932, flows from 1960 are replicated in 1933, and flows from 2003 are replicated in the initial three months of 1934.

The six months from 1 July 1931 to 31 December 1931 were replicated from the year with the nearest mean annual flow to the total mean flow of 51.7m³/s. The 1936 year has a mean flow of 51.1m³/s. The six months of record from 1 July 1936 to 31 December 1936 are replicated in 1931.

Care was taken to maintain the water balance in the river. Table 4.8 details the mean flows during the record correlation phases. Mean monthly flow values, and the distribution of flow are displayed in Appendix A.

Table 4.8 Hurunui at Mandamus mean flow

Record	Record Length	Mean Flow (m³/s)
Hurunui at Mandamus	1956-1991	51.2
Rated Hurunui at Mandamus*	1956-1991	52.1
Rated Hurunui at Mandamus	1931-2010	51.3

*Prior to superimposing the actual Hurunui at Mandamus record over the SPECTRA series

The monthly and annual flows in Appendix A show less amplitude in the synthetic record for flood flows although low flows are comparable.

4.15.2 Hurunui at SH1 Bridge

The most downstream site in the Hurunui catchment is the Hurunui at SH1 Bridge site. Flow data at this site exists from 1974 to 1999. Between June 1999 and July 2008 this site is used for flood warning only. It is now a fully rated site again. The lower Hurunui River is potentially the most useful for hydro-power development because of the greater catchment area and Pahau tributary.

The Hurunui at SH1 Bridge was extended back to 1931 through a distribution correlation with the extended Hurunui at Mandamus record. The distribution rating compared flow data over the period 1974 to 1999. Actual data from the Hurunui at SH1 Bridge record is applied to the rated data. Care was taken to maintain the water balance in the river. Table 4.9 details the mean flows during the record correlation phases. Mean monthly flow values, and the distribution of flow are displayed in Appendix A.

Table 4.9 Hurunui at SH1 Bridge mean flow

Record	Record Length	Mean Flow (m³/s)
Hurunui at SH1 Bridge	1974-1999	72.8
Rated Hurunui at SH1 Bridge*	1974-1999	72.9
Rated Hurunui at SH1 Bridge	1931-2010	66.3

*Prior to superimposing the actual Hurunui at SH1 Bridge record over the SPECTRA series

A study of the monthly low flows in Appendix A show the synthetic record contains lower monthly flows than the actual record. This is reflected in the lower mean flow for the whole record period. The Hurunui at Mandamus extended record is preferred as the main Hurunui flow dataset.

4.16 Mohaka River, Hawke's Bay

The Mohaka River originates in the Kaweka Ranges in Hawke's Bay. The catchment area is large at 2430km^2 and drains the steep and rugged landscape. The proposed hydro-power scheme is in the lower reaches of the 172km long river, near Raupunga. Figure 4.20 shows a possible power scheme location for the Mohaka River.

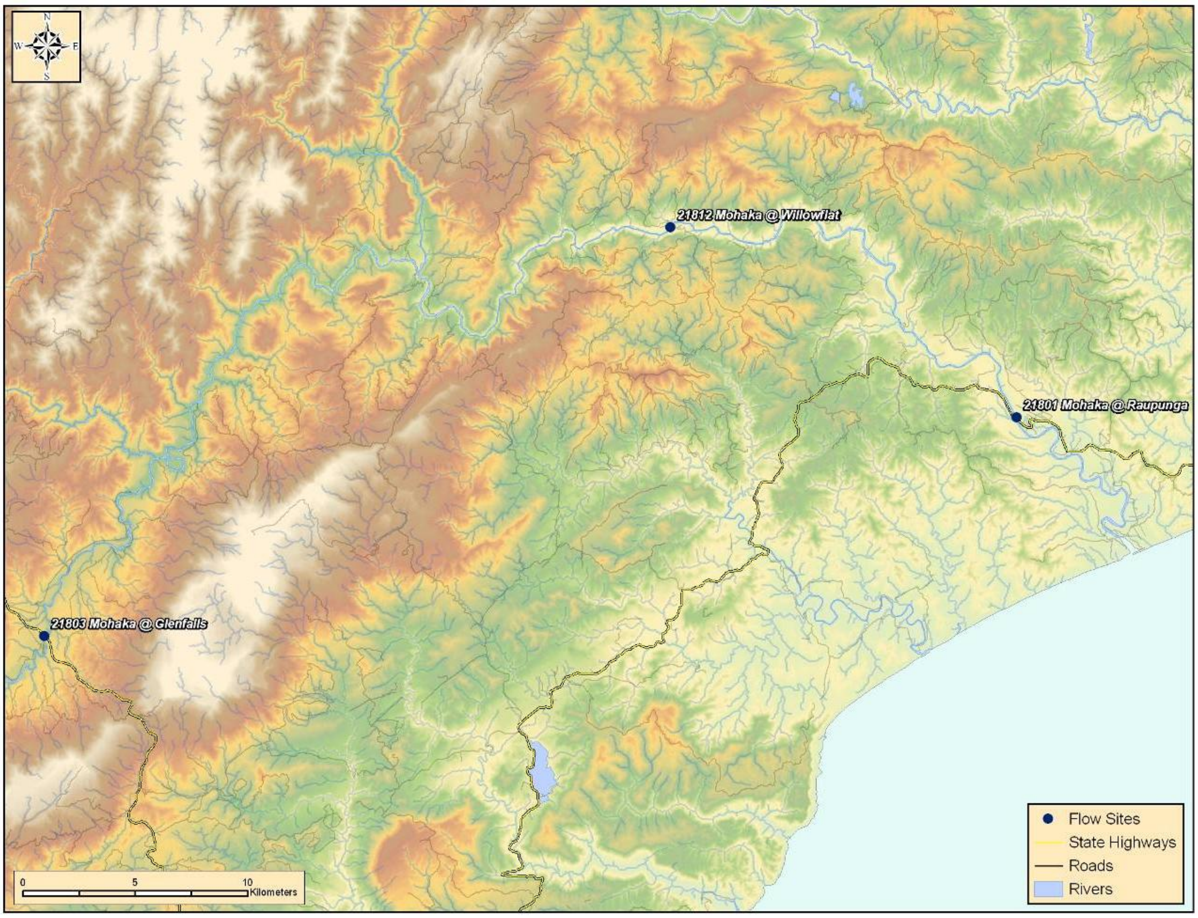

Figure 4.20 Mohaka River location diagram

4.16.1 Mohaka at Raupunga

The longest flow record on the Mohaka River is the Mohaka at Raupunga recorder. This record extends back to 1957. The Mohaka at Raupunga record was correlated with the Lake Waikaremoana inflow record to extend the SPECTRA series back to 1931.

On 6 January 1985 a large landslide occurred upstream of the Raupunga gauge. This suppressed flow at the gauge significantly for approximately 10 hours and impacted on flows for approximately 3 days. The low stage value resulting from the landslide was removed from the data for the distribution analysis to provide a normal distribution of data.

The best correlation was obtained through a distribution rating of the Lake Waikaremoana inflow record comparing flow data over the period 1957-2001. The distribution of flow in the resulting dataset is similar to actual flow at the high end of the spectrum. Flows at the low end of the spectrum are slightly lower than the actual record.

Inflow to Lake Waikaremoana is calculated from lake level and outflow data. The resulting Mohaka at Raupunga rated record between 1931 and 1957 has some lake level characteristics, including a greater number of oscillations. Rated low flows are slightly lower and more common than in the actual record as the lake inflow regularly drops to zero.

The Mohaka at Raupunga record (including the suppressed flow values in 1985) is used from 1957 to present. Gaps in the record were filled from correlation with the Ngaruroro at Whanawhana record.

Care was taken to maintain the water balance in the river. Table 4.10 details the mean flows during the record correlation phases. Mean monthly flow values, and the distribution of flow are displayed in Appendix A.

Table 4.10 Mohaka at Raupunga mean flow

Record	Record Length	Mean Flow (m^3/s)
Mohaka at Raupunga*	1957-2001	79.5
Rated Mohaka at Raupunga**	1957-2001	78.7
Rated Mohaka at Raupunga	1931-2010	78.8

*Without low flows triggered by the landslide

**Prior to superimposing the actual Mohaka at Raupunga record over the SPECTRA series

4.17 Monowai

The Monowai hydro-electric power station is situated on the banks of the Waiau River 51 km's from Tuatapere. The scheme was investigated in 1919; construction started in 1922 and opened in 1925. Initially there were two machines; a third was added in 1927. The annual energy output is 30GWH and the turbines are the horizontal Francis type.

Lake Monowai has an area of $31km^2$ and is about 8.5km's from the power house; controlled by gates at the Monowai River outlet. Water flows down the river for about 6km's into a lake formed by a weir across the river. The water is then diverted into a canal that is 856m long and arrives at a forebay area where a 1036m pipeline leads to a surge tank. From the surge tank three penstocks take the water to the turbines in the power house. Figure 4.21 shows a plan of the Monowai Power Development.

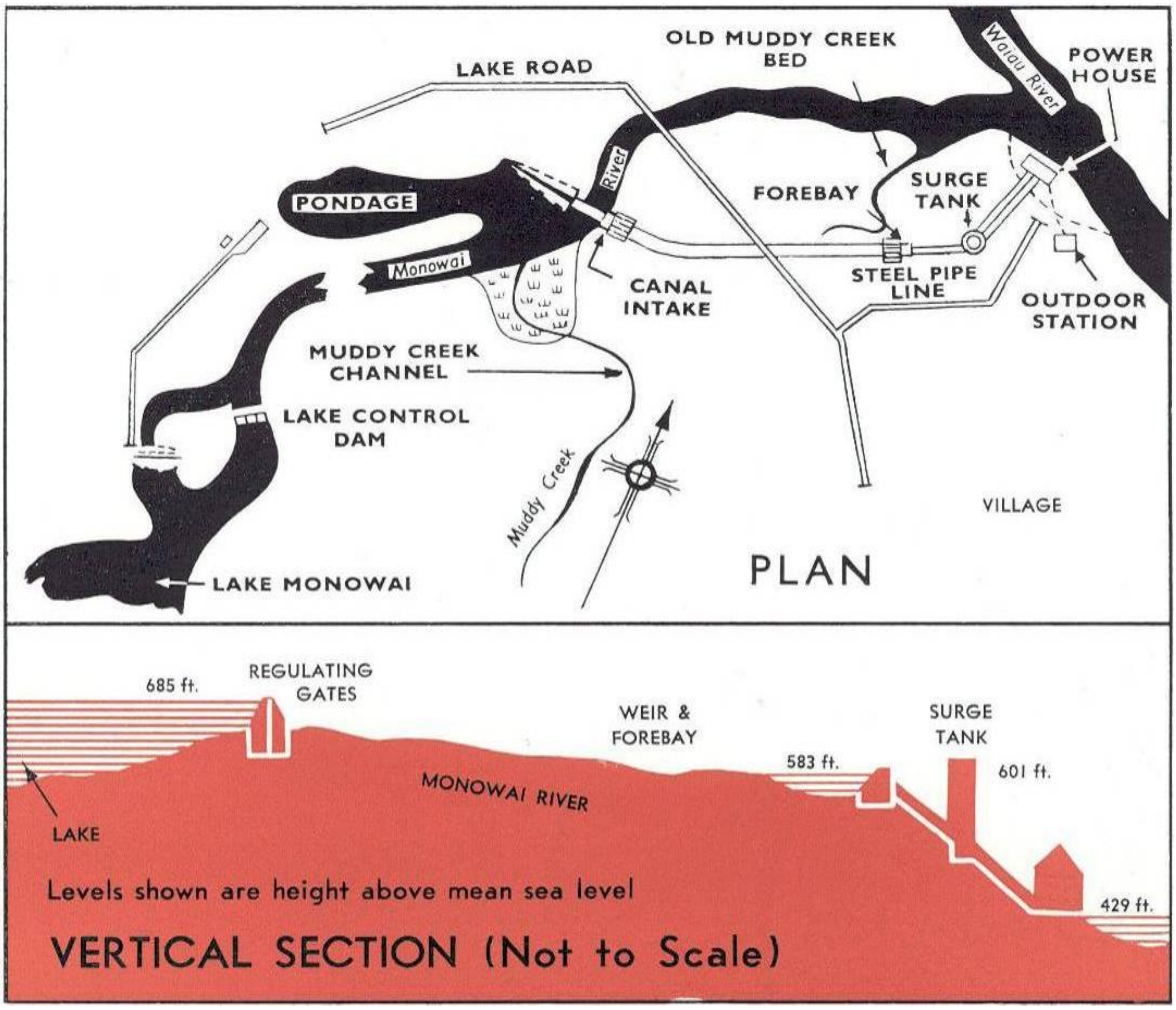

Figure 4.21 Monowai Power Development plan (original development)

Inflows exist from 1960 to 1999. It was therefore necessary to extend the lake inflows back to 1931 and forward to 2008.

A linear regression with Te Anau and Manapouri did not provide a suitable correlation. Therefore a flow distribution rating was applied to extend the Monowai record. A rating was derived from the Monowai Riddell - Opus and Lake Te Anau inflow data, and then applied to the Te Anau inflow data. This resulted in some differences for peak flow events in regard to timing, however, the two systems tracked each other well and flows were similar. The inflow is now calculated and has been recalculated back to May 1977 for this update. This causes some differences in data which are further explained in section 6.1.

Table 4.11 details the mean flows for the records and included in Appendix A are mean monthly flows values, and a flow distribution.

Table 4.11 Monowai mean flow

Record	Record Length	Mean Flow (m³/s)
Riddell Inflow 1986 Report	1960 - 1985	12.3
Riddell –Opus Inflow	1960 - 1999	12.9
Monowai Rated Inflow	1960 - 1999	13.1
Monowai Rated Inflow & Riddell – Opus Inflows	1927 - 2006	13.0
Monowai Rated Inflow & Riddell – Opus Inflows	1931 - 2010	13.0

4.18 Wheao/Flaxy

Scheme description

The Wheao/Flaxy Scheme was commissioned in 1980. The Hydro Electric Scheme is located the Kaingaroa Forest and is 82km from Rotorua, 25km from Murupara and 74km from Taupo.

The 26MW scheme produces power using water from the Wheao and Rangitaiki Rivers as well as from Flaxy Creek. Water sourced from the Rangitaiki River flows through a 4.7km open canal into the Wheao penstock intake. When a lot of power is needed, the Flaxy Power Station supplements supply. A complex arrangement of canals, tunnels and pipelines feed the water from the upper Wheao River and Flaxy Creek to the Flaxy Power Station.

Here, two Norwegian designed water driven turbines and generators produce 12,000KW each. Above the power station are the two penstocks through which the water drops126m down a rock wall at up to 45 degrees to the generators inside the power station.

Figure 4.22 shows the Wheao/Flaxy Power Stations and the associated flow recorders on, or in the vicinity of, the Wheao/Flaxy Power Stations. Table 4.12 shows the site number, site name, and the length of record existing for the sites.

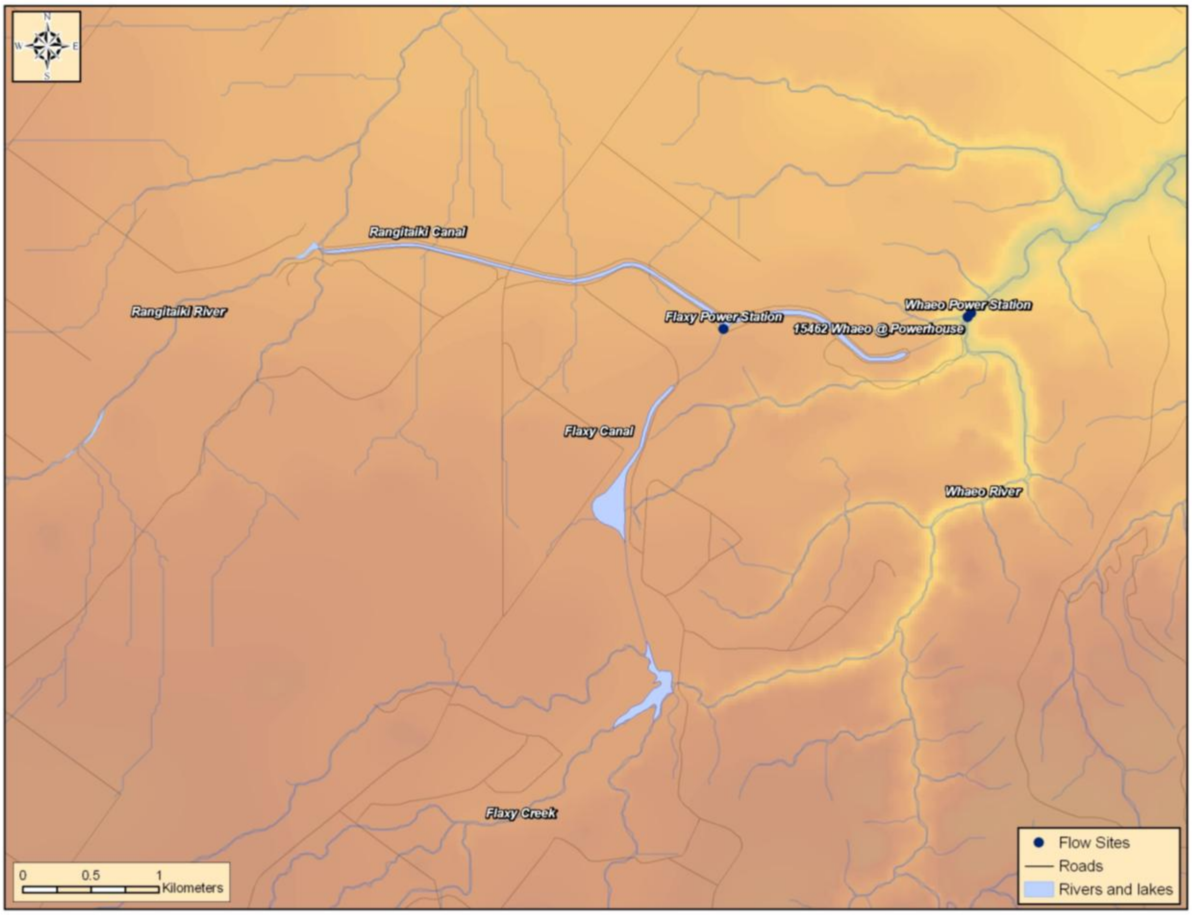

Figure 4.22 Wheao/Flaxy Power Station location diagram

Table 4.12 Flow recording stations in the vicinity of the Wheao/Flaxy power stations

Site Number	Site Name	Record Length
15462	Wheao at Powerhouse	Nov 85 to Sep 98
15408	Rangitaiki at Murapara	Jun 48 to present

Creation of synthetic data for Wheao Power Station

Data for the Wheao Power Station was supplied by TrustPower from 1999 to 2008. It was therefore necessary to extend this record back from 1999 to 1931. Data was available from Rangitaiki at Murapara from 1948 to 2008.

To create a synthetic record for Rangitaiki at Murupara from 1948 back to 1931 a flow distribution rating (obtained via analysis of Taupo Natural Outflows and Rangitaiki at Murupara) was applied to Taupo Natural Outflow.

To reduce the Rangitaiki at Murupara flow range to resemble Wheao Power Station flows another flow distribution rating was derived using Rangitaiki at Murupara and Wheao

Power Station. This flow distribution was then applied to actual and synthetic Rangitaiki at Murupara data to derive synthetic Wheao flow data.

Care was taken to maintain the water balance of the power station output. Table 4.13 details the mean flows for the synthetic and actual data. Mean monthly flow values, and the distribution of the flow are displayed in Appendix A.

Table 4.13 Mean flows for actual and synthetic Wheao power station data

Record	Record Length	Mean Flow (m^3/s)
Actual Wheao Power Station	1999-2007	12.5
Synthetic Wheao Power Station*	1999-2007	12.3
Actual and Synthetic Wheao Power Station	1931-2010	13.0

*Prior to superimposing the actual Wheao record over the SPECTRA series

The various datasets required to produce the average daily inflow record were not available for this site. Therefore, averge daily inflows had to be estimated from the metered generation data provided to the Electricity Authority (Section 3). The metered generation data was compared with Spectra flows (2004-2008) to obtain an empirical relationship between flow and generation (Figure 4.23).

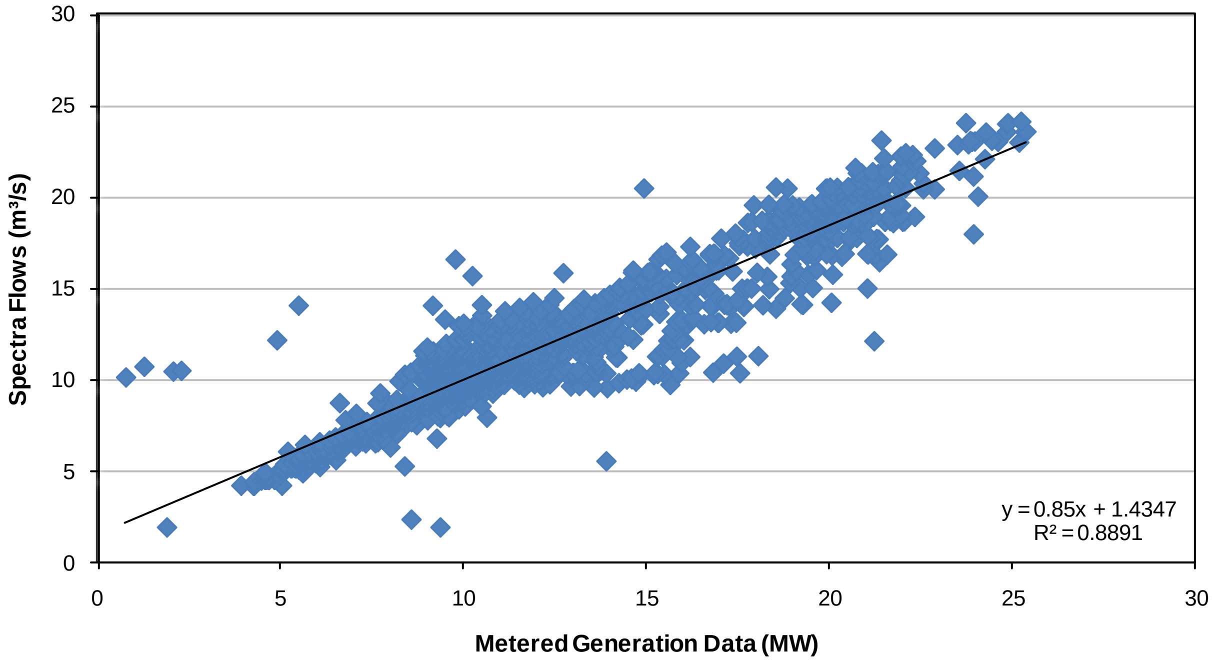

Figure 4.23 Comparison between the generation data and the Spectra flows

4.19 Patea

Scheme description

This catchment has an existing hydro-electric power station (Patea) and controlled lake storage (Lake Rotorangi). Figure 4.24 shows the Patea River and the associated flow recorders on, or in the vicinity of, the Patea River. Table 4.14 shows the site number, site name, and the length of record existing for these sites.

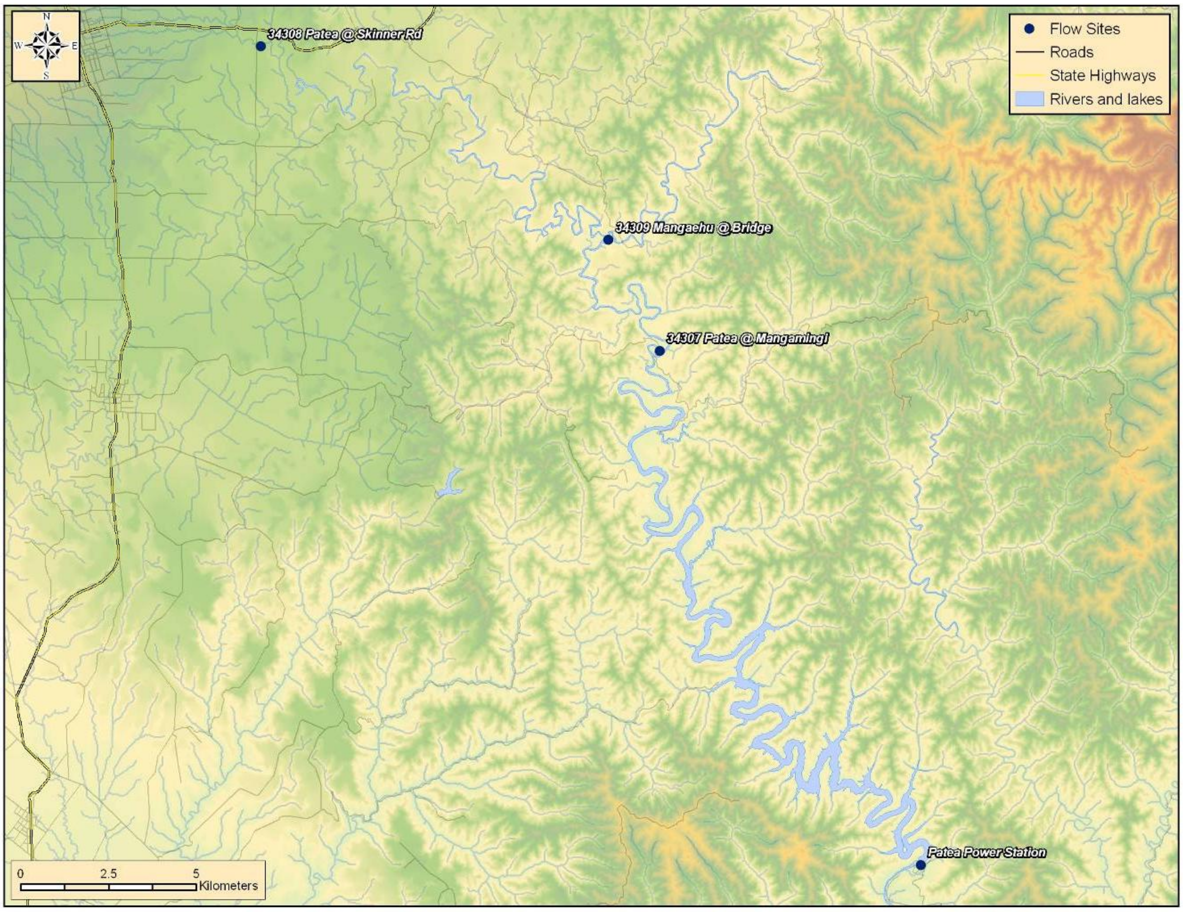

Figure 4.24 Patea River location diagram

Table 4.14 Flow Recording Stations in the vicinity of the Patea power station

Site Number	Site Name	Record Length
34308	Patea at Skinner Road	Feb-78 to present
34307	Patea at Mangamingi	Apr 75 to May 84
34309	Mangaehu at Bridge	Jan 78 to present
34305	Patea at McColls	Nov 86 to Jul 95

Patea – Diversion into Mangaehu

The Patea River originates on the eastern side of Mt Taranaki, flows through Stratford, and into the inland hill country where it is joined by a major tributary, the Mangehu Stream.

The upper reaches of the Patea River are not as deeply incised as the middle reaches; particularly upstream of Lake Rotorangi behind Patea Dam. However, approximately 1.7km upstream of the Mangamingi Bridge there is a site suitable for a storage dam with an overall height up to 64m. The river channel is incised about 30m.

A reservoir area of 3.9km^2 with an impoundment height of 50m and an installed capacity of 18MW would generate approximately 79GWh p.a. (50% plant factor).

Creation of synthetic data for Patea River

The synthetic data for Patea Power Station was created in 2007. Data for this power station was supplied by TrustPower from 1999 to 2007. It was therefore necessary to extend this record back from 1999 to 1931. To do this data from Patea River at Mangamingi and McColls were used.

The Patea at Mangamingi record begins in April 1975 and ends in April 1984. The Patea at McColls record is from November 1986 to July 1995. Data from these two sites were combined to give a non-continuous record from 1975 to 1995.

To create a synthetic record for Patea from 1975 back to 1931 a flow distribution rating (obtained via analysis of Taupo Natural inflow and combined Patea) was applied to Taupo Natural inflow.

To reduce the combined Patea flow range to resemble Patea Power Station flows another flow distribution rating was derived using combined Patea and Patea Power Station. This flow distribution was then applied to actual and synthetic Patea data to derive synthetic Patea flow data.

Care was taken to maintain the water balance in the Patea River. Table 4.15 details the mean flows during the record for the synthetic and actual data. Mean monthly flow values, and the distribution of the flow are displayed in Appendix A.

Table 4.15 Mean flows for Patea Power Station and Patea River

Record	Record Length	Mean Flow (m³/s)
Patea at Mangamingi	1975-1984	24.2
Patea at McColls	1986-1995	28.1
Patea Power Station	1999-2007	18.5
Synthetic Patea Power Station Data*	1999-2007	16.9
Actual and synthetic Patea Power Station	1931-2010	18.5

*Prior to superimposing the actual Patea record over the SPECTRA series

The various datasets required to produce the average daily inflow record were not available for this site. Therefore, averge daily inflows had to be estimated from the metered generation data provided to the Electricity Authority (Section 3). The metered generation data was compared with Spectra flows (2004-2006) to obtain an empirical relationship between flow and generation (Figure 4.25).

Flows below 2m³/s have been removed from the dataset because of consent conditions; Patea Dam must maintain a mean 24-hour flow of at least 2m³/s. Two years of data was used for this site as the dataset for 2006 to 2008 contained numbers directly obtained from flow correlation. The dam also times spillway operations to facilitate migration of mature eels downstream. Both these acivites lead to a high degree of scatter in the relationship between generation and flow.

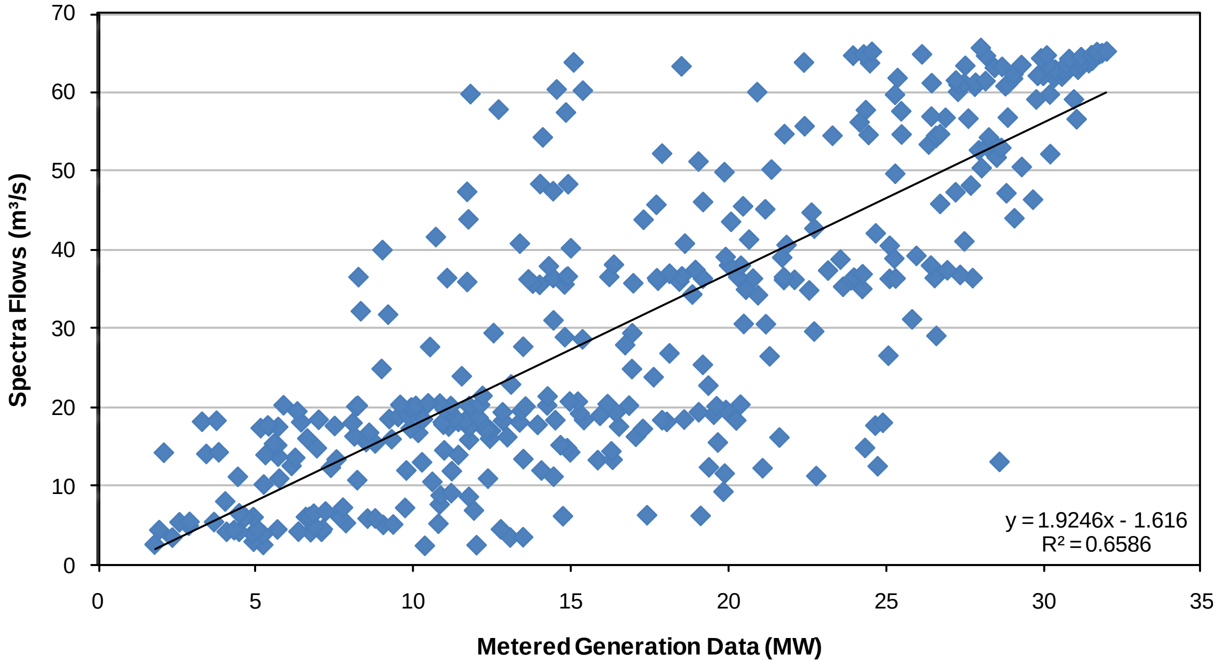

Figure 4.25 Comparison between the generation data and the Spectra flows

4.20 Highbank

Scheme description

The Highbank Power Station was constructed between 1939 and 1945 as part of a combined project to irrigate dry farmland and generate electricity. Water for the station is collected from the Rangitata River by means of a 66km long irrigation race, which provides water for use by farms in summer, when demand for electricity is lower. In winter when electricity demand increases, and demand for irrigation water reduces, the water is used for power generation purposes.

With an installed capacity of 25,200KW, the Highbank scheme has an average annual output of 94GWh.

Figure 4.26 shows the Highbank Power Station and the associated flow recorders on, or in the vicinity of, the Highbank Power Station. Table 4.16 shows the site number, site name, and the length of record existing for the sites.

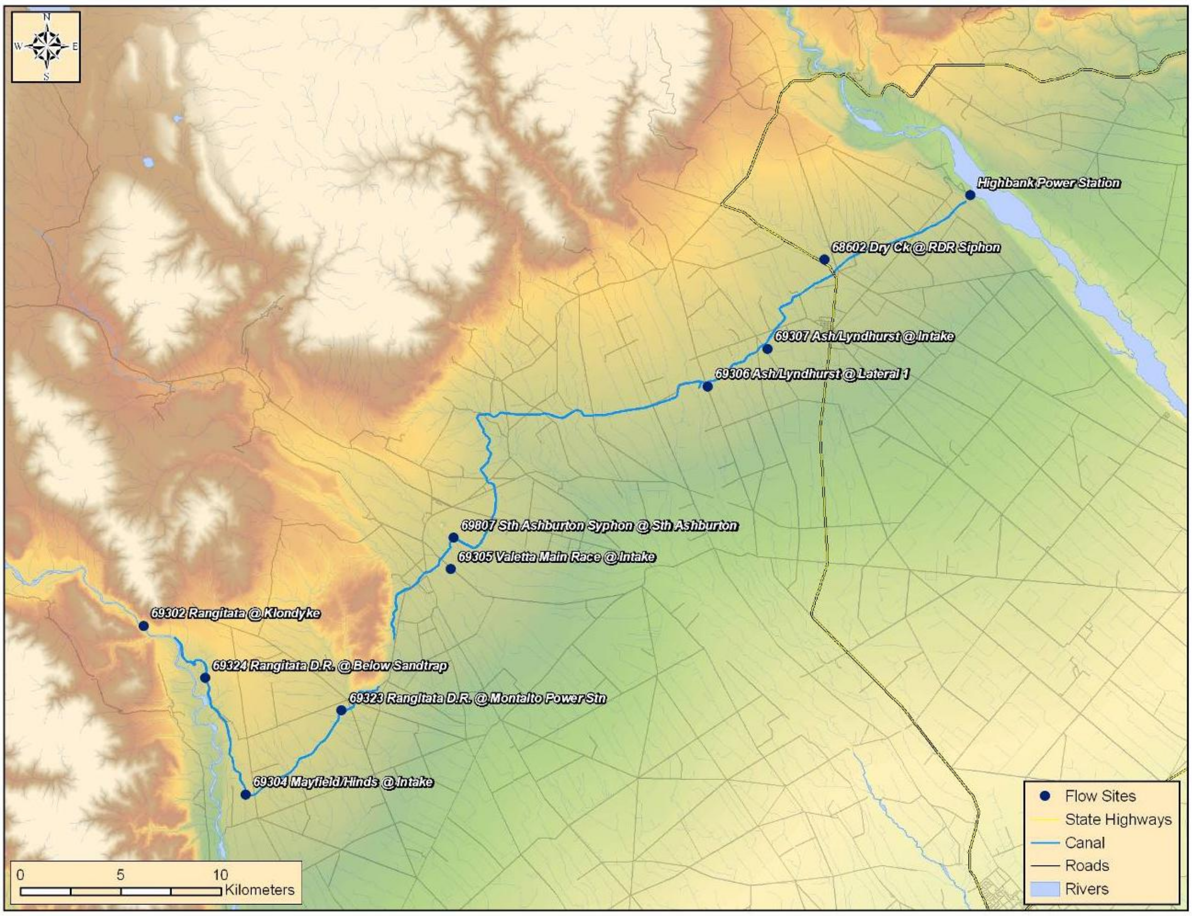

Figure 4.26 Highbank Power Station location diagram

Table 4.16 Flow recording stations in the vicinity of the Highbank power station

Site Number	Site Name	Record Length
7968	Highbank Power Station (Machine Output)	May 51 to Jul 98
77963	Highbank Power Station (Ext Flow Record)	Jan 30 to May 98

Creation of synthetic data for Highbank Power Station

The ECNZ Highbank Power Station record begins in May 1951 and ends in May 1998. In June 2002, TrustPower began recording flow which continues.

In a 1990 Opus report “Extended Flow Study – Mohaka, Mangahao, Grey, Arnold and Highbank” a synthetic Highbank dataset was created from 1931 to 1951. Some gaps exist in the dataset so as part of this report synthetic data were created to fill these gaps. The same PSIM that was used in the 1990 report was used in this study.

The PSIM uses variations in Lake Coleridge inflows to produce synthetic data. Actual Highbank data (ECNZ and Trustpower) and synthetic data were combined to provide a Spectra flow record for Highbank Power Station.

Table 4.17 shows the mean flow for each record for the synthetic and actual data. Comparisons were made to ensure a similar water balance was maintained for the Highbank Power Station when creating synthetic data. The differences in mean flow may be partly caused by different companies running the power station in different ways.

Table 4.17 Mean flow for Highbank Power Station

Record	Record Length	Mean Flow (m^3/s)
Highbank actual (ECNZ)	1951-1988	13.7
Highbank actual (TrustPower)	2002-2008	11.8
Synthetic Highbank	1931-2007	14.2
Actual and synthetic Highbank	1931-2010	13.4

The various datasets required to produce the average daily inflow record were not available for this site. Therefore, averge daily inflows had to be estimated from the metered generation data provided to the Electricity Authority (Section 3). The metered generation data was compared with Spectra flows (2004-2008) to obtain an empirical relationship between flow and generation (Figure 4.27).

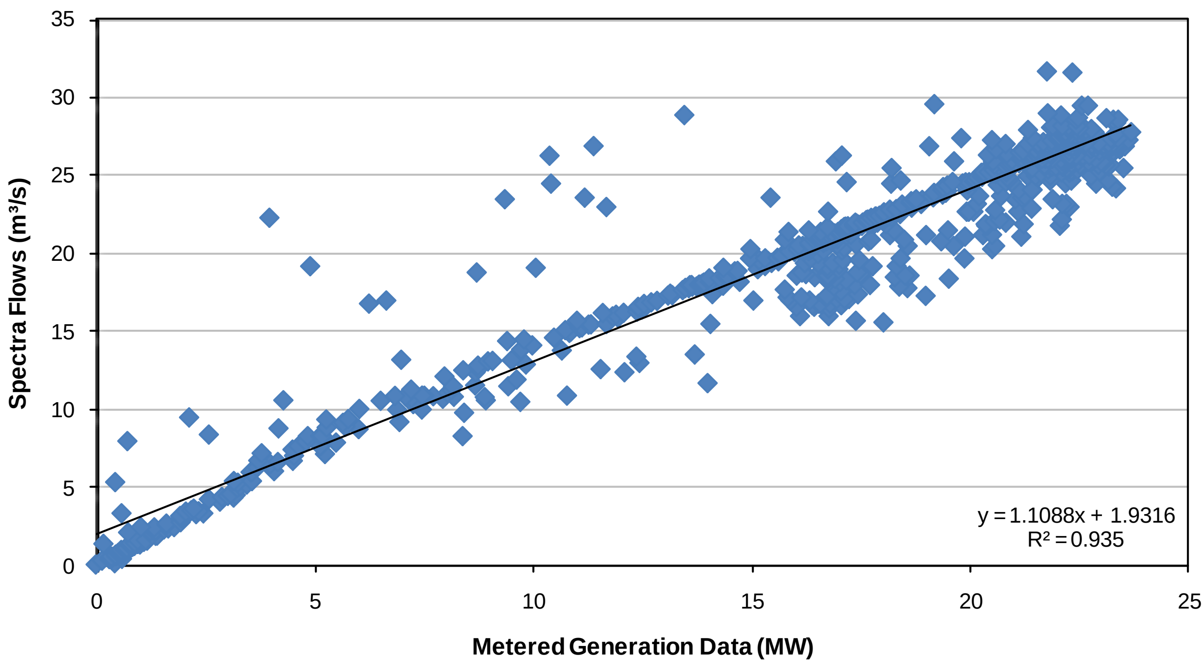

Figure 4.27 Comparison between generation data and Spectra flows

4.21 Kaimai

Scheme description

Electricity generation in the Wairoa River Catchment had it's beginnings in 1915 with the construction of a 150KW plant at Omanawa Falls. Capacity was increased to 750KW in 1921. This was followed in 1925 by the commissioning of the 2700KW McLaren Falls Station.

Today, the scheme consists of: the 350KW Kaimai 5 Station on a diversion tunnel feeding Lake Mangaonui; the 15,600KW Lloyd Mandeno station, sited on the west bank of the Mangapapa River: the 6,000KW Lower Mangapapa Station: and 4km further downstream the 20,000KW Ruahihi Station. The total annual output of the scheme is 165GWh. The McLaren Falls power station was decommissioned in 1989. A bypass was subsequently installed to allow the continued release of recreational flows into the Wairoa River on set days each year for activities such as rafting and canoeing.

Ruahihi Power Station

The Ruahihi Power Station is situated on the Wairoa River adjacent to SH29. Ruahihi is the third and largest station of the overall scheme. Construction contracts were let in mid 1977, and the station was commissioned in 1981. Failure of the feed canal later that year required major rebuilding. The station was recommissioned in 1983.

The reservoir for this station is Lake McLaren and the canal links the reservoir to the station. Lake McLaren was formed in 1925 by the construction of a 26m high concrete arch dam across the lower Mangapapa River to operate the now decommissioned McLarens Falls Power Station. Water passes through a gated inlet structure into a 2.5km canal. The construction of the canal involved moving 2,400,000m^3 of soil at depths up to 46m below original ground level, making it one of the larger canals in New Zealand. The depth of the water in this canal is 6m and the width at normal operating level is 30m. Flow velocities are up to 0.9m per second depending on machine settings and water levels.

Transition from the canal to penstock is a forebay which again has screens, a cleaner and control gates. Downstream of the forebay is a 1.6km low pressure conduit leading to twin high pressure penstock pipes down the escarpment and under State Highway 29 into the power house. There are two generating sets in the station, each producing 10,000KW at 86.4m head of water. Operating speed is 500rpm and the average energy produced is 75.6GWh per annum.

Figure 4.28 shows power stations of the Kaimai Power Scheme and the associated flow recorders on, or in the vicinity of the Kaimai Power Scheme. Table 4.18 shows the site number, site name, the length of record existing for each flow site.

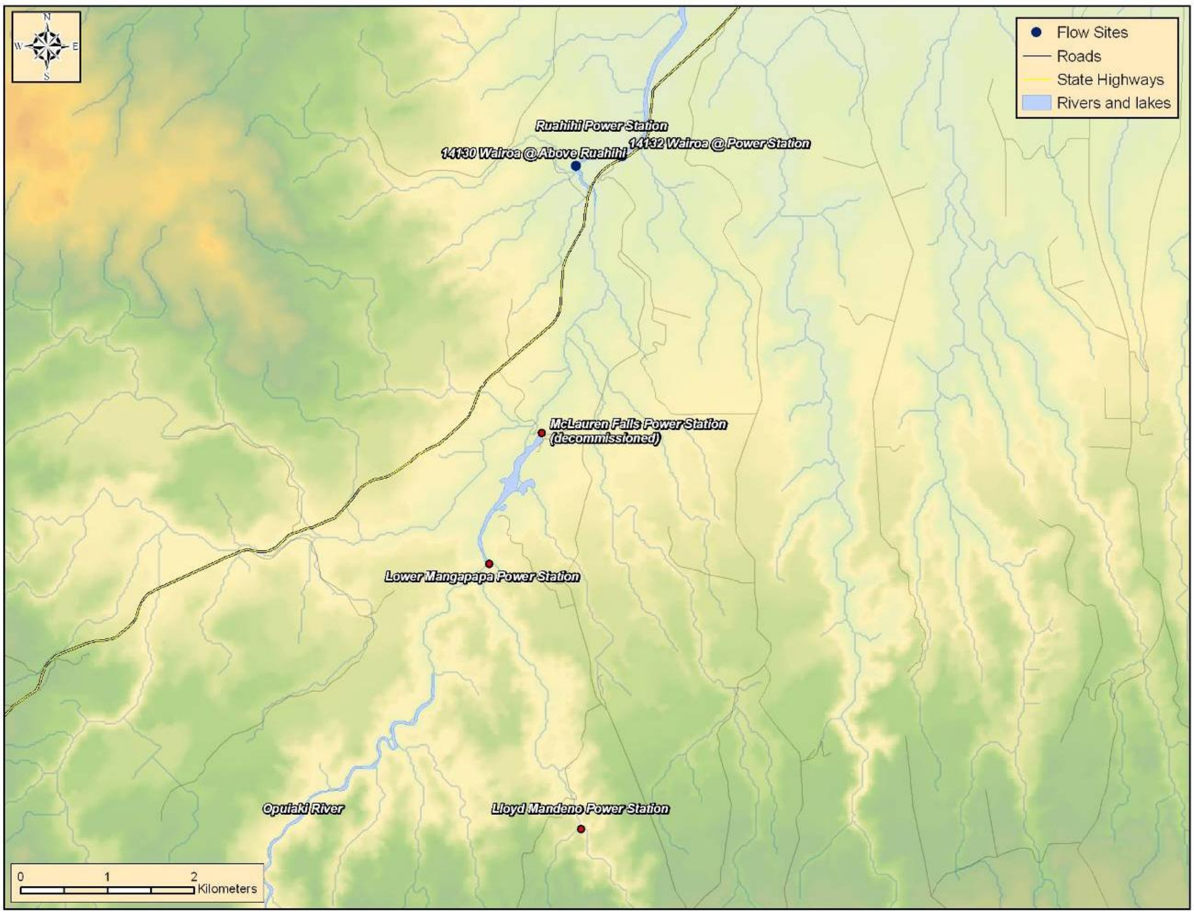

Figure 4.28 Kaimai Hydro Power Scheme location diagram

Table 4.18 Flow recording stations in the vicinity of the power station, including possible power station records

Site Number	Site Name	Record Length
14130	Wairoa at Above Ruahihi	Sep 90 to present
14132	Wairoa at Power Station	Jul 93 to present

Creation of synthetic data for Ruahihi Power Station

The Spectra dataset for the Kaimai scheme was created in 2007 using site 14132 Wairoa at Power Station. The site begins July 1993 and finishes in February 2007. The Wairoa at Power Station record was extended back from 1993 to 1931. Synthetic data was created by analysing simulated natural Taupo inflow and Wairoa at Power station and applying the distribution rating to the simulated natural inflow record at Lake Taupo.

Actual data and synthetic data were combined to provide a flow record for Wairoa at Power Station from 1931 to 2008.

Table 4.19 shows the mean flow for each record for synthetic and actual data. Comparisons were made to ensure a similar water balance was maintained for Wairoa at Power Station when creating synthetic data.

Table 4.19 Mean flow for Wairoa at Power Station

Record	Record Length	Mean Flow (m³/s)
Wairoa at Power Station	1993-2007	12.0
Synthetic Wairoa at Power Station*	1993-2007	12.1
Actual and synthetic Wairoa at Power Station	1931-2010	11.8

*Prior to superimposing the actual Wairoa record over the SPECTRA series

The various datasets required to produce the average daily inflow record were not available for this site. Therefore, averge daily inflows had to be estimated from the metered generation data provided to the Electricity Authority (Section 3). The metered generation data was compared with Spectra flows (2004-2006) to obtain an empirical relationship between flow and generation (Figure 4.29). Data points were removed from the correlation if the Spectra data was equal to 0 (see Section 1). Flows were removed if they were above the maximum generation available from the machines; in this case 25m³/s. Only 6 flow points were removed from the dataset (0.4%).

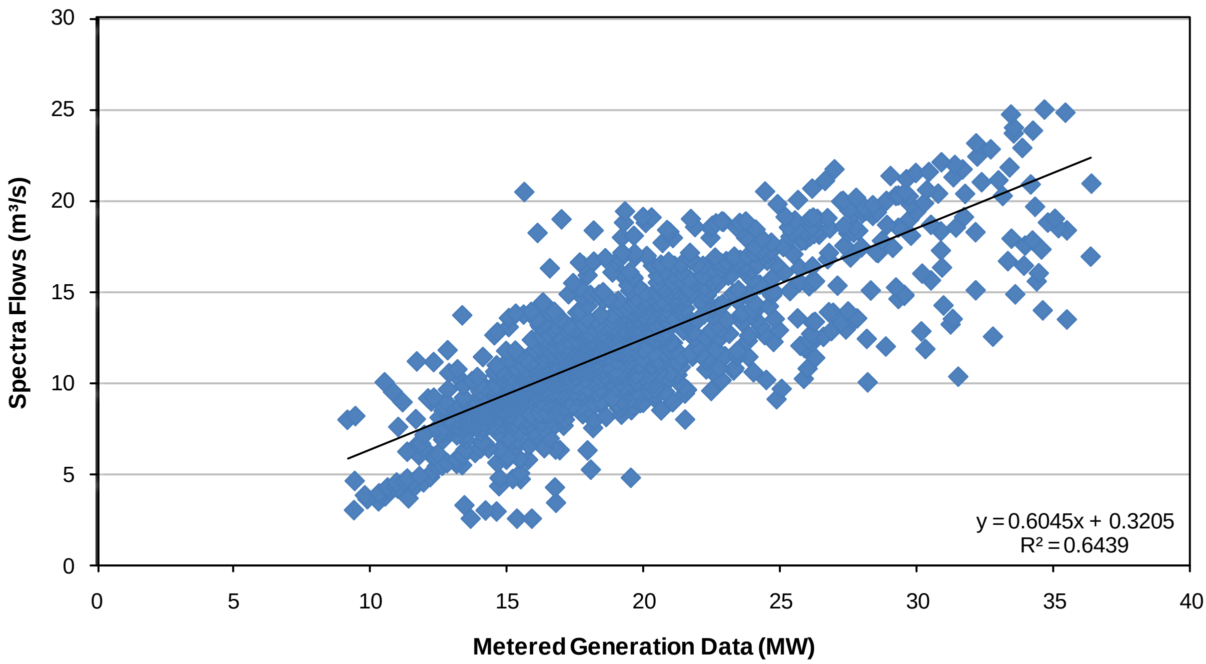

Figure 4.29 Comparison between generation data and Spectra flows

4.22 Waipori

Scheme description

The scheme comprises a network of four dams and power stations on the Waipori River. It consists of underground tunnels, surge chambers and an intergration of vintage machinery and the latest generation equipment.

The result is a high quality efficient power supply. The topography of the upper Waipori River catchment provides the ideal setting for generating hydro electricity. After a winding course the river emerges into a valley 27km long but with only a 30m fall. This provides the ideal setting for Lake Mahinerangi. Below this valley is a narrow gorge with a sharp decent of 165m over 4km. This gives the fall necessary for water to drive the turbines.

The system has its headwaters high in the Lammerlaw Range. A web of water races, open channels, diversion tunnels, and pipelines feed the scheme beginning with the 2,000ha Lake Mahinerangi and Station 1 below the dam. Downstream the dark, peat-stained waters pass through a further 3 dams. Figure 4.30 shows the Waipori Power Station and the associated flow recorders on, or in the vicinity of, the Waipori Power Station.

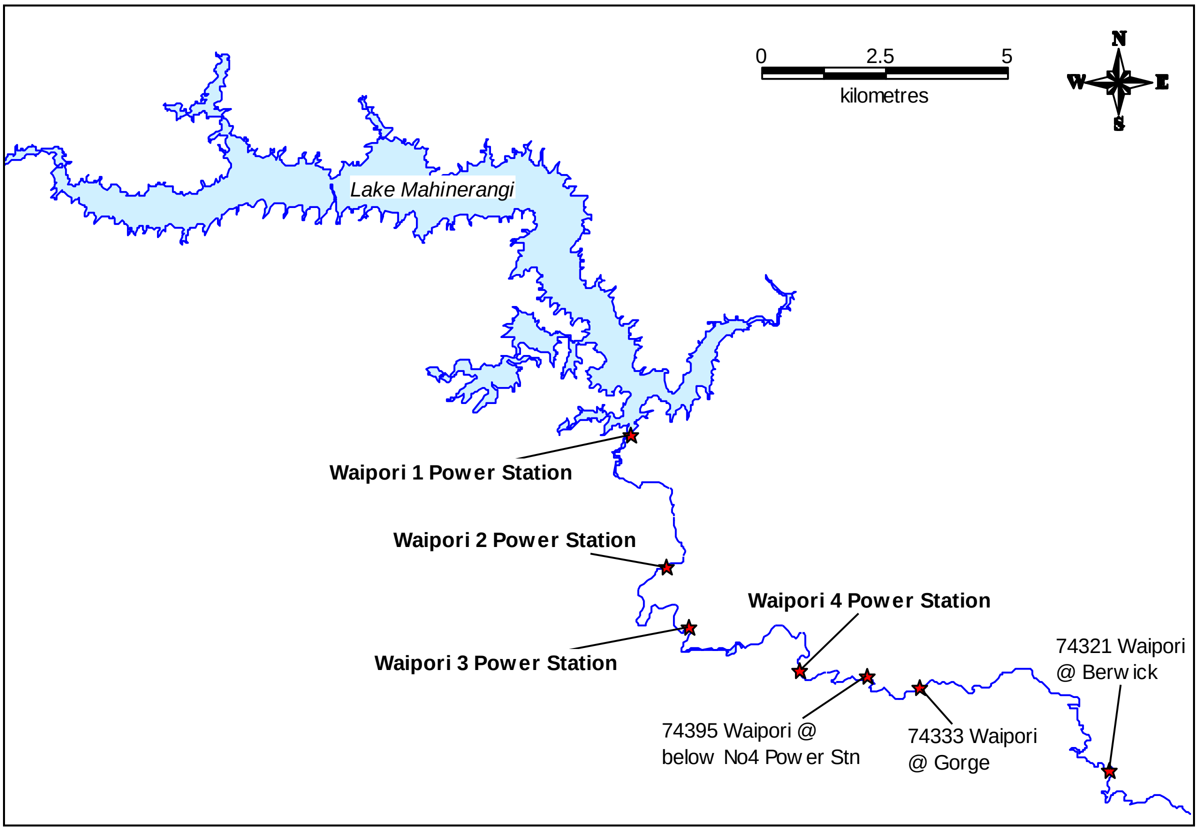

Figure 4.30 Waipori Power Station and gauging station location diagram

Creation of synthetic data for Waipori 4

The Spectra dataset for Waipori scheme was created in 2007. Waipori at Berwick and Waipori at Below No 4 Power Station data were correlated and compared with long term flow stations in the vicinity of the Waipori catchment. The long term flow stations used in the comparisons were Lake Wanaka, Lake Te Anau, Lake Manapouri, Lake Wakatipu, and Lake Roxburgh inflow, Clutha at Alexandra Bridge, and Clutha at Balclutha.

None of the seven lakes/flow sites had a comparable flow relationship with Waipori at Below No 4 Power Station (74395) or Waipori at Berwick (74321). The Waipori catchment contains a large lake, Lake Mahinerangi and four power stations along the Waipori River. Lake Mahinerangi has a large storage capacity and therefore can absorb any flood events. Any flow released from the lake passes through four power stations. This means that the flows in this catchment are totally controlled, and behave differently from the natural flow occurrences in adjoining catchments. Figure 4.31 shows a flow hydrograph for Waipori at Below No 4 power station.

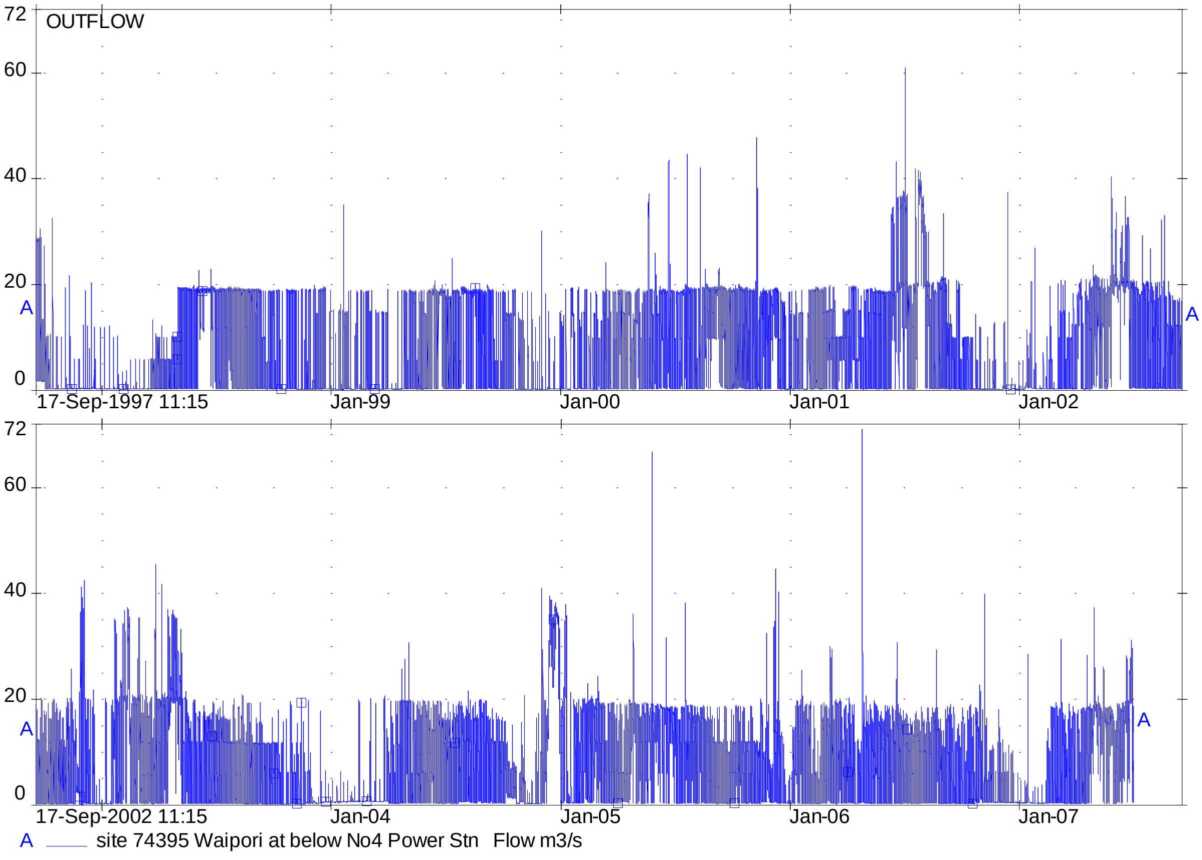

Figure 4.31 Waipori at Below No 4 Power Station flow

Figure 4.32 highlights how the Waipori catchment does not reflect the behaviour of the surrounding catchments. Figure 4.32 shows Waipori at Below No 4 power station versus Lake Wakatipu outflow. It can be seen that Waipori mainly has the profile associated with turbine discharge and occasional spill discharges. The spill discharges do not coincide with high flow events at Wakatipu. This comparison was found to be consistent across all flow sites when compared with Waipori.

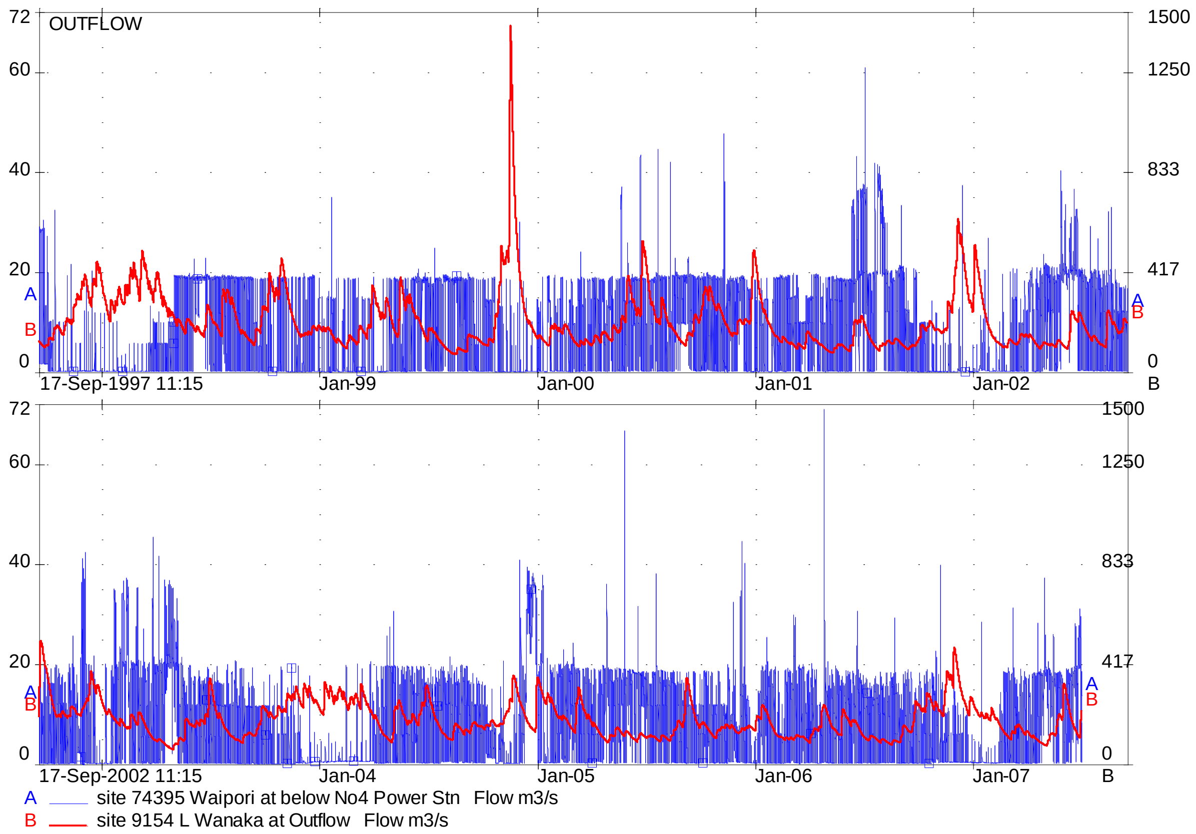

Figure 4.32 Waipori at Below No 4 Power Station flow compared with Lake Wanaka Outflow

To create a synthetic flow dataset for this catchment an analysis was conducted for Waipori at Berwick and Waipori at Below No 4. The resultant flow distribution rating was then applied to Waipori at Berwick to reduce flows to that of Waipori at Below No 4.

Synthetic Waipori at Below No 4 data was combined with actual Waipori at Below No 4 Power Station to give a record from 1988 to 2007. The ratios from the "Trends in Flow Data report (1993)" were used and annual data series that had means that reflected the historic means were used to infill the dataset from 1931 to 1988.

Actual data and synthetic data were combined to provide a flow record for Waipori at Below No 4 Power Station from 1931 to 2007.

Table 4.20 shows the mean flow for each record for synthetic and actual data. Comparisons were made to ensure a similar water balance was maintained for Waipori at Below No 4 Power Station when creating synthetic data.

Table 4.20 Mean flow for Waipori at Below No4 Power Station

Record	Record Length	Mean Flow (m³/s)
Waipori at Below No 4 Power Station	1997-2007	7.6
Waipori at Berwick	1988-2007	10.9
Synthetic Waipori at Below No 4 PS*	1998-2007	7.1
Actual and synthetic Waipori at Below No 4 Power Station	1931-2010	7.2

*Prior to superimposing the actual Waipori record over the SPECTRA series

5 Non-calculated sites

5.1 Sites

Some sites are not recalculated as part of the SPECTRA process. The annual data are supplied by the parent company and is simply appended to the previous dataset. Table 5.1 shows the sites that are not recalculated as part of the annual SPECTRA update.

Table 5.1 Sites where annual data has been supplied

Site number/item number	Site name	Data supplied by
97904 (1)	Coleridge	TrustPower
174395 (1)	Waipori	TrustPower
97520 (1)	Mangahao	Todd Group
3650 (1)	Waikaremoana	Genesis
42790 (1)	Taupo_Oper	Mighty River Power
77106 (1)	Grey_tara	FRST site

6 Data differences for calculated sites

6.1 Data differences

At each SPECTRA update differences between datasets may occur for variety of reasons. These include: rating changes; data modifications; inflows being recalculated, and various other reasons. Table 6.1 shows whether any data differences have occurred in between the previous and current update for the SPECTRA datasets.

All previous updates have retained the 1997 datasets up to that point. This includes the data used in the merge and processing routines.

The 1997 datasets were copied over all previous updates because these datasets were created in an era where all the required flow sites were open. SPECTRA processing scripts, executables, psims, and visual basic routines were all linked to active power archive directories. Therefore, the 1997 dataset was considered to be an accurate reflection of the data up to 1997.

However, if any data is modified before 1997 then a problem exists as data is over ridden by copying the 1997 datasets over modified data. Therefore, the practice of copying the 1997 datasets over calculated data has ceased for all sites except the TPD. The TPD processing scripts, psims and executables are very complicated and may need revising to reflect current operation practices. This issue will be discussed with Genesis to ensure the scripts are still producing output that is consistent with operational practices. Any differences along with reasons for differences will be noted in this report.

Table 6.1 shows if there were any differences in the data between the previous and current update. The following sections highlight the reasons for these differences.

Table 6.1 Data differences for previous and current updates

Site number/item number	Site name	Data differs
93254 (1)	Matahina	Yes
22790 (1)	Taupo Inflow	No
22790 (2)	Rangipo	No
22790 (3)	Tokaanu	No
42790 (1)	Taupo Operational	No
92724 (1)	Arapuni Tributaries	Yes
92790 (1)	Taupo	No
92790 (2)	Rangipo	No
92790 (3)	Tokaanu	No
3650 (1)	Waikaremoana Inflow	No
97502 (1)	Mangahao	No
97904 (2)	Cobb Inflow	No
97904 (1)	Coleridge Inflow	No
77106 (1)	Grey + Taramakau - Taipo	Yes
98770 (2)	Tekapo	No
98770 (1)	Pukaki	No
98614 (3)	Ohau	No
98614 (4)	Benmore Tributary	Yes
9154 (1)	Wanaka Outflow	No
9170 (1)	Hawea Inflow	No
99110 (1)	Roxburg	No
99552 (1)	Manapouri	Yes
9570 (1)	L Te Anau Inflow	Yes
98615 (2)	Benmore_tp	Yes
92714 (1)	Karapiro	Yes
99551 (1)	Manawmara	Yes
99550 (1)	Manapouri	Yes
98614 (6)	Ohau Res	No
98615 (1)	Pukaki, Tekapo	No
98614 (2)	Pukaki	No
98614 (1)	Tekapo	No
98714 (2)	Waitaki	No
162105 (1)	Jollies	No
164604 (1)	Glenhope	No
164602 (1)	Marble Point	Yes
123103 (1)	Whanawhana	Yes
123104 (1)	Kuripapango	Yes
123150 (1)	Chesterhope	Yes
160114 (1)	Dip Flat	Yes
165104 (1)	Mandamus	Yes
165101 (1)	SH1 Bridge	Yes
121801 (1)	Mohaka	No
199540 (1)	Monowai Inflow	No
15462 (1)	Wheao	No
34300 (1)	Patea	No
7968 (1)	Highbank	No
14130 (1)	Kaimai / Ruahihi	No
174395 (1)	Waipori (4)	No

6.2 93254 (1) Matahina

Large differences are apparent in the Matahina dataset beginning 1 July 2007 and finishing 30 June 2008 (Figure 6.2). These differences are due to a 1-day timeshift being removed.

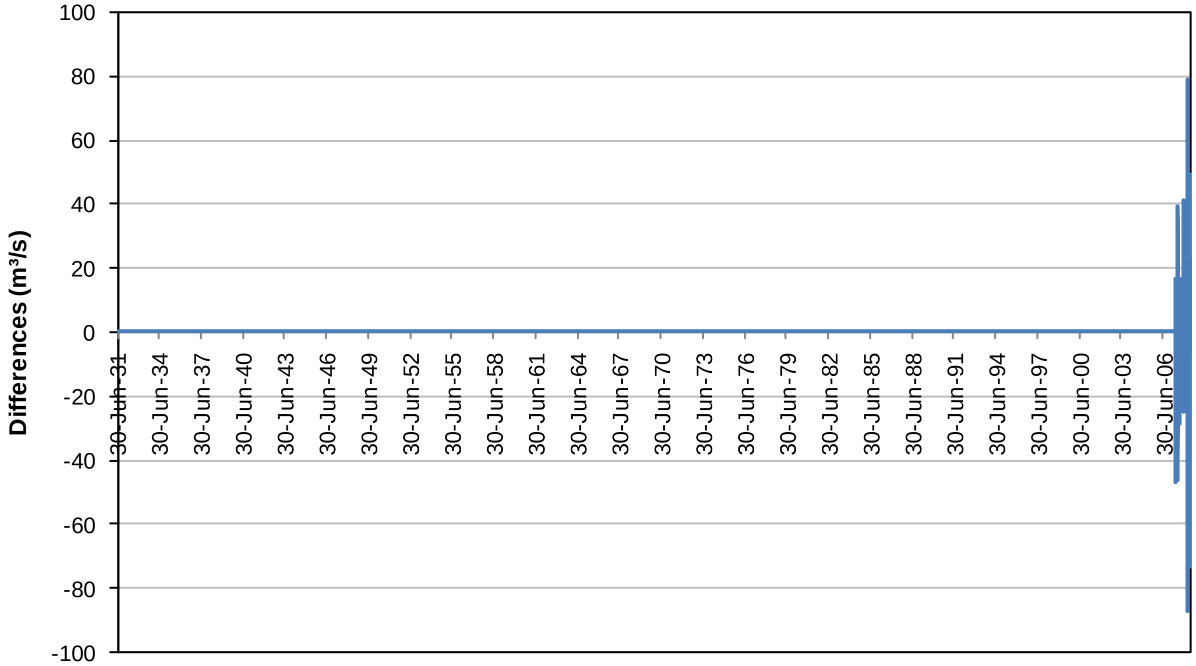

Figure 6.1 93254 (1) Matahina data difference plot

6.3 92724 (1) Arapuni Tributaries

Large differences are apparent in the Arapuni tributary dataset beginning 23 September 1969 (Figure 6.2). These differences are due to a rating change.

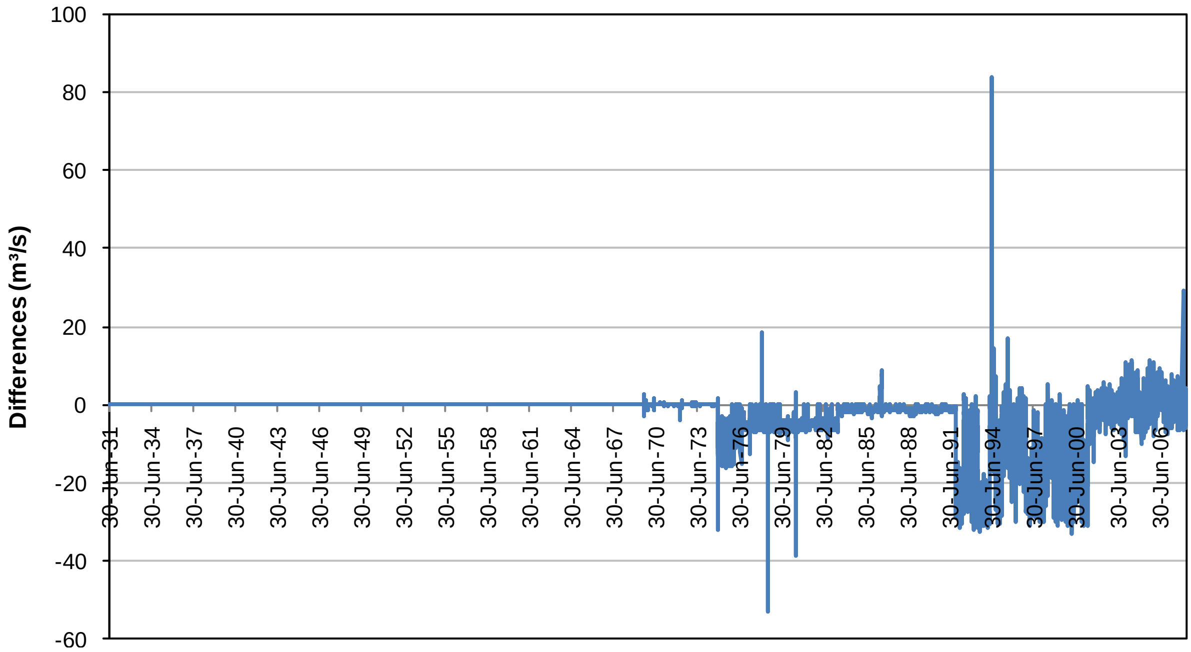

Figure 6.2 92724 (1) Arapuni tributaries data difference plot

6.4 77106 (1) Grey + Taramakau – Taipo

Differences of up 38.8m³/s are found from 22 October 2006 within site 77106 (1) data (Figure 6.3). These differences are caused by a rating change occurring on the Grey at Dobson site on 21 October 2006.

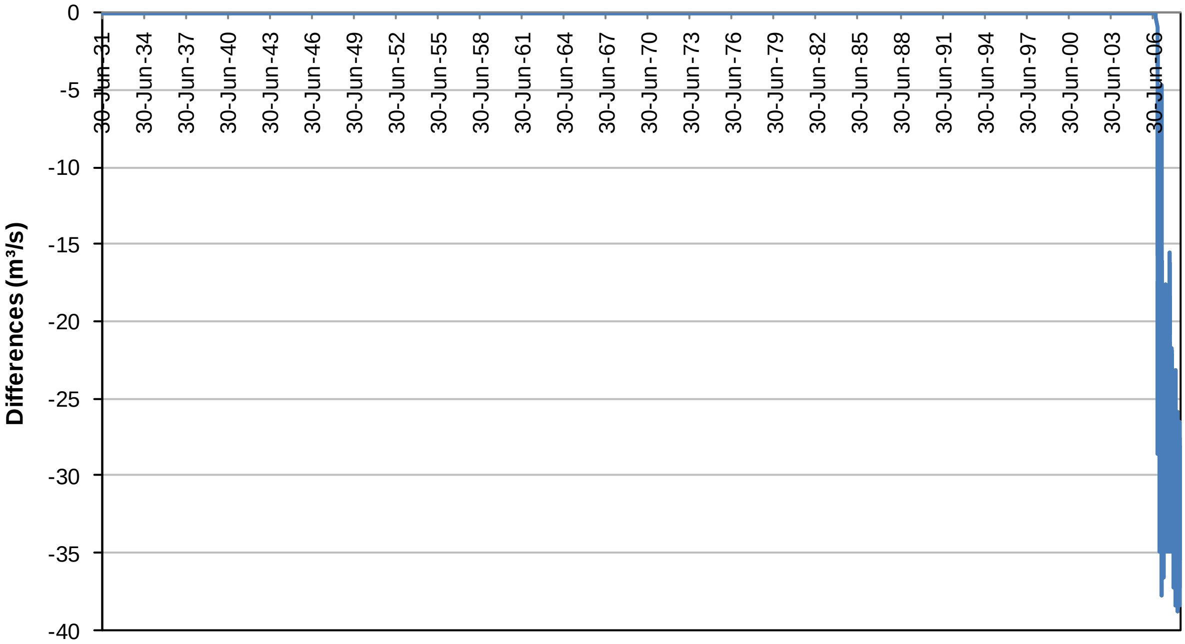

Figure 6.3 77106 (1) Grey + Taramakau - Taipo data difference plot

6.5 98614 (4) Benmore

Differences of up 61.1m³/s are found from 1 April 2008 within site 98614 (4) Benmore_tr data (Figure 6.4). These differences are due to the NIWA quarterly update data not being included in the 2008 update. The 2008 update included zeros for this period of time.

