water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

REPORT NO.: P WMA 02/B810/00/0608/2

GROOT LETABA RIVER WATER DEVELOPMENT PROJECT (GLeWaP)



TECHNICAL STUDY MODULE:

Review of Water Requirements

VOLUME 2

MAY 2010

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W46_2010/H505701

LIST OF STUDY REPORTS IN GROOT LETABA RIVER WATER DEVELOPMENT PROJECT (BRIDGING STUDIES)

This report forms part of the series of reports, done for the Bridging Study phase of the GLeWaP. All reports for the GLeWaP are listed below.

REPORT NUMBER	REPORT TITLE
P WMA 02/B810/00/0508	**Project Coordination and Management Team**
P WMA 02/B810/00/0508/1	Project Coordination and Management Team: Executive Summary Report: Vol 1
P WMA 02/B810/00/0508/2	Project Coordination and Management Team: Main Report: Vol 2
P WMA 02/B810/00/0508/3	Project Coordination and Management Team: Register of Decisions: Vol 3
P WMA 02/B810/00/0508/4	Project Coordination and Management Team
P WMA 02/B810/00/0508/5	Project Coordination and Management Team
P WMA 02/B810/00/0608	**Technical Study Module**
P WMA 02/B810/00/0608/1	Technical Study Module: Main Report: Vol 1
P WMA 02/B810/00/0608/2	Technical Study Module: Review of Water Requirements: Vol 2
P WMA 02/B810/00/0608/3	Technical Study Module: Groundwater: Vol 3
P WMA 02/B810/00/0608/4	Technical Study Module: Hydrology: Vol 4
P WMA 02/B810/00/0608/5	Technical Study Module: Water Resource Analysis: Vol 5
P WMA 02/B810/00/0608/6	Technical Study Module: Preliminary Design of Nwamitwa Dam: Vol 6
P WMA 02/B810/00/1110/1	Technical Study Module: Preliminary Design of Nwamitwa Dam: Vol 6 - Annexure 1: Appendices
P WMA 02/B810/00/1110/2	Technical Study Module: Preliminary Design of Nwamitwa Dam: Vol 6 - Annexure 2: Appendix B (Part 1): Geotechnical Investigations
P WMA 02/B810/00/1110/3	Technical Study Module: Preliminary Design of Nwamitwa Dam: Vol 6 - Annexure 3: Appendix B (Part 2): Geotechnical Investigations
P WMA 02/B810/00/1110/4	Technical Study Module: Preliminary Design of Nwamitwa Dam: Vol 6 - Annexure 4: Appendix H: Drawings
P WMA 02/B810/00/0608/7	Technical Study Module: Preliminary Design of the Raising of Tzaneen Dam: Vol 7
P WMA 02/B810/00/0608/8	Technical Study Module: Bulk Water Distribution Infrastructure: Vol 8
P WMA 02/B810/00/1110/5	Technical Study Module: Bulk Water Distribution Infrastructure: Vol 8 - Annexure 1 : Appendices
P WMA 02/B810/00/0708	**Environmental Management Module**
P WMA 02/B810/00/0708/1	Environmental Management Module: Scoping Report: Vol 1
P WMA 02/B810/00/0708/2	Environmental Management Module: Environmental Impact Assessment Report: Vol 2
P WMA 02/B810/00/0708/3	Environmental Management Module: Environmental Management Programme for Borrow Area 1 on the Farm Laborie 515: Vol 3
P WMA 02/B810/00/0708/4	Environmental Management Module: Environmental Management Programme for Borrow Area 2 on the Farm La Parisa 729 (Gubits Farm): Vol 4
P WMA 02/B810/00/0708/5	Environmental Management Module: Environmental Management Programme for Borrow Area 3 on the Farm Letaba Drift 727: Vol 5
P WMA 02/B810/00/0708/6	Environmental Management Module
P WMA 02/B810/00/0708/7	Environmental Management Module
P WMA 02/B810/00/0708/8	Environmental Management Module
P WMA 02/B810/00/0708/9	Environmental Management Module
P WMA 02/B810/00/0708/10	Environmental Management Module
P WMA 02/B810/00/0808	**Public Involvement Program**
P WMA 02/B810/00/0808/1	Public Involvement Program: Main Report: Vol 1
P WMA 02/B810/00/0808/2	Public Involvement Program
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P WMA 02/B810/00/0808/4	Public Involvement Program
P WMA 02/B810/00/0808/5	Public Involvement Program

REPORT DETAILS PAGE

Project name:	***Groot Letaba River Water Development Project***
Report title:	***Review of Water Requirements : Volume 2***
Authors:	***M A Killick and A Sparks***
DWA report reference no.:	***P 02/B810/00/0608/2***
PSP project reference no.:	***401775***
Status of report:	***Final***
First issue:	***September 2008***
Final issue:	***May 2010***

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EXECUTIVE SUMMARY

1. INTRODUCTION

1.1 BACKGROUND TO PROJECT

The catchment of the Groot Letaba River has many and varied land uses with their associated water requirements, for example commercial irrigation, commercial afforestation, tourism, as well as primary requirements by the population in the catchment. The water resources available in the catchment are limited, and considerable pressure has been put on these resources in the past. This situation has been investigated at various levels by the Department of Water Affairs (DWA).

The first major study undertaken for this area was the Letaba River Basin Study in 1985 (DWAF, 1990), which comprised the collection and analysis of all available data on water availability and use, as well as future water requirements and potential future water resource developments. This was followed by a Pre-feasibility Study (DWAF 1994), which was completed in 1994. The focus of the Pre-feasibility Study was the complete updating of the hydrology of the Basin. The next study undertaken was the Feasibility Study of the Development and Management Options (DWAF, 1998), which was completed in 1998.

The Feasibility Study proposed several options for augmenting water supply from the Groot Letaba River. These included some management interventions, as well as the construction of a dam at Nwamitwa and the possible raising of Tzaneen Dam. These options would enable additional water to be allocated to the primary water users, would allow the ecological Reserve to be implemented and could also improve the assurance of supply to the agricultural sector.

This Bridging Study was initiated by the (then) Department of Water Affairs and Forestry in 2006 (now Department of water Affairs (DWA)) in order to re-assess the recommendations contained in the Feasibility Study in the light of developments that have taken place in the intervening 10 years.

The study area, shown in ***Figure E1,*** *consists of the catchment of the Letaba River, upstream of its confluence with the Klein Letaba River. The catchment falls within the Mopane District Municipality, which is made up of six local municipalities. The four local municipalities, parts or all of which are within the catchment area, are Greater Tzaneen, Greater Letaba, Ba Phalaborwa, and Greater Giyani. The major town in the study area*

is Tzaneen, with Polokwane, the provincial capital city of Limpopo, located just outside of the catchment to the West. The site of the proposed Namitwa Dam is also shown on ***Figure E1****.*

1.2 SCOPE AND ORGANISATION OF PROJECT

The Department's Directorate: Options Analysis (OA), appointed Aurecon in Association with a number of sub-consultants to undertake this study. The official title of the study is: "The Groot Letaba River Water Development Project (Bridging Study)".

The Bridging Study comprises a number of modules. This Report focuses on part of the scope of work for the Technical Study Module (TSM). The tasks comprising the TSM are listed below:

TASK 1: WATER REQUIREMENTS
TASK 2: WATER RESOURCE EVALUATION
TASK 3: PRELIMINARY DESIGN OF NWAMITWA DAM
TASK 4: RAISING OF TZANEEN DAM
TASK 5: BULK WATER DISTRIBUTION INFRASTRUCTURE
TASK 6: IMPLEMENTING PROGRAMME
TASK 7: WATER QUALITY

1.3 SCOPE OF THIS REPORT

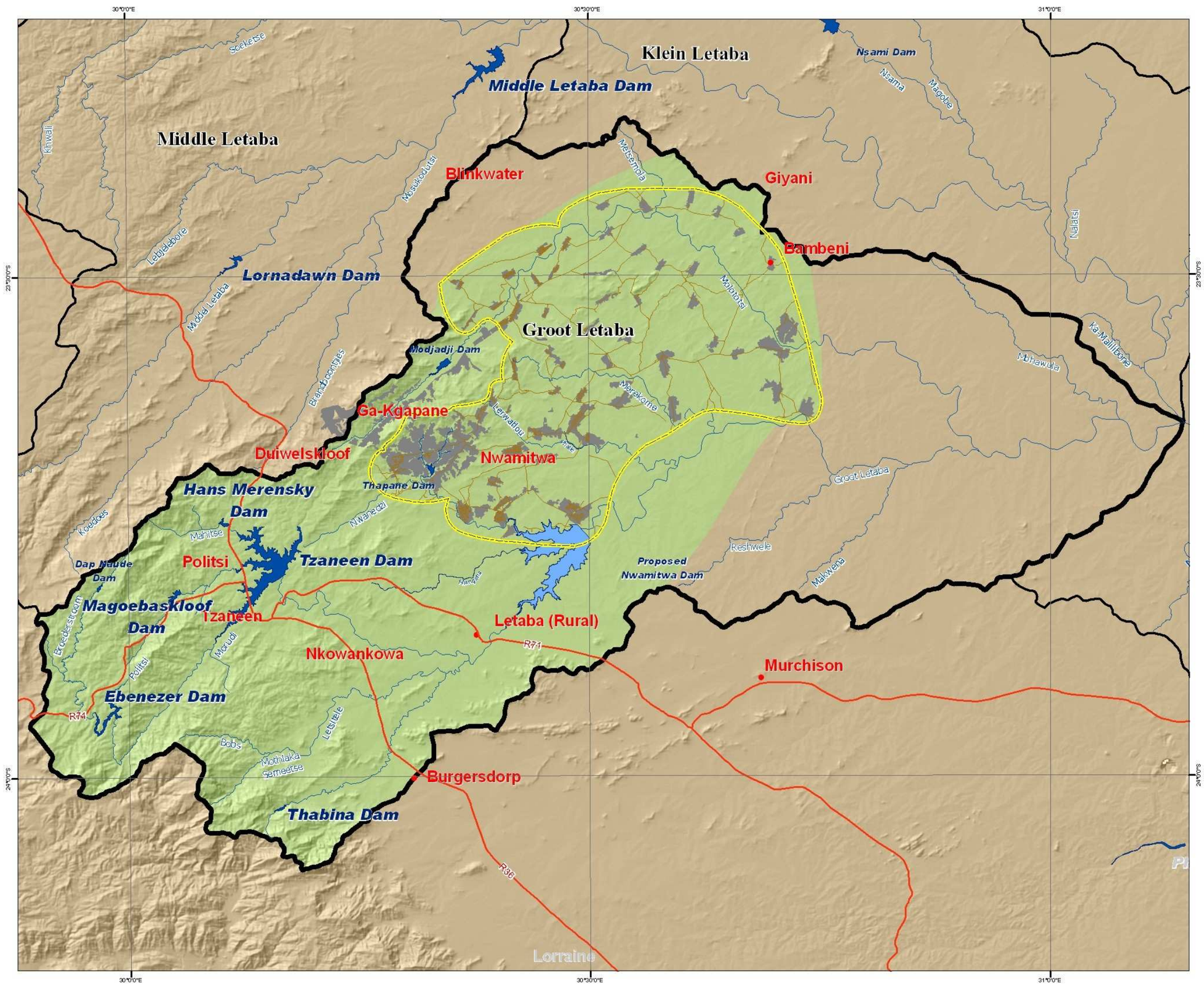
This report describes a portion of Task 1: Water Requirements.

The objectives of Task 1 : Water Requirements were as follows :

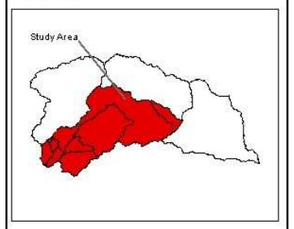
- *review the current estimates of future water requirements in all user sectors;*
- *establish present levels of water use in these sectors; and*
- *assess the availability of groundwater in the project area.*

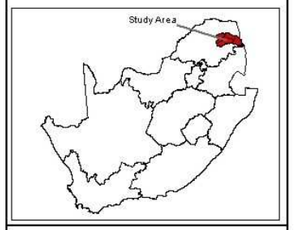
The first two objectives are reported on in this report (Review of Water Requirements) *and the last objective is reported on in a separate report* (Groundwater) (DWA, 2010a)*.*

Section 2 *of this report discusses the existing water supply schemes in the study area. The four different types of water requirements, namely primary water requirements, irrigation and losses, afforestation and ecological requirements are discussed in* ***Sections 3*** *to* ***6****. The conclusions are given in* ***Section 7*** *and the recommendations relating to water requirements in* ***Section 8****. The references are contained in* ***Section 9****.*



OVERVIEW MAPS :





LEGEND

- Towns
- National Roads
- Secondary Roads
- Rivers
- Dams
- Villages
- Study Area
- Proposed Supply Area from Nwamitwa Dam

PATH:

s\projects\mxd\Reports\WaterReq\figE1.mxd

SCALE

0 5 10 15 km

1:380,000

PROJECTION INFORMATION :

COORDINATE SYSTEM :	Transverse Mercator
PROJECTION NAME :	TM31
DATUM :	D_WGS_1984
SPHEROID :	WGS_1984
CENTRAL MERIDIAN :	31

CONSULTANT :

aurecon

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

TITLE :

GROOT LETABA RIVER WATER DEVELOPMENT PROJECT

PROJECT AREA

FIGURE NO. :

E1

2. EXISTING WATER SUPPLY SCHEMES

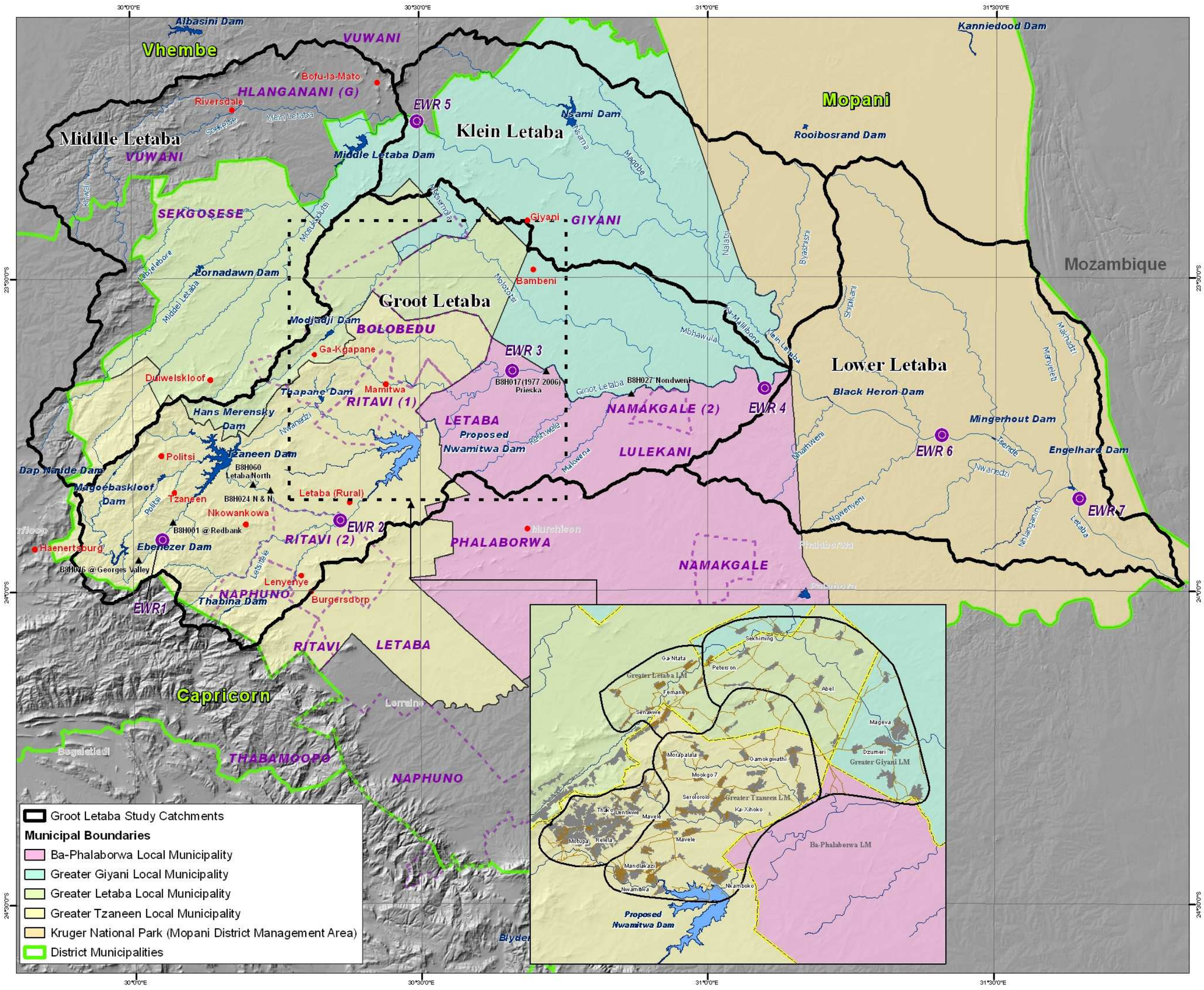
Water requirements throughout the catchment are met largely, through surface water supply schemes, with very little being supplied from groundwater sources. Surface water is supplied from the Groot Letaba River and its tributaries to the towns of Polokwane, Tzaneen, Haenertsburg, Duiwelskloof as well as to many rural villages. The main surface water supply schemes draw from the Dap Naude, Ebenezer and Tzaneen Dams, and these schemes are listed below. The locations of the towns and rural settlements supplied, as well the dams discussed below are shown in ***Figure E2****.*

- *Dap Naude Dam Water Supply Scheme*
- *Ebenezer Dam Water Scheme*
- *Magoebaskloof Dam and Vergelegen Dam Scheme*
- *Hans Merensky Dam Scheme*
- *Tzaneen Dam Scheme*
- *Thapane Dam Scheme*
- *Thabina Dam Scheme*
- *Letsitele River Run-of-River Scheme*
- *Modjadji Dam*

The following water resource scheme is located in the Middle Letaba catchment, and is also shown in ***Figure E2****.*

- *Middle Letaba Rural Water Supply Scheme (RWSS) supplied by Middle Letaba Dam*

The main conclusion that can be drawn from this section is that many of the existing surface water schemes in the Groot Letaba Catchment have existing allocations that exceed their yields. The overall yield of schemes in the Groot Letaba Catchment is 126 Mm³/a, and the total allocation for domestic, industrial and irrigation usage from these schemes is 177 Mm³/a.


30°0'0"E
30°30'0"E
31°0'0"E
31°30'0"E
23°30'0"S
24°0'0"S
24°30'0"S
Albasini Dam
Vhembe
VUWANI
Bofu-la-Mato
HLANGANANI (G)
Riversdale
EWR 5
Klein Letaba
Nsami Dam
Middle Letaba
VUWANI
Middle Letaba Dam
Klein Letaba
Mopani
Kanniedood Dam
Rooibosrand Dam
SEKGOSESE
Giyani
GIYANI
Lornadawn Dam
Bambeni
Mozambique
Groot Letaba
Modjadji Dam
BOLOBEDU
Ga-Kgapane
EWR 3
B8H017(1977 2006)
Prieska
B8H027 Nondweni
EWR 4
Lower Letaba
Black Heron Dam
Duiwelskloof
Mamitwa
Thapane Dam
RITAVI (1)
NAMAKGALE (2)
Hans Merensky Dam
LETABA
Proposed Nwamitwa Dam
LULEKANI
Mingerhout Dam
EWR 6
Engelhard Dam
Tzaneen Dam
Dap Naude Dam
Politsi
B8H060
Letaba North
Magoebaskloof Dam
Tzaneen
B8H024 N & N
Letaba (Rural)
Nkowankowa
EWR 7
B8H001 @ Redbank
EWR 2
RITAVI (2)
PHALABORWA
Haenertsburg
Ebenezer Dam
B8H026 @ Georges Valley
NAMAKGALE
Lenyenye
NAPHUNO
Thabina Dam
Burgersdorp
EWR1
RITAVI
LETABA
Capricorn
Lorraine
THABAMOOPO
NAPHUNO
Sekhiming
Ga-Ntata
Greater Letaba LM
Peters on
Femane
Abel
Senakwe
Mageva
Dzumeri
Greater Giyani LM
Morapalala
Gamokgwathi
Mookgo 7
Seroforo
Greater Tzaneen LM
Ka-Xihoko
Thako Lenokwe
Mavele
Motupa
Relela
Mavele
Ba-Phalaborwa LM
Mandlakazi
Nwamanwa
Nkamboko
Proposed Nwamitwa Dam
Groot Letaba Study Catchments
Municipal Boundaries
Ba-Phalaborwa Local Municipality
Greater Giyani Local Municipality
Greater Letaba Local Municipality
Greater Tzaneen Local Municipality
Kruger National Park (Mopani District Management Area)
District Municipalities
OVERVIEW MAPS :
Study Area
Study Area
LEGEND
Towns
Weirs
Ecological Water Requirements
Dams
Rivers
Magisterial Districts
PATH
s\projects\H401775\mxd\Reports\WaterReq\figE2.mxd
SCALE
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PROJECTION INFORMATION:
COORDINATE SYSTEM : Transverse Mercator
PROJECTION NAME : TM31
DATUM : D_WGS_1984
SPHEROID : WGS_1984
CENTRAL MERIDIAN : 31
CONSULTANT :
aurecon
water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA
TITLES :
GROOT LETABA RIVER WATER DEVELOPMENT PROJECT
PRIMARY WATER DEMANDS
FIGURE NO. :
E2

3. PRIMARY WATER REQUIREMENTS

For the purposes of this report, primary water requirements are defined as :

- *domestic water requirements (both urban and rural)*
- *industrial water requirements*
- *mining water requirements*

The existing primary water requirement for the Groot Letaba Catchment is estimated to be 23.5 Mm³/a in 2007. This consists mainly of domestic requirements (22 Mm³/a) and a small industrial component (1.5 Mm³/a). More details of these water requirements and a comparison with the allocations are provided in ***Table E1****.*

Future primary water requirements were estimated using a variety of methods described in ***Appendix B*** *of this report. Primary water requirements for the Groot Letaba Catchment were estimated to increase by 28.8 Mm³/a from 2007 to 2030, giving a total primary water use of 52.3 Mm³/a in 2030. It was assumed that the industrial component would remain constant at 1.5 Mm³/a, giving an estimated domestic water requirement of 50.8 Mm³/a in 2030. A breakdown of these additional future requirements per major settlement is given in* ***Table E1****. It should be noted that the increase in domestic water requirement of 28.8 Mm³/a is influenced by higher service levels for the areas surrounding the proposed Nwamitwa Dam (Ritavi 1 (Letaba), Naphuno and Bolobedu (this includes Modjadji, Thapane and the Worcester – Mototsi areas)).*

It is estimated that an additional 21 Mm³/a will be required in the area for future mining projects. It is anticipated that these requirements will be met from outside the Groot Letaba Catchment, so are not included in future estimates for the catchment.

Table E1 Summary of Current and Projected Primary Water Requirements

Description	Place Name	Water Requirements in Mm³/a				
		Allocation 2006/7	Usage 2006/7	Base Value used for Future Projections *1	Estimated Growth to 2030	Total Future Water Requirements (2030)
(Domestic use in Groot Letaba catchment upstream of confluence with Klein Letaba River	Haenertsburg	0.0	0.0	0.0	0.0	0.00
	Tzaneen Town	3.6	2.2 + 1.0 = 3.2	3.6	12.89	16.49
	Politsi	2.0	2.1	2.0	1.38	3.38
	Duiwelskloof					
	Ga-Kgapane					
	Letsitele	0.4	0.3	0.3	0.70	1.00
	Ritavi 2	3.5	8.2	8.2	-3.41	4.79
	Naphuno	1.7	1.3	1.3	1.60	2.90
	Namakgale	0.0	0.8	0.8	0.00	0.80
	Ritavi 1	0.0	1.9	1.9	3.30	5.20
	Bolobedu	0.2	0.2	0.2	11.31	11.51
	Sub-total	**11.4**	**18.0**	**18.3**	**27.8**	**46.07**
Domestic use in Middle and Klein Letaba Catchments	Giyani *3	3.7	3.7	3.7	1.0	4.7
	Cumulative Sub-total	**15.1**	**21.7**	**22.0*2**	**28.8**	**50.8**
	Middle Letaba Dam WTW	2.3	2.3	2.3	No estimate made*3	--
	Sub-Total	**6.0**	**6.0**	**6.0**	**--**	**--**
Cumulative Sub-total		**17.4**	**24.0**	**24.3**	**--**	**--**
Domestic use outside of Letaba Catchment	Polokwane	18.5	4.6 + 18.8 = 23.4	23.4	No estimate made*3	--
Sub-total for domestic use		35.9	47.4	47.7	--	--
	Industrial use	3.3	1.5	1.5*2	--	--
Overall total of primary water requirements		**39.2**	**48.9**	**49.2**	**--**	**--**

*1 Note that where the base value differs from the allocation in the previous column, this was based on actual water usage in 2006/7
*2 Current day primary water requirement for Groot Letaba Catchment = 23.5 Mm³/a (22.0 Mm³/a domestic + 1.5 Mm³/a industrial)
*3 Growth in water requirement to be met from outside Letaba catchment

4. IRRIGATION REQUIREMENTS AND LOSSES

Irrigation comprises the largest water requirement in the catchment, and is estimated to be approximately 192 Mm^3/a from surface water, and 29 Mm^3/a from groundwater.

The following differences in irrigation demands were found when the results of the 1995 Feasibility Study was compared to the 2007 Bridging Study Analysis :

- *The local demands supplied upstream of Tzaneen Dam increased by 8 Mm^3/a.*
- *An increase of 29 Mm^3/a along the Groot Letaba River from Tzaneen Dam to the Letaba Ranch. Part of this increase was from incorporating the proposed (as opposed to existing) supply of 22 Mm^3/a to emerging farmers downstream of the Nondweni Weir. The Feasibility Study reported that 7.9 Mm^3/a was supplied to the Masalal canal but this has not been maintained and is now unusable.*

Losses along each river reach were estimated and totalled approximately 27.2 Mm^3/a. Losses in the river system are a significant factor in the Groot Letaba Catchment, as they affect the yield of the system, especially in the critical drawdown period. Losses also affect the releases made to supply environmental requirements in the Kruger National Park, and international agreements for the flow leaving South Africa and entering Mozambique.

5. AFFORESTATION

Afforestation is a significant water use in the catchment, with an estimated 365 km^2 of commercial afforestation occurring in the catchment.

Afforestation and some indigenous forests occur in the wetter parts of this study area, mainly in areas with an average mean annual precipitation (MAP) of around 900 mm. These areas are concentrated in the upper reaches of the Groot Letaba, Letsitele, and Middle Letaba and Klein Letaba River catchments. Afforested areas are planted with mainly gum tree species (Eucalyptus), with pine tree species (Pinus spp) being planted to a lesser extent. In the previous studies the areas covered with forest in 1925 were assumed to be indigenous forests, since the afforestation industry only began to grow significantly from 1930 onwards.

There is very little likelihood of further development of afforestation in the catchment, since the Letaba Catchment was categorised as "Category 1" in terms of the 1984 Forestry Act (Act 122 of 1984), which implies that new licences will not be permitted in the catchment (DWAF, 1998). This happened as far back as 1972.

Updated information on the forestry areas (indigenous and afforested) and the growth of the areas was obtained from Schoeman & Vennote. Please refer to their report which is contained in ***Appendix C****.*

The total area of afforestation was estimated to be 356 km^2.

Afforestation Water Use

When the water requirements of afforestation modelled in this Bridging Study were compared to the afforestation requirements in the digital Water Resources Yield Model (WRYM) setup available for the previous study, significant differences were found. In most cases, there were differences in the average afforestation requirements between the two studies. The Bridging Study afforestation requirements were adjusted in order to match the afforestation requirements in the previous study, so that the average flows for the common period would remain the same. In most cases, the adjustments increased the water use by afforestation, giving an overall increase of 13 Mm^3/a to a total afforestation water use of 78 Mm^3/a.

6. ECOLOGICAL RESERVE

A Preliminary Reserve Determination was drafted by DWA, and this document contains the rules describing the desired environmental flow requirements. The proposed ecological water requirement (EWR) requirements consist of a low flow component of 16 Mm^3/a and a high flow component of 66 Mm^3/a, giving an average annual value of 82 Mm^3/a at EWR Site 4 (Letaba Ranch). It should be noted that these figures are average annual values, and so can be lower in a dry year and higher in a wet year.

The present EWR release is 15 Mm^3/a.

7. CONCLUSIONS

A summary of the main conclusions emanating from the Water Requirements and Water Resource Analysis is given below:

7.1 Obtaining sufficient suitable data was difficult, as detailed information about existing and future population and water use is not readily available. Where information was not available, estimations were made in order to provide figures to work from.

7.2 Water requirements are currently met mainly from surface water sources, with minimal use being made of groundwater. There is considerable potential for increasing the use of groundwater in the catchment, particularly in conjunction with surface water.

7.3 Currently the yield from most of the major surface water schemes is over-allocated. The result of this pressure on the available surface water supply is that the supply of water to the irrigation sector is curtailed to below their allocations on an ongoing basis.

7.4 The water requirements are summarised in ***Table E7.1***

Table E7.1 Summary of Water Requirements in the Groot Letaba Catchment

Description	Water Requirements in Mm^3/a		
	2007	Additional water requirement to 2030	Total in 2030
Primary – domestic (see **Table 2.6**)	22.0	28.8	50.8
Primary – industrial	1.5	0	1.5
Sub-total Primary	23.5	28.8	52.3
Irrigation (surface water) *1	192.3	0	192.3
Afforestation	77.6	0	77.6
Totals (excl. Environmental)	**293.4**	**28.8**	**322.2**
Primary – mining (to be supplied from outside the catchment)	0	21.0	21.0
Environmental *2	14.8 Mm^3/a = 0.469 m^3/s	min = 16 Mm^3/a max = 82 Mm^3/a For EWR Site 4	16 to 82 Mm^3/a at Site 4

*1 Irrigation supplied by groundwater is estimated to be an additional 29 Mm^3/a
*2 Note that the Environmental Requirement (non-consumptive use) cannot be added to the other water requirements

7.4.1 Based on the medium growth scenario, it is anticipated that the primary water requirement for the Groot Letaba Catchment will increase from a 2007 base of 24 Mm^3/a to approximately 52 Mm^3/a in 2030.

7.4.2 Estimates of future population growth rates in the catchment were used to project water requirements for the catchment up to 2030. It is projected that the growth in water requirement from Tzaneen Dam will increase from a current value of 14 Mm^3/a to an estimated 22.18 Mm^3/a in 2030. It is estimated that the water requirement from the proposed Nwamitwa Dam will be approximately 13 Mm^3/a. It must be noted that the figure of 13 Mm^3/a is based on a high service level for the areas of Ritavi 1 (Letaba) and Bolobedu (this includes Modjadji, Thapane and the Worcester-Molototsi areas).

7.4.3 Irrigation is the largest water requirement in the catchment (192 Mm^3/a in 2007) and losses from a significant portion of this requirement (27.2 Mm^3/a). The estimation of these losses is an important process because of their influence on the estimate of the yield of surface water schemes.

7.4.4 Afforestation is the second largest water requirement in the catchment (77 Mm^3/a in 2007). No increase in afforestation is anticipated in the catchment, but the influence of invasive alien plants has not been investigated.

7.4.5 The recent determination of the EWR has introduced an additional requirement, which has increased the pressure on the available surface water.

8. RECOMMENDATIONS

The following recommendations are made:

- *Given the stressed nature of the available water resources and the anticipated growth in primary water requirements, it is important to undertake verification and validation of water use in the Groot Letaba Catchment.*
- *It is important that municipalities measure and monitor water use so that in future accurate modelling can take place.*
- *Due to the stressed resources and the cost of developing new resources, the implementation of water demand/water conservation measures in the catchment is strongly recommended.*
- *Since the losses in the system are so significant, further investigations should be undertaken to refine the assumptions used to determine "river losses". This will enable the yields of dams in the system to be estimated with a higher level of certainty.*
- *When the hydrology for the Groot Letaba is revised, it is recommended that the water use of invasive alien plants be modelled as a separate water use.*
- *A regional study should be undertaken to further investigate increasing the use of groundwater in the catchment, particularly in conjunction with surface water.*

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1.2 SCOPE AND ORGANISATION OF PROJECT 2
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2.1 GROOT LETABA CATCHMENT 5
2.1.1 Dap Naude Water Supply Scheme 5
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ABBREVIATIONS

DWA	Department of Water Affairs
EMM	Environmental Management Module
EWR	Ecological water requirement
FSA	Full supply area
FSC	Full supply capacity
GWCA	Government Water Control Area
GLeWaP	Groot Letaba River Water Development Project
GLWUA	Groot Letaba Water User Association
GL	Groot Letaba
ha	Hectare
HFY	Historical firm yield
IFM	Institutional and Financial Module
ISP	Internal Strategic Perspective
km^2	Square kilometres
KNP	Kruger National Park
m^3/a	Cubic metres per annum
Mm^3/a	Million cubic metres per annum
MAP	Mean annual precipitation
MAR	Mean annual runoff
MASE	Mean annual S-pan evaporation
OA	Options Analysis
PCMT	Project Co-ordination and Management Team
PGRWSS	Polokwane Government Regional Water Supply Scheme
PIP	Public Involvement Programme
RDP	Reconstruction and Development Programme
RWSS	Rural Water Supply Scheme
SEE	Socio-economic Evaluation
TSM	Technical Study Module
WR90	Water Resources of South Africa, 1990
WRYM	Water Resources Yield Model
WSDP	Water Services Development Plan
WTW	Water Treatment Works
WUA	Water User Authority

1. STUDY INTRODUCTION

1.1 BACKGROUND TO PROJECT

The catchment of the Groot Letaba River has many and varied land uses with their associated water requirements. These include significant use by agriculture in the form of irrigated crops, commercial afforestation, tourism (particularly linked to the Kruger National Park, which lies partially within the catchment), as well as primary requirements by the population in the catchment. The water resources available in the catchment are limited, and considerable pressure has been put on these resources in the past, with periods of severe and protracted water restrictions occurring over the past 25 years. This situation has been investigated at various levels by the Department of Water Affairs (DWA).

The first major study undertaken for this area was the Letaba River Basin Study in 1985 (DWAF, 1990), which comprised the collection and analysis of all available data on water availability and use, as well as future water requirements and potential future water resource developments. This was followed by a Pre-feasibility Study (DWAF 1994), which was completed in 1994. The focus of the Pre-feasibility Study was the complete updating of the hydrology of the Basin. The next study undertaken was the Feasibility Study of the Development and Management Options (DWAF, 1998), which was completed in 1998.

The Feasibility Study proposed several options for augmenting water supply from the Groot Letaba River. These included some management interventions, as well as the construction of a dam at Nwamitwa and the possible raising of Tzaneen Dam. These options would enable additional water to be allocated to the primary water users, would allow the Ecological Reserve to be implemented and could also improve the assurance of supply to the agricultural sector.

This Bridging Study was initiated by the (then) Department of Water Affairs and Forestry (now DWA) in 2006, in order to re-assess the recommendations contained in the Feasibility Study, in the light of developments that have taken place in the intervening 10 years. Other contributing factors to the DWA's decision to undertake Bridging Studies were the promulgation of the Water Services Act and the National Water Act in 1997 and 1998, respectively, and the recently completed Reserve Study on the Letaba River.

The study area is shown in **Figure 1.1**. It consists of the catchment of the Letaba River, upstream of its confluence with the Klein Letaba River. The catchment falls within the Mopane District Municipality, which is made up of six Local Municipalities. The Local Municipalities within the catchment area are Greater Tzaneen, Greater Letaba, and Greater Giyane. The major town in the study area is Tzaneen, with the urban centre of Polokwane located just outside of the catchment to the west. The site of the proposed Namitwa Dam is also shown in **Figure 1.1**.

1.2 SCOPE AND ORGANISATION OF PROJECT

The DWA Directorate: Options Analysis (OA), appointed Aurecon in association with a number of sub-consultants (listed below) to undertake this study. The official title of the study is "The Groot Letaba River Water Development Project : Bridging Study".

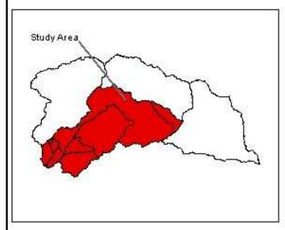
An association exists between the following consultants for the purposes of this study:

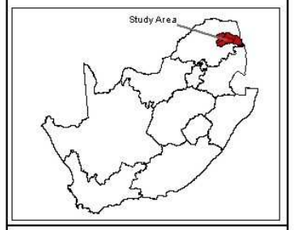
- Aurecon
- Semenya Furumele Consulting
- KLM Consulting Services
- Urban-Econ Developmental Economists
- Schoeman & Vennote

30°0'0"E
30°30'0"E
31°0'0"E
23°30'0"S
24°0'0"S

Klein Letaba
Middle Letaba
Groot Letaba
Middle Letaba Dam
Lornadawn Dam
Modjadji Dam
Thapane Dam
Hans Merensky Dam
Tzaneen Dam
Dap Naude Dam
Magoebaskloof Dam
Ebenezer Dam
Thabina Dam
Proposed Nwamitwa Dam
Nsami Dam
Blinkwater
Giyani
Bambeni
Ga-Kgapane
Nwamitwa
Duiwelskloof
Politsi
Tzaneen
Letaba (Rural)
Nkowankowa
Murchison
Burgersdorp
Lorraine
R71
R36
Khwali
Soekatse
Lebjelebore
Middel Letaba
Brandboomspruit
Koedoes
Mahitse
Broederstroom
Politsi
Molodi
Bobs
Mothlaka Semeetse
Letsitele
Nwaneedzi
Hlanganu
Reshiwele
Makwena
Groot Letaba
Matsemola
Mohlotsi
Morakorna
Lerwalilou
Mutse
Nsama
Magobe
Nalatsi
Mohlawuta
Ka-Mallilbopa

OVERVIEW MAPS :





LEGEND
- Towns
- National Roads
- Secondary Roads
- Rivers
- Dams
- Villages
- Study Area
- Proposed Supply Area from Nwamitwa Dam

PATH:
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SCALE
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1:380,000

PROJECTION INFORMATION :

COORDINATE SYSTEM :	Transverse Mercator
PROJECTION NAME :	TM31
DATUM :	D_WGS_1984
SPHEROID :	WGS_1984
CENTRAL MERIDIAN :	31

CONSULTANT :

aurecon

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

TITLE :

GROOT LETABA RIVER WATER DEVELOPMENT PROJECT

PROJECT AREA

FIGURE NO. :

1.1

The Bridging Study comprises a number of modules, namely: an Environmental Management Module (EMM), a Public Involvement Programme (PIP), a Technical Study Module (TSM), and an Economic Evaluation (EE). This Report focuses on part of Task 1 for the Technical Study Module (TSM).

The tasks comprising the TSM are summarised below:

TASK 1: WATER REQUIREMENTS
TASK 2: WATER RESOURCE EVALUATION
TASK 3: PRELIMINARY DESIGN OF NWAMITWA DAM
TASK 4: RAISING OF TZANEEN DAM
TASK 5: BULK WATER DISTRIBUTION INFRASTRUCTURE
TASK 6: IMPLEMENTING PROGRAMME
TASK 7: WATER QUALITY

1.3 SCOPE OF THIS REPORT

This report describes a portion of Task 1 : Water Requirements. The objectives of Task 1 : Water Requirements were as follows :

- review the current estimates of future water requirements in all user sectors,
- establish present levels of water use in these sectors,
- assess the availability of groundwater in the project area.

The first two objectives are reported on in this report *(Review of Water Requirements)* and the last objective is reported on in a separate report (*Groundwater*) (DWA, 2010a).

The main content of this report is contained in **Sections 2** to **6**. Section contains a description of the existing water supply infrastructure in the catchment, and how water is allocated to the different users from each scheme. The existing and future primary user water requirements are reviewed in **Section 3**.

Section 4 reports on the water demand of irrigated agriculture. The water use by commercial afforestation located in the wetter, western part of the catchment is discussed in **Section 5** of the report. The water requirement for the Ecological Reserve is reported on in **Section 6** of the report.

A summary of all the existing and future water requirements in the catchment is given in **Section 7**, along with the conclusions from the study. Recommendations relating to water requirements are given in **Section 8**. The references are contained in **Section 9**.

2. EXISTING WATER SUPPLY SCHEMES

This section of the report was compiled from information provided in previous reports, updated with the latest details obtained from sources such as the DWA, local municipalities and irrigators. Extensive use was made of the most recent study entitled *Letaba River System Annual Operating Analysis* by Semenya Furumele Consulting (DWAF, 2006a) for the background information pertaining to the various supply schemes, and this is particularly acknowledged.

The locations of the towns and settlements supplied, as well the dams discussed below are shown in **Figure 2.1**. A detailed table showing allocations actual usage and demands used in this Bridging Study is provided in **Appendix A**. The water requirements, allocation and usage are summarised in **Section 3**.

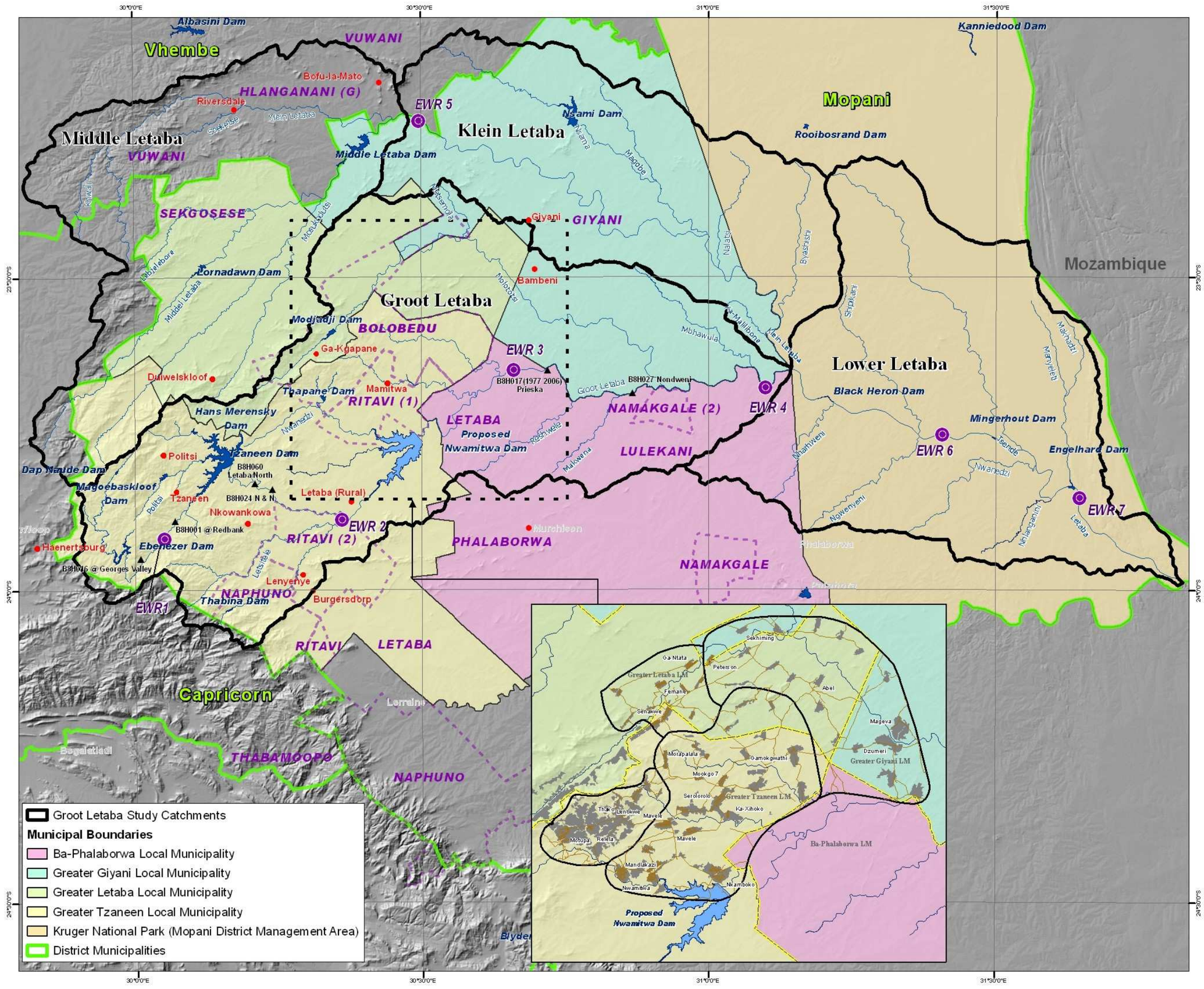
2.1 GROOT LETABA CATCHMENT

Water requirements throughout the catchment are met largely through surface water supply schemes, with very little being supplied from groundwater sources. Surface water is supplied from the Groot Letaba River and its tributaries to the towns of Polokwane, Tzaneen, Haenertsburg, Duiwelskloof as well as to many rural villages. The main surface water supply schemes are centred around the Dap Naude, Ebenezer and Tzaneen Dams, and these schemes are described in detail below. Their locations are shown on **Figure 2.1**.

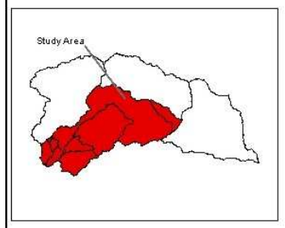
The groundwater investigation that was undertaken as part of this study (DWA, 2010a) reported that 10.6 Mm³/a was used for domestic supply to villages. The study showed that there was considerable potential for the increased use of groundwater in the catchment, particularly in conjunction with surface water, to improve the quality of groundwater without expensive treatment. It was recommended that a regional study be undertaken to investigate this option in more detail.

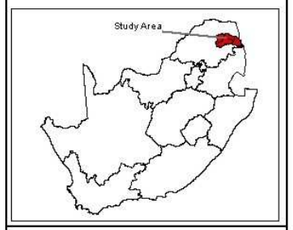
2.1.1 Dap Naude Water Supply Scheme

The Dap Naude Dam is the main component of this water supply scheme and was built in 1958. The dam is located on the Broederstroom, a tributary of the Groot Letaba River. The natural mean annual runoff (MAR) at this point is 15.4 Mm^3/a. The dam has a full supply capacity of 1.97 Mm^3, and the historic firm yield is 3.2 Mm^3/a (DWAF, 2006a).



OVERVIEW MAPS :





LEGEND

- Towns
- Weirs
- Ecological Water Requirements
- Dams
- Rivers
- Magisterial Districts

PATH:
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SCALE
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1:610,000

PROJECTION INFORMATION:

COORDINATE SYSTEM :	Transverse Mercator
PROJECTION NAME :	TM31
DATUM :	D_WGS_1984
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CENTRAL MERIDIAN :	31

CONSULTANT :

aurecon

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

TITLES :

GROOT LETABA RIVER WATER DEVELOPMENT PROJECT

PRIMARY WATER DEMANDS

FIGURE NO. :

2.1

Polokwane Municipality owns the Dap Naude Dam, and it is operated by Lepelle Northern Water for the Polokwane Government Regional Water Supply Scheme (PGRWSS). Water is used for domestic and industrial water requirements in Polokwane.

A compensation release for irrigation is made as defined by a Water Court ruling. The compensation release is 0.28 m^3/s from November to June, with the full inflow to the dam being released from July to October.

The allocation from the dam to Polokwane is 6.52 Mm^3/a, which is higher than the historic firm yield of the dam. The actual use in the 2007 calendar year was of the order of 3.2 Mm^3/a. For the purposes of this Bridging Study, the full allocation of 6.52 Mm^3/a was modelled in the Water Resources Yield Model (WRYM).

2.1.2 Ebenezer Dam Water Scheme

The Ebenezer Dam is located on the Helpmekaar River in the upper reaches of the Groot Letaba River, just downstream of the Dap Naude Dam. It supplies both domestic and irrigation users and has a gross storage capacity of 70.0 Mm^3.

Domestic water is supplied to Tzaneen and Polokwane and its surrounding settlements. According to DWA (pers comm., Jakkie Venter, 2008), Tzaneen Municipality has an allocation of 2.4 Mm^3/a from this dam, which was used for modelling purposes in this Bridging Study (note that 3.58 Mm^3/a is given in the Semenya Study).

The water allocation for Polokwane and its surrounding settlements from Ebenezer Dam is 12.0 Mm^3/a, which was used for modelling purposes in this Bridging Study. Their current usage from the dam is 18.8 Mm^3/a. The allocation from Ebenezer Dam to Polokwane was reduced from its original value of 18.5 Mm^3/a given in the White Paper WP-I 1984. This water is also supplied by the PGRWS, giving the PGRWS a total allocation of 18.5 Mm^3/a (6.5 Mm^3/a from Dap Naude and 12.0 Mm^3/a from Ebenezer) for bulk water supply to Polokwane from the Groot Letaba Catchment.

The allocation of irrigation water from the dam is 12.92 Mm^3/a, which includes about 3 Mm^3/a for transmission losses. This water is released from the Ebenezer Dam directly into the river and diverted further downstream into two canal systems at George's Valley weir (B8H016) and Pusela weir. If there are no restrictions, the bulk of the allocation is released into these two canals (2.57 and 6.55 Mm^3/a, respectively). It supplies irrigators along the river reach between Ebenezer Dam and Tzaneen Town.

A total of 27.32 Mm^3/a (2.4 Mm^3/a to Tzaneen Municipality + 12.0 Mm^3/a to Polokwane + 12.92 Mm^3/a to irrigation = 27.32 Mm^3/a) is currently allocated from Ebenezer Dam. This is higher than the 1:50 year yield of 23.9 Mm^3/a (DWAF, 2006a), which means that the dam is currently over-allocated at the 1:50 assurance level.

2.1.3 Magoebaskloof Dam and Vergelegen Dam Scheme

The Magoebaskloof Dam is located on the Politsi River, which is a tributary of the Groot Letaba River, upstream of the Tzaneen Dam. It has a gross storage capacity of 4.8 Mm^3 and a historic firm yield of 9.1 Mm^3/a (DWAF, 2006a). It supplies the towns of Politsi, Duiwelskloof and Ga-Kgapane with domestic and industrial water. A canal transfers water from the Magoebaskloof Dam to Vergelegen Dam, from where Politsi, Duiwelskloof and Ga-Kgapane are supplied. These domestic users have an allocation of 2.0 Mm^3/a, and used 2.1 Mm^3/a during 2006/2007. The allocation of 2.0 Mm^3/a was used for modelling purposes in this Bridging Study.

When the dam was built, the intention was to supply irrigation water to the now disbanded Tzaneen Irrigation Board and Sapekoe Tea Estates.

The Vergelegen Dam is mainly a balancing dam for accepting water from the Magoebaskloof Dam with some inflow from its own catchment. It has a capacity of 0.3 Mm^3. The water stored in the dam was used to irrigate up to 1 000 ha on the Sapekoe Tea Estate. This scheme is no longer viable, so there is no water use at present. However, the Magoeba tribe have laid claim to the land and may use the water in future. Hence the demand was retained on the system.

In addition, Sapekoe Estates has an allocation of 0.87 Mm^3/a from the Debengeni River upstream of the Magoeboeskloof Dam (of which 0.6 Mm^3/a is for irrigation), which is obtained via a pipeline.

Irrigation water users draw water from the canal between Magoebaskloof Dam and Vergelegen Dam as well as from the Vergelegen Dam itself. Irrigation water is abstracted either directly from the dam basin and outlets or from a gravity pipeline. Irrigation use is estimated to be 3.2 Mm^3/a.

2.1.4 Hans Merensky Dam Scheme

The Hans Merensky Dam is located on the Ramadiepa River, which is a tributary of the Groot Letaba River, upstream of Tzaneen Dam. It has a capacity of 1.2 Mm^3 and the historical firm yield is estimated to be 6.8 Mm^3/a (DWAF, 2006a).

Water is supplied from the Hans Merensky Dam to irrigate approximately 1 169 ha of agricultural land in the B81B catchment. Approximately 638 ha occurs on land belonging to Westfalia Estates, and the remainder on other farms in the quaternary catchment. Irrigators in the area also obtain water directly from the river, as well as from the Selokwe River and its tributaries.

2.1.5 Tzaneen Dam Scheme

Tzaneen Dam is located on the Groot Letaba River upstream of its confluence with the Letsitele River, close to the town of Tzaneen. It has a gross storage capacity of about 157.6 Mm^3. This mainly serves the irrigation requirement along the Groot Letaba River valley, domestic and industrial water supply to Tzaneen, Nkowakowa, Letsitele, Consolidated Murchinson Mines, several other small industrial users and a large number of rural villages. The present allocation from the dam to Tzaneen Town for domestic and industrial supply is 1.2 Mm^3/a and their usage from this dam in 2006/2007 was 1.0 Mm^3/a.

Currently, provision has also been made to release 0.6 m^3/s (19 Mm^3/a) from the Nondweni Weir supported by the Tzaneen Dam with 7.2 Mm^3/a to the Kruger National Park for ecological requirements. This provision to maintain a flow of 0.6 m^3/s will however change in the future, with the implementation of the Ecological Water Requirements (EWRs). This is discussed in more detail in **Section 2.6** of this report.

The irrigation water is released directly into the Groot Letaba River and is pumped from the river by irrigators and also diverted from the river into canals at the Letaba North (B8H060), N&N (B8H024) and Prieska (B8H017) weirs. The weirs are located approximately 10 km, 17 km and 75 km, respectively, downstream of Tzaneen Dam.

The gross irrigation allocation of 105 Mm^3/a includes 23% transmission losses abstracted as follows:

- Letaba North (just downstream of B8H060 at Yamorna) 28.8 Mm^3/a
- N&N canal (B8H024 at Fleurbaai) – 12.2 Mm^3/a
- Pump irrigators – 31.5 Mm^3/a
- Unused allocation available for emerging irrigators – 32.5 Mm^3/a

  105.0 Mm^3/a

A detailed table showing the allocations and useage from Tzaneen Dam for primary water requirements is provided in **Appendix A**. The current total allocation (for primary water requirements) is 8.4 Mm^3/a. A larger value of 13.9 Mm^3/a was used as a demand from Tzaneen Dam in the WRYM for this Bridging Study. This was mainly as a result of

the higher use than the allocations in some areas, such as Nkowakowa (use = 8.2 Mm^3/a compared to an allocation of 3.5 Mm^3/a), and Ritavi 1 (use = 9 Mm^3/a compared to an allocation of zero).

The total present water allocation from Tzaneen Dam is 113.4 Mm^3/a (105 (irrigation) + 1.2 (domestic) + 7.2 (EWR). The historical yield (1:68 years) is 74.6 Mm^3/a, according to the Semenya Furumele Report (DWAF, 2006a). One of the proposals which is considered in this study is raising Tzaneen Dam. This is reported on in the report entitled *Water Resource Analysis* (DWA, 2010b), which concluded that a 3 m raising would result in an additional 4 Mm^3/a of yield. The increase in yield could be made available to existing users.

2.1.6 Thapane Dam Scheme

This scheme abstracts water from a weir in the river downstream of the Thapane Dam. The Thapane Dam is located on the Nwanedzi River, which is a tributary of the Groot Letaba River. Its yield is estimated to be 1.5 Mm^3/a (Mopani WSDP, 2008).

Various boreholes with a combined yield of 1.4 Ml/day (0.5 Mm^3/a) provide additional water to this area. In addition, about 1 740 ha is irrigated in the upper reaches of the Nwanedzi and Hlangana Rivers by pumping from a number of farm dams, estimated to have a total combined storage capacity of about 10 Mm^3.

2.1.7 Thabina Dam Scheme

The Thabina Dam has a capacity of 2.8 Mm^3 and is located in the Thabina River, a tributary of the Letsitele River. The current allocation for domestic supply from the dam to Naphuno is 1.7 Mm^3/a, and the corresponding use in 2006/2007 was 1.3 Mm^3/a. The historic firm yield is 2.9 Mm^3/a (DWAF, 2006a), and this amount was abstracted from Thabina Dam when determining the yield of Nwamitwa for this Bridging Study.

Some 193 ha are irrigated from run-of-river with limited supplies from Thabina Dam. The total annual requirement for irrigation is 1.61 Mm^3.

In the lower reaches of the Thabina River, irrigation water is diverted by a weir into a canal on the right bank to irrigate some 193 ha. Impoundments on tributaries of the Thabina River, including Rigo Dam (capacity 1.30 Mm^3) and Burgersfort Dam (capacity), are used to augment irrigation water supply. Acording to Hennie Schoeman (pers comm., 2008), about 357 ha are irrigated from surface water resources in the Thabina Catchment.

2.1.8 Letsitele Run-of-River Scheme

According to Semenya Furumele (DWAF, 2006a), about 2 169 ha is scheduled for irrigation out of the Letsitele River. Six canals currently supply run-of-river water to about 900 ha and the remaining area is irrigated from river pumps. About 1 600 ha are under permanent crops. The remainder of the area is irrigated on an opportunistic basis.

According to Hennie Schoeman (pers. comm, 2008) about 2 700 ha is irrigated in the Letsitele Catchment from surface water.

2.1.9 Modjadji Dam

The Modjadji Dam is located on the Molototsi River and has a full supply capacity of 8.2 Mm^3. The yield is estimated to be 5.1 Mm^3/a. The urban supply from this dam to Bolebedu for domestic use was about 0.2 Mm^3/a. The water use in 2006/2007 matched this allocation. To model the full impact of this dam on the system, a demand equal to its historical firm yield (5.1 Mm^3/a) was applied when modelling the benefits of Nwamitwa Dam. A value of 5.1 Mm^3/a was used for modelling purposes in this Bridging Study.

2.2 MIDDLE LETABA CATCHMENT

2.2.1 Middle Letaba Rural Water Supply Scheme (RWSS)

The supply from the Water Treatment Works (WTW) at the Middle Letaba Dam and at Giyani (supplied from Nsami Dam, which is in turn augmented from the Middle Letaba Dam) was estimated to be 3.7 and 2.3 Mm^3/a, respectively, although the readings at the Giyani WTW (B8H068) were of poor quality. The actual allocation is not known.

The Middle Letaba Dam (capacity 184 Mm^3 and yield of 16 Mm^3/a (DWAF, 2006a)) delivers water to the Nsami Dam (capacity 24.4 Mm^3) through a 60 km long concrete canal with a capacity of 4 m^3/s. On the left bank, irrigation plots have been developed alongside the canal and 11 pump stations deliver water from the canal through a pipeline system to the field edge. A minimum flow has to be maintained in the canal to ensure sufficient head on the pumps.

From Nsami Dam, a short canal (6 km long) delivers water to irrigation plots on the left bank of the Nsami River, including 200 ha of bananas. Other irrigation areas not linked to the canal system include areas at Mabunda, the Melkpasies and the Dumazi, where water is obtained directly from the Klein Letaba and Nsami Rivers. A total of 2 400 ha has been developed and equipped for irrigation. The irrigation water requirement to serve this area is estimated to be approximately 21 Mm^3/a.

Because of the low yield of the system, the water supplied to irrigators may be significantly less than the annual requirement.

2.3 SYSTEM STORAGE

Historical information regarding storage capacities of existing dams is summarised in **Table 2.1**. One of the main factors that can be clearly seen in **Table 2.1** is that many of the surface water schemes have existing allocations that exceed their yields. The surface water schemes in the Groot Letaba catchment have a total allocation of 177 Mm^3/a and an estimated total yield of 126 Mm^3/a. The positions of the major dams mentioned in **Table 2.1** are shown in **Figure 2.1**.

Table 2.1 Storage Capacities of Existing Dams in the Catchment

Sub-catchment	WR90 Quaternary Sub-catchment	River	Major Dams							Farm Dams
			Name of Dam	Cumulative Natural MAR at damsite	Gross Full Supply Capacity (FSC) (Mm^3)	Full Supply Area (FSA) (km^2)	Year Built	Historic Firm Yield (Mm^3/a)	Volume Allocated (Mm^3/a)*6	Full Supply Capacity (Mm^3)
Groot Letaba	B81A	Broederstroom	Dap Naude	15.4	1.97	0.281	1958	3.2	6.52	1.7
		Confluence of Helpmekaar and Broederstroom	Ebenezer	48.6	70.0	3.86	1959	23.9*1	27.32	
	B81B	Politsi	Magoebaskloof	36.1	4.8	0.453	1971	9.1*2 15.9	8.3	2.9
		Mahitse	Hans Merensky	26.4	1.2	0.486	1958	6.8		
		Groot Letaba	Tzaneen	202.4	157.6	11.69	1977	74.6	8.4*4 + 105*5 = 113.4	
	B81C	--	--	--	--	--	---	--	--	6.3
	B81D	Thabina	Thabina	5.6	2.8	0.24	1984	2.9	1.7*4	7.1
	B81E	--	--	--	--	--	--	--	--	21.4
	B81F (portion)	--	--	--	--	--	--	--	--	9.4
	B81G and B81H	Molototsi	Modjadji	11.8	8.2	1.16	1997	5.1	0.2*4	5.2
	H81F (portion) and B81J	--	--	--	--	--	--	--		1.1
Sub-total for Groot Letaba					**246.57**			**125.6**	**177.4**	**55.1**
Middle Letaba	B82D	Middle Letaba	Middle Letaba	60.5	184		1984	Not available	--	Not available
	B82A		Lorna Dawn	20.6*3	12		1971		--	
Klein Letaba	B82H	Nsama	Nsami	3.4	24.4		176		--	
Overall Total				**--**	**466.9**	**--**	**--**	**125.6**	**177.4**	**55.1**

*1 1:50 year assurance
*2 Includes yield of Vergelegen Dam
*3 For whole of B82A
*4 Domestic allocation only
*5 Irrigation allocation only
*6 For more detail regarding allocations, please refer to **Table 7.2** in this report

3. PRIMARY WATER REQUIREMENTS

There were three main areas of focus for determining the primary water requirements. These are listed below, and shown on **Figure 2.1**.

- The catchment of the Groot Letaba River (excluding the catchments of the Middle, Klein and Lower Letaba Rivers).
- The supply area for the Greater Tzaneen Local Municipality (which includes the town of Tzaneen as well as numerous rural settlements, such as Naphuno and Ritavi 2).
- The supply area for the proposed Nwamitwa Dam, which is concentrated around Ritavi 1.

The full report on the Water Requirements task undertaken by Urban-Econ is contained in **Appendix B**. The main findings of their report are summarised in this section. Urban-Econ's focused on primary water requirements for the Groot Letaba Catchment only. Some information for the Middle, Klein and Lower Letaba Catchments has been added where applicable, but the emphasis is on the Groot Letaba Catchment.

The Urban-Econ report refers to the Groot Letaba Catchment as their "secondary study area". This includes the three local municipalities that cover the area, namely the Greater Tzaneen, Greater Letaba and Greater Giyani Local Municipalities, which form part of the Mopani District Municipality. The supply area around the proposed Nwamitwa Dam is referred to as their "primary study area".

For the purposes of this report, primary water requirements are determined as follows:

- domestic water requirements (both urban and rural)
- industrial water requirements
- mining water requirements

3.1 CURRENT PRIMARY WATER REQUIREMENTS

The current water requirements for the Groot Letaba Catchment, the Greater Tzaneen Local Municipality and Ritavi 1 (which falls in the area to be supplied by the proposed Nwamitwa Dam) are discussed in the sections that follow.

3.1.1 Groot Letaba Catchment

The primary demands in the catchment in 2006/2007 are summarised in **Table 3.1**. The water usage for the towns and settlements in the study area is given for the years 2000 (column 3) and 2006/7 (column 5). The official allocation to each settlement as at 2006/7 is also shown in the **Table 3.1** (column 4). If one looks at the Groot Letaba Catchment, the allocation of 11.4 Mm^3/a was exceeded in the year 2000, when the annual water usage was 13.95 Mm^3/a, and again in 2006/7 when the usage was 18 Mm^3/a.

The information in the three columns mentioned above was used to determine two different base case scenarios for this study, which are described below:

- Base Value used for Water Resources Yield Model (WRYM)

  One of the major outcomes of this study is the estimation of the incremental yield that will be available from the proposed Nwamitwa Dam. This was determined using the WRYM and the details of that process are contained in a separate report entitled *"Water Resource Analysis"* (DWA, 2010b). A set of current day water requirements was needed so that the water use in the system could be modelled as accurately as possible. The base values that were used for the WRYM are shown in column 6 of **Table 3.1** and total 50.8 Mm^3/a. In most cases, the largest volume was chosen as the base value for the WRYM. There were some exceptions where the allocation was chosen. For example, Polokwane's allocation of 18.5 Mm^3/a was chosen instead of their current day use of 23.4 Mm^3/a. In the case of Naphuno, a value of 2.9 Mm^3/a was chosen because it represents the historical firm yield (HFY) of Thabinia Dam. This is larger than the current usage (1.3 Mm^3/a) or allocation (1.7 Mm^3/a), and will allow the full yield of that dam to be used in future. Bolobedu was treated similarly, with a base value equivalent to the HFY of Modjadji Dam being selected (5.1 Mm^3/a), instead of the current day use of 0.2 Mm^3/a. This base value used for the WRYM is provided for completeness and is not used further in this report.

- Base Value used for Future Projections

  In order to estimate future water requirements, a present day base value was required. This is shown in Column 7 of **Table 3.1**. In most cases, the 2006/7 (column 5) usage was chosen. Tzaneen Town was an exception, where their allocation of 3.6 Mm^3/a was chosen instead of their current day usage of 3.2 Mm^3/a. Similarly, the allocation of 2.0 Mm^3/a was chosen for the settlements of Politsi, Duiwelskloof and Ga-Kgapane.

A value of 18.3 Mm³/a has been adopted as a base value for projections of future water requirements. This base value increases to 22.0 Mm^3/a when adding the domestic use for Giyani. Giyani is included because it obtains water from the Groot Letaba Catchment. An additional requirement of 1.5 Mm^3/a for industrial use in the catchment gives a total present day primary water requirement of 23.5 Mm^3/a for the Groot Letaba Catchment. If one adds the water required in the Middle Letaba Catchment and by Polokwane, which lies outside the catchment, a total of 49.2 Mm³/a is required.

Table 3.1 Primary Water Requirements (Table 12 from Urban-Econ Report in Appendix B) from the Letaba Catchment

Description	Place Name	Water Requirement in Mm³/a				
		Usage 2000	Allocation 2006/7	Usage 2006/7	Base Value used for WRYM	Base value used for Future Projections
Domestic use and requirements in Groot Letaba Catchment upstream of confluence with Klein Letaba River	Haenertsburg	0.04	0	0	0	0
	Tzaneen Town	5.5	2.4*1+1.2*2 = 3.6	2.2+1.0 = 3.2	2.4+1.2 = 3.6	3.6
	Politsi	0.14	2.0	2.1	2.0	2.0
	Duiwelskloof	0.41				
	Ga-Kgapane	0.35				
	Letsitele	0.26	0.4	0.3	0.3	0.3
	Ritavi 1	0.73	0	1.9	1.9	1.9
	Ritavi 2	2.66	3.5	8.2	8.2	8.2
	Naphuno	1.30	1.7	1.3	2.9 *3	1.3
	Bolobedu	2.56	0.2	0.2	5.1*4	0.2
	Namakgale	Groundwater*5	0	0.8	0.8	0.8
	Sub total	**13.95**	**11.4**	**18.0**	**24.8**	**18.3**
Domestic use in Middle and Klein Letaba Catchments	Giyani *6	0.98	3.7	3.7	3.7	3.7
	Cumulative Sub-total	**14.93**	**15.1**	**21.7**	**28.5**	**22.0**
	Middle Letaba Dam WTW	-	2.3	2.3	2.3	2.3
	Sub-total	**-**	**6.0**	**6.0**	**6.0**	**6.0**
Cumulative Sub-total		**-**	**17.4**	**24.0**	**30.8**	**24.3**
Domestic use outside of Letaba Catchment	Polokwane		18.5	4.6+18.8=23.4	6.5*7+12*8=18.5	23.4
Sub-total for Domestic use		-	35.9	47.4	49.3	47.7
Industrial use		-	3.3	1.5	1.5	1.5
Total primary water requirements			**39.2**	**48.9**	**50.8**	**49.2**

** 1 From Ebenezer Dam*
** 2 From Tzaneen Dam*
** 3 Based on Historical Firm Yield for Thabinia Dam*
**4 Based on Historical Firm Yield for Modjadji Dam.*
**5 Groundwater was used exclusively until 2006/7 when groundwater was supplemented with surface water from Tzaneeen Dam*
**6 Giyani obtains water from both the Groot Letaba River and the Middle Letaba River, and was therefore included in domestic requirements of the Groot Letaba Catchment.*
**7 From Dap Naude Dam*
**8 From Ebenezer Dam*

3.1.2 Greater Tzaneen Local Municipality

The location of the Greater Tzaneen Local Municipality is shown on **Figure 2.1**, and the main settlements are listed in **Table 3.2**.

Table 3.2 Settlements in the Greater Tzaneen Local Municipality

Settlement		
Tzaneen Town	Mapitlula	Musiphana East
Babanana	Marironi	Musiphana West
Bokuta	Mavele	Nkamboko
Botludi	Mawa 12	Nwamitwa
Fobeni	Mawa 8	Pjapjamela
Fofoza	Mawa 9	Relela
Gamokgwathi	Mbekwena	Rikhotso
Ga-Wally	Miragoma	Rikhotso North
Jokong	Moleketla	Runnymede
Jopi	Mookgo 6	Ruwanda
Ka-Mswazi	Mookgo 7	Semarela
Ka-Xihoko	Mofapalala	Senakwe
Kobjana	Moruji	Seopeng
Lerejene	Morwashetla	Serolorolo
Lwandlamuni	Mothoment	Sethone
Mabyepelong	Motupa	Thako
Madumane	Mpopye	Thapane
Mandlakazi	Mugwazini	

Source : DWA. EVN, Urban-Econ, 2007

Current Population

The population of the Greater Tzaneen Local Municipality was 375 587 in 2001, which is 45% of the total population of the Groot Letaba Catchment of 834 975 in 2001 (Urban-Econ Report; SA Statistics 2001 Census). This information is given in **Table 3.3** (reproduced Table 2 from the Urban-Econ Report).

Table 3.3 Population distribution for relevant local municipalities in the secondary study area

District	1996	2001	Growth Rate 1996 to 2001	2007
Limpopo Province Total	**4 520 529**	**4 995 533**	**2.02%**	**5 632 403**
Mopani District Municipality Total	**956 352**	**1 061 454**	**2.11%**	**1 203 125**
Greater Giyani LM Total	217 442	239 283	1.93%	268 364
Greater Letaba LM Total	202 069	220 105	1.72%	243 819
Greater Tzaneen LM Total	340 321	375 587	1.99%	422 723
Ba-Phalaborwa LM Total	107 813	131 092	3.99%	165 778
Maruleng LM Total	87 355	94 385	1.56%	103 571
Kruger Park North LM Total	1 353	1 002	-5.83%	699
TOTAL SUB-AREA of Greater Giyani + Greater Letaba LM + Greater Tzaneen LM	**759 832**	**834 975**	**1.90%**	**934 800**

Source : Urban-Econ calculations based on Census 1996 and 2001 data, 2007.

The population in the Greater Tzaneen Local Municipality in 2007 was estimated to be 422 723 based on an annual growth rate of almost 2%.

The most recent estimation of the population in the Greater Tzaneen Local Municipality was 459 485 in 2007. This appeared in Section D2 of the latest *Water Services Development Plans 2008 for Mopani District Municipality* (Mopani WSDP, 2008). Of this, an estimated 34 900 live in the town of Tzaneen.

Current Water Requirements

The current day water requirements for the Greater Tzaneen Local Municipality are given in **Table 3.1**, along with those for other municipalities in the catchment. The section of **Table 3.1** relevant to the Greater Tzaneen Local Municipality is extracted here as **Table 3.4**.

Table 3.4 Primary Water Requirements for the Greater Tzaneen Local Municipality

Place Name	Water Requirement in Mm^3/a			
	Usage 2000	Allocation 2006/7	Usage 2006/7	Value used as base value for Future Projections
Haenertsburg	0.04	0	0	0
Tzaneen Town	5.50	2.4+1.2 = 3.6	2.2+1.0 = 3.2	3.6
Politsi	0.14	2.0	2.1	2.0
Duiwelskloof	0.41			
Ga-Kgapane	0.35			
Letsitele	0.26	0.4	0.3	0.3
Ritavi 1 *[1]	0.73	0	1.9	1.9
Ritavi 2	2.66	3.5	8.2	8.2
Naphuno	1.30	1.7	1.3	1.3
Bolobedu *[2]	2.56	0.2	0.2	0.2
Namakgale	Groundwater*[4]	0	0.8	0.8
Sub total	**13.95**	**11.4**	**18.0**	**18.3**
Giyani *[3]	0.98	3.7	3.7	3.7

*1 Ritavi 1 is included in supply area for the proposed Nwamitwa Dam
*2 Part of Bolobedu falls outside of the Greater Tzaneen Local Municipality. It is also included in supply area for the proposed Nwamitwa Dam
*3 Giyani obtains water from both the Groot Letaba catchment and the Middle Letaba catchment. Giyani is included in the supply area for the proposed Nwamitwa Dam.
*4 Groundwater was used exclusively until 2006/2007 when groundwater was supplemented with surface water from Tzaneen Dam
*5 Based on Historical Firm Yield for Thabinia Dam
*6 Based on Historical Firm Yield for Modjadji Dam

The town of Tzaneen has a total allocation of 3.6 Mm^3/a. Part of this allocation (2.4 Mm^3/a) is from Ebenezer Dam, and the rest (1.2 Mm^3/a) from Tzaneen Dam. Their total usage in 2006/2007 was 3.2 Mm^3/a, which is less than their total allocation. This is the most recent estimate obtained from the Greater Tzaneen Local Municipality, and is believed to be more reliable than the water use in 2000 of 5.5 Mm^3/a, reported by Urban-Econ and repeated in **Table 3.4**. The water use for 2000 was obtained from the *"Luvuvu and Letaba Internal Strategic Perspective (ISP)"* (DWAF, 2007).

The settlement of Ritavi 2 used 8.2 Mm^3/a in 2006/2007, which was more than double its allocation of 3.5 Mm^3/a. The overall usage in the Greater Tzaneen Local Municipality, (2006/7) was 18.0 Mm^3/a, which exceeds its total allocation of 11.4 Mm^3/a, indicating that there is the need to increase the water supply to this Local Municipality. Part of Ritavi 1 and Bolobedu fall within the supply area of the proposed Nwamitwa Dam.

3.1.3 Ritavi 1 (area to be supplied by proposed Nwamitwa Dam)

The bulk water supply system serving the current Ritavi 1 area draws its water from a weir in the Great Letaba River. Raw water is pumped through a 300 mm diameter pipe to a raw water storage dam at Nkamboko WTW. The Nkamboko WTW currently has a capacity of 6 Ml/d (2.2 Mm^3/a), and is in the process of being upgraded to a 12 Ml/d WTW (4.4 Mm^3/a).

The bulk water supply system was first constructed in the period pre-1994, whereafter a significant number of upgrading and extension works have been undertaken to the system. The most recent of the extension works was the construction of a 5 Ml command reservoir at Serolorolo and a 315 mm diameter rising main from Nkamboko WTW to Serolorolo command reservoir. The 5 Ml command reservoir has, however, not been operational since construction due to a lack of supporting infrastructure.

No records of the flow leaving the Nkamboko WTW were available, but it is estimated that the current water usage is approximately 1.9 Mm^3/a.

3.2 PROJECTED PRIMARY WATER REQUIREMENTS FOR THE GROOT LETABA CATCHMENT

The projected primary water requirements for the Groot Letaba Catchment, the Greater Tzaneen Local Municipality and Ritavi 1 (the area to be supplied by the proposed Nwamitwa Dam) are described below.

3.2.1 Groot Letaba Catchment

Future domestic water requirements for the Groot Letaba catchment were projected by Urban-Econ using three different methods, as described in Section 4 of **Appendix B**. A base water requirement of 22.0 Mm^3/a in 2006/2007 was used as a starting point for all the projections. All three methods involved determining population growth rates and then using these growth rates to apply to the base value water requirements (**Table 3.1)** in order to project future water requirements up to 2030.

For the purposes of these projections, it is assumed that growth in Polokwane's requirements will be met from outside the Letaba Catchment, and that there is no growth in the industrial requirement.

(a) Method 1

The first method made use of a range of three population growth rates (low, medium and high) for the entire catchment as a whole. Pease refer to **Table 18** in **Appendix B** for the growth rates and projections used. The results of this method was to give a range of projected water requirements for the Groot Letaba in 2030, from 29.97 Mm^3/a for the low growth rate, to 36.18 Mm^3/a for the medium growth rate, to 46.98 Mm^3/a for the high growth rate.

(b) Method 2

The second method made use of separate population growth rates for each main settlement area, and projected the growth in water requirements independently. Please refer to **Table 21** in **Appendix B** for the growth rates and projections used.

This method resulted in the water requirement for the Groot Letaba Catchment only increasing from 22.0 Mm^3/a in 2007, by 12.31 Mm^3/a to 34.31 Mm^3/a, in 2030. This projected water requirement lies slightly below the medium growth scenario of Method 1. Method 2 was chosen to be the most representative of the three methods and was adjusted by adding more recent information as discussed in Section 3.2.1(d).

(c) Method 3

The third method was a combination of the two methods, using the "medium" growth rate from Method 1 to apply to each separate settlement area. As expected, this method came to the same result as for the medium growth scenario for Method 1 (see **Table 21** from the Urban-Econ Report in **Appendix B**).

(d) More recent estimates

During the course of the study, further estimates of future water requirements were made for the area around Nwamitwa Dam, based on more detailed work in the area (DWAF, 2008).

The more recent estimates resulted in considerably higher values for Ritavi 1 and Bolobedu (this includes Thapane, Modjadji and parts of the Worcester-Mothobeki and the Lower Molototsi areas) and Naphuno than are shown in **Table 3.6**. The higher estimates were added to the 2030 water requirements to get a total water requirement for 2030. The estimates assumed are for a high level of service, and are explained as follows :

Thapane	-	3.2 Mm^3/a
Modjadji	-	6.44 Mm^3/a
Worcester-Mothobeki	-	0.95 Mm^3/a
Lower Molototsi	-	0.92 Mm^3/a
Sub-Total		11.51 Mm^3/a (11.35 Mm^3/a higher than the estimate of 0.16 Mm^3/a Bolobedu in Method 2)
Ritavi 1	-	5.2 Mm^3/a (3.17 Mm^3/a higher than the estimate of 2.03 Mm^3/a in Method 2)
Naphuno	-	2.9 Mm^3/a (1.94 Mm^3/a higher than the estimate of 0.96 Mm^3/a in Method 2

Total recent estimate for Naphuno, Bolobedu and Ritavi 1 = 19.61 Mm^3/a (2.9+11.51+5.2 Mm^3/a) 16.46 Mm^3/a higher than the estimate of 3.15 Mm^3/a (0.16+2.03+0.96 Mm^3/a) in Method 2.

Based on the above calculations, the additional annual water requirement based on the higher service levels is estimated to be 16.46 Mm^3/a. If this additional volume of 16.46 Mm^3/a is added to the volume of 34.31 Mm^3/a in 2030 obtained from Method 2, a total future water requirement of 50.77 Mm^3/a is obtained. This figure falls above the high scenario projection for Method 1 of 46.98 Mm^3/a in 2030.

The values discussed above are shown in **Table 3.5**, which brings together the Method 2 estimates from **Appendix B** and the additional volumes for certain areas from the more recent estimates.

(e) Summary

The three methods give a water requirement range of between 29.97 Mm^3/a (Method 1, low scenario) and 46.98 Mm^3/a (Method 2, high scenario) for the Groot Letaba Catchment in 2030. The water requirement for the medium growth scenario ranges between 34.31 Mm^3/a (Method 2) and 36.18 Mm^3/a (Method 1, medium scenario). If the more recent estimates for the area around the proposed Nwamitwa Dam are used, a total future water requirement of 50.77 Mm^3/a is obtained, which is closer to the high scenario of 46.98 Mm^3/a. It is recommended that the higher value of 50.77 Mm^3/a be used for the purposes of this study.

The results of the water requirement projections provided by using all three methods indicate an ever-increasing population which translates directly into an increased requirement for water. Bearing in mind that the current water supply schemes are largely over-allocated, this indicates that the need to supply more water will continue to intensify in future.

Table 3.5 Projected Water Requirements in 2030 using Method 2 (Table 21 from Urban-Econ Report in Appendix B)

Domestic use	Annual Percentage Growth[*1] Rate (%/a)	Water requirements in Mm³/a					
		2007[*2]	2030[*2] (Method 2)	Growth between 2007 and 2030 (Method 2)	Additional growth due to increased service levels	Total future growth	Future estimate 2030 (recommended)
Haenertsburg	5.92	0.0	0.00	0.00	--	0.00	0.00
Tzaneen	6.84	3.6	16.49	12.89	--	12.89	16.49
Politsi	0.00	0.31	0.31	1.38	--	1.38	3.38
Duiwelskloof	5.08	0.91	2.85				
Ga-Kgapane	-5.32	0.78	0.22				
Letsitele	5.39	0.3	1.00	0.70	--	0.70	1.00
Ritavi 1 *[3]	0.28	1.9	2.03	0.13	3.17	3.30	5.20
Ritavi 2	-2.31	8.2	4.79	-3.41	--	-3.41	4.79
Naphuno *[3]	-1.33	1.3	0.96	-0.34	1.94	1.6	2.90
Bolobedu *[3]	-1.06	0.2	0.16	-0.04	11.35	11.31	11.51*[4]
Namakgale	Groundwater	0.8	0.80	0.0	--	0.0	0.80
Sub-total (excl. Giyani)	**0.27**	**18.3**	**29.61**	**11.31**	**16.46**	**27.77**	**46.07**
Giyani	1.05	3.7	4.70	1.0	--	1.0	4.70
TOTAL	**1.32**	**22.0**	**34.31**	**12.31**	**16.46**	**28.77**	**50.77**

(Source: *1 Urban-Econ Calculations from DWA statistics
*2 Urban-Econ Calculations using DWA population growth rates and demands used in Bridging Study)
*3 Note that updated estimates (DWAF, 2008) show higher growth rates for these three areas
*4 This figure for Bolobedu is made up of the following areas: Thapane (3.2 Mm³/a) + Modjadji (6.44 Mm³/a) + Worcester-Mothobeki (0.95 Mm³/a) + Lower Molototsi (0.92 Mm³/a) = 11.51 Mm³/a.

3.2.2 Greater Tzaneen Local Municipality

As mentioned previously, the most recent estimation of the population in the Greater Tzaneen Local Municipality was 459 485 in 2007 (Mopani, 2008 WSDP). The population projections for this local municipality are given in **Table 3.6.**

Table 3.6 Present and projected population in the Greater Tzaneen Local Municipality

Year	Population Estimation/Projection
2007	459 485
2017	504 489
2027	549 763

Source : Mopani WSDP 2008. Section D2)

These populations projections were made using annual population growth rates ranging from 1.009% per annum in 2026, to 1.017% per annum in 2004 (Ref : Section 1.1.1.3 of 2008 Mopani, WSDP). The range of growth rates used by Urban-Econ varied from 1.3% (low) to 3.3% (high). Please refer to **Table 16** in **Appendix B**.

Actual water requirement figures for the town of Tzaneen for the period 1976 to 2007 are shown in **Figure 3.1**. The Municipality advised against using the water consumption figures pre-1997 as there was a concern about the accuracy of this information. For the period 1997 to 2003, the annual growth in water requirement averaged at approximately 7.8 % per annum. The average growth rate for the period 2004 to 2007, was 3.65% per annum. The growth in water requirement for Tzaneen Municipality suggested by Urban Econ is 6.84% per annum (see **Table 3.5** of this report). Given the recent water restrictions in the area it is difficult to ascertain the actual unrestricted water requirements as well as the future projected growth in water requirement.

