MANUHERIKIA CATCHMENT WATER RESOURCE STUDY

A SUMMARY OF INFORMATION

Water and Soil
DUNEDIN

January 1987

1.0 INTRODUCTION

This report has been compiled in an attempt to identify and collate all existing information and data on the water resources of the Upper Manuherikia Valley.

It is not intended to be a sole source of information but rather a reference to be used as a guide to the present situation and to indicate other sources of existing information.

NOTE Major reporting on the Water Resources of the Manuherikia Valley was produced in January 1974 - the report is entitled "Manuherikia River - Catchment No. 752630 Water Resources - Preliminary Feasibility Report on Irrigation Development.

The above report is referred to throughout this text.

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2.0 BACKGROUND

2.1 Physical Features of the Manuherikia Catchment

The Manuherikia catchment is northeast-southwest trending and is bounded on the southwest side by the Clutha River, on the northwest by the Dunstan mountains, on the northeast by the Hawkdun range and on the southeast by the North Rough Ridge and the Rough Ridge.

The catchment is divided into two valleys - the Ida Valley, drained by the Ida Burn and Manor Burn, and the Manuherikia Valley drained by the Manuherikia River and its tributaries. The two valleys lie parallel to one another and are joined by the Pool Burn Gorge which cuts through the Raggedy Range.

The Manuherikia River is a north-eastern tributary of the Clutha River with a catchment area of 3110 km^2. The valley stretches some 64 km and is part of the extensive block and intermontane basin of the Central Otago Region.

2.2 Climate and Soils

The Manuherikia catchment has a climate that is typical of the Central Otago area characterised by hot, dry summers and cold, dry winters. The valley is classed as semi-arid and has an annual rainfall of around 350 mm to 500 mm while on the ranges it rises to over 1100 mm.

The soils of the area consist of a central-southern zone of brown-grey earths; a yellow-grey earth series along the foot of the Dunstans and across the middle of the valley; and yellow-brown earths in the upper valley. Salinity is not a problem and loess is evident in most areas.

Most of the soils are drought prone and show varying responses to irrigation. Many of the downland soils suffer from impeded drainage and water-logging.

2.3 Land Use

Generally, land use varies throughout the valley from intense orchard production around Clyde and Alexandra to very extensive sheep/beef farming on the high country runs.

The Omakau area is dominated by semi-extensive pastoral farming with some cereal cropping. Sheep production is the major practice. Good production levels depend on winter feed production and so reliance on irrigation is high. At present, stocking rates are around 10-15 su/ha. Soils are generally of good fertility and the major crops grown are barley and oats with yields of around three-six tonnes /ha being average. The high elevations (320 m) in the area limit the possibilities for horticulture.

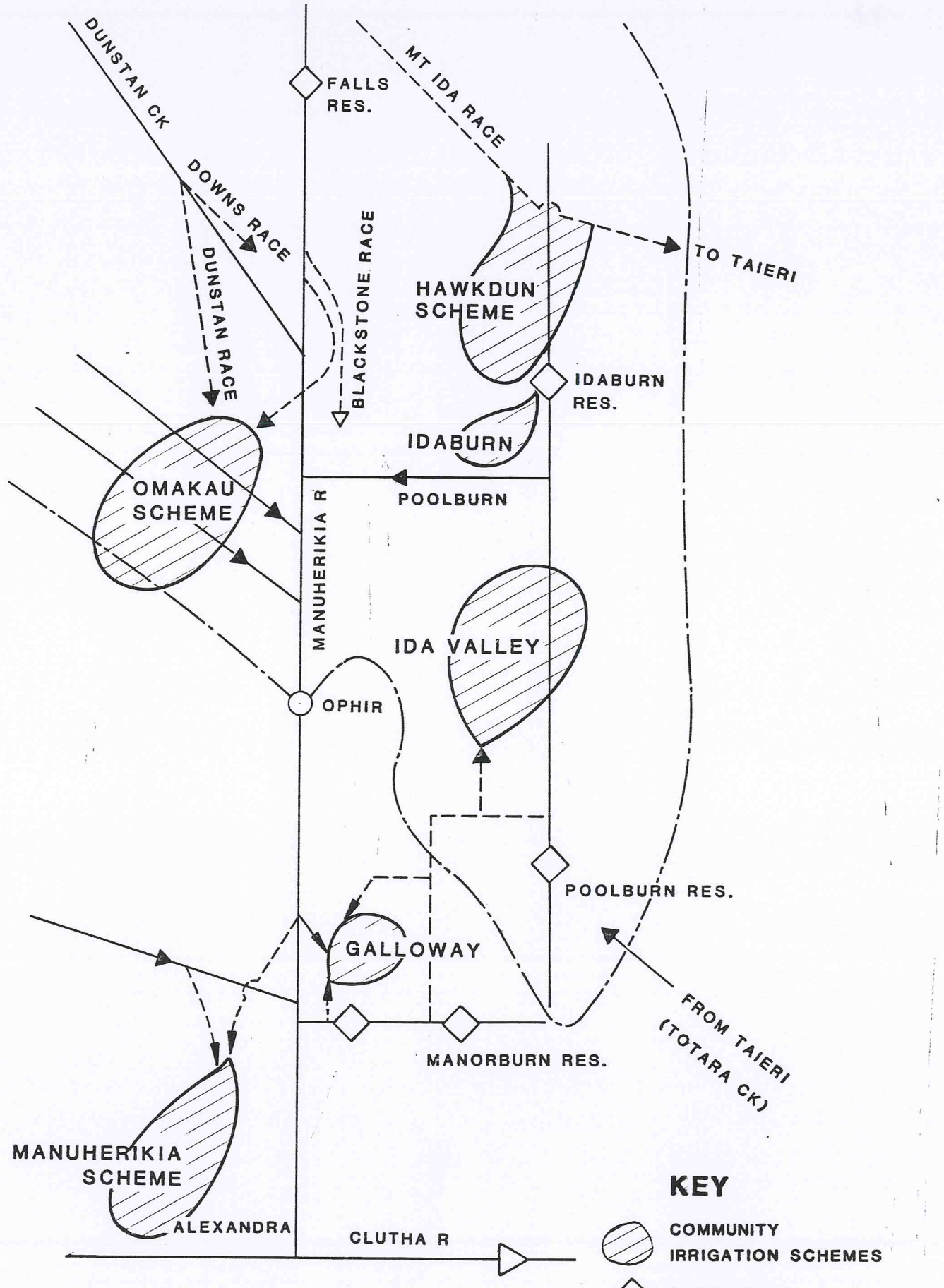
Within the Manuherikia Irrigation Scheme most of the land is again used for pastoral farming with only approximately 5% of the irrigated area in crops, but also 10% in horticulture. Lack of reliable water supply seems to be restricting development in this area. Major fruits grown are apples, cherries, apricots and nectarines for both export and domestic markets.

combine

The Galloway scheme has a diverse range of land uses. Flat areas are used for intensive sheep farming for both meat and wool production while the hill country is more extensive.

There are two dairy farms and also a few orchards.

The Ida Valley scheme area is again mostly sheep and beef farming with a few farmers venturing into deer. Horticulture is not viable because of the unsuitable climate and cropping is practised only on a small scale.



UPPER MANUHERIKIA VALLEY

WATER RESOURCES

Fig 1

3.0 THE WATER RESOURCE

The Manuherikia River rises in the north-east Hawkdun Range and is joined by Dunstan Creek near Becks which drains a western sub-catchment.* Figure 2 shows the various sub-catchments contributing to the Manuherikia River flow gauged at Ophir.

In the Upper Manuherikia sub-catchment, the left bank tributaries flow directly into the Manuherikia River from the Hawkdun Range. Combining the Upper Manuherikia and Dunstan sub-catchments shows that these two areas provide almost 60% of the water resource in the valley over 45% of the catchment area. High rainfalls on the ranges surrounding these catchments allows them to provide for the more fertile parts of the basin.

The Falls Dam provides storage for part of the water resource of these two areas but the present capacity of the reservoir (10.4 million m^3) is only 7% of the mean annual yield.

In the lower valley, however, there is some contribution from the Blackstone Hills, the Raggedy Range, and the Poolburn Gorge provides an outlet for the Poolburn and Idaburn.

The contribution through the gorge accounts for 4.5% of the Ophir flow (on an annual basis) but is as low as 2% in the irrigation season (defined as 15 September to 30 april).

There are a further two reservoirs in the Ida Valley, the Manorburn Dam with a capacity of 50.96 million cubic metres and the Poolburn Reservoir which can hold 25.9 million cubic metres. Even so, low catchment yields can often lead to water restrictions, and often these dams do not fill completely during the winter. Water stored in the Manorburn Dam is shared between the Ida Valley and Galloway irrigation schemes.

In addition, the Idaburn dam stores 0.234 million cubic metres for use on the Idaburn irrigation scheme. The reservoir is supplied by the Idaburn Creek and the 'R' race on the Hawkdun scheme.

On the western side of the river, downstream of Becks, tributary streams arise in the Dunstan Ranges and flow into the Manuherikia River along its course. The larger of these creeks being the Lauder, Thomsons and Chatto creeks.

this para-graph to page 6 please *

Figure 1 gives a schematic representation of the valley's water resources. (Flow data is summarised as mean monthly flows at Ophir.)

