Environment Waikato Technical Report 2005/60

Water Management Study of Four Municipal Water Supplies

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For:
Environment Waikato
PO Box 4010
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ISSN: 1172-4005

July 2005

Document #: 1006562

Environment Waikato
REGIONAL COUNCIL

Reviewed by:
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Approved for release by:
Viv Smith Signature  Date 12/12/05

AQUALINC RESEARCH LIMITED

Water Management Study of Four Municipal Water Supplies

Prepared for Environment Waikato

Report No H05013/1

June 2005

AQUALINC RESEARCH LIMITED

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Quality Control			
Client:	Environment Waikato		
Report reference:	Title: Water Management Study of Four Municipal Water Supplies		No: H05013/1
Prepared by:	Channa Rajanayaka		
Reviewed by:	Julian Weir	Approved for issue by:	
Date issued:	June 2005	Project No:	H05013

Document History							
Version:	1	Status:	Draft, for Client's review	Author:	C Rajanayaka	Reviewer:	J Weir
Date:	19/5/05	Doc ID:	H05013_EW_rpt1_municipal water supplies_draft.doc	Typist:	R Grant	Approver:	
Version:	2	Status:	Final	Author:	C Rajanayaka	Reviewer:	J Weir
Date:	20/6/05	Doc ID:	H05013_municipal water supplies_ rpt1_final.doc	Typist:	L Sallabanks	Approver:	J Bright

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EXECUTIVE SUMMARY

The purpose of this study is to investigate allocation issues (takes and discharges) associated with municipal water supplies in the Waikato Region. It follows on from a previous study that investigated improvements to Environment Waikato's water allocation processes and procedures (EW, 2005). The scope of the study is to compare actual water use against consented rates for determination of allocation utilisation, to determine the contribution of water discharges, and to determine the potential impact of allocation restrictions during periods of low flows on supply availability. The study has been conducted using four 'case' towns; Hamilton, Te Awamutu, Tairua and Morrinsville as representative of the range of water supply and discharge issues for municipal supplies in the Region.

Allocation Utilisation

Water take records of all four towns illustrate that the actual use is significantly lower than the annual consented volume This in turn locks-up the allocable resource. Maximum annual take for the largest city, Hamilton, is less than 54% of the consented take over the study period. For the smallest town, Tairua, the maximum annual take is less than 36% of the consented take.

There are noticeable seasonal trends and patterns associated with water takes, which peak in the summer months and gradually decrease into winter months. Hamilton City's maximum percentage use of the allocation limit for the low demand winter months is below 47%; for Tairua, it is below 29%. For the high use summer months, the take goes up to 75% and 50% of the consented volume for Hamilton and Tairua, respectively. However, due to the nature of Tairua's seasonal tourism, the town experiences high take rates in some summer days. The maximum annual use for more agriculturally based Te Awamutu and Morrisville are 59% and 33%, respectively.

Contribution of Discharges

Three of the four towns discharge their treated wastewater back into surface water sources, and Tairua discharges out of the catchment to Pauanui for treatment. Discharges make a significant contribution to the allocable resource and such volumes should be considered in the process of water resource planning and management.

Hamilton's annual discharge to the Waikato River equates to 82.5% of its annual take. Te Awamutu's contribution is in the order of 39.1% of the annual take. Limited one-year data shows that Morrinsville discharge volume is 15.02% of its use. Net annual and seasonal uses (take less discharge) of the take for towns are as follows:

	% net use		
	Annual	**Summer**	**Winter**
Hamilton	17.59%	35.88%	-5.25%
Te Awamutu	60.90%	71.84%	48.43%
Morrinsville	84.98%	84.47%	88.29%

1 INTRODUCTION

This study is part of an ongoing commitment by Environment Waikato to the development of water resource planning and management. It follows on from previous studies determining options for improvements in the process and procedures for water allocation and management in the Region. This project investigates allocation issues associated with municipal water supplies in the Waikato Region.

Municipal water use is generally regarded as a high priority use on social and economic grounds. However, as highlighted in a previous study (EW, 2005), water utilisation can be low and there is often no specific guidelines or rules for water conservation during droughts. In the interests of improving allocation efficiency and water security, there is a need to better understand patterns and trends in municipal water use and to identify improvements in the way water consents (takes and discharges) are allocated and managed.

1.1 Project Outline

The principal purpose of the study is to investigate allocation issues (takes and discharges) associated with municipal water supplies in the Waikato Region. This objective has been achieved through the determination of water use patterns and trends for four 'case' towns: Hamilton, Te Awamutu, Tairua and Morrinsville as representative of the range of water supply and discharge issues for municipal supplies in the Region.

Appendix A lists details of the objective and approach of the project.

1.2 Previous Work

A study was recently completed to identify options for improvements in the process and practices for water resource allocation and management in the Waikato Region (EW, 2005). The study was carried out in the Waihou catchment as a representative area for the entire Region. It was found that the cumulative allocation of surface water in the catchment is approaching the upper allocation limit of 10% of Q_5, and there are concerns regarding allocation to meet future growth in demand. One of the major consented takes is for municipal supply networks (town and rural schemes) and it accounted for 29% of the resource.

Major allocation issues identified in the study were:

- High take rates (greater than the equivalent 24 hour rate) that locks-up allocable surface water;
- Variability of seasonal demand within and between seasons that locks-up allocable surface water;
- Water use lower than consented take rates and volumes (approximately only 80% of the consented take is being used);
- Under-accounting for discharges to surface water.

2 STUDY METHODOLOGY

The study is based on a rapid desktop assessment approach, which accesses water take and discharge data for four case towns. In addition to that a variety of information sources are assessed including:

- Relevant previous studies in the Waikato Region;
- Waikato Regional Plan;
- Population growth statistics in the Waikato Region;
- Ministry of Health register of community drinking-water supplies in New Zealand; and
- Consultation with EW personnel.

Actual daily municipal water take records are compared against the consented rates on monthly, annual and seasonal basis to identify allocation efficiency and issues. Discharged treated wastewater volumes are analysed to identify its contribution to allocable resource.

In this study it was assumed that where treated wastewater is discharged back to surface water bodies, water meets the required health standards and can be reused.

3 SUPPLY SYSTEMS

The four towns that have been selected for this study are a representative cross-section of the municipal water uses in the Waikato Region. Hamilton City is the largest municipal water consumer in the Region. As Table 1 and Figure 1 show, the city takes water from the Waikato River and discharges back to the same river. Te Awamutu and Morrinsville are substantially smaller towns and have considerable agricultural presences. Both towns discharge their treated wastewater back to the surface water and increase the allocable resource in the catchment. Tairua is a smaller settlement; however, seasonal tourism can increase the water demand in summer months. Tairua exports its wastewater out of the catchment for treatment at Pauanui.

Details of water take and discharge consents for four case towns are presented in Appendix B, and consent locations are illustrated in Figure 1 to Figure 4.

Table 1: Details of four case towns

	Local authority	Service population	Primary water use	Take source	Discharge to
Hamilton	Hamilton City Council	117,100	Residential	Waikato River	Waikato River
Te Awamutu	Waipa District Council	9,165	Residential/ Agricultural	Mangauika Stream (Waipa River catchment)	Mangapiko Stream (Waipa River catchment)
Tairua	Thames Coromandel District Council	1,700	Residential/ Seasonal tourism	Pepe Stream and unnamed tributary of the Tairua Harbour	Export outside of the catchment
Morrinsville	Matamata Piako District Council	5,600	Residential/ Agricultural	Dam near head of Topehaehae Stream catchment (same catchment as Piako River)	Piako River