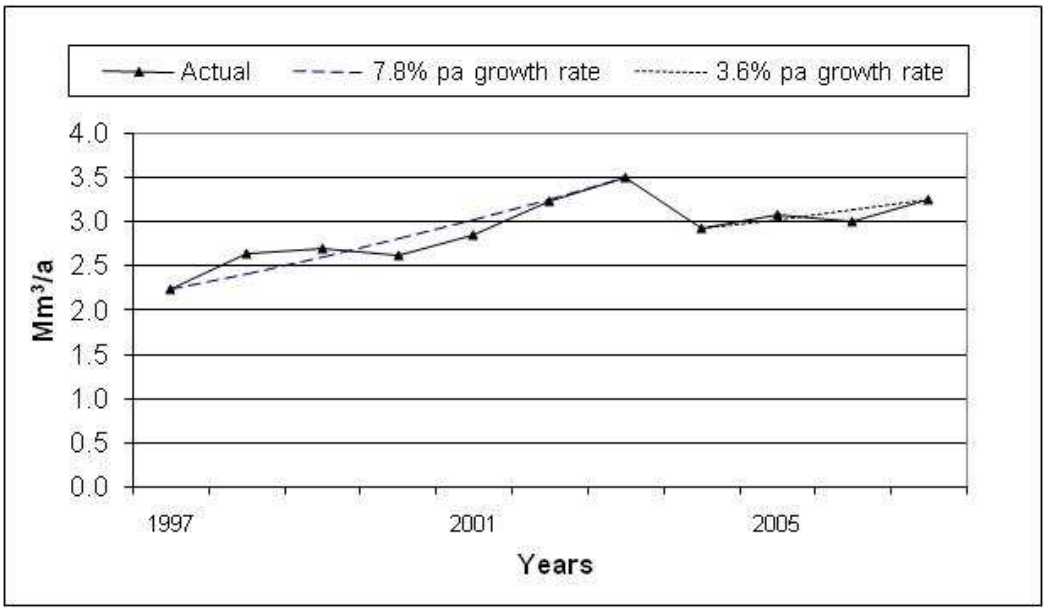


Figure 3.1 Historical water requirements for Tzaneen Town

3.2.3 Ritavi 1 (area to be served by the proposed Nwamitwa Dam)

EVN were appointed by DWA Limpopo Regional office to undertake a water services planning study to determine the future water requirements, potential supply zone and connector bulk infrastructure required for the area to be supplied from the proposed Nwamitwa Dam. The GLeWaP Report: *Bulk Water Distribution Infrastructure* details the outcome of this investigation. The GLeWAP 2027 *High Service Level Scenario Water Requirement* figures, received from EVN, were used to determine the 2027 infrastructure requirements and have also been included in this section of the report to give an indication of the possible future potential primary water requirement from Nwamitwa Dam. The High Service Level Scenario was chosen as the basis upon which to design the future infrastructure requirements as this represents the Water Service Authorities ultimate goal of providing water to each household as opposed to the current system of communal stand pipes.

The supply systems (sub-systems) which are to be supplied by the proposed Nwamitwa Dam are:

- the Worcester-Mothobeki sub-system,
- the Lower Molototsi sub-system,
- parts of the Greater Giyani sub-system,
- the Ritavi/Letaba system (Letaba system), and
- the Thapane system

It is estimated that the 2027 water requirement (excluding the water requirement which can be supplied from Thapane Dam) to provide a high service level to the above mentioned sub-systems is approximately 11.2 Mm^3/a (excluding bulk water supply losses). In addition to the 11.2 Mm^3/a, the proposed Nwamitwa Dam may also have to supplement a water resource shortfall in the Modjadji system by approximately 1 to 2 Mm^3/a. This could make the primary water requirement on the proposed Nwamitwa Dam to be in the order of 13 Mm^3/a. Currently the water requirement in the Ritavi 1 area is 1.9 Mm^3/a. The current water requirements for the other sub-systems are not known, as water requirement figures were not available. The proposed supply areas to be served by the proposed Nwamitwa Dam are shown in **Figure 3.2** , and the water volumes discussed above are summarised in **Table 3.7**.

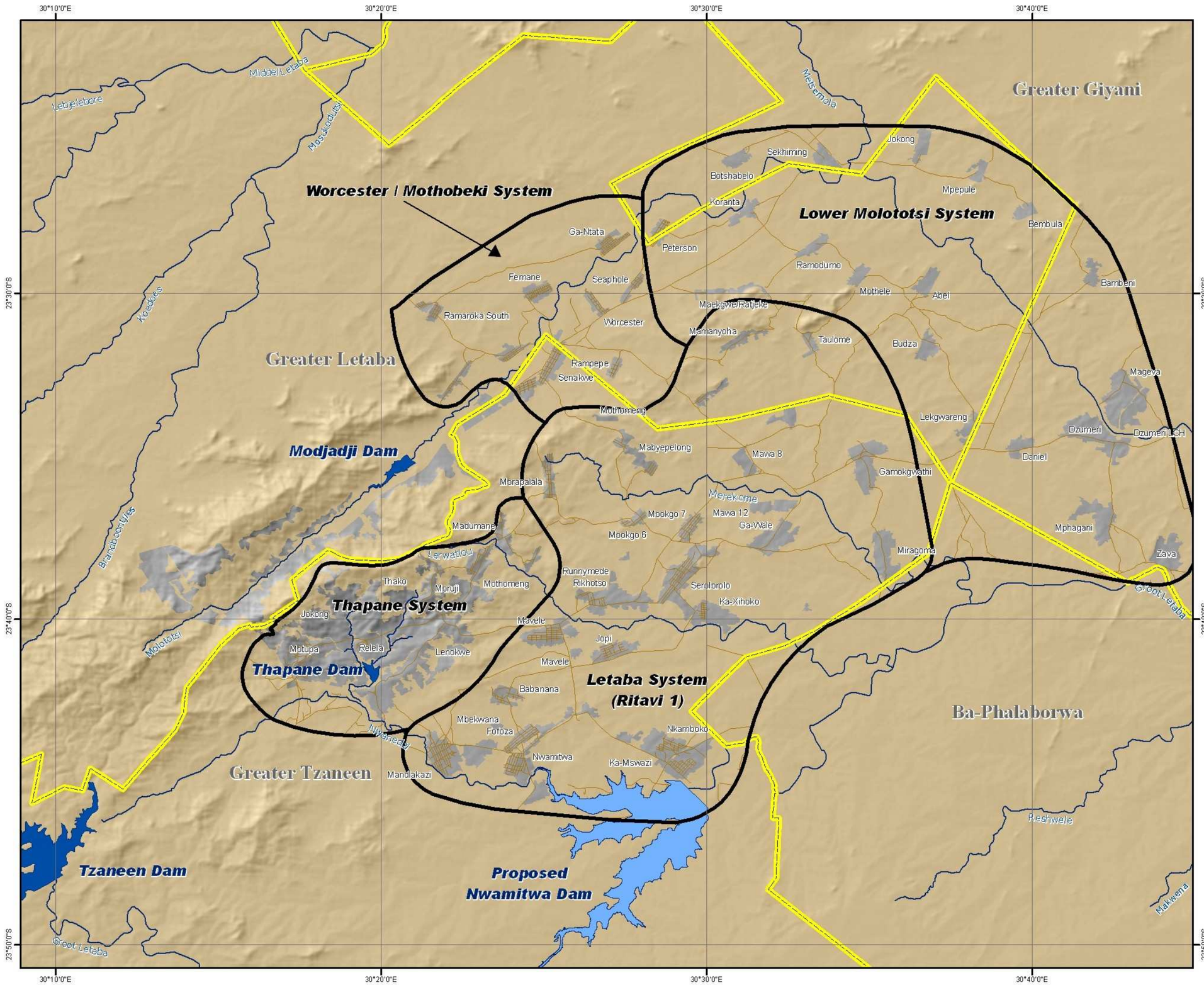
Table 3.7 Primary Water Requirements from Tzaneen and Proposed Nwamitwa Dam

Source		Current Usage (Mm^3/a)	Additional Requirement (Mm^3/a)			Total Future Requirement (Mm^3/a)
Existing and future sources	Tzaneen Dam (includes Ritavi 1)	13.9*[1]	10.18 (12.89 – 3.41 + 0.7)*[2]			22.18 (13.9-1.9*[3] + 10.18
	Nwamitwa Dam (excludes current groundwater use)		Ritavi 1	5.2	±13	±13
			Thapane (excludes Thapane Dam)	1.8		
			Worcester Mothobeki	0.95		
			Lower Molototsi	0.92		
			Giyani	2.29		
			Deficit in Modjadji	1 to 2		
TOTAL					**23.18**	**35.18**

*1 Includes Ritavi 1
*2 See **Table 3.5**
*3 Ritavi 1 useage to be supplied by proposed Nwamitwa Dam in future

3.2.4 Future Mining Developments

The potential future mining developments identified during the course of the study are described below. These new developments will require an estimated total of 21 Mm^3/a. None of these potential water requirements were included in this Bridging Study, as it is expected that they will need to be supplied from outside of the Groot Letaba Catchment.


30°10'0"E
30°20'0"E
30°30'0"E
30°40'0"E
23°30'0"S
23°40'0"S
23°50'0"S
Greater Giyani
Greater Letaba
Greater Tzaneen
Ba-Phalaborwa
Worcester / Mothobeki System
Lower Molototsi System
Letaba System (Ritavi 1)
Thapane System
Modjadji Dam
Thapane Dam
Tzaneen Dam
Proposed Nwamitwa Dam
Middel Letaba
Liebjelebore
Masuikoduiss
Koedoes
Broadcomyles
Molototsi
Nwaheda
Groot Letaba
Makwena
Reshwele
Merekome
Lerwatlou
Nkambako
Sekhiming
Jokong
Botshabelo
Koranta
Mpepule
Bembula
Bambeni
Ga-Ntata
Peterson
Ramodumo
Femane
Seaphole
Mothele
Abel
Ramaroka South
Worcester
Maekgwe/Ratjeke
Mamanyoha
Taulome
Budza
Rampepe
Senakwe
Mageva
Mohlomeng
Lekgwareng
Dzumeri
Dzumeri LOH
Mabyepelong
Mawa 8
Daniel
Gamokgwathi
Mbrapalala
Mookgo 7
Mawa 12
Ga-Wale
Mphagani
Madumane
Mookgo 6
Miragoma
Zava
Runnymede
Rikhotso
Thako
Moruji
Mothomeng
Serolorolo
Ka-Xihoko
Jokong
Mavele
Jopi
Motupa
Relela
Lenokwe
Babanana
Mbekwana
Fofoza
Nkambako
Nwamitwa
Ka-Mswazi
Mandlakazi
OVERVIEW MAP:
Study Area
Study Area
LEGEND
Secondary Roads
Rivers
Dams
Villages
Proposed Supply Areas of Nwamitwa Dam
Municipalitiy Boundaries
PATH:
s/projects/H401775/mxd/Reports/Water_Require/fig3.2.mxd
SCALE
0
2.5
5
7.5
km
PROJECTION INFORMATION:
COORDINATE SYSTEM : Transverse Mercator
PROJECTION NAME : TM 31
DATUM : D_WGS_1984
SPHEROID : WGS_1984
CENTRAL MERIDIAN : 31
CONSULTANT:
aurecon
water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA
TITLE:
GROOT LETABA RIVER WATER DEVELOPMENT PROJECT
PROPOSED SUPPLY AREA OF NWAMITWA DAM
FIGURE NO.:
3.2

(a) Gravellotte Heavy Minerals Mine

There are plans to start a new mine in 2014, with a lifespan of at least 10 years. The mine would be located on portions of the following farms: Rubbervale, Quagga, Gravelotte, Mon Desir, Solomons Mine, Free State and Begin. The water requirement is estimated to be 5 Mm^3/a. (source: e-mail correspondence between Hendrik Graham (Exxaro Resources) and Hermien Pieterse (BKS) dated 30 January 2008, and 15 February 2008).

(b) Tivani Mine (Red River Mining Project)

There are plans to start a new mine in 2010, beginning production in 2012. The mine would be located approximately 25 km south-east of Tzaneen Dam at Mohlaba's location (567LT). The water requirement is estimated to be 1 Mm^3/a during construction and 13 Mm^3/a during production (previously estimated at 8.3 Mm^3/a). The developers expect that this water will be supplied from the Groot Letaba River or the Phalaborwa barrage (or Lepelle North). Limited use of groundwater will be possible during construction. During production, some water will be sourced from mine dewatering and local runoff. The potential for use of treated effluent from Tzaneen Municipality will be investigated. The mine will utilise water reclamation and re-use procedures to the maximum (Source: e-mail correspondence between Jon van Zetten (developer) and Hermien Pieterse (BKS), dated 1 and 12 February 2008).

(c) Expansion of existing mine by Metorex Group

There are plans to expand the existing mine on the farm Josephine, 9 km from Gravelotte, beginning immediately, with the expansion being complete in 2009. The water requirement is estimated to be 2.5 m^3/s in 2008, and 3 m^3/s in 2009. This water requirement includes water that will be provided to Gravelotte, farmers, and 600 RDP houses in addition to water required by the mine. The developers expect that this water will be supplied from the current abstraction points on the Groot Letaba River and 6 km downstream of Nwamitwa (Source: e-mail correspondence from Hermien Pieterse (BKS), dated 1 February 2008, documenting a discussion held with Mr Allen Dodds of Metorex Group).

Table 3.8 Summary of Current and Projected Primary Water Requirements

Description	Place Name	Water Requirements in Mm³/a				
		Allocation 2006/7	Usage 2006/7	Base Value used for Future Projections *1	Estimated Growth to 2030	Total Future Water Requirements (2030)
(Domestic use in Groot Letaba catchment upstream of confluence with Klein Letaba River	Haenertsburg	0.0	0.0	0.0	0.0	0.00
	Tzaneen Town	3.6	2.2 + 1.0 = 3.2	3.6	12.89	16.49
	Politsi	2.0	2.1	2.0	1.38	3.38
	Duiwelskloof					
	Ga-Kgapane					
	Letsitele	0.4	0.3	0.3	0.70	1.00
	Ritavi 2	3.5	8.2	8.2	-3.41	4.79
	Naphuno	1.7	1.3	1.3	1.60	2.90
	Namakgale	0.0	0.8	0.8	0.00	0.80
	Ritavi 1	0.0	1.9	1.9	3.30	5.20
	Bolobedu	0.2	0.2	0.2	11.31	11.51
	Sub-total	**11.4**	**18.0**	**18.3**	**27.8**	**46.07**
Domestic use in Middle and Klein Letaba Catchments	Giyani *3	3.7	3.7	3.7	1.0	4.7
	Cumulative Sub-total	**15.1**	**21.7**	**22.0*2**	**28.8**	**50.8**
	Middle Letaba Dam WTW	2.3	2.3	2.3	No estimate made*3	--
	Sub-Total	**6.0**	**6.0**	**6.0**	**--**	**--**
Cumulative Sub-total		**17.4**	**24.0**	**24.3**	**--**	**--**
Domestic use outside of Letaba Catchment	Polokwane	18.5	4.6 + 18.8 = 23.4	23.4	No estimate made*3	--
Sub-total for domestic use		35.9	47.4	47.7	--	--
	Industrial use	3.3	1.5	1.5*2	--	--
Overall total of primary water requirements		**39.2**	**48.9**	**49.2**	**--**	**--**

*1 Note that where the base value differs from the allocation in the previous column, this was based on actual water usage in 2006/7
*2 Current day primary water requirement for Groot Letaba Catchment = 23.5 Mm³/a (22.0 Mm³/a domestic + 1.5 Mm³/a industrial)
*3 Growth in water requirements to be met from outside Letaba catchment

3.3 SUMMARY OF PRIMARY WATER REQUIREMENTS

The existing and future primary water requirements in the study area are summarised in **Tables 3.8** and **3.9**. **Table 3.8** contains estimates for those future requirements that are expected to be met from the Groot Letaba Catchment. The future mining requirements are summarised separately in **Table 3.9** because it is anticipated that they will be supplied water from outside of the Groot Letaba Catchment.

A table summarising the water use, allocations and yields from existing sources and the possible future water requirements up to 2030 is provided in **Section 7.1 (Table 7.2)**. The additional water use required by the year 2030, based on the projections by Urban Econ, EVN and information received from possible future developments, amounts to an additional volume of 23.18 Mm^3/a, as shown in **Table 3.8** in **Section 3.2.3.**

Table 3.9 Summary of Water Requirements of Potential New Mines

Source	Potential Future Water Requirement (Mm^3/a)
Tivani Mine	13
Gravelotte Heavy Minerals Mine	5
Expansion of existing Metorex Mine	3
Total	**21**

4. IRRIGATION REQUIREMENTS AND LOSSES

4.1 IRRIGATION REQUIREMENTS

A significant portion of the irrigation requirements in the study area (90.5 Mm^3/a excluding losses) is controlled by the Groot Letaba Water Users Association (GLWUA), which obtains its water from Tzaneen Dam. The remaining irrigation requirements (124.5 Mm^3/a including losses) are those of individual users who obtain the water from farm dams and rivers. They are not controlled by a specific Water User Authority (WUA). The irrigation requirements were analysed according to these two categories, and are also reported on in this way.

The two categories of users have different conditions of supply which affects the calculation of water allocated, specifically regarding losses. Transition losses are allowed for as part of the allocation to the GLWUA, and these are estimated in Section 4.2. It is assumed that the irrigation requirement for individual users including losses (i.e. gross requirement).

The irrigation requirements were deteremined based on a number of different sources of data which are listed below:

- An initial study of a general nature undertaken by Schoeman & Vennote of the irrigation taking place in the Groot Letaba Catchment. This did not form part of this Bridging Study. The report is entitled *Groot Letaba River Catchment, Section 9B (1c) Abstraction and Storage Control, Field Survey* (DWAF, 2007).

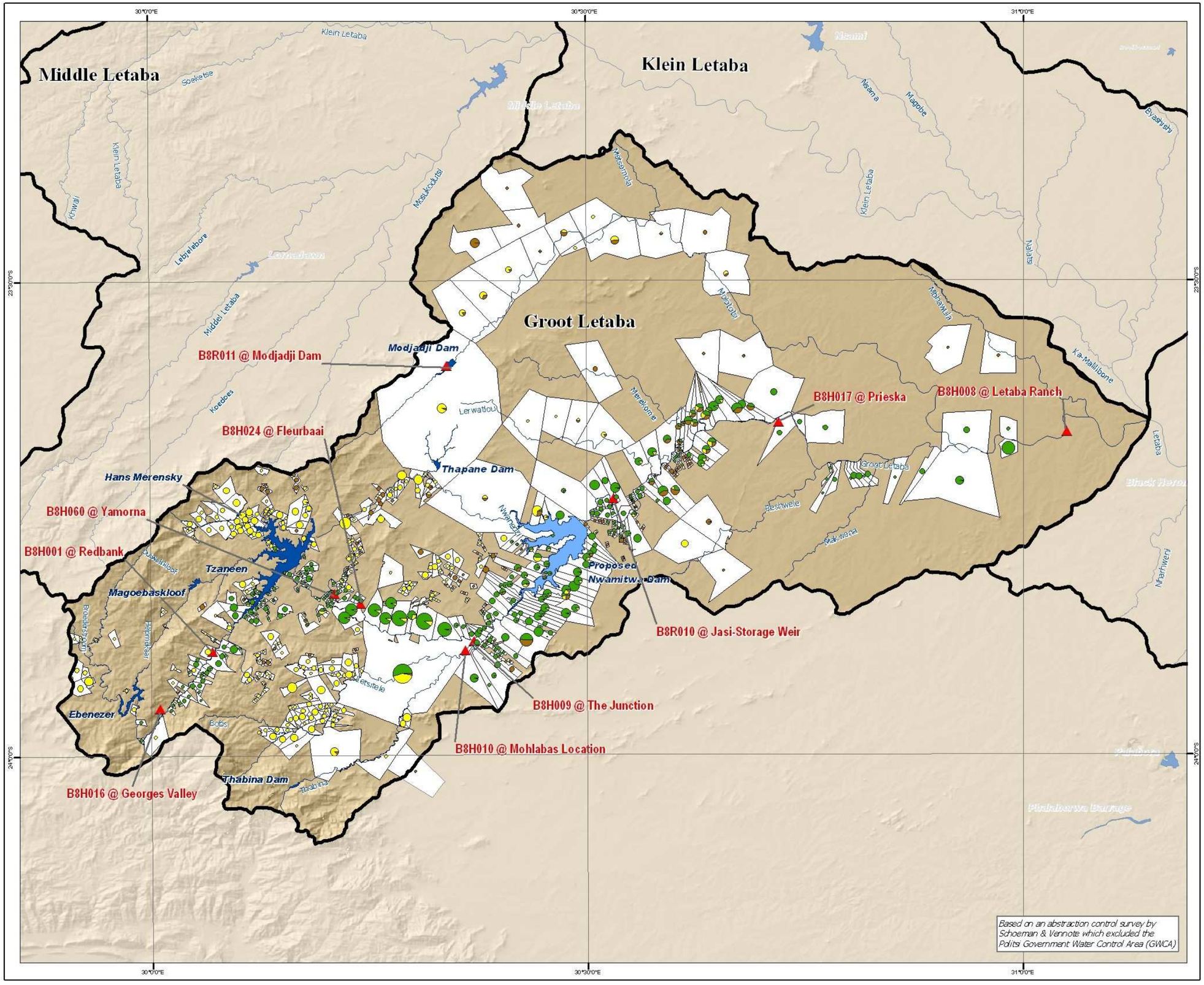
- The second study by Schoeman & Vennote which was commissioned as part of this Bridging Study. The outcome of this study is documented in a report entitled *Groot Letaba Study : Irrigation Assessment*, and contains a detailed field survey of the irrigated areas and storage on each of the erven in the Great Letaba River Catchment. A copy of this report is contained in **Appendix C**.

- Other sources, for example white papers, documentation from WUA's and the DWA.

The available data was analysed and a representative data set of present day irrigation requirements was built up. This was a complex process and assumptions were necessary in order to reconcile the different sources of data. Detailed information regarding the process followed and assumptions made are provided in **Appendix D**, mainly for future studies which will require this information. The results of the analysis and the data set decided upon are presented in this section.

The distribution of the irrigated areas and the relative proportion supplied from groundwater, the GLWUA and from other sources (recycled water and municipal sources) is illustrated schematically in **Figure 4.1.**

The application rate for crops in the Groot Letaba varies significantly from the cooler regions upstream of Tzaneen Dam down to the high evaporation areas of the lowveld. The scheduled application rate has been divided into three zones of 662, 892 and 1 090 mm/a. According to White Paper J of 1971, these rates are gross rates including an allowance for river channel/transmission losses and the field edge application rates are about 77% of the gross application rate. Though the White Paper is dated 1971, the application rates and allocated hectares form the basis for water allocation in the catchment and are still quoted by the irrigators and by DWA officials managing the system. The allocations to different consumers from Ebenezer and Tzaneen Dams are summarised in **Table 4.1** entitled Agricultural water allocations from the Government Water Supply Scheme in the Groot Letaba Catchment.


Middle Letaba
Klein Letaba
Groot Letaba
Modjadji Dam
B8R011 @ Modjadji Dam
B8H024 @ Fleurbaai
B8H017 @ Prieska
B8H008 @ Letaba Ranch
Thapane Dam
Hans Merensky
B8H060 @ Yamorna
B8H001 @ Redbank
Tzaneen
Magoebaskloof
Proposed Nwamitwa Dam
B8R010 @ Jasi-Storage Weir
B8H009 @ The Junction
B8H010 @ Mohlabas Location
Ebenezer
B8H016 @ Georges Valley
Thabina Dam
Letsitele
Lerwatlou
Mareikone
Great Letaba
Reshwele
Makwena
Nsama
Magobe
Byashishi
Mabjadji
Mphawuila
Ka-Mallilibone
Letaba
Nsami
Middle Letaba
Klein Letaba
Speketse
Khwali
Lebrelebore
Mesukoduasi
Magoebaskloof
Koedoes
Middel Letaba
Hans Merensky
Bobbejaankloof
Hermanskraal
Bobbs
Thabina
Nsami
Nsamai
Nsami
Nsami
Nsami

Using the application rates from the White Paper, and the current scheduled areas, the gross allocation of the GLWUA is 118 Mm^3/a (see **Table 4.1**). Factoring the gross requirement by 77% gives the field edge requirement of 90.5 Mm^3/a, allowing for losses of 23% or 27.5 Mm^3/a.

Table 4.1 Agricultural water allocations from the Government Water Supply Schemes in the Groot Letaba Catchment

Consumer	Area (ha)						Allocation Mm^3/a (including losses)		
	Ebenezer Dam		Tzaneen Dam			Total	Ebenezer	Tzaneen	Total
	Rainfall zone		Rainfall zone						
	1	2	1	2	3				
	Application rate m^3/ha								
	6 620	8 920	6 620	8 920	10 900				
Georges Valley Canal	389.2					389.2	2.6	0.0	**2.6**
Pusela Canal	822.5	174				996.5	7.0	0.0	**7.0**
N&N Canal				224	937.7	1 161.7	0.0	12.2	**12.2**
Letaba North Canal				2 240.1	809.5	3 049.6	0.0	28.8	**28.8**
River Pumps	515.9		199.4	512.7	2 346.4	3 574.4	3.4	31.5	**34.9**
Ledzee Canal				134.5			0.0	1.2	**1.2**
Dept Land Affairs				277.7	2 647.5	2 925.2	0.0	31.3	**31.3**
Total	**1 727.6**	**174**	**199.4**	**3 389.0**	**6 741.1**	**12 096.6**	**13.0**	**105.0**	**118.0**

Ref: I:\HYDRO\401775\WRYM\INPUTS\Fixed Irrigation Area Recordsva.xls sheet "allocation".xls

The total demands of the GLWUA are estimated to be 90.5 Mm^3/a and the total demands of the local irrigators are estimated to be 124.5 Mm^3/a, giving a total irrigation requirement of 215 Mm^3/a. These irrigation demands are asummarised in **Table 4.2**. A detailed breakdown of the irrigation demands in the Letaba is presented in **Appendix D**, mainly to assist further analysis of the demands in further studies.

Another breakdown, indicating the river reaches where the irrigation demands apply in the WRYM, is included in the *Water Resource Analysis* Report (DWA, 2010b) in the table describing the inflows and demands used in the present day analysis of the Letaba Catchment.

Differences in irrigation demands were found when the results of the 1995 Feasibility Study was compared to the 2007 Bridging Study Analysis. These are listed below:

- The local demands supplied upstream of Tzaneen Dam increased by 8 Mm^3/a.
- Increase of 29 Mm^3/a along the Groot Letaba River from Tzaneen Dam to the Letaba Ranch. Part of this increase was as a result of incorporating the proposed (as opposed to existing) supply of 22 Mm^3/a to emerging farmers downstream of the

Nondweni Weir. The Feasibility Study reported that 7.9 Mm³/a was supplied to the Masalal canal but this has not been maintained and is now unusable.

Table 4.2 Summary of Irrigation Requirements

Description	Field edge requirement (excluding losses) Mm³/a		
	Local Users	GLWUA	TOTAL
Groot Letaba Catchment	73.1	90.5	163.6
Middle Letaba	37.4	N/A	37.4
Klein Letaba	14.0	N/A	14.0
Grand Total	124.5	90.5	215.0

The areas irrigated by boreholes were provided by the Schoeman & Vennote study (**Appendix C**). The same reduced irrigation application rates determined for the GLWUA were applied to these areas. These reduced application rates reduced the supply from boreholes from the 3.29 Mm^3/a reported in the Schoeman & Vennote report to 29 Mm^3/a (see **Table 4.3**).

Table 4.3 Irrigation supplied from groundwater in the Groot Letaba Catchment (excluding the Politsi GWCA)

Sub-quaternary/quinary	Area irrigated from boreholes (ha)	Application rate scaled to obtain correct field edge allocation for the GLWUA (m^3/ha)	Requirement from boreholes (Mm^3/a)
A01	0	426	0.0
A10		426	0.0
B01	221	426	0.9
B10	0	426	0.0
B12	8	426	0.0
B14	1	426	0.0
B16	3	426	0.0
B20	16	426	0.1
B30	96	426	0.4
C01	1	574	0.0
C10	379	574	2.2
C15	63	574	0.4
D01	4	574	0.0
D10	9	574	0.1
D13	6	574	0.0
D16	25	574	0.1
D28	19	574	0.1
E01	427	574	2.4
E10	136	701	1.0
E20	244	701	1.7
E23	105	701	0.7
E25	473	701	3.3
E30	45	701	0.3
F01	156	701	1.1
F10	55	701	0.4
F20	270	701	1.9
F30	1197	701	8.4

Sub-quaternary/quinary	Area irrigated from boreholes (ha)	Application rate scaled to obtain correct field edge allocation for the GLWUA (m^3/ha)	Requirement from boreholes (Mm^3/a)
G01	338	701	2.4
G10	4	701	0.0
H01	63	701	0.4
H10	53	701	0.4
J01	23	701	0.2
J10	0	701	0.0
Total	4439		29.0

4.2 LOSSES

The Kruger National Park (KNP) is located at the lower end of the Groot Letaba Catchment and the impact of any upstream development on the KNP must be considered. The losses that will be incurred by releases intended for the KNP were estimated using the decrease in streamflow occurring between the Letaba Ranch (B8H008) (**Figure 4.2)** and the Black Heron Weir (B8H034) (**Figure 4.3**) in the Groot Letaba River. Both of these weirs have low flow notches to improve the accuracy of low flow measurement. The losses vary significantly, depending on the antecedent flow conditions. The Black Heron Weir also measures the contribution from the Klein Letaba River. The gauge on the Klein Letaba (B8H033) is 100 km from the Black Heron Weir and, for the purposes of this analysis, periods when this contribution (shown in green) were minimal were selected. The portions of record selected for further analysis are shown in red on **Figure 4.4**. The decrease in flow during the selected period was approximately 0.185 m^3/s over the 26 km stretch, or 0.0071 m^3/s/km.

Table 4.4 shows how the lengths of the different reaches and the loss per km were used to estimate the losses along each river reach. In some cases, such as the reach from Tzaneen Dam to the Letsitele confluence, the river bed is relatively narrow and rocky and the losses were reduced accordingly. Most of the data in **Table 4.4** was extracted from the *Basin Study Report: Annexure 17 Water Losses* (DWAF, 1990b) or from Google Earth.

The losses for the portion from Tzaneen to Letaba Ranch (about 0.814 m^3/s or 25.6 Mm^3/a) are similar to the scheduled allowance for losses described in White Paper 71J. The losses downstream of the Letaba Ranch are not caused by irrigation releases but by trying to meet EWR requirements in the KNP.

The losses determined in this manner correspond to losses measured during periods of low flow. The yield of the system is affected by the average losses over the critical draw-down period. Analyses were completed assuming that the average loss rate was

some factor of the loss measured during periods of low flow. The factors used varied between 0.0, 0.5 and 1.0.

When determining the losses relevant to irrigators it was assumed that the canal seepage losses and irrigation return flows were of the same magnitude and could be ignored.

The losses are substantial and are estimated to range from zero to a maximum of 76.1 Mm³/a for the Letaba River up to its confluence with the Olifants River. The assumptions used to estimate these losses are very important as they have a significant effect on the yields of the dams in the system.

The losses for the catchment of the Groot Letaba River up to the Letaba Ranch (flow gauge B8H008) are estimated to be 28.7 Mm³/a. If one adds this to the estimated field edge irrigation requirement (i.e. excluding losses) of 163.6 Mm³/a mentioned earlier (**Table 4.2**), the total irrigation requirement (including losses) for the Groot Letaba Catchment is estimated to be 192.3 Mm³/a.



Figure 4.2 Letaba Ranch Weir (B8H008)



Figure 4.3 Black Heron Weir (B8H034)

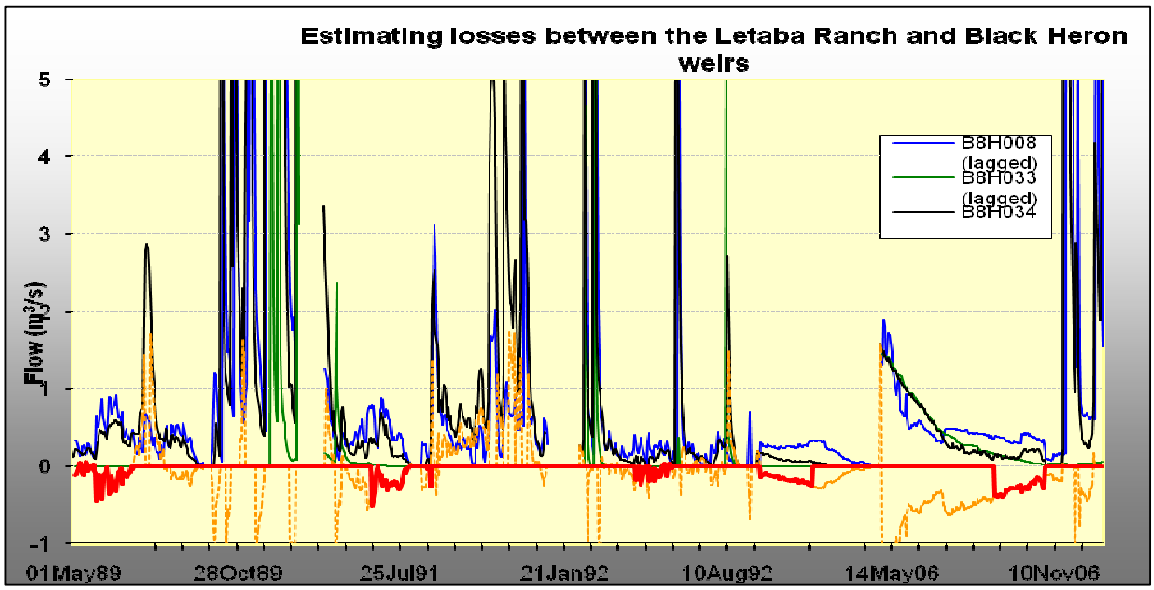


Figure 4.4 Observed losses between Letaba Ranch (B8H008) and Black Heron (B8H034) weirs

Table 4.2 Estimating River Channel Losses for Reaches along the Letaba River

Reach	Channel material	Slope (1 in ..) [1]	Distance [1] (km)	Length factor	Effective length	Combined lengths	Channel width 1	Vegetation width	WRYM Channel number	Loss	
										(m^3/s)	(Mm^3/a)
Column a	**b**	**c**	**d**	**e**	**f=d*e**	**g**	**h**	**i**	**j**	**k=f*0.0071m^3/s/km**	**l**
Upstream of Tzaneen Dam – assumed value										**0.095**	2.996
Tzaneen to Letsitele	rocky	150	37	20%	7.4		3-15	100			
Letsitele to Nwandezi	sand	400	21	100%	21	35	10-50	150	568	0.252	7.947
Nwanedzi to Nwamitwa	sand	600	7	100%	7		10-30	100-200			
Namitwa to Prieska Weir	sand	600	28	100%	28	28	30-60	100-300	430	0.199	6.276
Prieska Weir to Molototsi	sand	600	35	100%	35	51	10-30	100-200		0.363	11.448
Molototsi to Letaba Ranch	3m sand	750	16	100%	16		30-60	100-300	473		
Sub-total for Groot Letaba Catchment (losses affecting GLWUA)										0.909	28.7*
Letaba Ranch to Klein Letaba confluence	3m sand	750	15	100%	15	26	30-60	100-300	582	0.107	3.374
Klein Letaba confluence to Black Heron Weir	3m sand	750	11	100%	11		assumed 30-60	assumed 100-300	591	0.078	2.460
Klein Letaba River from B8H033 to confluence	sand	700	100	100%	100	100	30-60	100-300	669	0.712	22.454
Black Heron to EWR 6	unknown	727	22	100%	22	22.1	assumed 30-60	assumed 100-300	688	0.157	4.951
EWR6 to EWR 7	unknown	727	23	100%	23	23	assumed 30-60	assumed 100-300	689	0.164	5.172
EWR7 to Olifants confluence	unknown	727	40	100%	40	40	assumed 30-60	assumed 100-300	690	0.285	8.988
Sub-total downstream of the Groot Letaba Catchment										1.503	47.4
Total	**--**	**--**	**355**	**--**	**286**	**--**	**--**	**--**	**--**	**2.412**	**76.1**

Extracted from Tzn15.xls sheet "GrossLosses (2)"

** Estimated gross irrigation requirement (including river channel losses) for the Groot Letaba Catchment is 163.6 (from **Table 4.2**) + 28.7 = 192.3 Mm^3/a*
** Estimated gross irrigation for the Groot, Middle and Klein Letaba Catchments is 215.0 (from **Table 4.2**) + 28.7 = 243.7 Mm^3/a.*

5. AFFORESTATION

5.1 INTRODUCTION

Significant areas of exotic plantations (afforestation) and some indigenous forests occur in the wetter parts of this study area, mainly in areas with an average MAP of around 900 mm. These areas are concentrated in the upper reaches of the Groot Letaba, Letsitele, and Middle Letaba and Klein Letaba River Catchments. Afforested areas are planted with mainly gum tree species (*Eucalyptus*), with pine tree species (*Pinus spp*) being planted to a lesser extent. In the previous studies, the areas covered with forest in 1925 were assumed to be indigenous forests, since the afforestation industry only began to grow significantly from 1930 onwards.

There is very little likelihood of further development of afforestation in the catchment, since the Letaba Catchment was categorised as "Category 1" in terms of the 1984 Forestry Act (Act 122 of 1984), which implies that new licences will not be permitted in the catchment (DWA, 1998). This happened as far back as 1972.

Updated information on the forestry areas (indigenous and afforested) and the growth of the areas was obtained from Schoeman & Vennote. Please refer to their report which is contained in **Appendix C**.

The areas of afforestation in the catchment for 2005 conditions were obtained by marking up areas under plantations on the 2005 aerial photographs. The type of trees in each area was also noted, and these areas were digitised to provide a 'time slice' of information regarding the extent of afforestation in the catchment for 2005. This 2005 time slice was used as input to the rainfall-runoff model to generate a time series of monthly water use by that area of afforestation. In some areas of the catchment, up to date aerial photography was not available, for example the Middle Letaba and Klein Letaba catchments. Satellite images of these areas were obtained, and it was evident from these that not much development had taken place since the Basin Study (1990). So for these catchments, the areas of afforestation in 2005 were assumed to remain at the levels for 1990 used in the Feasibility Study.

The areas of afforestation in 2005 that were used for modelling purposes in this Bridging Study are summarised in **Table 5.1**. It should be noted that the final areas of afforestation adopted in the Bridging Study differ in some cases from those provided by Schoeman & Vennote in order to be compatible with the existing hydrology which was being extended.

The total afforestation area modelled in the B81 catchment in the Bridging Study has 283 ha, compared to the area of 344 ha provided by Schoeman & Vennote. The differences were concentrated in the quaternary sub-catchments B81B and B81C. This difference should be investigated when the hydrology is revisited.

Table 5.1 Afforestation Areas in the Letaba Catchment for 2005

Quaternary drainage region	Total afforested area (km^2)			
	Provided by Schoeman & Vennote		Total area modelled in Bridging Study	
B81A	95.6	344	95.5	283
B81B	177.0		103.17	
B81C	10.5		27.5	
B81D	38.4		34.5	
B81E	17.2		17.2	
B81F	0.0		0	
B81G	5.6		5.6	
B81H	0.0		0	
B81J	0.0		0	
B82A	Not available		4	75
B82B			17	
B82C			28	
B82D			7	
B82E			11	
B82F			7.5	
B82G			0	
B82H			0	
B82J			0	
B83B	Not available		0	0
B83C			0	
B83D			0	
B83E			0	
Sub-total B83 A-E			0	
Total	**Not available**		**358**	

5.2 AFFORESTATION WATER USE

The water requirements of afforestation modelled in this Bridging Study were compared to the afforestation requirements from the previous study. This comparison is summarised in **Table 5.2**. In most sub-catchments, there were differences in the

average afforestation requirements between the two studies. The Bridging Study afforestation requirements were adjusted in order to match the afforestation requirements in the previous study, so that the average flows for the common period would remain the same.

Table 5.2 Summary Water Use by Afforestation

Sub-catchment Name	Afforested area in 2005 used in Bridging Study (km^2)	Water use by afforestation (Mm^3/a)		Factor used to adjust Bridging Study results to match pre-feasibility results	Water use by afforestation (Mm^3/a	
		Pre-feasibility Study (SSI) (1925-1987)	Bridging Study (1925 - 1987)		Bridging Study after adjustment	
					1925 -1987	1925 - 2004
B8R001 – Ebenezer Dam catchment	95.5	11.2	6.2	1.8	11.2	15.0
B8R005 – Tzaneen Dam catchment	103.2	29.7	22.7 (incl B81B)	1.3	29.7	40.1
BH009 and B8H010	62.0	7.4	8.9	0.8	7.4	10.1
B8H017	17.2	2.8	1.7	1.6	2.8	4.2
B8H008	5.6	0.0	0.5	1.0	0.0	0.0
Ungauged sub-catchment downstream of B8H008 to confluence with Klein Letaba (J01)	0.0	0.0	0.0	1.0	0.0	0.0
Middle Letaba	74.5	5.7	3.2	1.8	5.7	8.1
Klein Letaba	0	0.0	0.0	1.0	0.0	0.0
Groot Letaba downstream of confluence with Klein Letaba, to entry to KNP	0	0.0	0.0	1.0	0.0	0.0
TOTAL	**358.0**	**56.7**	**43.4**	**1.3**	**56.7**	**77.6**

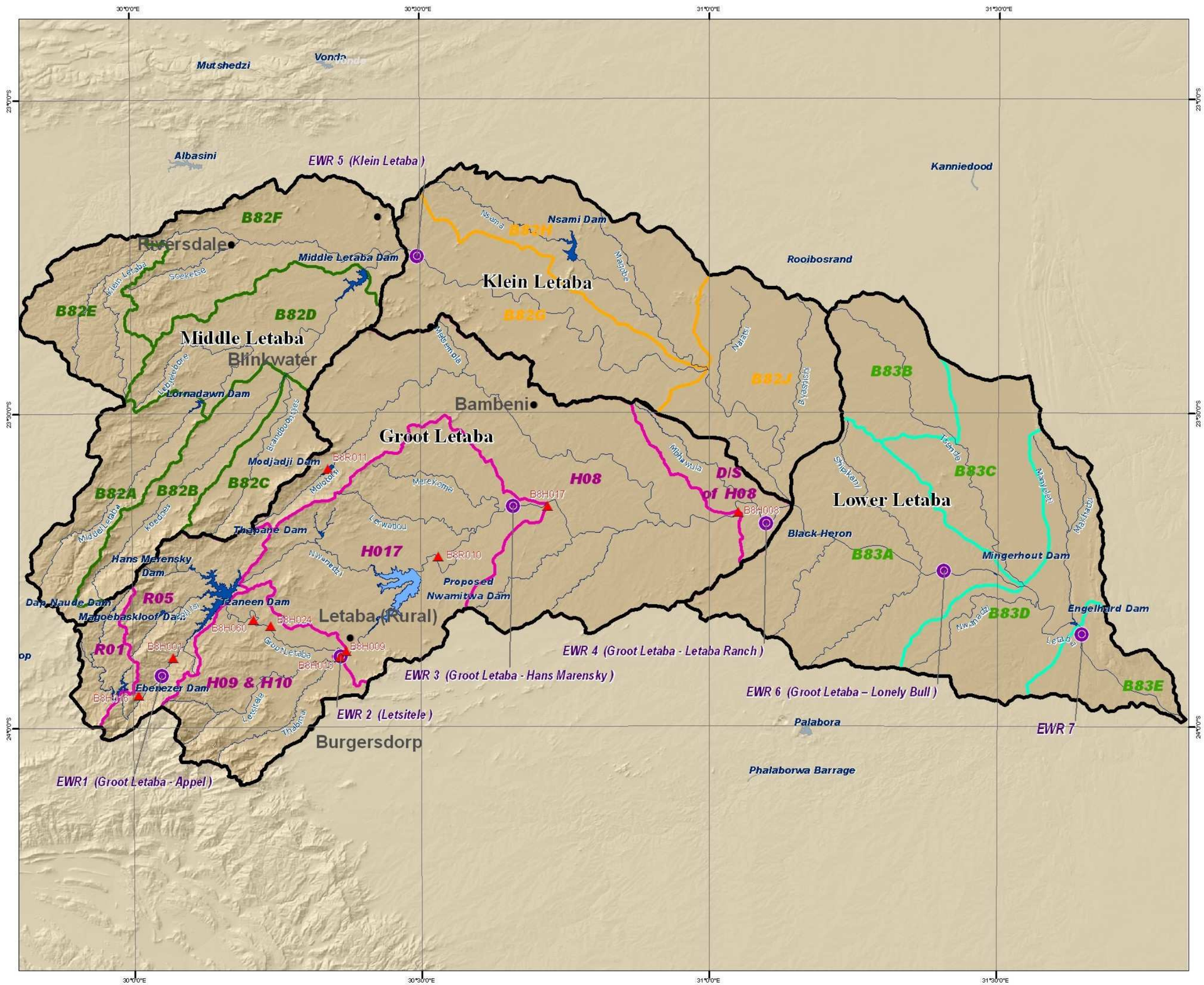
In most cases, the adjustments increased the water use by afforestation, giving an overall increase of 13 Mm^3/a.

The final volumes of current day (2005) water use by afforestation used in the Bridging Study are also summarised in **Table 5.2**.

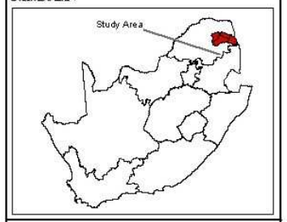
6. ECOLOGICAL RESERVE

In 1994/1995 EWR sites were selected. Their positions are shown on **Figure 6.1**. The following were adhered to in selection of these sites:

- the locality of gauging weirs with good quality hydrological data
- the locality of the proposed developments
- the locality and characteristics of tributaries
- the habitat integrity/conservation status of the different river reaches
- the reaches where social communities depend on a healthy river ecosystem
- the suitability of the sites for follow-up monitoring
- the habitat diversity for aquatic organisms, marginal and riparian vegetation
- suitability of the sites for accurate hydraulic modelling throughout the range of flow, especially low flows
- accessibility of the sites



OVERVIEW MAP :



LEGEND

- Towns
- Weirs
- Ecological Water Requirements
- Rivers
- Dams
- Groot Letaba Study Catchments
- Middle Letaba Sub Catchments
- Klein Letaba Sub Catchments
- Groot Letaba Sub Catchments
- Lower Letaba Sub Catchments

PATH: s/H401775/mxd/Reports/Water_Require/fig61_ewr.mxd

SCALE: 0 5 10 15 20 25 km
1:620,000

PROJECTION INFORMATION :

COORDINATE SYSTEM :	Transverse Mercator
PROJECTION NAME :	TM 31
DATUM :	D_WGS_1984
SPHEROID :	WGS_1984
CENTRAL MERIDIAN :	31

CONSULTANT :

aurecon

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

TITLE :

GROOT LETABA RIVER WATER DEVELOPMENT PROJECT

Positions of EWR Sites

FIGURE NO :

6.1

Some adjustments were made in 1996 and again during the Reserve Determination Study, with regard to the actual location of the EWR sites, in consideration of the hydraulics at representative cross-sections. An additional two sites, one between Ebenezer and Tzaneen Dams on the Groot Letaba River and the other downstream of the confluence of the Middle and Klein Letaba Rivers, were selected during the Reserve Determination Study.

Hydrology at EWR sites

Each quaternary catchment was split into relevant sub-catchments in order to apportion natural runoff at the individual EWR sites.

Present day hydrology

Comparison of the natural and present flow gives a clear indication of the impact of the water resources development. Agriculture and domestic use are the major demand sectors in the system. The decline in present day flow, when compared to the natural flow, is mainly attributed to the large demand of irrigation in the Groot Letaba Catchment and Middle and Klein Letaba sub-catchments. According to the Letaba Reserve Determination Study (DWAF, 2006c), 14.8 Mm^3/a (0.47 m^3/s) was allocated from Tzaneen Dam and Nondweni weir to regulate the release. Of this, 6.06 Mm^3 was abstracted downstream for domestic use. The remaining 8.74 Mm^3 flowed to the KNP.

In 2007, the dam operator made an allowance of 0.6 m^3/s (18.9 Mm^3/a) from Tzaneen Dam for the KNP, so it seems that the KNP release has been increased. It is not clear however whether this release is made every year, or whether it was reduced during drought periods.

The Letaba Catchment Reserve Determination Study was commissioned because of the water stress in the Letaba Catchment. An outcome of this study was the development of the Preliminary Reserve for the catchment. It should be noted that the study did not take into account the proposed Nwamitwa Dam. A separate Reserve Determination Study for Nwamitwa Dam needs to be undertaken.

The ecological water requirements at key sites along the Groot Letaba River determined during the Reserve Determination Study are summarised in **Table 6.1** columns b, c and d summarise natural flow and the associated EWR supplied at the seven sites along the Letaba River. When the rule specifying the ecological requirements was modelled in the WRYM, slightly different ecological requirements were generated, as can be seen in column j. This is partly because the hydrology was updated and because the WRYM version used for the initial analysis limited the number of nodes that can be used to determine the natural inflow used to generate the ecological requirement.

The older WRYM.exe obtained with the data file from SSI was used for the analyses to avoid the problems encountered when changing to a new executable. This executable limited the number of nodes that could be used to determine the natural inflow used to generate the ecological requirement. Problems were in fact experienced when the version of the WRYM was changed to 7.5 as this version did not interpret the switch to use natural/present day flows correctly.

EWR releases are derived from two sources: explicit releases and accruals from relatively unregulated rivers. The timing of the flows in the unregulated tributaries might not always coincide with the flows specified by the rule, though they would still provide a valuable ecological function. For instance, the rule might specify a high flow in February when the actual streamflows provide a high flow in January. As a result, the streamflows contributing to the environment might exceed the minimum specified requirements for a certain category.

In the Reserve Determination Study, a reduced ecological requirement (Scenario 7) was specified on the understanding that the shortfall in the rule would be made up from unregulated streamflows. It was also specified without the proposed Nwamitwa Dam in place, and therefore relied on the unregulated inflow from the Letsifele River. As mentioned earlier, a Reserve Determination Study still needs to be undertaken for the proposed Nwamitwa Dam. Column f in **Table 6.1** describes this optimised scenario and indicates where the requirements were reduced by adopting a lower class or omitting flood requirements. The extent to which various EWR scenarios, including the optimised scenario, satisfied the EWR is discussed in the **Appendix B**: "Details of compliance with EWR sites 3 – 7" in the *Water Resource Analysis* Report (DWA, 2010b).

Unfortunately, the rule used to generate Scenario 7 was not available in the WRYM and the following procedure was adopted to estimate these rules :

- Enter natural MAR and the total maintenance (high plus low flow) requirements into IFREDIT.
- Use RESDSS to generate the baseflow requirement rule
- Use the baseflow rule to generate an EWR sequence in the WRYM
- Compare the MAR of this generated sequence with the required MAR and factor the generated sequence accordingly (i.e. factor in column L of **Table 6.1).**

River channel losses may also impact on the volume of water that needs to be released for the Reserve.

Table 6.1 Ecological Water Requirements at Key Sites along the Letaba River

EWR site	Total Requirement					Explicit supply – assume accruals contribute toward the total requirement					Bridging Study							
	Preliminary Reserve					Main Report (Table 11.1), Hydrology support and water resource evaluation (Section 6.1.14) and Appendix K					Natural MAR Total (Mm^3/a)	EWRs modelled in WRYM (1925 – 1986) *1						
						Optimised Scenario												
	Class	Natural (1922 – 1995)	EWR Requirement (Table F, Main Report)		Appendix K of Reserve Determination Report	"Optimised", i.e. Scenario 7 from Table 11.1 of Main Report (called Scenario 14 in Water Resource Report)		Required EWR Flow (Mm^3/a) from Section 6.1.14 of Resource Report	Required EWR Flow (Mm^3/a) from Appendix K		1925 – 1986	Total	Low flows	Possible low flow adjustment to obtain optimised scenario	Adjusted requirement	% MAR	Requirements in WRYM (1925 – 2004) (Mm^3/a) See Appendix B for flow sequences	
		Mm^3/a	Mm^3/a	% of natural MAR	Mm^3/a			Mm^3/a			Mm^3/a	Mm^3/a	Mm^3/a	% of natural MAR	Mm^3/a	% of natural MAR	Total	Low flows
Column a	b	c	d		e	f		g	h		i	j	k	L=g/k	m	n	o	p
1	C	72	20	28%	19	D		8	D	10	74	17	--	--	--	--	17.5	n.a.
2	D	86	32	37%	37	D		23	D	37	87	32	--	--	--	--	31.1*2	n.a.
3	C/D	365	42	12%	48	D	Omit annual flood of 50-90 m^3/s, keep 12-18 m^3/s floods	12	D	17	375	45	10.4	117%	12	3%	40.9	12.1
4	C/D	402	70	17%	75	D – low flow		16	D – low flow	7	417	82	13.8	115%	16	4%	72.2	15.8
5	C	95	17	18%	31	D	No floods > 5 m^3/s	6	D	18	95	17	8.3	74%	6	6%	14.9	5.3
6	C	547	47	9%	55	D – low flow	Supply shortfalls from Middle Letaba	9	D – low flow	5	536	52	13.5	63%	9	2%	45.9	8.4
7	C	562	52	9%	61	D – low flow	Supply shortfalls from Middle Letaba	13	D – low flow	8	552	57	18.8	67%	13	2%	50	12.3

*1 This shorter period enabled the system to be modelled down to Massingir Dam, as the streamflows in the Crocodile system feeding Massingir Dam only extended to 1986.
*2 Not enforced – outflows from Letsitele River Sub-system were used instead.

7. CONCLUSIONS

7.1 CURRENT WATER REQUIREMENTS AND AVAILABLE WATER SUPPLY

Obtaining sufficient reliable data was difficult, as detailed information about existing and future population and water use is not readily available. In most cases, estimations needed to be made to provide figures to work from. The water requirements discussed in this report are summarised in **Table 7.1**

Table 7.1 Summary of Water Requirements in the Groot Letaba Catchment

Description	Water Requirements in Mm^3/a		
	2007	**Additional to 2030**	**Total in 2030**
Primary – domestic (see **Table 2.11**)	22.0	28.8	50.8
Primary – industrial	1.5	0.0	1.5
Sub-total Primary	23.5	28.8	52.3
Irrigation (surface water) *[1]	192.3	0	192.3
Afforestation	77.6	0	77.6
Totals (excl. Environmental)	**293.4**	**28.8**	**322.2**
Primary – mining (to be supplied from outside the catchment)	0.0	21.0	21.0
Environmental *[2]	14.8 Mm^3/a = 0.469 m^3/s	min = 16 Mm^3/a max = 82 Mm^3/a for EWR Site 4	16 to 82 Mm^3/a at Site 4

*1 Irrigation supplied from surface water calculated from **Table 2.14** and **Table 2.16** (163.6 + 28.7). Irrigation supplied by groundwater is estimated to be an additional 29 Mm^3/a.

*2 Note that the Environmental Requirement (non-consumptive user) cannot be simply added to the other water requirements

The existing (2007) water requirements in the Groot Letaba Catchment total approximately 293 Mm^3/a. The water use, allocations and yields from existing surface water sources are consolidated in **Table 7.2**.

The yield of the existing major dams in the Groot Letaba catchment is 125.6 Mm^3/a which is substantially less than the current water requirements. Currently, the yield of most of the major surface water schemes is over-allocated. The result of this pressure on the available surface water supply is that the supply of water to the irrigation sector is curtailed to below their allocations on an ongoing basis. This is shown in the last two columns of **Table 7.2** where the irrigation requirement is 192 Mm^3/a and the actual volume supplied is 158 Mm^3/a.

Table 7.2 Summary of Existing and Future Sources and their Usage

Source		Historic Firm Yield (Mm^3/a)		Allocation			Current Primary Water Use 2006/7 (Mm^3/a)	Gross Irrigation Water Use Values used in this Study *[6]	
				Primary (Mm^3/a)	Irrigation (Mm^3/a)	Total [1] (Mm^3/a)		Requirement (Mm^3/a)	Supply (Mm^3/a)
Existing Sources	Dap Naude Dam	3.2		6.52	0.0	6.5	4.6	1.1	1.1
	Ebenezer Dam	23.9*[2]		14.4	12.9	27.3	21.0	13.0	10.5
	Magoebaskloof and Vergelegen Dams	9.1	15.9	3.0	11.9*[5]	8.3	2.1	12.0	11.6
	Hans Merensky Dam and Selokwe River	6.8			13.3*[3]		--	13.3	13.3
	Tzaneen Dam	74.6		8.4	105.0	113.4	13.7	105.5*[4]	85.0*[4]
	Thabina Dam	2.9	8.0	Uncertain 1.9		Uncertain 1.9	1.5	--	--
	Modjadji Dam	5.1							
	Total	125.6		34.2	143.2	177.4	42.9	144.9	123.8
	Local sources from d/s Tzaneen to confluence with Klein Letaba	--		--	47.3*[3]	47.3	--	47.3*[4]	36.5*[4]
	Overall Total	125.6		34.2	190.5	224.7	42.9	192.2	158.0

1. Please note that these totals are at different assurances of supply.
2. 1:50 year assurance.
3. Existing water use.
4. No irrigation allowed in the KNP below the Letaba Ranch weir. All losses below this point are not caused by irrigation and are not included in the gross irrigation requirement or supply.
5. Although Sapeko no longer uses its allocation, the allocation was assumed to continue as the Magoeba tribe wish to claim this allocation. Includes 11.0 from Magoebaskloof + 0.87 Mm^3/a from Debengeni Stream (of which 0.3 Mm^3/a actually domestic).
6. For more detail, please refer to the detailed table in the Water Balance section of the *Water Resource Analysis Report*.

The recent determination of the EWR has introduced an additional requirement, which has increased the pressure on the available surface water.

Water requirements are not mainly from surface water sources, with minimal use being made of groundwater. There is considerable potential for increasing the use of groundwater in the catchment, particularly in conjunction with surface water to improve the quality of the groundwater without expensive treatment.

7.2 FUTURE WATER REQUIREMENTS AND POTENTIAL FUTURE WATER SUPPLY

7.2.1 Primary water requirements

It is anticipated that the water requirement for primary water use from Tzaneen Dam and the proposed Nwamitwa Dam supply area will grow from 13.9 Mm³/a in 2007 to a value of approximately 35.2 Mm³/a in 2030 (refer to **Table 3.7** in **Section 3.2.3**). This additional growth in water requirement will need to be accommodated by the implementation of an additional water resource (e.g. raising of Tzaneen Dam, construction of the proposed Nwamitwa Dam or from groundwater schemes.). At present, Polokwane is using more than their quota from the Groot Letaba Catchment. **

7.2.2 Other future water requirements

It was assumed that irrigation and afforestation requirements would remain constant. Future mining requirements were estimated to be 21 Mm³/a (**Table 3.9** in **Section 3.3**). Because of the pressure on the water resources in the catchment, it was assumed that where possible, future water supplies for Polokwane and future mining operations would be found outside of the Groot Letaba Catchment.

8. RECOMMENDATIONS

The following recommendations regarding water requirements are made:

- Given the stressed nature of the available water resources and the anticipated growth in primary water requirements, it is important to undertake verification and validation of water use in the Groot Letaba Catchment.
- It is important that municipalities measure and monitor water use so that in future accurate modelling can take place.
- Due to the stressed resources and the cost of developing new resources, the implementation of water demand/water conservation measures in the catchment is strongly recommended.
- Since the losses in the system are so significant, further investigations should be undertaken to refine the assumptions used to determine “river losses”. This will enable the yields of dams in the system to be estimated with a higher level of certainty.
- When the hydrology for the Groot Letaba is revised, it is recommended that the water use of invasive alien plants be modelled as a separate water use.
- A regional study should be undertaken to further investigate increasing the use of groundwater in the catchment, particularly in conjunction with surface water.

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Appendix A : Demands used in WRYM

Domestic use		Allocation	Usage (Mm3/a	Feasibility study: Water Requirements and System Analysis (Note 3) 1995	aggregated 1995	2020	aggregated 2020	aggregated	Interpolated 2007	aggregated 2007	Main Report 2020 (Tables 5.3, 5.4 and 5.5) - Note 5	Bridging study WRYM	Aggregated Bridging WRYM	Source	Aggregated Bridging WRYM by source	Channel	Avg req (m3/s)
Polokwane (previously Pietersburg) (from Dap Naude)		6.5	4.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	6.5	6.5	Dap Naude	6.5	303	0.207
Polokwane (from Ebenezer)		12.0	18.8	13.5	13.5	13.5	13.5	13.0	13.5	13.5	12.9	12.0	12.0	Ebenezer	12.0		
Haenertsburg			0.0								0.1	0.00		Ebenezer		312	0.380
Politsi		2.0	2.1	1.52	1.5	5.16	5.2	2.4	2.7	2.7	1.2	2.0	2.0	Magoebaskloof	2.0	332	
Duiwelskloof														Magoebaskloof/Vergelegen/Hans Merensky			
Ga-Kgapane											1.2			Magoebaskloof/Vergelegen/Hans Merensky			0.063
Tzaneen (For Feasibility study this included growth at the Thabina and Modjadji Dams when this exceeded their capacity)	**Tzaneen u/s WTW**	2.4	2.2	3.95	13.4	25.53	51.7	38.1	9.7	22.6	18.2	2.4	16.3	Ebenezer	2.4	325(reuse)	0.075
	Tzaneen d/s WTW	1.2	1.0									1.2		Tzaneen	13.9	358	
	Industrial (Consolidated and Letaba Citrus Processors, Consolidated Murchison, Maranda Mining Co)	3.3	1.5	1.99		1.99			2.0		1.5	1.5		Tzaneen			
												0.0		Tzaneen			
Excess demand from Naphuno and Bolebedu shifted to Gt Letaba				0.00		7.34					5.25						
Letsitele		0.4	0.3	0.22		0.76			0.4		0.7	0.3		Tzaneen			
Ritavi 2	Nkowakowa	3.5	8.2	5.60		11.42			7.9		9.8	8.2		Tzaneen			
Ritavi 1	Mamitwa	0.0	1.9	1.59		4.70			2.7		2.7	1.9		Tzaneen			
Namakgale		0				-						0.0		Tzaneen			
	Nondweni	0	0.8									0.8		Tzaneen			
																	0.440
Naphuno		1.7	1.3	2.02	2.0	6.62	2.9	2.9	3.6	3.6	4.2	2.9	2.9	Thabina	2.9	391	0.090
Assumed Naphuno shifted to Gt Letaba / Tzaneen						-3.76					-1.4						
Bolobedu		0.2	0.2	0.00	0.0	7.95	4.4	4.4	0.2	0.2	8.3	5.1	5.1	Modjaji	5.1	468	0.162
Assume Bolebedu shifted to Gt Letaba / Tzaneen						-3.58					-3.9						
Groot Letaba Total		**33.2**	**42.8**	**36.0**	**36.0**	**83.3**	**83.3**	**66.4**	**48.2**	**48.2**	**66.4**	**44.8**	**44.8**		**44.8**		
Giyani		3.7	3.7									3.7	6.0	Middle Letaba/Nsami	6.0	632 (20Mm^3/a including irrigation+losses)	0.634
Middle Letaba Dam WTW		2.3	2.3									2.3				624	0.073
TOTAL		**39.2**	**48.8**									**50.8**	**50.8**		**50.8**		

Additional agricultural demands

1. **Feasibility Study Report. Volume 2. Water requirements and system analyses. Report PBB810/00/0398 Annexure A : Domestic and Industrial Water Use and Water Demand. Domestic from Table 7.**
2. **0.3 million m^3/a demand of SAPEKOE on the Debengeni R is included with SAPEKOEs agricultural demand**
3. **Feasibility Study Report. Volume 2. Water requirements and system analyses. Report PBB810/00/0398 Annexure A : Domestic and Industrial Water Use and Water Demand. Domestic from Table 9 and 10.**
4. **Excludes Debengeni to SAPEKOE**
5. **In Table 5.4 of the Feasibility Report there is an error and the individual rural domestic requirements add up tp 25.04 instead of the 29.01 quoted for Scenario 1 in 2020 (Possibly the total included Giyani, Lulekani and Namakgale 2). As a result the total industrial/domestic demand of 66.4 is less than the 70.4 reported in Table 5.6 of the Main Report**

Notes

The actual usage by Polokwane, Nkowakowa and Ritav1 exceeds the allocation by 13.4 million m3/a.
Assume Polokwane demand is limited to its allocation as it is external to the water supply system and might find an alternative water source
The estimate of the actual usage is 4.3 million m3/a less than the projected demand for 2007 and the adopted present day demands are about 2.3 million m3/a less thant the Feasibility Projection
If Thapane was modelled a target draft of 1Mcm/a could act on that dam

Appendix B : Water Requirements Report – Urban-Econ

2007

Groot Letaba Water Study
Task One – Water Requirements

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List of Acronyms

AIDS:	Acquired Immune Deficiency Syndrome
DWAF:	Department of Water Affairs and Forestry
HIV:	Human Immunodeficiency Virus
IDP:	Integrated Development Plan
ISP:	Internal Strategic Perspectives
LED:	Local Economic Development Plan
SEA:	Strategic Environment Assessment
WSDP:	Water Service Development Plan
WMA:	Water Management Area

CHAPTER 1 – ORIENTATION

1.1 PROJECT BACKGROUND

The Groot Letaba catchment falls within the Luvubu-Letaba Water Management Area (WMA), one of the 19 WMAs into which South Africa is divided. Human settlement, agricultural production and tourism between the Drakensberg escarpment and the Kruger National Park have placed demands on the water resources of the Groot Letaba River which can no longer be met within reasonable risks of shortages from the existing infrastructure.

Due to this situation the Department of Water Affairs and Forestry (DWAF) is reassessing how best to manage the supply of water from the Groot Letaba River system. The system includes Dap Naude Dam, Ebenhaezer Dam, Tzaneen Dam and other smaller dams. Practical implementation of water releases for the Reserve in the Groot Letaba River system as a whole is being investigated. Investigations include an assessment of the yield characteristics of all available resources in the river system serving the wide variety of user sectors and abstraction points.

A Feasibility Study, to investigate these needs, was conducted in 1998. As a result of the study it was proposed that the following be undertaken:

- construction of a large dam on the Groot Letaba River at the Nwamitwa site, downstream of the confluence of the Nwanezi River,
- realignment of the roads to accommodate the dam, and
- construction of bulk water pipelines and pump stations from the dam for water supply for domestic and industrial use in the area,
- Raising of the Tzaneen Dam wall be considered.

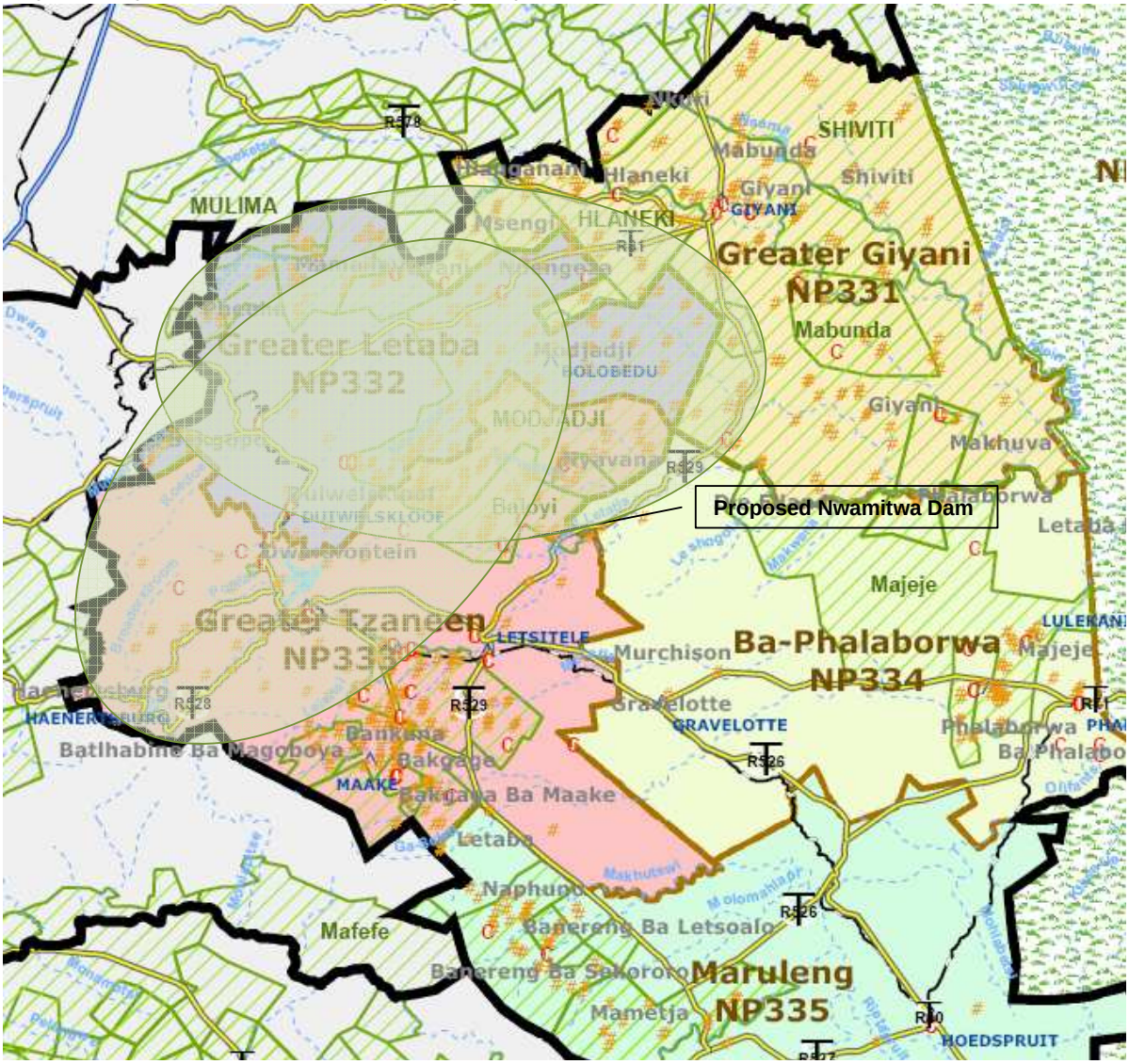
DWAF is now reviewing the water supply needs of the Groot Letaba catchment area and post feasibility bridging studies are being conducted to confirm whether the recommendations made previously are still relevant and how they should be taken forward.

1.2 PRIMARY STUDY AREA

According to the 1998 Main Feasibility Report regarding the Groot Letaba Water Resource Development, The Groot Letaba River is one of the main rivers draining the Drakensberg escarpment, eastwards through the Lowveld and the Kruger National park, to meet with the Olifants River in a spectacular gorge on the border with Mozambique. The Groot Letaba River has important tributaries draining a large portion of the northern part of the catchment area, namely the Middle Letaba River, Klein Letaba River and Shingwedzi River.

The proposed Nwamitwa Dam site falls in the Groot Letaba River catchment which is located in the Limpopo Province, 90km east of Polokwane, and covers approximately 5,000 km² between longitudes 30° 11' E and 31° 00 E' and latitudes 23° 15' S and 24° 00' S. The Groot Letaba River drains a catchment of 2885 km² with three main tributaries upstream of the Klein Letaba River, namely, the Letsitele River, the Nwanedzi River and Molototsi River.

Map 1: Graphical illustration of the primary study area



Source: Demarcation Board, 2007.

Based on early requested by the client, the original study area under consideration was the area around the proposed dam site with a 60 km radius around with included the District Municipalities of Mopani (DC33), Vhembe (DC34) and Capricorn (DC35). Later requests from the client necessitated that the study area to be brought in line with the study area considered by the earlier investigations into the proposed Nwamitwa Dam and the specific settlements that were considered to form part of the study area was cross checked with a database provided by the client originating from EVN Africa Consulting Services (Pty) Ltd. The final demarcated primary study area consists of settlements from the Greater Tzaneen, Greater Letaba and Greater Giyani Local Municipalities, all forming part of the Mopani District Municipality.

The Mopani District municipality is situated in the North-eastern part of the Limpopo Province, 70 km from Polokwane (main City of the Limpopo Province). It is bordered in the east by Mozambique, in the north, by Zimbabwe and Vhembe District Municipality, in the south, by Mpumalanga province through Ehlanzeni District Municipality and, to the west, by Capricorn District Municipality and, in the south-west, by Sekhukhune District Municipality. The district has been named Mopani because of abundance of nutritional Mopani worm found in the area. The district spans a total area of 2 242 183 ha (22 421.83 km²), with 15 urban areas (towns and townships), 325 villages (rural settlements) and a total of 106 wards. The Mopani District, by virtue of the Kruger National Park as a District Management Area, is part of the Great Limpopo Transfrontier Park, the park that combines South Africa, Mozambique and Zimbabwe[1].

Although the settlement names were checked, there are some discrepancies between the population sizes of the various settlements and therefore the study area as a whole, certain adjustments were made to accommodate these differences.

Before providing an overview of the size of the population located in the study area, it is important to note that the information provided by DWAF for the current assessment was obtained by them from the 2001 Census data, and therefore reflects the population in 2001 and this figure is adjusted by DWAF annually with the STATS SA population growth formulas. According to DWAF regular adjustments area made with regard to the Reference Framework Studies that are regularly undertaken.

1.3 PURPOSE OF THIS REPORT

The primary objective of this report was to review and update the findings regarding the water use requirements as set out in the 1998 Feasibility Study in order to ensure that the findings of that document are still in line with the current and potential future water requirements.

All existing information on historical, current and proposed water use in the study area was reviewed and where necessary and possible, updated. This report also utilized population projections, water use profiles, socio economic profiles and trend analysis to estimate future water requirements till 2030.

1.4 INFORMATION SOURCES

In this report, data was obtained from the following sources:

- Mopani District Municipality: They provided data in the form of IDP's en LED's. The district data have been collected from the Local Municipalities, which in turn got their data from DWAF and various field surveys.
- DWAF: The Department of Water Affairs and Forestry is the custodian of South Africa's water and forestry resources. It is primarily responsible for the formulation and implementation of policy governing these two sectors. It also has override responsibility for water services provided by local government. DWAF provided data on water related subjects and information.
- Quantec: Quantec Research (Pty) Ltd is a South African based consultancy. They focus on the marketing, distribution and support of economic and financial data, country intelligence and quantitative analytical software. They also provide consultancy in custom economic and financial database solutions, economic analysis and forecasting, and market analysis and segmentation.

[1] According to the Mopani District Municipality Reviewed IDP for 2007/08.

- Stats SA: They provide relevant and accurate body of statistics to inform users on the dynamics in the economy and society through the application of internationally acclaimed practices. They were helpful in providing personal and household data.

Additional data regarding the specific conditions in the study are concerning development and communities were obtained from:

- WSDP: Water Service Development Plan. Provided water services related information.
- ISPs: Internal Strategic Perspectives. The Internal Strategic Perspective (ISP) aims to ensure synergy within the Department of Water Affairs and Forestry (DWAF) regarding water resources management. The ISP presents a common and consistent departmental approach to guide officials when addressing water management related queries and evaluating water license applications. The ISP provided important data regarded the quaternary catchments that falls within the study area.

All of the above mentioned documents were used to review and update the previous 1998 Main Feasibility Report undertaken on the Groot Letaba Water Resource Development Project.

Apart from the time difference between the two studies, there are a number of aspects that might impact on the results of the investigations and therefore must be highlighted at this point in the document:

1. The study area that was used in the current study is somewhat bigger than the study area of the 1998 Feasibility assessment. The study area of the current study is set out in detail in the next chapter. It is however clear that study area in the current study is similar to that of the 1998 study with the difference of more focus falling on the rural settlements.
2. The information concerning the population and associated population growth were obtained from the Quantec and DWAF databases, and no fieldwork was undertaken.

1.5 DOCUMENT OUTLINE

The remainder of the document is set out as follow:

Chapter 2 – Provides an overview of the socio-economic conditions of the study area considered.
Chapter 3 –
Chapter 4 –
Chapter 5 –

CHAPTER 2 – SOCIO-ECONOMIC PROFILE

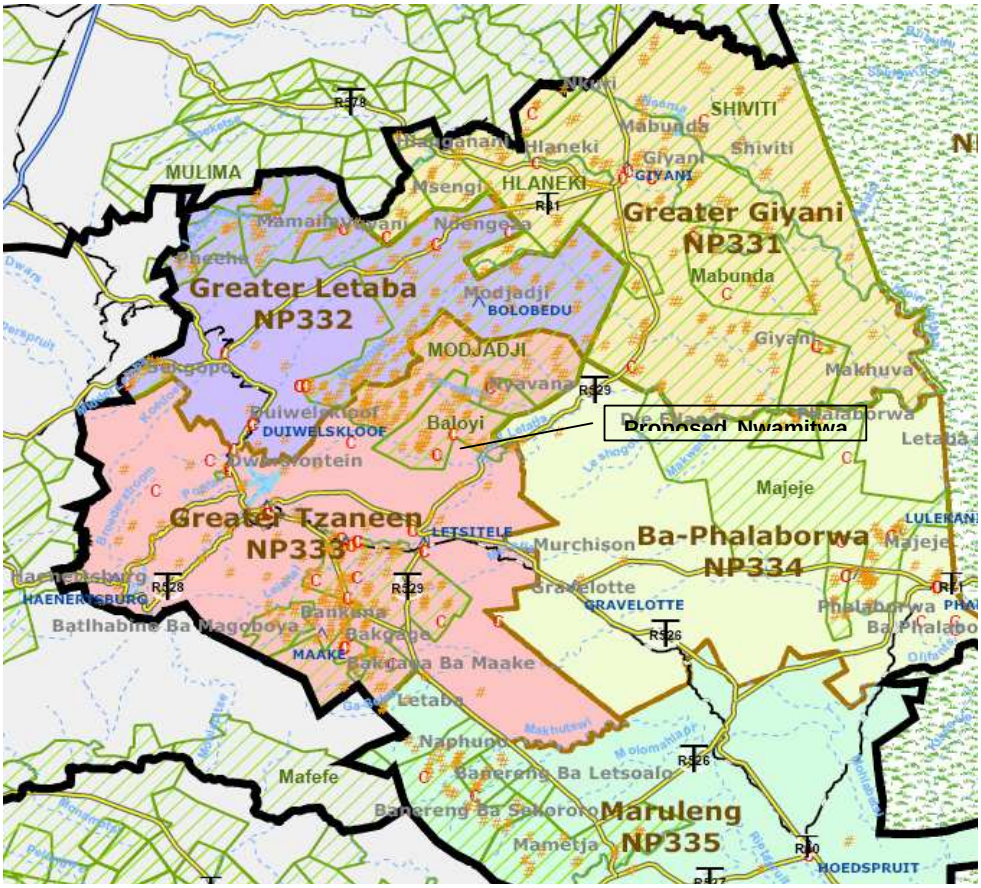
The aim of this chapter is to provide an overview of the current socio-economic conditions in the various municipalities located with the area of interest of the Nwamitwa Dam. Some of the areas within these municipalities are located directly within the primary study area. More specifically it should be noted that any demographic or economic changes in these municipalities or the so-called secondary study area will affect the settlements located in the primary study area or area of focus.

The remainder of this section will therefore provide an overview of the most prominent social and economic data regarding the secondary study area which could potentially have an impact on the primary study area.

2.1 LOCATION

The aim of this section is just to clarify the specific area that will be under consideration for the socio-economic assessment. The secondary study area is set out in the following map – it encompasses the three local municipalities that partially form part of the primary study area, namely the Greater Tzaneen, Greater Letaba and Greater Giyani Local Municipalities.

Map 2: Graphical illustration of the secondary study area



Source: Demarcation Board, 2007.

2.2 GROOT LETABA RIVER CATCHMENT

The proposed Nwamitwa Dam site falls in the Groot Letaba River Catchment. This river system can be divided into three sub-systems as follows:

- The Groot Letaba sub-system stretching down to its confluence with the Klein Letaba River.
- The Klein Letaba sub-system stretching to its confluence with the Groot Letaba River.
- The Lower Letaba sub-system which stretches from the confluence of the Klein and Groot Letaba Rivers to the confluence with the Olifants River just upstream of the border with Mozambique.

The above mentioned sub-systems can future be divided into quaternary catchments. The study area covers the full extent of the B81 tertiary catchment area as defined by the WR90 Quaternary Drainage Regions Map and measures about 5,000 km². It comprises the catchment of the Groot Letaba River and its major tributaries, the Letsitele, Nwanedzi and Molototsi Rivers.

The study area also includes the lower parts of the Klein Letaba Catchment which includes the B82A-B82D and B82G catchments.

Due to the fact that the aim of this document is to provide a review and update of the 1998 Main Feasibility Report concerning the current and anticipated future water requirements, the specific catchment information is not discussed at length but only included in the report in order to indicate a holistic understanding of the study area.

2.3 SOCIO-DEMOGRAPHIC OVERVIEW

2.3.1 Study area composition

The primary and secondary study areas have been explained in Chapter One as well as Section 2.1. The aim of this section is to provide the relevant socio-demographic data for the three relevant municipalities, and provide comparisons with the Mopani District and the Province where relevant or necessary to contextualize the information.

According to the DWAF database, compared to the EVN database and finally the adjusted Urban-Econ database used for the current assessment, the following settlements fall within the primary study area:

Table 1: List of Main Places within the primary study area

LOCAL MUNICIPALITY	SETTLEMENT
Greater Giyani Local Municipality	BAMBENI
	DANIEL
	DZUMERI
	DZUMERI ICH
	MAGEVA
	MPHAGENI
	ZAVA
Greater Letaba Local Municipality	ABEL
	BEMBULA
	BOTSHABELO
	BUDZA
	FEMANE
	GA-NTATA
	HLOHLOKWE
	JOKONG
	KORANTA
	LEKGWARENG
	LENOKWE
	MAEKGWE / RATJEKE
	MAMANYOHA
	MOTHELE
	MOTHOBEKI

LOCAL MUNICIPALITY	SETTLEMENT
	MPEPULE
	PETERSON
	POLASENG
	RAMAROKA NORTH
	RAMAROKA SOUTH
	RAMODUMO
	RAMPEPE
	SEAPHOLE
	SEKHIMING
	TAULOME
	WORCESTER
Greater Tzaneen Local Municipality	BABANANA
	BOKUTA
	BOTLUDI
	FOBENI
	FOFOZA
	GAMOKGWATHI
	GA-WALLY
	JOKONG
	JOPI
	KA-MSWAZI
	KA-XIHOKO
	KOBJANA
	LEREJENE
	LWANDLAMUNI
	MABYEPELONG
	MADUMANE
	MANDLAKAZI
	MAPITLULA
	MARIRONI
	MAVELE
	MAWA 12
	MAWA 8
	MAWA 9
	MBEKWENA
	MIRAGOMA
	MOLEKETLA
	MOOKGO 6
	MOOKGO 7
	MORAPALALA
	MORUJI
	MORWASHETLA
	MOTHOMENG
	MOTHOMENG
	MOTUPA
	MPOPYE
	MUGWAZINI
	MUSIPHANA EAST
	MUSIPHANA WEST
	NKAMBOKO
	NWAMITWA
	PJAPJAMELA
	RELELA
	RIKHOTSO
	RIKHOTSO NORTH
	RUNNYMEDE
	RUWANDA
	SEMARELA
	SENAKWE
	SEOPENG
	SEROLOROLO
	SETHONE
	THAKO
	THAPANE

Source: DWAF, EVN, Urban-Econ, 2007.

In addition to the settlements set out in the table above, the 1998 report also makes reference to the urban water demand of the following towns:

- Tzaneen
- Haenertsburg
- Duiwelskloof
- Ga-Kgapane
- Politsi

- Letsitele
- Pietersburg and environs.