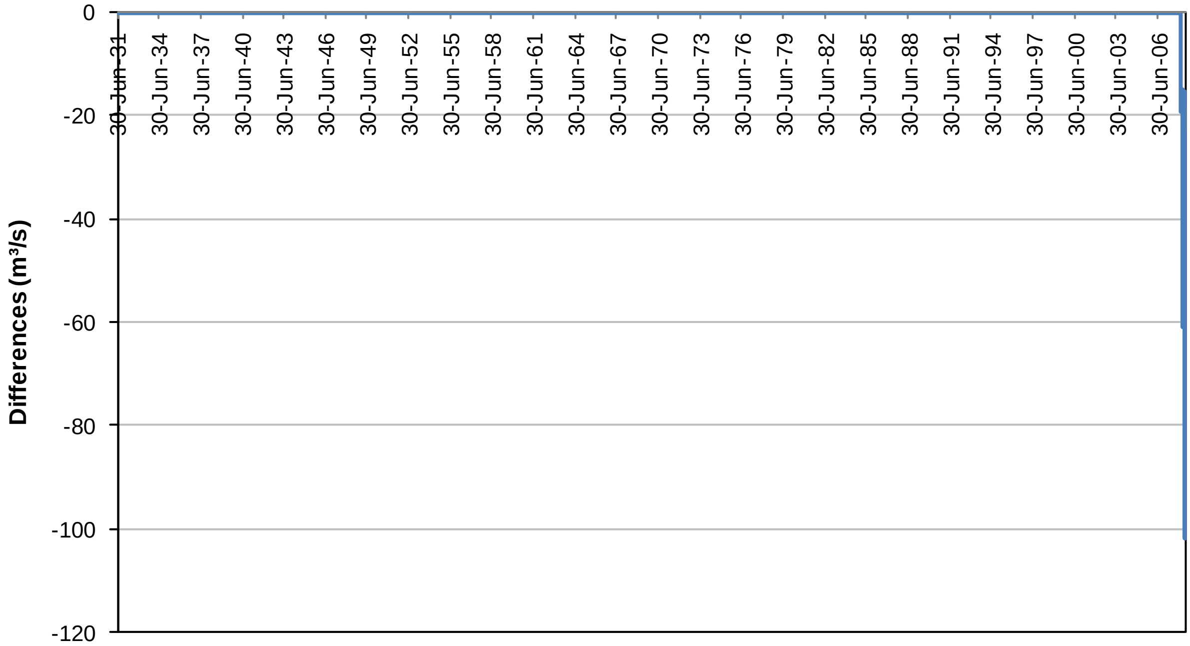

Figure 6.4 98614 (4) Benmore data difference plot

6.6 99552 (1) Manapouri

The differences apparent in site 99552 (1) range from -223.0 to 253.5m³/s (Figure 6.5). The differences in 1973 are due to a recalculation in 2008 not copied across and the differences starting in 1976 are due to a rating change on the 3 March 1976.

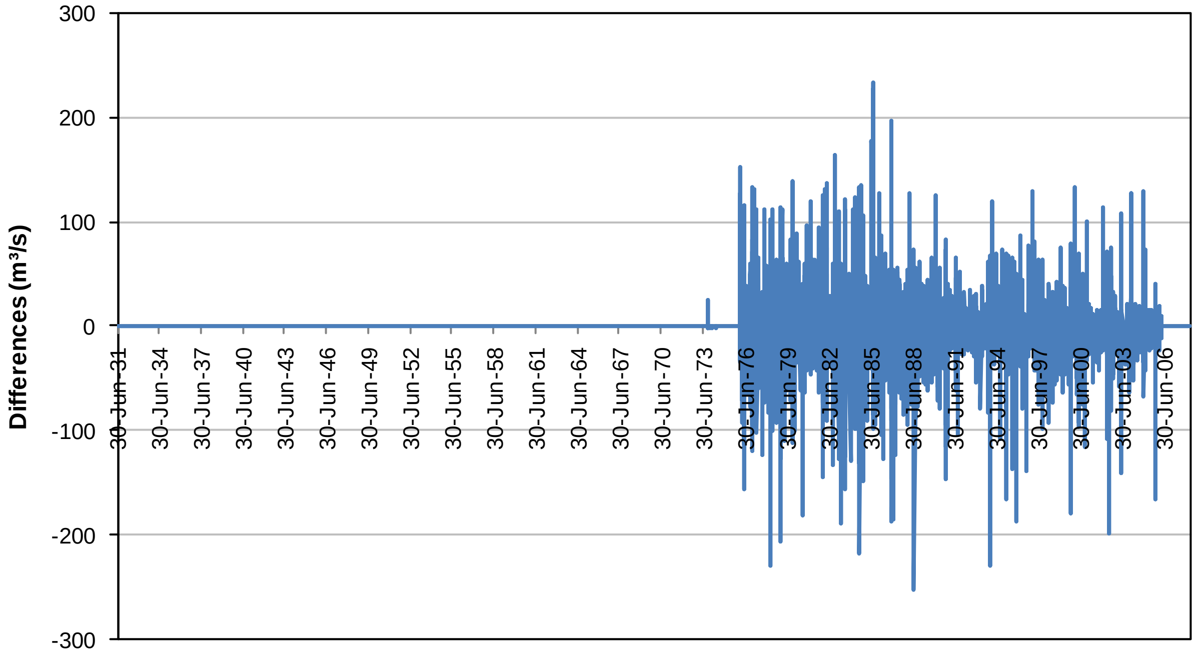

Figure 6.5 99552 (1) Manapori data difference plot

6.7 9570 (1) Lake Te Anau

The data differences of site 9570 (1) begin on 3 March 1976 ranging between -210 and 198m³/s (Figure 6.6). These differences are because of a rating change that occurred on the 3 March 1976.

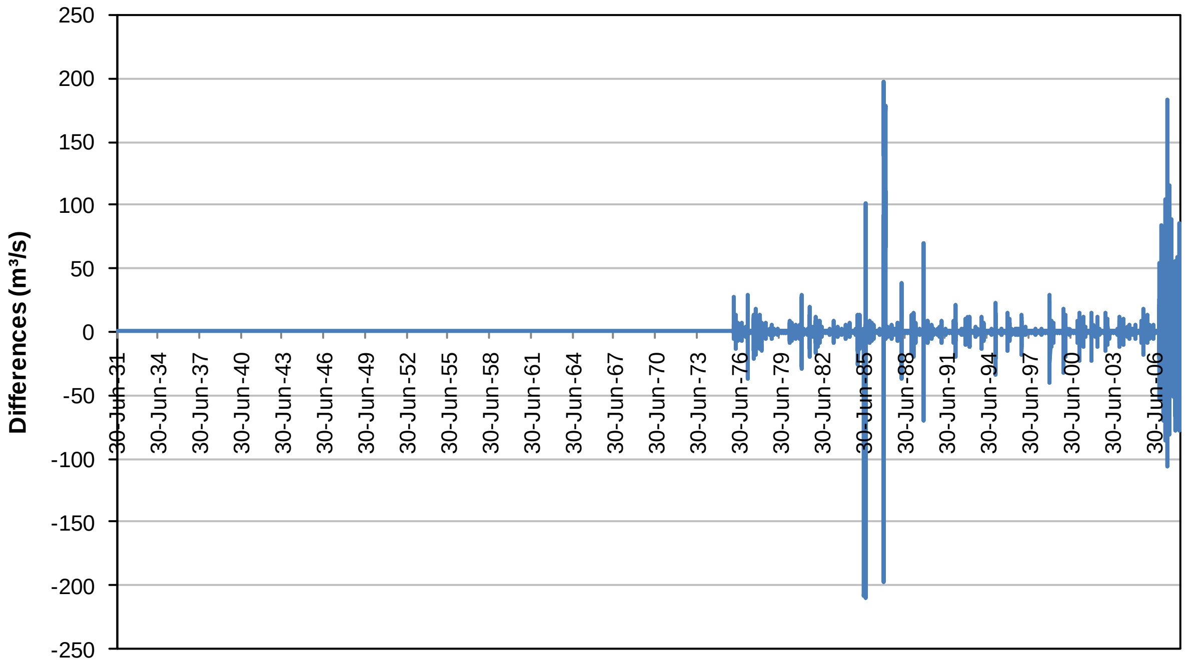

Figure 6.6 9570 (1) Lake Te Anau inflow data difference plot

6.8 98615 (2) Benmore_tp

The data differences of site 98615 (2) begin on 1 April 2008 ranging to 61.1m³/s (Figure 6.6). These differences are similar to those seen at Benmore site 96814 (4) and are caused by the missing NIWA quarterly update data.

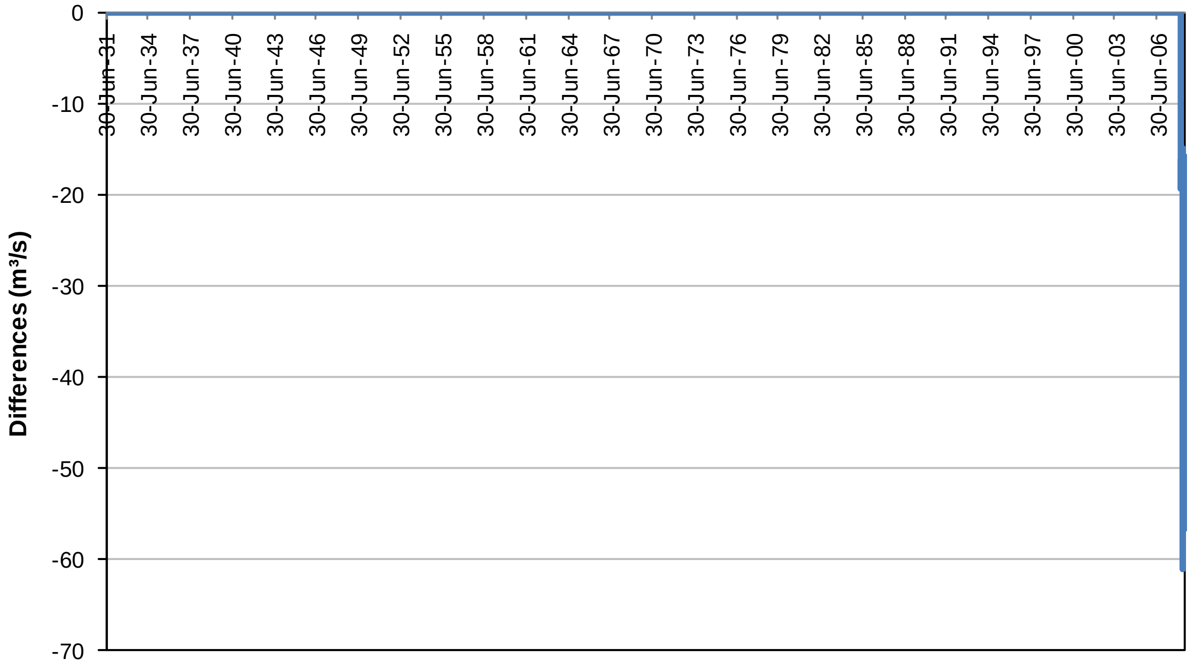

Figure 6.7 98615 (2) Benmore_tp data difference plot

6.9 92714 (1) Karapiro

The large data differences begin on 23 Spetember 1969 (Figure 6.6). These differences are similar to those seen in the Karapiro tributary site 92724 and are caused by a rating change.

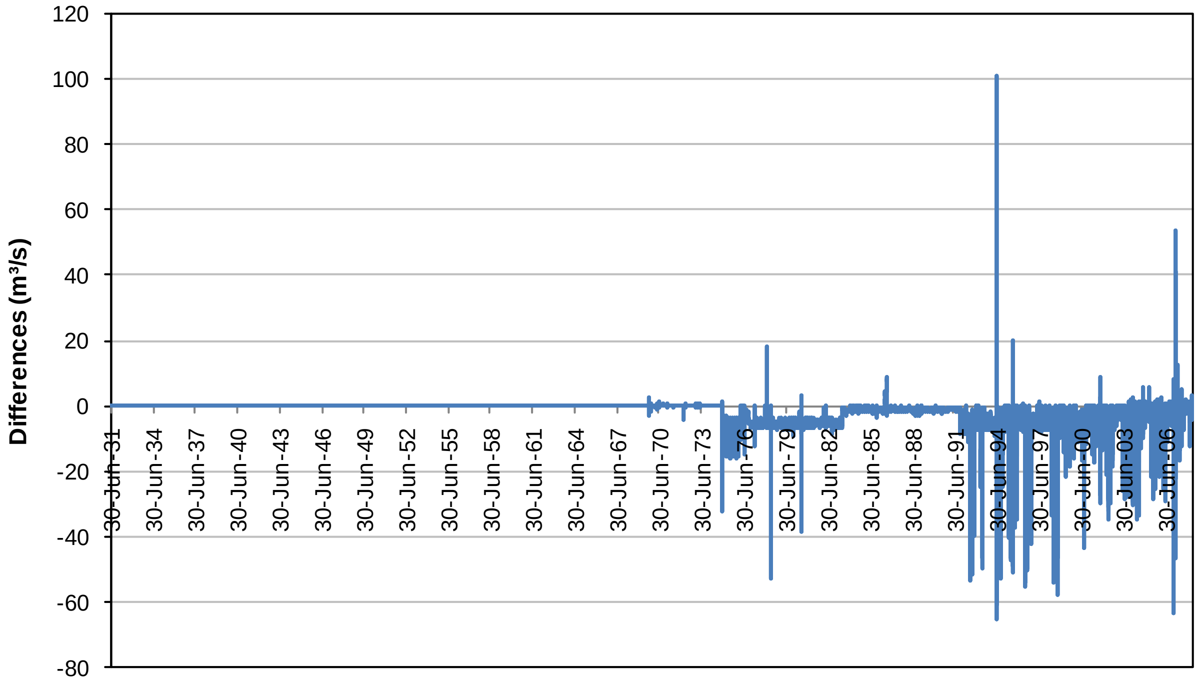

Figure 6.8 92714 (1) Karapiro data difference plot

6.10 99551 (1) Manawmara

Differences in site 99551 (1) range from 286.5 to -253.5m³/s (Figure 6.9). The differences in 1973 are due to a recalculation in 2008 not copied across and the differences starting in 1976 are due to a rating change on the 3 March 1976.

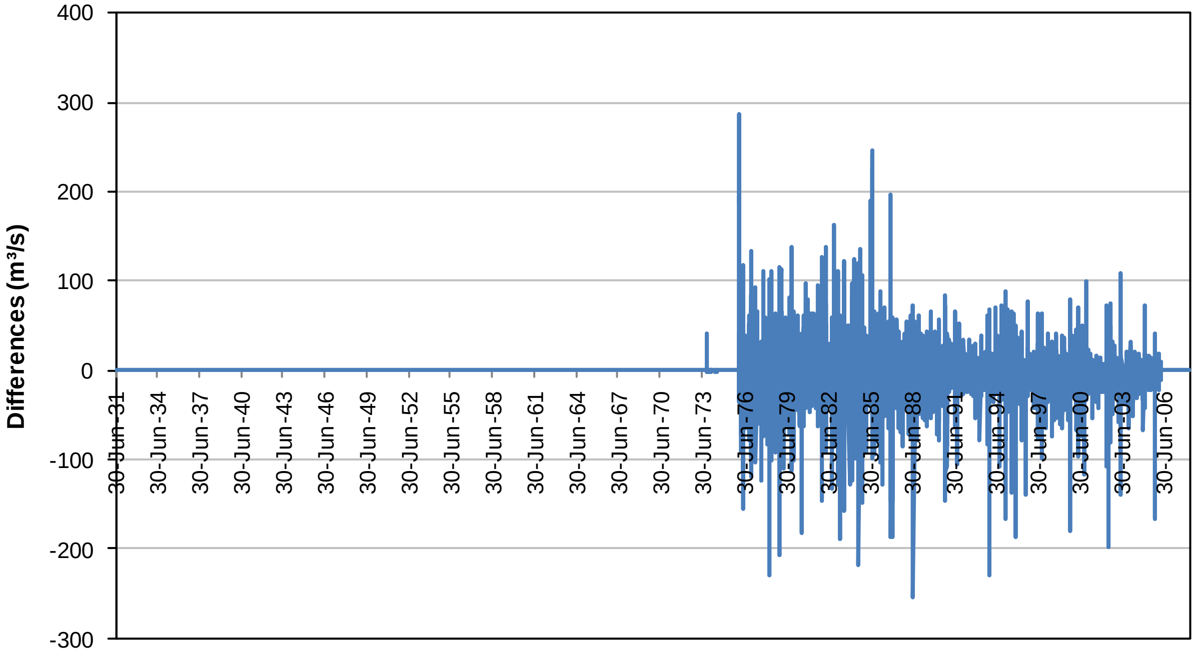

Figure 6.9 99551 (1) Manawmara data difference plot

6.11 99550 (1) Manapouri

The differences in this site; Manapouri, are very similar to those at Manawmara (Figure 6.10). These begin on the same day and are also caused by the rating change.

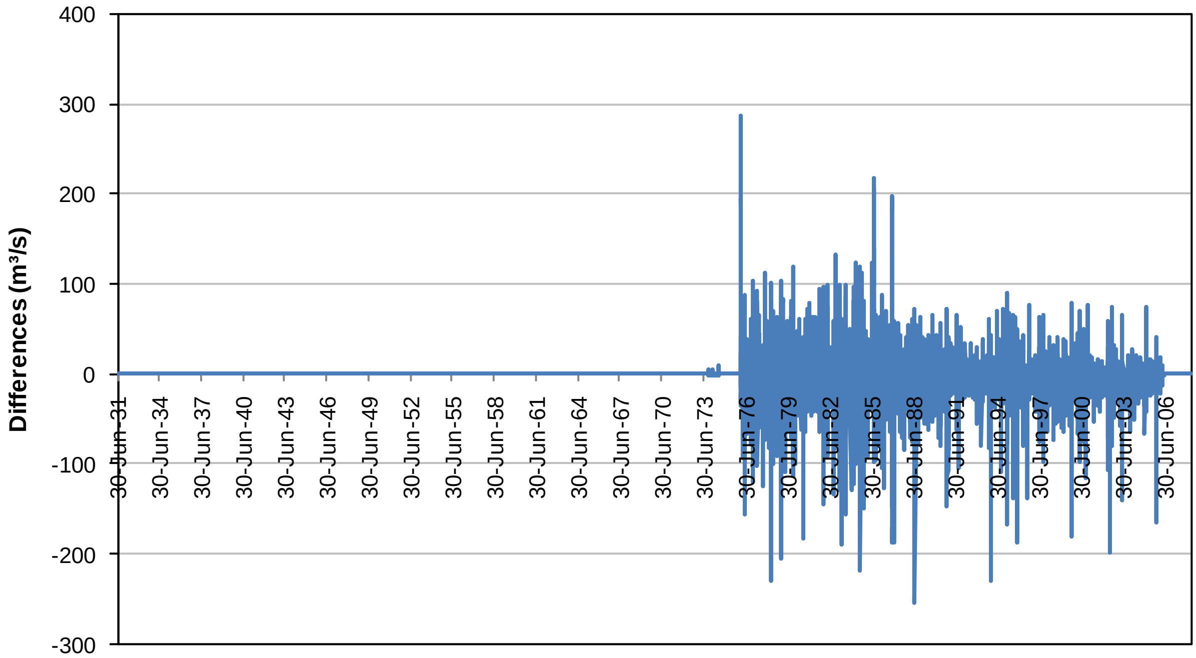

Figure 6.10 99550 (1) Manapouri data difference plot

6.12 164602 (1) Marble Point

Small differences ranging from 0.3 to 4.5m³/s occur in the site 164602 (1) (Figure 6.11). These small differences are attributed to a rating change starting on the 18 November 2006.

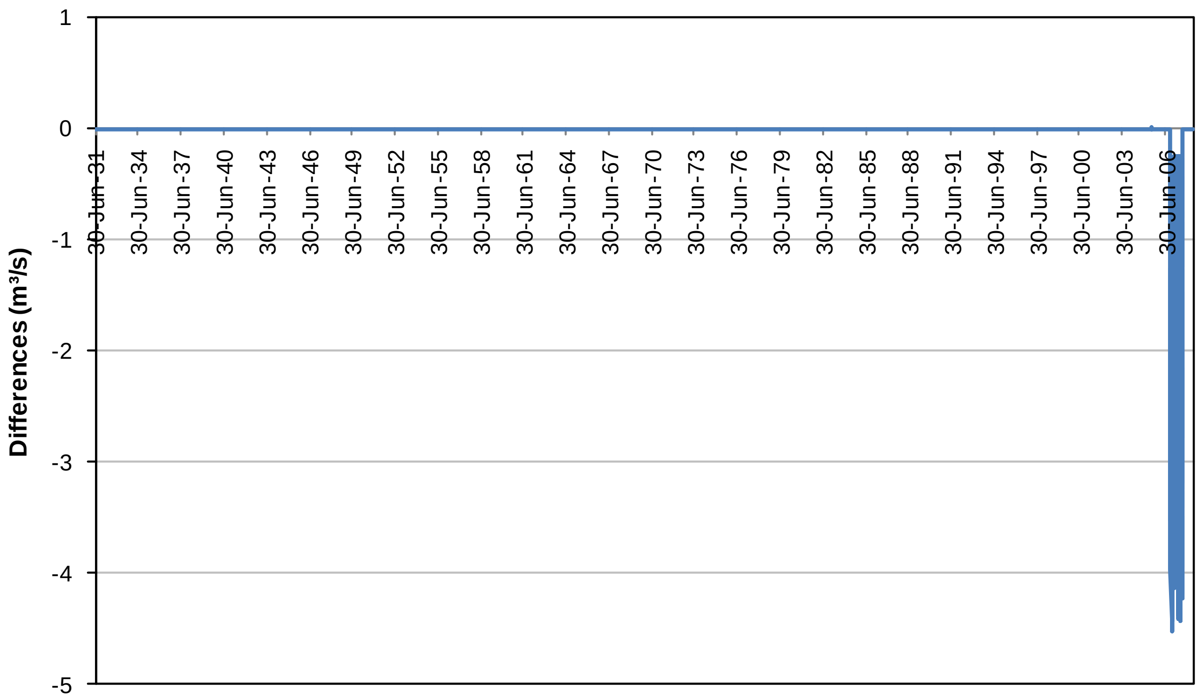

Figure 6.11 164602 (1) Marble Point data difference plot

6.13 123103 (1) Whanawhana

The first set of differences in site 123103 (1) start on 1 July 2005 and run until 30 June 2006. These differences are are attributed to an error in processing the data in the 2008 report. The second set of differences start on 20 December 2007 and are due to a rating change (Figure 6.12).

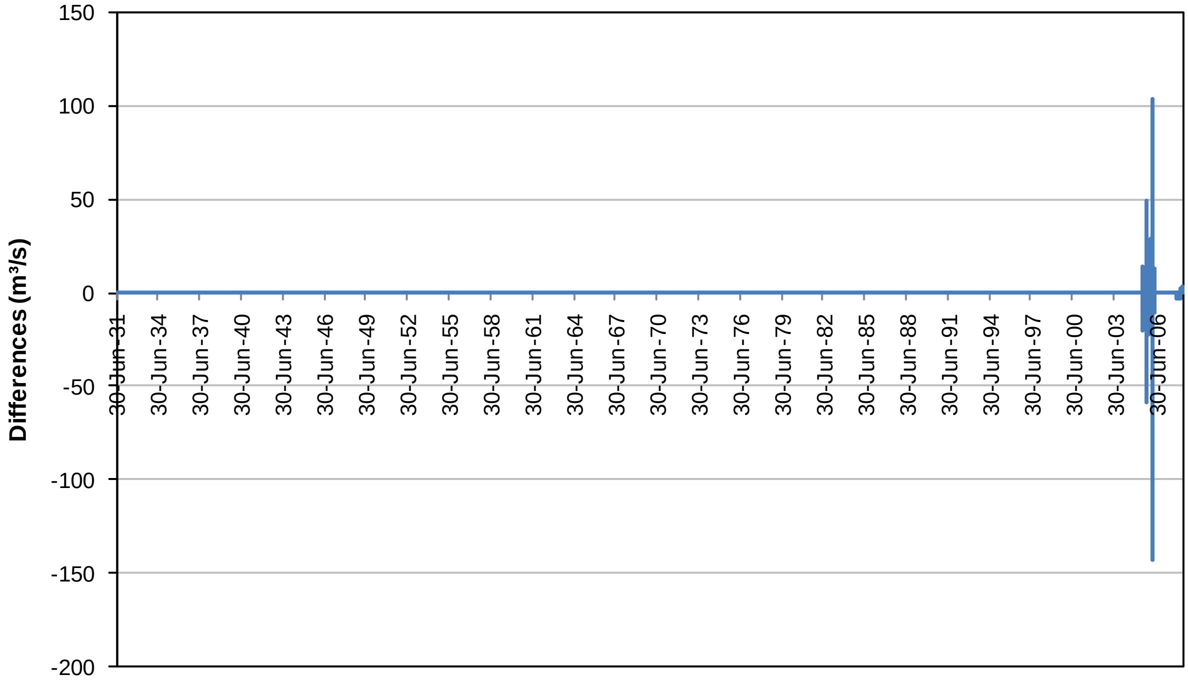

Figure 6.12 123103 (1) Whanawhana data difference plot

6.14 123104 (1) Kuripapango

Small differences between the 2008 and 2010 datasets occur in the site 123104 (1) data (Figure 6.13). These differences are due to two rating changes which start on 23 August 2003 and 30 April 2006.

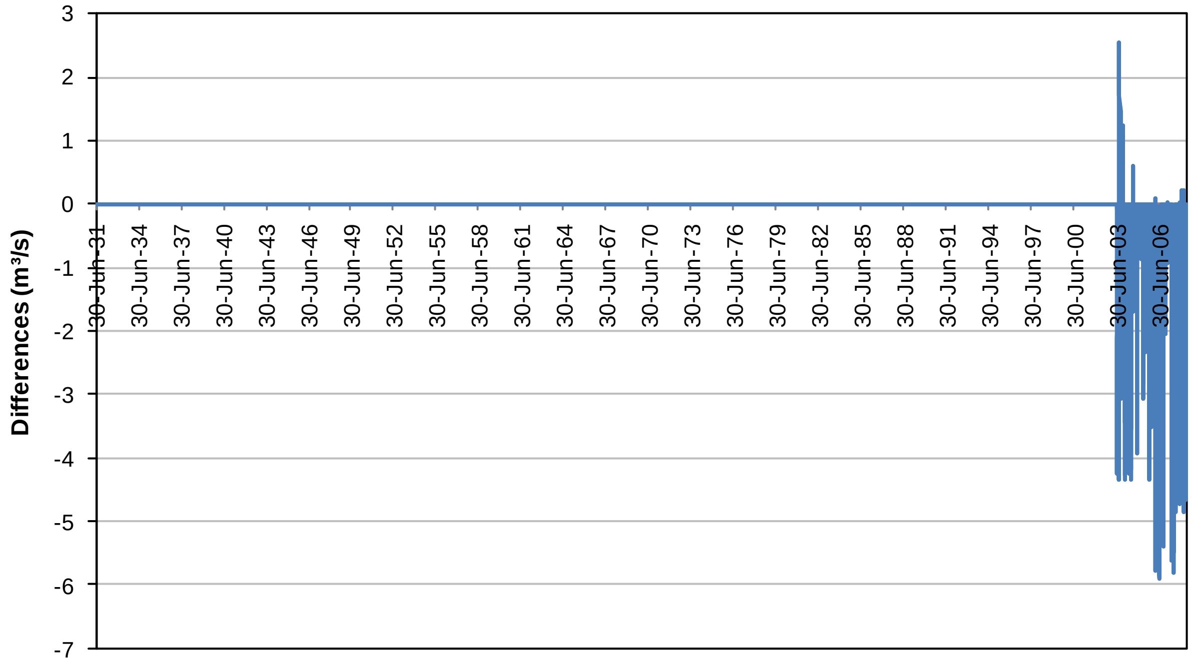

Figure 6.13 123104 (1) Kuripapango data difference plot

6.15 123150 (1) Chesterhope

Differences ranging from 14.1 to -1.7m³/s occur in the site 123150 (1) data (Figure 6.14). These small differences are attributed to a rating change starting on the 17 July 2007.

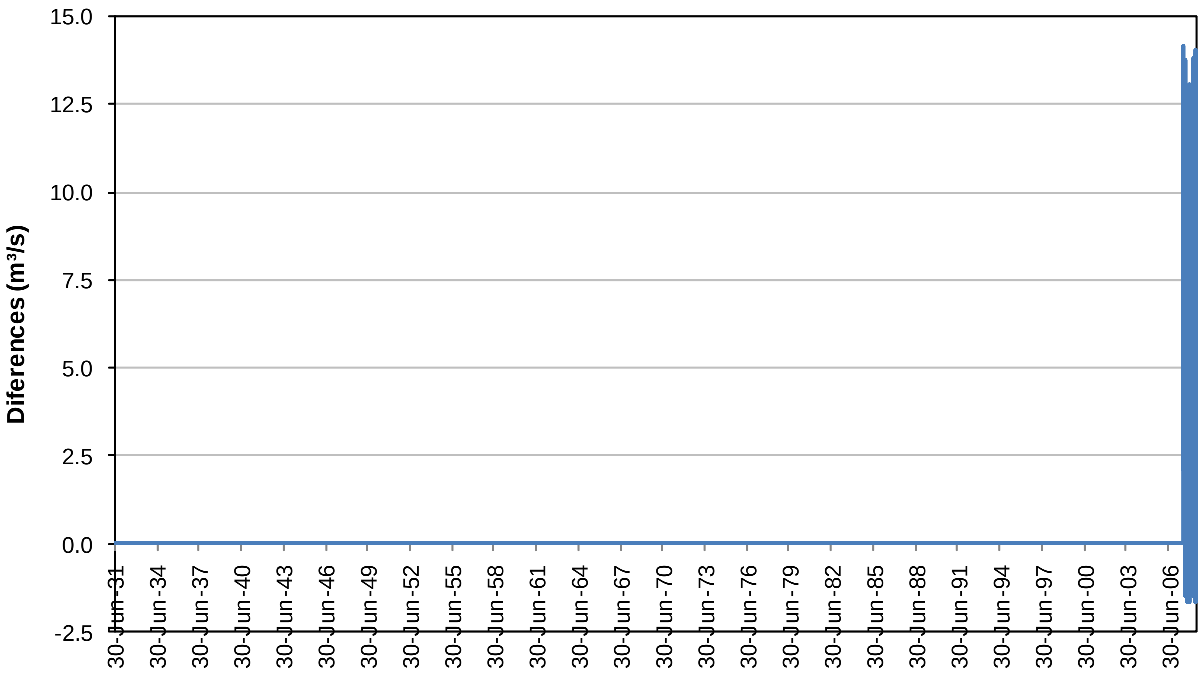

Figure 6.14 123150 (1) Chesterhope data difference plot

6.16 160114 (1) Dip Flat

Differences ranging from 6.3 to -22.5m³/s occur in the site 160114 (1) data (Figure 6.15). These differences are attributed to two rating changes with the first one starting on the 8 November 2006 and the second on 8 October 2007.

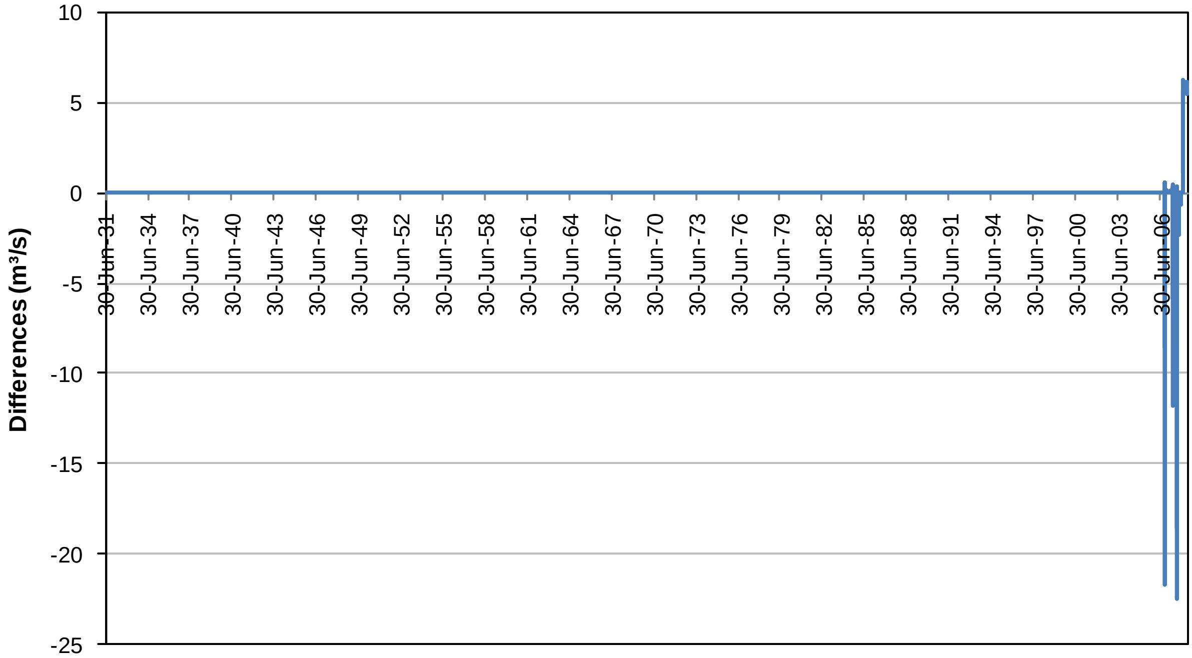

Figure 6.15 160114 (1) Dip Flat data difference plot

6.17 165104 (1) Mandamus

Data discrepancies for site 165104 (1) begin on 14 November 2006 (Figure 6.16). These small differences are correlated to a rating change which occured from November 2006. There is also a second rating change which starts on 7 July 2007.

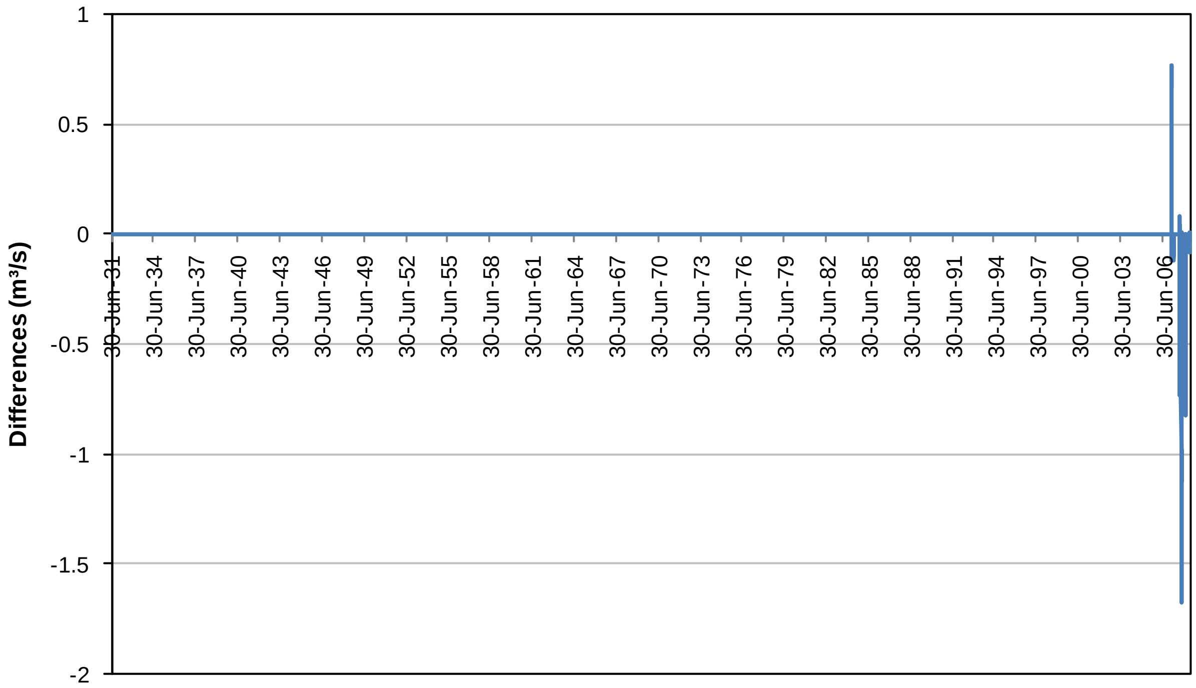

Figure 6.16 165104 (1) Mandamus data difference plot

6.18 165101 (1) Hurunui SH1 Bridge

Data discrepancies for site 165101 (1) begin on 19 August 2000 ranging from 22.0 to -44.1m³/s (Figure 6.17). These differences are correlated to three rating changes which occured on 19 August 2000, 4 August 2004 and 6 October 2007.

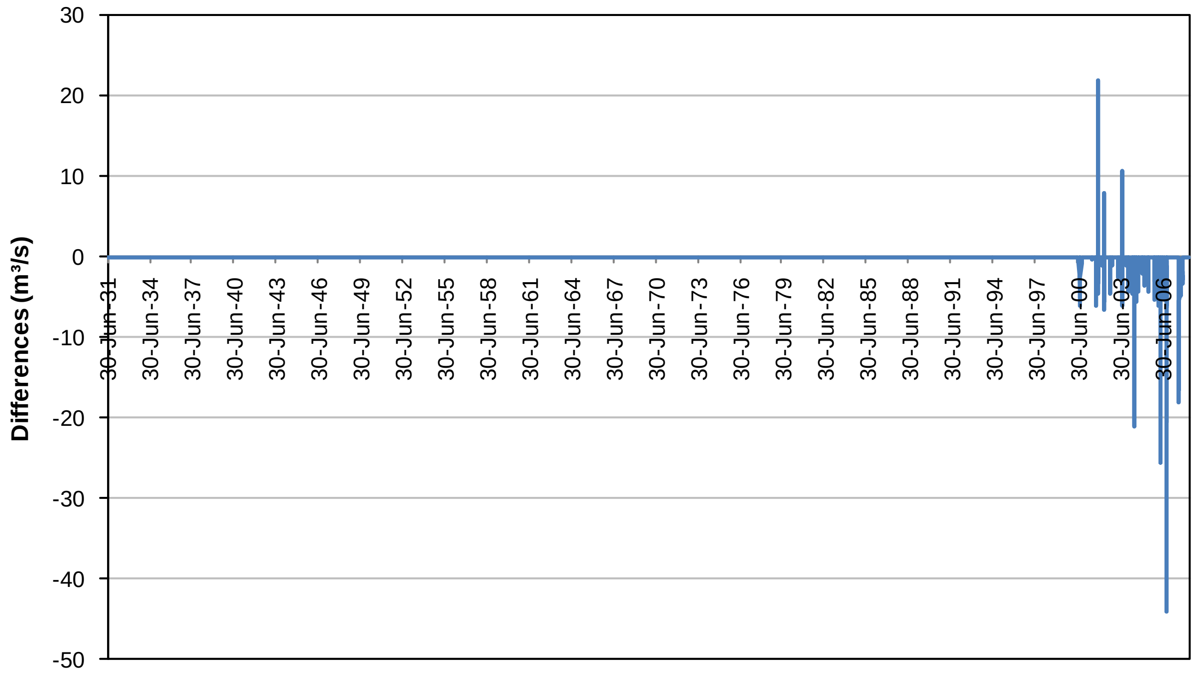

Figure 6.17 165101 (1) Hurunui SH1 Bridge data differences plot

7 Negative flows in datasets

There has been some discussion regarding the apparent negative values in datasets. The SPECTRA series are derived to indicate potential generation. Therefore, a negative value implies that there is no water for generation. In reality, negative data can not exist as this implies that water is being lost from the system. Therefore, although a negative data value is not incorrect it shows that there is no water available for generation.

The following four sites have negative flows in their dataset. They are:

- Lake Waikaremoana - 3650: Waikaremoana has negatives because of leakage from Lake Waikaremoana. Opus, who previously calculated Waikaremoana inflows on behalf of Genesis, had a minimum inflow value to ensure that no negative inflows were calculated. Genesis prefers to have negative inflows in the data until a solution can be found to quantify and resolve lake leakage.

- OhauRes - 98614(6): This dataset has negative data values when the inflow to Lake Ohau drops below the required residual consent flow of $8m^3/s$ for 1 May to 31 October and $12m^3/s$ for 1 November to 30 April.

- Manareduced - 99552: This dataset simulates the effects of minimum flow regimes, Mararoa dirty water spill, and flushing and recreational flows. The dataset will have negative values if the inflow to Lake Manapouri is less than the required $150m^3/s$ flushing and recreational consent flows. In some instances when the Mararoa is in flood, and the spill of dirty water is required (if flow is greater then $40m^3/s$), because of the outflows timing issues inflows to Manapouri will be less than outflows resulting in negative water.

- Manawmara - 99551: This dataset only simulates the effects of dirty water flows. In some instances, when the Mararoa is in flood and the spill of dirty water is required (if the flow is greater than $40m^3/s$), because of timing issues inflows to Manapouri will be less than outflows resulting in negative water.

8 Appendix A - Statistical summaries - PCAL and PDIST listings

Contents **Site Number**

*** New site in 2008 update**

Note: All PCAL and PDIST listings are based on daily data

8.1 Matahina – 93254 (Item 1)

Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							75	73	74	67	67	65	70
1932	57	58	53	59	58	72	61	60	62	70	59	56	60
1933	59	64	66	61	73	59	68	71	63	57	60	56	63
1934	53	68	54	60	59	67	72	68	61	70	68	62	63
1935	55	69	61	58	70	86	75	84	68	72	84	66	71
1936	79	88	66	66	65	61	74	72	75	68	68	63	70
1937	72	58	60	62	79	63	61	58	60	59	57	60	63
1938	57	67	51	74	61	66	66	71	67	59	70	64	64
1939	65	54	53	53	50	68	63	83	70	60	57	67	62
1940	72	83	64	57	60	62	57	58	61	69	71	58	64
1941	65	58	70	55	53	68	67	70	68	83	72	65	66
1942	65	62	63	67	69	58	84	75	96	78	67	70	71
1943	57	54	56	61	57	84	81	73	88	77	67	61	68
1944	55	67	62	59	61	60	67	69	68	68	61	67	64
1945	77	63	67	60	70	69	72	79	77	76	68	58	70
1946	57	50	58	68	63	59	66	91	80	78	71	61	67
1947	64	55	51	56	53	85	76	68	71	84	62	65	66
1948	62	51	50	60	80	77	104	76	58	68	72	59	68
1949	59	47	38	35	97	93	81	79	68	52	48	43	62
1950	33	45	35	37	49	54	65	56	54	47	56	41	48
1951	52	49	45	38	38	47	106	71	48	49	64	58	56
1952	52	51	41	39	42	77	79	70	55	69	122	111	67
1953	76	73	56	53	74	93	133	114	93	89	68	60	82
1954	48	42	55	51	58	56	61	80	74	50	42	50	56
1955	41	38	35	42	56	61	77	79	69	73	53	53	57
1956	53	43	37	63	104	149	140	114	90	95	89	74	88
1957	61	52	54	45	70	58	70	50	46	50	48	49	54
1958	40	70	56	40	40	41	61	68	60	53	90	120	62
1959	88	73	77	93	75	74	58	57	49	73	61	47	69
1960	40	82	64	45	44	86	79	69	71	75	67	52	65
1961	49	41	39	37	38	36	51	53	60	48	39	44	45
1962	41	50	78	74	142	144	101	99	103	136	126	125	102

1963	87	69	53	47	46	73	106	76	117	73	55	50	71
1964	48	42	70	40	41	42	120	91	91	102	74	66	69
1965	64	137	73	60	52	67	70	98	70	53	73	61	73
1966	80	65	82	61	77	76	109	104	101	85	86	69	83
1967	62	135	74	50	52	55	57	107	99	69	75	97	77
1968	42	52	48	55	76	95	101	88	86	72	63	70	71
1969	83	98	59	49	55	48	47	46	87	58	46	59	61
1970	49	39	40	43	43	94	73	164	131	152	121	69	85
1971	74	62	59	52	115	134	70	75	117	120	105	97	90
1972	78	59	103	62	55	51	77	69	69	66	52	46	66
1973	46	39	40	39	40	54	43	58	73	63	51	44	49
1974	38	38	35	70	54	78	105	104	85	87	71	82	71
1975	71	57	66	58	61	103	71	80	84	102	74	56	74
1976	78	93	57	61	67	67	75	80	75	74	65	57	71
1977	49	45	42	39	45	69	86	76	65	61	49	52	57
1978	41	37	34	39	35	37	75	53	57	55	65	54	49
1979	40	52	80	63	68	56	56	105	106	99	95	68	74
1980	73	57	51	62	54	56	72	70	79	57	56	68	63
1981	60	50	48	50	57	80	87	92	69	68	92	75	69
1982	64	56	56	50	53	66	54	53	49	45	41	41	52
1983	37	32	31	36	36	46	54	47	53	122	102	78	56
1984	51	55	68	54	44	44	67	59	59	51	44	69	55
1985	57	46	44	55	46	62	64	66	82	51	49	64	57
1986	97	59	59	46	56	63	63	90	86	65	56	47	66
1987	50	43	50	53	48	55	47	57	47	48	49	63	51
1988	47	50	44	36	41	46	55	84	83	80	64	69	58
1989	119	75	55	44	52	85	87	59	67	107	80	54	74
1990	52	48	52	45	57	54	57	116	72	89	100	65	67
1991	51	59	48	45	48	45	53	89	83	75	67	46	59
1992	54	51	44	41	37	40	58	94	71	72	56	85	59
1993	50	43	39	39	42	80	52	43	39	34	38	37	45
1994	35	30	30	36	35	61	82	101	71	75	77	51	57
1995	44	45	42	79	64	70	111	91	89	93	72	94	75
1996	74	63	58	75	88	79	82	78	97	68	57	58	73
1997	57	49	57	54	49	92	73	58	58	68	56	48	60
1998	41	41	40	40	43	63	182	100	84	86	73	63	72
1999	54	47	49	51	56	79	72	77	81	59	101	67	66

2000	53	50	41	47	50	71	61	67	68	65	52	50	56
2001	48	61	49	59	73	56	49	58	57	66	75	108	63
2002	70	53	47	50	50	69	88	63	54	53	49	50	58
2003	38	33	32	36	40	55	51	37	62	93	56	75	51
2004	66	68	64	43	55	93	155	102	77	85	74	67	79
2005	82	53	50	45	59	63	65	56	62	72	53	62	60
2006	59	73	50	56	93	97	81	105	63	56	63	50	71
2007	63	47	42	40	40	38	61	68	47	49	39	39	48
2008	33	29	29	48	51	45	81	127	91	74	56	48	60
2009	40	40	35	30	33	51	60	58	58	81	48	40	48
2010	38	41	31	30	48	78							44
Min.	33	29	29	30	33	36	43	37	39	34	38	37	45
Mean	58	57	53	52	58	69	76	77	73	72	67	63	65
Max.	119	137	103	93	142	149	182	164	131	152	126	125	102

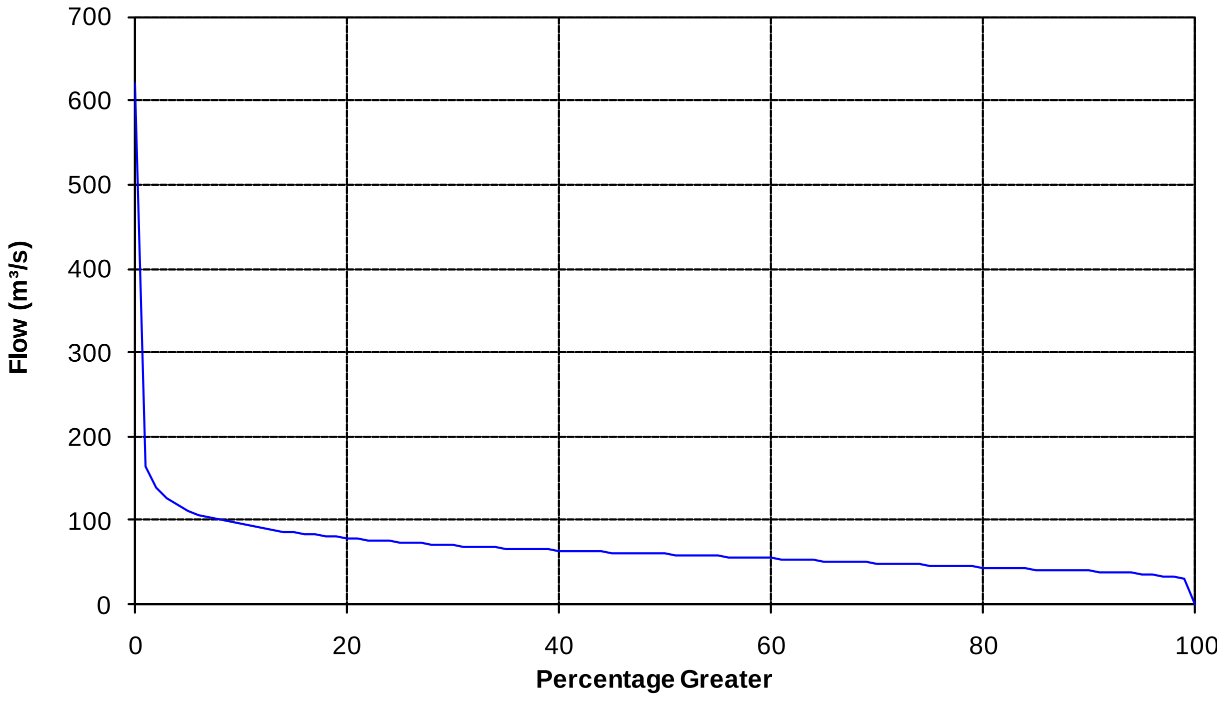

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	620	164	140	127	118	112	107	104	100	98
10	95	93	91	89	87	86	84	83	82	80
20	79	78	77	76	75	74	73	72	71	71
30	70	69	69	68	68	67	66	66	65	65
40	64	64	63	63	62	62	61	61	61	60
50	60	59	59	58	58	57	57	56	56	55
60	54	54	53	53	52	52	51	51	50	50
70	49	49	48	48	47	47	46	46	45	45
80	44	43	43	43	42	42	41	41	41	40
90	40	39	38	38	37	36	35	34	32	30
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	65	60	620

8.2 Taupo Linear – 22790 (Item 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							200	188	195	158	158	147	175
1932	108	115	92	118	113	184	132	123	132	173	121	102	126
1933	119	145	154	130	192	121	163	181	139	110	123	106	140
1934	90	168	93	123	121	158	185	164	131	175	162	136	142
1935	97	168	131	116	173	257	201	248	166	186	247	152	178
1936	218	266	152	155	150	130	195	184	198	165	163	140	176
1937	186	116	125	134	219	140	129	113	125	121	111	126	137
1938	109	161	82	195	130	152	153	177	161	118	177	144	146
1939	149	93	88	90	76	164	139	239	176	125	111	161	135
1940	184	242	144	107	123	132	111	117	127	170	178	115	145
1941	152	113	177	100	92	165	162	176	162	243	186	152	157
1942	148	137	141	157	169	112	248	202	305	217	159	173	181
1943	110	97	102	130	111	249	231	191	267	211	158	129	166
1944	99	163	137	118	131	127	162	172	164	167	130	158	144
1945	209	140	159	124	176	169	186	219	212	208	162	115	174
1946	107	75	113	167	137	120	152	281	227	214	182	131	159
1947	143	98	81	104	89	252	206	165	178	244	132	146	154
1948	135	80	77	124	226	173	220	178	148	218	180	124	157
1949	123	121	103	119	198	239	236	188	148	150	145	111	157
1950	79	143	70	94	107	132	130	161	150	134	176	117	124
1951	125	108	101	111	101	120	227	138	110	184	228	191	146
1952	133	145	86	104	130	310	212	163	130	172	283	230	175
1953	152	131	98	122	202	234	265	209	175	219	194	140	179
1954	114	103	131	100	126	134	142	182	161	105	113	144	130
1955	96	121	79	133	210	191	175	199	179	179	152	154	156
1956	164	118	82	197	181	312	276	222	170	207	197	189	193
1957	142	98	139	96	176	148	163	126	120	176	180	193	147
1958	116	313	141	91	148	168	193	202	137	142	151	346	178
1959	198	140	154	175	152	153	135	145	116	180	145	107	150
1960	94	180	102	73	116	188	193	176	187	146	127	89	139
1961	116	98	85	120	85	126	195	139	176	141	97	116	125
1962	133	100	215	148	191	257	186	220	219	287	231	246	203

1963	153	136	86	102	118	187	205	145	242	114	117	103	142
1964	137	106	186	81	98	111	277	225	268	233	160	218	176
1965	159	203	148	124	113	179	155	211	132	111	222	167	160
1966	168	156	133	141	167	165	253	174	186	131	166	169	168
1967	149	181	133	89	114	109	124	240	148	115	200	187	149
1968	102	88	77	85	151	212	169	162	139	175	142	169	139
1969	145	179	86	95	133	105	104	135	199	118	104	153	129
1970	92	58	88	92	136	216	173	211	296	234	187	125	159
1971	150	134	90	84	137	187	139	204	242	280	196	182	169
1972	122	89	251	100	166	120	228	173	177	165	138	111	154
1973	120	81	91	72	149	163	100	172	227	126	168	125	133
1974	79	89	60	111	131	158	291	209	173	210	149	174	153
1975	141	83	103	103	181	219	201	246	214	228	164	130	168
1976	218	170	124	114	151	170	232	235	213	185	146	149	176
1977	132	105	92	84	160	271	236	188	188	172	144	130	159
1978	103	77	54	111	86	100	220	152	164	144	190	141	129
1979	84	129	189	154	211	131	149	210	190	256	195	171	173
1980	192	121	145	185	146	159	181	210	212	168	184	202	176
1981	139	124	126	109	132	229	217	197	187	186	201	189	170
1982	118	156	123	93	147	145	125	126	151	138	122	159	133
1983	111	92	75	132	142	150	139	137	176	242	195	150	145
1984	120	136	166	93	119	120	189	162	138	116	132	182	140
1985	133	92	97	101	77	174	149	137	164	125	130	185	130
1986	253	159	97	97	161	148	191	199	178	189	133	116	160
1987	138	79	128	137	146	145	116	135	154	176	143	183	140
1988	87	103	117	94	150	194	195	245	235	227	234	224	176
1989	233	153	125	100	133	225	187	141	152	275	163	127	168
1990	144	109	186	142	182	132	165	287	165	178	186	110	166
1991	118	171	107	111	100	97	166	275	227	188	138	129	152
1992	151	137	123	107	86	135	214	269	194	175	157	197	162
1993	114	90	82	91	141	214	114	105	105	103	152	116	119
1994	99	84	57	94	130	180	213	253	216	200	271	141	162
1995	118	133	145	229	159	194	281	200	255	238	202	217	198
1996	163	163	137	224	176	160	233	224	278	194	173	213	195
1997	129	120	89	106	108	131	127	127	162	160	150	139	129
1998	118	126	90	104	140	166	357	201	192	294	178	154	177
1999	127	80	108	105	183	194	159	172	177	121	244	143	152

2000	143	101	65	118	118	172	156	164	178	255	139	166	148
2001	115	147	94	95	176	141	118	151	115	136	195	302	149
2002	149	100	93	105	117	45	213	157	189	156	141	175	137
2003	108	72	87	63	135	169	143	99	208	246	178	196	142
2004	109	280	126	104	155	259	205	214	173	233	158	176	182
2005	172	114	95	62	121	125	155	137	140	222	97	174	135
2006	143	146	88	163	156	160	174	239	134	134	208	140	157
2007	156	91	103	76	93	133	204	227	135	187	125	135	139
2008	72	57	61	117	117	136	274	336	226	228	149	139	160
2009	97	125	88	80	120	124	169	186	185	233	132	141	140
2010	111	110	59	61	110	222							112
Min.	72	57	54	61	76	45	100	99	105	103	97	89	119
Mean	134	128	113	115	141	168	186	187	180	182	165	158	155
Max.	253	313	251	229	226	312	357	336	305	294	283	346	203

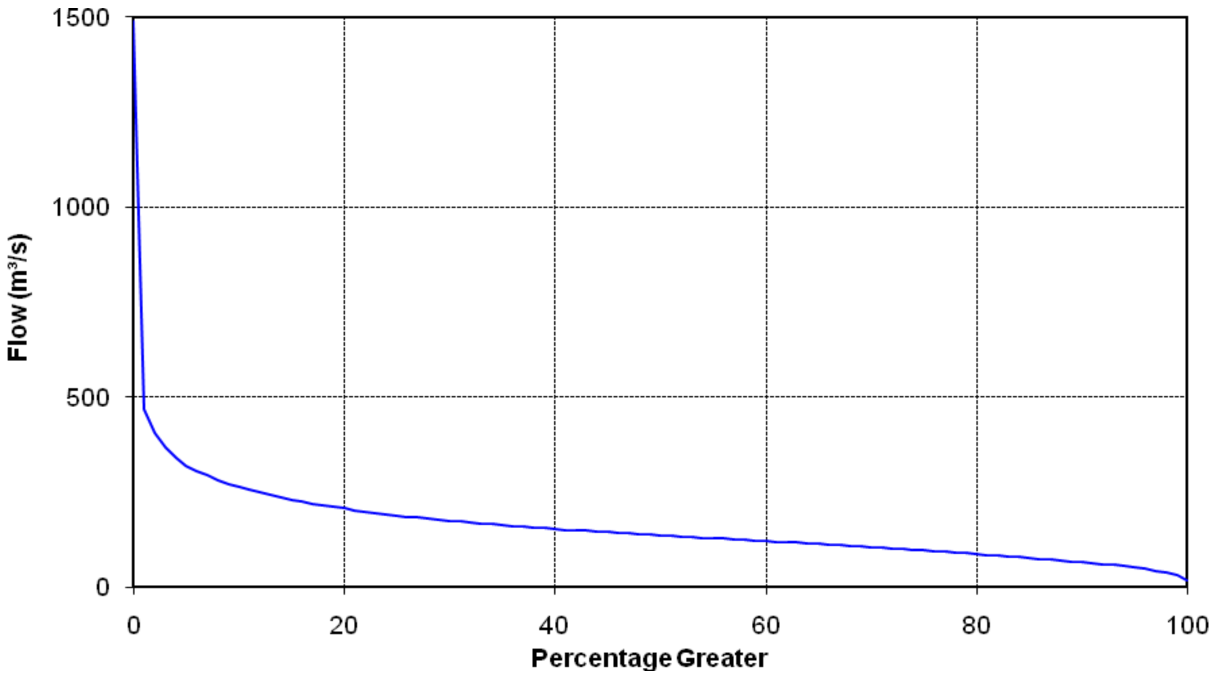

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	1489	470	406	368	341	321	307	294	282	272
10	264	256	249	243	237	231	226	221	216	212
20	207	203	199	196	192	189	186	183	180	177
30	175	172	170	168	166	163	161	159	157	155
40	153	151	150	148	147	145	143	141	140	138
50	137	135	134	132	131	129	128	126	125	123
60	122	120	119	117	116	114	113	111	109	107
70	106	104	102	100	99	97	95	93	91	89
80	87	85	83	81	79	77	75	73	70	68
90	66	63	61	58	55	52	48	43	38	31
100	18									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	18	155	137	1489

8.3 Rangipo Linear – 22790 (Item 2)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							43	41	43	33	32	29	37
1932	18	20	14	21	20	38	24	22	25	37	22	16	23
1933	21	29	25	24	41	21	32	38	27	19	22	18	27
1934	13	23	14	22	22	28	39	34	24	37	33	26	26
1935	15	30	25	21	36	56	44	55	35	40	55	31	37
1936	42	52	31	32	31	24	42	39	42	35	33	26	36
1937	40	20	23	25	39	27	24	19	23	22	19	23	25
1938	19	33	11	34	24	31	30	37	33	21	37	29	28
1939	30	13	13	14	9	32	27	44	37	23	20	33	25
1940	32	41	28	18	22	25	19	21	24	35	37	21	27
1941	29	20	33	16	15	33	32	37	33	47	37	30	30
1942	29	26	27	32	35	20	52	43	58	47	32	37	36
1943	19	16	16	24	19	42	45	40	52	46	32	24	31
1944	16	21	26	21	25	21	32	35	34	31	25	31	27
1945	38	27	32	23	35	35	40	42	43	37	33	20	34
1946	18	9	20	32	26	22	30	57	44	46	39	25	31
1947	28	16	11	17	12	48	44	35	38	53	25	29	30
1948	25	10	10	23	43	36	48	37	30	48	38	23	31
1949	23	22	17	21	34	52	47	40	29	30	28	19	30
1950	10	18	8	14	18	24	24	32	29	26	37	21	22
1951	23	18	16	19	16	21	42	27	19	38	48	40	27
1952	25	29	12	17	25	55	39	34	25	36	58	50	34
1953	31	24	15	22	37	46	53	45	37	43	41	27	35
1954	20	17	21	15	23	25	28	37	33	17	20	28	24
1955	15	22	9	20	45	41	37	43	38	38	31	30	31
1956	33	21	10	41	35	55	49	49	36	45	40	40	38
1957	27	15	27	15	36	29	33	23	22	37	38	41	29
1958	21	37	28	13	30	34	35	45	26	27	29	45	31
1959	31	27	31	32	30	31	25	29	20	38	28	17	28
1960	15	31	16	8	20	39	36	37	39	29	24	13	26
1961	19	15	11	21	11	23	42	27	37	27	15	20	22
1962	24	15	30	28	37	46	40	42	47	51	48	38	37

1963	24	26	12	16	21	37	43	29	49	20	21	16	26
1964	27	16	27	10	15	19	40	49	49	52	33	43	32
1965	32	33	29	22	19	37	30	40	25	19	40	33	30
1966	31	32	25	22	29	32	46	36	37	24	30	31	31
1967	28	26	24	12	18	19	22	43	29	20	36	36	26
1968	16	12	9	11	26	43	34	33	27	37	28	29	26
1969	27	30	12	15	24	17	17	26	36	21	17	29	22
1970	14	5	12	13	24	43	36	44	50	43	39	22	29
1971	29	21	13	11	26	36	26	42	52	54	43	37	33
1972	22	12	40	16	25	21	46	36	38	34	27	19	28
1973	21	11	13	8	29	32	16	35	40	23	34	25	24
1974	10	15	7	20	22	30	55	44	37	44	30	36	29
1975	27	12	16	18	36	43	42	44	46	49	33	24	33
1976	40	26	22	18	29	34	47	47	38	39	28	29	33
1977	24	18	14	12	29	46	48	41	37	35	28	24	30
1978	17	11	6	17	13	17	43	31	32	25	28	27	22
1979	12	26	31	27	37	25	28	42	39	46	41	34	33
1980	37	24	28	38	29	32	37	39	45	35	35	39	35
1981	28	23	24	19	25	47	45	42	38	39	42	39	34
1982	20	23	23	16	29	29	23	23	29	26	21	31	25
1983	17	13	9	24	25	28	26	26	35	48	35	30	26
1984	23	26	34	14	21	22	39	33	27	20	25	34	27
1985	25	14	17	16	11	31	30	26	33	24	25	33	24
1986	41	31	15	16	25	29	34	37	34	39	25	20	29
1987	23	10	24	26	28	28	20	26	30	35	27	37	26
1988	13	18	20	15	27	34	39	52	51	51	44	38	34
1989	45	34	23	17	27	42	39	28	31	53	33	23	33
1990	28	20	25	26	34	24	34	54	34	38	38	19	31
1991	21	28	18	22	18	15	33	51	49	38	26	24	29
1992	25	24	20	17	12	25	42	49	41	36	32	41	30
1993	20	16	13	14	20	41	21	18	17	17	27	21	20
1994	17	15	7	15	23	35	44	47	42	43	45	27	30
1995	23	26	28	45	28	37	51	40	46	48	37	35	37
1996	26	30	27	41	33	32	47	45	49	41	35	39	37
1997	25	25	17	19	20	25	24	24	30	31	29	26	24
1998	22	27	16	18	24	33	49	39	38	49	37	29	32
1999	24	14	21	20	28	35	32	35	34	23	41	28	28

2000	28	18	10	23	23	32	27	34	37	42	27	31	28
2001	20	29	16	17	33	28	22	29	22	25	39	46	27
2002	30	17	17	18	21	0	36	32	38	30	26	34	25
2003	19	12	17	8	17	32	25	17	35	45	32	37	25
2004	19	44	17	19	30	41	37	43	35	45	31	31	32
2005	33	22	17	9	23	23	31	27	24	41	16	33	25
2006	22	23	15	31	31	32	34	39	27	26	41	26	29
2007	31	16	20	12	15	22	38	46	26	37	23	24	26
2008	11	7	8	15	22	25	46	51	46	43	29	28	28
2009	17	24	15	14	23	24	35	37	39	48	26	27	27
2010	19	20	7	8	20	41							19
Min.	10	5	6	8	9	0	16	17	17	17	15	13	20
Mean	24	22	19	20	25	32	36	37	36	36	32	29	29
Max.	45	52	40	45	45	56	55	57	58	54	58	50	38

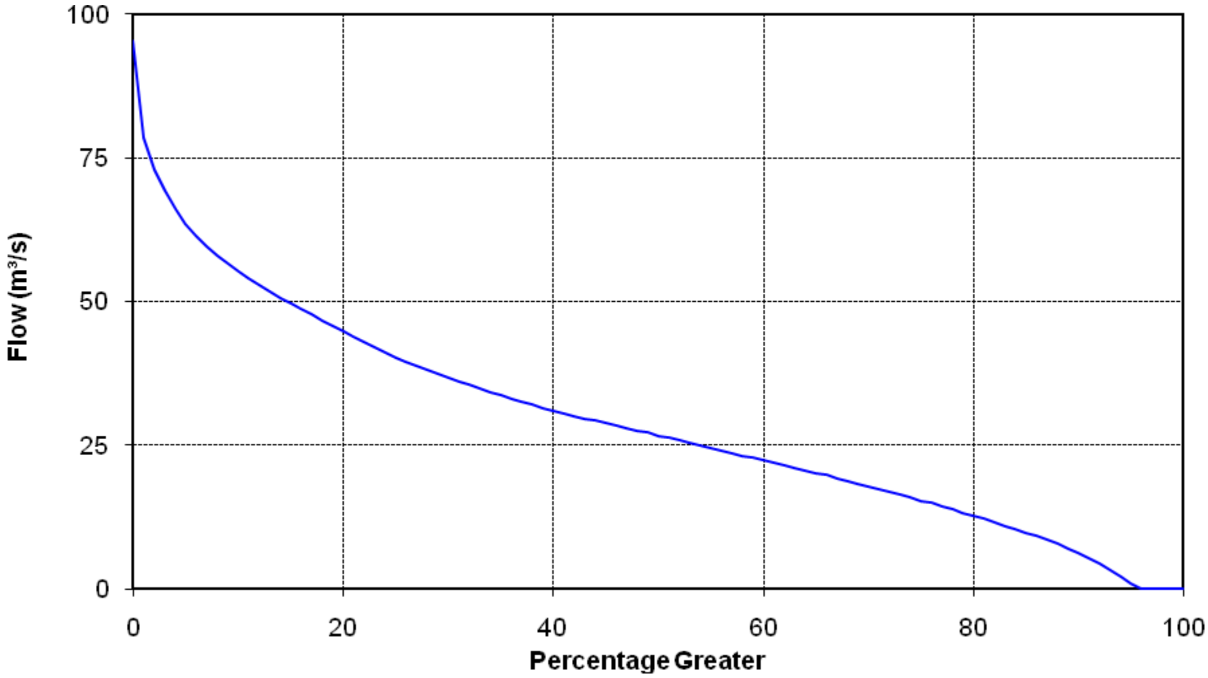

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	95	79	73	69	66	64	61	60	58	57
10	55	54	53	52	51	50	49	48	47	46
20	45	44	43	42	41	40	40	39	38	37
30	37	36	36	35	34	34	33	33	32	32
40	31	31	30	30	29	29	29	28	28	27
50	27	26	26	25	25	25	24	24	23	23
60	22	22	22	21	21	20	20	19	19	18
70	18	17	17	16	16	15	15	14	14	13
80	13	12	12	11	10	10	9	9	8	7
90	6	5	4	3	2	1	0	0	0	0
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	29	27	95

8.4 Tokaanu – Linear 22790 (Item 3)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							70	66	69	56	56	52	62
1932	39	42	35	43	41	64	48	45	47	61	44	38	46
1933	43	51	54	47	68	44	57	64	50	40	45	39	50
1934	34	52	35	44	44	55	65	59	47	62	57	49	50
1935	36	58	47	43	61	88	71	86	59	65	85	54	63
1936	74	88	54	55	53	47	69	65	69	58	57	49	61
1937	65	43	45	48	73	50	46	41	45	44	41	45	49
1938	40	58	32	65	47	54	54	62	57	43	62	51	52
1939	53	35	33	35	30	58	50	81	62	45	41	57	48
1940	63	80	51	39	45	47	40	43	46	60	63	42	51
1941	55	42	62	38	35	58	58	62	57	82	65	55	56
1942	53	49	51	55	59	41	85	70	102	76	56	61	63
1943	41	38	37	46	41	82	78	67	89	73	56	46	58
1944	36	54	49	43	47	46	57	61	58	59	46	56	51
1945	70	50	56	45	61	60	65	75	73	69	57	42	60
1946	39	30	41	58	49	43	54	94	77	74	64	47	56
1947	51	36	32	39	32	84	71	58	63	84	47	52	54
1948	48	31	30	46	77	61	76	63	52	76	63	44	56
1949	44	43	38	43	65	82	80	66	52	53	51	40	55
1950	30	49	28	35	39	47	46	57	53	48	62	42	44
1951	45	39	37	40	38	43	75	49	40	64	79	67	51
1952	47	52	32	38	47	101	71	58	46	60	96	79	61
1953	54	47	35	44	69	79	89	73	62	75	67	49	62
1954	41	37	46	36	45	48	51	64	57	37	41	51	46
1955	35	43	30	46	73	67	61	70	63	63	54	54	55
1956	57	43	31	68	63	101	90	77	60	72	68	66	67
1957	50	35	49	35	62	52	57	45	43	62	64	67	52
1958	42	80	50	33	53	59	66	71	49	50	53	101	59
1959	66	50	55	60	54	54	48	52	42	64	51	39	53
1960	35	61	37	28	42	66	67	62	66	52	45	33	49
1961	42	36	32	43	31	45	68	50	62	50	35	42	45
1962	48	37	72	52	66	84	65	75	76	94	79	79	69

1963	52	48	32	37	43	65	71	52	83	41	42	38	50
1964	49	39	60	30	35	40	90	78	88	81	57	74	60
1965	56	67	52	44	40	63	55	73	48	41	74	58	56
1966	57	56	47	49	58	58	83	61	65	47	57	59	58
1967	52	56	47	33	42	40	44	80	53	41	68	65	52
1968	37	32	29	33	54	74	59	57	50	62	50	58	50
1969	52	61	32	36	47	38	37	48	68	43	37	53	46
1970	34	25	33	35	48	74	61	73	97	79	65	45	56
1971	53	47	33	31	49	65	49	71	83	93	69	63	59
1972	45	33	81	37	56	43	78	61	63	58	49	41	54
1973	43	31	34	28	53	59	34	59	77	46	61	39	47
1974	28	28	20	35	41	53	101	74	59	76	54	60	52
1975	50	29	36	35	64	78	74	81	77	80	60	48	60
1976	69	52	42	37	56	63	80	88	74	67	53	55	61
1977	50	37	31	29	60	93	83	66	67	61	53	48	57
1978	36	25	17	34	28	33	77	55	59	51	64	52	44
1979	31	38	56	55	75	46	50	73	68	85	69	63	59
1980	61	40	52	68	52	57	65	75	80	61	66	71	62
1981	49	44	40	39	46	83	80	72	71	69	70	69	61
1982	44	48	42	28	53	51	45	45	55	50	45	60	47
1983	44	34	28	48	56	56	50	48	66	86	65	52	53
1984	39	46	56	33	45	42	69	60	48	43	46	65	49
1985	49	31	33	32	25	57	52	49	58	43	45	64	45
1986	72	57	35	34	56	55	67	69	64	71	49	42	56
1987	47	28	45	46	51	53	41	47	57	66	52	69	50
1988	30	33	42	32	57	68	73	91	89	71	85	75	62
1989	66	45	44	33	42	81	66	49	52	95	59	44	56
1990	53	37	58	49	68	49	62	100	60	63	67	39	59
1991	39	59	37	31	32	35	56	93	82	70	51	45	53
1992	56	52	47	39	31	49	78	98	72	61	53	70	59
1993	41	26	23	31	44	77	39	35	37	35	52	41	40
1994	32	22	16	29	50	68	79	87	77	72	90	52	56
1995	38	44	50	80	54	69	99	71	86	87	74	71	69
1996	53	56	45	78	63	58	82	79	86	70	63	75	67
1997	45	33	23	35	31	44	42	45	53	57	54	51	43
1998	37	36	25	34	49	60	91	64	68	84	57	53	55
1999	36	19	30	31	57	68	56	60	60	41	79	51	49

2000	47	32	15	34	36	60	51	55	60	80	48	58	48
2001	42	47	29	28	58	49	40	54	38	47	70	91	50
2002	51	31	26	30	39	34	70	57	70	58	54	62	49
2003	36	17	21	15	38	60	50	31	73	86	64	74	47
2004	38	92	42	33	54	86	70	79	64	85	57	65	64
2005	62	33	27	15	37	44	54	47	47	78	33	58	45
2006	47	45	25	55	54	56	64	79	45	44	75	50	53
2007	52	26	26	20	30	47	70	83	46	69	43	43	46
2008	19	13	14	31	35	46	92	105	77	79	54	48	51
2009	31	40	26	20	41	40	57	63	64	83	46	52	47
2010	38	36	15	14	32	76							35
Min.	19	13	14	14	25	33	34	31	37	35	33	33	40
Mean	46	43	38	40	49	59	64	65	63	64	58	55	54
Max.	74	92	81	80	77	101	101	105	102	95	96	101	69