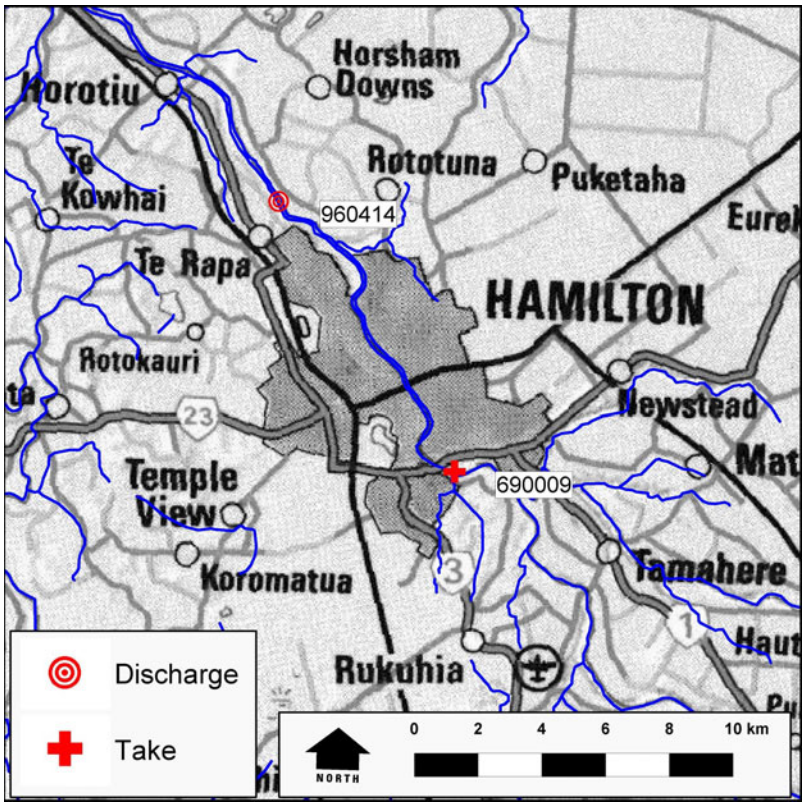

Figure 1: Hamilton municipal water take and discharge locations

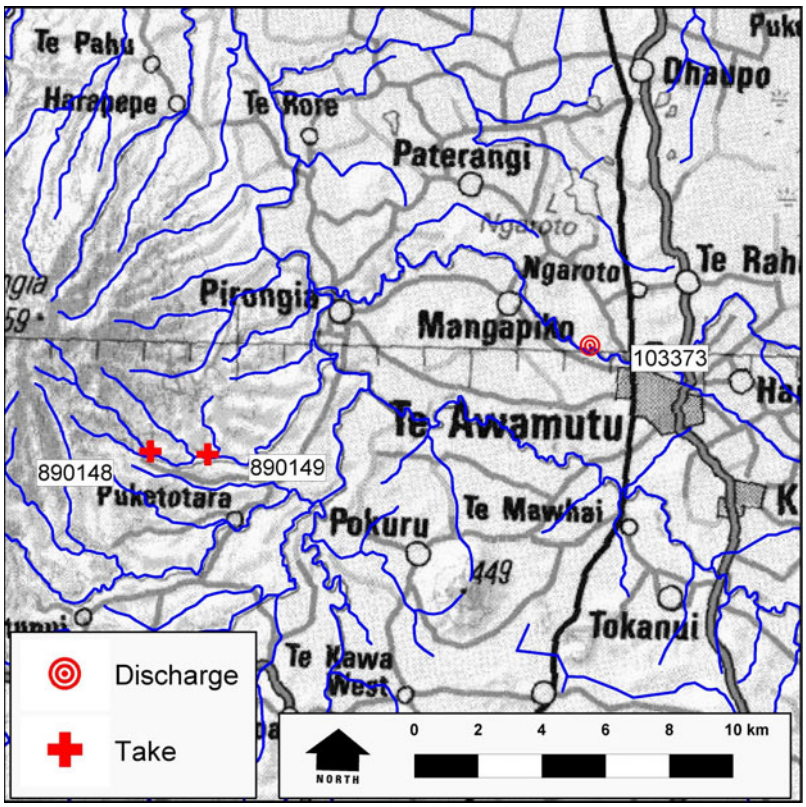

Figure 2: Te Awamutu municipal water take and discharge locations

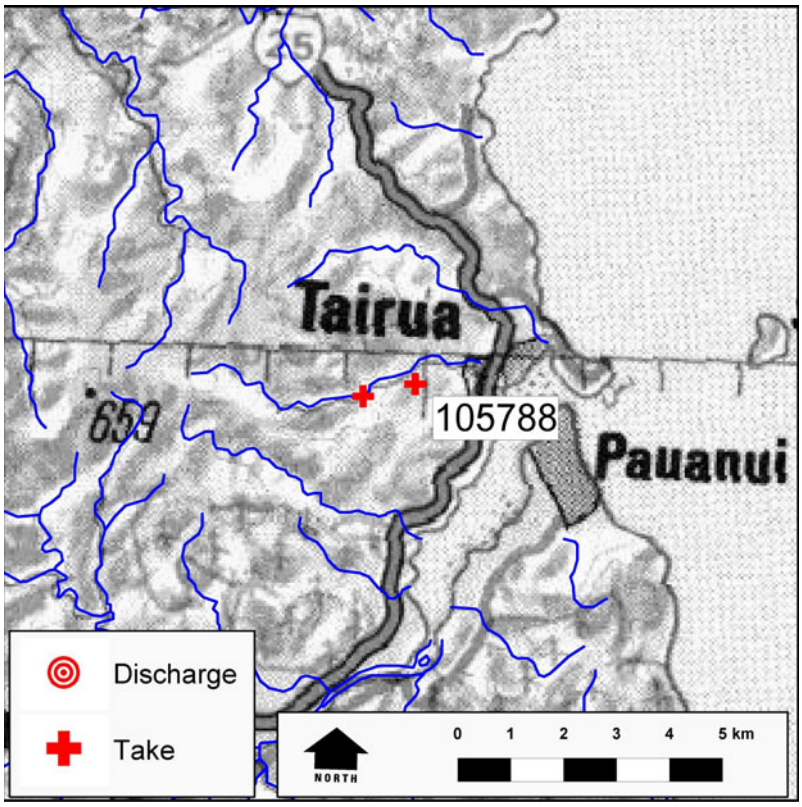

Figure 3: Tairua municipal water take and discharge locations

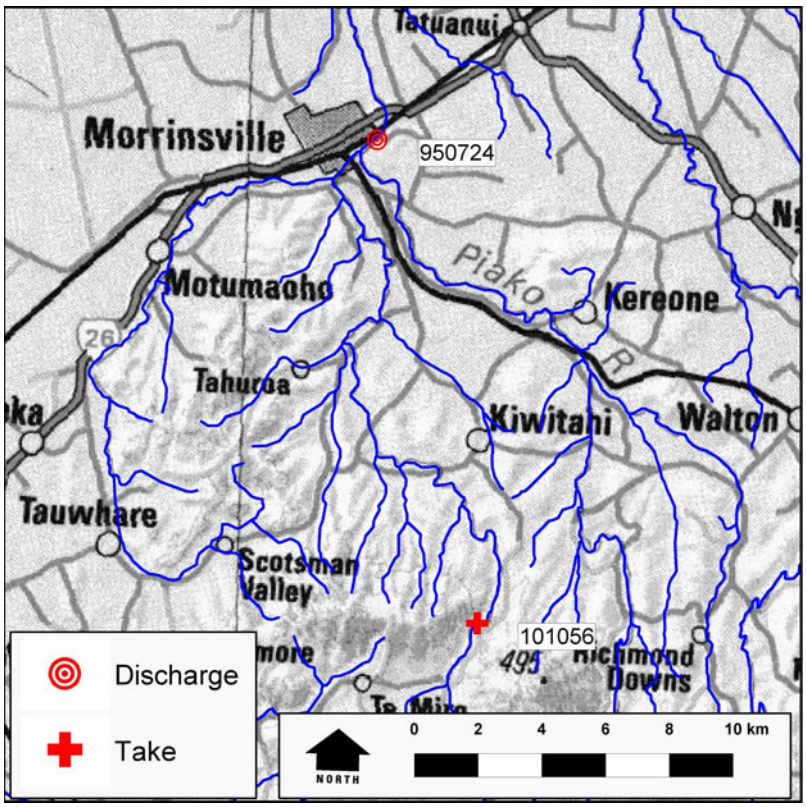

Figure 4: Morrinsville municipal water take and discharge locations

4 WATER USE

In this section, water use patterns, trends and comparison of actual use against the consented take rates are analysed for four towns. Moreover, seasonal water use trends for summer (Dec-Feb) and winter (Jun-Aug) months are evaluated. The approach has been based on the determination of trends and patterns over a period of several years.

4.1 Hamilton

The consented water take for Hamilton City is 95,000 m^3/d throughout the year (Appendix B). However, Table 2 illustrates that actual annual water utilisation is at best less than 54% of the consented volume Furthermore, Figure 5 and Figure 6 demonstrate a general seasonal pattern of high demand over the summer and low demand during the winter. The seasonal water take analysis given in Table 3 show that water use during winter months is in the order of 45% of the consented rate.

Table 2 also shows that Hamilton City's water use remained largely unchanged over the six years analysed, even though there was a 7.9% population growth from 1996 to 2004 (EW, 2004b; MOH, 2004).

Table 2: Hamilton annual water take

Year	Actual annual take (Mm^3)	Consented volume (Mm^3/yr)	Annual use as % of consented volume
1999	18.4	34.7	53.0%
2000	18.0	34.8	51.7%
2001*	9.2	17.2	53.2%
2002	18.0	34.7	52.0%
2003	18.0	34.7	51.9%
2004*	16.4	31.7	51.6%

* Take records are not complete. Consented volumes were calculated only for dates that take records are available.