The data obtained for the main towns regarding water demand and water use is closely correlated to these towns and might include some additional information or might be lacking some small part of data. For the purpose of the current assessment the information obtained mainly through secondary sources were deemed adequate.

In addition to the urban and rural users, the industrial users that were considered included:

- Consolidated Murchison Mine near Gravelotte
- Letaba Citrus Processors
- Sapekoe industries.

The database used by Urban-Econ to undertake the demand projections were finalised through detailed consultations and input received from the client, and where possible all the most recent information about all the water users were assessed.

Were possible the most recent information was obtained in order to ensure that the water demand projections reflect the true situation currently prevalent in the study area.

2.3.2 Population size and growth

In order to have a clear understanding, Urban-Econ deemed it essential to investigate in more detail the historical population growth trends to indicate the 2007 population in the relevant local municipalities of which certain segments of the population form part of the primary study area. The total population of the relevant municipalities for 1996, 2001 and the estimated population in each area in 2007 are presented in the following table based on the historical growth rates between 1996 and 2001.

Table 2: Population distribution for relevant local municipalities in the secondary study area

DISTRICT	1996	2001	Growth Rate 1996 to 2001	2007
Limpopo Province Total	**4,520,529**	**4,995,533**	**2.02%**	**5,632,403**
Mopani District Municipality Total	956,352	1,061,454	2.11%	1,203,125
• Greater Giyani LM Total	217,442	239,283	1.93%	268,364
• Greater Letaba LM Total	202,069	220,105	1.72%	243,819
• Greater Tzaneen LM Total	340,321	375,587	1.99%	422,723
TOTAL SUB-AREA	**759,832**	**834,975**	**1.90%**	**934,800**
• Ba-Phalaborwa LM Total	107,813	131,092	3.99%	165,778
• Maruleng LM Total	87,355	94,385	1.56%	103,571
• Kruger Park North LM Total	1,353	1,002	-5.83%	699

Source: Urban-Econ calculations based on Census 1996 and 2001 data, 2007

The preceding table provides insight into the situation regarding population growth in the local municipal areas that have areas that make up the current assessments primary study area as set out in Map 1.

From the table it is clear that the overall population growth was positive reaching almost 2% in Greater Giyani and Greater Tzaneen. This is slightly lower than the provincial and district growth rate which is 2.02% and 2.11% respectively for the period 1996 to 2001.

Due to the fact that the data provided by DWAF are already been adjusted by themselves based on the STATS SA population growth rates and additional work undertaken by DWAF, the estimated composition of the primary study area population, for the purpose of the current assessment, are taken to be as follow:

Table 3: Population distribution in the relevant settlements per relevant local municipalities within the primary study area

RELEVANT MUNICIPALITY	POPULATION IN PRIMARY STUDY AREA FOR 2007	% REPRESENTATION FOR PRIMARY STUDY AREA IN 2007
Mopani (DC33)		
• Greater Giyani	29,855	12%
• Greater Letaba	50,803	21%
• Greater Tzaneen	160,670	67%
AREA SUB TOTAL	**241,248**	**100%**

Source: Urban-Econ calculations based on Census 1996 and 2001 data and DWAF database for primary study area, 2007

From Table 3 it is clear that the settlements that form part of the Greater Tzaneen Local Municipality account for 67% of the total population of the primary study area while the smallest contribution is made by the villages located in the Giyani Local Municipal area.

In addition to the population in the settlements, the population of the main centres also had to be considered, and the information obtained in this instance, were as follow:

Table 4: Population per main towns considered in the current assessment

RELEVANT MUNICIPALITY	POPULATION IN PRIMARY STUDY AREA FOR 2007	% REPRESENTATION FOR PRIMARY STUDY AREA IN 2007
Mopani (DC33)		
• Greater Giyani	29,855	12%
• Greater Letaba	50,803	21%
• Greater Tzaneen	160,670	67%
AREA SUB TOTAL	**241,248**	**100%**

Source: Urban-Econ calculations based on Census 1996 and 2001 data and DWAF database for primary study area, 2007

2.3.3 Urbanization

The following Table indicates the level of urbanization for the Limpopo Province and Mopani District. On National level and Provincial level the percentage of people living in urban areas has increased while the population living in non-urban areas has decreased. This is however not the case in Mopani District where the percentage people living in urban areas have decreased from 14.9% in 1996 to 6.6% in 2001, the percentage people living in non urban areas have grown from 85.1% to 93.4%. The reason why people in the Mopani District have moved to the non-urban areas might be contributed to people opting to make a living in the agricultural sector.

Table 5: Composition of Population in S.A. Limpopo and Mopani District

Year	Limpopo Province		Mopani District	
	1996	2001	1996	2001
Total population	4916880	5273637	957164	1060442
Urban/ Non				
Urban	11.0%	11.3%	14.9%	6.6%
Non-Urban	89.0%	88.7%	85.1%	93.4%

(Source: Mopani District Municipality)

It is clear that the majority of the people in the secondary study area fall within rural areas and in many instances this hampers the delivery of water and services due to the lack of appropriate infrastructure. Due to the nature of the area, the dependence on agriculture, and intensive farming activities such as commercial timber, cash crops, tropical and citrus fruit production, and the location of the people in the more rural areas is understandable.

The level of formalisation, the available infrastructure and the level of access to services and water could influence the demand for water, and more specifically the way in which water is utilised. In the next chapter more information is provided on the assumptions that were in used as a basis during the modeling of the water requirements, regarding per capita water use.

The reviewed IDP of the Mopani District for 2007/08 provides an indication of the urbanisation in 2006, and it is stated that of the districts population, 81% resides in rural areas while 14,2% study in urban area and 4,6% stay on farms.

2.4 REGIONAL ECONOMIC OVERVIEW

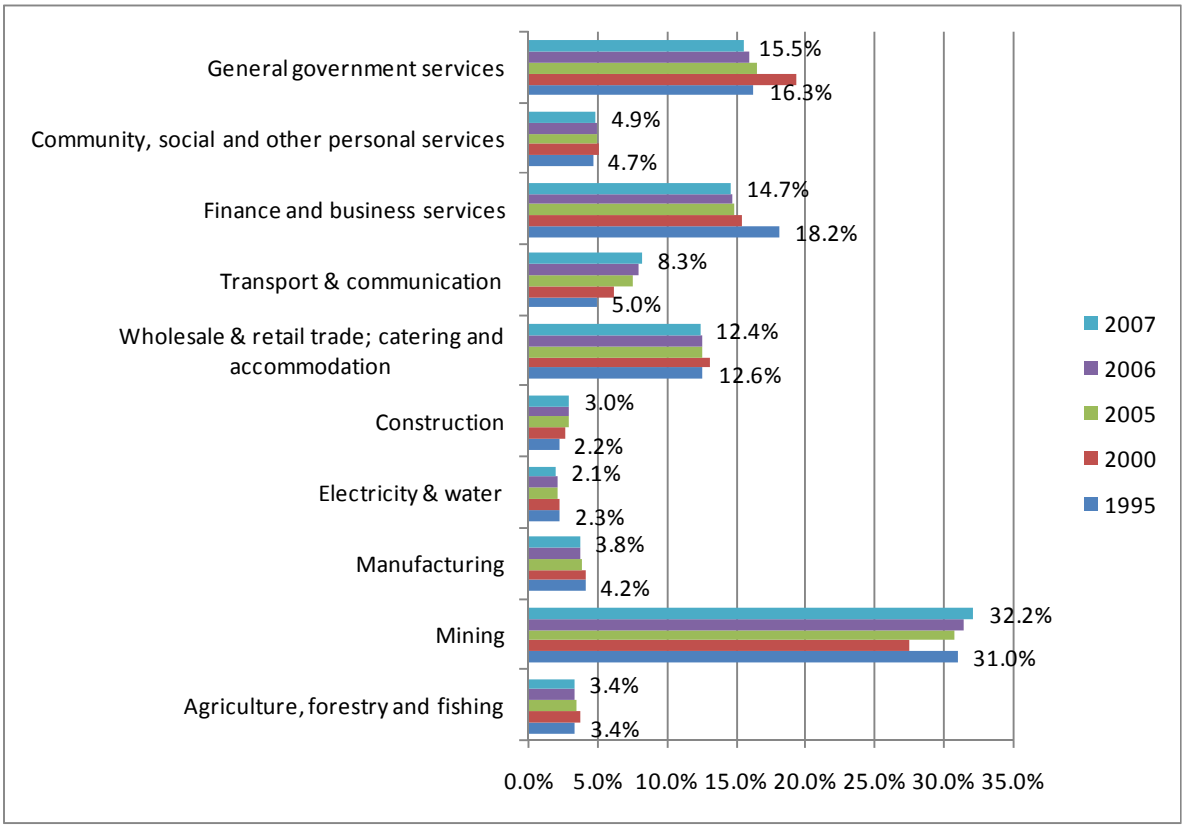
In order to fully understand the future water demand requirements that would need to be catered for, either through the proposed Nwamitwa Dam, the raising of the Tzaneen Dam or other means, is largely influenced by the regional economic development taking place.

Apart from the residential or primary users of water, the economic users of water are also a very important aspect to consider. It has already been mentioned that the area consists mostly of commercial farming or agriculture related activities, there is also some mining activities taking place as well as a well established services sector.

It is therefore essential to understand the economic conditions in order to understand the related water demands set out in later chapters of this document.

The aim of this section is to provide insight into the type of sectors and industries that play an important role in the economic conditions of the area under assessment. The following diagram provides insight into the percentage contribution of the different economic sectors to the GDP of the Mopani District Municipality.

Diagram 1: Sectoral contribution to the Gross Domestic Product of the Mopani District Municipality, 1995 to 2007



Source: Urban-Econ calculations based on Quantec Economic Database, 2007

From the diagram the following can be deduced:

1. Three sectors, namely the mining-, construction- and community, social and other personal services sectors indicated positive growth in the period 1995 to 2007.
2. Most sectors showed an overall decline in the percentage contributions it makes to the GDP of the Mopani District Municipality with the exception of the agriculture, forestry and fishing sector which had some fluctuations in the period between 1995 and 2007, but the contribution in 1995 and 2007 are equal.

The website of the Mopani District indicates the following in terms of the manufacturing and trade within the area:

Manufacturing and Trade

In terms of the previous Regional Industrial Development Programmes (RIDP), three towns qualified as Industrial Development points, namely Giyani, Tzaneen and Nkowakowa. The modus industries in the district are mainly basic metals and fabricated metals followed by food manufacturing.

The basic metals and fabricated metals dominated by structural steel and engineering workshops. The district also has a number of industries involved in the processing of wood (saw milling). The food manufacturing industries are dominated by canned, preserved and dried fruit and vegetable juices which indicates a degree of linkages to the local Agriculture sector. Of significance, is to ensure that even small and emerging farmers have access to these markets.

Major trading centers in the district include Tzaneen/Nkowakowa/ Lenyenye node, the Phalaborwa/Lulekani/Namakgale node and to a lesser extent the Giyani node. Generally there is a net of outflow of buying power, particularly so from the smaller nodes as they do not cater for the entire consumer needs, and secondly because a considerable number of people work outside these nodes in places such as Polokwane. Key investments are also needed in towns like Phalaborwa and Tzaneen to achieve the minimum agglomeration for sustainable industrial development.

Business and investment opportunities

Mopani District Municipality is the centre of the Limpopo Province tourism and business attraction and home to one of the areas identified by the government for its Spatial Development Initiative, Nodal point, Expanded Public Works Programme (EPWP) which is aimed at providing platforms for business and investors to improve competitiveness. A District that have vast contrasts; vibrant and steeped in tradition and history. From Bushveld wilderness, wildlife, mountain ranges, age old indigenous forests and cycads, waterfalls, to subtropical fruit and tea plantations are only few of the attraction that characterise the vastness of this land

Development Opportunities/Potential in Mopani District

The provincial economic development study identified Tourism, Agriculture, Mining and Trade and Manufacturing as sectors with potential for growth in the district. Applying arithmetic reasoning the region has comparative advantages in Agriculture, Manufacturing and Trade. Although the region has potential in all sectors, some of the sectors like agriculture are under performing.

SMME Development and LED

Giyani Local Business service Centre and Phalaborwa entrepreneurial Support Centre were established in the District. The centers provide supportive services to SMMEs and Entrepreneur development with regard to business training, counseling and business information. Other initiatives around local economic development have been through the assistance of Social Plan Fund and Local Economic Development Fund.

Spatial Development Initiatives (SDI)

Phalaborwa has been identified as one of the growth points within the districts. Phalaborwa SDI joins with Maputo Development Corridor. The main road link run from Phalaborwa to Nelspruit in the Mpumalanga Province, where the SDI join the Maputo Development Corridor. The Development Corridor aims to create better access between the port of Maputo and mining potential around Phalaborwa in the Limpopo Province and the Agricultural projects near Xenon and the rest of the Districts.

The objectives of the Phalaborwa SDI is to generate sustainable economic growth and development in this relatively under developed district according to the area's inherent economic potential in tourism, agriculture, mining and mineral processing and forestry. The Phalaborwa SDI is a vehicle to enhance efforts of generating long term and sustainable employment for the local inhabitants by exploiting the spin- off opportunities that arise from the relative crowding in of private and public sector investments.

Agriculture

Agriculture is the backbone of any developing economy. It is the sector that is able to create more sustainable jobs, absorbing even the unskilled and semiskilled workers, and as such bring about sustainable rural development.

The district (Lowveld region) contributes significantly towards the activity of agriculture on the provincial level. About 50% of the farm income in the province in Horticulture is earned in the district. Most important crops in terms of monetary value are citrus, vegetables and subtropical fruit. 6,7% of the land can be considered arable of which 43% is under irrigation, which by far the most of all districts in the province.

The most important irrigation schemes in the region are Lower –Letaba, Blyde irrigation and Middle Letaba. The region has future agricultural potential highly concentrated in subtropical fruit, citrus fruit production and vegetables. Unutilized potential is estimated at between 10 000 to 70 000 hectares. According to the Provincial Economic Development Strategy, 10, 000 hectares of this potential could be brought into production over the next 5 years, mainly in new orchards in the Letaba/Letsitele basin area and about 1500 hectares in the Klein Letaba area.

Mineral Development

Although it can be said that this region is mostly agricultural, it also contains a major mining cluster at Phalaborwa. Phalaborwa has been declared a Spatial Development Initiatives. The objectives of the SDI is to exploit the unutilized and underutilized potentials of the area by combining private and public sector resources in a sustainable manner. Other significant mineral zones in the region are the Murchison Greenstone Belt (Gravellotte towards Leewkop in the Kruger National Park [KNP]), Giyani Greenbelt-from KNP in the south Western direction to the town of Giyani, and Rooiwater Complex Northern flank of Murchison.

There are number of mega projects that mining companies have been considering for implementation or exploration in the district. This includes the expansion of rock Phosphate production by FOSKOR, the Phlogopite processing facility, the Koalin clay project, institution of underground copper mining operations at Phalaborwa, surface strip mining of mineral sand in Gravellotte area, exploitation of heavy mineral deposits in the Tzaneen area (by Red River mining and ISCOR), erection of a steel production facility (Magnetie).

There are small mining initiatives such as the small gold mining projects in the Giyani and Murchison sequence greenstone areas and the production of dimension stone for the building industry at the Mica area. Potential also exist for small scale mining in the Murchison sequence near Gravellotte (antimony and emeralds) and along the East/ West ridge of mineralization south of Phalaborwa and extending from the Kruger National Park to Mica.

Overall the main potential is centered around Phalaborwa in the Phalaborwa Mineral complex with its well known copper and Phosphate resources and in the Murchison Range from Gravellotte towards Nkowakowa / Tzaneen which is reputed to be the most diverse mineralization zones in the world.

Mining development has a potential to contribute over R6300 million in direct investments through the different ventures/prospecting in the district. Mining development could in the short term form the corner stone of economic growth not only in the district but also in the whole of Limpopo Province.

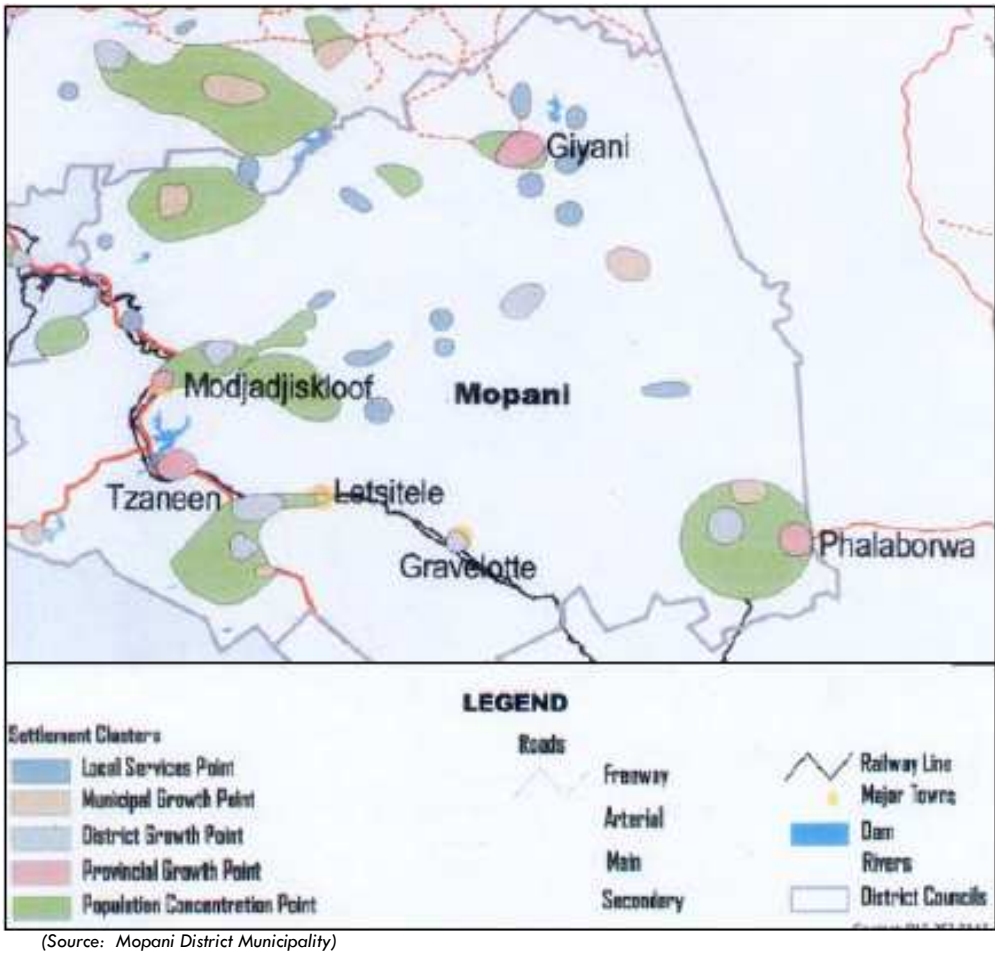
Source: http://www.mopani.gov.za/bus_investment/led.htm

Another project that provides insight into the development potential of the area is the **Limpopo Province Spatial Rational** (2002), which identified a total of 16 Growth Points have been identified within the study area consisting of three types of growth points and population concentrations. These are as follows:

- 4 Provincial growth points namely:
  - Phalaborwa
  - Giyani
  - Tzaneen
  - Modjadjeskloof
- 6 District growth points namely:
  - Namakgale
  - Gravelotte
  - Mageva
  - Kgagapane
  - Nkowankowa
  - Lenyenye
- 6 Municipal growth points namely:
  - Lulekani
  - Xawela
  - Senwamokgope
  - Haenertsburg
  - Bergersdorp
  - Letsitele

The 16 growth points identified above are illustrated on the Map below:

Map 3: Nodal growth points



(Source: Mopani District Municipality)

The 16 Growth Points are identified as being located within first order settlements. The First Order Settlements (Growth Points) are individual settlements or a group of settlements located relatively close to each other where meaningful economic, social and institutional activities and a substantial number of people are grouped together. These settlements are further classified as Provincial, District and Municipal Growth Points.

Phalaborwa, Giyani, Tzaneen and Mojdjadjeskloof have been identified as Provincial Growth Points within these first order settlements. The Provincial Growth Points are settlements with relatively large economies employing a large residential area. These settlements have regional and some Provincial service delivery elements. This includes at least local municipal offices which performs all municipal services such as water, electricity, sanitation, refuse removal, road maintenance, etc.

Greater Giyani is situated to the north of the District in the former homeland of Gazankhulu. The Growth Points in the Municipality are scattered and the municipality mostly has local service points due to its rural nature. A result of the scattered nature of these villages a lack of infrastructure and services exist.

From the preceding it is clear that there is a number of economic growth and development opportunities that could have a potential impact on the water demand requirements of the area in order to sustain the growth and development. According to the Greater Mopani District Municipality's LED, the scarcity of water is one of the main constraints on development, and due to the fact that the availability of water is such a problem, it is important to understand the current water demand situation before assessing the potential future water demand requirements of the study area.

2.5 SYNTHESIS

The aim of this chapter was not too provide an extensive overview of the socio-economic conditions, but more to create an understanding of the aspects related to the socio-demographic and economic conditions that have either a direct or indirect impact on the demand for water.

From the information presented in this chapter, it is clear that the study area considered has a growing population, and although the modeling regarding water requirements until 2030 have been done in order to reflect different development scenarios, the main point to note is that the overall expectation is growth in the area. More people in an area translate directly into an increased water demand and the relevant infrastructure.

Additionally it had been shown that there is economic growth and development taking place, but many of the sectors are experiencing problems with regard to growth potential due to the decreasing availability of water. In order to sustain and improve economic growth the provision of water to all the end users in the area is essential.

The level of water use and the amount of water required are also influenced by the financial status of the people residing in the area. This can be ascribed to the fact when people only receive the basic minimum allowed without charge water use will be related to specific water use levels, when the situation changes and people have to pay for water, the amount of water could significantly change. The same could be said for situations where water becomes scarcer which leads to an increase of the price of water, the impact on water demand could be drastic.

Therefore the following chapter provides more detail information on the water demand assessment that was undertaken.

CHAPTER 3 – WATER USE ASSESSMENT

In the 1998 Main Feasibility report, a section is included that deals with the difficulties associated with determining specific water demands due to the uncertainty regarding per capita water demand. The main focus of the current assessment is also on the water use of the more rural areas and a lack of information does increase the difficulty of assessing the water demand for the primary study area.

The preceding section did however provide some insight into the type of access the people in the study area have to water and the from the type of connections the 1998 Main Feasibility Study determined that these connections can be translated into levels of living which has a direct influence on the amount of water demand per capita.

The aim of this section, and the report as a whole, is to review and update the water requirements assessment that was done as part of the 1998 Main Feasibility Report. Therefore the aim this section is to provide updated water requirements assessment based on the anticipated change in population, the changes that have taken place in terms of the economic environments in these areas and also provide insight into any other aspect that might influence water demand.

3.1 WATER USE INDICATORS

In the previous 1998 Main Feasibility Report, in Part Two Annexure A, the part of the document dealing specifically with the water demand projections, the influence of a number of water indicators were also regarded as having significant impact on the amount of water demanded by the people in the study area.

The indicators that were considered included:

1. Construction materials used for the construction of dwellings
2. Dwelling types
3. Enthusiasm for gardening
4. Extent of electricity connections
5. Ease of access to places of employment and other services.

These indicators were investigated as part of the previous feasibility assessment by cursory field checks, and the information was deemed sufficient for the purpose of the 1998 document. During the current review and update of the information, no additional fieldwork was conducted and the information of the previous assessment would therefore be used as a basis for some of the assumptions made with regard to updating the water demand projections.

3.2 LAND USE

3.2.1 Irrigation

Due to the fact that there are consultants concerned in more detail with regard to the water use requirements of the irrigated agriculture sector present in the area, the aim of this sub-section is merely to create an understanding of the sector and not to provide an extensive and detailed assessment.

The Groot Letaba River catchment is a highly productive agricultural area with mixed farming including cattle ranching, game farming, dryland crop production and a wide variety of crops produced under irrigation. Citrus and sub-tropical fruit are most widely produced under irrigation together with vegetables and other high-value crops such as tea. Agriculture and the irrigation sector in particular, is the main base of the economy of the region and provide the major portion of local employment opportunities.

Irrigation is by far the largest water user and will remain so for the foreseeable future. Numerous irrigation schemes and irrigation boards exist in the catchment, some of which are supplied from storage and others depend on run-of-river abstractions.

Table 6: Irrigation and forestry coverage in study area

Quaternary Catchment	Irrigation (km^2)	Forestry (km^2)
B81A	0.7	113
B81B	56.2	241
B81C	11.1	6
B81D	11.1	41
B81E	30.4	13
B81F	79.4	0
B81G	0.8	3
B81H	0.8	0
B81J	0.0	0
B82A	6.1	7
B82B	18.3	8
B82C	10.9	13
B82D	0.3	15
B82G	10.1	0
TOTAL	**236.2**	**460**

(Source: DWAF, 2007)

The majority of the irrigation schemes are situated in Greater Tzaneen where the majority of citrus fruit are grown in the District. In both Greater Letaba and Greater Giyani subtropical fruit and some tomatoes are produced. It is therefore clear that there is already a number of agriculture activities taking place in the some areas and the revitalization of the schemes as set out in Table 4, will create additional opportunities for the expansion of agriculture in areas such as Namakgale and Phalaborwa, where agriculture is currently not a strong sector. The revitalisation will in many instances upgrade the systems, provide all the necessary equipment that might current be outstanding from the schemes and improve the overall functioning of the schemes in order to ensure that water is used efficiently.

Table 7: Irrigation schemes earmarked for revitalization

Irrigation Scheme	Area
Thabina	Greater Tzaneen
Solani	
Berlyn Citrus	
Coombe Bank	
Mariveni	
Naphuno farms	
Mabunda	Greater Giyani
Homu	
Middle Letaba	
Maemetia	Sekgosese
Klipplaatdrift	
Molototsi Mango	Greater Letaba
Mokjadji	

Irrigation Scheme	Area
Modjadji Dairy	
Selwane	Namakgale
Makhushane Diary	
Majeje	Phalaborwa

(Source: Mopani District Municipality, 2007)

3.2.2 Afforestation

The timber industry in the study area includes a significant capital investment in infrastructure including saw mills and provides highly valued employment opportunities. Previous hydrological analyses indicated that afforestation (including 9,300ha indigenous) decreases the mean annual runoff in the system by about 50 million m³ (98mm over 509,000ha) with the maximum impact being on low flow periods during seasons of relatively low rainfall. This impact on stream flow led to controversy involving the irrigation sector and the afforestation industry due mainly to the fact that the amount of water available from the system for irrigation purposes has decreased.

Table 8: Hydrology of the study area

Quaternary Catchment	Rainfall (mm)	Mean annual runoff (million m^3/annum)
B81A	1194	63.9
B81B	1163	115.6
B81C	880	17.2
B81D	832	67.3
B81E	667	29.5
B81F	544	18.8
B81G	627	16.2
B81H	510	7.1
B81J	502	5.3
B82A	721	23.2
B82B	702	18.1
B82C	712	14.2
B82D	623	16.5
B82G	524	14.3
TOTAL/AVERAGE	**729**	**427.2**

(Source: DWAF, 2007)

3.3 RDP WATER RATINGS FOR THE SPECIFIC AREAS IN STUDY

The Department of Water Affairs and Forestry (DWAF) in the Community Water Supply and Sanitation (CWSS) Strategic Study states that the **need for water is measured in the number of people who do not comply with the standards** referred to in the White Paper on Water Supply and Sanitation. These standards are referred to as the RDP level and for the purposes of water supply the following 5 criteria define the minimum RDP level, viz.:

- **Quality**: 4 water quality classes to qualify the portability of water (e.g. classes 0 and 1 are ideal, class 2 is for short term use only and class 3 is unacceptable for domestic use);
- **Quantity**: a minimum quantity of 25 liter per person per day;
- **Distance**: water must be within a distance of 200 m from the dwelling/house;
- **Reliability**: access to the water resource for at least 98% of the time (1 in 50 year resource reliability); and
- **Flow**: the availability or flow of water at a communal tap should at least be equal to 10 liter per minute.

Table 9: RDP water ratings for the specific areas in the study area

Area in study area	Population	Number of people receiving water below RDP standards	Number of people receiving water greater than RDP standards
Ba-Phalaborwa Area	**139 225**	**5 314**	**133 911**
Greater Giyani Area	**253 926**	**85 179**	**168 747**
Greater Letaba Area	**241 914**	**72 370**	**169 544**
Greater Tzaneen Area	**390 887**	**130 430**	**260 457**
Maruleng Area	**97 066**	**12 777**	**84 289**

(Source: DWAF, 2007)

3.4 WATER AVAILABILITY AND REQUIREMENTS

Water is one of the most fundamental and indispensable of all natural resources. It is fundamental to life and the quality of life, to the environment, food production, hygiene, industry, and power generation. The availability of affordable water can be a limiting factor for economic growth and social development, especially in South Africa where water is a relatively scarce resource that is distributed unevenly, geographically and through time, as well as socio-politically.

The gross surface water availability in the study area is estimated at 168 million m^3/a, which is derived from the yield of the Tzaneen and Ebenezer dams as well as significant run-of-river abstractions. The Tzaneen Dam, if operated in isolation, provides a yield of approximately 60 million m^3/a. However, when operated in a systems context to supply water to irrigators downstream only when the run-of-river flows are inadequate, the total yield is much greater. Hence the large gross yield of the system. To meet the requirements of the ecological Reserve, (based on a desktop estimate) means that an estimated 25 million m^3/a, of otherwise available yield must be released into rivers. A comprehensive Reserve Determination was carried out by DWAF for the Groot Letaba River.

Invasive Alien Plants reduce the yield by a further 10 million m^3/a, the available surface water resource is then 133 million m^3/a (at a 1:50 year assurance).

The contribution of groundwater to the available water resource in the study area is estimated to be 12 million m^3/a while the recently completed registration of water use gives the groundwater use as 23 million m^3/a. This groundwater use is mostly downstream of the Tzaneen Dam where it is used to supplement irrigation supplies from surface water during times of drought. In many cases groundwater abstraction takes place close to the river and probably has a direct impact on the surface water flow. This groundwater/surface water dependency needs to be quantified.

Table 10: Water availability in the study area

Resource category	Volume of water available/used (Mm^3/a)
Gross surface water resource:	168
Subtract:	
- Ecological Reserve	25
- Alien Vegetation	10
Net Surface water resource	133
Ground water	23
Return flows	14
Total local yield	**170**

(Source: Internal Strategic Perspective compiled by DWAF using 2000 data. Data source provided to Urban-Econ by DWAF in 2007)

3.4.1 Current Water Requirements

The irrigation requirement in the study area is based on an irrigated area of 191 km². Approximately 28 million m³/a of this requirement occurs upstream of the Tzaneen Dam and is supplied from the Ebenezer Dam (13.9 million m³/a), the Magoebaskloof Dam (7 million m³/a) and run-of-river (7.1 million m³/a). The irrigation requirement downstream of the Tzaneen Dam is 105 million m³/a. This is supplied partially from the Tzaneen Dam with irrigators making use of run-of-river and the many weirs on the Groot Letaba River to increase the total yield made available from Tzaneen Dam. Some of the irrigation is also supplied from tributaries to the Groot Letaba, farm dams and groundwater.

The irrigators downstream of the Tzaneen Dam generally experience a low assurance of supply with severe restrictions being placed on their water use during periods of drought.

The forestry requirement is based on an afforested area of 417 km², which reduces the runoff by an estimated 50 million m³/a. This reduces the yield of the system by an estimated 35 million m³/a as given in Table 11.

Table 11: Local Water Requirements in the study area (1:50 year assurance)

User sector	Water requirement/Impact on yield (million m³/a)
Irrigation	133
Urban	3
Rural	10
Industrial and mining	0
Afforestation	35
Power Generation	0
Total local requirements	**181**

(Source: DWAF ISP, 2007)

Table 12: Primary water demands (Mm³/a)

Description	Place Name	2000	Allocation 2006/7	Usage 2006/7	Value used for Bridging Study
Domestic Use in Groot Letaba catchment upstream of confluence with Klein Letaba River	Haenertsburg	0.04	0	0	0
	Tzaneen	5.5	2.4+1.2 = 3.6	2.2+1.0 = 3.2	2.4+1.2 = 3.6
	Politsi	0.14	2.0	2.1	2.0
	Duiwelskloof	0.41			
	Ga-Kgapane	0.35			
	Letsitele	0.26	0.4	0.3	0.3
	Ritavi 1	0.73	0	1.9	1.9
	Ritavi 2	2.66	3.5	8.2	8.2
	Naphuno	1.3	1.7	1.3	2.9 *1 (1.3)
	Bolobedu	2.56	0.2	0.2	5.1*2 (0.2)
	Namakgale	Groundwater	0	0.8	0.8
	Sub total	**13.95**	11.4	18.0	24.8 (18.3)
Domestic Use in Middle and Klein Letaba Catchments	Giyani	0.98	3.7	3.7	3.7
	Cumulative Subtotal	14.93	15.1	21.7	28.5 (22.0)
	Middle Letaba Dam WTW	-	2.3	2.3	2.3
	Subtotal	-	6.0	6.0	6.0
Cumulative Subtotal		-	17.4	24.0	30.8 (28.0)

Description	Place Name	2000	Allocation 2006/7	Usage 2006/7	Value used for Bridging Study
Domestic Use outside of Letaba Catchment	Polokwane		18.5	4.6+18.8=23.4	6.5+12=18.5
Subtotal for Domestic use		-	35.9	47.4	49.3 (46.5)
Industrial Use		-	3.3	1.5	1.5
Overall total of primary water demands			**39.2**	**48.9**	**50.8 (48.0)**
		(Source: DWAF, 2007)	*Source : Various sources used to determine values adopted in Bridging Study*		

**1 Based on Historical Firm Yield for Thabinia Dam – for future projections, rather use actual use by Naphuno in 2006/7*
**1 Based on Historical Firm Yield for Modjadji Dam – for future projections, rather use actual use by Bolobedu in 2006/7*

Several industrial water users occur in the study area which draws water from the Groot Letaba River system. These water user groups are indicated in the table below:

Table 13: Water use by industrial water users

Industry/Mine	Quaternary catchment	Water use in 2000 (million m³/annum)
Letaba Citrus	B81B	0.24
Koedoe Co-op	B81C	0.1
Addington Farm	B81C	0.05
Sapekoe	B81B	0.3
TOTAL		**0.69**

(Source: DWAF, 2007)

Sapekoe Tea closed down on the 10th of December 2004 due to the fact that the biggest shareholder, Lintonpark pulled out to avoid the strong rand[2].

Various land claims on the land of Sapekoe also created a number of problems and various initiatives were put in place to resuscitate the business by the Limpopo Government. According to new information obtained it seems that Sapekoe was revitalized as a fruit farm in January 2007 and there are additional plans for the future that might see increased production activity in the future, and therefore should still be regarded as a water user.

3.4.2 Transfers

There are no transfers into the Groot Letaba River sub-area. However, there is a significant transfer out of the sub-area to Polokwane. The bulk of the water for this transfer is sourced from the Ebenezer Dam while Polokwane also transfers water from Dap Naude Dam. According to White Paper WP I – 84, the allocation to Polokwane from the Ebenezer Dam is 18,5 million m³/a. However, this was later reduced by means of a court order to 12 million m³/a. Polokwane also have a water court order which allows them to abstract up to 6,53 million m³/a from the Dap Naude Dam. This is in excess of the historical yield of the dam, which is quoted estimated to be 3,2 million m³/a (White Paper WP I-84) before making any allowance for the ecological Reserve. The current transfer rate to Polokwane from Ebenezer Dam is approximately 10 million m³/a.

[2] SABC News. Sapekoe Tea Plantation Closes Down. 10 December 2004.

There is also a small transfer out of the Letaba catchment downstream of the Tzaneen Dam to the Consolidated Murchison Gold mine near Gravelotte. The allocation for the mine from Tzaneen Dam is 1.8 million m^3/a. The actual transfer to the mine to meet current requirements is estimated at 0,4 million m^3/a and this is not expected to increase in the foreseeable future. Also, about 0,3 million m^3/a is transferred out to domestic users in the Olifants WMA from the Thabina Dam.

The total transfer in 2000 out of the Letaba catchment is summarised as follows:

Polokwane:

- From Ebenezer Dam: 10 million m^3/a
- From Dap Naude Dam: 3,2 million m^3/a
- From the Letaba River: 1,8 million m^3/a
- From the Thabina Dam: 0.3 million m^3/a
- Total: 15,3 million m^3/a

3.4.3 Reconciliation of Requirements and Available Water

Throughout this document, the problems regarding the scarcity of water in the study area (both primary and secondary) have been discussed and in order to ensure that there is a clear understanding of the full magnitude regarding the water demand issues it is deemed necessary to look at the specifics regarding the available water resources and the water requirements. Table 14 provides more insight into this issue.

Table 14: Reconciliation of requirements and available water for 2000

Available Water (Mm^3/a)	Local Yield	170
	Transfer In	0
	Total	**170**
Water requirements (Mm^3/a)	Local requirements	181
	Transfers out	15
	Total	**196**
Balance	**-26**	

(Source: DWAF, 2007)

From the table it is clear that there is already a water deficit. The users who are currently experiencing water shortages are the irrigators downstream of the Tzaneen Dam.

3.5 AFFECT OF HIV/AIDS ON THE POPULATION AND THE RESPECTIVE GROWTH RATES ESTIMATIONS

Before we have a look at possible water use/demand and demography, it is crucial that we have an in-depth look at the effects that HIV/AIDS have on population growth rates and on water usage and demand. The impact of the HIV/AIDS pandemic on future development is cause of great concern to decision makers and planners. The challenge lies in trying to identify and plan for the impact of HIV/AIDS on sustainable development and more specifically, in terms of the Strategic Environmental Assessment (SEA), on water management issues.

The population of Limpopo increased from 4.9 million in 1996 to 5.2 million (11% of the population of South Africa) in 2001. This implies an annual population growth rate of 1.3%. During 2002 the Department of Finance and Economic Development of the Limpopo government made projections for the Development Information Database, namely that the population growth rate is expected to decline to 1.0% by 2008.

The HIV/AIDS infection in the District Municipality of Mopani, which also makes up the study area, is below that of the Province, but it can still be regarded as significant.

One of the most important considerations that have arisen from the available information on the spread of HIV/AIDS is the difficulty in accurately projecting possible population numbers over a long timeframe. Population projections that extend beyond a five to seven year timeframe contain increasingly larger inaccuracies and should be treated with caution. This is largely due to uncertainties around probable behavioral changes in response to the anticipated massive mortalities that can be expected as the pandemic proceeds. It is essential to remember that any estimates made are likely to underestimate the true prevalence of HIV/AIDS.

3.6 AFFECTS OF HIV/AIDS ON WATER

At first sight, the issues of HIV/AIDS and water would appear to bear very little relation to each other. HIV/AIDS is a global-scale pandemic that is transmitted between people primarily through sexual contact, while water is a renewable natural resource of which the availability depends on a variety of geographic and climate factors. However, a closer inspection of the features that characterize the spread of HIV/AIDS and its implications for individuals, communities and societies reveals several significant linkages with water, as well as important consequences for water resource management. The links between HIV/AIDS and water reflect some of the often unanticipated effects of the pandemic on society, with long-term implications for effective water resource management and the provision of wholesome water supplies to communities.

There is also compelling evidence that the current trends in HIV infection will have a profound impact on future rates of infant, child and maternal mortality, life expectancy and economic growth throughout the region.

Against the background provided by the data on HIV/AIDS prevalence in Southern Africa, it is instructive to examine the availability of water resources and the provision of water supplies and sanitation services. Adequate supplies of fresh water represent one of the scarcest natural resources within Southern Africa and have a clear potential to retard social and economic development.

Some important consequences of the HIV/AIDS pandemic have been most easily visible as the dramatic increase in mortality rates and an equally spectacular reduction in population growth rates. For example, population growth rates in several Southern African countries have decreased by over 50% in the last five years. Clearly, demographic changes of this magnitude can have enormous social, economic and environmental implications for the timely provision of water supplies and sanitation services to both urban and rural communities. Insufficient supplies of water cause unnecessary hardship and stress, while over-provision leads to wastage, environmental damage end economic loss.

Against the background provided by the prevalence of HIV/AIDS and the availability of water resources, problems or 'problem areas' can be identified where HIV/AIDS impinges on water resources management:

- Inaccurate estimates of population growth rates and mortality rates lead to incorrect estimates of water demand in specific geographic areas. In turn, inadequate or incorrect demographic information hinders proper planning and prevents construction schedules from matching water demand profiles.
- Changes in the socio-economic profiles of communities receiving services such as water supplies and sanitation are such that there is widespread difficulty to pay for these services.

- Staff members infected with HIV/Aids shows a dramatic decline in productivity as the disease progresses. Additional productivity losses will be attributable to workers having to care for sick family members and relatives, as well as attending funerals.
- Any decline in drinking water quality caused be inadequate water treatment will lead to increased public health risks, particularly for individuals with compromised immune systems.
- There is a small risk that local ground water resources may become contaminated if individuals bury their relatives in areas that are unsuitable for location of graveyards. This practice will also prevent areas from being used for alternative purposes.
- Water is needed for taking antiretroviral medication, bathing patients, washing soiled clothing and linen; and for essential hygiene, which reduces exposure to infections.
- Home-based caregivers undertake a range of activities, including fetching water, bathing patients, washing, laundry, digging pits for solid waste disposal, cleaning households and yards, assisting with access to social , health and other services, and providing counseling, information and support.

If water demand estimates do not take HIV/AIDS-related mortality into account, demands for water could be overestimated. This would pose several possible unanticipated consequences for the construction and operation of large-scale water supply schemes. In particular, if anticipated HIV/AIDS mortalities do indeed reach very high levels, it would delay the demand for water. The converse situation is also important: if mortality rates are overestimated, the growth in water demand profiles of an area or country will not be anticipated correctly. Given the relatively long lead-in times for water supply projects, a population would face undue hardship if adequate water supplies cannot be provided in time.

3.7 SYNTHESIS

From this chapter, it is clear that there are a number of water users dependent on the availability of water to adequately take advantage of the various growth and development opportunities in the area. Additionally the growing population in the area is also placing increased pressure on the water system.

The following chapter provides a more detailed assessment of the water demand projections for the future.

CHAPTER 4 – FUTURE WATER DEMAND ESTIMATES

The aim of this chapter is to combine all the findings of the investigations into the potential water requirements into an integrated assessment and to provide the future population growth projections and link this with the future water demand estimates.

4.1 POPULATION GROWTH PROJECTIONS

The calculation of the future demand water estimates were based on the anticipated population growth projections made for the primary study area (which refers to the rural settlements as set out in Section One of this report) and the secondary study area (which refers to the municipal areas of Giyani, Tzaneen and Letaba).

The Census 1996 and 2001 population statistics were used as a basis and the growth rates from 1996 to 2030 were also calculated using that information. In order to ensure that the different development potential and therefore the population growth potential are taken into consideration, it was decided that the best way in which to achieve this was to provide three different population growth scenarios. In order to create some clarity, Table 2 provided in Section 2 of this document is provided again in this chapter.

Table 15: Population distribution for relevant local municipalities in the secondary study area

DISTRICT	1996	2001	Growth Rate 1996 to 2001	2007
Limpopo Province Total	**4,520,529**	**4,995,533**	**2.02%**	**5,632,403**
Mopani District Municipality Total	956,352	1,061,454	2.11%	1,203,125
• Greater Giyani LM Total	217,442	239,283	1.93%	268,364
• Greater Letaba LM Total	202,069	220,105	1.72%	243,819
• Greater Tzaneen LM Total	340,321	375,587	1.99%	422,723
TOTAL SUB-AREA	**759,832**	**834,975**	**1.90%**	**934,800**
• Ba-Phalaborwa LM Total	107,813	131,092	3.99%	165,778
• Maruleng LM Total	87,355	94,385	1.56%	103,571
• Kruger Park North LM Total	1,353	1,002	-5.83%	699

Source: Urban-Econ calculations based on Census 1996 and 2001 data, 2007

Based on the historical performance of the population growth trends in the secondary study area, future growth potential scenarios could be formulated. The following table provides more detail regarding the growth rate scenarios that have been formulated:

Table 16: Population growth projection scenarios

Growth Rate Period	Low (negative growth)	Medium (in line with District historical performance)	High (higher positive growth)
growth rate 1996 to 2001	1.52%	2.02%	3.02%
growth rate 2002 to 2005	1.48%	2.06%	3.10%
growth rate 2006 to 2010	1.44%	2.10%	3.18%
growth rate 2011 to 2015	1.40%	2.14%	3.26%
growth rate 2016 to 2020	1.36%	2.18%	3.34%
growth rate 2021 to 2025	1.32%	2.22%	3.42%
growth rate 2026 to 2030	1.28%	2.26%	3.50%

Source: Urban-Econ calculations based on Census 1996 and 2001 data, 2007

The growth scenarios, as set out below comprised three different scenarios namely low, medium and high. The low scenario was based on the premise that population growth will be lower than the growth anticipated based on the historical growth trends between 1996 and 2001. The medium scenario used historical performance as the basis for anticipated growth, and the high scenario anticipated growth patterns higher than the historical performance.

For all three scenarios, the anticipated growth rates were not kept constant, and in the case on the low scenario showed a steady decline in the growth rate, were the medium and high scenarios both showed an incremental growth rate.

It is important to note that the medium growth scenario is anticipated to be the scenario providing growth projections closer to the real situation, but there are various growth aspects that might affect the areas and therefore the inclusion of the high and low scenarios . Using the population future growth estimations scenarios, the estimated future populations for both the primary and secondary areas have been calculated and are set out in the table below:

Table 17: Population growth estimations based on the growth scenarios

Year	Growth Rate Scenario	Primary Study Area	Secondary Study Area
2001	Census 2001	N/A	834,975
2007	Low	713,268	921,070
	Medium	**723,983**	**934,906**
	High	747,063	964,711
2010	Low	744,527	961,436
	Medium	770,558	995,051
	High	820,623	1,059,702
2015	Low	798,123	1,030,647
	Medium	856,613	1,106,177
	High	963,395	1,244,069
2020	Low	853,892	1,102,664
	Medium	954,144	1,232,123
	High	1,135,394	1,466,178
2025	Low	911,757	1,177,386
	Medium	1,064,862	1,375,097
	High	1,343,288	1,734,640
2030	Low	971,622	1,254,693
	Medium	1,190,755	1,537,667
	High	1,595,405	2,060,208

Source: Urban-Econ calculations based on Census 1996 and 2001 data, 2007

4.2 WATER DEMAND ESTIMATIONS

In order to calculate the most likely water demand requirements, it is essential to have not only an understanding of the growth potential of the population (as this is but one of the major water users in the area), it is also essential to identify the growth expectations with regard to the additional water users. Due to the lack of updated information, this report was based on secondary sources where applicable, and it seems that most of the other water users have stayed constant. It has therefore been determined that with regard to water users, for calculating the water demand estimations until 2030, the following assumptions were put in place:

- Irrigation will stay constant
- Domestic usage will increase in line with population growth
- Industrial and mining will remain constant
- Afforestation will remain constant

- Power Generation will remain constant
- Payment for water consumed has a major impact on the actual volume of water used by residents. If residents have to start paying for water due to the services that they receive, the actual water use may decline. For the purpose of estimating future water demand in this study, in the absence of more updated actual water use information, it was assumed that the situation will stay more or less the same.

The remainder of this section will provide insight into two models that were utilised in to determine the future water requirements within the study area and the specific implications of the increasing population figures on the water situation.

Method 1: Total population growth and water demand implications

The aim of method one is to determine the overall increase that can be expected as a result of the increase in population within the Secondary Study Area. The aim of the method is to use the growth rates associated with population growth and translate that into impact on water demand.

Table 18: Water Requirements 2030 according to Method 1

Year	Population Estimates			Population growth rates			Domestic water requirement (Mm^3/a)		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
2007	921,070	934,906	964,711	N/A	N/A	N/A	22.0	22.0	22.0
2010	961,436	995,081	1,059,702	4.38%	6.44%	9.85%	22.96	23.42	24.17
2015	1,030,647	1,106,177	1,244,069	7.20%	11.16%	17.40%	24.62	26.03	28.37
2020	1,102,664	1,232,123	1,466,178	6.99%	11.39%	17.85%	26.34	28.99	33.44
2025	1,177,386	1,375,097	1,734,640	6.78%	11.60%	18.31%	28.12	32.36	39.56
2030	1,254,693	1,537,667	2,060,208	6.57%	11.82%	18.77%	29.97	36.18	46.98

(Source: Urban-Econ Calculations from DWAF and Census 2001, 1996 Statistics)

From the preceding table it is clear that the water demand can increase from **22.00 million m^3/a** in 2007 to as much as **46.98 million m^3/a** in 2030 in the medium growth scenario. It should however be noted that in some instances this can be regarded as being a very low demand estimate due to the fact that water demand can increase or decrease depending on the development situations present in the area.

Method one is based on the three growth scenarios formulated for the secondary study area, while method two is based on actual data provided by DWAF in terms of population statistics. In some instances this leads to negative growth rates, but again it should be noted that the data used was provided by DWAF. Method one might therefore be regarded as the more accurate water demand projections.

Table 19: Total Water Requirements in 2030 according to Method 1 (using the medium scenario population growth projections)

User sector	Water requirement/Impact on yield (Mm^3/a)
Irrigation	133
Domestic	46.98
Afforestation	35
Industrial	0.69
Power Generation	0
Total local requirements	**215.67**

(Source: Urban-Econ Calculations from DWAF Statistics)

Table 20: Reconciliation of Requirements and Available Water in 2030 – according to Method 1:

Available Water (Mm^3/a)	Local Yield	170
	Transfer In	0
	Total	**170**
Water requirements (Mm^3/a)	Local requirements	215.67
	Transfers out	15
	Total	**230.67**
Balance	**-15.0**	

(Source: Urban-Econ Calculations from DWAF statistics)

According to method 1, the above water balance indicates that according to the current population growth rates, the total deficit will reach -15.0 million m^3/a by the year 2030.

Method 2: Anticipated water demand according to population growth in specific areas

The aim of method two is to determine the overall increase that can be expected as a result of the increase in population within specific areas set out in the table below. The aim of the method is to use the growth rates associated with population growth and translate that into impact on water demand.

Table 21: Water Requirements selected years according to Method 2 (using area specific historical growth trends)

Domestic use	Growth*1	1995*1	2000*1	2007*2		2010*2	2020*2	2030*2
Haenertsburg	5.92	0.03	0.04	0.0		0.00	0.00	0.00
Tzaneen	6.84	3.95	5.5	3.6		4.39	8.51	16.49
Politsi	0.00	0.14	0.14	0.31		0.31	0.31	0.31
Duiwelskloof	5.08	0.32	0.41	0.91	2.0	1.06	1.74	2.85
Ga-Kgapane	-5.32	0.46	0.35	0.78		0.66	0.38	0.22
Letsitele	5.39	0.2	0.26	0.3		0.35	0.59	1.00
Ritavi 1	0.28	0.72	0.73	1.9		1.92	1.97	2.03
Ritavi 2	-2.31	2.99	2.66	8.2		7.64	6.05	4.79
Naphuno	-1.33	1.39	1.3	1.3		1.25	91.09	0.96
Bolobedu	-1.06	2.7	2.56	0.2		0.19	0.17	0.16
Giyani	1.05	0.93	0.98	3.7		3.82	4.24	4.70
Namakgale	GROUND WATER			0.8		0.80	0.80	0.80
TOTAL	1.32	13.8	14.93	**22.0**		**22.39**	**25.86**	**34.31**

*(Source: *1 Urban-Econ Calculations from DWAF statistics*
2 Urban-econ Calculations using DWAF population growth rates and demands used in Bridging Study)

Table 22: Water Requirements in 2030 according to Method 2 (using area specific historical growth trends)

User sector	Water requirement/Impact on yield (Mm^3/a)
Irrigation	133
Domestic	34.31
Afforestation	35
Industrial	0.69
Power Generation	0
Total local requirements	**203.0**

(Source: Urban-Econ Calculations from DWAF statistics)

Table 23: Reconciliation of Requirements and Available Water in 2030 – according to Method 2 (using area specific historical growth trends)

Available Water	Local Yield	170
	Transfer In	0
	Total	**170**
Water requirements	Local requirements	203.0
	Transfers out	15
	Total	**218**
Balance	**-48.0**	

(Source: Urban-Econ Calculations from DWAF statistics)

According to method 2, the above water balance indicates that according to the current population growth rates, the total deficit will reach -48 million m^3/a by the year 2030.

Method 3: Anticipated water demand according to the medium population growth scenario in specific areas

The aim of method three is to determine the overall increase that can be expected as a result of the increase in population within specific areas according to the three growth scenarios formulated as part of the method one approach. The aim of the method is to use the growth rates associated with the medium population growth scenario in the greater secondary study area and translate that into impact on water demand. This alternative method is used in order to compensate for the fact that the historical growth trends used in Method 2 in some cases indicate a negative growth in water demand – which might not be reflecting the true situation.

Therefore the following table provides the water demand for selected area and selected years based on the high, medium and low scenarios used in method one.

Table 24: Water Requirements for selected years according to Method 3 (using the medium growth scenario formulated as part of Method 1)

Domestic use	Water Requirement (Mm^3/a)							
	1995	2000	2007	2010	2015	2020	2025	2030
Haenertsburg	0.03	0.04	0.0	0.00	0.00	0.00	0.00	0.00
Tzaneen	3.95	5.5	3.6	3.83	4.26	4.74	5.30	5.92
Politsi	0.14	0.14	0.31	0.33	0.37	0.41	0.46	0.51
Duiwelskloof	0.32	0.41	0.91	0.97	1.08	1.20	1.34	1.50
Ga-Kgapane	0.46	0.35	0.78	0.83	0.92	1.03	1.14	1.28
Letsitele	0.2	0.26	0.3	0.32	0.35	0.40	0.44	0.49
Ritavi 1	0.72	0.73	1.9	2.02	2.25	2.50	2.79	3.12
Ritavi 2	2.99	2.66	8.2	8.73	9.70	10.81	12.06	13.49
Naphuno	1.39	1.3	1.3	1.38	1.54	1.71	1.91	2.14
Bolobedu	2.7	2.56	0.2	0.21	0.24	0.26	0.29	0.33
Giyani	0.93	0.98	3.7	3.94	4.38	4.88	5.44	6.09
Namakgale			0.8	0.85	0.95	1.05	1.18	1.32
TOTAL	13.8	14.93	**22.0**	**23.42**	**26.03**	**28.99**	**32.36**	**36.18**

(Source: Urban-Econ Calculations from DWAF statistics)

Table 25: Water Requirements in 2030 according to Method 3 (using the medium growth scenario formulated as part of Method 1)

User sector	Water requirement/Impact on yield (Mm^3/a)
Irrigation	133
Domestic	36.18
Afforestation	35
Industrial	0.69
Power Generation	0
Total local requirements	**204.87**

(Source: Urban-Econ Calculations from DWAF statistics)

Table 26: Reconciliation of Requirements and Available Water in 2030 – according to Method 3 (using the medium growth scenario formulated as part of the method one approach)

Available Water (Mm^3/a)	Local Yield	170
	Transfer In	0
	Total	**170**
Water requirements (Mm^3/a)	Local requirements	**204.87**
	Transfers out	15
	Total	
Balance	**-49.87**	

(Source: Urban-Econ Calculations from DWAF statistics)

According to method 3, the above water balance indicates that according to the current population growth rates, the total deficit will reach -50 million m^3/a by the year 2030.

4.3 CONCLUSION

The various population growth scenarios and the related methods employed to determine the most likely water demand requirements that will be experienced by the study area, all have one thing in common. The area for which water planning must be done is growing and water is becoming an increasing problem.

The results of the water demand projections done by using all three methods indicate an ever increasing population which translates directly into an increased demand for water.

The information is mostly based on secondary data, but it is regarded as being sufficient for the purpose of the current study. The overall aim of the study was to review and update the water demand projections done as part of the 1998 Main Feasibility Report. The current report investigated various ways in which to determine the growth potential of the area and translate that into water demand projections.

CHAPTER 5 – CONCLUSION AND RECOMMENDATIONS

The following are the main issues in the study area:

- Substantial run-off is generated in the upper reaches of the study area but forestry has a significant impact on this. Dams such as Tzaneen, Ebenezer and Magoebaskloof result in substantial utilizable yield in this catchment. The catchment as a whole is in deficit although users upstream of the Tzaneen Dam enjoy a relatively high level of assurance while users downstream experience shortages.
- Irrigation has developed and expanded to fully utilise the water resources (prior to any allowance for the ecological Reserve). These are mostly perennial high-value crops. Financial losses during droughts have resulted in a need for more efficient water use by irrigators. Current schemes are reportedly very efficient and well managed but there is also some upliftment programmes planned for some of the less efficient irrigations schemes. Large-scale afforestation in the upper catchments has a large impact on the water resources.

Domestic water users occur all over the study area in urban and non-urban environments. Extensive development has occurred in the study area and due to shortages in domestic supply it is clear that additional storage is required. This becomes even more critical in the year 2030 due to the growth anticipated in the domestic demand.

The total water requirements as set out in this document by 2030 is estimated between 205.98, 218.16 and 341.78 million m^3 per annum according to method 1, 2 and 3 respectively.

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Appendix C : Irrigation Assessment – Schoeman & Vennote

GROOT LETABA RIVER WATER RESOURCE DEVELOPMENT PROJECT: POST FEASIBILITY BRIDGING STUDY

IRRIGATION ASSESSMENT

EXECUTIVE SUMMARY

Schoeman & Vennote was previously appointed by the Department of Water Affairs and Forestry: Sub Directorate- Abstraction and Storage to conduct field surveys on all farms situated within the Great Letaba River Catchment Area for abstraction and storage control in terms of Section 9B(1C) of the Water Act (Act 54 of 1956). The findings of these surveys are fully described in report B0301/2 dated June 2007, submitted to the said Sub Directorate.

The total annual water use for each property was determined based on the type of crop under irrigation and corresponding irrigation requirements determined through SAPWAT with a target irrigation efficiency of 85%.

Water abstracted from groundwater (32 922 058 cubic metres) represents 16.1% of the total annual volume of water abstracted for irrigation. Some 171 670 318 cubic metres of water or 83.7% of the total annual volume is abstracted from the surface water resources.

The monthly abstraction for irrigation purposes peaks in September during which some 23 137 747 cubic metres of water (11.5% of annual total) is abstracted from all resources.

In terms of both area under irrigation (35.3%) and annual water use (39.1%), Citrus is the main crop under irrigation followed by Mangoes and Avocados.

The results of the survey were subsequently analysed to create information in a format useful for further hydrological modelling. Time series of irrigation demands were generated for quaternary catchments and for smaller quinary catchments.

GROOT LETABA RIVER WATER RESOURCE DEVELOPMENT PROJECT: POST FEASIBILITY BRIDGING STUDY

IRRIGATION ASSESSMENT

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ANNEXURES

Annexure A: Fixed Area Irrigation Demand Time Series

LIST OF ABBREVIATIONS

DWAF	Department of Water Affairs and Forestry
FAO	Food and Agriculture Organisation
GIS	Geographical Information System
PSP	Professional Service Provider
WARMS	Water Authorisation and Resource Management System
WRSM2000	Water Resources Simulation Model or Pitman model
WRYM	Water Resources Yield Model
SAPWAT	SAPWAT is a computer program used for estimating crop irrigation requirements in South Africa and has been released as Water Research Commission Report No. 624/1/99. The program combines crop and climatic databases that enable the water manager to develop realistic estimates that reflect the complex factors that determine average monthly crop water requirements. The program contains extensive default information on crops, climate, soil, irrigation methods and management practices.

1. INTRODUCTION

The Department of Water Affairs and Forestry (DWAF) initiated a study "*Groot Letaba River Water Resource Development Project: Post Feasibility Bridging Study*". The study area covers the Groot Letaba River catchment.

This report is an assessment of the water required for irrigation within the study area. The assessment is based upon the findings of a previous study completed for DWAF: Sub Directorate- Abstraction and Storage. In that study field surveys on all farms situated within the Great Letaba River Catchment Area were done for abstraction and storage control in terms of Section 9B(1C) of the Water Act (Act 54 of 1956). A total of 2843 properties were surveyed between August 1994 and November 2001. The main focus was to gather information on property owners, survey all water works in order to determine their abstraction/storage capacities and to determine the land use on each property in terms of arable and irrigated land. The total average annual water use for each property was determined based on the type of crop under irrigation and corresponding irrigation requirements determined through SAPWAT with a target irrigation efficiency of 85%. That study covered all of the Groot Letaba catchment, but excluded the Politsi Government Water Control Area. The Politsi area excluded covers the irrigation area served by the Magoebaskloof Dam.

2. PURPOSE OF THIS STUDY

The main tasks and objectives of this study are as follows:

- To identify areas under irrigation using the data obtained during the field survey study and to determine the associated irrigation water requirements.
- To generate two separate monthly time series in hydrological years (from October 1925 to September 2006) for the abstraction of water for irrigation purposes. The first series is based on historical requirement, i.e. the real growth in irrigation requirement over the period. The second series is based on present day irrigation requirement i.e. as if the current irrigation existed since 1926 and remained constant over the whole period.

3. PURPOSE OF THIS REPORT

The purpose of this report is to present the following:

- A description of the data sources used.
- A description of the steps and processes followed during the determination of irrigation requirements.
- Analyses of water use and water requirement for irrigation in the Great Letaba River Catchment.

4. INFORMATION GATHERING AND DATA PREPARATION

The irrigation assessment for the entire B81 tertiary catchment, excluding the Politsi Government Water Control Area, was done as the major task for this study. Data was prepared to be used in the Water Resources Yield Model (WRYM).

Updated rainfall data was obtained from the modellers, and the overlapping period of October 1925 to September 2006 was used in further analyses.

Only the data available from the filed survey study was used in further analyses. As most of the irrigation from surface water resources are controlled by allocations determined under the previous Water Act, 1956 the irrigation demands have stabilised over the past number of years. No new irrigation development with surface water resources were allowed, and irrigation from boreholes was also limited to the level of the 1998 development when the National Water Act was introduced. It is therefore accepted that no meaningful changes occurred in the irrigation development since the completion of the field surveys in 2001.

5. DESCRIPTION OF THE STUDY AREA

The Great Letaba River is situated within the Levuvhu/Letaba Water Management area in the Limpopo Province. The Great Letaba and Little Letaba Rivers join one another at the boundary of the Kruger National park and thereafter the river is known as the Letaba River. The Letaba River flows into the Olifants River just before the Olifants River crosses the border of Mozambique.

The area stretches from Haenertsburg in the southwest past Tzaneen and Duiwelskloof (north of Tzaneen), and further in an eastern direction past Letsitele, “Die Eiland” Holiday Resort up to the Kruger National Park at the confluence of the Great Letaba and Klein-Letaba Rivers. The river is known as the Letaba River downstream of the said confluence.

The area originates in the upper course of the Broederstroom on the farm Grootbosch. It continues in a southern direction for approximately 22km along the Broederstroom past the Dap Naude Dam up to the Ebenezer Dam. Downstream of the Ebenezer Dam, the river is known as the Great Letaba River, which stretches further northeast for roughly 24km up to the Tzaneen Dam. From the Tzaneen Dam, the Great Letaba River extends in an eastern direction for some 30km up to where the Letsitele connects from a southern angle, and for some 22km northwest where the Nwanedzi joins from a north-western direction. The Great Letaba River continues with its trajectory in a north-eastern direction for approximately 21km where the Lerwatlou conjoins from a northern angle and for some 42km east up to where the Molototsi connects from the North. Lastly this river carries on for about 32km east, up to the confluence with the Little-Letaba River on the farms Letaba Ranch and M’Baula Ranch.

6. IRRIGATION DEVELOPMENT

By using the information obtained from the field survey the annual irrigated areas per quaternary drainage and sub-drainage level were determined. These values were

provided to the team responsible for the updating of the hydrology and systems yield models. The results for 2004 are shown in **Table 6-1:**

Table 6-1: Irrigation Areas (ha)

	CROP AREA DEVELOPMENT							
	SURFACE WATER DEVELOPMENT (ha)		BOREHOLE WATER DEVELOPMENT (ha)		OTHER WATER DEVELOPMENT (ha)		TOTAL WATER DEVELOPMENT (ha)	
Quaternary	Quinary	2004 area	Quinary	2004 area	Quinary	2004 area	Quinary	2004 area
B81A	B81A01	443.94	B81A01	0.00	B81A01	0.00	B81A01	443.94
	Total	**443.94**	**Total**	**0.00**	**Total**	**0.00**	**Total**	**443.94**
B81B	B81B01	2306.64	B81B01	237.64	B81B01	57.77	B81B01	2602.05
	B81B10	93.23	B81B10	0.00	B81B10	0.00	B81B10	93.23
	B81B12	158.77	B81B12	6.61	B81B12	0.00	B81B12	165.38
	B81B14	544.12	B81B14	1.66	B81B14	0.00	B81B14	545.78
	B81B16	197.93	B81B16	2.62	B81B16	0.00	B81B16	200.55
	B81B20	69.69	B81B20	0.00	B81B20	0.00	B81B20	69.69
	B81B30	617.74	B81B30	95.68	B81B30	5.10	B81B30	718.52
	Total	**3988.12**	**Total**	**344.21**	**Total**	**62.87**	**Total**	**4395.20**
B81C	B81C01	1534.36	B81C01	0.00	B81C01	8.25	B81C01	1542.61
	B81C10	1932.64	B81C10	378.76	B81C10	0.00	B81C10	2311.40
	B81C15	1043.62	B81C15	62.96	B81C15	0.00	B81C15	1106.58
	Total	**4510.62**	**Total**	**441.72**	**Total**	**8.25**	**Total**	**4960.59**
B81D	B81D01	806.81	B81D01	19.06	B81D01	0.00	B81D01	825.87
	B81D10	392.48	B81D10	8.94	B81D10	0.00	B81D10	401.42
	B81D13	281.04	B81D13	0.00	B81D13	0.00	B81D13	281.04
	B81D16	1758.46	B81D16	13.92	B81D16	0.00	B81D16	1772.38
	B81D28	335.04	B81D28	32.56	B81D28	0.00	B81D28	367.60
	Total	**3573.83**	**Total**	**74.48**	**Total**	**0.00**	**Total**	**3648.31**
B81E	B81E01	4364.01	B81E01	428.12	B81E01	0.00	B81E01	4792.13
	B81E10	698.72	B81E10	139.40	B81E10	0.00	B81E10	838.12
	B81E20	630.15	B81E20	212.32	B81E20	0.00	B81E20	842.47
	B81E23	321.92	B81E23	96.97	B81E23	0.00	B81E23	418.89
	B81E25	1125.44	B81E25	470.86	B81E25	0.00	B81E25	1596.30
	B81E30	303.82	B81E30	50.58	B81E30	0.00	B81E30	354.40
	Total	**7444.06**	**Total**	**1398.25**	**Total**	**0.00**	**Total**	**8842.31**
B81F	B81F01	1053.36	B81F01	219.65	B81F01	0.00	B81F01	1273.01
	B81F10	324.84	B81F10	48.62	B81F10	0.00	B81F10	373.46
	B81F20	597.07	B81F20	301.20	B81F20	0.00	B81F20	898.27
	B81F30	1858.68	B81F30	1104.84	B81F30	8.28	B81F30	2971.80
	Total	**3833.95**	**Total**	**1674.31**	**Total**	**8.28**	**Total**	**5516.54**
B81G	B81G01	283.06	B81G01	318.82	B81G01	0.00	B81G01	601.88
	B81G10	159.31	B81G10	9.26	B81G10	0.00	B81G10	168.57
	Total	**442.37**	**Total**	**328.08**	**Total**	**0.00**	**Total**	**770.45**

	CROP AREA DEVELOPMENT							
	SURFACE WATER DEVELOPMENT (ha)		BOREHOLE WATER DEVELOPMENT (ha)		OTHER WATER DEVELOPMENT (ha)		TOTAL WATER DEVELOPMENT (ha)	
Quaternary	Quinary	2004 area	Quinary	2004 area	Quinary	2004 area	Quinary	2004 area
B81H	B81H01	34.97	B81H01	72.24	B81H01	0.00	B81H01	107.21
	B81H10	73.19	B81H10	65.78	B81H10	0.00	B81H10	138.97
	Total	**108.16**	**Total**	**138.02**	**Total**	**0.00**	**Total**	**246.18**
B81J	B81J01	0.00	B81J01	18.41	B81J01	0.00	B81J01	18.41
	B81J10	520.65	B81J10	0.00	B81J10	0.00	B81J10	520.65
	Total	**520.65**	**Total**	**18.41**	**Total**	**0.00**	**Total**	**539.06**
	TOTAL	**24865.70**	**TOTAL**	**4417.48**	**TOTAL**	**79.40**	**TOTAL**	**29362.58**

7. GIS COMPILATION

All information used, compiled and generated during the project were standardised and linked to the GIS. The GIS information was provided in Arc View shape file format and included inter alia:

- Farm boundaries
- Property
- Populated places, Towns and Municipal boundaries
- Quaternary catchments
- Sub catchments
- Rivers
- Satellite images
- 1:50 000 topo cadastral reference grid

8. IRRIGATION WATER REQUIREMENTS

8.1 SUMMARY

In this part of the study, the theoretical water requirement of the identified irrigation development was determined. Following this, the actual practical situation was assessed, taking cognisance of on-farm irrigation system efficiency, the effect of droughts on the theoretical irrigation demands and the expected return flows from irrigated fields back to the water resource(-s).

The quaternary catchment was used as the basic unit for output in the study. On request of the modellers, the quaternary catchments were subsequently divided into smaller sub catchments for modelling purposes. Time series, on a monthly resolution, were generated for the theoretical irrigation demands and the practical ("actual") demands, based on both a growth model and a fixed model of irrigation development in every catchment.

In the growth model, the start date of the available rainfall record was used as the base date of the development. From this point the irrigation development was increased up to the date of the present assessment. The growth in irrigation area is not necessarily linear, and in this model it was based on discovered external influences, such as the

introduction of awareness programs, changes in cropping patterns, introduction of electricity and the establishment of Irrigation Boards.

In the fixed model, the current irrigation development was retained as fixed over the total time span of the rainfall record, and the time series of demand were analysed statistically to discover to what level of assurance the current irrigation development can be entertained. A quota per field area, based on an acceptable level of assurance, was determined for every catchment from a statistical analysis of the long term irrigation requirements as determined from the fixed model.

This model also calculated the abstraction rate that should be allowed in each quaternary catchment.

The typical monthly crop factors for use with Penman-Monteith ET_0 reference evaporation were also calculated by using the fixed model.

8.2 REPRESENTATIVE CROP

The field survey was scrutinised to determine the type of crop, the irrigation system, the area, the water source and the quaternary catchment of each surveyed irrigation field in the project area.

The aim of this exercise was to facilitate the definition of a representative crop that mimics the effect of all the crops and irrigations systems within a particular quaternary or smaller subcatchment.

8.3 RAINFALL

Rainfall records were incorporated in the irrigation demand model to determine a time series of irrigation demands. The extended records, as provided by the modelling teams were used.

The rainfall records were converted into records of effective rainfall (i.e. effective for irrigation fields) by using the methods used in the SAPWAT program These records were used in conjunction with the SAPWAT model to determine the irrigation demands.

8.4 EVAPOTRANSPIRATION

The monthly Penman-Monteith evapotranspiration grids available from the South African Atlas of Climatology and Agro-hydrology (Schulze et al 2006) were analysed to determine the representative monthly evapotranspiration per quaternary catchment. From these values, the average and median daily evaporation values were generated as inputs into the SAPWAT model.

8.5 SAPWAT MODEL

Using the median rainfall records (actual, not effective) together with the daily evapotranspiration records, a driver climatic station was generated for each quaternary catchment. By using this approach, the number of usable SAPWAT climate stations was increased from the original 350 to some 1946 countrywide, without sacrificing any accuracy. The use of a driver station per quaternary catchment resulted in 9 climate stations for this catchment.

Only the basic front end of the SAPWAT model was used in this exercise. No attempt was made to improve the generic data used in the basic front end with further refined soil data, rooting depths, scheduling techniques or refined irrigation practices. The results from the basic front en analysis were captured from the text files that the SAPWAT model generated. Data for both “with rain” and “without rain” were captured and further analysed.

8.6 IRRIGATION REQUIREMENT TIME SERIES

A model was set up to deliver the required irrigation requirement time series. In the first part of the model, irrigation fields with the same crop and irrigation system were lumped together per quaternary catchment. SAPWAT was then used to determine the irrigation requirements, both with and without taking rainfall into account.

The SAPWAT results were fed back into the demand model, resulting in a monthly irrigation requirement for every crop/system combination in each quaternary catchment. The results excluding rainfall were subsequently used in the model to determine the monthly irrigation requirement time series and to quantify required abstraction rates.

The record generation part of the model used the “SAPWAT without rainfall” results together with the effective rainfall records generated earlier to determine the monthly records of irrigation requirements. This part of the model allowed for the generation of different sets of records for different water sources or water resources. Different records were generated for surface water, borehole water and other water sources. A complete set of records was generated for each quaternary catchment. Such a set of records consists of results per water resource, both for the growth model and fixed model described earlier.

8.7 ACTUAL IRRIGATION USAGE

Recognising that during periods of water scarcity the total irrigation requirements will most probably not realise as irrigators postpone planting dates until the first rain falls, or even not irrigate at all during a particularly dry year, it was deemed necessary to reduce the requirements to be balanced with the expected irrigation practices. The model took this into account by calculating a "drought reduction factor" and subsequently created "actual" irrigation usages based on expected irrigation patterns. The algorithm for this process was based on the mean monthly and the mean annual rainfall in the respective quaternary catchments.

The model generated time series of actual irrigation usage, both for the growth model and fixed model for each quaternary catchment.

It must be stressed that this approach has only been thought through for irrigation in the catchments of the northern part of the country (north of the Orange River). In these parts of the country, irrigation is normally supplemental to rainfall, as the extent of the rainfall is such that it should normally be taken into account. In other parts of the country where rainfall is lower or more erratic, a different approach may be contemplated.

8.8 IRRIGATION EFFICIENCY

Based on the outcomes of the field survey, a representative efficiency of 85% was adopted for all irrigation systems in this area.

8.9 ABSTRATION RATE

This output of the study was the required abstraction rate in l/s/ha for each quaternary catchment. These results may be used as licence conditions during future licensing of water use in the area.

8.10 CROP FACTORS

The output of this part of the study was the calculated Penman-Monteith crop factors for the representative crop, planting dates and irrigation strategies per quaternary catchment.

8.11 MODEL INTERFACE

This output was the evaluation of the return flows generated from the irrigated fields. The return flows were defined as a portion of the total in-field irrigation losses. The weighted average results for every crop/system combination were fed back into the demand model, resulting in a monthly return flow time series for each quaternary catchment.

8.12 RETURN FLOWS

The final output of the model was a spreadsheet interface that allows the user the input of variables, such as irrigated areas, return flow fractions and return flow limitations. It also allows for the calculation of proposed irrigation quotas per field area. The generated time series for any combination of the parameters are included in the model.

8.13 DETAILED ANALYSES

8.13.1 Representative crop

The first task in identifying the representative crop was the analysis of the depth of irrigation required for the crop/system combination in the relevant quaternary catchment. The process is shown schematically in **Figure 8-1:**

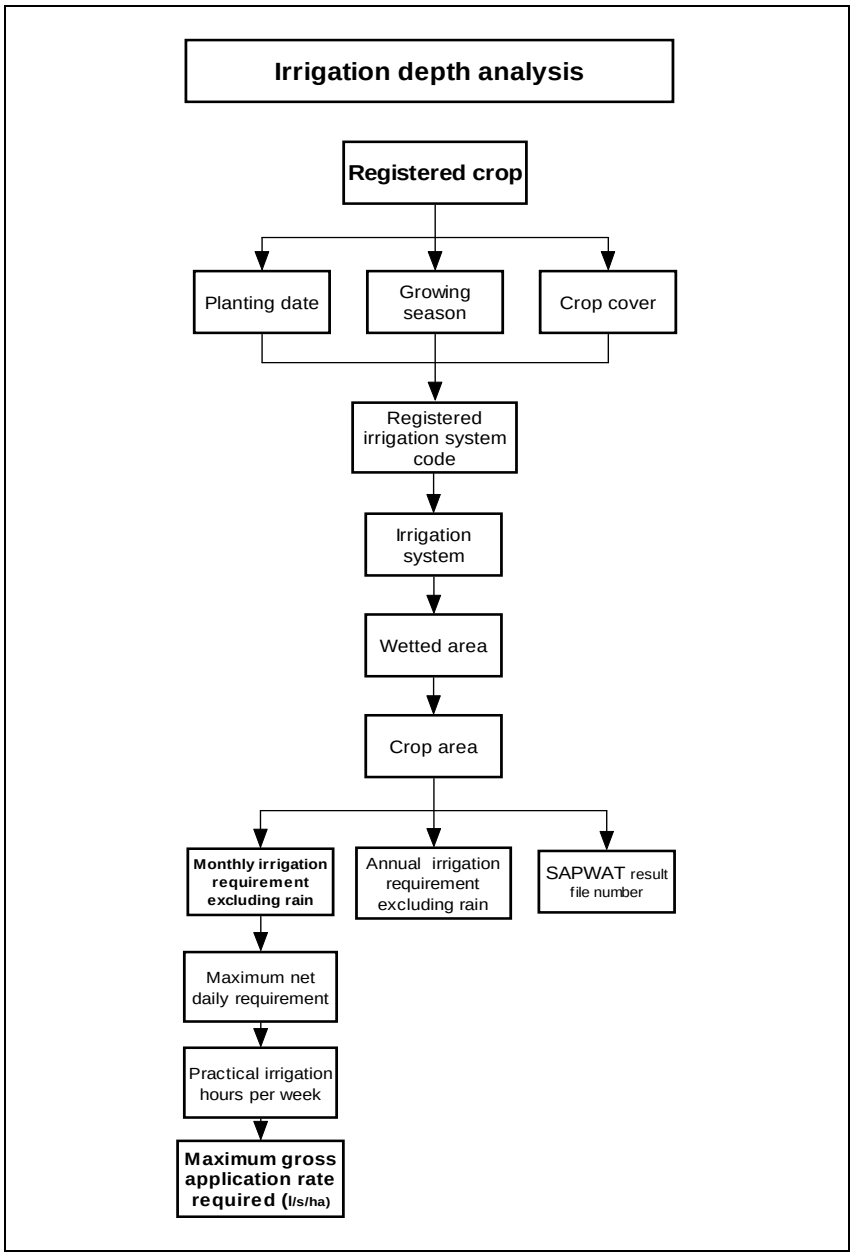


Figure 8-1: Irrigation depth analysis

The survey information was used to do a normal SAPWAT determination of the irrigation requirements. For each unique crop/irrigation combination, a SAPWAT calculation was completed. During this process, details pertaining to the crop name, planting date, length of the growing period, season during which the crop is cultivated, crop cover, irrigation system and wetted area were fed into SAPWAT. The resultant text file created by SAPWAT named “summary.dat” was then renamed with a numerical prefix and the suffix “csv” and the renamed file saved with the data of that particular catchment. A typical file name would be “23.csv”, which is the file of the 23rd crop combination for that particular catchment.

The data from the said text file was subsequently imported into a worksheet for further analysis. Data for both rainfall included and rainfall excluded were imported. The two-sheet worksheet was further populated with the registered crop area under irrigation for every crop combination. This worksheet was generically named to reflect the relevant quaternary catchment. A typical name would be “Registered B81A.xls”, where B81A is the quaternary catchment.

The first sheet on the said worksheet computes the total annual depth of irrigation required for each crop combination. It furthermore computes the maximum net daily depth of irrigation required both for “with rain” and “without rain”. These depths are then converted to a required continuous abstraction rate, expressed in litres per second per hectare. The net required abstraction rate is then converted to a practical value by limiting the total available hours per week from 168 to 144. The resultant practical abstraction rate (for the case that excludes rainfall) is the suggested allowable abstraction rate for licensing purposes. In the model, these calculations are included in a sheet called Reg_Crops_mm.

The second task in the identification of the representative crop was an analysis of the irrigation volumes required. This process is shown schematically in **Figure 8-2:**

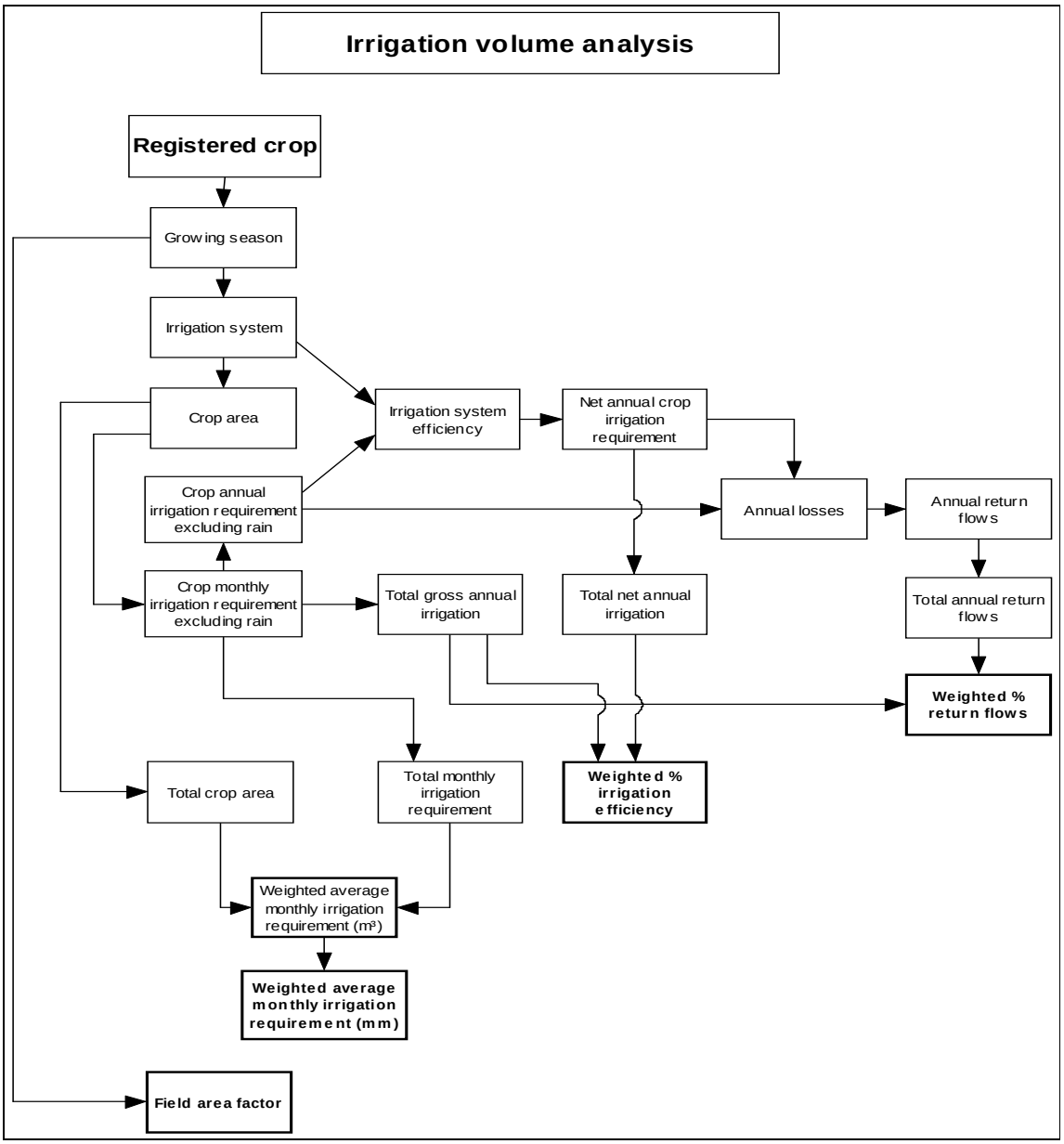


Figure 8- 2

This task follows on the previous task. As SAPWAT does not provide for the analysis of a time series of records, it was necessary to create a demand excluding rainfall, from which the effective rainfall record can be subtracted, resulting in a time series of irrigation demands. The shortcoming in this method is that the irrigation demands are quantified using average values of evaporation. Although not strictly accurate, this is presently the best approach available, as no representative time series of evaporation is yet available. The same crop and other data as described above, is used in this task. The crop area was multiplied by the depth of irrigation required to obtain monthly volumetric values based on the requirement with rainfall excluded.