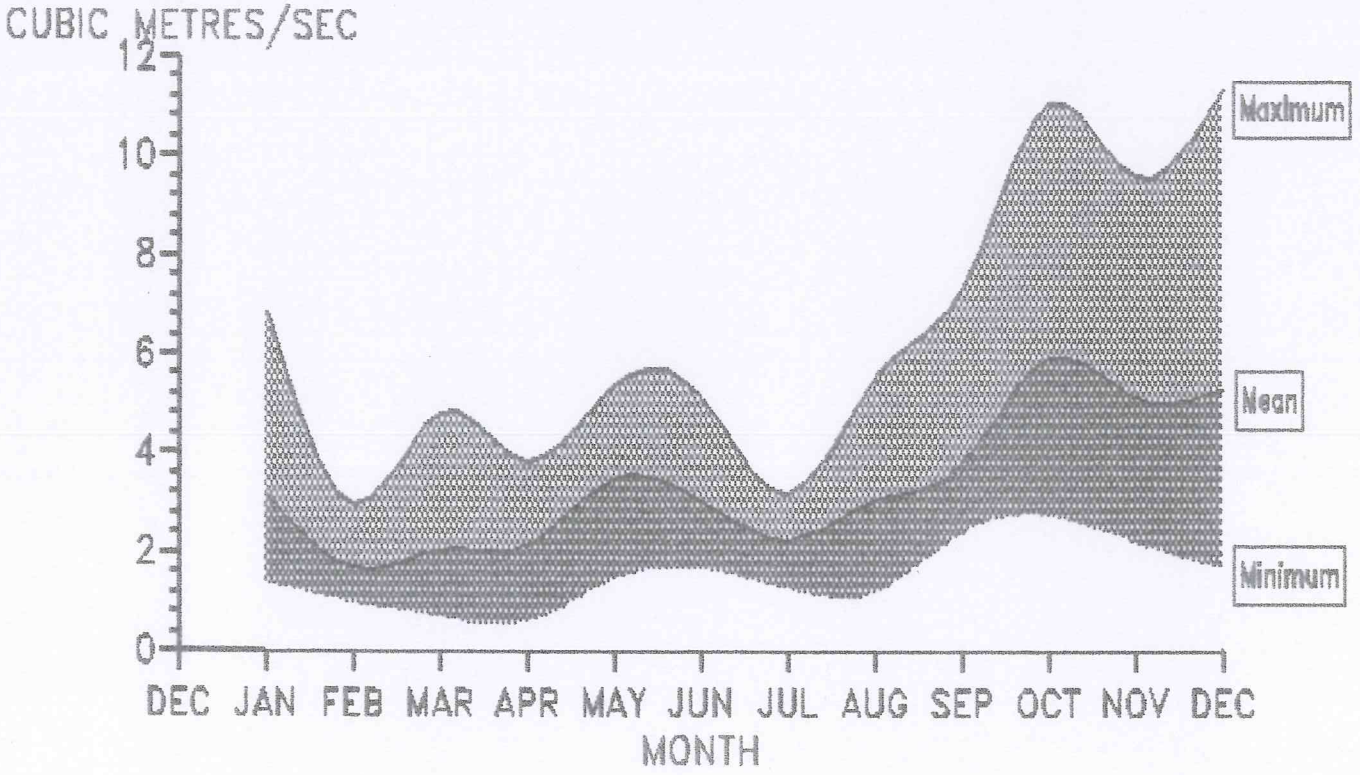
3.1 FLOW DATA

The flow records for this study were obtained from the Dunedin MWD Hydrological Survey data for daily mean flows at Ophir (Site No. 75253 Map Reference: S134:357629) over the period 1971 to 1985. These records are summarised in the appendix 3.1 and are represented graphically on the following page. Data from a second site (No. 75251) known as "Downstream of Forks" (Map Reference: S125:619060) was also available over the period of 1976 to 1985 and is presented. (Approximate locations are shown on figure 2.)

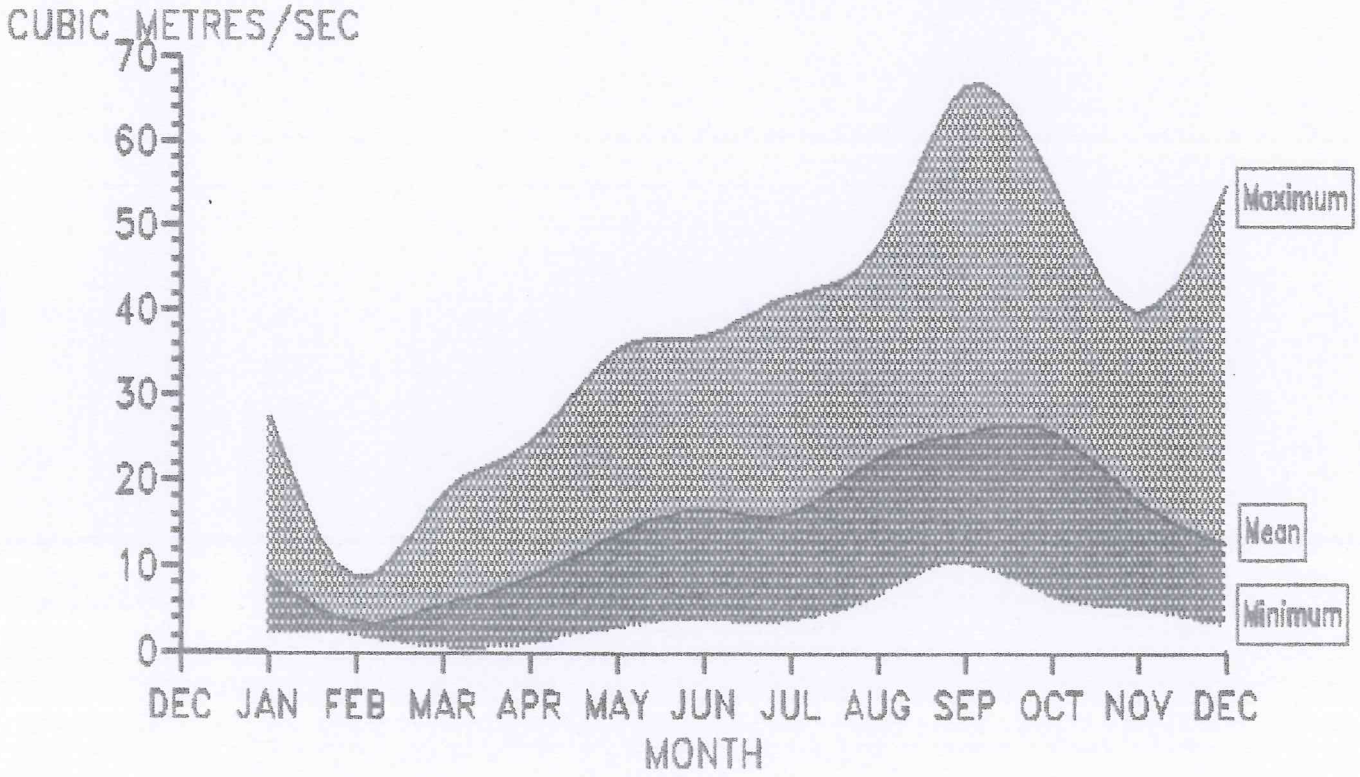
Since the Ophir site is more representative of the entire catchment, this gauging site was chosen as the base station for the Manuherikia catchment; and figure 2 relates each of the sub-catchments for its contribution to the total flows. (Note: Of the 30% contribution of the flow from the western tributaries the January 1974 report states that 5% of this enters the river below the Ophir site. It also notes that these streams have variable behaviour, and subsurface losses are considered to be high.)

A number of smaller tributaries enter the Manuherikia River below Ophir, but unfortunately there is no gauging site south of Ophir to enable an estimate of their contribution.

FLOWS AT DOWNSTREAM FORKS SITE
(1976 – 1985)



FLOWS AT OPHIR
(1976 – 1985)



3.2 FALLS DAM AND ITS OPERATION

Constructed in 1935, the Falls Dam stands 33.5 m high and has a storage capacity of 11 000 Ml. It provides storage for the three main irrigation schemes presently operating in the valley, but the existing capacity is only 7% of the mean annual yield of the Upper Manuherikia Valley. The crest has already been raised once, in 1955, to increase storage, and there is a further possibility to raise the dam to 51 m, increasing the capacity to 47 000 Ml of storage.

The flooding spillway is of the Morning Glory type which discharges 75 m downstream of the toe of the dam and operates almost continually outside the irrigation season (15 September through to 30 April).

Under present levels of service, the reservoir is seldom called upon before December, when water is released from the dam for irrigation. The reservoir water usually lasts six-eight weeks without replenishment. In dry seasons during the critical months (February especially) there may be water shortages, and rationing of the water for irrigation may be necessary.

In addition, there are a further four reservoirs in the Ida Valley; the Poolburn (25.9 million m^3 capacity), the Upper Manorburn (50.96 million m^3), the Lower Manorburn (0.23 million m^3) and the Idaburn (0.23 million m^3).

The Upper Manorburn and Poolburn dams, which have significant capacities for storage, generally do not fill, and water often has to be rationed according to the amount of storage at the beginning of the season.

The Idaburn Reservoir has limited storage and reliable supply can only be achieved for two to three weeks.

4.0 WATER USE FOR IRRIGATION

There are five community irrigation schemes which utilise the water resources of the Manuherikia Valley (see appendix 8.2 for diagrams of the three main schemes). Figure 1 shows the locations of these schemes.

HAWKDUN

During the irrigation season, this scheme draws run-off from the Hawkdun range tributaries via the Mt Ida water race, and diverts water (approximate race capacity of 1.1 cumecs) to the Hawkdun Scheme. This scheme is one of the largest in Central Otago and serves 3580 ha. The Mt Ida race continues on past the Manuherikia catchment boundary, collecting water from various tributaries, and distributing the resource into a number of distributary race along its course.

OMAKAU

The Omakau scheme has 5770 ha under irrigation agreement. Water is diverted from the Manuherikia River above its junction with Dunstan Creek, crosses the river via the main race to Tiger Hills and to a pumped extension.

The Dunstan race diverts water from the creek and serves a higher area of the scheme, as do other smaller races which take water supplies from the Lauder, Thomson and Devonshire Creeks.

Falls Dam provides 10.4 million cubic metres of storage for the Omakau, Manuherikia and Galloway schemes.