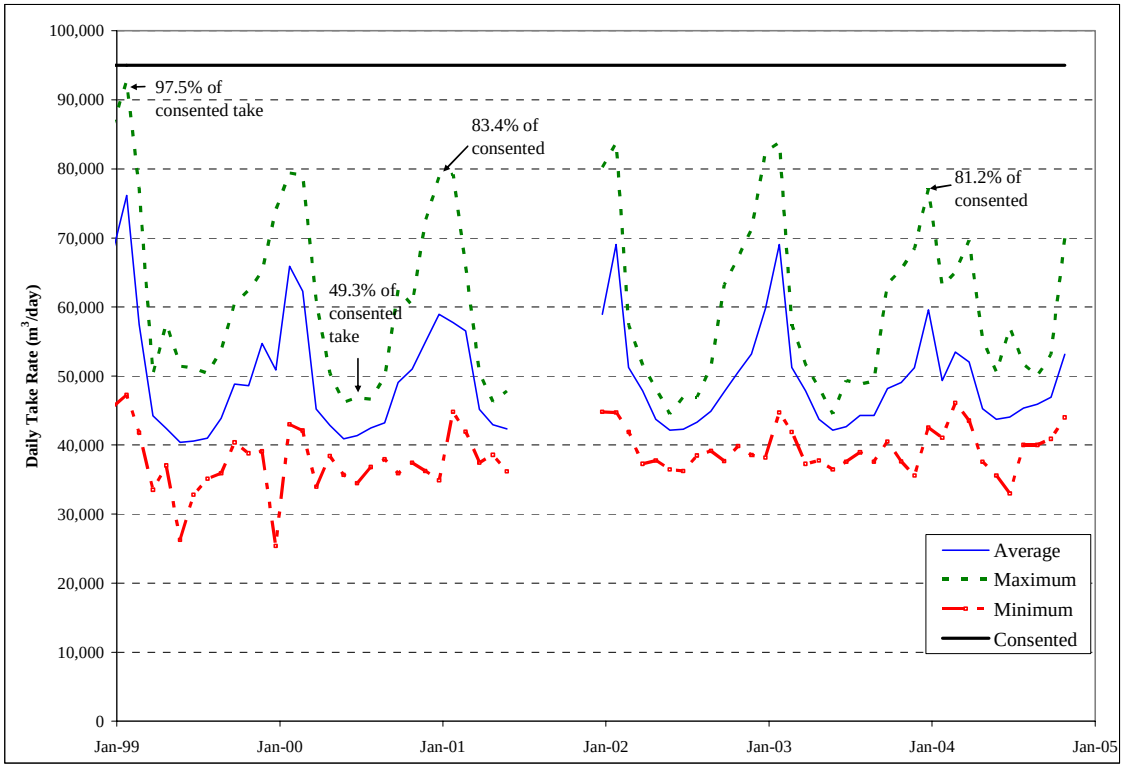

Figure 5: Hamilton monthly water take

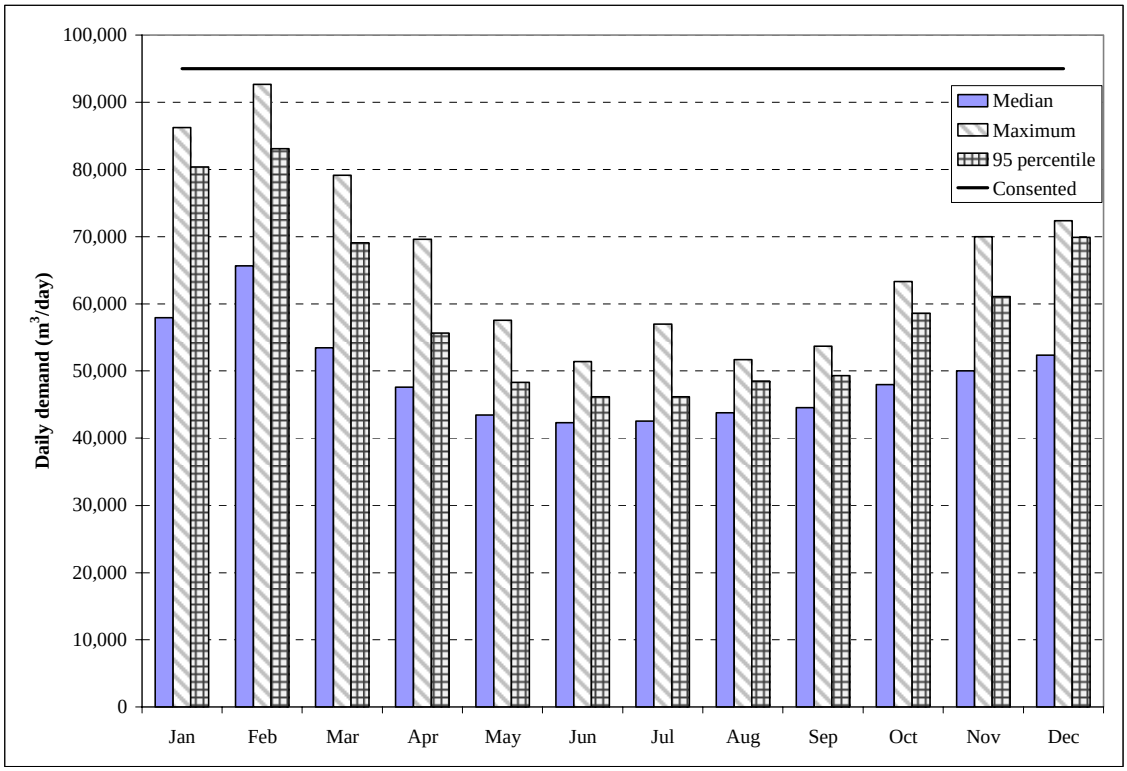

Figure 6: Hamilton seasonal water demand (Jan 1999-Nov 2004)

Table 3: Hamilton seasonal water use trends

Year	Summer			Winter		
	Take (Mm^3)	Consented (Mm^3/yr)	Use as % of consented volume	Take (Mm^3)	Consented (Mm^3/yr)	Use as % of consented volume
1998*	4.2	5.6	75.6			
1999	5.2	8.6	59.9	3.7	8.7	42.8
2000	5.1	8.6	60.2	3.8	8.7	43.8
2001*	3.8	5.6	67.1	1.3	2.9	44.6
2002	5.4	8.6	63.6	3.9	8.7	44.8
2003	4.9	8.6	56.3	4.0	8.7	45.3
2004				4.0	8.7	46.7

* Take records are not available for the entire period, therefore, total consented volume for the year is based on dates that records are available.

4.2 Te Awamutu

Te Awamutu takes water at two locations (Figure 2) from the Mangauika Stream at a combined consented rate of 22,700 m^3/d (details are provided in Appendix B). Table 4 illustrates that the actual annual water take is less than 60% of the consented volume. Further, winter utilisation is between 38% and 44% (Table 5). Monthly and seasonal water use trends are shown in Figure 7 and Figure 8, respectively. Although seasonal water use patterns are not as pronounced as Hamilton, this data demonstrates a reasonable pattern of higher demand over the summer and lower demand during the winter.

There are a few uncharacteristic peaks and dips in the plot of the Te Awamutu daily use record (Figure 7). Large differences between the maximum and 95 percentile values presented in Figure 8 demonstrate that there are a small number of days with high use. However, as daily water take meter readings have been recorded at different times of the day, data has been corrected to represent 24-hour volumes. Therefore, the accuracy of some of the values is uncertain.

Table 4: Te Awamutu annual water take

Year	Annual take (Mm^3)	Consented volume (Mm^3/yr)	Annual use as % of consented volume
1999#	0.420	0.704	59.7%
2000*	4.178	7.990	52.3%
2001	4.331	8.286	52.3%
2002*	3.936	7.536	52.2%
2003	4.175	8.263	50.5%
2004*	3.286	6.924	47.5%

1999 records available only from 29 November.

* Take records are not complete. Consented volumes were calculated only for dates that take records are available.

Table 5: Te Awamutu seasonal water use trends

Year	Summer			Winter		
	Take (Mm^3)	Consented (Mm^3/yr)	Use as % of consented volume	Take (Mm^3)	Consented (Mm^3/yr)	Use as % of consented volume
1999	0.975	1.612*	60.5			
2000	1.262	2.043	61.8	0.824	2.043	40.3
2001	1.273	2.043	62.3	0.833	2.088	39.9
2002	1.156	1.975*	58.5	0.911	2.088	43.6
2003	1.105	2.066	53.5	0.870	2.088	41.7
2004	0.976	1.612*	60.5	0.795	2.088	38.1

* Take records are not available for the entire period; therefore, total consented volume for the year is based on dates that records are available.