The volumetric demands for every crop combination were calculated and aggregated per month. The monthly totals were then divided by the total crop areas, resulting in a weighted average monthly demand per crop hectare. These results were then converted back to irrigation depths in millimetre per month for further use in the model. These results mimic the monthly irrigation demand (rainfall excluded) for all of the crop combinations occurring within the relevant quaternary catchment. It therefore defines a single crop representing the effect of all crop combinations. This imaginary crop is called the representative crop.

The seasonal classification of the crop combination made it possible to determine the actual field sizes. Although for all of the permanent crops the field sizes equal the crop areas, this is not necessarily true for seasonal crops. Some of the winter crops are cultivated on the same fields that were used for summer crops. In order to express the irrigation demand in terms of a quota per field area, it was deemed necessary to determine the actual field sizes as accurately as possible. In the model the smallest of either the winter or summer crop areas were deemed also to be irrigated during the alternate season. In the whole of the project area it was found that the sometimes the winter areas and sometimes the summer areas governed this decision. This resulted in the assumption that the field areas might be calculated by adding the largest of the summer or winter areas to the permanent areas. This resultant field area was called the “quota area” in the model. A further factor, called the “quota factor” was developed to facilitate further calculations in the model. The quota factor was calculated by dividing the total crop area by the quota area. In any particular quaternary catchment dividing the total crop area by the quota factor will thus result in the actual field area for that catchment. Dividing the irrigation demand by the quota factor will result in the demand per field hectare.

The SAPWAT irrigation demands include the effect of the efficiency of the relevant irrigation systems. In this study an efficiency of 85% was accepted. This representative efficiency was subsequently used in the model used to calculate the representative crop evapotranspiration factor (Etc).

The final part of this task analysed the potential return flows from the crop areas. The hypothesis was that 50% of the difference between the irrigation requirement and the crop water requirement will be available as return flows. These calculated values were once again aggregated on an annual basis. Dividing the aggregated return flows by the total crop area within the relevant catchment resulted in a weighted return flow percentage per crop hectare. This value was used further down in the model to determine a time series of monthly return flows. In the model, these calculations are included in a sheet called Reg_Crops_m^3.

8.13.2 Generation of time series records

The defining driver for all of the time series records generated by the model was the rainfall record for each quaternary catchment. These records were obtained from the modellers. The full set of records used contained monthly rainfall records for each catchment, stretching from October 1925 to September 2006.

The process of converting the rainfall records for purposes of this model is shown in **Figure 8-3.**

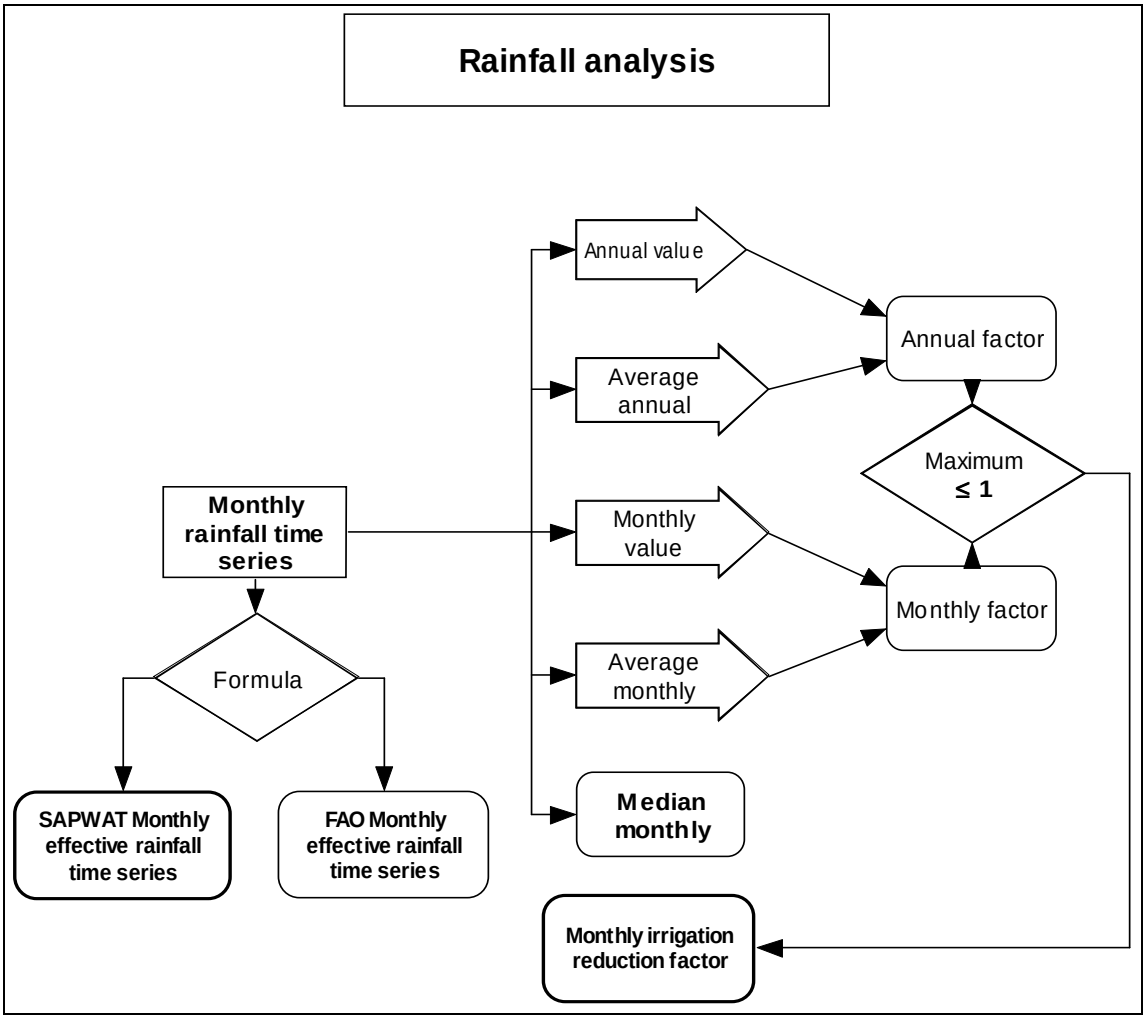


Figure 8-3

The first task in this process was to convert the monthly rainfall values to effective rainfall (effective for irrigation).

The formula used by SAPWAT was implemented in this part. The relevant reference literature is found in the minutes of meetings of the steering committee responsible for the development of SAPWAT. We accept the accuracy and theoretical basis of the formula. This formula does take cognisance of the available water retaining capacity of the soil in that it evaluates the monthly evapotranspiration. In SAPWAT the maximum monthly evapotranspiration considered is limited to 75 mm. This formula is:

$$r_e = ET\left(-0{,}001\frac{r^2}{ET} + 0{,}025\frac{r^2}{ET^2} + 0{,}0016r + 0{,}6\frac{r}{ET}\right)$$ where *ET* is limited to 75 mm

In this formula: r_e = the effective monthly rainfall
r = the actual monthly rainfall
ET = the monthly crop evapotranspiration

A time series of effective rainfall was subsequently compiled by using this equation, and using the actual rainfall for every month of the record plus the weighted monthly crop evapotranspiration.

The drought reduction factors were then calculated as the **second task**. The algorithm for this process was based on the actual and mean monthly and the actual and mean annual rainfall in the respective quaternary catchments. For every month of the time series, the rainfall for that particular month was divided by the mean rainfall for that particular month over the whole time series. Should this result be greater than 1, it was limited to 1 and memorised. A result smaller than 1 was also put into memory. While evaluating that particular month, the actual rainfall for the hydrological year in which that specific month falls, was divided by the mean annual rainfall for all hydrological years of the time series. Once again, this result was limited to a maximum of 1. These results were then compared with the monthly results held in memory. The model then defines the drought reduction factor for that particular month as the larger of these two values.

The reasoning behind this algorithm is that a single dry month in an otherwise normal or wet year will not limit the planting of irrigation crops. The actual planting date may be postponed by a month or two, or alternative crops may be planted should the year turn out to be normal or wet. During a particularly dry year, a smaller area of planted crops, or even no planting at all, may reasonably be expected.

The drought reduction factors were used deeper down in the model to reduce the theoretical irrigation requirements to actual (drought restricted) irrigation requirements. In the model these calculations are included in a sheet named **Rain**.

This approach obviously does not take into account the irrigation of permanent crops such as orchards. Care should be taken not to use a drought reduction factor that mimics actual irrigation use at levels lower than those required for the permanent crops. Such problems were encountered in the study area. The final results presented therefore do not include the drought restricted time series, as most of the crops irrigated in the study area are of a permanent nature.

The third task was to develop time series based on a fixed area of irrigation.
The gross monthly irrigation requirements (mm) for the representative crop, excluding rainfall, are used as the point of departure. For every month of the time series, the effective rainfall is the subtracted from the gross irrigation requirement for that month. These results were limited to a minimum of 0 and are included under a heading of Net irrigation requirements (mm) in a sheet named Flow_Fix_m³.

The total annual irrigation requirements obtained from this time series were then analysed statistically to obtain the annual irrigation depth that will satisfy the requirements at different levels of assurance. The depths were converted into a volume per field area by multiplying the crop area with the quota factor described earlier. These results are shown to the right of the table containing the net irrigation requirements.
The time series for the depth of irrigation requirements was then converted to a time series of the volume of irrigation requirements. This is shown under the heading Net irrigation requirements (m³).

The next time series in the model, under the heading Drought reduction factor included is the result when the net irrigation requirements (m³) are multiplied with the drought reduction factor calculated earlier.

In the last part of the sheet Flow_Fix_m³ the return flows are quantified. The weighted average return flow percentage is multiplied by the corresponding monthly irrigation requirements. In the model, the return flows during drought restricted months is reduced by multiplying the results with a factor of 0,75. This is done in order to appreciate higher losses during severe droughts and also to cater for drier soil profiles, holding back more water than during wetter periods.

The results of the calculations done on the sheet Flow_Fix_m3 are carried over to a sheet called Flow_Fix_Record, and are portrayed in a format that is user friendly for further modelling purposes. The values are expressed in million cubic metres under the headings Net irrigation requirements (10^6m³), Drought reduction factor included and Return flows respectively.

The fourth task was to develop the growth model that mimics the growth in irrigation from the base date of October 1925 to the last date used in the model, namely September 2006. Benchmark data were available for 1998 and 2004 (survey data).

The growth model is based on the following assumptions:

Range	Assumption
1925 – 1970	Exponential growth to weighted% of 1998 figure
1971 – 1998	Linear growth to 1998 figure
1999 – 2004	Linear growth to 2004 figure

For the period 1925 to 1970, an exponential relationship was developed to show low initial growth, followed by increased growth in the last ten years before the first formal government water control was instituted.

The formula developed is:

$$y = b \times m^{yearnumber} \times \frac{Area_{Control}}{Area_{Survey}}$$

Where b = 3.383 and m = 1.08 (year number is 1 in 1925 and 46 in 1970)

The compilation of the growth model is included in a sheet called **Grow_Model** in the model.

The **fifth task** was to develop time series of irrigation requirements based on the growth in irrigation areas over the whole period of the available record. This task follows the same procedures described earlier for a fixed area of irrigation, except that the calculations are based upon a growing area of irrigation.

The **sixth task** was to reverse engineer the calculations done earlier to obtain representative monthly crop factors for the representative crop.

In this task the calculated crop evapotranspiration Et_c as calculated by multiplying the monthly irrigation requirement by the system efficiency, was compared with the Penman-Monteith evaporation. The following relationship was used:

$Et_c = K_c * Et_0$, where Et_c is the crop evapotranspiration, Et_0 is the Penman-Monteith evaporation and K_c is the representative crop factor.

The K_c-values are shown in sheet **ETo** in the model.

Graphical results showing the time series for the fixed area model is included in sheet **Fix_Model_Graph** and that for the growing area model is included in sheet **Grow_Model_Graph** of the model.

8.14 MODEL INTERFACE

A user friendly model interface was developed for each quaternary and each quinary catchment. This interface allows the user to evaluate all aspects described in this part of the report and facilitates the development of different time series, as required by the user.

The model interface is contained in a sheet called **Variables**. The input structure was designed so that the user can input areas for both the growth model and the fixed area model. The left hand part of the input table contains the data used in the scenario that the user wants to analyse, while the right hand part contains the data found under our assignment.

8.15 RESULTS

The results of this part of the study are summarised in the sections that follow.

8.15.1 Rainfall

A summary of the mean (average) annual rainfall in mm per quaternary catchment is shown in **Table 8-1** and the calculated mean annual effective rainfall (that amount of rainfall that enters into the soil profile and is available for use by the crop) is presented in **Table 8-2.**

Table 8-1

AVERAGE RAINFALL (mm)													
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Tot**
B81A01	69	125	176	201	199	158	67	26	16	17	16	30	**1100**
Average	**69**	**125**	**176**	**201**	**199**	**158**	**67**	**26**	**16**	**17**	**16**	**30**	**1100**
B81B01	75	146	195	221	213	171	70	28	16	16	17	34	**1200**
B81B10	66	119	168	192	190	151	64	25	15	16	16	29	**1050**
B81B12	62	113	160	183	181	144	61	24	14	15	15	27	**1000**
B81B14	62	113	160	183	181	144	61	24	14	15	15	27	**1000**
B81B16	81	147	208	238	235	187	79	31	18	20	19	36	**1300**
B81B20	94	183	244	276	266	213	88	34	20	20	21	42	**1500**
B81B30	75	146	195	221	213	171	70	28	16	16	17	34	**1200**
Average	**74**	**138**	**190**	**216**	**211**	**169**	**70**	**28**	**16**	**17**	**17**	**33**	**1179**
B81C01	48	91	123	162	158	113	43	17	11	10	8	18	**803**
B81C10	57	108	146	193	188	135	51	20	13	12	9	22	**954**
B81C15	54	102	138	183	178	128	48	19	12	12	9	21	**903**
Average	**53**	**100**	**136**	**179**	**175**	**125**	**47**	**19**	**12**	**11**	**9**	**20**	**887**
B81D01	45	74	105	132	124	88	34	12	7	9	5	16	**650**
B81D10	77	155	211	252	233	183	79	30	16	17	16	33	**1300**
B81D13	71	143	194	233	215	169	73	27	14	15	15	31	**1200**
B81D16	59	119	162	194	179	141	60	23	12	13	13	26	**1000**
B81D28	45	74	105	132	124	88	34	12	7	9	5	16	**650**
Average	**59**	**113**	**155**	**188**	**175**	**134**	**56**	**21**	**11**	**12**	**11**	**24**	**960**
B81E01	45	74	105	132	124	88	34	12	7	9	5	16	**650**
B81E10	38	63	89	111	105	75	29	10	6	7	4	13	**550**
B81E20	54	102	138	183	178	128	48	19	12	12	9	21	**903**
B81E23	45	74	105	132	124	88	34	12	7	9	5	16	**650**
B81E25	41	69	97	122	114	82	31	11	7	8	4	15	**600**
B81E30	54	102	138	183	178	128	48	19	12	12	9	21	**903**
Average	**46**	**81**	**112**	**144**	**137**	**98**	**37**	**14**	**9**	**9**	**6**	**17**	**709**
B81F01	31	51	72	91	86	61	23	9	5	6	3	11	**450**
B81F10	41	69	97	122	114	82	31	11	7	8	4	15	**600**
B81F20	38	63	89	111	105	75	29	10	6	7	4	13	**550**
B81F30	38	63	89	111	105	75	29	10	6	7	4	13	**550**
Average	**37**	**61**	**86**	**109**	**102**	**73**	**28**	**10**	**6**	**7**	**4**	**13**	**538**
B81G01	38	63	89	111	105	75	29	10	6	7	4	13	**550**
B81G10	52	86	121	152	143	102	39	14	8	10	6	18	**750**
Average	**45**	**74**	**105**	**132**	**124**	**88**	**34**	**12**	**7**	**9**	**5**	**16**	**650**
B81H01	34	57	80	101	95	68	26	10	6	7	4	12	**500**
B81H10	38	63	89	111	105	75	29	10	6	7	4	13	**550**
Average	**36**	**60**	**84**	**106**	**100**	**71**	**27**	**10**	**6**	**7**	**4**	**13**	**525**
B81J01	31	51	72	91	86	61	23	9	5	6	3	11	**450**
B81J10	31	51	72	91	86	61	23	9	5	6	3	11	**450**
Average	**31**	**51**	**72**	**91**	**86**	**61**	**23**	**9**	**5**	**6**	**3**	**11**	**450**

Table 8-2

AVERAGE EFFECTIVE RAINFALL (mm)													
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Tot**
B81A01	44	76	101	107	107	90	42	17	10	11	11	19	**635**
Average	**44**	**76**	**101**	**107**	**107**	**90**	**42**	**17**	**10**	**11**	**11**	**19**	**635**
B81B01	49	87	108	113	110	94	44	18	10	10	11	23	**680**
B81B10	43	74	97	104	103	87	41	17	10	11	11	20	**619**
B81B12	41	71	94	101	100	84	39	16	9	10	10	19	**595**
B81B14	41	71	94	101	100	84	39	16	9	10	10	19	**595**
B81B16	52	88	114	119	118	102	49	20	12	13	13	24	**725**
B81B20	59	103	125	127	124	109	54	22	13	13	14	28	**793**
B81B30	49	87	108	113	110	94	44	18	10	10	11	23	**679**
Average	**48**	**83**	**106**	**111**	**110**	**94**	**44**	**18**	**11**	**11**	**12**	**22**	**669**
B81C01	32	58	75	89	85	67	28	12	7	7	6	13	**477**
B81C10	37	67	86	99	94	76	34	14	9	8	7	15	**545**
B81C15	36	64	83	96	91	73	31	13	8	8	6	14	**523**
Average	**35**	**63**	**81**	**95**	**90**	**72**	**31**	**13**	**8**	**8**	**6**	**14**	**515**
B81D01	30	48	65	77	70	54	22	8	5	6	3	10	**398**
B81D10	50	91	114	121	116	99	49	19	10	11	11	22	**714**
B81D13	46	85	108	116	111	94	46	18	10	10	10	21	**675**
B81D16	39	73	94	104	98	82	39	15	8	8	9	18	**587**
B81D28	29	47	65	77	70	54	22	8	5	6	3	14	**399**
Average	**39**	**69**	**89**	**99**	**93**	**77**	**36**	**14**	**8**	**8**	**7**	**17**	**555**
B81E01	30	48	65	77	70	54	22	9	5	6	3	11	**399**
B81E10	26	41	57	67	62	47	19	7	4	5	3	9	**347**
B81E20	36	64	83	96	91	73	32	13	8	8	6	14	**523**
B81E23	30	48	65	77	70	54	23	8	5	6	3	11	**399**
B81E25	28	45	61	72	66	51	21	8	4	5	3	10	**373**
B81E30	36	64	83	96	91	73	32	13	8	8	6	14	**523**
Average	**31**	**52**	**69**	**81**	**75**	**59**	**25**	**10**	**6**	**6**	**4**	**11**	**427**
B81F01	21	34	47	57	52	40	16	6	3	4	2	7	**290**
B81F10	28	45	61	72	66	51	20	8	5	5	3	10	**373**
B81F20	26	41	57	67	62	47	19	7	4	5	3	9	**346**
B81F30	26	41	57	67	62	47	19	7	4	5	3	9	**347**
Average	**25**	**40**	**55**	**66**	**60**	**46**	**18**	**7**	**4**	**5**	**3**	**9**	**339**
B81G01	26	41	57	67	62	48	18	7	4	5	3	12	**349**
B81G10	34	54	73	85	77	60	26	10	6	7	4	12	**448**
Average	**30**	**48**	**65**	**76**	**69**	**54**	**22**	**8**	**5**	**6**	**3**	**12**	**399**
B81H01	22	36	52	62	57	42	17	7	4	4	3	10	**316**
B81H10	24	41	57	67	61	47	18	7	4	5	3	0	**334**
Average	**23**	**39**	**54**	**65**	**59**	**44**	**18**	**7**	**4**	**5**	**3**	**5**	**325**
B81J01	20	34	47	57	52	38	15	6	3	4	2	7	**287**
B81J10	20	34	47	57	52	38	15	6	3	4	2	7	**286**
Average	**20**	**34**	**47**	**57**	**52**	**38**	**15**	**6**	**3**	**4**	**2**	**7**	**287**

8.15.2 Average annual irrigation requirements

Table 8-3 shows the average annual irrigation requirements in addition to rainfall in m³ per crop ha:

Table 8-3

AVERAGE NETT IRRIGATION REQUIREMENTS (Rain included) in m³/crop ha													
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Tot**
B81A01	232	111	83	60	39	54	185	398	403	350	433	237	**2585**
Average	**232**	**111**	**83**	**60**	**39**	**54**	**185**	**398**	**403**	**350**	**433**	**237**	**2585**
B81B01	581	436	424	356	216	200	314	494	502	499	627	667	**5316**
B81B10	664	603	563	450	263	247	377	562	559	540	685	731	**6243**
B81B12	621	509	459	359	207	215	355	516	511	492	627	674	**5546**
B81B14	657	603	562	445	256	238	361	536	536	525	670	714	**6103**
B81B16	618	461	374	291	171	150	243	414	439	443	577	671	**4850**
B81B20	461	310	311	259	160	135	227	414	433	431	540	569	**4252**
B81B30	622	455	426	361	211	179	266	434	449	445	553	638	**5040**
Average	**603**	**482**	**446**	**360**	**212**	**195**	**306**	**482**	**490**	**482**	**611**	**666**	**5336**
B81C01	760	544	478	362	292	423	317	658	611	626	809	882	**6764**
B81C10	778	701	737	551	380	377	482	608	559	571	724	812	**7278**
B81C15	731	541	508	368	288	375	393	616	552	555	715	825	**6465**
Average	**756**	**595**	**574**	**427**	**320**	**392**	**397**	**627**	**574**	**584**	**749**	**840**	**6836**
B81D01	501	486	547	427	312	322	387	624	563	525	634	514	**5842**
B81D10	672	474	514	394	260	241	343	493	477	483	615	743	**5708**
B81D13	740	469	460	335	232	255	381	501	463	455	600	822	**5714**
B81D16	838	629	642	503	336	246	338	470	445	443	579	770	**6239**
B81D28	159	221	349	262	126	84	281	547	501	408	411	14	**3363**
Average	**582**	**456**	**502**	**384**	**253**	**230**	**346**	**527**	**490**	**463**	**568**	**573**	**5373**
B81E01	765	674	594	501	417	485	390	711	650	641	814	843	**7484**
B81E10	896	810	734	616	513	595	477	724	660	666	849	951	**8492**
B81E20	955	829	789	604	388	360	447	553	506	515	630	904	**7480**
B81E23	869	870	876	703	490	471	569	653	562	525	668	842	**8097**
B81E25	760	718	690	558	413	440	486	685	602	564	697	751	**7365**
B81E30	736	600	590	439	291	271	431	573	499	470	584	704	**6190**
Average	**830**	**750**	**712**	**570**	**419**	**437**	**467**	**650**	**580**	**564**	**707**	**832**	**7518**
B81F01	771	818	924	784	510	477	491	689	607	568	664	645	**7948**
B81F10	683	649	657	549	414	444	424	729	659	628	746	681	**7261**
B81F20	733	714	742	616	449	467	467	725	646	611	722	694	**7587**
B81F30	830	780	776	647	501	551	479	742	664	645	785	823	**8223**
Average	**754**	**741**	**775**	**649**	**468**	**485**	**465**	**721**	**644**	**613**	**729**	**711**	**7755**
B81G01	591	813	1141	1145	861	52	95	221	212	171	165	9	**5477**

AVERAGE NETT IRRIGATION REQUIREMENTS (Rain included) in m³/crop ha													
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Tot**
B81G10	479	505	583	480	301	267	528	757	683	611	665	416	**6276**
Average	**535**	**659**	**862**	**813**	**581**	**160**	**311**	**489**	**448**	**391**	**415**	**212**	**5876**
B81H01	132	208	321	261	123	179	521	850	756	613	556	17	**4536**
B81H10	267	424	678	594	314	86	284	541	491	390	355	0	**4424**
Average	**200**	**316**	**500**	**428**	**218**	**132**	**402**	**696**	**624**	**501**	**455**	**8**	**4480**
B81J01	372	482	669	546	293	244	418	704	634	543	552	202	**5658**
B81J10	328	460	672	541	266	195	432	688	615	511	499	131	**5339**
Average	**350**	**471**	**670**	**543**	**279**	**220**	**425**	**696**	**625**	**527**	**525**	**166**	**5498**

8.15.3 Required abstraction rates

Table 8-4 shows the abstraction rates in litres per second per hectare required to satisfy the peak irrigation requirements.

Table 8-4

MONTHLY GROSS FLOW RATE REQUIREMENTS (l/s/ha)													
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Max**
B81A01	0.68	0.71	0.73	0.67	0.62	0.51	0.45	0.41	0.38	0.36	0.50	0.60	**0.73**
Max	**0.68**	**0.71**	**0.73**	**0.67**	**0.62**	**0.51**	**0.45**	**0.41**	**0.38**	**0.36**	**0.50**	**0.60**	**0.73**
B81B01	0.71	0.69	0.78	0.72	0.64	0.59	0.62	0.51	0.47	0.44	0.54	0.67	**0.78**
B81B10	0.64	0.69	0.74	0.69	0.64	0.59	0.51	0.46	0.43	0.40	0.49	0.61	**0.74**
B81B12	0.64	0.69	0.78	0.72	0.64	0.59	0.51	0.51	0.46	0.40	0.49	0.61	**0.78**
B81B14	0.64	0.69	0.74	0.69	0.64	0.59	0.51	0.51	0.46	0.40	0.49	0.61	**0.74**
B81B16	0.61	0.69	0.74	0.69	0.64	0.48	0.39	0.34	0.33	0.36	0.47	0.57	**0.74**
B81B20	0.64	0.66	0.74	0.69	0.61	0.53	0.45	0.38	0.32	0.31	0.40	0.57	**0.74**
B81B30	0.64	0.69	0.90	0.85	0.64	0.59	0.51	0.46	0.43	0.44	0.49	0.61	**0.90**
Max	**0.71**	**0.69**	**0.90**	**0.85**	**0.64**	**0.59**	**0.62**	**0.51**	**0.47**	**0.44**	**0.54**	**0.67**	**0.90**
B81C01	0.73	0.77	0.79	0.75	0.72	0.67	0.58	0.52	0.49	0.48	0.58	0.69	**0.79**
B81C10	0.84	0.90	1.04	1.00	0.86	0.80	0.72	0.59	0.52	0.54	0.55	0.78	**1.04**
B81C15	0.69	0.75	0.90	0.85	0.72	0.62	0.72	0.59	0.52	0.42	0.54	0.65	**0.90**
Max	**0.84**	**0.90**	**1.04**	**1.00**	**0.86**	**0.80**	**0.72**	**0.59**	**0.52**	**0.54**	**0.58**	**0.78**	**1.04**
B81D01	0.63	0.67	0.90	0.83	0.70	0.60	0.45	0.56	0.50	0.41	0.38	0.56	**0.90**
B81D10	0.69	0.73	0.84	0.80	0.70	0.60	0.46	0.43	0.40	0.41	0.53	0.64	**0.84**
B81D13	0.69	0.76	0.90	0.83	0.73	0.66	0.45	0.56	0.50	0.41	0.53	0.64	**0.90**
B81D16	0.69	0.76	0.90	0.94	0.89	0.66	0.45	0.56	0.50	0.41	0.53	0.64	**0.94**
B81D28	0.63	0.67	0.90	0.83	0.56	0.48	0.45	0.56	0.50	0.41	0.38	0.56	**0.90**
Max	**0.69**	**0.76**	**0.90**	**0.94**	**0.89**	**0.66**	**0.46**	**0.56**	**0.50**	**0.41**	**0.53**	**0.64**	**0.94**
B81E01	0.71	0.78	1.07	1.05	0.75	0.68	0.59	0.62	0.55	0.47	0.56	0.66	**1.07**
B81E10	0.71	0.78	1.07	1.05	0.97	0.89	0.59	0.62	0.55	0.60	0.71	0.79	**1.07**

MONTHLY GROSS FLOW RATE REQUIREMENTS (l/s/ha)													
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Max**
B81E20	0.71	0.80	1.07	1.05	0.97	0.72	0.55	0.62	0.55	0.57	0.56	0.66	**1.07**
B81E23	0.71	0.77	1.07	1.05	0.76	0.65	0.51	0.62	0.55	0.44	0.56	0.66	**1.07**
B81E25	0.71	0.80	0.93	0.89	0.79	0.72	0.76	0.62	0.55	0.44	0.56	0.66	**0.93**
B81E30	0.65	0.71	0.93	1.00	0.97	0.69	0.51	0.62	0.55	0.44	0.52	0.61	**1.00**
Max	**0.71**	**0.80**	**1.07**	**1.05**	**0.97**	**0.89**	**0.76**	**0.62**	**0.55**	**0.60**	**0.71**	**0.79**	**1.07**
B81F01	0.70	0.84	1.14	1.12	1.04	0.76	0.52	0.64	0.57	0.46	0.41	0.59	**1.14**
B81F10	0.67	0.74	0.99	0.95	0.65	0.55	0.52	0.64	0.57	0.46	0.41	0.59	**0.99**
B81F20	0.67	0.74	0.99	1.07	1.04	0.55	0.52	0.64	0.57	0.46	0.41	0.59	**1.07**
B81F30	0.74	0.84	1.14	1.12	0.84	0.76	0.54	0.64	0.57	0.46	0.58	0.68	**1.14**
Max	**0.74**	**0.84**	**1.14**	**1.12**	**1.04**	**0.76**	**0.54**	**0.64**	**0.57**	**0.46**	**0.58**	**0.68**	**1.14**
B81G01	0.67	0.74	0.99	1.07	1.04	0.66	0.52	0.64	0.57	0.46	0.40	0.59	**1.07**
B81G10	0.74	0.81	0.99	0.95	0.81	0.73	0.63	0.64	0.57	0.49	0.58	0.68	**0.99**
Max	**0.74**	**0.81**	**0.99**	**1.07**	**1.04**	**0.73**	**0.63**	**0.64**	**0.57**	**0.49**	**0.58**	**0.68**	**1.07**
B81H01	0.68	0.75	1.01	0.97	0.66	0.55	0.52	0.65	0.58	0.46	0.41	0.59	**1.01**
B81H10	0.52	0.75	1.01	1.09	1.06	0.36	0.52	0.65	0.58	0.46	0.40	0.00	**1.09**
Max	**0.68**	**0.75**	**1.01**	**1.09**	**1.06**	**0.55**	**0.52**	**0.65**	**0.58**	**0.46**	**0.41**	**0.59**	**1.09**
B81J01	0.53	0.66	1.01	0.96	0.60	0.54	0.52	0.65	0.58	0.46	0.41	0.49	**1.01**
B81J10	0.68	0.75	1.01	0.96	0.66	0.56	0.52	0.65	0.58	0.46	0.41	0.60	**1.01**
Max	**0.68**	**0.75**	**1.01**	**0.96**	**0.66**	**0.56**	**0.52**	**0.65**	**0.58**	**0.46**	**0.41**	**0.60**	**1.01**

8.15.4 Proposed irrigation quota

The proposed irrigation quotas based on cubic metres per field hectare per annum are presented in **Table 8-5**.:

Table 8-5

PROPOSED IRRIGATION QUOTA PER FIELD AREA	
	Annual m³/ha
B81A01	4102
Median	**4102**
B81B01	5944
B81B10	6876
B81B12	6575
B81B14	6776
B81B16	5435
B81B20	4819
B81B30	5665
Median	**5944**

PROPOSED IRRIGATION QUOTA PER FIELD AREA	
	Annual m³/ha
B81C01	7427
B81C10	8365
B81C15	7430
Median	**7430**
B81D01	7760
B81D10	6341
B81D13	6483
B81D16	6982
B81D28	7221
Median	**6982**
B81E01	8480
B81E10	9316
B81E20	8472
B81E23	9589
B81E25	9139
B81E30	7792
Median	**8810**
B81F01	10102
B81F10	9157
B81F20	9587
B81F30	9696
Median	**9642**
B81G01	7512
B81G10	9819
Median	**8666**
B81H01	12311
B81H10	8423
Median	**10367**
B81J01	9758
B81J10	9956
Median	**9857**

8.15.5 Crop factors

The crop factors to be used with the Penman-Monteith evaporation are shown in **Table 8-6:**

Table 8-6

PENMAN-MONTEITH CROP FACTORS														
		Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Annual**
B81A01	**Eto**	103.16	103.51	109.88	100.05	87.36	88.06	74.28	68.41	61.84	59.39	76.09	91.61	1023.64
	1998 Kc	0.57	0.66	0.73	0.72	0.63	0.61	0.66	0.74	0.72	0.67	0.62	0.40	0.64
B81B01	**Eto**	117.67	122.48	130.18	122.66	106.35	109.15	90.95	84.44	75.24	73.88	90.19	106.96	1230.15
	1998 Kc	0.83	0.98	1.07	1.06	0.98	0.82	0.72	0.71	0.71	0.71	0.72	0.74	0.86
B81B10	**Eto**	117.67	122.48	130.18	122.66	106.35	109.15	90.95	84.44	75.24	73.88	90.19	106.96	1230.15
	1998 Kc	0.85	1.01	1.10	1.10	1.02	0.85	0.76	0.76	0.76	0.76	0.76	0.77	0.89
B81B12	**Eto**	117.67	122.48	130.18	122.66	106.35	109.15	90.95	84.44	75.24	73.88	90.19	106.96	1230.15
	1998 Kc	0.80	0.91	0.99	0.98	0.90	0.78	0.72	0.71	0.70	0.70	0.70	0.71	0.82
B81B14	**Eto**	117.67	122.48	130.18	122.66	106.35	109.15	90.95	84.44	75.24	73.88	90.19	106.96	1230.15
	1998 Kc	0.82	0.99	1.07	1.06	0.98	0.81	0.73	0.73	0.73	0.74	0.74	0.74	0.87
B81B16	**Eto**	117.67	122.48	130.18	122.66	106.35	109.15	90.95	84.44	75.24	73.88	90.19	106.96	1230.15
	1998 Kc	0.89	1.00	1.06	1.05	0.97	0.79	0.68	0.64	0.66	0.68	0.69	0.76	0.85
B81B20	**Eto**	117.67	122.48	130.18	122.66	106.35	109.15	90.95	84.44	75.24	73.88	90.19	106.96	1230.15
	1998 Kc	0.81	0.98	1.08	1.08	0.99	0.81	0.69	0.67	0.66	0.66	0.66	0.70	0.84
B81B30	**Eto**	117.67	122.48	130.18	122.66	106.35	109.15	90.95	84.44	75.24	73.88	90.19	106.96	1230.15
	1998 Kc	0.86	1.00	1.07	1.07	0.97	0.79	0.66	0.64	0.65	0.65	0.65	0.72	0.84
B81C01	**Eto**	133.78	139.45	150.40	145.20	125.17	127.96	106.11	97.87	86.36	87.53	104.56	121.53	1425.92
	1998 Kc	0.72	0.73	0.74	0.74	0.74	0.74	0.49	0.69	0.69	0.69	0.71	0.72	0.71
B81C10	**Eto**	133.78	139.45	150.40	145.20	125.17	127.96	106.11	97.87	86.36	87.53	104.56	121.53	1425.92
	1998 Kc	0.77	0.90	0.98	0.96	0.89	0.76	0.69	0.67	0.65	0.65	0.65	0.69	0.79
B81C15	**Eto**	133.78	139.45	150.40	145.20	125.17	127.96	106.11	97.87	86.36	87.53	104.56	121.53	1425.92
	1998 Kc	0.73	0.77	0.81	0.80	0.77	0.74	0.59	0.67	0.64	0.63	0.64	0.69	0.72
B81D01	**Eto**	133.23	136.88	149.53	142.27	122.44	123.74	102.02	93.32	82.61	83.63	101.64	119.66	1390.96
	1998 Kc	0.54	0.63	0.73	0.72	0.65	0.59	0.53	0.66	0.64	0.60	0.56	0.44	0.61
B81D10	**Eto**	133.23	136.88	149.53	142.27	122.44	123.74	102.02	93.32	82.61	83.63	101.64	119.66	1390.96
	1998 Kc	0.79	0.93	1.02	1.01	0.95	0.82	0.71	0.65	0.62	0.61	0.62	0.71	0.81
B81D13	**Eto**	133.23	136.88	149.53	142.27	122.44	123.74	102.02	93.32	82.61	83.63	101.64	119.66	1390.96
	1998 Kc	0.82	0.88	0.94	0.92	0.87	0.81	0.72	0.64	0.59	0.58	0.60	0.76	0.78
B81D16	**Eto**	133.23	136.88	149.53	142.27	122.44	123.74	102.02	93.32	82.61	83.63	101.64	119.66	1390.96
	1998 Kc	0.83	0.91	0.98	0.97	0.92	0.72	0.62	0.58	0.55	0.55	0.57	0.69	0.77
B81D28	**Eto**	133.23	136.88	149.53	142.27	122.44	123.74	102.02	93.32	82.61	83.63	101.64	119.66	1390.96
	1998 Kc	0.27	0.43	0.59	0.58	0.39	0.27	0.42	0.59	0.57	0.48	0.37	0.03	0.41
B81E01	**Eto**	136.38	144.76	154.48	152.19	132.58	133.59	112.00	102.94	90.36	91.74	108.19	123.42	1482.64
	1998 Kc	0.70	0.72	0.74	0.73	0.70	0.67	0.48	0.67	0.67	0.66	0.67	0.66	0.68
B81E10	**Eto**	136.38	144.76	154.48	152.19	132.58	133.59	112.00	102.94	90.36	91.74	108.19	123.42	1482.64
	1998 Kc	0.75	0.76	0.77	0.76	0.74	0.71	0.53	0.67	0.67	0.67	0.69	0.73	0.71
B81E20	**Eto**	136.38	144.76	154.48	152.19	132.58	133.59	112.00	102.94	90.36	91.74	108.19	123.42	1482.64
	1998 Kc	0.86	0.92	0.96	0.94	0.83	0.70	0.61	0.58	0.57	0.56	0.55	0.74	0.76
B81E23	**Eto**	136.38	144.76	154.48	152.19	132.58	133.59	112.00	102.94	90.36	91.74	108.19	123.42	1482.64
	1998 Kc	0.76	0.84	0.90	0.87	0.77	0.66	0.63	0.62	0.58	0.55	0.56	0.66	0.72
B81E25	**Eto**	136.38	144.76	154.48	152.19	132.58	133.59	112.00	102.94	90.36	91.74	108.19	123.42	1482.64
	1998 Kc	0.68	0.72	0.77	0.75	0.67	0.62	0.55	0.64	0.62	0.58	0.58	0.59	0.66
B81E30	**Eto**	136.38	144.76	154.48	152.19	132.58	133.59	112.00	102.94	90.36	91.74	108.19	123.42	1482.64
	1998 Kc	0.72	0.78	0.84	0.82	0.73	0.62	0.59	0.60	0.56	0.52	0.51	0.60	0.67
B81F01	**Eto**	142.43	151.42	164.78	162.85	142.25	141.72	118.81	107.22	94.31	96.21	111.24	126.98	1560.23
	1998 Kc	0.61	0.69	0.76	0.75	0.63	0.54	0.48	0.60	0.58	0.54	0.53	0.49	0.61
B81F10	**Eto**	142.43	151.42	164.78	162.85	142.25	141.72	118.81	107.22	94.31	96.21	111.24	126.98	1560.23
	1998 Kc	0.60	0.65	0.70	0.69	0.63	0.59	0.47	0.65	0.64	0.61	0.60	0.53	0.62

PENMAN-MONTEITH CROP FACTORS														
		Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Annual**
B81F20	**Eto**	142.43	151.42	164.78	162.85	142.25	141.72	118.81	107.22	94.31	96.21	111.24	126.98	1560.23
	1998 Kc	0.62	0.67	0.72	0.71	0.64	0.58	0.49	0.64	0.63	0.59	0.58	0.53	0.62
B81F30	**Eto**	142.43	151.42	164.78	162.85	142.25	141.72	118.81	107.22	94.31	96.21	111.24	126.98	1560.23
	1998 Kc	0.68	0.71	0.74	0.73	0.68	0.64	0.50	0.66	0.64	0.62	0.63	0.62	0.66
B81G01	**Eto**	136.95	147.23	157.32	156.67	136.40	136.04	112.89	103.02	91.31	90.08	106.49	123.98	1498.39
	1998 Kc	0.55	0.75	0.98	1.05	0.97	0.17	0.18	0.25	0.24	0.20	0.15	0.02	0.51
B81G10	**Eto**	136.95	147.23	157.32	156.67	136.40	136.04	112.89	103.02	91.31	90.08	106.49	123.98	1498.39
	1998 Kc	0.54	0.64	0.77	0.74	0.61	0.52	0.62	0.72	0.70	0.65	0.57	0.37	0.62
B81H01	**Eto**	144.26	153.88	168.35	165.19	144.39	143.77	118.97	107.67	94.97	95.64	111.14	128.46	1576.70
	1998 Kc	0.20	0.32	0.45	0.44	0.29	0.32	0.52	0.73	0.72	0.59	0.45	0.03	0.40
B81H10	**Eto**	144.26	153.88	168.35	165.19	144.39	143.77	118.97	107.67	94.97	95.64	111.14	128.46	1576.70
	1998 Kc	0.32	0.49	0.67	0.68	0.51	0.22	0.35	0.49	0.48	0.40	0.29	0.00	0.42
B81J01	**Eto**	143.43	152.73	167.82	163.44	143.20	145.27	120.21	107.83	95.85	96.04	112.13	129.54	1577.50
	1998 Kc													
B81J10	**Eto**	143.43	152.73	167.82	163.44	143.20	145.27	120.21	107.83	95.85	96.04	112.13	129.54	1577.50
	1998 Kc	0.33	0.47	0.62	0.60	0.43	0.32	0.43	0.60	0.58	0.49	0.40	0.12	0.45

9. CONCLUSIONS

9.1 IRRIGATION AREAS AND WATER SOURCES

The total irrigated crop area in the study area amounted to some 29 363 ha during 2004. From the results obtained from the study it is evident that 84,7% of the areas under irrigation are from surface water resources and most of this falls within Irrigation Board Districts. A total crop area of some 24 866 ha was identified as being irrigated with surface water. Irrigation with groundwater totalled 4 417 ha or 15% of the total irrigated area while irrigation from other water resources amounted to some 79 ha or 0,3% of the total irrigation.

9.2 IRRIGATION VOLUMES

The calculated average annual irrigation volume from surface water resources amounts to some 171 670 300 m³ (83,7% of the total), while from boreholes the volume is some 32 922 000 m³ (16,1% of the total). Irrigation from other sources such as recycled water and municipal sources amounts to some 470 880 m³ (0,2% of the total.

The total annual water requirement for irrigation in the area amounts to an average of some 205 063 000 m³ for the irrigation of some 29 363 ha of crops. This gives an average quota of some 6 984 m³/ha/annum.

HN Schoeman Pr Eng
16 October 2007

Annexure A of Appendix C

Fixed Area Irrigation Demand Time Series

FIXED AREA IRRIGATION DEMAND TIME SERIES B81A01

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.072	0.077	0.000	0.000	0.000	0.225	0.231	0.225	0.000	0.223	0.087	**1.345**
1926	0.292	0.062	0.032	0.000	0.000	0.000	0.063	0.186	0.192	0.101	0.216	0.135	**1.280**
1927	0.000	0.083	0.101	0.000	0.000	0.000	0.000	0.113	0.232	0.143	0.149	0.165	**0.987**
1928	0.200	0.058	0.000	0.000	0.000	0.000	0.067	0.234	0.064	0.164	0.139	0.118	**1.044**
1929	0.111	0.000	0.000	0.000	0.000	0.000	0.082	0.227	0.213	0.157	0.226	0.131	**1.147**
1930	0.299	0.059	0.000	0.000	0.000	0.000	0.000	0.258	0.191	0.000	0.248	0.098	**1.153**
1931	0.189	0.000	0.126	0.000	0.000	0.000	0.109	0.115	0.210	0.208	0.238	0.140	**1.335**
1932	0.142	0.202	0.000	0.000	0.000	0.048	0.086	0.242	0.231	0.196	0.216	0.170	**1.534**
1933	0.196	0.000	0.000	0.000	0.000	0.000	0.153	0.234	0.142	0.178	0.215	0.135	**1.254**
1934	0.150	0.000	0.000	0.000	0.000	0.013	0.188	0.133	0.226	0.181	0.245	0.130	**1.267**
1935	0.170	0.289	0.091	0.000	0.000	0.000	0.039	0.064	0.162	0.098	0.207	0.030	**1.149**
1936	0.021	0.000	0.000	0.000	0.000	0.000	0.183	0.258	0.232	0.137	0.215	0.066	**1.113**
1937	0.185	0.244	0.000	0.000	0.067	0.096	0.000	0.214	0.094	0.180	0.212	0.000	**1.292**
1938	0.000	0.007	0.000	0.000	0.000	0.000	0 115	0.103	0.108	0.000	0.185	0.024	**0.543**
1939	0.158	0.000	0.000	0.072	0.000	0.000	0.000	0.190	0.058	0.201	0.145	0.000	**0.824**
1940	0.200	0.000	0.000	0.000	0.000	0.121	0.000	0.251	0.223	0.196	0.178	0.165	**1.335**
1941	0.096	0.129	0.030	0.000	0.158	0.000	0.112	0.062	0.143	0.129	0.086	0.000	**0.946**
1942	0.000	0.006	0.000	0.154	0.000	0.000	0.000	0.188	0.231	0.022	0.000	0.033	**0.634**
1943	0.215	0.000	0.062	0.000	0.000	0.000	0.180	0.259	0.024	0.208	0.226	0.143	**1.317**
1944	0.000	0.076	0.156	0.000	0.000	0.000	0.139	0.263	0.232	0.182	0.231	0.185	**1.464**
1945	0.000	0.087	0.000	0.000	0.000	0.000	0.100	0.209	0.192	0.204	0.236	0.191	**1.219**
1946	0.182	0.123	0.173	0.128	0.000	0.000	0.000	0.214	0.161	0.178	0.248	0.092	**1.499**
1947	0.111	0.000	0.000	0.000	0.000	0.000	0.133	0.177	0.232	0.180	0.219	0.145	**1.197**
1948	0.000	0.019	0.223	0.000	0.000	0.000	0.115	0.095	0.150	0.121	0.232	0.085	**1.039**
1949	0.196	0.000	0.000	0.000	0.000	0.000	0.000	0.127	0.171	0.183	0.122	0.154	**0.952**
1950	0.272	0.000	0.000	0.000	0.213	0.000	0.000	0.000	0.232	0.187	0.169	0.015	**1.088**
1951	0.000	0.187	0.000	0.000	0.000	0.067	0.074	0.201	0.169	0.084	0.163	0.186	**1.129**
1952	0.134	0.000	0.000	0.000	0.000	0.000	0.000	0.249	0.232	0.111	0.181	0.149	**1.056**
1953	0.172	0.000	0.000	0.000	0.000	0.000	0.000	0.197	0.202	0.208	0.100	0.126	**1.004**
1954	0.067	0.000	0.000	0.000	0.000	0.000	0.000	0.146	0.104	0.166	0.247	0.150	**0.880**
1955	0.000	0.000	0.000	0.000	0.000	0.000	0.134	0.105	0.124	0.180	0.218	0.000	**0.762**
1956	0.129	0.082	0.000	0.000	0.000	0.000	0.000	0.130	0.127	0.014	0.103	0.072	**0.657**
1957	0.000	0.036	0.071	0.000	0.000	0.004	0.000	0.258	0.209	0.207	0.244	0.000	**1.030**
1958	0.050	0.073	0.000	0.000	0.000	0.000	0.201	0.261	0.226	0.092	0.235	0.129	**1.267**
1959	0.063	0.000	0.000	0.158	0.000	0.000	0.000	0.213	0.136	0.200	0.220	0.100	**1.090**
1960	0.227	0.000	0.000	0.090	0.000	0.000	0.000	0.196	0.139	0.088	0.101	0.092	**0.933**
1961	0.227	0.130	0.038	0.000	0.106	0.096	0.005	0.197	0.232	0.206	0.248	0.165	**1.650**
1962	0.284	0.000	0.000	0.000	0.163	0.128	0.045	0.136	0.083	0.155	0.201	0.170	**1.366**
1963	0.156	0.052	0.087	0.090	0.001	0.205	0.115	0.228	0.232	0.208	0.238	0.157	**1.769**
1964	0.003	0.122	0.000	0.000	0.125	0.169	0.041	0.241	0.212	0.198	0.189	0.067	**1.367**
1965	0.232	0.000	0.158	0.000	0.000	0.153	0.146	0.229	0.217	0.182	0.229	0.026	**1.571**
1966	0.050	0.046	0.000	0.000	0.000	0.000	0.000	0.236	0.217	0.136	0.246	0.181	**1.113**
1967	0.110	0.000	0.090	0.158	0.000	0.000	0.017	0.090	0.099	0.154	0.203	0.175	**1.097**
1968	0.133	0.000	0.000	0.000	0.069	0.000	0.000	0.222	0.197	0.185	0.223	0.104	**1.133**
1969	0.000	0.183	0.000	0.097	0.000	0.195	0.182	0.167	0.173	0.119	0.241	0.120	**1.476**
1970	0.104	0.151	0.000	0.000	0.000	0.184	0.000	0.040	0.189	0.208	0.243	0.124	**1.244**
1971	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.122	0.222	0.185	0.186	0.171	**0.885**
1972	0.000	0.000	0.197	0.018	0.000	0.000	0.000	0.223	0.196	0.119	0.222	0.000	**0.976**
1973	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.062	0.226	0.163	0.205	0.000	**0.656**
1974	0.210	0.000	0.000	0.000	0.000	0.000	0.045	0.159	0.163	0.202	0.203	0.162	**1.144**
1975	0.180	0.089	0.000	0.000	0.000	0.000	0.000	0.000	0.191	0.207	0.230	0.155	**1.053**
1976	0.158	0.000	0.098	0.000	0.000	0.000	0.001	0.203	0.231	0.208	0.143	0.000	**1.042**
1977	0.164	0.027	0.000	0.000	0.000	0.000	0.088	0.227	0.232	0.147	0.235	0.089	**1.209**
1978	0.177	0.000	0.078	0.000	0.000	0.000	0.106	0.159	0.222	0.150	0.000	0.108	**0.999**
1979	0.000	0.000	0.000	0.000	0.000	0.000	0.160	0.227	0.232	0.196	0.113	0.000	**0.928**
1980	0.035	0.000	0.000	0.000	0.000	0.000	0.081	0.192	0.232	0.199	0.105	0.075	**0.920**
1981	0.006	0.000	0.000	0.000	0.085	0.030	0.000	0.049	0.232	0.195	0.230	0.098	**0.926**
1982	0.085	0.050	0.063	0.080	0.082	0.012	0.182	0.246	0.169	0.198	0.074	0.179	**1.419**
1983	0.000	0.000	0.072	0.153	0.000	0.000	0.067	0.261	0.215	0.000	0.185	0.108	**1.061**
1984	0.013	0.000	0.303	0.000	0.000	0.000	0.222	0.033	0.110	0.190	0.238	0.018	**1.127**
1985	0.000	0.139	0.041	0.000	0.000	0.000	0.000	0.192	0.176	0.202	0.201	0.143	**1.093**
1986	0.000	0.000	0.069	0.118	0.000	0.041	0.175	0.185	0.132	0.208	0.173	0.000	**1.102**
1987	0.109	0.013	0.000	0.027	0.000	0.000	0.077	0.251	0.000	0.171	0.119	0.004	**0.772**
1988	0.000	0.148	0.030	0.099	0.000	0.115	0.085	0.228	0.138	0.178	0.203	0.168	**1.391**
1989	0.073	0.000	0.000	0.000	0.000	0.000	0.026	0.252	0.230	0.178	0.221	0.164	**1.143**
1990	0.093	0.000	0.000	0.000	0.000	0.000	0.248	0.210	0.085	0.208	0.242	0.123	**1.210**
1991	0.240	0.108	0.208	0.180	0.125	0.064	0.208	0.263	0.184	0.200	0.229	0.173	**2.181**
1992	0.196	0.135	0.000	0.128	0.000	0.000	0.149	0.257	0.173	0.127	0.169	0.164	**1.497**
1993	0.104	0.000	0.000	0.048	0.000	0.055	0.156	0.255	0.219	0.201	0.159	0.159	**1.357**
1994	0.000	0.228	0.000	0.000	0.000	0.000	0.010	0.170	0.227	0.192	0.163	0.161	**1.151**
1995	0.089	0.000	0.000	0.000	0.000	0.000	0.098	0.000	0.144	0.022	0.100	0.174	**0.627**
1996	0.110	0.000	0.000	0.000	0.000	0.000	0.150	0.207	0.232	0.159	0.232	0.000	**1.090**
1997	0.000	0.000	0.066	0.000	0.088	0.071	0.141	0.263	0.228	0.000	0.205	0.040	**1.101**
1998	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.051	0.149	0.000	0.208	0.140	**0.548**
1999	0.158	0.000	0.000	0.000	0.000	0.000	0.157	0.164	0.134	0.111	0.149	0.096	**0.969**
2000	0.000	0.027	0.000	0.213	0.000	0.000	0.094	0.165	0.212	0.144	0.238	0.137	**1.228**
2001	0.000	0.000	0.000	0.000	0.000	0.163	0.155	0.240	0.083	0.188	0.196	0.110	**1.135**
2002	0.004	0.243	0.053	0.075	0.017	0.072	0.236	0.251	0.070	0.181	0.245	0.029	**1.475**
2003	0.063	0.085	0.122	0.015	0.000	0.000	0.000	0.245	0.187	0.166	0.159	0.139	**1.182**
2004	0.112	0.171	0.000	0.000	0.133	0.000	0.000	0.192	0.191	0.199	0.202	0.096	**1.296**
2005	0.180	0.000	0.000	0.000	0.000	0.000	0.157	0.164	0.134	0.111	0.149	0.096	**0.991**
Average	**0.102**	**0.050**	**0.036**	**0.026**	**0.018**	**0.026**	**0.078**	**0.182**	**0.176**	**0.152**	**0.191**	**0.104**	**1.141**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.038	0.019	0.013	0.010	0.007	0.010	0.030	0.068	0.068	0.057	0.071	0.040	0.036

FIXED AREA IRRIGATION DEMAND TIME SERIES B81B01

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	1.659	1.942	1.666	0.000	0.000	1.655	1.420	1.380	0.148	1.642	1.377	**14.890**
1926	2.498	1.516	1.821	0.000	1.384	0.455	0.899	1.138	1.235	1.152	1.547	1.796	**15.441**
1927	0.372	1.743	1.863	0.000	1.117	0.992	0.723	1.315	1.442	1.154	1.193	1.777	**13.691**
1928	2.266	1.422	1.583	0.643	0.000	0.000	0.767	1.538	0.796	1.093	1.209	1.438	**12.754**
1929	1.462	1.431	0.000	1.276	0.211	0.000	0.962	1.500	1.442	1.136	1.638	1.688	**12.748**
1930	2.617	1.610	0.000	0.212	0.180	0.037	0.182	1.507	1.280	0.092	1.745	1.799	**11.261**
1931	1.898	0.321	2.341	0.452	0.849	0.168	1.057	0.863	1.352	1.425	1.754	1.831	**14.310**
1932	1.560	2.410	0.389	0.000	0.754	1.125	1.069	1.500	1.434	1.373	1.511	2.036	**15.160**
1933	1.795	0.000	1.118	0.000	0.223	0.000	0.964	1.425	1.012	1.264	1.566	1.798	**11.166**
1934	1.799	0.000	0.000	0.647	0.799	1.028	1.432	0.915	1.380	1.310	1.710	1.677	**12.696**
1935	1.807	2.850	1.969	0.957	0.000	0.000	0.560	0.534	1.024	1.055	1.589	1.417	**13.761**
1936	1.021	0.000	0.265	0.000	0.000	0.266	1.203	1.573	1.412	1.195	1.601	1.345	**9.881**
1937	1.907	2.677	0.000	0.000	1.419	1.406	0.000	1.379	0.775	1.306	1.535	0.858	**13.262**
1938	0.550	1.472	0.000	0.385	0.000	0.000	0.920	0.781	0.846	0.341	1.430	1.046	**7.771**
1939	1.822	0.000	0.000	1.874	0.433	0.000	0.000	1.354	0.539	1.390	1.237	0.775	**9.422**
1940	2.066	1.184	0.000	1.825	1.240	1.683	0.249	1.576	1.410	1.360	1.427	2.029	**16.049**
1941	1.595	2.180	1.984	1.350	2.161	0.000	1.210	0.511	1.221	1.047	1.007	0.573	**14.839**
1942	0.726	1.685	0.052	2.509	1.276	0.000	0.000	1.366	1.442	0.486	0.489	1.279	**11.309**
1943	2.216	0.747	1.907	0.815	0.000	0.248	1.370	1.596	0.314	1.425	1.592	1.875	**14.104**
1944	0.285	1.473	2.461	0.828	0.000	0.000	1.131	1.620	1.442	1.308	1.628	2.092	**14.267**
1945	0.680	1.745	1.427	0.000	0.000	0.211	0.972	1.354	1.243	1.393	1.647	2.106	**12.777**
1946	1.789	1.849	2.534	2.113	0.000	0.367	0.000	1.254	1.138	1.275	1.754	1.603	**15.675**
1947	1.511	0.662	0.000	0.358	0.336	0.000	1.003	1.321	1.442	1.219	1.654	1.877	**11.383**
1948	0.120	1.318	2.348	0.000	0.000	1.038	1.033	0.641	1.016	1.059	1.702	1.501	**11.778**
1949	2.200	0.667	0.343	0.571	0.000	0.000	0.000	0.856	1.213	1.284	1.282	1.894	**10.309**
1950	2.441	1.307	0.000	1.407	2.519	0.000	0.252	0.000	1.442	1.333	1.284	1.135	**13.121**
1951	0.188	2.421	1.387	1.470	0.802	1.247	0.685	1.421	1.135	0.819	1.451	2.109	**15.134**
1952	1.810	0.274	0.000	0.000	0.000	0.000	0.000	1.405	1.442	1.011	1.413	1.955	**9.311**
1953	1.973	0.361	0.000	0.000	0.000	0.607	0.160	1.242	1.270	1.425	1.045	1.862	**9.946**
1954	1.414	0.185	0.231	0.000	0.000	0.000	0.000	0.930	0.904	1.188	1.754	1.815	**8.421**
1955	0.643	0.000	0.000	1.101	0.000	0.000	1.145	0.638	0.689	1.346	1.533	0.356	**7.452**
1956	1.811	1.542	1.118	1.560	0.000	0.000	0.000	0.823	0.938	0.156	0.938	1.302	**10.187**
1957	0.059	1.515	1.990	0.509	0.867	0.702	0.060	1.585	1.371	1.411	1.754	0.000	**11.822**
1958	1.451	1.403	0.000	0.000	0.000	0.782	1.572	1.557	1.388	0.884	1.720	1.687	**12.444**
1959	1.381	0.000	0.155	2.252	0.000	0.714	0.050	1.118	0.790	1.398	1.575	1.581	**11.014**
1960	2.223	0.000	0.000	2.088	0.000	0.000	0.000	1.301	0.753	0.655	1.017	1.561	**9.596**
1961	2.016	1.933	1.417	0.916	1.495	1.433	0.296	1.216	1.442	1.378	1.754	1.989	**17.284**
1962	2.409	0.001	0.000	1.401	1.918	1.388	0.505	0.914	0.483	0.982	1.623	1.889	**13.513**
1963	1.661	1.438	1.408	1.708	1.326	2.006	0.911	1.443	1.442	1.425	1.714	1.760	**18.242**
1964	0.613	1.613	0.000	0.000	1.656	1.726	0.579	1.513	1.335	1.384	1.471	1.328	**13.219**
1965	2.115	0.988	2.242	0.000	0.000	1.702	1.273	1.583	1.278	1.238	1.576	1.194	**15.190**
1966	1.013	1.573	0.263	0.362	0.000	0.000	0.000	1.387	1.395	1.028	1.682	2.083	**10.786**
1967	1.409	0.471	1.971	2.507	0.795	0.000	0.164	0.610	0.631	1.054	1.448	1.990	**13.050**
1968	1.494	0.298	0.452	0.191	1.600	0.000	0.036	1.482	1.157	1.252	1.627	1.535	**11.124**
1969	0.000	1.893	0.282	1.872	0.785	1.789	1.339	1.080	1.067	0.873	1.703	1.714	**14.398**
1970	1.211	0.768	1.201	0.000	0.737	1.768	0.000	0.633	1.123	1.425	1.724	1.680	**12.271**
1971	0.000	0.350	0.673	0.000	0.000	0.000	0.348	0.776	1.374	1.327	1.351	1.980	**8.179**
1972	0.246	0.887	2.751	1.277	0.991	0.415	0.000	1.315	1.334	0.872	1.584	0.000	**11.673**
1973	0.305	0.546	0.000	0.000	0.000	0.000	0.253	1.198	1.399	0.953	1.423	0.528	**6.604**
1974	1.935	0.328	0.365	0.000	0.000	0.000	0.632	0.996	1.020	1.401	1.516	1.895	**10.089**
1975	1.789	1.625	0.000	0.000	0.000	0.000	0.334	0.000	1.276	1.421	1.611	1.886	**9.942**
1976	1.594	0.506	2.266	0.000	0.000	0.000	0.513	1.206	1.442	1.425	1.198	0.310	**10.462**
1977	1.813	1.539	0.000	0.000	0.000	0.000	0.806	1.403	1.441	1.133	1.627	1.600	**11.362**
1978	1.905	0.000	1.750	0.327	0.633	0.000	0.970	0.846	1.415	1.193	0.295	1.499	**10.832**
1979	0.500	0.629	0.209	0.069	0.000	0.395	1.122	1.472	1.442	1.270	1.052	0.627	**8.787**
1980	1.073	0.000	0.701	0.000	0.000	0.000	0.733	1.273	1.442	1.406	0.800	1.392	**8.822**
1981	0.747	0.238	1.222	1.062	2.018	1.274	0.000	0.244	1.442	1.275	1.662	1.634	**12.818**
1982	1.284	1.175	1.860	1.571	1.790	0.618	1.348	1.547	1.082	1.389	0.804	2.028	**16.498**
1983	0.802	1.130	1.691	2.289	1.070	0.000	0.690	1.603	1.348	0.000	1.290	1.502	**13.413**
1984	0.736	0.000	2.897	0.406	0.000	0.000	1.571	0.259	0.596	1.351	1.699	1.114	**10.629**
1985	0.725	2.075	1.310	1.431	0.394	0.719	0.000	1.131	1.233	1.410	1.382	1.776	**13.588**
1986	0.615	0.226	1.208	1.765	0.000	0.727	1.311	1.180	0.876	1.425	1.296	0.000	**10.630**
1987	1.298	1.164	0.000	1.039	0.000	0.000	0.817	1.545	0.217	1.192	1.155	0.864	**9.293**
1988	0.000	1.945	1.382	1.798	0.000	1.364	0.632	1.346	0.740	1.317	1.409	1.912	**13.845**
1989	0.989	0.266	0.596	0.000	0.000	0.000	0.463	1.320	1.366	1.200	1.580	1.984	**9.764**
1990	1.203	1.111	0.222	0.000	0.000	0.000	1.583	1.326	0.695	1.425	1.709	1.561	**10.835**
1991	2.338	1.457	2.635	2.376	2.036	1.010	1.554	1.620	1.226	1.408	1.599	1.962	**21.219**
1992	2.010	1.961	0.404	2.386	0.703	0.000	1.155	1.333	1.237	1.134	1.549	1.889	**15.761**
1993	1.623	0.277	0.000	1.905	0.000	1.394	1.322	1.592	1.442	1.389	1.454	1.958	**14.356**
1994	0.602	2.128	0.923	1.200	0.061	0.000	0.297	0.699	1.432	1.365	1.389	1.970	**12.065**
1995	1.688	0.000	0.000	0.000	0.000	0.546	0.584	0.000	0.936	0.419	0.593	1.904	**6.670**
1996	1.296	0.626	1.657	0.000	0.000	0.000	0.770	1.275	1.441	1.107	1.702	0.367	**10.240**
1997	1.140	0.254	1.847	0.000	1.807	1.773	1.161	1.620	1.399	0.399	1.615	1.035	**14.051**
1998	0.255	0.665	0.000	0.000	0.000	0.000	0.000	0.606	1.154	0.950	1.580	1.842	**7.052**
1999	1.778	0.350	0.152	0.000	0.000	0.000	1.226	1.066	0.895	0.878	1.193	1.579	**9.117**
2000	0.686	1.234	0.346	2.674	0.000	0.378	1.058	0.754	1.328	1.188	1.662	1.781	**13.087**
2001	0.588	0.000	0.412	1.273	1.113	1.778	1.093	1.554	0.630	1.343	1.486	1.571	**12.840**
2002	1.160	2.596	1.743	1.718	0.866	1.293	1.626	1.486	0.459	1.323	1.752	1.469	**17.491**
2003	1.572	1.647	2.553	1.492	0.000	0.000	0.000	1.570	1.212	1.123	1.492	1.764	**14.424**
2004	1.142	1.961	0.341	0.606	2.149	0.657	0.377	1.320	1.214	1.406	1.501	1.579	**14.252**
2005	2.131	0.768	0.614	0.515	0.000	0.000	1.226	1.066	0.895	0.878	1.193	1.579	**10.865**
Average	**1.305**	**1.040**	**0.928**	**0.827**	**0.525**	**0.484**	**0.691**	**1.164**	**1.145**	**1.132**	**1.446**	**1.511**	**12.220**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.487	0.401	0.347	0.309	0.215	0.181	0.267	0.435	0.442	0.422	0.540	0.583	0.387

FIXED AREA IRRIGATION DEMAND TIME SERIES B81B10

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.078	0.088	0.070	0.000	0.004	0.070	0.064	0 062	0.008	0.070	0.067	**0.668**
1926	0.106	0.076	0.079	0.003	0.056	0.021	0.036	0.055	0.055	0.040	0.069	0.077	**0.674**
1927	0.018	0.080	0.093	0.000	0.054	0.034	0.000	0.040	0.063	0.048	0.055	0.084	**0.568**
1928	0.087	0.075	0.063	0.066	0.000	0.000	0.037	0.065	0.029	0.053	0.053	0.073	**0.601**
1929	0.069	0.057	0.000	0.054	0.027	0.000	0.040	0.063	0.059	0.051	0.071	0.076	**0.568**
1930	0.108	0.075	0.000	0.039	0.023	0.010	0.013	0.070	0.055	0.015	0.076	0.069	**0.553**
1931	0.085	0.027	0.098	0.041	0.042	0.015	0.045	0.040	0.058	0.062	0.073	0.078	**0.665**
1932	0.075	0.104	0.041	0.000	0.047	0.053	0.041	0.066	0.063	0.059	0.069	0.085	**0.703**
1933	0.086	0.000	0.066	0.000	0.022	0.007	0.055	0.065	0.045	0.056	0.069	0.077	**0.547**
1934	0.077	0.030	0.022	0.047	0.040	0.046	0.062	0.044	0.062	0.056	0.075	0.076	**0.637**
1935	0.081	0.122	0.091	0.057	0.000	0.000	0.031	0.030	0.049	0.039	0.067	0.055	**0.621**
1936	0.050	0.010	0.037	0.000	0.000	0.032	0.061	0.070	0.063	0.047	0.069	0.062	**0.502**
1937	0.084	0.113	0.015	0.017	0.073	0.063	0.000	0.060	0.035	0.056	0.068	0.045	**0.629**
1938	0.020	0.065	0.000	0.039	0.000	0.000	0.047	0.038	0.038	0.018	0.062	0.054	**0.380**
1939	0.079	0.000	0.007	0.086	0.006	0.000	0.006	0.056	0.027	0.060	0.054	0.038	**0.418**
1940	0.087	0.052	0.027	0.053	0.050	0.068	0.000	0.068	0.061	0.059	0.061	0.084	**0.671**
1941	0.066	0.089	0.078	0.052	0.091	0.000	0.046	0.029	0.045	0.045	0.042	0.034	**0.618**
1942	0.026	0.064	0.024	0.102	0.048	0.000	0.000	0.055	0.063	0.023	0.021	0.055	**0.483**
1943	0.090	0.033	0.085	0.034	0.000	0.016	0.060	0.070	0.021	0.062	0.071	0.079	**0.620**
1944	0.021	0.079	0.104	0.053	0.000	0.010	0.052	0.071	0.063	0.056	0.072	0.088	**0.669**
1945	0.042	0.081	0.070	0.000	0.000	0.014	0.044	0 060	0.055	0.061	0.073	0.089	**0.588**
1946	0.084	0.088	0.107	0.097	0.000	0.029	0.009	0.061	0.048	0.056	0.076	0.068	**0.723**
1947	0.069	0.042	0.022	0.033	0.026	0.000	0.050	0.053	0.063	0.056	0.069	0.079	**0.563**
1948	0.023	0.067	0.117	0.000	0.000	0.040	0.047	0.036	0.046	0.044	0.072	0.066	**0.558**
1949	0.086	0.045	0.041	0.033	0.001	0.000	0.000	0.043	0.050	0.057	0.049	0.081	**0.485**
1950	0.102	0.058	0.000	0.067	0.103	0.000	0.016	0.000	0.063	0.057	0.059	0.052	**0.576**
1951	0.017	0.101	0.066	0.061	0.038	0.057	0.038	0.058	0.050	0.036	0.058	0.088	**0.668**
1952	0.074	0.032	0.022	0.000	0.000	0.000	0.002	0.068	0.063	0.042	0.061	0.080	**0.443**
1953	0.081	0.028	0.000	0.000	0.000	0.015	0.022	0.057	0.057	0.062	0.045	0.075	**0.442**
1954	0.060	0.028	0.025	0.000	0.000	0.000	0.017	0.047	0.037	0.053	0.075	0.080	**0.422**
1955	0.040	0.012	0.000	0.053	0.000	0.000	0.051	0.038	0.041	0.056	0.069	0.030	**0.390**
1956	0.073	0.080	0.069	0.071	0.019	0.000	0.000	0.043	0.041	0.022	0.045	0.064	**0.527**
1957	0.016	0.071	0.087	0.032	0.042	0.044	0.017	0.070	0.058	0.062	0.075	0.012	**0.585**
1958	0.056	0.078	0.007	0.015	0.000	0.040	0.064	0.070	0.062	0.038	0.073	0.076	**0.580**
1959	0.059	0.000	0.014	0.103	0.000	0.043	0.010	0.060	0.043	0.060	0.070	0.070	**0.532**
1960	0.093	0.014	0.000	0.089	0.000	0.000	0.000	0.057	0.044	0.037	0.045	0.068	**0.448**
1961	0.093	0.090	0.080	0.039	0.081	0.063	0.024	0.057	0.063	0.061	0.076	0.084	**0.810**
1962	0.105	0.032	0.000	0.066	0.093	0.070	0.032	0.045	0.032	0.051	0.066	0.085	**0.676**
1963	0.078	0.074	0.090	0.089	0.059	0.086	0.047	0.063	0.063	0.062	0.074	0.082	**0.866**
1964	0.047	0.088	0.000	0.002	0.085	0.078	0.031	0.066	0.059	0.060	0.063	0.063	**0.641**
1965	0.094	0.063	0.104	0.027	0.000	0.075	0.053	0.064	0.060	0.056	0.072	0.054	**0.721**
1966	0.056	0.073	0.032	0.029	0.000	0.000	0.000	0.065	0.060	0.047	0.075	0.087	**0.524**
1967	0.069	0.040	0.091	0.103	0.052	0.003	0.026	0.035	0.036	0.051	0.066	0.086	**0.657**
1968	0.073	0.035	0.044	0.022	0.073	0.000	0.016	0.062	0.056	0.057	0.070	0.070	**0.579**
1969	0.000	0.100	0.040	0.091	0.050	0.084	0.061	0.051	0.051	0.043	0.074	0.074	**0.718**
1970	0.067	0.094	0.072	0.000	0.042	0.081	0.000	0.025	0.054	0.062	0.075	0.075	**0.647**
1971	0.017	0.040	0.050	0.000	0.000	0.000	0.019	0.041	0.061	0.057	0.062	0.085	**0.434**
1972	0.036	0.053	0.112	0.075	0.044	0.025	0.000	0.062	0.056	0.043	0.070	0.003	**0.580**
1973	0.023	0.057	0.000	0.000	0.000	0.000	0.020	0.029	0.062	0.052	0.067	0.035	**0.345**
1974	0.089	0.035	0.044	0.010	0.000	0.000	0.032	0.049	0.049	0.061	0.066	0.083	**0.519**
1975	0.083	0.081	0.000	0.000	0.000	0.000	0.019	0.008	0.055	0.061	0.072	0.081	**0.461**
1976	0.079	0.045	0.092	0.000	0.000	0.000	0.023	0.058	0.063	0.062	0.054	0.019	**0.494**
1977	0.080	0.069	0.011	0.000	0.000	0.006	0.041	0 063	0.063	0.049	0.073	0.067	**0.522**
1978	0.082	0.014	0.088	0.021	0.040	0.008	0.045	0.049	0.061	0.050	0.023	0.071	**0.552**
1979	0.038	0.053	0.034	0.026	0.000	0.016	0.056	0.063	0.063	0.059	0.047	0.035	**0.491**
1980	0.053	0.000	0.062	0.000	0.000	0.000	0.040	0.056	0.063	0.060	0.046	0.064	**0.444**
1981	0.047	0.026	0.068	0.069	0.076	0.049	0.003	0.027	0.063	0.059	0.072	0.069	**0.629**
1982	0.064	0.073	0.085	0.087	0.076	0.045	0.061	0.067	0.050	0.060	0.039	0.087	**0.794**
1983	0.043	0.063	0.087	0.102	0.055	0.000	0.037	0.070	0.060	0.000	0.062	0.071	**0.650**
1984	0.049	0.007	0.134	0.033	0.000	0.015	0.069	0.023	0.038	0.058	0.074	0.052	**0.551**
1985	0.042	0.092	0.081	0.059	0.042	0.041	0.000	0.056	0.052	0.060	0.066	0.079	**0.670**
1986	0.035	0.031	0.086	0.095	0.000	0.052	0.059	0.055	0.042	0.062	0.060	0.015	**0.592**
1987	0.069	0.066	0.014	0.077	0.000	0.000	0.039	0.068	0.014	0.054	0.049	0.049	**0.498**
1988	0.000	0.093	0.078	0.091	0.000	0.067	0.040	0.063	0.044	0.056	0.066	0.084	**0.683**
1989	0.061	0.025	0.037	0.000	0.021	0.027	0.028	0.068	0.063	0.056	0.070	0.083	**0.540**
1990	0.065	0.059	0.036	0.005	0.012	0.000	0.075	0.060	0.033	0.062	0.074	0.075	**0.555**
1991	0.096	0.085	0.114	0.108	0.084	0.056	0.066	0.071	0.053	0.060	0.072	0.085	**0.950**
1992	0.087	0.091	0.041	0.097	0.013	0.000	0.054	0.069	0.051	0.045	0.059	0.083	**0.690**
1993	0.067	0.039	0.019	0.081	0.016	0.054	0.055	0.069	0.060	0.060	0.057	0.082	**0.661**
1994	0.037	0.110	0.054	0.062	0.000	0.009	0.025	0.051	0.062	0.058	0.058	0.083	**0.610**
1995	0.064	0.000	0.025	0.000	0.000	0.033	0.043	0.000	0.045	0.024	0.045	0.086	**0.364**
1996	0.069	0.054	0.071	0.000	0.000	0.000	0.054	0.059	0.063	0.052	0.072	0.022	**0.515**
1997	0.043	0.050	0.086	0.000	0.077	0.058	0.052	0.071	0.062	0.017	0.067	0.057	**0.638**
1998	0.022	0.054	0.000	0.000	0.000	0.000	0.008	0.027	0.046	0.006	0.067	0.078	**0.308**
1999	0.079	0.032	0.059	0.000	0.004	0.000	0.055	0.050	0.043	0.042	0.055	0.069	**0.487**
2000	0.039	0.069	0.065	0.114	0.000	0.033	0.042	0.050	0.059	0.048	0.073	0.078	**0.670**
2001	0.037	0.000	0.042	0.061	0.055	0.077	0.055	0.066	0.032	0.058	0.065	0.072	**0.620**
2002	0.047	0.113	0.083	0.086	0.062	0.058	0.072	0.068	0.030	0.056	0.075	0.055	**0.805**
2003	0.059	0.081	0.097	0.074	0.000	0.000	0.000	0.067	0.054	0.053	0.057	0.078	**0.620**
2004	0.069	0.098	0.018	0.039	0.086	0.032	0.022	0.056	0.055	0.060	0.066	0.069	**0.669**
2005	0.083	0.049	0.031	0.033	0.004	0.000	0.055	0.050	0.043	0.042	0.055	0.069	**0.514**
Average	**0.063**	**0.057**	**0.052**	**0.043**	**0.026**	**0.024**	**0.034**	**0.053**	**0.052**	**0.050**	**0.064**	**0.068**	**0.584**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.024	0.022	0.019	0.016	0.011	0.009	0.013	0.020	0.020	0.019	0.024	0.026	0.019

FIXED AREA IRRIGATION DEMAND TIME SERIES B81B12

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.115	0.129	0.097	0.000	0.000	0.112	0.101	0.096	0.010	0.110	0.105	**1.018**
1926	0.171	0.112	0.114	0.000	0.078	0.029	0.058	0.086	0.086	0.061	0.108	0.122	**1.023**
1927	0.026	0.119	0.137	0.000	0.073	0.050	0.000	0.062	0.099	0.075	0.085	0.132	**0.858**
1928	0.140	0.110	0.089	0.092	0.000	0.000	0.059	0.102	0.043	0.082	0.082	0.116	**0.914**
1929	0.110	0.080	0.000	0.072	0.030	0.000	0.064	0.100	0.092	0.080	0.111	0.120	**0.859**
1930	0.173	0.111	0.000	0.046	0.023	0.010	0.021	0.110	0.085	0.021	0.118	0.109	**0.828**
1931	0.136	0.031	0.145	0.050	0.054	0.018	0.073	0.062	0.091	0.097	0.115	0.123	**0.997**
1932	0.120	0.158	0.051	0.000	0.062	0.081	0.065	0.104	0.098	0.092	0.108	0.134	**1.075**
1933	0.139	0.000	0.092	0.000	0.021	0.006	0.088	0.102	0.069	0.087	0.107	0.122	**0.832**
1934	0.123	0.037	0.020	0.060	0.051	0.069	0.099	0.068	0.097	0.087	0.118	0.120	**0.950**
1935	0.130	0.187	0.133	0.077	0.000	0.000	0.050	0.045	0.076	0.060	0.105	0.085	**0.948**
1936	0.080	0.003	0.045	0.000	0.000	0.047	0.098	0.110	0.099	0.073	0.107	0.098	**0.760**
1937	0.135	0.172	0.008	0.010	0.104	0.097	0.000	0.095	0.053	0.087	0.106	0.070	**0.938**
1938	0.031	0.094	0.000	0.046	0.000	0.000	0.075	0.058	0.058	0.027	0.097	0.083	**0.569**
1939	0.126	0.000	0.000	0.124	0.000	0.000	0.009	0.087	0.041	0.094	0.084	0.058	**0.622**
1940	0.140	0.073	0.028	0.071	0.067	0.105	0.000	0.108	0.096	0.092	0.095	0.132	**1.006**
1941	0.105	0.134	0.113	0.068	0.135	0.000	0.074	0.045	0.069	0.070	0.064	0.051	**0.929**
1942	0.039	0.093	0.023	0.151	0.064	0.000	0.000	0.086	0.099	0.035	0.031	0.087	**0.708**
1943	0.145	0.041	0.124	0.038	0.000	0.021	0.097	0.110	0.030	0.097	0.111	0.125	**0.938**
1944	0.032	0.117	0.155	0.069	0.000	0.011	0.083	0.111	0.099	0.088	0.113	0.139	**1.017**
1945	0.066	0.120	0.100	0.000	0.000	0.017	0.070	0.094	0.086	0.095	0.114	0.141	**0.902**
1946	0.134	0.132	0.161	0.142	0.000	0.041	0.014	0.095	0.075	0.086	0.118	0.107	**1.107**
1947	0.110	0.056	0.019	0.036	0.028	0.000	0.081	0.083	0.099	0.087	0.109	0.125	**0.834**
1948	0.034	0.097	0.177	0.000	0.000	0.059	0.075	0.056	0.072	0.067	0.113	0.104	**0.855**
1949	0.139	0.061	0.051	0.037	0.000	0.000	0.000	0.066	0.078	0.088	0.076	0.128	**0.724**
1950	0.164	0.082	0.000	0.093	0.154	0.000	0.025	0.000	0.099	0.089	0.092	0.080	**0.878**
1951	0.024	0.153	0.093	0.084	0.047	0.087	0.061	0.091	0.078	0.055	0.090	0.140	**1.003**
1952	0.118	0.040	0.020	0.000	0.000	0.000	0.002	0.107	0.099	0.064	0.096	0.127	**0.671**
1953	0.131	0.034	0.000	0.000	0.000	0.018	0.035	0.089	0.089	0.097	0.069	0.119	**0.679**
1954	0.095	0.033	0.026	0.000	0.000	0.000	0.028	0.073	0.056	0.082	0.118	0.127	**0.638**
1955	0.063	0.006	0.000	0.070	0.000	0.000	0.082	0.059	0.063	0.087	0.108	0.045	**0.583**
1956	0.116	0.119	0.098	0.099	0.017	0.000	0.000	0.067	0.064	0.032	0.070	0.100	**0.781**
1957	0.023	0.103	0.127	0.036	0.054	0.066	0.027	0.110	0.091	0.096	0.117	0.016	**0.866**
1958	0.090	0.115	0.000	0.008	0.000	0.059	0.104	0.111	0.097	0.058	0.114	0.120	**0.874**
1959	0.094	0.000	0.006	0.152	0.000	0.064	0.015	0.095	0.067	0.094	0.109	0.110	**0.805**
1960	0.149	0.010	0.000	0.130	0.000	0.000	0.000	0.089	0.068	0.057	0.069	0.107	**0.679**
1961	0.149	0.135	0.116	0.048	0.117	0.097	0.038	0.089	0.099	0.096	0.118	0.132	**1.234**
1962	0.169	0.040	0.000	0.092	0.137	0.108	0.051	0.069	0.049	0.079	0.103	0.134	**1.030**
1963	0.125	0.108	0.132	0.130	0.082	0.134	0.075	0.100	0.099	0.097	0.115	0.129	**1.326**
1964	0.074	0.132	0.000	0.000	0.124	0.122	0.050	0.104	0.092	0.093	0.098	0.098	**0.987**
1965	0.151	0.090	0.156	0.027	0.000	0.116	0.085	0.100	0.094	0.088	0.112	0.084	**1.103**
1966	0.090	0.106	0.037	0.030	0.000	0.000	0.000	0.102	0.094	0.072	0.118	0.138	**0.788**
1967	0.110	0.053	0.133	0.152	0.070	0.000	0.042	0.054	0.055	0.078	0.103	0.136	**0.987**
1968	0.117	0.044	0.057	0.019	0.105	0.000	0.026	0.098	0.087	0.089	0.110	0.111	**0.862**
1969	0.000	0.152	0.050	0.132	0.067	0.130	0.098	0.079	0.079	0.067	0.116	0.117	**1.086**
1970	0.108	0.142	0.102	0.000	0.054	0.127	0.000	0.037	0.085	0.097	0.117	0.118	**0.985**
1971	0.025	0.053	0.067	0.000	0.000	0.000	0.031	0.064	0.095	0.089	0.097	0.134	**0.656**
1972	0.057	0.075	0.169	0.106	0.057	0.036	0.000	0.098	0.087	0.067	0.110	0.001	**0.861**
1973	0.036	0.080	0.000	0.000	0.000	0.000	0.031	0.045	0.097	0.081	0.104	0.053	**0.527**
1974	0.144	0.045	0.057	0.000	0.000	0.000	0.051	0.077	0.076	0.094	0.103	0.131	**0.779**
1975	0.133	0.121	0.000	0.000	0.000	0.000	0.031	0.010	0.085	0.096	0.112	0.129	**0.717**
1976	0.126	0.061	0.136	0.000	0.000	0.000	0.037	0.091	0.099	0.097	0.083	0.027	**0.756**
1977	0.128	0.100	0.002	0.000	0.000	0.004	0.066	0.099	0.099	0.076	0.114	0.106	**0.794**
1978	0.132	0.009	0.129	0.017	0.051	0.006	0.072	0.077	0.096	0.077	0.034	0.112	**0.812**
1979	0.060	0.074	0.040	0.025	0.000	0.020	0.090	0.099	0.099	0.092	0.073	0.053	**0.727**
1980	0.085	0.000	0.086	0.000	0.000	0.000	0.064	0.088	0.099	0.093	0.071	0.101	**0.686**
1981	0.075	0.030	0.097	0.096	0.110	0.075	0.005	0.040	0.099	0.092	0.112	0.109	**0.940**
1982	0.101	0.108	0.124	0.126	0.109	0.068	0.097	0.106	0.078	0.093	0.060	0.137	**1.209**
1983	0.069	0.090	0.127	0.150	0.075	0.000	0.059	0.111	0.093	0.000	0.097	0.112	**0.984**
1984	0.077	0.000	0.203	0.037	0.000	0.019	0.111	0.035	0.058	0.090	0.115	0.081	**0.828**
1985	0.067	0.137	0.117	0.080	0.055	0.062	0.000	0.088	0.080	0.094	0.102	0.124	**1.007**
1986	0.055	0.038	0.126	0.139	0.000	0.078	0.095	0.086	0.066	0.097	0.093	0.021	**0.893**
1987	0.110	0.096	0.006	0.109	0.000	0.000	0.062	0.107	0.020	0.084	0.075	0.077	**0.745**
1988	0.000	0.140	0.113	0.133	0.000	0.103	0.065	0.100	0.068	0.087	0.103	0.133	**1.045**
1989	0.097	0.028	0.045	0.000	0.020	0.039	0.045	0.108	0.098	0.086	0.109	0.132	**0.808**
1990	0.104	0.084	0.043	0.000	0.005	0.000	0.120	0.094	0.050	0.097	0.116	0.118	**0.830**
1991	0.154	0.127	0.172	0.159	0.123	0.086	0.106	0.111	0.083	0.094	0.112	0.135	**1.463**
1992	0.139	0.136	0.052	0.142	0.007	0.000	0.086	0.109	0.079	0.069	0.092	0.132	**1.044**
1993	0.108	0.051	0.015	0.116	0.012	0.083	0.089	0.109	0.095	0.094	0.089	0.130	**0.989**
1994	0.059	0.167	0.074	0.085	0.000	0.009	0.040	0.080	0.097	0.091	0.090	0.131	**0.923**
1995	0.103	0.000	0.024	0.000	0.000	0.048	0.069	0.000	0.070	0.035	0.069	0.135	**0.553**
1996	0.110	0.076	0.101	0.000	0.000	0.000	0.087	0.093	0.099	0.080	0.113	0.031	**0.789**
1997	0.067	0.070	0.125	0.000	0.111	0.088	0.084	0.111	0.097	0.024	0.104	0.089	**0.970**
1998	0.033	0.076	0.000	0.000	0.000	0.000	0.013	0.041	0.071	0.006	0.105	0.124	**0.468**
1999	0.126	0.040	0.082	0.000	0.000	0.000	0.089	0.078	0.066	0.064	0.085	0.108	**0.739**
2000	0.061	0.100	0.091	0.170	0.000	0.048	0.068	0.079	0.092	0.075	0.115	0.122	**1.021**
2001	0.059	0.000	0.054	0.084	0.076	0.119	0.088	0.104	0.049	0.090	0.101	0.113	**0.937**
2002	0.074	0.172	0.121	0.125	0.087	0.089	0.116	0.107	0.045	0.087	0.117	0.085	**1.226**
2003	0.094	0.119	0.144	0.105	0.000	0.000	0.000	0.105	0.084	0.083	0.088	0.123	**0.946**
2004	0.110	0.148	0.013	0.047	0.126	0.047	0.035	0.088	0.085	0.093	0.103	0.108	**1.003**
2005	0.133	0.068	0.036	0.036	0.000	0.000	0.089	0.078	0.066	0.064	0.085	0.108	**0.765**
Average	**0.100**	**0.082**	**0.072**	**0.058**	**0.035**	**0.036**	**0.054**	**0.084**	**0.080**	**0.077**	**0.099**	**0.106**	**0.883**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.037	0.032	0.027	0.022	0.014	0.013	0.021	0.031	0.031	0.029	0.037	0.041	0.028