The Blackstone Hills race takes its water supply from the Manuherikia below Falls Dam and serves 345 ha. This part of the scheme is farmer operated, and, since the intake is above the Ophir gauging site, has been accounted for in terms of water resources.

MANUHERIKIA

The Manuherikia scheme has its intake at the ~~Manuherikia~~ Ophir Gorge, and currently has 1910 ha under irrigation agreement. The scheme draws its main supply from the Manuherikia River at the Ophir Gorge. Water is carried through as far as Clyde via the main race, and water is also abstracted from Chatto Creek and six other smaller tributaries.

GALLOWAY

The Galloway scheme serves 1200 ha, and is supplied partly with Manorburn water (some being stored storage in the Manorburn reservoirs) and partly by Manuherikia River flows. Water is pumped from the Manuherikia River to irrigate the northern areas of the scheme. Upper Manorburn dam water is shared with the Ida Valley scheme while the Lower Manorburn dam irrigates the Galloway Flats.

IDA VALLEY

Storage for this scheme at the Upper Manorburn and the Poolburn Reservoirs amounts to 75 000 Ml, and the area served is 5600 ha.

Low catchment yields in successive years have often lead to water restrictions.

Totara Creek supplements the run-off into the Poolburn dam via the Totara Creek Diversion Race. Several small creeks also feed into the race system. It is important to note that the water resource is often insufficient to fully supply the agreement area.

IDABURN

The Idaburn Scheme is a small scheme serving only 230 ha. Storage is available at the Idaburn reservoir which has a capacity of 0.234 million cubic metres.

The scheme is served partly by the Hawkdun 'R' race, and partly by the Idaburn reservoir, but is only sparsely irrigated.

4.1 WATER USE DATA

Water use data for the Manuherikia and Omakau schemes ~~has~~ have been summarised over the nine irrigation seasons from 1975/76 to 1983/84 (from information available in the scheme inventory reports).

The Hawkdun scheme water use is only partly contributed from the Upper Manuherikia Valley. During the irrigation season, the Mt Ida water race, which traverses the Hawkdun Range, and collects water from tributaries along its course. As such, water use can only be estimated from the 1.1 m^3/s carried by this race.

All data are summarised in Appendix 8.1.

5.0 TOTAL IN RELATION TO WATER USE

The following graph shows the summary of the water resource available in relation to the water required for irrigation. The total water resource, (~~red and blue areas~~ the area under the curve) is taken as the total flow at Ophir plus water used for the Omakau, ~~Scheme~~, Idaburn, Ida Valley and Hawkdun irrigation schemes.

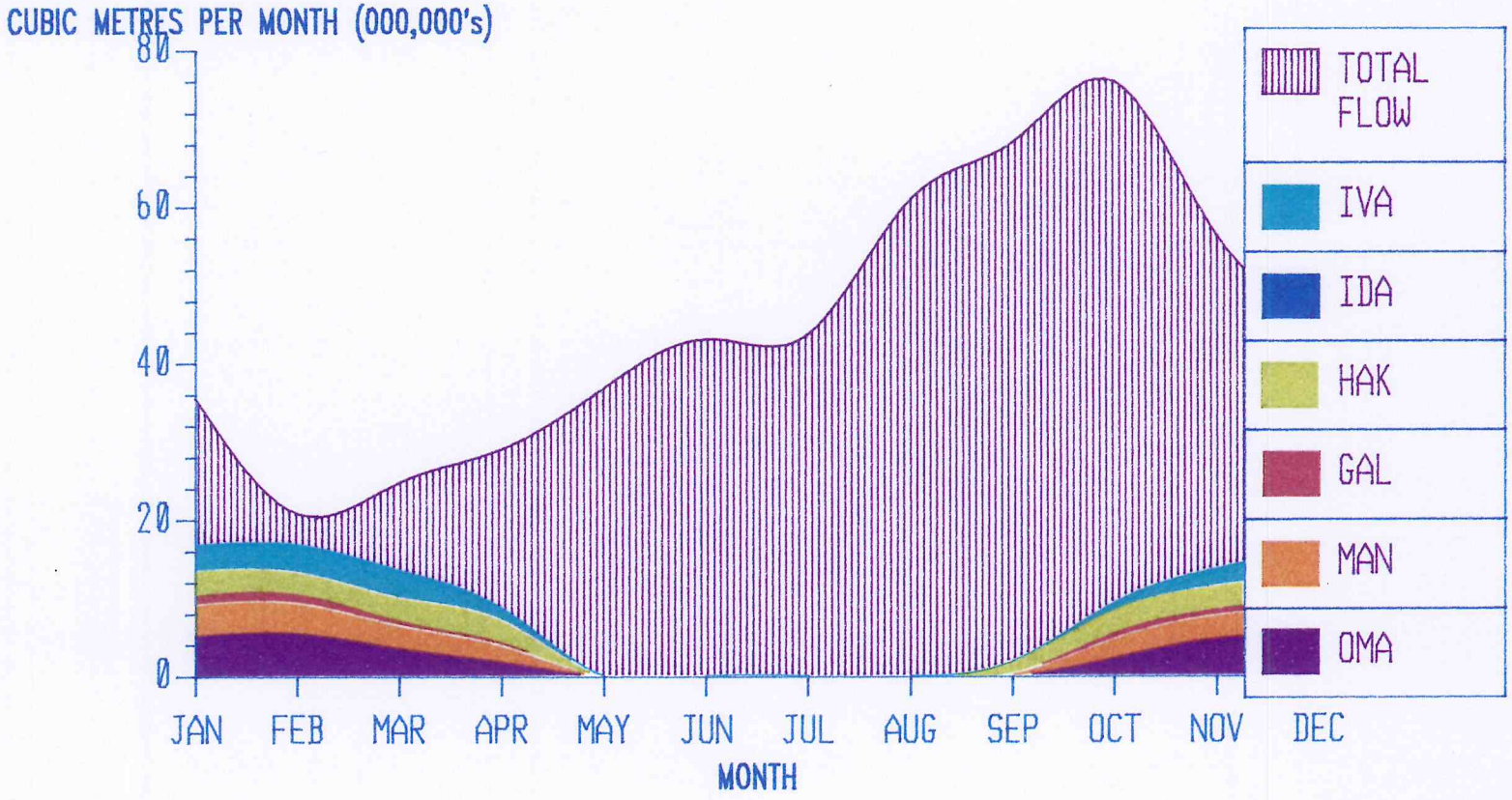
The coloured shadings represent water presently utilised in an average season by the Omakau, Manuherikia, Galloway, Idaburn, Ida Valley and Hawkdun Schemes. Thus the ~~blue~~ purple hatched area is that which is not presently utilised in an "average" year and shows the potential for increased storage for expanded or improved irrigation supply. The situation for the "minimum recorded" data is also shown graphically.

6.0 WATER RIGHTS

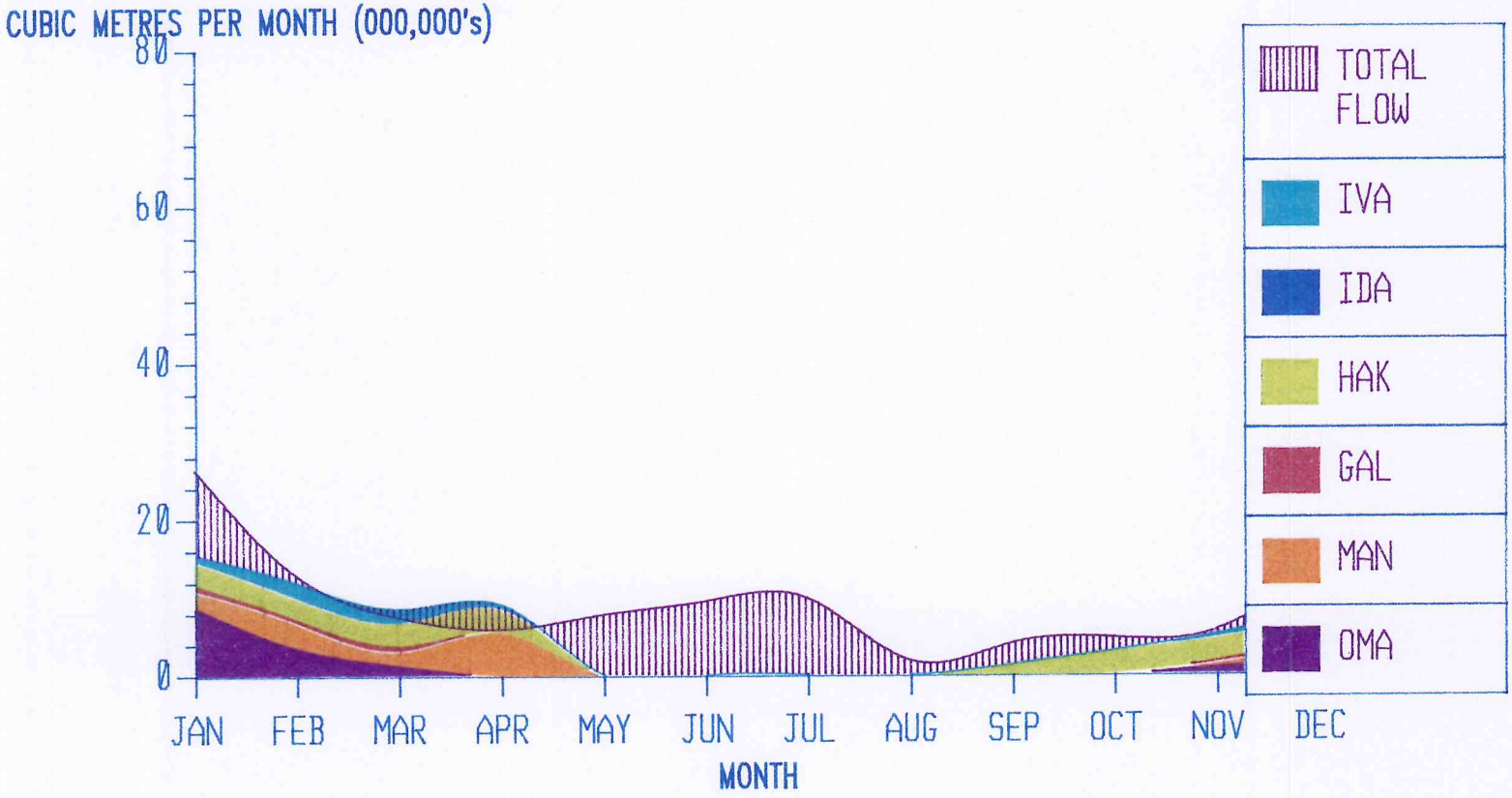
Figure 3 gives a schematic representation of the various water courses and the water rights in the valley. Crown and private rights can be distinguished and quantities taken are given in cusecs (m^3/s) or heads.