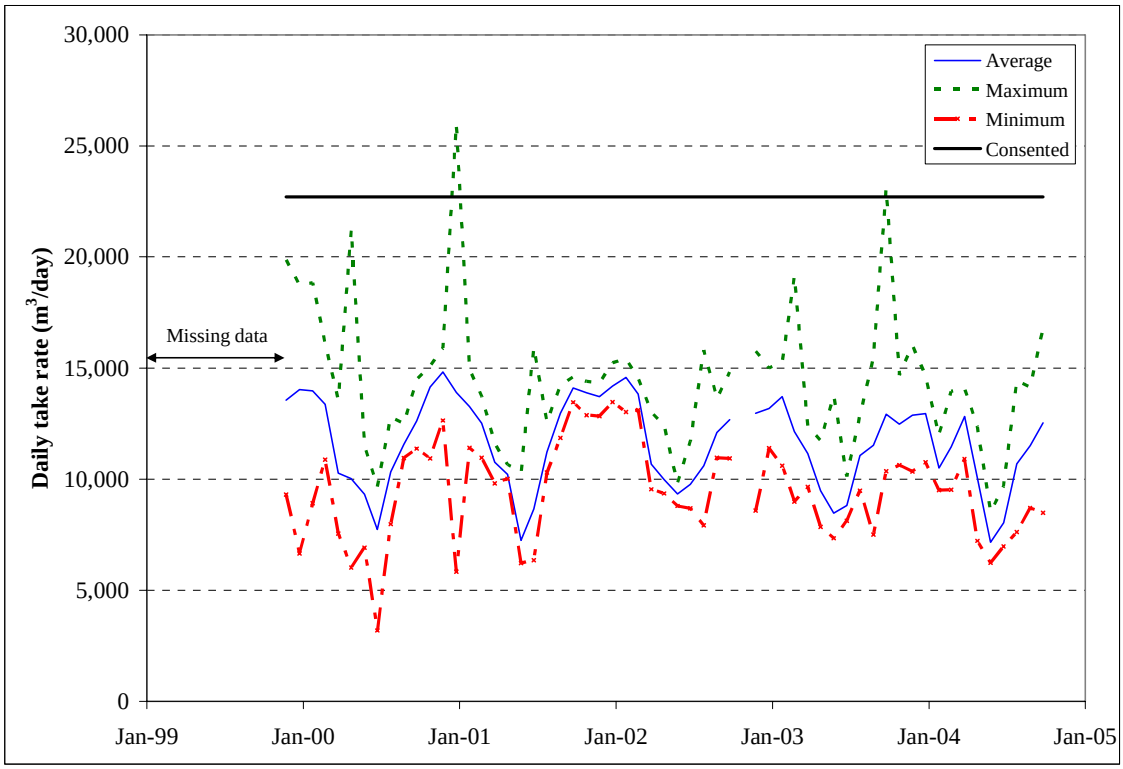

Figure 7: Te Awamutu monthly water take

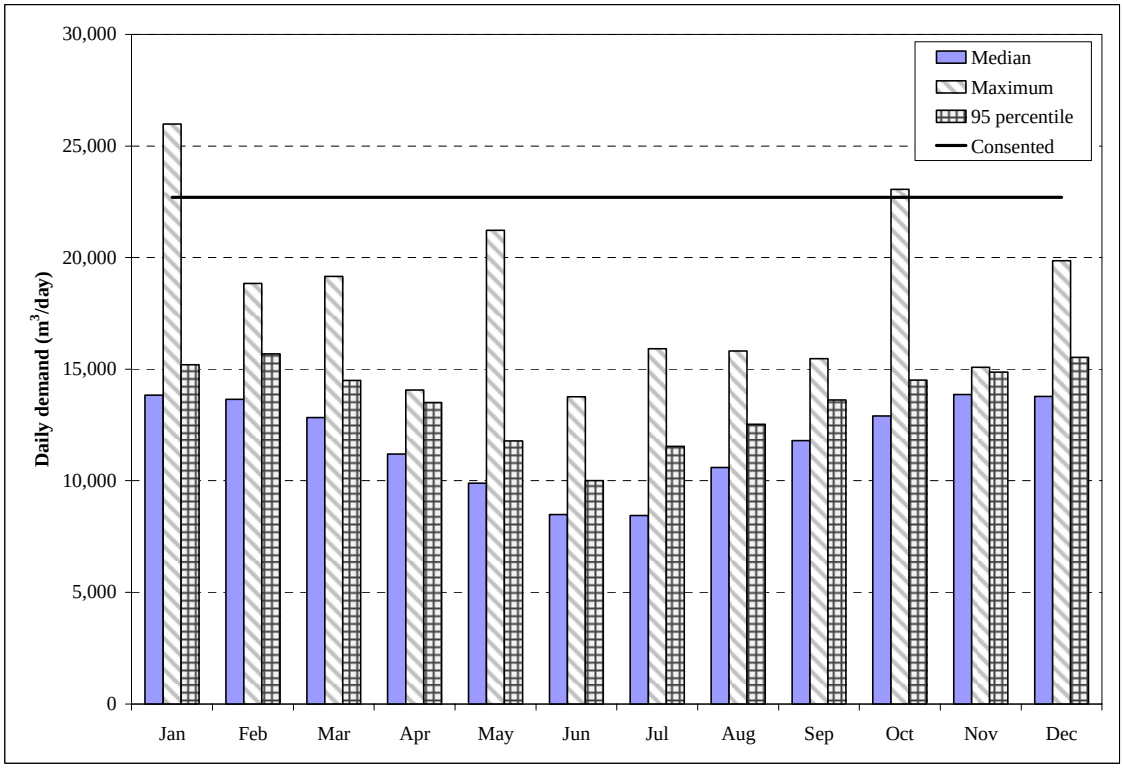

Figure 8: Te Awamutu seasonal water demand (Jan 1999-Oct 2004)

4.3 Tairua

The Thames-Coromandel District Council takes water for Tairua town from two surface water sources at a combined consented total of 2,200 m^3/d (Appendix B) As Table 6 shows, annual water use at best is less than 36% of the consented volume and reduces to 20% during winter months (Table 7). However, monthly and seasonal water use patterns in Figure 9 and Figure 10 illustrate that there are periods where water take virtually reaches consented rate during summer months. This may represent the seasonal high demand in the tourism season. However, a large difference between the maximum and 95 percentile illustrates a variation of demand within most months. These variations may have occurred as a result of unusual tourist influxes in popular holiday weekends and/or due to lack of storage facilities.

Table 6: Tairua annual water take

Year	Annual take (m^3)	Consented volume (m^3/yr)	Annual use as % of consented volume
1996*	125,392	404,800	31.0%
1997	268,832	803,000	33.5%
1998	245,995	803,000	30.6%
1999	241,136	803,000	30.0%
2000	250,514	805,200	31.1%
2001	249,399	803,000	31.1%
2002*	186,110	594,000	31.3%
2003	274,565	803,000	34.2%
2004*	118,857	334,400	35.5%

* Take records are not complete. Consented volumes were calculated only for dates that take records are available.

Table 7: Tairua seasonal water use trends

	Summer			Winter		
Year	Take (m^3)	Consented (m^3/yr)	Use as % of consented volume	Take (m^3)	Consented (m^3/yr)	Use as % of consented volume
1996	88,843	198,000	44.9	27,786	136,400*	20.4
1997	89,176	198,000	45.0	56,103	202,400	27.7
1998	78,219	182,600*	42.8	46,634	187,000*	24.9
1999	78,654	195,800*	40.2	47,370	202,400	23.4
2000	88,024	198,000	44.5	47,631	202,400	23.5
2001	71,882	198,000	36.3	51,443	202,400	25.4
2002	64,838	127,600*	50.8	54,105	198,000*	27.3
2003	87,678	200,200	43.8	58,033	202,400	28.7

* Take records are not available for the entire period, therefore, total consented volume for the year is based on dates that records are available.