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81B14**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.451	0.508	0.401	0.000	0.021	0.388	0.357	0.344	0.052	0.401	0.381	**3.810**
1926	0.607	0.440	0.456	0.025	0.320	0.121	0.201	0.305	0.307	0.226	0.392	0.439	**3.841**
1927	0.110	0.464	0.535	0.000	0.304	0.194	0.000	0.222	0.353	0.274	0.315	0.475	**3.247**
1928	0.501	0.435	0.371	0.381	0.000	0.000	0.205	0.360	0.161	0.299	0.304	0.418	**3.433**
1929	0.398	0.332	0.007	0.313	0.157	0.000	0.222	0.352	0.330	0.291	0.404	0.434	**3.240**
1930	0.614	0.437	0.000	0.226	0.133	0.056	0.076	0.388	0.305	0.090	0.430	0.395	**3.149**
1931	0.488	0.164	0.564	0.238	0.238	0.084	0.253	0.225	0.327	0.349	0.418	0.445	**3.793**
1932	0.433	0.600	0.242	0.000	0.265	0.298	0.228	0.369	0.351	0.335	0.392	0.482	**3.995**
1933	0.495	0.000	0.383	0.000	0.127	0.042	0.305	0.360	0.250	0.315	0.392	0.439	**3.106**
1934	0.443	0.183	0.135	0.273	0.230	0.258	0.344	0.245	0.346	0.318	0.427	0.434	**3.634**
1935	0.466	0.698	0.524	0.332	0.000	0.000	0.174	0.166	0.273	0.222	0.383	0.314	**3.550**
1936	0.294	0.068	0.221	0.000	0.000	0.183	0.339	0.388	0.353	0.268	0.391	0.357	**2.862**
1937	0.483	0.647	0.093	0.103	0.411	0.354	0.000	0.337	0.195	0.317	0.388	0.261	**3.588**
1938	0.126	0.377	0.000	0.226	0.000	0.000	0.261	0.211	0.211	0.109	0.357	0.307	**2.183**
1939	0.452	0.000	0.050	0.491	0.035	0.000	0.033	0.310	0.154	0.341	0.310	0.219	**2.396**
1940	0.500	0.307	0.161	0.309	0.283	0.383	0.000	0.380	0.342	0.335	0.349	0.475	**3.823**
1941	0.380	0.516	0.455	0.301	0.516	0.000	0.257	0.163	0.251	0.258	0.242	0.197	**3.537**
1942	0.155	0.376	0.147	0.584	0.274	0.000	0.000	0.307	0.352	0.136	0.127	0.318	**2.775**
1943	0.517	0.198	0.491	0.197	0.000	0.093	0.335	0.388	0.116	0.349	0.405	0.449	**3.538**
1944	0.131	0.456	0.597	0.305	0.000	0.058	0.288	0.393	0.353	0.319	0.410	0.500	**3.810**
1945	0.245	0.468	0.408	0.000	0.000	0.080	0.244	0.332	0.307	0.344	0.416	0.506	**3.350**
1946	0.479	0.509	0.616	0.555	0.000	0.164	0.052	0.338	0.271	0.314	0.430	0.388	**4.117**
1947	0.397	0.250	0.133	0.191	0.150	0.000	0.281	0.295	0.353	0.317	0.396	0.451	**3.213**
1948	0.138	0.390	0.673	0.000	0.000	0.223	0.261	0.202	0.259	0.249	0.411	0.379	**3.185**
1949	0.495	0.265	0.241	0.193	0.005	0.000	0.000	0.238	0.283	0.320	0.283	0.462	**2.784**
1950	0.584	0.338	0.000	0.385	0.580	0.000	0.087	0.000	0.353	0.325	0.338	0.296	**3.285**
1951	0.104	0.582	0.384	0.354	0.216	0.320	0.213	0.322	0.280	0.206	0.331	0.501	**3.813**
1952	0.423	0.193	0.134	0.000	0.000	0.000	0.010	0.377	0.353	0.238	0.351	0.456	**2.535**
1953	0.467	0.172	0.000	0.000	0.000	0.083	0.124	0.318	0.318	0.349	0.258	0.428	**2.517**
1954	0.347	0.168	0.154	0.000	0.000	0.000	0.098	0.260	0.207	0.301	0.429	0.457	**2.419**
1955	0.235	0.077	0.000	0.307	0.000	0.000	0.283	0.213	0.230	0.317	0.395	0.178	**2.234**
1956	0.418	0.463	0.401	0.407	0.110	0.000	0.000	0.241	0.233	0.128	0.262	0.363	**3.026**
1957	0.100	0.411	0.501	0.189	0.240	0.248	0.094	0.388	0.326	0.348	0.425	0.077	**3.346**
1958	0.327	0.452	0.051	0.093	0.000	0.224	0.359	0.391	0.345	0.216	0.415	0.432	**3.305**
1959	0.342	0.000	0.088	0.588	0.000	0.240	0.056	0.336	0.243	0.339	0.398	0.398	**3.027**
1960	0.531	0.092	0.000	0.511	0.000	0.000	0.003	0.317	0.246	0.211	0.259	0.388	**2.559**
1961	0.532	0.518	0.464	0.230	0.455	0.354	0.134	0.318	0.353	0.347	0.430	0.475	**4.608**
1962	0.598	0.193	0.000	0.382	0.522	0.392	0.180	0.249	0.183	0.288	0.375	0.481	**3.841**
1963	0.449	0.428	0.520	0.511	0.333	0.481	0.260	0.353	0.353	0.349	0.418	0.465	**4.922**
1964	0.273	0.508	0.000	0.014	0.477	0.439	0.175	0.368	0.330	0.338	0.361	0.358	**3.641**
1965	0.538	0.366	0.600	0.160	0.000	0.420	0.296	0.354	0.335	0.319	0.407	0.309	**4.105**
1966	0.327	0.422	0.193	0.170	0.000	0.000	0.000	0.362	0.336	0.266	0.427	0.494	**2.999**
1967	0.396	0.238	0.523	0.589	0.293	0.018	0.149	0.195	0.201	0.287	0.377	0.488	**3.754**
1968	0.422	0.208	0.261	0.131	0.412	0.000	0.092	0.346	0.312	0.322	0.401	0.402	**3.311**
1969	0.000	0.578	0.237	0.519	0.282	0.469	0.338	0.283	0.285	0.246	0.421	0.421	**4.081**
1970	0.389	0.542	0.416	0.000	0.239	0.456	0.000	0.138	0.303	0.349	0.424	0.426	**3.684**
1971	0.104	0.240	0.297	0.000	0.000	0.000	0.109	0.232	0.341	0.323	0.357	0.482	**2.484**
1972	0.214	0.312	0.644	0.430	0.249	0.144	0.000	0.348	0.311	0.247	0.400	0.025	**3.324**
1973	0.142	0.332	0.000	0.000	0.000	0.000	0.111	0.164	0.346	0.297	0.380	0.205	**1.976**
1974	0.512	0.210	0.262	0.065	0.000	0.000	0.180	0.274	0.274	0.342	0.378	0.472	**2.968**
1975	0.477	0.471	0.000	0.000	0.000	0.000	0.108	0.044	0.306	0.347	0.409	0.463	**2.626**
1976	0.451	0.266	0.532	0.000	0.000	0.000	0.130	0.325	0.352	0.349	0.307	0.114	**2.826**
1977	0.458	0.400	0.073	0.000	0.000	0.035	0.229	0.352	0.353	0.279	0.415	0.384	**2.977**
1978	0.473	0.088	0.509	0.124	0.228	0.044	0.250	0.275	0.341	0.282	0.138	0.407	**3.159**
1979	0.227	0.311	0.203	0.152	0.000	0.092	0.313	0.352	0.353	0.335	0.274	0.204	**2.814**
1980	0.310	0.000	0.361	0.000	0.000	0.000	0.222	0.312	0.353	0.338	0.264	0.367	**2.527**
1981	0.276	0.160	0.399	0.396	0.431	0.278	0.019	0.149	0.353	0.334	0.409	0.394	**3.598**
1982	0.368	0.426	0.492	0.500	0.427	0.256	0.337	0.374	0.280	0.337	0.228	0.492	**4.519**
1983	0.255	0.365	0.502	0.583	0.312	0.000	0.205	0.391	0.333	0.000	0.357	0.406	**3.710**
1984	0.285	0.048	0.763	0.193	0.000	0.087	0.384	0.131	0.214	0.328	0.418	0.301	**3.151**
1985	0.248	0.528	0.467	0.341	0.241	0.234	0.000	0.312	0.289	0.342	0.375	0.448	**3.826**
1986	0.208	0.186	0.500	0.543	0.000	0.290	0.330	0.304	0.238	0.349	0.342	0.092	**3.384**
1987	0.395	0.384	0.087	0.440	0.000	0.000	0.217	0.380	0.081	0.306	0.280	0.284	**2.854**
1988	0.007	0.538	0.455	0.522	0.000	0.376	0.226	0.353	0.245	0.315	0.377	0.479	**3.891**
1989	0.353	0.154	0.220	0.000	0.121	0.155	0.158	0.380	0.350	0.315	0.398	0.474	**3.079**
1990	0.377	0.345	0.213	0.033	0.071	0.000	0.415	0.333	0.185	0.349	0.423	0.425	**3.167**
1991	0.547	0.492	0.656	0.613	0.477	0.317	0.368	0.393	0.297	0.339	0.408	0.485	**5.392**
1992	0.496	0.523	0.244	0.554	0.078	0.000	0.300	0.386	0.285	0.256	0.338	0.474	**3.933**
1993	0.389	0.230	0.119	0.463	0.093	0.306	0.308	0.384	0.338	0.341	0.327	0.469	**3.767**
1994	0.221	0.629	0.320	0.359	0.000	0.052	0.140	0.287	0.347	0.330	0.331	0.470	**3.486**
1995	0.372	0.000	0.149	0.000	0.000	0.186	0.241	0.000	0.252	0.137	0.258	0.486	**2.081**
1996	0.396	0.316	0.411	0.000	0.000	0.000	0.301	0.329	0.352	0.292	0.411	0.129	**2.939**
1997	0.250	0.296	0.496	0.000	0.434	0.325	0.290	0.393	0.347	0.098	0.380	0.326	**3.636**
1998	0.134	0.316	0.000	0.000	0.000	0.000	0.046	0.151	0.258	0.037	0.383	0.446	**1.771**
1999	0.452	0.192	0.347	0.000	0.022	0.000	0.309	0.280	0.241	0.238	0.315	0.393	**2.788**
2000	0.227	0.400	0.380	0.650	0.000	0.185	0.236	0.281	0.329	0.275	0.418	0.441	**3.823**
2001	0.221	0.000	0.250	0.353	0.313	0.431	0.307	0.367	0.183	0.326	0.370	0.409	**3.530**
2002	0.274	0.647	0.480	0.494	0.352	0.326	0.400	0.379	0.168	0.318	0.426	0.314	**4.578**
2003	0.342	0.466	0.560	0.426	0.000	0.000	0.000	0.372	0.301	0.301	0.326	0.444	**3.539**
2004	0.399	0.564	0.109	0.227	0.486	0.182	0.122	0.312	0.305	0.338	0.377	0.393	**3.814**
2005	0.477	0.290	0.188	0.192	0.022	0.000	0.309	0.280	0.241	0.238	0.315	0.393	**2.944**
Average	**0.354**	**0.335**	**0.304**	**0.245**	**0.148**	**0.136**	**0.189**	**0.298**	**0.289**	**0.282**	**0.363**	**0.385**	**3.332**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.132	0.129	0.113	0.091	0.061	0.051	0.073	0.111	0.111	0.105	0.135	0.149	0.106

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81B16**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.138	0.145	0.102	0.000	0.000	0.127	0.110	0.111	0.000	0.131	0.128	**1.181**
1926	0.236	0.133	0.123	0.000	0.080	0.000	0.040	0.086	0.094	0.059	0.127	0.156	**1.133**
1927	0.011	0.143	0.158	0.000	0.072	0.029	0.000	0.048	0.115	0.081	0.091	0.172	**0.920**
1928	0.186	0.130	0.085	0.093	0.000	0.000	0.042	0.111	0.026	0.093	0.086	0.146	**0.999**
1929	0.139	0.084	0.000	0.064	0.008	0.000	0.050	0.108	0.105	0.089	0.133	0.153	**0.931**
1930	0.240	0.131	0.000	0.027	0.000	0.000	0.000	0.124	0.093	0.000	0.144	0.135	**0.894**
1931	0.180	0.013	0.171	0.032	0.043	0.000	0.064	0.049	0.103	0.116	0.139	0.158	**1.068**
1932	0.155	0.205	0.031	0.000	0.055	0.076	0.052	0.116	0.114	0.110	0.127	0.175	**1.217**
1933	0.184	0.000	0.091	0.000	0.000	0.000	0.088	0.112	0.067	0.100	0.127	0.155	**0.923**
1934	0.160	0.021	0.000	0.047	0.039	0.057	0.106	0.058	0.112	0.102	0.143	0.153	**0.997**
1935	0.170	0.251	0.152	0.072	0.000	0.000	0.028	0.022	0.078	0.057	0.122	0.097	**1.050**
1936	0.092	0.000	0.023	0.000	0.000	0.024	0.104	0.124	0.115	0.078	0.126	0.117	**0.804**
1937	0.178	0.227	0.000	0.000	0.120	0.101	0.000	0.101	0.042	0.101	0.125	0.073	**1.068**
1938	0.018	0.105	0.000	0.027	0.000	0.000	0.067	0.043	0.049	0.005	0.110	0.094	**0.518**
1939	0.164	0.000	0.000	0.142	0.000	0.000	0.000	0.088	0.023	0.112	0.089	0.054	**0.672**
1940	0.186	0.074	0.000	0.062	0.063	0.114	0.000	0.121	0.110	0.110	0.107	0.172	**1.118**
1941	0.131	0.167	0.122	0.059	0.169	0.000	0.066	0.021	0.068	0.074	0.057	0.044	**0.977**
1942	0.030	0.104	0.000	0.184	0.059	0.000	0.000	0.087	0.114	0.017	0.005	0.099	**0.700**
1943	0.194	0.027	0.138	0.015	0.000	0.000	0.102	0.125	0.006	0.116	0.133	0.160	**1.015**
1944	0.020	0.140	0.186	0.060	0.000	0.000	0.080	0.127	0.115	0.102	0.135	0.184	**1.149**
1945	0.070	0.145	0.102	0.000	0.000	0.000	0.060	0.098	0.094	0.114	0.138	0.187	**1.007**
1946	0.176	0.164	0.194	0.171	0.000	0.015	0.000	0.101	0.077	0.100	0.144	0.132	**1.275**
1947	0.139	0.049	0.000	0.013	0.005	0.000	0.077	0.081	0.115	0.101	0.129	0.161	**0.869**
1948	0.023	0.110	0.220	0.000	0.000	0.042	0.068	0.039	0.071	0.070	0.135	0.127	**0.905**
1949	0.184	0.055	0.031	0.013	0.000	0.000	0.000	0.055	0.082	0.102	0.076	0.166	**0.766**
1950	0.225	0.087	0.000	0.095	0.199	0.000	0.000	0.000	0.115	0.105	0.102	0.089	**1.016**
1951	0.008	0.197	0.091	0.081	0.033	0.085	0.046	0.094	0.081	0.050	0.098	0.184	**1.050**
1952	0.151	0.025	0.000	0.000	0.000	0.000	0.000	0.119	0.115	0.064	0.108	0.164	**0.746**
1953	0.171	0.016	0.000	0.000	0.000	0.000	0.005	0.092	0.099	0.116	0.065	0.150	**0.714**
1954	0.116	0.014	0.000	0.000	0.000	0.000	0.000	0.065	0.047	0.093	0.144	0.164	**0.643**
1955	0.065	0.000	0.000	0.061	0.000	0.000	0.078	0.044	0.058	0.101	0.128	0.035	**0.570**
1956	0.148	0.143	0.098	0.105	0.000	0.000	0.000	0.056	0.059	0.013	0.066	0.120	**0.810**
1957	0.007	0.119	0.142	0.012	0.044	0.053	0.000	0.124	0.102	0.116	0.142	0.000	**0.861**
1958	0.107	0.138	0.000	0.000	0.000	0.042	0.113	0.126	0.112	0.054	0.137	0.152	**0.981**
1959	0.113	0.000	0.000	0.186	0.000	0.049	0.000	0.100	0.064	0.112	0.129	0.136	**0.890**
1960	0.201	0.000	0.000	0.151	0.000	0.000	0.000	0.092	0.065	0.052	0.065	0.131	**0.758**
1961	0.201	0.168	0.126	0.029	0.141	0.101	0.010	0.092	0.115	0.115	0.144	0.172	**1.413**
1962	0.232	0.025	0.000	0.094	0.171	0.118	0.031	0.060	0.036	0.088	0.119	0.175	**1.149**
1963	0.163	0.127	0.151	0.151	0.085	0.160	0.067	0.108	0.115	0.116	0.139	0.168	**1.551**
1964	0.082	0.163	0.000	0.000	0.151	0.140	0.029	0.115	0.104	0.111	0.112	0.118	**1.126**
1965	0.204	0.100	0.187	0.000	0.000	0.131	0.084	0.109	0.107	0.102	0.134	0.095	**1.252**
1966	0.107	0.124	0.012	0.004	0.000	0.000	0.000	0.112	0.107	0.078	0.143	0.181	**0.869**
1967	0.138	0.044	0.152	0.186	0.067	0.000	0.016	0.035	0.045	0.087	0.120	0.178	**1.070**
1968	0.150	0.031	0.039	0.000	0.121	0.000	0.000	0.105	0.096	0.104	0.131	0.138	**0.916**
1969	0.000	0.195	0.029	0.155	0.063	0.154	0.103	0.076	0.084	0.068	0.141	0.147	**1.214**
1970	0.135	0.179	0.105	0.000	0.043	0.148	0.000	0.010	0.092	0.116	0.142	0.149	**1.120**
1971	0.008	0.045	0.054	0.000	0.000	0.000	0.000	0.052	0.110	0.104	0.111	0.176	**0.659**
1972	0.056	0.076	0.207	0.115	0.048	0.007	0.000	0.106	0.095	0.069	0.130	0.000	**0.908**
1973	0.025	0.085	0.000	0.000	0.000	0.000	0.000	0.021	0.112	0.092	0.121	0.048	**0.502**
1974	0.192	0.032	0.040	0.000	0.000	0.000	0.030	0.072	0.078	0.113	0.120	0.171	**0.848**
1975	0.176	0.147	0.000	0.000	0.000	0.000	0.000	0.000	0.093	0.115	0.135	0.167	**0.832**
1976	0.164	0.056	0.156	0.000	0.000	0.000	0.008	0.095	0.115	0.116	0.088	0.007	**0.804**
1977	0.167	0.115	0.000	0.000	0.000	0.000	0.053	0.108	0.115	0.083	0.137	0.130	**0.908**
1978	0.174	0.000	0.146	0.000	0.039	0.000	0.063	0.072	0.110	0.085	0.010	0.140	**0.838**
1979	0.062	0.075	0.016	0.000	0.000	0.000	0.091	0.108	0.115	0.109	0.072	0.047	**0.696**
1980	0.099	0.000	0.081	0.000	0.000	0.000	0.050	0.089	0.115	0.111	0.068	0.122	**0.735**
1981	0.084	0.011	0.097	0.100	0.130	0.066	0.000	0.015	0.115	0.109	0.135	0.134	**0.996**
1982	0.125	0.126	0.138	0.146	0.128	0.056	0.103	0.118	0.081	0.111	0.051	0.180	**1.365**
1983	0.074	0.099	0.143	0.183	0.076	0.000	0.042	0.126	0.106	0.000	0.111	0.140	**1.100**
1984	0.088	0.000	0.262	0.013	0.000	0.000	0.124	0.006	0.050	0.106	0.139	0.091	**0.880**
1985	0.071	0.172	0.128	0.076	0.045	0.046	0.000	0.089	0.085	0.113	0.119	0.160	**1.104**
1986	0.054	0.022	0.142	0.165	0.000	0.072	0.100	0.086	0.062	0.116	0.104	0.000	**0.922**
1987	0.138	0.108	0.000	0.119	0.000	0.000	0.047	0.121	0.000	0.096	0.075	0.084	**0.787**
1988	0.000	0.177	0.122	0.156	0.000	0.111	0.051	0.108	0.065	0.100	0.120	0.174	**1.184**
1989	0.119	0.009	0.022	0.000	0.000	0.011	0.021	0.121	0.114	0.100	0.130	0.172	**0.818**
1990	0.129	0.090	0.019	0.000	0.000	0.000	0.139	0.099	0.037	0.116	0.141	0.149	**0.920**
1991	0.208	0.156	0.212	0.197	0.151	0.084	0.117	0.127	0.089	0.112	0.134	0.177	**1.764**
1992	0.184	0.170	0.032	0.170	0.000	0.000	0.085	0.124	0.083	0.073	0.102	0.172	**1.196**
1993	0.135	0.041	0.000	0.129	0.000	0.079	0.089	0.123	0.108	0.112	0.097	0.169	**1.082**
1994	0.059	0.219	0.064	0.084	0.000	0.000	0.013	0.077	0.112	0.107	0.099	0.170	**1.004**
1995	0.127	0.000	0.000	0.000	0.000	0.025	0.058	0.000	0.068	0.018	0.065	0.177	**0.539**
1996	0.138	0.078	0.103	0.000	0.000	0.000	0.086	0.097	0.115	0.090	0.136	0.014	**0.856**
1997	0.072	0.069	0.140	0.000	0.131	0.088	0.081	0.127	0.113	0.000	0.121	0.103	**1.044**
1998	0.021	0.078	0.000	0.000	0.000	0.000	0.000	0.015	0.071	0.000	0.123	0.158	**0.466**
1999	0.164	0.025	0.075	0.000	0.000	0.000	0.090	0.074	0.063	0.064	0.091	0.134	**0.780**
2000	0.062	0.115	0.089	0.214	0.000	0.025	0.056	0.075	0.104	0.081	0.139	0.156	**1.117**
2001	0.059	0.000	0.035	0.081	0.076	0.137	0.089	0.115	0.036	0.105	0.116	0.141	**0.991**
2002	0.083	0.227	0.133	0.143	0.094	0.088	0.132	0.120	0.029	0.101	0.143	0.097	**1.392**
2003	0.114	0.144	0.169	0.113	0.000	0.000	0.000	0.117	0.091	0.094	0.096	0.158	**1.095**
2004	0.139	0.189	0.000	0.027	0.155	0.023	0.004	0.089	0.093	0.111	0.120	0.134	**1.085**
2005	0.175	0.066	0.010	0.013	0.000	0.000	0.090	0.074	0.063	0.064	0.091	0.134	**0.780**
Average	**0.123**	**0.093**	**0.073**	**0.058**	**0.036**	**0.032**	**0.046**	**0.085**	**0.086**	**0.086**	**0.113**	**0.131**	**0.961**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.046	0.036	0.027	0.022	0.015	0.012	0.018	0.032	0.033	0.032	0.042	0.051	0.030

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81B20**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.040	0.048	0.040	0.000	0.000	0.046	0.039	0.038	0.000	0.045	0.033	**0.383**
1926	0.073	0.035	0.044	0.000	0.033	0.000	0.018	0.028	0.033	0.030	0.041	0.048	**0.383**
1927	0.000	0.043	0.045	0.000	0.023	0.019	0.012	0.035	0.041	0.030	0.028	0.048	**0.323**
1928	0.064	0.031	0.036	0.005	0.000	0.000	0.014	0.043	0.017	0.028	0.029	0.035	**0.300**
1929	0.035	0.032	0.000	0.026	0.000	0.000	0.021	0.042	0.041	0.029	0.045	0.044	**0.314**
1930	0.077	0.038	0.000	0.000	0.000	0.000	0.000	0.042	0.035	0.000	0.049	0.049	**0.289**
1931	0.051	0.000	0.063	0.000	0.014	0.000	0.024	0.018	0.037	0.040	0.049	0.050	**0.345**
1932	0.038	0.067	0.000	0.000	0.010	0.024	0.025	0.042	0.040	0.038	0.040	0.057	**0.381**
1933	0.047	0.000	0.020	0.000	0.000	0.000	0.021	0.039	0.025	0.034	0.042	0.049	**0.275**
1934	0.047	0.000	0.000	0.005	0.012	0.020	0.038	0.020	0.038	0.036	0.047	0.044	**0.307**
1935	0.047	0.083	0.049	0.015	0.000	0.000	0.006	0.006	0.025	0.026	0.043	0.034	**0.335**
1936	0.019	0.000	0.000	0.000	0.000	0.000	0.030	0.044	0.040	0.031	0.043	0.032	**0.238**
1937	0.051	0.077	0.000	0.000	0.034	0.034	0.000	0.037	0.016	0.035	0.041	0.014	**0.339**
1938	0.002	0.033	0.000	0.000	0.000	0.000	0.019	0.015	0.019	0.000	0.037	0.021	**0.145**
1939	0.048	0.000	0.000	0.047	0.000	0.000	0.000	0.036	0.007	0.039	0.030	0.011	**0.217**
1940	0.057	0.023	0.000	0.045	0.027	0.044	0.000	0.044	0.040	0.037	0.037	0.057	**0.412**
1941	0.039	0.059	0.050	0.029	0.061	0.000	0.030	0.005	0.032	0.026	0.021	0.003	**0.355**
1942	0.008	0.041	0.000	0.070	0.029	0.000	0.000	0.037	0.041	0.005	0.002	0.029	**0.262**
1943	0.062	0.008	0.047	0.010	0.000	0.000	0.036	0.045	0.000	0.040	0.043	0.051	**0.343**
1944	0.000	0.033	0.067	0.011	0.000	0.000	0.027	0.046	0.041	0.036	0.044	0.060	**0.364**
1945	0.006	0.043	0.030	0.000	0.000	0.000	0.021	0.036	0.033	0.039	0.045	0.060	**0.314**
1946	0.046	0.047	0.070	0.056	0.000	0.000	0.000	0.032	0.029	0.034	0.049	0.041	**0.405**
1947	0.036	0.005	0.000	0.000	0.000	0.000	0.022	0.035	0.041	0.032	0.045	0.051	**0.268**
1948	0.000	0.028	0.063	0.000	0.000	0.020	0.023	0.010	0.025	0.026	0.047	0.037	**0.280**
1949	0.062	0.005	0.000	0.002	0.000	0.000	0.000	0.018	0.032	0.035	0.032	0.052	**0.237**
1950	0.071	0.027	0.000	0.031	0.074	0.000	0.000	0.000	0.041	0.036	0.032	0.024	**0.336**
1951	0.000	0.067	0.029	0.033	0.012	0.028	0.011	0.039	0.029	0.017	0.038	0.060	**0.363**
1952	0.047	0.000	0.000	0.000	0.000	0.000	0.000	0.038	0.041	0.024	0.036	0.054	**0.241**
1953	0.053	0.000	0.000	0.000	0.000	0.005	0.000	0.032	0.034	0.040	0.023	0.051	**0.238**
1954	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.021	0.031	0.049	0.049	**0.203**
1955	0.005	0.000	0.000	0.020	0.000	0.000	0.028	0.010	0.013	0.037	0.041	0.000	**0.153**
1956	0.047	0.036	0.020	0.036	0.000	0.000	0.000	0.016	0.022	0.000	0.019	0.030	**0.226**
1957	0.000	0.035	0.050	0.000	0.014	0.008	0.000	0.045	0.038	0.039	0.049	0.000	**0.278**
1958	0.034	0.031	0.000	0.000	0.000	0.011	0.043	0.044	0.039	0.020	0.048	0.044	**0.314**
1959	0.032	0.000	0.000	0.061	0.000	0.009	0.000	0.027	0.016	0.039	0.042	0.040	**0.267**
1960	0.063	0.000	0.000	0.055	0.000	0.000	0.000	0.034	0.015	0.011	0.022	0.040	**0.239**
1961	0.055	0.050	0.030	0.014	0.037	0.035	0.000	0.031	0.041	0.038	0.049	0.056	**0.434**
1962	0.070	0.000	0.000	0.030	0.052	0.033	0.004	0.020	0.005	0.023	0.044	0.052	**0.334**
1963	0.042	0.032	0.030	0.041	0.031	0.056	0.019	0.039	0.041	0.040	0.048	0.047	**0.465**
1964	0.004	0.038	0.000	0.000	0.042	0.046	0.007	0.042	0.037	0.038	0.039	0.031	**0.324**
1965	0.059	0.016	0.059	0.000	0.000	0.045	0.032	0.045	0.035	0.033	0.042	0.026	**0.391**
1966	0.018	0.037	0.000	0.000	0.000	0.000	0.000	0.037	0.039	0.025	0.046	0.059	**0.262**
1967	0.033	0.000	0.049	0.070	0.012	0.000	0.000	0.009	0.011	0.026	0.038	0.056	**0.302**
1968	0.036	0.000	0.000	0.000	0.040	0.000	0.000	0.041	0.030	0.033	0.044	0.039	**0.264**
1969	0.000	0.048	0.000	0.047	0.011	0.048	0.035	0.026	0.027	0.019	0.047	0.045	**0.354**
1970	0.025	0.008	0.022	0.000	0.010	0.047	0.000	0.009	0.029	0.040	0.048	0.044	**0.283**
1971	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.015	0.038	0.036	0.034	0.055	**0.183**
1972	0.000	0.012	0.078	0.026	0.019	0.000	0.000	0.035	0.037	0.019	0.043	0.000	**0.268**
1973	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.030	0.039	0.022	0.037	0.002	**0.131**
1974	0.052	0.000	0.000	0.000	0.000	0.000	0.009	0.023	0.025	0.039	0.040	0.052	**0.240**
1975	0.046	0.038	0.000	0.000	0.000	0.000	0.000	0.000	0.035	0.040	0.044	0.052	**0.255**
1976	0.039	0.000	0.060	0.000	0.000	0.000	0.004	0.031	0.041	0.040	0.028	0.000	**0.243**
1977	0.047	0.035	0.000	0.000	0.000	0.000	0.015	0.038	0.041	0.029	0.044	0.041	**0.291**
1978	0.051	0.000	0.041	0.000	0.006	0.000	0.021	0.017	0.040	0.031	0.000	0.037	**0.245**
1979	0.000	0.004	0.000	0.000	0.000	0.000	0.027	0.040	0.041	0.034	0.023	0.005	**0.174**
1980	0.020	0.000	0.006	0.000	0.000	0.000	0.012	0.033	0.041	0.039	0.014	0.033	**0.199**
1981	0.009	0.000	0.023	0.019	0.056	0.029	0.000	0.000	0.041	0.034	0.046	0.042	**0.299**
1982	0.028	0.023	0.045	0.036	0.047	0.005	0.035	0.043	0.027	0.039	0.014	0.057	**0.400**
1983	0.011	0.021	0.039	0.062	0.021	0.000	0.011	0.045	0.037	0.000	0.032	0.037	**0.317**
1984	0.008	0.000	0.083	0.000	0.000	0.000	0.043	0.000	0.009	0.037	0.047	0.023	**0.251**
1985	0.008	0.055	0.026	0.032	0.000	0.009	0.000	0.028	0.033	0.039	0.035	0.048	**0.312**
1986	0.004	0.000	0.023	0.043	0.000	0.009	0.034	0.030	0.020	0.040	0.032	0.000	**0.234**
1987	0.029	0.022	0.000	0.018	0.000	0.000	0.015	0.043	0.000	0.031	0.027	0.014	**0.199**
1988	0.000	0.050	0.029	0.045	0.000	0.032	0.009	0.036	0.015	0.036	0.036	0.053	**0.339**
1989	0.017	0.000	0.002	0.000	0.000	0.000	0.003	0.035	0.038	0.032	0.043	0.055	**0.225**
1990	0.025	0.020	0.000	0.000	0.000	0.000	0.044	0.035	0.013	0.040	0.047	0.040	**0.264**
1991	0.067	0.032	0.073	0.065	0.056	0.019	0.043	0.046	0.033	0.039	0.043	0.055	**0.572**
1992	0.055	0.051	0.000	0.066	0.008	0.000	0.028	0.035	0.033	0.029	0.041	0.052	**0.398**
1993	0.040	0.000	0.000	0.048	0.000	0.033	0.034	0.045	0.041	0.039	0.038	0.055	**0.373**
1994	0.004	0.057	0.013	0.023	0.000	0.000	0.000	0.012	0.040	0.038	0.035	0.055	**0.277**
1995	0.043	0.000	0.000	0.000	0.000	0.003	0.007	0.000	0.022	0.003	0.006	0.052	**0.136**
1996	0.028	0.004	0.038	0.000	0.000	0.000	0.014	0.033	0.041	0.028	0.047	0.000	**0.233**
1997	0.023	0.000	0.045	0.000	0.048	0.047	0.028	0.046	0.039	0.002	0.044	0.020	**0.342**
1998	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.008	0.030	0.022	0.043	0.050	**0.158**
1999	0.046	0.000	0.000	0.000	0.000	0.000	0.030	0.025	0.020	0.020	0.028	0.040	**0.210**
2000	0.007	0.025	0.000	0.076	0.000	0.000	0.024	0.014	0.036	0.031	0.046	0.048	**0.307**
2001	0.003	0.000	0.000	0.026	0.023	0.048	0.026	0.044	0.011	0.037	0.039	0.040	**0.295**
2002	0.024	0.074	0.041	0.042	0.014	0.030	0.045	0.041	0.004	0.036	0.049	0.036	**0.436**
2003	0.039	0.039	0.070	0.034	0.000	0.000	0.000	0.044	0.032	0.029	0.039	0.047	**0.373**
2004	0.023	0.051	0.000	0.003	0.061	0.007	0.000	0.035	0.032	0.039	0.040	0.040	**0.330**
2005	0.059	0.008	0.003	0.000	0.000	0.000	0.030	0.025	0.020	0.020	0.028	0.040	**0.235**
Average	**0.033**	**0.022**	**0.021**	**0.018**	**0.012**	**0.010**	**0.015**	**0.030**	**0.030**	**0.029**	**0.038**	**0.039**	**0.294**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.012	0.009	0.008	0.007	0.005	0.004	0.006	0.011	0.011	0.011	0.014	0.015	0.009

FIXED AREA IRRIGATION DEMAND TIME SERIES B81B30

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.458	0.522	0.451	0.000	0.000	0.404	0.341	0.336	0.007	0.393	0.350	**3.826**
1926	0.695	0.420	0.490	0.000	0.364	0.094	0.204	0.266	0.298	0.275	0.368	0.463	**3.937**
1927	0.125	0.481	0.501	0.000	0.293	0.238	0.157	0.313	0.353	0.275	0.275	0.457	**3.468**
1928	0.633	0.395	0.426	0.177	0.000	0.000	0.169	0.372	0.181	0.259	0.279	0.367	**3.257**
1929	0.417	0.397	0.000	0.346	0.050	0.000	0.221	0.362	0.353	0.271	0.392	0.434	**3.244**
1930	0.727	0.445	0.000	0.061	0.042	0.000	0.013	0.364	0.310	0.000	0.421	0.463	**2.846**
1931	0.534	0.100	0.629	0.126	0.221	0.017	0.246	0.193	0.329	0.347	0.423	0.472	**3.637**
1932	0.444	0.659	0.106	0.000	0.196	0.274	0.249	0.362	0.351	0.333	0.359	0.527	**3.859**
1933	0.507	0.000	0.302	0.000	0.054	0.000	0.221	0.342	0.239	0.304	0.373	0.463	**2.805**
1934	0.508	0.007	0.000	0.178	0.208	0.247	0.345	0.207	0.336	0.317	0.411	0.431	**3.195**
1935	0.510	0.777	0.530	0.261	0.000	0.000	0.114	0.106	0.242	0.249	0.379	0.361	**3.528**
1936	0.299	0.000	0.073	0.000	0.000	0.044	0.284	0.381	0.345	0.286	0.383	0.342	**2.437**
1937	0.537	0.731	0.000	0.000	0.374	0.349	0.000	0.330	0.176	0.316	0.365	0.211	**3.388**
1938	0.173	0.408	0.000	0.108	0.000	0.000	0.210	0.171	0.195	0.059	0.337	0.262	**1.922**
1939	0.514	0.000	0.000	0.506	0.110	0.000	0.000	0.323	0.113	0.338	0.286	0.189	**2.379**
1940	0.579	0.331	0.000	0.493	0.326	0.423	0.031	0.382	0.344	0.330	0.337	0.525	**4.101**
1941	0.453	0.598	0.533	0.366	0.573	0.000	0.286	0.100	0.294	0.247	0.225	0.135	**3.810**
1942	0.220	0.465	0.016	0.677	0.335	0.000	0.000	0.327	0.353	0.098	0.088	0.324	**2.902**
1943	0.619	0.214	0.513	0.223	0.000	0.039	0.329	0.388	0.053	0.347	0.380	0.484	**3.588**
1944	0.102	0.408	0.661	0.226	0.000	0.000	0.265	0.394	0.353	0.316	0.390	0.542	**3.657**
1945	0.208	0.481	0.384	0.000	0.000	0.029	0.223	0.324	0.300	0.339	0.395	0.546	**3.228**
1946	0.505	0.509	0.681	0.571	0.000	0.071	0.000	0.297	0.272	0.307	0.423	0.411	**4.046**
1947	0.431	0.191	0.000	0.100	0.084	0.000	0.232	0.315	0.353	0.293	0.396	0.484	**2.878**
1948	0.058	0.367	0.631	0.000	0.000	0.250	0.239	0.134	0.240	0.250	0.409	0.383	**2.963**
1949	0.615	0.193	0.094	0.158	0.000	0.000	0.000	0.191	0.292	0.310	0.298	0.489	**2.639**
1950	0.680	0.364	0.000	0.381	0.668	0.000	0.032	0.000	0.353	0.323	0.299	0.286	**3.385**
1951	0.076	0.662	0.374	0.398	0.208	0.306	0.147	0.341	0.271	0.186	0.343	0.546	**3.860**
1952	0.511	0.087	0.000	0.000	0.000	0.000	0.000	0.337	0.353	0.237	0.333	0.505	**2.363**
1953	0.554	0.111	0.000	0.000	0.000	0.135	0.007	0.294	0.307	0.347	0.236	0.480	**2.471**
1954	0.405	0.063	0.064	0.000	0.000	0.000	0.000	0.211	0.210	0.284	0.423	0.468	**2.128**
1955	0.198	0.000	0.000	0.300	0.000	0.000	0.269	0.134	0.153	0.326	0.365	0.077	**1.821**
1956	0.511	0.427	0.301	0.422	0.000	0.000	0.000	0.183	0.219	0.010	0.207	0.330	**2.610**
1957	0.042	0.420	0.535	0.141	0.226	0.160	0.000	0.385	0.334	0.343	0.423	0.000	**3.008**
1958	0.414	0.390	0.000	0.000	0.000	0.182	0.382	0.377	0.338	0.204	0.414	0.433	**3.135**
1959	0.396	0.000	0.044	0.608	0.000	0.163	0.000	0.261	0.180	0.340	0.376	0.405	**2.772**
1960	0.621	0.000	0.000	0.564	0.000	0.000	0.000	0.309	0.170	0.143	0.228	0.400	**2.434**
1961	0.566	0.531	0.382	0.250	0.394	0.356	0.043	0.287	0.353	0.335	0.423	0.514	**4.434**
1962	0.671	0.014	0.000	0.380	0.507	0.344	0.099	0.207	0.098	0.230	0.388	0.487	**3.426**
1963	0.471	0.399	0.379	0.462	0.349	0.510	0.207	0.347	0.353	0.347	0.412	0.453	**4.689**
1964	0.190	0.446	0.000	0.000	0.437	0.435	0.119	0.366	0.324	0.336	0.348	0.337	**3.338**
1965	0.592	0.278	0.603	0.000	0.000	0.428	0.303	0.384	0.309	0.298	0.376	0.301	**3.873**
1966	0.297	0.435	0.073	0.101	0.000	0.000	0.000	0.332	0.340	0.242	0.404	0.539	**2.764**
1967	0.403	0.140	0.530	0.676	0.207	0.000	0.008	0.126	0.137	0.249	0.342	0.515	**3.333**
1968	0.426	0.094	0.123	0.056	0.422	0.000	0.000	0.357	0.277	0.301	0.389	0.393	**2.839**
1969	0.000	0.521	0.078	0.506	0.204	0.452	0.321	0.251	0.253	0.201	0.409	0.440	**3.635**
1970	0.350	0.220	0.324	0.000	0.191	0.446	0.000	0.132	0.268	0.347	0.415	0.431	**3.124**
1971	0.016	0.108	0.182	0.000	0.000	0.000	0.057	0.170	0.335	0.321	0.316	0.512	**2.018**
1972	0.092	0.251	0.739	0.347	0.259	0.083	0.000	0.313	0.324	0.201	0.378	0.000	**2.987**
1973	0.108	0.160	0.000	0.000	0.000	0.000	0.032	0.282	0.341	0.222	0.335	0.123	**1.603**
1974	0.544	0.102	0.100	0.000	0.000	0.000	0.133	0.229	0.241	0.341	0.360	0.489	**2.538**
1975	0.505	0.449	0.000	0.000	0.000	0.000	0.054	0.000	0.309	0.346	0.385	0.487	**2.534**
1976	0.453	0.149	0.609	0.000	0.000	0.000	0.101	0.284	0.353	0.347	0.276	0.065	**2.638**
1977	0.511	0.426	0.000	0.000	0.000	0.000	0.179	0.337	0.352	0.270	0.389	0.410	**2.874**
1978	0.536	0.004	0.471	0.092	0.163	0.000	0.223	0.189	0.345	0.286	0.036	0.383	**2.728**
1979	0.160	0.182	0.058	0.023	0.000	0.078	0.263	0.355	0.353	0.306	0.237	0.149	**2.165**
1980	0.313	0.000	0.190	0.000	0.000	0.000	0.160	0.302	0.353	0.342	0.171	0.354	**2.185**
1981	0.226	0.078	0.329	0.289	0.534	0.314	0.000	0.029	0.353	0.307	0.399	0.419	**3.276**
1982	0.370	0.329	0.500	0.425	0.473	0.138	0.323	0.375	0.257	0.338	0.171	0.525	**4.224**
1983	0.240	0.317	0.455	0.618	0.280	0.000	0.148	0.389	0.328	0.000	0.300	0.384	**3.459**
1984	0.223	0.000	0.778	0.113	0.000	0.000	0.382	0.033	0.128	0.328	0.409	0.280	**2.673**
1985	0.220	0.570	0.353	0.388	0.099	0.165	0.000	0.264	0.297	0.343	0.325	0.457	**3.482**
1986	0.190	0.074	0.326	0.477	0.000	0.167	0.313	0.277	0.203	0.347	0.302	0.000	**2.677**
1987	0.374	0.326	0.000	0.283	0.000	0.000	0.182	0.374	0.027	0.285	0.265	0.213	**2.328**
1988	0.000	0.535	0.372	0.486	0.000	0.338	0.133	0.321	0.166	0.318	0.332	0.494	**3.495**
1989	0.291	0.085	0.162	0.000	0.000	0.000	0.088	0.315	0.332	0.288	0.377	0.513	**2.450**
1990	0.348	0.311	0.062	0.000	0.000	0.000	0.385	0.316	0.154	0.347	0.411	0.399	**2.734**
1991	0.652	0.404	0.708	0.641	0.539	0.243	0.377	0.394	0.295	0.343	0.382	0.507	**5.485**
1992	0.564	0.539	0.110	0.644	0.182	0.000	0.272	0.318	0.298	0.270	0.369	0.487	**4.054**
1993	0.460	0.088	0.000	0.515	0.000	0.346	0.316	0.386	0.353	0.338	0.344	0.506	**3.651**
1994	0.187	0.584	0.249	0.326	0.010	0.000	0.044	0.150	0.350	0.331	0.326	0.509	**3.066**
1995	0.478	0.000	0.000	0.000	0.000	0.118	0.120	0.000	0.218	0.080	0.115	0.491	**1.622**
1996	0.373	0.182	0.446	0.000	0.000	0.000	0.169	0.303	0.352	0.263	0.409	0.080	**2.576**
1997	0.331	0.082	0.497	0.000	0.478	0.447	0.273	0.394	0.341	0.074	0.386	0.259	**3.563**
1998	0.094	0.192	0.000	0.000	0.000	0.000	0.000	0.125	0.276	0.221	0.377	0.475	**1.760**
1999	0.502	0.108	0.043	0.000	0.000	0.000	0.291	0.247	0.207	0.202	0.275	0.404	**2.279**
2000	0.210	0.344	0.095	0.721	0.000	0.074	0.246	0.164	0.322	0.284	0.399	0.458	**3.317**
2001	0.183	0.000	0.113	0.345	0.292	0.448	0.255	0.377	0.137	0.325	0.352	0.402	**3.230**
2002	0.336	0.709	0.469	0.465	0.226	0.319	0.396	0.358	0.091	0.320	0.422	0.375	**4.488**
2003	0.447	0.455	0.686	0.404	0.000	0.000	0.000	0.381	0.292	0.267	0.354	0.454	**3.739**
2004	0.332	0.539	0.093	0.167	0.569	0.148	0.065	0.315	0.292	0.342	0.356	0.404	**3.623**
2005	0.596	0.220	0.167	0.143	0.000	0.000	0.291	0.247	0.207	0.202	0.275	0.404	**2.752**
Average	**0.376**	**0.291**	**0.250**	**0.224**	**0.138**	**0.116**	**0.156**	**0.274**	**0.274**	**0.270**	**0.341**	**0.387**	**3.102**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.140	0.112	0.093	0.084	0.056	0.043	0.060	0.102	0.106	0.101	0.127	0.149	0.098

FIXED AREA IRRIGATION DEMAND TIME SERIES B81C01

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	1.551	1.591	0.517	0.000	0.764	0.918	1.142	1.071	0.434	1.342	1.561	**11.930**
1926	1.704	1.260	1.711	0.000	0.684	1.271	0.817	0.973	1.070	0.639	1.333	1.578	**13.039**
1927	0.181	0.800	1.077	0.077	1.345	1.405	0.517	1.131	1.071	1.051	1.085	1.517	**11.257**
1928	1.485	0.925	1.136	0.260	0.000	0.000	0.775	1.187	0.873	0.906	1.013	1.442	**10.001**
1929	0.863	0.171	0.392	0.340	0.000	0.494	0.000	1.086	1.005	0.942	1.329	1.372	**7.995**
1930	1.724	1.262	0.000	1.064	0.632	0.640	0.103	1.222	0.966	0.354	1.342	1.525	**10.835**
1931	1.009	0.547	1.561	0.661	0.426	0.859	0.342	0.684	0.995	1.086	1.318	1.555	**11.042**
1932	1.316	0.716	0.530	0.000	0.999	1.248	0.833	1.222	1.071	1.086	1.306	1.525	**11.852**
1933	1.531	0.000	0.782	0.000	0.000	0.401	0.560	1.075	0.842	1.086	1.042	1.277	**8.595**
1934	1.203	0.661	0.821	0.928	0.760	1.010	0.830	1.127	1.071	1.086	1.342	1.384	**12.223**
1935	1.498	1.724	1.728	0.395	0.175	0.142	0.743	0.776	0.991	0.874	1.252	1.550	**11.847**
1936	1.140	0.863	1.112	0.602	0.000	0.382	0.876	1.197	1.050	1.063	1.263	1.265	**10.813**
1937	1.395	1.453	0.000	0.000	1.515	1.160	0.000	1.105	1.008	1.065	1.301	0.618	**10.619**
1938	1.178	1.609	0.000	0.511	0.000	0.212	0.812	0.818	0.940	0.650	1.268	1.292	**9.290**
1939	1.656	0.000	0.224	1.235	0.684	0.000	0.000	0.828	0.190	1.086	1.266	0.363	**7.532**
1940	1.304	0.943	0.463	1.049	1.345	0.888	0.521	1.222	1.071	1.050	1.314	1.545	**12.717**
1941	1.413	1.318	1.188	0.466	1.359	0.000	0.810	0.790	0.895	0.822	0.667	1.214	**10.944**
1942	1.161	0.975	0.899	1.351	0.000	0.398	0.000	0.555	1.071	0.377	1.125	1.438	**9.351**
1943	1.646	0.529	1.571	0.828	0.000	1.060	0.800	1.216	0.743	1.086	1.342	1.532	**12.352**
1944	0.381	1.453	1.773	0.610	1.230	1.077	0.277	1.181	1.071	0.967	1.298	1.580	**12.898**
1945	1.066	0.955	0.919	0.000	0.210	1.196	0.674	1.158	0.976	1.006	1.313	1.534	**11.007**
1946	1.550	1.318	1.757	0.281	0.644	0.900	0.367	1.115	0.256	1.010	1.342	1.328	**11.868**
1947	1.601	1.014	0.477	0.352	0.851	0.000	0.554	1.179	1.067	0.995	1.332	1.540	**10.960**
1948	0.692	1.112	1.328	0.000	0.243	0.618	0.490	1.078	0.932	0.824	1.306	1.453	**10.075**
1949	1.640	0.609	0.916	0.185	0.281	1.145	0.000	1.032	1.039	1.075	1.270	1.522	**10.715**
1950	1.719	1.316	0.000	1.012	1.650	0.046	0.228	0.368	1.071	1.061	1.244	1.172	**10.886**
1951	0.408	1.509	1.549	0.275	0.267	1.298	0.531	1.152	0.687	0.986	1.320	1.550	**11.533**
1952	1.024	0.834	0.666	0.617	0.151	0.286	0.000	1.204	1.071	0.695	1.236	1.516	**9.301**
1953	1.402	0.609	0.477	0.000	0.112	0.960	0.000	0.931	1.035	1.086	1.018	1.488	**9.118**
1954	1.537	1.192	0.166	0.000	0.000	0.291	0.556	1.161	0.677	0.993	1.281	1.475	**9.328**
1955	1.216	0.428	0.000	1.263	0.000	0.000	0.682	0.742	1.050	0.995	1.334	0.995	**8.705**
1956	1.316	1.095	1.025	0.000	0.000	0.571	0.066	0.633	0.839	0.785	1.080	1.197	**8.605**
1957	0.703	1.105	0.120	0.000	0.000	1.321	0.342	1.191	1.015	1.083	1.283	0.842	**9.004**
1958	1.083	1.230	0.000	0.000	0.294	0.952	0.884	1.070	1.042	0.884	1.329	1.479	**10.248**
1959	1.341	1.191	0.209	1.252	0.000	0.773	0.000	1.098	0.595	1.064	1.332	1.462	**10.316**
1960	1.406	0.000	0.000	0.771	0.000	0.354	0.245	1.199	0.334	0.952	1.120	1.538	**7.919**
1961	1.560	1.162	1.176	0.276	0.653	0.712	0.019	1.025	1.071	1.066	1.342	1.472	**11.534**
1962	1.648	0.027	0.298	1.205	1.185	0.736	0.218	0.613	0.524	1.035	1.342	1.527	**10.359**
1963	1.197	1.606	0.837	0.270	0.289	1.529	0.681	1.164	1.060	1.086	1.247	1.563	**12.527**
1964	0.657	0.372	0.427	0.558	0.791	1.227	0.366	1.214	0.899	1.086	1.271	1.350	**10.218**
1965	1.531	0.854	1.049	0.243	0.000	1.313	0.686	1.178	0.967	1.083	1.251	1.161	**11.317**
1966	1.067	1.267	0.648	0.160	0.000	0.311	0.000	1.203	0.972	0.962	1.313	1.547	**9.450**
1967	1.238	0.000	1.259	1.590	0.705	1.140	0.124	0.582	0.891	1.036	1.275	1.555	**11.396**
1968	1.257	0.000	0.499	0.800	1.195	0.000	0.439	1.124	0.990	1.071	1.330	1.272	**9.976**
1969	0.447	1.199	0.748	1.667	0.529	1.334	0.848	1.043	0.856	0.985	1.332	1.545	**12.531**
1970	0.928	0.580	0.050	0.000	0.791	1.162	0.029	0.970	0.967	1.086	1.337	1.347	**9.248**
1971	0.631	0.508	0.561	0.000	0.000	0.000	0.670	0.768	1.057	1.059	1.279	1.526	**8.060**
1972	0.432	1.057	1.194	1.147	0.977	0.588	0.116	1.065	0.991	0.869	1.324	0.640	**10.401**
1973	0.026	1.163	0.000	0.000	0.000	0.000	0.112	0.873	1.053	0.878	1.263	0.801	**6.168**
1974	1.666	0.000	0.534	0.362	0.000	0.600	0.252	0.827	0.987	1.086	1.278	1.562	**9.154**
1975	1.454	1.214	0.000	0.000	0.000	0.000	0.000	0.152	0.946	1.086	1.318	1.519	**7.689**
1976	1.242	0.389	1.105	0.000	0.000	0.000	0.787	1.204	1.066	1.083	1.111	0.507	**8.494**
1977	1.093	1.259	0.042	0.000	0.000	0.707	0.564	1.141	1.038	0.840	1.315	1.494	**9.493**
1978	1.309	0.220	1.371	0.831	0.423	0.075	0.421	1.010	1.023	1.049	0.931	1.480	**10.143**
1979	0.999	0.774	0.686	0.568	0.000	0.704	0.507	1.172	1.071	1.021	1.204	1.029	**9.736**
1980	1.140	0.000	1.145	0.000	0.000	0.000	0.842	0.741	1.071	1.036	1.226	1.247	**8.448**
1981	1.138	0.171	1.096	0.810	0.262	1.667	0.472	0.525	1.071	1.058	1.327	1.554	**11.151**
1982	1.270	1.428	1.274	0.723	1.587	0.696	0.894	1.074	0.973	1.008	0.936	1.578	**13.442**
1983	1.357	0.755	1.507	1.406	1.192	0.466	0.404	1.222	1.049	0.099	1.195	1.128	**11.778**
1984	0.631	0.643	1.578	0.244	0.081	0.068	0.899	0.628	0.953	1.032	1.327	0.118	**8.202**
1985	0.906	1.608	0.466	1.364	0.318	1.424	0.000	1.156	1.065	1.086	1.139	1.401	**11.932**
1986	0.886	0.051	0.387	0.993	0.446	1.163	0.658	1.032	1.004	1.086	1.245	1.041	**9.992**
1987	1.134	1.031	0.000	0.709	0.000	0.318	0.514	1.166	0.447	1.086	0.867	1.297	**8.568**
1988	0.000	1.366	1.279	1.862	0.255	1.368	0.759	1.164	0.700	1.060	1.332	1.546	**12.691**
1989	0.746	0.210	0.231	0.175	0.643	0.613	0.561	1.210	1.071	1.064	1.335	1.579	**9.438**
1990	1.188	0.597	0.763	0.000	0.253	0.000	0.940	1.036	0.852	1.086	1.342	1.580	**9.639**
1991	1.724	0.886	1.140	0.999	0.752	0.476	0.883	1.222	0.697	1.086	0.994	1.580	**12.439**
1992	1.608	0.961	0.000	1.366	0.000	0.806	0.876	1.166	0.945	0.958	1.282	1.580	**11.549**
1993	1.263	0.096	0.840	0.628	0.998	1.352	0.694	1.207	1.071	1.086	1.267	1.534	**12.036**
1994	1.462	1.103	1.010	1.061	0.000	0.514	0.101	0.619	1.050	1.083	1.237	1.538	**10.776**
1995	1.240	0.601	1.200	0.000	0.000	1.278	0.344	0.611	0.965	0.460	1.161	1.477	**9.336**
1996	1.357	0.645	1.057	0.212	0.325	0.261	0.727	1.095	1.071	1.032	1.342	0.858	**9.982**
1997	1.056	0.739	1.531	0.006	1.215	1.218	0.714	1.222	1.071	0.944	1.202	1.449	**12.367**
1998	0.929	0.974	0.017	0.000	0.000	0.000	0.587	1.068	0.953	0.687	1.333	1.576	**8.123**
1999	1.167	0.431	0.017	0.000	0.588	0.000	0.189	1.050	1.009	1.086	1.342	1.492	**8.371**
2000	1.147	0.588	0.833	1.616	0.000	0.461	0.216	1.028	1.022	0.989	1.337	1.433	**10.671**
2001	1.463	0.000	0.000	0.790	1.547	1.481	0.686	1.023	0.610	1.086	1.268	1.462	**11.417**
2002	1.067	1.530	1.274	1.221	0.904	0.441	0.861	1.181	0.903	1.082	1.326	1.404	**13.193**
2003	0.944	1.524	0.000	0.723	0.423	0.000	0.884	1.222	0.896	1.032	1.237	1.493	**10.378**
2004	1.320	1.498	0.453	1.269	1.260	1.300	0.810	1.182	1.038	1.045	1.104	1.580	**13.859**
2005	1.682	0.601	0.482	0.623	0.355	0.380	0.717	0.987	0.840	0.855	1.104	1.341	**9.966**
Average	**1.159**	**0.839**	**0.744**	**0.560**	**0.454**	**0.667**	**0.484**	**1.012**	**0.933**	**0.962**	**1.241**	**1.358**	**10.424**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.433	0.324	0.278	0.209	0.186	0.249	0.187	0.378	0.360	0.359	0.463	0.524	0.330

FIXED AREA IRRIGATION DEMAND TIME SERIES B81C10

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	2.407	2.714	1.093	0.000	0.827	1.621	1.367	1.277	0.325	1.548	1.872	**16.360**
1926	2.290	1.978	2.892	0.210	1.057	1.569	1.463	1.117	1.275	0.625	1.535	1.898	**17.909**
1927	0.077	1.308	1.961	0.482	2.026	1.767	1.000	1.352	1.277	1.234	1.170	1.807	**15.460**
1928	1.965	1.489	2.048	0.733	0.000	0.000	1.397	1.434	0.983	1.019	1.064	1.695	**13.827**
1929	1.051	0.417	0.987	0.845	0.000	0.439	0.000	1.285	1.179	1.071	1.528	1.592	**10.394**
1930	2.322	1.981	0.000	1.877	0.983	0.649	0.375	1.487	1.121	0.208	1.548	1.819	**14.369**
1931	1.264	0.946	2.670	1.297	0.688	0.964	0.733	0.691	1.164	1.285	1.513	1.863	**15.078**
1932	1.715	1.188	1.181	0.000	1.516	1.535	1.487	1.487	1.277	1.285	1.494	1.818	**15.983**
1933	2.033	0.000	1.538	0.121	0.000	0.305	1.065	1.268	0.937	1.285	1.107	1.450	**11.110**
1934	1.548	1.108	1.594	1.680	1.168	1.185	1.483	1.345	1.277	1.285	1.548	1.609	**16.830**
1935	1.984	2.665	2.917	0.922	0.331	0.000	1.347	0.827	1.158	0.971	1.416	1.856	**16.394**
1936	1.455	1.399	2.012	1.214	0.000	0.278	1.554	1.449	1.245	1.252	1.432	1.432	**14.723**
1937	1.831	2.262	0.113	0.000	2.278	1.405	0.000	1.314	1.183	1.254	1.487	0.484	**13.610**
1938	1.512	2.493	0.101	1.084	0.000	0.039	1.455	0.888	1.083	0.641	1.439	1.472	**12.208**
1939	2.220	0.000	0.754	2.127	1.057	0.000	0.000	0.904	0.000	1.285	1.436	0.117	**9.901**
1940	1.697	1.514	1.086	1.856	2.026	1.008	1.006	1.487	1.277	1.232	1.507	1.849	**17.546**
1941	1.858	2.064	2.124	1.022	2.047	0.000	1.452	0.847	1.016	0.894	0.561	1.357	**15.241**
1942	1.487	1.561	1.705	2.297	0.025	0.302	0.000	0.503	1.277	0.241	1.229	1.690	**12.317**
1943	2.204	0.921	2.684	1.536	0.000	1.258	1.436	1.477	0.792	1.285	1.548	1.830	**16.970**
1944	0.360	2.262	2.984	1.225	1.856	1.283	0.634	1.426	1.277	1.108	1.483	1.901	**17.799**
1945	1.348	1.532	1.734	0.000	0.381	1.459	1.240	1.392	1.136	1.167	1.505	1.833	**14.724**
1946	2.062	2.062	2.960	0.762	1.000	1.025	0.772	1.328	0.077	1.172	1.548	1.525	**16.293**
1947	2.137	1.617	1.105	0.862	1.299	0.000	1.055	1.422	1.270	1.151	1.532	1.841	**15.295**
1948	0.803	1.761	2.327	0.000	0.428	0.617	0.957	1.274	1.070	0.897	1.495	1.711	**13.340**
1949	2.195	1.034	1.730	0.630	0.482	1.383	0.000	1.205	1.229	1.269	1.441	1.815	**14.414**
1950	2.314	2.060	0.385	1.801	2.479	0.000	0.561	0.230	1.277	1.248	1.404	1.294	**15.054**
1951	0.398	2.346	2.651	0.755	0.462	1.609	1.021	1.383	0.709	1.137	1.516	1.857	**15.842**
1952	1.285	1.357	1.373	1.235	0.298	0.142	0.000	1.460	1.277	0.708	1.392	1.806	**12.333**
1953	1.842	1.034	1.106	0.000	0.244	1.112	0.068	1.055	1.223	1.285	1.072	1.763	**11.804**
1954	2.042	1.878	0.675	0.000	0.000	0.150	1.059	1.396	0.693	1.147	1.458	1.745	**12.243**
1955	1.568	0.776	0.157	2.167	0.000	0.000	1.253	0.777	1.246	1.150	1.536	1.034	**11.664**
1956	1.714	1.736	1.887	0.209	0.000	0.549	0.320	0.616	0.933	0.840	1.163	1.332	**11.296**
1957	0.819	1.751	0.612	0.479	0.073	1.642	0.733	1.440	1.193	1.280	1.462	0.810	**12.295**
1958	1.372	1.934	0.000	0.000	0.500	1.100	1.567	1.260	1.234	0.986	1.529	1.751	**13.234**
1959	1.751	1.876	0.734	2.152	0.000	0.840	0.000	1.302	0.573	1.252	1.533	1.725	**13.739**
1960	1.847	0.169	0.000	1.454	0.000	0.240	0.587	1.452	0.191	1.087	1.222	1.838	**10.087**
1961	2.076	1.835	2.105	0.756	1.013	0.752	0.251	1.194	1.277	1.255	1.548	1.739	**15.802**
1962	2.208	0.217	0.856	2.083	1.790	0.786	0.546	0.588	0.470	1.210	1.548	1.822	**14.124**
1963	1.539	2.489	1.616	0.748	0.492	1.952	1.251	1.400	1.260	1.285	1.408	1.875	**17.315**
1964	0.753	0.698	1.037	1.151	1.212	1.503	0.770	1.475	1.021	1.285	1.444	1.558	**13.908**
1965	2.033	1.386	1.922	0.711	0.000	1.632	1.259	1.422	1.122	1.280	1.414	1.279	**15.458**
1966	1.348	1.989	1.347	0.596	0.000	0.179	0.159	1.458	1.129	1.101	1.505	1.851	**12.662**
1967	1.600	0.118	2.227	2.649	1.088	1.377	0.406	0.542	1.010	1.211	1.449	1.863	**15.541**
1968	1.628	0.060	1.136	1.496	1.804	0.000	0.880	1.341	1.157	1.262	1.531	1.442	**13.736**
1969	0.452	1.888	1.489	2.762	0.834	1.662	1.510	1.221	0.958	1.135	1.533	1.849	**17.294**
1970	1.145	0.993	0.517	0.000	1.213	1.409	0.265	1.113	1.122	1.285	1.540	1.554	**12.157**
1971	0.716	0.890	1.224	0.000	0.000	0.000	1.235	0.815	1.256	1.245	1.456	1.821	**10.657**
1972	0.431	1.681	2.131	1.997	1.484	0.574	0.394	1.254	1.159	0.963	1.521	0.516	**14.106**
1973	0.000	1.835	0.000	0.000	0.000	0.000	0.388	0.969	1.249	0.977	1.431	0.750	**7.600**
1974	2.234	0.000	1.186	0.876	0.000	0.590	0.598	0.901	1.152	1.285	1.453	1.874	**12.151**
1975	1.918	1.911	0.000	0.000	0.000	0.000	0.093	0.000	1.091	1.285	1.512	1.811	**9.621**
1976	1.605	0.721	2.002	0.000	0.000	0.000	1.416	1.460	1.269	1.281	1.208	0.324	**11.287**
1977	1.386	1.976	0.507	0.000	0.000	0.745	1.071	1.367	1.228	0.921	1.508	1.772	**12.481**
1978	1.705	0.485	2.391	1.541	0.683	0.000	0.853	1.172	1.206	1.230	0.945	1.751	**13.961**
1979	1.250	1.270	1.402	1.165	0.000	0.741	0.983	1.413	1.277	1.188	1.345	1.083	**13.117**
1980	1.455	0.000	2.060	0.000	0.000	0.000	1.502	0.775	1.277	1.210	1.377	1.406	**11.063**
1981	1.452	0.416	1.990	1.511	0.454	2.158	0.931	0.459	1.277	1.243	1.526	1.862	**15.279**
1982	1.646	2.225	2.248	1.386	2.385	0.729	1.583	1.268	1.131	1.170	0.952	1.898	**18.623**
1983	1.775	1.243	2.590	2.377	1.799	0.399	0.828	1.487	1.243	0.000	1.331	1.229	**16.300**
1984	0.716	1.083	2.695	0.711	0.201	0.000	1.591	0.609	1.102	1.205	1.525	0.000	**11.437**
1985	1.113	2.491	1.091	2.316	0.534	1.795	0.000	1.388	1.267	1.285	1.250	1.633	**16.164**
1986	1.084	0.251	0.980	1.774	0.716	1.411	1.215	1.205	1.177	1.285	1.405	1.101	**13.604**
1987	1.447	1.643	0.000	1.365	0.000	0.188	0.994	1.403	0.357	1.285	0.851	1.479	**11.012**
1988	0.000	2.133	2.256	3.053	0.445	1.713	1.373	1.400	0.728	1.246	1.532	1.850	**17.730**
1989	0.881	0.470	0.764	0.617	0.999	0.610	1.067	1.470	1.277	1.253	1.537	1.899	**12.843**
1990	1.527	1.017	1.511	0.000	0.442	0.000	1.655	1.211	0.953	1.285	1.548	1.901	**13.050**
1991	2.321	1.432	2.053	1.783	1.156	0.413	1.565	1.487	0.723	1.285	1.037	1.901	**17.157**
1992	2.149	1.541	0.221	2.318	0.000	0.888	1.554	1.404	1.090	1.096	1.460	1.901	**15.621**
1993	1.637	0.313	1.620	1.251	1.514	1.689	1.272	1.464	1.277	1.285	1.437	1.832	**16.592**
1994	1.931	1.748	1.865	1.873	0.000	0.467	0.372	0.596	1.245	1.281	1.393	1.838	**14.607**
1995	1.602	1.023	2.141	0.000	0.000	1.580	0.736	0.584	1.119	0.363	1.281	1.748	**12.176**
1996	1.775	1.086	1.933	0.667	0.544	0.108	1.323	1.299	1.277	1.206	1.548	0.832	**13.595**
1997	1.332	1.221	2.625	0.385	1.833	1.491	1.302	1.487	1.277	1.074	1.342	1.706	**17.075**
1998	1.147	1.559	0.473	0.000	0.066	0.000	1.107	1.258	1.101	0.696	1.534	1.896	**10.836**
1999	1.495	0.781	0.472	0.000	4.186	0.000	0.504	1.231	1.185	1.285	1.548	1.770	**14.457**
2000	1.465	1.004	1.611	2.688	0.000	0.392	0.544	1.199	1.205	1.142	1.541	1.681	**14.471**
2001	1.933	0.000	0.000	1.482	2.326	1.880	1.260	1.192	0.595	1.285	1.438	1.725	**15.116**
2002	1.349	2.376	2.249	2.106	1.377	0.363	1.530	1.425	1.027	1.279	1.525	1.638	**18.244**
2003	1.169	2.367	0.102	1.386	0.683	0.000	1.567	1.487	1.018	1.205	1.393	1.772	**14.147**
2004	1.721	2.329	1.072	2.176	1.900	1.611	1.451	1.427	1.227	1.225	1.197	1.901	**19.239**
2005	2.258	1.023	1.113	1.243	0.586	0.276	1.307	1.138	0.935	0.943	1.197	1.545	**13.564**
Average	**1.494**	**1.359**	**1.436**	**1.076**	**0.746**	**0.750**	**0.928**	**1.178**	**1.073**	**1.103**	**1.400**	**1.575**	**14.132**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.558	0.524	0.536	0.402	0.306	0.280	0.358	0.440	0.414	0.412	0.523	0.608	0.448

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81C15**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	1.095	1.168	0.341	0.000	0.448	0.750	0.742	0.676	0.181	0.822	1.018	**7.904**
1926	1.167	0.875	1.259	0.000	0.431	0.830	0.671	0.614	0.675	0.335	0.816	1.031	**8.703**
1927	0.024	0.529	0.780	0.021	0.930	0.932	0.438	0.734	0.676	0.646	0.629	0.984	**7.323**
1928	1.000	0.623	0.825	0.153	0.000	0.000	0.638	0.776	0.526	0.536	0.575	0.927	**6.579**
1929	0.530	0.065	0.273	0.212	0.000	0.247	0.000	0.700	0.626	0.563	0.813	0.874	**4.902**
1930	1.183	0.876	0.000	0.748	0.392	0.355	0.121	0.803	0.597	0.121	0.822	0.990	**7.010**
1931	0.640	0.341	1.145	0.448	0.239	0.519	0.303	0.395	0.619	0.672	0.805	1.013	**7.138**
1932	0.872	0.467	0.375	0.000	0.668	0.813	0.683	0.803	0.676	0.672	0.795	0.990	**7.813**
1933	1.035	0.000	0.560	0.000	0.000	0.177	0.471	0.691	0.503	0.672	0.597	0.801	**5.508**
1934	0.786	0.425	0.590	0.647	0.488	0.633	0.681	0.731	0.676	0.672	0.822	0.883	**8.033**
1935	1.010	1.228	1.272	0.252	0.054	0.000	0.613	0.465	0.616	0.512	0.755	1.009	**7.784**
1936	0.738	0.576	0.807	0.404	0.000	0.163	0.716	0.784	0.660	0.655	0.763	0.792	**7.059**
1937	0.931	1.021	0.000	0.000	1.059	0.746	0.000	0.715	0.628	0.656	0.791	0.304	**6.851**
1938	0.767	1.140	0.000	0.337	0.000	0.039	0.667	0.496	0.577	0.343	0.767	0.813	**5.945**
1939	1.131	0.000	0.151	0.877	0.431	0.000	0.000	0.505	0.012	0.672	0.765	0.113	**4.657**
1940	0.862	0.636	0.325	0.738	0.930	0.541	0.441	0.803	0.676	0.645	0.802	1.006	**8.405**
1941	0.945	0.919	0.864	0.304	0.941	0.000	0.665	0.475	0.543	0.473	0.317	0.754	**7.200**
1942	0.754	0.660	0.648	0.965	0.000	0.176	0.000	0.298	0.676	0.138	0.659	0.924	**5.898**
1943	1.122	0.328	1.153	0.572	0.000	0.670	0.657	0.798	0.428	0.672	0.822	0.996	**8.219**
1944	0.171	1.021	1.307	0.410	0.843	0.683	0.253	0.772	0.676	0.582	0.789	1.032	**8.539**
1945	0.683	0.645	0.662	0.000	0.079	0.773	0.559	0.755	0.604	0.612	0.800	0.997	**7.170**
1946	1.050	0.918	1.294	0.168	0.401	0.550	0.323	0.722	0.061	0.615	0.822	0.840	**7.765**
1947	1.088	0.689	0.335	0.221	0.556	0.000	0.466	0.770	0.673	0.604	0.815	1.002	**7.219**
1948	0.401	0.763	0.969	0.000	0.104	0.339	0.417	0.694	0.571	0.474	0.796	0.935	**6.462**
1949	1.118	0.387	0.660	0.099	0.132	0.735	0.000	0.659	0.652	0.664	0.768	0.988	**6.862**
1950	1.179	0.917	0.000	0.709	1.162	0.000	0.216	0.158	0.676	0.653	0.749	0.721	**7.141**
1951	0.191	1.064	1.136	0.164	0.122	0.851	0.448	0.750	0.386	0.596	0.806	1.010	**7.524**
1952	0.650	0.555	0.475	0.415	0.036	0.092	0.000	0.790	0.676	0.377	0.743	0.984	**5.793**
1953	0.937	0.387	0.336	0.000	0.008	0.595	0.000	0.582	0.649	0.672	0.579	0.962	**5.706**
1954	1.040	0.824	0.109	0.000	0.000	0.096	0.468	0.757	0.378	0.602	0.776	0.952	**6.001**
1955	0.796	0.253	0.000	0.898	0.000	0.000	0.565	0.439	0.660	0.603	0.817	0.587	**5.619**
1956	0.871	0.750	0.742	0.000	0.000	0.304	0.093	0.357	0.500	0.445	0.626	0.740	**5.427**
1957	0.410	0.758	0.076	0.000	0.000	0.868	0.303	0.779	0.633	0.670	0.778	0.472	**5.748**
1958	0.695	0.852	0.000	0.000	0.142	0.589	0.723	0.687	0.654	0.520	0.813	0.955	**6.631**
1959	0.890	0.822	0.140	0.890	0.000	0.455	0.000	0.709	0.316	0.655	0.815	0.942	**6.635**
1960	0.940	0.000	0.000	0.529	0.000	0.143	0.229	0.785	0.120	0.571	0.656	1.000	**4.973**
1961	1.057	0.801	0.854	0.165	0.408	0.409	0.057	0.653	0.676	0.657	0.822	0.950	**7.511**
1962	1.125	0.000	0.204	0.855	0.809	0.427	0.208	0.342	0.263	0.634	0.822	0.992	**6.681**
1963	0.781	1.138	0.601	0.161	0.137	1.027	0.564	0.759	0.668	0.672	0.751	1.019	**8.278**
1964	0.376	0.212	0.299	0.372	0.511	0.797	0.322	0.797	0.546	0.672	0.769	0.857	**6.529**
1965	1.035	0.570	0.760	0.141	0.000	0.862	0.568	0.770	0.597	0.670	0.754	0.713	**7.440**
1966	0.683	0.880	0.461	0.081	0.000	0.111	0.011	0.789	0.601	0.578	0.800	1.007	**6.003**
1967	0.813	0.000	0.917	1.146	0.447	0.731	0.137	0.318	0.540	0.634	0.772	1.013	**7.469**
1968	0.827	0.000	0.351	0.551	0.816	0.000	0.377	0.728	0.615	0.661	0.814	0.797	**6.537**
1969	0.219	0.829	0.535	1.204	0.315	0.878	0.694	0.667	0.513	0.596	0.815	1.006	**8.272**
1970	0.578	0.366	0.026	0.000	0.512	0.748	0.065	0.612	0.597	0.672	0.819	0.854	**5.848**
1971	0.356	0.312	0.397	0.000	0.000	0.000	0.556	0.459	0.666	0.652	0.775	0.991	**5.164**
1972	0.208	0.722	0.868	0.810	0.651	0.317	0.130	0.684	0.616	0.508	0.809	0.320	**6.645**
1973	0.000	0.801	0.000	0.000	0.000	0.000	0.127	0.538	0.662	0.515	0.763	0.441	**3.848**
1974	1.138	0.000	0.377	0.228	0.000	0.325	0.235	0.503	0.613	0.672	0.774	1.018	**5.884**
1975	0.976	0.840	0.000	0.000	0.000	0.000	0.000	0.000	0.581	0.672	0.804	0.986	**4.860**
1976	0.815	0.224	0.801	0.000	0.000	0.000	0.647	0.790	0.672	0.670	0.649	0.221	**5.489**
1977	0.703	0.874	0.020	0.000	0.000	0.406	0.474	0.742	0.651	0.486	0.802	0.966	**6.124**
1978	0.866	0.100	1.002	0.575	0.237	0.000	0.364	0.642	0.640	0.644	0.514	0.956	**6.539**
1979	0.632	0.510	0.490	0.379	0.000	0.403	0.430	0.765	0.676	0.623	0.719	0.613	**6.239**
1980	0.738	0.000	0.831	0.000	0.000	0.000	0.690	0.438	0.676	0.634	0.735	0.779	**5.522**
1981	0.737	0.064	0.795	0.559	0.118	1.132	0.403	0.276	0.676	0.651	0.811	1.012	**7.234**
1982	0.836	1.002	0.928	0.494	1.114	0.397	0.731	0.691	0.602	0.614	0.518	1.031	**8.958**
1983	0.902	0.495	1.104	1.006	0.814	0.226	0.351	0.803	0.659	0.000	0.712	0.688	**7.760**
1984	0.356	0.412	1.158	0.141	0.000	0.000	0.735	0.353	0.587	0.631	0.811	0.000	**5.185**
1985	0.562	1.139	0.328	0.974	0.159	0.946	0.000	0.753	0.671	0.672	0.670	0.895	**7.770**
1986	0.547	0.000	0.269	0.695	0.254	0.749	0.546	0.659	0.626	0.672	0.750	0.622	**6.388**
1987	0.734	0.702	0.000	0.483	0.000	0.116	0.435	0.760	0.205	0.672	0.466	0.816	**5.390**
1988	0.000	0.955	0.932	1.353	0.113	0.904	0.626	0.759	0.395	0.652	0.815	1.006	**8.510**
1989	0.442	0.093	0.156	0.092	0.401	0.335	0.472	0.794	0.676	0.656	0.817	1.031	**5.965**
1990	0.775	0.378	0.547	0.000	0.111	0.000	0.767	0.662	0.511	0.672	0.822	1.032	**6.278**
1991	1.182	0.593	0.828	0.700	0.482	0.233	0.722	0.803	0.393	0.672	0.561	1.032	**8.202**
1992	1.094	0.649	0.000	0.976	0.000	0.480	0.717	0.761	0.581	0.576	0.777	1.032	**7.642**
1993	0.831	0.010	0.603	0.424	0.667	0.892	0.575	0.792	0.676	0.672	0.766	0.997	**7.906**
1994	0.982	0.756	0.730	0.746	0.000	0.261	0.119	0.346	0.660	0.670	0.743	1.000	**7.015**
1995	0.813	0.381	0.873	0.000	0.000	0.836	0.304	0.340	0.596	0.200	0.686	0.954	**5.984**
1996	0.902	0.414	0.765	0.118	0.164	0.074	0.600	0.707	0.676	0.632	0.822	0.484	**6.359**
1997	0.675	0.484	1.122	0.000	0.831	0.790	0.590	0.803	0.676	0.565	0.717	0.932	**8.186**
1998	0.579	0.659	0.002	0.000	0.000	0.000	0.492	0.686	0.586	0.371	0.815	1.029	**5.221**
1999	0.758	0.255	0.002	0.000	1.473	0.000	0.187	0.672	0.629	0.672	0.822	0.965	**6.437**
2000	0.743	0.371	0.598	1.166	0.000	0.222	0.207	0.656	0.639	0.599	0.819	0.920	**6.941**
2001	0.983	0.000	0.000	0.544	1.084	0.990	0.569	0.652	0.328	0.672	0.767	0.942	**7.530**
2002	0.683	1.080	0.929	0.867	0.596	0.207	0.705	0.772	0.549	0.669	0.811	0.898	**8.764**
2003	0.590	1.075	0.000	0.494	0.237	0.000	0.723	0.803	0.544	0.631	0.744	0.966	**6.807**
2004	0.875	1.056	0.318	0.902	0.865	0.852	0.665	0.773	0.651	0.641	0.643	1.032	**9.274**
2005	1.150	0.381	0.339	0.420	0.186	0.162	0.593	0.625	0.502	0.498	0.643	0.850	**6.348**
Average	**0.759**	**0.568**	**0.538**	**0.387**	**0.304**	**0.403**	**0.408**	**0.644**	**0.572**	**0.579**	**0.747**	**0.864**	**6.779**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.283	0.219	0.201	0.144	0.125	0.150	0.157	0.241	0.221	0.216	0.279	0.333	0.215