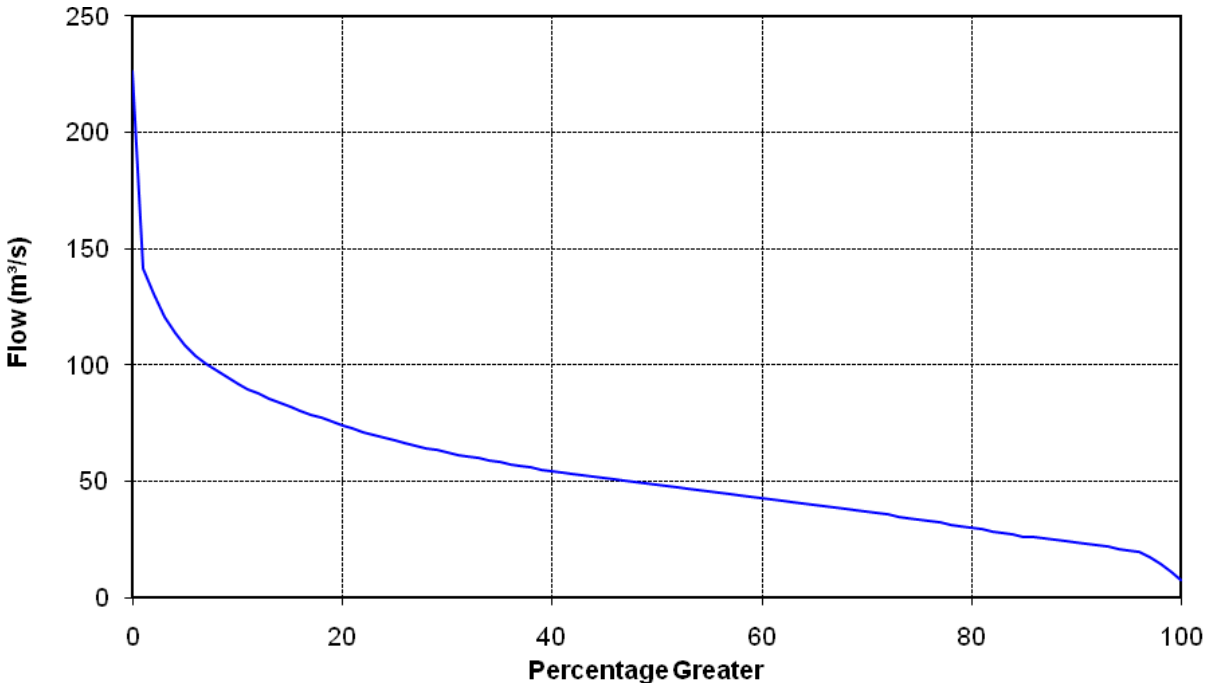

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	226	141	130	121	114	109	104	101	97	95
10	92	90	88	86	84	82	81	79	77	76
20	74	73	71	70	69	68	66	65	64	64
30	63	62	61	60	59	58	58	57	56	55
40	55	54	53	53	52	52	51	50	50	49
50	49	48	47	47	46	46	45	45	44	43
60	43	42	42	41	41	40	39	39	38	38
70	37	36	36	35	34	34	33	32	32	31
80	30	29	29	28	27	26	26	25	25	24
90	24	23	23	22	21	20	20	18	15	11
100	7									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	7	54	49	226

8.5 Taupo Operational – 42790 (Item 1)

Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							203	191	199	159	158	147	176
1932	100	107	81	113	105	183	127	118	130	175	117	94	121
1933	114	145	148	127	195	114	160	180	137	104	117	99	137
1934	80	157	83	114	116	153	186	160	127	178	162	135	137
1935	88	165	128	110	173	259	204	251	167	188	249	152	178
1936	218	267	152	155	151	126	198	185	198	166	163	135	176
1937	188	109	121	131	219	139	126	106	123	115	105	122	134
1938	102	159	70	189	126	153	152	177	161	113	177	144	143
1939	151	83	78	78	60	160	136	237	177	120	105	160	129
1940	177	241	142	99	116	130	105	111	123	169	179	110	141
1941	144	107	172	91	81	163	159	178	164	243	188	148	154
1942	145	133	134	157	170	106	249	203	306	220	157	174	180
1943	102	82	94	125	103	244	232	191	265	213	157	125	161
1944	91	152	132	113	128	119	158	171	165	163	128	155	140
1945	207	138	158	117	173	166	188	219	213	205	162	108	172
1946	99	60	106	162	133	117	150	281	229	216	183	128	156
1947	141	90	68	96	79	249	206	167	180	247	130	145	150
1948	130	66	64	116	225	174	222	179	148	221	181	120	154
1949	119	115	95	110	194	241	238	190	147	150	142	104	154
1950	66	134	55	82	101	127	126	160	148	132	176	112	118
1951	121	102	93	104	90	115	226	136	105	184	230	191	142
1952	130	143	75	95	126	308	210	164	127	172	284	232	172
1953	152	126	89	116	201	236	266	211	176	220	195	139	178
1954	109	95	122	91	123	131	141	181	162	99	108	140	125
1955	87	115	66	123	211	193	176	202	180	181	153	150	153
1956	162	111	70	197	180	311	276	225	173	209	198	190	192
1957	140	90	136	88	174	147	164	123	117	177	182	195	145
1958	111	301	140	82	148	168	192	206	136	139	148	337	175
1959	196	137	153	172	150	153	132	145	110	182	144	99	148
1960	84	176	94	59	111	189	191	178	188	146	125	80	135
1961	105	89	74	113	74	122	197	137	178	139	89	109	119
1962	129	89	210	145	191	256	188	222	220	286	232	243	202

1963	149	134	74	93	112	187	207	145	243	108	111	94	138
1964	136	94	180	69	91	105	273	227	266	236	161	216	172
1965	159	201	146	119	105	180	153	208	129	103	220	166	157
1966	166	154	128	131	162	162	252	175	186	128	163	167	165
1967	144	175	126	79	104	103	119	239	147	111	197	187	144
1968	94	78	63	73	142	215	169	162	139	177	141	167	135
1969	140	175	73	85	128	98	97	133	198	113	97	150	123
1970	83	39	76	80	130	217	175	213	295	235	187	118	155
1971	146	126	80	72	132	186	134	201	243	281	196	180	165
1972	115	78	247	88	157	111	225	172	177	161	131	97	147
1973	111	66	77	55	129	161	95	174	226	121	165	131	126
1974	69	88	52	111	130	162	285	210	178	208	148	175	152
1975	139	75	95	100	178	217	198	245	213	229	162	125	165
1976	222	172	121	112	146	165	232	228	212	184	143	146	174
1977	125	100	86	77	151	265	234	191	188	172	140	125	155
1978	99	72	45	110	81	98	218	151	162	140	183	137	125
1979	75	137	197	149	204	130	148	212	190	255	190	162	171
1980	212	114	145	180	134	154	186	213	213	162	173	210	175
1981	135	109	121	103	130	232	221	194	180	179	202	184	166
1982	102	155	122	94	142	144	121	122	149	135	114	153	129
1983	96	81	64	129	133	144	138	135	175	247	196	141	140
1984	110	134	168	90	109	114	192	160	137	124	122	178	137
1985	123	81	92	101	77	186	148	138	164	115	122	191	128
1986	281	150	90	84	149	140	199	201	179	182	119	102	157
1987	135	67	129	148	134	137	108	133	149	173	138	179	136
1988	78	102	116	83	142	190	194	243	236	240	220	219	172
1989	260	166	113	85	136	230	185	133	155	279	162	117	169
1990	135	103	186	130	176	129	162	296	159	177	183	95	162
1991	118	171	90	120	96	90	168	287	224	180	130	116	149
1992	144	123	108	98	76	132	215	269	201	185	160	199	159
1993	116	90	81	91	147	220	120	106	110	105	152	116	121
1994	98	82	54	92	134	188	222	258	221	206	282	142	165
1995	118	133	145	230	163	199	288	208	265	240	201	214	201
1996	165	164	137	227	180	164	244	231	284	196	172	213	198
1997	129	118	89	108	105	135	133	135	166	166	151	137	131
1998	114	123	87	101	136	164	367	204	194	293	179	153	177
1999	121	75	101	103	181	193	162	176	175	117	242	144	150

2000	140	99	60	114	115	177	157	164	179	258	137	164	147
2001	115	140	89	89	174	141	117	154	115	133	191	300	147
2002	141	97	90	98	114	202	228	162	192	155	137	177	150
2003	104	68	82	58	128	166	142	99	217	251	176	192	141
2004	118	292	167	103	155	260	218	219	178	236	158	179	190
2005	173	113	95	62	116	130	159	139	141	226	98	174	136
2006	143	142	85	165	164	166	209	249	137	132	209	142	162
2007	154	90	100	70	90	134	210	233	137	190	126	135	140
2008	71	54	57	112	116	139	290	345	229	228	146	137	161
2009	98	122	88	78	123	127	173	192	187	245	135	142	143
2010	117	116	57	59	110	229							114
Min.	66	39	45	55	60	90	95	99	105	99	89	80	118
Mean	131	123	107	110	137	169	187	188	180	182	163	155	153
Max.	281	301	247	230	225	311	367	345	306	293	284	337	202

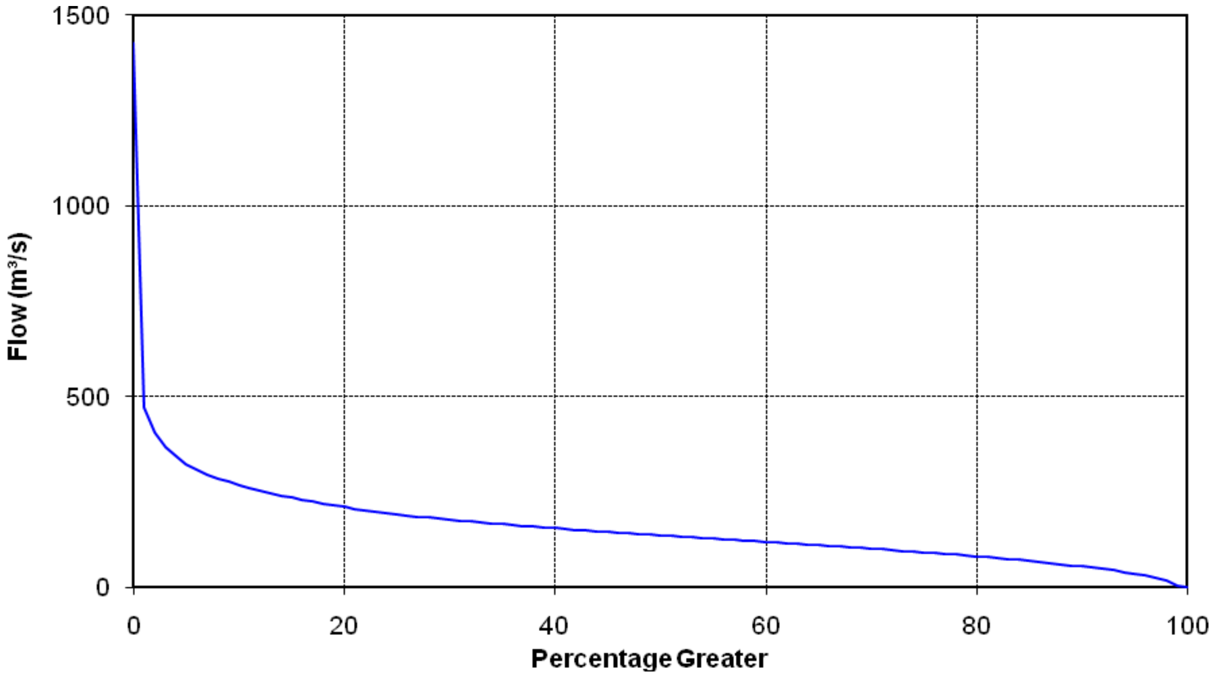

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	1426	471	404	368	343	324	310	296	285	276
10	268	260	253	247	241	235	230	225	220	215
20	211	207	203	200	196	192	189	186	183	181
30	178	175	173	171	168	166	164	161	159	157
40	155	153	152	150	148	146	144	142	140	139
50	137	135	133	131	130	128	126	124	123	121
60	119	118	116	114	113	111	109	107	105	104
70	102	100	98	96	94	92	90	88	86	84
80	82	80	77	75	72	69	67	64	61	58
90	55	52	48	45	41	36	31	25	17	4
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	153	137	1426

8.6 Waikato tributaries at Arapuni – 92724 (Item 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							73	58	54	51	51	55	57
1932	59	68	72	65	69	89	77	56	65	71	55	64	67
1933	66	47	60	54	69	61	65	70	75	66	69	64	64
1934	66	69	63	62	68	83	101	92	73	81	80	65	75
1935	59	61	61	81	84	112	99	124	109	103	129	94	93
1936	106	129	107	91	105	90	117	115	123	106	107	99	108
1937	114	91	89	93	121	92	79	79	78	75	71	77	88
1938	61	89	62	79	90	73	97	108	102	81	85	106	86
1939	76	52	44	48	66	82	89	114	107	86	69	78	76
1940	78	99	84	65	76	77	71	75	77	77	85	68	78
1941	68	63	80	74	68	94	95	91	89	118	81	84	84
1942	75	61	66	65	70	60	97	112	166	120	86	98	90
1943	75	119	39	63	63	99	86	67	109	119	103	69	84
1944	59	78	87	74	66	90	101	99	99	98	79	80	84
1945	87	79	85	71	96	88	109	115	122	104	93	76	94
1946	57	58	68	76	77	76	89	132	114	95	83	77	84
1947	64	59	65	73	68	107	85	71	82	83	75	66	75
1948	63	56	56	69	102	92	101	84	77	112	85	71	81
1949	68	61	67	76	101	109	97	81	73	68	66	62	77
1950	53	64	56	64	67	76	84	87	83	69	80	57	70
1951	56	54	61	62	61	62	107	80	65	82	91	78	72
1952	56	57	54	61	68	134	87	76	69	81	121	99	80
1953	71	67	57	60	109	107	113	121	97	100	82	74	89
1954	61	66	74	70	74	84	88	97	85	66	67	70	75
1955	54	65	55	72	70	83	81	86	82	82	68	67	72
1956	61	51	52	75	81	138	116	107	91	100	98	89	88
1957	72	62	77	60	85	87	94	82	77	93	84	80	79
1958	64	112	71	61	77	73	88	100	83	84	78	117	84
1959	77	78	74	108	94	89	89	83	79	103	77	71	85
1960	64	78	71	65	67	96	102	92	110	89	78	68	82
1961	68	52	57	57	62	77	105	78	84	70	60	64	70
1962	57	57	106	80	106	125	114	105	117	138	134	163	109

1963	88	78	73	70	79	90	124	97	118	82	83	72	88
1964	73	70	94	74	78	87	159	126	120	130	90	92	100
1965	86	121	93	81	83	106	100	113	85	78	84	68	91
1966	83	77	92	76	101	100	142	122	131	108	99	96	103
1967	94	121	96	81	84	90	92	122	111	88	113	113	100
1968	81	79	68	89	99	123	118	115	110	98	88	100	97
1969	66	89	70	71	82	82	87	86	96	65	70	52	76
1970	54	53	43	51	56	85	75	107	99	112	95	69	75
1971	69	78	64	59	71	87	70	77	120	127	91	85	83
1972	60	62	70	69	72	67	108	88	90	76	62	64	74
1973	57	51	53	58	57	76	67	79	102	74	69	66	67
1974	50	62	53	59	58	91	110	104	94	89	70	83	77
1975	85	65	74	59	75	108	93	110	103	94	76	63	84
1976	82	92	66	62	73	78	104	102	89	89	75	72	82
1977	66	63	59	53	73	99	106	89	83	81	67	71	76
1978	53	54	56	58	53	62	89	69	72	64	75	59	64
1979	46	58	90	73	87	71	80	108	98	117	91	81	83
1980	91	77	69	79	67	73	91	94	98	69	74	87	81
1981	69	60	61	63	59	91	98	95	82	83	78	83	77
1982	62	66	57	57	65	61	62	62	63	64	52	55	60
1983	49	47	44	52	56	65	61	57	73	98	86	63	63
1984	49	57	60	59	52	53	75	77	68	57	59	64	61
1985	58	51	52	49	51	73	68	64	66	57	54	63	59
1986	92	61	54	51	60	60	83	97	82	71	58	52	69
1987	59	45	56	66	66	67	60	63	66	65	57	59	61
1988	46	52	51	40	59	74	82	104	82	99	85	81	71
1989	88	70	60	57	64	92	91	71	83	122	91	76	81
1990	67	58	85	75	84	76	72	134	86	81	81	64	80
1991	58	69	56	54	57	60	76	119	98	91	72	63	73
1992	79	78	72	73	83	92	112	125	100	97	90	104	92
1993	81	79	81	88	92	103	84	86	88	85	94	80	87
1994	71	67	75	85	94	103	110	113	100	102	102	86	92
1995	81	77	80	93	79	109	149	111	118	106	101	92	100
1996	95	88	85	117	103	103	126	124	141	103	103	100	107
1997	89	95	96	97	98	110	96	100	108	104	101	86	98
1998	75	78	77	86	93	110	177	119	102	111	97	85	101
1999	81	76	84	80	86	84	100	102	90	75	99	87	87

2000	78	71	72	85	78	86	84	87	94	108	72	75	82
2001	73	81	77	74	92	67	64	71	63	64	82	90	75
2002	73	58	54	57	60	92	108	77	73	74	64	72	72
2003	54	47	55	53	58	83	65	57	86	98	73	83	68
2004	75	77	86	57	75	102	98	104	85	94	80	82	85
2005	65	60	63	55	75	69	88	85	88	105	66	86	76
2006	69	72	68	80	84	87	91	109	75	69	86	68	80
2007	64	55	64	60	57	67	84	101	70	72	63	63	68
2008	46	49	52	66	68	72	118	138	88	97	68	71	78
2009	54	65	52	56	71	78	93	106	95	114	75	69	77
2010	65	59	55	62	73	108							70
Min.	46	45	39	40	51	53	60	56	54	51	51	52	59
Mean	69	70	68	69	76	87	95	95	92	90	81	78	81
Max.	114	129	107	117	121	138	177	138	166	138	134	163	109

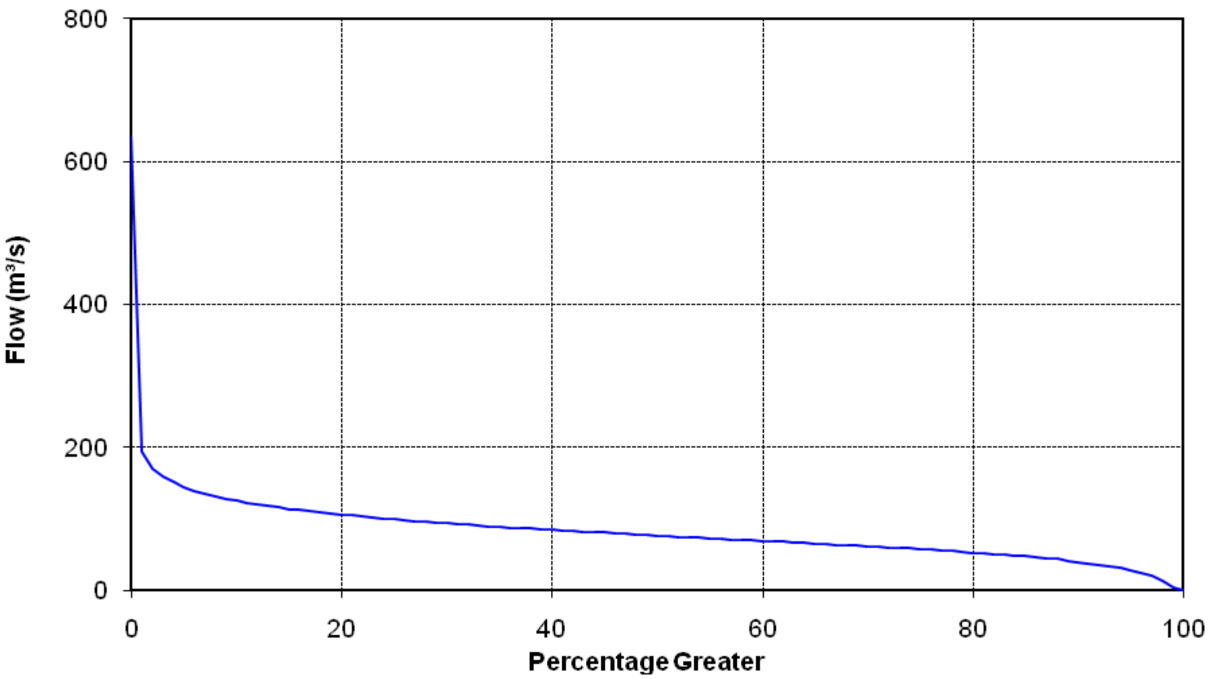

Figure depicting percentage exceedance graph

Table Depicting Percentage Exceedance: Flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	636	195	171	160	151	144	139	135	131	128
10	126	123	120	118	116	114	113	111	109	108
20	106	105	103	102	101	100	98	97	96	95
30	94	93	92	91	90	89	88	87	87	86
40	85	84	83	82	81	81	80	79	78	78
50	77	76	75	75	74	73	72	71	71	70
60	69	69	68	67	67	66	65	64	63	63
70	62	61	60	59	59	58	57	56	55	54
80	53	52	51	50	49	48	47	45	44	42
90	40	38	36	34	31	28	25	20	14	4
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	81	77	636

8.7 TPD Flows at Taupo – 92790 (Item 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							209	194	201	164	161	146	179
1932	104	113	78	114	107	188	134	120	134	176	120	96	123
1933	117	147	156	132	196	123	163	185	141	109	120	100	141
1934	79	162	83	119	115	157	193	169	132	177	165	136	140
1935	89	173	129	112	175	272	208	260	170	189	265	156	183
1936	232	278	158	160	152	134	201	188	210	167	166	132	181
1937	203	115	121	138	225	141	130	109	126	124	105	122	139
1938	106	164	65	208	125	154	161	182	162	115	179	147	147
1939	150	83	80	79	65	165	135	251	181	128	104	167	133
1940	182	249	155	100	124	134	106	112	127	176	178	116	146
1941	146	105	180	97	78	170	169	179	167	253	186	158	158
1942	150	135	142	158	175	108	262	212	318	231	161	178	186
1943	105	84	95	128	107	252	241	206	276	226	164	127	168
1944	92	165	135	117	124	127	162	177	170	174	130	161	144
1945	224	144	160	124	180	170	193	231	223	209	174	108	179
1946	101	60	108	173	135	118	153	298	236	227	190	130	162
1947	141	86	73	94	75	262	222	169	185	254	130	151	154
1948	132	70	62	118	233	183	231	186	146	232	183	122	159
1949	121	117	99	115	204	249	240	201	150	151	147	110	159
1950	66	141	52	83	106	127	132	164	153	134	181	113	121
1951	124	106	96	103	94	120	241	141	110	191	236	203	147
1952	134	144	73	96	129	319	236	168	130	176	299	247	179
1953	155	131	85	120	216	244	276	219	184	225	201	143	184
1954	112	95	127	93	124	135	146	186	164	102	112	142	128
1955	90	120	68	124	221	199	179	206	183	188	152	160	158
1956	165	118	70	205	193	317	287	235	181	216	212	189	199
1957	143	93	137	91	184	151	165	128	117	186	185	199	149
1958	114	340	136	84	153	169	202	208	139	142	156	339	181
1959	208	160	157	180	151	156	136	146	115	185	144	105	154
1960	85	177	94	62	115	198	207	180	195	144	126	86	139
1961	111	89	75	113	76	128	206	151	184	142	95	108	123
1962	122	88	224	145	198	273	196	238	230	291	244	252	209

1963	149	133	73	93	117	204	218	154	251	113	117	95	143
1964	140	88	202	68	98	114	282	240	285	245	179	219	181
1965	164	208	156	126	117	190	160	222	140	117	227	180	167
1966	175	152	129	147	163	174	254	188	186	124	172	173	170
1967	156	179	137	75	111	110	124	250	156	115	202	196	151
1968	101	80	62	79	151	226	184	169	157	184	150	175	143
1969	141	183	73	88	133	108	108	137	199	115	102	147	127
1970	79	37	71	73	133	217	183	215	302	251	191	118	157
1971	146	126	73	65	142	198	139	199	254	294	208	186	169
1972	114	75	243	94	170	124	233	179	182	162	132	97	151
1973	111	60	71	56	131	157	86	164	228	118	159	126	123
1974	60	67	44	102	128	154	281	211	169	203	140	160	144
1975	146	74	95	101	178	227	208	248	223	228	161	126	169
1976	229	176	111	103	164	171	244	243	221	184	144	153	179
1977	128	97	79	77	168	282	235	194	196	178	143	128	159
1978	90	64	41	101	78	101	223	158	165	145	200	136	126
1979	74	136	195	157	213	128	150	212	192	263	197	169	174
1980	222	124	146	192	136	157	192	205	219	165	174	219	180
1981	136	110	123	101	134	244	226	197	186	185	202	192	170
1982	108	165	114	93	153	148	126	125	156	140	121	164	134
1983	110	82	63	134	146	159	142	139	187	252	210	146	148
1984	103	131	169	95	120	117	198	164	138	129	124	187	140
1985	130	85	86	100	70	191	149	148	168	119	128	196	131
1986	289	159	96	75	167	140	216	201	182	186	126	102	162
1987	139	71	129	156	137	140	114	137	154	184	146	183	141
1988	79	99	122	83	152	197	203	257	241	279	226	224	181
1989	274	176	110	79	147	241	189	129	157	283	163	120	172
1990	142	99	195	138	188	127	169	299	167	176	188	100	166
1991	121	177	92	131	105	97	171	297	234	181	140	114	155
1992	154	135	120	109	81	136	227	282	201	187	153	195	165
1993	111	80	80	94	151	226	112	99	111	102	166	114	120
1994	98	82	56	93	140	196	232	257	219	212	283	149	168
1995	120	136	151	243	163	195	293	205	266	241	215	223	204
1996	176	163	148	256	182	160	250	229	296	201	179	212	204
1997	140	132	91	103	106	157	130	138	159	175	149	135	134
1998	108	146	94	100	146	174	403	221	200	318	206	178	192
1999	151	96	124	120	192	253	197	194	195	132	269	168	175

2000	155	117	70	140	131	196	175	188	208	286	159	178	167
2001	124	164	100	108	203	155	131	138	161	155	203	327	164
2002	165	117	109	111	128	216	259	179	203	173	143	191	167
2003	118	84	102	67	147	185	168	122	238	279	194	203	159
2004	120	305	218	120	176	275	246	246	199	261	172	180	209
2005	204	133	113	74	130	152	158	138	147	245	99	186	149
2006	141	155	81	171	171	164	210	248	134	137	217	150	165
2007	154	88	96	78	104	126	218	242	139	188	126	142	142
2008	73	56	59	125	137	135	268	341	230	229	166	150	165
2009	113	133	104	100	137	136	181	188	200	241	139	140	151
2010	131	125	70	79	133	227							127
Min.	60	37	41	56	65	97	86	99	110	102	95	86	120
Mean	136	128	111	115	144	177	195	194	187	188	169	159	159
Max.	289	340	243	256	233	319	403	341	318	318	299	339	209

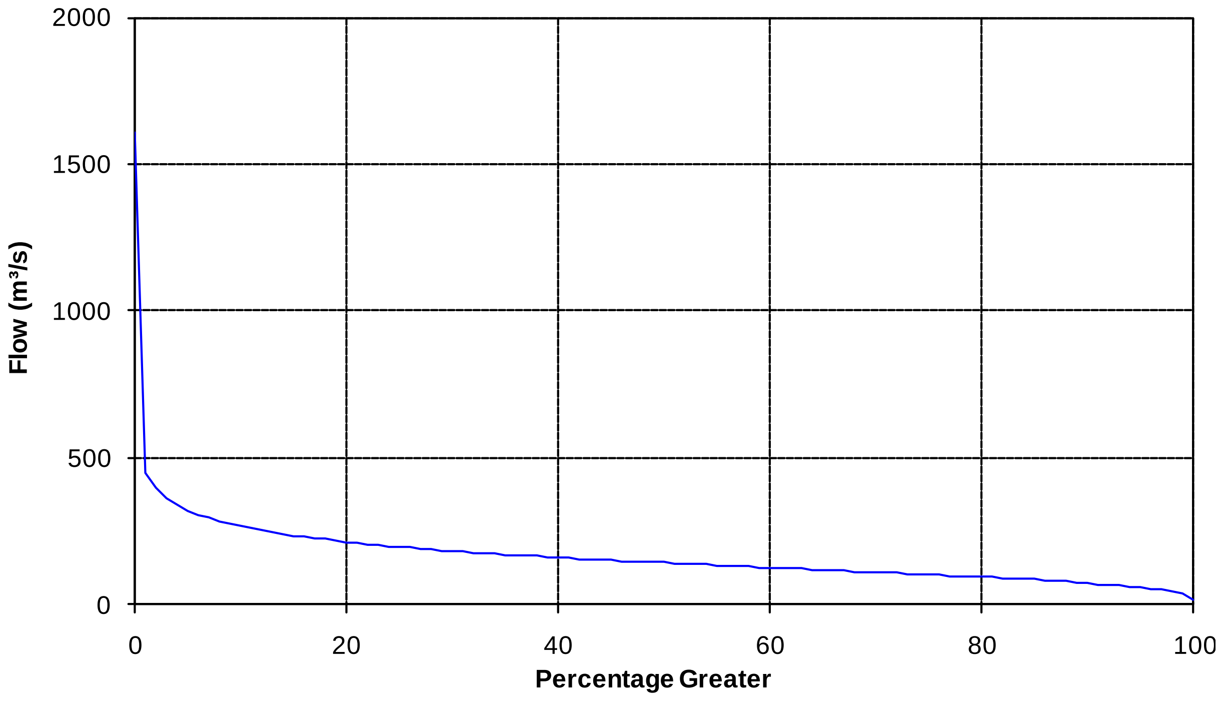

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	1609	447	395	364	341	321	307	293	283	275
10	266	260	253	246	240	234	230	225	221	217
20	213	209	205	202	198	195	192	189	186	184
30	181	179	176	174	172	169	167	165	163	161
40	159	157	155	153	151	150	148	146	145	143
50	141	140	138	136	134	133	131	129	128	126
60	124	123	121	120	118	116	115	113	112	110
70	108	107	105	104	102	101	99	97	96	94
80	93	91	89	88	86	83	81	79	77	74
90	71	68	66	63	60	57	53	50	46	39
100	17									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	17	159	141	1609

8.8 TPD Flows at Rangipo – 92790 (Item: 2)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							48	45	46	38	38	34	41
1932	27	29	22	29	27	42	32	30	32	41	29	25	30
1933	29	35	33	32	45	30	37	40	33	27	29	26	33
1934	22	33	23	30	29	33	43	39	32	41	39	32	33
1935	24	35	31	29	41	57	48	57	40	43	58	37	42
1936	46	51	40	37	36	32	46	43	46	39	39	31	41
1937	46	29	29	33	42	35	31	27	30	30	26	30	32
1938	27	38	20	35	34	36	37	41	38	28	41	35	34
1939	35	23	22	22	20	36	32	52	43	31	26	38	32
1940	40	44	41	26	30	32	26	28	30	40	42	28	34
1941	35	27	37	25	22	40	39	41	39	54	43	37	37
1942	35	32	34	37	40	27	56	48	56	54	38	42	42
1943	27	23	24	31	27	41	48	51	48	55	39	31	37
1944	24	30	35	29	30	30	37	40	40	35	32	36	33
1945	44	34	37	30	41	40	44	47	51	37	44	28	40
1946	26	19	27	40	32	29	36	59	46	53	43	31	37
1947	33	23	21	25	21	45	54	40	43	55	31	35	36
1948	32	20	19	30	44	45	51	42	34	52	42	29	37
1949	30	29	26	29	39	55	51	46	35	36	34	27	37
1950	20	29	18	24	27	31	32	38	35	32	42	28	29
1951	30	27	25	26	25	29	47	34	27	42	53	45	34
1952	32	34	21	26	31	50	50	42	31	40	57	56	39
1953	36	32	23	29	48	53	54	49	43	50	41	34	41
1954	28	25	31	25	30	32	34	39	38	25	27	34	31
1955	24	29	20	31	49	45	41	47	42	43	36	37	37
1956	38	29	20	45	37	52	49	56	49	50	47	44	43
1957	33	24	33	24	41	36	38	31	28	43	42	45	35
1958	28	30	39	23	35	39	38	50	33	33	36	31	35
1959	48	46	40	39	35	37	32	35	28	43	33	26	37
1960	19	32	29	21	32	46	45	44	42	32	31	24	33
1961	31	25	22	26	22	30	51	46	47	32	25	24	32
1962	27	20	39	30	40	45	53	52	48	46	52	46	42

1963	33	27	21	20	25	45	49	42	47	29	27	21	32
1964	28	20	31	19	23	31	37	53	42	56	55	41	36
1965	36	42	39	32	30	42	34	52	40	30	42	41	38
1966	39	33	29	27	42	40	45	47	43	28	32	36	37
1967	37	34	28	24	29	30	32	49	43	27	37	41	34
1968	28	22	18	27	35	48	47	48	42	45	36	35	36
1969	35	34	23	24	31	27	28	30	39	29	22	28	29
1970	20	14	15	20	27	41	43	46	45	52	42	29	33
1971	33	25	23	18	38	43	30	40	53	56	53	42	38
1972	30	23	33	25	39	31	49	41	41	34	26	22	33
1973	23	17	18	17	29	35	23	35	43	27	33	24	27
1974	20	17	16	29	31	39	53	52	43	43	34	30	34
1975	30	21	24	24	35	46	47	42	51	42	32	26	35
1976	39	35	25	23	39	39	52	55	50	38	34	34	39
1977	32	27	22	23	41	48	53	48	47	47	30	31	38
1978	22	19	15	20	23	23	39	40	35	30	32	32	28
1979	24	30	35	33	45	30	30	47	45	49	42	39	37
1980	45	36	35	42	36	35	40	42	51	37	36	40	40
1981	27	24	29	30	34	49	46	39	38	39	41	38	36
1982	28	26	32	24	32	34	28	27	36	29	25	37	30
1983	25	17	18	35	41	37	37	34	44	48	44	36	35
1984	28	30	40	27	30	27	47	42	35	35	29	43	34
1985	36	25	29	28	23	39	39	41	38	29	29	45	33
1986	40	46	33	24	32	35	38	44	39	40	28	26	35
1987	29	23	34	37	32	33	28	30	34	42	37	43	34
1988	25	26	33	24	37	36	37	53	56	57	38	44	39
1989	50	47	30	24	34	47	46	30	35	51	40	32	39
1990	36	25	33	33	37	32	39	41	49	41	45	26	37
1991	27	37	23	30	30	24	36	49	56	43	34	26	35
1992	34	30	31	26	22	31	46	47	53	43	32	44	37
1993	29	23	23	27	31	46	28	23	31	26	34	27	29
1994	24	23	25	24	34	41	50	50	38	54	45	46	38
1995	30	40	38	52	37	43	50	43	47	53	46	42	43
1996	42	39	38	47	42	36	45	50	46	51	40	48	44
1997	33	31	25	26	28	36	31	33	37	41	35	32	32
1998	28	34	25	26	35	40	35	52	51	40	46	47	38
1999	39	25	30	29	34	50	44	45	44	31	43	43	38

2000	36	29	21	34	32	40	35	44	46	44	43	40	37
2001	30	38	26	27	39	38	31	33	38	36	47	46	36
2002	47	30	27	23	33	47	44	44	46	40	34	44	38
2003	29	23	26	20	28	44	37	29	44	52	45	47	35
2004	29	57	41	32	40	40	49	57	51	56	41	41	44
2005	41	32	29	21	32	36	37	33	34	53	25	42	35
2006	28	34	22	40	40	38	47	45	34	33	47	35	37
2007	36	24	26	22	27	30	47	53	33	43	30	34	34
2008	21	18	19	29	33	32	49	43	54	51	46	35	36
2009	28	32	26	25	33	32	42	43	45	53	33	33	36
2010	31	30	21	22	32	50							31
Min.	19	14	15	17	20	23	23	23	27	25	22	21	27
Mean	32	29	28	28	33	38	41	43	42	41	38	35	36
Max.	50	57	41	52	49	57	56	59	56	57	58	56	44

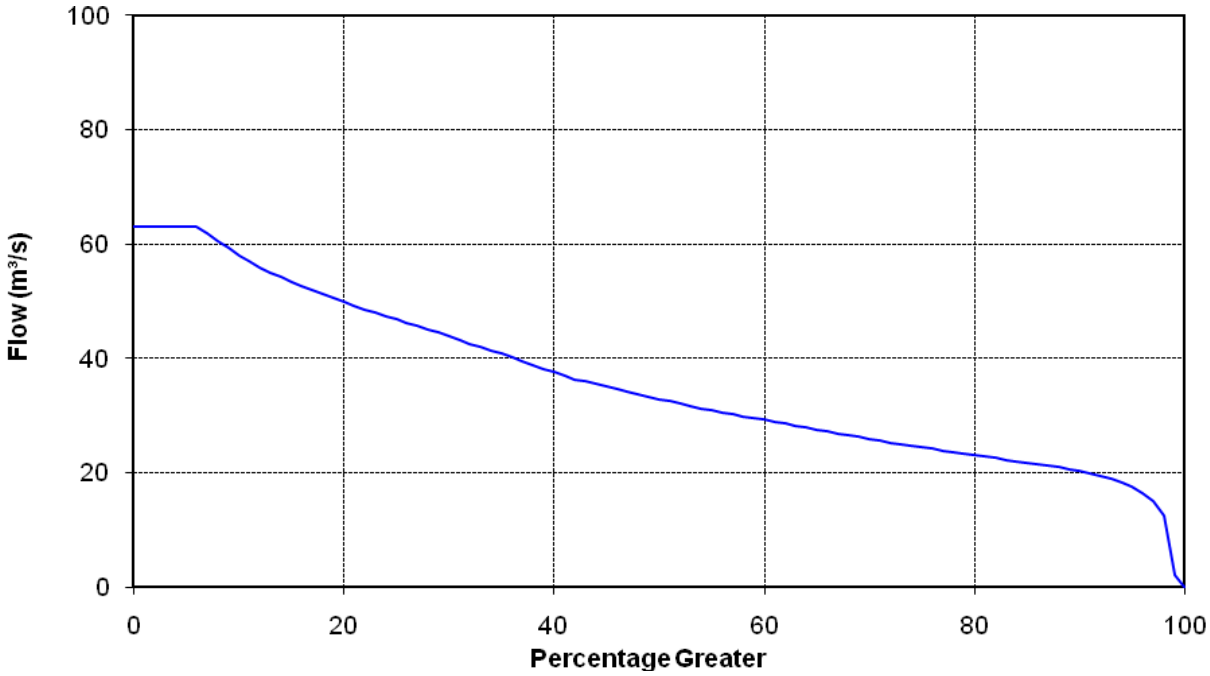

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	63	63	63	63	63	63	63	62	61	59
10	58	57	56	55	54	53	53	52	51	51
20	50	49	49	48	47	47	46	46	45	45
30	44	43	43	42	41	41	40	40	39	38
40	38	37	36	36	36	35	35	34	34	33
50	33	33	32	32	31	31	31	30	30	30
60	29	29	29	28	28	28	27	27	27	26
70	26	26	25	25	25	25	24	24	24	23
80	23	23	23	22	22	22	22	21	21	21
90	20	20	20	19	18	18	17	15	13	2
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	36	33	63

8.9 TPD Flows at Tokaanu – 92790 (Item: 3)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							73	67	70	56	55	50	62
1932	34	37	23	38	34	65	46	41	46	60	41	31	41
1933	39	50	52	46	68	42	56	64	48	37	41	32	48
1934	24	55	25	39	38	54	67	58	45	62	57	46	47
1935	28	60	44	36	60	95	72	91	58	65	93	53	63
1936	81	91	57	55	52	46	70	65	73	58	57	45	62
1937	71	38	41	47	75	49	44	37	43	43	36	41	47
1938	34	56	17	68	44	53	55	63	56	39	62	50	50
1939	51	26	24	23	17	57	46	87	63	44	35	57	44
1940	61	81	57	33	41	46	36	38	43	61	62	39	50
1941	49	35	62	32	24	59	58	62	57	88	64	54	54
1942	51	46	47	54	60	37	92	74	109	84	56	62	64
1943	34	25	31	43	35	83	83	76	92	82	57	43	57
1944	29	53	47	39	42	43	56	61	58	59	45	55	49
1945	74	49	55	42	62	59	67	79	80	68	63	35	61
1946	33	16	35	60	46	40	53	103	81	82	66	44	55
1947	48	27	21	30	22	87	81	58	64	89	44	52	52
1948	44	20	17	38	79	66	81	64	50	81	63	41	54
1949	41	39	32	37	69	88	82	71	51	52	51	36	54
1950	18	45	12	24	35	43	45	57	52	46	63	38	40
1951	41	35	31	34	29	41	79	48	37	65	82	70	50
1952	46	49	21	30	43	106	84	60	44	61	104	89	61
1953	53	44	27	40	75	86	95	77	65	79	70	49	63
1954	37	30	43	28	41	46	49	65	56	34	37	46	43
1955	28	41	20	39	77	72	65	73	65	68	54	54	55
1956	56	40	21	71	65	105	97	88	70	78	74	65	69
1957	49	33	43	29	59	50	57	43	40	63	62	68	50
1958	39	70	54	27	49	54	64	73	46	45	53	92	55
1959	75	62	57	60	53	54	46	47	37	59	44	29	52
1960	18	53	34	17	40	74	75	67	72	54	45	30	48
1961	39	28	21	32	21	39	74	62	67	45	33	29	41
1962	38	21	68	49	67	84	77	84	76	93	91	75	69
1963	51	46	23	24	39	76	71	61	82	40	43	25	48

1964	49	20	58	21	33	43	93	90	97	96	83	76	63
1965	61	73	60	47	45	67	59	82	54	45	80	68	62
1966	64	53	43	47	62	61	78	63	61	39	52	59	57
1967	51	53	45	27	37	36	41	84	59	39	65	68	51
1968	38	26	16	33	61	73	73	69	63	71	58	58	53
1969	54	52	24	27	45	39	38	42	59	38	26	39	40
1970	17	5	7	16	31	69	59	68	93	87	66	42	47
1971	43	33	18	10	48	75	41	58	84	102	80	66	55
1972	42	22	60	33	62	45	80	62	65	53	41	28	50
1973	33	10	13	11	48	51	28	48	67	40	56	36	37
1974	19	10	9	24	32	46	92	72	56	73	50	45	44
1975	44	24	25	30	55	76	71	81	78	71	50	40	54
1976	68	55	29	26	61	64	88	89	76	60	52	53	60
1977	49	29	18	23	63	87	84	66	71	66	49	45	54
1978	21	12	8	17	18	25	70	53	52	48	61	47	36
1979	26	45	47	55	73	41	43	70	64	81	65	63	56
1980	83	55	53	69	53	53	64	70	81	58	61	65	64
1981	41	35	36	37	44	81	79	62	66	65	65	62	56
1982	43	37	39	28	46	47	40	38	51	43	37	64	43
1983	40	23	15	47	62	57	55	48	69	85	81	55	53
1984	33	40	57	35	46	37	70	63	47	48	41	67	49
1985	54	31	29	30	18	54	55	60	62	41	40	71	46
1986	94	69	40	23	50	52	68	68	63	65	43	34	56
1987	40	28	41	61	44	48	36	41	52	65	54	70	49
1988	30	31	46	27	62	64	74	98	101	107	84	81	67
1989	102	76	38	22	49	86	66	41	45	89	60	44	60
1990	53	27	67	49	67	49	60	98	68	58	68	37	59
1991	37	60	29	47	37	34	56	100	85	67	50	37	53
1992	53	55	48	36	28	45	83	103	84	70	52	73	61
1993	48	26	24	37	53	80	40	29	43	37	57	40	43
1994	30	19	22	26	53	77	88	94	80	85	102	67	62
1995	44	55	58	87	60	68	93	74	87	88	79	77	73
1996	64	59	56	78	74	63	81	82	97	77	65	82	73
1997	48	45	28	33	34	54	44	47	55	60	51	46	45
1998	35	50	30	32	49	60	114	80	74	101	73	67	64
1999	55	31	42	40	61	86	68	67	67	45	89	61	59

2000	53	39	20	47	45	68	59	66	71	92	59	61	57
2001	42	57	32	36	67	55	45	47	55	53	70	98	55
2002	63	41	36	34	44	76	87	64	70	60	49	66	58
2003	39	26	33	18	43	65	58	41	80	96	69	72	54
2004	41	105	69	43	61	83	86	88	73	91	60	62	71
2005	69	45	37	22	43	52	54	47	50	86	33	65	50
2006	46	54	25	59	59	56	73	84	47	47	75	51	56
2007	53	28	30	23	34	43	76	85	47	65	43	48	48
2008	22	14	15	40	46	47	92	109	83	81	63	51	55
2009	38	45	35	33	47	46	62	65	70	85	47	48	52
2010	44	42	20	24	44	79							42
Min.	17	5	7	10	17	25	28	29	37	34	26	25	36
Mean	46	41	35	37	49	60	67	67	65	65	59	54	54
Max.	102	105	69	87	79	106	114	109	109	107	104	98	73

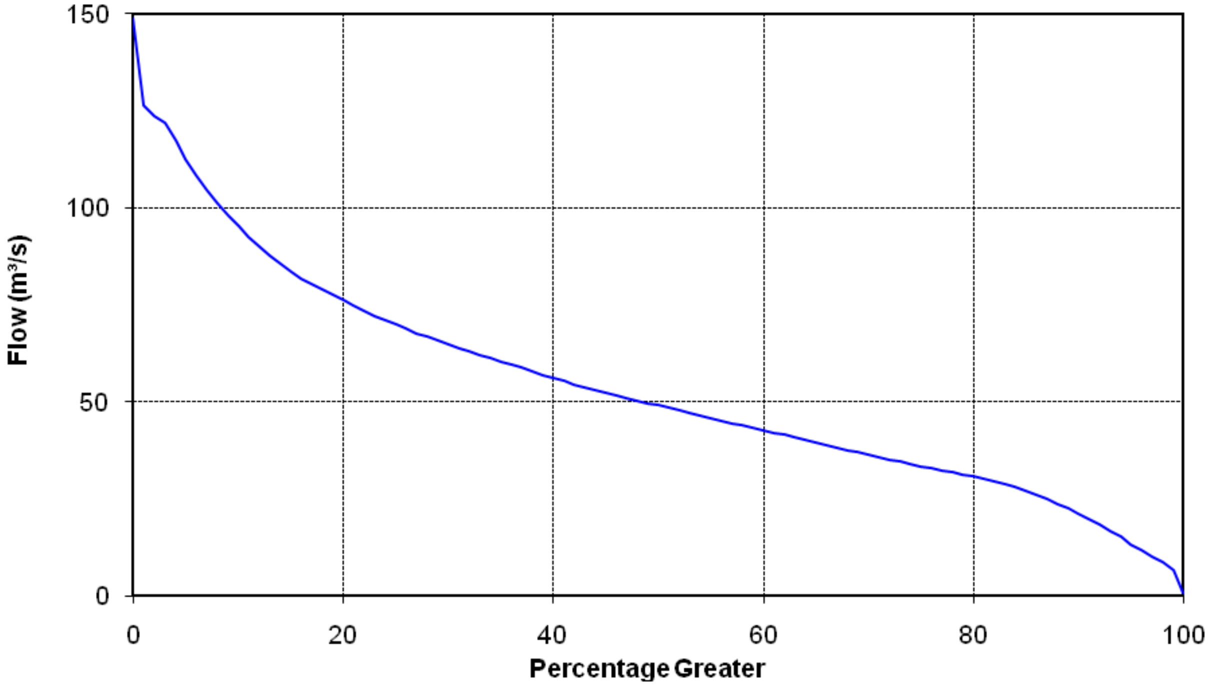

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	149	126	124	122	118	113	108	105	101	98
10	95	93	90	88	86	84	82	80	79	78
20	76	75	73	72	71	70	69	68	67	66
30	65	64	63	62	61	61	60	59	58	57
40	56	55	55	54	53	52	52	51	50	50
50	49	48	48	47	46	46	45	45	44	43
60	43	42	42	41	40	40	39	38	38	37
70	37	36	35	35	34	34	33	32	32	31
80	31	30	30	29	28	27	26	25	24	23
90	21	20	18	17	15	13	12	10	9	7
100	1									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	1	54	49	149

8.10 Lake Waikaremoana Inflow – 3650 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							29	16	29	8	4	2	15
1932	3	53	33	14	28	11	14	22	17	15	4	3	18
1933	4	12	12	3	31	18	31	24	26	18	10	9	17
1934	2	20	4	8	16	17	19	24	14	13	10	4	13
1935	1	9	17	44	17	29	23	33	19	10	31	8	20
1936	23	27	18	8	12	17	22	10	12	9	10	9	15
1937	15	5	5	7	9	20	37	17	20	15	11	11	14
1938	6	25	5	52	24	20	51	28	8	6	7	17	21
1939	3	4	3	9	21	16	14	24	22	13	9	16	13
1940	14	13	14	13	22	14	29	26	18	21	24	7	18
1941	11	4	13	17	9	19	30	31	18	27	10	7	17
1942	22	28	10	12	14	31	43	37	25	9	12	15	21
1943	14	9	10	20	47	51	20	26	54	15	24	15	25
1944	28	29	66	8	22	24	30	31	16	13	7	10	24
1945	13	10	4	3	24	20	19	20	21	21	6	3	14
1946	1	0	1	15	24	27	31	23	24	18	8	4	15
1947	8	10	8	31	28	45	42	13	11	14	5	4	18
1948	3	0	0	17	73	33	19	16	12	26	28	7	20
1949	12	1	6	4	34	22	15	40	13	13	11	7	15
1950	6	12	1	19	19	13	37	22	27	39	42	7	20
1951	16	19	35	19	40	17	22	29	9	13	13	9	20
1952	6	14	4	2	5	25	16	36	47	16	34	32	20
1953	15	10	3	14	16	46	18	13	9	12	3	3	13
1954	0	0	10	67	25	16	23	65	21	8	12	22	23
1955	6	6	17	29	16	19	66	33	29	19	9	9	22
1956	5	8	8	15	62	42	39	33	16	20	13	5	22
1957	5	3	7	8	11	22	30	27	22	19	9	8	14
1958	3	11	3	0	14	6	28	27	13	29	12	24	14
1959	9	13	19	18	37	16	18	26	12	34	10	4	18
1960	7	31	19	42	27	30	29	21	26	11	64	30	28
1961	7	3	6	7	19	31	29	35	33	12	7	9	16
1962	5	8	9	23	30	33	52	28	19	27	13	25	23

1963	13	4	4	4	9	36	37	15	25	10	9	24	16
1964	8	4	8	3	13	20	35	16	19	15	10	6	13
1965	7	20	6	8	6	20	27	65	27	13	24	9	20
1966	11	4	13	9	27	18	33	54	25	10	16	13	20
1967	16	20	10	10	10	13	25	36	20	9	20	9	16
1968	7	1	0	21	43	38	34	44	12	11	10	20	20
1969	15	27	4	5	12	9	10	14	19	10	8	8	12
1970	4	35	13	13	28	32	14	44	31	17	16	5	21
1971	11	19	21	11	43	20	17	27	31	37	22	15	23
1972	4	11	37	12	13	15	33	17	9	11	3	11	15
1973	7	4	3	21	6	35	12	39	19	9	7	6	14
1974	9	5	19	43	25	36	41	33	30	24	10	12	24
1975	15	4	12	7	16	35	13	15	17	24	13	16	16
1976	35	30	6	32	12	8	11	17	65	21	15	23	23
1977	10	16	10	31	10	39	25	38	39	16	5	12	21
1978	3	7	0	10	11	28	33	20	20	15	13	6	14
1979	1	18	29	12	24	19	18	37	30	31	15	12	20
1980	16	3	22	25	8	44	23	24	14	6	8	39	19
1981	9	2	7	15	31	28	43	36	11	21	15	10	19
1982	2	6	11	42	17	25	3	1	9	16	5	9	12
1983	1	0	0	5	23	17	26	15	16	29	16	15	14
1984	6	10	17	9	11	25	20	15	26	13	5	10	14
1985	5	1	35	20	23	45	35	21	17	7	9	12	19
1986	9	2	16	2	13	9	28	23	45	12	8	13	15
1987	16	5	29	21	9	10	32	19	11	6	22	19	17
1988	9	21	68	12	12	18	35	20	32	13	6	8	21
1989	21	11	3	0	29	35	22	30	59	25	17	18	22
1990	9	5	17	5	7	28	23	46	12	38	15	3	18
1991	2	9	16	23	30	20	12	26	12	14	39	5	17
1992	9	13	4	8	22	22	27	22	17	38	26	22	19
1993	6	25	11	10	24	27	22	12	28	4	13	7	16
1994	5	4	3	9	11	35	21	19	15	31	28	4	15
1995	5	18	5	22	33	16	34	13	15	14	9	3	15
1996	45	25	32	36	25	10	28	16	14	7	6	14	22
1997	10	7	33	10	5	42	39	31	22	23	10	3	20
1998	1	8	3	4	3	13	57	20	13	13	8	13	13
1999	18	3	3	11	17	19	18	18	12	7	16	15	13

2000	10	3	20	25	12	17	35	9	14	15	16	14	16
2001	12	20	9	10	11	10	20	24	19	23	21	32	18
2002	8	14	5	6	6	18	44	28	10	10	7	11	14
2003	3	2	12	11	13	16	13	33	46	24	14	15	17
2004	14	13	6	4	27	28	42	29	13	21	8	10	18
2005	7	4	15	7	19	24	19	11	15	39	30	14	17
2006	9	9	17	26	30	43	31	25	11	10	12	10	19
2007	9	4	3	2	5	17	44	13	16	18	5	10	12
2008	6	2	11	21	28	22	35	35	14	12	8	5	17
2009	5	7	4	5	30	30	47	20	17	35	11	6	18
2010	30	18	5	10	16	32							19
Min.	0	0	0	0	3	6	3	1	8	4	3	2	12
Mean	10	11	13	15	21	24	28	26	21	17	14	12	18
Max.	45	53	68	67	73	51	66	65	65	39	64	39	28

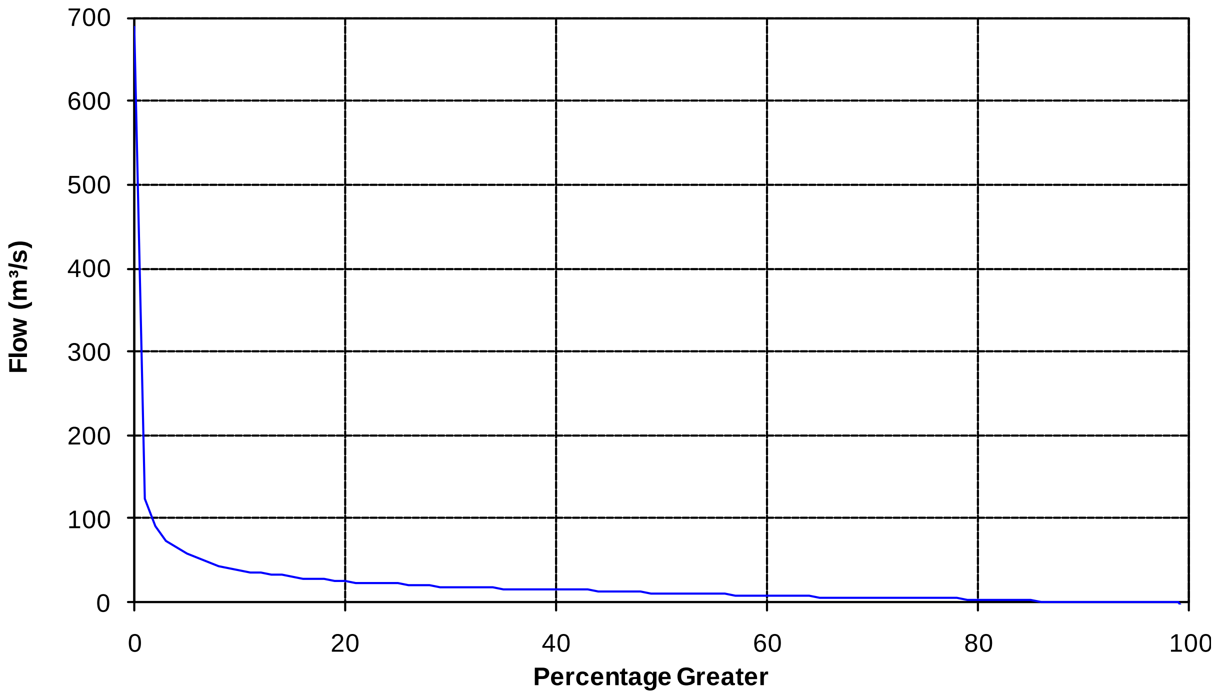

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	689	123	91	74	65	57	52	47	44	41
10	38	36	35	33	32	30	29	28	27	26
20	25	24	24	23	23	22	21	20	20	19
30	18	18	17	17	17	16	16	16	15	15
40	15	14	14	14	13	13	13	12	12	11
50	11	11	10	10	10	9	9	8	8	8
60	8	7	7	7	7	6	6	6	6	5
70	5	5	5	5	4	4	4	4	4	3
80	3	3	2	2	2	2	1	1	1	1
90	1	0	0	0	0	0	0	0	0	0
100	-18									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	-18	18	11	689

8.11 Mangahao Inflow – 97502 (Item: 1)

Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							13	8	10	9	8	6	9
1932	6	6	4	10	5	9	5	11	6	9	9	7	7
1933	6	7	8	9	10	10	7	6	8	8	6	5	7
1934	9	5	8	8	8	6	9	11	8	10	5	3	7
1935	6	8	7	8	10	10	7	10	9	30	9	6	10
1936	8	6	7	9	6	7	10	13	11	9	10	26	10
1937	10	11	7	7	13	5	6	6	11	6	6	5	8
1938	5	9	7	9	8	9	8	8	10	10	8	14	9
1939	9	7	7	10	7	14	10	17	11	8	10	8	10
1940	10	11	7	7	9	7	5	6	10	10	7	7	8
1941	7	7	8	5	7	8	7	9	9	13	12	11	9
1942	9	9	15	11	13	7	11	9	8	8	11	11	10
1943	9	13	13	6	7	10	11	9	7	8	5	9	9
1944	10	4	10	10	8	10	9	9	8	10	12	14	10
1945	8	9	11	13	14	12	10	13	14	11	9	14	11
1946	14	12	10	12	10	11	11	14	13	13	13	14	12
1947	11	7	3	7	11	11	9	12	14	11	5	7	9
1948	8	9	5	9	14	10	12	11	11	12	11	12	10
1949	5	11	10	12	8	13	14	13	7	15	8	13	11
1950	11	10	9	10	6	12	12	9	8	7	7	14	10
1951	5	5	8	9	8	8	10	12	12	15	14	14	10
1952	13	7	5	7	9	15	5	5	5	8	14	7	8
1953	8	10	5	7	10	9	7	7	9	10	11	8	8
1954	5	10	6	5	6	9	10	10	7	6	12	8	8
1955	5	16	5	9	9	11	10	11	7	10	7	5	9
1956	10	5	6	11	6	10	11	7	5	9	8	7	8
1957	6	7	5	8	9	8	6	6	7	9	10	13	8
1958	7	7	6	7	11	8	7	9	4	5	6	10	7
1959	7	9	5	6	10	7	9	5	10	8	10	7	8
1960	6	5	3	5	7	7	8	7	6	6	8	4	6
1961	3	5	6	7	6	7	11	6	9	6	7	4	6
1962	9	4	6	6	7	10	11	11	6	10	7	7	8

1963	4	7	5	4	9	11	7	7	10	6	11	6	7
1964	8	3	7	3	8	6	10	9	11	7	6	7	7
1965	4	6	9	4	6	8	8	8	7	14	9	7	7
1966	5	5	3	7	5	8	8	6	5	6	9	10	6
1967	6	5	5	5	6	5	5	10	6	7	8	7	6
1968	5	7	5	8	9	11	9	6	9	11	7	7	8
1969	5	3	4	6	6	5	5	8	5	8	2	6	5
1970	6	2	3	3	6	9	9	6	13	12	4	6	7
1971	5	3	2	4	5	9	6	9	9	11	7	5	6
1972	6	0	7	8	12	3	10	9	11	12	7	6	8
1973	6	4	6	7	14	9	3	6	10	7	10	3	7
1974	4	5	3	5	9	5	14	6	10	9	4	5	6
1975	1	4	11	8	13	7	11	10	9	8	6	9	8
1976	10	2	8	5	7	8	12	10	7	9	4	11	8
1977	6	0	4	7	10	10	7	8	10	8	10	6	7
1978	3	2	2	9	4	6	12	8	8	6	8	6	6
1979	7	6	7	8	10	7	9	8	11	9	7	10	8
1980	14	9	6	13	8	7	10	11	12	11	13	8	10
1981	3	5	1	6	7	11	8	9	11	10	4	10	7
1982	5	7	2	2	5	5	5	9	7	7	9	13	6
1983	6	3	5	8	9	8	5	9	11	9	9	5	7
1984	3	4	2	3	8	7	11	7	5	8	8	5	6
1985	7	3	2	2	3	9	9	7	4	6	8	5	5
1986	8	6	3	6	9	9	8	9	10	18	6	5	8
1987	6	6	1	6	9	10	5	7	9	10	7	9	7
1988	5	7	4	4	9	8	11	10	21	15	10	9	9
1989	5	3	7	5	9	7	6	3	6	9	7	5	6
1990	8	4	7	4	7	9	9	13	4	7	8	9	7
1991	13	15	2	14	4	8	8	16	9	11	9	14	10
1992	10	10	3	8	6	9	12	13	11	9	7	14	9
1993	7	5	5	8	6	5	5	6	6	6	12	8	7
1994	6	2	5	4	8	9	9	9	10	6	18	7	8
1995	5	6	9	11	5	9	9	7	11	8	10	7	8
1996	2	7	6	12	11	11	9	9	10	10	11	11	9
1997	3	8	9	9	3	5	6	7	9	3	1	1	5
1998	0	0	1	7	14	15	14	16	15	28	6	13	11
1999	7	4	2	8	15	11	12	11	9	13	15	13	10

2000	12	5	7	19	9	11	10	8	16	28	6	13	12
2001	11	4	9	2	9	14	7	16	7	19	27	20	12
2002	12	27	21	5	6	17	16	9	12	13	12	14	14
2003	4	2	2	2	8	17	11	3	13	11	14	18	9
2004	8	32	9	7	7	20	8	15	25	29	11	22	16
2005	17	6	6	3	13	9	14	9	8	9	5	14	9
2006	9	5	6	9	16	35	14	11	16	19	34	11	15
2007	7	5	14	4	10	7	13	15	7	15	14	2	9
2008	12	4	4	6	5	12	20	22	11	27	11	6	12
2009	3	18	4	6	9	4	9	11	9	17	20	16	10
2010	14	9	5	7	5	12							9
Min.	0	0	1	2	3	3	3	3	4	3	1	1	5
Mean	7	7	6	7	8	9	9	9	9	11	9	9	9
Max.	17	32	21	19	16	35	20	22	25	30	34	26	16

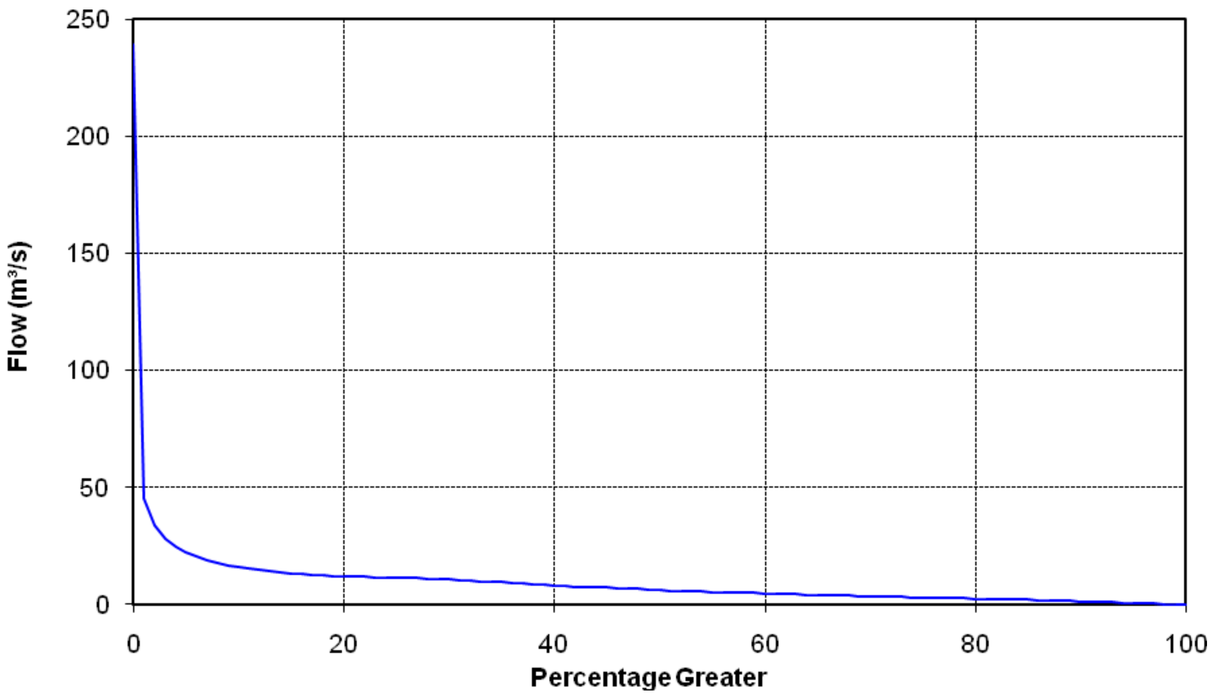

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	239	45	34	28	25	22	21	19	18	17
10	16	15	15	14	14	13	13	13	12	12
20	12	12	12	12	12	11	11	11	11	11
30	11	11	10	10	10	10	9	9	9	9
40	8	8	8	8	7	7	7	7	7	6
50	6	6	6	6	6	5	5	5	5	5
60	5	5	5	4	4	4	4	4	4	4
70	4	3	3	3	3	3	3	3	3	3
80	3	2	2	2	2	2	2	2	2	2
90	1	1	1	1	1	1	0	0	0	0
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	9	6	239

8.12 Inflow at Cobb [Coleridge & Cobb] – 97904 (Item: 2)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							7	7	8	11	11	10	9
1932	7	7	5	6	7	5	4	4	6	11	10	8	7
1933	6	9	6	8	8	5	7	7	6	7	7	9	7
1934	8	5	5	6	7	6	6	7	6	9	6	5	7
1935	7	6	6	6	7	8	5	4	4	5	4	6	6
1936	5	5	4	5	6	3	5	6	7	10	11	7	6
1937	9	7	8	7	10	6	4	3	4	4	6	6	6
1938	7	6	8	8	6	6	4	5	7	7	8	11	7
1939	8	6	4	3	5	7	5	4	6	6	8	11	6
1940	7	12	9	5	5	5	4	2	3	7	7	5	6
1941	5	9	5	5	4	4	6	5	4	3	6	9	5
1942	7	5	7	15	9	5	8	5	6	9	8	8	8
1943	5	9	6	5	5	4	4	3	6	7	7	6	5
1944	4	5	5	6	6	4	5	4	6	7	9	9	6
1945	9	8	7	6	5	4	4	7	7	6	11	4	7
1946	2	2	1	4	3	3	4	7	7	7	6	6	4
1947	2	1	0	2	2	8	4	7	7	8	3	3	4
1948	4	1	2	5	10	6	7	3	2	8	3	3	5
1949	1	4	2	4	7	6	6	3	2	6	2	4	4
1950	2	1	1	3	6	5	4	6	2	1	1	3	3
1951	2	2	4	5	5	3	9	3	3	6	9	8	5
1952	5	4	3	2	8	11	4	6	3	4	6	5	5
1953	1	5	3	5	10	6	6	8	6	5	6	5	5
1954	2	2	10	4	8	8	5	5	4	2	3	3	5
1955	1	11	4	3	11	7	4	10	3	6	3	3	5
1956	3	4	3	6	5	5	7	4	4	7	9	7	5
1957	4	2	6	16	10	6	7	9	4	10	12	13	8
1958	3	5	5	6	16	6	4	7	5	6	2	9	6
1959	1	1	3	7	6	6	3	4	8	6	4	3	4
1960	1	2	5	1	5	11	4	4	9	6	6	1	5
1961	4	4	4	2	6	5	9	5	10	6	8	2	5
1962	7	2	3	4	10	7	8	6	7	17	8	1	7

1963	1	3	2	2	6	6	6	10	9	2	7	2	5
1964	10	2	4	2	5	4	7	7	8	10	7	6	6
1965	4	3	2	4	6	8	6	7	7	6	10	6	6
1966	3	1	1	7	4	6	5	3	6	3	6	7	4
1967	3	1	2	5	5	2	4	10	3	4	20	6	5
1968	1	3	5	8	6	7	7	8	9	22	12	7	8
1969	4	2	1	6	5	3	4	3	14	3	2	6	4
1970	2	1	2	2	4	6	7	10	15	7	4	1	5
1971	2	2	1	3	8	12	4	7	7	15	5	3	6
1972	2	1	4	7	10	5	9	5	8	10	4	4	6
1973	1	1	1	4	8	3	2	6	4	2	5	1	3
1974	2	1	1	13	4	2	9	5	6	6	3	1	4
1975	1	1	7	8	12	6	6	10	6	6	4	3	6
1976	9	8	2	4	5	7	8	7	5	6	5	7	6
1977	4	2	2	2	5	7	6	5	5	8	6	6	5
1978	2	1	1	3	5	3	7	4	5	5	3	4	4
1979	2	5	6	5	8	3	6	5	6	8	8	7	6
1980	10	8	5	7	5	6	4	8	16	8	6	2	7
1981	1	0	3	4	6	9	9	4	7	9	14	8	6
1982	4	6	3	4	15	13	7	8	11	4	4	5	7
1983	6	1	2	10	14	7	8	5	10	13	5	6	7
1984	2	2	5	5	5	4	9	9	5	7	4	10	6
1985	7	3	2	5	2	5	5	6	9	4	6	8	5
1986	6	4	6	4	4	6	5	7	5	6	4	3	5
1987	3	1	4	5	6	4	3	6	8	8	7	6	5
1988	2	10	13	2	7	5	12	10	6	21	7	4	8
1989	5	4	3	3	4	10	6	6	5	7	4	4	5
1990	4	1	1	4	6	4	7	20	5	5	7	3	6
1991	5	3	1	4	3	3	3	12	10	7	5	5	5
1992	3	3	5	1	3	3	8	16	4	9	5	6	6
1993	3	3	4	3	6	12	3	3	5	6	4	4	5
1994	4	1	2	2	7	8	9	8	9	6	23	2	7
1995	2	5	5	7	6	6	5	8	15	10	5	9	7
1996	6	2	3	6	4	6	8	7	16	9	14	3	7
1997	3	2	2	4	3	4	2	6	4	5	6	5	4
1998	2	3	4	5	4	6	9	6	6	23	4	4	6
1999	1	1	2	5	3	5	5	5	5	4	8	2	4

2000	4	4	1	5	4	8	7	6	7	8	3	5	5
2001	3	1	0	1	10	5	1	5	3	6	5	9	4
2002	3	2	3	2	5	14	4	4	8	5	6	5	5
2003	3	2	3	2	4	8	4	4	7	7	5	2	4
2004	2	4	1	3	7	10	4	6	7	7	4	5	5
2005	3	1	3	1	4	5	7	6	2	3	1	2	3
2006	4	2	1	10	5	5	6	5	4	5	4	4	5
2007	3	4	4	5	6	5	6	6	5	5	6	3	5
2008	3	4	2	2	2	2	6	5	4	4	6	2	4
2009	0	1	2	3	3	3	3	7	3	4	1	2	3
2010	2	1	1	1	4	5							2
Min.	0	0	0	1	2	2	1	2	2	1	1	1	3
Mean	4	3	4	5	6	6	6	6	6	7	6	5	5
Max.	10	12	13	16	16	14	12	20	16	23	23	13	8

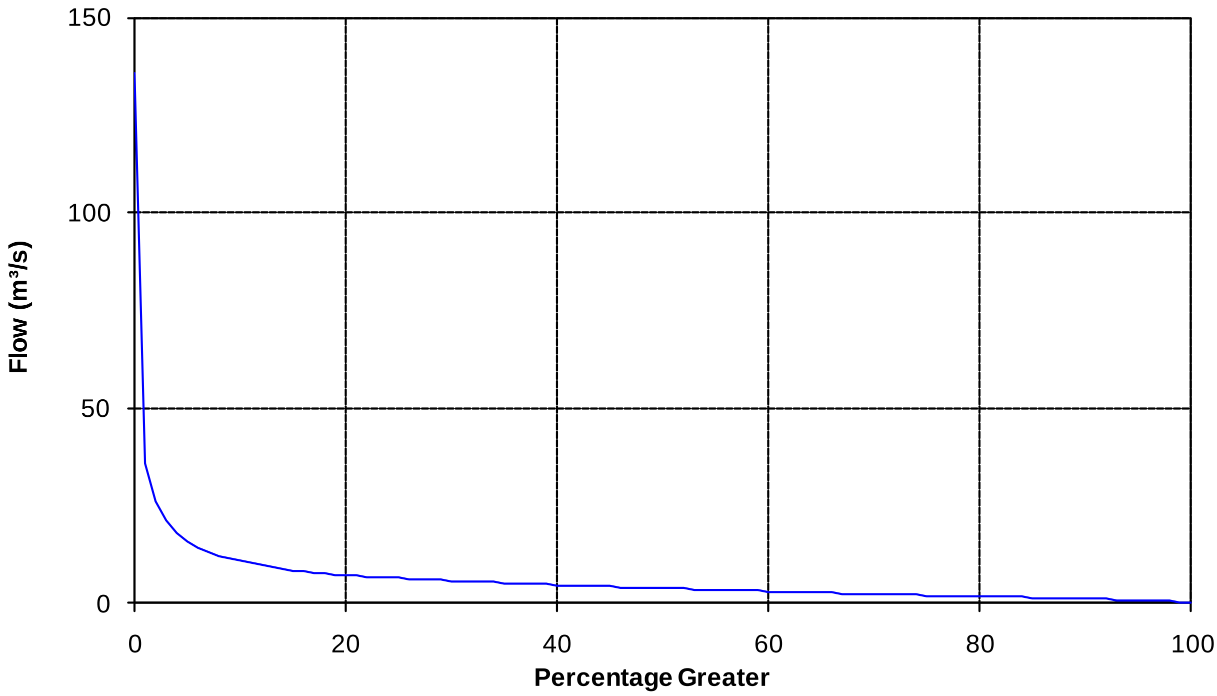

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	136	36	26	21	18	16	14	13	12	11
10	11	10	10	9	9	8	8	8	8	7
20	7	7	7	7	6	6	6	6	6	6
30	6	6	5	5	5	5	5	5	5	5
40	5	5	4	4	4	4	4	4	4	4
50	4	4	4	4	3	3	3	3	3	3
60	3	3	3	3	3	3	3	2	2	2
70	2	2	2	2	2	2	2	2	2	2
80	2	2	2	1	1	1	1	1	1	1
90	1	1	1	1	1	1	1	1	0	0
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	5	4	136