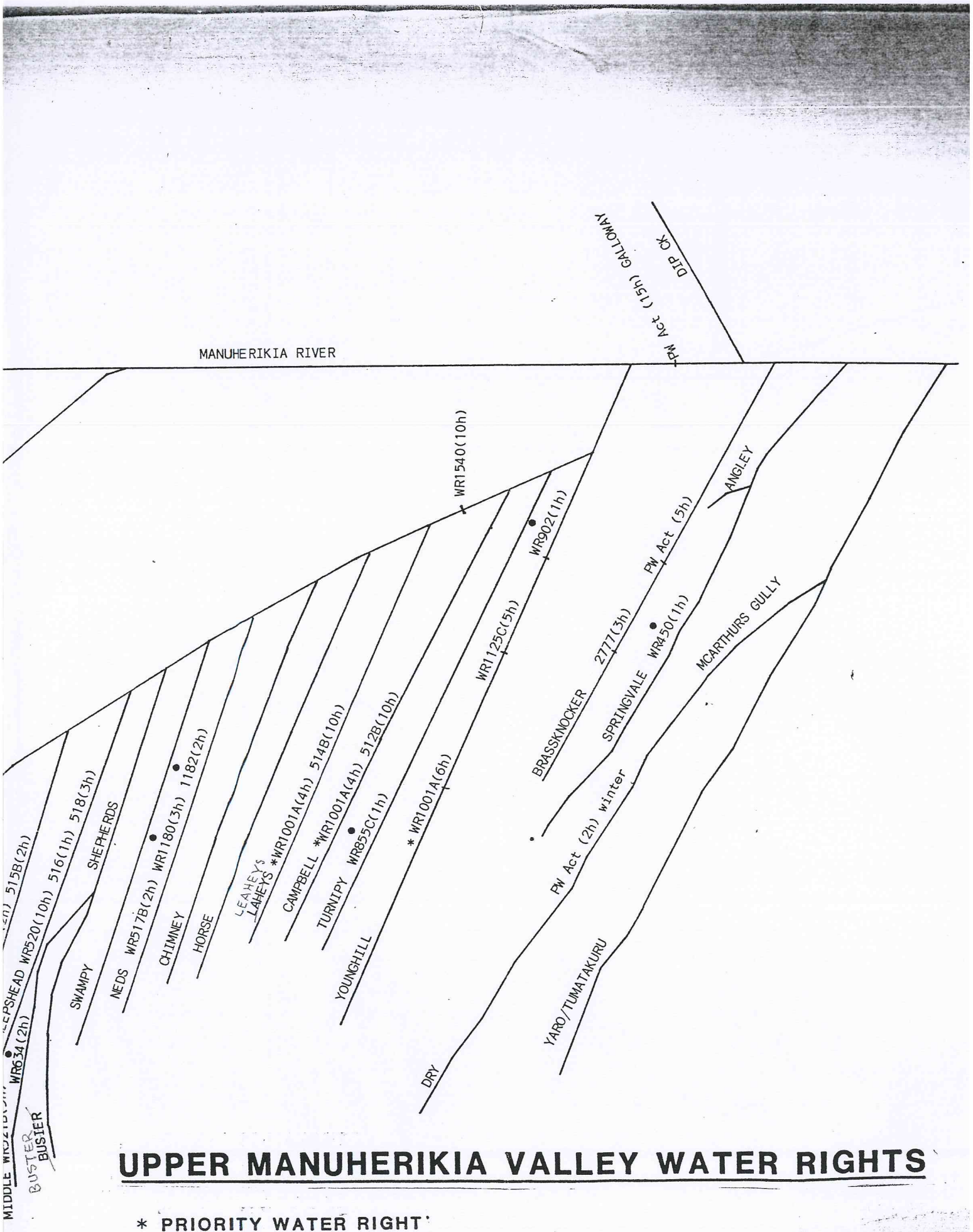
The most recent listing of water rights was contained in reference No. 1 (see section 7.0) produced in January 1974. Since it is unlikely that there have been any major changes, this has not been updated and a copy is reproduced in Appendix 8.3.

MANUHERIKIA WATER RESOURCES
MEAN MONTHLY DATA
(FLOWS 1973 - 1985 IRRIGATION USAGE 1975/76 - 1983/84)



MANUHERIKIA WATER RESOURCES
MINIMUM MONTHLY DATA
(FLOWS 1973 – 1985 IRRIGATION USAGE 1975/76 – 1983/84)





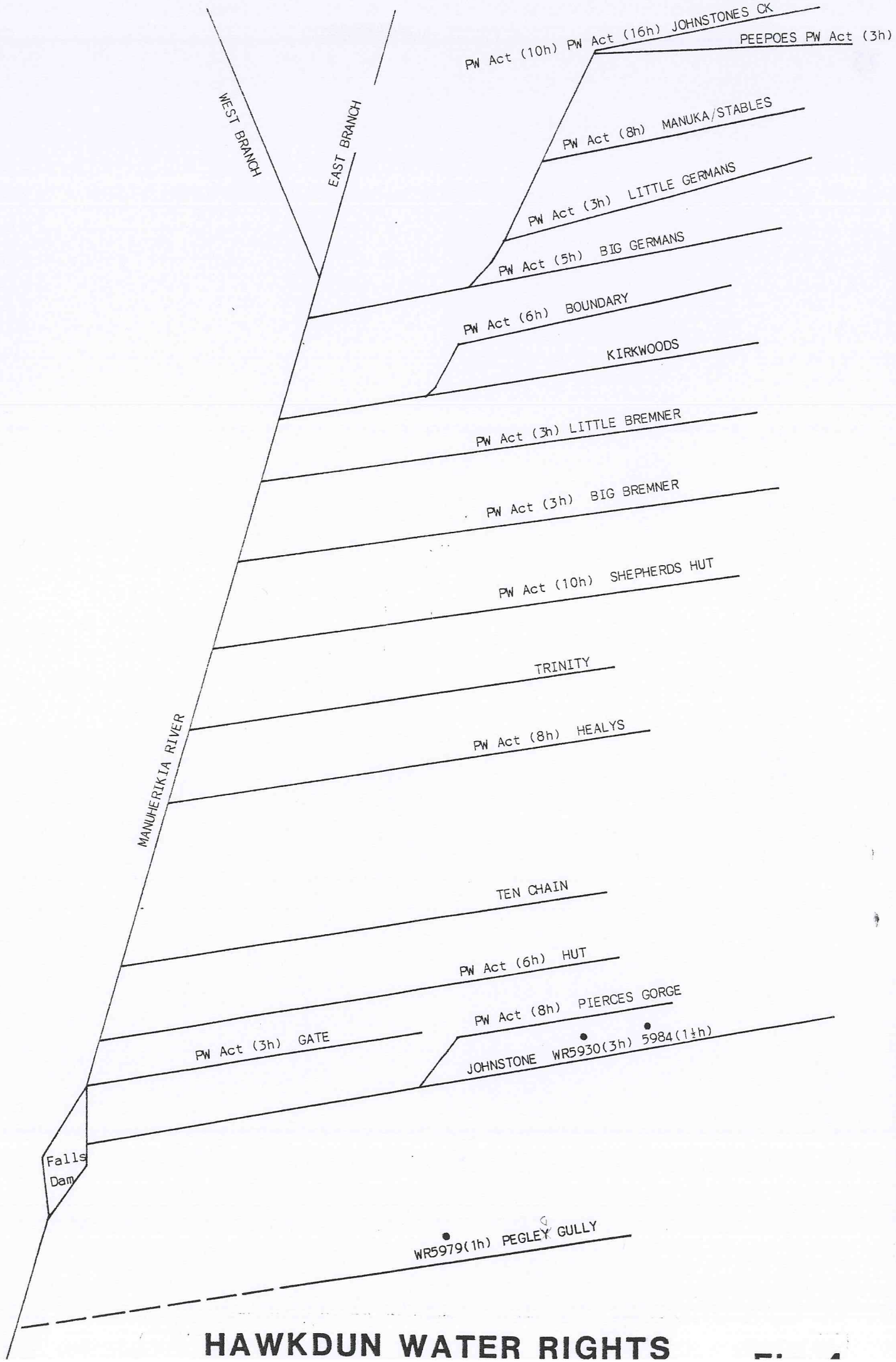
UPPER MANUHERIKIA VALLEY WATER RIGHTS

* PRIORITY WATER RIGHT

• PRIVATE WATER RIGHT (REMAINDER ARE CROWN WATER RIGHTS)

NOTE : INTAKE LOCATIONS ARE UNKNOWN IN MANY CASES
SOME ARE APPROXIMATED WHERE KNOWN

Fig 3



HAWKDUN WATER RIGHTS

7.0 REFERENCES

1 MWD (Water and Soil) Dunedin (1974) : Manuherikia River - Catchment No. 752630 Water Resources - Preliminary Feasibility Report on Irrigation Development (Volumes 1 and 2).