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81E01**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	4.663	4.857	2.343	0.000	2.428	2.719	3.356	3.087	1.581	3.725	4.163	**36.175**
1926	4.798	3.986	5.137	0.751	2.433	3.622	2.484	2.964	3.084	2.059	3.704	4.202	**39.225**
1927	1.192	2.896	3.646	1.258	3.989	3.934	1.787	3.332	3.087	3.016	3.134	4.062	**35.332**
1928	4.293	3.195	3.788	1.713	0.000	0.000	2.386	3.460	2.627	2.680	2.966	3.889	**30.999**
1929	2.835	1.371	1.991	1.912	0.553	1.783	0.000	3.227	2.934	2.763	3.695	3.728	**26.793**
1930	4.846	3.990	0.000	3.657	2.310	2.134	0.815	3.542	2.844	1.393	3.725	4.080	**33.335**
1931	3.181	2.289	4.787	2.692	1.816	2.653	1.376	2.289	2.910	3.096	3.671	4.149	**34.909**
1932	3.901	2.697	2.331	0.000	3.179	3.568	2.520	3.542	3.087	3.096	3.641	4.080	**35.642**
1933	4.399	0.000	2.941	0.580	0.583	1.558	1.886	3.201	2.556	3.096	3.034	3.507	**27.341**
1934	2.007	0.878	4.451	5.465	3.020	4.482	2.779	2.772	3.087	3.096	3.725	3.527	**39.288**
1935	3.860	5.228	3.761	0.000	0.000	0.000	2.508	2.666	3.087	2.533	3.725	2.289	**29.657**
1936	4.887	3.182	4.208	0.712	0.000	1.779	2.070	3.542	3.087	3.096	3.725	3.779	**34.068**
1937	4.083	4.435	0.359	0.000	4.383	3.362	0.000	3.272	2.940	3.047	3.630	1.959	**31.471**
1938	3.578	4.798	0.336	2.329	0.000	1.101	2.473	2.603	2.784	2.085	3.555	3.541	**29.183**
1939	2.300	4.928	0.000	5.438	3.393	0.000	1.890	1.386	0.519	3.096	3.725	3.372	**30.047**
1940	3.236	1.208	1.342	3.085	4.764	1.704	0.000	3.084	2.638	2.647	3.264	3.744	**30.717**
1941	3.466	5.340	0.000	3.005	4.764	0.000	2.779	3.542	3.087	3.096	3.725	4.208	**37.012**
1942	4.887	4.128	3.310	5.722	1.649	0.000	0.000	2.221	3.087	0.486	3.725	4.208	**33.422**
1943	4.887	4.065	5.851	2.558	0.000	4.213	2.779	3.542	2.684	3.096	3.725	4.208	**41.609**
1944	2.416	5.340	5.348	2.419	0.959	4.629	1.845	3.084	2.638	2.647	3.264	3.744	**38.332**
1945	2.912	3.365	5.235	0.000	0.023	1.008	2.190	3.498	3.022	2.890	3.725	4.208	**32.076**
1946	2.486	2.132	2.180	1.885	2.544	0.180	2.694	2.717	2.310	2.885	3.725	4.208	**29.946**
1947	3.733	4.538	2.077	2.104	3.093	0.000	2.470	3.542	3.087	2.933	3.725	3.893	**35.196**
1948	1.134	1.891	4.538	0.000	3.265	4.244	1.609	3.188	2.846	2.491	3.535	4.047	**32.789**
1949	4.572	2.280	0.023	3.933	1.831	2.583	0.622	2.624	2.966	3.096	3.703	4.208	**32.441**
1950	4.539	2.759	1.820	4.896	4.764	1.531	0.090	2.501	3.087	3.079	2.979	3.476	**35.521**
1951	1.601	4.295	4.756	2.418	2.765	1.638	1.622	3.495	2.489	2.584	3.692	4.177	**35.531**
1952	2.996	3.795	0.306	0.957	0.177	2.223	0.242	3.531	3.087	2.948	3.725	4.116	**28.102**
1953	4.463	1.269	4.576	1.707	1.380	3.981	0.000	3.146	2.985	3.096	3.333	3.878	**33.814**
1954	2.968	0.000	0.946	2.118	0.103	1.415	1.854	2.653	2.999	3.085	3.725	4.208	**26.074**
1955	3.171	1.470	2.317	5.205	0.000	2.812	2.379	2.871	3.046	2.874	3.447	2.096	**31.688**
1956	4.596	4.554	1.968	1.200	0.000	2.486	2.124	3.098	2.792	2.545	3.490	3.067	**31.919**
1957	2.050	4.040	2.945	0.000	2.594	4.524	1.262	3.542	2.914	2.992	3.725	3.597	**34.184**
1958	4.205	3.264	2.068	0.000	0.490	3.064	2.403	3.535	3.087	2.627	3.725	4.101	**32.569**
1959	4.650	3.533	2.113	4.434	0.000	3.457	0.000	1.207	2.811	2.956	3.692	4.198	**33.051**
1960	4.750	1.256	0.000	4.061	0.000	0.997	1.291	3.231	1.870	3.028	3.664	3.197	**27.346**
1961	3.819	4.088	2.790	2.287	2.988	1.248	0.115	3.542	3.002	3.096	3.461	3.906	**34.341**
1962	4.257	1.011	2.582	5.542	4.214	3.395	2.008	3.107	1.185	2.452	3.620	4.189	**37.561**
1963	3.709	3.851	2.602	3.380	4.445	4.313	2.175	3.162	3.084	3.096	3.699	3.996	**41.510**
1964	2.163	2.937	0.831	2.484	2.313	3.592	2.397	3.537	3.084	3.096	3.725	3.303	**33.462**
1965	4.609	3.772	4.805	0.000	0.000	4.597	2.475	3.382	2.661	3.096	3.135	4.073	**36.605**
1966	2.848	3.894	2.412	0.000	0.000	2.646	0.752	3.510	3.078	2.392	3.725	4.201	**29.458**
1967	3.643	3.268	3.004	3.513	2.352	4.531	1.820	2.705	2.240	3.087	3.683	4.194	**38.041**
1968	3.871	2.016	0.134	1.454	2.693	0.000	1.812	3.542	3.087	2.893	3.725	3.685	**28.911**
1969	0.793	3.750	2.920	5.596	3.321	4.281	2.397	3.461	2.972	2.691	3.725	4.195	**40.102**
1970	3.996	4.436	1.176	0.083	4.505	3.022	1.538	3.198	2.338	3.096	3.723	3.635	**34.746**
1971	2.688	2.588	1.585	0.000	0.000	0.000	2.256	2.424	3.087	3.008	3.617	4.146	**25.399**
1972	2.585	3.366	4.345	3.523	3.306	1.148	0.978	3.152	3.087	2.911	3.725	0.000	**32.126**
1973	2.740	3.030	2.411	2.785	0.000	1.713	1.131	2.917	3.087	1.217	3.539	2.116	**26.688**
1974	4.571	2.508	3.021	0.000	0.556	4.421	0.775	2.842	2.842	3.096	3.725	4.201	**32.559**
1975	4.825	3.685	0.000	0.000	0.000	0.336	1.702	1.804	3.070	3.096	3.725	4.192	**26.434**
1976	3.893	2.761	4.793	0.000	0.000	1.098	2.645	3.353	3.087	3.096	3.610	1.221	**29.556**
1977	4.578	3.536	0.611	0.000	1.399	0.000	0.000	3.504	3.064	3.068	3.717	4.201	**27.678**
1978	2.296	1.125	0.404	2.254	1.801	2.781	1.824	2.692	3.085	2.946	1.130	4.176	**26.514**
1979	2.043	3.516	1.362	1.396	0.000	1.688	1.601	3.460	3.087	3.095	3.608	1.655	**26.510**
1980	3.266	0.000	1.430	0.000	1.014	0.725	2.529	3.333	3.087	3.096	3.402	3.301	**25.182**
1981	2.703	2.419	3.851	4.499	4.118	4.002	1.690	2.802	2.972	3.087	3.725	4.208	**40.075**
1982	4.031	3.561	4.129	3.946	4.754	0.287	2.710	3.294	2.802	3.038	3.347	4.190	**40.088**
1983	3.635	0.732	3.473	2.509	3.925	1.095	1.855	3.542	2.805	0.788	3.525	2.551	**30.435**
1984	0.229	2.143	3.613	0.000	0.209	1.294	2.535	2.098	2.508	2.549	3.723	3.841	**24.742**
1985	1.069	3.295	2.755	4.538	1.867	4.276	0.000	3.517	3.087	3.096	3.515	3.898	**34.913**
1986	3.895	2.511	2.186	3.948	2.558	0.239	2.726	2.858	2.995	3.096	2.290	1.741	**31.044**
1987	2.655	4.331	0.000	3.337	0.000	0.439	2.634	3.498	2.555	3.096	3.357	3.594	**29.495**
1988	1.420	4.528	3.925	4.921	1.180	3.884	2.497	3.167	2.597	3.082	3.725	4.208	**39.133**
1989	1.589	0.000	1.419	2.867	3.782	0.601	1.614	3.542	3.087	2.938	3.703	4.208	**29.349**
1990	2.630	2.931	1.811	2.500	1.019	1.163	2.660	3.377	2.165	3.096	3.725	4.170	**31.247**
1991	4.770	2.809	4.565	3.314	4.286	1.974	2.355	3.542	2.641	3.096	3.634	4.208	**41.196**
1992	4.827	3.601	1.670	4.031	2.760	2.739	2.052	3.473	3.087	2.967	3.672	4.208	**39.086**
1993	3.599	1.862	0.681	2.152	4.625	3.180	1.839	3.468	3.087	3.096	3.725	3.912	**35.225**
1994	2.525	5.042	4.170	1.107	1.494	2.637	0.384	2.467	3.087	3.096	3.576	4.079	**33.664**
1995	3.349	3.158	4.093	0.000	0.000	1.006	2.040	2.292	2.922	1.295	3.584	3.951	**27.690**
1996	3.040	2.357	5.123	0.000	0.000	1.813	1.490	2.873	3.087	3.093	3.645	2.860	**29.381**
1997	3.900	0.511	5.048	2.488	4.616	4.401	2.219	3.542	3.087	2.988	3.609	3.947	**40.355**
1998	2.869	2.393	0.236	1.782	1.896	1.116	1.319	3.051	3.082	2.841	3.665	4.208	**28.458**
1999	1.796	2.116	1.435	0.000	0.000	0.000	0.608	3.426	2.254	2.942	3.717	4.093	**22.387**
2000	3.497	2.313	3.900	4.885	0.000	2.565	2.069	3.287	2.886	3.059	3.713	4.208	**36.382**
2001	1.326	0.000	0.121	0.595	4.663	4.501	0.861	3.449	2.826	3.092	3.725	2.690	**27.849**
2002	4.283	5.016	2.711	2.346	1.857	2.940	2.619	3.542	2.289	3.096	3.725	3.918	**38.343**
2003	3.604	3.919	3.286	3.875	0.000	0.000	1.308	3.531	2.708	3.043	3.603	4.163	**33.040**
2004	4.064	3.378	2.887	2.346	3.463	4.160	2.071	3.487	3.087	3.051	3.723	4.208	**39.926**
2005	4.773	1.853	4.589	2.149	1.191	1.056	2.332	3.080	2.633	2.642	3.259	3.739	**33.295**
Average	**3.301**	**2.950**	**2.608**	**2.210**	**1.852**	**2.173**	**1.696**	**3.109**	**2.826**	**2.799**	**3.555**	**3.688**	**32.802**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	1.232	1.138	0.974	0.825	0.759	0.811	0.654	1.161	1.090	1.045	1.327	1.423	1.039

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81E10**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.811	0.836	0.482	0.083	0.478	0.479	0.541	0.495	0.299	0.617	0.733	**6.469**
1926	0.826	0.718	0.875	0.256	0.482	0.642	0.447	0.487	0.495	0.365	0.615	0.738	**6.945**
1927	0.329	0.568	0.670	0.328	0.696	0.684	0.351	0.537	0.495	0.495	0.537	0.719	**6.410**
1928	0.757	0.610	0.690	0.393	0.001	0.003	0.434	0.555	0.433	0.450	0.514	0.695	**5.534**
1929	0.557	0.355	0.439	0.421	0.219	0.388	0.065	0.523	0.475	0.461	0.613	0.673	**5.190**
1930	0.832	0.719	0.000	0.665	0.465	0.437	0.217	0.566	0.463	0.273	0.617	0.721	**5.975**
1931	0.605	0.484	0.827	0.531	0.397	0.509	0.294	0.395	0.472	0.506	0.610	0.731	**6.360**
1932	0.704	0.541	0.487	0.000	0.585	0.634	0.452	0.566	0.495	0.506	0.606	0.721	**6.297**
1933	0.772	0.000	0.572	0.231	0.223	0.357	0.365	0.520	0.423	0.506	0.523	0.643	**5.135**
1934	0.443	0.285	0.781	0.912	0.563	0.759	0.487	0.461	0.495	0.506	0.617	0.646	**6.956**
1935	0.698	0.888	0.686	0.000	0.000	0.028	0.450	0.447	0.495	0.430	0.617	0.477	**5.216**
1936	0.838	0.608	0.748	0.250	0.000	0.388	0.390	0.566	0.495	0.506	0.617	0.680	**6.086**
1937	0.729	0.780	0.205	0.021	0.750	0.606	0.036	0.529	0.476	0.500	0.604	0.431	**5.667**
1938	0.660	0.829	0.202	0.480	0.000	0.293	0.445	0.438	0.454	0.368	0.594	0.648	**5.412**
1939	0.483	0.847	0.000	0.908	0.615	0.134	0.365	0.271	0.144	0.506	0.617	0.625	**5.516**
1940	0.613	0.332	0.347	0.585	0.801	0.377	0.085	0.504	0.434	0.445	0.554	0.676	**5.754**
1941	0.644	0.903	0.147	0.574	0.801	0.000	0.487	0.566	0.495	0.506	0.617	0.739	**6.481**
1942	0.838	0.738	0.624	0.947	0.373	0.085	0.000	0.386	0.495	0.148	0.617	0.739	**5.989**
1943	0.838	0.729	0.972	0.512	0.000	0.722	0.487	0.566	0.441	0.506	0.617	0.739	**7.129**
1944	0.499	0.903	0.903	0.492	0.276	0.779	0.359	0.504	0.434	0.445	0.554	0.676	**6.826**
1945	0.568	0.633	0.888	0.000	0.143	0.280	0.407	0.560	0.487	0.478	0.617	0.739	**5.799**
1946	0.509	0.462	0.466	0.417	0.498	0.163	0.476	0.454	0.390	0.478	0.617	0.739	**5.667**
1947	0.681	0.794	0.451	0.448	0.573	0.000	0.445	0.566	0.495	0.484	0.617	0.696	**6.251**
1948	0.320	0.428	0.793	0.000	0.597	0.727	0.327	0.518	0.463	0.424	0.591	0.717	**5.904**
1949	0.795	0.483	0.156	0.703	0.399	0.499	0.190	0.441	0.479	0.506	0.614	0.739	**6.003**
1950	0.791	0.549	0.415	0.835	0.801	0.353	0.116	0.424	0.495	0.504	0.515	0.639	**6.438**
1951	0.386	0.761	0.823	0.492	0.528	0.368	0.328	0.559	0.414	0.437	0.613	0.734	**6.444**
1952	0.580	0.692	0.197	0.285	0.165	0.449	0.137	0.564	0.495	0.486	0.617	0.726	**5.396**
1953	0.780	0.340	0.798	0.392	0.336	0.691	0.000	0.512	0.482	0.506	0.564	0.694	**6.095**
1954	0.576	0.021	0.290	0.450	0.155	0.337	0.360	0.445	0.484	0.505	0.617	0.739	**4.979**
1955	0.604	0.369	0.485	0.877	0.000	0.531	0.433	0.475	0.490	0.476	0.580	0.450	**5.767**
1956	0.798	0.796	0.436	0.320	0.000	0.486	0.397	0.506	0.455	0.431	0.585	0.583	**5.794**
1957	0.449	0.726	0.573	0.000	0.505	0.765	0.279	0.566	0.472	0.492	0.617	0.656	**6.098**
1958	0.745	0.619	0.450	0.000	0.210	0.565	0.436	0.565	0.495	0.443	0.617	0.724	**5.870**
1959	0.806	0.656	0.456	0.771	0.000	0.619	0.058	0.246	0.458	0.487	0.613	0.737	**5.909**
1960	0.819	0.338	0.000	0.720	0.000	0.278	0.283	0.524	0.330	0.497	0.609	0.601	**5.000**
1961	0.693	0.732	0.551	0.474	0.559	0.313	0.120	0.566	0.484	0.506	0.581	0.698	**6.277**
1962	0.752	0.304	0.522	0.922	0.727	0.611	0.381	0.507	0.236	0.419	0.603	0.736	**6.719**
1963	0.677	0.700	0.525	0.626	0.758	0.736	0.404	0.514	0.495	0.506	0.614	0.710	**7.266**
1964	0.464	0.574	0.273	0.502	0.466	0.638	0.435	0.565	0.495	0.506	0.617	0.616	**6.151**
1965	0.800	0.689	0.829	0.093	0.079	0.774	0.446	0.544	0.438	0.506	0.537	0.720	**6.455**
1966	0.559	0.706	0.498	0.000	0.000	0.508	0.208	0.561	0.494	0.410	0.617	0.738	**5.300**
1967	0.669	0.620	0.581	0.645	0.471	0.766	0.356	0.452	0.380	0.505	0.612	0.737	**6.792**
1968	0.700	0.446	0.172	0.356	0.518	0.000	0.354	0.566	0.495	0.479	0.617	0.668	**5.371**
1969	0.272	0.686	0.569	0.930	0.605	0.732	0.435	0.555	0.480	0.451	0.617	0.737	**7.068**
1970	0.717	0.780	0.323	0.159	0.766	0.560	0.317	0.519	0.394	0.506	0.617	0.661	**6.318**
1971	0.537	0.525	0.381	0.000	0.087	0.000	0.416	0.414	0.495	0.494	0.603	0.730	**4.683**
1972	0.523	0.633	0.766	0.646	0.603	0.299	0.239	0.513	0.495	0.481	0.617	0.000	**5.817**
1973	0.544	0.587	0.498	0.544	0.022	0.378	0.261	0.481	0.495	0.249	0.592	0.453	**5.104**
1974	0.795	0.514	0.583	0.083	0.219	0.751	0.211	0.471	0.462	0.506	0.617	0.738	**5.951**
1975	0.829	0.677	0.038	0.000	0.000	0.185	0.339	0.329	0.493	0.506	0.617	0.736	**4.750**
1976	0.703	0.549	0.828	0.080	0.000	0.292	0.469	0.540	0.495	0.506	0.602	0.328	**5.393**
1977	0.796	0.657	0.242	0.135	0.338	0.000	0.093	0.561	0.492	0.502	0.616	0.738	**5.170**
1978	0.483	0.320	0.212	0.469	0.394	0.526	0.356	0.450	0.495	0.486	0.260	0.734	**5.186**
1979	0.448	0.654	0.350	0.348	0.000	0.375	0.326	0.555	0.495	0.506	0.601	0.389	**5.046**
1980	0.617	0.155	0.359	0.000	0.284	0.240	0.453	0.537	0.495	0.506	0.573	0.615	**4.836**
1981	0.539	0.502	0.698	0.780	0.714	0.694	0.338	0.465	0.480	0.505	0.617	0.739	**7.071**
1982	0.722	0.660	0.737	0.704	0.800	0.178	0.478	0.532	0.457	0.498	0.566	0.736	**7.067**
1983	0.667	0.264	0.646	0.505	0.687	0.292	0.360	0.566	0.457	0.190	0.590	0.513	**5.738**
1984	0.192	0.463	0.665	0.000	0.170	0.320	0.454	0.369	0.417	0.432	0.617	0.689	**4.788**
1985	0.311	0.623	0.546	0.786	0.404	0.731	0.000	0.562	0.495	0.506	0.589	0.697	**6.250**
1986	0.703	0.515	0.466	0.705	0.500	0.171	0.480	0.473	0.483	0.506	0.421	0.401	**5.823**
1987	0.533	0.766	0.059	0.620	0.000	0.199	0.468	0.560	0.423	0.506	0.567	0.655	**5.356**
1988	0.360	0.793	0.709	0.838	0.308	0.678	0.449	0.515	0.429	0.504	0.617	0.739	**6.938**
1989	0.384	0.032	0.358	0.555	0.668	0.222	0.327	0.566	0.495	0.485	0.614	0.739	**5.446**
1990	0.529	0.573	0.413	0.504	0.285	0.301	0.471	0.543	0.370	0.506	0.617	0.733	**5.848**
1991	0.822	0.556	0.797	0.617	0.736	0.415	0.429	0.566	0.435	0.506	0.605	0.739	**7.223**
1992	0.830	0.666	0.393	0.716	0.528	0.521	0.388	0.556	0.495	0.489	0.610	0.739	**6.930**
1993	0.662	0.424	0.252	0.455	0.783	0.581	0.358	0.556	0.495	0.506	0.617	0.698	**6.388**
1994	0.515	0.862	0.742	0.307	0.352	0.507	0.157	0.420	0.495	0.506	0.597	0.721	**6.181**
1995	0.628	0.604	0.732	0.095	0.000	0.280	0.386	0.396	0.473	0.260	0.598	0.704	**5.155**
1996	0.586	0.493	0.873	0.103	0.060	0.392	0.310	0.475	0.495	0.506	0.607	0.555	**5.455**
1997	0.704	0.232	0.862	0.502	0.781	0.748	0.411	0.566	0.495	0.492	0.602	0.703	**7.098**
1998	0.562	0.498	0.187	0.403	0.408	0.295	0.287	0.499	0.495	0.472	0.609	0.739	**5.453**
1999	0.413	0.460	0.360	0.113	0.000	0.000	0.188	0.550	0.382	0.485	0.616	0.723	**4.291**
2000	0.649	0.487	0.705	0.833	0.000	0.497	0.390	0.531	0.468	0.501	0.616	0.739	**6.415**
2001	0.347	0.000	0.170	0.233	0.788	0.761	0.223	0.553	0.460	0.506	0.617	0.532	**5.191**
2002	0.756	0.859	0.540	0.482	0.402	0.548	0.465	0.566	0.387	0.506	0.617	0.699	**6.829**
2003	0.663	0.709	0.620	0.695	0.000	0.125	0.285	0.564	0.444	0.499	0.601	0.732	**5.938**
2004	0.726	0.635	0.565	0.482	0.624	0.715	0.390	0.558	0.495	0.500	0.617	0.739	**7.047**
2005	0.822	0.423	0.800	0.455	0.309	0.287	0.426	0.503	0.434	0.445	0.554	0.675	**6.131**
Average	**0.621**	**0.567**	**0.515**	**0.435**	**0.363**	**0.427**	**0.332**	**0.507**	**0.460**	**0.466**	**0.594**	**0.666**	**5.956**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.232	0.219	0.192	0.162	0.149	0.159	0.128	0.189	0.177	0.174	0.222	0.257	0.189

FIXED AREA IRRIGATION DEMAND TIME SERIES B81E25

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	1.227	1.333	0.693	0.000	0.569	0.802	0.832	0.737	0.348	0.825	0.961	**9.163**
1926	1.205	1.065	1.400	0.305	0.625	0.856	0.746	0.739	0.736	0.461	0.820	0.970	**9.928**
1927	0.339	0.803	1.043	0.429	0.998	0.930	0.577	0.826	0.737	0.686	0.687	0.936	**8.992**
1928	1.085	0.875	1.077	0.540	0.000	0.000	0.722	0.857	0.629	0.607	0.648	0.895	**7.935**
1929	0.735	0.434	0.643	0.589	0.170	0.414	0.077	0.801	0.701	0.627	0.818	0.857	**6.866**
1930	1.216	1.066	0.000	1.010	0.595	0.499	0.341	0.876	0.680	0.303	0.825	0.941	**8.352**
1931	0.818	0.657	1.317	0.778	0.476	0.623	0.477	0.579	0.696	0.705	0.812	0.957	**8.895**
1932	0.991	0.755	0.726	0.000	0.804	0.843	0.754	0.876	0.737	0.705	0.805	0.941	**8.937**
1933	1.110	0.000	0.873	0.263	0.177	0.360	0.601	0.795	0.612	0.705	0.664	0.805	**6.964**
1934	0.536	0.314	1.236	1.443	0.766	1.061	0.817	0.693	0.737	0.705	0.825	0.809	**9.942**
1935	0.981	1.362	1.071	0.000	0.000	0.000	0.751	0.668	0.737	0.573	0.825	0.514	**7.482**
1936	1.226	0.872	1.178	0.296	0.000	0.413	0.645	0.876	0.737	0.705	0.825	0.869	**8.642**
1937	1.034	1.172	0.243	0.000	1.092	0.793	0.027	0.812	0.702	0.693	0.803	0.435	**7.808**
1938	0.914	1.259	0.238	0.690	0.000	0.249	0.743	0.653	0.666	0.467	0.785	0.813	**7.476**
1939	0.607	1.290	0.000	1.436	0.856	0.000	0.602	0.363	0.127	0.705	0.825	0.773	**7.582**
1940	0.832	0.395	0.485	0.873	1.183	0.395	0.112	0.767	0.631	0.599	0.717	0.861	**7.850**
1941	0.887	1.388	0.146	0.853	1.183	0.000	0.817	0.876	0.737	0.705	0.825	0.971	**9.388**
1942	1.226	1.099	0.962	1.504	0.436	0.000	0.000	0.562	0.737	0.087	0.825	0.971	**8.409**
1943	1.226	1.084	1.571	0.745	0.000	0.997	0.817	0.876	0.642	0.705	0.825	0.971	**10.458**
1944	0.635	1.388	1.451	0.712	0.269	1.096	0.591	0.767	0.631	0.599	0.717	0.861	**9.716**
1945	0.754	0.916	1.424	0.000	0.040	0.226	0.674	0.865	0.722	0.656	0.825	0.971	**8.074**
1946	0.651	0.619	0.689	0.582	0.652	0.025	0.796	0.680	0.554	0.655	0.825	0.971	**7.699**
1947	0.951	1.197	0.664	0.635	0.784	0.000	0.742	0.876	0.737	0.666	0.825	0.896	**8.974**
1948	0.325	0.561	1.257	0.000	0.825	1.004	0.534	0.792	0.680	0.563	0.781	0.933	**8.254**
1949	1.151	0.655	0.160	1.076	0.480	0.607	0.294	0.658	0.709	0.705	0.820	0.971	**8.286**
1950	1.143	0.770	0.601	1.307	1.183	0.353	0.166	0.629	0.737	0.701	0.651	0.797	**9.038**
1951	0.438	1.139	1.309	0.711	0.705	0.379	0.537	0.865	0.596	0.584	0.817	0.964	**9.044**
1952	0.774	1.019	0.230	0.356	0.078	0.520	0.203	0.873	0.737	0.670	0.825	0.949	**7.234**
1953	1.125	0.409	1.266	0.539	0.371	0.941	0.000	0.782	0.713	0.705	0.734	0.893	**8.478**
1954	0.767	0.000	0.388	0.639	0.060	0.325	0.593	0.665	0.716	0.702	0.825	0.971	**6.651**
1955	0.816	0.458	0.722	1.381	0.000	0.662	0.720	0.717	0.728	0.653	0.760	0.468	**8.084**
1956	1.157	1.201	0.637	0.415	0.000	0.583	0.658	0.771	0.668	0.575	0.770	0.700	**8.135**
1957	0.546	1.078	0.874	0.000	0.664	1.071	0.449	0.876	0.696	0.680	0.825	0.826	**8.586**
1958	1.063	0.892	0.662	0.000	0.154	0.722	0.726	0.874	0.737	0.595	0.825	0.946	**8.196**
1959	1.170	0.957	0.673	1.197	0.000	0.816	0.064	0.320	0.672	0.672	0.817	0.969	**8.326**
1960	1.193	0.406	0.000	1.107	0.000	0.224	0.457	0.802	0.449	0.689	0.811	0.731	**6.869**
1961	0.971	1.089	0.837	0.680	0.758	0.285	0.172	0.876	0.717	0.705	0.763	0.899	**8.752**
1962	1.076	0.346	0.787	1.461	1.052	0.801	0.630	0.773	0.286	0.553	0.801	0.967	**9.533**
1963	0.945	1.033	0.791	0.944	1.107	1.020	0.671	0.786	0.737	0.705	0.819	0.921	**10.477**
1964	0.574	0.813	0.359	0.727	0.596	0.848	0.724	0.875	0.737	0.705	0.825	0.756	**8.540**
1965	1.160	1.014	1.321	0.029	0.000	1.088	0.743	0.838	0.637	0.705	0.687	0.939	**9.161**
1966	0.739	1.043	0.745	0.000	0.000	0.622	0.326	0.868	0.735	0.539	0.825	0.969	**7.412**
1967	0.929	0.893	0.889	0.976	0.606	1.073	0.585	0.678	0.537	0.703	0.815	0.968	**9.649**
1968	0.984	0.591	0.188	0.477	0.688	0.000	0.583	0.876	0.737	0.657	0.825	0.847	**7.451**
1969	0.241	1.008	0.868	1.474	0.838	1.013	0.725	0.857	0.710	0.610	0.825	0.968	**10.137**
1970	1.014	1.173	0.444	0.140	1.121	0.712	0.516	0.794	0.560	0.705	0.824	0.835	**8.839**
1971	0.700	0.729	0.544	0.000	0.000	0.000	0.690	0.611	0.737	0.684	0.800	0.956	**6.452**
1972	0.675	0.916	1.211	0.978	0.835	0.260	0.381	0.784	0.737	0.661	0.825	0.000	**8.263**
1973	0.713	0.836	0.745	0.800	0.000	0.397	0.418	0.728	0.737	0.261	0.782	0.473	**6.889**
1974	1.151	0.710	0.892	0.013	0.171	1.046	0.331	0.710	0.680	0.705	0.825	0.970	**8.203**
1975	1.211	0.993	0.000	0.000	0.000	0.063	0.556	0.463	0.733	0.705	0.825	0.967	**6.516**
1976	0.989	0.771	1.318	0.007	0.000	0.248	0.784	0.831	0.737	0.705	0.798	0.257	**7.446**
1977	1.152	0.957	0.306	0.100	0.375	0.000	0.125	0.867	0.732	0.698	0.823	0.970	**7.105**
1978	0.606	0.374	0.254	0.672	0.473	0.654	0.586	0.674	0.737	0.670	0.215	0.963	**6.878**
1979	0.545	0.952	0.490	0.463	0.000	0.391	0.532	0.856	0.737	0.704	0.798	0.362	**6.830**
1980	0.839	0.092	0.506	0.000	0.282	0.158	0.756	0.826	0.737	0.705	0.750	0.756	**6.407**
1981	0.704	0.688	1.092	1.212	1.029	0.946	0.553	0.700	0.710	0.703	0.825	0.971	**10.134**
1982	1.022	0.963	1.159	1.080	1.180	0.051	0.800	0.817	0.670	0.691	0.737	0.967	**10.137**
1983	0.927	0.278	1.002	0.733	0.983	0.247	0.593	0.876	0.671	0.159	0.778	0.577	**7.825**
1984	0.104	0.622	1.035	0.000	0.086	0.296	0.758	0.533	0.601	0.576	0.825	0.884	**6.318**
1985	0.309	0.899	0.828	1.222	0.489	1.012	0.000	0.870	0.737	0.705	0.776	0.897	**8.743**
1986	0.989	0.711	0.690	1.080	0.655	0.039	0.804	0.714	0.716	0.705	0.489	0.383	**7.975**
1987	0.692	1.147	0.000	0.933	0.000	0.088	0.782	0.865	0.612	0.705	0.739	0.825	**7.389**
1988	0.394	1.195	1.110	1.313	0.322	0.918	0.749	0.787	0.622	0.701	0.825	0.971	**9.907**
1989	0.435	0.000	0.504	0.820	0.949	0.127	0.535	0.876	0.737	0.668	0.820	0.971	**7.441**
1990	0.686	0.812	0.599	0.731	0.283	0.264	0.788	0.837	0.519	0.705	0.825	0.962	**8.012**
1991	1.198	0.782	1.264	0.928	1.069	0.460	0.714	0.876	0.632	0.705	0.804	0.971	**10.403**
1992	1.212	0.973	0.565	1.100	0.704	0.644	0.641	0.860	0.737	0.674	0.813	0.971	**9.893**
1993	0.918	0.553	0.323	0.647	1.150	0.750	0.589	0.858	0.737	0.705	0.825	0.901	**8.956**
1994	0.661	1.317	1.169	0.392	0.398	0.620	0.237	0.621	0.737	0.705	0.790	0.941	**8.588**
1995	0.859	0.866	1.151	0.033	0.000	0.226	0.638	0.579	0.698	0.280	0.792	0.910	**7.032**
1996	0.785	0.673	1.397	0.047	0.000	0.421	0.505	0.717	0.737	0.704	0.806	0.650	**7.443**
1997	0.991	0.224	1.379	0.728	1.148	1.041	0.681	0.876	0.737	0.679	0.798	0.909	**10.192**
1998	0.744	0.682	0.213	0.557	0.496	0.253	0.463	0.760	0.736	0.645	0.811	0.971	**7.329**
1999	0.485	0.615	0.507	0.063	0.000	0.000	0.291	0.848	0.540	0.669	0.823	0.944	**5.786**
2000	0.894	0.663	1.104	1.304	0.000	0.602	0.645	0.815	0.690	0.696	0.822	0.971	**9.207**
2001	0.371	0.000	0.184	0.267	1.159	1.065	0.352	0.854	0.676	0.704	0.825	0.610	**7.067**
2002	1.082	1.311	0.818	0.694	0.486	0.692	0.778	0.876	0.549	0.705	0.825	0.902	**9.718**
2003	0.920	1.049	0.957	1.063	0.000	0.000	0.461	0.873	0.648	0.692	0.796	0.960	**8.419**
2004	1.030	0.919	0.860	0.694	0.872	0.984	0.645	0.863	0.737	0.694	0.825	0.971	**10.095**
2005	1.199	0.551	1.269	0.646	0.325	0.238	0.709	0.766	0.630	0.598	0.716	0.860	**8.508**
Average	**0.848**	**0.810**	**0.781**	**0.634**	**0.473**	**0.509**	**0.545**	**0.773**	**0.675**	**0.635**	**0.785**	**0.848**	**8.323**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.316	0.313	0.291	0.237	0.194	0.190	0.210	0.289	0.261	0.237	0.293	0.327	0.264

FIXED AREA IRRIGATION DEMAND TIME SERIES B81D01

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.699	0.856	0.354	0.000	0.285	0.500	0.550	0.500	0.202	0.542	0.497	**5.372**
1926	0.670	0.574	0.908	0.060	0.320	0.505	0.456	0.479	0.500	0.289	0.539	0.504	**5.804**
1927	0.006	0.372	0.632	0.154	0.608	0.562	0.328	0.546	0.500	0.463	0.437	0.479	**5.087**
1928	0.577	0.428	0.658	0.238	0.000	0.000	0.438	0.569	0.417	0.402	0.407	0.449	**4.583**
1929	0.309	0.090	0.326	0.274	0.000	0.166	0.000	0.527	0.472	0.417	0.537	0.421	**3.540**
1930	0.679	0.575	0.000	0.597	0.298	0.231	0.148	0.584	0.456	0.168	0.542	0.483	**4.760**
1931	0.372	0.260	0.843	0.419	0.206	0.326	0.252	0.356	0.468	0.477	0.533	0.495	**5.007**
1932	0.505	0.336	0.389	0.000	0.458	0.495	0.463	0.584	0.500	0.477	0.528	0.483	**5.217**
1933	0.596	0.000	0.502	0.028	0.000	0.125	0.346	0.522	0.404	0.477	0.419	0.381	**3.800**
1934	0.156	0.000	0.781	0.931	0.429	0.663	0.511	0.444	0.500	0.477	0.542	0.385	**5.820**
1935	0.497	0.804	0.653	0.000	0.000	0.000	0.461	0.425	0.500	0.375	0.542	0.165	**4.422**
1936	0.686	0.425	0.736	0.053	0.000	0.165	0.380	0.584	0.500	0.477	0.542	0.429	**4.979**
1937	0.538	0.657	0.025	0.000	0.681	0.457	0.000	0.535	0.474	0.468	0.526	0.105	**4.465**
1938	0.445	0.724	0.020	0.351	0.000	0.040	0.454	0.413	0.445	0.294	0.512	0.388	**4.088**
1939	0.210	0.748	0.000	0.926	0.498	0.000	0.347	0.191	0.031	0.477	0.542	0.358	**4.328**
1940	0.383	0.060	0.206	0.491	0.751	0.152	0.000	0.501	0.419	0.396	0.460	0.423	**4.242**
1941	0.425	0.824	0.000	0.477	0.751	0.000	0.511	0.584	0.500	0.477	0.542	0.505	**5.597**
1942	0.686	0.600	0.570	0.979	0.175	0.000	0.000	0.343	0.500	0.002	0.542	0.505	**4.903**
1943	0.686	0.588	1.040	0.394	0.000	0.614	0.511	0.584	0.427	0.477	0.542	0.505	**6.369**
1944	0.232	0.824	0.947	0.368	0.048	0.690	0.338	0.501	0.419	0.396	0.460	0.423	**5.646**
1945	0.323	0.459	0.926	0.000	0.000	0.023	0.402	0.576	0.489	0.440	0.542	0.505	**4.685**
1946	0.244	0.231	0.361	0.269	0.341	0.000	0.495	0.434	0.359	0.439	0.542	0.505	**4.222**
1947	0.474	0.676	0.342	0.310	0.442	0.000	0.454	0.584	0.500	0.448	0.542	0.450	**5.222**
1948	0.000	0.187	0.797	0.000	0.474	0.619	0.295	0.520	0.457	0.368	0.508	0.477	**4.701**
1949	0.628	0.258	0.000	0.648	0.209	0.313	0.112	0.417	0.478	0.477	0.538	0.505	**4.586**
1950	0.622	0.347	0.295	0.826	0.751	0.120	0.014	0.394	0.500	0.474	0.409	0.376	**5.129**
1951	0.082	0.631	0.837	0.368	0.382	0.139	0.297	0.575	0.391	0.385	0.537	0.500	**5.124**
1952	0.338	0.539	0.015	0.098	0.000	0.247	0.042	0.582	0.500	0.451	0.542	0.489	**3.843**
1953	0.608	0.072	0.804	0.236	0.126	0.571	0.000	0.512	0.482	0.477	0.472	0.447	**4.807**
1954	0.333	0.000	0.133	0.313	0.000	0.098	0.340	0.422	0.484	0.475	0.542	0.505	**3.646**
1955	0.371	0.109	0.386	0.883	0.000	0.356	0.437	0.462	0.493	0.437	0.493	0.130	**4.556**
1956	0.633	0.679	0.322	0.143	0.000	0.296	0.390	0.503	0.447	0.378	0.500	0.303	**4.593**
1957	0.164	0.584	0.502	0.000	0.350	0.671	0.231	0.584	0.469	0.458	0.542	0.397	**4.953**
1958	0.561	0.440	0.340	0.000	0.000	0.402	0.442	0.583	0.500	0.393	0.542	0.486	**4.689**
1959	0.643	0.490	0.349	0.741	0.000	0.474	0.000	0.158	0.450	0.452	0.537	0.503	**4.797**
1960	0.661	0.069	0.000	0.672	0.000	0.021	0.236	0.527	0.279	0.465	0.532	0.327	**3.788**
1961	0.490	0.593	0.474	0.344	0.423	0.067	0.019	0.584	0.485	0.477	0.495	0.452	**4.902**
1962	0.570	0.024	0.436	0.945	0.650	0.463	0.368	0.505	0.153	0.361	0.524	0.502	**5.500**
1963	0.469	0.549	0.439	0.546	0.692	0.632	0.399	0.515	0.500	0.477	0.538	0.468	**6.224**
1964	0.185	0.380	0.112	0.380	0.298	0.499	0.440	0.583	0.500	0.477	0.542	0.345	**4.743**
1965	0.635	0.534	0.846	0.000	0.000	0.684	0.455	0.555	0.423	0.477	0.437	0.481	**5.528**
1966	0.311	0.557	0.404	0.000	0.000	0.325	0.136	0.578	0.499	0.350	0.542	0.504	**4.207**
1967	0.457	0.441	0.514	0.570	0.305	0.672	0.334	0.432	0.346	0.476	0.535	0.503	**5.585**
1968	0.499	0.210	0.000	0.190	0.368	0.000	0.332	0.584	0.500	0.441	0.542	0.413	**4.080**
1969	0.000	0.530	0.498	0.956	0.485	0.626	0.440	0.569	0.480	0.404	0.542	0.503	**6.033**
1970	0.522	0.657	0.175	0.000	0.703	0.394	0.282	0.521	0.364	0.477	0.542	0.404	**5.043**
1971	0.282	0.315	0.251	0.000	0.000	0.000	0.414	0.380	0.500	0.461	0.523	0.494	**3.622**
1972	0.263	0.459	0.761	0.572	0.482	0.049	0.178	0.513	0.500	0.444	0.542	0.000	**4.764**
1973	0.291	0.397	0.404	0.436	0.000	0.153	0.206	0.470	0.500	0.136	0.509	0.134	**3.637**
1974	0.628	0.301	0.517	0.000	0.000	0.652	0.141	0.457	0.456	0.477	0.542	0.504	**4.674**
1975	0.675	0.518	0.000	0.000	0.000	0.000	0.312	0.267	0.497	0.477	0.542	0.502	**3.791**
1976	0.503	0.347	0.844	0.000	0.000	0.040	0.486	0.550	0.500	0.477	0.522	0.000	**4.270**
1977	0.629	0.491	0.071	0.000	0.129	0.000	0.000	0.577	0.496	0.472	0.541	0.504	**3.911**
1978	0.209	0.045	0.033	0.338	0.203	0.350	0.334	0.429	0.500	0.450	0.075	0.499	**3.467**
1979	0.163	0.487	0.210	0.179	0.000	0.149	0.293	0.569	0.500	0.477	0.522	0.050	**3.599**
1980	0.388	0.000	0.222	0.000	0.058	0.000	0.465	0.546	0.500	0.477	0.485	0.345	**3.486**
1981	0.284	0.284	0.670	0.753	0.632	0.575	0.310	0.449	0.479	0.476	0.542	0.505	**5.959**
1982	0.529	0.495	0.721	0.650	0.749	0.000	0.498	0.539	0.448	0.467	0.475	0.502	**6.074**
1983	0.456	0.000	0.600	0.385	0.596	0.039	0.340	0.584	0.449	0.057	0.507	0.211	**4.225**
1984	0.000	0.233	0.626	0.000	0.000	0.076	0.466	0.321	0.395	0.378	0.542	0.440	**3.478**
1985	0.000	0.446	0.467	0.760	0.216	0.625	0.000	0.579	0.500	0.477	0.505	0.450	**5.027**
1986	0.504	0.301	0.362	0.651	0.343	0.000	0.501	0.459	0.484	0.477	0.285	0.066	**4.434**
1987	0.276	0.638	0.000	0.538	0.000	0.000	0.484	0.576	0.404	0.477	0.477	0.397	**4.266**
1988	0.048	0.674	0.684	0.831	0.089	0.553	0.459	0.516	0.411	0.475	0.542	0.505	**5.786**
1989	0.079	0.000	0.220	0.451	0.570	0.000	0.296	0.584	0.500	0.449	0.538	0.505	**4.193**
1990	0.271	0.379	0.293	0.383	0.059	0.052	0.489	0.554	0.333	0.477	0.542	0.499	**4.330**
1991	0.665	0.356	0.802	0.534	0.663	0.201	0.433	0.584	0.419	0.477	0.526	0.505	**6.165**
1992	0.675	0.503	0.267	0.666	0.381	0.342	0.377	0.571	0.500	0.454	0.533	0.505	**5.774**
1993	0.449	0.181	0.084	0.319	0.726	0.423	0.337	0.571	0.500	0.477	0.542	0.453	**5.063**
1994	0.252	0.769	0.729	0.126	0.147	0.323	0.068	0.388	0.500	0.477	0.516	0.482	**4.778**
1995	0.403	0.421	0.715	0.000	0.000	0.023	0.374	0.356	0.470	0.150	0.517	0.460	**3.890**
1996	0.346	0.273	0.905	0.000	0.000	0.172	0.273	0.462	0.500	0.477	0.528	0.267	**4.203**
1997	0.505	0.000	0.891	0.381	0.724	0.648	0.407	0.584	0.500	0.458	0.522	0.459	**6.079**
1998	0.315	0.279	0.002	0.250	0.221	0.043	0.241	0.495	0.499	0.431	0.532	0.505	**3.814**
1999	0.117	0.228	0.223	0.000	0.000	0.000	0.110	0.563	0.349	0.449	0.541	0.485	**3.066**
2000	0.431	0.265	0.679	0.824	0.000	0.310	0.380	0.537	0.464	0.471	0.540	0.505	**5.406**
2001	0.031	0.000	0.000	0.031	0.733	0.667	0.156	0.567	0.453	0.476	0.542	0.236	**3.893**
2002	0.575	0.764	0.459	0.355	0.214	0.379	0.481	0.584	0.355	0.477	0.542	0.454	**5.641**
2003	0.450	0.561	0.566	0.637	0.000	0.000	0.239	0.582	0.431	0.468	0.521	0.497	**4.953**
2004	0.535	0.462	0.492	0.355	0.511	0.604	0.380	0.574	0.500	0.469	0.542	0.505	**5.928**
2005	0.665	0.180	0.806	0.318	0.091	0.032	0.428	0.500	0.418	0.395	0.459	0.422	**4.715**
Average	**0.402**	**0.394**	**0.444**	**0.349**	**0.256**	**0.268**	**0.311**	**0.505**	**0.453**	**0.423**	**0.512**	**0.416**	**4.736**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.150	0.152	0.166	0.130	0.105	0.100	0.120	0.189	0.175	0.158	0.191	0.161	0.150

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81D10**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.257	0.296	0.010	0.000	0.000	0.267	0.269	0.227	0.000	0.283	0.286	**2.340**
1926	0.485	0.284	0.399	0.000	0.226	0.186	0.144	0.126	0.224	0.157	0.186	0.331	**2.749**
1927	0.000	0.249	0.344	0.000	0.164	0.192	0.000	0.140	0.235	0.188	0.174	0.364	**2.051**
1928	0.428	0.194	0.284	0.265	0.000	0.000	0.151	0.240	0.109	0.179	0.183	0.301	**2.332**
1929	0.271	0.232	0.000	0.225	0.110	0.000	0.177	0.260	0.223	0.172	0.275	0.300	**2.246**
1930	0.489	0.272	0.000	0.110	0.000	0.000	0.000	0.274	0.227	0.000	0.293	0.326	**1.992**
1931	0.363	0.000	0.413	0.138	0.229	0.097	0.205	0.147	0.218	0.237	0.292	0.362	**2.704**
1932	0.323	0.457	0.228	0.000	0.170	0.246	0.161	0.252	0.234	0.236	0.256	0.379	**2.940**
1933	0.366	0.000	0.294	0.000	0.000	0.000	0.208	0.252	0.156	0.223	0.261	0.336	**2.096**
1934	0.339	0.000	0.079	0.141	0.229	0.226	0.277	0.145	0.221	0.222	0.290	0.314	**2.484**
1935	0.360	0.545	0.433	0.235	0.000	0.000	0.139	0.090	0.158	0.152	0.272	0.276	**2.659**
1936	0.201	0.020	0.116	0.000	0.000	0.048	0.256	0.273	0.231	0.192	0.269	0.261	**1.868**
1937	0.384	0.445	0.015	0.005	0.316	0.263	0.000	0.224	0.123	0.220	0.267	0.155	**2.415**
1938	0.140	0.300	0.000	0.132	0.000	0.000	0.218	0.094	0.133	0.049	0.246	0.178	**1.490**
1939	0.359	0.000	0.000	0.339	0.177	0.000	0.000	0.230	0.024	0.230	0.218	0.145	**1.723**
1940	0.397	0.198	0.125	0.381	0.278	0.300	0.000	0.270	0.235	0.229	0.241	0.376	**3.029**
1941	0.306	0.381	0.286	0.174	0.439	0.000	0.237	0.075	0.149	0.184	0.194	0.168	**2.594**
1942	0.138	0.255	0.111	0.484	0.251	0.000	0.000	0.219	0.235	0.032	0.051	0.246	**2.021**
1943	0.424	0.167	0.359	0.184	0.000	0.064	0.233	0.274	0.048	0.237	0.272	0.344	**2.606**
1944	0.046	0.310	0.455	0.127	0.000	0.059	0.180	0.279	0.235	0.214	0.275	0.388	**2.568**
1945	0.125	0.305	0.291	0.000	0.000	0.107	0.184	0.238	0.195	0.230	0.282	0.394	**2.351**
1946	0.358	0.336	0.473	0.382	0.000	0.063	0.000	0.221	0.168	0.215	0.293	0.319	**2.828**
1947	0.289	0.128	0.069	0.074	0.087	0.000	0.201	0.211	0.235	0.220	0.267	0.354	**2.135**
1948	0.013	0.273	0.453	0.000	0.027	0.207	0.213	0.100	0.157	0.174	0.286	0.293	**2.197**
1949	0.408	0.122	0.105	0.123	0.000	0.000	0.000	0.137	0.178	0.219	0.236	0.344	**1.872**
1950	0.456	0.243	0.000	0.239	0.493	0.000	0.037	0.000	0.234	0.220	0.204	0.195	**2.320**
1951	0.050	0.441	0.295	0.320	0.199	0.261	0.130	0.252	0.179	0.132	0.250	0.390	**2.897**
1952	0.348	0.066	0.038	0.000	0.000	0.000	0.000	0.245	0.235	0.166	0.239	0.359	**1.697**
1953	0.373	0.043	0.021	0.000	0.000	0.171	0.045	0.208	0.200	0.237	0.175	0.347	**1.819**
1954	0.275	0.034	0.094	0.000	0.000	0.000	0.040	0.165	0.146	0.193	0.285	0.347	**1.580**
1955	0.144	0.000	0.000	0.155	0.000	0.000	0.228	0.115	0.118	0.211	0.270	0.080	**1.321**
1956	0.334	0.286	0.286	0.272	0.000	0.000	0.000	0.157	0.166	0.041	0.161	0.252	**1.955**
1957	0.043	0.319	0.377	0.000	0.207	0.150	0.055	0.274	0.214	0.234	0.292	0.027	**2.193**
1958	0.278	0.273	0.000	0.000	0.000	0.187	0.299	0.268	0.229	0.150	0.291	0.324	**2.299**
1959	0.283	0.000	0.072	0.406	0.000	0.152	0.017	0.192	0.114	0.231	0.273	0.300	**2.039**
1960	0.386	0.000	0.000	0.435	0.000	0.000	0.000	0.229	0.100	0.108	0.168	0.287	**1.712**
1961	0.384	0.342	0.296	0.180	0.303	0.296	0.058	0.194	0.235	0.233	0.293	0.366	**3.179**
1962	0.429	0.000	0.044	0.326	0.354	0.302	0.103	0.165	0.063	0.172	0.271	0.348	**2.579**
1963	0.319	0.287	0.320	0.127	0.211	0.401	0.192	0.253	0.235	0.237	0.290	0.336	**3.209**
1964	0.128	0.281	0.000	0.000	0.228	0.340	0.218	0.268	0.214	0.231	0.248	0.246	**2.402**
1965	0.406	0.231	0.423	0.000	0.000	0.337	0.241	0.271	0.211	0.207	0.265	0.239	**2.832**
1966	0.201	0.321	0.044	0.122	0.000	0.000	0.000	0.239	0.224	0.164	0.283	0.384	**1.982**
1967	0.286	0.092	0.399	0.452	0.170	0.000	0.032	0.101	0.084	0.178	0.249	0.375	**2.418**
1968	0.301	0.055	0.105	0.032	0.307	0.000	0.059	0.263	0.201	0.198	0.274	0.292	**2.088**
1969	0.000	0.364	0.084	0.403	0.136	0.339	0.260	0.188	0.162	0.153	0.290	0.326	**2.705**
1970	0.267	0.155	0.239	0.000	0.194	0.346	0.000	0.129	0.186	0.237	0.290	0.320	**2.363**
1971	0.058	0.069	0.177	0.000	0.000	0.000	0.050	0.119	0.226	0.219	0.220	0.374	**1.511**
1972	0.070	0.189	0.548	0.295	0.202	0.125	0.000	0.223	0.220	0.142	0.267	0.000	**2.281**
1973	0.073	0.140	0.000	0.000	0.000	0.000	0.048	0.179	0.206	0.214	0.238	0.108	**1.206**
1974	0.375	0.069	0.063	0.000	0.000	0.000	0.126	0.164	0.188	0.233	0.256	0.353	**1.827**
1975	0.357	0.306	0.000	0.000	0.000	0.000	0.127	0.000	0.206	0.237	0.274	0.352	**1.859**
1976	0.310	0.100	0.391	0.000	0.000	0.000	0.110	0.185	0.234	0.237	0.202	0.008	**1.778**
1977	0.347	0.287	0.063	0.000	0.000	0.000	0.168	0.239	0.235	0.176	0.275	0.294	**2.084**
1978	0.349	0.000	0.327	0.103	0.161	0.000	0.206	0.130	0.225	0.193	0.047	0.293	**2.034**
1979	0.107	0.149	0.100	0.030	0.000	0.081	0.190	0.250	0.235	0.215	0.179	0.141	**1.678**
1980	0.223	0.000	0.148	0.000	0.000	0.000	0.146	0.203	0.235	0.225	0.149	0.260	**1.588**
1981	0.157	0.046	0.278	0.232	0.383	0.249	0.065	0.068	0.235	0.209	0.279	0.321	**2.524**
1982	0.262	0.251	0.348	0.318	0.363	0.131	0.277	0.255	0.174	0.230	0.143	0.373	**3.125**
1983	0.155	0.183	0.336	0.416	0.206	0.000	0.138	0.276	0.219	0.000	0.217	0.278	**2.424**
1984	0.120	0.000	0.552	0.102	0.000	0.034	0.288	0.041	0.095	0.204	0.284	0.197	**1.918**
1985	0.143	0.377	0.247	0.304	0.072	0.189	0.000	0.195	0.204	0.235	0.222	0.342	**2.532**
1986	0.071	0.028	0.261	0.344	0.000	0.162	0.235	0.190	0.134	0.237	0.214	0.000	**1.876**
1987	0.264	0.256	0.000	0.252	0.000	0.000	0.197	0.259	0.038	0.205	0.185	0.176	**1.832**
1988	0.000	0.369	0.341	0.348	0.000	0.322	0.145	0.232	0.108	0.227	0.239	0.359	**2.690**
1989	0.213	0.028	0.116	0.015	0.028	0.000	0.086	0.247	0.235	0.194	0.262	0.368	**1.792**
1990	0.255	0.228	0.116	0.000	0.012	0.000	0.312	0.232	0.103	0.237	0.286	0.329	**2.110**
1991	0.448	0.228	0.513	0.505	0.390	0.211	0.287	0.279	0.209	0.237	0.272	0.368	**3.948**
1992	0.387	0.388	0.087	0.434	0.212	0.000	0.243	0.270	0.211	0.193	0.215	0.354	**2.994**
1993	0.308	0.016	0.138	0.209	0.253	0.228	0.224	0.265	0.232	0.231	0.243	0.357	**2.704**
1994	0.110	0.423	0.203	0.220	0.004	0.000	0.043	0.171	0.233	0.232	0.249	0.365	**2.252**
1995	0.334	0.000	0.000	0.000	0.000	0.091	0.119	0.000	0.152	0.040	0.114	0.358	**1.208**
1996	0.259	0.145	0.334	0.000	0.000	0.000	0.175	0.231	0.235	0.185	0.284	0.075	**1.923**
1997	0.216	0.066	0.380	0.000	0.267	0.326	0.182	0.279	0.229	0.060	0.265	0.218	**2.489**
1998	0.104	0.124	0.000	0.000	0.000	0.000	0.060	0.078	0.178	0.003	0.266	0.337	**1.151**
1999	0.336	0.111	0.061	0.000	0.000	0.000	0.093	0.207	0.164	0.166	0.220	0.320	**1.678**
2000	0.173	0.212	0.165	0.516	0.000	0.141	0.178	0.140	0.206	0.181	0.280	0.339	**2.530**
2001	0.152	0.000	0.125	0.250	0.303	0.239	0.247	0.271	0.105	0.227	0.249	0.307	**2.476**
2002	0.232	0.479	0.392	0.348	0.139	0.227	0.314	0.262	0.063	0.223	0.293	0.270	**3.241**
2003	0.283	0.337	0.424	0.276	0.000	0.000	0.000	0.271	0.187	0.186	0.238	0.331	**2.534**
2004	0.251	0.338	0.135	0.166	0.444	0.091	0.068	0.238	0.203	0.232	0.249	0.320	**2.734**
2005	0.412	0.187	0.087	0.121	0.000	0.000	0.093	0.207	0.164	0.166	0.220	0.320	**1.977**
Average	**0.257**	**0.194**	**0.200**	**0.158**	**0.110**	**0.101**	**0.132**	**0.198**	**0.183**	**0.185**	**0.242**	**0.287**	**2.252**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.096	0.075	0.075	0.059	0.045	0.038	0.051	0.074	0.071	0.069	0.090	0.111	0.071

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81D13**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.181	0.193	0.000	0.000	0.000	0.200	0.191	0.157	0.000	0.196	0.228	**1.675**
1926	0.356	0.199	0.262	0.000	0.144	0.142	0.118	0.097	0.154	0.107	0.132	0.258	**1.970**
1927	0.000	0.176	0.225	0.000	0.103	0.146	0.000	0.106	0.162	0.127	0.124	0.280	**1.448**
1928	0.319	0.139	0.184	0.163	0.000	0.000	0.122	0.172	0.079	0.121	0.130	0.238	**1.666**
1929	0.215	0.165	0.000	0.136	0.066	0.000	0.139	0.186	0.154	0.117	0.191	0.237	**1.605**
1930	0.359	0.191	0.000	0.057	0.000	0.000	0.000	0.195	0.157	0.000	0.203	0.255	**1.417**
1931	0.276	0.000	0.272	0.076	0.147	0.082	0.158	0.111	0.151	0.159	0.202	0.278	**1.912**
1932	0.249	0.315	0.146	0.000	0.106	0.182	0.129	0.180	0.161	0.158	0.178	0.289	**2.094**
1933	0.278	0.000	0.191	0.000	0.000	0.000	0.160	0.180	0.110	0.150	0.182	0.261	**1.511**
1934	0.260	0.003	0.043	0.078	0.146	0.169	0.206	0.109	0.153	0.149	0.201	0.246	**1.764**
1935	0.274	0.373	0.285	0.143	0.000	0.000	0.114	0.073	0.111	0.103	0.189	0.221	**1.885**
1936	0.167	0.020	0.069	0.000	0.000	0.049	0.192	0.194	0.159	0.130	0.187	0.212	**1.378**
1937	0.290	0.307	0.000	0.000	0.205	0.193	0.000	0.161	0.088	0.148	0.185	0.141	**1.718**
1938	0.126	0.211	0.000	0.072	0.000	0.000	0.167	0.075	0.095	0.035	0.172	0.156	**1.108**
1939	0.273	0.000	0.000	0.214	0.111	0.000	0.011	0.166	0.022	0.155	0.153	0.134	**1.239**
1940	0.298	0.141	0.075	0.241	0.179	0.218	0.001	0.192	0.162	0.154	0.169	0.288	**2.118**
1941	0.237	0.264	0.185	0.101	0.287	0.000	0.180	0.063	0.105	0.124	0.137	0.149	**1.834**
1942	0.125	0.180	0.065	0.310	0.161	0.000	0.000	0.158	0.162	0.023	0.043	0.201	**1.429**
1943	0.316	0.120	0.235	0.108	0.000	0.059	0.177	0.195	0.038	0.159	0.189	0.267	**1.863**
1944	0.063	0.217	0.299	0.069	0.000	0.056	0.141	0.198	0.162	0.144	0.191	0.295	**1.836**
1945	0.116	0.213	0.189	0.000	0.000	0.088	0.144	0.171	0.135	0.155	0.196	0.300	**1.708**
1946	0.272	0.234	0.312	0.242	0.000	0.059	0.010	0.159	0.118	0.145	0.203	0.250	**2.004**
1947	0.227	0.094	0.036	0.032	0.050	0.000	0.155	0.153	0.162	0.148	0.185	0.273	**1.515**
1948	0.040	0.192	0.298	0.000	0.009	0.156	0.164	0.079	0.110	0.117	0.198	0.233	**1.597**
1949	0.305	0.090	0.061	0.066	0.000	0.000	0.000	0.104	0.124	0.148	0.165	0.266	**1.329**
1950	0.337	0.172	0.000	0.146	0.322	0.012	0.046	0.000	0.161	0.148	0.144	0.167	**1.654**
1951	0.065	0.305	0.192	0.200	0.126	0.192	0.108	0.180	0.125	0.090	0.174	0.297	**2.053**
1952	0.266	0.051	0.014	0.000	0.000	0.000	0.000	0.176	0.162	0.113	0.167	0.277	**1.225**
1953	0.282	0.035	0.002	0.000	0.000	0.132	0.051	0.151	0.139	0.159	0.125	0.269	**1.344**
1954	0.217	0.029	0.053	0.000	0.000	0.000	0.048	0.123	0.103	0.130	0.197	0.268	**1.170**
1955	0.129	0.000	0.000	0.088	0.000	0.000	0.173	0.090	0.085	0.142	0.187	0.091	**0.985**
1956	0.257	0.201	0.185	0.168	0.000	0.000	0.000	0.118	0.116	0.030	0.115	0.206	**1.395**
1957	0.061	0.223	0.247	0.000	0.132	0.118	0.058	0.195	0.148	0.157	0.202	0.054	**1.594**
1958	0.219	0.192	0.000	0.000	0.000	0.142	0.220	0.191	0.158	0.102	0.202	0.253	**1.679**
1959	0.222	0.000	0.038	0.258	0.000	0.119	0.032	0.141	0.082	0.156	0.189	0.237	**1.474**
1960	0.291	0.000	0.000	0.278	0.000	0.000	0.000	0.165	0.072	0.074	0.120	0.228	**1.228**
1961	0.290	0.238	0.193	0.105	0.196	0.215	0.060	0.142	0.162	0.157	0.203	0.281	**2.240**
1962	0.320	0.005	0.018	0.205	0.230	0.219	0.090	0.123	0.048	0.117	0.188	0.269	**1.833**
1963	0.246	0.201	0.208	0.069	0.134	0.285	0.149	0.181	0.162	0.159	0.201	0.261	**2.258**
1964	0.118	0.197	0.000	0.000	0.145	0.245	0.167	0.191	0.148	0.155	0.173	0.201	**1.741**
1965	0.304	0.164	0.279	0.000	0.000	0.242	0.182	0.193	0.146	0.140	0.184	0.197	**2.031**
1966	0.168	0.224	0.018	0.066	0.000	0.000	0.000	0.171	0.155	0.111	0.196	0.293	**1.402**
1967	0.225	0.069	0.262	0.289	0.107	0.001	0.042	0.080	0.062	0.121	0.174	0.287	**1.718**
1968	0.234	0.044	0.061	0.003	0.199	0.000	0.060	0.188	0.140	0.133	0.190	0.232	**1.484**
1969	0.000	0.253	0.047	0.256	0.084	0.244	0.195	0.138	0.114	0.104	0.201	0.254	**1.889**
1970	0.211	0.112	0.154	0.000	0.123	0.248	0.000	0.099	0.129	0.159	0.201	0.251	**1.688**
1971	0.071	0.053	0.111	0.000	0.000	0.000	0.054	0.092	0.156	0.147	0.154	0.286	**1.125**
1972	0.079	0.135	0.362	0.184	0.128	0.100	0.000	0.161	0.152	0.097	0.185	0.000	**1.584**
1973	0.081	0.102	0.000	0.000	0.000	0.000	0.053	0.132	0.143	0.144	0.167	0.109	**0.930**
1974	0.283	0.053	0.032	0.000	0.000	0.000	0.106	0.122	0.131	0.157	0.178	0.273	**1.334**
1975	0.272	0.214	0.000	0.000	0.000	0.000	0.106	0.000	0.143	0.159	0.190	0.272	**1.356**
1976	0.240	0.074	0.257	0.000	0.000	0.000	0.095	0.136	0.161	0.159	0.143	0.041	**1.307**
1977	0.265	0.201	0.031	0.000	0.000	0.013	0.133	0.171	0.162	0.119	0.191	0.233	**1.521**
1978	0.266	0.005	0.214	0.052	0.100	0.000	0.159	0.099	0.155	0.130	0.040	0.233	**1.453**
1979	0.104	0.108	0.058	0.001	0.000	0.071	0.148	0.179	0.162	0.145	0.128	0.131	**1.235**
1980	0.182	0.000	0.091	0.000	0.000	0.000	0.119	0.148	0.162	0.151	0.107	0.210	**1.170**
1981	0.138	0.038	0.181	0.141	0.249	0.184	0.065	0.058	0.162	0.141	0.194	0.251	**1.801**
1982	0.208	0.177	0.228	0.199	0.236	0.105	0.206	0.182	0.122	0.155	0.103	0.285	**2.207**
1983	0.136	0.131	0.220	0.265	0.131	0.000	0.114	0.196	0.151	0.000	0.152	0.222	**1.719**
1984	0.113	0.000	0.365	0.051	0.000	0.039	0.214	0.040	0.069	0.138	0.197	0.169	**1.394**
1985	0.128	0.262	0.159	0.190	0.040	0.144	0.000	0.143	0.141	0.158	0.156	0.265	**1.787**
1986	0.080	0.025	0.169	0.217	0.000	0.126	0.178	0.139	0.095	0.159	0.151	0.023	**1.361**
1987	0.210	0.181	0.000	0.154	0.000	0.000	0.153	0.185	0.031	0.138	0.131	0.154	**1.338**
1988	0.000	0.256	0.223	0.220	0.000	0.233	0.118	0.167	0.078	0.153	0.167	0.276	**1.891**
1989	0.175	0.025	0.069	0.000	0.009	0.000	0.078	0.177	0.162	0.131	0.182	0.282	**1.292**
1990	0.203	0.162	0.069	0.000	0.000	0.000	0.229	0.167	0.075	0.159	0.198	0.256	**1.519**
1991	0.332	0.162	0.339	0.325	0.254	0.158	0.213	0.198	0.145	0.159	0.189	0.283	**2.756**
1992	0.291	0.269	0.048	0.277	0.135	0.000	0.184	0.192	0.146	0.130	0.151	0.273	**2.097**
1993	0.239	0.017	0.084	0.125	0.163	0.170	0.171	0.189	0.160	0.155	0.170	0.275	**1.917**
1994	0.106	0.293	0.129	0.133	0.000	0.000	0.050	0.126	0.161	0.156	0.174	0.280	**1.607**
1995	0.257	0.000	0.000	0.000	0.000	0.077	0.101	0.000	0.107	0.029	0.084	0.275	**0.931**
1996	0.206	0.105	0.219	0.000	0.000	0.000	0.138	0.166	0.162	0.125	0.197	0.087	**1.405**
1997	0.177	0.052	0.250	0.000	0.172	0.235	0.143	0.198	0.158	0.043	0.184	0.183	**1.794**
1998	0.102	0.091	0.000	0.000	0.000	0.000	0.061	0.065	0.124	0.004	0.185	0.262	**0.895**
1999	0.258	0.082	0.030	0.000	0.000	0.000	0.083	0.150	0.115	0.113	0.155	0.250	**1.236**
2000	0.149	0.151	0.103	0.332	0.000	0.111	0.140	0.106	0.142	0.122	0.194	0.263	**1.814**
2001	0.134	0.000	0.075	0.153	0.196	0.177	0.186	0.193	0.076	0.152	0.174	0.242	**1.759**
2002	0.188	0.330	0.257	0.219	0.086	0.169	0.230	0.187	0.048	0.150	0.203	0.217	**2.285**
2003	0.223	0.235	0.279	0.170	0.000	0.000	0.000	0.193	0.130	0.126	0.167	0.257	**1.780**
2004	0.201	0.235	0.082	0.096	0.290	0.078	0.066	0.171	0.140	0.156	0.174	0.250	**1.939**
2005	0.308	0.134	0.049	0.065	0.000	0.000	0.083	0.150	0.115	0.113	0.155	0.250	**1.422**
Average	**0.204**	**0.137**	**0.128**	**0.096**	**0.070**	**0.077**	**0.105**	**0.144**	**0.128**	**0.125**	**0.169**	**0.228**	**1.613**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.076	0.053	0.048	0.036	0.029	0.029	0.041	0.054	0.049	0.047	0.063	0.088	0.051

FIXED AREA IRRIGATION DEMAND TIME SERIES B81D16

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	1.428	1.568	0.439	0.000	0.000	1.081	1.092	0.921	0.057	1.162	1.340	**11.214**
1926	2.268	1.526	1.946	0.000	1.236	0.852	0.657	0.600	0.909	0.674	0.828	1.498	**12.994**
1927	0.239	1.399	1.742	0.000	1.010	0.873	0.000	0.647	0.947	0.780	0.788	1.613	**10.039**
1928	2.070	1.196	1.520	1.436	0.000	0.000	0.679	0.992	0.514	0.750	0.818	1.392	**11.366**
1929	1.520	1.338	0.048	1.288	0.809	0.000	0.770	1.063	0.905	0.726	1.133	1.390	**10.990**
1930	2.283	1.482	0.000	0.847	0.282	0.000	0.000	1.109	0.920	0.000	1.195	1.480	**9.599**
1931	1.845	0.389	1.997	0.954	1.249	0.527	0.869	0.673	0.891	0.947	1.193	1.605	**13.139**
1932	1.704	2.142	1.310	0.000	1.031	1.064	0.715	1.034	0.942	0.943	1.069	1.662	**13.616**
1933	1.855	0.000	1.558	0.000	0.355	0.000	0.877	1.033	0.677	0.898	1.087	1.516	**9.855**
1934	1.762	0.434	0.722	0.966	1.248	0.995	1.116	0.667	0.900	0.894	1.185	1.437	**12.326**
1935	1.835	2.449	2.067	1.325	0.000	0.000	0.637	0.473	0.684	0.656	1.124	1.303	**12.553**
1936	1.267	0.532	0.871	0.000	0.000	0.345	1.042	1.107	0.934	0.794	1.113	1.254	**9.260**
1937	1.919	2.100	0.452	0.418	1.562	1.126	0.000	0.937	0.563	0.887	1.105	0.876	**11.946**
1938	1.045	1.586	0.000	0.931	0.000	0.000	0.911	0.488	0.598	0.297	1.034	0.959	**7.849**
1939	1.831	0.000	0.266	1.712	1.056	0.000	0.093	0.960	0.217	0.923	0.937	0.842	**8.836**
1940	1.963	1.211	0.907	1.861	1.423	1.257	0.041	1.094	0.947	0.919	1.019	1.654	**14.297**
1941	1.642	1.875	1.527	1.095	1.996	0.000	0.979	0.421	0.654	0.766	0.855	0.923	**12.734**
1942	1.039	1.421	0.851	2.231	1.326	0.000	0.000	0.920	0.947	0.236	0.356	1.200	**10.528**
1943	2.058	1.095	1.798	1.132	0.000	0.402	0.964	1.109	0.301	0.947	1.125	1.543	**12.474**
1944	0.698	1.620	2.146	0.913	0.000	0.384	0.781	1.126	0.947	0.868	1.134	1.694	**12.311**
1945	0.990	1.601	1.548	0.000	0.000	0.562	0.796	0.988	0.811	0.923	1.158	1.715	**11.091**
1946	1.827	1.713	2.211	1.867	0.000	0.399	0.090	0.927	0.719	0.873	1.195	1.456	**13.276**
1947	1.585	0.947	0.683	0.703	0.722	0.000	0.852	0.895	0.947	0.888	1.105	1.577	**10.905**
1948	0.573	1.488	2.139	0.000	0.493	0.926	0.896	0.509	0.679	0.730	1.171	1.365	**10.970**
1949	2.002	0.927	0.827	0.896	0.075	0.000	0.000	0.638	0.752	0.886	1.001	1.541	**9.545**
1950	2.169	1.378	0.000	1.341	2.182	0.139	0.278	0.000	0.944	0.887	0.888	1.018	**11.225**
1951	0.711	2.087	1.562	1.640	1.138	1.119	0.606	1.033	0.754	0.586	1.049	1.700	**13.984**
1952	1.793	0.710	0.552	0.000	0.000	0.000	0.000	1.011	0.947	0.705	1.011	1.595	**8.325**
1953	1.879	0.622	0.478	0.000	0.000	0.796	0.307	0.882	0.829	0.947	0.789	1.553	**9.081**
1954	1.536	0.588	0.782	0.000	0.000	0.000	0.290	0.736	0.643	0.796	1.167	1.552	**8.089**
1955	1.061	0.355	0.000	1.020	0.000	0.000	0.946	0.563	0.545	0.860	1.115	0.608	**7.073**
1956	1.744	1.533	1.528	1.464	0.255	0.000	0.029	0.709	0.710	0.268	0.740	1.222	**10.202**
1957	0.687	1.653	1.864	0.000	1.169	0.720	0.343	1.109	0.876	0.936	1.192	0.411	**10.959**
1958	1.546	1.486	0.356	0.353	0.191	0.853	1.188	1.088	0.927	0.649	1.189	1.473	**11.299**
1959	1.561	0.140	0.695	1.953	0.000	0.726	0.204	0.829	0.530	0.928	1.126	1.389	**10.080**
1960	1.925	0.294	0.000	2.057	0.000	0.000	0.000	0.955	0.481	0.502	0.765	1.342	**8.322**
1961	1.919	1.733	1.567	1.116	1.514	1.244	0.353	0.834	0.947	0.933	1.195	1.617	**14.972**
1962	2.076	0.448	0.578	1.663	1.697	1.265	0.514	0.736	0.354	0.725	1.120	1.557	**12.732**
1963	1.689	1.536	1.654	0.914	1.183	1.613	0.821	1.039	0.947	0.947	1.184	1.515	**15.043**
1964	1.001	1.515	0.000	0.168	1.242	1.399	0.914	1.088	0.876	0.927	1.043	1.199	**11.371**
1965	1.996	1.332	2.034	0.348	0.000	1.387	0.992	1.100	0.867	0.844	1.099	1.174	**13.174**
1966	1.269	1.660	0.577	0.893	0.000	0.014	0.000	0.988	0.910	0.696	1.159	1.682	**9.849**
1967	1.575	0.811	1.944	2.117	1.032	0.078	0.261	0.511	0.427	0.746	1.045	1.648	**12.196**
1968	1.627	0.670	0.829	0.531	1.529	0.000	0.357	1.073	0.832	0.813	1.130	1.360	**10.751**
1969	0.000	1.813	0.745	1.941	0.907	1.395	1.057	0.814	0.698	0.658	1.185	1.479	**12.691**
1970	1.504	1.051	1.352	0.000	1.121	1.418	0.000	0.612	0.779	0.947	1.184	1.459	**11.427**
1971	0.741	0.722	1.113	0.000	0.000	0.000	0.325	0.575	0.918	0.884	0.944	1.645	**7.867**
1972	0.785	1.178	2.480	1.549	1.150	0.627	0.000	0.936	0.895	0.623	1.105	0.000	**11.328**
1973	0.798	0.993	0.228	0.000	0.000	0.000	0.319	0.783	0.849	0.867	1.008	0.707	**6.551**
1974	1.886	0.722	0.658	0.330	0.000	0.067	0.594	0.732	0.787	0.933	1.068	1.575	**9.351**
1975	1.825	1.605	0.000	0.000	0.000	0.000	0.595	0.000	0.848	0.947	1.131	1.570	**8.521**
1976	1.658	0.841	1.917	0.000	0.000	0.000	0.536	0.806	0.945	0.947	0.885	0.341	**8.876**
1977	1.790	1.537	0.655	0.000	0.206	0.146	0.739	0.988	0.947	0.740	1.134	1.367	**10.250**
1978	1.795	0.448	1.682	0.819	0.998	0.070	0.871	0.612	0.912	0.795	0.341	1.366	**10.711**
1979	0.924	1.029	0.807	0.522	0.000	0.465	0.816	1.029	0.947	0.873	0.804	0.827	**9.044**
1980	1.347	0.002	0.998	0.000	0.000	0.000	0.662	0.868	0.947	0.906	0.698	1.247	**7.676**
1981	1.109	0.635	1.500	1.315	1.798	1.076	0.378	0.398	0.947	0.851	1.148	1.461	**12.618**
1982	1.487	1.407	1.760	1.632	1.728	0.650	1.114	1.044	0.738	0.924	0.677	1.642	**14.804**
1983	1.100	1.156	1.714	1.990	1.163	0.000	0.636	1.117	0.892	0.000	0.934	1.311	**12.012**
1984	0.972	0.028	2.493	0.813	0.000	0.291	1.153	0.300	0.465	0.835	1.165	1.027	**9.542**
1985	1.056	1.860	1.384	1.583	0.667	0.862	0.000	0.840	0.842	0.941	0.952	1.534	**12.521**
1986	0.792	0.563	1.434	1.728	0.025	0.765	0.970	0.821	0.600	0.947	0.924	0.237	**9.807**
1987	1.496	1.426	0.284	1.388	0.000	0.000	0.840	1.059	0.266	0.836	0.824	0.950	**9.369**
1988	0.099	1.830	1.733	1.744	0.000	1.335	0.659	0.965	0.512	0.913	1.010	1.595	**12.394**
1989	1.312	0.563	0.871	0.462	0.495	0.060	0.451	1.017	0.947	0.801	1.090	1.626	**9.694**
1990	1.461	1.323	0.874	0.140	0.435	0.000	1.232	0.964	0.493	0.947	1.172	1.490	**10.532**
1991	2.141	1.322	2.356	2.306	1.823	0.940	1.148	1.126	0.859	0.947	1.122	1.627	**17.717**
1992	1.928	1.899	0.755	2.054	1.186	0.000	0.999	1.096	0.865	0.796	0.926	1.578	**14.081**
1993	1.651	0.516	0.958	1.229	1.336	1.002	0.932	1.079	0.936	0.927	1.024	1.586	**13.174**
1994	0.937	2.025	1.214	1.268	0.402	0.026	0.299	0.755	0.941	0.928	1.044	1.614	**11.453**
1995	1.745	0.000	0.371	0.000	0.000	0.502	0.568	0.000	0.664	0.265	0.577	1.589	**6.281**
1996	1.477	1.012	1.709	0.000	0.121	0.000	0.765	0.963	0.946	0.768	1.166	0.587	**9.513**
1997	1.321	0.713	1.878	0.000	1.384	1.349	0.789	1.126	0.926	0.337	1.100	1.101	**12.024**
1998	0.914	0.935	0.000	0.000	0.033	0.000	0.360	0.432	0.752	0.134	1.103	1.519	**6.183**
1999	1.750	0.884	0.649	0.000	0.362	0.000	0.476	0.879	0.705	0.705	0.946	1.457	**8.812**
2000	1.169	1.263	1.066	2.345	0.000	0.686	0.773	0.647	0.847	0.754	1.151	1.525	**12.226**
2001	1.090	0.000	0.907	1.383	1.515	1.042	1.013	1.098	0.500	0.911	1.046	1.413	**11.918**
2002	1.379	2.220	1.920	1.742	0.918	0.998	1.239	1.070	0.353	0.898	1.194	1.284	**15.214**
2003	1.564	1.718	2.037	1.477	0.000	0.000	0.000	1.099	0.783	0.774	1.007	1.495	**11.955**
2004	1.448	1.719	0.948	1.063	2.014	0.504	0.387	0.985	0.837	0.930	1.045	1.457	**13.336**
2005	2.015	1.171	0.757	0.889	0.362	0.000	0.476	0.879	0.705	0.705	0.946	1.457	**10.362**
Average	**1.435**	**1.143**	**1.135**	**0.893**	**0.632**	**0.461**	**0.585**	**0.843**	**0.770**	**0.764**	**1.021**	**1.336**	**11.040**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.536	0.441	0.424	0.333	0.259	0.172	0.226	0.315	0.297	0.285	0.381	0.515	0.350