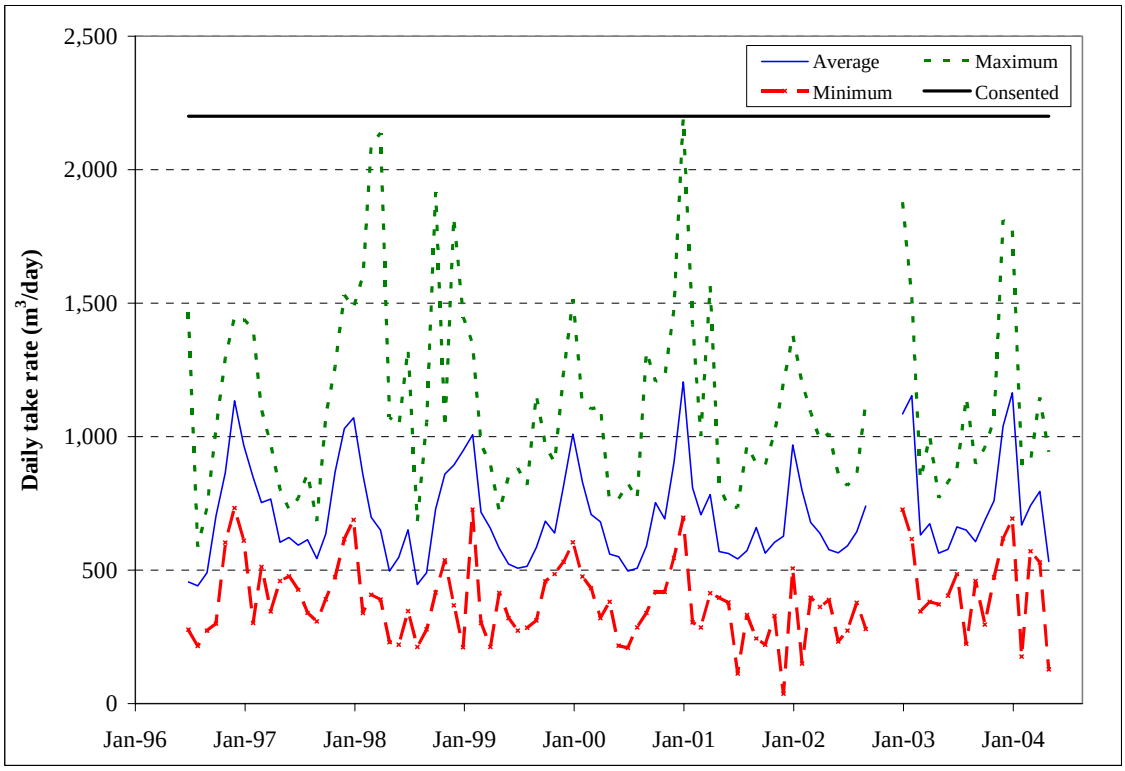

Figure 9: Tairua monthly water take

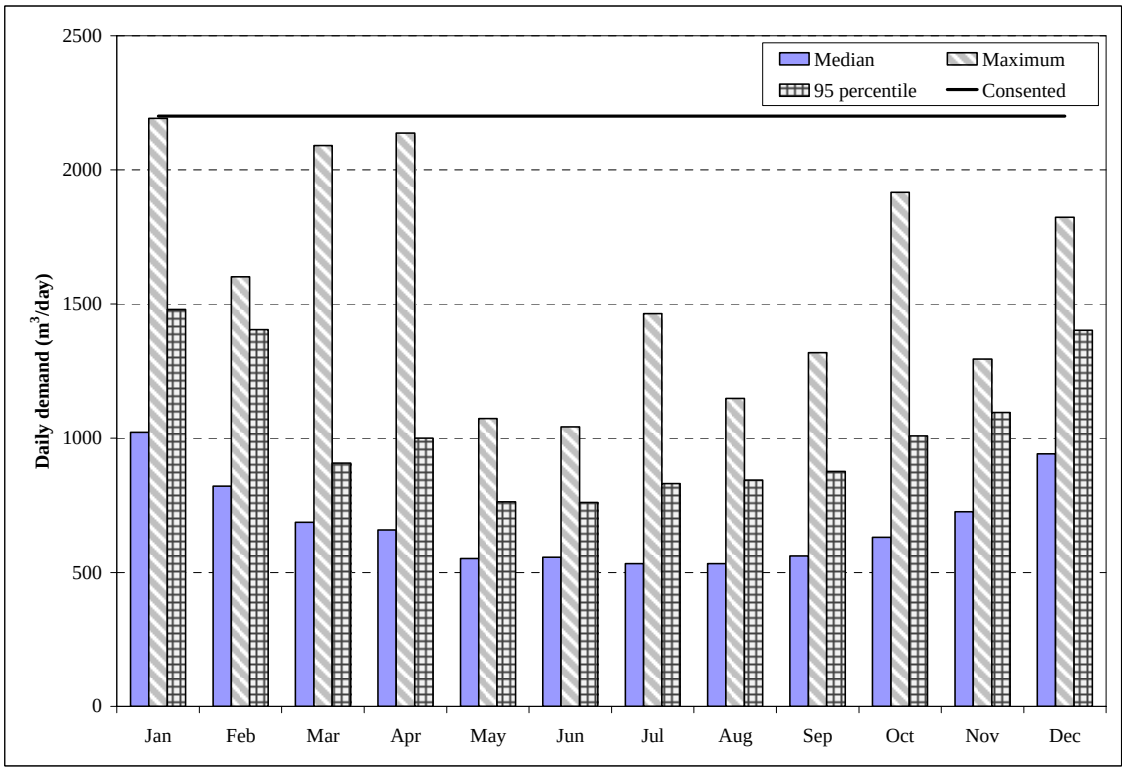

Figure 10: Tairua seasonal water demand (Jul 1996-May 2004)

4.4 Morrinsville

The Matamata-Piako District Council takes water for Morrinsville from a dam located at the head of the Topehaehae Stream catchment. The consented maximum take rate is 12,000 m^3/d (Appendix B). Water take data is available only for a 12 month period from April 2004 to March 2005. Although the one-year period of data is not sufficient to establish the water use pattern for the town, it is expected that the following analysis would present an approximate indication of water utilisation patterns and trends in Morrinsville

Table 8 illustrates that annual water use is less than 34% of the consented volume and the summer and winter use approximately 40% and 27%, respectively. Figure 11 and Figure 12 show that water use variation between months is relatively small compared to the other case towns. Moreover, data shows that difference between median, maximum and 95 percentile is minor, indicating similar water use patterns throughout each month.

Table 8: Morrinsville water take

Period	Actual take (m^3)	Consented volume (m^3)	Use as % of consented volume
Apr 04–Mar 05	1,484,344	4,392,000	33.8%
Summer	425,246	1,080,000	39.4%
Winter	303,064	1,116,000	27.2%

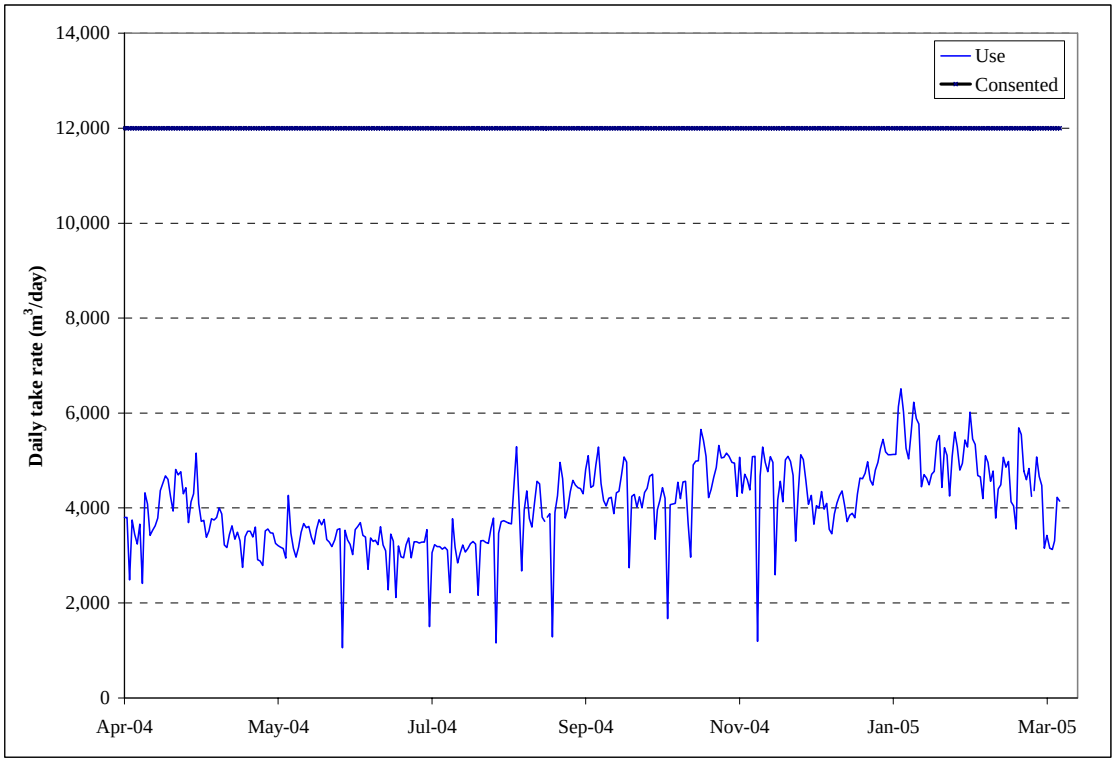

Figure 11: Morrinsville daily water take for the short period where data is available.