2 MWD (Water and Soil) Dunedin (1979) : Manuherikia Valley Irrigation - Feasibility Report.

3 MWD (Water and Soil) Dunedin (1986) : Refurbishment Summary Report; and also
Individual Scheme Refurbishment Reports

4 MWD Alexandra (1985) : Manuherikia Irrigation Scheme - Review of Old Central Otago Irrigation Schemes - Phase I - Scheme Description and Inventory of Components.

5 MWD Alexandra (1985) : Omakau Irrigation Scheme - Review of Old Central Otago Irrigation Schemes - Phase I - Scheme Description and Inventory of Components.

6 MWD Alexandra (1985) : Ida Valley Irrigation Scheme - Review of Old Central Otago Irrigation Schemes - Phase I - Scheme Description and Inventory of Components.

7 MWD Alexandra (1985) : Idaburn Irrigation Scheme - Review of Old Central Otago Irrigation Schemes - Phase I - Scheme : Description and Inventory of Structures.

8 Lincoln College (1982) : Lincoln Papers in Resource Management No. 9 - Resource Use Options for the Upper Manuherikia Valley - A Case Study.

9 Data from MWD Hydrological Surveys (Dunedin)

10 PWD Files 15/24, 33/2, various correspondence and reports.

11 Various files held by Water and Soil Dunedin

APPENDIX 1

FLOW AND WATER USE DATA SUMMARIES

RIVER FLOWS AT OPHIR – (RECORDS FOR 1971 → 1985)

DAILY MEAN FLOW, MONTHLY BASIS (m^3/s)

	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL.
1971	?	1.267	2.354	5.448	6.920	30.881	12.243	10.572	21.205	18.492	19.307	4.675	133.364
1972	4.912	3.607	4.076	5.714	15.474	17.980	28.345	17.560	40.366	27.722	12.336	5.541	183.633
1973	3.715	2.894	2.123	4.359	9.373	9.449	5.968	14.065	24.731	15.176	31.135	3.120	126.108
1974	2.136	4.578	6.397	10.350	10.329	11.382	15.981	32.840	27.014	32.743	13.145	4.387	182.664
1975	4.516	4.914	9.098	18.155	16.509	15.481	16.462	33.962	27.221	17.130	12.849	3.588	179.885
1976	2.654	2.348	1.123	0.960	4.140	11.500	16.155	20.460	21.734	25.351	17.115	54.638	178.178
1977	24.888	3.752	2.288	3.415	20.588	14.741	13.047	6.620	15.801	22.150	12.455	6.495	146.240
1978	4.256	2.443	1.880	2.936	9.143	12.269	16.347	37.626	66.177	55.176	24.719	24.181	257.153
1979	4.463	2.896	10.002	20.620	26.390	17.300	10.556	18.897	25.081	28.588	15.614	14.679	195.086
1980	27.885	8.600	6.688	14.821	19.286	36.889	16.540	47.468	25.698	19.468	17.152	8.610	249.105
1981	2.672	2.190	8.587	7.773	7.172	12.495	25.014	22.551	14.874	14.319	5.005	3.613	126.265
1982	3.224	1.911	0.506	4.341	12.813	12.836	7.369	11.169	21.696	30.057	39.776	18.525	164.223
1983	24.291	5.048	6.758	24.288	35.175	35.338	41.711	34.674	32.127	53.789	29.747	19.875	342.821
1984	11.891	6.319	18.270	6.709	10.038	7.003	15.344	19.774	11.862	22.637	8.498	10.384	148.729
1985	3.319	2.658	2.285	1.642	2.942	3.692	3.666	13.421	10.431	6.534	9.342	9.487	69.419
AVERAGE	8.916	3.695	5.496	8.769	13.753	16.616	16.317	22.777	25.735	25.955	17.880	12.787	178.858
MINIMUM RECORDED	2.136	1.911	0.506	0.960	2.942	3.692	3.666	6.620	10.431	6.534	5.005	3.120	69.419
MAXIMUM RECORDED	27.885	8.600	18.270	24.288	35.178	36.889	41.711	47.468	66.177	55.176	39.776	54.638	342.821

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RIVER FLOWS AT DOWNSTREAM FORKS. - (RECORDS FOR 1976 → 1985)

DAILY MEAN FLOW, MONTHLY BASIS (M^3/S)

	J	F	M	A	M	J	J	A	S	O	N	D
1976	1·824	1·265	0·699	0·579	2·004	3·035	3·091	2·650	3·203	4·853	5·056	11·359
1977	3·789	2·140	1·277	1·351	4·807	2·729	2·066	1·175	3·144	5·672	4·972	3·767
1978	2·699	1·129	0·810	1·277	3·741	2·198	2·473	4·397	7·322	7·853	?	?
1979	1·521	1·246	2·318	3·764	4·753	2·857	1·835	2·298	3·814	6·486	4·755	5·343
1980	6·921	2·938	3·005	3·831	3·568	5·117	2·100	5·516	3·848	5·651	5·596	3·710
1981	1·611	0·989	3·957	2·138	2·694	3·705	2·557	2·465	2·372	4·096	2·217	1·691
1982	1·370	1·084	0·790	1·705	3·904	2·554	1·878	2·149	3·416	5·407	9·571	6·545
1983	5·701	2·141	1·778	3·645	5·348	5·134	3·145	3·554	5·313	11·054	6·834	5·947
1984	4·529	2·665	4·790	2·114	2·467	1·651	2·260	2·758	2·433	5·527	3·468	5·801
1985	2·260	1·318	1·055	1·187	1·446	1·847	1·269	3·367	3·168	2·745	3·746	3·771
AVERAGE	3·223	1·692	2·048	2·159	3·473	3·083	2·268	3·033	3·803	5·934	5·135	5·326
MINIMUM RECORDED.	1·370	0·989	0·699	0·579	1·446	1·651	1·269	1·175	2·372	2·745	2·217	1·691
MAXIMUM RECORDED.	6·921	2·938	4·790	3·831	5·348	5·134	3·145	5516	7·322	11·054	9·571	11·359

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MANUHERIKIA IRRIGATION SCHEME - WATER USE (1975/76 → 1983/84)

(CUSEC HOURS)

	S	O	N	D	J	F	M	A
1975/76	—	43139	28415	50283	45902	41729	23085	16595
1976/77	3192	12792	38719	19480	34982	44581	45498	27764
1977/78	13357	35593	43637	45574	46086	30582	29486	17748
1978/79	991	1490	4203	44813	49509	42123	28591	5569
1979/80	3174	17531	33801	30198	24175	36794	41880	17629
1980/81	—	34398	30758	41081	47875	41002	22492	27539
1981/82	—	33669	42093	35881	42856	29994	18077	24912
1982/83	3961	37376	38772	39443	19477	44832	32159	22379
1983/84	—	2474	6590	16646	46301	35522	16890	23325
AVERAGE	2741	24274	29665	35983	39685	38573	28679	20384
MINIMUM RECORDED	—	1490	4203	16646	19477	29994	16890	5569
MAXIMUM RECORDED	13357	43139	43637	50283	49509	44832	45498	27764

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OMAKAU IRRIGATION SCHEME - WATER USE (1975|76 → 1983|84)

CUSEC HOURS.

	S	O	N	D	J	F	M	A
1975|76	—	32237	37988	74665	72099	59613	37904	31262
1976|77	—	—	35100	17467	8806	54193	65900	36676
1977|78	4647	31409	66211	74158	72267	61260	47223	16148
1978|79	—	—	9971	54259	65405	65722	29264	—
1979|80	—	—	35500	30111	12502	35891	49143	7227
1980|81	—	24848	42177	58820	69533	60440	20614	1227
1981|82	—	116070	180493	137449	150873	106623	60225	70263
1982|83	—	23443	43419	36546	10929	50547	28558	5621
1983|84	—	—	19866	39546	53189	46225	13865	13326
AVERAGE	4647	22800	47073	52302	51560	54051	35270	18175
MINIMUM RECORDED	—	—	9971	17467	8806	35891	13865	—
MAXIMUM RECORDED.	4647	116070	180493	137449	72267	106623	65900	70263

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GALLOWAY IRRIGATION SCHEME - WATER USE (1975/76 → 1983/84).

(CUSEC HOURS).

	S	O	N	D	J	F	M	A
1975/76	2153	9944	8831	14545	15083	10676	9830	5589
1976/77	1968	8982	3906	9962	13331	15310	5262	—
1977/78	3914	12527	11780	13448	15595	13082	11195	1843
1978/79	—	57	6395	12317	15001	13785	4243	638
1979/80	—	4478	8795	7527	6468	10087	8702	6960
1980/81	—	8554	9741	12662	14670	12769	3624	5609
1981/82	1224	13193	9030	12973	11998	9759	6761	4364
1982/83	1492	11261	10717	10845	5682	13915	5031	5284
1983/84	—	864	5041	12304	12265	7745	2852	6749
AVERAGE	1195	7762	8248	11843	12233	11903	6389	4115
MINIMUM	—	57	3906	7527	5682	7745	2852	—
MAXIMUM	3914	13193	11780	14545	15595	15310	11195	6960

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Description UPPER MANAWHERIKIA WATER RESOURCES

16/12/86

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PROJECT .....

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(6)

IDABURN IRRIGATION SCHEME - WATER USE (1975/76 → 1983/84).

(CUSEC HOURS).

	S	O	N	D	J	F	M	A
1975/76	313	3934	3860	2230	2140	605	—	—
1976/77	254	2340	1439	1269	148	1804	2281	1791
1977/78	—	—	—	1842	2508	114	—	—
1978/79	—	1196	2670	2669	3625	1938	1103	965
1979/80	—	—	231	105	1752	1471	2496	3028
1980/81	—	723	1869	1776	2744	—	1638	2340
1981/82	—	518	2260	1718	—	—	—	1404
1982/83	—	858	704	3258	1458	2954	2110	1711
1988/84	—	—	42	613	1895	3160	1042	845
AVERAGE	63	1063	1397	1720	1808	1338	1186	1843
MINIMUM	—	—	—	105	—	—	—	—
MAXIMUM	313	3934	3860	3258	3625	3160	2496	3028

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Description UPPER MANUHERIKIA WATER RESOURCES 16/12/86

PROJECT .....