FIXED AREA IRRIGATION DEMAND TIME SERIES B81D28

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.180	0.274	0.066	0.000	0.000	0.166	0.202	0.186	0.046	0.150	0.009	**1.305**
1926	0.136	0.130	0.295	0.000	0.017	0.061	0.149	0.173	0.186	0.082	0.148	0.012	**1.388**
1927	0.000	0.048	0.181	0.000	0.131	0.084	0.096	0.200	0.186	0.152	0.108	0.002	**1.189**
1928	0.100	0.071	0.192	0.018	0.000	0.000	0.141	0.210	0.152	0.128	0.096	0.000	**1.107**
1929	0.000	0.000	0.054	0.033	0.000	0.000	0.000	0.193	0.175	0.134	0.148	0.000	**0.736**
1930	0.139	0.130	0.000	0.167	0.007	0.000	0.022	0.216	0.168	0.032	0.150	0.003	**1.036**
1931	0.020	0.003	0.269	0.093	0.000	0.000	0.065	0.123	0.173	0.158	0.146	0.008	**1.057**
1932	0.072	0.033	0.080	0.000	0.072	0.057	0.151	0.216	0.186	0.158	0.144	0.003	**1.174**
1933	0.108	0.000	0.127	0.000	0.000	0.000	0.104	0.191	0.147	0.158	0.100	0.000	**0.934**
1934	0.000	0.000	0.243	0.306	0.060	0.122	0.171	0.159	0.186	0.158	0.150	0.000	**1.555**
1935	0.069	0.222	0.190	0.000	0.000	0.000	0.150	0.151	0.186	0.117	0.150	0.000	**1.235**
1936	0.142	0.070	0.224	0.000	0.000	0.000	0.117	0.216	0.186	0.158	0.150	0.000	**1.264**
1937	0.085	0.163	0.000	0.000	0.160	0.042	0.000	0.196	0.176	0.155	0.143	0.000	**1.120**
1938	0.049	0.190	0.000	0.065	0.000	0.000	0.148	0.146	0.164	0.084	0.138	0.000	**0.983**
1939	0.000	0.200	0.000	0.304	0.088	0.000	0.104	0.055	0.000	0.158	0.150	0.000	**1.058**
1940	0.024	0.000	0.004	0.123	0.187	0.000	0.000	0.182	0.153	0.125	0.117	0.000	**0.916**
1941	0.041	0.230	0.000	0.117	0.187	0.000	0.171	0.216	0.186	0.158	0.150	0.012	**1.469**
1942	0.142	0.140	0.155	0.326	0.000	0.000	0.000	0.118	0.186	0.000	0.150	0.012	**1.229**
1943	0.142	0.136	0.350	0.083	0.000	0.103	0.171	0.216	0.156	0.158	0.150	0.012	**1.677**
1944	0.000	0.230	0.312	0.072	0.000	0.132	0.100	0.182	0.153	0.125	0.117	0.000	**1.424**
1945	0.000	0.084	0.303	0.000	0.000	0.000	0.126	0.213	0.182	0.143	0.150	0.012	**1.212**
1946	0.000	0.000	0.068	0.031	0.025	0.000	0.164	0.155	0.128	0.143	0.150	0.012	**0.876**
1947	0.060	0.171	0.061	0.048	0.065	0.000	0.147	0.216	0.186	0.146	0.150	0.000	**1.251**
1948	0.000	0.000	0.249	0.000	0.078	0.105	0.083	0.190	0.169	0.114	0.136	0.001	**1.125**
1949	0.120	0.002	0.000	0.188	0.000	0.000	0.008	0.148	0.177	0.158	0.148	0.012	**0.961**
1950	0.118	0.038	0.041	0.262	0.187	0.000	0.000	0.139	0.186	0.157	0.096	0.000	**1.225**
1951	0.000	0.153	0.266	0.072	0.041	0.000	0.084	0.213	0.142	0.121	0.147	0.010	**1.248**
1952	0.006	0.116	0.000	0.000	0.000	0.000	0.000	0.215	0.186	0.147	0.150	0.006	**0.826**
1953	0.112	0.000	0.252	0.018	0.000	0.087	0.000	0.187	0.179	0.158	0.122	0.000	**1.115**
1954	0.004	0.000	0.000	0.049	0.000	0.000	0.101	0.150	0.180	0.157	0.150	0.012	**0.803**
1955	0.019	0.000	0.079	0.286	0.000	0.002	0.141	0.166	0.183	0.142	0.130	0.000	**1.148**
1956	0.122	0.172	0.052	0.000	0.000	0.000	0.121	0.183	0.164	0.118	0.133	0.000	**1.066**
1957	0.000	0.134	0.127	0.000	0.029	0.125	0.056	0.216	0.174	0.151	0.150	0.000	**1.161**
1958	0.094	0.076	0.060	0.000	0.000	0.021	0.142	0.216	0.186	0.124	0.150	0.005	**1.073**
1959	0.125	0.096	0.063	0.227	0.000	0.049	0.000	0.041	0.166	0.148	0.147	0.011	**1.075**
1960	0.132	0.000	0.000	0.198	0.000	0.000	0.058	0.193	0.095	0.153	0.145	0.000	**0.976**
1961	0.066	0.137	0.115	0.062	0.058	0.000	0.000	0.216	0.180	0.158	0.131	0.000	**1.124**
1962	0.098	0.000	0.099	0.312	0.147	0.045	0.113	0.184	0.044	0.111	0.142	0.011	**1.305**
1963	0.058	0.120	0.101	0.146	0.164	0.110	0.125	0.188	0.186	0.158	0.148	0.000	**1.505**
1964	0.000	0.051	0.000	0.077	0.008	0.059	0.142	0.216	0.186	0.158	0.150	0.000	**1.047**
1965	0.123	0.114	0.270	0.000	0.000	0.130	0.148	0.204	0.155	0.158	0.108	0.003	**1.412**
1966	0.000	0.123	0.086	0.000	0.000	0.000	0.017	0.214	0.186	0.106	0.150	0.011	**0.894**
1967	0.053	0.076	0.132	0.156	0.011	0.126	0.099	0.154	0.123	0.158	0.147	0.011	**1.245**
1968	0.070	0.000	0.000	0.000	0.036	0.000	0.098	0.216	0.186	0.143	0.150	0.000	**0.899**
1969	0.000	0.112	0.125	0.316	0.082	0.108	0.142	0.210	0.178	0.128	0.150	0.011	**1.563**
1970	0.079	0.163	0.000	0.000	0.169	0.018	0.077	0.191	0.131	0.158	0.150	0.000	**1.135**
1971	0.000	0.025	0.023	0.000	0.000	0.000	0.131	0.133	0.186	0.152	0.142	0.008	**0.800**
1972	0.000	0.084	0.235	0.157	0.081	0.000	0.035	0.187	0.186	0.145	0.150	0.000	**1.259**
1973	0.000	0.058	0.086	0.100	0.000	0.000	0.046	0.170	0.186	0.018	0.137	0.000	**0.802**
1974	0.120	0.019	0.133	0.000	0.000	0.118	0.019	0.164	0.168	0.158	0.150	0.012	**1.061**
1975	0.138	0.107	0.000	0.000	0.000	0.000	0.090	0.086	0.185	0.158	0.150	0.011	**0.925**
1976	0.072	0.038	0.269	0.000	0.000	0.000	0.161	0.202	0.186	0.158	0.142	0.000	**1.228**
1977	0.120	0.096	0.000	0.000	0.000	0.000	0.000	0.213	0.185	0.156	0.149	0.012	**0.932**
1978	0.000	0.000	0.000	0.060	0.000	0.000	0.099	0.153	0.186	0.147	0.000	0.010	**0.655**
1979	0.000	0.095	0.006	0.000	0.000	0.000	0.082	0.210	0.186	0.158	0.141	0.000	**0.878**
1980	0.026	0.000	0.011	0.000	0.000	0.000	0.152	0.201	0.186	0.158	0.127	0.000	**0.861**
1981	0.000	0.012	0.197	0.232	0.141	0.088	0.089	0.161	0.178	0.158	0.150	0.012	**1.417**
1982	0.081	0.098	0.218	0.189	0.187	0.000	0.165	0.198	0.165	0.154	0.123	0.011	**1.590**
1983	0.053	0.000	0.168	0.079	0.126	0.000	0.101	0.216	0.165	0.000	0.136	0.000	**1.044**
1984	0.000	0.000	0.178	0.000	0.000	0.000	0.152	0.108	0.143	0.118	0.150	0.000	**0.850**
1985	0.000	0.078	0.113	0.235	0.000	0.108	0.000	0.214	0.186	0.158	0.135	0.000	**1.227**
1986	0.072	0.019	0.069	0.190	0.026	0.000	0.167	0.165	0.180	0.158	0.046	0.000	**1.091**
1987	0.000	0.156	0.000	0.143	0.000	0.000	0.160	0.213	0.147	0.158	0.124	0.000	**1.099**
1988	0.000	0.170	0.202	0.264	0.000	0.080	0.149	0.188	0.150	0.157	0.150	0.012	**1.523**
1989	0.000	0.000	0.010	0.107	0.116	0.000	0.083	0.216	0.186	0.147	0.148	0.012	**1.025**
1990	0.000	0.051	0.040	0.078	0.000	0.000	0.162	0.204	0.118	0.158	0.150	0.009	**0.970**
1991	0.134	0.042	0.252	0.141	0.153	0.000	0.139	0.216	0.153	0.158	0.143	0.012	**1.543**
1992	0.138	0.101	0.029	0.196	0.041	0.000	0.116	0.211	0.186	0.149	0.146	0.012	**1.325**
1993	0.050	0.000	0.000	0.052	0.177	0.029	0.100	0.211	0.186	0.158	0.150	0.000	**1.113**
1994	0.000	0.208	0.221	0.000	0.000	0.000	0.000	0.136	0.186	0.158	0.139	0.003	**1.053**
1995	0.032	0.068	0.215	0.000	0.000	0.000	0.115	0.123	0.174	0.024	0.140	0.000	**0.892**
1996	0.009	0.008	0.294	0.000	0.000	0.000	0.074	0.166	0.186	0.158	0.144	0.000	**1.040**
1997	0.072	0.000	0.289	0.077	0.177	0.117	0.129	0.216	0.186	0.150	0.142	0.000	**1.554**
1998	0.000	0.010	0.000	0.023	0.000	0.000	0.061	0.180	0.186	0.140	0.145	0.012	**0.757**
1999	0.000	0.000	0.011	0.000	0.000	0.000	0.006	0.207	0.124	0.147	0.149	0.004	**0.650**
2000	0.043	0.004	0.201	0.262	0.000	0.000	0.117	0.197	0.172	0.155	0.149	0.012	**1.312**
2001	0.000	0.000	0.000	0.000	0.180	0.124	0.026	0.209	0.167	0.158	0.150	0.000	**1.013**
2002	0.099	0.206	0.109	0.067	0.000	0.012	0.159	0.216	0.127	0.158	0.150	0.000	**1.303**
2003	0.051	0.125	0.153	0.184	0.000	0.000	0.060	0.215	0.158	0.154	0.141	0.009	**1.251**
2004	0.084	0.085	0.123	0.067	0.093	0.100	0.117	0.212	0.186	0.155	0.150	0.012	**1.382**
2005	0.134	0.000	0.253	0.051	0.000	0.000	0.137	0.182	0.153	0.125	0.117	0.000	**1.152**
Average	**0.055**	**0.075**	**0.119**	**0.089**	**0.043**	**0.029**	**0.094**	**0.184**	**0.167**	**0.137**	**0.138**	**0.005**	**1.132**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.021	0.029	0.044	0.033	0.018	0.011	0.036	0.069	0.064	0.051	0.052	0.002	0.036

FIXED AREA IRRIGATION DEMAND TIME SERIES B81E20

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.854	0.905	0.406	0.000	0.258	0.493	0.408	0.379	0.085	0.442	0.664	**5.438**
1926	0.848	0.721	0.960	0.125	0.359	0.489	0.445	0.331	0.378	0.178	0.438	0.672	**5.945**
1927	0.158	0.512	0.671	0.212	0.660	0.551	0.303	0.403	0.379	0.365	0.327	0.644	**5.184**
1928	0.748	0.568	0.698	0.292	0.000	0.000	0.424	0.428	0.289	0.299	0.295	0.610	**4.651**
1929	0.464	0.231	0.365	0.327	0.015	0.137	0.000	0.383	0.349	0.315	0.436	0.578	**3.599**
1930	0.858	0.722	0.000	0.651	0.336	0.202	0.110	0.444	0.331	0.049	0.442	0.648	**4.794**
1931	0.530	0.398	0.891	0.470	0.243	0.301	0.220	0.200	0.344	0.380	0.432	0.661	**5.072**
1932	0.670	0.474	0.426	0.000	0.502	0.478	0.452	0.444	0.379	0.380	0.426	0.648	**5.280**
1933	0.769	0.000	0.538	0.097	0.020	0.095	0.323	0.377	0.275	0.380	0.308	0.534	**3.715**
1934	0.619	0.449	0.556	0.590	0.394	0.370	0.451	0.401	0.379	0.380	0.442	0.583	**5.613**
1935	0.754	0.934	0.968	0.352	0.131	0.000	0.409	0.242	0.343	0.284	0.402	0.659	**5.477**
1936	0.589	0.540	0.687	0.444	0.000	0.086	0.473	0.433	0.369	0.370	0.407	0.528	**4.926**
1937	0.706	0.809	0.085	0.000	0.739	0.438	0.000	0.391	0.350	0.371	0.424	0.233	**4.546**
1938	0.607	0.880	0.081	0.403	0.000	0.011	0.442	0.261	0.320	0.183	0.409	0.541	**4.138**
1939	0.827	0.083	0.291	0.729	0.359	0.000	0.000	0.266	0.000	0.380	0.408	0.118	**3.461**
1940	0.665	0.576	0.396	0.645	0.660	0.315	0.304	0.444	0.379	0.364	0.430	0.657	**5.835**
1941	0.715	0.747	0.721	0.383	0.667	0.000	0.441	0.248	0.299	0.261	0.141	0.505	**5.129**
1942	0.599	0.591	0.591	0.782	0.034	0.094	0.000	0.142	0.379	0.060	0.345	0.608	**4.225**
1943	0.822	0.390	0.896	0.545	0.000	0.393	0.436	0.441	0.230	0.380	0.442	0.651	**5.627**
1944	0.247	0.809	0.989	0.447	0.608	0.400	0.190	0.426	0.379	0.326	0.422	0.673	**5.916**
1945	0.556	0.582	0.599	0.000	0.147	0.455	0.376	0.415	0.336	0.344	0.429	0.652	**4.892**
1946	0.778	0.747	0.981	0.301	0.341	0.320	0.232	0.396	0.010	0.346	0.442	0.557	**5.451**
1947	0.801	0.608	0.402	0.333	0.435	0.000	0.320	0.425	0.377	0.339	0.437	0.655	**5.132**
1948	0.386	0.653	0.785	0.000	0.162	0.192	0.290	0.379	0.316	0.262	0.426	0.614	**4.465**
1949	0.819	0.426	0.598	0.259	0.179	0.431	0.000	0.358	0.364	0.375	0.410	0.646	**4.867**
1950	0.856	0.746	0.173	0.628	0.801	0.000	0.167	0.058	0.379	0.369	0.398	0.485	**5.060**
1951	0.259	0.835	0.885	0.299	0.172	0.502	0.309	0.412	0.205	0.335	0.432	0.659	**5.305**
1952	0.537	0.527	0.486	0.450	0.121	0.044	0.000	0.436	0.379	0.204	0.395	0.644	**4.222**
1953	0.710	0.426	0.402	0.000	0.104	0.347	0.014	0.312	0.362	0.380	0.297	0.631	**3.986**
1954	0.772	0.690	0.265	0.000	0.000	0.046	0.321	0.417	0.200	0.338	0.415	0.625	**4.088**
1955	0.624	0.345	0.099	0.742	0.000	0.000	0.380	0.227	0.369	0.339	0.439	0.405	**3.969**
1956	0.670	0.645	0.647	0.125	0.000	0.171	0.093	0.177	0.274	0.244	0.325	0.497	**3.868**
1957	0.391	0.650	0.245	0.032	0.050	0.512	0.220	0.430	0.353	0.379	0.416	0.335	**4.014**
1958	0.564	0.707	0.000	0.019	0.184	0.343	0.476	0.375	0.366	0.289	0.436	0.627	**4.387**
1959	0.681	0.689	0.284	0.737	0.000	0.262	0.000	0.388	0.163	0.370	0.438	0.619	**4.632**
1960	0.711	0.153	0.000	0.519	0.000	0.074	0.175	0.434	0.045	0.320	0.343	0.654	**3.428**
1961	0.782	0.676	0.715	0.299	0.345	0.235	0.071	0.355	0.379	0.371	0.442	0.623	**5.295**
1962	0.823	0.168	0.323	0.716	0.587	0.245	0.163	0.169	0.131	0.357	0.442	0.649	**4.773**
1963	0.616	0.879	0.563	0.297	0.182	0.608	0.380	0.418	0.374	0.380	0.400	0.665	**5.760**
1964	0.371	0.320	0.380	0.424	0.407	0.469	0.232	0.441	0.301	0.380	0.410	0.567	**4.703**
1965	0.769	0.536	0.658	0.285	0.000	0.508	0.382	0.424	0.332	0.379	0.401	0.481	**5.156**
1966	0.556	0.724	0.478	0.248	0.000	0.055	0.043	0.436	0.334	0.324	0.429	0.658	**4.285**
1967	0.635	0.136	0.754	0.891	0.369	0.429	0.119	0.154	0.297	0.358	0.412	0.662	**5.217**
1968	0.643	0.118	0.412	0.532	0.592	0.000	0.266	0.400	0.342	0.373	0.437	0.531	**4.645**
1969	0.276	0.693	0.523	0.927	0.289	0.518	0.459	0.363	0.281	0.334	0.438	0.657	**5.758**
1970	0.493	0.413	0.215	0.000	0.408	0.439	0.076	0.330	0.332	0.380	0.440	0.566	**4.092**
1971	0.359	0.381	0.439	0.000	0.000	0.000	0.375	0.238	0.373	0.368	0.414	0.648	**3.596**
1972	0.270	0.628	0.724	0.689	0.492	0.179	0.115	0.373	0.343	0.282	0.434	0.243	**4.773**
1973	0.090	0.676	0.000	0.000	0.000	0.000	0.114	0.286	0.371	0.286	0.407	0.316	**2.545**
1974	0.831	0.000	0.427	0.337	0.000	0.184	0.179	0.265	0.341	0.380	0.413	0.665	**4.023**
1975	0.733	0.700	0.029	0.000	0.000	0.000	0.022	0.000	0.322	0.380	0.431	0.645	**3.263**
1976	0.636	0.328	0.683	0.000	0.000	0.000	0.430	0.436	0.377	0.379	0.339	0.183	**3.791**
1977	0.568	0.720	0.212	0.000	0.000	0.233	0.325	0.408	0.364	0.269	0.430	0.633	**4.161**
1978	0.667	0.253	0.804	0.546	0.242	0.000	0.257	0.348	0.357	0.363	0.259	0.627	**4.724**
1979	0.526	0.500	0.495	0.428	0.000	0.231	0.298	0.422	0.379	0.351	0.381	0.420	**4.430**
1980	0.589	0.066	0.701	0.040	0.000	0.000	0.457	0.226	0.379	0.358	0.390	0.520	**3.727**
1981	0.589	0.231	0.680	0.537	0.170	0.671	0.281	0.129	0.379	0.367	0.436	0.661	**5.131**
1982	0.649	0.797	0.760	0.498	0.772	0.228	0.481	0.377	0.334	0.345	0.261	0.672	**6.175**
1983	0.689	0.491	0.866	0.807	0.590	0.124	0.250	0.444	0.369	0.000	0.376	0.465	**5.472**
1984	0.359	0.441	0.899	0.285	0.090	0.000	0.484	0.175	0.325	0.356	0.435	0.009	**3.858**
1985	0.483	0.880	0.397	0.788	0.195	0.559	0.000	0.414	0.376	0.380	0.352	0.590	**5.415**
1986	0.474	0.179	0.362	0.619	0.252	0.440	0.369	0.358	0.349	0.380	0.399	0.425	**4.606**
1987	0.587	0.616	0.000	0.491	0.000	0.058	0.301	0.419	0.096	0.380	0.230	0.543	**3.721**
1988	0.004	0.769	0.763	1.016	0.167	0.534	0.417	0.418	0.211	0.369	0.437	0.658	**5.761**
1989	0.411	0.248	0.294	0.255	0.341	0.190	0.323	0.439	0.379	0.370	0.439	0.673	**4.362**
1990	0.612	0.421	0.530	0.000	0.166	0.000	0.503	0.360	0.280	0.380	0.442	0.673	**4.367**
1991	0.858	0.551	0.699	0.622	0.390	0.129	0.476	0.444	0.209	0.380	0.287	0.673	**5.718**
1992	0.804	0.584	0.120	0.789	0.000	0.277	0.473	0.419	0.322	0.322	0.415	0.673	**5.199**
1993	0.646	0.198	0.564	0.455	0.501	0.526	0.386	0.437	0.379	0.380	0.408	0.652	**5.535**
1994	0.737	0.649	0.641	0.650	0.000	0.145	0.109	0.171	0.369	0.379	0.395	0.654	**4.899**
1995	0.635	0.422	0.727	0.000	0.000	0.492	0.221	0.167	0.331	0.097	0.361	0.626	**4.080**
1996	0.689	0.442	0.662	0.271	0.198	0.033	0.402	0.387	0.379	0.356	0.442	0.342	**4.602**
1997	0.551	0.485	0.877	0.181	0.601	0.465	0.395	0.444	0.379	0.316	0.380	0.613	**5.687**
1998	0.494	0.590	0.201	0.000	0.047	0.000	0.335	0.374	0.325	0.200	0.438	0.672	**3.676**
1999	0.602	0.347	0.201	0.000	0.988	0.000	0.150	0.366	0.351	0.380	0.442	0.633	**4.459**
2000	0.593	0.417	0.561	0.903	0.000	0.122	0.162	0.356	0.357	0.337	0.440	0.605	**4.852**
2001	0.738	0.079	0.046	0.528	0.753	0.585	0.382	0.354	0.170	0.380	0.409	0.619	**5.044**
2002	0.556	0.844	0.760	0.723	0.459	0.113	0.465	0.425	0.303	0.378	0.435	0.592	**6.054**
2003	0.500	0.841	0.081	0.498	0.242	0.000	0.476	0.444	0.300	0.356	0.395	0.633	**4.767**
2004	0.672	0.830	0.392	0.744	0.621	0.502	0.441	0.426	0.364	0.362	0.336	0.673	**6.363**
2005	0.838	0.423	0.404	0.453	0.211	0.086	0.397	0.338	0.274	0.276	0.336	0.563	**4.598**
Average	**0.599**	**0.524**	**0.501**	**0.384**	**0.248**	**0.234**	**0.281**	**0.350**	**0.317**	**0.325**	**0.397**	**0.571**	**4.734**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.224	0.202	0.187	0.143	0.102	0.087	0.108	0.131	0.122	0.121	0.148	0.220	0.150

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81E23**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.410	0.454	0.252	0.004	0.174	0.264	0.229	0.199	0.081	0.228	0.307	**2.874**
1926	0.387	0.360	0.474	0.134	0.213	0.262	0.246	0.200	0.199	0.116	0.226	0.310	**3.127**
1927	0.121	0.280	0.364	0.172	0.328	0.285	0.193	0.227	0.199	0.185	0.185	0.299	**2.838**
1928	0.350	0.302	0.375	0.205	0.000	0.000	0.238	0.237	0.166	0.161	0.173	0.287	**2.493**
1929	0.242	0.167	0.242	0.220	0.074	0.126	0.037	0.220	0.188	0.166	0.225	0.275	**2.184**
1930	0.391	0.361	0.000	0.349	0.204	0.152	0.119	0.243	0.181	0.067	0.228	0.301	**2.594**
1931	0.268	0.235	0.449	0.277	0.167	0.191	0.161	0.151	0.186	0.191	0.224	0.306	**2.805**
1932	0.321	0.265	0.267	0.000	0.268	0.258	0.249	0.243	0.199	0.191	0.222	0.301	**2.782**
1933	0.358	0.000	0.312	0.122	0.076	0.110	0.200	0.218	0.161	0.191	0.178	0.258	**2.183**
1934	0.181	0.131	0.424	0.482	0.256	0.325	0.268	0.186	0.199	0.191	0.228	0.260	**3.131**
1935	0.318	0.452	0.373	0.000	0.000	0.000	0.248	0.179	0.199	0.150	0.228	0.169	**2.314**
1936	0.394	0.301	0.406	0.131	0.000	0.126	0.214	0.243	0.199	0.191	0.228	0.278	**2.710**
1937	0.334	0.393	0.122	0.017	0.357	0.243	0.022	0.223	0.188	0.187	0.221	0.144	**2.451**
1938	0.297	0.420	0.120	0.251	0.000	0.076	0.245	0.174	0.177	0.117	0.215	0.261	**2.354**
1939	0.203	0.430	0.000	0.480	0.284	0.000	0.200	0.085	0.012	0.191	0.228	0.248	**2.360**
1940	0.272	0.155	0.194	0.306	0.385	0.121	0.048	0.209	0.166	0.158	0.194	0.276	**2.485**
1941	0.289	0.460	0.093	0.301	0.385	0.000	0.268	0.243	0.199	0.191	0.228	0.310	**2.965**
1942	0.394	0.371	0.340	0.501	0.155	0.000	0.000	0.146	0.199	0.001	0.228	0.310	**2.643**
1943	0.394	0.366	0.527	0.268	0.000	0.306	0.268	0.243	0.170	0.191	0.228	0.310	**3.269**
1944	0.212	0.460	0.490	0.257	0.104	0.336	0.197	0.209	0.166	0.158	0.194	0.276	**3.060**
1945	0.248	0.314	0.482	0.000	0.035	0.069	0.223	0.239	0.194	0.176	0.228	0.310	**2.519**
1946	0.217	0.223	0.256	0.218	0.221	0.008	0.262	0.182	0.143	0.175	0.228	0.310	**2.443**
1947	0.309	0.401	0.249	0.234	0.261	0.000	0.245	0.243	0.199	0.179	0.228	0.287	**2.833**
1948	0.117	0.206	0.430	0.000	0.274	0.308	0.179	0.217	0.182	0.147	0.214	0.298	**2.571**
1949	0.371	0.234	0.097	0.369	0.168	0.185	0.104	0.176	0.190	0.191	0.226	0.310	**2.622**
1950	0.368	0.270	0.230	0.440	0.385	0.108	0.064	0.167	0.199	0.189	0.174	0.256	**2.849**
1951	0.151	0.383	0.446	0.257	0.237	0.116	0.180	0.239	0.156	0.154	0.225	0.308	**2.852**
1952	0.254	0.346	0.118	0.149	0.046	0.159	0.076	0.242	0.199	0.180	0.228	0.303	**2.300**
1953	0.363	0.160	0.433	0.205	0.135	0.288	0.000	0.214	0.192	0.191	0.199	0.286	**2.665**
1954	0.252	0.000	0.165	0.235	0.041	0.099	0.198	0.178	0.193	0.190	0.228	0.310	**2.088**
1955	0.267	0.175	0.266	0.463	0.000	0.202	0.238	0.194	0.196	0.174	0.208	0.154	**2.537**
1956	0.372	0.402	0.241	0.167	0.000	0.178	0.218	0.210	0.178	0.151	0.211	0.226	**2.554**
1957	0.185	0.364	0.313	0.000	0.225	0.329	0.153	0.243	0.187	0.183	0.228	0.265	**2.672**
1958	0.343	0.307	0.248	0.000	0.069	0.221	0.240	0.242	0.199	0.157	0.228	0.302	**2.556**
1959	0.376	0.327	0.251	0.406	0.000	0.250	0.033	0.072	0.179	0.180	0.225	0.309	**2.609**
1960	0.384	0.159	0.000	0.378	0.000	0.068	0.155	0.220	0.111	0.186	0.223	0.235	**2.119**
1961	0.315	0.368	0.301	0.248	0.254	0.087	0.066	0.243	0.193	0.191	0.209	0.288	**2.761**
1962	0.347	0.141	0.286	0.488	0.344	0.245	0.209	0.211	0.061	0.144	0.220	0.309	**3.005**
1963	0.307	0.350	0.287	0.328	0.361	0.313	0.222	0.215	0.199	0.191	0.226	0.294	**3.293**
1964	0.193	0.283	0.157	0.262	0.204	0.260	0.239	0.242	0.199	0.191	0.228	0.243	**2.700**
1965	0.373	0.344	0.450	0.052	0.002	0.334	0.245	0.231	0.168	0.191	0.185	0.300	**2.875**
1966	0.243	0.353	0.273	0.000	0.000	0.190	0.114	0 240	0.198	0.140	0.228	0.310	**2.290**
1967	0.302	0.307	0.317	0.338	0.207	0.329	0.195	0.181	0.138	0.190	0.225	0.309	**3.038**
1968	0.319	0.215	0.105	0.186	0.232	0.000	0.194	0.243	0.199	0.176	0.228	0.271	**2.368**
1969	0.092	0.343	0.311	0.492	0.278	0.311	0.239	0.237	0.191	0.161	0.228	0.309	**3.190**
1970	0.328	0.393	0.182	0.085	0.366	0.218	0.174	0.217	0.145	0.191	0.227	0.268	**2.794**
1971	0.232	0.257	0.212	0.000	0.006	0.000	0.228	0.161	0.199	0.184	0.220	0.305	**2.005**
1972	0.224	0.315	0.416	0.339	0.277	0.080	0.131	0.214	0.199	0.177	0.228	0.000	**2.599**
1973	0.235	0.290	0.273	0.284	0.000	0.121	0.143	0.197	0.199	0.054	0.214	0.156	**2.167**
1974	0.370	0.251	0.318	0.047	0.074	0.321	0.116	0.191	0.181	0.191	0.228	0.310	**2.599**
1975	0.389	0.338	0.038	0.000	0.000	0.020	0.186	0.116	0.198	0.191	0.228	0.309	**2.012**
1976	0.320	0.270	0.449	0.045	0.000	0.076	0.258	0.229	0.199	0.191	0.219	0.090	**2.346**
1977	0.371	0.327	0.141	0.073	0.137	0.000	0.052	0.240	0.197	0.188	0.227	0.310	**2.262**
1978	0.203	0.149	0.125	0.245	0.166	0.200	0.195	0.180	0.199	0.180	0.040	0.308	**2.191**
1979	0.184	0.326	0.196	0.182	0.000	0.119	0.178	0.237	0.199	0.190	0.219	0.122	**2.152**
1980	0.274	0.064	0.201	0.000	0.108	0.048	0.249	0.227	0.199	0.191	0.204	0.243	**2.009**
1981	0.233	0.245	0.379	0.411	0.337	0.290	0.185	0.188	0.191	0.190	0.228	0.310	**3.187**
1982	0.331	0.329	0.400	0.370	0.384	0.016	0.263	0.224	0.178	0.186	0.200	0.309	**3.191**
1983	0.301	0.120	0.352	0.264	0.323	0.076	0.198	0.243	0.179	0.023	0.213	0.188	**2.479**
1984	0.050	0.224	0.362	0.000	0.049	0.090	0.250	0.137	0.157	0.151	0.227	0.283	**1.981**
1985	0.112	0.309	0.299	0.414	0.171	0.310	0.000	0.241	0.199	0.191	0.212	0.287	**2.745**
1986	0.321	0.251	0.257	0.370	0.222	0.012	0.264	0.193	0.192	0.191	0.124	0.128	**2.526**
1987	0.229	0.386	0.049	0.325	0.000	0.027	0.257	0.239	0.160	0.191	0.201	0.265	**2.329**
1988	0.138	0.400	0.385	0.442	0.120	0.281	0.247	0.215	0.164	0.189	0.228	0.310	**3.119**
1989	0.151	0.003	0.200	0.290	0.312	0.039	0.179	0.243	0.199	0.179	0.226	0.310	**2.331**
1990	0.227	0.282	0.229	0.263	0.108	0.081	0.259	0.230	0.132	0.191	0.228	0.307	**2.538**
1991	0.385	0.273	0.432	0.323	0.349	0.140	0.236	0.243	0.167	0.191	0.221	0.310	**3.271**
1992	0.389	0.332	0.219	0.376	0.237	0.197	0.213	0.237	0.199	0.181	0.224	0.310	**3.114**
1993	0.299	0.204	0.146	0.238	0.375	0.229	0.197	0.237	0.199	0.191	0.228	0.288	**2.828**
1994	0.220	0.438	0.403	0.160	0.144	0.189	0.087	0.164	0.199	0.191	0.217	0.301	**2.712**
1995	0.280	0.299	0.397	0.053	0.000	0.069	0.212	0.151	0.187	0.060	0.217	0.291	**2.218**
1996	0.258	0.240	0.473	0.057	0.000	0.129	0.170	0.194	0.199	0.190	0.222	0.211	**2.342**
1997	0.321	0.104	0.468	0.262	0.374	0.319	0.226	0.243	0.199	0.183	0.219	0.291	**3.208**
1998	0.245	0.243	0.113	0.210	0.173	0.077	0.157	0.207	0.199	0.172	0.223	0.310	**2.329**
1999	0.166	0.222	0.201	0.062	0.000	0.000	0.103	0.234	0.139	0.179	0.227	0.302	**1.835**
2000	0.291	0.237	0.383	0.439	0.000	0.184	0.214	0.224	0.185	0.188	0.227	0.310	**2.882**
2001	0.131	0.000	0.104	0.123	0.377	0.327	0.122	0.236	0.180	0.190	0.228	0.198	**2.216**
2002	0.349	0.436	0.295	0.252	0.170	0.212	0.256	0.243	0.141	0.191	0.228	0.289	**3.061**
2003	0.299	0.355	0.338	0.365	0.000	0.000	0.156	0.242	0.172	0.187	0.219	0.307	**2.639**
2004	0.333	0.315	0.308	0.252	0.289	0.302	0.214	0.238	0.199	0.187	0.227	0.310	**3.176**
2005	0.385	0.203	0.434	0.237	0.121	0.073	0.234	0.209	0.166	0.158	0.194	0.275	**2.690**
Average	**0.279**	**0.281**	**0.283**	**0.228**	**0.161**	**0.156**	**0.183**	**0.211**	**0.180**	**0.169**	**0.215**	**0.272**	**2.617**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.104	0.108	0.106	0.085	0.066	0.058	0.070	0.079	0.069	0.063	0.080	0.105	0.083

FIXED AREA IRRIGATION DEMAND TIME SERIES B81E30

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.339	0.369	0.130	0.000	0.087	0.232	0.203	0.181	0.028	0.199	0.259	**2.221**
1926	0.341	0.275	0.396	0.000	0.127	0.198	0.209	0.166	0.180	0.073	0.197	0.262	**2.425**
1927	0.009	0.174	0.256	0.036	0.273	0.228	0.141	0.201	0.181	0.162	0.144	0.249	**2.052**
1928	0.293	0.201	0.269	0.075	0.000	0.000	0.199	0.213	0.137	0.131	0.129	0.232	**1.879**
1929	0.156	0.039	0.109	0.092	0.000	0.028	0.000	0.191	0.166	0.138	0.196	0.217	**1.332**
1930	0.346	0.275	0.000	0.248	0.116	0.060	0.048	0.221	0.158	0.011	0.199	0.251	**1.932**
1931	0.188	0.119	0.363	0.161	0.071	0.107	0.101	0.103	0.164	0.169	0.194	0.257	**1.998**
1932	0.256	0.156	0.138	0.000	0.196	0.193	0.212	0.221	0.181	0.169	0.191	0.251	**2.164**
1933	0.303	0.000	0.192	0.000	0.000	0.008	0.150	0.188	0.131	0.169	0.135	0.196	**1.473**
1934	0.231	0.144	0.201	0.219	0.144	0.141	0.212	0.200	0.181	0.169	0.199	0.220	**2.258**
1935	0.296	0.377	0.400	0.104	0.017	0.000	0.192	0.123	0.163	0.124	0.180	0.256	**2.231**
1936	0.217	0.188	0.264	0.148	0.000	0.004	0.222	0.215	0.176	0.165	0.182	0.193	**1.974**
1937	0.273	0.317	0.000	0.000	0.310	0.174	0.000	0.195	0.167	0.165	0.190	0.051	**1.842**
1938	0.225	0.352	0.000	0.128	0.000	0.000	0.208	0.132	0.152	0.075	0.183	0.199	**1.654**
1939	0.331	0.000	0.073	0.286	0.127	0.000	0.000	0.134	0.000	0.169	0.183	0.000	**1.304**
1940	0.253	0.205	0.124	0.245	0.273	0.114	0.141	0.221	0.181	0.162	0.193	0.255	**2.366**
1941	0.277	0.288	0.281	0.119	0.276	0.000	0.207	0.126	0.142	0.112	0.055	0.182	**2.064**
1942	0.221	0.212	0.218	0.311	0.000	0.007	0.000	0.074	0.181	0.016	0.153	0.232	**1.625**
1943	0.329	0.115	0.365	0.197	0.000	0.152	0.205	0.219	0.109	0.169	0.199	0.252	**2.311**
1944	0.052	0.317	0.410	0.150	0.247	0.155	0.086	0.212	0.181	0.144	0.190	0.263	**2.405**
1945	0.201	0.208	0.222	0.000	0.025	0.182	0.176	0.207	0.160	0.152	0.193	0.253	**1.977**
1946	0.307	0.287	0.406	0.079	0.119	0.117	0.107	0.197	0.003	0.153	0.199	0.207	**2.181**
1947	0.319	0.221	0.127	0.095	0.164	0.000	0.149	0.211	0.180	0.150	0.197	0.254	**2.065**
1948	0.119	0.242	0.311	0.000	0.032	0.055	0.134	0.189	0.150	0.113	0.191	0.235	**1.771**
1949	0.327	0.133	0.221	0.059	0.040	0.170	0.000	0.179	0.174	0.167	0.184	0.250	**1.904**
1950	0.345	0.287	0.016	0.237	0.340	0.000	0.076	0.034	0.181	0.164	0.178	0.173	**2.030**
1951	0.057	0.330	0.360	0.078	0.037	0.204	0.144	0.205	0.097	0.148	0.194	0.256	**2.111**
1952	0.191	0.181	0.167	0.151	0.012	0.000	0.000	0.217	0.181	0.085	0.176	0.249	**1.611**
1953	0.275	0.133	0.127	0.000	0.004	0.130	0.002	0.157	0.173	0.169	0.130	0.242	**1.541**
1954	0.304	0.260	0.061	0.000	0.000	0.000	0.149	0.207	0.095	0.149	0.186	0.240	**1.651**
1955	0.233	0.094	0.000	0.292	0.000	0.000	0.178	0.115	0.176	0.150	0.197	0.134	**1.569**
1956	0.255	0.238	0.245	0.000	0.000	0.045	0.040	0.091	0.130	0.104	0.143	0.178	**1.470**
1957	0.121	0.241	0.051	0.000	0.000	0.209	0.101	0.214	0.168	0.169	0.187	0.100	**1.561**
1958	0.204	0.268	0.000	0.000	0.043	0.128	0.224	0.187	0.174	0.126	0.196	0.241	**1.791**
1959	0.261	0.259	0.070	0.290	0.000	0.089	0.000	0.193	0.077	0.165	0.197	0.237	**1.837**
1960	0.275	0.001	0.000	0.185	0.000	0.000	0.079	0.215	0.020	0.141	0.152	0.254	**1.321**
1961	0.309	0.253	0.278	0.079	0.121	0.075	0.029	0.177	0.181	0.165	0.199	0.239	**2.106**
1962	0.329	0.008	0.089	0.279	0.237	0.081	0.073	0.087	0.061	0.158	0.199	0.251	**1.854**
1963	0.229	0.351	0.204	0.077	0.042	0.255	0.178	0.208	0.178	0.169	0.179	0.259	**2.330**
1964	0.111	0.082	0.116	0.139	0.151	0.188	0.107	0.219	0.143	0.169	0.184	0.212	**1.820**
1965	0.303	0.186	0.250	0.072	0.000	0.207	0.179	0.211	0.158	0.169	0.180	0.170	**2.085**
1966	0.201	0.276	0.164	0.054	0.000	0.000	0.016	0.216	0.159	0.143	0.193	0.256	**1.676**
1967	0.238	0.000	0.296	0.364	0.132	0.169	0.052	0.080	0.141	0.159	0.185	0.257	**2.075**
1968	0.242	0.000	0.131	0.191	0.239	0.000	0.123	0.199	0.163	0.166	0.197	0.195	**1.846**
1969	0.066	0.261	0.185	0.381	0.094	0.212	0.216	0.181	0.134	0.148	0.197	0.255	**2.329**
1970	0.170	0.126	0.037	0.000	0.151	0.174	0.031	0.165	0.158	0.169	0.198	0.211	**1.591**
1971	0.105	0.111	0.145	0.000	0.000	0.000	0.175	0.121	0.178	0.164	0.186	0.251	**1.435**
1972	0.062	0.230	0.282	0.266	0.191	0.049	0.051	0.186	0.163	0.122	0.195	0.056	**1.855**
1973	0.000	0.253	0.000	0.000	0.000	0.000	0.050	0.144	0.177	0.124	0.182	0.091	**1.022**
1974	0.333	0.000	0.139	0.097	0.000	0.051	0.081	0.134	0.162	0.169	0.185	0.259	**1.611**
1975	0.286	0.265	0.000	0.000	0.000	0.000	0.006	0.000	0.153	0.169	0.194	0.250	**1.322**
1976	0.239	0.085	0.262	0.000	0.000	0.000	0.202	0.217	0.180	0.169	0.150	0.027	**1.531**
1977	0.206	0.274	0.035	0.000	0.000	0.074	0.151	0.203	0.173	0.116	0.193	0.244	**1.671**
1978	0.254	0.049	0.321	0.198	0.071	0.000	0.119	0.174	0.170	0.161	0.111	0.241	**1.869**
1979	0.186	0.168	0.172	0.141	0.000	0.074	0.138	0.210	0.181	0.155	0.170	0.141	**1.735**
1980	0.217	0.000	0.271	0.000	0.000	0.000	0.215	0.115	0.181	0.159	0.174	0.189	**1.520**
1981	0.216	0.039	0.261	0.193	0.036	0.286	0.130	0.068	0.181	0.163	0.196	0.257	**2.026**
1982	0.245	0.312	0.299	0.174	0.326	0.072	0.227	0.188	0.159	0.153	0.112	0.262	**2.530**
1983	0.264	0.164	0.351	0.323	0.239	0.022	0.115	0.221	0.176	0.000	0.168	0.163	**2.205**
1984	0.106	0.140	0.366	0.072	0.000	0.000	0.228	0.090	0.155	0.158	0.196	0.000	**1.510**
1985	0.165	0.351	0.125	0.314	0.048	0.232	0.000	0.206	0.179	0.169	0.156	0.223	**2.169**
1986	0.161	0.014	0.108	0.233	0.076	0.174	0.172	0.179	0.166	0.169	0.178	0.144	**1.774**
1987	0.215	0.224	0.000	0.171	0.000	0.000	0.140	0.208	0.045	0.169	0.098	0.200	**1.470**
1988	0.000	0.298	0.301	0.424	0.035	0.220	0.196	0.208	0.100	0.164	0.197	0.255	**2.396**
1989	0.130	0.047	0.075	0.057	0.118	0.054	0.151	0.218	0.181	0.165	0.198	0.263	**1.656**
1990	0.227	0.130	0.188	0.000	0.034	0.000	0.237	0.180	0.133	0.169	0.199	0.263	**1.761**
1991	0.346	0.193	0.270	0.234	0.142	0.024	0.224	0.221	0.099	0.169	0.125	0.263	**2.310**
1992	0.320	0.209	0.000	0.314	0.000	0.096	0.222	0.208	0.153	0.142	0.186	0.263	**2.115**
1993	0.244	0.023	0.205	0.154	0.196	0.216	0.181	0.217	0.181	0.169	0.183	0.253	**2.221**
1994	0.288	0.240	0.242	0.248	0.000	0.032	0.047	0.088	0.176	0.169	0.177	0.254	**1.960**
1995	0.239	0.131	0.283	0.000	0.000	0.200	0.101	0.087	0.157	0.034	0.160	0.240	**1.632**
1996	0.264	0.140	0.252	0.065	0.050	0.000	0.188	0.193	0.181	0.158	0.199	0.104	**1.794**
1997	0.198	0.161	0.356	0.022	0.244	0.186	0.185	0.221	0.181	0.139	0.169	0.234	**2.295**
1998	0.170	0.212	0.030	0.000	0.000	0.000	0.156	0.187	0.155	0.083	0.197	0.262	**1.452**
1999	0.223	0.094	0.030	0.000	0.431	0.000	0.067	0.183	0.167	0.169	0.199	0.243	**1.806**
2000	0.218	0.128	0.203	0.370	0.000	0.021	0.073	0.178	0.170	0.149	0.198	0.230	**1.938**
2001	0.288	0.000	0.000	0.189	0.317	0.245	0.179	0.177	0.080	0.169	0.183	0.237	**2.064**
2002	0.201	0.334	0.300	0.283	0.175	0.017	0.219	0.211	0.144	0.169	0.196	0.224	**2.471**
2003	0.174	0.333	0.000	0.174	0.071	0.000	0.224	0.221	0.143	0.158	0.177	0.244	**1.917**
2004	0.256	0.327	0.122	0.293	0.254	0.204	0.207	0.212	0.173	0.161	0.148	0.263	**2.621**
2005	0.337	0.131	0.128	0.153	0.056	0.004	0.186	0.169	0.130	0.119	0.148	0.210	**1.770**
Average	**0.224**	**0.183**	**0.181**	**0.135**	**0.090**	**0.085**	**0.130**	**0.175**	**0.151**	**0.143**	**0.178**	**0.215**	**1.890**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.084	0.071	0.068	0.050	0.037	0.032	0.050	0.065	0.058	0.053	0.066	0.083	0.060

FIXED AREA IRRIGATION DEMAND TIME SERIES B81F01

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	1.173	1.392	0.928	0.205	0.580	0.700	0.768	0.681	0.396	0.728	0.761	**9.110**
1926	1.061	1.058	1.439	0.636	0.717	0.785	0.661	0.703	0.680	0.476	0.724	0.767	**9.709**
1927	0.437	0.869	1.184	0.731	0.984	0.838	0.542	0.764	0.681	0.635	0.632	0.744	**9.041**
1928	0.976	0.922	1.209	0.814	0.097	0.000	0.644	0.786	0.605	0.580	0.604	0.716	**7.951**
1929	0.727	0.598	0.890	0.850	0.381	0.467	0.185	0.747	0.656	0.593	0.723	0.690	**7.507**
1930	1.069	1.058	0.058	1.159	0.696	0.529	0.375	0.799	0.641	0.364	0.728	0.747	**8.223**
1931	0.787	0.763	1.380	0.990	0.609	0.619	0.472	0.590	0.652	0.648	0.719	0.758	**8.986**
1932	0.910	0.834	0.952	0.000	0.846	0.776	0.667	0.799	0.681	0.648	0.714	0.747	**8.574**
1933	0.994	0.000	1.060	0.604	0.387	0.427	0.559	0.743	0.593	0.648	0.615	0.653	**7.283**
1934	0.582	0.507	1.323	1.467	0.819	0.930	0.710	0.671	0.681	0.648	0.728	0.657	**9.723**
1935	0.903	1.268	1.204	0.164	0.000	0.002	0.665	0.653	0.681	0.555	0.728	0.450	**7.273**
1936	1.076	0.919	1.281	0.629	0.000	0.466	0.590	0.799	0.681	0.648	0.728	0.698	**8.516**
1937	0.941	1.134	0.586	0.325	1.051	0.741	0.148	0.754	0.657	0.640	0.713	0.395	**8.083**
1938	0.855	1.196	0.582	0.925	0.000	0.346	0.659	0.643	0.631	0.481	0.700	0.659	**7.675**
1939	0.634	1.218	0.081	1.463	0.883	0.141	0.560	0.436	0.247	0.648	0.728	0.631	**7.668**
1940	0.796	0.568	0.771	1.059	1.115	0.453	0.210	0.723	0.607	0.574	0.653	0.692	**8.221**
1941	0.836	1.287	0.510	1.045	1.115	0.000	0.710	0.799	0.681	0.648	0.728	0.768	**9.126**
1942	1.076	1.082	1.125	1.510	0.579	0.077	0.022	0.578	0.681	0.209	0.728	0.768	**8.435**
1943	1.076	1.071	1.559	0.966	0.000	0.885	0.710	0.799	0.614	0.648	0.728	0.768	**9.826**
1944	0.654	1.287	1.475	0.941	0.455	0.955	0.552	0.723	0.607	0.574	0.653	0.692	**9.568**
1945	0.741	0.951	1.456	0.000	0.283	0.329	0.611	0.792	0.670	0.614	0.728	0.768	**7.942**
1946	0.666	0.735	0.924	0.845	0.736	0.178	0.696	0.662	0.552	0.613	0.728	0.768	**8.104**
1947	0.881	1.152	0.906	0.885	0.831	0.000	0.658	0.799	0.681	0.621	0.728	0.716	**8.859**
1948	0.426	0.692	1.338	0.083	0.861	0.890	0.512	0.740	0.641	0.548	0.697	0.742	**8.170**
1949	1.023	0.761	0.521	1.207	0.611	0.607	0.342	0.646	0.661	0.648	0.724	0.768	**8.519**
1950	1.018	0.846	0.859	1.371	1.115	0.422	0.249	0.625	0.681	0.645	0.606	0.648	**9.086**
1951	0.510	1.110	1.375	0.941	0.775	0.441	0.514	0.791	0.582	0.564	0.722	0.763	**9.089**
1952	0.755	1.025	0.576	0.675	0.312	0.544	0.276	0.797	0.681	0.624	0.728	0.753	**7.745**
1953	1.005	0.579	1.344	0.813	0.531	0.846	0.091	0.733	0.664	0.648	0.664	0.714	**8.633**
1954	0.750	0.160	0.698	0.888	0.298	0.402	0.554	0.651	0.666	0.646	0.728	0.768	**7.208**
1955	0.785	0.616	0.949	1.424	0.000	0.646	0.643	0.688	0.674	0.611	0.683	0.418	**8.137**
1956	1.027	1.155	0.886	0.720	0.000	0.590	0.599	0.725	0.632	0.557	0.690	0.581	**8.162**
1957	0.590	1.067	1.061	0.000	0.745	0.937	0.452	0.799	0.652	0.631	0.728	0.668	**8.331**
1958	0.961	0.934	0.904	0.108	0.370	0.690	0.647	0.798	0.681	0.571	0.728	0.750	**8.142**
1959	1.036	0.980	0.912	1.293	0.000	0.757	0.175	0.405	0.635	0.625	0.722	0.766	**8.308**
1960	1.053	0.577	0.148	1.229	0.000	0.327	0.457	0.748	0.478	0.637	0.718	0.602	**6.973**
1961	0.896	1.075	1.034	0.918	0.813	0.372	0.253	0.799	0.667	0.648	0.685	0.719	**8.879**
1962	0.970	0.532	0.997	1.480	1.022	0.746	0.580	0.727	0.362	0.542	0.711	0.765	**9.433**
1963	0.877	1.035	1.000	1.111	1.061	0.902	0.608	0.736	0.681	0.648	0.724	0.733	**10.116**
1964	0.610	0.877	0.676	0.953	0.696	0.780	0.646	0.798	0.681	0.648	0.728	0.620	**8.712**
1965	1.030	1.021	1.383	0.421	0.199	0.949	0.659	0.773	0.610	0.648	0.632	0.746	**9.071**
1966	0.729	1.042	0.966	0.165	0.000	0.618	0.364	0.794	0.679	0.532	0.728	0.767	**7.385**
1967	0.866	0.934	1.071	1.134	0.703	0.938	0.548	0.660	0.540	0.647	0.721	0.765	**9.528**
1968	0.905	0.714	0.542	0.767	0.762	0.000	0.546	0.799	0.681	0.615	0.728	0.683	**7.742**
1969	0.364	1.017	1.057	1.489	0.871	0.896	0.646	0.786	0.662	0.581	0.728	0.766	**9.863**
1970	0.926	1.135	0.740	0.509	1.071	0.683	0.500	0.742	0.557	0.648	0.728	0.674	**8.912**
1971	0.702	0.815	0.816	0.269	0.211	0.000	0.622	0.612	0.681	0.634	0.710	0.758	**6.830**
1972	0.684	0.951	1.305	1.136	0.868	0.354	0.403	0.734	0.681	0.618	0.728	0.000	**8.462**
1973	0.711	0.893	0.966	1.006	0.124	0.455	0.430	0.695	0.681	0.334	0.698	0.421	**7.414**
1974	1.023	0.801	1.074	0.408	0.382	0.920	0.368	0.683	0.641	0.648	0.728	0.767	**8.442**
1975	1.066	1.006	0.362	0.133	0.042	0.207	0.528	0.507	0.678	0.648	0.728	0.765	**6.670**
1976	0.909	0.846	1.381	0.403	0.000	0.345	0.688	0.768	0.681	0.648	0.709	0.267	**7.645**
1977	1.024	0.981	0.634	0.477	0.535	0.000	0.219	0.793	0.677	0.643	0.727	0.767	**7.477**
1978	0.633	0.553	0.595	0.912	0.606	0.641	0.548	0.657	0.681	0.623	0.296	0.763	**7.508**
1979	0.589	0.977	0.775	0.756	0.000	0.450	0.510	0.786	0.681	0.648	0.709	0.342	**7.223**
1980	0.802	0.338	0.788	0.000	0.465	0.278	0.668	0.765	0.681	0.648	0.675	0.619	**6.726**
1981	0.704	0.786	1.219	1.304	1.006	0.849	0.526	0.676	0.662	0.647	0.728	0.768	**9.874**
1982	0.932	0.985	1.268	1.209	1.113	0.198	0.699	0.758	0.634	0.638	0.666	0.765	**9.864**
1983	0.865	0.480	1.154	0.957	0.973	0.344	0.554	0.799	0.634	0.261	0.695	0.495	**8.212**
1984	0.260	0.737	1.178	0.000	0.318	0.380	0.669	0.557	0.585	0.558	0.728	0.708	**6.678**
1985	0.415	0.939	1.027	1.311	0.618	0.896	0.043	0.795	0.681	0.648	0.694	0.717	**8.783**
1986	0.909	0.802	0.925	1.209	0.739	0.189	0.701	0.685	0.666	0.648	0.492	0.357	**8.323**
1987	0.696	1.117	0.391	1.104	0.000	0.225	0.686	0.792	0.593	0.648	0.668	0.668	**7.587**
1988	0.478	1.150	1.232	1.376	0.495	0.830	0.663	0.737	0.600	0.646	0.728	0.768	**9.701**
1989	0.508	0.175	0.786	1.021	0.949	0.255	0.513	0.799	0.681	0.622	0.724	0.768	**7.801**
1990	0.691	0.876	0.858	0.956	0.466	0.357	0.690	0.772	0.528	0.648	0.728	0.762	**8.330**
1991	1.057	0.854	1.342	1.100	1.034	0.501	0.639	0.799	0.607	0.648	0.713	0.768	**10.061**
1992	1.066	0.992	0.832	1.224	0.774	0.634	0.587	0.788	0.681	0.627	0.719	0.768	**9.691**
1993	0.859	0.686	0.648	0.894	1.091	0.710	0.551	0.787	0.681	0.648	0.728	0.720	**9.001**
1994	0.673	1.237	1.275	0.703	0.552	0.616	0.300	0.620	0.681	0.648	0.704	0.747	**8.754**
1995	0.816	0.915	1.261	0.424	0.000	0.329	0.585	0.590	0.654	0.348	0.705	0.726	**7.352**
1996	0.763	0.775	1.437	0.435	0.174	0.472	0.491	0.688	0.681	0.648	0.715	0.546	**7.825**
1997	0.910	0.439	1.424	0.954	1.090	0.917	0.616	0.799	0.681	0.630	0.709	0.725	**9.894**
1998	0.733	0.781	0.562	0.827	0.623	0.348	0.462	0.718	0.680	0.606	0.718	0.768	**7.826**
1999	0.545	0.732	0.789	0.448	0.000	0.000	0.339	0.780	0.543	0.623	0.727	0.749	**6.273**
2000	0.841	0.767	1.228	1.370	0.000	0.604	0.590	0.757	0.648	0.642	0.726	0.768	**8.940**
2001	0.461	0.046	0.540	0.607	1.098	0.933	0.383	0.784	0.638	0.647	0.728	0.518	**7.382**
2002	0.975	1.232	1.020	0.928	0.616	0.669	0.683	0.799	0.548	0.648	0.728	0.721	**9.567**
2003	0.859	1.046	1.121	1.197	0.000	0.129	0.460	0.797	0.618	0.639	0.708	0.760	**8.336**
2004	0.938	0.953	1.051	0.928	0.895	0.876	0.591	0.790	0.681	0.641	0.728	0.768	**9.839**
2005	1.057	0.685	1.346	0.893	0.497	0.337	0.635	0.722	0.606	0.573	0.652	0.691	**8.695**
Average	**0.804**	**0.863**	**0.975**	**0.833**	**0.543**	**0.515**	**0.516**	**0.727**	**0.638**	**0.599**	**0.700**	**0.681**	**8.402**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.300	0.333	0.364	0.311	0.222	0.192	0.199	0.271	0.246	0.224	0.261	0.263	0.266

FIXED AREA IRRIGATION DEMAND TIME SERIES B81F10

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.331	0.373	0.197	0.000	0.166	0.210	0.254	0.231	0.120	0.254	0.254	**2.606**
1926	0.323	0.284	0.393	0.085	0.181	0.248	0.194	0.227	0.231	0.153	0.253	0.256	**2.827**
1927	0.073	0.208	0.290	0.120	0.288	0.270	0.145	0.253	0.231	0.219	0.214	0.247	**2.558**
1928	0.288	0.229	0.299	0.152	0.000	0.000	0.187	0.262	0.200	0.196	0.203	0.235	**2.251**
1929	0.187	0.102	0.174	0.166	0.049	0.121	0.002	0.246	0.221	0.202	0.252	0.224	**1.946**
1930	0.326	0.284	0.000	0.288	0.172	0.145	0.078	0.267	0.215	0.107	0.254	0.248	**2.385**
1931	0.211	0.166	0.369	0.221	0.138	0.181	0.117	0.181	0.219	0.224	0.250	0.253	**2.530**
1932	0.261	0.194	0.198	0.000	0.232	0.245	0.196	0.267	0.231	0.224	0.248	0.248	**2.546**
1933	0.295	0.000	0.241	0.072	0.051	0.105	0.152	0.244	0.195	0.224	0.207	0.209	**1.996**
1934	0.129	0.067	0.345	0.413	0.221	0.308	0.214	0.214	0.231	0.224	0.254	0.211	**2.832**
1935	0.258	0.370	0.298	0.000	0.000	0.000	0.195	0.207	0.231	0.186	0.254	0.126	**2.125**
1936	0.329	0.228	0.329	0.082	0.000	0.121	0.165	0.267	0.231	0.224	0.254	0.228	**2.458**
1937	0.273	0.315	0.059	0.000	0.316	0.230	0.000	0.249	0.221	0.221	0.248	0.104	**2.235**
1938	0.239	0.340	0.057	0.196	0.000	0.073	0.193	0.202	0.210	0.155	0.242	0.212	**2.119**
1939	0.150	0.349	0.000	0.411	0.247	0.000	0.153	0.118	0.054	0.224	0.254	0.200	**2.160**
1940	0.215	0.090	0.129	0.248	0.342	0.115	0.012	0.236	0.200	0.194	0.223	0.225	**2.229**
1941	0.231	0.377	0.031	0.243	0.342	0.000	0.214	0.267	0.231	0.224	0.254	0.257	**2.671**
1942	0.329	0.294	0.266	0.431	0.126	0.000	0.000	0.176	0.231	0.045	0.254	0.257	**2.408**
1943	0.329	0.289	0.442	0.212	0.000	0.289	0.214	0.267	0.204	0.224	0.254	0.257	**2.981**
1944	0.158	0.377	0.407	0.202	0.078	0.318	0.149	0.236	0.200	0.194	0.223	0.225	**2.767**
1945	0.192	0.241	0.399	0.000	0.012	0.067	0.173	0.264	0.227	0.210	0.254	0.257	**2.297**
1946	0.163	0.155	0.187	0.165	0.188	0.009	0.208	0.210	0.178	0.210	0.254	0.257	**2.184**
1947	0.249	0.322	0.180	0.180	0.227	0.000	0.193	0.267	0.231	0.213	0.254	0.235	**2.552**
1948	0.069	0.138	0.351	0.000	0.238	0.291	0.133	0.243	0.215	0.183	0.241	0.246	**2.348**
1949	0.307	0.165	0.035	0.307	0.139	0.176	0.065	0.204	0.223	0.224	0.253	0.257	**2.355**
1950	0.305	0.199	0.162	0.374	0.342	0.103	0.028	0.195	0.231	0.223	0.203	0.207	**2.573**
1951	0.101	0.305	0.366	0.202	0.204	0.111	0.134	0.264	0.190	0.189	0.252	0.255	**2.573**
1952	0.198	0.271	0.055	0.099	0.023	0.151	0.038	0.266	0.231	0.214	0.254	0.251	**2.052**
1953	0.300	0.095	0.354	0.152	0.107	0.273	0.000	0.240	0.224	0.224	0.227	0.234	**2.431**
1954	0.196	0.000	0.100	0.181	0.018	0.095	0.150	0.206	0.225	0.224	0.254	0.257	**1.906**
1955	0.210	0.109	0.197	0.395	0.000	0.192	0.186	0.221	0.228	0.209	0.235	0.113	**2.297**
1956	0.309	0.323	0.173	0.116	0.000	0.170	0.169	0.237	0.211	0.187	0.238	0.179	**2.311**
1957	0.133	0.288	0.241	0.000	0.192	0.310	0.109	0.267	0.219	0.217	0.254	0.215	**2.446**
1958	0.282	0.234	0.180	0.000	0.045	0.210	0.188	0.267	0.231	0.192	0.254	0.249	**2.332**
1959	0.312	0.253	0.183	0.342	0.000	0.237	0.000	0.106	0.212	0.215	0.252	0.256	**2.367**
1960	0.319	0.094	0.000	0.316	0.000	0.066	0.111	0.246	0.147	0.220	0.250	0.188	**1.957**
1961	0.255	0.291	0.230	0.193	0.219	0.084	0.029	0.267	0.225	0.224	0.236	0.236	**2.491**
1962	0.285	0.076	0.216	0.418	0.304	0.233	0.161	0.237	0.100	0.180	0.247	0.255	**2.713**
1963	0.248	0.275	0.217	0.269	0.320	0.296	0.172	0.241	0.231	0.224	0.252	0.242	**2.987**
1964	0.140	0.211	0.092	0.207	0.172	0.246	0.188	0.267	0.231	0.224	0.254	0.195	**2.429**
1965	0.310	0.269	0.370	0.005	0.000	0.315	0.193	0.256	0.202	0.224	0.214	0.248	**2.606**
1966	0.188	0.278	0.204	0.000	0.000	0.181	0.074	0.265	0.231	0.176	0.254	0.256	**2.106**
1967	0.243	0.234	0.245	0.278	0.175	0.311	0.148	0.209	0.173	0.224	0.251	0.256	**2.747**
1968	0.259	0.147	0.043	0.134	0.199	0.000	0.147	0.267	0.231	0.211	0.254	0.221	**2.113**
1969	0.045	0.268	0.239	0.422	0.242	0.294	0.188	0.262	0.223	0.197	0.254	0.256	**2.888**
1970	0.267	0.315	0.117	0.037	0.324	0.207	0.128	0.243	0.180	0.224	0.254	0.218	**2.515**
1971	0.177	0.187	0.146	0.000	0.000	0.000	0.178	0.190	0.231	0.218	0.247	0.253	**1.826**
1972	0.170	0.241	0.338	0.279	0.241	0.077	0.089	0.240	0.231	0.212	0.254	0.000	**2.372**
1973	0.180	0.218	0.204	0.228	0.000	0.116	0.100	0.224	0.231	0.095	0.241	0.115	**1.952**
1974	0.307	0.181	0.246	0.000	0.050	0.303	0.075	0.219	0.214	0.224	0.254	0.256	**2.331**
1975	0.324	0.263	0.000	0.000	0.000	0.020	0.140	0.147	0.230	0.224	0.254	0.256	**1.858**
1976	0.260	0.199	0.369	0.000	0.000	0.073	0.205	0.254	0.231	0.224	0.246	0.053	**2.115**
1977	0.307	0.253	0.077	0.025	0.109	0.000	0.016	0.265	0.230	0.222	0.253	0.256	**2.014**
1978	0.150	0.085	0.062	0.190	0.137	0.190	0.148	0.209	0.231	0.214	0.077	0.255	**1.947**
1979	0.132	0.251	0.130	0.130	0.000	0.114	0.133	0.262	0.231	0.224	0.246	0.083	**1.936**
1980	0.217	0.003	0.135	0.000	0.082	0.047	0.197	0.253	0.231	0.224	0.232	0.195	**1.816**
1981	0.178	0.175	0.304	0.346	0.297	0.275	0.139	0.216	0.223	0.224	0.254	0.257	**2.888**
1982	0.270	0.254	0.323	0.308	0.341	0.016	0.209	0.250	0.212	0.220	0.228	0.256	**2.888**
1983	0.242	0.057	0.278	0.208	0.284	0.073	0.150	0.267	0.212	0.066	0.240	0.144	**2.221**
1984	0.005	0.156	0.287	0.000	0.025	0.087	0.197	0.168	0.191	0.187	0.254	0.232	**1.789**
1985	0.064	0.236	0.228	0.349	0.141	0.293	0.000	0.265	0.231	0.224	0.240	0.236	**2.508**
1986	0.260	0.182	0.188	0.308	0.189	0.013	0.210	0.220	0.225	0.224	0.156	0.089	**2.265**
1987	0.175	0.308	0.000	0.266	0.000	0.027	0.204	0.264	0.195	0.224	0.229	0.215	**2.106**
1988	0.089	0.321	0.309	0.376	0.093	0.266	0.194	0.241	0.198	0.223	0.254	0.257	**2.822**
1989	0.100	0.000	0.134	0.233	0.274	0.038	0.133	0.267	0.231	0.214	0.253	0.257	**2.135**
1990	0.173	0.211	0.162	0.208	0.082	0.078	0.206	0.256	0.168	0.224	0.254	0.254	**2.274**
1991	0.321	0.202	0.353	0.264	0.309	0.134	0.185	0.267	0.201	0.224	0.248	0.257	**2.965**
1992	0.325	0.257	0.152	0.314	0.203	0.187	0.164	0.262	0.231	0.216	0.250	0.257	**2.818**
1993	0.240	0.136	0.082	0.183	0.332	0.218	0.149	0.262	0.231	0.224	0.254	0.237	**2.549**
1994	0.166	0.357	0.326	0.110	0.115	0.180	0.048	0.193	0.231	0.224	0.244	0.248	**2.442**
1995	0.223	0.227	0.321	0.006	0.000	0.067	0.163	0.181	0.220	0.101	0.244	0.239	**1.991**
1996	0.201	0.171	0.392	0.010	0.000	0.123	0.125	0.221	0.231	0.224	0.249	0.165	**2.112**
1997	0.261	0.041	0.387	0.207	0.332	0.302	0.175	0.267	0.231	0.217	0.246	0.239	**2.905**
1998	0.189	0.173	0.050	0.157	0.143	0.074	0.113	0.233	0.231	0.207	0.250	0.257	**2.079**
1999	0.115	0.154	0.135	0.015	0.000	0.000	0.064	0.259	0.174	0.214	0.253	0.249	**1.632**
2000	0.233	0.168	0.307	0.373	0.000	0.175	0.165	0.250	0.217	0.222	0.253	0.257	**2.620**
2001	0.082	0.000	0.042	0.074	0.335	0.309	0.081	0.261	0.213	0.224	0.254	0.154	**2.028**
2002	0.287	0.355	0.225	0.197	0.141	0.201	0.203	0.267	0.176	0.224	0.254	0.237	**2.767**
2003	0.240	0.279	0.265	0.303	0.000	0.000	0.112	0.266	0.205	0.221	0.246	0.254	**2.392**
2004	0.272	0.242	0.237	0.197	0.252	0.285	0.165	0.263	0.231	0.221	0.254	0.257	**2.877**
2005	0.321	0.136	0.355	0.183	0.094	0.070	0.183	0.235	0.200	0.193	0.222	0.225	**2.418**
Average	**0.222**	**0.211**	**0.215**	**0.180**	**0.137**	**0.148**	**0.137**	**0.237**	**0.213**	**0.204**	**0.242**	**0.222**	**2.369**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.083	0.082	0.080	0.067	0.056	0.055	0.053	0.089	0.082	0.076	0.091	0.086	0.075

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81F20**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.633	0.720	0.412	0.021	0.321	0.404	0.463	0.415	0.224	0.451	0.470	**4.962**
1926	0.608	0.554	0.753	0.219	0.363	0.461	0.376	0.417	0.415	0.279	0.449	0.474	**5.368**
1927	0.183	0.426	0.578	0.281	0.545	0.498	0.294	0.460	0.415	0.390	0.384	0.458	**4.912**
1928	0.550	0.461	0.595	0.336	0.000	0.000	0.365	0.475	0.362	0.351	0.365	0.438	**4.297**
1929	0.379	0.244	0.380	0.360	0.137	0.245	0.050	0.448	0.397	0.361	0.448	0.420	**3.869**
1930	0.614	0.555	0.000	0.568	0.348	0.286	0.180	0.484	0.387	0.202	0.451	0.460	**4.535**
1931	0.420	0.354	0.712	0.454	0.289	0.348	0.246	0.338	0.394	0.399	0.445	0.468	**4.867**
1932	0.504	0.402	0.421	0.000	0.450	0.455	0.380	0.484	0.415	0.399	0.442	0.460	**4.813**
1933	0.562	0.000	0.494	0.198	0.141	0.218	0.306	0.445	0.353	0.399	0.372	0.395	**3.883**
1934	0.281	0.184	0.673	0.780	0.432	0.561	0.411	0.395	0.415	0.399	0.451	0.397	**5.377**
1935	0.499	0.699	0.591	0.000	0.000	0.000	0.379	0.382	0.415	0.334	0.451	0.254	**4.006**
1936	0.619	0.460	0.644	0.214	0.000	0.244	0.328	0.484	0.415	0.399	0.451	0.426	**4.684**
1937	0.525	0.607	0.181	0.019	0.591	0.431	0.026	0.453	0.398	0.393	0.440	0.216	**4.279**
1938	0.466	0.649	0.178	0.410	0.000	0.163	0.375	0.375	0.380	0.282	0.432	0.399	**4.109**
1939	0.316	0.664	0.000	0.777	0.476	0.028	0.306	0.232	0.115	0.399	0.451	0.379	**4.143**
1940	0.426	0.224	0.302	0.501	0.635	0.235	0.067	0.431	0.363	0.347	0.399	0.422	**4.352**
1941	0.453	0.712	0.131	0.491	0.635	0.000	0.411	0.484	0.415	0.399	0.451	0.475	**5.057**
1942	0.619	0.571	0.538	0.809	0.269	0.000	0.000	0.330	0.415	0.095	0.451	0.475	**4.573**
1943	0.619	0.564	0.836	0.438	0.000	0.530	0.411	0.484	0.368	0.399	0.451	0.475	**5.574**
1944	0.330	0.712	0.777	0.421	0.187	0.578	0.301	0.431	0.363	0.347	0.399	0.422	**5.268**
1945	0.388	0.482	0.764	0.000	0.073	0.152	0.342	0.479	0.407	0.375	0.451	0.475	**4.388**
1946	0.338	0.335	0.403	0.357	0.376	0.052	0.401	0.388	0.325	0.375	0.451	0.475	**4.275**
1947	0.485	0.619	0.391	0.383	0.440	0.000	0.374	0.484	0.415	0.380	0.451	0.439	**4.862**
1948	0.176	0.306	0.683	0.000	0.461	0.534	0.273	0.443	0.387	0.329	0.430	0.456	**4.479**
1949	0.582	0.353	0.139	0.601	0.291	0.339	0.157	0.378	0.401	0.399	0.449	0.475	**4.563**
1950	0.578	0.410	0.360	0.714	0.635	0.215	0.094	0.363	0.415	0.397	0.366	0.391	**4.937**
1951	0.233	0.591	0.708	0.421	0.402	0.227	0.275	0.479	0.346	0.340	0.447	0.471	**4.939**
1952	0.398	0.532	0.174	0.244	0.092	0.297	0.112	0.483	0.415	0.382	0.451	0.464	**4.044**
1953	0.570	0.231	0.687	0.335	0.237	0.503	0.000	0.438	0.403	0.399	0.407	0.437	**4.648**
1954	0.395	0.000	0.253	0.385	0.083	0.201	0.302	0.381	0.405	0.398	0.451	0.475	**3.728**
1955	0.419	0.256	0.420	0.750	0.000	0.366	0.364	0.406	0.410	0.373	0.420	0.232	**4.415**
1956	0.585	0.621	0.378	0.274	0.000	0.328	0.334	0.433	0.381	0.336	0.424	0.344	**4.437**
1957	0.286	0.561	0.495	0.000	0.382	0.566	0.233	0.484	0.395	0.387	0.451	0.405	**4.644**
1958	0.540	0.470	0.390	0.000	0.130	0.396	0.367	0.483	0.415	0.345	0.451	0.462	**4.448**
1959	0.591	0.501	0.395	0.660	0.000	0.442	0.044	0.211	0.383	0.383	0.447	0.474	**4.531**
1960	0.603	0.230	0.000	0.616	0.000	0.151	0.236	0.448	0.274	0.391	0.444	0.359	**3.751**
1961	0.495	0.566	0.476	0.405	0.428	0.181	0.097	0.484	0.405	0.399	0.421	0.440	**4.798**
1962	0.546	0.200	0.451	0.789	0.571	0.435	0.320	0.434	0.193	0.325	0.439	0.473	**5.176**
1963	0.482	0.539	0.454	0.536	0.598	0.542	0.340	0.440	0.415	0.399	0.448	0.451	**5.642**
1964	0.300	0.431	0.239	0.429	0.348	0.458	0.366	0.484	0.415	0.399	0.451	0.371	**4.690**
1965	0.587	0.529	0.714	0.080	0.018	0.575	0.375	0.466	0.366	0.399	0.384	0.459	**4.950**
1966	0.381	0.544	0.431	0.000	0.000	0.347	0.172	0.480	0.414	0.318	0.451	0.474	**4.012**
1967	0.474	0.470	0.502	0.551	0.353	0.567	0.298	0.387	0.317	0.398	0.446	0.473	**5.237**
1968	0.501	0.321	0.152	0.305	0.393	0.000	0.297	0.484	0.415	0.376	0.451	0.415	**4.111**
1969	0.135	0.527	0.492	0.795	0.467	0.538	0.366	0.475	0.402	0.352	0.451	0.473	**5.473**
1970	0.515	0.607	0.281	0.136	0.605	0.391	0.265	0.444	0.328	0.399	0.451	0.409	**4.833**
1971	0.362	0.390	0.331	0.000	0.025	0.000	0.349	0.354	0.415	0.389	0.439	0.468	**3.522**
1972	0.350	0.482	0.660	0.552	0.465	0.169	0.199	0.439	0.415	0.378	0.451	0.000	**4.560**
1973	0.368	0.442	0.431	0.465	0.000	0.236	0.217	0.412	0.415	0.181	0.430	0.234	**3.831**
1974	0.582	0.380	0.504	0.071	0.138	0.554	0.175	0.403	0.387	0.399	0.451	0.474	**4.518**
1975	0.612	0.519	0.038	0.000	0.000	0.071	0.284	0.281	0.413	0.399	0.451	0.473	**3.541**
1976	0.503	0.410	0.713	0.068	0.000	0.163	0.395	0.462	0.415	0.399	0.438	0.129	**4.095**
1977	0.583	0.502	0.212	0.116	0.240	0.000	0.074	0.480	0.412	0.396	0.450	0.474	**3.937**
1978	0.315	0.214	0.186	0.401	0.288	0.363	0.299	0.385	0.415	0.382	0.152	0.471	**3.871**
1979	0.285	0.499	0.304	0.298	0.000	0.233	0.272	0.475	0.415	0.399	0.438	0.180	**3.798**
1980	0.430	0.073	0.312	0.000	0.193	0.118	0.381	0.460	0.415	0.399	0.414	0.371	**3.566**
1981	0.363	0.369	0.602	0.667	0.560	0.506	0.283	0.398	0.402	0.398	0.451	0.475	**5.474**
1982	0.519	0.505	0.635	0.602	0.634	0.065	0.402	0.455	0.382	0.392	0.408	0.473	**5.473**
1983	0.473	0.166	0.558	0.432	0.538	0.162	0.302	0.484	0.382	0.131	0.428	0.284	**4.341**
1984	0.067	0.336	0.574	0.000	0.096	0.186	0.382	0.316	0.348	0.336	0.451	0.433	**3.525**
1985	0.169	0.473	0.472	0.672	0.295	0.537	0.000	0.481	0.415	0.399	0.427	0.439	**4.780**
1986	0.503	0.380	0.404	0.602	0.377	0.059	0.404	0.405	0.404	0.399	0.287	0.190	**4.416**
1987	0.358	0.595	0.056	0.530	0.000	0.083	0.394	0.479	0.353	0.399	0.409	0.405	**4.061**
1988	0.211	0.618	0.611	0.716	0.213	0.492	0.378	0.441	0.358	0.397	0.451	0.475	**5.361**
1989	0.231	0.000	0.311	0.475	0.521	0.103	0.274	0.484	0.415	0.381	0.449	0.475	**4.118**
1990	0.355	0.430	0.359	0.431	0.194	0.170	0.397	0.465	0.308	0.399	0.451	0.470	**4.429**
1991	0.605	0.416	0.686	0.528	0.580	0.267	0.361	0.484	0.363	0.399	0.441	0.475	**5.605**
1992	0.612	0.509	0.342	0.612	0.401	0.358	0.325	0.476	0.415	0.384	0.445	0.475	**5.354**
1993	0.469	0.303	0.220	0.389	0.619	0.410	0.300	0.476	0.415	0.399	0.451	0.441	**4.892**
1994	0.342	0.678	0.640	0.263	0.251	0.346	0.129	0.359	0.415	0.399	0.434	0.460	**4.715**
1995	0.440	0.457	0.631	0.081	0.000	0.152	0.324	0.339	0.396	0.190	0.435	0.445	**3.890**
1996	0.403	0.362	0.751	0.089	0.002	0.248	0.259	0.406	0.415	0.399	0.442	0.320	**4.097**
1997	0.504	0.139	0.742	0.429	0.618	0.552	0.345	0.484	0.415	0.387	0.438	0.445	**5.498**
1998	0.383	0.366	0.165	0.345	0.299	0.165	0.239	0.427	0.414	0.370	0.444	0.475	**4.092**
1999	0.256	0.333	0.313	0.097	0.000	0.000	0.155	0.471	0.318	0.381	0.450	0.462	**3.236**
2000	0.457	0.357	0.608	0.712	0.000	0.337	0.327	0.455	0.392	0.395	0.450	0.475	**4.964**
2001	0.200	0.000	0.151	0.200	0.624	0.564	0.185	0.473	0.385	0.398	0.451	0.300	**3.930**
2002	0.549	0.675	0.467	0.412	0.294	0.381	0.392	0.484	0.323	0.399	0.451	0.442	**5.268**
2003	0.469	0.547	0.535	0.594	0.000	0.019	0.238	0.483	0.371	0.393	0.437	0.470	**4.556**
2004	0.523	0.483	0.488	0.412	0.484	0.524	0.328	0.478	0.415	0.394	0.451	0.475	**5.454**
2005	0.606	0.302	0.689	0.389	0.215	0.158	0.358	0.430	0.362	0.347	0.398	0.421	**4.674**
Average	**0.435**	**0.427**	**0.445**	**0.372**	**0.272**	**0.286**	**0.278**	**0.434**	**0.385**	**0.365**	**0.432**	**0.415**	**4.548**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.162	0.165	0.166	0.139	0.112	0.107	0.107	0.162	0.148	0.136	0.161	0.160	0.144

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81F30**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	2.100	2.307	1.350	0.191	1.179	1.279	1.471	1.325	0.757	1.521	1.709	**16.703**
1926	2.074	1.854	2.408	0.748	1.253	1.615	1.194	1.329	1.324	0.931	1.514	1.723	**17.968**
1927	0.751	1.455	1.864	0.942	1.822	1.728	0.939	1.462	1.325	1.277	1.309	1.672	**16.546**
1928	1.892	1.565	1.916	1.113	0.000	0.000	1.158	1.509	1.159	1.156	1.249	1.610	**14.327**
1929	1.360	0.887	1.249	1.188	0.553	0.940	0.178	1.425	1.270	1.186	1.511	1.551	**13.299**
1930	2.092	1.856	0.000	1.836	1.208	1.070	0.581	1.538	1.237	0.689	1.521	1.679	**15.307**
1931	1.487	1.230	2.281	1.480	1.025	1.261	0.788	1.083	1.261	1.306	1.502	1.703	**16.409**
1932	1.749	1.381	1.377	0.000	1.527	1.595	1.207	1.538	1.325	1.306	1.492	1.678	**16.176**
1933	1.930	0.000	1.604	0.682	0.564	0.857	0.975	1.415	1.133	1.306	1.273	1.471	**13.211**
1934	1.055	0.701	2.159	2.494	1.469	1.926	1.302	1.259	1.325	1.306	1.521	1.479	**17.995**
1935	1.735	2.305	1.906	0.000	0.000	0.000	1.203	1.221	1.325	1.103	1.521	1.028	**13.346**
1936	2.106	1.560	2.070	0.733	0.000	0.939	1.042	1.538	1.325	1.306	1.521	1.570	**15.712**
1937	1.816	2.018	0.627	0.125	1.964	1.520	0.101	1.441	1.272	1.288	1.488	0.906	**14.566**
1938	1.632	2.149	0.618	1.344	0.000	0.687	1.190	1.198	1.216	0.941	1.460	1.484	**13.919**
1939	1.163	2.197	0.000	2.484	1.605	0.265	0.976	0.752	0.389	1.306	1.521	1.423	**14.081**
1940	1.507	0.826	1.004	1.625	2.102	0.911	0.231	1.373	1.163	1.144	1.356	1.557	**14.800**
1941	1.591	2.345	0.474	1.596	2.102	0.000	1.302	1.538	1.325	1.306	1.521	1.725	**16.825**
1942	2.106	1.906	1.740	2.587	0.963	0.133	0.000	1.058	1.325	0.356	1.521	1.725	**15.422**
1943	2.106	1.883	2.666	1.430	0.000	1.829	1.302	1.538	1.179	1.306	1.521	1.725	**18.487**
1944	1.206	2.345	2.485	1.378	0.705	1.979	0.960	1.373	1.163	1.144	1.356	1.557	**17.651**
1945	1.389	1.627	2.444	0.000	0.351	0 652	1.086	1.523	1.302	1.232	1.521	1.725	**14.851**
1946	1.232	1.172	1.320	1.178	1.294	0.340	1.271	1.239	1.044	1.230	1.521	1.725	**14.566**
1947	1.689	2.055	1.282	1.261	1.495	0.000	1.189	1.538	1.325	1.247	1.521	1.611	**16.213**
1948	0.729	1.082	2.191	0.000	1.558	1.840	0.873	1.410	1.238	1.088	1.453	1.667	**15.131**
1949	1.993	1.227	0.496	1.937	1.031	1.235	0.510	1.206	1.281	1.306	1.513	1.725	**15.461**
1950	1.981	1.404	1.185	2.288	2.102	0.847	0.314	1.161	1.325	1.300	1.253	1.460	**16.620**
1951	0.904	1.967	2.270	1.378	1.375	0.887	0.878	1.521	1.109	1.121	1.510	1.714	**16.633**
1952	1.419	1.785	0.606	0.827	0.410	1.103	0.370	1.534	1.325	1.253	1.521	1.692	**13.846**
1953	1.953	0.849	2.205	1.111	0.863	1.745	0.000	1.395	1.288	1.306	1.381	1.606	**15.702**
1954	1.409	0.000	0.853	1.266	0.382	0.804	0.963	1.216	1.293	1.302	1.521	1.725	**12.735**
1955	1.484	0.924	1.372	2.400	0.000	1.319	1.155	1.295	1.310	1.226	1.422	0.957	**14.864**
1956	2.001	2.061	1.241	0.919	0.000	1.200	1.062	1.378	1.218	1.107	1.437	1.312	**14.937**
1957	1.071	1.874	1.605	0.000	1.312	1.942	0.746	1.538	1.263	1.269	1.521	1.504	**15.645**
1958	1.860	1.590	1.278	0.000	0.529	1.412	1.164	1.536	1.325	1.137	1.521	1.686	**15.038**
1959	2.021	1.689	1.295	2.120	0.000	1.555	0.159	0.686	1.225	1.256	1.510	1.721	**15.237**
1960	2.057	0.844	0.000	1.984	0.000	0.648	0.757	1.426	0.884	1.282	1.500	1 359	**12.739**
1961	1.720	1.891	1.548	1.329	1.457	0.741	0.323	1.538	1.295	1.306	1.427	1.616	**16.191**
1962	1.879	0.751	1.471	2.522	1.903	1.532	1.020	1.381	0.634	1.074	1.484	1.718	**17.367**
1963	1.680	1.805	1.478	1.734	1.987	1.865	1.081	1.401	1.324	1.306	1.512	1.648	**18.820**
1964	1.113	1.470	0.809	1.402	1.209	1.604	1.162	1.537	1.324	1.306	1.521	1.397	**15.855**
1965	2.006	1.776	2.288	0.315	0.179	1.968	1.191	1.481	1.171	1.306	1.310	1.676	**16.666**
1966	1.365	1.821	1.407	0.000	0.000	1.259	0.558	1.527	1.322	1.052	1.521	1.722	**13.554**
1967	1.656	1.592	1.627	1.783	1.224	1.944	0.951	1.235	1.019	1.303	1.506	1.720	**17.558**
1968	1.739	1.129	0.539	1.016	1.349	0.000	0.948	1.538	1.325	1.233	1.521	1.536	**13.873**
1969	0.601	1.768	1.596	2.541	1.579	1.854	1.162	1.509	1.284	1.160	1.521	1.720	**18.296**
1970	1.784	2.018	0.941	0.490	2.009	1.396	0.847	1.414	1.054	1.306	1.521	1.518	**16.298**
1971	1.306	1.341	1.096	0.016	0.203	0.000	1.110	1.133	1.325	1.275	1.483	1.702	**11.990**
1972	1.268	1.628	2.120	1.787	1.573	0.704	0.642	1.397	1.325	1.240	1.521	0.000	**15.205**
1973	1.325	1.504	1.407	1.514	0.028	0.914	0.698	1.312	1.325	0.625	1.455	0.964	**13.072**
1974	1.992	1.311	1.633	0.289	0.554	1.904	0.567	1.285	1.237	1.306	1.521	1.722	**15.322**
1975	2.084	1.744	0.182	0.000	0.000	0.399	0.907	0.906	1.319	1.306	1.521	1.719	**12.088**
1976	1.747	1.405	2.283	0.280	0.000	0.686	1.253	1.470	1.325	1.306	1.480	0.633	**13.868**
1977	1.995	1.690	0.725	0.427	0.870	0.000	0.251	1.525	1.317	1.296	1.519	1.722	**13.336**
1978	1.162	0.794	0.645	1.316	1.020	1.308	0.952	1.230	1.324	1.252	0.581	1.713	**13.298**
1979	1.068	1.683	1.012	0.994	0.000	0.905	0.871	1.509	1.325	1.306	1.480	0.794	**12.945**
1980	1.518	0.355	1.037	0.000	0.726	0.546	1.210	1.463	1.325	1.306	1.406	1.397	**12.289**
1981	1.312	1.279	1.939	2.144	1.869	1.753	0.903	1.270	1.283	1.303	1.521	1.725	**18.300**
1982	1.797	1.699	2.041	1.942	2.098	0.380	1.276	1.449	1.222	1.285	1.386	1.718	**18.294**
1983	1.653	0.645	1.801	1.411	1.799	0.684	0.964	1.538	1.223	0 467	1.450	1.123	**14.759**
1984	0.387	1.176	1.852	0.000	0.422	0.759	1.212	1.014	1.116	1.109	1.521	1.592	**12.159**
1985	0.705	1.601	1.535	2.158	1.044	1.852	0.000	1.530	1.325	1.306	1.446	1.613	**16.115**
1986	1.747	1.313	1.322	1.942	1.299	0.362	1.282	1.291	1.292	1.306	1.005	0.826	**14.988**
1987	1.294	1.980	0.239	1.718	0.000	0.438	1.249	1.523	1.133	1.306	1.390	1.503	**13.771**
1988	0.836	2.051	1.967	2.297	0.788	1.710	1.199	1.403	1.148	1.301	1.521	1.725	**17.946**
1989	0.900	0.029	1.033	1.545	1.747	0.499	0.875	1.538	1.325	1.249	1.513	1.725	**13.978**
1990	1.285	1.468	1.182	1.408	0.728	0.710	1.258	1.479	0.991	1.306	1.521	1.711	**15.047**
1991	2.064	1.423	2.201	1.710	1.929	1.011	1.146	1.538	1.164	1.306	1.489	1.725	**18.707**
1992	2.085	1.714	1.128	1.973	1.374	1.293	1.036	1.513	1.325	1.260	1.502	1.725	**17.927**
1993	1.640	1.071	0.751	1.278	2.052	1.454	0.958	1.512	1.325	1.306	1.521	1.618	**16.486**
1994	1.246	2.238	2.056	0.884	0.906	1 255	0.422	1.148	1.325	1.306	1.468	1.678	**15.933**
1995	1.548	1.551	2.028	0.321	0.000	0.651	1.031	1.085	1.265	0 653	1.471	1.632	**13.237**
1996	1.435	1.255	2.403	0.343	0.129	0.952	0.830	1.296	1.325	1.305	1.493	1.236	**14.003**
1997	1.749	0.561	2.376	1.404	2.049	1.897	1.097	1.538	1.325	1.267	1.480	1.630	**18.373**
1998	1.373	1.269	0.579	1.139	1.055	0.692	0.767	1.361	1.323	1.214	1.500	1.725	**13.997**
1999	0.976	1.166	1.039	0.369	0.000	0.000	0.505	1.496	1.024	1.251	1.519	1.683	**11.028**
2000	1.603	1.239	1.958	2.284	0.000	1.229	1.042	1.446	1.252	1.293	1.517	1.725	**16.587**
2001	0.801	0.000	0.534	0.688	2.066	1.933	0.598	1.505	1.231	1.304	1.521	1.174	**13.357**
2002	1.888	2.228	1.518	1.351	1.040	1.366	1.243	1.538	1.036	1.306	1.521	1.620	**17.658**
2003	1.641	1.830	1.732	1.916	0.000	0.239	0.763	1.535	1.188	1.287	1.478	1.709	**15.317**
2004	1.809	1.632	1.584	1.351	1.631	1.810	1.043	1.518	1.325	1.290	1.521	1.725	**18.238**
2005	2.065	1.068	2.209	1.277	0.792	0.670	1.138	1.371	1.161	1.142	1.354	1.555	**15.804**
Average	**1.526**	**1.453**	**1.448**	**1.215**	**0.944**	**1.051**	**0.888**	**1.381**	**1.230**	**1.199**	**1.460**	**1.534**	**15.344**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.570	0.560	0.540	0.454	0.387	0.392	0.343	0.516	0.475	0.447	0.545	0.592	0.486