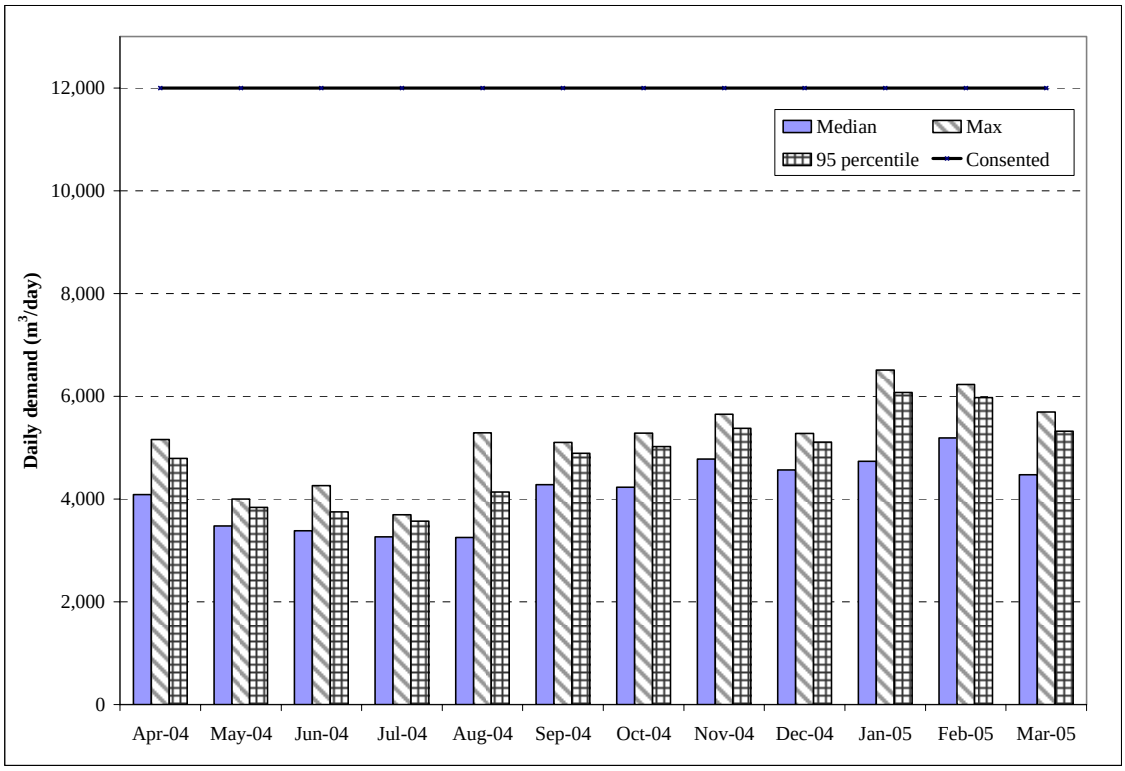

Figure 12: Morrinsville seasonal water demand (Apr 2004 – Mar 2005)

5 DISCHARGES

Three of the four municipals considered in this study discharge their treated wastewater back to surface water bodies. As mentioned above, the previous water allocation processes and procedures study (EW, 2005) found that treated discharge volumes are under-accounted in the process of determining allocable surface water volumes. Therefore, the contribution of discharges of treated municipal wastewater to surface water has been analysed.

5.1 Hamilton

Hamilton's wastewater is treated and discharged back to the Waikato River a few kilometres downstream of the intake (Figure 1). Monthly water take and discharge volumes for the period 1999 to 2004 are plotted in Figure 13 and listed in Appendix C. Data shows that the annual discharge volume to the Waikato River equates to 82.41% of the take, thus the net use[1] is only 17.59%. During summer the net use is 35.88% and during winter -5.25%. It should be noted that discharge water amounts do not include only wastewater produced by users of supply water, but also from ingress and groundwater infiltration in the catchment. Net water use (take less discharge) during some low demand seasons (winter) is negative, which significantly increases the allocable resource.

[1] Negative net use implies more water was discharged than abstracted, positive net use implies the abstraction volume exceeded the discharge volume. Zero net use implies that the abstraction and discharge volumes were equal.

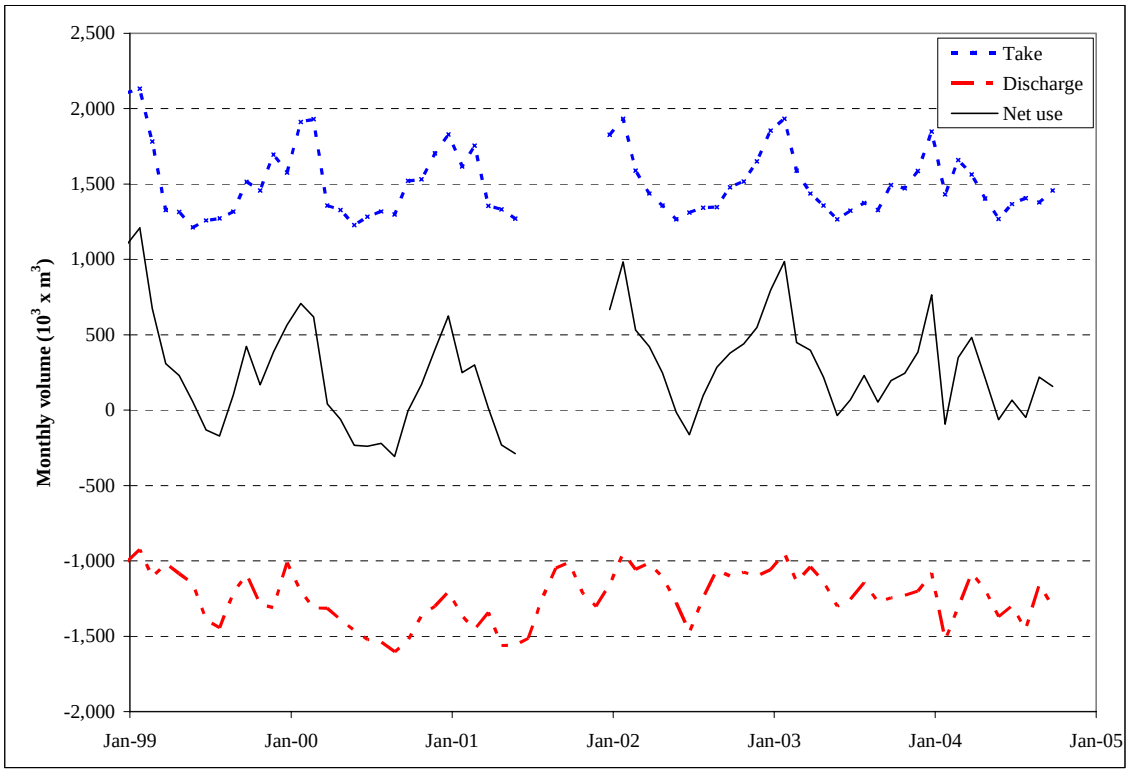

Figure 13: Hamilton water take, discharges and net use

5.2 Te Awamutu

Treated wastewater from Te Awamutu discharges to the Mangapiko Stream via a land based treatment plant. As Figure 2 shows, the Mangapiko Stream and the Mangauika Stream, which is the water supply source, are in the same catchment (Waipa River). Annual take and discharge data shows that the discharge volume equates to 39.1% of the take, thus the net use is only 60.9%. During summer the net use is 71.84% and during winter 48.43% (Appendix D). This proportion of net use is significantly higher than that of Hamilton City. However, a considerable proportion of water seeps into groundwater as a result of the land-based treatment, and the data presented does not represent these losses. This seeped water may indirectly contribute to the allocable resource.

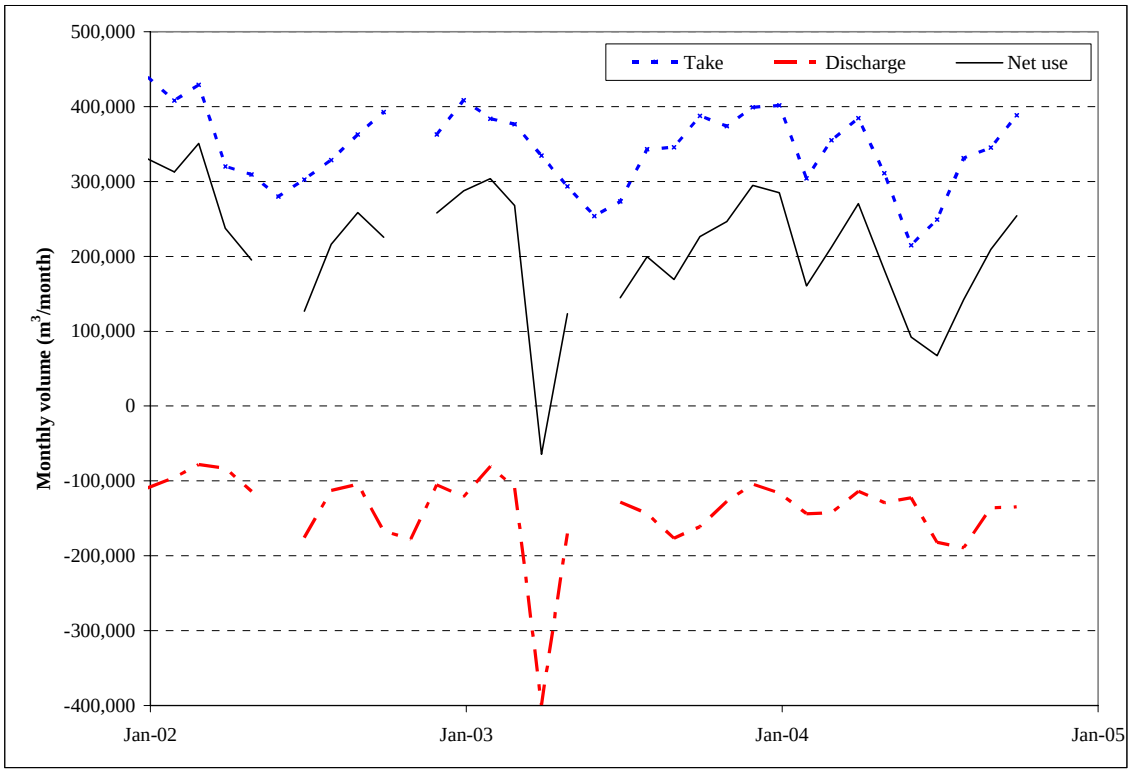

Figure 14: Te Awamutu water take, discharges and net use

5.3 Tairua

Tairua exports its wastewater out of the catchment for treatment at Pauanui. This, therefore, does not contribute to the allocable resource.