Sheet No. .....

(7)

IDA VALLEY IRRIGATION SCHEME - WATER USE (1975/76 → 1983/84)

(CUSEC HOURS)

	S	O	N	D	J	F	M	A
1975/76	540	29900	22687	45179	40994	23785	34135	6491
1976/77	—	72	19305	9297	10530	47849	45169	28043
1977/78	—	21581	29570	37510	44249	31759	42243	10396
1978/79	—	—	10548	41746	43276	34596	26965	5476
1979/80	—	144	20621	19467	12672	39054	46654	23225
1980/81	—	5921	28468	39096	48118	39054	20680	14189
1981/82	—	27665	31669	37229	36077	33171	45081	10776
1982/83	—	3803	27817	28826	7827	34472	19309	12021
1983/84	—	—	5361	26846	40485	18901	16787	14547
AVERAGE	60	9898	21777	31688	31581	33627	32930	13907
MINIMUM	—	—	5361	9297	7827	18901	16787	5476
MAXIMUM	540	29900	31669	45179	48118	47849	46052	28043

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IDA CULTIVATION SHEET

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APPROXIMATION OF MANUHERIKIA CATCHMENT WATER RESOURCE BY THE HAWKOUN SCHEME

HAWKOUN RACE CAPACITY = $1.1\ m^3/s \times 86400\ (s/day) \times$ days in month

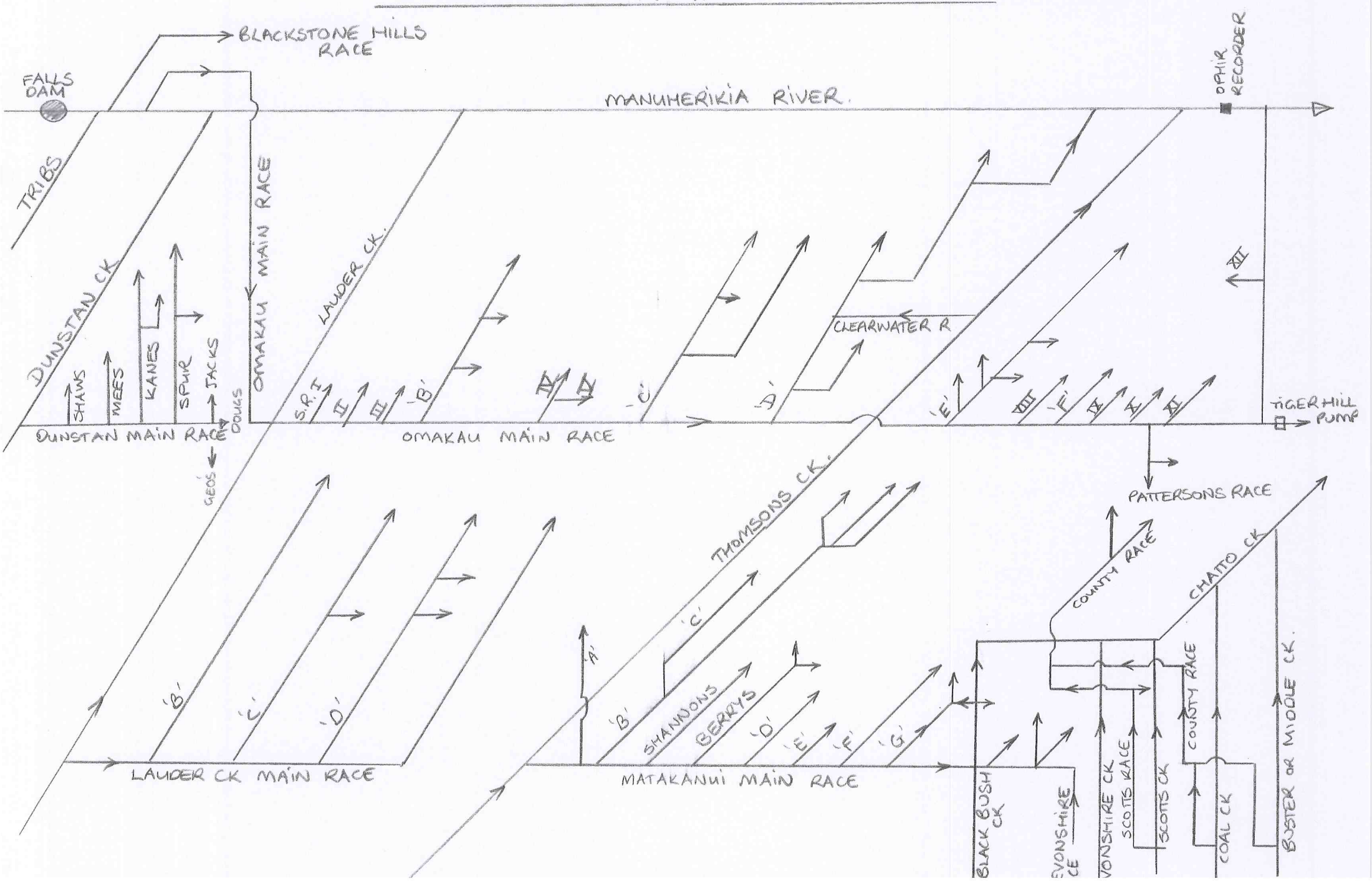
$\Rightarrow$ use in m^3 per month ($\times 10^6$)

MONTH.	S	O	N	D	J	F	M	A.
WATER USE ($m^3/mth \times 10^6$)	1.12	2.95	2.85	2.95	2.95	2.66	2.95	2.85.