8.13 Inflow at Coleridge [Coleridge & Cobb] – 97904 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							21	22	25	40	41	33	30
1932	21	22	11	17	20	10	8	9	17	39	34	24	19
1933	14	31	17	25	26	13	20	21	17	19	21	28	21
1934	25	12	12	23	37	27	27	34	34	25	33	19	26
1935	18	22	22	25	26	33	16	11	11	34	22	28	22
1936	13	23	27	17	19	11	22	22	29	13	8	25	19
1937	31	25	20	14	26	17	5	1	2	10	15	9	15
1938	19	23	18	23	19	17	10	24	32	33	29	26	23
1939	17	11	7	3	8	18	12	14	29	30	19	20	16
1940	16	34	19	25	31	19	12	11	17	32	27	18	22
1941	10	16	18	25	24	26	21	21	33	35	31	31	24
1942	24	18	23	22	20	18	27	20	27	23	37	29	24
1943	15	24	17	17	16	26	21	18	35	40	29	21	23
1944	16	25	22	27	21	22	29	26	27	26	28	35	25
1945	27	33	27	25	27	20	18	34	42	36	21	30	28
1946	28	22	19	19	19	14	23	31	28	35	26	22	24
1947	30	24	13	10	10	23	19	22	31	40	29	16	22
1948	17	10	12	15	18	25	20	13	19	36	39	33	21
1949	24	18	21	22	22	28	33	28	17	37	12	17	23
1950	26	11	8	10	12	24	22	31	38	29	26	34	23
1951	26	22	14	42	27	16	26	21	24	40	39	27	27
1952	24	24	7	8	26	29	16	15	23	36	43	40	24
1953	22	21	16	34	33	29	21	25	32	35	41	41	29
1954	26	23	12	13	18	24	22	25	25	32	33	28	23
1955	16	31	20	10	33	29	18	28	35	32	30	19	25
1956	14	15	11	19	28	28	28	20	16	27	30	37	23
1957	23	14	27	14	28	23	14	14	16	38	39	29	23
1958	26	25	22	25	25	23	16	18	15	19	18	17	21
1959	19	13	20	25	28	26	16	18	24	27	24	30	22
1960	16	12	20	12	15	25	19	19	14	16	18	13	17
1961	11	15	16	15	17	22	29	26	23	29	38	22	22
1962	17	13	10	13	35	30	27	29	24	25	28	15	22

1963	11	15	15	22	27	37	31	28	42	35	43	31	28
1964	33	18	28	19	34	22	30	34	31	43	43	40	31
1965	30	22	14	16	16	22	17	25	27	40	37	32	25
1966	20	17	15	18	22	19	16	17	21	22	36	29	21
1967	18	9	14	14	33	16	21	35	28	36	41	27	24
1968	24	27	25	34	27	26	27	30	33	26	33	25	28
1969	26	19	16	17	19	15	15	19	31	23	19	23	20
1970	24	14	24	17	13	25	30	29	32	35	21	33	25
1971	20	11	9	11	18	29	19	19	34	32	33	31	22
1972	15	8	13	19	29	15	22	18	35	36	15	23	21
1973	7	7	9	15	31	26	12	35	41	39	37	27	24
1974	20	20	16	26	24	24	32	26	39	41	38	44	29
1975	27	29	29	35	25	39	36	42	43	39	25	34	34
1976	37	40	23	19	30	34	35	35	40	42	42	49	35
1977	34	36	13	5	7	13	17	6	15	35	39	34	21
1978	28	20	14	29	26	26	28	37	40	38	34	33	29
1979	27	26	20	26	22	23	23	22	39	40	38	38	29
1980	38	35	31	29	26	29	22	28	32	29	28	28	30
1981	26	19	22	28	30	37	33	25	29	53	34	30	31
1982	20	10	11	10	16	17	11	19	32	26	38	23	19
1983	19	15	14	23	29	30	29	27	28	33	36	33	26
1984	32	31	27	18	22	18	37	34	19	17	16	22	24
1985	14	10	7	11	10	21	21	24	35	22	10	20	17
1986	14	11	19	18	25	34	27	32	30	36	31	31	26
1987	27	20	31	29	31	31	18	22	26	34	28	30	27
1988	27	24	28	18	21	31	31	26	26	26	23	26	26
1989	23	23	22	18	17	33	20	15	12	24	27	35	22
1990	29	17	13	16	30	19	22	27	20	28	26	27	23
1991	30	26	16	24	19	13	9	18	24	35	35	35	24
1992	29	25	25	19	14	10	16	49	24	44	30	29	26
1993	30	27	23	24	24	32	19	15	16	41	30	39	27
1994	25	22	26	20	28	35	34	29	31	28	32	30	28
1995	29	22	22	23	12	21	16	20	39	18	10	9	20
1996	7	6	2	10	19	14	18	17	38	41	37	38	21
1997	28	29	27	31	24	22	21	29	19	29	36	30	27
1998	33	30	32	31	25	25	40	38	30	33	32	35	32
1999	25	17	16	17	20	32	28	22	24	39	44	20	25

2000	25	37	17	35	33	45	31	40	41	33	34	36	34
2001	31	22	11	16	16	28	23	26	20	30	35	31	24
2002	32	18	23	17	16	30	24	27	35	34	37	35	27
2003	29	27	17	18	30	31	28	10	32	46	41	33	28
2004	30	23	17	15	29	29	20	24	31	35	37	27	26
2005	27	26	24	17	16	15	18	17	28	20	18	26	21
2006	27	17	11	31	28	34	31	26	26	31	33	30	27
2007	33	28	12	20	18	19	23	21	16	26	31	22	22
2008	26	30	25	18	24	18	29	22	50	37	31	28	28
2009	12	16	17	20	17	18	11	25	29	15	25	34	20
2010	26	13	15	21	36	30							24
Min.	7	6	2	3	7	10	5	1	2	10	8	9	15
Mean	23	21	18	20	23	24	22	24	28	32	30	28	24
Max.	38	40	32	42	37	45	40	49	50	53	44	49	35

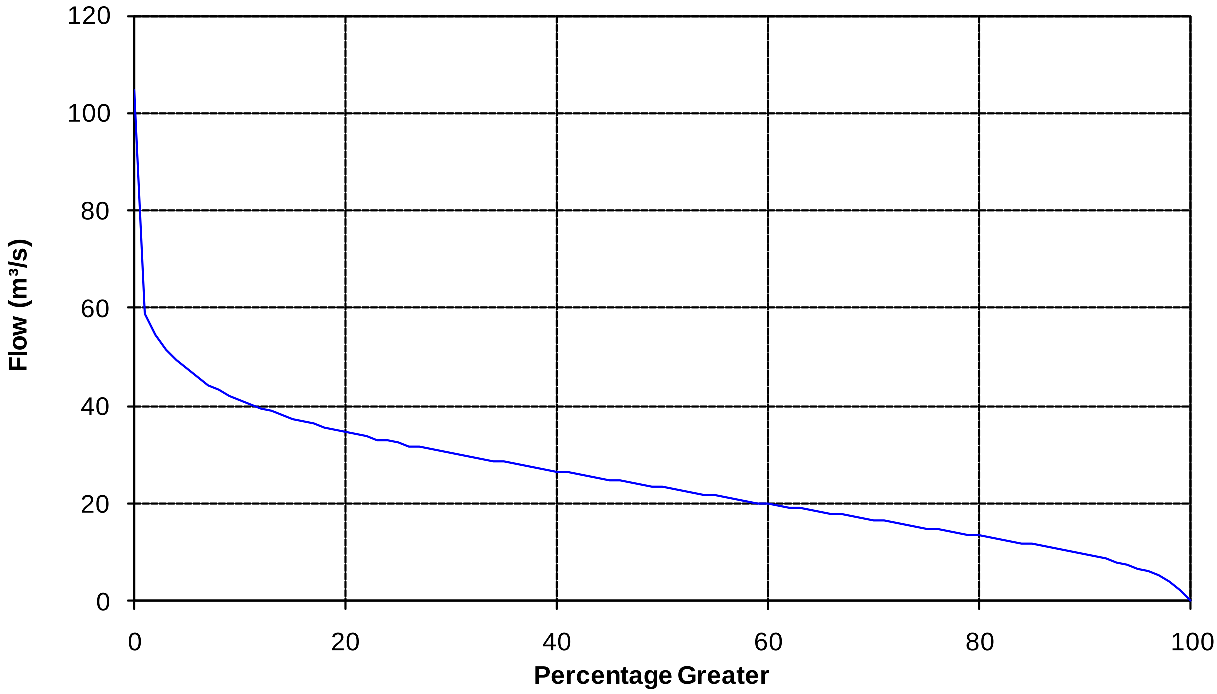

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	105	59	55	52	49	48	46	44	43	42
10	41	40	40	39	38	37	37	36	36	35
20	35	34	34	33	33	32	32	32	31	31
30	30	30	30	29	29	28	28	28	27	27
40	27	26	26	26	25	25	25	24	24	24
50	23	23	23	22	22	22	21	21	21	20
60	20	20	19	19	19	18	18	18	17	17
70	17	16	16	16	15	15	15	14	14	14
80	13	13	13	12	12	12	11	11	10	10
90	10	9	9	8	7	7	6	5	4	2
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	25	23	105

8.14 Grey + Taramakau – Taipo – 77106 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							391	297	278	655	567	447	439
1932	638	390	221	353	306	229	174	264	370	420	616	348	360
1933	360	686	520	774	713	174	275	412	443	640	381	431	483
1934	351	165	454	540	571	291	344	459	589	598	317	302	417
1935	787	220	436	360	395	308	219	369	178	559	277	337	373
1936	355	289	313	475	445	227	302	613	607	854	739	428	471
1937	581	373	354	581	405	211	321	271	293	269	374	292	360
1938	456	293	329	260	298	364	185	385	412	708	387	537	385
1939	486	500	186	441	382	498	263	224	453	341	540	591	407
1940	287	951	429	393	505	415	181	301	388	705	372	439	445
1941	431	379	342	402	512	317	308	171	383	326	749	317	386
1942	455	271	472	532	653	359	447	409	577	608	574	407	482
1943	378	533	487	513	382	337	263	206	342	363	448	337	381
1944	276	482	304	527	267	491	376	265	409	593	567	432	415
1945	492	459	772	536	295	201	218	442	477	385	897	402	464
1946	432	806	238	269	212	207	333	537	608	724	328	638	442
1947	299	274	161	177	322	457	288	340	578	479	419	312	342
1948	341	229	528	231	352	277	415	297	512	657	616	655	427
1949	298	708	561	580	252	169	517	416	303	638	308	503	437
1950	604	334	326	295	386	330	371	306	386	297	292	489	369
1951	212	195	195	282	257	172	585	237	486	462	559	336	332
1952	538	540	464	498	704	855	461	228	322	282	414	407	475
1953	250	277	287	571	765	492	434	364	523	460	593	826	488
1954	520	521	389	510	327	752	547	446	380	311	526	335	462
1955	202	1233	503	358	745	644	304	737	414	469	560	351	538
1956	323	272	303	626	324	627	644	475	385	344	684	479	457
1957	444	265	292	677	755	494	529	400	246	681	811	1348	581
1958	584	612	638	644	1070	584	410	577	390	516	320	520	573
1959	242	262	275	373	435	559	256	406	612	576	497	473	414
1960	335	388	399	220	489	508	394	368	560	446	381	219	392
1961	145	277	445	416	199	429	612	425	436	357	769	245	396
1962	637	280	210	228	506	581	581	518	572	832	576	272	484

1963	203	398	354	252	562	562	275	495	656	270	623	246	407
1964	910	245	448	316	622	318	632	714	621	676	562	607	559
1965	392	315	196	301	1239	562	366	418	426	487	821	493	503
1966	471	457	286	540	290	378	340	235	262	250	415	445	363
1967	314	231	399	579	515	272	352	647	365	388	1011	615	475
1968	399	519	600	325	518	191	250	391	570	928	796	332	485
1969	201	184	337	614	368	327	296	372	791	355	154	284	357
1970	379	158	241	342	148	306	537	505	1133	617	393	347	426
1971	137	159	115	140	196	474	225	305	636	831	336	251	317
1972	272	113	313	489	572	298	466	318	656	838	559	401	442
1973	186	122	131	523	914	449	117	339	307	279	675	285	361
1974	247	354	189	803	304	291	619	218	172	383	457	229	355
1975	108	193	329	637	821	453	623	565	477	430	437	408	458
1976	452	283	249	212	472	571	595	454	284	437	341	610	415
1977	599	241	315	202	454	434	325	210	348	610	631	588	415
1978	269	105	212	169	264	175	535	417	317	359	387	474	309
1979	324	372	294	552	811	335	383	345	664	748	517	771	511
1980	729	526	434	366	599	375	352	606	1025	462	638	386	541
1981	165	450	453	505	446	511	511	276	659	729	456	618	481
1982	639	326	280	160	572	260	279	380	464	319	746	678	426
1983	638	217	428	565	754	432	487	404	664	649	477	522	522
1984	333	249	251	298	357	399	503	486	244	635	700	723	433
1985	571	232	149	242	232	357	385	300	390	224	257	524	323
1986	407	302	229	385	423	622	332	273	285	442	242	328	356
1987	577	470	211	473	542	648	275	365	467	618	380	504	460
1988	330	507	467	265	615	597	717	650	906	1255	652	403	614
1989	312	256	529	411	282	605	324	175	116	307	459	660	370
1990	591	233	272	526	822	427	488	520	186	310	423	577	450
1991	649	576	154	468	265	327	245	869	516	559	345	374	445
1992	324	407	472	222	182	318	463	880	247	293	291	291	367
1993	617	315	210	280	364	885	350	232	296	663	232	429	407
1994	1008	218	338	317	721	549	563	592	591	365	1168	350	567
1995	425	292	555	447	472	421	568	527	959	665	490	625	539
1996	281	386	369	637	424	407	221	387	557	881	796	489	485
1997	208	435	277	514	325	335	275	589	193	381	782	1025	445
1998	359	436	567	527	325	416	781	526	502	1220	289	449	535
1999	245	204	239	569	474	484	397	328	328	788	530	169	397

2000	339	292	155	575	455	627	373	396	521	857	263	398	438
2001	310	245	205	244	372	485	180	401	217	337	660	865	378
2002	484	134	469	265	421	1079	382	376	645	542	631	530	498
2003	316	353	170	147	447	714	455	180	552	453	512	358	387
2004	426	657	462	260	415	725	309	544	602	522	354	506	481
2005	341	444	415	209	306	343	448	360	384	309	262	337	346
2006	590	200	241	695	252	520	329	308	526	633	1006	482	482
2007	352	245	328	239	479	621	397	422	366	1046	276	304	425
2008	259	282	317	230	182	362	538	451	472	495	630	556	398
2009	322	264	300	429	530	222	366	571	392	308	303	723	396
2010	648	250	312	418	349	363							392
Min.	108	105	115	140	148	169	117	171	116	224	154	169	309
Mean	410	358	343	412	465	435	395	411	467	541	517	469	436
Max.	1008	1233	772	803	1239	1079	781	880	1133	1255	1168	1348	614

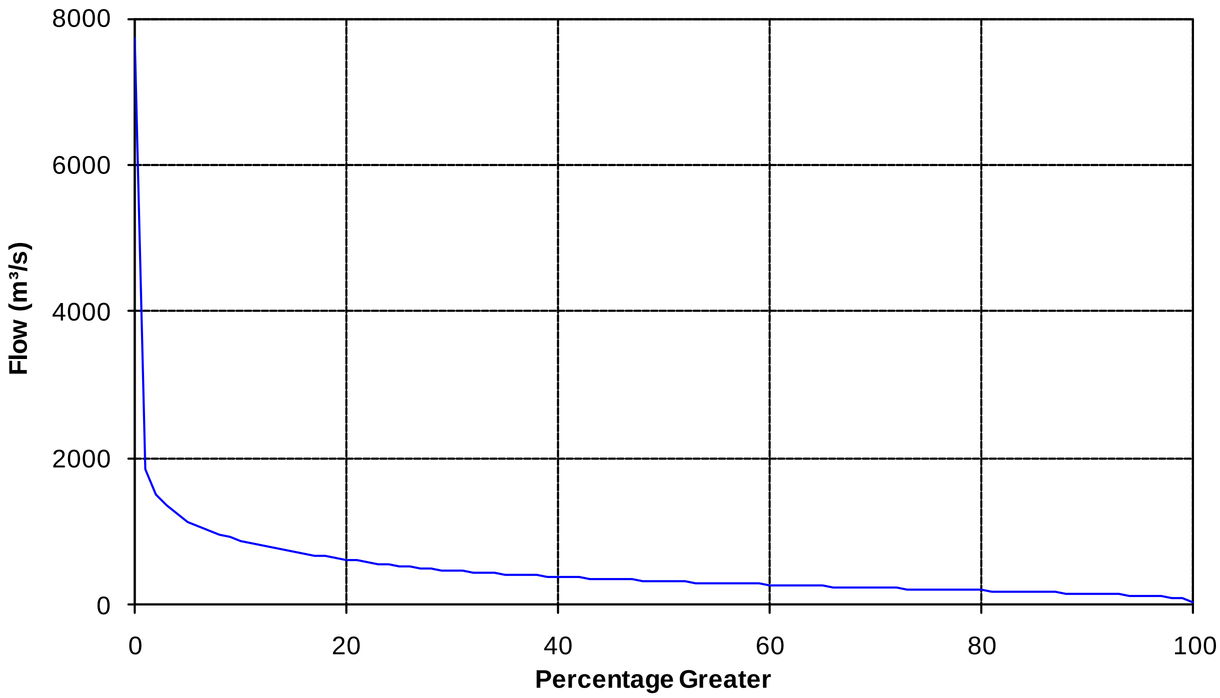

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	7740	1837	1502	1351	1230	1138	1060	1003	956	911
10	872	838	809	778	752	723	697	676	655	632
20	612	593	575	557	541	525	512	498	486	476
30	464	454	445	435	427	418	410	401	393	386
40	378	372	364	357	352	347	340	335	330	323
50	317	313	308	302	298	294	288	284	280	276
60	271	266	262	259	253	249	245	241	237	232
70	229	225	221	217	213	210	205	201	197	193
80	189	185	180	177	173	169	165	161	157	152
90	147	143	138	133	127	120	113	105	95	81
100	42									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	42	436	317	7740

8.15 Tekapo Natural – 98770 (Item: 2)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							35	33	33	84	85	114	64
1932	90	97	68	76	44	32	19	22	28	61	93	96	60
1933	113	198	98	130	77	45	72	57	34	51	70	135	89
1934	113	97	69	133	76	60	43	56	52	117	92	101	84
1935	150	122	118	75	71	70	35	47	30	51	71	121	80
1936	90	108	93	107	58	30	43	46	56	125	168	117	87
1937	122	106	67	122	66	45	31	27	28	31	56	94	66
1938	170	120	113	175	56	46	40	48	58	72	97	118	93
1939	70	73	66	50	47	58	36	26	46	55	102	123	63
1940	147	151	115	66	91	53	32	28	28	71	82	108	81
1941	120	129	88	54	39	67	44	32	38	33	84	108	69
1942	110	72	84	161	108	38	57	29	36	146	90	106	87
1943	79	127	81	83	41	33	28	29	47	97	107	120	72
1944	103	174	113	140	63	36	45	38	37	73	126	110	88
1945	222	178	121	100	48	38	39	54	93	64	182	138	106
1946	129	145	100	49	36	26	25	50	90	110	60	139	80
1947	90	88	59	37	25	30	28	28	35	99	95	136	62
1948	99	92	70	59	34	50	39	28	31	90	176	124	74
1949	112	172	102	82	102	65	62	49	31	135	100	99	92
1950	180	70	52	45	96	57	46	53	53	52	67	143	76
1951	101	92	69	112	42	26	61	38	35	95	129	121	77
1952	98	184	95	55	67	39	26	22	31	72	80	94	71
1953	81	80	77	82	109	52	31	35	48	40	120	155	76
1954	116	146	108	53	43	53	33	36	30	47	97	104	72
1955	89	208	87	65	129	67	35	42	54	64	74	107	84
1956	114	95	56	111	88	79	55	36	31	56	141	113	81
1957	106	99	74	88	96	43	57	38	28	80	154	281	95
1958	217	260	134	85	96	55	27	30	37	84	90	158	105
1959	91	78	70	60	39	40	28	21	42	48	120	135	64
1960	126	104	101	49	55	57	36	63	68	70	75	70	73
1961	71	92	107	117	39	42	39	45	35	107	116	105	76
1962	143	69	72	37	99	47	65	62	70	127	93	87	81

1963	88	126	87	56	82	60	36	41	66	56	66	67	69
1964	95	80	98	55	84	39	49	43	45	52	77	119	70
1965	158	95	81	50	43	38	29	35	31	50	112	136	72
1966	171	128	85	74	48	35	29	29	40	71	96	107	76
1967	131	98	159	145	62	52	106	85	34	69	149	157	104
1968	100	132	145	95	136	54	37	63	58	111	107	109	96
1969	110	79	79	66	53	32	24	24	142	40	58	159	72
1970	141	80	110	93	36	43	35	88	216	89	113	114	97
1971	79	68	51	38	54	83	28	28	51	103	89	105	65
1972	97	59	112	69	59	42	44	33	74	107	162	97	80
1973	89	65	56	76	62	57	27	32	45	93	146	80	69
1974	75	130	94	114	43	34	36	27	30	73	109	98	71
1975	87	110	127	161	90	56	42	70	58	89	103	97	91
1976	108	64	72	42	52	65	26	27	28	37	50	149	60
1977	115	105	81	58	49	43	40	27	27	50	77	83	63
1978	106	69	83	102	123	54	47	81	83	79	93	99	85
1979	92	103	134	97	130	50	39	43	54	111	120	259	103
1980	174	102	78	80	60	59	43	64	84	93	103	117	88
1981	95	93	152	77	67	82	49	38	36	104	97	143	86
1982	122	102	125	42	66	51	33	34	43	52	182	122	81
1983	143	63	85	94	108	62	68	72	82	182	169	148	107
1984	119	99	103	55	41	32	73	64	44	82	147	261	94
1985	169	71	64	67	49	49	40	57	67	48	93	139	76
1986	108	92	103	84	56	85	52	54	42	80	92	105	79
1987	142	132	127	104	89	85	40	39	47	109	101	98	93
1988	92	89	69	48	47	52	66	64	81	143	134	138	85
1989	112	101	130	63	69	86	48	36	30	30	102	183	82
1990	122	80	78	61	89	63	61	68	36	106	96	162	85
1991	147	138	51	93	36	30	30	95	96	84	67	97	80
1992	117	94	53	42	34	29	31	65	39	78	128	107	68
1993	121	77	86	65	63	116	40	35	34	93	59	82	72
1994	281	80	109	66	53	56	51	52	60	51	208	127	100
1995	128	88	120	139	78	43	33	38	136	121	99	285	109
1996	111	117	89	139	73	49	33	33	50	161	93	88	86
1997	88	109	69	104	57	38	38	62	40	54	90	151	75
1998	129	160	156	97	71	69	103	67	85	174	83	97	107
1999	89	86	102	78	85	61	48	37	48	110	206	72	85

2000	133	95	56	121	74	120	80	56	85	110	68	148	95
2001	89	69	70	40	43	44	33	35	36	70	103	181	68
2002	180	71	69	58	43	77	43	66	98	70	92	129	83
2003	94	92	63	50	111	76	62	36	53	68	85	109	75
2004	138	120	106	46	84	71	50	50	52	65	102	88	81
2005	119	102	90	47	47	40	39	41	91	49	62	79	67
2006	94	65	43	103	69	78	43	41	56	92	167	118	81
2007	106	75	67	45	46	51	51	34	37	95	69	121	67
2008	92	84	78	53	42	45	54	37	97	84	154	160	81
2009	111	85	73	159	158	55	39	72	64	49	76	128	89
2010	146	69	67	97	85	59							88
Min.	70	59	43	37	25	26	19	21	27	30	50	67	60
Mean	119	105	90	82	68	53	43	45	55	82	106	125	81
Max.	281	260	159	175	158	120	106	95	216	182	208	285	109

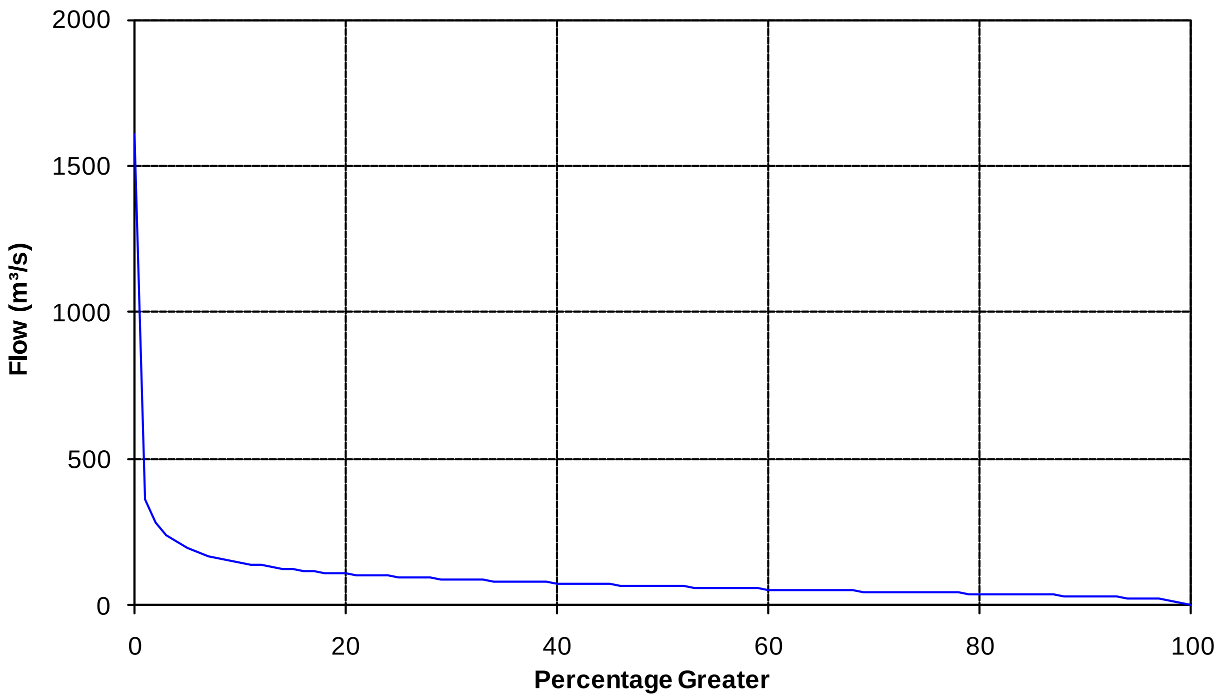

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	1607	359	285	240	214	194	179	169	160	152
10	145	139	134	129	124	120	117	114	111	109
20	106	104	102	100	98	96	94	93	91	89
30	88	86	85	84	82	81	80	78	77	76
40	75	74	72	71	70	69	68	67	66	65
50	64	63	62	61	60	59	58	57	56	55
60	54	53	52	52	51	50	49	48	48	47
70	46	45	44	44	43	42	41	41	40	39
80	38	37	37	36	35	34	34	33	32	31
90	30	29	28	27	25	24	22	19	16	10
100	2									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	2	81	64	1607

8.16 Pukaki Natural – 98770 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							49	39	37	117	85	165	82
1932	205	205	125	96	63	47	26	23	34	83	159	168	103
1933	212	402	209	235	107	50	84	74	45	85	104	228	151
1934	222	216	143	227	147	75	54	73	73	163	113	179	140
1935	348	277	217	133	97	83	48	65	50	70	92	215	141
1936	181	201	137	165	76	44	61	68	69	203	199	174	131
1937	200	193	129	192	79	50	38	37	41	49	89	164	104
1938	337	268	243	312	69	58	39	55	63	79	125	173	151
1939	121	166	145	88	77	86	39	31	57	59	125	175	97
1940	250	244	296	123	108	59	32	30	38	111	110	176	131
1941	234	282	173	92	57	82	54	35	36	45	123	163	114
1942	211	140	171	343	165	48	74	37	60	236	174	199	155
1943	189	252	147	121	49	44	38	27	61	101	137	206	114
1944	197	290	187	196	72	45	53	45	47	88	147	138	125
1945	404	309	206	160	55	33	33	56	105	72	245	177	153
1946	258	340	195	81	50	36	38	70	111	135	88	219	134
1947	168	187	148	83	61	57	48	45	57	148	146	292	120
1948	226	218	157	78	61	62	62	38	67	119	236	216	128
1949	204	390	194	142	112	72	82	76	47	165	133	152	146
1950	285	135	125	86	178	80	80	77	80	82	116	252	132
1951	189	173	121	130	62	42	91	47	56	119	168	164	113
1952	174	218	217	131	98	81	54	46	75	122	119	148	123
1953	167	165	161	148	130	44	41	63	91	55	195	244	125
1954	212	314	209	77	53	73	55	49	24	69	160	167	121
1955	196	427	188	98	182	68	32	66	82	97	112	182	143
1956	236	159	109	204	120	103	67	59	50	75	140	193	126
1957	184	207	162	150	136	55	46	56	35	107	168	348	138
1958	305	474	273	135	145	82	48	52	41	116	134	255	170
1959	187	165	139	91	55	60	42	34	81	62	158	187	105
1960	267	198	182	80	80	76	60	66	104	101	115	120	120
1961	143	186	178	181	58	68	67	63	58	127	168	149	120
1962	280	147	136	59	133	67	87	70	79	122	128	134	120

1963	166	232	156	65	102	79	29	49	83	74	89	108	102
1964	160	134	163	88	138	65	43	50	61	72	99	174	104
1965	248	167	184	78	60	56	40	43	53	81	152	204	114
1966	329	308	176	127	56	49	48	51	52	69	122	187	130
1967	270	205	371	260	92	45	92	114	60	103	176	245	170
1968	195	236	271	136	161	55	50	73	76	142	139	148	140
1969	179	162	163	128	72	52	44	46	185	73	108	255	122
1970	277	185	208	169	54	55	53	105	241	113	176	215	154
1971	177	169	120	69	79	101	50	24	74	137	107	162	106
1972	193	136	235	120	86	42	54	53	115	118	219	147	127
1973	173	196	143	163	128	91	44	48	56	135	230	157	130
1974	149	287	183	227	60	58	54	40	46	90	148	197	127
1975	203	213	242	248	116	48	26	76	64	103	127	143	134
1976	177	103	145	69	65	81	28	12	15	31	44	208	82
1977	166	195	149	107	43	44	48	74	27	61	103	122	94
1978	183	161	185	187	171	72	55	90	88	91	109	127	126
1979	169	181	267	132	140	65	59	54	81	157	142	394	154
1980	300	180	133	134	93	78	45	75	99	121	141	170	131
1981	195	250	279	131	92	109	56	47	59	145	124	219	142
1982	289	218	265	71	105	59	38	51	66	61	226	194	137
1983	262	136	195	153	154	74	66	76	98	202	147	196	147
1984	200	176	189	100	55	44	85	90	71	117	195	357	140
1985	275	143	124	116	66	52	44	78	84	63	123	218	116
1986	216	182	163	140	68	104	39	44	53	104	110	173	116
1987	262	226	197	169	117	106	43	46	67	146	149	170	141
1988	191	179	136	84	76	69	74	80	116	200	167	232	134
1989	206	214	245	98	86	93	48	44	34	68	153	348	136
1990	237	201	170	104	145	78	70	81	52	123	126	280	139
1991	278	267	109	153	49	42	34	122	107	99	84	131	122
1992	190	190	94	69	49	16	48	83	35	92	139	159	97
1993	259	165	141	98	74	138	46	43	50	127	81	126	112
1994	509	170	161	98	71	68	62	63	70	52	252	172	146
1995	242	186	210	185	82	58	43	55	151	138	121	466	161
1996	231	225	152	186	91	54	33	33	57	180	110	116	122
1997	139	213	115	149	71	41	33	79	38	76	141	257	112
1998	261	345	286	151	98	75	114	74	85	218	121	159	165
1999	187	177	186	126	111	63	49	24	45	124	283	112	123

2000	205	173	91	151	85	139	83	55	85	130	77	210	123
2001	133	151	143	60	52	65	31	47	45	108	140	286	105
2002	293	121	108	84	55	102	43	73	111	71	103	182	112
2003	166	168	113	63	141	85	66	31	72	76	116	179	106
2004	279	179	203	64	106	75	40	49	55	71	142	123	115
2005	197	199	163	60	55	40	41	51	103	64	99	162	102
2006	204	135	83	145	72	76	43	46	85	115	205	160	114
2007	182	143	123	69	75	64	56	49	68	116	87	208	103
2008	199	170	148	73	59	59	67	42	126	96	195	217	121
2009	215	163	126	244	199	45	30	91	72	54	92	227	130
2010	253	154	134	160	109	48							143
Min.	121	103	83	59	43	16	26	12	15	31	44	108	82
Mean	224	210	174	133	93	66	52	57	71	106	140	196	127
Max.	509	474	371	343	199	139	114	122	241	236	283	466	170

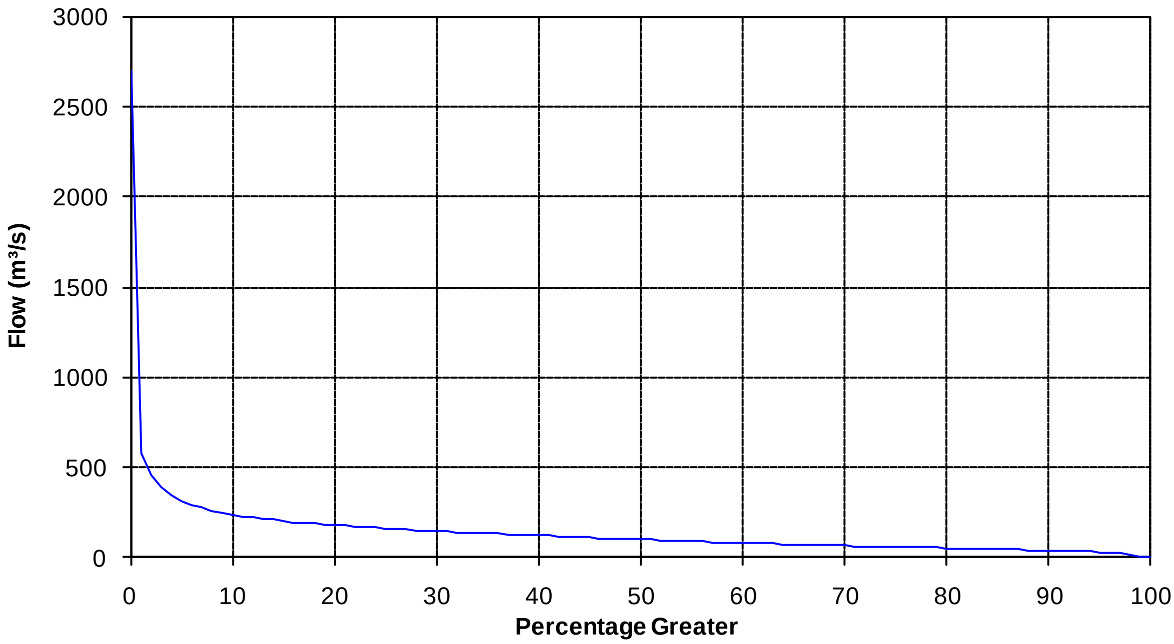

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	2699	582	455	389	344	314	291	273	257	245
10	235	227	219	212	206	199	194	189	185	180
20	176	173	169	165	162	159	155	153	150	147
30	144	141	139	136	134	132	129	127	125	122
40	120	118	115	113	111	109	106	105	102	100
50	98	96	94	92	90	88	86	84	82	81
60	79	77	75	74	72	70	69	67	66	64
70	63	61	60	58	57	56	54	53	52	51
80	50	48	47	46	44	43	42	40	39	38
90	36	35	33	32	30	28	25	20	15	3
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	126	98	2699

8.17 Waitaki System at Ohau [separate Tekapo sim] – 98614 (Item: 3)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							37	30	32	101	83	102	64
1932	98	91	51	53	44	35	20	18	29	72	107	91	59
1933	94	164	111	148	93	42	78	73	40	78	77	117	93
1934	105	79	62	112	102	59	39	58	65	145	83	83	83
1935	140	94	85	68	69	53	25	38	23	61	71	104	69
1936	71	80	63	93	52	28	38	60	57	157	148	112	80
1937	110	95	68	114	68	45	27	27	35	42	65	90	65
1938	142	90	96	135	56	55	34	54	67	84	98	122	86
1939	69	74	59	43	58	68	38	24	56	61	104	109	64
1940	129	160	129	83	90	58	29	23	33	108	94	93	85
1941	86	98	72	69	50	68	49	25	25	32	115	105	66
1942	107	75	90	165	131	45	63	35	56	192	129	132	102
1943	95	120	90	81	49	36	36	24	54	87	106	111	74
1944	99	143	108	131	65	42	49	41	42	86	130	115	88
1945	226	177	143	104	53	32	29	56	105	75	207	142	112
1946	144	156	86	51	43	32	32	64	102	137	76	134	88
1947	95	85	55	32	33	37	35	35	51	123	99	124	67
1948	91	63	72	50	33	53	50	30	55	113	190	137	78
1949	100	182	107	102	78	49	63	51	37	139	89	95	91
1950	164	72	56	43	82	52	59	52	72	65	76	139	78
1951	87	63	50	93	46	30	80	42	66	98	152	132	78
1952	124	181	74	53	78	50	32	20	44	97	83	111	79
1953	70	70	70	125	95	54	40	48	66	41	161	142	82
1954	103	125	96	57	38	58	43	35	32	60	114	101	72
1955	80	184	83	54	120	76	34	47	69	67	71	105	82
1956	76	70	41	110	85	86	57	46	43	74	128	130	79
1957	100	81	68	103	113	40	51	28	27	103	177	280	98
1958	185	243	141	112	147	77	33	35	31	109	109	178	116
1959	89	68	61	56	37	58	28	22	68	59	134	126	67
1960	122	95	78	44	63	50	47	61	85	73	76	67	72
1961	53	74	83	97	43	50	55	54	44	111	121	91	73
1962	98	58	52	29	72	51	74	53	57	98	118	80	70

1963	69	88	84	46	66	53	29	37	76	67	72	65	62
1964	106	60	83	48	98	35	42	39	44	67	86	115	69
1965	164	87	88	48	43	46	28	27	42	68	141	138	77
1966	172	121	75	85	35	40	28	32	36	53	92	112	73
1967	143	114	165	166	80	32	68	106	40	71	149	185	110
1968	114	109	123	66	127	50	34	65	74	133	117	120	94
1969	112	73	76	81	54	36	28	34	178	60	79	147	80
1970	115	75	80	72	31	39	42	108	250	104	135	129	98
1971	71	52	48	42	52	67	31	28	62	125	97	115	66
1972	91	50	95	72	74	34	40	31	110	91	170	106	80
1973	81	55	48	96	86	63	29	33	40	112	163	73	73
1974	56	100	89	92	40	36	52	32	35	77	119	106	69
1975	82	87	114	176	111	59	52	82	67	97	115	100	95
1976	100	64	66	41	68	82	33	29	27	40	52	142	62
1977	120	101	74	62	55	47	41	23	32	60	83	88	65
1978	99	60	78	98	118	61	43	97	92	119	108	93	89
1979	95	99	145	114	134	55	39	35	69	123	118	242	106
1980	161	99	78	97	76	61	37	60	79	96	100	116	88
1981	78	89	141	81	66	73	40	28	33	106	74	117	77
1982	143	86	112	41	89	49	25	40	50	39	184	141	83
1983	177	64	94	88	110	50	49	58	82	164	154	122	101
1984	129	83	95	52	44	36	62	63	44	111	140	258	93
1985	162	59	44	56	52	51	49	62	54	48	103	133	73
1986	106	97	108	86	55	86	39	43	44	85	81	91	77
1987	134	124	133	103	90	99	33	38	53	123	94	90	93
1988	76	84	67	49	50	64	67	66	104	180	145	134	90
1989	94	80	124	52	43	71	44	36	25	44	83	188	74
1990	102	66	84	64	128	64	55	60	28	84	82	175	83
1991	114	138	47	93	36	36	23	105	95	79	66	96	77
1992	96	88	57	43	33	16	39	64	29	89	117	92	64
1993	117	78	62	57	69	128	51	36	37	114	58	90	75
1994	266	76	96	62	61	58	51	54	55	47	209	131	97
1995	123	81	135	116	64	45	34	49	150	121	107	291	110
1996	105	107	84	137	80	53	28	28	52	156	86	95	84
1997	78	98	61	105	53	33	32	70	36	70	126	138	75
1998	107	126	132	102	58	67	94	61	73	160	79	84	95
1999	70	67	84	79	81	55	48	30	43	92	212	63	77

2000	92	68	45	74	76	130	75	50	90	121	67	157	87
2001	89	62	58	43	43	61	34	42	37	68	87	168	66
2002	140	49	64	54	42	87	45	71	109	65	93	139	80
2003	96	87	57	42	86	83	53	30	60	67	97	109	72
2004	138	124	115	49	90	75	45	50	53	64	108	89	83
2005	104	80	80	43	51	40	42	50	86	55	66	75	64
2006	93	52	51	86	60	58	41	38	73	100	149	103	75
2007	89	63	58	40	55	58	50	44	46	90	67	102	64
2008	75	62	62	42	36	42	47	31	105	78	119	127	69
2009	98	70	59	123	123	44	36	93	63	50	77	137	81
2010	135	54	63	92	76	54							80
Min.	53	49	41	29	31	16	20	18	23	32	52	63	59
Mean	110	93	83	79	70	55	43	47	61	91	110	123	81
Max.	266	243	165	176	147	130	94	108	250	192	212	291	116

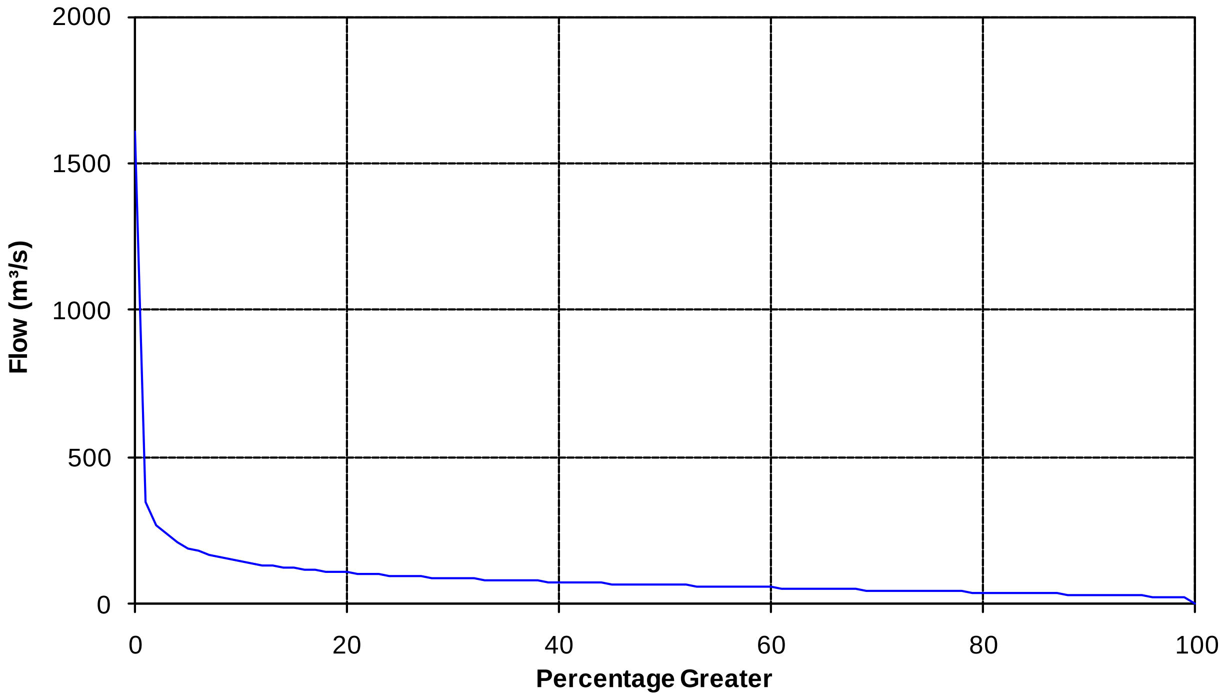

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	1606	349	269	235	211	191	178	167	157	149
10	143	138	133	128	124	121	117	114	111	109
20	106	104	101	99	97	95	94	92	90	88
30	87	85	84	83	81	80	78	77	76	75
40	74	72	71	70	69	68	67	66	65	64
50	64	63	62	61	60	59	58	57	56	55
60	55	54	53	52	51	50	49	49	48	47
70	46	45	44	44	43	42	41	41	40	39
80	38	38	37	36	35	34	33	33	32	31
90	30	30	29	28	27	26	25	24	22	19
100	2									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	2	81	64	1606

8.18 Waitaki System at Benmore tr [separate Tekapo sim] - 98614 (Item: 4)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							57	46	48	154	127	157	98
1932	150	140	78	81	68	54	30	28	45	110	163	140	90
1933	143	251	170	227	143	65	120	112	61	119	118	179	142
1934	161	121	95	171	157	90	60	89	100	223	128	127	127
1935	215	145	131	104	106	81	39	58	35	94	109	160	106
1936	108	123	96	142	79	42	59	91	87	241	227	177	123
1937	183	146	105	174	104	69	42	41	54	64	99	138	101
1938	218	137	147	207	85	84	52	82	103	129	150	186	132
1939	106	113	91	67	88	105	58	37	86	94	159	167	97
1940	197	245	201	126	138	88	44	35	50	165	145	143	131
1941	131	150	111	106	77	105	75	39	38	49	176	161	101
1942	164	115	137	253	201	68	97	54	85	294	198	203	156
1943	145	185	138	124	75	55	54	37	83	134	162	170	113
1944	151	220	166	207	100	65	76	62	64	132	200	177	135
1945	375	335	232	159	82	49	45	86	161	115	317	217	180
1946	234	279	132	79	66	49	48	98	156	210	117	206	139
1947	146	129	85	49	51	57	54	53	78	188	151	191	103
1948	139	97	110	76	51	82	77	47	85	174	291	209	120
1949	154	326	164	157	120	76	96	78	56	212	136	134	141
1950	236	107	82	64	115	82	96	90	128	112	115	190	118
1951	129	89	65	143	76	52	122	80	116	165	238	201	123
1952	177	262	103	73	117	87	56	36	76	161	135	174	121
1953	96	91	90	177	151	93	61	80	110	65	212	193	118
1954	136	159	130	89	62	104	81	68	66	99	162	139	108
1955	102	241	116	69	168	123	54	74	106	98	97	132	114
1956	91	83	47	136	123	139	96	71	67	120	192	196	113
1957	137	103	101	145	175	70	88	48	45	166	285	531	159
1958	403	501	233	167	246	130	58	58	50	149	152	252	198
1959	125	92	83	79	61	87	48	39	107	103	200	182	100
1960	166	132	112	71	96	84	73	102	146	118	113	95	109
1961	72	101	121	140	70	83	104	108	87	182	176	134	115

1962	131	79	81	47	105	92	119	102	103	160	187	112	110
1963	93	122	120	69	95	91	55	71	147	121	114	96	99
1964	139	80	108	67	142	58	64	66	77	112	139	178	103
1965	261	128	126	74	70	76	49	46	70	115	220	203	120
1966	251	166	105	125	57	61	45	49	58	81	133	152	106
1967	192	161	235	253	128	53	103	167	66	109	224	311	167
1968	167	164	212	98	196	79	52	108	126	219	192	192	151
1969	165	104	110	111	81	54	47	55	279	99	119	228	121
1970	165	105	107	100	47	60	72	168	380	174	211	227	151
1971	101	73	72	68	81	110	52	45	102	212	160	178	105
1972	127	72	129	102	115	59	66	52	197	156	258	156	124
1973	113	76	66	131	129	98	48	52	64	175	248	104	109
1974	79	146	135	135	63	58	82	53	63	113	175	144	104
1975	121	135	169	263	180	99	84	128	110	152	174	142	146
1976	134	88	88	58	100	125	54	47	45	68	85	209	92
1977	180	139	100	87	87	73	63	38	50	94	126	127	97
1978	133	81	102	133	176	99	68	156	150	201	174	139	135
1979	130	138	211	172	197	85	63	57	109	201	186	460	168
1980	300	159	121	156	121	111	65	108	138	161	174	174	149
1981	111	120	207	127	110	121	68	51	59	173	116	171	120
1982	193	121	158	63	141	80	42	68	85	72	290	217	128
1983	270	95	128	133	179	85	86	111	144	273	273	264	171
1984	200	124	151	82	74	59	100	107	76	188	213	492	156
1985	298	87	67	81	80	80	78	106	97	82	161	192	118
1986	154	143	170	126	86	144	66	73	76	143	126	132	120
1987	190	179	217	167	137	164	57	64	85	200	145	130	144
1988	106	122	101	75	73	96	107	107	170	292	224	200	140
1989	137	113	184	80	69	115	70	56	41	67	114	261	109
1990	148	90	122	93	205	109	91	100	51	136	125	250	127
1991	169	231	69	143	61	56	38	172	165	140	110	143	124
1992	135	121	84	67	55	31	68	108	49	150	193	135	100
1993	171	114	89	89	112	213	90	64	64	184	93	145	119
1994	446	117	147	94	99	96	92	96	96	86	330	206	159
1995	190	117	193	169	96	73	54	84	258	210	181	589	185
1996	161	165	124	202	124	85	46	45	86	249	138	150	131
1997	122	143	95	158	85	58	53	124	64	120	202	206	119
1998	149	179	210	159	92	112	158	106	116	254	134	141	151

1999	94	87	116	125	123	89	81	51	76	137	348	102	119
2000	142	103	69	109	119	227	130	88	158	200	115	240	142
2001	140	89	79	62	64	98	58	68	60	101	134	266	102
2002	243	74	90	78	63	134	74	114	186	106	140	209	126
2003	143	124	81	59	122	125	91	48	97	115	155	158	110
2004	198	185	180	77	145	125	75	85	90	109	173	136	131
2005	168	118	120	69	76	62	65	84	139	90	101	105	100
2006	133	73	72	124	95	91	68	64	116	154	323	193	125
2007	131	90	79	56	78	89	82	75	76	155	111	148	98
2008	107	87	92	61	57	67	78	53	180	133	179	205	108
2009	159	107	87	169	216	80	59	153	107	80	119	186	127
2010	190	76	86	131	125	88							117
Min.	72	72	47	47	47	31	30	28	35	49	85	95	90
Mean	167	140	123	118	109	89	71	77	101	146	172	192	126
Max.	446	501	235	263	246	227	158	172	380	294	348	589	198

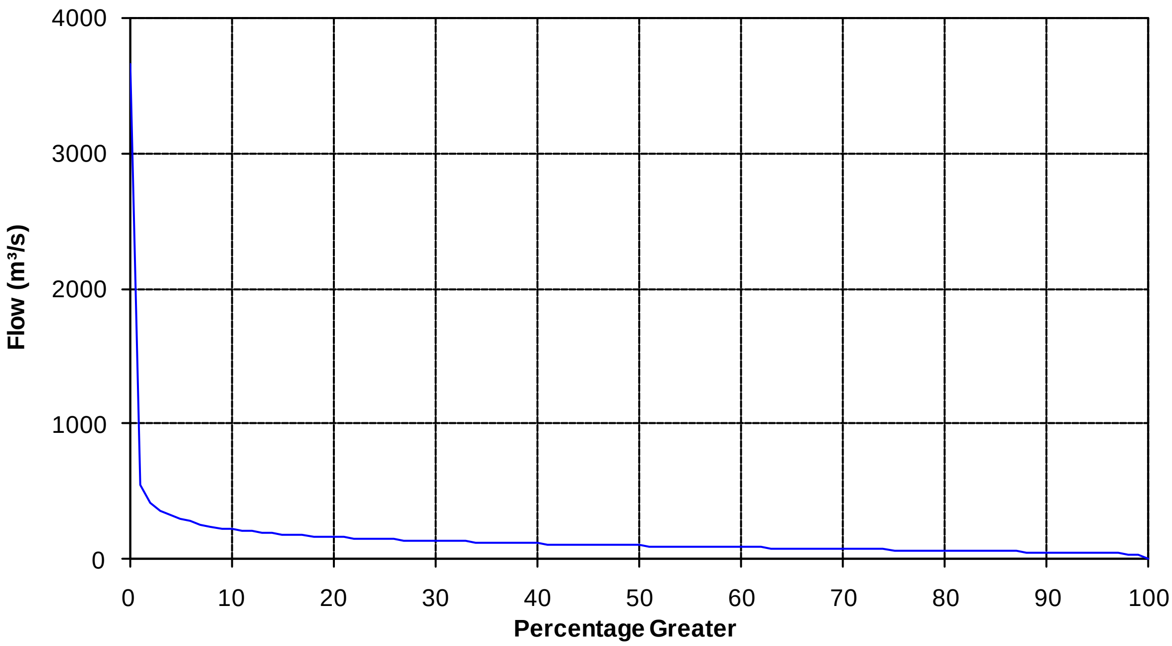

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	3659	544	419	358	322	295	275	256	242	230
10	220	211	203	197	191	185	180	175	170	166
20	162	159	156	152	149	146	143	141	138	136
30	133	131	129	127	125	123	121	119	117	115
40	113	112	110	109	107	105	104	102	101	100
50	98	97	96	94	93	92	90	89	88	86
60	85	84	83	82	80	79	78	77	76	74
70	73	72	71	70	68	67	66	65	64	63
80	62	61	60	59	57	56	55	54	52	51
90	50	49	47	46	44	43	42	39	36	33
100	8									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2008	8	125	98	3659

8.19 Lake Wanaka Outflow – 9154 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							130	87	97	237	242	238	172
1932	250	232	172	181	150	107	72	60	107	223	211	260	169
1933	186	322	308	359	269	169	116	153	122	207	163	184	212
1934	185	161	126	277	310	179	137	132	141	300	205	180	195
1935	327	244	215	248	157	158	103	87	63	132	146	180	171
1936	149	178	164	199	176	89	85	144	208	317	394	305	201
1937	245	196	171	299	223	149	86	84	99	110	140	164	164
1938	265	185	218	228	149	140	108	113	174	222	206	263	189
1939	174	160	156	149	162	186	162	83	159	180	243	335	179
1940	227	299	316	198	207	171	108	81	111	236	314	267	211
1941	211	231	183	178	125	188	152	86	74	104	226	288	170
1942	250	187	192	259	241	179	164	137	179	365	308	240	225
1943	240	278	288	214	195	137	125	75	104	159	223	213	187
1944	188	241	283	273	212	126	140	127	104	173	281	232	198
1945	366	366	429	310	148	89	83	112	204	209	373	328	251
1946	230	351	241	135	142	102	96	167	235	370	207	288	213
1947	212	167	129	91	93	99	127	111	134	271	280	253	164
1948	245	159	179	143	103	166	140	99	105	228	499	290	196
1949	265	375	357	306	191	151	147	164	142	266	238	243	236
1950	361	171	125	119	141	207	124	126	151	142	149	229	171
1951	162	119	100	144	101	88	166	159	113	217	303	253	161
1952	205	365	191	174	185	138	106	66	86	217	181	156	172
1953	114	87	89	151	268	176	89	117	156	107	223	371	163
1954	241	221	257	186	98	111	145	87	93	140	259	192	169
1955	166	279	233	167	291	202	107	97	157	187	165	239	190
1956	152	105	88	170	250	209	168	108	108	146	321	306	178
1957	251	238	173	197	286	134	159	110	85	180	391	500	226
1958	371	566	384	301	305	244	92	88	85	212	299	257	265
1959	186	145	131	102	87	109	92	63	161	187	261	265	149
1960	184	258	170	109	123	179	141	212	190	174	167	149	171
1961	118	110	159	208	115	111	127	162	120	219	289	213	163
1962	219	146	142	80	162	151	156	190	168	209	288	184	175

1963	145	176	197	141	136	152	90	93	179	164	190	147	150
1964	209	163	155	150	226	130	117	121	131	190	186	307	174
1965	397	189	223	155	137	157	117	82	99	167	309	316	196
1966	286	264	179	243	150	95	84	70	92	129	181	274	170
1967	220	292	363	322	292	112	121	267	156	177	252	400	248
1968	259	202	372	164	276	167	81	108	158	281	333	279	224
1969	244	149	183	168	125	83	81	104	449	204	180	301	189
1970	311	228	184	187	117	98	120	223	563	307	287	314	245
1971	165	115	114	110	124	165	93	75	178	329	243	258	164
1972	218	127	229	222	195	113	100	89	261	266	337	192	196
1973	171	152	118	182	229	169	98	93	131	234	406	183	180
1974	134	159	198	198	112	76	110	94	91	174	200	193	145
1975	140	195	262	463	328	208	111	227	165	208	248	200	229
1976	165	121	125	100	134	206	94	73	62	74	95	229	123
1977	215	217	154	161	142	133	111	66	65	120	217	196	149
1978	188	135	125	266	255	173	102	210	198	355	259	206	206
1979	234	247	282	190	237	141	110	99	146	225	250	435	216
1980	302	276	156	197	201	178	154	165	267	272	255	253	223
1981	185	171	309	199	196	158	127	98	91	251	225	285	192
1982	262	274	328	143	232	204	85	98	153	130	305	347	213
1983	469	221	193	260	289	147	152	223	215	383	377	305	270
1984	262	284	309	177	162	116	130	220	178	306	332	525	250
1985	510	215	159	148	192	161	162	183	206	165	222	254	215
1986	330	173	225	199	192	264	159	120	108	194	174	210	196
1987	290	296	234	303	187	315	136	122	155	307	271	198	234
1988	174	148	165	136	98	132	165	196	282	445	400	345	224
1989	233	167	231	177	117	178	151	147	81	135	273	298	183
1990	279	160	226	147	314	209	179	178	97	165	178	368	209
1991	319	349	157	203	117	90	60	245	300	234	194	165	202
1992	222	187	129	129	84	60	96	157	95	206	337	221	160
1993	261	217	155	145	179	335	210	155	115	238	175	170	196
1994	562	275	188	169	154	169	161	170	174	141	422	341	244
1995	290	212	227	332	192	147	95	103	356	374	280	606	268
1996	362	253	180	256	199	152	81	70	127	449	263	205	216
1997	165	129	123	214	155	134	93	168	141	161	265	375	177
1998	293	362	385	308	206	194	237	229	166	347	266	171	263
1999	167	127	177	274	254	223	148	89	133	172	679	252	224

2000	150	178	125	146	192	345	294	185	173	303	200	257	212
2001	279	139	118	128	101	161	139	127	111	183	216	437	179
2002	319	124	136	129	119	183	165	175	298	248	216	305	202
2003	208	175	158	86	124	183	222	110	154	215	275	280	183
2004	276	276	262	144	202	221	193	134	155	165	258	200	207
2005	283	186	222	133	131	116	113	135	237	143	154	147	167
2006	199	116	112	163	166	170	108	96	164	252	297	311	180
2007	211	170	137	110	137	207	160	144	132	236	204	243	174
2008	217	153	190	112	114	121	129	83	207	248	243	336	180
2009	296	154	166	226	324	169	89	199	251	138	140	298	205
2010	289	128	120	241	341	131							210
Min.	114	87	88	80	84	60	60	60	62	74	95	147	123
Mean	244	210	200	194	184	159	128	130	161	221	259	268	197
Max.	562	566	429	463	341	345	294	267	563	449	679	606	270

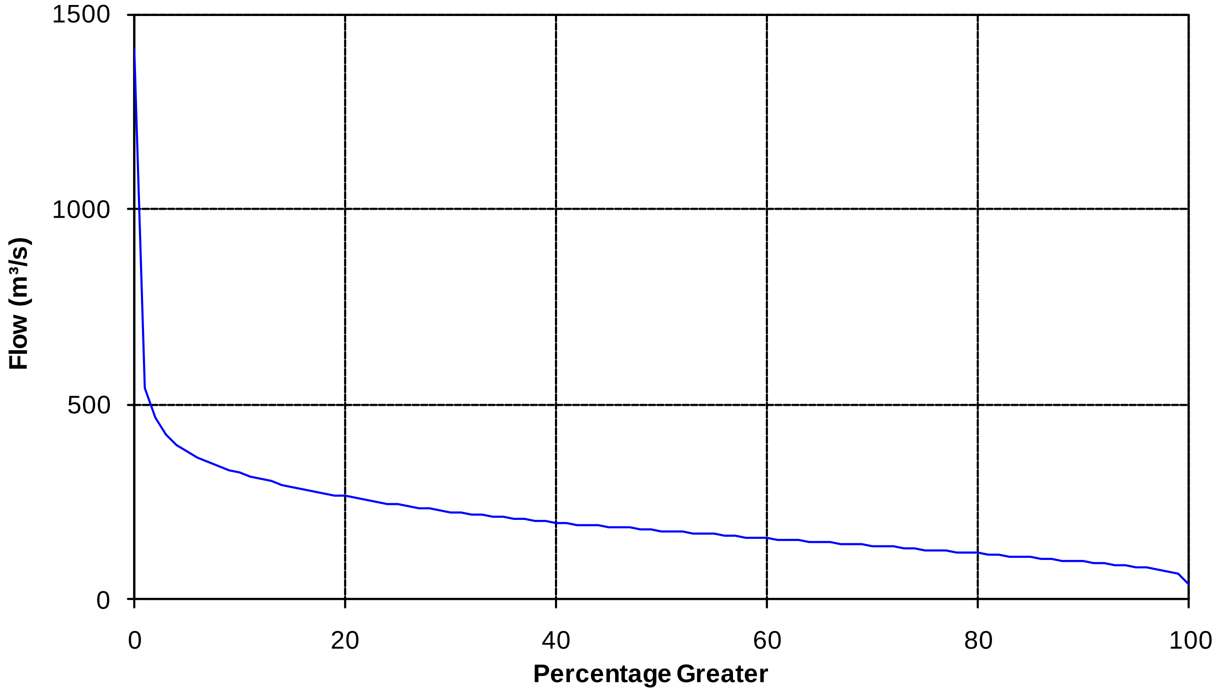

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	1414	539	464	424	397	377	364	352	341	330
10	322	315	308	301	295	289	283	277	273	268
20	263	259	254	250	246	242	238	234	231	227
30	224	221	218	215	212	209	207	204	202	199
40	197	194	192	190	187	185	183	181	179	177
50	175	173	171	169	167	165	163	161	160	158
60	156	154	152	151	149	147	145	143	141	139
70	137	135	133	131	129	127	125	123	121	119
80	117	115	112	110	108	106	104	102	100	98
90	95	93	91	88	85	83	80	76	72	66
10	39									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	39	197	175	1414

8.20 Lake Hawea Inflow – 9170 (Item: 1)

Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							43	36	35	108	70	73	61
1932	51	52	41	55	30	10	19	20	32	73	84	69	45
1933	50	112	78	126	81	32	70	42	52	81	55	75	71
1934	54	39	38	99	100	48	34	73	57	136	60	57	66
1935	88	64	74	54	63	52	26	36	24	62	62	67	56
1936	40	57	48	77	47	28	41	91	81	160	143	88	75
1937	79	61	52	102	82	60	23	39	42	41	54	61	58
1938	80	49	61	88	43	51	32	62	58	85	83	91	65
1939	45	46	37	43	51	69	29	24	93	54	95	84	56
1940	80	93	83	56	94	60	31	29	45	125	86	74	71
1941	52	49	52	46	46	61	58	24	27	33	107	77	53
1942	81	39	58	102	122	42	68	35	83	172	92	90	82
1943	66	72	81	81	58	47	40	28	59	41	32	38	53
1944	74	90	73	90	58	39	52	42	21	96	95	80	68
1945	132	126	113	77	41	25	23	53	119	64	166	102	86
1946	85	90	54	28	36	27	41	66	106	140	58	99	69
1947	61	46	28	22	23	38	35	35	57	103	76	74	50
1948	54	44	44	29	44	37	39	24	56	100	179	96	62
1949	67	133	93	85	69	39	77	65	33	130	61	79	77
1950	125	42	33	28	64	34	55	62	57	52	53	81	57
1951	33	35	30	58	35	24	97	32	57	83	117	80	57
1952	89	110	47	41	55	45	31	19	48	86	55	56	57
1953	28	25	42	115	80	42	36	50	61	37	118	100	61
1954	60	69	79	45	28	54	46	43	32	64	88	53	55
1955	45	108	56	41	100	77	28	44	52	49	56	62	59
1956	48	24	20	79	70	71	44	37	38	65	107	97	58
1957	70	46	53	77	82	46	49	32	28	87	162	206	78
1958	111	179	97	61	125	57	28	30	27	102	81	106	83
1959	46	35	37	35	24	44	21	17	84	51	97	81	48
1960	68	50	41	23	57	49	44	62	74	60	58	36	52
1961	26	41	52	67	23	48	55	51	44	109	93	57	55
1962	60	32	31	21	56	42	87	52	54	124	93	54	59
1963	42	69	52	33	62	51	30	52	76	60	56	40	52

1964	77	31	54	36	87	25	48	55	61	70	78	98	60
1965	148	43	64	36	40	47	26	30	42	65	116	90	62
1966	101	82	47	69	25	35	27	30	48	40	73	70	54
1967	83	67	114	154	60	34	63	110	56	61	114	126	87
1968	57	69	99	43	118	42	33	60	73	128	115	98	78
1969	66	35	51	44	46	29	35	47	195	58	69	110	65
1970	83	31	43	38	20	44	61	107	232	97	103	78	78
1971	33	28	26	22	33	47	25	29	67	128	82	89	51
1972	53	29	71	52	63	42	55	42	135	94	122	63	68
1973	46	27	32	75	58	73	50	67	50	89	137	42	62
1974	30	68	56	49	39	44	58	28	32	74	75	53	50
1975	34	64	84	120	104	61	71	89	75	94	83	59	78
1976	51	36	46	47	63	71	48	45	39	49	44	98	53
1977	84	45	36	44	44	35	45	26	46	51	63	58	48
1978	54	24	40	48	73	36	32	91	79	115	85	56	61
1979	59	67	99	83	90	44	51	55	95	111	86	171	85
1980	107	70	61	72	65	58	54	99	106	106	97	77	81
1981	44	46	109	66	57	68	55	49	54	110	62	94	68
1982	80	55	78	29	112	58	46	76	61	58	153	104	76
1983	139	41	56	79	111	59	74	91	107	166	139	96	97
1984	103	64	96	45	47	57	92	69	61	144	114	232	94
1985	164	44	32	54	50	73	50	90	99	46	99	96	75
1986	86	55	64	66	45	105	51	70	50	72	65	69	67
1987	90	77	116	85	84	101	45	72	63	121	67	59	82
1988	48	50	48	37	41	63	65	92	110	199	123	96	81
1989	59	45	94	35	30	67	53	67	53	53	60	121	62
1990	61	34	59	48	104	67	48	54	19	70	54	122	62
1991	80	86	26	68	23	21	18	126	104	74	46	62	61
1992	57	52	32	28	20	19	48	57	21	103	99	55	49
1993	73	40	35	36	61	126	56	33	32	104	44	66	59
1994	215	47	53	42	52	54	48	59	58	49	187	92	80
1995	75	48	95	80	50	30	22	56	174	111	94	251	91
1996	69	62	58	110	62	39	15	19	57	164	70	71	66
1997	41	41	26	79	40	27	29	87	36	70	107	105	57
1998	71	88	101	74	39	63	95	58	71	140	55	53	76
1999	28	28	56	72	68	45	44	23	53	83	227	40	64

2000	58	37	23	41	69	152	81	40	86	110	46	114	71
2001	55	31	30	18	26	63	26	38	33	53	70	139	49
2002	91	18	31	29	21	75	35	74	133	62	70	103	62
2003	60	50	30	12	51	75	49	28	68	73	87	78	55
2004	98	88	76	25	79	86	40	59	59	61	94	73	70
2005	75	42	57	22	38	30	30	51	86	47	45	45	48
2006	56	20	24	58	50	46	32	29	73	90	130	85	58
2007	55	29	31	18	44	59	47	43	45	95	53	72	49
2008	52	31	39	26	24	44	41	23	113	74	99	110	56
2009	68	37	30	80	115	46	30	103	54	32	52	96	62
2010	79	21	33	79	59	45							53
Min.	26	18	20	12	20	10	15	17	19	32	32	36	45
Mean	71	55	56	58	59	52	45	53	67	87	89	86	65
Max.	215	179	116	154	125	152	97	126	232	199	227	251	97

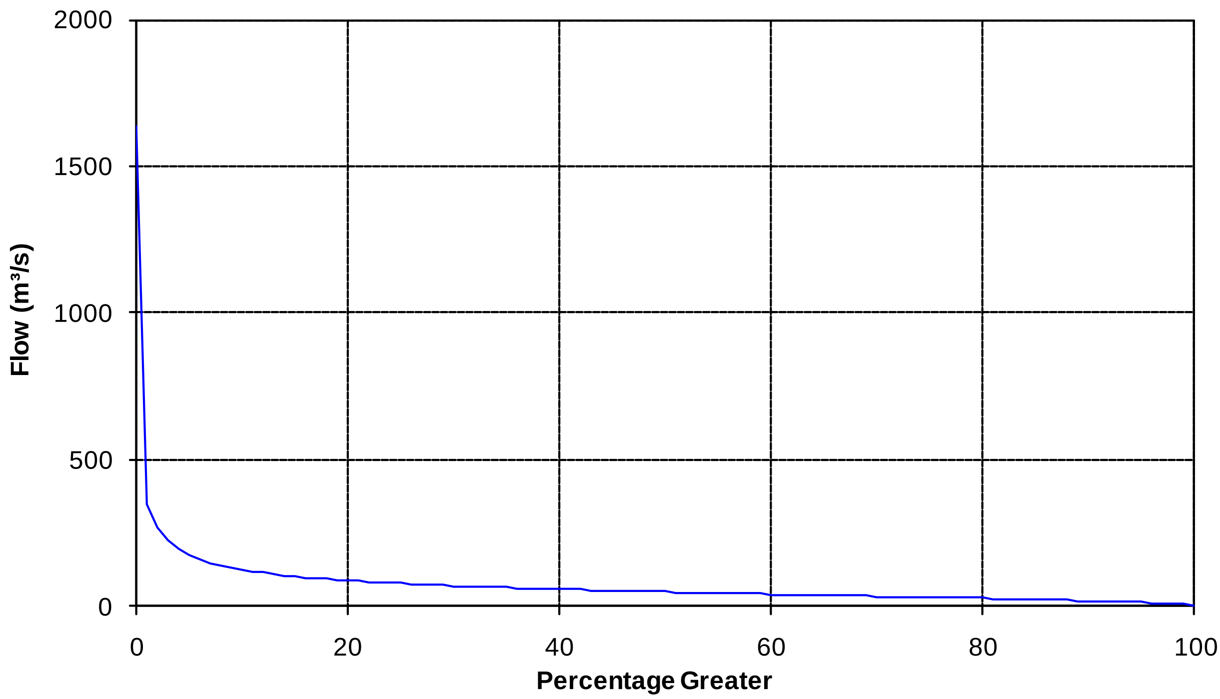

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	1634	343	264	221	194	173	159	147	138	130
10	124	118	113	108	104	100	96	93	91	88
20	85	83	81	79	78	76	74	73	71	70
30	69	67	66	65	63	62	61	60	59	58
40	57	56	55	54	53	52	51	51	50	49
50	48	47	46	46	45	44	43	42	42	41
60	40	39	38	38	37	36	35	35	34	33
70	32	32	31	31	30	30	29	28	27	27
80	26	25	24	23	23	22	21	20	19	18
90	17	16	15	14	13	11	10	9	7	4
100	2									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	2	65	48	1634

8.21 Clutha Tributaries at Roxburgh – 99110 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							329	276	284	537	572	516	419
1932	527	486	344	319	293	201	130	164	255	393	443	474	335
1933	395	586	585	677	655	363	328	455	338	472	429	430	475
1934	429	362	317	534	635	404	330	376	432	705	495	410	453
1935	629	502	435	565	402	409	234	261	188	351	372	394	394
1936	344	361	359	421	442	239	238	361	470	717	839	701	458
1937	578	484	506	630	571	497	312	224	240	250	296	339	410
1938	562	369	390	428	319	327	279	268	432	522	466	549	409
1939	393	370	344	294	324	347	365	226	426	449	573	632	395
1940	468	598	608	482	555	433	280	194	259	519	669	512	464
1941	428	463	363	398	281	376	293	202	209	240	489	565	358
1942	501	384	393	602	603	385	410	277	394	868	710	593	511
1943	496	508	602	416	445	318	283	228	380	429	569	515	432
1944	393	497	521	553	457	337	396	327	309	436	599	529	446
1945	687	729	847	666	461	286	216	292	463	503	802	749	557
1946	542	733	499	310	282	236	227	381	546	875	547	640	483
1947	516	394	303	238	206	250	310	277	301	553	566	465	365
1948	474	327	349	303	225	354	308	234	261	499	1080	685	425
1949	568	738	855	765	445	359	378	386	337	546	497	438	525
1950	729	424	310	274	308	449	313	265	387	369	350	462	387
1951	384	278	229	297	258	252	393	372	342	523	691	561	382
1952	459	776	426	399	383	335	291	195	243	536	425	360	401
1953	271	212	225	339	530	368	238	255	390	276	437	704	355
1954	489	406	468	382	246	266	345	262	261	360	551	421	371
1955	371	495	473	343	580	470	290	264	379	422	335	473	408
1956	307	241	194	320	459	368	335	331	298	380	627	697	380
1957	583	517	416	433	704	357	419	303	217	468	1072	1220	560
1958	950	1274	861	746	929	633	248	236	218	465	652	559	643
1959	389	305	255	192	210	274	267	189	371	426	639	608	344
1960	412	532	375	262	216	345	306	552	468	391	367	333	379
1961	264	243	362	467	278	256	316	389	295	563	645	498	382
1962	481	315	321	183	350	361	399	470	426	514	635	407	406

1963	316	368	400	287	309	333	203	234	456	433	463	335	344
1964	441	343	341	326	469	281	248	236	319	443	450	702	384
1965	813	431	488	347	313	395	301	222	260	450	759	688	456
1966	672	557	378	513	311	205	210	168	205	277	373	577	369
1967	476	635	756	642	694	269	255	524	337	414	620	937	547
1968	603	425	909	463	578	376	220	305	385	654	791	695	535
1969	557	345	389	398	300	203	207	253	945	478	429	647	429
1970	675	454	386	357	227	194	259	507	1272	792	665	680	539
1971	381	255	253	252	278	403	254	204	458	755	598	558	388
1972	495	280	502	525	470	288	291	252	717	675	798	424	476
1973	349	329	240	377	565	419	233	193	318	534	854	391	400
1974	289	341	418	394	212	161	268	250	234	442	445	399	321
1975	306	393	504	957	697	499	275	565	399	471	567	442	506
1976	368	248	243	178	295	458	235	205	180	238	296	605	296
1977	482	473	319	350	379	330	235	156	152	349	573	438	352
1978	400	291	251	528	516	381	215	482	490	837	623	513	461
1979	524	581	541	384	565	363	262	239	351	591	587	943	494
1980	755	675	384	455	463	548	383	523	730	736	658	609	576
1981	434	369	607	420	446	357	282	234	244	593	492	581	423
1982	555	639	681	318	470	458	187	234	388	324	793	821	488
1983	1075	530	475	573	658	418	397	530	550	891	816	642	631
1984	564	642	637	388	407	279	310	487	391	694	691	973	539
1985	1005	475	322	294	379	323	332	367	401	379	438	485	434
1986	627	365	448	393	406	591	362	293	284	504	408	443	428
1987	547	613	661	706	422	677	332	287	378	706	582	404	525
1988	399	368	369	309	212	303	376	401	648	987	941	795	509
1989	531	353	439	382	268	402	339	293	165	285	486	545	374
1990	539	328	412	297	652	452	403	389	226	363	368	664	426
1991	655	706	341	432	275	225	149	642	670	587	477	409	462
1992	467	402	301	299	184	150	258	344	256	512	803	491	372
1993	545	495	292	293	370	698	499	354	302	571	388	466	439
1994	1226	759	540	405	383	424	478	442	433	365	957	834	603
1995	639	454	478	686	426	373	238	290	877	918	705	1345	620
1996	903	538	361	550	489	464	247	197	322	989	621	455	511
1997	398	319	281	466	384	303	228	434	340	386	595	789	411
1998	618	668	757	673	436	427	496	532	421	794	619	380	568
1999	353	274	337	520	497	470	365	247	334	367	1430	641	486