5.4 Morrinsville

Matamata-Piako DC discharges treated domestic effluent and treated wastewater into the Piako River. Limited take and discharge data (April 2004–March 2005) shows that the discharge volume equates to a relative low percentage (13.8%) of the take, the net use is 84.98%. During summer the net use is 84.47% and during winter 88.29% (Appendix E). This high net use may be due to the poor accuracy of the water meter at the wastewater treatment plant and short record which are under representing the discharge volume.

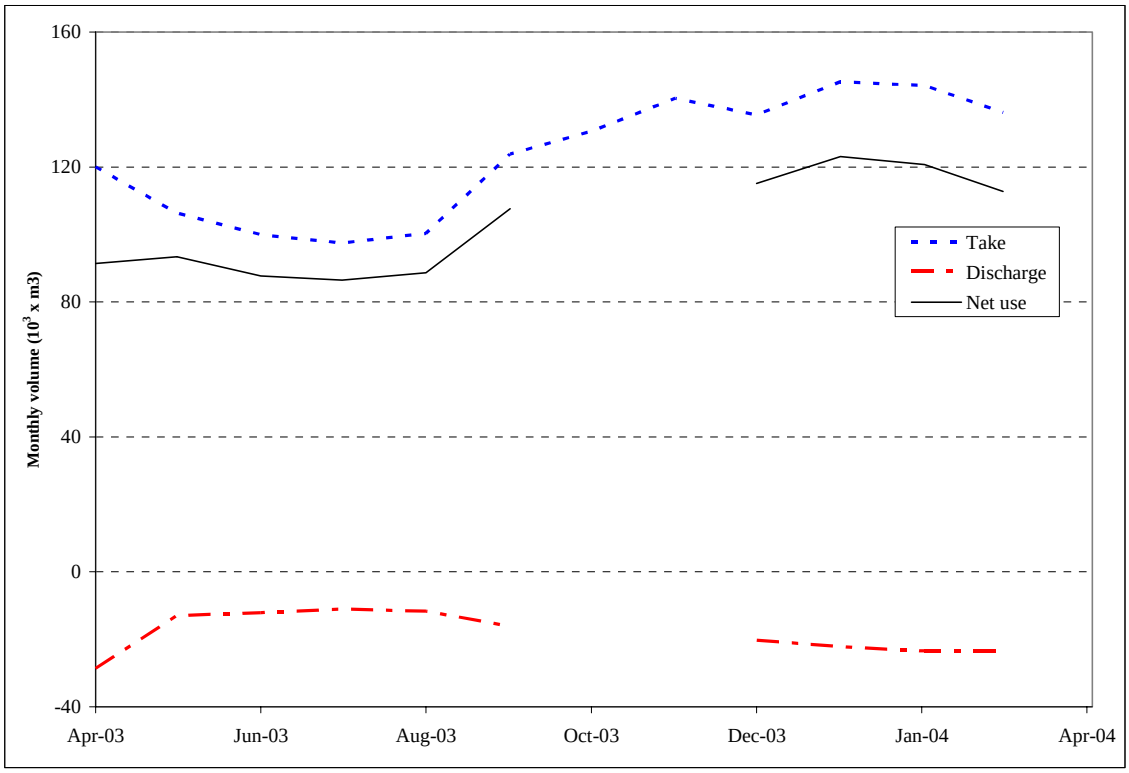

Figure 15: Morrinsville water take, discharges and net use

6 CONCLUSIONS

The principal conclusions from the study are summarised as follows:

a. Water take records of all four towns illustrate that annual consented volumes are significantly higher than the actual use. This locks-up the allocable resource such that it is not available to other potential water users.

b. There are seasonal trends and patterns associated with water takes, which peak in the summer months and gradually decrease over the winter months. The maximum annual and seasonal water use for four towns for the study period is as follows:

Town	% maximum use of consented volume		
	Annual	Summer	Winter
Hamilton	53.0	75.6	46.7
Te Awamutu	59.7	62.3	43.6
Tairua	35.5	50.8	28.7
Morrisville	33.8	39.4	27.2

This data shows that it is possible to assign two different take rates, one for the summer months and one for the winter. This would then release some of the locked-up resource for further allocation. However, a careful consideration of daily peak takes for each town may be needed; a high use in the summer may be an indication of the level of non-essential use such as gardening compared to winter months.

c. Municipal water takes and discharge volumes in all four case towns (Hamilton, Te Awamutu, Tairua and Morrinsville) have not increased over the period considered for the study. Although Hamilton City experienced a reasonable population growth from 1996 to 2004 (7.9% growth) (EW, 2004b; MOH, 2004), water use remains largely unchanged over this time.

d. Discharges make a significant contribution to the allocable resource and such volumes can be considered in the process of water resource planning and management. Further, discharge volumes can be taken into account in times of restrictions.

7 REFERENCES

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Appendix A: Project objectives and scope

The objectives and scope as presented in the proposal for the service are listed below.

Objectives
The objective of the project is to investigate allocation issues (takes and discharges) associated with municipal water supplies in the Waikato Region.

The study's specific objectives include:

- To compare actual water use with consented take rates for determination of levels of allocation utilisation;
- Determine the contribution of water discharges (treated wastewater) to water availability;
- Determine the potential impact of allocation restrictions during period of low flow on supply availability.

These objectives will be achieved through the determination of water use patterns and trends for four 'case' towns; Hamilton city, Te Awamutu, Tairua and Morrinsville as representative of the range of water supply and discharge issues for municipal supplies in the Region.

Approach
The approach is based on analysis of water use, discharges and restrictions for the four 'case' towns. It will draw on water use, discharge and flow records from Environment Waikato databases. The approach is a rapid assessment of water utilisation of municipal supplies and contribution of discharges to resource availability.

The following subsections outline the key elements to the study approach:

Water use trends -- The key element of the project is the determination of water use patterns and trends (peak daily, average daily and annual) and comparison of these values with consented take rates. The approach is based on the determination of trends and patterns over a number of years.

Water discharges -- Discharges of treated wastewater can potentially increase resource availability. The study will determine the contribution of discharges to allocable resources and the impact on net water demand.

Water take restrictions -- The potential impact of restrictions on water takes from surface water supplies during periods of low flow will be determined from relevant flow records. The purpose of the approach is to determine the frequency, severity and duration of restrictions on takes. It will show the likely impact of restrictions on municipal supplies, and will highlight issues associated with security of water supply (alternative supply options and storage requirements), and potential impact on water users.

Key issues
The analysis will provide the basis for determining and quantifying the following key allocation issues:

- Levels of under-utilisation of consented takes (daily and annual water use);
- Seasonal variations in water demand;
- Level of discharge contributions to surface water availability;
- The frequency and levels of water conservation required during low flow periods.

Appendix B: Details of take and discharge consents

Consent details of water takes and discharges for the four case towns are as follows:

Water take

	Consent No	Source	Consented rate (m^3/d)	Start date	Expiry date
Hamilton	690009	Waikato River	95,000	11-05-1988	01-10-2026
Te Awamutu	890148	Mangauika Stream	19,000	03-05-1991	30-04-2011
	890149	Mangauika Stream	3,700	03-05-1991	30-04-2011
Tairua	105788	Pepe Stream	1,200	31-10-2001	#
		Unnamed tributary	1,000	31-10-2001	#
Morrinsville	101056	Topehaehae Stream	12,000	22-08-2000	30-06-2010

being processed, expiry date and consent conditions have not yet been set.