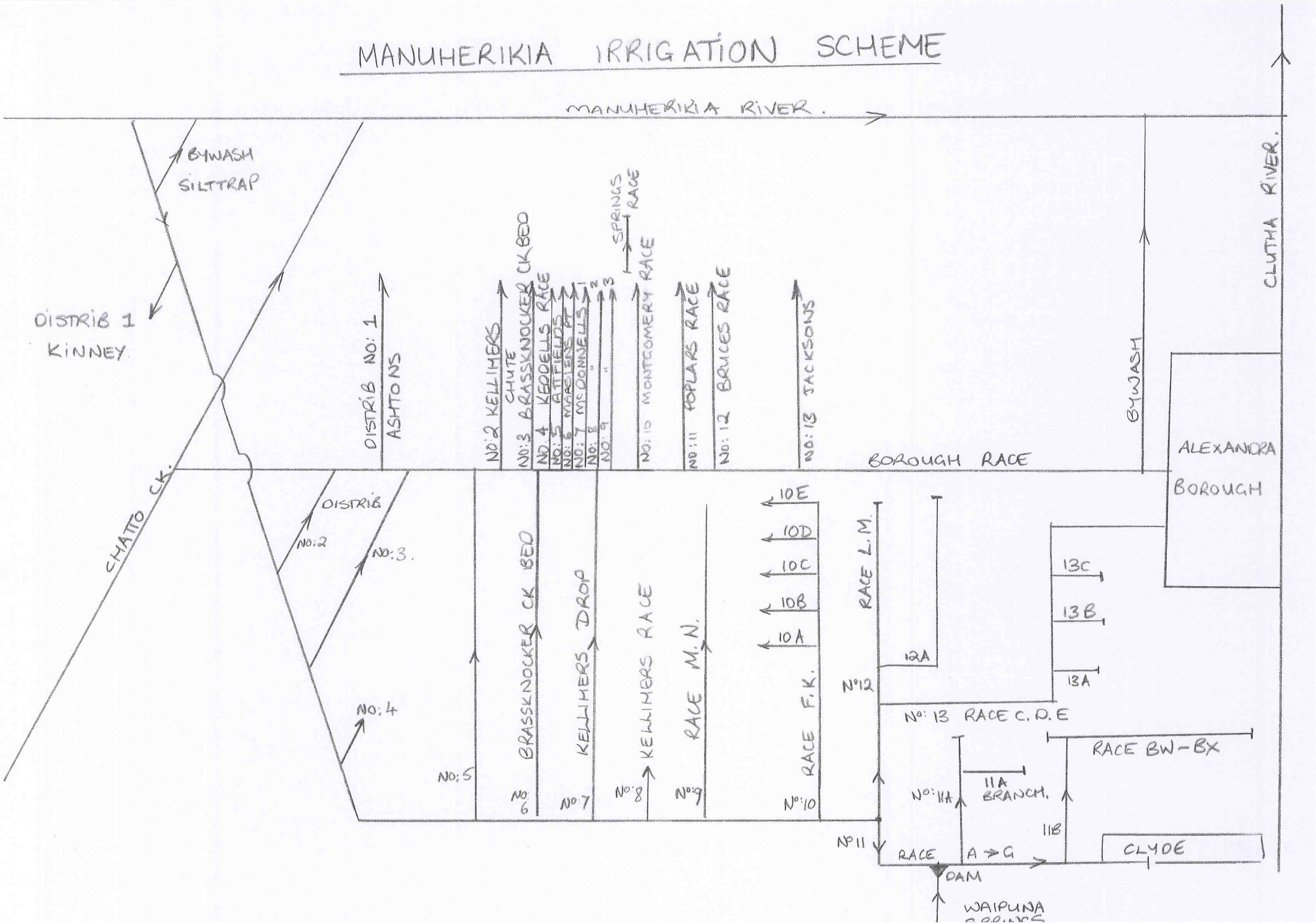
APPENDIX 2

DIAGRAMS OF OMAKAU, MANUHERIKIA AND GALLOWAY SCHEMES

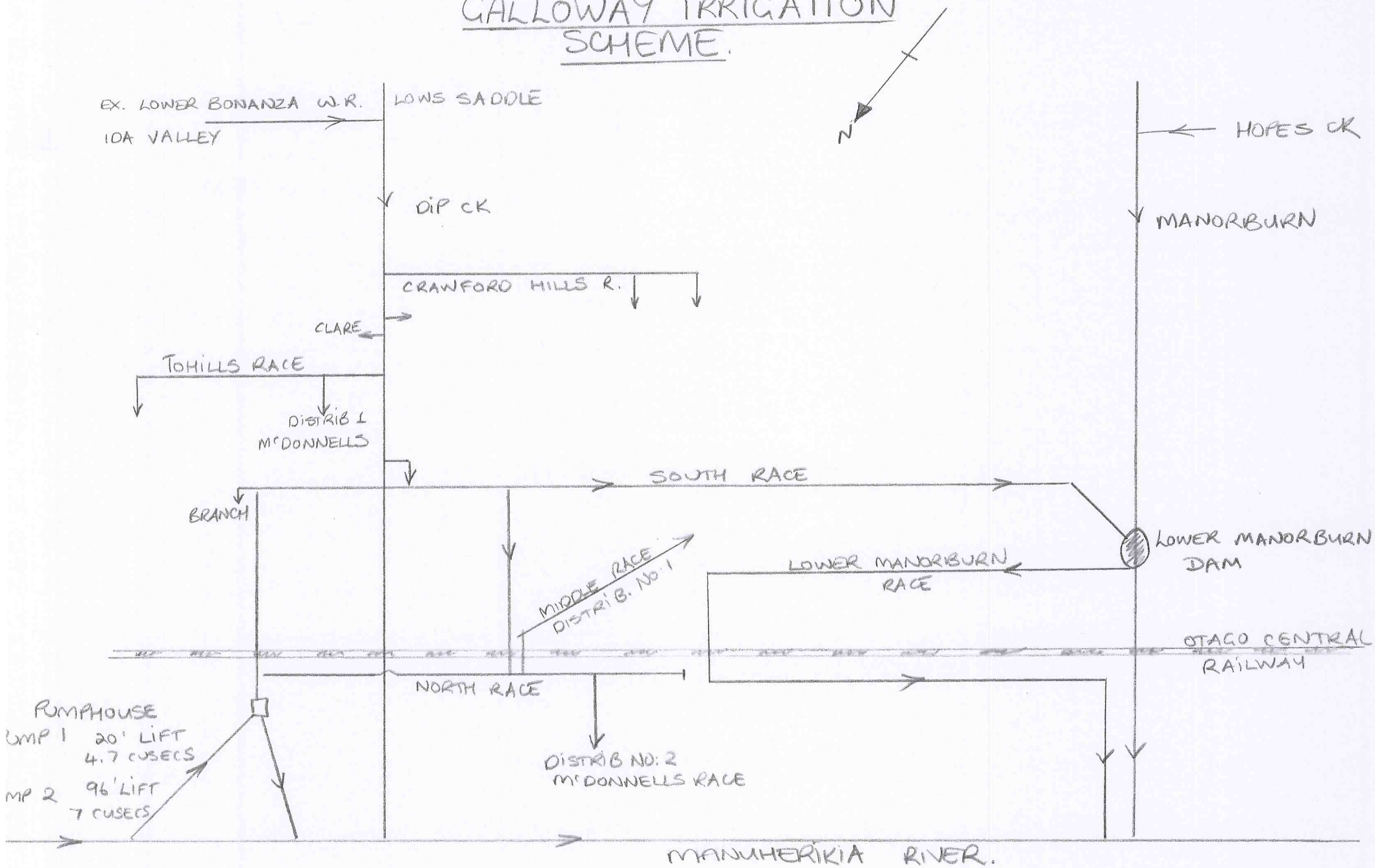
OMAKAU IRRIGATION SCHEME



MANUHERIKIA IRRIGATION SCHEME



GALLOWAY IRRIGATION SCHEME.



APPENDIX 3

WATER RIGHTS

Mining Privilege No.	Holder	Priority Date	Quantity (cusecs)	Location	Remarks
				752630	
WR 415	L.L. Thomson & I.L. Thomson	23.8.1905	3	Manuherikia R. S.134:401652	
WR 747B	J.K. Leask, E.C. Nelson & M.A. Nelson	14.12.1912	2	S.134:402652?	
WR 915C	Crown		100	S.134:330609	Manuherikia Scheme
WR 4363	Crown		12	S.125:564828	Blackstone Hill Re
WR 5785	Crown		80	S.134:532797	Omakau Scheme
PW Act	Crown		15	S.134:250522	Galloway Scheme
WR 442B					Notified, but previously struck off
				752631	
WR 1700	J.W.M. Sanders		2	Bickerstaff Ck.	
WR 2175	I.B. Sanders		0.5	Graveyard Gully	
WR 179,181	Crown		90	Manorburn	Ida Valley Scheme
WR 2060	Crown		8	Manorburn	Galloway Scheme
WR 519A	J.W.M. Sanders & Alex. Boro.		2	Mt Campbell Ck.	B also exists
WR 517A	J.C. Sanders & Alex. Boro.		2	Speargrass Ck.	B also exists
WR 2231	J. Sanders		3.5	Speargrass Ck.	

ning Privilege No.	Holder	Priority Date	Quantity (cusecs)	Location	Remarks
				752632	
1124C	Crown	6.4.27	4	S.134:216508 Scrubby Gully Un-named Ck.	Manuherikia Scheme
N.Act	Crown		2W	McArthurs Ck. S.133.200549	
450C	G.A. Kelliher	21.6.02	1	Springvale Ck.	
319(2777)	Crown		3	Brassknocker Ck. S.134:242552	Manuherikia Scheme
N.Act	Crown		5	Brassknocker Ck. S.134:245543	Manuherikia Scheme
519B	Crown		10		Lands & Survey Dept
1540	Crown		10	Chatto Ck. S.134:280633	Manuherikia Scheme "Mining only" but Crown not bound by Mining Act. Subject dispute at time of transfer.
902	J.D. & B.F. Duncan	26.6.13	1	Younghill Ck. S.134:270572	
.1001A	Crown	6.1.1864	6	Younghill Ck. S.134:262591	See also Laheys Ck and Campbells Ck. Lease to Moutere Station Ltd.
.1125C	Crown	11.5.27	5	Younghill Ck S.134:266584	Manuherikia Scheme
			7.5 cusec. days per month	Trib.Younghill Ck. S.134:254605	Now Right 577

ining Privilege No.	Holder	Priority Date	Quantity (cusecs)	Location	Remarks
R.855C	Moutere Station Ltd	1.4.22	1	Turnipy Ck. S.134:215641	Renewed 7.2.67.
R 512	Crown	28.6.06	10	Campbells Ck	Lands & Survey Dept
R 1001A	Crown	21.1.1864	4	Campbells Ck. S.134:220653 S.134:230653 S.134:232653	See also Laheys and Younghill Cks. Leas to Moutere Station Ltd with certain rights under Deed 3068 held by M.D.Co
R 704A	J.L. Ferris	27.6.03	1	Metcalfe's Gully	
R 514B	Crown	28.6.06	10	Lahey's Ck.	Lands & Survey Dept
R 1001A	Crown	16.4.1864	4	Lahey's Ck.	Leased to Moutere S Ltd. See also Young hill & Campbells Ck
R 517B	Crown	28.6.06	2	Ned's Ck.	Lands & Survey Dept
R 1180	Matakanui Station Ltd		3	Ned's Ck.	
R 1182	Matakanui Station Ltd		2	Ned's Ck.	
R 521B	Crown	28.6.06	5	Middle Ck	Lands & Survey Dept

ote: Creek shown as Buster Ck on NZMS 1 inch to 1 mile maps is in fact Middle or Shepherd's Ck. Buster Ck. i the name applying only to the South Branch of Shephers and is shown in the wrong location. The North Branch of Shepherds Ck, in addition to being known as Middle Ck is also believed to be Centre Ck.

634C	W.S. McIntosh	1.9.06	2	Middle Ck S.134:242674	Now right No.454

Mining Privilege No.	Holder	Priority Date	Quantity (cusecs)	Location	Remarks
WR.516	Crown	28.6.06	1	Coal Ck S.134:266709	Omakau Scheme Also notified by I S. Dept as 5.
WR.518B	Crown	28.6.06	3	Trib. Coal Ck. S.134:277712	Omakau Scheme Also notified by I Dept
WR.520	Crown	28.6.06	10	Sheepshead Ck	Lands & Survey De
WR 507	C.N. & J.W.G. White	2.5.06	2	Scotts Ck	
WR 515B	Crown	28.6.06	2	Scotts Ck S.134:284724	Omakau Scheme Also notified by I S. Dept
WR 301	Crown	6.3.89	1	Devonshire Ck. S.134:289727	Omakau Scheme via Vincent County Formerly for 8 cus
WR 1191	G.W. Naylor & E.B. Naylor	29.3.30	3	Devonshire Ck.	Renewed 7/11/72.
WR 817	(A.E. Marslin)		3	Insleys Gully	Struck off.
WR 576	C.N. & J.W.G. White		2	Expired	
WR 580	C.N. & J.W.G. White		1	Expired	
				752634	
WR 172B	E.F. Donnelly	11.11.01	4	Blackbush Ck	
WR 178B	E.F. Donnelly	18. 3.91	2	Blackbush Ck S.134:299746	