2000	388	401	272	297	399	757	655	436	467	756	504	541	490
2001	602	317	250	270	216	341	289	282	267	391	444	792	373
2002	690	278	287	272	265	425	375	403	676	598	545	695	460
2003	480	381	324	190	265	413	473	263	363	513	599	596	405
2004	554	528	549	322	445	504	454	340	398	433	600	540	472
2005	684	455	493	318	317	275	271	314	445	329	339	328	380
2006	456	269	265	352	390	368	262	245	391	564	643	729	412
2007	484	367	319	252	310	438	356	376	347	607	533	506	408
2008	453	326	371	230	224	255	294	214	487	610	508	667	387
2009	609	356	289	423	718	404	219	474	565	369	382	610	452
2010	630	318	272	528	793	354							486
Min.	264	212	194	178	184	150	130	156	152	238	296	328	296
Mean	532	451	426	416	415	371	307	321	393	525	591	585	444
Max.	1226	1274	909	957	929	757	655	642	1272	989	1430	1345	643

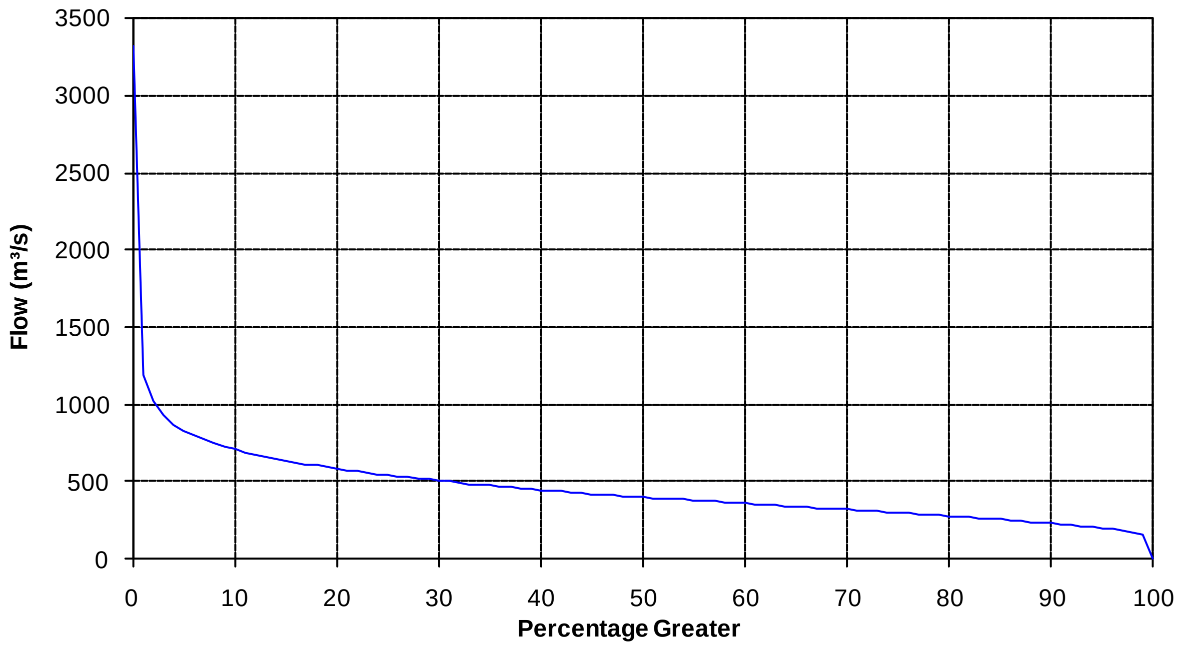

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	3315	1189	1025	934	872	831	799	771	748	725
10	708	692	677	664	651	638	625	615	605	595
20	585	575	565	556	548	540	533	526	520	513
30	506	499	492	486	479	473	467	462	456	450
40	445	440	435	430	425	421	416	412	407	403
50	399	395	391	387	382	378	375	370	366	362
60	358	354	350	346	342	338	334	330	326	322
70	318	314	310	306	302	298	294	290	285	281
80	276	271	267	263	258	253	249	244	239	234
90	228	222	216	211	204	198	191	182	172	156
100	3									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	3	444	399	3315

8.22 Manapouri Local Inflow at Water Right Reduction – 99552 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							146	117	102	162	201	183	152
1932	200	177	76	85	97	63	46	76	108	94	163	64	104
1933	62	156	124	174	266	41	52	113	139	176	91	94	124
1934	87	15	116	135	177	68	96	147	182	192	55	48	111
1935	188	24	128	64	115	86	55	120	51	180	76	103	100
1936	110	75	65	106	134	65	87	185	201	269	187	123	134
1937	152	117	86	122	154	77	115	93	85	82	118	98	108
1938	115	72	44	24	74	97	83	100	111	223	111	118	98
1939	164	137	32	86	111	128	75	82	196	109	165	168	121
1940	85	337	96	107	165	141	54	72	112	198	110	110	131
1941	78	119	75	104	155	121	84	46	135	89	232	101	111
1942	123	68	120	103	182	113	141	132	184	180	167	136	138
1943	71	127	134	120	130	90	85	41	112	118	144	79	104
1944	73	128	50	128	61	164	98	69	123	186	177	119	114
1945	142	96	202	99	135	54	55	117	161	112	251	129	130
1946	93	229	35	63	38	43	91	174	232	253	120	211	131
1947	93	62	16	15	76	132	90	111	184	164	114	102	97
1948	104	57	105	48	114	81	136	80	189	227	192	211	129
1949	69	167	150	109	62	32	190	125	87	214	52	125	115
1950	186	102	53	51	63	104	130	89	117	81	83	150	101
1951	40	25	30	44	99	97	228	115	175	166	166	107	108
1952	223	136	109	79	147	164	81	32	132	203	60	56	118
1953	7	15	78	174	128	56	108	143	167	80	170	157	107
1954	101	106	113	81	30	265	115	116	138	201	141	73	123
1955	165	121	68	70	167	174	69	116	174	98	157	73	121
1956	44	34	43	110	84	139	128	113	149	109	139	179	106
1957	169	87	59	130	223	200	138	102	70	211	343	239	165
1958	158	217	131	130	324	212	51	88	110	136	100	93	145
1959	47	95	44	72	122	196	124	52	210	125	222	117	118
1960	108	155	59	43	56	141	106	175	98	85	95	98	102
1961	53	79	60	151	122	180	193	114	84	232	254	99	135
1962	115	82	56	67	147	150	167	98	150	143	102	73	113

1963	123	116	69	67	164	90	53	131	135	174	211	116	121
1964	233	59	115	106	186	79	94	137	152	142	207	157	139
1965	88	85	91	69	195	187	47	11	153	163	212	152	121
1966	150	132	71	137	77	122	69	66	54	90	112	145	102
1967	116	132	118	246	177	38	70	148	91	154	248	211	146
1968	125	161	148	67	135	38	90	135	153	252	186	93	132
1969	76	40	101	91	58	86	107	128	344	243	116	139	128
1970	100	64	60	86	25	67	177	194	319	201	99	123	127
1971	28	1	54	58	78	75	41	87	165	142	95	45	73
1972	56	17	125	83	145	120	133	51	309	185	150	57	119
1973	63	98	36	130	181	123	38	55	79	152	137	71	97
1974	34	71	44	24	48	91	134	30	61	80	57	41	60
1975	61	80	108	179	168	105	127	186	111	107	68	99	117
1976	63	31	37	46	158	164	108	62	33	57	95	90	79
1977	160	140	37	140	144	116	48	23	82	195	154	82	110
1978	101	56	69	74	174	43	68	169	74	145	149	61	99
1979	232	126	50	98	126	126	126	68	197	119	56	164	124
1980	145	120	77	42	127	116	76	244	224	158	166	94	132
1981	84	90	54	110	111	92	103	57	171	229	88	165	113
1982	216	160	112	62	228	87	84	199	98	141	363	147	158
1983	296	80	129	104	130	135	118	98	178	112	123	146	138
1984	235	105	54	120	165	155	100	156	131	223	141	141	144
1985	213	69	39	88	100	125	123	90	4	81	71	69	90
1986	159	128	84	134	120	184	144	96	136	167	100	133	132
1987	145	201	141	105	129	143	119	148	162	229	97	71	141
1988	234	138	76	85	118	196	191	165	259	473	241	148	194
1989	77	56	88	75	55	135	77	78	26	79	155	145	87
1990	130	52	62	94	244	148	97	69	73	142	53	236	117
1991	145	193	36	83	102	117	43	205	125	213	134	93	124
1992	113	175	96	77	71	62	166	119	56	144	113	69	105
1993	218	111	48	57	99	218	151	117	95	215	91	111	128
1994	194	68	71	104	187	115	174	187	131	101	271	134	145
1995	145	58	160	68	165	96	82	152	276	177	115	234	145
1996	89	72	37	117	163	160	61	71	138	230	124	141	117
1997	29	89	58	151	130	90	103	201	77	189	307	255	140
1998	117	233	168	189	109	171	134	147	195	272	69	78	156
1999	61	23	75	80	195	118	127	115	84	126	193	68	106

2000	46	68	35	68	214	187	110	125	166	212	98	215	129
2001	109	74	52	84	68	183	47	115	103	105	139	140	101
2002	71	83	87	75	160	249	113	154	223	141	176	216	146
2003	91	118	42	37	177	191	113	105	193	146	228	140	131
2004	113	179	80	86	147	235	71	121	176	125	159	133	135
2005	137	126	129	74	168	136	149	131	88	81	103	70	116
2006	265	56	87	67	85	94	122	132	226	150	213	100	134
2007	89	52	65	51	180	96	134	162	130	232	100	92	116
2008	70	63	90	40	52	122	119	66	217	181	161	95	106
2009	199	48	49	69	156	53	86	195	167	108	164	167	122
2010	158	41	131	294	69	74							129
Min.	7	1	16	15	25	32	38	11	4	57	52	41	60
Mean	122	101	81	95	132	122	105	115	143	163	148	123	121
Max.	296	337	202	294	324	265	228	244	344	473	363	255	194

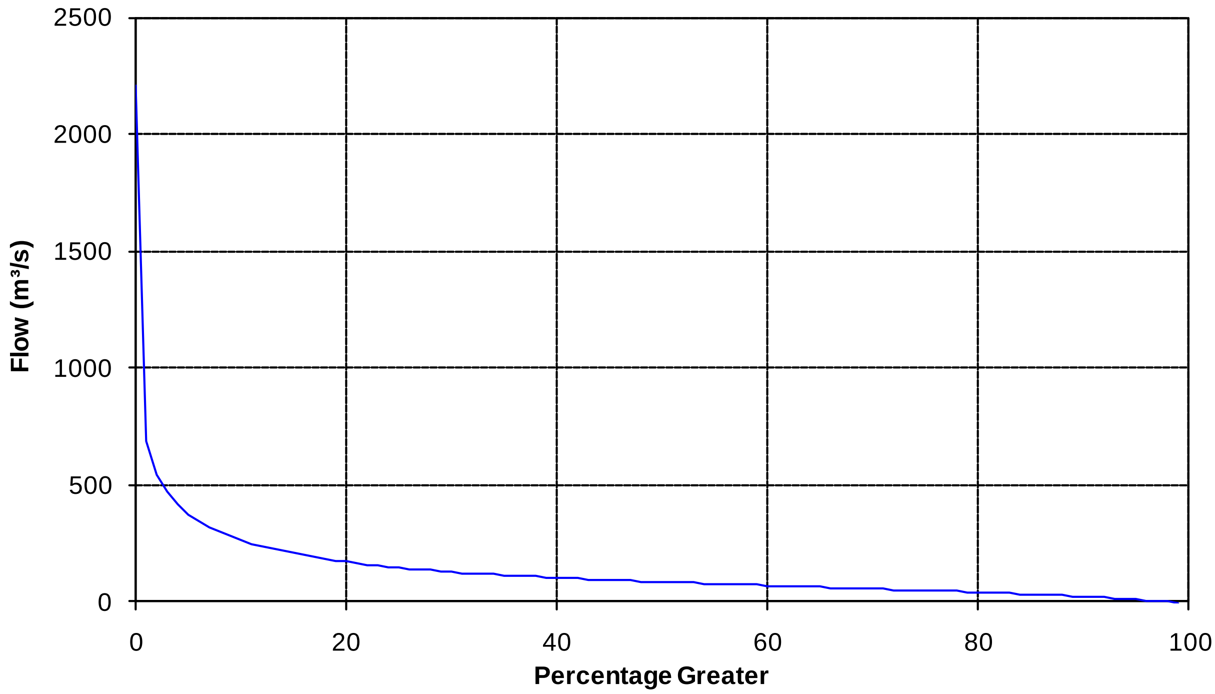

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	2207	685	543	468	411	371	342	316	296	278
10	262	248	234	223	213	205	197	189	183	176
20	170	164	158	153	149	144	139	135	132	129
30	125	122	120	116	114	111	109	107	104	102
40	100	98	96	94	92	91	89	87	85	83
50	82	80	78	77	75	74	72	71	69	68
60	66	65	64	62	61	60	58	57	55	54
70	52	51	49	48	47	45	44	42	41	39
80	38	36	35	33	31	30	28	26	24	22
90	20	18	16	13	10	7	4	1	-4	-11
100	-90									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	-90	121	82	2207

8.23 Lake Te Anau Inflow – 9570 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							266	190	177	458	385	299	296
1932	447	263	139	243	196	145	108	175	245	281	446	234	243
1933	245	484	380	591	556	110	181	281	318	467	255	295	346
1934	238	101	324	385	420	193	230	321	416	430	205	198	290
1935	600	146	317	241	265	197	138	242	111	390	176	217	255
1936	248	184	203	331	316	143	194	433	428	653	559	300	333
1937	407	246	236	419	272	135	211	174	188	172	244	187	241
1938	330	188	214	166	192	241	116	260	283	523	261	373	263
1939	329	367	115	324	249	350	177	142	305	220	378	431	281
1940	189	746	310	275	361	286	111	200	260	547	257	302	319
1941	309	247	235	276	354	214	205	109	262	209	563	210	266
1942	327	177	336	369	483	241	312	286	412	460	417	269	342
1943	258	369	352	374	263	217	169	133	226	241	302	217	259
1944	183	335	196	372	170	338	251	169	268	417	400	286	281
1945	352	332	582	380	197	126	139	297	323	259	690	284	330
1946	294	633	157	171	135	134	225	371	450	567	228	479	319
1947	194	174	100	112	215	316	184	221	404	331	287	219	230
1948	220	145	364	148	247	176	288	180	396	479	480	489	302
1949	196	511	420	432	160	104	365	287	196	440	200	348	304
1950	451	221	210	196	277	218	251	200	264	190	191	338	251
1951	132	123	126	182	173	107	440	151	343	321	395	218	226
1952	382	423	321	245	350	300	140	95	279	458	146	146	273
1953	69	80	232	438	242	145	218	280	374	160	408	382	253
1954	226	276	406	218	84	422	312	221	244	378	353	192	277
1955	312	330	276	194	381	305	122	254	368	181	325	239	273
1956	157	101	154	378	200	312	220	246	269	238	332	409	251
1957	373	220	197	340	407	249	297	197	164	407	708	604	348
1958	422	666	453	458	725	423	112	196	227	370	264	242	378
1959	131	246	179	199	181	369	206	133	438	233	455	233	249
1960	248	315	135	172	184	248	226	361	248	175	197	212	226
1961	120	152	201	396	196	293	274	199	206	437	447	243	264
1962	282	184	138	145	310	320	369	232	359	320	231	165	255
1963	252	270	270	193	324	168	104	256	270	294	362	198	247

1964	519	118	374	239	414	118	207	275	304	299	440	393	310
1965	261	174	256	194	355	325	139	92	337	330	463	291	268
1966	303	325	197	376	114	242	106	131	167	183	261	312	225
1967	335	340	359	617	301	73	189	322	198	283	533	473	335
1968	251	356	433	196	337	101	129	267	335	607	471	275	313
1969	204	104	357	283	153	156	218	297	615	321	172	390	274
1970	241	221	200	304	64	138	404	478	610	346	318	381	309
1971	118	72	151	144	160	200	85	232	508	465	355	293	232
1972	276	95	569	308	276	146	260	98	698	376	403	185	308
1973	149	240	182	452	407	274	95	144	204	386	431	171	261
1974	111	258	198	171	112	221	292	70	160	237	155	180	180
1975	168	289	353	600	509	198	308	330	304	334	294	316	334
1976	165	109	185	165	322	339	186	119	75	137	182	277	189
1977	334	260	173	470	242	253	106	79	196	405	306	204	252
1978	228	135	297	291	531	149	140	387	176	401	396	178	277
1979	514	378	183	274	296	249	247	138	420	315	196	564	314
1980	401	316	275	144	292	227	162	536	530	379	347	267	323
1981	182	220	229	328	203	174	193	93	287	454	157	358	240
1982	437	433	411	143	525	174	109	337	212	246	755	354	344
1983	760	129	443	267	382	265	223	296	453	288	336	309	348
1984	552	247	203	325	276	254	218	311	271	522	298	443	328
1985	633	142	130	259	225	269	224	249	376	149	156	211	253
1986	340	232	217	383	208	433	251	162	229	319	199	311	274
1987	296	393	367	282	315	386	188	275	298	487	204	238	310
1988	286	252	203	197	184	340	331	318	564	1007	421	442	379
1989	185	166	315	152	190	304	199	203	78	234	384	383	233
1990	277	126	251	306	528	360	245	164	123	285	147	590	285
1991	405	415	105	299	162	180	100	571	288	429	205	167	276
1992	237	336	254	196	118	123	357	226	90	365	247	163	226
1993	445	189	124	151	232	526	306	194	192	458	183	247	271
1994	603	179	174	310	393	235	300	382	263	167	691	287	333
1995	340	142	480	253	362	169	144	318	645	391	258	656	348
1996	228	195	136	417	288	342	84	127	299	632	251	295	274
1997	85	218	194	452	237	131	190	434	128	342	614	562	299
1998	263	545	518	510	229	342	320	286	365	610	146	167	357
1999	156	111	312	282	431	235	250	179	188	326	643	144	272

2000	134	217	144	211	451	496	233	207	336	505	159	518	302
2001	180	128	216	194	160	375	109	224	198	234	312	351	224
2002	181	160	302	157	222	498	214	312	588	295	350	457	312
2003	173	241	132	84	339	468	250	229	448	310	476	332	290
2004	317	380	278	192	350	521	166	253	334	222	339	239	298
2005	257	281	429	178	320	201	252	254	209	172	211	165	244
2006	474	126	227	262	190	182	225	216	460	328	476	269	287
2007	221	135	269	134	421	201	284	355	304	553	196	215	276
2008	199	180	234	110	150	235	220	109	459	340	330	258	235
2009	443	128	203	361	381	120	206	439	302	191	281	366	287
2010	340	93	364	818	205	136							328
Min.	69	72	100	84	64	73	84	70	75	137	146	144	180
Mean	293	250	264	289	287	248	213	243	311	359	338	305	283
Max.	760	746	582	818	725	526	440	571	698	1007	755	656	379

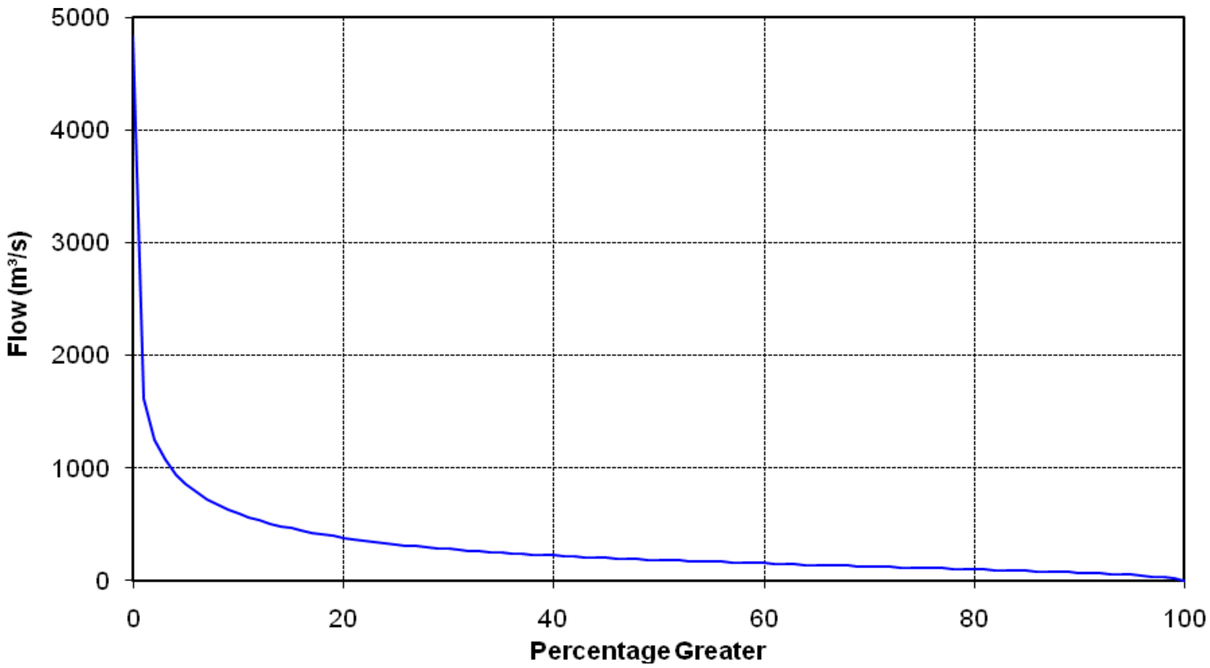

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	4830	1616	1255	1073	944	862	789	724	675	635
10	596	564	534	510	487	466	446	428	410	396
20	383	369	355	344	333	323	314	305	297	289
30	282	275	268	262	256	250	244	239	234	229
40	224	220	216	212	207	204	200	196	192	189
50	185	181	179	176	172	169	167	164	161	158
60	155	153	149	146	143	141	138	135	133	131
70	128	125	122	120	118	115	112	110	107	105
80	102	99	96	93	91	88	85	81	78	76
90	72	68	65	61	56	52	45	39	30	20
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	284	185	4830

8.24 Benmore at Ben_tp – 98615 (Item: 2)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							57	46	48	154	127	157	98
1932	150	140	78	81	68	54	30	28	45	110	163	140	90
1933	143	251	170	227	143	65	120	112	61	119	118	179	142
1934	161	121	95	171	157	90	60	89	100	223	128	127	127
1935	215	145	131	104	106	81	39	58	35	94	109	160	106
1936	108	123	96	142	79	42	59	91	87	241	227	172	122
1937	168	146	105	174	104	69	42	41	54	64	99	138	100
1938	218	137	147	207	85	84	52	82	103	129	150	186	132
1939	106	113	91	67	88	105	58	37	86	94	159	167	97
1940	197	245	198	126	138	88	44	35	50	165	145	143	131
1941	131	150	111	106	77	105	75	39	38	49	176	161	101
1942	164	115	137	253	201	68	97	54	85	294	198	203	156
1943	145	185	138	124	75	55	54	37	83	134	162	170	113
1944	151	220	166	201	100	65	76	62	64	132	200	177	134
1945	346	272	219	159	82	49	45	86	161	115	317	217	172
1946	221	239	132	79	66	49	48	98	156	210	117	206	135
1947	146	129	85	49	51	57	54	53	78	188	151	191	103
1948	139	97	110	76	51	82	77	47	85	174	291	209	120
1949	153	279	164	157	120	76	96	78	56	212	136	134	138
1950	226	107	82	64	115	82	96	90	128	112	115	190	118
1951	129	89	65	143	76	52	122	80	116	165	238	201	123
1952	177	255	103	73	117	87	56	36	76	161	135	174	120
1953	96	91	90	177	151	93	61	80	110	65	212	193	118
1954	136	159	130	89	62	104	81	68	66	99	162	139	108
1955	102	241	116	69	168	123	54	74	106	98	97	132	114
1956	91	83	47	136	123	139	96	71	67	120	192	196	113
1957	137	103	101	145	175	70	88	48	45	166	285	420	149
1958	302	358	206	167	246	130	58	58	50	149	152	252	176
1959	125	92	83	79	61	87	48	39	107	103	200	182	100
1960	166	132	112	71	96	84	73	102	146	118	113	95	109
1961	72	101	121	140	70	83	104	108	87	182	176	134	115

1962	131	79	81	47	105	92	119	102	103	160	187	112	110
1963	93	122	120	69	95	91	55	71	147	121	114	96	99
1964	139	80	108	67	142	58	64	66	77	112	139	178	103
1965	261	128	126	74	70	76	49	46	70	115	220	203	120
1966	251	166	105	125	57	61	45	49	58	81	133	152	106
1967	192	161	235	253	128	53	103	167	66	109	224	273	164
1968	166	153	191	98	196	79	52	108	126	219	192	192	148
1969	165	104	110	111	81	54	47	55	279	99	119	228	121
1970	165	105	107	100	47	60	72	168	380	174	209	187	148
1971	101	73	72	68	81	110	52	45	102	212	160	178	105
1972	127	72	129	102	115	59	66	52	197	156	258	156	124
1973	113	76	66	131	129	98	48	52	64	175	248	104	109
1974	79	146	135	135	63	58	82	53	63	113	175	144	104
1975	121	135	169	263	180	99	84	128	110	152	174	142	146
1976	134	88	88	58	100	125	54	47	45	68	85	209	92
1977	180	139	100	87	87	73	63	38	50	94	126	127	97
1978	133	81	102	133	176	99	68	156	150	201	174	139	135
1979	130	138	211	172	197	85	63	57	109	201	186	379	161
1980	245	152	121	156	121	111	65	108	138	161	174	174	144
1981	111	120	207	127	110	121	68	51	59	173	116	171	120
1982	193	121	158	63	141	80	42	68	85	72	290	217	128
1983	266	95	128	133	179	85	86	111	144	273	246	189	162
1984	195	122	151	82	74	59	100	107	76	188	213	399	148
1985	242	87	67	81	80	80	78	106	97	82	161	192	113
1986	154	143	170	126	86	144	66	73	76	143	126	132	120
1987	190	179	217	167	137	164	57	64	85	200	145	130	144
1988	106	122	101	75	73	96	107	107	170	292	224	192	139
1989	132	113	184	80	69	115	70	56	41	67	114	261	109
1990	148	90	122	93	205	109	91	100	51	136	125	250	127
1991	160	203	69	143	61	56	38	172	165	140	110	143	121
1992	135	121	84	67	55	31	68	108	49	150	193	135	100
1993	171	114	89	89	112	213	90	64	64	184	93	145	119
1994	405	117	147	94	99	96	92	96	96	86	330	206	156
1995	178	111	193	169	96	73	54	84	258	210	181	440	171
1996	156	151	124	202	124	85	46	45	86	249	138	150	129
1997	122	143	95	158	85	58	53	124	64	120	202	206	119
1998	149	179	195	159	92	112	158	106	116	254	130	121	148

1999	94	87	116	125	123	89	81	51	76	137	348	100	119
2000	135	101	69	109	119	227	130	88	158	200	115	240	141
2001	140	89	79	62	64	98	58	68	60	101	134	266	102
2002	213	74	90	78	63	134	74	114	186	106	140	209	124
2003	143	124	81	59	122	125	91	48	97	115	155	158	110
2004	198	185	180	77	145	125	75	85	90	109	173	136	131
2005	168	118	120	69	76	62	65	84	139	90	101	105	100
2006	133	73	72	124	95	91	68	64	116	154	229	158	115
2007	131	90	79	56	78	89	82	75	76	155	111	148	98
2008	107	87	92	61	57	67	78	53	180	133	179	202	108
2009	144	107	87	169	209	80	59	153	107	80	119	186	125
2010	190	76	86	92	76	54							96
Min.	72	72	47	47	47	31	30	28	35	49	85	95	90
Mean	162	135	122	118	108	88	71	77	101	146	171	184	124
Max.	405	358	235	263	246	227	158	172	380	294	348	440	176

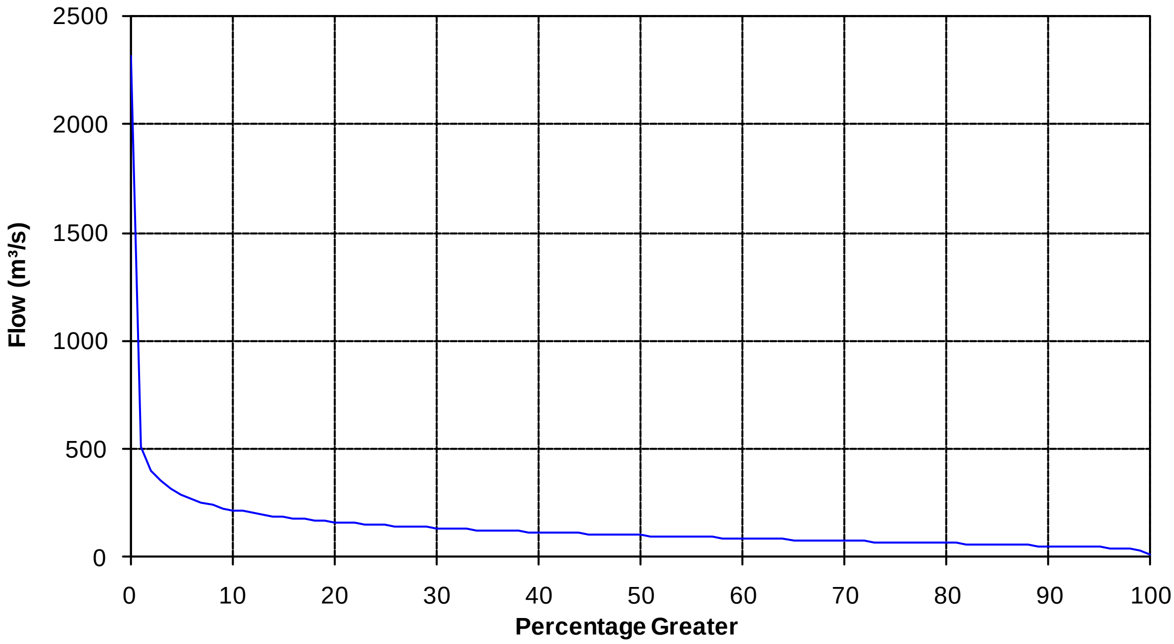

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	2313	509	399	347	311	286	267	251	239	226
10	217	209	202	195	189	183	178	173	169	165
20	161	158	155	152	149	146	143	140	138	135
30	133	131	129	127	125	123	121	118	117	115
40	113	112	110	108	107	105	104	102	101	99
50	98	97	95	94	93	91	90	89	87	86
60	85	84	83	82	80	79	78	77	75	74
70	73	72	71	69	68	67	66	65	64	63
80	62	61	60	58	57	56	55	53	52	51
90	50	48	47	46	44	43	42	39	36	33
100	8									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	8	124	98	2313

8.25 Karapiro Tributaries at Karapiro – 92714 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							88	69	65	61	62	66	69
1932	70	82	86	77	82	107	92	68	78	85	66	77	81
1933	79	56	72	65	83	74	78	84	89	79	83	77	77
1934	79	82	75	74	82	99	121	110	87	97	96	78	90
1935	71	73	74	97	101	135	119	149	130	124	155	112	112
1936	127	154	128	110	127	108	140	137	148	127	129	119	129
1937	137	109	106	111	145	111	94	94	94	90	86	92	106
1938	73	107	74	95	108	88	116	130	122	97	102	128	103
1939	92	63	53	58	79	98	107	136	129	103	82	94	91
1940	93	119	101	78	91	93	86	90	92	93	102	82	93
1941	82	76	96	88	82	112	114	110	107	141	98	101	101
1942	90	74	80	78	84	72	116	134	199	143	103	117	108
1943	90	142	47	75	76	119	103	81	131	142	123	82	101
1944	70	94	105	88	79	109	121	119	119	117	94	95	101
1945	105	95	102	85	116	106	131	138	146	125	111	91	113
1946	68	70	81	91	92	92	107	158	137	114	99	92	100
1947	77	71	78	87	82	129	52	8	7	28	40	71	61
1948	74	65	62	83	111	106	124	106	97	134	107	84	96
1949	84	72	73	89	112	127	100	82	86	80	74	70	87
1950	60	72	59	68	69	84	96	94	89	75	93	62	77
1951	62	59	63	67	69	71	118	92	70	92	105	88	80
1952	69	69	63	67	71	156	111	94	85	98	153	125	97
1953	86	83	63	72	136	136	73	119	113	83	93	88	95
1954	72	76	88	81	87	99	106	114	98	69	68	75	86
1955	54	67	56	75	71	87	91	95	88	88	73	67	76
1956	65	54	53	80	83	166	133	118	105	115	113	104	99
1957	81	73	87	70	94	100	111	94	86	107	94	87	90
1958	73	126	77	62	86	82	98	115	110	105	96	134	97
1959	85	86	79	115	114	101	102	100	99	117	90	92	98
1960	78	92	80	77	93	108	114	117	129	98	87	84	96
1961	82	72	72	69	81	88	108	90	99	85	72	83	84
1962	71	67	119	90	108	132	110	122	131	147	147	144	116

1963	107	92	88	83	93	106	139	112	131	102	103	86	104
1964	87	80	101	85	89	110	176	137	129	141	95	103	111
1965	96	135	109	98	99	125	118	137	105	96	104	87	109
1966	103	94	111	94	114	118	167	145	154	128	121	117	123
1967	115	137	114	97	101	106	110	145	131	106	136	137	119
1968	104	95	84	106	119	150	142	137	130	116	107	122	118
1969	89	105	83	84	99	100	105	104	115	81	86	67	93
1970	66	63	52	62	70	100	90	140	123	153	114	84	93
1971	76	90	76	70	86	105	89	94	153	149	111	102	100
1972	79	82	93	87	94	83	139	110	115	101	82	82	96
1973	71	64	62	72	71	92	78	94	125	92	86	78	82
1974	59	72	65	70	71	108	135	129	115	107	83	100	93
1975	99	78	87	72	90	121	102	129	121	110	91	77	98
1976	94	98	79	76	89	98	133	130	114	105	92	89	100
1977	82	76	70	66	87	122	133	112	105	104	83	92	95
1978	69	66	69	73	66	78	110	86	94	81	97	77	81
1979	62	75	105	87	106	85	100	136	121	137	113	98	102
1980	102	90	85	96	80	85	106	114	120	92	92	105	97
1981	81	66	75	75	74	107	115	118	100	97	96	102	92
1982	76	80	70	69	80	77	79	80	82	80	68	72	76
1983	64	62	56	64	67	78	74	70	89	121	91	74	76
1984	64	70	72	74	65	62	90	95	85	69	70	78	75
1985	69	62	62	58	62	93	84	79	82	70	69	81	73
1986	103	78	69	67	76	77	108	118	98	86	71	66	85
1987	76	60	76	79	80	84	77	83	87	85	74	75	78
1988	63	68	68	56	78	88	101	128	93	127	101	94	89
1989	99	83	72	64	77	109	108	89	101	154	101	85	95
1990	77	68	91	82	103	96	95	175	111	103	103	82	99
1991	76	89	77	70	71	76	97	147	115	105	88	78	91
1992	80	81	73	74	102	90	118	164	135	137	101	130	107
1993	87	75	78	83	93	133	94	86	86	76	89	75	88
1994	69	66	69	81	89	103	134	142	114	133	120	79	100
1995	72	70	67	91	80	121	197	144	136	119	100	93	108
1996	91	87	82	114	106	103	144	159	183	124	106	104	117
1997	84	86	86	85	88	104	92	95	103	102	96	77	91
1998	64	66	67	73	81	105	210	137	99	114	101	80	100
1999	73	67	71	67	77	80	94	95	87	69	94	76	79

2000	64	59	59	71	64	77	77	81	92	111	65	65	74
2001	61	71	65	62	87	72	70	75	66	65	86	99	74
2002	77	62	58	61	65	103	126	83	78	76	68	77	78
2003	57	49	59	58	62	90	68	60	94	106	74	90	72
2004	77	86	91	57	81	117	111	123	94	100	82	86	92
2005	64	61	64	57	77	70	94	91	94	121	71	93	80
2006	75	73	68	88	91	93	97	119	79	72	89	71	85
2007	64	54	68	61	59	70	92	116	75	76	64	63	72
2008	46	48	52	70	68	76	134	178	106	107	73	76	87
2009	55	68	52	59	68	76	100	113	106	138	80	73	83
2010	67	64	54	62	74	112							72
Min.	46	48	47	56	59	62	52	8	7	28	40	62	61
Mean	79	79	77	78	87	100	109	111	107	104	93	89	93
Max.	137	154	128	115	145	166	210	178	199	154	155	144	129

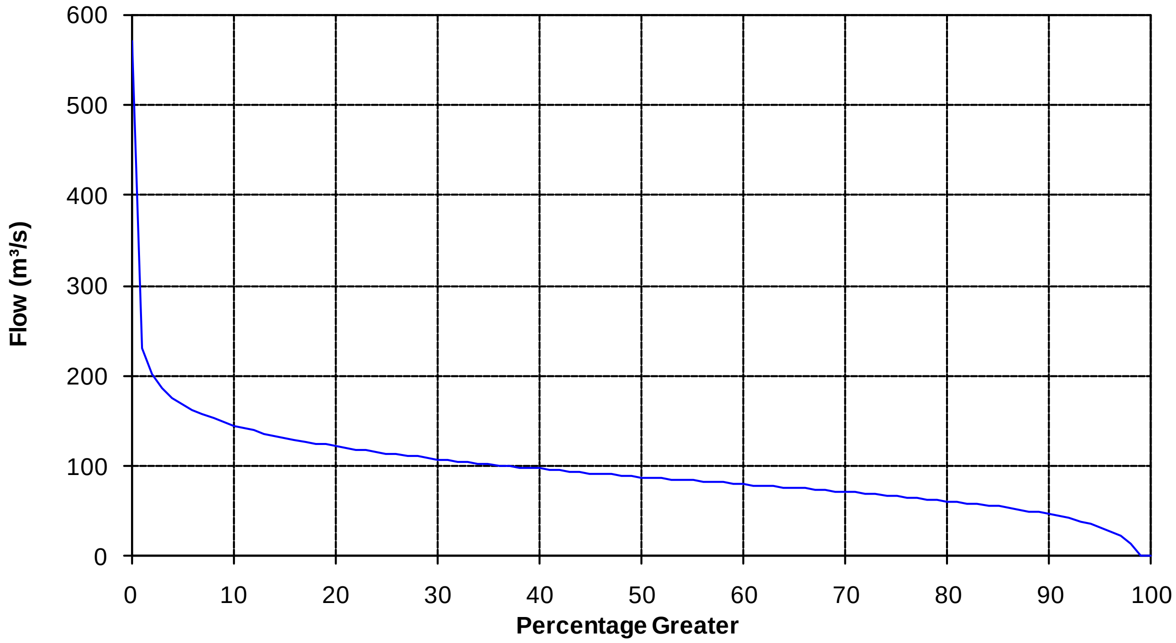

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	572	230	202	186	176	168	162	157	153	149
10	145	142	139	136	134	132	129	127	125	123
20	122	120	118	117	115	114	112	111	110	109
30	108	106	105	104	103	102	101	100	99	98
40	97	96	95	94	93	92	91	90	89	88
50	88	87	86	85	84	83	83	82	81	80
60	79	79	78	77	76	75	75	74	73	72
70	71	70	69	68	67	66	65	64	63	62
80	61	60	59	58	56	55	53	52	50	48
90	46	44	42	39	36	32	28	22	14	0
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	**Minimum**	**Mean**	**Median**	**Maximum**
Jul 1931 to Jun 2010	0	93	88	572

8.26 Manapouri at Manawmara – 99551 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							156	129	114	172	211	194	163
1932	207	189	135	111	114	75	58	86	124	106	172	78	121
1933	76	160	158	228	272	53	63	123	147	182	105	106	139
1934	100	31	158	179	186	78	107	158	193	197	70	62	127
1935	195	39	166	103	127	99	66	132	66	190	92	116	117
1936	124	91	95	138	149	78	98	192	213	272	192	134	148
1937	161	131	145	168	169	89	126	106	101	95	131	113	128
1938	127	86	73	37	89	108	95	108	124	229	126	127	111
1939	175	149	48	112	120	132	87	94	211	123	175	179	133
1940	99	342	125	134	178	151	67	83	128	205	125	122	146
1941	91	132	102	158	163	133	96	58	150	102	239	116	128
1942	135	82	144	182	194	123	150	142	192	190	175	147	155
1943	84	137	177	143	141	101	97	53	125	131	157	93	119
1944	87	140	89	184	73	173	108	81	134	191	187	130	131
1945	154	109	274	197	147	66	66	127	173	125	256	142	153
1946	106	236	50	96	54	55	102	182	242	263	133	222	144
1947	109	77	32	38	89	142	101	121	192	176	127	117	110
1948	116	73	166	73	128	93	146	92	200	233	201	220	145
1949	83	173	203	204	72	45	196	135	103	219	65	136	136
1950	195	116	82	86	72	115	140	100	130	95	97	160	116
1951	56	41	55	69	112	110	236	128	188	178	176	120	123
1952	234	149	155	128	157	173	93	45	145	211	75	70	136
1953	23	30	121	214	136	68	119	153	180	94	178	167	124
1954	115	118	167	142	47	275	126	128	152	211	151	88	143
1955	177	132	101	111	176	184	81	124	188	113	169	86	136
1956	60	50	72	139	94	148	138	123	164	121	150	191	121
1957	178	101	114	163	231	210	149	113	86	217	348	244	180
1958	166	221	169	218	328	220	64	99	124	146	113	107	164
1959	62	108	68	100	134	206	136	64	221	138	231	132	133
1960	122	166	75	82	72	152	117	185	113	99	108	113	117
1961	68	94	103	197	138	190	203	125	101	242	262	112	153
1962	128	97	79	93	157	159	174	110	161	153	115	89	126

1963	135	128	118	113	175	102	65	142	149	183	221	131	138
1964	238	75	169	139	192	92	106	147	165	154	216	165	155
1965	100	101	116	102	205	196	60	24	162	174	221	165	135
1966	162	142	104	213	90	133	82	79	69	102	125	157	121
1967	128	144	145	266	187	51	81	158	105	165	253	222	159
1968	137	172	183	100	144	51	103	144	167	255	191	107	146
1969	90	56	159	133	73	98	119	138	348	254	132	150	146
1970	113	78	79	128	38	79	183	193	326	213	110	134	140
1971	44	17	75	88	93	87	54	98	173	147	107	57	87
1972	67	33	182	125	156	132	143	64	315	194	160	72	137
1973	79	111	62	163	187	133	51	68	95	162	146	86	112
1974	50	84	66	38	65	98	144	43	78	92	73	57	74
1975	77	96	157	229	177	111	134	191	126	116	79	115	134
1976	79	47	75	70	168	172	116	74	46	76	110	103	95
1977	176	153	70	221	149	126	60	36	96	204	164	98	129
1978	117	72	102	106	188	52	80	173	92	155	161	76	115
1979	244	135	79	135	127	136	136	80	210	128	70	170	138
1980	153	129	133	65	139	124	87	244	226	167	175	109	146
1981	100	106	87	148	123	104	115	70	184	237	104	176	130
1982	230	168	151	95	236	96	96	207	110	151	363	157	172
1983	302	96	196	140	142	139	126	101	184	117	133	159	153
1984	245	120	94	194	173	168	113	163	146	230	157	153	163
1985	219	85	63	142	116	133	133	100	14	95	87	85	106
1986	172	143	121	210	131	184	152	105	153	178	114	149	151
1987	159	212	147	151	141	142	129	159	177	237	113	87	154
1988	249	152	139	126	135	204	200	173	267	470	249	160	211
1989	93	72	150	108	72	138	87	91	39	98	171	158	107
1990	145	68	94	160	243	150	100	79	91	154	69	244	134
1991	156	198	57	131	119	129	55	206	137	220	150	109	138
1992	129	190	168	117	86	75	171	126	74	152	126	85	125
1993	229	125	68	81	116	217	158	128	110	222	107	126	141
1994	200	80	99	173	189	121	178	192	138	116	274	143	159
1995	159	74	194	105	178	105	92	156	275	179	125	238	157
1996	101	88	66	166	174	164	74	84	152	232	140	156	133
1997	45	104	108	198	142	103	113	204	95	201	310	259	157
1998	132	244	249	238	126	173	141	153	204	271	82	94	175
1999	77	39	130	135	210	128	134	126	100	138	197	84	125

2000	62	84	73	119	228	186	118	137	179	216	114	228	145
2001	122	90	90	144	84	186	59	123	121	120	152	155	120
2002	86	98	168	117	173	251	123	163	230	148	185	226	164
2003	107	134	75	60	194	194	121	114	196	155	238	155	145
2004	129	190	131	137	161	238	80	129	186	138	173	146	153
2005	149	139	175	107	180	148	158	142	105	95	119	85	134
2006	275	72	151	110	102	105	134	142	237	160	224	113	153
2007	105	68	118	79	197	108	140	171	146	232	112	108	133
2008	86	79	126	59	69	135	130	78	224	190	177	111	122
2009	212	64	95	104	164	65	96	200	180	123	180	179	139
2010	170	57	191	322	77	82							151
Min.	23	17	32	37	38	45	51	24	14	76	65	57	74
Mean	135	114	121	137	144	131	115	124	156	173	159	136	137
Max.	302	342	274	322	328	275	236	244	348	470	363	259	211

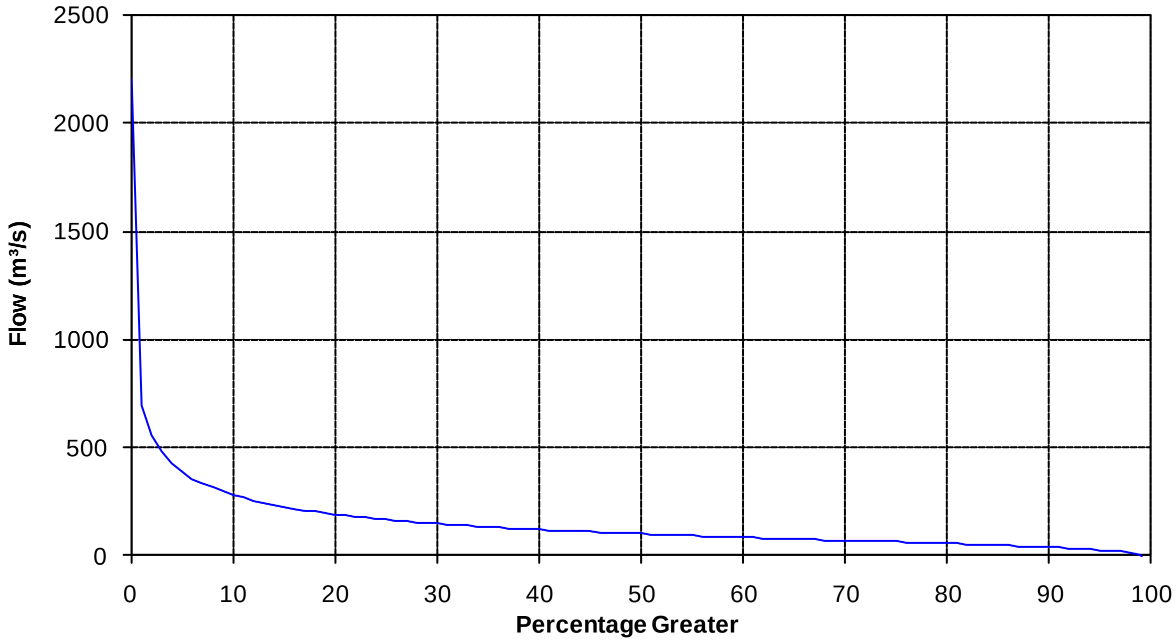

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	2207	695	552	479	425	387	356	331	311	294
10	279	265	253	242	231	223	215	208	201	195
20	189	183	178	173	168	164	160	156	152	148
30	145	141	138	135	132	129	127	124	122	120
40	117	115	113	111	109	107	105	104	102	100
50	98	96	94	93	91	90	88	87	85	83
60	82	80	79	77	76	75	73	72	70	69
70	68	66	65	64	62	61	60	58	57	55
80	54	52	50	49	47	45	44	42	40	38
90	36	34	31	29	26	23	19	15	10	3
100	-90									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	-90	137	98	2207

8.27 Manapouri at Manapouri (no Mararoa) – 99550 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							137	107	95	158	189	174	144
1932	194	175	121	97	94	60	46	73	106	89	159	60	106
1933	59	155	145	215	262	41	51	110	134	168	86	91	126
1934	86	19	143	166	173	65	90	137	176	188	52	48	113
1935	184	26	156	88	113	78	57	112	56	174	72	98	102
1936	112	71	79	118	131	63	83	179	197	267	182	119	134
1937	146	112	128	154	150	77	110	88	85	79	114	94	111
1938	116	73	58	23	72	92	85	95	110	218	103	112	97
1939	157	133	35	101	105	121	72	82	192	102	160	160	118
1940	85	334	109	119	161	135	56	70	110	196	104	105	131
1941	77	115	90	143	151	117	82	49	135	82	226	97	113
1942	123	70	128	167	181	110	135	128	178	174	165	130	141
1943	70	121	158	132	129	85	85	43	111	113	137	75	105
1944	75	124	75	166	57	156	93	66	119	175	168	112	115
1945	139	94	261	180	131	55	56	112	157	106	249	123	139
1946	90	225	37	83	42	44	90	168	228	246	119	204	131
1947	88	59	20	27	76	126	87	107	178	156	110	103	95
1948	103	58	151	59	116	75	125	73	180	220	190	207	130
1949	69	160	189	188	59	34	181	121	88	207	50	120	122
1950	181	98	64	71	62	99	127	85	113	75	84	146	101
1951	41	27	45	52	99	98	226	112	175	162	160	103	109
1952	217	132	141	109	143	158	80	34	135	199	61	58	122
1953	16	23	108	204	116	55	106	138	167	80	166	150	111
1954	102	103	154	126	37	257	111	109	138	194	136	71	128
1955	165	119	79	94	163	169	69	112	173	92	149	75	121
1956	44	38	59	124	81	137	126	110	147	103	134	176	107
1957	164	85	97	147	215	195	136	99	73	203	337	237	166
1958	155	215	154	208	317	206	52	83	113	129	95	91	151
1959	50	94	56	87	117	191	119	53	206	120	216	109	118
1960	108	151	60	66	58	136	101	174	101	83	95	98	102
1961	57	78	85	185	124	177	188	113	81	223	249	98	138
1962	114	81	65	79	142	139	157	90	148	132	100	70	110

1963	120	113	103	96	160	85	55	121	134	167	207	113	123
1964	229	61	160	128	183	80	91	131	149	133	202	152	142
1965	86	83	100	86	189	181	46	13	149	155	205	148	120
1966	147	129	95	196	77	117	70	64	58	86	111	142	107
1967	118	129	130	255	168	43	71	144	91	148	243	205	145
1968	122	158	171	83	128	39	89	130	149	243	180	83	131
1969	73	44	144	119	58	88	101	121	334	239	114	137	131
1970	99	65	68	114	31	66	172	184	319	192	94	121	127
1971	32	9	65	75	82	69	45	82	162	134	93	46	75
1972	57	26	173	115	136	120	129	53	309	177	143	60	125
1973	63	103	50	156	171	116	40	54	78	148	130	71	98
1974	41	73	57	24	54	93	131	28	62	74	59	45	62
1975	68	80	140	221	167	103	120	182	108	98	67	103	122
1976	69	40	69	64	150	156	98	53	30	61	87	86	80
1977	159	138	60	205	134	109	43	28	88	188	148	82	115
1978	104	66	94	93	176	41	60	162	66	141	144	56	101
1979	227	123	66	126	123	115	113	58	192	109	50	161	122
1980	141	115	112	49	130	107	61	234	223	153	161	87	131
1981	88	98	69	138	98	83	95	50	165	220	89	164	113
1982	207	155	137	77	229	81	78	183	90	137	363	138	156
1983	291	81	184	126	141	120	110	95	170	106	112	137	140
1984	230	99	74	175	162	148	92	146	127	215	132	137	145
1985	210	67	53	130	95	118	109	88	32	75	73	68	93
1986	154	128	105	192	114	181	131	86	132	159	96	129	134
1987	138	196	133	133	118	142	104	137	151	221	92	73	136
1988	231	139	121	105	115	184	179	155	258	470	233	143	195
1989	76	60	136	88	52	131	68	72	30	85	154	146	92
1990	129	60	80	144	243	143	90	63	81	135	56	236	122
1991	139	188	46	114	99	106	43	203	120	204	122	88	122
1992	112	166	147	100	69	62	158	110	53	137	102	70	107
1993	213	108	56	66	97	216	139	106	92	209	86	105	125
1994	189	65	76	159	177	104	170	180	130	95	268	127	145
1995	139	61	189	91	165	89	72	148	275	175	104	229	145
1996	80	70	55	146	151	155	55	64	130	228	116	132	115
1997	31	90	95	188	117	84	96	194	76	182	303	251	142
1998	113	230	236	225	102	162	127	140	188	270	65	79	161
1999	68	34	120	121	193	108	118	106	81	123	188	65	111

2000	48	68	63	104	214	183	101	113	163	208	94	213	131
2001	106	81	82	130	71	179	42	104	102	102	135	134	105
2002	70	89	154	100	151	242	104	148	220	133	167	207	149
2003	91	117	64	53	176	186	105	99	188	135	219	135	131
2004	115	177	112	121	146	226	64	117	165	112	148	123	135
2005	130	124	156	90	155	124	137	119	86	76	102	70	114
2006	260	63	132	95	82	86	113	126	217	138	206	93	135
2007	90	56	102	69	177	90	129	153	127	231	93	93	118
2008	75	71	111	51	51	113	106	60	211	176	151	91	105
2009	193	55	84	90	153	43	85	184	157	100	159	161	123
2010	153	48	179	309	61	62							136
Min.	16	9	20	23	31	34	40	13	30	61	50	45	62
Mean	120	101	107	123	129	117	100	109	141	157	143	120	122
Max.	291	334	261	309	317	257	226	234	334	470	363	251	195

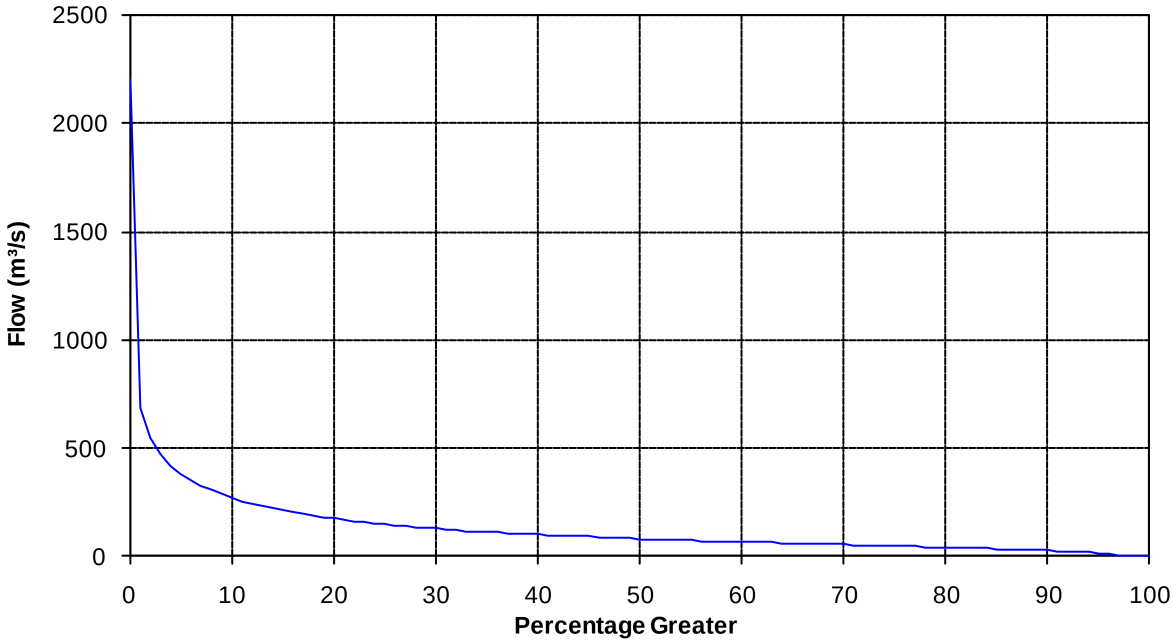

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	2207	686	547	471	417	378	349	323	301	284
10	268	254	240	228	218	209	201	194	187	180
20	174	167	161	156	151	146	141	138	134	130
30	126	123	119	116	114	111	108	105	103	101
40	98	96	94	92	91	89	87	85	83	81
50	79	78	76	75	73	72	70	69	67	66
60	65	63	62	61	59	58	57	55	54	53
70	52	51	49	48	47	46	45	43	42	41
80	40	38	37	35	34	32	31	29	28	26
90	24	22	20	17	15	12	7	2	0	0
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	122	79	2207

8.28 Ohau (separate Tekapo simulation) at Ohau Res. – 98614 (Item: 6)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							25	18	20	89	75	94	54
1932	90	83	43	45	32	23	8	6	17	60	99	83	49
1933	86	156	103	140	81	30	66	61	28	66	69	109	82
1934	97	71	54	104	90	47	27	46	53	133	75	75	73
1935	132	86	77	60	57	41	13	26	11	49	63	96	59
1936	63	72	55	85	40	16	26	48	45	145	140	104	70
1937	102	87	60	106	56	33	15	15	23	30	57	82	55
1938	134	82	88	127	44	43	22	42	55	72	90	114	76
1939	61	66	51	35	46	56	26	12	44	49	96	101	54
1940	121	152	121	75	78	46	17	11	21	96	86	85	75
1941	78	90	64	61	38	56	37	13	13	20	107	97	56
1942	99	67	82	157	119	33	51	23	44	180	121	124	92
1943	87	112	82	73	37	24	24	12	42	75	98	103	64
1944	91	135	100	123	53	30	37	29	30	74	122	107	78
1945	218	169	135	96	41	20	17	44	93	63	199	134	102
1946	136	148	78	43	31	20	20	52	90	125	68	126	78
1947	87	77	47	24	21	25	23	23	39	111	91	116	57
1948	83	55	64	42	21	41	38	18	43	101	182	129	68
1949	92	174	99	94	66	37	51	39	25	127	81	87	80
1950	156	64	48	35	70	40	47	40	60	53	68	131	68
1951	79	55	42	85	34	18	68	30	54	86	144	124	68
1952	116	173	66	45	66	38	20	8	32	85	75	103	69
1953	62	62	62	117	83	42	28	36	54	29	153	134	72
1954	95	117	88	49	26	46	31	23	20	48	106	93	62
1955	72	176	75	46	108	64	22	35	57	55	63	97	72
1956	68	62	33	102	73	74	45	34	31	62	120	122	69
1957	92	73	60	95	101	28	39	16	15	91	169	272	88
1958	177	235	133	104	135	65	21	23	19	97	101	170	106
1959	81	60	53	48	25	46	16	10	56	47	126	118	57
1960	114	87	70	36	51	38	35	49	73	61	68	59	62
1961	45	66	75	89	31	38	43	42	32	99	113	83	63
1962	90	50	44	21	60	39	62	41	45	86	110	72	60
1963	61	80	76	38	54	41	17	25	64	55	64	57	52

1964	98	52	75	40	86	23	30	27	32	55	78	107	59
1965	156	79	80	40	31	34	16	15	30	56	133	130	67
1966	164	113	67	77	23	28	16	20	24	41	84	104	63
1967	135	106	157	158	68	20	56	94	28	59	141	177	100
1968	106	101	115	58	115	38	22	53	62	121	109	112	84
1969	104	65	68	73	42	24	16	22	166	48	71	139	70
1970	107	67	72	64	19	27	30	96	238	92	127	121	88
1971	63	44	40	34	40	55	19	16	50	113	89	107	56
1972	83	42	87	64	62	22	28	19	98	79	162	98	70
1973	73	47	40	88	74	51	17	21	28	100	155	65	63
1974	48	92	81	84	28	24	40	20	23	65	111	98	59
1975	74	79	106	168	99	47	40	70	55	85	107	92	85
1976	92	56	58	33	56	70	21	17	15	28	44	134	52
1977	112	93	66	54	43	35	29	11	20	48	75	80	55
1978	91	52	70	90	106	49	31	85	80	107	100	85	79
1979	87	91	137	106	122	43	27	23	57	111	110	234	96
1980	153	91	70	89	64	49	25	48	67	84	92	108	78
1981	70	81	133	73	54	61	28	16	21	94	66	109	67
1982	135	78	104	33	77	37	13	28	38	27	176	133	73
1983	169	56	86	80	98	38	37	46	70	152	146	114	91
1984	121	75	87	44	32	24	50	51	32	99	132	250	83
1985	154	51	36	48	40	39	37	50	42	36	95	125	63
1986	98	89	100	78	43	74	27	31	32	73	73	83	67
1987	126	116	125	95	78	87	21	26	41	111	86	82	83
1988	68	76	59	41	38	52	55	54	92	168	137	126	80
1989	86	72	116	44	31	59	32	24	13	32	75	180	64
1990	94	58	76	56	116	52	43	48	16	72	74	167	73
1991	106	130	39	85	24	24	11	93	83	67	58	88	67
1992	88	80	49	35	21	4	27	52	17	77	109	84	54
1993	109	70	54	49	57	116	39	24	25	102	50	82	65
1994	258	68	88	54	49	46	39	42	43	35	201	123	87
1995	115	73	127	108	52	33	22	37	138	109	99	283	100
1996	97	99	76	129	68	41	16	16	40	144	78	87	74
1997	70	90	53	97	41	21	20	58	24	58	118	130	65
1998	99	118	124	94	46	55	82	49	61	148	71	76	85
1999	62	59	76	71	69	43	36	18	31	80	204	55	67

2000	84	60	37	66	64	118	63	38	78	109	59	149	77
2001	81	54	50	35	31	49	22	30	25	56	79	160	56
2002	132	41	56	46	30	75	33	59	97	53	85	131	70
2003	88	79	49	34	74	71	41	18	48	55	89	101	62
2004	130	116	107	41	78	63	33	38	41	52	100	81	73
2005	96	72	72	35	39	28	30	38	74	43	58	67	54
2006	85	44	43	78	48	46	29	26	61	88	141	95	65
2007	81	55	50	32	43	46	38	32	34	78	59	94	54
2008	67	54	54	34	24	30	35	19	93	66	111	119	59
2009	90	62	51	115	111	32	24	81	51	38	69	129	71
2010	127	46	55	84	64	42							70
Min.	45	41	33	21	19	4	8	6	11	20	44	55	49
Mean	102	85	75	71	58	43	31	35	49	79	102	115	71
Max.	258	235	157	168	135	118	82	96	238	180	204	283	106

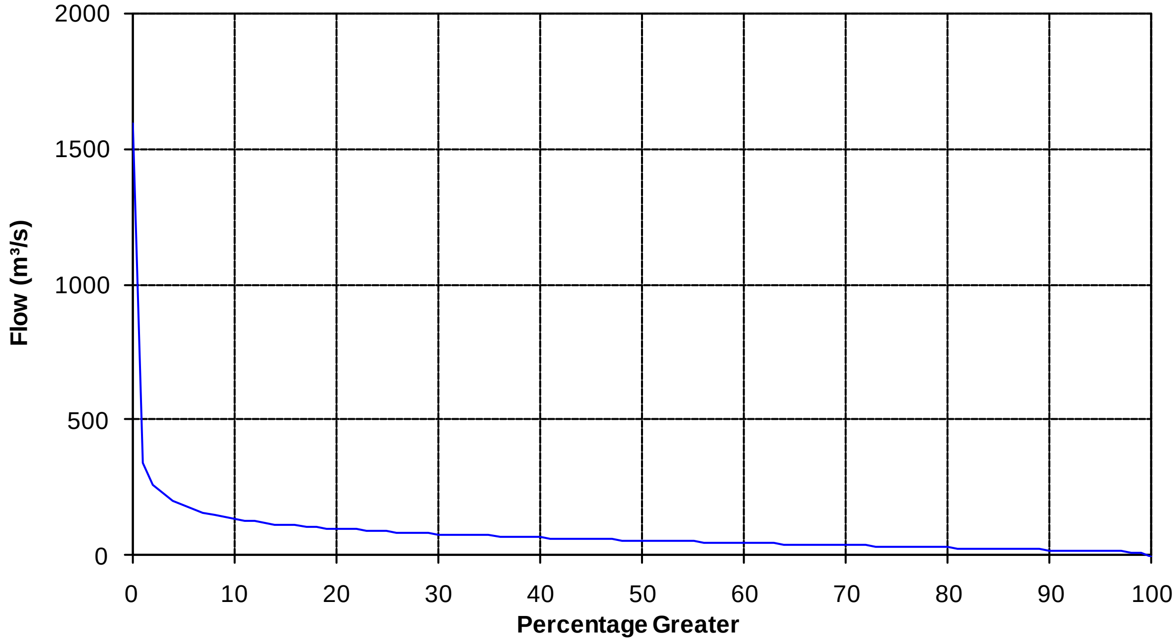

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	1598	340	260	226	202	182	169	157	148	140
10	134	129	124	119	115	112	108	105	102	99
20	97	95	93	90	88	86	85	83	81	79
30	78	76	75	73	72	71	69	68	67	65
40	64	63	62	61	60	59	58	57	56	55
50	54	53	52	51	50	49	48	47	46	45
60	44	43	43	42	41	40	39	38	37	36
70	35	35	34	33	32	31	30	29	29	28
80	27	26	25	25	24	23	22	21	20	20
90	19	18	17	16	15	14	13	12	10	7
100	-8									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	-8	71	54	1598

8.29 Pukaki, Tekapo at Tek_puk - 98615 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							84	72	70	202	169	279	146
1932	296	303	192	173	107	79	45	46	62	144	252	263	163
1933	325	599	307	365	185	96	156	131	79	136	174	362	241
1934	335	313	213	360	222	135	98	130	125	280	206	281	224
1935	498	400	335	209	167	154	83	111	80	121	163	336	221
1936	271	309	230	272	134	74	104	114	125	328	367	291	218
1937	322	299	195	314	145	96	69	64	69	80	144	258	170
1938	506	387	357	487	125	104	80	103	121	150	221	291	243
1939	190	239	212	138	125	144	75	56	103	114	227	298	160
1940	397	395	411	189	199	112	64	58	66	181	191	284	212
1941	354	411	261	146	95	148	99	67	74	78	207	271	183
1942	321	212	255	504	274	85	131	66	96	382	264	305	241
1943	268	379	227	204	90	77	66	56	109	198	244	327	186
1944	300	464	300	336	135	82	99	83	83	161	272	248	212
1945	626	487	327	260	102	71	72	109	198	136	427	315	259
1946	387	485	294	131	85	62	63	121	201	245	148	357	214
1947	258	275	208	120	86	87	76	72	92	246	240	428	182
1948	325	310	227	136	95	112	101	66	99	208	411	340	202
1949	316	562	296	224	214	137	144	125	78	300	233	251	238
1950	465	205	177	131	274	136	126	130	133	134	183	395	208
1951	290	265	190	242	103	67	152	85	91	214	297	284	190
1952	272	402	311	186	166	120	80	68	106	194	199	242	195
1953	248	245	238	230	239	95	73	99	139	95	315	399	201
1954	328	460	317	130	95	126	88	85	54	116	257	271	192
1955	285	635	275	163	311	135	67	108	136	161	186	289	227
1956	350	253	165	315	208	182	122	95	81	131	280	306	207
1957	289	306	235	238	232	98	102	94	63	187	321	628	233
1958	522	734	407	220	240	137	75	82	78	200	224	413	275
1959	278	243	209	151	94	100	69	55	124	110	278	322	169
1960	394	302	282	130	135	133	96	129	171	171	189	190	193
1961	213	278	285	297	97	110	106	108	94	234	284	254	196
1962	423	216	208	96	232	114	152	132	148	249	221	221	202

1963	255	358	243	121	185	139	65	90	149	130	155	175	171
1964	255	214	261	143	222	104	92	93	106	124	176	293	174
1965	407	263	265	128	102	95	69	78	84	130	264	340	185
1966	500	437	261	201	104	84	77	80	92	139	218	294	206
1967	402	303	530	405	155	98	198	200	93	172	324	402	274
1968	295	368	416	232	297	109	86	137	134	253	246	257	236
1969	289	241	243	195	125	84	67	70	327	113	167	413	194
1970	418	266	318	263	90	98	89	193	457	202	289	329	250
1971	255	237	172	107	133	184	78	52	126	241	197	267	170
1972	290	194	347	190	146	85	98	87	189	224	382	244	206
1973	261	261	199	239	190	147	70	81	101	228	376	237	199
1974	224	417	277	341	103	92	90	67	75	164	257	295	198
1975	291	324	369	409	205	104	68	146	122	192	230	240	224
1976	285	167	217	111	117	147	54	39	43	67	93	357	142
1977	281	300	230	165	92	87	88	104	52	111	180	205	157
1978	289	230	268	288	294	122	102	171	171	170	202	226	211
1979	261	284	402	229	269	115	97	97	135	268	262	653	257
1980	474	282	211	215	153	137	88	133	182	214	244	287	218
1981	290	343	431	209	159	191	104	85	94	249	221	363	228
1982	411	320	390	113	171	110	69	85	109	113	408	316	217
1983	405	199	278	247	262	136	133	148	180	384	315	343	253
1984	319	275	292	155	96	75	158	154	115	199	341	618	234
1985	443	215	188	183	115	101	84	134	152	112	217	357	192
1986	325	274	265	224	124	188	92	97	94	185	202	278	195
1987	404	358	324	272	206	192	83	86	114	255	250	268	234
1988	283	267	205	132	123	121	139	143	197	343	300	369	219
1989	318	315	375	161	155	179	95	80	63	99	255	531	219
1990	358	282	248	164	234	141	131	149	85	229	221	441	224
1991	425	405	161	246	86	72	64	217	203	183	151	228	202
1992	306	283	147	111	83	45	80	148	75	170	267	266	165
1993	380	242	227	163	133	254	86	78	85	220	139	207	184
1994	790	250	269	165	123	124	112	114	129	103	460	299	245
1995	370	273	330	323	160	101	75	94	287	258	220	751	271
1996	343	342	241	325	163	103	66	66	107	341	203	204	208
1997	227	322	184	253	128	79	71	141	79	130	231	408	187
1998	390	506	442	248	169	144	217	141	170	392	204	256	272
1999	276	263	288	204	196	124	96	61	92	234	489	184	208

2000	338	268	147	271	158	259	162	111	169	240	145	357	219
2001	222	220	213	99	96	110	64	82	79	178	243	467	173
2002	473	193	177	142	97	180	86	139	209	141	194	311	195
2003	260	260	176	113	253	161	127	66	126	144	201	288	181
2004	417	300	309	110	190	147	90	99	107	136	244	211	196
2005	316	302	252	107	102	80	80	92	194	112	161	241	169
2006	298	200	126	249	142	155	86	87	141	207	373	278	195
2007	288	218	190	114	121	115	107	84	104	211	156	329	170
2008	291	254	226	125	101	104	121	79	223	180	349	377	202
2009	326	248	200	403	357	100	69	164	136	103	167	355	219
2010	399	224	201	257	194	106							231
Min.	190	167	126	96	83	45	45	39	43	67	93	175	142
Mean	343	316	264	215	161	119	95	102	125	188	245	322	208
Max.	790	734	530	504	357	259	217	217	457	392	489	751	275

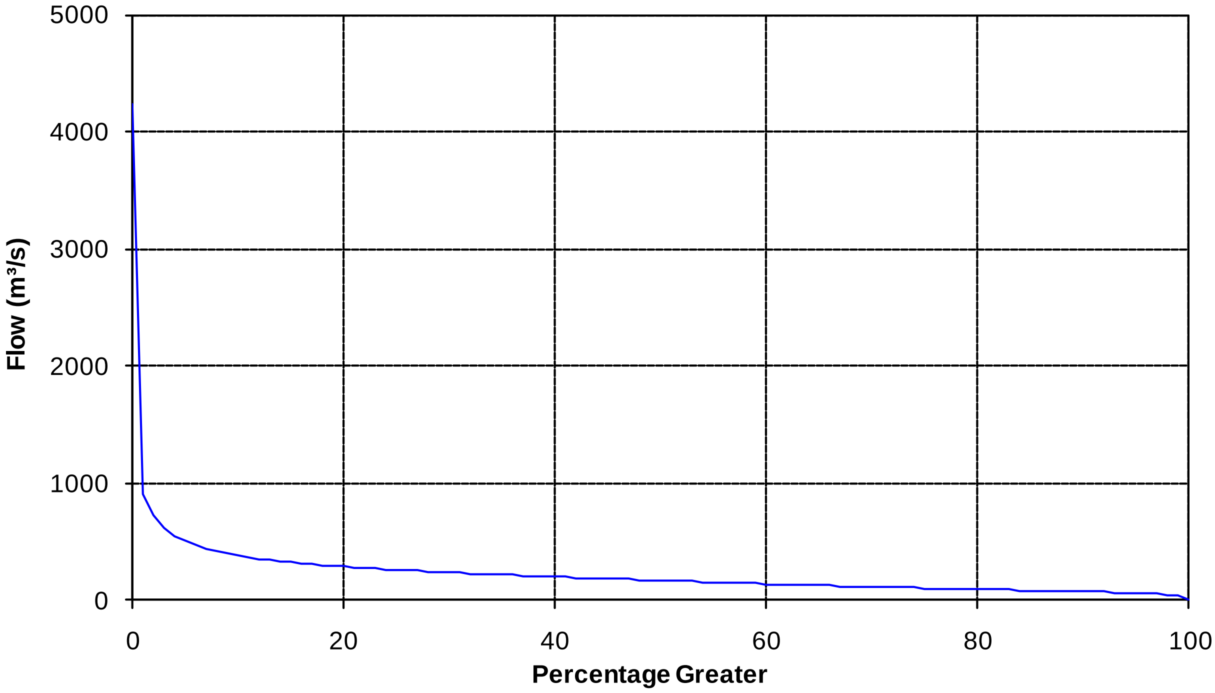

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	4234	910	719	617	547	500	464	436	413	393
10	376	361	349	339	329	320	311	302	295	288
20	281	275	269	263	258	254	249	245	241	236
30	232	227	224	220	216	213	209	206	202	199
40	195	192	189	186	182	179	176	173	170	167
50	164	161	158	156	152	149	146	143	141	138
60	135	132	130	127	124	121	119	117	114	112
70	110	107	105	103	101	99	97	95	93	91
80	89	87	85	83	81	79	77	76	74	72
90	70	67	65	63	61	58	55	51	45	36
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	208	164	4234