Discharge

	Consent No	Discharge to	Consented rate (m^3/d)	Start date	Expiry date
Hamilton	960414	Waikato River	150,000	16-09-1998	30-11-2006
Te Awamutu	103373	Mangapiko Stream via a rock filter	12,000 + rainfall	01-10-2000	30-09-2003
			10,000 + rainfall	01-10-2003	31-10-2015
Tairua	Export out of the catchment to Pauanui for treatment				
Morrinsville	950724	Piako River	N/A	18-12-1998	18-12-2008

Appendix C: Hamilton net water use

Month	Take (m^3)	Discharge (m^3)	Net use (m^3)	Month	Take (m^3)	Discharge (m^3)	Net use (m^3)
Jan-99	2,104,150	1,012,129	1,092,021	Jan-02	1,826,670	1,159,558	667,112
Feb-99	2,131,750	923,888	1,207,862	Feb-02	1,933,110	949,859	983,251
Mar-99	1,781,690	1,108,856	672,834	Mar-02	1,588,190	1,056,894	531,296
Apr-99	1,327,000	1,018,767	308,233	Apr-02	1,435,920	1,015,970	419,950
May-99	1,314,450	1,084,358	230,092	May-02	1,355,500	1,108,678	246,822
Jun-99	1,211,750	1,153,619	58,131	Jun-02	1,264,470	1,278,590	-14,120
Jul-99	1,257,990	1,388,117	-130,127	Jul-02	1,310,380	1,474,260	-163,880
Aug-99	1,271,530	1,443,749	-172,219	Aug-02	1,342,630	1,245,879	96,751
Sep-99	1,315,880	1,215,639	100,241	Sep-02	1,347,000	1,062,076	284,924
Oct-99	1,514,460	1,090,803	423,657	Oct-02	1,478,580	1,099,870	378,710
Nov-99	1,458,220	1,289,810	168,410	Nov-02	1,516,700	1,076,359	440,341
Dec-99	1,696,050	1,308,895	387,155	Dec-02	1,648,900	1,100,690	548,210
1999 Total	**18,384,920**	**14,038,630**	**4,346,290**	**2002 Total**	**18,048,050**	**13,628,683**	**4,419,367**
Jan-00	1,576,870	1,012,129	564,741	Jan-03	1,854,140	1,058,527	795,613
Feb-00	1,910,670	1,203,285	707,385	Feb-03	1,933,110	948,758	984,352
Mar-00	1,929,830	1,311,741	618,089	Mar-03	1,588,190	1,140,158	448,032
Apr-00	1,356,280	1,314,916	41,364	Apr-03	1,435,920	1,039,897	396,023
May-00	1,328,420	1,389,686	-61,266	May-03	1,355,500	1,137,582	217,918
Jun-00	1,226,930	1,460,063	-233,133	Jun-03	1,264,470	1,301,236	-36,766
Jul-00	1,282,460	1,521,739	-239,279	Jul-03	1,322,431	1,254,436	67,995
Aug-00	1,317,490	1,537,810	-220,320	Aug-03	1,373,940	1,143,853	230,087
Sep-00	1,296,300	1,604,169	-307,869	Sep-03	1,328,280	1,275,165	53,115
Oct-00	1,521,050	1,525,359	-4,309	Oct-03	1,493,300	1,245,024	196,306
Nov-00	1,530,490	1,361,524	168,966	Nov-03	1,472,560	1,228,922	243,638
Dec-00	1,702,540	1,300,526	402,014	Dec-03	1,586,210	1,200,903	385,307
2000 Total	**17,979,330**	**16,542,947**	**1,436,383**	**2003 Total**	**18,008,051**	**13,974,461**	**3,981,620**
Jan-01	1,826,930	1,203,654	623,276	Jan-04	1,847,590	1,082,254	765,336
Feb-01	1,616,040	1,367,162	248,878	Feb-04	1,430,600	1,522,597	-91,997
Mar-01	1,753,340	1,453,448	299,892	Mar-04	1,657,960	1,308,544	349,416
Apr-01	1,354,890	1,341,932	12,958	Apr-04	1,563,090	1,079,985	483,105
May-01	1,330,690	1,561,909	-231,219	May-04	1,403,020	1,190,044	212,976
Jun-01	1,270,060	1,557,905	-287,845	Jun-04	1,268,580	1,370,093	-63,483
Jul-01				Jul-04	1,365,790	1,299,775	66,015
Aug-01				Aug-04	1,406,290	1,454,586	-48,296
Sep-01				Sep-04	1,376,990	1,158,139	218,851
Oct-01				Oct-04	1,455,750	1,298,666	157,084
Nov-01				Nov-04			
Dec-01				Dec-04			
2001 Total	**9,151,950**	**8,486,010**	**665,940**	**2004 Total**	**14,775,660**	**12,764,683**	**2,049,007**
				Grand Total (m^3)	**96,347,961**	**79,397,384**	**16,898,607**
				% net volume used			**17.59%**
				% discharge back to source			**82.41%**

Year	Summer			Winter		
	Take (m^3)	Discharge (m^3)	Net use (m^3)	Take (m^3)	Discharge (m^3)	Net use (m^3)
1998	4,235,900	1,936,017	2,299,883			
1999	5,183,590	3,524,309	1,659,281	3,741,270	3,985,485	-244,215
2000	5,145,510	3,871,342	1,274,168	3,826,880	4,519,612	-692,732
2001	3,759,780	2,109,417	1,650,363	1,270,060	1,557,905	-287,845
2002	5,436,150	3,107,975	2,328,175	3,917,480	3,998,729	-81,249
2003	4,864,400	3,805,754	1,058,646	3,960,841	3,699,525	261,316
2004				4,040,660	4,124,454	-45,764
Grand Total (m^3)	**28,625,330**	**18,354,814**	**10,270,516**	**20,757,191**	**21,885,710**	**-1,090,489**
% net volume used			**35.88%**			**-5.25%**
% discharge back to source			**64.12%**			**105.25%**

Appendix D: Te Awamutu net water use

Month	Take (m^3)	Discharge (m^3)	Net use (m^3)	Month	Take (m^3)	Discharge (m^3)	Net use (m^3)
Jan-02	439,700	109,143	330,557	Jan-04	401,618	116,444	285,175
Feb-02	408,106	95,354	312,753	Feb-04	304,482	143,652	160,831
Mar-02	428,917	77,988	350,929	Mar-04	355,090	142,546	212,545
Apr-02	320,142	82,830	237,313	Apr-04	384,471	113,723	270,749
May-02	309,349	113,869	195,480	May-04	311,094	128,945	182,150
Jun-02	279,878			Jun-04	214,867	122,310	92,557
Jul-02	302,621	175,778	126,844	Jul-04	249,211	181,896	67,315
Aug-02	328,674	112,623	216,052	Aug-04	331,385	188,992	142,393
Sep-02	362,984	104,250	258,734	Sep-04	345,183	135,720	209,463
Oct-02	392,906	167,199	225,708	Oct-04	388,572	134,385	254,188
Nov-02		177,661		Nov-04			
Dec-02	363,081	105,230	257,852	Dec-04			
2002 Total	**3,936,364**	**1,321,924**	**2,614,440**	**2004 Total**	**3,285,978**	**1,408,610**	**1,877,367**
Jan-03	408,796	121,001	287,796	**Grand total (m^3)**	**11,396,878**	**4,451,363**	**6,945,515**
Feb-03	383,905	80,360	303,546				
Mar-03	376,627	108,926	267,701	**% net volume used**			**60.9%**
Apr-03	334,556	398,940	-64,383				
May-03	293,669	170,054	123,616	**% discharge back to source**			**39.1%**
Jun-03	253,790						
Jul-03	273,321	128,470	144,851				
Aug-03	343,017	143,655	199,363				
Sep-03	345,821	176,663	169,159				
Oct-03	387,760	161,126	226,635				
Nov-03	373,992	127,350	246,642				
Dec-03	399,276	104,284	294,992				
2003 Total	**4,174,536**	**1,720,828**	**2,453,708**				

Year	Summer			Winter		
	Take (m^3)	Discharge (m^3)	Net use (m^3)	Take (m^3)	Discharge (m^3)	Net use (m^3)
2001	847,806	204,497	643,310			
2002	1,155,782	306,591	849,194	631,295	288,401	342,896
2003	1,105,376	364,380	740,998	616,338	272,125	344,214
2004				795,463	493,198	302,265
Grand Total (m^3)	**3,108,964**	**875,468**	**2,233,502**	**2,043,096**	**1,053,724**	**989,375**
% net volume used			**71.84%**			**48.43%**
% discharge back to source			**28.16%**			**51.57%**

Appendix E: Morrinsville water use

Month	Take (m^3)	Discharge (m^3)	Net use (m^3)
Apr-03	120,081	28,644	91,437
May-03	106,371	13,019	93,352
Jun-03	99,934	12,146	87,788
Jul-03	97,503	11,030	86,473
Aug-03	100,334	11,680	88,654
Sep-03	123,823	16,136	107,687
Oct-03	63,111	8,631	54,480
Nov-03	87,144	13,416	73,728
Dec-03	135,500	20,318	115,182
Jan-04	145,280	22,217	123,063
Feb-04	144,185	23,455	120,730
Mar-04	136,218	23,465	112,753
Total	**1,359,484**	**204,158**	**1,155,326**
% net volume used			**84.98%**
% discharge back to source			**15.02%**

	Take (m^3)	Discharge (m^3)	Net use (m^3)	% net volume used	% discharge back to source
Summer	424,965	65,990	358,975	84.47%	15.53%
Winter	297,771	34,856	262,915	88.29%	11.71%