Mining Privilege No.	Holder	Priority Date	Quantity (cusecs)	Location	Remarks
WR 184B	E.J. Berry, G. Harvey F.B.P. Donnelly, T. Duggan G.C. Wilson, S.D.Clouston etc.	2.11.1865	8	Blackbush Ck.	Includes permissio to run water under WR.4076, 4077 and 4079.
P.W.Act	Crown		2	Blackbush Ck S.134:325721	Omakau Scheme
P.W.Act	Crown		2	Blackbush Ck S.134:315736	Omakau Scheme
WR 182B	Crown	20.6.1867	2	Candler's Ck	Not notified, not
WR 679B	G.C. Wilson	16.11.09	2	Sailor Jack's Ck	
WR 680B	G.C. Wilson	27.11.09	1	Sailor Jack's Ck	
WR 186B	E.F. Donnelly	26.5.1866	2	Brickfield Ck	
WR 188B	E.J. Berry	8.8.1865	2	Brickfield Ck	Includes permissi run water taken u WR 4078.
			Notified but previously struck off		
WR 156B	E. & R. Huddlestone		1	Donnellys Gully	Renewed 1944 for 42 years.
WR 190B	T. Duggan				
-	C.G. Wilson		?	Trib.Long.Gully S134:333703	Not traceable
WR 139B?	H.M. Ferry		1	Smoker's Ck	Dredging Claim su dered absolutely.
WR 289	Crown		)	)	Omakau Scheme
WR 295	Crown		) Thomson's Ck	)	Omakau Scheme
WR 1464	Crown	12.7.34	15	) S.134:327781	Omakau Scheme
WR 303B	Crown		)	)	Omakau Scheme For for total 20 cuse

lining Privilege No.	Holder	Priority Date	Quantity (cusecs)	Location	Remarks
/R 961	Crown		2	Thomson's Ck	Notified by T.F. Stafford and not by Crown
/R 977	D. Fraser		Notified but previously lapsed. Covenant to Crown not exercised.		
/R 1165	T.J. Quigley		Notified but previously surrendered absolutely		
/R 1240) /R 306)	Crown	23.9.20 7.3.88	10	Thomson's Ck S.134:363696	(see 963) Omakau Scheme
			1	S.134:358755	Omakau Scheme
P.W.Act	Crown		3	S.134:367724	Omakau Scheme
P.W.Act	Crown				
				752635	
/R 378B	O.O.Gordon-Glassford	29.5.65	2	Shepherd's Gully Drybread?	
/R 446	O.McI.Gordon-Glassford	4.2.91	2	Rocky Gully	
/R 219(213)	Crown	4.5.87	1	Muddy Ck S.134:377762	Omakau Scheme Formerly for 2 cus
/R 432B	J.T. Moran		6?	Muddy Ck	
DA 600B	J.T. Moran		2	Trib.Muddy Ck	Drainage Channel o
60/99	Crown				Alluvial Claim onl
/R 382B	O.McI. Gordon-Glassford	24.11.1865	3	Trib.Lauder Ck	1st
/R 488	R.V. Wilson	28.5.1869	4	Chimney Gully Trib.Lauder Ck	2nd Partially forf ed. WR 1266,10.8.3
/R 490	G.S. Hamilton	24.5.1872	4	Chimney Ck Trib. Lauder Ck	3rd

Mining Privilege No.	Holder	Priority Date	Quantity (cusecs)	Location	Remarks
WR 7714	Crown	6.3.1889	4	Lauder Ck.	4th Ex 509B & 1096
WR 380B	O.M. Glassford	28.5.1889	3	Irishman's Ck Trib.Lauder Ck	5th
					6th Run in 432B
WR 386B	J. Clouston	6.11.1889	2	Lauder Ck	7th
WR 271	Crown	9.3.1903	6	Lauder Ck	8th See 386B above
WR 432B	Moran Brown & Clouston	24.11.1905	6	Lauder Ck.	9th Expires 22.4.1
WR 478B	Brown Moran Corrigal	17.2.06	2	Trib.Lauder Ck	10th Omakau Scheme
WR 513B	Crown	28.6.06	15	Lauder Ck	11th.
WR 590	A.N.A. Brown	27.6.07	2	Lauder Ck	12th
WR 611B	A.J. Alexander	21.11.07	4	Lauder Ck	13th
WR 631	A.S. & F.J.Samuels	11.5.08	2	Lauder Ck	-
WR 642	-	-	Struck off		-
WR 756	-	17.6.18	Struck off		-
WR 1067	Leith	25.3.24	1	Lauder Ck	14th
WR 1255B	G.S. Hamilton		0.125 domestic	Mellors Ck	Also known as Mil
			2	Mellors Ck	
WR 2013N	R. Wilson		2	Mellors Ck S.134:452772	Now Right No.54 Struck off N. re
WR 2122N			3	Becks Ck	Also known as "N Ck" Now Right No
WR 492	N.M. Hamilton		Struck off		Branch Race only
WR 1338	H.F. Passmore		1	S.125:432841 Becks Ck	Now Right 475
WR 3034					

Mining Privilege No.	Holder	Priority Date	Quantity (cusecs)	Location	Remarks
P.W. Act	Crown		2	Becks Ck S.134:485765	Omakau Scheme
P.W. Act	Crown		4	S.134:483778	Omakau Scheme
				752638	
WR 4384N	G.F. Waldron and Z.M.Waldron		3	Browns Gully S.125:514949	
WR 1531N)			2	Donald Stuarts Ck S.125:466879	
1532N)	S.E.J.W. Harley		2	S.125:466879	
1533N)			2	S.125:466879	
WR ?	C.W. Harrex		2.5	Firewood Ck	May be Donald Stuarts Ck
WR 1889N	Crown 1	1.10.72	6	Dunstan Ck	Near Becks
WR 641	(O'Hara) -		6	Dunstan Ck	Struck off
WR 633	(O'Hara) -		6	Dunstan Ck	Struck off

Note

Beattie transferred surrendered his 10? heads to L. & S. in early 1930's, on condition that he received 1½ from the Downs Race. Correspondence on file P.W.33/2 (Alex) indicates that Downs Settlers were "promised" 10 + 3 hea by L. & S. Dept on signing up. This might indicate that 2639 and 4690 were combined and 3 heads to give 489 3 heads. Register shows all 3 rights to be independent of each other and all still current as Crown rights .W.D. installation of Dunstan Intake (Omakau Scheme) in 1936 led to dispute, L. & S. Settlers and P.W.D. on. Minister of Works settled dispute (see P.W.33/2 of 26.8.36) assigning "1st 10 heads" to L. & S. and P.W. hereafter. This "1st 10 heads" applied to the 1st 10 Crown heads, as at that time there existed at least wo prior mining rights of 3 cusecs each (returning above the irrigation intakes and also a prior private rig f 6 cusecs at unknown location, downstream of the intakes. This 6 heads may refer to one of 641 or 633 truck off, or may be 1889 subsequently acquired by the Crown. (See P.W.33/2 R.E. Alex. of 4/9/37).

ning Privilege No.	Holder	Priority Date	Quantity (cusecs)	Location	Remarks
1534 N	Crown 2	22.6.03	8	Dunstan Ck	Not notified?
2639 N	Crown 3	20.9.07	5	Dunstan Ck	Lands & Survey Dept ex Beattie
4384 N	Beattie 4	31/10/22	3	Dunstan Ck	
4397	Morgan Bros	20/12/22	3	Dunstan Ck	Expired. Deed of Covenant for transfer to Crown not exercised
4690N	Crown 5	15/7/27	5	Dunstan Ck	L. & S. Dept (ex Beattie)
4892N	Crown 6	29/5/30	13	Dunstan Ck	L. & S. Dept
5784N	Crown 7	25/7/38	15	Dunstan Ck S.125:496869	But notified as 18. Omakau Scheme.
4202N?	M.H. Mee		?	Trib. Dunstan	? Not traceable.
8697Cr	J.A. Harley	7/11/56	2	Shepherds Ck	Covenant to Crown expires 1978.
1434N	S.E.J.W. Harley		1	Three-Mile Ck	Woolshed Ck?
4204N	G.D. Hamilton		2	Woolshed Ck S.125:481837	
4710N	F.M. Pyle	7/11/27	2	Clear Ck	Below Falls Ck prob ly Mata Ck Expires 1987.
1899N	C.P.,J.C.& A.J. Harrex	27/1/1865	25	Commences 2 miles above forks of Manuherikia ends near St Bathans.Collects all tributaries	Probably "Scandinavian"

ning Privilege No.	Holder	Priority Date	Quantity (cusecs)	Location	Remarks
1887N	C.P.,J.C.& A.J. Harrex	21/1/1864	17	Wild Duck to St Bathans (with 60 tribs)	
1877N	C.P.,J.C.& A.J. Harrex				(previously 635N) Struck off
1885N	C.P.,J.C.& A.J. Harrex	1/5/1866	12	Mountain Ck & Rocks Ck to St Bathans	M.& E.Race, then Kildare consolidated.Ju below Scandinavian Race
				752637	
N.Act	Crown,Hawkdun Scheme		3	Big Bremner Ck	S.125:646 047
"	"		5	Big German Ck	S.116:636 101
"	"		6	Boundary Ck	S.125:630 087
"	"		3	Gate Ck	S.125:675 945
"	"		8	Healeys Ck	S.125:663 005
"	"		6	Hut Ck	S.125:673 969
"	"		10	Johnston Ck	S.116:626 125
WR 5930	Dillon Mason & Mason		3	Johnstons Gully	As notified
WR 5984	"		1½	"	Notified as 4
P.W. Act	Crown		16	Johnstones Ck	S.125:702 898
"	"		3	Little Bremner Ck	S.125:645 059
"	"		3	Little German Ck	S.116:635 107
"	"		8	Manuka Ck	S.116:623 117
"	"		3	Peepoes Ck	S.116:688 928

Mining Privilege No.	Holder	Quantity (cusecs)	Location	Remarks
WR 5979	B.E. Dillon	1	Pegley Gully	S.125:610 872
P.W. Act	Crown, Hawkdun Scheme	8	Pierces Gorge Ck	S.125:687 940
P.W. Act	Crown	10	Shepherds Hut Ck	S.125:651 036