8.30 Tekapo at Tekapo – 98614 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							108	108	78	59	30	55	73
1932	100	94	71	76	108	98	19	22	28	51	30	39	61
1933	92	104	108	108	108	108	108	108	102	51	30	45	89
1934	94	100	86	86	108	108	108	86	52	60	30	55	81
1935	104	108	108	108	108	108	108	101	30	51	30	34	83
1936	88	86	100	100	108	108	67	46	56	60	30	59	76
1937	112	108	108	108	108	108	108	65	28	31	30	34	79
1938	85	100	107	108	108	108	108	108	80	59	30	55	88
1939	83	74	65	50	108	108	54	26	46	55	30	55	63
1940	100	102	109	108	108	108	108	76	28	49	30	47	81
1941	100	100	100	96	108	108	62	32	38	33	30	34	70
1942	83	100	81	106	108	108	108	95	36	59	30	58	81
1943	101	101	105	100	108	108	43	29	47	58	30	55	73
1944	100	107	109	111	108	108	108	108	63	51	30	55	88
1945	112	114	110	108	108	108	108	98	78	60	30	58	91
1946	111	114	108	107	108	108	52	50	76	60	30	55	81
1947	100	100	88	42	108	70	28	28	35	59	30	55	62
1948	102	100	100	74	108	106	39	28	30	60	30	58	69
1949	109	112	108	108	108	108	108	108	100	54	30	56	92
1950	112	108	104	86	108	108	108	53	53	49	30	39	80
1951	100	100	79	100	108	100	59	40	35	60	30	58	72
1952	104	109	108	107	108	108	105	22	31	51	30	37	77
1953	79	83	67	74	108	108	108	48	48	40	30	55	71
1954	107	108	108	106	108	108	93	36	30	47	30	41	77
1955	90	103	108	103	108	108	108	108	59	59	30	34	85
1956	90	100	71	68	108	108	108	102	31	46	30	55	77
1957	100	100	100	100	108	108	108	52	28	53	30	65	79
1958	116	117	111	108	108	108	108	108	40	50	30	55	88
1959	104	100	100	66	108	99	28	21	42	48	30	55	67
1960	100	106	105	100	108	108	73	63	68	57	30	34	79
1961	40	89	98	100	108	108	58	45	35	58	30	55	69
1962	107	106	100	70	108	108	108	71	74	60	30	55	83

1963	100	100	100	90	108	108	90	41	66	52	30	34	76
1964	40	81	81	74	108	108	84	43	45	52	30	37	65
1965	100	105	100	82	108	102	29	35	31	49	30	55	69
1966	107	108	108	107	108	108	86	29	40	60	30	53	79
1967	79	100	106	108	108	108	108	108	108	60	30	65	91
1968	109	110	114	108	108	108	108	108	108	60	30	58	94
1969	108	108	106	100	108	108	45	24	93	60	30	47	78
1970	102	105	105	104	108	108	78	47	108	60	32	77	86
1971	108	105	100	52	108	108	73	28	51	60	30	55	73
1972	100	81	94	88	108	108	58	33	74	60	30	58	74
1973	108	103	88	70	108	108	65	32	45	52	30	55	72
1974	100	100	101	102	108	108	82	27	30	54	30	55	75
1975	88	96	100	108	108	108	108	108	108	60	30	55	90
1976	100	98	73	42	108	108	56	27	28	37	30	39	62
1977	100	100	100	62	108	108	44	27	27	45	30	34	65
1978	65	85	55	100	108	108	108	108	108	60	30	55	82
1979	96	96	100	100	108	108	108	103	54	60	30	65	86
1980	119	112	108	104	108	108	108	84	84	60	30	55	90
1981	100	100	102	103	108	108	108	93	36	58	30	58	84
1982	104	108	108	105	108	108	99	34	43	49	30	58	79
1983	110	108	104	100	108	108	108	108	108	60	42	77	95
1984	109	111	108	106	108	108	108	72	44	50	30	62	85
1985	117	108	106	100	108	108	65	57	67	48	30	51	80
1986	100	100	100	100	108	108	108	62	42	59	30	53	81
1987	100	107	108	108	108	108	108	108	83	59	30	55	90
1988	100	100	85	50	108	108	74	66	81	60	30	62	77
1989	111	108	108	108	108	108	108	108	56	29	30	56	86
1990	108	107	101	94	108	108	108	90	36	51	30	58	83
1991	109	115	108	105	108	108	61	92	93	60	30	35	85
1992	100	100	65	44	108	80	31	65	39	51	30	55	64
1993	102	103	100	96	108	108	108	55	34	57	30	34	78
1994	101	108	108	107	108	108	108	75	60	49	30	58	85
1995	110	110	108	108	108	108	108	108	108	60	30	69	95
1996	111	110	108	108	108	108	108	108	59	60	30	58	90
1997	103	100	100	100	108	108	78	62	40	54	30	55	78
1998	100	106	112	108	108	108	108	108	108	60	48	78	96
1999	108	108	108	106	108	108	108	87	48	56	30	60	86

2000	109	109	107	106	108	108	108	108	108	60	30	58	93
2001	109	108	101	78	108	108	33	35	36	56	30	58	71
2002	115	108	104	100	108	108	83	66	86	60	30	55	85
2003	100	100	79	52	108	108	108	86	53	60	30	43	77
2004	96	100	107	100	108	108	108	68	52	57	30	35	81
2005	100	100	100	64	108	105	39	41	91	49	30	34	72
2006	44	64	44	80	108	108	108	57	56	60	30	58	68
2007	108	108	100	82	108	108	59	34	37	60	30	55	74
2008	100	83	83	50	108	108	55	37	85	60	30	61	72
2009	112	108	106	101	110	108	108	108	108	60	30	55	93
2010	107	108	100	100	108	108							105
Min.	40	64	44	42	108	70	19	21	27	29	30	34	61
Mean	99	102	98	92	108	107	86	67	60	55	30	52	79
Max.	119	117	114	111	110	108	108	108	108	60	48	78	96

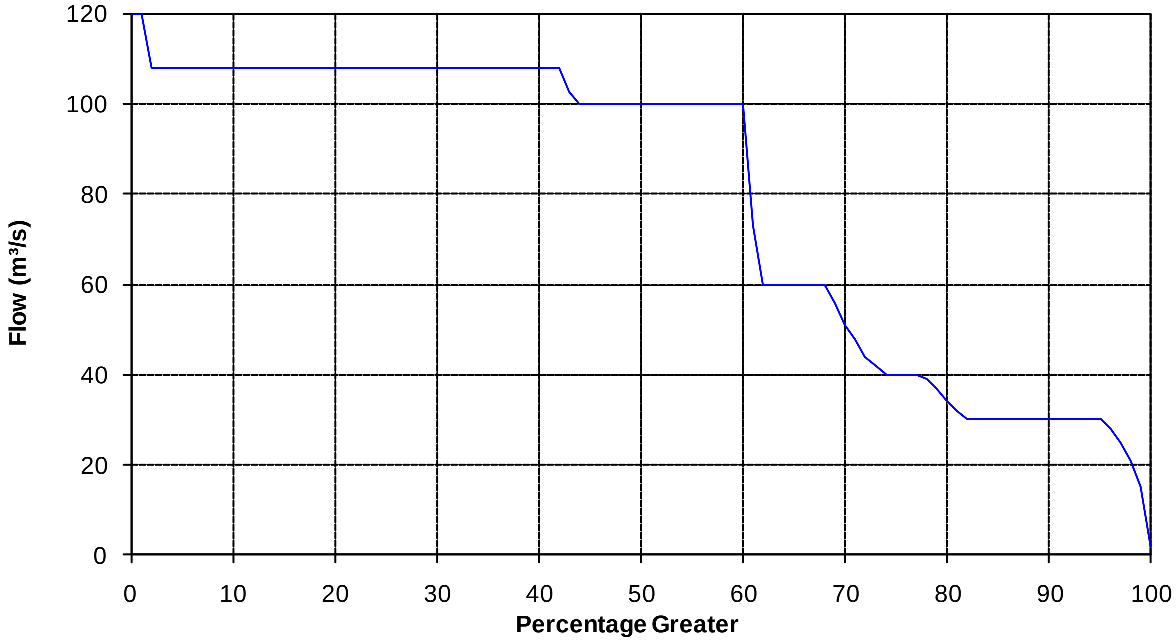

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	120	120	108	108	108	108	108	108	108	108
10	108	108	108	108	108	108	108	108	108	108
20	108	108	108	108	108	108	108	108	108	108
30	108	108	108	108	108	108	108	108	108	108
40	108	108	108	103	100	100	100	100	100	100
50	100	100	100	100	100	100	100	100	100	100
60	100	73	60	60	60	60	60	60	60	56
70	51	48	44	42	40	40	40	40	39	37
80	34	32	30	30	30	30	30	30	30	30
90	30	30	30	30	30	30	28	25	21	15
100	2									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	2	80	100	120

8.31 Pukaki at Pukaki - 98614 (Item: 2)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							157	147	114	176	115	220	155
1932	305	299	196	172	171	145	45	46	62	134	189	207	164
1933	304	505	317	343	215	158	192	182	147	136	134	273	241
1934	316	316	230	313	255	183	162	159	125	223	143	234	221
1935	452	385	325	241	205	191	156	166	80	121	122	249	224
1936	269	286	237	265	184	152	127	114	125	263	229	233	207
1937	312	301	237	300	187	158	146	101	69	80	119	197	183
1938	421	368	350	420	177	166	147	163	142	138	155	228	239
1939	203	241	210	138	185	194	94	56	103	114	155	230	160
1940	350	346	405	231	216	167	140	106	66	159	140	223	212
1941	334	382	273	188	165	190	116	67	74	78	153	197	183
1942	294	240	251	449	273	156	182	133	96	294	204	256	236
1943	290	353	251	221	157	152	81	56	109	159	167	261	187
1944	297	397	296	306	180	153	161	153	110	139	177	193	213
1945	516	423	316	268	163	141	141	154	184	132	275	235	244
1946	368	454	303	188	158	144	90	121	187	195	118	274	215
1947	268	287	237	125	169	128	76	72	92	207	176	347	182
1948	328	318	257	152	169	168	101	66	98	179	266	273	197
1949	313	503	302	250	220	180	190	184	148	219	163	208	238
1950	397	243	229	172	286	188	188	130	133	130	146	292	211
1951	289	273	200	230	170	142	150	87	91	179	198	221	185
1952	277	327	325	238	206	189	159	68	106	173	149	185	200
1953	246	248	228	222	238	152	149	112	139	95	225	299	196
1954	319	422	317	184	161	181	148	85	54	116	190	209	197
1955	287	530	296	202	290	176	140	174	141	156	142	216	227
1956	327	259	180	272	228	211	175	161	81	121	170	248	203
1957	284	307	262	250	244	163	154	108	63	160	198	412	217
1958	421	591	384	243	253	190	156	160	81	166	164	310	258
1959	290	265	239	157	163	159	69	55	124	110	188	242	171
1960	368	304	286	180	188	184	132	129	171	157	145	153	200
1961	183	275	276	281	166	176	125	108	94	185	198	204	188
1962	387	253	236	129	241	175	195	142	153	182	158	188	203

1963	266	332	256	155	210	187	120	90	149	126	119	142	178
1964	200	215	243	162	246	173	127	93	106	124	129	212	169
1965	348	273	284	160	168	158	69	78	84	130	182	259	182
1966	436	416	284	235	164	157	134	80	92	128	152	240	209
1967	349	305	477	368	200	153	200	222	168	163	206	311	260
1968	305	346	385	244	269	163	158	181	184	202	169	205	234
1969	287	270	270	228	180	160	88	70	279	133	138	302	200
1970	379	290	312	273	162	163	132	152	349	173	208	291	240
1971	285	274	220	121	187	209	124	52	126	197	137	217	179
1972	293	217	329	208	194	150	113	87	189	178	249	205	201
1973	281	299	232	233	236	199	109	81	101	187	260	212	202
1974	249	387	284	329	168	166	136	67	75	145	178	252	202
1975	292	309	342	356	224	156	134	184	172	163	157	198	223
1976	277	201	218	111	173	189	84	39	43	67	74	247	144
1977	266	295	249	169	151	152	92	104	52	106	133	156	160
1978	248	246	240	287	278	176	163	198	196	151	139	181	208
1979	266	277	367	232	248	173	167	157	135	217	172	459	239
1980	419	292	241	238	201	186	153	154	182	181	171	225	220
1981	295	350	380	235	200	217	164	140	94	203	154	277	225
1982	393	326	373	176	213	167	135	85	109	110	256	251	216
1983	371	244	297	253	262	182	173	184	206	262	187	273	242
1984	309	287	297	206	163	151	193	162	115	167	225	419	225
1985	392	251	230	216	174	160	109	134	152	112	153	269	196
1986	316	282	263	240	176	212	147	106	94	164	140	226	197
1987	362	333	305	277	225	214	151	154	150	205	179	224	231
1988	291	279	220	134	184	177	148	145	197	260	196	294	210
1989	317	322	354	206	194	201	156	152	89	98	183	403	223
1990	345	308	271	198	253	186	178	172	85	174	156	337	222
1991	387	383	217	259	157	150	94	214	199	158	114	166	207
1992	290	290	160	113	157	96	80	148	75	142	169	213	161
1993	361	268	241	194	178	246	154	99	85	184	111	159	190
1994	610	278	269	206	179	176	170	138	129	101	282	229	231
1995	352	295	318	293	190	166	151	163	259	198	151	535	256
1996	342	335	260	294	199	162	141	141	116	240	140	173	212
1997	242	313	215	249	179	149	111	141	79	130	171	312	190
1998	361	451	399	259	206	183	222	182	193	278	169	237	261
1999	295	285	294	232	219	171	157	111	92	180	313	172	210

2000	314	282	198	257	193	247	191	163	193	190	107	267	217
2001	242	259	244	138	160	173	64	82	79	164	170	343	176
2002	407	229	212	184	163	210	126	139	197	131	133	237	197
2003	266	268	191	115	249	193	174	115	126	136	146	222	183
2004	375	279	310	164	214	183	148	117	107	127	172	158	196
2005	297	299	263	124	163	145	80	92	194	112	129	196	174
2006	248	199	127	225	180	184	151	103	141	175	235	218	182
2007	290	251	223	151	183	172	114	84	104	176	117	262	177
2008	299	253	231	123	167	167	122	79	211	156	225	278	192
2009	327	271	233	345	310	153	138	199	180	114	120	281	222
2010	360	262	234	260	217	156							249
Min.	183	199	127	111	151	96	45	39	43	67	74	142	144
Mean	323	312	272	225	201	173	138	124	130	161	170	249	206
Max.	610	591	477	449	310	247	222	222	349	294	313	535	261

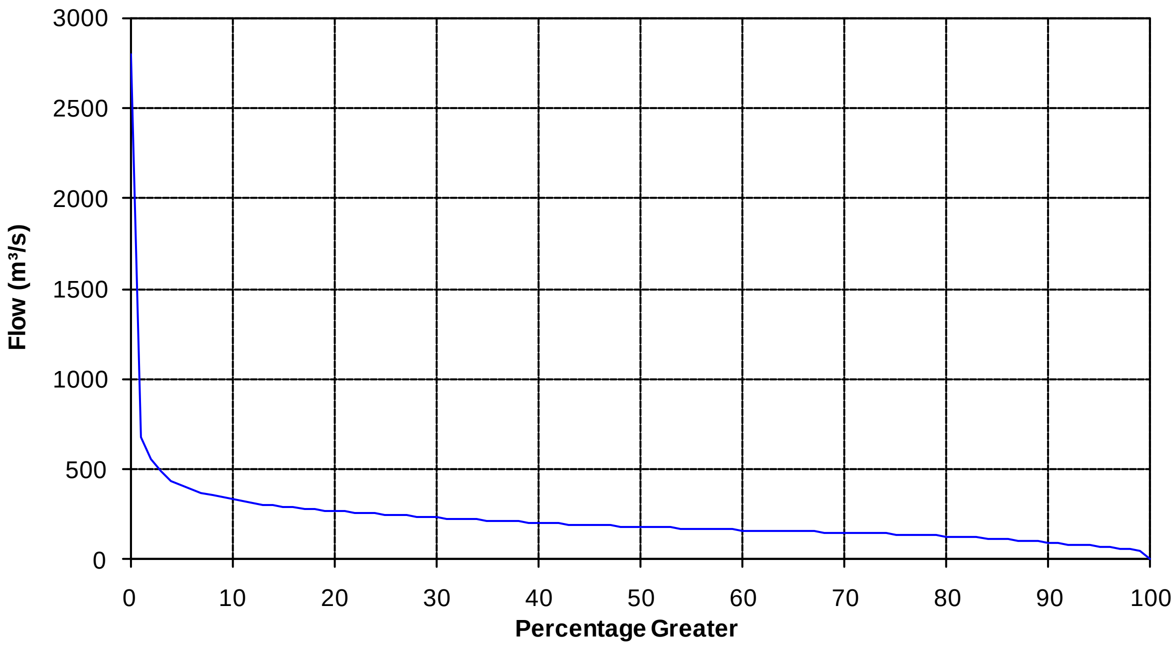

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	2799	676	550	486	438	408	385	367	351	339
10	328	319	312	304	298	292	286	280	276	271
20	267	262	258	254	251	247	244	241	237	234
30	231	228	225	222	218	215	213	210	207	204
40	202	199	196	194	192	189	187	185	182	181
50	179	176	175	173	171	169	167	166	164	163
60	161	160	158	157	155	154	152	151	149	148
70	146	145	144	142	140	138	137	134	132	130
80	127	124	121	118	114	111	108	104	100	96
90	92	87	83	78	74	69	63	59	52	41
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	206	179	2799

8.32 Waitaki Power Station at Waitaki – 98714 (Item: 2)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931								84	111	334	234	267	207
1932	144	167	108	126	111	76	74	77	105	170	188	197	128
1933	127	216	184	246	186	98	138	152	98	134	141	132	154
1934	103	116	97	131	222	150	96	127	157	322	194	172	158
1935	162	122	128	128	93	102	60	61	26	96	128	148	104
1936	130	110	116	168	126	60	83	140	149	250	273	190	150
1937	183	144	152	199	149	124	72	75	82	91	92	112	123
1938	197	92	112	190	128	119	103	126	163	172	161	190	146
1939	107	83	79	68	85	109	90	70	130	150	158	159	107
1940	181	192	188	127	207	137	85	65	66	172	197	146	147
1941	112	130	123	132	83	120	97	65	80	78	146	163	111
1942	136	98	102	191	215	114	126	76	103	314	245	244	164
1943	150	134	128	68	100	74	80	63	146	188	167	154	121
1944	145	235	220	252	157	105	135	126	107	150	224	222	173
1945	335	288	225	182	138	88	65	137	248	220	306	283	209
1946	174	194	134	105	90	71	66	131	197	297	152	184	149
1947	146	107	72	53	56	63	75	73	93	206	148	127	102
1948	101	68	81	87	59	96	75	54	75	166	360	185	117
1949	145	228	180	171	122	108	130	128	100	178	129	140	146
1950	212	117	85	73	84	105	99	93	156	128	113	177	120
1951	135	92	61	186	95	68	133	103	115	191	268	213	139
1952	168	316	62	57	113	69	47	34	53	167	161	216	121
1953	116	99	83	160	206	143	83	95	116	84	193	211	132
1954	147	135	123	88	71	87	76	74	93	115	171	161	111
1955	113	225	136	120	166	172	94	85	134	135	117	161	137
1956	132	134	90	123	152	172	139	86	90	154	208	195	139
1957	137	121	105	108	219	88	144	63	81	195	307	514	174
1958	352	420	270	227	287	167	63	58	52	130	149	174	195
1959	144	92	86	98	91	112	65	60	120	139	193	210	118
1960	145	173	110	96	97	102	77	125	162	147	134	114	123
1961	112	144	180	187	97	85	157	136	112	210	209	174	150
1962	139	111	112	69	119	124	119	141	121	136	269	158	135

1963	123	140	155	121	118	116	123	120	219	176	151	122	140
1964	142	118	134	97	140	71	104	86	91	121	129	0	103
1965	207	215	171	121	93	114	92	81	100	162	244	223	151
1966	484	221	159	133	80	70	59	70	86	78	123	169	144
1967	177	244	295	258	228	68	74	187	103	124	265	413	203
1968	241	200	236	157	228	117	59	185	195	280	279	228	201
1969	196	127	130	117	96	61	72	69	289	119	130	224	136
1970	206	148	112	100	57	73	82	156	599	277	226	190	185
1971	96	80	72	88	84	138	79	90	149	243	195	152	122
1972	154	93	143	95	159	95	93	93	253	233	278	154	154
1973	125	66	65	107	127	87	91	118	71	141	261	107	114
1974	169	57	141	138	91	69	107	107	124	174	209	102	125
1975	115	130	155	339	236	149	154	232	176	198	207	164	188
1976	158	122	72	107	89	161	75	133	150	90	174	211	128
1977	187	166	93	101	170	159	85	43	73	114	164	120	122
1978	117	109	103	160	198	156	90	221	227	265	200	176	169
1979	151	137	206	213	254	125	116	75	148	197	281	326	186
1980	369	213	148	152	215	225	119	180	207	186	257	201	206
1981	124	140	290	170	136	178	114	99	105	205	145	183	158
1982	180	116	224	85	158	104	137	135	120	59	333	266	160
1983	289	110	144	155	225	143	161	173	220	380	387	332	228
1984	207	220	174	106	102	86	170	168	101	203	191	471	184
1985	381	99	82	94	91	97	102	132	144	115	170	219	144
1986	181	159	267	153	109	180	111	167	143	228	157	172	169
1987	192	224	322	236	175	213	104	116	137	225	163	153	188
1988	129	144	109	94	84	109	121	133	212	273	267	239	160
1989	139	131	202	115	103	152	105	76	70	106	123	250	131
1990	185	100	123	93	233	133	117	154	99	204	162	255	156
1991	167	210	96	155	89	82	98	223	259	206	142	174	158
1992	158	141	113	79	78	120	131	121	63	176	245	159	132
1993	186	131	106	107	152	236	119	85	99	206	109	210	146
1994	462	218	212	140	122	131	155	164	159	140	398	225	210
1995	194	136	181	188	118	96	78	113	308	290	211	521	203
1996	239	223	148	237	189	131	81	103	124	302	174	166	176
1997	159	169	136	175	110	86	93	170	101	142	204	200	145
1998	158	195	265	210	103	121	196	139	154	270	193	148	179
1999	124	123	110	138	155	120	130	94	123	148	380	134	148

2000	193	151	107	153	160	289	218	192	317	274	173	246	206
2001	210	119	110	99	114	103	117	71	98	137	184	305	139
2002	311	130	124	119	108	179	135	209	235	172	195	256	181
2003	182	162	112	102	180	163	170	90	151	187	205	202	159
2004	243	262	239	123	192	189	135	129	154	159	211	173	184
2005	251	160	151	109	109	87	98	109	170	118	121	125	134
2006	140	79	70	139	132	151	118	107	147	185	264	252	149
2007	180	120	105	96	100	95	116	97	101	184	129	155	123
2008	116	119	121	90	87	75	95	95	220	167	169	257	134
2009	160	143	134	146	382	158	104	195	158	120	146	209	172
2010	245	89	99	119	187	149							149
Min.	96	57	61	53	56	60	47	34	26	59	92	0	102
Mean	181	152	142	137	140	121	106	115	144	182	201	203	152
Max.	484	420	322	339	382	289	218	232	599	380	398	521	228

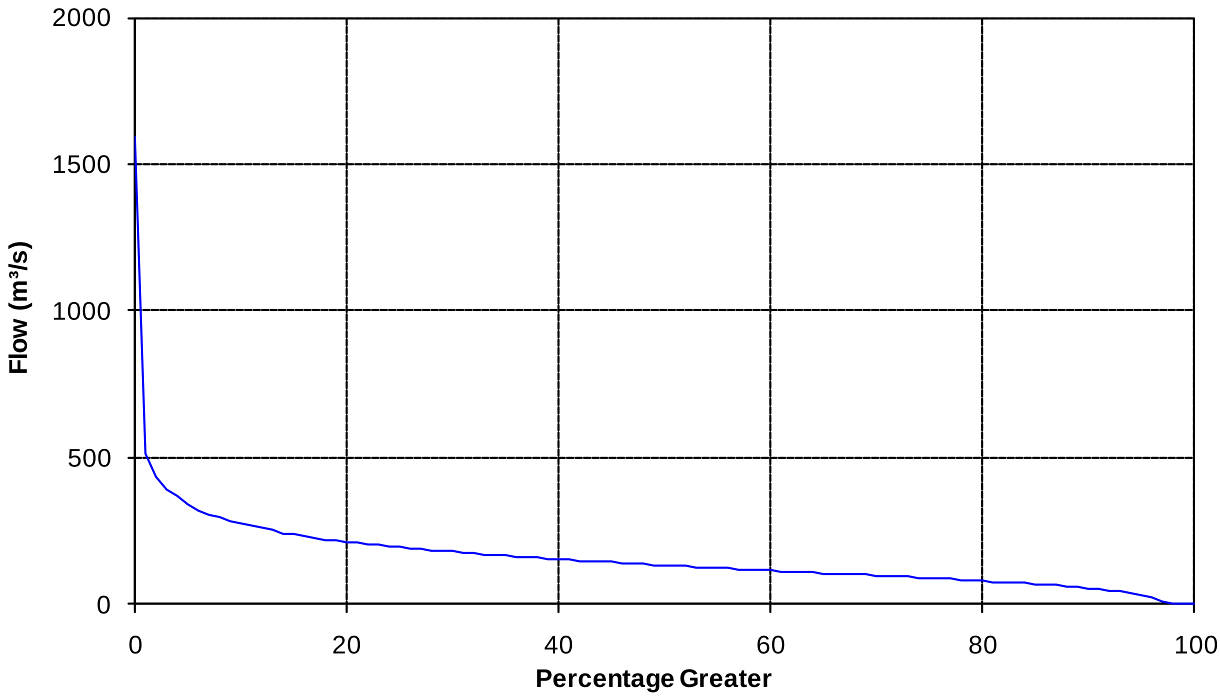

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	1593	511	432	393	365	340	321	307	294	284
10	274	265	257	249	242	236	229	224	220	215
20	211	207	203	199	196	192	189	186	183	180
30	177	174	171	169	166	163	161	159	156	154
40	152	149	147	145	143	141	139	137	135	133
50	132	129	128	126	124	122	120	118	116	115
60	113	111	110	108	106	105	103	101	100	98
70	96	95	93	91	89	88	86	84	82	80
80	78	76	74	72	70	68	65	63	60	57
90	54	51	47	42	37	30	21	10	0	0
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	152	132	1593

8.33 Waiau River at Clarence at Jollies – 162105 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							10	12	16	34	35	18	21
1932	5	8	5	13	10	10	19	6	7	8	29	16	11
1933	8	4	3	7	10	9	10	11	21	7	6	8	9
1934	10	12	10	14	17	14	15	18	15	28	15	9	15
1935	17	13	12	13	17	20	10	8	6	11	8	12	12
1936	10	9	6	8	15	4	10	12	16	34	35	18	15
1937	28	17	20	15	29	15	5	4	7	7	12	13	14
1938	18	13	22	23	11	12	8	10	19	16	19	38	17
1939	23	12	7	4	9	15	10	7	13	15	22	44	15
1940	18	43	29	9	9	9	5	3	3	18	16	10	14
1941	11	27	10	11	6	8	12	10	6	5	12	25	12
1942	18	11	17	93	27	8	21	8	12	30	21	21	24
1943	11	25	12	9	9	7	6	4	17	16	16	14	12
1944	6	10	11	15	12	8	9	6	12	20	26	27	13
1945	28	20	16	14	11	6	6	15	19	12	31	30	17
1946	17	17	7	8	4	4	7	17	14	16	14	36	13
1947	19	11	5	4	2	8	7	8	9	27	19	15	11
1948	17	6	6	11	13	14	9	5	5	20	34	19	13
1949	15	21	15	12	11	16	17	13	5	25	15	18	15
1950	20	7	4	14	12	20	8	11	9	6	6	16	11
1951	11	4	3	8	7	7	15	9	6	19	37	46	14
1952	21	18	13	10	16	24	10	4	4	7	15	15	13
1953	10	12	9	18	27	15	7	8	11	9	23	36	15
1954	20	15	13	16	7	17	10	5	6	6	21	12	12
1955	6	64	33	9	25	12	4	10	7	12	15	10	17
1956	4	8	5	13	10	10	19	6	7	8	29	16	11
1957	18	6	10	16	23	10	7	5	3	14	29	89	19
1958	33	22	24	14	39	24	8	9	8	14	15	22	19
1959	10	5	8	7	7	9	4	5	18	16	22	23	11
1960	5	5	6	5	6	12	17	15	16	12	15	15	11
1961	9	8	9	7	9	12	21	19	14	31	17	5	14
1962	10	4	5	9	9	16	21	19	20	22	14	7	13

1963	5	5	7	7	12	17	24	19	26	13	23	7	14
1964	22	5	6	5	14	14	17	18	21	21	15	11	14
1965	10	8	21	24	11	16	12	19	21	18	29	11	17
1966	8	8	7	12	24	9	11	14	22	15	15	13	13
1967	15	8	7	7	9	8	9	18	13	11	35	14	13
1968	6	10	5	19	13	12	15	15	15	43	30	21	17
1969	8	4	3	7	10	9	10	11	21	7	6	8	9
1970	6	3	11	5	7	14	15	19	37	14	10	6	12
1971	9	3	2	2	6	13	8	18	22	34	15	7	12
1972	4	3	4	12	16	9	17	9	23	31	11	10	13
1973	5	2	2	5	13	12	6	27	21	9	20	7	11
1974	6	6	12	50	23	26	33	15	42	33	20	7	23
1975	11	8	12	16	23	17	29	28	26	29	22	9	19
1976	11	23	5	7	13	18	22	17	19	26	19	27	17
1977	23	9	5	4	15	17	21	11	23	29	18	11	16
1978	6	4	3	20	26	17	24	21	29	21	13	13	16
1979	5	7	10	20	32	12	19	32	29	24	19	26	20
1980	33	10	22	23	16	22	18	33	27	22	19	15	22
1981	5	3	5	8	17	22	16	13	25	29	11	11	14
1982	6	4	3	6	23	23	9	16	18	15	25	16	14
1983	10	4	4	15	38	26	26	16	20	38	15	15	19
1984	9	24	10	6	8	6	20	12	9	23	22	16	14
1985	10	5	5	6	9	16	20	29	22	14	18	21	15
1986	8	8	12	24	8	14	16	26	34	44	16	8	18
1987	9	8	38	12	12	14	8	14	8	18	13	18	14
1988	6	9	13	6	19	15	31	20	27	36	15	8	17
1989	5	6	6	6	5	32	10	11	11	19	11	13	11
1990	8	4	4	7	22	13	14	25	14	14	19	10	13
1991	7	16	5	17	11	13	13	37	13	15	22	11	15
1992	11	6	15	7	10	6	16	21	24	39	24	16	16
1993	12	7	5	9	13	24	8	5	22	24	13	31	15
1994	24	6	9	6	23	20	19	19	16	19	54	10	19
1995	7	7	9	9	13	25	15	18	30	37	19	12	17
1996	7	7	9	15	14	14	15	22	27	28	23	12	16
1997	9	9	17	14	8	14	14	21	13	17	11	23	14
1998	6	5	6	9	7	11	34	18	18	36	13	4	14
1999	3	2	5	9	10	21	14	19	14	20	26	10	13

2000	9	8	9	10	9	26	12	28	17	33	9	10	15
2001	8	3	2	3	5	12	11	21	11	17	21	19	11
2002	24	10	6	7	6	21	13	12	15	12	27	17	14
2003	9	6	4	16	10	17	17	12	38	33	14	8	15
2004	9	24	11	7	12	20	11	21	22	24	11	13	15
2005	9	4	7	8	9	10	12	10	6	10	6	5	8
2006	9	5	4	15	16	18	20	16	20	28	35	19	17
2007	8	5	3	3	6	5	14	10	8	47	9	5	10
2008	3	5	4	2	4	7	27	37	34	24	18	8	14
2009	4	5	4	5	26	14	11	14	13	28	15	13	13
2010	9	5	4	3	17	28							11
Min.	3	2	2	2	2	4	4	3	3	5	6	4	8
Mean	12	10	9	12	14	14	14	15	17	21	19	17	15
Max.	33	64	38	93	39	32	34	37	42	47	54	89	24

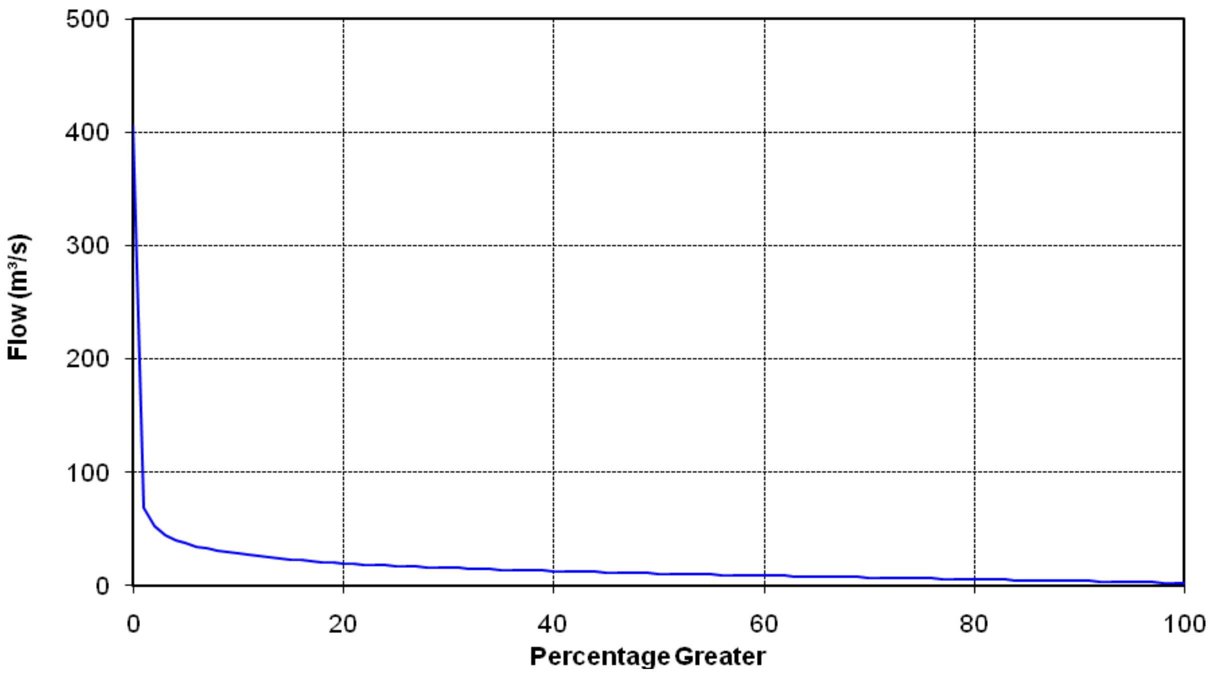

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	406	69	53	45	41	37	35	33	31	30
10	28	27	26	25	24	23	23	22	21	21
20	20	19	19	18	18	18	17	17	17	16
30	16	16	15	15	15	14	14	14	14	13
40	13	13	13	12	12	12	12	11	11	11
50	11	11	10	10	10	10	10	10	9	9
60	9	9	9	8	8	8	8	8	8	8
70	7	7	7	7	7	7	6	6	6	6
80	6	6	5	5	5	5	5	5	5	4
90	4	4	4	4	4	3	3	3	3	2
100	2									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	2	15	11	406

8.34 Waiau River at Glenhope – 164604 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							25	28	36	66	69	40	44
1932	17	22	15	31	25	25	41	19	20	22	58	36	28
1933	22	15	11	19	26	24	26	27	45	20	18	22	23
1934	25	29	25	33	37	33	34	39	34	57	33	23	34
1935	37	32	29	31	37	43	26	22	18	28	21	29	29
1936	25	23	19	22	35	15	25	28	36	66	69	40	34
1937	56	38	43	35	59	34	17	15	20	20	29	31	33
1938	39	31	46	49	28	29	22	25	42	37	42	73	38
1939	49	29	20	14	23	35	25	20	31	34	46	81	34
1940	39	81	57	24	23	23	16	11	13	40	36	25	32
1941	27	54	25	28	18	21	30	25	17	16	28	52	28
1942	40	27	37	142	55	22	45	22	29	60	45	44	47
1943	27	51	29	23	24	19	19	14	36	37	36	32	29
1944	17	26	27	34	30	21	23	19	28	42	54	55	31
1945	57	43	35	32	27	19	18	35	42	28	62	60	38
1946	37	38	20	21	14	15	20	38	32	37	32	69	31
1947	42	28	17	14	10	21	19	22	24	55	41	34	27
1948	37	18	18	27	31	33	23	15	16	43	67	42	31
1949	34	44	34	30	28	35	37	31	17	51	33	39	34
1950	43	21	13	31	28	42	22	28	23	18	19	36	27
1951	27	14	12	21	21	21	33	24	18	40	73	87	33
1952	45	40	31	25	36	50	26	14	14	20	34	34	31
1953	25	29	24	39	55	33	21	21	27	24	48	71	35
1954	42	35	32	36	19	37	25	16	18	18	44	29	29
1955	18	104	64	23	51	29	13	25	21	28	34	26	36
1956	15	22	15	31	25	25	41	19	20	22	58	36	27
1957	39	19	25	36	47	25	20	17	13	33	57	153	41
1958	65	47	50	33	75	49	22	24	22	32	35	46	42
1959	26	17	22	20	20	23	14	15	38	36	47	49	27
1960	17	16	18	17	18	29	37	35	36	28	34	34	27
1961	23	21	24	21	24	29	44	41	24	61	38	17	31
1962	26	14	16	24	24	36	45	41	42	46	32	20	31

1963	16	16	20	20	29	38	47	41	54	31	48	20	32
1964	46	16	18	16	32	31	38	40	45	46	34	28	33
1965	26	21	43	48	27	35	29	40	44	39	58	27	37
1966	23	21	19	28	48	23	27	33	46	34	34	30	31
1967	34	21	20	21	23	22	24	39	30	26	67	32	30
1968	18	26	16	41	31	29	34	34	34	79	59	45	37
1969	22	15	11	19	26	24	26	27	45	20	18	22	23
1970	18	12	26	16	19	32	35	40	71	32	25	18	29
1971	24	12	9	10	18	30	21	39	46	67	34	20	28
1972	14	11	14	29	36	24	38	24	48	61	27	25	29
1973	16	10	8	14	31	28	19	55	44	24	43	20	26
1974	17	22	20	90	50	41	57	30	44	53	53	27	42
1975	21	18	26	42	56	43	43	41	45	58	61	36	41
1976	41	44	20	18	27	45	38	30	25	38	37	55	35
1977	59	28	19	14	23	26	30	18	27	43	46	37	31
1978	23	14	14	27	44	25	32	41	48	44	40	42	33
1979	22	27	24	36	80	28	35	57	62	70	42	66	46
1980	64	47	45	43	36	41	25	44	56	48	53	40	45
1981	21	19	29	35	36	41	31	22	34	62	35	42	34
1982	33	19	14	14	34	30	19	31	32	29	62	46	30
1983	33	15	19	36	70	41	48	31	45	82	34	34	41
1984	23	30	20	18	21	20	43	38	22	54	70	62	35
1985	51	21	14	20	17	29	31	35	38	29	32	46	30
1986	30	25	24	42	24	31	28	41	45	66	42	27	35
1987	35	28	42	36	33	41	20	29	24	47	34	45	35
1988	25	31	40	24	47	41	58	41	55	101	56	32	46
1989	20	17	26	20	14	63	27	17	19	40	27	31	27
1990	25	19	19	26	50	24	24	40	21	26	33	33	28
1991	31	37	16	30	21	28	22	67	35	38	41	34	33
1992	31	23	40	20	15	15	27	44	28	47	50	37	31
1993	42	24	16	16	20	52	18	13	24	52	28	70	31
1994	77	22	22	15	44	43	39	39	36	36	148	44	47
1995	33	26	33	31	36	43	33	31	63	71	50	48	41
1996	29	23	23	33	17	27	24	32	53	73	62	40	37
1997	27	29	26	30	24	27	23	35	22	34	48	80	34
1998	25	21	25	33	19	28	66	40	37	94	37	20	37
1999	14	12	19	30	27	40	32	41	32	43	53	26	31

2000	24	22	23	26	24	54	29	52	37	65	24	25	34
2001	21	12	9	10	16	29	26	45	27	38	44	41	27
2002	48	25	19	20	18	44	30	29	34	29	56	38	33
2003	24	18	13	36	26	37	37	29	75	70	51	37	38
2004	36	49	31	19	30	53	30	38	35	50	36	36	37
2005	28	19	22	16	15	20	25	22	17	19	16	16	20
2006	32	15	11	47	31	36	32	22	33	52	95	53	38
2007	29	20	14	12	21	21	28	25	23	86	31	20	28
2008	19	19	18	10	10	13	41	54	60	46	47	31	31
2009	19	21	17	22	46	25	27	37	37	46	34	50	32
2010	37	15	17	17	28	42							26
Min.	14	10	8	10	10	13	13	11	13	16	16	16	20
Mean	31	26	24	28	31	32	30	31	34	44	45	40	33
Max.	77	104	64	142	80	63	66	67	75	101	148	153	47

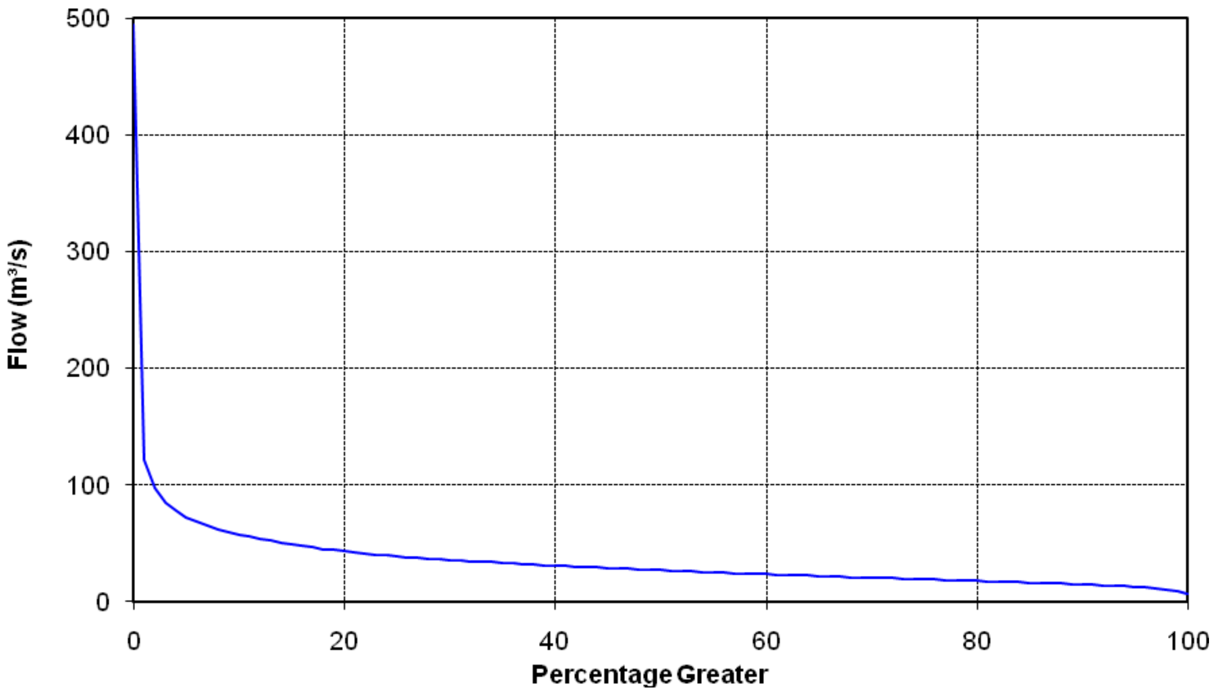

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	495	122	97	85	78	73	69	65	62	60
10	58	56	54	52	51	49	48	47	45	44
20	43	42	41	41	40	39	38	38	37	37
30	36	36	35	34	34	33	33	32	32	32
40	31	31	30	30	29	29	29	28	28	28
50	27	27	26	26	26	25	25	25	24	24
60	24	23	23	23	22	22	22	22	21	21
70	21	20	20	20	20	19	19	19	19	18
80	18	18	17	17	17	17	16	16	16	15
90	15	15	14	14	13	13	13	12	11	9
100	7									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	7	33	27	495

8.35 Waiau River at Marble Point – 164602 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							68	78	100	208	211	113	129
1932	44	59	40	88	69	69	120	51	55	59	173	100	77
1933	61	40	30	52	71	66	72	75	130	55	47	61	63
1934	69	78	69	92	105	90	96	110	97	168	93	62	94
1935	104	87	81	86	105	122	69	58	49	76	57	79	81
1936	67	62	50	60	97	38	68	78	100	208	211	113	96
1937	167	107	123	98	175	96	45	40	53	52	80	84	93
1938	110	84	138	142	77	78	58	67	120	104	118	225	110
1939	141	79	54	36	64	97	68	53	85	93	136	268	98
1940	111	258	177	66	62	63	43	28	34	115	100	68	93
1941	74	160	68	75	46	57	82	69	46	41	77	152	78
1942	114	73	104	470	164	60	130	60	80	189	130	127	142
1943	72	149	80	62	64	51	50	36	107	103	100	88	80
1944	46	71	73	94	82	57	62	50	79	124	157	162	88
1945	168	122	99	89	74	51	48	97	118	77	188	183	109
1946	103	108	53	57	37	38	53	107	88	103	89	215	88
1947	118	76	45	36	27	57	52	60	66	163	117	94	76
1948	104	48	47	74	86	91	63	40	44	125	212	119	88
1949	95	133	95	81	75	100	105	87	44	151	93	111	98
1950	122	56	35	89	87	124	59	76	62	47	50	102	76
1951	74	36	31	57	56	56	95	65	48	115	222	282	95
1952	129	114	87	67	102	147	72	35	38	55	96	94	86
1953	69	78	66	111	161	93	56	57	73	65	141	217	99
1954	123	97	87	102	52	110	67	41	48	47	129	79	82
1955	47	357	200	63	154	80	35	68	56	77	95	72	107
1956	40	59	40	88	69	69	120	51	55	59	173	100	77
1957	112	49	67	101	136	68	53	45	34	91	182	546	125
1958	205	135	147	90	241	149	59	65	58	90	97	133	123
1959	70	44	58	54	55	63	36	40	116	102	134	144	76
1960	44	42	47	44	48	83	107	98	103	77	97	96	74
1961	62	57	65	57	66	82	128	120	67	185	110	45	87
1962	74	37	43	66	65	101	129	116	121	134	90	54	86

1963	42	43	54	53	82	109	143	118	160	86	144	55	91
1964	135	42	47	41	90	89	108	115	132	131	95	76	92
1965	72	57	131	145	73	101	81	115	128	111	174	73	105
1966	61	59	52	82	145	63	77	94	133	96	95	85	87
1967	99	57	54	56	64	61	67	113	83	74	261	130	93
1968	64	93	68	88	82	67	84	73	87	248	198	151	109
1969	89	44	41	59	64	50	52	57	134	63	49	68	64
1970	60	31	46	43	42	53	81	115	266	130	89	65	85
1971	53	29	23	24	36	64	45	74	141	262	127	78	80
1972	57	42	64	101	115	69	102	62	147	218	117	80	98
1973	44	25	25	63	122	83	41	93	82	76	152	57	72
1974	53	69	51	194	83	99	162	92	174	153	131	57	110
1975	54	56	92	122	171	119	127	132	138	166	134	90	117
1976	114	113	53	48	84	123	117	83	95	123	115	143	101
1977	161	78	54	41	79	90	100	63	96	130	132	95	93
1978	69	36	47	90	124	86	108	127	146	115	97	86	94
1979	45	66	66	99	170	77	87	125	163	168	122	171	114
1980	179	132	139	123	108	118	82	151	194	151	146	106	136
1981	48	52	60	80	104	115	90	73	128	186	94	111	95
1982	101	50	33	35	112	108	68	83	100	82	195	139	92
1983	130	51	73	94	207	127	134	93	142	232	109	98	125
1984	65	85	65	56	62	60	114	103	63	145	183	132	95
1985	106	47	34	47	41	76	93	95	100	78	82	120	77
1986	67	60	49	89	66	89	86	142	124	188	103	75	95
1987	100	70	120	93	89	121	60	79	70	131	86	122	95
1988	64	97	95	60	141	130	205	137	202	287	145	76	137
1989	50	42	73	56	39	152	71	46	56	86	70	102	70
1990	90	45	50	82	166	75	81	121	70	78	93	95	88
1991	91	123	39	77	63	86	75	200	100	116	118	93	98
1992	77	66	114	52	45	49	98	141	86	139	128	98	91
1993	120	66	44	53	62	159	57	38	72	149	76	151	87
1994	191	47	48	44	140	111	123	119	108	92	373	110	126
1995	84	62	89	70	83	114	101	114	215	201	147	121	117
1996	62	62	62	112	88	75	83	90	146	202	179	115	106
1997	67	93	86	98	67	79	68	100	56	91	137	212	96
1998	60	53	66	87	49	69	187	117	118	256	86	62	101
1999	33	33	54	83	66	111	77	76	75	145	144	60	80

2000	62	46	40	95	81	137	93	146	152	239	72	98	105
2001	69	36	34	33	51	84	62	80	57	80	128	175	75
2002	135	52	70	57	49	190	83	77	124	117	175	144	106
2003	84	79	47	72	83	117	101	65	193	185	132	78	103
2004	97	151	84	49	96	163	75	119	118	141	85	90	105
2005	64	52	61	42	45	51	70	58	46	55	43	48	53
2006	102	43	37	122	65	97	89	68	96	154	258	133	105
2007	63	51	39	34	65	68	77	75	69	267	79	62	79
2008	45	58	46	28	28	40	112	166	174	131	133	85	87
2009	50	56	44	62	133	68	76	104	105	128	94	144	89
2010	104	40	43	44	79	120							72
Min.	33	25	23	24	27	38	35	28	34	41	43	45	53
Mean	87	75	67	79	88	89	85	87	102	130	128	116	94
Max.	205	357	200	470	241	190	205	200	266	287	373	546	142

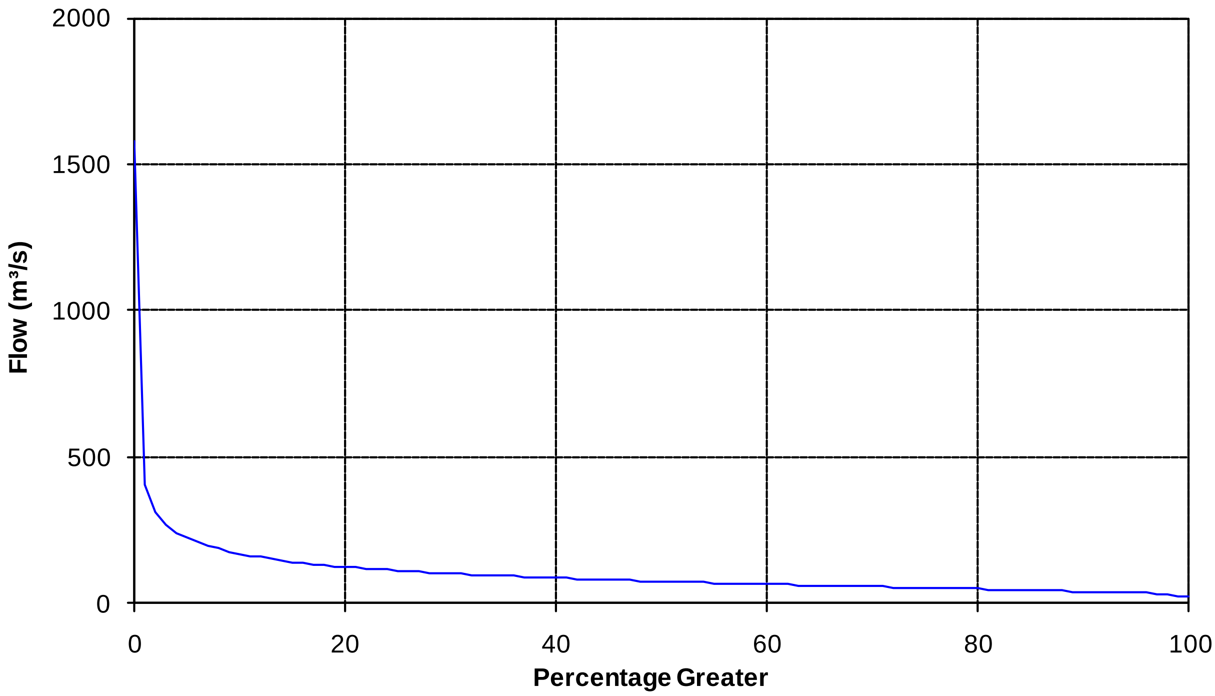

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	1579	407	314	270	242	222	207	194	184	176
10	168	162	155	150	145	141	136	133	129	126
20	123	120	118	115	113	111	109	106	105	103
30	101	99	98	96	94	93	91	90	88	87
40	85	84	83	81	80	79	78	77	75	74
50	73	72	71	70	69	68	67	66	65	65
60	64	63	62	61	61	60	59	58	57	57
70	56	55	54	53	53	52	51	50	49	49
80	48	47	46	45	44	43	42	41	41	40
90	39	38	37	36	35	34	33	31	28	25
100	20									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	20	95	73	1579

8.36 Ngaruroro River at Whanawhana – 123103 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							52	34	53	23	15	11	31
1932	9	85	59	29	52	26	29	42	33	34	14	13	35
1933	14	27	28	14	53	39	52	48	49	36	26	24	34
1934	12	38	15	22	34	35	38	46	30	28	24	16	28
1935	9	20	35	76	34	53	42	61	38	23	56	20	39
1936	43	50	37	20	27	34	44	24	28	23	23	23	31
1937	33	16	16	20	22	36	66	34	42	32	27	28	31
1938	15	46	17	87	47	37	85	52	22	18	19	35	40
1939	11	16	13	17	42	33	30	45	42	29	24	33	28
1940	30	28	31	29	42	30	53	48	38	41	46	20	36
1941	26	15	28	34	24	37	54	57	38	49	24	20	34
1942	43	51	25	27	29	57	72	65	47	23	25	33	41
1943	30	23	23	40	75	87	41	48	90	32	45	32	47
1944	51	53	109	20	39	47	53	56	34	29	20	24	45
1945	29	23	14	10	45	39	39	38	37	43	21	11	29
1946	8	2	4	30	45	43	62	46	44	37	22	14	30
1947	21	23	21	57	51	74	74	29	26	30	18	14	36
1948	12	2	2	35	119	58	41	34	28	48	51	20	38
1949	28	9	15	10	60	43	32	69	30	29	25	20	31
1950	18	26	6	36	38	29	66	43	50	67	71	18	39
1951	33	38	60	38	71	35	42	54	23	28	29	23	40
1952	17	30	13	7	17	45	35	62	81	34	58	57	38
1953	33	26	14	27	35	78	37	28	23	28	13	11	29
1954	2	2	19	111	48	35	40	109	42	21	28	42	42
1955	19	18	35	51	35	38	107	58	53	38	23	23	42
1956	17	21	21	32	98	74	69	58	34	40	29	16	43
1957	17	14	18	22	25	41	53	50	43	36	23	22	30
1958	12	20	13	6	26	19	49	51	30	53	28	44	29
1959	22	28	35	40	61	36	36	50	27	59	26	16	37
1960	19	55	39	71	49	55	54	40	92	42	79	91	57
1961	55	29	17	17	31	55	79	73	72	26	16	19	41
1962	16	22	31	25	32	52	73	42	34	43	30	76	40

1963	27	13	9	10	10	54	74	40	49	36	21	19	30
1964	19	13	28	9	11	25	56	24	35	17	10	8	21
1965	12	15	61	13	7	16	28	97	14	9	32	37	29
1966	47	31	27	32	73	45	65	78	52	9	14	14	41
1967	25	47	32	14	17	42	45	102	42	22	54	63	42
1968	35	15	8	61	83	126	104	83	50	49	30	36	57
1969	29	35	16	20	23	26	27	33	43	28	21	31	28
1970	15	17	29	24	38	52	37	54	48	39	29	13	33
1971	27	18	23	56	57	30	50	67	72	72	42	30	45
1972	15	12	41	20	37	33	44	34	26	21	13	25	27
1973	19	15	14	37	18	42	35	52	44	24	17	17	28
1974	16	8	17	43	43	31	41	54	53	49	28	26	34
1975	32	14	43	22	32	70	43	51	39	38	23	19	36
1976	73	52	16	26	36	30	54	65	106	39	39	31	47
1977	20	12	12	35	40	65	57	85	88	49	18	25	42
1978	10	16	6	19	21	54	79	39	29	31	23	17	29
1979	9	12	44	32	29	30	35	66	59	44	26	20	34
1980	35	22	64	54	20	36	47	42	40	23	24	73	40
1981	43	20	29	60	52	68	68	68	49	43	37	26	47
1982	14	20	20	35	28	38	37	32	18	20	15	21	25
1983	12	7	6	13	29	43	46	30	27	51	34	27	27
1984	13	15	21	14	18	17	28	37	55	33	15	23	24
1985	18	13	50	24	26	77	88	63	47	21	19	35	40
1986	42	30	25	10	19	20	38	47	72	33	15	15	30
1987	21	14	62	42	20	18	75	40	24	27	33	29	34
1988	14	30	113	23	26	29	72	54	87	27	18	22	43
1989	35	27	10	8	27	68	43	53	151	68	40	26	46
1990	19	12	18	12	19	30	44	92	23	52	31	13	31
1991	9	17	15	48	65	22	26	62	27	25	55	15	32
1992	17	16	14	17	21	41	69	63	41	99	56	41	42
1993	18	40	26	18	35	34	21	20	27	19	18	13	24
1994	10	10	9	11	18	33	54	51	33	43	62	14	29
1995	9	13	16	35	41	35	50	36	43	29	22	26	30
1996	36	33	23	52	30	35	70	42	42	22	16	21	35
1997	25	13	19	16	12	36	70	40	35	34	19	13	28
1998	9	10	8	9	10	14	107	40	27	44	21	35	28
1999	27	15	11	23	41	40	31	35	27	14	43	42	29

2000	25	15	10	31	28	36	92	33	31	44	22	24	33
2001	17	10	9	10	45	34	47	67	43	39	40	70	36
2002	22	24	14	12	16	41	141	99	37	29	14	40	41
2003	21	13	23	11	27	30	25	95	105	67	26	21	39
2004	17	47	29	10	21	45	58	54	31	38	20	20	32
2005	19	10	15	12	34	47	45	22	18	51	26	45	29
2006	22	19	18	41	79	42	111	52	22	16	23	18	39
2007	15	11	11	10	10	20	69	47	32	30	14	20	24
2008	11	7	10	21	35	32	67	108	46	27	16	13	33
2009	11	11	13	9	34	32	70	48	33	67	22	21	31
2010	31	65	12	10	25	87							38
Min.	2	2	2	6	7	14	21	20	14	9	10	8	21
Mean	22	23	25	28	37	42	56	53	44	36	28	27	35
Max.	73	85	113	111	119	126	141	109	151	99	79	91	57

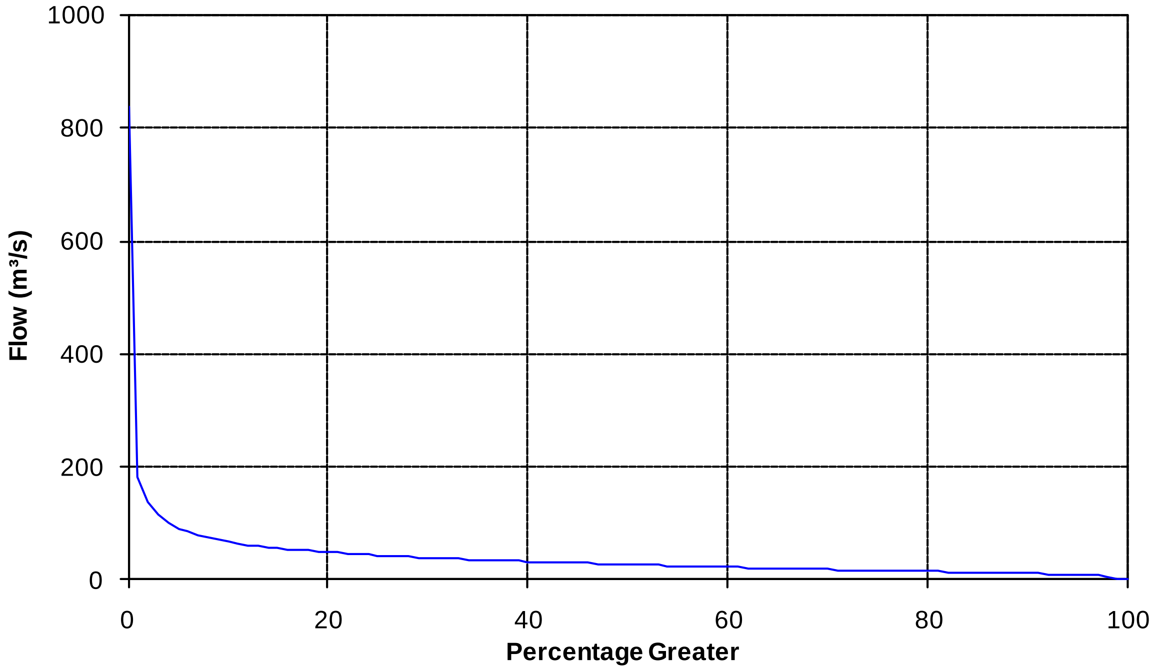

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	837	181	136	113	100	91	84	78	74	70
10	67	64	61	59	57	55	54	52	50	49
20	48	47	45	44	43	42	41	41	40	39
30	38	37	36	36	35	34	34	33	33	32
40	32	31	30	30	29	29	28	28	27	27
50	26	26	25	25	24	24	23	23	22	22
60	21	21	21	20	20	19	19	19	18	18
70	17	17	17	16	16	16	15	15	15	14
80	14	13	13	13	12	12	12	11	11	11
90	10	10	9	9	9	8	7	7	5	2
100	1									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	1	35	26	837

8.37 Ngaruroro River at Kuripapango – 123104 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							26	16	26	11	8	5	15
1932	4	43	29	14	26	12	14	21	16	16	7	7	17
1933	7	13	14	7	26	19	26	24	24	17	12	12	17
1934	6	19	7	11	17	17	19	23	15	14	12	8	14
1935	5	10	17	38	17	26	20	30	18	11	28	10	19
1936	22	25	18	10	13	17	21	12	14	11	11	12	15
1937	16	8	8	10	11	18	33	16	20	16	13	14	15
1938	8	23	8	43	23	19	43	26	11	9	9	17	20
1939	5	8	6	8	21	16	15	22	21	14	12	17	14
1940	15	14	15	14	21	15	26	24	18	20	23	10	18
1941	13	7	14	17	12	18	27	28	18	24	12	10	17
1942	21	25	12	13	14	29	36	32	23	11	12	16	21
1943	15	11	11	20	38	44	20	24	45	16	22	15	23
1944	25	26	55	10	20	23	27	28	17	14	10	12	22
1945	14	12	7	5	23	19	19	19	18	22	10	5	14
1946	4	1	2	15	22	21	31	23	22	18	11	7	15
1947	11	11	10	28	25	37	37	14	13	15	9	7	18
1948	6	1	1	17	60	29	20	16	14	24	26	10	19
1949	14	5	8	5	30	21	16	34	15	14	12	10	15
1950	9	13	3	18	18	14	33	21	25	34	36	9	19
1951	16	19	30	18	36	17	20	27	11	14	14	11	20
1952	9	15	7	3	8	22	17	31	41	16	29	28	19
1953	16	12	7	13	17	39	18	14	11	13	7	5	14
1954	1	1	9	56	24	17	20	55	21	10	14	21	21
1955	10	9	17	26	17	19	54	29	26	19	11	11	21
1956	8	10	10	16	50	37	35	29	16	20	14	8	21
1957	9	7	9	11	12	21	26	25	21	18	11	11	15
1958	6	10	7	3	13	9	25	25	15	26	14	22	15
1959	11	14	17	20	31	17	18	25	13	30	13	8	18
1960	9	28	19	36	25	27	27	20	47	20	39	46	28
1961	28	14	9	9	15	28	40	37	37	13	8	10	20
1962	8	11	16	12	16	26	37	20	16	21	15	38	20

1963	13	6	5	5	5	27	37	19	27	10	8	9	14
1964	13	7	24	4	6	13	44	22	36	19	14	15	18
1965	14	20	25	11	7	20	21	61	19	11	24	18	21
1966	18	9	11	16	29	21	33	40	33	11	16	14	21
1967	20	21	15	7	9	16	18	45	18	8	21	16	18
1968	9	5	4	11	25	44	46	38	20	23	13	16	21
1969	15	18	7	6	13	11	10	14	26	12	7	16	13
1970	6	9	9	13	23	34	18	33	41	19	17	6	19
1971	14	10	11	16	28	27	18	29	35	38	18	15	22
1972	7	5	21	9	20	10	27	15	15	10	6	6	13
1973	6	4	4	5	10	24	11	24	22	9	10	7	11
1974	6	4	8	26	22	32	45	22	20	25	12	12	20
1975	12	7	13	8	14	32	19	29	20	22	11	9	16
1976	35	28	7	12	21	17	27	27	56	19	14	15	23
1977	9	6	7	18	17	32	28	39	40	22	9	11	20
1978	5	6	3	10	9	21	39	15	17	13	15	8	13
1979	4	9	21	15	14	13	14	33	25	29	16	12	17
1980	24	9	24	31	12	21	29	22	20	10	11	37	21
1981	15	7	9	20	24	34	28	27	16	19	21	16	20
1982	7	11	12	20	16	24	15	13	13	12	9	16	14
1983	8	4	3	10	16	21	24	16	16	32	19	17	15
1984	7	10	15	9	11	11	22	18	23	16	8	13	14
1985	9	6	30	15	13	42	33	32	26	10	9	16	20
1986	27	14	12	5	13	12	24	26	38	18	7	8	17
1987	14	7	29	23	11	12	30	19	13	16	16	18	17
1988	8	12	54	10	14	17	33	27	39	18	13	16	22
1989	23	18	6	4	13	40	20	19	50	34	17	13	21
1990	11	6	16	9	14	15	22	52	14	23	18	7	17
1991	5	13	8	22	27	11	14	37	15	13	23	6	16
1992	9	9	8	8	8	17	23	30	17	43	22	20	18
1993	7	14	10	8	23	23	11	8	14	9	10	7	12
1994	6	5	5	6	10	22	27	30	19	23	45	8	17
1995	6	9	12	23	22	17	29	21	27	17	13	19	18
1996	24	18	13	27	18	13	32	20	29	13	10	15	19
1997	13	6	9	9	6	24	34	21	21	20	10	7	15
1998	5	7	5	5	7	11	60	23	17	33	12	15	17
1999	9	6	6	10	22	19	16	20	15	7	24	14	14

2000	10	8	5	13	13	18	34	16	17	23	10	12	15
2001	8	5	4	6	22	14	17	26	14	16	19	32	15
2002	8	12	8	7	9	21	41	28	15	12	7	19	16
2003	8	5	7	7	19	16	14	39	51	39	15	13	19
2004	8	34	19	3	14	31	33	31	15	23	11	11	19
2005	12	4	6	5	15	23	22	10	10	30	12	20	14
2006	12	12	10	24	36	21	52	31	9	8	19	12	21
2007	10	6	6	5	6	11	40	23	12	17	7	10	13
2008	5	3	5	14	21	17	44	53	23	15	8	7	18
2009	5	6	7	5	18	18	30	27	19	32	9	8	15
2010	17	30	5	4	13	44							19
Min.	1	1	1	3	5	9	10	8	9	7	6	5	11
Mean	11	12	12	14	18	22	27	26	22	18	15	14	18
Max.	35	43	55	56	60	44	60	61	56	43	45	46	28

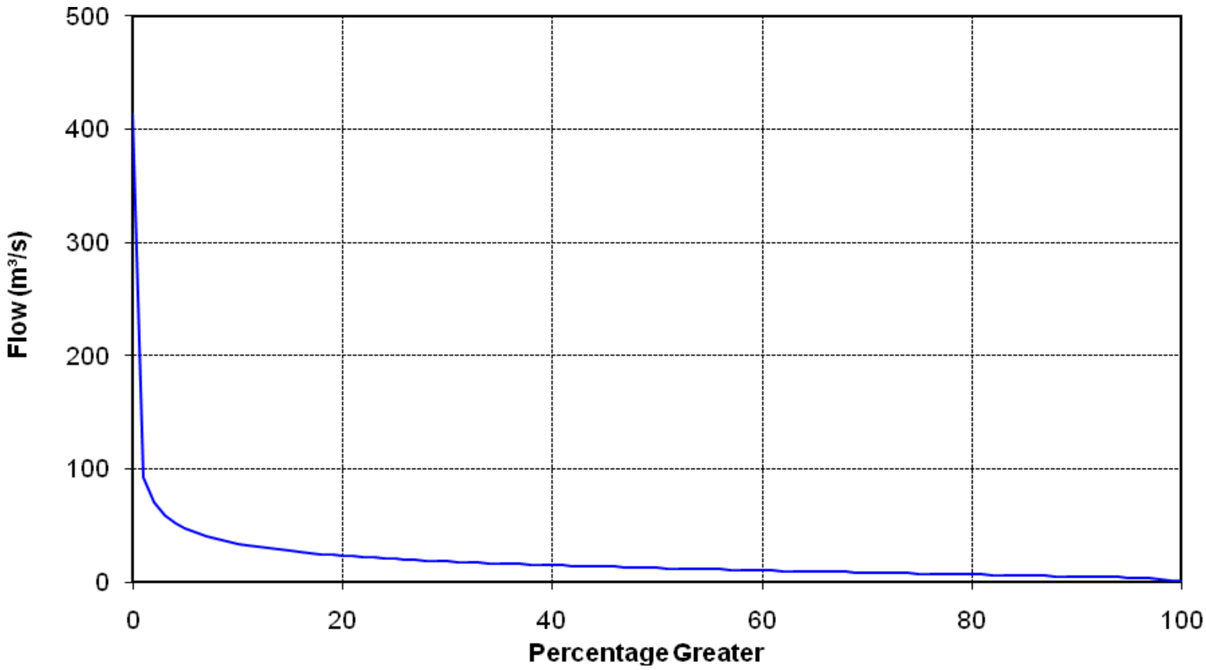

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	414	92	71	60	53	48	44	41	38	36
10	34	33	31	30	29	28	27	26	25	24
20	24	23	22	22	21	21	20	20	19	19
30	19	18	18	17	17	17	16	16	16	15
40	15	15	15	14	14	14	14	13	13	13
50	13	12	12	12	12	12	11	11	11	11
60	11	10	10	10	10	10	9	9	9	9
70	9	9	8	8	8	8	8	7	7	7
80	7	7	7	6	6	6	6	6	6	5
90	5	5	5	5	4	4	4	3	3	1
100	1									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	1	18	13	414

8.38 Ngaruroro River at Chesterhope – 123150 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							66	39	67	25	15	9	37
1932	9	128	82	33	68	28	33	51	38	39	14	12	44
1933	13	30	32	13	76	47	65	61	62	42	28	26	41
1934	10	46	14	24	40	42	45	57	35	33	26	15	32
1935	8	23	41	114	41	67	50	81	44	25	72	21	49
1936	54	66	45	21	30	40	53	27	32	25	24	26	37
1937	39	16	15	20	23	44	90	39	50	37	30	31	36
1938	17	59	17	135	58	45	118	66	23	18	20	41	51
1939	10	16	11	19	52	39	34	55	52	33	26	39	32
1940	34	32	36	33	51	35	69	59	45	49	58	21	44
1941	29	14	32	40	26	44	70	72	45	61	26	21	40
1942	54	65	27	30	33	75	100	86	59	25	28	38	52
1943	35	25	24	48	104	117	49	59	132	37	55	37	60
1944	71	69	166	21	50	59	69	72	40	32	21	26	58
1945	33	26	13	9	59	47	47	46	45	54	22	10	34
1946	7	2	4	38	58	55	85	56	54	45	24	13	37
1947	23	26	22	78	66	98	100	33	29	34	18	13	45
1948	12	1	1	41	199	74	49	39	32	60	65	21	50
1949	32	8	16	10	81	52	37	99	35	33	28	21	38
1950	18	30	5	46	45	33	93	52	63	90	95	19	49
1951	39	45	78	45	100	41	51	70	25	31	33	25	49
1952	18	35	13	6	17	55	42	82	117	39	75	73	48
1953	38	28	13	30	42	110	44	32	25	31	12	10	35
1954	1	1	21	177	59	41	49	163	51	22	32	52	56
1955	20	18	43	70	42	46	157	75	67	46	24	25	53
1956	17	22	22	37	142	98	93	75	39	49	33	16	54
1957	17	13	18	23	28	51	68	63	52	46	25	24	36
1958	11	26	13	4	33	20	62	63	34	73	32	59	36
1959	23	33	41	48	84	42	43	63	30	76	28	16	44
1960	19	73	46	102	62	69	69	48	127	50	116	130	76
1961	71	33	17	17	36	71	106	96	95	29	15	20	51
1962	16	23	37	28	38	66	97	51	40	53	34	112	50

1963	30	11	7	9	8	77	102	47	61	41	22	20	36
1964	19	13	34	7	9	28	72	26	43	17	8	6	24
1965	11	14	93	11	5	16	32	149	13	7	37	44	37
1966	57	35	30	38	97	55	87	108	65	8	15	14	51
1967	27	62	38	13	17	52	56	148	51	24	70	81	53
1968	41	14	6	79	111	188	154	116	61	61	33	42	76
1969	33	40	16	21	25	28	29	38	53	31	23	35	31
1970	14	17	34	27	44	65	43	68	60	47	32	12	39
1971	30	18	24	78	76	34	62	87	95	97	50	34	58
1972	13	11	51	20	45	37	54	40	29	22	12	28	30
1973	20	14	13	46	19	52	41	65	53	26	17	17	32
1974	16	6	17	56	52	35	50	67	68	62	31	29	41
1975	37	13	56	23	37	94	53	64	47	45	24	23	43
1976	109	67	15	29	42	34	69	85	160	47	44	31	61
1977	17	11	13	41	42	88	83	147	127	63	24	27	57
1978	7	17	5	24	20	85	116	47	35	29	25	15	35
1979	7	12	88	39	33	45	62	108	117	74	30	21	53
1980	40	30	105	106	30	54	76	52	42	24	19	151	61
1981	59	19	21	88	58	98	78	109	67	50	45	31	60
1982	12	23	21	43	30	48	44	38	20	19	16	15	27
1983	7	4	3	12	24	53	50	27	25	62	32	22	27
1984	10	15	21	13	19	18	32	59	82	38	16	23	29
1985	14	10	84	24	26	111	178	85	51	18	16	36	55
1986	40	33	21	9	15	16	37	54	95	42	15	13	32
1987	16	11	78	47	22	20	108	48	29	25	46	28	40
1988	12	38	176	22	16	14	102	70	130	31	14	19	54
1989	34	24	7	5	30	67	39	62	288	74	39	32	58
1990	16	12	19	10	17	23	43	129	42	39	28	10	33
1991	6	11	13	31	92	25	29	64	25	23	71	14	34
1992	16	14	12	15	21	49	90	68	52	150	73	65	52
1993	24	80	42	22	49	45	24	23	33	17	16	11	32
1994	8	7	6	7	17	39	76	65	32	47	70	10	32
1995	5	12	14	62	65	45	74	51	47	31	26	25	38
1996	45	41	21	59	36	45	106	46	58	20	14	21	43
1997	40	13	21	16	12	63	130	54	59	57	22	11	42
1998	6	7	5	7	10	16	121	45	29	30	19	42	28
1999	38	15	12	26	52	58	38	37	32	15	49	44	35

2000	20	14	7	34	27	38	138	45	45	51	27	28	40
2001	19	9	8	10	45	28	44	62	41	33	32	71	34
2002	25	24	13	10	15	45	144	109	45	38	16	44	44
2003	25	10	45	16	35	34	29	171	180	83	21	30	57
2004	20	65	40	11	31	64	89	76	35	49	21	18	43
2005	19	8	16	14	55	76	82	27	16	80	35	70	42
2006	30	25	24	69	145	70	192	87	31	19	31	22	63
2007	15	10	9	9	8	29	144	48	33	30	13	19	31
2008	7	4	7	17	39	35	100	130	52	27	14	11	37
2009	7	5	15	7	37	44	98	61	41	85	26	21	38
2010	26	131	18	13	42	121							57
Min.	1	1	1	4	5	14	24	23	13	7	8	6	24
Mean	25	27	31	35	46	54	75	69	58	42	32	31	44
Max.	109	131	176	177	199	188	192	171	288	150	116	151	76

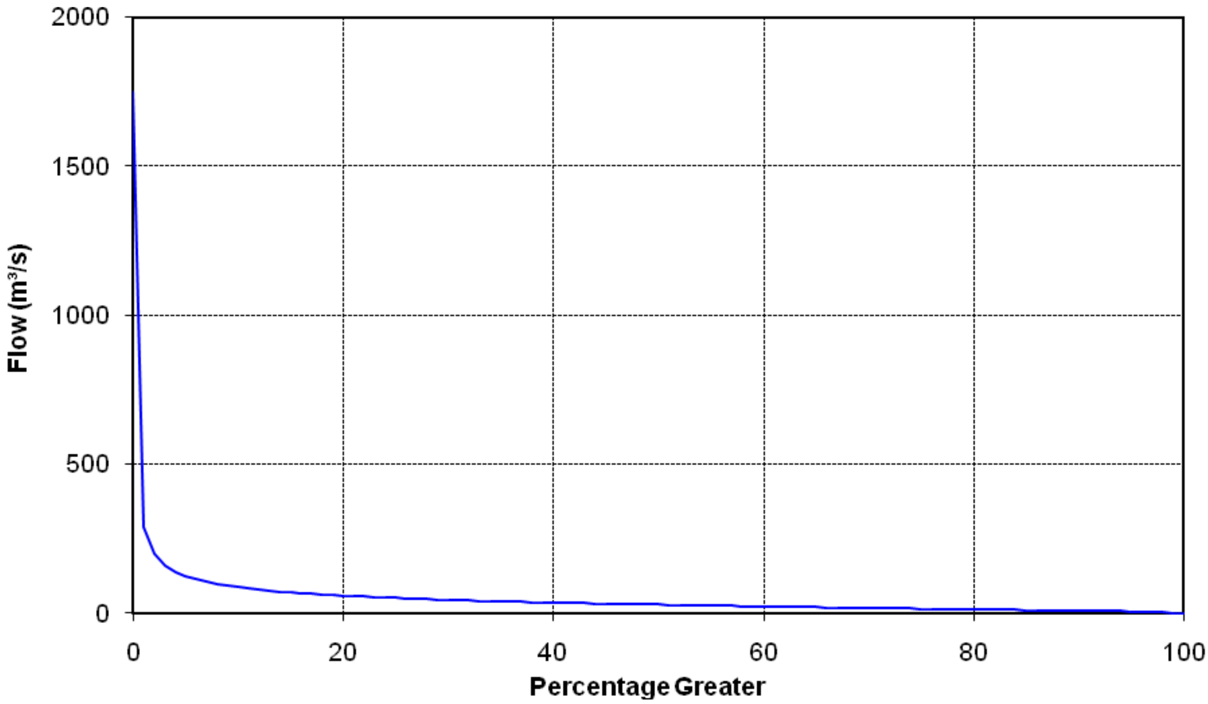

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	1750	288	200	160	139	124	113	105	98	92
10	87	83	79	75	72	70	67	65	63	61
20	59	57	55	54	52	51	50	48	47	46
30	45	44	43	42	41	40	39	38	37	36
40	36	35	34	34	33	32	31	31	30	29
50	29	28	27	27	26	26	25	24	24	23
60	23	22	22	21	20	20	19	19	18	18
70	17	17	16	16	15	15	14	14	13	13
80	12	12	12	11	11	10	10	10	9	9
90	8	8	8	7	6	6	5	4	3	1
100	1									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	1	44	29	1750

8.39 Wairau River at Dip Flat – 160114 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							23	20	19	33	33	52	30
1932	21	44	18	20	13	15	22	19	13	11	21	42	21
1933	21	44	18	20	13	15	22	19	13	11	21	42	21
1934	38	24	29	25	29	25	26	30	27	46	25	17	28
1935	28	24	22	23	29	33	19	16	13	21	15	21	22
1936	18	17	13	16	27	11	18	21	27	58	58	31	26
1937	46	29	34	27	49	26	12	11	14	14	22	23	26
1938	30	23	38	39	21	21	16	18	33	28	32	63	30
1939	39	21	15	10	18	26	18	14	23	25	38	77	27
1940	30	72	50	18	17	17	12	8	9	32	27	18	26
1941	20	44	18	20	13	15	22	19	13	11	21	42	21
1942	31	20	28	149	45	16	36	16	22	53	35	35	40
1943	20	41	22	17	17	14	13	10	30	28	27	24	22
1944	13	19	20	25	22	16	17	14	21	34	43	45	24
1945	46	33	27	24	20	14	13	27	32	21	52	51	30
1946	28	29	14	16	10	11	14	29	24	28	24	60	24
1947	32	21	12	10	8	16	14	16	18	45	32	25	21
1948	28	13	13	20	23	25	17	11	12	34	59	32	24
1949	26	37	26	22	21	27	29	24	12	42	25	30	27
1950	33	15	10	25	24	34	16	21	17	13	14	28	21
1951	20	10	9	15	15	13	32	14	15	39	60	52	25
1952	24	23	20	14	34	36	21	14	18	25	39	38	26
1953	29	26	20	27	47	29	19	22	29	26	47	54	31
1954	38	24	29	34	23	37	18	14	17	21	37	27	26
1955	13	72	22	8	39	23	12	25	21	25	22	17	24
1956	15	15	12	33	21	29	30	13	18	27	50	28	24
1957	17	12	20	38	38	16	15	15	13	35	66	90	31
1958	28	22	33	18	55	28	19	21	18	32	30	34	28
1959	14	15	19	25	24	25	12	13	38	33	39	32	24
1960	16	19	23	13	25	28	19	20	22	28	23	11	21
1961	11	12	24	22	12	13	20	21	21	50	54	13	23
1962	31	14	14	11	36	30	26	24	27	77	43	15	29

1963	8	18	12	11	27	30	16	24	39	19	39	20	22
1964	54	11	20	13	24	13	18	17	24	38	43	36	26
1965	32	18	10	13	13	19	11	14	20	28	64	31	23
1966	29	22	16	27	22	15	14	11	17	21	31	26	21
1967	17	12	22	27	22	14	19	45	18	26	74	49	29
1968	18	31	22	41	32	20	22	22	23	79	80	64	38
1969	36	17	12	17	23	13	10	10	67	21	16	27	22
1970	21	10	13	15	8	14	20	36	96	37	31	22	27
1971	20	14	12	14	34	49	16	17	29	66	37	25	28
1972	21	12	22	37	32	18	26	18	39	77	40	19	30
1973	12	7	6	15	27	20	10	21	20	18	56	18	19
1974	17	20	12	79	19	18	29	17	23	52	48	20	29
1975	16	15	24	36	41	25	22	25	30	46	47	23	29
1976	37	22	13	14	21	32	23	20	19	33	33	52	27
1977	45	18	14	9	15	23	24	9	11	28	39	37	23
1978	17	9	10	15	35	18	18	21	29	35	31	34	23
1979	18	29	10	21	60	17	24	18	26	44	44	56	31
1980	60	38	27	27	23	29	16	31	39	40	36	31	33
1981	15	11	21	21	32	37	24	17	22	52	36	44	28
1982	26	16	11	9	36	28	13	13	32	20	61	37	25
1983	33	14	12	41	51	25	46	19	24	64	34	32	33
1984	17	18	15	17	16	13	25	24	17	34	53	37	24
1985	39	17	12	21	14	23	17	18	36	22	20	43	23
1986	32	22	25	28	20	26	16	19	23	44	32	20	26
1987	32	22	19	29	29	29	12	20	20	37	28	42	27
1988	18	30	46	17	40	25	49	33	47	78	46	33	39
1989	24	17	22	18	11	54	23	13	12	22	26	36	23
1990	29	13	13	20	38	16	22	38	15	23	41	29	25
1991	31	36	11	18	14	12	9	42	36	31	27	28	24
1992	27	22	31	15	9	8	12	26	14	35	45	34	23
1993	31	15	16	14	17	46	14	10	13	40	25	28	22
1994	48	17	17	11	26	31	24	25	26	29	138	37	36
1995	28	28	24	34	34	24	18	23	57	66	48	53	36
1996	32	23	23	45	19	17	13	19	47	67	53	32	32
1997	18	20	27	24	17	20	13	17	14	28	34	59	24
1998	21	17	21	28	18	25	75	40	37	87	33	15	35
1999	11	10	14	25	20	33	17	15	20	39	58	17	23

2000	20	19	9	35	25	37	30	27	38	65	21	23	29
2001	21	10	8	9	15	27	11	18	18	33	47	70	24
2002	25	12	18	14	13	47	20	18	36	27	39	43	26
2003	20	14	11	17	23	32	31	11	35	51	44	31	27
2004	29	43	25	11	20	49	22	26	28	51	37	29	31
2005	28	18	24	17	11	19	21	21	16	16	13	11	18
2006	25	15	9	43	26	27	15	12	20	31	77	31	27
2007	17	13	9	8	19	15	26	17	15	80	33	26	23
2008	23	19	19	9	8	8	25	22	47	48	55	36	27
2009	17	17	15	20	33	24	14	24	27	31	27	42	24
2010	32	15	12	12	20	30							20
Min.	8	7	6	8	8	8	9	8	9	11	13	11	18
Mean	26	22	19	23	25	24	20	20	25	38	40	35	26
Max.	60	72	50	149	60	54	75	45	96	87	138	90	40

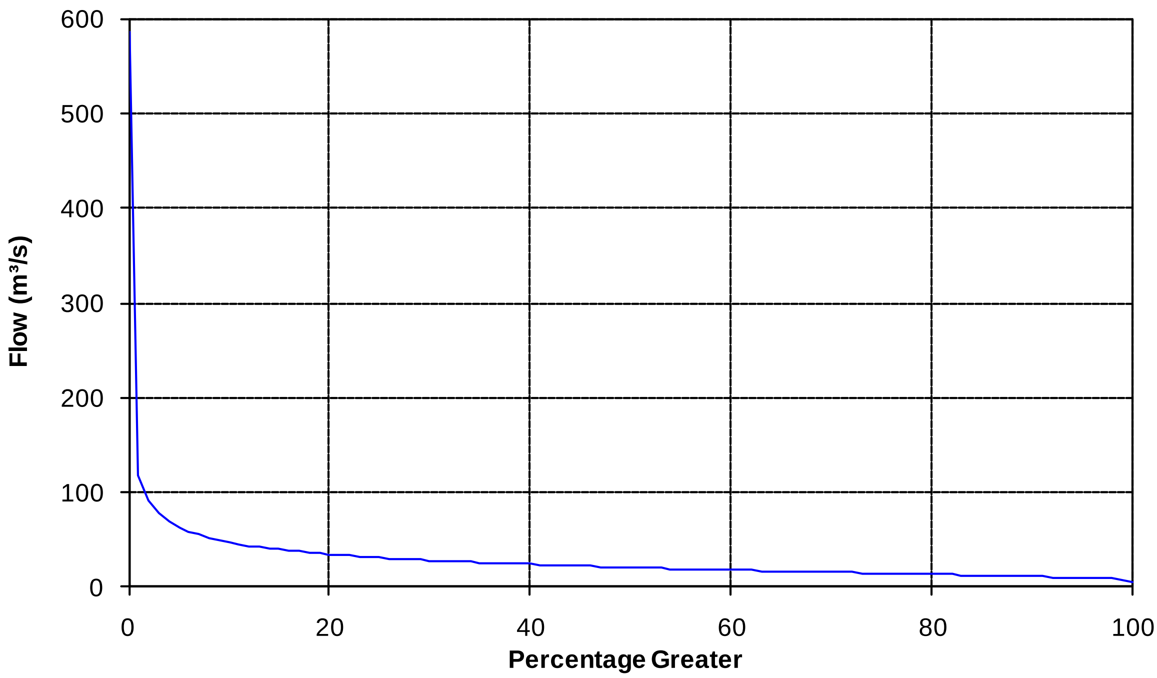

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	588	119	91	78	69	63	58	55	51	49
10	47	45	43	42	40	39	38	37	36	35
20	34	33	33	32	31	30	30	29	29	28
30	28	27	27	26	26	25	25	25	24	24
40	24	23	23	22	22	22	21	21	21	21
50	20	20	20	19	19	19	19	18	18	18
60	18	17	17	17	17	16	16	16	16	15
70	15	15	15	15	14	14	14	14	13	13
80	13	13	12	12	12	12	12	11	11	11
90	11	10	10	10	10	9	9	9	8	7
100	4									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	4	26	20	588

8.40 Hurunui River at Mandamus – 165104 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							73	64	56	70	78	35	63
1932	29	23	41	33	24	81	39	27	39	44	39	59	40
1933	27	35	32	22	26	33	31	35	71	37	33	27	34
1934	47	47	28	50	57	49	52	59	52	89	50	33	51
1935	56	47	44	47	56	65	38	32	27	41	31	43	44
1936	36	34	27	33	52	21	37	42	54	106	109	61	51
1937	88	57	66	53	92	51	25	22	29	29	43	46	50
1938	59	45	72	76	42	42	32	36	64	56	64	117	59
1939	75	43	30	19	34	52	37	29	46	50	72	133	52
1940	59	131	90	36	34	34	23	13	18	61	54	37	49
1941	40	85	37	41	26	31	44	37	25	23	42	81	42
1942	61	39	56	260	87	33	69	32	43	95	70	68	76
1943	39	79	43	34	35	28	27	19	55	56	54	48	43
1944	25	39	39	51	44	31	34	28	43	66	84	86	47
1945	89	65	54	48	40	28	27	53	63	42	97	94	58
1946	56	58	29	31	20	20	28	57	48	55	48	110	47
1947	63	41	25	19	13	30	28	33	36	86	63	51	41
1948	56	27	26	40	46	49	34	22	23	66	107	64	47
1949	51	69	51	44	41	54	57	47	25	79	50	59	52
1950	66	31	18	47	44	65	32	41	33	26	28	55	41
1951	40	20	15	31	31	31	51	35	26	62	116	140	50
1952	69	61	47	37	55	78	39	19	19	30	52	51	46
1953	37	42	36	59	85	50	30	31	40	35	74	112	53
1954	65	52	47	55	28	58	37	23	26	26	68	43	44
1955	26	183	102	34	79	43	19	36	31	42	51	39	56
1956	22	32	21	47	38	38	64	28	30	33	77	54	40
1957	44	29	41	54	72	46	61	32	25	90	120	164	65
1958	81	57	55	39	135	74	39	59	39	50	37	53	60
1959	26	19	24	36	38	50	33	48	59	55	72	45	42
1960	25	35	32	22	26	33	31	35	71	37	33	27	34
1961	21	31	40	45	60	45	73	64	56	70	78	35	52
1962	54	23	11	13	34	38	50	40	58	77	67	22	41

1963	19	23	31	27	42	54	67	41	70	36	81	34	44
1964	97	28	43	33	93	35	57	68	63	73	60	58	59
1965	40	41	22	27	40	55	43	45	52	84	90	54	50
1966	48	41	26	34	43	28	38	35	31	29	41	43	36
1967	34	35	52	61	51	28	37	57	38	36	150	85	55
1968	34	47	39	45	43	36	49	40	46	134	105	65	57
1969	33	22	25	43	31	27	30	35	77	35	26	38	35
1970	38	21	21	26	22	27	40	66	177	65	45	34	48
1971	25	12	10	10	11	37	33	36	70	138	59	35	40
1972	29	19	28	47	74	34	46	26	71	136	60	42	51
1973	26	15	13	28	66	52	22	46	46	41	80	38	39
1974	28	42	31	111	34	39	69	40	65	73	71	31	53
1975	26	28	58	84	100	72	76	77	78	81	80	47	68
1976	53	47	25	20	41	73	60	46	54	56	53	55	49
1977	83	44	28	21	34	39	44	27	32	48	57	41	41
1978	32	18	21	50	57	38	54	75	74	73	47	39	48
1979	31	37	40	44	125	39	38	51	64	84	59	93	59
1980	96	58	74	54	49	72	35	81	128	80	78	57	72
1981	22	31	33	40	51	59	40	36	65	136	59	69	54
1982	63	34	24	17	54	44	37	52	55	39	120	94	53
1983	75	29	35	60	107	70	83	55	84	114	60	65	70
1984	40	42	42	29	36	40	65	72	40	93	136	91	61
1985	58	25	19	19	21	42	53	46	47	39	38	57	39
1986	39	35	35	54	38	56	47	85	61	98	43	36	52
1987	55	44	52	57	51	91	40	43	39	79	45	61	55
1988	35	43	48	30	77	69	127	88	139	132	95	50	78
1989	29	23	41	33	24	81	39	27	39	44	39	59	40
1990	54	24	25	36	86	37	40	61	31	41	41	73	46
1991	59	90	20	39	34	37	32	129	57	58	48	41	54
1992	43	35	61	29	22	33	52	99	50	59	50	36	48
1993	74	43	20	26	29	97	33	23	31	86	38	74	48
1994	149	28	28	21	66	68	95	78	76	50	230	48	78
1995	42	26	46	42	44	56	55	64	129	122	69	68	64
1996	39	36	38	100	52	47	54	44	86	137	105	62	66
1997	35	51	48	64	44	39	38	66	30	43	73	155	57
1998	44	32	40	59	31	34	116	82	61	156	57	41	63
1999	22	19	27	47	44	68	43	39	35	87	105	30	47

2000	35	30	19	61	40	83	54	90	118	153	37	40	63
2001	42	21	15	22	23	43	29	37	25	32	81	106	40
2002	97	21	45	31	22	133	55	44	84	71	94	69	64
2003	48	47	26	30	49	64	58	25	97	112	65	36	55
2004	50	75	46	30	58	95	37	74	67	78	47	42	58
2005	34	30	39	25	26	28	41	36	36	36	24	25	32
2006	61	27	21	64	35	67	38	35	53	82	167	73	60
2007	35	23	17	18	39	46	43	44	35	172	40	27	45
2008	22	25	22	13	15	23	73	91	94	64	63	55	47
2009	35	32	31	33	82	36	49	71	69	61	38	72	51
2010	58	21	24	29	46	56							39
Min.	19	12	10	10	11	20	19	13	18	23	24	22	32
Mean	48	40	36	43	48	49	47	48	56	70	68	60	51
Max.	149	183	102	260	135	133	127	129	177	172	230	164	78

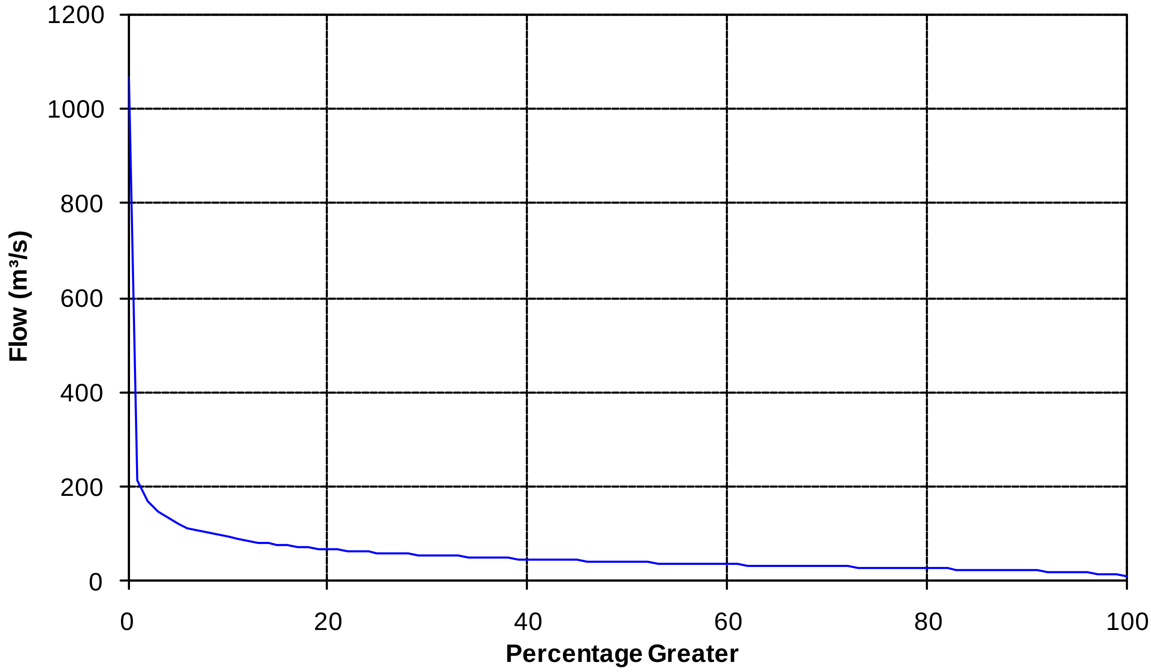

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	1066	215	169	147	132	122	113	106	101	96
10	92	88	85	82	79	77	75	73	71	69
20	67	66	64	63	61	60	59	58	57	56
30	55	54	53	52	51	50	49	48	48	47
40	46	45	45	44	43	43	42	41	41	40
50	40	39	38	38	37	37	36	36	35	35
60	34	34	34	33	33	32	32	31	31	31
70	30	30	29	29	28	28	28	27	27	26
80	26	26	25	25	24	24	23	23	22	22
90	21	21	20	19	19	18	17	16	14	12
100	8									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	8	51	40	1066

8.41 Hurunui River at SH1 Bridge – 165101 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							93	84	74	91	99	46	81
1932	37	30	52	43	31	104	51	35	50	57	51	76	51
1933	35	46	42	28	33	44	40	46	92	49	43	35	44
1934	62	60	36	65	74	64	68	77	68	113	66	44	66
1935	73	62	57	61	73	85	50	41	35	54	40	57	57
1936	48	45	35	42	68	26	49	55	71	135	138	79	66
1937	112	74	85	69	117	67	32	28	37	37	56	60	65
1938	77	60	92	97	55	56	42	48	83	73	82	146	76
1939	97	56	38	25	44	68	48	38	61	66	92	173	67
1940	77	165	116	47	44	45	30	17	23	78	71	49	63
1941	53	108	49	54	33	41	58	49	33	29	55	103	55
1942	80	52	73	383	110	43	89	43	56	122	90	88	102
1943	52	102	56	44	46	36	35	24	69	73	71	63	55
1944	33	51	52	66	58	40	44	36	55	83	107	110	61
1945	114	84	70	64	53	36	34	69	82	55	123	119	75
1946	73	76	38	41	26	26	37	75	62	73	62	140	61
1947	82	54	32	24	16	39	37	43	48	109	82	67	53
1948	73	34	33	52	61	64	45	28	30	86	136	83	61
1949	67	88	67	58	54	70	74	61	31	101	66	76	68
1950	85	40	24	60	56	84	42	54	44	33	36	72	52
1951	52	25	19	40	40	40	65	46	34	80	145	176	64
1952	90	80	61	48	72	99	51	24	24	39	68	67	60
1953	50	56	47	77	109	66	40	40	52	47	95	141	68
1954	84	68	62	72	37	74	48	29	34	33	88	56	57
1955	33	257	132	45	102	57	23	47	40	55	67	51	75
1956	28	42	27	60	49	49	82	36	39	43	99	71	52
1957	58	38	54	70	93	60	79	41	32	114	157	216	85
1958	104	74	71	51	173	94	51	76	52	65	49	68	78
1959	34	24	31	46	50	64	42	62	74	71	93	60	54
1960	33	45	42	28	33	44	40	46	92	49	43	35	44
1961	27	40	52	58	80	58	94	84	74	91	99	46	67
1962	71	29	14	16	44	50	65	52	75	99	85	29	53

1963	24	30	41	34	55	70	90	53	90	47	104	45	57
1964	123	37	56	43	119	46	74	88	81	94	79	76	77
1965	52	54	28	36	53	72	57	60	69	107	115	71	64
1966	62	53	34	44	56	36	50	46	41	38	53	57	48
1967	45	46	68	79	67	36	47	74	49	48	193	108	72
1968	44	61	51	59	56	47	64	52	60	175	134	84	74
1969	43	28	33	56	40	35	39	46	98	45	34	48	46
1970	50	27	27	33	29	35	52	88	227	84	59	44	63
1971	32	14	12	12	13	49	42	48	91	178	76	47	51
1972	38	24	37	60	96	45	60	34	91	184	77	54	67
1973	33	18	15	36	85	67	29	61	60	54	102	50	51
1974	37	54	40	142	45	51	89	53	86	94	92	39	68
1975	33	38	105	105	103	107	98	106	102	102	102	48	88
1976	57	68	30	27	48	87	97	70	109	83	64	73	68
1977	108	54	33	27	44	54	92	63	69	76	69	48	62
1978	36	20	22	94	81	79	132	121	136	94	59	51	77
1979	36	40	78	71	144	49	58	111	86	97	76	106	80
1980	133	85	142	93	61	108	56	104	143	98	91	71	99
1981	30	35	39	47	69	88	54	62	87	145	62	69	66
1982	63	37	27	22	58	73	57	68	66	53	125	88	62
1983	74	33	38	72	121	73	92	71	107	147	74	80	82
1984	48	70	87	33	45	47	91	80	50	109	143	104	76
1985	61	29	19	21	26	47	70	63	58	50	57	89	49
1986	49	45	53	72	46	68	79	191	109	125	53	42	78
1987	55	48	99	65	67	109	64	57	49	92	63	80	71
1988	42	47	58	40	85	85	146	93	173	193	98	55	93
1989	36	30	51	45	32	104	61	47	92	76	44	65	57
1990	61	30	32	42	97	48	50	79	40	46	57	80	56
1991	61	90	32	49	52	56	71	148	78	69	71	50	69
1992	48	35	69	36	33	46	102	139	98	99	65	48	68
1993	81	52	24	36	50	112	40	30	52	90	53	119	62
1994	158	34	34	30	79	79	141	98	88	72	287	57	97
1995	49	34	52	59	60	127	94	124	189	150	91	82	93
1996	47	43	45	107	72	65	116	75	102	138	109	69	82
1997	48	74	83	85	57	64	68	85	43	59	74	148	74
1998	43	36	47	63	34	38	134	94	75	176	70	48	72
1999	26	23	39	64	61	96	57	50	46	111	133	39	62

2000	46	38	25	79	52	106	70	124	119	149	31	34	73
2001	39	18	17	20	24	45	46	49	30	39	100	108	45
2002	147	23	39	36	23	122	64	52	84	79	107	69	71
2003	48	42	28	56	57	72	74	50	152	131	52	31	66
2004	42	75	42	31	69	102	48	108	85	104	58	58	68
2005	46	37	51	46	44	44	66	53	47	54	34	33	46
2006	70	36	30	80	58	95	60	48	61	105	194	91	77
2007	40	26	21	23	44	50	52	52	42	206	43	27	53
2008	18	38	28	22	24	33	121	219	128	81	69	62	71
2009	36	39	39	38	113	47	75	82	85	91	44	78	64
2010	18	14	12	12	13	26	23	17	23	29	31	27	44
	59	51	48	56	61	65	65	67	74	89	85	74	66
Min.	158	257	142	383	173	127	146	219	227	206	287	216	102
Mean	25	27	31	35	46	54	75	69	58	42	32	31	44
Max.	109	131	176	177	199	188	192	171	288	150	116	151	76

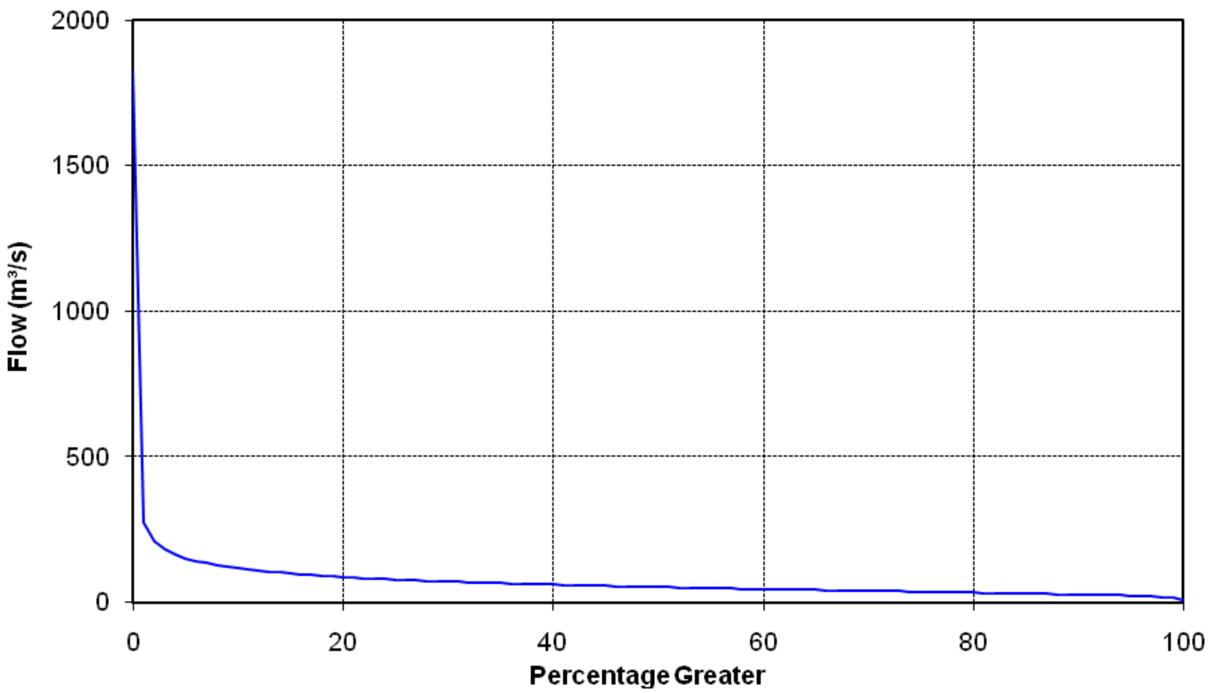

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	1828	274	211	181	164	151	142	134	127	122
10	117	112	109	105	102	99	96	94	91	89
20	87	85	83	81	79	78	76	75	74	72
30	71	70	69	68	67	66	65	64	63	62
40	61	60	59	58	57	56	56	55	54	53
50	52	52	51	50	49	49	48	47	47	46
60	45	45	44	43	43	42	42	41	40	40
70	39	39	38	38	37	36	36	35	34	34
80	33	32	32	31	30	30	29	28	28	27
90	26	26	25	24	24	22	21	19	17	15
100	10									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	10	66	52	1828

8.42 Mohaka River at Raupunga – 121801 (Item 1)

Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							115	78	114	55	38	29	71
1932	28	176	126	67	115	59	66	94	75	77	36	34	79
1933	35	61	65	36	108	90	112	105	110	81	61	56	77
1934	31	84	36	52	78	77	86	103	69	65	57	39	65
1935	26	49	79	157	78	116	91	133	85	54	123	48	87
1936	95	106	85	47	61	76	97	57	65	54	52	55	71
1937	76	40	39	47	52	79	142	76	94	72	62	64	70
1938	40	101	42	178	104	83	178	115	53	42	46	79	88
1939	29	41	32	43	93	77	69	100	92	68	55	76	65
1940	67	65	72	66	93	70	113	108	85	90	103	49	82
1941	59	37	64	77	56	84	116	125	87	107	57	49	77
1942	94	112	58	61	67	126	151	140	105	53	58	77	92
1943	71	54	53	90	156	186	93	105	187	74	99	72	103
1944	108	114	225	48	85	104	116	121	77	66	48	56	98
1945	67	55	36	29	97	86	88	85	81	97	51	30	67
1946	25	16	19	69	97	89	139	103	95	85	54	35	69
1947	50	54	49	121	109	156	159	67	60	68	44	35	81
1948	34	16	15	79	248	124	94	77	66	107	111	49	85
1949	65	27	40	29	127	97	73	147	71	66	58	49	71
1950	43	59	22	80	85	67	140	96	111	145	152	44	87
1951	77	86	126	86	151	79	93	117	56	64	67	55	88
1952	43	69	35	24	41	98	81	131	171	77	126	126	85
1953	76	60	34	61	80	163	84	65	53	64	35	30	67
1954	15	15	47	230	107	79	87	227	93	50	64	92	93
1955	47	43	78	106	82	85	220	125	117	87	53	54	92
1956	41	50	50	73	202	159	147	126	78	91	67	40	94
1957	42	35	46	31	55	122	138	107	88	107	99	71	79
1958	45	127	57	29	67	62	115	125	87	96	82	176	89
1959	63	56	71	115	151	97	108	116	60	142	98	50	94
1960	40	67	75	103	72	123	120	93	113	71	207	163	104
1961	85	55	31	33	59	105	125	119	139	55	31	32	72
1962	31	53	89	73	117	142	203	138	125	130	109	150	114

1963	76	31	23	23	26	112	157	78	115	55	37	59	66
1964	52	29	65	28	34	51	175	102	107	98	68	45	71
1965	52	85	62	42	30	61	87	199	86	42	83	59	74
1966	77	45	49	46	96	79	162	199	113	61	64	69	89
1967	88	135	53	33	34	62	90	130	87	49	80	70	76
1968	44	27	23	45	86	196	178	188	85	92	59	76	92
1969	63	121	42	30	38	40	42	50	70	51	33	52	52
1970	31	44	37	45	92	116	72	158	149	119	70	33	81
1971	55	52	70	77	145	93	95	132	189	199	90	105	109
1972	40	30	97	37	61	60	114	65	47	46	28	33	55
1973	35	26	24	35	42	114	57	112	111	68	41	31	58
1974	28	22	39	82	76	153	180	143	102	111	61	64	89
1975	70	36	46	33	64	163	115	107	120	125	79	51	84
1976	196	174	51	81	81	64	85	110	258	107	76	55	111
1977	43	37	35	87	67	164	141	180	188	92	45	51	94
1978	29	33	19	51	37	102	150	89	84	79	79	42	66
1979	26	52	130	83	99	80	72	164	143	129	73	58	93
1980	100	50	134	156	62	125	117	105	103	58	52	164	102
1981	81	41	41	85	104	145	146	152	78	88	70	78	93
1982	41	39	46	97	75	96	74	61	47	62	43	38	60
1983	26	18	17	32	50	80	86	66	70	146	103	55	63
1984	42	51	73	38	38	59	73	69	95	70	37	43	57
1985	37	28	207	78	72	189	219	89	86	33	26	60	94
1986	88	56	50	28	52	47	91	115	145	92	48	40	71
1987	51	33	77	96	48	54	137	78	50	45	56	65	66
1988	38	82	181	38	53	88	136	124	191	94	44	59	94
1989	131	72	30	22	66	126	96	107	174	143	65	52	90
1990	45	33	61	37	60	62	81	202	60	149	80	42	76
1991	31	47	39	43	115	55	61	146	68	71	143	38	72
1992	48	54	37	41	44	79	126	126	70	167	101	113	84
1993	42	76	43	42	68	92	64	47	52	36	47	37	54
1994	28	24	19	25	36	86	110	130	72	112	192	44	73
1995	26	41	40	90	111	77	153	88	96	92	55	47	77
1996	86	71	59	145	95	61	157	97	110	52	40	57	86
1997	63	32	83	52	34	105	172	100	85	86	51	32	75
1998	24	29	29	24	29	47	250	108	65	89	53	67	68
1999	49	24	20	29	66	97	65	75	66	37	66	55	54

2000	34	30	26	59	46	80	183	67	69	141	55	51	71
2001	53	47	43	54	55	49	67	90	62	58	71	148	67
2002	54	44	35	34	40	75	192	130	51	50	33	52	66
2003	33	26	34	29	46	54	54	143	166	119	62	78	71
2004	64	87	63	28	53	109	166	135	59	96	64	39	81
2005	55	29	26	19	51	91	92	44	45	163	54	87	63
2006	52	48	39	74	172	159	175	126	52	33	70	54	88
2007	55	35	25	18	19	40	153	93	65	71	34	39	54
2008	21	18	26	45	86	72	155	214	99	74	41	30	74
2009	21	19	21	12	53	66	169	88	86	141	56	37	65
2010	61	135	25	21	45	159							73
Min.	15	15	15	12	19	40	42	44	45	33	26	29	52
Mean	54	55	56	61	78	96	121	113	96	85	68	61	79
Max.	196	176	225	230	248	196	250	227	258	199	207	176	114

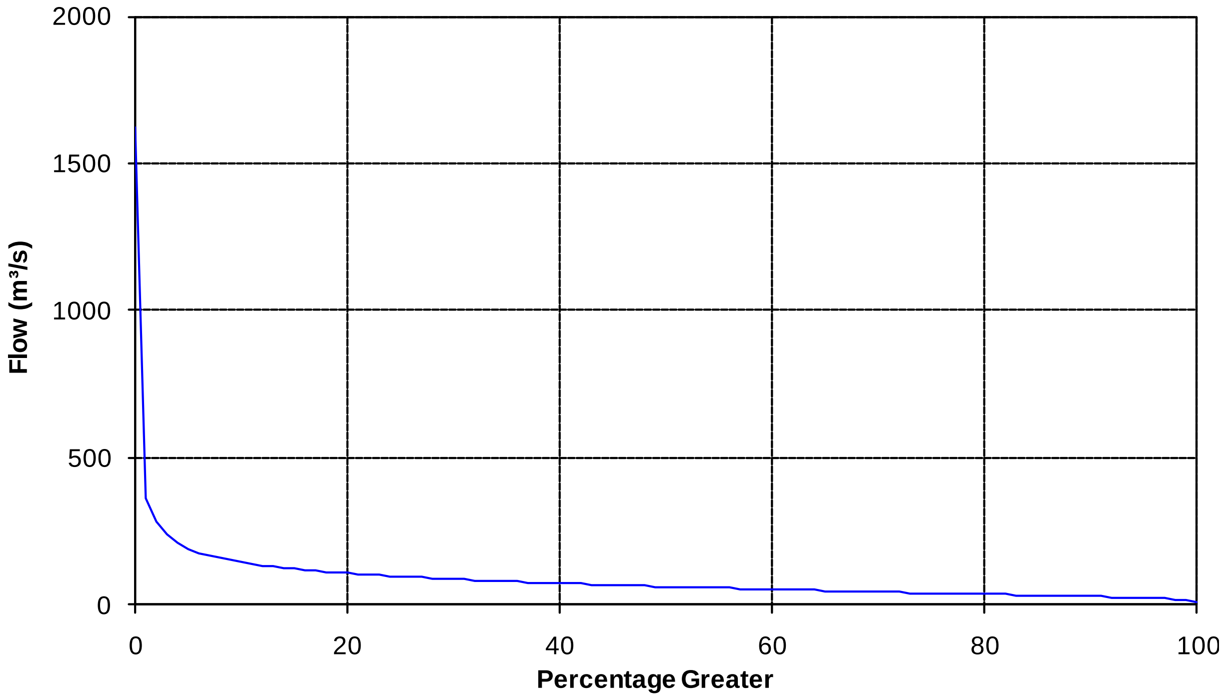

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	1620	358	279	236	210	191	177	166	157	150
10	143	137	132	128	124	121	118	115	112	109
20	106	104	102	99	97	95	93	91	90	88
30	86	84	83	81	79	78	77	75	74	73
40	72	70	69	68	67	66	65	64	63	61
50	60	59	58	57	56	56	55	54	53	52
60	51	50	49	48	47	47	46	45	44	43
70	42	42	41	40	39	38	38	37	36	35
80	35	34	33	32	31	31	30	29	28	28
90	27	26	25	24	23	22	21	19	16	15
100	7									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	7	79	60	1620

8.43 Monowai Inflow – 199540 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							12	8	8	22	18	14	14
1932	21	12	6	11	9	6	4	8	11	13	21	11	11
1933	11	23	18	28	27	4	8	13	15	22	12	14	16
1934	11	4	15	18	20	8	10	15	20	20	9	9	13
1935	29	6	15	11	12	9	5	11	4	18	8	10	12
1936	11	8	9	16	15	6	9	20	20	32	27	14	16
1937	19	11	11	20	13	5	9	7	8	7	11	8	11
1938	15	8	9	7	9	11	4	12	13	25	12	18	12
1939	15	17	4	15	11	16	8	6	14	10	18	21	13
1940	8	36	14	13	17	13	4	9	12	27	12	14	15
1941	14	11	10	13	16	10	9	4	12	9	27	9	12
1942	15	7	16	17	23	11	14	13	19	22	20	13	16
1943	12	17	17	17	12	10	7	5	10	11	14	10	12
1944	8	16	9	18	7	16	11	7	12	20	19	13	13
1945	16	16	28	18	9	5	6	14	15	12	33	13	15
1946	14	31	7	7	5	5	10	18	21	28	10	23	15
1947	9	8	4	4	10	15	8	10	19	16	13	10	10
1948	10	6	17	6	11	8	14	8	19	23	23	23	14
1949	9	25	20	21	7	4	17	13	9	21	9	16	14
1950	22	10	9	9	13	10	11	9	12	8	8	16	11
1951	5	5	5	8	7	4	21	6	16	15	19	10	10
1952	18	21	15	11	16	14	6	3	13	22	6	6	13
1953	2	3	10	21	11	6	10	13	18	7	19	18	12
1954	10	13	19	10	3	20	15	10	11	18	17	8	13
1955	14	15	13	9	18	14	5	11	17	8	15	11	13
1956	7	4	7	18	9	14	10	11	12	11	16	20	11
1957	18	10	9	16	19	11	14	9	7	19	35	29	16
1958	20	33	22	22	35	20	4	9	10	18	12	11	18
1959	5	11	8	9	8	18	9	5	21	11	22	11	11
1960	8	12	6	7	7	19	11	24	12	7	6	8	10
1961	3	5	8	13	11	14	16	16	10	15	19	6	11
1962	8	8	9	8	9	11	14	11	19	11	8	4	10

1963	12	8	7	7	12	12	9	13	11	14	17	8	11
1964	20	6	16	11	19	8	8	13	13	11	17	10	13
1965	5	5	7	6	18	19	10	6	20	18	19	11	12
1966	13	11	12	16	11	11	11	9	8	12	7	14	11
1967	7	10	8	23	15	6	5	11	8	12	24	20	12
1968	10	10	17	9	9	5	10	11	17	28	21	16	14
1969	9	6	11	14	8	10	12	13	15	18	5	12	11
1970	7	8	8	15	5	7	18	15	27	16	9	13	12
1971	3	3	9	10	10	16	4	9	25	21	17	11	12
1972	9	7	20	15	14	16	14	7	31	14	15	7	14
1973	5	7	4	16	19	10	4	6	10	17	15	8	10
1974	5	8	4	5	7	14	18	8	9	12	8	4	9
1975	5	6	10	24	19	12	16	17	14	13	7	12	13
1976	7	6	5	4	13	22	14	11	7	10	15	8	10
1977	12	13	4	18	23	15	8	6	15	22	14	7	13
1978	8	5	6	9	15	7	14	22	14	16	13	10	12
1979	21	13	5	15	23	12	13	10	22	13	5	14	14
1980	19	14	11	7	16	23	12	29	27	16	18	6	16
1981	7	6	5	13	9	8	11	10	20	24	7	13	11
1982	16	10	8	9	24	9	12	20	10	20	39	13	16
1983	31	8	15	13	15	16	14	15	21	10	8	15	15
1984	21	10	7	16	16	13	9	15	13	23	10	12	14
1985	17	6	4	14	13	12	12	11	12	8	7	8	10
1986	13	17	10	15	14	22	17	15	16	21	10	11	15
1987	11	24	24	14	12	20	19	13	20	27	6	7	16
1988	9	16	9	9	12	19	19	18	26	41	22	8	17
1989	7	8	14	10	8	18	10	5	5	9	11	14	10
1990	10	5	5	14	28	16	11	7	9	16	6	21	12
1991	13	24	5	12	13	12	8	24	14	23	16	7	14
1992	9	15	18	11	10	7	19	16	10	17	12	9	13
1993	20	11	8	7	10	20	13	11	13	24	12	14	14
1994	16	10	10	13	16	16	22	21	15	12	30	12	16
1995	10	3	17	5	19	13	10	16	25	22	13	19	14
1996	10	7	5	13	17	20	11	10	14	26	15	11	13
1997	8	12	11	17	11	7	12	23	9	17	33	21	15
1998	7	19	23	23	9	16	11	14	21	26	7	10	15
1999	5	3	10	12	14	11	13	14	10	10	20	7	11

2000	11	6	9	9	19	26	9	10	17	24	10	17	14
2001	11	5	6	10	10	21	9	11	10	7	12	11	10
2002	4	10	15	14	19	31	14	18	22	16	20	19	17
2003	8	10	5	7	20	21	14	13	19	15	21	10	14
2004	6	18	10	16	17	24	9	15	22	14	14	18	15
2005	16	15	17	8	15	17	14	12	8	9	8	8	12
2006	23	6	14	12	11	12	16	17	23	16	21	14	15
2007	7	3	10	7	13	10	13	17	13	27	10	8	12
2008	3	8	10	6	7	13	13	12	24	18	12	7	11
2009	14	9	8	5	21	5	11	17	16	13	15	13	12
2010	14	3	14	25	15	12							14
Min.	2	3	4	4	3	4	4	3	4	7	5	4	9
Mean	12	11	11	13	14	13	11	12	15	17	15	12	13
Max.	31	36	28	28	35	31	22	29	31	41	39	29	18

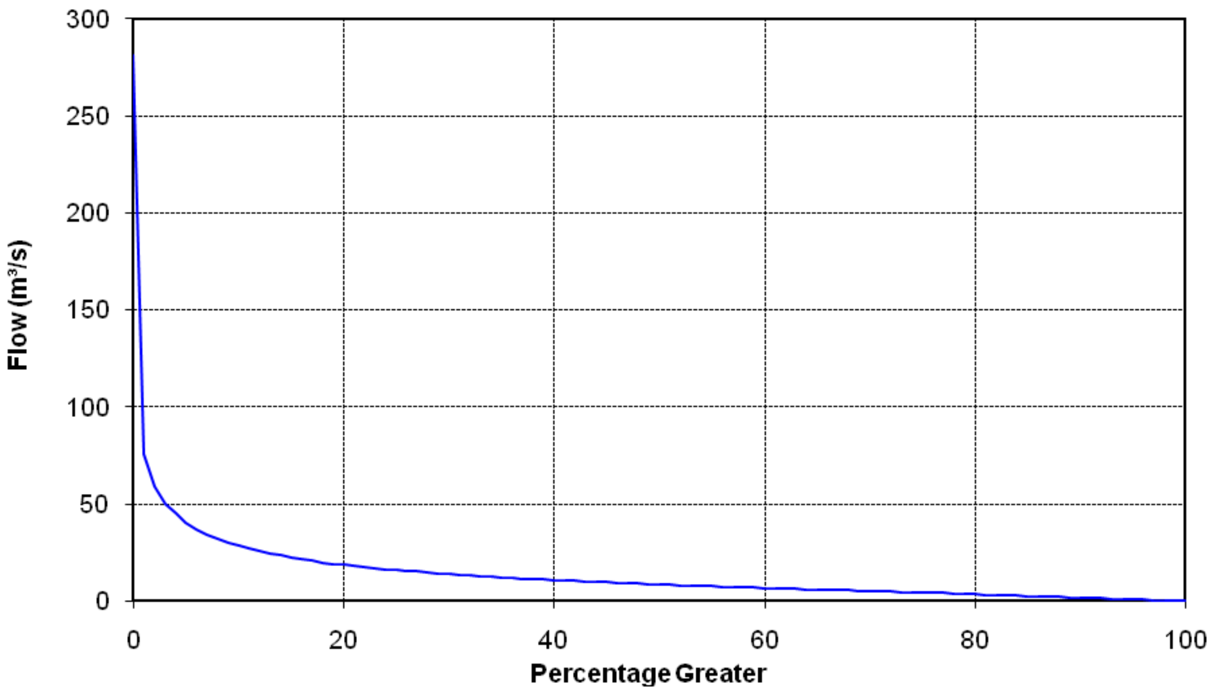

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	281	76	59	50	45	41	37	34	32	30
10	28	27	26	25	24	22	22	21	20	19
20	19	18	18	17	16	16	16	15	15	14
30	14	14	13	13	13	12	12	12	11	11
40	11	11	10	10	10	10	9	9	9	9
50	9	8	8	8	8	8	7	7	7	7
60	7	7	6	6	6	6	6	6	5	5
70	5	5	5	5	4	4	4	4	4	4
80	4	3	3	3	3	3	2	2	2	2
90	2	2	1	1	1	1	1	0	0	0
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	13	9	281

8.44 Wheao Outflow – 15462 (Item: 1)

Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							12	14	15	15	14	13	14
1932	12	11	10	10	10	10	11	10	10	11	11	10	11
1933	10	10	11	11	12	12	12	12	13	12	11	10	11
1934	10	10	10	10	10	10	11	13	12	12	13	12	11
1935	11	11	11	10	11	15	17	18	18	17	19	18	15
1936	18	19	19	16	15	13	14	14	16	16	15	13	16
1937	14	13	12	11	13	14	12	11	11	10	10	10	12
1938	10	10	10	10	11	11	11	12	13	12	13	12	11
1939	12	11	10	10	10	10	10	11	14	13	11	12	11
1940	11	14	17	13	11	11	11	10	10	11	12	11	12
1941	11	11	11	11	10	10	11	12	13	16	17	15	12
1942	14	13	12	13	13	12	14	16	19	20	19	18	15
1943	15	12	11	10	10	11	16	17	18	20	19	16	15
1944	13	11	12	11	11	10	11	12	13	13	13	12	12
1945	14	14	14	13	13	13	14	15	17	18	18	15	15
1946	12	10	10	10	11	10	10	14	17	19	18	17	13
1947	14	12	10	10	10	10	14	14	15	17	17	14	13
1948	13	11	10	10	11	13	16	15	14	13	14	13	13
1949	12	11	10	10	13	14	15	15	14	12	11	11	12
1950	10	10	10	10	10	10	10	10	10	10	11	10	10
1951	10	10	10	10	10	10	11	11	11	10	12	13	11
1952	12	11	10	10	10	13	16	14	13	13	18	19	13
1953	18	16	13	11	12	15	18	18	17	17	15	14	15
1954	12	11	11	10	10	10	10	12	13	11	10	10	11
1955	10	10	10	10	10	11	12	14	14	14	13	12	12
1956	13	13	11	12	17	20	20	19	19	18	18	17	16
1957	16	14	12	11	11	11	13	11	11	11	11	11	12
1958	11	12	14	11	11	11	12	14	14	12	16	17	13
1959	19	17	17	18	16	16	16	15	13	15	15	14	16
1960	12	12	12	11	10	12	13	13	13	15	14	12	12
1961	11	11	11	10	10	10	11	11	11	11	11	11	11
1962	10	10	13	12	16	18	19	19	19	20	21	22	17

1963	19	17	15	13	11	12	16	15	17	16	13	12	15
1964	11	11	11	11	10	10	16	18	18	19	18	16	14
1965	15	18	17	15	13	13	14	16	15	13	14	13	15
1966	15	15	16	13	15	15	18	19	18	18	17	17	16
1967	16	19	17	14	13	12	12	14	16	14	15	16	15
1968	14	13	11	11	12	15	17	16	17	16	15	15	14
1969	15	16	14	12	12	11	11	11	12	11	10	11	12
1970	11	10	10	10	10	12	12	17	19	21	20	17	14
1971	15	13	12	11	14	14	12	13	18	19	19	20	15
1972	18	15	17	14	14	13	15	14	15	14	12	11	14
1973	11	10	10	10	10	10	10	10	12	13	12	11	11
1974	10	10	10	11	10	12	16	19	18	17	17	17	14
1975	18	16	13	12	11	16	15	15	18	18	17	15	15
1976	16	18	16	14	14	13	14	16	16	17	16	14	15
1977	12	11	10	10	10	12	15	15	15	14	13	12	12
1978	11	10	10	10	10	10	10	10	11	10	12	11	10
1979	10	11	13	13	13	13	12	15	17	18	18	17	14
1980	17	15	14	14	13	13	14	14	17	15	13	15	15
1981	15	13	12	11	12	14	17	17	17	15	16	17	15
1982	16	14	13	12	12	12	11	11	11	11	10	10	12
1983	10	10	10	10	10	10	10	10	10	14	18	15	11
1984	12	12	13	12	11	10	11	11	12	11	11	12	11
1985	11	11	10	10	10	10	10	11	11	10	10	11	10
1986	15	12	11	10	10	11	11	13	14	14	13	12	12
1987	12	11	11	11	10	11	11	11	11	10	10	10	11
1988	10	10	10	10	10	10	11	14	18	18	17	17	13
1989	19	17	15	12	12	14	15	13	13	16	16	14	15
1990	13	12	12	11	12	12	12	17	15	16	18	16	14
1991	13	13	12	11	10	10	10	15	15	15	14	12	12
1992	11	11	11	10	10	10	11	16	16	15	13	16	13
1993	13	12	11	11	10	13	12	11	10	10	10	10	11
1994	10	10	9	10	10	10	13	18	15	17	18	16	13
1995	13	12	11	13	12	13	18	18	18	19	18	17	15
1996	16	14	13	14	15	15	16	17	18	16	14	14	15
1997	13	12	12	12	11	14	13	11	11	13	12	11	12
1998	10	10	10	10	10	10	19	19	18	18	17	15	14
1999	13	11	12	12	12	13	12	13	13	13	13	12	12

2000	12	12	11	11	11	11	11	12	13	13	13	13	12
2001	12	12	11	11	11	11	11	11	12	11	12	17	12
2002	12	12	11	11	11	12	17	13	11	11	11	12	12
2003	11	10	10	10	10	10	11	10	12	17	13	16	12
2004	16	13	14	12	11	15	18	19	19	19	20	15	16
2005	17	12	12	12	11	11	11	11	11	12	12	11	12
2006	11	12	11	11	12	13	19	21	18	15	15	13	14
2007	13	11	8	8	7	7	9	11	10	10	9	8	9
2008	7	6	5	5	6	6	12	21	19	18	16	14	11
2009	11	10	7	6	6	7	9	10	11	14	13	11	10
2010	10	9	6	7	7	11							8
Min.	7	6	5	5	6	6	9	10	10	10	9	8	9
Mean	13	12	12	11	11	12	13	14	14	15	14	14	13
Max.	19	19	19	18	17	20	20	21	19	21	21	22	17

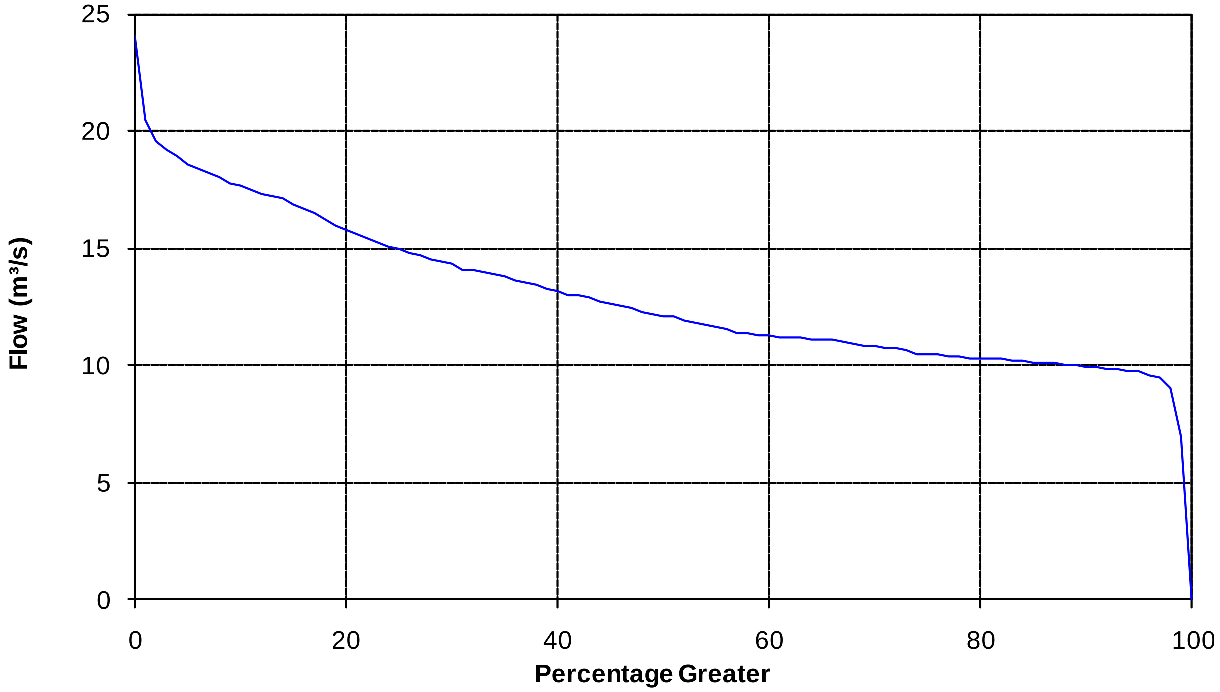

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	24	21	20	19	19	19	18	18	18	18
10	18	18	17	17	17	17	17	17	16	16
20	16	16	15	15	15	15	15	15	15	14
30	14	14	14	14	14	14	14	14	13	13
40	13	13	13	13	13	13	13	12	12	12
50	12	12	12	12	12	12	12	11	11	11
60	11	11	11	11	11	11	11	11	11	11
70	11	11	11	11	11	11	11	10	10	10
80	10	10	10	10	10	10	10	10	10	10
90	10	10	10	10	10	10	10	10	9	7
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	13	12	24

8.45 Patea Outflow – 34300 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							35	33	34	19	21	15	26
1932	7	10	5	9	8	30	14	10	6	24	5	1	11
1933	5	11	20	7	33	12	19	28	13	5	11	5	14
1934	1	13	4	10	9	17	29	27	13	21	20	9	14
1935	2	15	7	10	26	49	38	53	25	31	54	18	27
1936	34	52	17	20	15	12	35	31	33	23	22	14	26
1937	32	10	10	8	31	14	11	7	1	7	4	9	12
1938	8	28	1	26	10	11	16	28	21	8	26	14	16
1939	10	2	1	7	4	23	15	42	27	12	6	20	14
1940	27	36	16	7	10	7	2	6	7	19	27	4	14
1941	19	6	23	4	1	20	23	23	17	44	28	23	19
1942	16	14	18	18	23	7	48	32	61	41	20	27	27
1943	9	10	3	12	8	37	38	31	45	38	20	11	22
1944	4	18	15	9	12	13	23	27	22	24	9	19	16
1945	29	14	21	12	23	27	28	39	32	27	19	11	24
1946	7	3	8	21	15	5	19	53	37	34	29	11	20
1947	13	4	4	7	2	42	35	22	27	49	9	17	19
1948	16	2	1	16	38	26	41	26	13	43	28	7	21
1949	9	8	6	14	24	48	43	28	12	15	15	7	19
1950	1	12	1	8	5	12	12	18	15	12	28	7	11
1951	10	6	5	7	9	8	37	11	5	29	43	32	17
1952	12	15	2	9	13	52	31	22	11	25	59	44	25
1953	15	11	4	7	29	41	51	36	28	36	27	10	25
1954	5	5	12	7	7	13	14	26	20	2	4	14	11
1955	3	10	1	13	37	31	25	35	27	26	15	18	20
1956	19	10	1	32	25	55	49	45	23	40	33	30	30
1957	11	3	15	2	28	13	14	9	5	28	30	28	16
1958	5	28	14	1	16	19	26	41	9	12	17	48	20
1959	20	14	18	21	19	17	12	13	10	28	13	6	16
1960	4	23	6	1	8	29	30	25	30	14	8	1	15
1961	14	4	4	11	1	9	34	13	24	11	3	9	11
1962	15	6	26	17	26	39	30	37	39	51	40	36	30

1963	12	12	3	6	10	27	36	15	45	7	8	6	16
1964	12	8	21	1	2	6	43	42	43	49	20	33	23
1965	18	24	20	9	6	26	18	40	12	9	34	20	20
1966	18	23	15	14	21	24	39	24	27	12	18	24	22
1967	16	17	13	2	10	5	8	39	16	5	31	27	16
1968	5	4	1	5	18	36	21	21	11	26	12	16	15
1969	16	21	4	5	14	7	4	13	31	8	3	14	12
1970	3	1	5	9	14	33	24	37	53	36	29	13	21
1971	18	19	2	1	16	26	14	30	48	53	35	24	24
1972	11	3	37	4	17	8	36	21	25	18	11	6	17
1973	9	1	3	2	10	17	2	22	31	6	19	12	11
1974	1	3	1	10	14	18	46	30	22	30	12	23	18
1975	17	1	7	9	31	19	17	24	25	40	9	2	17
1976	16	13	3	4	38	46	48	48	19	17	3	11	22
1977	7	9	5	4	35	51	38	38	27	13	11	7	21
1978	1	0	0	8	17	17	49	34	24	12	13	4	15
1979	1	7	8	14	36	4	14	29	23	32	14	16	17
1980	25	1	11	27	13	32	43	33	50	13	9	12	22
1981	1	2	2	7	5	38	35	35	19	26	5	11	16
1982	3	3	2	4	21	25	13	8	33	12	7	26	13
1983	6	1	1	15	25	7	13	14	35	28	21	5	14
1984	2	5	18	13	11	8	28	17	13	6	9	23	13
1985	10	4	8	8	4	27	15	13	17	9	9	24	12
1986	39	17	4	5	19	14	25	26	21	24	3	1	17
1987	12	2	6	24	14	13	14	4	12	23	6	29	14
1988	1	1	2	2	20	21	36	48	42	44	9	12	20
1989	8	16	2	2	17	50	30	11	20	40	11	9	18
1990	32	10	35	14	24	37	45	51	23	20	38	7	28
1991	6	14	1	18	5	12	25	57	20	16	4	1	15
1992	2	21	4	1	18	10	43	49	37	29	5	7	19
1993	9	1	1	9	20	31	6	3	16	10	9	7	10
1994	2	1	6	15	24	50	40	52	32	31	49	3	26
1995	1	3	15	43	21	51	54	30	41	41	29	25	30
1996	15	17	15	33	22	19	42	39	50	25	23	30	27
1997	13	12	4	6	10	14	10	14	20	19	14	13	12
1998	11	13	5	6	17	24	57	29	23	47	27	16	23
1999	15	2	11	1	20	34	28	37	18	3	21	16	17

2000	4	1	2	11	26	31	15	12	37	36	1	7	15
2001	1	2	1	2	11	20	14	46	2	15	40	37	16
2002	12	15	5	4	14	38	32	33	40	20	17	18	21
2003	4	2	1	5	18	38	48	3	41	38	17	22	20
2004	18	61	23	12	23	55	26	42	25	30	6	13	28
2005	14	1	7	8	31	23	33	16	14	44	2	17	18
2006	2	2	1	9	13	29	41	43	19	18	47	23	21
2007	11	7	11	7	10	21	35	54	13	37	7	9	19
2008	5	2	4	17	29	23	58	51	22	39	15	13	23
2009	7	13	7	6	24	18	26	29	31	41	12	21	20
2010	6	6	4	4	25	42							14
Min.	1	0	0	1	1	4	2	3	1	2	1	1	10
Mean	11	10	8	10	17	25	29	29	25	25	18	16	19
Max.	39	61	37	43	38	55	58	57	61	53	59	48	30

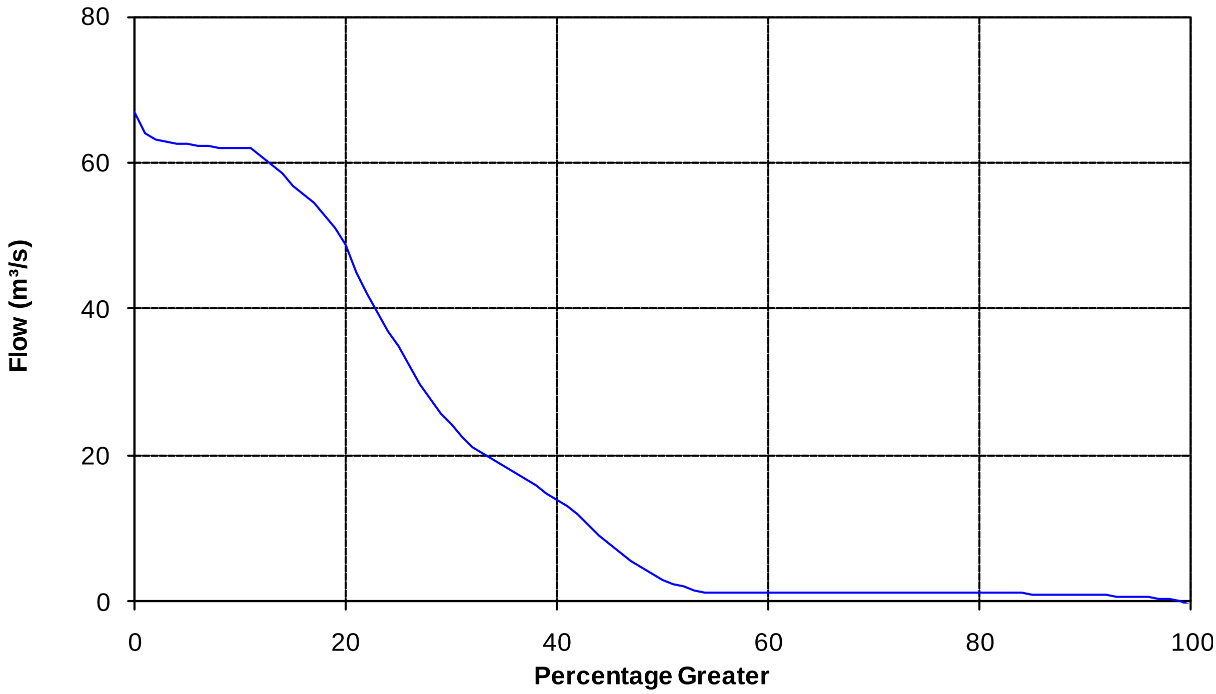

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	67	64	63	63	63	63	62	62	62	62
10	62	62	61	60	59	57	56	55	53	51
20	49	45	42	40	37	35	32	30	28	26
30	24	22	21	20	19	19	18	17	16	15
40	14	13	12	10	9	8	7	6	5	4
50	3	2	2	1	1	1	1	1	1	1
60	1	1	1	1	1	1	1	1	1	1
70	1	1	1	1	1	1	1	1	1	1
80	1	1	1	1	1	1	1	1	1	1
90	1	1	1	1	1	1	1	0	0	0
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	19	3	67

8.46 Highbank Outflow – 7968 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							25	23	24	19	8	5	17
1932	1	0	0	16	23	11	9	12	23	19	8	5	11
1933	1	0	0	15	22	12	14	16	22	19	8	5	11
1934	1	0	0	19	25	25	25	25	24	19	8	5	15
1935	1	0	1	15	25	25	24	21	20	19	8	5	14
1936	1	0	1	15	25	22	23	25	24	19	8	5	14
1937	1	0	1	15	25	25	23	9	10	18	8	5	12
1938	1	0	1	15	23	22	22	21	24	19	8	5	14
1939	1	0	0	9	12	20	14	14	24	19	8	5	11
1940	1	0	0	16	25	25	17	11	19	19	8	5	12
1941	1	0	1	15	25	25	25	25	24	19	8	5	14
1942	1	0	1	15	25	23	25	25	23	19	8	5	14
1943	1	0	1	19	23	23	24	18	23	19	8	5	14
1944	1	0	1	15	24	22	25	25	23	19	8	5	14
1945	1	0	1	15	25	23	21	24	24	19	8	5	14
1946	1	0	1	15	25	18	19	25	24	19	8	5	14
1947	1	0	0	11	10	20	23	23	24	19	8	5	12
1948	1	0	0	14	23	24	25	19	14	19	8	5	13
1949	1	0	1	16	23	25	25	25	23	18	8	4	14
1950	1	0	0	12	12	24	20	25	24	19	8	5	13
1951	1	0	0	15	14	26	25	25	24	20	20	20	16
1952	8	5	19	17	25	27	27	26	26	24	26	26	21
1953	21	25	23	26	27	26	25	22	25	25	23	21	24
1954	20	20	20	22	25	26	26	26	26	22	21	23	23
1955	17	21	22	17	26	22	24	26	22	23	16	15	21
1956	10	15	16	24	21	26	23	26	22	24	24	20	21
1957	0	0	12	25	15	25	26	26	25	23	20	19	18
1958	8	8	6	11	22	21	19	21	10	17	10	9	14
1959	0	6	12	21	25	23	24	24	16	11	0	0	14
1960	0	0	0	2	23	25	23	25	23	22	17	17	15
1961	9	8	1	17	22	24	24	24	23	14	9	9	15
1962	9	8	7	9	7	24	24	24	23	14	9	8	14

1963	7	5	3	8	12	23	23	23	23	14	6	8	13
1964	4	0	0	0	3	23	24	24	20	8	10	7	10
1965	7	10	4	20	23	23	23	23	22	11	18	9	16
1966	4	4	13	18	23	23	23	23	21	16	12	9	16
1967	4	1	0	9	14	23	23	22	20	14	17	11	13
1968	4	0	11	18	21	22	21	21	12	17	8	8	14
1969	5	0	0	1	11	23	22	22	18	1	1	11	10
1970	12	3	12	14	22	22	22	20	17	0	0	0	12
1971	0	0	2	11	17	22	21	21	17	15	12	5	12
1972	3	3	6	16	5	20	20	20	15	15	9	11	12
1973	4	3	0	0	0	20	20	20	19	10	8	6	9
1974	4	11	18	17	20	19	20	20	19	18	13	4	15
1975	4	6	18	18	20	19	19	17	18	16	14	2	14
1976	5	2	1	10	15	19	19	19	16	9	0	0	10
1977	0	0	0	3	20	21	21	21	21	15	2	0	10
1978	0	0	1	16	25	25	25	25	24	23	15	13	16
1979	7	0	11	23	7	25	24	24	22	21	13	10	16
1980	13	0	0	0	21	25	25	25	14	5	14	11	13
1981	2	0	5	9	25	25	26	25	19	15	9	0	13
1982	0	0	0	15	9	24	25	25	15	17	9	4	12
1983	1	0	4	9	0	0	0	4	24	24	10	12	7
1984	5	0	0	6	23	26	27	26	17	0	1	4	11
1985	0	0	0	0	15	26	26	26	22	1	3	13	11
1986	4	0	20	16	17	26	26	27	26	25	12	4	17
1987	0	0	3	10	26	26	26	26	18	9	2	2	12
1988	0	0	0	0	12	25	26	26	11	1	0	0	8
1989	0	0	0	0	24	26	25	21	13	7	0	0	10
1990	0	0	0	0	6	26	25	26	22	13	8	1	11
1991	0	3	1	7	22	21	18	24	24	8	7	5	12
1992	4	0	0	0	12	16	19	25	25	25	9	7	12
1993	1	0	0	0	9	25	24	21	13	6	0	0	8
1994	0	0	0	0	2	26	26	26	15	21	2	0	10
1995	0	0	0	16	25	24	24	24	24	25	11	1	15
1996	0	13	18	21	2	24	23	25	17	5	4	0	13
1997	6	9	8	19	23	23	23	24	21	12	0	0	14
1998	0	0	4	0	20	25	25	25	24	19	8	5	13
1999	1	0	1	16	25	25	25	25	24	19	8	5	15

2000	1	0	1	15	25	25	25	25	24	19	8	5	15
2001	1	0	1	14	23	25	25	25	24	19	8	5	14
2002	1	0	1	15	25	23	25	23	12	10	9	1	12
2003	0	0	1	23	27	20	27	26	22	19	3	0	14
2004	0	2	1	2	5	26	27	22	24	23	1	0	11
2005	0	0	0	15	21	20	19	21	15	11	0	0	10
2006	0	0	0	5	26	26	27	27	2	7	13	20	13
2007	20	0	3	2	12	24	24	22	15	19	1	0	12
2008	0	9	5	3	13	24	26	25	24	8	3	9	12
2009	1	8	16	8	24	26	24	18	13	25	9	6	15
2010	1	3	3	9	25	26							11
Min.	0	0	0	0	0	0	0	4	2	0	0	0	7
Mean	3	3	4	12	19	23	23	23	20	16	9	7	13
Max.	21	25	23	26	27	27	27	27	26	25	26	26	24

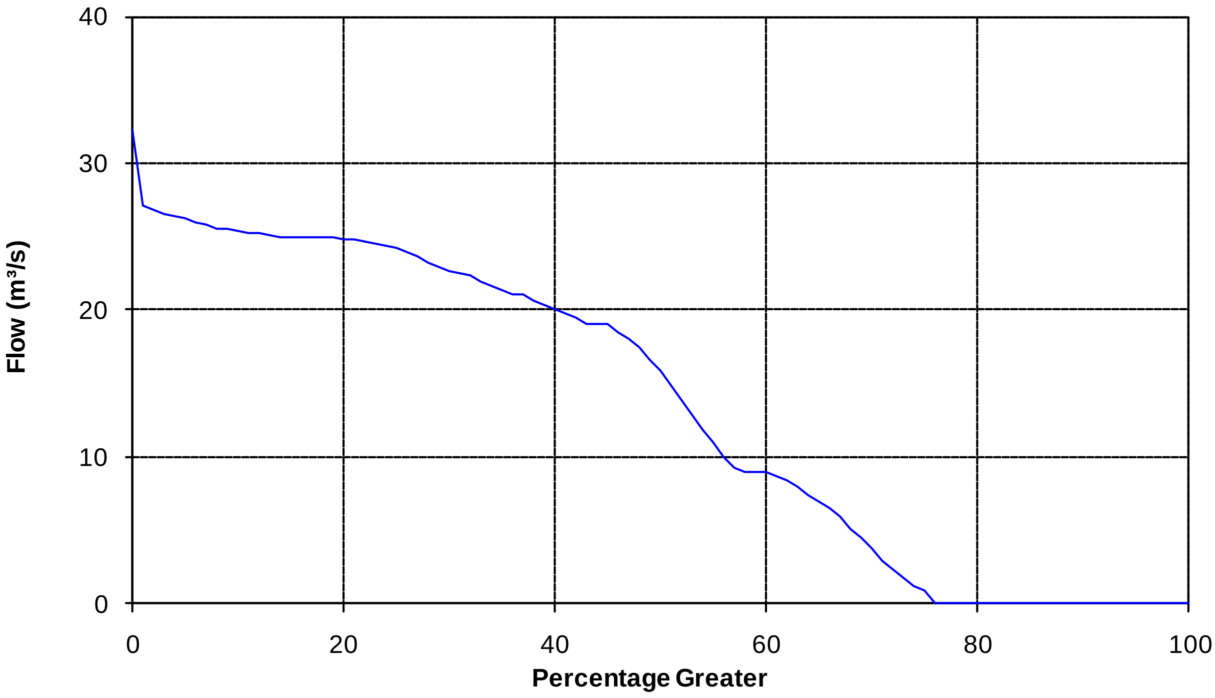

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	32	27	27	27	26	26	26	26	26	26
10	25	25	25	25	25	25	25	25	25	25
20	25	25	25	25	24	24	24	24	23	23
30	23	23	22	22	22	21	21	21	21	20
40	20	20	20	19	19	19	19	18	17	17
50	16	15	14	13	12	11	10	9	9	9
60	9	9	8	8	7	7	7	6	5	5
70	4	3	2	2	1	1	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	13	16	32

8.47 Kaimai Outflow – 14130 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							15	14	15	13	13	12	13
1932	10	9	8	10	9	14	11	10	11	13	10	9	10
1933	10	12	11	11	14	10	12	13	12	10	10	9	11
1934	8	9	8	9	10	12	14	12	11	13	13	11	11
1935	9	12	11	10	13	16	15	16	13	14	16	12	13
1936	15	16	12	12	12	11	14	14	14	13	13	11	13
1937	14	10	11	11	14	12	11	10	11	10	10	10	11
1938	9	12	7	13	11	12	12	13	13	10	13	12	11
1939	12	9	8	8	7	12	11	15	13	10	10	12	11
1940	12	15	12	9	10	11	10	10	11	13	13	10	11
1941	10	9	12	9	7	12	12	13	13	15	14	11	12
1942	11	11	10	12	13	10	16	14	18	15	12	13	13
1943	9	7	9	11	9	15	15	14	16	15	12	11	12
1944	9	10	11	10	11	10	12	13	13	12	11	12	11
1945	14	11	12	10	13	12	14	15	14	14	13	10	13
1946	9	7	9	12	11	11	12	17	15	15	14	11	12
1947	12	9	7	9	9	15	14	13	14	16	11	12	12
1948	11	7	7	10	15	13	15	13	12	15	14	11	12
1949	11	10	9	10	13	16	16	14	12	12	12	10	12
1950	8	11	7	8	10	11	11	12	12	11	13	10	10
1951	10	10	9	10	9	10	15	11	10	13	16	14	11
1952	11	12	8	9	11	17	14	13	11	13	18	16	13
1953	12	11	9	10	14	15	17	15	13	15	14	12	13
1954	10	9	10	9	11	11	12	13	13	10	10	11	11
1955	9	10	8	10	15	14	13	15	13	14	12	12	12
1956	12	10	8	14	13	18	17	16	13	15	14	14	14
1957	12	9	12	9	13	12	13	11	11	13	14	14	12
1958	10	14	12	9	12	13	13	15	11	11	12	17	12
1959	13	11	12	13	12	12	11	12	10	14	12	10	12
1960	8	13	9	8	10	14	13	13	14	12	11	9	11
1961	9	9	8	10	8	11	14	11	13	11	9	10	10
1962	11	9	13	12	14	16	14	15	15	17	15	15	14

1963	11	11	8	9	10	14	15	12	16	10	10	9	11
1964	11	9	12	8	9	10	16	15	16	16	13	14	13
1965	12	13	12	11	10	13	12	14	11	10	14	13	12
1966	12	12	11	10	12	12	15	13	14	11	12	13	12
1967	11	12	11	9	9	10	11	15	12	10	14	13	11
1968	9	9	7	8	10	15	13	13	12	13	12	12	11
1969	11	12	8	8	11	10	10	11	14	10	10	12	11
1970	9	5	9	8	11	15	13	15	17	15	14	10	12
1971	12	11	9	8	11	13	11	14	16	17	14	13	13
1972	10	9	15	9	12	10	15	13	13	12	11	10	12
1973	10	8	9	7	11	12	9	13	14	10	12	11	10
1974	8	9	7	9	11	12	16	14	13	14	11	13	11
1975	12	8	9	10	13	15	14	15	15	15	13	11	13
1976	14	12	11	10	12	13	15	15	14	13	11	12	13
1977	11	10	9	8	12	16	15	14	13	13	11	11	12
1978	9	8	6	10	8	9	14	12	12	11	12	11	10
1979	8	11	13	11	13	11	11	14	13	15	14	12	12
1980	14	10	12	13	11	12	13	13	15	12	13	14	13
1981	11	10	10	10	11	15	15	14	13	13	14	13	12
1982	10	11	10	9	12	12	10	11	12	11	10	12	11
1983	9	8	8	11	11	11	11	11	13	16	13	12	11
1984	10	11	13	9	10	10	14	13	12	11	11	13	11
1985	11	9	9	9	9	13	12	11	12	10	11	13	11
1986	16	12	9	8	12	11	13	14	13	13	11	10	12
1987	11	8	11	12	11	11	10	11	12	13	11	13	11
1988	9	9	10	9	11	13	13	16	15	16	14	13	12
1989	15	13	10	9	11	15	13	11	12	17	13	11	13
1990	11	10	12	11	13	11	13	17	12	13	13	10	12
1991	10	12	9	10	10	9	13	16	15	13	11	10	12
1992	12	10	10	9	9	11	15	16	14	13	12	14	12
1993	10	9	9	9	11	14	10	10	10	10	12	10	10
1994	10	9	6	9	11	13	15	16	14	15	16	11	12
1995	10	11	12	15	12	14	17	14	15	15	14	14	14
1996	12	12	12	15	13	12	16	15	17	14	13	14	14
1997	11	11	9	10	10	12	11	11	12	13	12	11	11
1998	10	11	10	10	11	13	18	14	13	17	13	12	13
1999	11	9	10	10	12	13	13	13	13	11	15	12	12

2000	11	9	8	11	11	13	12	12	13	15	11	12	12
2001	10	12	9	9	13	11	11	12	10	12	14	16	12
2002	12	9	9	9	10	14	14	12	13	12	11	13	12
2003	9	8	9	8	11	12	11	10	14	15	12	13	11
2004	10	16	12	10	12	15	14	15	13	15	13	13	13
2005	13	10	10	7	11	11	13	11	12	16	9	13	11
2006	11	11	9	13	13	13	12	15	11	10	11	9	11
2007	12	10	11	11	12	11	16	16	13	13	10	10	12
2008	8	8	8	12	13	13	15	16	13	13	10	10	12
2009	10	10	11	10	12	12	14	14	13	14	10	10	12
2010	10	10	9	8	12	15							11
Min.	8	5	6	7	7	9	9	10	10	10	9	9	10
Mean	11	10	10	10	11	13	13	13	13	13	12	12	12
Max.	16	16	15	15	15	18	18	17	18	17	18	17	14

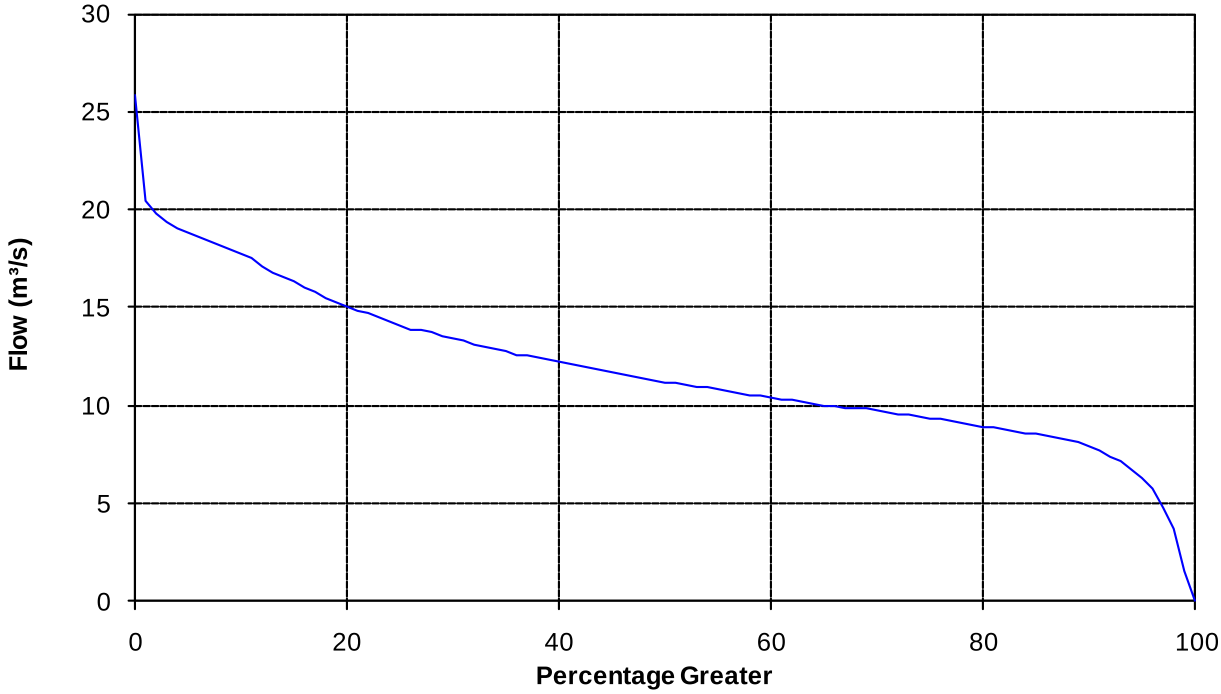

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m^3/s)

	0	1	2	3	4	5	6	7	8	9
0	26	21	20	19	19	19	19	18	18	18
10	18	18	17	17	17	16	16	16	16	15
20	15	15	15	15	14	14	14	14	14	14
30	13	13	13	13	13	13	13	13	12	12
40	12	12	12	12	12	12	12	12	11	11
50	11	11	11	11	11	11	11	11	11	11
60	10	10	10	10	10	10	10	10	10	10
70	10	10	10	10	9	9	9	9	9	9
80	9	9	9	9	9	9	8	8	8	8
90	8	8	7	7	7	6	6	5	4	2
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m^3/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	12	11	26

8.48 Waipori Outflow – 174395 (Item: 1)

Flow (m³/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1931							18	18	12	1	0	0	8
1932	0	0	4	0	4	11	12	10	7	1	7	8	5
1933	1	1	4	10	16	19	13	11	7	6	6	3	8
1934	1	0	1	3	14	17	13	13	8	7	5	5	7
1935	9	5	10	6	9	10	8	8	6	6	3	1	7
1936	1	0	1	3	14	17	13	13	8	7	5	5	7
1937	0	2	0	1	14	15	15	13	14	1	0	0	6
1938	0	2	0	1	14	15	15	13	14	1	0	0	6
1939	0	2	0	1	14	15	15	13	14	1	0	0	6
1940	1	0	1	3	14	17	13	13	8	7	5	5	7
1941	0	2	0	1	14	15	15	13	14	1	0	0	6
1942	1	2	11	4	12	18	18	17	17	0	0	0	8
1943	0	0	0	1	14	17	18	18	12	1	0	0	7
1944	1	0	1	3	14	17	13	13	8	7	5	5	7
1945	4	4	7	10	9	13	12	11	12	9	8	9	9
1946	1	1	4	10	16	19	13	11	7	6	6	3	8
1947	0	2	0	1	14	15	15	13	14	1	0	0	6
1948	1	0	1	3	14	17	13	13	8	7	5	5	7
1949	1	1	4	10	16	19	13	11	7	6	6	3	8
1950	0	2	0	1	14	15	15	13	14	1	0	0	6
1951	3	2	2	2	7	13	11	12	6	6	1	1	6
1952	0	2	0	1	14	15	15	13	14	1	0	0	6
1953	0	2	0	1	14	15	15	13	14	1	0	0	6
1954	0	2	0	1	14	15	15	13	14	1	0	0	6
1955	9	5	10	6	9	10	8	8	6	6	3	1	7
1956	0	2	0	1	14	15	15	13	14	1	0	0	6
1957	4	4	7	10	9	13	12	11	12	9	8	9	9
1958	8	10	8	11	13	16	13	10	5	7	6	4	9
1959	3	2	2	2	7	13	11	12	6	6	1	1	6
1960	3	2	2	2	7	13	11	12	6	6	1	1	6
1961	0	2	0	1	14	15	15	13	14	1	0	0	6
1962	0	2	0	1	14	15	15	13	14	1	0	0	6

1963	0	0	4	0	4	11	12	10	7	1	7	8	5
1964	0	0	0	1	14	17	18	18	12	1	0	0	7
1965	0	0	0	1	14	17	18	18	12	1	0	0	7
1966	3	2	2	2	7	13	11	12	6	6	1	1	6
1967	5	12	9	8	11	19	21	15	7	1	1	1	9
1968	1	1	4	10	16	19	13	11	7	6	6	3	8
1969	2	8	10	9	13	14	14	10	9	2	1	1	8
1970	1	1	4	10	16	19	13	11	7	6	6	3	8
1971	0	2	0	1	14	15	15	13	14	1	0	0	6
1972	2	8	10	9	13	14	14	10	9	2	1	1	8
1973	9	5	10	6	9	10	8	8	6	6	3	1	7
1974	0	0	4	0	4	11	12	10	7	1	7	8	5
1975	1	1	4	10	16	19	13	11	7	6	6	3	8
1976	0	0	4	0	4	11	12	10	7	1	7	8	5
1977	0	2	0	1	14	15	15	13	14	1	0	0	6
1978	6	8	3	6	13	16	16	12	11	1	0	2	8
1979	1	2	11	4	12	18	18	17	17	0	0	0	8
1980	8	10	8	11	13	16	13	10	5	7	6	4	9
1981	1	0	1	3	14	17	13	13	8	7	5	5	7
1982	8	10	8	11	13	16	13	10	5	7	6	4	9
1983	8	10	8	11	13	16	13	10	5	7	6	4	9
1984	5	12	9	8	11	19	21	15	7	1	1	1	9
1985	0	2	0	1	14	15	15	13	14	1	0	0	6
1986	0	2	0	1	14	15	15	13	14	1	0	0	6
1987	6	8	3	6	13	16	16	12	11	1	0	2	8
1988	1	1	4	10	16	19	14	17	14	1	0	0	8
1989	0	1	1	0	12	14	13	8	9	1	0	0	5
1990	0	0	0	1	8	10	10	9	8	1	0	0	4
1991	0	2	0	1	14	15	15	13	14	1	0	0	6
1992	0	0	0	1	14	17	18	18	12	1	0	0	7
1993	6	8	3	6	13	16	16	12	11	1	0	2	8
1994	1	2	11	4	12	18	18	17	17	0	0	0	8
1995	0	0	4	0	4	11	12	10	7	1	7	8	5
1996	7	2	5	9	9	11	10	9	9	9	4	2	7
1997	2	8	10	9	13	14	14	10	9	2	1	1	8
1998	1	0	1	3	14	17	13	13	8	7	5	5	7
1999	3	2	2	2	7	13	11	12	6	6	1	1	6

2000	4	4	7	10	9	13	12	11	12	9	8	9	9
2001	5	12	9	8	11	19	21	15	7	1	1	1	9
2002	1	1	4	10	16	19	13	11	7	6	6	3	8
2003	5	16	11	18	11	7	8	7	5	3	1	1	8
2004	1	1	1	5	8	9	9	10	7	4	1	23	7
2005	8	10	8	11	13	16	13	10	5	7	6	4	9
2006	9	5	10	6	9	10	8	8	6	5	1	1	7
2007	0	3	7	10	17	15	14	10	8	5	2	6	8
2008	5	14	8	5	13	8	6	15	2	2	0	0	7
2009	1	1	2	2	17	14	12	0	5	5	6	1	6
2010	3	3	4	3	6	22							7
Min.	0	0	0	0	4	7	6	0	2	0	0	0	4
Mean	2	3	4	5	12	15	14	12	10	4	3	3	7
Max.	9	16	11	18	17	22	21	18	17	9	8	23	9

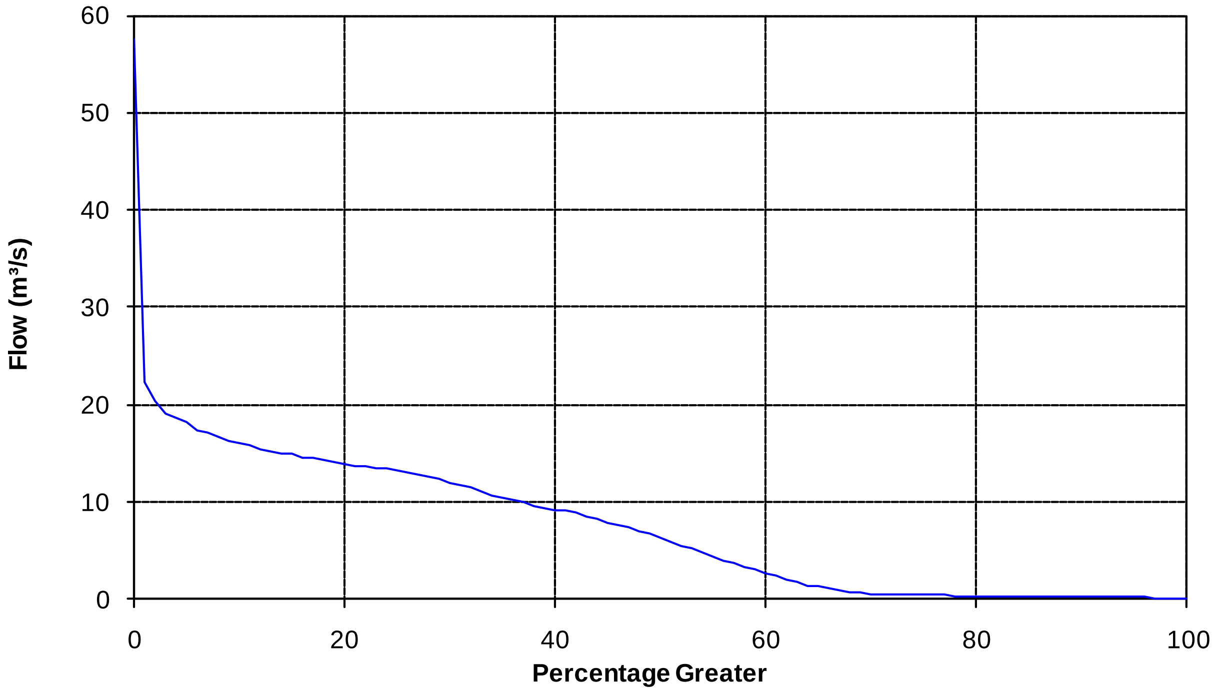

Figure depicting percentage exceedance graph

Table depicting percentage exceedance: flow (m³/s)

	0	1	2	3	4	5	6	7	8	9
0	58	22	20	19	19	18	17	17	17	16
10	16	16	15	15	15	15	15	15	14	14
20	14	14	14	14	13	13	13	13	13	12
30	12	12	11	11	11	10	10	10	10	9
40	9	9	9	9	8	8	8	7	7	7
50	6	6	6	5	5	4	4	4	3	3
60	3	2	2	2	1	1	1	1	1	1
70	1	1	1	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0
100	0									

Note: 0% is the maximum flow and 100% is the minimum flow.

Summary table: flow (m³/s)

Record Length	Minimum	Mean	Median	Maximum
Jul 1931 to Jun 2010	0	7	6	58

9 Appendix B - Spectra PSIM's

Listing of PSIM Programme: MATAHINA.SIM

```
$$$***************************************************************************
$$$ MATAHINA.SIM  Version: July 1992
$$$***************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Matahina Flow
$$$   AUTHOR:          unknown                DATE:   unknown
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$
$$$***************************************************************************
        $$$ COMPUTE MATAHINA FLOW USING ACTUAL DISCHARGE 3254 FROM 1/6/67,
        $$$ RANGITAIKI FLOW AT TE TEKO 3201 FOR THE PERIOD 1/6/48 TO 1/6/67
        $$$ AND TAUPO INFLOW 2790 PRIOR TO THAT.
GET  TAUPI RNTKO MATO
TIME D
IF D GT 670609 1
   MATO=RNTKO - 6778
IF D GT 480609 1
   MATO=TAUPI*0.2181+38789
IF MATO GE 0 1
   MATO=0
PUT  MATO      $$$ 93254
```

Listing of PSIM Programme: TAUPO.SIM

```
$$$***************************************************************************
$$$ TAUPO.SIM  Version: 3 May 94
$$$***************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate TPD Flows
$$$   AUTHOR:          unknown                DATE:   unknown
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$ Ammended February 1994 by J R Duffy to incorporate new simulation
$$$     equations as derived by Henderson (Feb 1993)
$$$ Ammended February 1994 to fill Waihohonu gaps
$$$ TKUL Equation ammended 22 April 1994
$$$ Reverted to old simulation equations 3 May 1994
$$$***************************************************************************
        $$$  READ TAUPO INFLOWS 2790
        $$$  READ WAIHOHONU FLOW AT DESERT ROAD 2521
        $$$  READ WESTERN DIVERSION INFLOWS 2536
        $$$  READ MOAWHANGO INFLOWS 4650
GET  TPOI DESE WDIV MOAI  $$$ 82790
TIME D
MMDD = MOD(D,10000)
DUMMY= 1
        $$$  COMPUTE THE TAUPO NATURAL INFLOWS
        $$$  DEDUCT INFLOWS FROM WESTERN DIVERSION AFTER 31/05/73
IF D LT 730531 1
TPOI = TPOI - WDIV
        $$$  ASSUME MOAWHANGO INFLOWS HAVE BEEN UTILISED AS THEY
        $$$  ARRIVE, AND DEDUCT THEM TOO AFTER 8/10/79
```

```
IF D LT 791008 1
   TPOI = TPOI – MOAI

IF TPOI GE 0 1
   TPOI= 0
           $$$  THIS IS THE TAUPO NATURAL INFLOW
TPONI = TPOI
           $$$  SIMULATE THE WESTERN DIVERSION FLOWS FOR FULL PERIOD
           $$$  WHILE DIVERSION HAS BEEN OPERATING, ALLOW FOR MINIMUM
           $$$  SPILL OF 0.6 CUMECS DOWN WHAKAPAPA
IF D LT 730531 1
   WDIVT = WDIV + 600
           $$$  SIMULATE FROM TAUPO NATURAL INFLOW FOR PERIOD BEFORE 31/5/73
IF D GE 730531 1
   WDIVT = TPONI * 0.0514 + 12685.4      $$$ Line ammended 3 May 1994 J R Duffy
           $$$  NEW RULES FOR WHAKAPAPA AND PIRIAKA.  APPROX ONLY FOR
           $$$  PIRIAKA - A MORE EXACT MODELLING OF THIS IS DESIRABLE
           $$$  SOME DAY CONSTANT 3 CUME             $$$ DEDUCTION CASE.
WDIV = WDIVT - 3000
           $$$  MAXIMUM DIVERSION IS 41.6 CUMECS
IF WDIV LE 41600 1
   WDIV= 41600
                      $$$ PUT  WDIV TPONI $$$  92536
                      $$$  READ WESTERN DIVERSION INFLOWS FROM PART 1 92536
                      $$$  READ TAUPO INFLOWS FROM PART 1 92536(2)
                      $$$  READ WAIHOHONU FLOW AT DESERT ROAD 2521
                      $$$  READ MOAWHANGO INFLOWS 4650
                      $$$ GET  DESE MOAI
                      $$$ XGET WDIV TPOI
                      $$$ XLOCK
                      $$$ TIME D
                      $$$ MMDD = MOD(D, 10000)
                      $$$ DUMMY= 1
            $$$  COMPUTE EASTERN DIVERSION FLOWS
            $$$  SIMULATE TONGARIRO NATURAL FLOW FROM TAUPO NATURAL FLOW
TONG = TPONI * 0.27707 + 18343       $$$ Line ammended 3 May 1994 J R Duffy
           $$$  ALLOCATE TONGARIRO TRIB FLOW AS FOLLOWS:
           $$$  1. TOKAANU LOCAL FLOWS DIRECT TO ROTOAIRA (PREVIOUSLY TO TONGARIRO)
TKUL = TONG * 0.05360 + 4610       $$$ Line ammended 3 May 1994 J R Duffy
           $$$  2. TONGARIRO INFLOW BELOW POUTU
LOWT = TONG * 0.25875 - 3071       $$$ Line ammended 3 May 1994 J R Duffy
           $$$  3. TONGARIRO INFLOW BETWEEN RANGIPO & POUTU
MIDT = TONG * 0.26298 + 4761       $$$ Line ammended 3 May 1994 J R Duffy
           $$$  4. TONGARIRO INFLOW ABOVE RANGIPO
RPOI = TONG * 0.42467 - 6300       $$$ Line ammended 3 May 1994 J R Duffy
           $$$  THE TOTAL OF 1 - 4 SHOULD EQUAL THE TONGARIRO FLOW.
           $$$  HOWEVER, ABOUT 47% (ON AVERAGE) IS DIVERTED FROM
           $$$  MIDDLE FLOWS TO RANGIPO BY WAIHOHONU, UPTO A MAXIMUM OF 27 CUMECS
WAIHO = MIDT * 0.47       $$$ Line ammended 3 May 1994 J R Duffy
IF D LT 610801 1
   WAIHO = DESE * 0.982 + 3564       $$$ Line ammended 3 May 1994 J R Duffy
IF WAIHO LE MIDT 1
   WAIHO = MIDT
      $$$ SEVERAL GAPS OCCUR IN WAIHOHONU RECORD, FILL USING 47% OF MIDT.
IF D LT 640310 GOTO CONTINUE       $$$ }
IF D LT 641016 GOTO GAP          $$$ }
IF D LT 810729 GOTO CONTINUE       $$$ }
IF D LT 810804 GOTO GAP          $$$ }
IF D LT 820305 GOTO CONTINUE       $$$ }
IF D LT 820317 GOTO GAP          $$$ } Lines added Feb 1994 J R Duffy
IF D LT 830124 GOTO CONTINUE       $$$ }
IF D LT 830208 GOTO GAP          $$$ }
IF D LT 850708 GOTO CONTINUE       $$$ }
IF D LT 850715 GOTO GAP          $$$ }
```

```
IF D LT 851202 GOTO CONTINUE       $$$ }
IF D LT 851230 GOTO GAP            $$$ }
IF D LT 870306 GOTO CONTINUE       $$$ }
IF D LT 870401 GOTO GAP            $$$ }
GOTO CONTINUE                      $$$ }
GAP:                       $$$ }
WAIHO = MIDT * 0.47              $$$ Line ammended 3 May 1994 J R Duffy
CONTINUE:                     $$$ }
IF WAIHO LE 27000 1
   WAIHO= 27000
MIDT = MIDT - WAIHO
RPOI = RPOI + WAIHO

$$$  SIMULATE MOAWHANGO INFLOWS USING TAUPO NATURAL FLOWS
MOAI = TPONI * 0.0608 + 1847        $$$ Line ammended 3 May 1994 J R Duffy
           $$$  SIMULATE WAHIANOA AQUEDUCT FLOW USING TAUPO
           $$$  NATURAL FLOW WITH A MAXIMUM OF 6 CUMECS.
WAHNA = TPONI * 0.00402 + 2791        $$$ Line ammended 3 May 1994 J R Duffy
IF WAHNA LE 6000 1
   WAHNA= 6000
MOAI = MOAI + WAHNA
           $$$  DETERMINE FLOW THAT MUST BE SPILLED PAST POUTU.
           $$$  WE MUST SUPPLEMENT THE LOWER TRIBS SO AS TO MAKE UP
           $$$  27.2 CUMECS AT TURANGI.  ALSO, MINIMUM SPILL AT POUTU
           $$$  INTAKE IS 11.3 CUMECS. 27.2 CUMECS WILL INCLUDE
           $$$  MINIMUM 0.6 CUMECS FROM POUTU STREAM.
PUTS = 27200 - LOWT - 600
IF PUTS GE 11300 1
   PUTS= 11300
           $$$  DETERMINE REQUIRED SPILL PAST RANGIPO
           $$$  ANY SPILL AT POUTU THAT MUST COME FROM ABOVE RANGIPO,
           $$$  MUST BE SPILLED AT RANGIPO WITHOUT PASSING THROUGH
           $$$  THE STATION.  THEN, EVEN IF STATION TRIPS, SUFFICIENT
           $$$  FLOWS CAN BE MAINTAINED DOWN THE TONGARIRO RIVER.
           $$$  MINIMUM SPILL AT RANGIPO IS 0.6 CUMECS.
RPOS = PUTS - MIDT
IF RPOS GE 600 1
   RPOS= 600
           $$$  IF INFLOWS TO POUTU (MIDT & RPOI) ARE GREATER THAN THAT
           $$$  REQUIRED TO SUPPLY THE POUTU SPILL & FILL THE TUNNEL,
           $$$  THEN RANGIPO MUST BE SHUT DOWN.
           $$$  NOTE THAT MOAWHANGO INFLOWS ARE NOT INCLUDED IN THIS
           $$$  CHECK, AS IF RANGIPO IS TO BE SHUT DOWN, MOAWHANGO
           $$$  WOULD ALSO BE CLOSED AND THE WATER COULD BE USED AT
           $$$  RANGIPO AT A LATER DATE.
TOT = RPOI + MIDT
MAX = PUTS + 69000
           $$$  POUTU TUNNEL CAPACITY TAKEN AS 69 CUMECS.
IF TOT LE MAX 1
   RPOS= RPOI
           $$$  DETERMINE THE TRIB FLOW AVAILABLE FOR GENERATION AT RANGIPO.
RPOF = RPOI - RPOS + MOAI
IF RPOF GE 0 1
   RPOF= 0
           $$$  CALCULATE THE FLOW AVAILABLE FOR GENERATION AT TOKAANU.
           $$$  1. FLOW FROM EASTERN DIVERSION THROUGH POUTU TUNNEL.
PUTD = RPOI + MIDT - PUTS
           $$$  ANY EXCESS OVER THE TUNNEL CAPACITY IS SPILLED
IF PUTD LE 69000 2
   PUTS = PUTS + PUTD - 69000
   PUTD= 69000

IF PUTD GE 0 1
   PUTD= 0
           $$$  2.  ADD LOCAL INFLOWS TO ROTOAIRA AND ALLOW FOR
```

```
        $$$  MINIMUM POUTU STREAM FLOW OF 0.6 CUMECS.
TKUI = TKUL + PUTD - 600
        $$$  3.  ADD MOAWHANGO & WESTERN DIVERSION FLOWS TO GET TOTAL FLOW.
TKUFL = TKUI + WDIV + MOAI
IF TKUFL GE 0 1
   TKUFL= 0
        $$$  CALCULATE TAUPO INFLOW WITHOUT DIVERSIONS.
        $$$  1. TONGARIRO COMPENSATION FLOW IS THE LOWER TRIBS FLOW
        $$$  + POUTU SPILL WITH 0.6 CUMECS FROM POUTU STREAM.
TNARO = LOWT + PUTS + 600
        $$$  2. TAUPO DOESN'T RECEIVE THE NATURAL TONGARIRO FLOW,
        $$$  ONLY THE COMPENSATION FLOW.
TPONI = TPONI - TONG + TNARO
        $$$  3. TOTAL TAUPO INFLOW WITH EASTERN & WESTERN DIVERSIONS.
TPOI = TPONI + TKUFL
PUT  TPOI RPOF TKUFL MOAI WDIV PUTD WAIHO WAHNA  $$$ 92790
```

Listing of PSIM Programme: TAUPOFUN.SIM

```
$$$*****************************************************************************
$$$ TAUPOFUN.SIM  Version: January 1996
$$$*****************************************************************************
$$$   CALLED FROM:    PROCESS.SCR
$$$   FUNCTION:       Simualate TPD flows using Taupo inflows
$$$   AUTHOR:         R D Henderson       DATE:   1 June 1995

$$$   LOCATION:       NIWA Christchurch
$$$ Modification history

$$$ Originally created as part of TAUPO.SIM, then split off as separate sim
$$$     when real data was introduced.  Two of the original functions
$$$     modelling local inflows (MIDT and LOWT) were replaced by functions
$$$     modelling flow at DSPOUTU and Rotoaira outflow    Nov 1995 - Jan 1996
$$$
$$$ As at Jan 96 there is a limit of ten functions
$$$*****************************************************************************
$$$
$$$                     Initialisation
$$$
$$$*****************************************************************************
$$$
$$$ the following functions transform taupo natural inflows into natural flows
$$$    or diversion flows at various locations within the TPD
$$$
$$$ WDIVT from Taupo natural inflows*0.19
FUNCTION 1  3221 9100  5771 10300  8406 12400  10094 14000 &
         12821 15400  15105 16600  17273 18000  19571 19400 &
         22196 20800  25551 22600  30639 25500  40508 33000  &
         51724 45300  55873 47200  223000 200000
$$$ TONG from Taupo natural inflows*0.40
FUNCTION 2  6781 20000   12370 24000  17773 27900  21200 30400  &
         26800 34200  31634 37500  36221 41200  41066 45100  &
         46608 49600  53560 54800  64088 62800  85026 78000  &
         108212 96400  469927 927800
$$$ TKUL from Taupo natural inflows*0.05

FUNCTION 3  848 1500   1546 3200  2222 4100  2650 4600  &
         3350 5200  3954 5600  4528 6000  5133 6500   &
         5826 7100  6695 7800  8011 8800  10628 10700 &
         13527 12600 17680 15600 58741 43700
$$$ ROUT from Taupo natural inflows*0.06 (l/s)
FUNCTION 4  1017 3195  1856 3841  2148 4066  2666 4688  3180 5207 &
```

```
        3618 5452  4020 5660  4745 6032  5433 6423  6160 6873 &
        6991 7364  8034 7922  9613 8556  12754 9634  16232 10697 &
        21216 12274  24716 13449 46000 18000  70489 20540
$$$ DSPoutu from Taupo natural inflows*0.20 (l/s)
FUNCTION 5  3391 7000 6185 15105  7161 16153  8886 17988  10600 19683 &
        12061 20930  13400 22009  15817 23963  18111 25891 &
        20533 28076  23304 30587  26780 33758  32044 38674 &
        42513 48741  54106 61659  70721 86267  82385 112498 &
        234963 534547
$$$ RPOI from Taupo natural inflows*0.14
FUNCTION 6  4330 5700  6220 6900  7420 7700  9380 8800   11072 9800 &
        12677 10900  14373 12200  16313 13800  18746 15900      &
        22431 19100  29560 26200  37874 35700  49505 52700      &
        57670 70700  164474 391800
$$$ WAIHO from Taupo natural inflows*0.09
FUNCTION 7  1526 5700  2692 6300  3935 7000  4755 7300  6041 7700  &
        7146 8200  8174 8700  9233 9000  10443 9500  11992 10100 &
        14306 11000 18900 12200 24000 14100 105734 24600
$$$ MOAI from Taupo natural inflows*0.09
FUNCTION 8  1526 1700  2783 1730  4000 2350  4770 2860   6030 3650  &
        7118 4520  8150 5670  9240 6980  10487 8560   12051 10460 &
        14420 13050  19131 17710  24348 22860  105730 173800
$$$ WAHNA from Taupo natural inflows*0.04
FUNCTION 9  1892 2600 2246 2800 2773 3000 3228 3100 3671 3200  &
        4112 3400 4624 3500 5287 3800 6305 4000 8233 4300  &
        10242 4600 11970 4800 13600 4900 16074 5100 34256 7800
$$$ TEMAIRE from Taupo natural inflows*0.65
function 10  11019 15900  19743 21000  28759 28000   34532 32200  &
         43861 40500   51675 47800   59092 55800   66955 65300 &
         75934 77700   87410 94000   104817 117600 138580 165900 &
         176951 226600  191144 249600  207553 280000  230690 328700 &
         271010 417000  763631 1313500
$$$**************************************************************************
$$$
$$$                     Main data loop
$$$
$$$**************************************************************************
                    $$$ Net Taupo inflows (82790)
                    $$$ calculated by TAUPOIN.EXE from
                    $$$     Taupo levels (2795) and
                    $$$     Net Taupo outflows (27900)
                    $$$     which have Moawhango Tunnel (2540)
                    $$$     and Wairehu (2536) subtracted
GET  tponi
                    $$$ function for WDIVT (Western Diversion with no rules)
mult1 = tponi*0.19
interp wdivt mult1 1
wdivt = wdivt*0.97
                    $$$ function for TONG (Tongariro River at Turangi)
mult2 = tponi*0.40
interp tong mult2 2
tong = tong*0.99
                    $$$ function for TKUL (Rotoaira natural inflows)
mult3 = tponi*0.05
interp tkul mult3 3

tkul = tkul*0.986
                    $$$ function for ROUT (Rotoaira natural outflows)
mult4 = tponi*0.06
interp rout mult4 4
rout = rout*0.986
                    $$$ function for DSPOUTU (Tongariro at DSPoutu)
mult5 = tponi*0.20
interp dspoutu mult5 5
dspoutu = dspoutu*0.99
```

```
                    $$$ function for RPOI (Tongariro at Rangipo Barrage)
mult6 = tponi*0.14
interp rpoi mult6 6
rpoi = rpoi*0.987
                    $$$ function for WAIHO (Waihohonu Tunnel)
mult7 = tponi*0.09
interp waiho mult7 7
waiho = waiho*0.99
                    $$$ function for MOAI (Moawhango natural inflows)
mult8 = tponi*0.09
interp moai mult8 8
moai = moai*0.98
                    $$$ function for WAHNA (Wahianoa Aqueduct)
mult9 = tponi*0.04
interp wahna mult9 9
wahna = wahna*0.97
                    $$$ function for TEMAIRE (on the Whanganui River)
mult10 = tponi*0.65
interp temaire mult10 10
temaire = temaire*0.98
                    $$$ put data to be read by TAUPOTPD.SIM
PUT  WDIVT TONG TKUL ROUT DSPOUTU RPOI WAIHO MOAI WAHNA TEMAIRE tponi   $$$ 401
$$$****************************************************************************
$$$
$$$                     End data loop
$$$
$$$****************************************************************************
endloop
```

Listing of PSIM Programme: TAUPOTPD.SIM

```
$$$ TAUPOTPD.SIM
$$$****************************************************************************
$$$ TAUPOTPD.SIM  Version: 31 January 1996
$$$****************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate TPD Flows
$$$   AUTHOR:          unknown            DATE:   unknown
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$ Amended February 1994 by J R Duffy (WCS Wgtn) to incorporate
$$$     new simulation equations as derived by R D Henderson        Feb 1993
$$$ Amended to fill Waihohonu gaps                               Feb 1994
$$$ TKUL Equation Amended                                    22 April 1994
$$$ Reverted to old simulation equations                        3 May 1994
$$$ Modifications by NIWA Christchurch (R D Henderson) to model all sites
$$$     using transformations of recalculated Taupo inflows, as follows:
$$$ Non-linear functions introduced                          1 June 1995
$$$ 16/22 rules at DSP and Turangi introduced                    1 June 1995

$$$ 1990 Te Maire Decision introduced                          1 June 1995
$$$ Capacity of Moawhango Tunnel, Rangipo Intake                  1 June 1995
$$$ Moatun added to PUTD                                     1 June 1995
$$$ Spill flows reset when flows less than zero at diversions     1 June 1995
$$$ Waikato Falls 5 cumecs minimum flow                         1 June 1995
$$$ Transformations split off to TAUPOFUN.SIM                  January 1996
$$$ New transformations for DSPOUTU and Rotoaira outflow introduced
$$$     necessitating different calculation for MIDT and LOWT    January 1996
$$$****************************************************************************
$$$
$$$                    Initialisation
$$$
```

```
$$$**************************************************************************
                        $$$ define L Moawhango parameters
INI moalev 835.75               $$$ mean level to start is min level
INI moamin 835.75               $$$ minimum level
INI minarea 2.8                 $$$ lake area km^2
INI moamax 23000                $$$ tunnel capacity cumecs
INI margin 836.46               $$$ margin is the level from which
                        $$$ moamax can draw moalev down to moamin
$$$**************************************************************************
$$$
$$$                      Main data loop
$$$
$$$**************************************************************************
                        $$$ Net Taupo inflows (82790)
                        $$$ calculated by TAUPOIN.EXE from
                        $$$     Taupo levels (2795) and
                        $$$     Net Taupo outflows (27900)
                        $$$     which have Moawhango Tunnel (2540)
                        $$$     and Wairehu (2536) subtracted
GET  wdivt tong tkul rout dspoutu rpoi waiho moai wahna temaire tponi
STEP dt                      $$$ time step in second usually fixed at one day
TIME D                       $$$ data in YYMMDD format
MMDD = MOD(D,10000)             $$$ decode MMDD for use in Te Maire rule

WDIV = WDIVT - 3000            $$$ Whakapapa release is 3 cumecs
IF WDIV LE 41600 1             $$$ Maximum diversion is 41.6 cumecs
   WDIV= 41600

temres = temaire - wdiv
M = 29000                    $$$ minimum rule at Te Maire
IF MMDD LT 600 2                $$$ June
   IF MMDD GT 1200 1            $$$ December
      M = 0                  $$$ no rule June to December
IF TEMRES GE M GOTO TEMOK       $$$ is the new TEMAIRE less than mimimum ?
   DEFICIT = 29000 - TEMRES    $$$ if yes then ...
   WDIV = WDIV - DEFICIT       $$$ ... adjust diversion
   TEMRES = M                  $$$ ... and Te Maire
   IF WDIV GE 0 goto TEMOK     $$$ Check water available ...
      WDIV = 0                 $$$ ... and reconcile if not
      TEMRES = TEMAIRE         $$$ ... so water is conserved
TEMOK:
$$$
$$$  ALLOCATE TONGARIRO TRIB FLOW AS FOLLOWS:
$$$  1. TOKAANU LOCAL FLOWS DIRECT TO ROTOAIRA (PREVIOUSLY TO TONGARIRO)
midt = dspoutu - rpoi
midtsave = midt
falls = rpoi + midt            $$$ Waikato falls

IF WAIHO LE 27000 1             $$$ Waiho tunnel capacity 27 cumecs

   WAIHO= 27000
MIDT = MIDT - WAIHO            $$$ adjust MIDT ...
RPOI = RPOI + WAIHO            $$$ ... and RPOI

IF WAHNA LE 6000 1              $$$ Wahianoa tunnel capacity 6 cumecs
   WAHNA= 6000
MOAI = MOAI + WAHNA              $$$ adjust MOAI
$$$
$$$ Model Lake Moawhango
$$$
                        $$$ lake area is a linear function of level
moarea = minarea+0.167*(moalev-moamin)
moaspil = 0                  $$$ spill from L Moawhango using linear
IF moalev LT 851 3              $$$ ... relationships between 851 and 852 m ...
moaspil = 253000*(moalev-851)   $$$ ... and ...
```

```
If moalev LT 852 1              $$$ ... above 852
moaspil = 253000+598000*(moalev-852)
                                $$$ check level against margin ...
                                $$$ ... to ensure that lake is not about ...
                                $$$ ... to be drawn down too far
moatun = moamax
IF moalev GT 836.46 1           $$$ If it is then restrict tunnel flow
moatun = MIN(moatun,moai)
$$$
$$$  DETERMINE FLOW THAT MUST BE SPILLED PAST POUTU.
$$$  WE MUST SUPPLEMENT THE LOWER TRIBS SO AS TO MAKE UP
$$$  22 CUMECS AT TURANGI.  ALSO, MINIMUM SPILL AT POUTU
$$$  INTAKE IS 16 CUMECS. 22 CUMECS WILL INCLUDE
$$$  MINIMUM 0.6 CUMECS FROM POUTU STREAM.
$$$
lowt = tong - dspoutu - rout
PUTS = 22000 - LOWT - 600
IF PUTS GE 16000 1
   PUTS= 16000
RPOS = 5000 - MIDT              $$$  Keep Waikato Falls at 5 cumecs or greater
IF RPOS GE 600 1                $$$ check minimum flow rule
   RPOS= 600                    $$$ and reset
$$$
$$$  IF INFLOWS TO POUTU (MIDT & RPOI) ARE GREATER THAN THAT
$$$  REQUIRED TO SUPPLY THE POUTU SPILL & FILL THE TUNNEL,
$$$  THEN RANGIPO MUST BE SHUT DOWN.
$$$  NOTE THAT MOAWHANGO INFLOWS ARE NOT INCLUDED IN THIS
$$$  CHECK, AS IF RANGIPO IS TO BE SHUT DOWN, MOAWHANGO
$$$  WOULD ALSO BE CLOSED AND THE WATER COULD BE USED AT
$$$  RANGIPO AT A LATER DATE.
$$$
TOT = RPOI + MIDT
MAX = PUTS + 69000              $$$  POUTU TUNNEL CAPACITY 69 CUMECS.
IF TOT LE MAX 2
   RPOS= RPOI
   moatun = 0
falls = falls + moatun
$$$  DETERMINE THE TRIB FLOW AVAILABLE FOR GENERATION AT RANGIPO.
RPOF = RPOI - RPOS + MOAtun
IF RPOF LE 63000 2
   RPOS = RPOS+RPOF-63000       $$$ Rangipo capacity 63 cumecs
   RPOF = 63000

IF RPOF GE 0 2                  $$$ check for negative flows
   RPOF= 0                      $$$ ... and reset
   RPOS = RPOI+moatun

falls = falls - rpof
$$$
$$$  CALCULATE THE FLOW AVAILABLE FOR GENERATION AT TOKAANU.
$$$  1. FLOW FROM EASTERN DIVERSION THROUGH POUTU TUNNEL.
$$$
PUTD = RPOI + MIDT - PUTS + moatun
$$$
$$$  ANY EXCESS OVER THE TUNNEL CAPACITY IS SPILLED
$$$
IF PUTD LE 69000 2
   PUTS = PUTS + PUTD - 69000
   PUTD= 69000
IF PUTD GE 0 2                  $$$ check for negative flow
   PUTD= 0                      $$$ ... and reset
   PUTS = RPOI+MIDT+moatun
$$$
$$$  2.  ADD LOCAL INFLOWS TO ROTOAIRA AND ALLOW FOR
$$$  MINIMUM POUTU STREAM FLOW OF 0.6 CUMECS.
```

```
$$$
TKUI = TKUL + PUTD - 600
$$$
$$$  3.  ADD MOAWHANGO & WESTERN DIVERSION FLOWS TO GET TOTAL FLOW.
$$$
TKUFL = TKUI + WDIV
IF TKUFL GE 0 1              $$$ check for negative flows
   TKUFL= 0                  $$$ ... and reset
$$$
$$$  CALCULATE TAUPO INFLOW WITHOUT DIVERSIONS.
$$$  1. TONGARIRO COMPENSATION FLOW IS THE LOWER TRIBS FLOW
$$$  + POUTU SPILL WITH 0.6 CUMECS FROM POUTU STREAM.
$$$
TNARO = LOWT + PUTS + 600
$$$
$$$  2. TAUPO DOESN'T RECEIVE THE NATURAL TONGARIRO FLOW,
$$$  ONLY THE COMPENSATION FLOW.
$$$
TPONI = TPONI - TONG + TNARO
$$$
$$$  3. TOTAL TAUPO INFLOW WITH EASTERN & WESTERN DIVERSIONS.
$$$
TPOI = TPONI + TKUFL
$$$
$$$ Lake Moawhango Model
$$$
$$$ inflow minus outflow equals change in storage to give new level
    flow = (moai-moaspil-moatun)/1000
    moalev = moalev+flow*dt/(moarea*1000000)
    moalevmm = moalev*1000
PUT  TPOI RPOF TKUFL MOAI WDIV PUTD WAIHO WAHNA  $$$ 92790
$$$*****************************************************************************
$$$
$$$                    End data loop
$$$
$$$*****************************************************************************
```

Listing of PSIM Programme: ARAPUNI.SIM

```
$$$*****************************************************************************
$$$   ARAPUNI.SIM  Version: March 1994
$$$*****************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Waikato Tributries at Arapuni
$$$   AUTHOR:          unknown              DATE:   June 1992 ?
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$     March 1994 - Renamed from WAIKATO.SIM to avoid confusion with
$$$     KARAPIRO.SIM, also data input format changed to use same site
$$$     as KARAPIRO.SIM - J R Duffy
$$$*****************************************************************************

          $$$  WAIKATO TRIB FLOW AT ARAPUNI
          $$$  IS ARAPUNI OUTFLOW 2724 - TAUPO  OUTFLOW 2794.
          $$$  FOR JAN'61 SIMULATE FILLING OF LAKE OHAKURI
GET  ARIO TAUPO *  $$$ FROM 3-ITEM SITE 82714 (ALSO INCLUDES KARAPIRO OUTFLOW)
            $$$ Altered from Get & XGet March 1994 - J R Duffy
TIME D
```

```
WKTRB = ARIO - TAUPO
   $$$  SIMULATE OHAKURI FILLING IN JANUARY 1961 USING THE
   $$$  REGRESSION ARAPUNI TRIB FLOW = TAUPO OUTFLOW * 0.164 + 45927.
IF D LT 610101 2
   IF D GT 610131 1
      WKTRB = TAUPO*0.164 +45927
IF WKTRB GE 0 1
   WKTRB = 0
PUT  WKTRB     $$$ 92724
```

Listing of PSIM Programme: KARAPIRO.SIM

```
$$$***************************************************************************
$$$   KARAPIRO.SIM (3/2/94) Version: Feb 94
$$$***************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Waikato Tributary flows at Karapiro
$$$   AUTHOR:          T Halliburton              DATE:   December 1993
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$     February 1994 - Minor changes to comments by J R Duffy
$$$     9/5/96        - Change of start date for Karapiro total discharge
$$$                     record from 2/1/54 to 7/7/47 to account for extended
$$$                     record.  (R Jack)
$$$***************************************************************************
           $$$  WAIKATO TRIB FLOW AT KARAPIRO
           $$$  IS KARAPIRO OUTFLOW 2714 - TAUPO  OUTFLOW 2794.
           $$$  FOR JAN'61 SIMULATE FILLING OF LAKE OHAKURI
GET  ARIO TAUPO  KPO
TIME D
WKTRB = (ARIO - TAUPO) * 1.2  $$$ Before 1947 use Arap trib x 1.2
IF D LT 470707 1
   WKTRB = KPO - TAUPO
$$$  SIMULATE OHAKURI FILLING IN JANUARY 1961 USING THE REGRESSION
$$$  KARA TRIBS = ARAP TRIBS x 1.2 = (TAUPO OUTFLOW * 1.164 + 45927)*1.2
IF D LT 610101 2
   IF D GT 610131 1

      WKTRB = TAUPO*0.1968 +55112
IF WKTRB GE 0 1
   WKTRB = 0
PUT  WKTRB     $$$ 92714
```

Listing of PSIM Programme: MANGAHAO.SIM

```
$$$***************************************************************************
$$$ MANGAHAO.SIM  Version: June 1992
$$$***************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Mangahao Power Scheme total inflow
$$$   AUTHOR:          unknown                DATE:   unknown
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$
$$$***************************************************************************
           $$$ READ MANGAHAO FLOW AT NO 2 DAM 75020
GET  INFL
INFT = INFL
SPIL = 0
IF INFL LT 11900 2
  SPIL = 1240 + 0.52*(INFL-11900)
```

```
  INFL = INFL - SPIL
INFL = INFL + INFT * 0.03
PUT  INFL SPIL  $$$ 97502
```

Listing of PSIM Programme: COLERIDGE.SIM

```
$$$****************************************************************************
$$$*   COLERIDG.SIM  Version: March 94
$$$****************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Coleridge and Cobb Inflows
$$$   AUTHOR:          unknown              DATE:   unknown
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$     UPDATED 1 MARCH 1994 TO FILL 1956 GAP IN COBB INFLOWS, J R DUFFY
$$$
$$$     UPDATED FEB 94 (J R DUFFY) TO INCLUDE NEW COLERIDGE DATA FROM POWER
$$$     STATION SUMMARY SHEETS (PRE 1951) LOADED IN NOVEMBER 1993 AND
$$$     NEW COBB SIMULATION FROM "TRENDS" REPORT FEB 1993 (& PALMER 1992)
$$$****************************************************************************

                 $$$  READ HARPER RIVER FLOWS 87904(1) EX 7904
                 $$$  READ COLERIDGE INFLOWS 87904(2) EX 7950
                 $$$  READ GOWAN @ ROTOROA 87904(3) EX 6454
                 $$$  READ COBB FLOWS 87904(4) EX 6050
                 $$$  BEFORE 21/11/1945 COBB SIMULATED
GET  HAR COLE GOWAN COBB
TIME D
$$$     lines deleted here simulated local Colerdige inflows and Harper
$$$     race flows from Harper River flows (deleted JRD Feb 1994)
                 $$$  WILBERFORCE RIVER FLOW IS SIMULATED FROM HARPER RIVER
                 $$$  FLOW.  WILBERFORCE GRAVEL BANK WASHOUT LIMIT IS 40
                 $$$  CUMECS.  NO OAKDN CANAL DIVERSION IS POSSIBLE DURING


                 $$$  A WASHOUT.  OTHERWISE, OAKDN DIVERSION IS WILBERFORCE
                 $$$  CANAL FLOW LESS 3 CUMECS LEAKAGE FLOW.  MAXIMUM
                 $$$  DIVERSION THROUGH OAKDN CANAL IS 30 CUMECS.
WILFC=HAR*2.5-12500
IF WILFC GT HAR 1
   WILFC=HAR
IF WILFC LT 40000 1
   F=D+1
OAKDN=WILFC-3000
IF D GT F 1
   OAKDN=0
IF OAKDN LT 30000 1
   OAKDN=30000
                 $$$ CALCULATE THE TOTAL COLERIDGE INFLOWS
$$$     lines deleted here added Harper Race flows to Coleridge natural
$$$     inflows to get pre 1951 Coleridge inflows (deleted JRD Feb 1994)
COLI=COLE
IF D GE 771219 1
   COLI=COLI+OAKDN    $$$ BEFORE 19.12.77 ADD SIMULATED OAKDEN CANAL

IF COLI GE 0 1
   COLI=0
                 $$$ SIMULATE COBB
            $$$ NEW SIMULATION FROM REPORT BY L PALMER 28 JAN 1992
            $$$ USE LAKE ROTOROA OUTFLOW AT GOWAN PRIOR TO 1945
            $$$ (RECORD STARTS AT 340328 SO USE COLERIDGE BEFORE THIS)
IF D GT 340328 3
   COBB=COLI*0.224
```

```
   COBB=COBB+2391
   GOTO END
IF D GT 560101 1            $$$ Line added JRD 1/3/94 to fill Cobb gap
IF D GT 451121 GOTO END
IF D GT 561002 GOTO END      $$$ Line added JRD 1/3/94 to fill Cobb gap
   COBB=GOWAN*0.199
   COBB=COBB+751
END:
PUT  COLI COBB     $$$ 97904
```

Listing of PSIM Programme: NATTKPK.SIM

```
$$$**************************************************************************
$$$ NAT_TKPK.SIM        Version: March 1994
$$$**************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Natural Pukaki and Tekapo inflows
$$$   AUTHOR:          unknown              DATE:   unknown
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$     March 1994 - Format of GET statement modified to use site 88614 as
$$$     for BENMORE.SIM - J R Duffy
$$$**************************************************************************
      $$$ Natural Tekapo and Pukaki inflows
      $$$ READ TEKAPO INFLOW 8790
      $$$ READ PUKAKI INFLOW 8770
      $$$ READ TEKAPO 'B' DISCHARGE 8793
GET TKIN PUKI * * * TKDIS       $$$ From site 88614 as for BENMORE.SIM
                         $$$ Line ammended March 1994 J R Duffy
TIME D
MMDD = MOD(D,10000)

      $$$ TEKAPO B STATION DISCHARGES SINCE ITS COMMISSIONING ON
      $$$ 22/8/1977 SUBTRACTED FROM THE COMBINED FLOW TO AVOID
      $$$ DUPLICATION.
IF D LT 770822 1
   PUKI = PUKI - TKDIS
IF PUKI GE 0 1
   PUKI = 0
PUT PUKI TKIN          $$$ 98770
```

Listing of PSIM Programme: TEK_PUK.SIM

```
$$$**************************************************************************
$$$ TEK_PUK.SIM   Version:  March 1993
$$$**************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Pukaki total and Benmore tributary flows
$$$                 based on combined lakes simuilation of Pukaki & Tekapo
$$$   AUTHOR:          unknown              DATE:   unknown
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$**************************************************************************
            $$$  Tekapo and Pukaki flows added together.  No Tekapo canal simulation
            $$$  Benmore without Tekapo spill
            $$$ Tehapo inflows in raw form
            $$$  READ TEKAPO INFLOW 8790
            $$$  READ PUKAKI INFLOW 8770
            $$$  READ OHAU INFLOW 8760
            $$$  READ AHURIRI RIVER FLOW AT BENMORE 8614
            $$$  READ AHURIRI RIVER FLOW AT SOUTH DIADEM 8615
            $$$  READ TEKAPO `B' DISCHARGE 8793
GET  TKIN PUKI OHAUI AHURB AHURS TKDIS
```

```
TIME D
MMDD = MOD(D,10000)
        $$$  AHURIRI RIVER FLOW AT BENMORE IS SIMULATED AS 40%
        $$$  OHAU INFLOW FOR THE PERIOD BEFORE 1/12/1949.  ACTUAL
        $$$  RIVER FLOWS ARE AVAILABLE FOR THE PERIOD 1/12/1949 TO
        $$$  1/10/1964 FROM A GAUGING STATION AT BENMORE, WHICH HAS
        $$$  BEEN SUBMERGED WITH THE CONSTRUCTION OF BENMORE
        $$$  DAM.  FLOWS AFTER THIS IS SIMULATED FROM AHURIRI
        $$$  RIVER FLOW AT SOUTH DIADEM.
IF D GT 491201 1
  AHURB=OHAUI*.4
IF D LT 641001 1
  AHURB=AHURS*1.429
IF AHURB GE 0 1
  AHURB=0
        $$$  ALL OTHER INFLOWS TO BENMORE FROM TWIZEL & SMALL
        $$$  STREAMS, AND ALSO THE SPILL FROM LAKE PUKAKI IS TAKEN
        $$$  INTO ACCOUNT BY INCREASING THE AHURIRI FLOW AT
        $$$  BENMORE BY A FACTOR OF 0.33
BENTR = OHAUI + 1.33 * AHURB
        $$$  PUKAKI + TEKAPO INFLOWS COMBINED IS ABBREVIATED `PUKT'
        $$$  TEKAPO B STATION DISCHARGES SINCE ITS COMMISSIONING ON
        $$$  22/8/1977 SUBTRACTED FROM THE COMBINED FLOW TO AVOID
        $$$  DUPLICATION.
PUKT = PUKI + TKIN
IF D LT 770822 1
  PUKT = PUKT - TKDIS
IF PUKT GE 0 1
  PUKT = 0
PUT  PUKT BENTR $$$ 98615
```

Listing of PSIM Programme: BENMORE.SIM

```
$$$*****************************************************************************
$$$  BENMORE.SIM  Version: March 93
$$$*****************************************************************************
$$$  CALLED FROM:     PROCESS.SCR
$$$  FUNCTION:        Calculate Waitaki Scheme flows using separate Tekapo
$$$                   Simulation
$$$  AUTHOR:          unknown              DATE:   unknown
$$$  LOCATION:        Wellington
$$$  MODIFICATION HISTORY:
$$$
$$$    9/4/96  Upper Ohau residual flow changed from constant 12 cumecs to
$$$            12 cumecs (May - Oct) and 8 cumecs (Nov - Apr).  Output is
$$$            variable 'OHAUS'.  OHAUL has been retained in a placeholder
$$$            capacity only, to maintain a six item output.  (Robert J)
$$$
$$$*****************************************************************************
        $$$  READ TEKAPO INFLOW 8790
        $$$  READ PUKAKI INFLOW 8770
        $$$  READ OHAU INFLOW 8760
        $$$  READ AHURIRI RIVER FLOW AT BENMORE 8614
        $$$  READ AHURIRI RIVER FLOW AT SOUTH DIADEM 8615
        $$$  READ TEKAPO `B' DISCHARGE 8793
GET  TKIN PUKI OHAUI AHURB AHURS TKDIS
        $$$  SET INITIAL TEKAPO STORAGE
INITIALISE TKSTO 6000
DUMMY= 3
TIME D
MMDD = MOD(D,10000)   $$$  DEFINE MAXIMUM MONTHLY TEKAPO STORAGES
TKMAX = 7792
IF MMDD GE 832 10
 IF MMDD LT 232 9
```

```
      TKMAX = 8124
      IF MMDD LT 332 7
        TKMAX = 8459
        IF MMDD LT 432 5
          TKMAX = 8797
          IF MMDD LT 532 3
            TKMAX = 9138
            IF MMDD LT 732 1
                TKMAX = 8459
               $$$  ALL CALCULATIONS IN CMD/CUMECS UNTIL STATED OTHERWISE
TKIN = TKIN/1000
TKSTO = TKSTO + TKIN
               $$$  SET TEKAPO OUTFLOWS FOR PERIOD 21/12 TO 30/4 AS FOLLOWS:
               $$$  0 - 2000 CMD, 0; 2001 - 4000 CMD, 40 CUMECS;
               $$$  4001 - 6000 CMD, 100 CUMECS; 6001 CMD & OVER, 108 CUMECS;
IF MMDD GE 1221 1
  IF MMDD GE 432 8
    TKOUT = 0
    IF TKSTO LE 2000 5
      TKOUT = 40
      IF TKSTO LE 4000 3
        TKOUT = 100
        IF TKSTO LE 6000 1
          TKOUT = 108
IF DUMMY EQ 3 12
               $$$  SET TEKAPO OUTFLOW FOR PERIOD 1/10 TO 31/10 AT ACTUAL
               $$$  FLOW OR 60 CUMECS, WHICHEVER IS LESSER.  OUTFLOW FROM
               $$$  1/11 TO 20/12 IS ASSUMED TO BE 30 CUMECS FOR MACHINE MAINTENANCE.
IF MMDD LT 932 8
  TKOUT = TKSTO
  IF TKSTO LT 60 1
    TKOUT = 60
  IF MMDD LT 1032 3
    TKOUT = TKSTO
    IF TKSTO LT 30 1
      TKOUT = 30
  IF DUMMY EQ 3 3
               $$$  SET TEKAPO OUTFLOW FOR PERIOD 1/5 TO 30/9 TO ACTUAL
               $$$  FLOW WITH 108 CUMECS MAXIMUM.
    TKOUT = TKSTO
    IF TKSTO LE 108 1
      TKOUT = 108
               $$$  COMPUTE BALANCE STORAGE IN TEKAPO AFTER RELEASES.
TKSTO = TKSTO - TKOUT
TKSPL= 0
ADREL= 0
               $$$  CALCULATE TEKAPO SPILL
IF TKSTO LE TKMAX 11
  TKSPL = TKSTO - TKMAX
  TKSTO = TKMAX
               $$$  INCRESE TEKAPO OUTFLOW TO 120 CUMECS MAXIMUM IF ANY
               $$$  SPILL EXISTS.  HOWEVER, OUTFLOW IS LIMITED TO 60
               $$$  CUMECS FROM 1/11 TO 20/12 TO ALLOW FOR MACHINE MAINTENANCE.
  IF MMDD GT 1220 1
    IF MMDD GE 1032 5
  IF TKOUT GE 120 3
    tksplx=120-tkout
    ADREL = MIN(TKsplx,TKSPL)
    TKSPL = TKSPL - ADREL
  IF DUMMY EQ 3 4
    IF TKOUT GE 60 3
      tksplx=60-tkout
      ADREL = MIN(TKsplx,TKSPL)
      TKSPL = TKSPL - ADREL
               $$$  CONVERT BACK TO LITRES UNITS, EXCEPT TEKAPO STORAGE.
```

```
TKOUT = (TKOUT + ADREL) * 1000
TKSPL = TKSPL * 1000
TKIN = TKIN * 1000
        $$$  AHURIRI RIVER FLOW AT BENMORE IS SIMULATED AS 40%
        $$$  OHAU INFLOW FOR THE PERIOD BEFORE 1/12/1949.  ACTUAL
        $$$  RIVER FLOWS ARE AVAILABLE FOR THE PERIOD 1/12/1949 TO
        $$$  1/10/1964 FROM A GAUGING STATION AT BENMORE, WHICH HAS
        $$$  BEEN SUBMERGED WITH THE CONSTRUCTION OF BENMORE
        $$$  DAM.  FLOWS AFTER THIS IS SIMULATED FROM AHURIRI
        $$$  RIVER FLOW AT SOUTH DIADEM.
IF D GT 491201 1
  AHURB=OHAUI*.4
IF D LT 641001 1
  AHURB=AHURS*1.429
IF AHURB GE 0 1
  AHURB=0
        $$$  ALL OTHER INFLOWS TO BENMORE FROM TWIZEL & SMALL
        $$$  STREAMS, AND ALSO THE SPILL FROM LAKE PUKAKI IS TAKEN
        $$$  INTO ACCOUNT BY INCREASING THE AHURIRI FLOW AT
        $$$  BENMORE BY A FACTOR OF 0.33
BENTR = OHAUI + 1.33 * AHURB
        $$$  PUKAKI + TEKAPO FLOWS COMBINED IS ABBREVIATED `PUKT'
        $$$  TEKAPO B STATION DISCHARGES SINCE ITS COMMISSIONING ON
        $$$  22/8/1977 SUBTRACTED FROM THE COMBINED FLOW TO AVOID
        $$$  DUPLICATION.
PUKT = PUKI + TKOUT
IF D LT 770822 1
  PUKT = PUKT - TKDIS
IF PUKT GE 0 1
  PUKT = 0
        $$$  COMBINE TEKAPO SPILL WITH BENMORE INFLOW (BENMORE TOTAL TRIB)
BENTR = BENTR + TKSPL
            $$$ DEDUCT RESIDUAL FLOWS IN UPPER OHAU RIVER
OHAUS=OHAUI - 8000
IF MMDD GT 1031 2
  if mmdd le 430 1
    OHAUS=OHAUI - 12000
OHAUL = OHAUI          $$$ Dummy value to retain 6 item output
PUT  TKOUT PUKT OHAUI BENTR OHAUL OHAUS    $$$ 98614
```

Listing of PSIM Programme: WAITAKI.SIM

```
$$$****************************************************************************
$$$ WAITAKI.SIM (4/2/94)  Version: Feb 94
$$$****************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Waitaki Tributary flow at Waitaki PS
$$$   AUTHOR:          T S Halliburton             DATE:   Dec 1993
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$     Ammended February 1994 by J R Duffy to fill gaps in Pukaki outflow
$$$****************************************************************************

    $$$ INPUT SITE IS 88714, 5 ITEM SITE
GET TEKT PUKT TEKSP TKBGEN WTKTOT        $$$ Line ammended Feb 1994 J R Duffy
TIME D
$$$ SEVERAL GAPS OCCUR IN PUKAKI OUTFLOW RECORD, FILL USING
$$$ REGRESSION WITH TEKAPO OUTFLOW, CORRELATION COEFF r2=0.78
$$$ PUKAKI OUTFLOW = TEKAPO OUTFLOW x 2.106 - 38764
IF D LT 310401 GOTO CONTINUE      $$$ }
IF D LT 311024 GOTO GAP           $$$ }
IF D LT 311206 GOTO CONTINUE      $$$ }
IF D LT 320223 GOTO GAP           $$$ }
IF D LT 320405 GOTO CONTINUE      $$$ }
```

```
IF D LT 321107 GOTO GAP           $$$ } Lines added Feb 1994 J R Duffy
IF D LT 340501 GOTO CONTINUE      $$$ }
IF D LT 340609 GOTO GAP           $$$ }
IF D LT 351003 GOTO CONTINUE      $$$ }
IF D LT 351125 GOTO GAP           $$$ }
IF D LT 430923 GOTO CONTINUE      $$$ }
IF D LT 431217 GOTO GAP           $$$ }
GOTO CONTINUE                     $$$ }

GAP:                    $$$ Line added Feb 1994 J R Duffy
PUKT = (TEKT * 2.106) - 38764     $$$ Line added Feb 1994 J R Duffy

CONTINUE:               $$$ Line added Feb 1994 J R Duffy
IF D GT 770822 1
   LAKE = PUKT + TEKT   $$$ Before Tekapo B
IF D LT 770822 1
   LAKE = PUKT + TEKSP    $$$ After Tekapo B
WTKTRB = WTKTOT - LAKE
IF WTKTRB GE 0 1
   WTKTRB = 0
PUT LAKE WTKTRB
```

Listing of PSIM Programme: ROXBURGH.SIM

```
$$$*****************************************************************************
$$$ ROXBURGH.SIM  Version: June 1992
$$$*****************************************************************************
$$$   CALLED FROM:    PROCESS.SCR
$$$   FUNCTION:       Calculate Clutha Tributary flow at Roxburgh
$$$   AUTHOR:         unknown             DATE:   unknown
$$$   LOCATION:       Wellington
$$$   MODIFICATION HISTORY:
$$$*****************************************************************************
          $$$  READ ROXBURGH LAKE INFLOW 9110
GET  ROXTI
          $$$  READ LAKE HAWEA OUTFLOW 9174
XGET  HWEO
XLOCK
          $$$  SUBTRACT HAWEA OUTFLOW FROM ROXBURGH INFLOW TO OBTAIN
          $$$  CLUTHA RIVER TRIBUTARY FLOW AT ROXBURGH.
RXTRB=ROXTI-HWEO
IF RXTRB GE 0 1
    RXTRB= 0
PUT  RXTRB    $$$ 99110
```

Listing of PSIM Programme: ROXB1.SIM

```
$$$*****************************************************************************
$$$ ROXB1.SIM  Version: October 1996
$$$*****************************************************************************
$$$   CALLED FROM:    PROCESS.SCR
$$$   FUNCTION:       Calc. Clutha Tributary flow at Roxburgh from 960201
$$$   AUTHOR:         P M Mitchell          DATE:   9 October 1996
$$$   LOCATION:       Wellington
$$$   MODIFICATION HISTORY:
$$$ Modifications to calculation of site 99110 Roxburgh at Clutha Tributaries
$$$ as Roxburgh Inflow record not available from 960201. Roxburgh Tributaries
$$$ calculated from 960201 as (Chards Rd + Wanaka Outflow) * 1.10
$$$*****************************************************************************
XLOCK
          $$$  READ CHARDS RD FLOW 9013
GET  CHARDSRD
```

```
          $$$  READ LAKE WANAKA OUTFLOW 9154
XGET  WANAO
          $$$  ADDS (CHARDS RD FLOW TO WANAKA OUTFLOW) * 1.10 TO OBTAIN
          $$$  CLUTHA RIVER TRIBUTARY FLOW AT ROXBURGH.
RXTRB=(CHARDSRD+WANAO)*1.10
IF RXTRB GE 0 1
   RXTRB= 0
PUT  RXTRB    $$$ 99110
```

Listing of PSIM Programme: MANAPOUR.SIM

```
$$$*****************************************************************************
$$$ MANAPOUR.SIM  Version: March 1993
$$$*****************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Manapouri Local Inflows without Mararoa
$$$   AUTHOR:          unknown              DATE:   unknown

$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$
$$$*****************************************************************************
          $$$  No Mararoa
          $$$  READ TE ANAU INFLOW 9570
          $$$  READ TE ANAU OUTFLOW 9574
          $$$  READ MANAPOURI TOTAL INFLOW 9550
          $$$  READ MARAROA 9523
GET  TANUI TANUO MPRTI MARAI
          $$$  COMPUTE MANAPOURI TRIBUTARY FLOW BY SUBTRACTING
          $$$  TE ANAU OUTFLOW FROM MANAPOURI TOTAL INFLOW.
TIME D
IF D GT 320502 1
   MPRTI=TANUO*1.498+1972
MPRI=MPRTI-TANUO
IF D LT 690908 1        $$$ Changed from 760416 to 690908 7/3/94 JRD
   MPRI = MPRI - MARAI
IF MPRI GE 0 1
   MPRI= 0
PUT  MPRI  $$$ 99550
```

Listing of PSIM Programme: MANARED.SIM

```
$$$*****************************************************************************
$$$ MANARED.SIM  Version: March 1993
$$$*****************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Manapouri Local Inflows with Mararoa and
$$$                possible water right reduction
$$$   AUTHOR:          unknown              DATE:   unknown
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$
$$$     9/4/96  Modification of residual flow regime (R Jack)
$$$
$$$*****************************************************************************
$$$ Manapouri local inflow with Mararoa and possible water right reduction
init flush 0
init recdate 0428
               $$$  READ TE ANAU INFLOW 9570
               $$$  READ TE ANAU OUTFLOW 9574
               $$$  READ MANAPOURI TOTAL INFLOW 9550
```

```
                $$$  READ MARAROA 9523
GET  TANUI TANUO MPRTI MARAI
                $$$  COMPUTE MANAPOURI TRIBUTARY FLOW BY SUBTRACTING
                $$$  TE ANAU OUTFLOW FROM MANAPOURI TOTAL INFLOW.
TIME D
mmdd=mod(D,10000)
IF D GT 19320502 1
   MPRTI=TANUO*1.498+1972
MPRI=MPRTI-TANUO
IF MPRI GE 0 1
   MPRI= 0
IF D GT 19690908 2
  $$$ Changed from 760416 to 690908 7/3/94 JRD
   MARAI = TANUI * 0.112
   MPRI = MPRI + MARAI
           $$$  SPILL MARAROA DIRTY WATER IF MARAROA FLOW > 40 CUMECS.
IF MARAI LT  40000 2
           resflow=marai
           goto resid

$$$ Minimum flow regime (modified 9/6/96, R Jack)
            resflow=16000
            if mmdd gt 1031 goto resid
             resflow=14000
             if mmdd gt 0930 goto resid
              resflow=12000
             if mmdd gt 0430 goto resid
             resflow=14000
            if mmdd gt 0331 goto resid
            resflow=16000
resid:
MPRIT=MPRI
MPRI = MPRI - resflow

$$$ 150 cumec flushing discharge in Mar-May and Sep-Nov (added 9/4/96, R Jack)

$$$ Sep to Nov
PARTA:
if mmdd gt 1130 goto CloseA
if mmdd lt 0901 goto PARTB
  if flush eq 1 goto Recflow
   if MPRIT lt 150000 goto Recflow
     MPRI=MPRIT-150000
 $$$ residual flow included in discharge
     flush=1
goto next
CloseA:
flush=0

 $$$ Mar to May
PARTB:
if mmdd le 0531 2
flush=0
        $$$ 31/5 < date < 1/9
goto Recflow
if mmdd lt 0301 goto Recflow
  if flush eq 1 goto Recflow
   if MPRIT lt 150000 goto Recflow
     MPRI=MPRIT-150000
if recdate eq 0428 goto recflow
 $$$ residual flow included in discharge
     flush=1

$$$  Seven monthly flushing flows.  4th Sunday of each month is assumed to
$$$  occur on the 28th of each month.  (added 9/4/96, R Jack)
```

```
Recflow:
if mmdd lt 1031 2
recdate=0428
  $$$ recdate is the date the next discharge is to ...
goto NEXT
  $$$ occur on
if mmdd ne recdate goto NEXT
  MPRI=MPRIT-35000
  $$$ residual flow included in discharge
  recdate=recdate+100

NEXT:
PUT  MPRI
 $$$ 99552 with water right reduction
```

Listing of PSIM Programme: MANAWMAR.SIM

```
$$$*****************************************************************************
$$$ MANAWMAR.SIM  Version: March 1993
$$$*****************************************************************************
$$$   CALLED FROM:     PROCESS.SCR
$$$   FUNCTION:        Calculate Manapouri Local Inflows with Mararoa
$$$   AUTHOR:          unknown               DATE:   unknown
$$$   LOCATION:        Wellington
$$$   MODIFICATION HISTORY:
$$$
$$$*****************************************************************************
$$$ Manapouri local inflow with Mararoa.
                 $$$  READ TE ANAU INFLOW 9570
                 $$$  READ TE ANAU OUTFLOW 9574
                 $$$  READ MANAPOURI TOTAL INFLOW 9550
                 $$$  READ MARAROA 9523
GET  TANUI TANUO MPRTI MARAI
                 $$$  COMPUTE MANAPOURI TRIBUTARY FLOW BY SUBTRACTING
                 $$$  TE ANAU OUTFLOW FROM MANAPOURI TOTAL INFLOW.
TIME D
IF D GT 320502 1
   MPRTI=TANUO*1.498+1972
MPRI=MPRTI-TANUO
IF MPRI GE 0 1
   MPRI= 0
IF D GT 690908 2        $$$ Changed from 760416 to 690908 7/3/94 JRD
   MARAI = TANUI * 0.112
   MPRI = MPRI + MARAI
            $$$  SPILL MARAROA DIRTY WATER IF MARAROA FLOW > 40 CUMECS.
IF MARAI LT  40000 1
   MPRI = MPRI - MARAI
PUT  MPRI  $$$ 99551
```

OPUS