FIXED AREA IRRIGATION DEMAND TIME SERIES **B81J01**

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.014	0.020	0.011	0.000	0.005	0.011	0.014	0.012	0.006	0.011	0.005	**0.115**
1926	0.011	0.012	0.020	0.006	0.007	0.008	0.010	0.013	0.012	0.008	0.011	0.005	**0.124**
1927	0.000	0.009	0.016	0.008	0.012	0.009	0.008	0.014	0.012	0.011	0.009	0.005	**0.113**
1928	0.010	0.010	0.016	0.009	0.000	0.000	0.010	0.014	0.011	0.010	0.009	0.004	**0.102**
1929	0.005	0.004	0.011	0.010	0.001	0.003	0.002	0.013	0.012	0.010	0.011	0.004	**0.086**
1930	0.011	0.012	0.000	0.015	0.007	0.004	0.005	0 014	0.012	0.006	0.011	0.005	**0.102**
1931	0.006	0.007	0.019	0.012	0.005	0.006	0.007	0.011	0.012	0.011	0.010	0.005	**0.112**
1932	0.008	0.008	0.012	0.000	0.009	0.008	0.010	0.014	0.012	0.011	0.010	0.005	**0.109**
1933	0.010	0.000	0.014	0.006	0.002	0.002	0.008	0.013	0.011	0.011	0.009	0.003	**0.089**
1934	0.003	0.002	0.018	0.021	0.009	0.011	0.011	0.012	0.012	0.011	0.011	0.003	**0.124**
1935	0.008	0.016	0.016	0.000	0.000	0.000	0.010	0.012	0.012	0.009	0.011	0.000	**0.095**
1936	0.011	0.010	0.018	0.006	0.000	0.003	0.009	0.014	0.012	0.011	0.011	0.004	**0.109**
1937	0.009	0.013	0.005	0.001	0.013	0.008	0.001	0.013	0.012	0.011	0.010	0.000	**0.097**
1938	0.008	0.014	0.005	0.011	0.000	0.001	0.010	0.011	0.012	0.008	0.010	0.003	**0.094**
1939	0.004	0.015	0.000	0.021	0.010	0.000	0.008	0.008	0.005	0.011	0.011	0.003	**0.095**
1940	0.007	0.004	0.009	0.014	0.014	0 003	0.002	0.013	0.011	0.010	0.009	0.004	**0.098**
1941	0.007	0.016	0.004	0.013	0.014	0.000	0.011	0.014	0.012	0.011	0.011	0.005	**0.119**
1942	0.011	0.012	0.015	0.022	0.005	0.000	0.000	0.010	0.012	0.003	0.011	0.005	**0.107**
1943	0.011	0.012	0.022	0.012	0.000	0.010	0.011	0.014	0.011	0.011	0.011	0.005	**0.131**
1944	0.004	0.016	0.021	0.012	0.003	0.011	0.008	0.013	0.011	0.010	0.009	0.004	**0.122**
1945	0.006	0.010	0.021	0.000	0.000	0.001	0.009	0.014	0.012	0.010	0.011	0.005	**0.099**
1946	0.004	0.006	0.011	0.010	0.008	0.000	0.011	0.012	0.010	0.010	0.011	0.005	**0.098**
1947	0.008	0.014	0.011	0.011	0.009	0.000	0.010	0.014	0.012	0.010	0.011	0.004	**0.114**
1948	0.000	0.006	0.019	0.000	0.010	0.010	0.008	0.013	0.012	0.009	0.010	0.005	**0.101**
1949	0.010	0.007	0.004	0.016	0.005	0.006	0.005	0.012	0.012	0.011	0.011	0.005	**0.103**
1950	0.010	0.008	0.010	0.019	0.014	0.002	0.003	0.011	0.012	0.011	0.009	0.003	**0.113**
1951	0.002	0.013	0.019	0.012	0.008	0.003	0.008	0.014	0.011	0.009	0.011	0.005	**0.114**
1952	0.006	0.011	0.005	0.007	0.000	0.004	0.003	0.014	0.012	0.010	0.011	0.005	**0.090**
1953	0.010	0.004	0.019	0.009	0.004	0.010	0.000	0.013	0.012	0.011	0.010	0.004	**0.105**
1954	0.006	0.000	0.007	0.011	0.000	0.002	0.008	0.012	0.012	0.011	0.011	0.005	**0.084**
1955	0.006	0.004	0.012	0.020	0.000	0.006	0.010	0.012	0.012	0.010	0.010	0.000	**0.103**
1956	0.010	0.014	0.011	0.008	0.000	0.005	0.009	0.013	0.012	0.009	0.010	0.002	**0.103**
1957	0.003	0.012	0.014	0.000	0.008	0.011	0.007	0.014	0.012	0.011	0.011	0.003	**0.105**
1958	0.009	0.010	0.011	0.000	0.001	0.007	0.010	0.014	0.012	0.010	0.011	0.005	**0.100**
1959	0.011	0.011	0.011	0.018	0.000	0.008	0.002	0.007	0.012	0 010	0.011	0.005	**0.105**
1960	0.011	0.004	0.000	0.017	0.000	0.001	0.007	0.013	0.009	0.011	0.010	0.002	**0.084**
1961	0.008	0.012	0.013	0.011	0.009	0.002	0.003	0.014	0.012	0.011	0.010	0.004	**0.110**
1962	0.009	0.003	0.013	0.021	0.013	0.008	0.009	0.013	0.007	0.009	0.010	0.005	**0.119**
1963	0.008	0.012	0.013	0.015	0.013	0.010	0.009	0.013	0.012	0.011	0.011	0.004	**0.131**
1964	0.003	0.009	0.007	0.012	0.007	0.008	0.010	0.014	0.012	0.011	0.011	0.003	**0.107**
1965	0.010	0.011	0.019	0.002	0.000	0.011	0.010	0.014	0.011	0.011	0.009	0.005	**0.114**
1966	0.005	0.012	0.012	0.000	0.000	0.006	0.005	0.014	0.012	0.009	0.011	0.005	**0.091**
1967	0.008	0.010	0.014	0.015	0.007	0.011	0.008	0.012	0.010	0.011	0.011	0.005	**0.121**
1968	0.008	0.006	0.005	0.009	0.008	0.000	0.008	0.014	0.012	0.010	0.011	0.004	**0.095**
1969	0.000	0.011	0.014	0.021	0.010	0.010	0.010	0.014	0.012	0.010	0.011	0.005	**0.128**
1970	0.009	0.013	0.008	0.004	0.013	0.007	0.007	0.013	0.010	0.011	0.011	0.003	**0.110**
1971	0.005	0.008	0.009	0.000	0.000	0.000	0.009	0.011	0.012	0.011	0.010	0.005	**0.081**
1972	0.005	0.010	0.018	0.015	0.010	0.001	0.006	0.013	0.012	0.010	0.011	0.000	**0.111**
1973	0.005	0.009	0.012	0.013	0.000	0.003	0.006	0.012	0.012	0.005	0.010	0.000	**0.089**
1974	0.010	0.008	0.014	0.002	0.001	0.011	0.005	0.012	0.012	0.011	0.011	0.005	**0.102**
1975	0.011	0.011	0.002	0.000	0.000	0.000	0.008	0.009	0.012	0.011	0.011	0.005	**0.079**
1976	0.008	0.008	0.019	0.002	0.000	0.001	0.011	0.014	0.012	0.011	0.010	0.000	**0.097**
1977	0.010	0.011	0.006	0.003	0.004	0.000	0.003	0.014	0.012	0.011	0.011	0.005	**0.090**
1978	0.004	0.003	0.006	0.011	0.005	0.006	0.008	0.012	0.012	0.010	0.003	0.005	**0.086**
1979	0.003	0.011	0.009	0.008	0.000	0.003	0.008	0.014	0.012	0.011	0.010	0.000	**0.089**
1980	0.007	0.000	0.009	0.000	0.003	0.000	0.010	0.014	0.012	0.011	0.010	0.003	**0.078**
1981	0.005	0.007	0.017	0.018	0.012	0.010	0.008	0.012	0.012	0.011	0.011	0.005	**0.127**
1982	0.009	0.011	0.017	0.016	0.014	0.000	0.011	0.014	0.012	0.011	0.010	0.005	**0.128**
1983	0.008	0.002	0.015	0.012	0.012	0.001	0.008	0.014	0.012	0.004	0.010	0.000	**0.098**
1984	0.000	0.006	0.016	0.000	0.000	0.002	0.010	0.010	0.011	0.009	0.011	0.004	**0.079**
1985	0.000	0.010	0.013	0.018	0.006	0.010	0.000	0.014	0.012	0.011	0.010	0.004	**0.109**
1986	0.008	0.008	0.011	0.016	0.008	0.000	0.011	0.012	0.012	0.011	0.007	0.000	**0.104**
1987	0.005	0.013	0.002	0.014	0.000	0.000	0.011	0.014	0.011	0.011	0.010	0.003	**0.094**
1988	0.001	0.014	0.017	0.019	0.003	0.009	0.010	0.013	0.011	0.011	0.011	0.005	**0.124**
1989	0.002	0.000	0.009	0.013	0.011	0.000	0.008	0.014	0.012	0.010	0.011	0.005	**0.095**
1990	0.005	0.009	0.010	0.012	0.003	0.001	0.011	0.014	0.010	0.011	0.011	0.005	**0.100**
1991	0.011	0.009	0.019	0.014	0.013	0.004	0.010	0.014	0.011	0.011	0.010	0.005	**0.130**
1992	0.011	0.011	0.010	0.017	0.008	0.006	0.009	0.014	0.012	0.010	0.010	0.005	**0.124**
1993	0.008	0.006	0.007	0.011	0.014	0.007	0.008	0.014	0.012	0.011	0.011	0.004	**0.112**
1994	0.004	0.015	0.017	0.007	0.004	0.006	0.004	0.011	0.012	0.011	0.010	0.005	**0.108**
1995	0.007	0.010	0 017	0.003	0.000	0.001	0.009	0.011	0.012	0.006	0.010	0.004	**0.089**
1996	0.006	0.007	0.020	0.003	0.000	0.003	0.007	0.012	0.012	0.011	0.010	0.001	**0.094**
1997	0.008	0.001	0.020	0.012	0.014	0.011	0.009	0.014	0.012	0.011	0.010	0.004	**0.127**
1998	0.006	0.007	0.005	0.010	0.006	0.001	0.007	0.013	0.012	0.010	0 010	0.005	**0.092**
1999	0.002	0.006	0.009	0.003	0.000	0.000	0.005	0.014	0.010	0.010	0.011	0.005	**0.075**
2000	0.007	0.007	0.017	0.019	0.000	0.005	0.009	0.013	0.012	0.011	0.011	0.005	**0.116**
2001	0.001	0.000	0.005	0.006	0.014	0.011	0.005	0 014	0.012	0.011	0.011	0.001	**0.089**
2002	0.010	0.015	0.013	0.011	0.006	0.007	0.011	0.014	0.010	0.011	0.011	0.004	**0.122**
2003	0.008	0.012	0.015	0.016	0.000	0.000	0.007	0.014	0.011	0.011	0.010	0.005	**0.108**
2004	0.009	0.010	0.014	0.011	0.010	0.010	0.009	0.014	0.012	0.011	0.011	0.005	**0.126**
2005	0.011	0.006	0.019	0.011	0.003	0.001	0.010	0.013	0.011	0 010	0.009	0.004	**0.107**
Average	**0.009**	**0.009**	**0.012**	**0.010**	**0.005**	**0.005**	**0.008**	**0.013**	**0.012**	**0.010**	**0.010**	**0.004**	**0.105**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.003	0.003	0.005	0.004	0.002	0.002	0.003	0.005	0.004	0.004	0.004	0.001	0.003

FIXED AREA IRRIGATION DEMAND TIME SERIES B81J10

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.385	0.553	0.317	0.000	0.110	0.314	0.380	0.341	0.167	0.273	0.094	**3.098**
1926	0.286	0.329	0.577	0.173	0.185	0.206	0.295	0.347	0.341	0.206	0.272	0.097	**3.314**
1927	0.000	0.236	0.451	0.220	0.314	0.231	0.237	0.378	0.341	0.284	0.227	0.087	**3.005**
1928	0.247	0.262	0.463	0.261	0.000	0.000	0.287	0.388	0.303	0.257	0.214	0.074	**2.755**
1929	0.129	0.103	0.306	0.279	0.022	0.056	0.061	0.369	0.329	0.263	0.271	0.062	**2.250**
1930	0.290	0.329	0.000	0.432	0.175	0.085	0.155	0.395	0.321	0.151	0.273	0.088	**2.694**
1931	0.158	0.184	0.548	0.348	0.133	0.128	0.202	0.291	0.327	0.290	0.269	0.093	**2.971**
1932	0.216	0.219	0.336	0.000	0.247	0.202	0.298	0.395	0.341	0.290	0.267	0.088	**2.898**
1933	0.255	0.000	0.390	0.157	0.025	0.037	0.245	0.367	0.297	0.290	0.219	0.046	**2.328**
1934	0.060	0.058	0.519	0.584	0.234	0.274	0.319	0.331	0.341	0.290	0.273	0.047	**3.332**
1935	0.212	0.432	0.460	0.000	0.000	0.000	0.297	0.323	0.341	0.245	0.273	0.000	**2.583**
1936	0.293	0.261	0.499	0.169	0.000	0.056	0.260	0.395	0.341	0.290	0.273	0.066	**2.903**
1937	0.230	0.366	0.155	0.019	0.346	0.185	0.043	0.373	0.329	0.286	0.266	0.000	**2.599**
1938	0.190	0.397	0.153	0.316	0.000	0.000	0.294	0.317	0.316	0.208	0.260	0.048	**2.499**
1939	0.085	0.407	0.000	0.582	0.265	0.000	0.245	0.215	0.126	0.290	0.273	0.035	**2.525**
1940	0.162	0.088	0.247	0.382	0.376	0.049	0.074	0.357	0.304	0.254	0.238	0.064	**2.595**
1941	0.181	0.441	0.117	0.375	0.376	0.000	0.319	0.395	0.341	0.290	0.273	0.097	**3.207**
1942	0.293	0.341	0.422	0.605	0.118	0.000	0.000	0.286	0.341	0.075	0.273	0.097	**2.851**
1943	0.293	0.335	0.636	0.336	0.000	0.253	0.319	0.395	0.308	0.290	0.273	0.097	**3.537**
1944	0.095	0.441	0.595	0.324	0.058	0.285	0.242	0.357	0.304	0.254	0.238	0.064	**3.256**
1945	0.136	0.276	0.585	0.000	0.000	0.000	0.270	0.391	0.336	0.274	0.273	0.097	**2.639**
1946	0.101	0.170	0.322	0.277	0.194	0.000	0.312	0.327	0.277	0.273	0.273	0.097	**2.624**
1947	0.202	0.375	0.313	0.296	0.240	0.000	0.293	0.395	0.341	0.277	0.273	0.075	**3.081**
1948	0.000	0.149	0.527	0.000	0.255	0.255	0.222	0.366	0.321	0.241	0.259	0.086	**2.680**
1949	0.268	0.183	0.123	0.455	0.134	0.122	0.138	0.319	0.331	0.290	0.272	0.097	**2.734**
1950	0.266	0.225	0.290	0.537	0.376	0.034	0.093	0.309	0.341	0.289	0.215	0.043	**3.018**
1951	0.026	0.355	0.545	0.324	0.213	0.044	0.223	0.391	0.292	0.249	0.271	0.095	**3.027**
1952	0.143	0.313	0.150	0.192	0.000	0.093	0.106	0.394	0.341	0.278	0.273	0.091	**2.374**
1953	0.260	0.093	0.530	0.261	0.095	0.234	0.015	0.362	0.333	0.290	0.243	0.074	**2.790**
1954	0.140	0.000	0.210	0.297	0.000	0.025	0.242	0.322	0.334	0.289	0.273	0.097	**2.231**
1955	0.157	0.111	0.335	0.562	0.000	0.141	0.286	0.340	0.338	0.272	0.252	0.000	**2.794**
1956	0.270	0.376	0.303	0.214	0.000	0.114	0.265	0.358	0.317	0.246	0.255	0.011	**2.731**
1957	0.064	0.333	0.390	0.000	0.199	0.277	0.193	0.395	0.327	0.282	0.273	0.052	**2.785**
1958	0.240	0.268	0.312	0.000	0.017	0.161	0.288	0.394	0.341	0.252	0.273	0.090	**2.637**
1959	0.275	0.291	0.316	0.498	0.000	0.193	0.057	0.200	0.318	0.279	0.271	0.097	**2.794**
1960	0.282	0.092	0.000	0.466	0.000	0.000	0.195	0.369	0.241	0.285	0.269	0.022	**2.221**
1961	0.209	0.337	0.376	0.312	0.232	0.010	0.095	0.395	0.334	0.290	0.253	0.076	**2.920**
1962	0.244	0.070	0.358	0.590	0.332	0.188	0.255	0.359	0.183	0.238	0.265	0.096	**3.179**
1963	0.200	0.318	0.360	0.408	0.351	0.260	0.269	0.364	0.341	0.290	0.271	0.082	**3.514**
1964	0.074	0.240	0.199	0.330	0.175	0.204	0.287	0.394	0.341	0.290	0.273	0.030	**2.838**
1965	0.271	0.311	0.549	0.067	0.000	0.283	0.294	0.382	0.306	0.290	0.227	0.088	**3.068**
1966	0.131	0.321	0.343	0.000	0.000	0.128	0.150	0.392	0.340	0.233	0.273	0.097	**2.408**
1967	0.195	0.268	0.395	0.419	0.178	0.277	0.240	0.326	0.271	0.289	0.270	0.096	**3.226**
1968	0.213	0.160	0.134	0.238	0.207	0.000	0.239	0.395	0.341	0.274	0.273	0.059	**2.532**
1969	0.000	0.309	0.388	0.595	0.259	0.258	0.287	0.388	0.332	0.258	0.273	0.097	**3.443**
1970	0.223	0.367	0.231	0.110	0.356	0.158	0.216	0.367	0.279	0.290	0.273	0.055	**2.926**
1971	0.117	0.210	0.269	0.000	0.000	0.000	0.276	0.302	0.341	0.283	0.265	0.093	**2.156**
1972	0.109	0.276	0.510	0.420	0.258	0.002	0.169	0.363	0.341	0.275	0.273	0.000	**2.997**
1973	0.122	0.248	0.343	0.356	0.000	0.050	0.182	0.343	0.341	0.136	0.259	0.000	**2.380**
1974	0.268	0.203	0.396	0.060	0.023	0.269	0.151	0.337	0.321	0.290	0.273	0.097	**2.690**
1975	0.288	0.304	0.044	0.000	0.000	0.000	0.230	0.250	0.340	0.290	0.273	0.096	**2.116**
1976	0.215	0.225	0.548	0.058	0.000	0.000	0.308	0.379	0.341	0.290	0.265	0.000	**2.628**
1977	0.269	0.291	0.179	0.094	0.097	0.000	0.078	0.392	0.339	0.288	0.273	0.097	**2.397**
1978	0.085	0.080	0.159	0.309	0.131	0.139	0.240	0.325	0.341	0.278	0.065	0.095	**2.248**
1979	0.064	0.289	0.249	0.232	0.000	0.048	0.221	0.388	0.341	0.290	0.264	0.000	**2.386**
1980	0.165	0.000	0.255	0.000	0.063	0.000	0.298	0.378	0.341	0.290	0.248	0.030	**2.068**
1981	0.119	0.195	0.468	0.503	0.324	0.236	0.229	0.334	0.332	0.289	0.273	0.097	**3.400**
1982	0.226	0.293	0.492	0.456	0.376	0.000	0.313	0.374	0.318	0.286	0.244	0.096	**3.474**
1983	0.194	0.045	0.436	0.332	0.309	0.000	0.242	0.395	0.318	0.100	0.258	0.000	**2.629**
1984	0.000	0.171	0.448	0.000	0.000	0.014	0.299	0.275	0.294	0.246	0.273	0.071	**2.091**
1985	0.000	0.270	0.373	0.507	0.137	0.258	0.000	0.393	0.341	0.290	0.257	0.075	**2.901**
1986	0.215	0.203	0.323	0.456	0.196	0.000	0.315	0.339	0.334	0.290	0.160	0.000	**2.830**
1987	0.115	0.358	0.059	0.404	0.000	0.000	0.307	0.391	0.297	0.290	0.245	0.052	**2.518**
1988	0.010	0.374	0.475	0.539	0.078	0.227	0.296	0.364	0.301	0.289	0.273	0.097	**3.323**
1989	0.025	0.000	0.254	0.363	0.297	0.000	0.222	0.395	0.341	0.278	0.272	0.097	**2.544**
1990	0.113	0.239	0.289	0.331	0.064	0.003	0.309	0.381	0.265	0.290	0.273	0.095	**2.653**
1991	0.284	0.229	0.529	0.402	0.338	0.072	0.284	0.395	0.304	0.290	0.266	0.097	**3.491**
1992	0.288	0.296	0.277	0.464	0.213	0.135	0.259	0.389	0.341	0.280	0.269	0.097	**3.308**
1993	0.191	0.146	0.185	0.300	0.365	0.171	0.241	0.389	0.341	0.290	0.273	0.076	**2.970**
1994	0.104	0.417	0.495	0.206	0.105	0.127	0.118	0.306	0.341	0.290	0.262	0.088	**2.859**
1995	0.171	0.259	0.489	0.068	0.000	0.000	0.258	0.291	0.328	0.143	0.263	0.079	**2.348**
1996	0.146	0.190	0.576	0.074	0.000	0.058	0.212	0.340	0.341	0.290	0.267	0.000	**2.494**
1997	0.215	0.024	0.569	0.330	0.364	0.267	0.273	0.395	0.341	0.281	0.265	0.079	**3.404**
1998	0.132	0.193	0.143	0.267	0.140	0.000	0.198	0.354	0.341	0.270	0.269	0.097	**2.404**
1999	0.043	0.169	0.255	0.080	0.000	0.000	0.137	0.385	0.273	0.278	0.273	0.089	**1.981**
2000	0.183	0.186	0.472	0.536	0.000	0.121	0.260	0.374	0.325	0.287	0.273	0.097	**3.114**
2001	0.002	0.000	0.132	0.158	0.368	0.275	0.159	0.387	0.320	0.290	0.273	0.000	**2.366**
2002	0.246	0.415	0.369	0.318	0.136	0.151	0.306	0.395	0.275	0.290	0.273	0.076	**3.251**
2003	0.192	0.323	0.420	0.450	0.000	0.000	0.197	0.394	0.310	0.286	0.264	0.094	**2.930**
2004	0.229	0.278	0.385	0.318	0.271	0.249	0.260	0.390	0.341	0.287	0.273	0.097	**3.377**
2005	0.284	0.145	0.531	0.300	0.079	0.000	0.282	0.357	0.304	0.254	0.237	0.063	**2.836**
Average	**0.172**	**0.240**	**0.351**	**0.284**	**0.141**	**0.105**	**0.224**	**0.359**	**0.320**	**0.266**	**0.260**	**0.069**	**2.790**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.064	0.093	0.131	0.106	0.058	0.039	0.087	0.134	0.123	0.099	0.097	0.027	0.088

FIXED AREA IRRIGATION DEMAND TIME SERIES B81G01

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.329	0.456	0.358	0.151	0.000	0.065	0.075	0.072	0.000	0.054	0.005	**1.728**
1926	0.248	0.292	0.472	0.266	0.312	0.027	0.053	0.055	0.072	0.007	0.053	0.007	**1.865**
1927	0.047	0.231	0.389	0.296	0.399	0.043	0.016	0.074	0.072	0.057	0.025	0.000	**1.649**
1928	0.220	0.248	0.397	0.322	0.117	0.000	0.048	0.080	0.049	0.040	0.016	0.000	**1.538**
1929	0.139	0.145	0.295	0.333	0.206	0.000	0.000	0.069	0.064	0.044	0.053	0.000	**1.348**
1930	0.251	0.292	0.044	0.432	0.305	0.000	0.000	0.084	0.060	0.000	0.054	0.001	**1.523**
1931	0.159	0.197	0.453	0.378	0.278	0.000	0.000	0.020	0.063	0.061	0.052	0.004	**1.663**
1932	0.199	0.220	0.315	0.004	0.354	0.024	0.055	0.084	0.072	0.061	0.050	0.001	**1.439**
1933	0.226	0.000	0.349	0.256	0.207	0.000	0.022	0.067	0.045	0.061	0.020	0.000	**1.254**
1934	0.093	0.116	0.434	0.532	0.345	0.070	0.068	0.045	0.072	0.061	0.054	0.000	**1.891**
1935	0.196	0.360	0.395	0.124	0.022	0.000	0.054	0.040	0.072	0.032	0.054	0.000	**1.351**
1936	0.253	0.247	0.420	0.264	0.000	0.000	0.031	0.084	0.072	0.061	0.054	0.000	**1.487**
1937	0.209	0.317	0.201	0.172	0.421	0.014	0.000	0.071	0.065	0.058	0.050	0.000	**1.575**
1938	0.181	0.337	0.199	0.357	0.015	0.000	0.052	0.037	0.057	0.009	0.046	0.000	**1.290**
1939	0.109	0.344	0.051	0.531	0.366	0.000	0.022	0.000	0.000	0.061	0.054	0.000	**1.538**
1940	0.162	0.135	0.258	0.400	0.442	0.000	0.000	0.061	0.049	0.038	0.032	0.000	**1.577**
1941	0.175	0.367	0.177	0.396	0.442	0.000	0.068	0.084	0.072	0.061	0.054	0.007	**1.902**
1942	0.253	0.300	0.370	0.546	0.268	0.000	0.000	0.017	0.072	0.000	0.054	0.007	**1.887**
1943	0.253	0.296	0.511	0.370	0.000	0.057	0.068	0.084	0.052	0.061	0.054	0.007	**1.813**
1944	0.116	0.367	0.484	0.362	0.229	0.078	0.019	0.061	0.049	0.038	0.032	0.000	**1.835**
1945	0.144	0.257	0.477	0.000	0.175	0.000	0.038	0.082	0.069	0.051	0.054	0.007	**1.353**
1946	0.120	0.188	0.306	0.332	0.319	0.000	0.064	0.043	0.032	0.050	0.054	0.007	**1.514**
1947	0.189	0.322	0.300	0.344	0.349	0.000	0.052	0.084	0.072	0.053	0.054	0.000	**1.821**
1948	0.043	0.174	0.439	0.101	0.359	0.059	0.007	0.067	0.060	0.030	0.045	0.000	**1.383**
1949	0.236	0.196	0.181	0.448	0.279	0.000	0.000	0.038	0.066	0.061	0.053	0.007	**1.563**
1950	0.234	0.223	0.286	0.501	0.442	0.000	0.000	0.031	0.072	0.060	0.017	0.000	**1.866**
1951	0.070	0.309	0.451	0.362	0.331	0.000	0.007	0.082	0.041	0.035	0.053	0.005	**1.747**
1952	0.148	0.281	0.197	0.278	0.184	0.000	0.000	0.084	0.072	0.053	0.054	0.002	**1.355**
1953	0.230	0.139	0.441	0.322	0.253	0.046	0.000	0.064	0.067	0.061	0.035	0.000	**1.657**
1954	0.147	0.009	0.235	0.345	0.180	0.000	0.020	0.039	0.067	0.060	0.054	0.007	**1.164**
1955	0.158	0.150	0.314	0.518	0.000	0.000	0.048	0.050	0.070	0.050	0.041	0.000	**1.399**
1956	0.237	0.323	0.294	0.293	0.082	0.000	0.034	0.062	0.057	0.033	0.043	0.000	**1.458**
1957	0.095	0.295	0.350	0.000	0.321	0.073	0.000	0.084	0.063	0.056	0.054	0.000	**1.391**
1958	0.216	0.252	0.300	0.108	0.202	0.000	0.049	0.084	0.072	0.037	0.054	0.002	**1.374**
1959	0.240	0.267	0.302	0.475	0.000	0.019	0.000	0.000	0.058	0.054	0.053	0.006	**1.474**
1960	0.246	0.138	0.070	0.455	0.072	0.000	0.000	0.069	0.009	0.057	0.051	0.000	**1.166**
1961	0.194	0.297	0.341	0.355	0.343	0.000	0.000	0.084	0.068	0.061	0.041	0.000	**1.785**
1962	0.218	0.124	0.329	0.537	0.411	0.015	0.028	0.062	0.000	0.028	0.049	0.006	**1.808**
1963	0.188	0.284	0.330	0.417	0.424	0.062	0.037	0.065	0.072	0.061	0.053	0.000	**1.993**
1964	0.102	0.233	0.228	0.366	0.306	0.026	0.049	0.084	0.072	0.061	0.054	0.000	**1.580**
1965	0.238	0.280	0.454	0.201	0.149	0.076	0.053	0.076	0.050	0.061	0.025	0.000	**1.662**
1966	0.140	0.287	0.319	0.125	0.006	0.000	0.000	0.083	0.071	0.025	0.054	0.006	**1.116**
1967	0.184	0.252	0.353	0.424	0.308	0.073	0.018	0.042	0.028	0.060	0.052	0.006	**1.801**
1968	0.197	0.181	0.187	0.307	0.327	0.000	0.018	0.084	0.072	0.051	0.054	0.000	**1.478**
1969	0.024	0.279	0.348	0.540	0.362	0.061	0.049	0.080	0.066	0.040	0.054	0.006	**1.908**
1970	0.204	0.317	0.248	0.227	0.427	0.000	0.003	0.067	0.034	0.061	0.054	0.000	**1.642**
1971	0.131	0.214	0.272	0.155	0.152	0.000	0.041	0.027	0.072	0.056	0.049	0.004	**1.174**
1972	0.125	0.257	0.428	0.425	0.361	0.000	0.000	0.065	0.072	0.052	0.054	0.000	**1.839**
1973	0.134	0.239	0.319	0.383	0.126	0.000	0.000	0.053	0.072	0.000	0.045	0.000	**1.371**
1974	0.236	0.209	0.354	0.196	0.206	0.067	0.000	0.049	0.060	0.061	0.054	0.006	**1.498**
1975	0.250	0.275	0.133	0.115	0.101	0.000	0.012	0.000	0.071	0.061	0.054	0.006	**1.077**
1976	0.198	0.223	0.453	0.195	0.050	0.000	0.061	0.075	0.072	0.061	0.049	0.000	**1.437**
1977	0.236	0.267	0.215	0.218	0.254	0.000	0.000	0.082	0.071	0.059	0.054	0.006	**1.463**
1978	0.109	0.130	0.203	0.353	0.277	0.000	0.018	0.041	0.072	0.053	0.000	0.005	**1.263**
1979	0.095	0.266	0.259	0.304	0.000	0.000	0.006	0.080	0.072	0.061	0.049	0.000	**1.191**
1980	0.163	0.063	0.263	0.046	0.232	0.000	0.055	0.074	0.072	0.061	0.038	0.000	**1.069**
1981	0.132	0.204	0.400	0.479	0.406	0.047	0.011	0.047	0.066	0.060	0.054	0.007	**1.914**
1982	0.206	0.268	0.416	0.448	0.441	0.000	0.065	0.072	0.058	0.058	0.036	0.006	**2.073**
1983	0.184	0.108	0.379	0.367	0.395	0.000	0.020	0.084	0.058	0.000	0.045	0.000	**1.640**
1984	0.000	0.188	0.387	0.070	0.186	0.000	0.056	0.010	0.042	0.033	0.054	0.000	**1.027**
1985	0.040	0.253	0.339	0.481	0.281	0.060	0.000	0.083	0.072	0.061	0.044	0.000	**1.713**
1986	0.198	0.209	0.306	0.448	0.319	0.000	0.065	0.050	0.067	0.061	0.000	0.000	**1.725**
1987	0.129	0.311	0.142	0.414	0.001	0.000	0.061	0.082	0.045	0.061	0.036	0.000	**1.281**
1988	0.060	0.322	0.405	0.502	0.242	0.041	0.054	0.065	0.047	0.060	0.054	0.007	**1.858**
1989	0.069	0.014	0.262	0.388	0.387	0.000	0.007	0.084	0.072	0.053	0.053	0.007	**1.397**
1990	0.128	0.233	0.285	0.367	0.232	0.000	0.062	0.076	0.024	0.061	0.054	0.005	**1.528**
1991	0.247	0.226	0.440	0.413	0.415	0.000	0.046	0.084	0.049	0.061	0.050	0.007	**2.039**
1992	0.250	0.270	0.277	0.453	0.331	0.000	0.030	0.081	0.072	0.054	0.052	0.007	**1.877**
1993	0.182	0.173	0.220	0.347	0.434	0.004	0.019	0.081	0.072	0.061	0.054	0.000	**1.646**
1994	0.122	0.350	0.418	0.287	0.259	0.000	0.000	0.030	0.072	0.061	0.047	0.001	**1.647**
1995	0.168	0.246	0.414	0.201	0.000	0.000	0.030	0.020	0.064	0.000	0.047	0.000	**1.190**
1996	0.151	0.201	0.471	0.205	0.141	0.000	0.000	0.051	0.072	0.061	0.050	0.000	**1.402**
1997	0.199	0.095	0.467	0.366	0.433	0.066	0.039	0.084	0.072	0.055	0.049	0.000	**1.926**
1998	0.141	0.203	0.193	0.326	0.282	0.000	0.000	0.060	0.072	0.048	0.051	0.007	**1.383**
1999	0.081	0.187	0.263	0.209	0.000	0.000	0.000	0.078	0.029	0.053	0.054	0.001	**0.956**
2000	0.176	0.198	0.403	0.500	0.069	0.000	0.031	0.071	0.062	0.059	0.054	0.007	**1.631**
2001	0.054	0.000	0.187	0.257	0.436	0.071	0.000	0.080	0.059	0.061	0.054	0.000	**1.259**
2002	0.220	0.349	0.336	0.358	0.280	0.000	0.060	0.084	0.031	0.061	0.054	0.000	**1.833**
2003	0.182	0.288	0.369	0.444	0.023	0.000	0.000	0.084	0.053	0.058	0.048	0.005	**1.554**
2004	0.208	0.258	0.346	0.358	0.370	0.055	0.031	0.081	0.072	0.059	0.054	0.007	**1.899**
2005	0.247	0.172	0.442	0.347	0.242	0.000	0.045	0.061	0.049	0.038	0.031	0.000	**1.674**
Average	**0.168**	**0.230**	**0.324**	**0.327**	**0.245**	**0.015**	**0.026**	**0.063**	**0.060**	**0.049**	**0.047**	**0.003**	**1.556**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.063	0.089	0.121	0.122	0.100	0.006	0.010	0.024	0.023	0.018	0.018	0.001	0.049

FIXED AREA IRRIGATION DEMAND TIME SERIES B81G10

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.149	0.184	0.078	0.000	0.041	0.129	0.131	0.119	0.047	0.113	0.084	**1.145**
1926	0.135	0.120	0.196	0.014	0.058	0.090	0.119	0.115	0.119	0.066	0.112	0.085	**1.230**
1927	0.000	0.075	0.134	0.035	0.122	0.103	0.088	0.130	0.119	0.106	0.089	0.080	**1.082**
1928	0.114	0.087	0.140	0.053	0.000	0.000	0.114	0.136	0.100	0.092	0.082	0.073	**0.992**
1929	0.053	0.013	0.067	0.061	0.000	0.014	0.002	0.126	0.113	0.096	0.112	0.067	**0.723**
1930	0.137	0.120	0.000	0.132	0.052	0.029	0.047	0.139	0.109	0.039	0.113	0.080	**0.999**
1931	0.068	0.050	0.181	0.092	0.032	0.050	0.071	0.086	0.112	0.110	0.111	0.083	**1.047**
1932	0.098	0.067	0.080	0.000	0.088	0.088	0.120	0.139	0.119	0.110	0.110	0.080	**1.100**
1933	0.118	0.000	0.105	0.008	0.000	0.005	0.093	0.125	0.097	0.110	0.085	0.058	**0.803**
1934	0.019	0.000	0.167	0.207	0.082	0.126	0.132	0.107	0.119	0.110	0.113	0.059	**1.241**
1935	0.096	0.172	0.139	0.000	0.000	0.000	0.120	0.102	0.119	0.086	0.113	0.009	**0.957**
1936	0.139	0.087	0.157	0.013	0.000	0.014	0.101	0.139	0.119	0.110	0.113	0.069	**1.061**
1937	0.105	0.139	0.002	0.000	0.139	0.079	0.000	0.128	0.113	0.108	0.109	0.000	**0.922**
1938	0.084	0.154	0.001	0.078	0.000	0.000	0.118	0.099	0.107	0.068	0.106	0.059	**0.874**
1939	0.031	0.160	0.000	0.206	0.097	0.000	0.093	0.048	0.012	0.110	0.113	0.052	**0.923**
1940	0.070	0.006	0.040	0.109	0.155	0.011	0.007	0.120	0.100	0.091	0.094	0.067	**0.871**
1941	0.080	0.177	0.000	0.105	0.155	0.000	0.132	0.139	0.119	0.110	0.113	0.085	**1.215**
1942	0.139	0.126	0.120	0.218	0.025	0.000	0.000	0.083	0.119	0.001	0.113	0.085	**1.032**
1943	0.139	0.124	0.226	0.087	0.000	0.114	0.132	0.139	0.102	0.110	0.113	0.085	**1.371**
1944	0.036	0.177	0.205	0.081	0.000	0.132	0.091	0.120	0.100	0.091	0.094	0.067	**1.194**
1945	0.057	0.094	0.200	0.000	0.000	0.000	0.106	0.137	0.117	0.101	0.113	0.085	**1.011**
1946	0.039	0.044	0.074	0.060	0.062	0.000	0.128	0.104	0.087	0.101	0.113	0.085	**0.897**
1947	0.091	0.143	0.070	0.069	0.085	0.000	0.118	0.139	0.119	0.103	0.113	0.073	**1.123**
1948	0.000	0.034	0.171	0.000	0.092	0.116	0.081	0.124	0.109	0.084	0.105	0.079	**0.996**
1949	0.126	0.050	0.000	0.143	0.033	0.047	0.039	0.100	0.114	0.110	0.112	0.085	**0.960**
1950	0.124	0.070	0.060	0.184	0.155	0.004	0.017	0.095	0.119	0.109	0.083	0.057	**1.075**
1951	0.003	0.133	0.180	0.081	0.071	0.008	0.081	0.137	0.094	0.088	0.112	0.084	**1.074**
1952	0.060	0.112	0.000	0.023	0.000	0.032	0.023	0.139	0.119	0.104	0.113	0.082	**0.807**
1953	0.121	0.009	0.173	0.052	0.014	0.105	0.000	0.122	0.115	0.110	0.097	0.072	**0.991**
1954	0.059	0.000	0.025	0.069	0.000	0.000	0.091	0.101	0.116	0.109	0.113	0.085	**0.769**
1955	0.067	0.017	0.080	0.197	0.000	0.056	0.114	0.111	0.118	0.100	0.102	0.002	**0.963**
1956	0.127	0.144	0.066	0.032	0.000	0.043	0.103	0.120	0.107	0.087	0.103	0.040	**0.972**
1957	0.021	0.122	0.105	0.000	0.064	0.127	0.066	0.139	0.112	0.105	0.113	0.061	**1.038**
1958	0.110	0.090	0.070	0.000	0.000	0.067	0.115	0.139	0.119	0.090	0.113	0.081	**0.995**
1959	0.129	0.101	0.071	0.164	0.000	0.083	0.000	0.041	0.108	0.104	0.112	0.085	**0.999**
1960	0.133	0.008	0.000	0.149	0.000	0.000	0.067	0.126	0.068	0.107	0.111	0.046	**0.815**
1961	0.094	0.124	0.099	0.076	0.080	0.000	0.018	0.139	0.116	0.110	0.102	0.074	**1.032**
1962	0.112	0.000	0.090	0.211	0.132	0.080	0.098	0.121	0.039	0.083	0.109	0.085	**1.160**
1963	0.090	0.115	0.091	0.121	0.141	0.118	0.105	0.123	0.119	0.110	0.112	0.077	**1.322**
1964	0.026	0.077	0.020	0.084	0.053	0.089	0.115	0.139	0.119	0.110	0.113	0.050	**0.994**
1965	0.127	0.111	0.182	0.000	0.000	0.130	0.118	0.132	0.101	0.110	0.089	0.080	**1.182**
1966	0.054	0.116	0.084	0.000	0.000	0.050	0.044	0.138	0.119	0.080	0.113	0.085	**0.883**
1967	0.087	0.090	0.108	0.126	0.054	0.128	0.090	0.104	0.084	0.109	0.111	0.085	**1.176**
1968	0.096	0.039	0.000	0.042	0.068	0.000	0.090	0.139	0.119	0.101	0.113	0.065	**0.874**
1969	0.000	0.110	0.104	0.213	0.094	0.117	0.115	0.136	0.115	0.093	0.113	0.085	**1.295**
1970	0.102	0.139	0.034	0.000	0.144	0.065	0.078	0.125	0.088	0.110	0.113	0.063	**1.059**
1971	0.047	0.062	0.050	0.000	0.000	0.000	0.109	0.092	0.119	0.106	0.109	0.083	**0.778**
1972	0.043	0.095	0.163	0.127	0.094	0.000	0.054	0.123	0.119	0.102	0.113	0.000	**1.032**
1973	0.049	0.081	0.083	0.096	0.000	0.011	0.060	0.113	0.119	0.031	0.106	0.002	**0.753**
1974	0.126	0.059	0.108	0.000	0.000	0.123	0.045	0.109	0.109	0.110	0.113	0.085	**0.988**
1975	0.136	0.108	0.000	0.000	0.000	0.000	0.085	0.066	0.119	0.110	0.113	0.085	**0.821**
1976	0.097	0.070	0.182	0.000	0.000	0.000	0.126	0.131	0.119	0.110	0.108	0.000	**0.943**
1977	0.126	0.102	0.012	0.000	0.015	0.000	0.010	0.138	0.119	0.109	0.113	0.085	**0.827**
1978	0.031	0.003	0.003	0.075	0.032	0.055	0.090	0.103	0.119	0.104	0.007	0.084	**0.707**
1979	0.021	0.101	0.041	0.040	0.000	0.010	0.081	0.136	0.119	0.110	0.108	0.000	**0.767**
1980	0.071	0.000	0.044	0.000	0.000	0.000	0.121	0.130	0.119	0.110	0.100	0.050	**0.745**
1981	0.048	0.056	0.142	0.167	0.128	0.106	0.084	0.108	0.115	0.109	0.113	0.085	**1.261**
1982	0.103	0.103	0.154	0.144	0.154	0.000	0.128	0.129	0.107	0.107	0.098	0.085	**1.312**
1983	0.087	0.000	0.127	0.085	0.120	0.000	0.091	0.139	0.108	0.014	0.105	0.020	**0.895**
1984	0.000	0.044	0.133	0.000	0.000	0.000	0.121	0.078	0.095	0.087	0.113	0.071	**0.742**
1985	0.000	0.092	0.097	0.169	0.034	0.117	0.000	0.138	0.119	0.110	0.105	0.073	**1.054**
1986	0.097	0.059	0.074	0.144	0.063	0.000	0.129	0.110	0.116	0.110	0.054	0.000	**0.957**
1987	0.046	0.135	0.000	0.119	0.000	0.000	0.125	0.137	0.097	0.110	0.098	0.061	**0.928**
1988	0.000	0.143	0.146	0.185	0.006	0.101	0.119	0.123	0.099	0.109	0.113	0.085	**1.229**
1989	0.002	0.000	0.044	0.100	0.114	0.000	0.081	0.139	0.119	0.103	0.112	0.085	**0.900**
1990	0.045	0.077	0.059	0.085	0.000	0.000	0.126	0.132	0.081	0.110	0.113	0.084	**0.911**
1991	0.134	0.072	0.172	0.118	0.135	0.022	0.113	0.139	0.101	0.110	0.109	0.085	**1.310**
1992	0.136	0.104	0.054	0.148	0.071	0.053	0.100	0.136	0.119	0.104	0.111	0.085	**1.223**
1993	0.085	0.033	0.014	0.070	0.149	0.072	0.091	0.136	0.119	0.110	0.113	0.074	**1.066**
1994	0.041	0.164	0.156	0.028	0.019	0.049	0.029	0.094	0.119	0.110	0.107	0.080	**0.997**
1995	0.075	0.086	0.153	0.000	0.000	0.000	0.099	0.086	0.112	0.035	0.107	0.075	**0.829**
1996	0.062	0.053	0.195	0.000	0.000	0.016	0.076	0.111	0.119	0.110	0.110	0.032	**0.883**
1997	0.098	0.000	0.192	0.084	0.149	0.122	0.107	0.139	0.119	0.105	0.108	0.075	**1.299**
1998	0.055	0.055	0.000	0.056	0.035	0.000	0.068	0.118	0.119	0.099	0.111	0.085	**0.802**
1999	0.011	0.043	0.044	0.000	0.000	0.000	0.038	0.134	0.084	0.103	0.113	0.081	**0.652**
2000	0.081	0.051	0.145	0.183	0.000	0.046	0.101	0.128	0.111	0.108	0.113	0.085	**1.152**
2001	0.000	0.000	0.000	0.008	0.150	0.126	0.049	0.135	0.108	0.110	0.113	0.025	**0.826**
2002	0.114	0.163	0.096	0.078	0.034	0.062	0.125	0.139	0.086	0.110	0.113	0.074	**1.193**
2003	0.085	0.117	0.119	0.141	0.000	0.000	0.068	0.139	0.103	0.108	0.108	0.084	**1.073**
2004	0.104	0.095	0.103	0.078	0.100	0.112	0.101	0.137	0.119	0.108	0.113	0.085	**1.257**
2005	0.134	0.032	0.173	0.070	0.007	0.000	0.112	0.120	0.100	0.091	0.094	0.067	**1.000**
Average	**0.078**	**0.081**	**0.094**	**0.077**	**0.049**	**0.044**	**0.084**	**0.121**	**0.108**	**0.097**	**0.106**	**0.067**	**1.004**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.029	0.031	0.035	0.029	0.020	0.016	0.032	0.045	0.042	0.036	0.040	0.026	0.032

FIXED AREA IRRIGATION DEMAND TIME SERIES B81H01

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.016	0.025	0.008	0.000	0.006	0.025	0.031	0.028	0.014	0.020	0.001	**0.178**
1926	0.011	0.012	0.026	0.000	0.003	0.013	0.023	0.029	0.028	0.017	0.020	0.001	**0.186**
1927	0.000	0.006	0.017	0.001	0.013	0.015	0.019	0.031	0.028	0.023	0.017	0.001	**0.170**
1928	0.009	0.007	0.018	0.004	0.000	0.000	0.023	0.032	0.025	0.021	0.016	0.000	**0.155**
1929	0.000	0.000	0.006	0.006	0.000	0.002	0.006	0.031	0.027	0.021	0.020	0.000	**0.119**
1930	0.012	0.012	0.000	0.017	0.003	0.004	0.013	0.032	0.027	0.013	0.020	0.001	**0.153**
1931	0.002	0.002	0.024	0.011	0.000	0.007	0.016	0.025	0.027	0.023	0.020	0.001	**0.159**
1932	0.006	0.004	0.009	0.000	0.008	0.013	0.024	0.032	0 028	0.023	0.020	0.001	**0.168**
1933	0.009	0.000	0.013	0.000	0.000	0.001	0.020	0.030	0.025	0.023	0.016	0.000	**0.137**
1934	0.000	0.000	0.022	0.028	0.007	0.018	0.025	0.028	0.028	0.023	0.020	0.000	**0.200**
1935	0.006	0.020	0.018	0.000	0.000	0.000	0.024	0.027	0.028	0.020	0.020	0.000	**0.162**
1936	0.012	0.007	0.021	0.000	0.000	0.002	0.021	0.032	0.028	0.023	0.020	0.000	**0.167**
1937	0.007	0.015	0.000	0.000	0.015	0.012	0.005	0.031	0.027	0.023	0.020	0.000	**0.154**
1938	0.004	0.017	0.000	0.008	0.000	0.000	0.023	0.027	0.026	0.017	0.019	0.000	**0.143**
1939	0.000	0.018	0.000	0.028	0.009	0.000	0.020	0.019	0.012	0.023	0.020	0.000	**0.149**
1940	0.002	0.000	0.002	0.013	0.017	0.002	0.007	0.030	0.025	0.021	0.018	0.000	**0.136**
1941	0.004	0 020	0.000	0.013	0.017	0.000	0.025	0.032	0.028	0.023	0.020	0.001	**0.185**
1942	0.012	0.013	0.015	0.030	0.000	0.000	0.000	0.024	0.028	0.007	0.020	0.001	**0.151**
1943	0.012	0.013	0.031	0.010	0.000	0.017	0.025	0.032	0.026	0.023	0.020	0.001	**0.210**
1944	0.000	0.020	0.028	0.009	0.000	0.019	0.019	0.030	0.025	0.021	0.018	0.000	**0.189**
1945	0.001	0.008	0.027	0.000	0.000	0.000	0.022	0.032	0.028	0.022	0 020	0.001	**0.161**
1946	0.000	0.001	0.008	0.005	0.004	0.000	0.025	0.027	0.023	0.022	0.020	0.001	**0.137**
1947	0.005	0.016	0.007	0.007	0.007	0.000	0.023	0.032	0.028	0.022	0.020	0.000	**0.169**
1948	0.000	0.000	0.023	0.000	0.008	0.017	0.018	0.030	0.027	0.020	0.019	0.000	**0.162**
1949	0.010	0.002	0.000	0.019	0.000	0.007	0.012	0.027	0.027	0.023	0.020	0.001	**0.148**
1950	0.010	0.005	0.005	0.025	0.017	0.000	0.008	0.026	0.028	0.023	0.016	0.000	**0.164**
1951	0.000	0.014	0.024	0.009	0.005	0.001	0.018	0.032	0.024	0.020	0.020	0.001	**0.170**
1952	0.001	0.011	0.000	0.000	0.000	0.005	0.009	0.032	0.028	0.022	0.020	0.001	**0.130**
1953	0.010	0.000	0.023	0.004	0.000	0.015	0.003	0.030	0.027	0.023	0.018	0.000	**0.153**
1954	0.001	0.000	0.000	0.007	0.000	0.000	0.020	0.027	0.027	0.023	0.020	0.001	**0.127**
1955	0.002	0.000	0.009	0.026	0.000	0.008	0.023	0.028	0.028	0.022	0.019	0.000	**0.165**
1956	0.010	0.016	0.006	0.001	0.000	0.006	0.021	0.030	0.026	0.020	0.019	0.000	**0.156**
1957	0.000	0.013	0 013	0.000	0.004	0.018	0.016	0.032	0.027	0.023	0.020	0.000	**0.166**
1958	0.008	0.008	0.007	0.000	0.000	0.010	0.023	0.032	0.028	0.020	0.020	0.001	**0.158**
1959	0.011	0.010	0.007	0.022	0.000	0.012	0.006	0.018	0.026	0.022	0.020	0.001	**0.155**
1960	0.011	0.000	0.000	0.019	0.000	0.000	0.016	0.031	0.020	0.023	0.020	0.000	**0.140**
1961	0.006	0.013	0.012	0.008	0.007	0.000	0.008	0.032	0.028	0.023	0.019	0.000	**0.156**
1962	0.008	0.000	0.010	0.028	0.014	0.012	0.020	0.030	0.016	0.019	0.020	0.001	**0.180**
1963	0.005	0.011	0.010	0.015	0.015	0.017	0.022	0.030	0.028	0.023	0.020	0.000	**0.198**
1964	0.000	0.006	0.000	0.009	0.003	0.013	0.023	0.032	0.028	0.023	0.020	0.000	**0.158**
1965	0.010	0.011	0.024	0.000	0.000	0.019	0.023	0.031	0.025	0.023	0.017	0.001	**0.186**
1966	0.000	0.012	0.009	0.000	0.000	0.007	0.013	0.032	0.028	0.019	0.020	0.001	**0.142**
1967	0.005	0.008	0.013	0.016	0.003	0.019	0.019	0.027	0.023	0.023	0.020	0.001	**0.177**
1968	0.006	0.000	0.000	0.003	0.005	0.000	0.019	0.032	0.028	0.022	0.020	0.000	**0.136**
1969	0.000	0.011	0.012	0.029	0.009	0.017	0.023	0.032	0.027	0.021	0.020	0.001	**0.203**
1970	0.007	0.015	0.001	0.000	0.016	0.010	0.018	0.030	0.023	0.023	0.020	0.000	**0.163**
1971	0.000	0.004	0.004	0.000	0.000	0.000	0.022	0.025	0.028	0.023	0.020	0.001	**0.127**
1972	0.000	0.009	0.021	0.016	0.009	0.000	0.014	0.030	0.028	0.022	0.020	0.000	**0.169**
1973	0.000	0.006	0.009	0.011	0.000	0.002	0.015	0.029	0.028	0.012	0.019	0.000	**0.131**
1974	0.010	0.003	0.013	0.000	0.000	0.018	0.013	0.028	0.026	0.023	0.020	0.001	**0.157**
1975	0.012	0.010	0.000	0.000	0.000	0.000	0.019	0.022	0.028	0.023	0.020	0.001	**0.135**
1976	0.006	0.005	0.024	0.000	0.000	0.000	0.025	0.031	0.028	0.023	0.020	0.000	**0.162**
1977	0.010	0.010	0.000	0.000	0.000	0.000	0.007	0.032	0.028	0.023	0.020	0.001	**0.132**
1978	0.000	0.000	0.000	0.008	0.000	0.008	0.019	0.027	0.028	0.022	0.005	0.001	**0.119**
1979	0.000	0.009	0.002	0.002	0.000	0.001	0.018	0.032	0.028	0.023	0.020	0.000	**0.136**
1980	0.003	0.000	0.003	0.000	0.000	0.000	0.024	0.031	0.028	0.023	0.019	0.000	**0.130**
1981	0.000	0.003	0.018	0.022	0.013	0.015	0.018	0.028	0.027	0.023	0.020	0.001	**0.191**
1982	0.007	0.010	0.020	0.019	0.017	0.000	0.025	0.031	0.026	0.023	0.018	0.001	**0.197**
1983	0.005	0.000	0.016	0.009	0.012	0.000	0.020	0.032	0.026	0.009	0.019	0.000	**0.149**
1984	0.000	0.001	0.017	0.000	0.000	0.000	0.024	0.023	0.024	0.020	0.020	0.000	**0.130**
1985	0.000	0.008	0.011	0.022	0.000	0.017	0.001	0.032	0.028	0.023	0.019	0.000	**0.162**
1986	0.006	0.003	0.008	0.019	0.004	0.000	0.025	0.028	0.027	0.023	0.012	0.000	**0.156**
1987	0.000	0.014	0.000	0.015	0.000	0.000	0.024	0.032	0.025	0.023	0.018	0.000	**0.152**
1988	0.000	0.015	0.019	0.025	0.000	0.015	0.024	0.030	0.025	0.023	0.020	0.001	**0.197**
1989	0.000	0.000	0.003	0.012	0.011	0.000	0.018	0.032	0.028	0.022	0.020	0.001	**0.148**
1990	0.000	0.006	0.005	0.009	0.000	0.000	0.025	0.031	0.022	0.023	0.020	0.001	**0.144**
1991	0.011	0.005	0.023	0.015	0.014	0.003	0.023	0.032	0.025	0.023	0.020	0.001	**0.196**
1992	0.012	0.010	0.004	0.019	0.005	0.008	0.021	0.032	0.028	0.022	0.020	0.001	**0.183**
1993	0.005	0.000	0.000	0.007	0.016	0.011	0.019	0.032	0.028	0.023	0.020	0.000	**0.162**
1994	0.000	0.018	0.020	0.000	0.000	0.007	0.010	0.026	0.028	0.023	0.020	0.001	**0.154**
1995	0.003	0.007	0.020	0.000	0.000	0.000	0.021	0.025	0.027	0.012	0.020	0.000	**0.134**
1996	0.001	0.002	0.026	0.000	0.000	0.002	0.017	0.028	0.028	0.023	0.020	0.000	**0.149**
1997	0.006	0.000	0.026	0.009	0.016	0.018	0.022	0.032	0.028	0.023	0.020	0.000	**0.200**
1998	0.000	0.003	0.000	0.005	0.000	0.000	0.016	0.029	0.028	0 022	0.020	0.001	**0.124**
1999	0.000	0.001	0.003	0.000	0.000	0.000	0.012	0.032	0.023	0.022	0.020	0.001	**0.113**
2000	0.004	0.002	0.019	0.024	0.000	0.007	0.021	0.031	0.027	0.023	0.020	0.001	**0.179**
2001	0.000	0.000	0.000	0.000	0.017	0.018	0.013	0.032	0.026	0.023	0.020	0.000	**0.150**
2002	0.009	0.018	0.011	0.008	0.000	0.009	0.024	0.032	0.023	0.023	0.020	0.000	**0.179**
2003	0.005	0.012	0.015	0.018	0.000	0.000	0.016	0.032	0.026	0.023	0.020	0.001	**0.167**
2004	0.007	0.009	0.012	0.008	0.010	0.016	0.021	0.032	0.028	0.023	0.020	0.001	**0.188**
2005	0.011	0.000	0.023	0.007	0.000	0.000	0.023	0.030	0.025	0.020	0.018	0.000	**0.157**
Average	**0.007**	**0.007**	**0.011**	**0.009**	**0.004**	**0.006**	**0.018**	**0.030**	**0.026**	**0.021**	**0.019**	**0.001**	**0.159**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.003	0.003	0.004	0.003	0.002	0.002	0.007	0.011	0.010	0.008	0.007	0.000	0.005

FIXED AREA IRRIGATION DEMAND TIME SERIES B81H10

Monthly irrigation demand in 10^6m^3

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.204	0.055	0.083	0.049	0.000	0.000	0.035	0.043	0.039	0.012	0.028	0.000	**0.361**
1926	0.038	0.045	0.087	0.025	0.030	0.014	0.031	0.038	0.039	0.018	0.028	0.000	**0.395**
1927	0.000	0.030	0.066	0.032	0.053	0.018	0.022	0.043	0.039	0.031	0.021	0.000	**0.355**
1928	0.031	0.034	0.068	0.039	0.000	0.000	0.030	0.045	0.033	0.027	0.018	0.000	**0.325**
1929	0.011	0.007	0.042	0.042	0.003	0.000	0.000	0.041	0.037	0.028	0.028	0.000	**0.240**
1930	0.039	0.045	0.000	0.068	0.029	0.000	0.008	0.046	0.036	0.009	0.028	0.000	**0.307**
1931	0.016	0.021	0.082	0.054	0.021	0.001	0.016	0.028	0.037	0.033	0.028	0.000	**0.337**
1932	0.026	0.027	0.047	0.000	0.041	0.013	0.032	0.046	0.039	0.033	0.027	0.000	**0.331**
1933	0.033	0.000	0.056	0.022	0.003	0.000	0.023	0.041	0.032	0.033	0.019	0.000	**0.262**
1934	0.000	0.000	0.078	0.094	0.039	0.025	0.035	0.035	0.039	0.033	0.028	0.000	**0.406**
1935	0.025	0.063	0.068	0.000	0.000	0.000	0.032	0.034	0.039	0.025	0.028	0.000	**0.314**
1936	0.039	0.034	0.074	0.024	0.000	0.000	0.026	0.046	0.039	0.033	0.028	0.000	**0.343**
1937	0.028	0.052	0.017	0.000	0.058	0.011	0.000	0.042	0.037	0.032	0.027	0.000	**0.305**
1938	0.022	0.057	0.017	0.048	0.000	0.000	0.031	0.033	0.035	0.019	0.026	0.000	**0.288**
1939	0.004	0.059	0.000	0.093	0.044	0.000	0.023	0.016	0.003	0.033	0.028	0.000	**0.303**
1940	0.017	0.005	0.032	0.059	0.064	0.000	0.000	0.039	0.033	0.026	0.022	0.000	**0.298**
1941	0.020	0.065	0.011	0.058	0.064	0.000	0.035	0.046	0.039	0.033	0.028	0.000	**0.399**
1942	0.039	0.047	0.061	0.097	0.019	0.000	0.000	0.027	0.039	0.000	0.028	0.000	**0.359**
1943	0.039	0.047	0.098	0.052	0.000	0.022	0.035	0.046	0.034	0.033	0.028	0.000	**0.433**
1944	0.006	0.065	0.090	0.050	0.009	0.027	0.022	0.039	0.033	0.026	0.022	0.000	**0.390**
1945	0.012	0.036	0.089	0.000	0.000	0.000	0.027	0.045	0.039	0.030	0.028	0.000	**0.307**
1946	0.006	0.019	0.045	0.042	0.032	0.000	0.034	0.034	0.029	0.030	0.028	0.000	**0.299**
1947	0.024	0.053	0.043	0.045	0.040	0.000	0.031	0.046	0.039	0.030	0.028	0.000	**0.380**
1948	0.000	0.015	0.079	0.000	0.042	0.022	0.019	0.041	0.036	0.024	0.026	0.000	**0.305**
1949	0.035	0.021	0.012	0.072	0.022	0.000	0.005	0.033	0.038	0.033	0.028	0.000	**0.298**
1950	0.035	0.028	0.039	0.086	0.064	0.000	0.000	0.031	0.039	0.032	0.018	0.000	**0.372**
1951	0.000	0.050	0.082	0.050	0.035	0.000	0.019	0.045	0.031	0.026	0.028	0.000	**0.366**
1952	0.014	0.043	0.016	0.028	0.000	0.000	0.000	0.046	0.039	0.031	0.028	0.000	**0.244**
1953	0.034	0.006	0.079	0.039	0.015	0.019	0.000	0.040	0.038	0.033	0.023	0.000	**0.326**
1954	0.013	0.000	0.026	0.045	0.000	0.000	0.023	0.033	0.038	0.032	0.028	0.000	**0.240**
1955	0.016	0.009	0.047	0.090	0.000	0.003	0.030	0.036	0.039	0.030	0.025	0.000	**0.324**
1956	0.035	0.054	0.041	0.032	0.000	0.000	0.026	0.040	0.035	0.025	0.025	0.000	**0.313**
1957	0.000	0.046	0.056	0.000	0.033	0.026	0.014	0.046	0.037	0.031	0.028	0.000	**0.317**
1958	0.030	0.035	0.043	0.000	0.002	0.007	0.030	0.046	0.039	0.026	0.028	0.000	**0.286**
1959	0.036	0.039	0.044	0.079	0.000	0.012	0.000	0.013	0.036	0.031	0.028	0.000	**0.317**
1960	0.037	0.006	0.000	0.074	0.000	0.000	0.015	0.041	0.023	0.032	0.027	0.000	**0.254**
1961	0.025	0.047	0.054	0.048	0.038	0.000	0.000	0.046	0.038	0.033	0.025	0.000	**0.353**
1962	0.031	0.002	0.050	0.095	0.056	0.011	0.025	0.040	0.013	0.024	0.027	0.000	**0.373**
1963	0.023	0.043	0.051	0.064	0.059	0.023	0.027	0.040	0.039	0.033	0.028	0.000	**0.431**
1964	0.002	0.030	0.024	0.051	0.029	0.014	0.030	0.046	0.039	0.033	0.028	0.000	**0.326**
1965	0.035	0.042	0.083	0.008	0.000	0.027	0.031	0.044	0.034	0.033	0.021	0.000	**0.357**
1966	0.012	0.044	0.048	0.000	0.000	0.001	0.007	0.045	0.039	0.023	0.028	0.000	**0.247**
1967	0.022	0.035	0.057	0.066	0.029	0.026	0.022	0.034	0.028	0.032	0.028	0.000	**0.379**
1968	0.026	0.017	0.014	0.035	0.034	0.000	0.022	0.046	0.039	0.030	0.028	0.000	**0.291**
1969	0.000	0.042	0.055	0.095	0.043	0.023	0.030	0.045	0.038	0.027	0.028	0.000	**0.427**
1970	0.027	0.052	0.030	0.015	0.060	0.006	0.018	0.041	0.029	0.033	0.028	0.000	**0.339**
1971	0.009	0.025	0.036	0.000	0.000	0.000	0.028	0.030	0.039	0.031	0.027	0.000	**0.226**
1972	0.008	0.036	0.076	0.066	0.043	0.000	0.010	0.040	0.039	0.030	0.028	0.000	**0.377**
1973	0.010	0.032	0.048	0.055	0.000	0.000	0.012	0.037	0.039	0.007	0.026	0.000	**0.266**
1974	0.035	0.024	0.057	0.007	0.003	0.025	0.007	0.036	0.036	0.033	0.028	0.000	**0.290**
1975	0.038	0.041	0.000	0.000	0.000	0.000	0.020	0.022	0.039	0.033	0.028	0.000	**0.222**
1976	0.026	0.028	0.082	0.006	0.000	0.000	0.034	0.043	0.039	0.033	0.027	0.000	**0.318**
1977	0.035	0.039	0.021	0.012	0.015	0.000	0.000	0.045	0.039	0.032	0.028	0.000	**0.267**
1978	0.004	0.004	0.018	0.047	0.021	0.003	0.022	0.034	0.039	0.031	0.000	0.000	**0.223**
1979	0.000	0.039	0.032	0.035	0.000	0.000	0.019	0.045	0.039	0.033	0.027	0.000	**0.268**
1980	0.017	0.000	0.033	0.000	0.010	0.000	0.032	0.043	0.039	0.033	0.024	0.000	**0.231**
1981	0.010	0.023	0.069	0.080	0.055	0.019	0.020	0.036	0.038	0.032	0.028	0.000	**0.409**
1982	0.028	0.039	0.073	0.072	0.064	0.000	0.034	0.042	0.036	0.032	0.023	0.000	**0.443**
1983	0.022	0.000	0.063	0.051	0.052	0.000	0.023	0.046	0.036	0.001	0.026	0.000	**0.319**
1984	0.000	0.019	0.065	0.000	0.000	0.000	0.032	0.026	0.031	0.025	0.028	0.000	**0.227**
1985	0.000	0.035	0.053	0.080	0.022	0.023	0.000	0.045	0.039	0.033	0.025	0.000	**0.357**
1986	0.026	0.024	0.045	0.072	0.032	0.000	0.035	0.036	0.038	0.033	0.009	0.000	**0.350**
1987	0.009	0.050	0.002	0.063	0.000	0.000	0.033	0.045	0.032	0.033	0.023	0.000	**0.291**
1988	0.000	0.053	0.070	0.086	0.012	0.018	0.032	0.041	0.033	0.032	0.028	0.000	**0.404**
1989	0.000	0.000	0.033	0.056	0.050	0.000	0.019	0.046	0.039	0.030	0.028	0.000	**0.302**
1990	0.008	0.030	0.039	0.051	0.010	0.000	0.034	0.043	0.027	0.033	0.028	0.000	**0.303**
1991	0.038	0.028	0.079	0.063	0.057	0.000	0.030	0.046	0.033	0.033	0.027	0.000	**0.433**
1992	0.038	0.040	0.037	0.073	0.035	0.002	0.025	0.045	0.039	0.031	0.028	0.000	**0.393**
1993	0.022	0.015	0.022	0.046	0.062	0.008	0.022	0.045	0.039	0.033	0.028	0.000	**0.342**
1994	0.007	0.060	0.074	0.030	0.017	0.001	0.002	0.031	0.039	0.033	0.026	0.000	**0.320**
1995	0.018	0.033	0.072	0.008	0.000	0.000	0.025	0.028	0.037	0.008	0.026	0.000	**0.257**
1996	0.014	0.022	0.087	0.009	0.000	0.000	0.017	0.037	0.039	0.033	0.027	0.000	**0.285**
1997	0.026	0.000	0.086	0.051	0.062	0.024	0.028	0.046	0.039	0.031	0.027	0.000	**0.419**
1998	0.012	0.022	0.015	0.040	0.023	0.000	0.015	0.039	0.039	0.029	0.027	0.000	**0.262**
1999	0.000	0.018	0.033	0.010	0.000	0.000	0.005	0.044	0.028	0.030	0.028	0.000	**0.197**
2000	0.020	0.021	0.070	0.085	0.000	0.000	0.026	0.042	0.037	0.032	0.028	0.000	**0.361**
2001	0.000	0.000	0.014	0.023	0.062	0.026	0.009	0.044	0.036	0.032	0.028	0.000	**0.274**
2002	0.031	0.060	0.052	0.049	0.022	0.005	0.033	0.046	0.028	0.033	0.028	0.000	**0.387**
2003	0.022	0.044	0.061	0.071	0.000	0.000	0.015	0.046	0.034	0.032	0.027	0.000	**0.351**
2004	0.028	0.037	0.055	0.049	0.045	0.021	0.026	0.045	0.039	0.032	0.028	0.000	**0.405**
2005	0.038	0.014	0.080	0.046	0.012	0.000	0.029	0.039	0.033	0.026	0.022	0.000	**0.340**
Average	**0.022**	**0.031**	**0.050**	**0.044**	**0.023**	**0.006**	**0.021**	**0.040**	**0.036**	**0.029**	**0.026**	**0.000**	**0.325**
	31	30	31	31	28.25	31	30	31	30	31	31	30	365.25
Average (m3/s)	0.008	0.012	0.019	0.016	0.010	0.002	0.008	0.015	0.014	0.011	0.010	0.000	0.010

Appendix D : Detailed Information Regarding the Determination of Irrigation Demands

Schoeman & Vennote undertook a field by field assessment of the crop areas and types for most of the Groot Letaba Catchment, excluding the Politsi Government Water Control Area (GWCA), supplied from Magoebaskloof Scheme, and the Middle/Klein Letaba. This assessment provides theoretical field edge water requirements for each quinary which totalled 168 Mm^3/a for the study area for the period 1925 – 2005 (Schoeman & Vennote's report gives a total of 171 Mm^3/a which is based on demands for the period 1912 to 2005 (hydrological years) instead of the 1925 to 2004 period (hydrological years) adopted for this study). At a later stage, Schoeman & Vennote provided a coverage (irrperproperty) that could be used to break the irrigated areas within each quinary down into :

- GLWUA
- Other surface water irrigators not part of the GLWUA
- Groundwater

This breakdown was then used to determine what proportion of the surface irrigation in a quinary was undertaken by the GLWUA. This proportion was then used to determine the GLWUA's theoretical surface water requirement in each quinary (105.5 Mm^3/a) and the remaining surface requirement was assumed to represent the surface water requirement of local users (62.05 Mm^3/a). The total area irrigated from surface water in irrperproperty appears to include some future developments and is 5% more than that in the field assessment report. However, because the irrperproperty coverage was only used to determine the ratio of local to GLWUA demands, this discrepancy will have had a negligible effect on the demands used.

The GLWUA's total theoretical requirements upstream (13.1 Mm^3/a) and downstream (92.4 = 105.5 - 13.1) of the Tzaneen Dam, were determined by summing the relevant GLWUA quinary requirements. In addition, emerging farmers upstream of the Letaba Ranch weir may be allocated a portion of the allocation from Tzaneen Dam (22.2 = 26 475 ha at 838 mm/ha – personal correspondence from Jurg Venter). The planned theoretical allocations for the GLWUA of 127.7 Mm^3/a (127.7 = 105.5 + 22.2) were greater than the total scheduled field edge demands of 10 Mm^3/a upstream and 80.5 Mm^3/a downstream of Tzaneen Dam, giving a total of 90.5 Mm^3/a. This effectively reduced the application rates below the theoretical rates so that the increased area irrigated by the GLWUA still uses the volume of water corresponding to the scheduled volume.

The local demands remaining after deducting the GLWUA's theoretical surface water requirement in each quinary did not include the Politsi GWCA of about 11 Mm^3/a and the demands from the Middle Letaba of 51 Mm^3/a estimated from WRSM2000 and the 2005/6 *Operating Analysis* Report. Combining the local irrigation demands upstream of the Kruger National Park gives a total local (i.e. non-GLWUA) irrigation demand of 124 Mm^3/a (124 = 62 + 11 + 51). For simplicity, in the Middle Letaba, the losses and urban demands supplied from the canal from Nsami were combined with the agricultural demands giving a total "agricultural" demand of 132.6 Mm^3/a (61 + 11 + 59.6).

Appendix D: Detailed breakdown of the irrigation demands used in the Letaba

Code	Quinary	Description / Component	Total	Source	Ratio of local to total irrigation demand	Local (Mm³/a)					Groot Letaba Water Users' Association (Mm³/a)								
						Calculated (= d x f)	First consolidation to reduce number of demands	Second consolidation	Filename in WRYM	Comment	Theoretical estimate	Sub-totals		Gross allocation (from schedule)	Field edge allocation (77% of gross allocation)	Correction		Final GL (field edge)	Filename in WRYM
a	b	C	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
GLA	A10	u/s Dap Naude	0.000	H Schoeman	0%	0.00	0.0				0.0								
GLA	A01	u/s Ebenezer Dam	1.141	H Schoeman	100%	1.14	1.1	1.1	A01irr.DEM		0.0								
GLA	B10	u/s Georges Valley canal offtake	0.58	H Schoeman	55%	0.32					0.3	13.1	13.10	12.98	10.0		-3.1	10.0	GL_usTZ.DEM
GLA	B12		0.88	H Schoeman	28%	0.25					0.6								
GLA	B14	u/s Redbank weir offtake to Pusela Canal	3.33	H Schoeman	20%	0.67	6.5	7.4	XusTZ.DEM		2.7								
GLA	B16	u/s Grysbank weir	0.96	H Schoeman	29%	0.28					0.7								
PRS	B01,B20,B30	Politsi GWCA (PGWCA) supplied from Magoebaskloof	11.03	Basin Study		11.03	11.0	11.4	Pol_GWCA.DEM										
GLA	B01	Excl PGWCA	12.22	H Schoeman	71%	8.72					3.5								

Code	Quinary	Description / Component	Total	Source	Ratio of local to total irrigation demand	Local (Mm³/a)					Groot Letaba Water Users' Association (Mm³/a)								
						Calculated (= d x f)	First consolidation to reduce number of demands	Second consolidation	Filename in WRYM	Comment	Theoretical estimate	Sub-totals		Gross allocation (from schedule)	Field edge allocation (77% of gross allocation)	Correction		Final GL (field edge)	Filename in WRYM
a	b	C	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
PRS	B01	Ramadiepa d/s Hans Merensky		H Schoeman			0.8	3.9	Ramadiep.dem										
PRS	B01	Selokwe		H Schoeman			2.0	2.0	Selokwe.dem										
PRS	B01	Politsi		H Schoeman			0.1	see PGWCA											
GLA	B01	B01 remainder including pumps on dam		J Venter			0.8	0.0											
GLA	B01	Additional local demand u/s Tzaneen					0.0												
PRS	B20	Excl PGWCA	0.29	H Schoeman	100%	0.29	0.3	see PGWCA											
PRS	B30	Excl PGWCA (Feasibility WRYM had 1.7Mcm of this demand supplied from the H Merensky Dam)	3.10	H Schoeman	100%	3.10	3.1												
GLA	C10	Portion of		H		0.00					5.0								

Code	Quinary	Description / Component	Total	Source	Ratio of local to total irrigation demand	Local (Mm³/a)					Groot Letaba Water Users' Association (Mm³/a)								
						Calculated (= d x f)	First consolidation to reduce number of demands	Second consolidation	Filename in WRYM	Comment	Theoretical estimate	Sub-totals		Gross allocation (from schedule)	Field edge allocation (77% of gross allocation)	Correction		Final GL (field edge)	Filename in WRYM
a	b	C	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
		C10 supplied from Pusela canal		Schoeman															
GLB	C10	u/s Yamorna weir	14.13	H Schoeman	34%	4.77	4.77	9.5	LocTzNw.DEM		4.4	63.4	114.6	104.7	80.5	Factor irrigation demand d/s Tzaneen by 70%	-23.4	40.0	GL_TzNw.DEM
GLA	C15	Portion of C15 supplied from Pusela canal		H Schoeman		0.00	0.00				0.4								
GLB	C15	u/s N&N canal offtake	6.78	H Schoeman	11%	0.77	0.77				5.6								
GLB	C01	u/s The Junction weir	10.42	H Schoeman	11%	1.13	1.13				9.3								
GLB	E10		5.96	H Schoeman	2%	0.11	0.11				5.8								
GLB	E01	u/s Jasi Weir	32.80	H Schoeman	8%	2.67	2.67				30.1								
GLC	F30	u/s Prieska Weir	15.34	H Schoeman	13%	1.94	1.94	3.9	LocNw3.DEM		13.4	18.3					-6.8	11.6	GL_Nw3.DEM
GLC	F10		2.37	H	34%	0.80	0.80				1.6								

Code	Quinary	Description / Component	Total	Source	Ratio of local to total irrigation demand	Local (Mm³/a)					Groot Letaba Water Users' Association (Mm³/a)								
						Calculated (= d x f)	First consolidation to reduce number of demands	Second consolidation	Filename in WRYM	Comment	Theoretical estimate	Sub-totals		Gross allocation (from schedule)	Field edge allocation (77% of gross allocation)	Correction		Final GL (field edge)	Filename in WRYM
a	b	C	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
				Schoeman															
GLC	F20		4.55	H Schoeman	26%	1.19	1.19				3.4								
GLD	F01		8.40	H Schoeman	8%	0.68	0.68				7.7	10.7					-3.9	6.7	GL_ds3.DEM
GLD	J10	u/s Letaba Ranch Weir	2.79	H Schoeman	1%	0.01	0.01	0.8	LocDs3		2.8								
GLD	J10	u/s Letaba Ranch Weir (Unused allocation for emerging farmers)	22.19	Jurg Venter's area and applic rate in WPJ71			0.00				22.2	22.2						22.2	GL_HDI.DEM
NW	E20		4.73	H Schoeman	100%	4.73	4.7	4.7	E20-7irr.DEM										
NW	E23		2.62	H Schoeman	100%	2.62	2.6	2.6	E23-7irr.DEM										
NW	E25		8.32	H Schoeman	64%	5.30	5.3	5.3	E25-7irr.DEM		3.0								
NW	E30		1.89	H Schoeman	59%	1.11	1.1	1.1	E30-7irr.DEM		0.8								
MOL	G01		1.56	H Schoeman	100%	1.56	1.6	1.6	G01-7irr.DEM										

Code	Quinary	Description / Component	Total	Source	Ratio of local to total irrigation demand	Local (Mm³/a)					Groot Letaba Water Users' Association (Mm³/a)								
						Calculated (= d x f)	First consolidation to reduce number of demands	Second consolidation	Filename in WRYM	Comment	Theoretical estimate	Sub-totals		Gross allocation (from schedule)	Field edge allocation (77% of gross allocation)	Correction		Final GL (field edge)	Filename in WRYM
a	b	C	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
MOL	G10		1.00	H Schoeman	100%	1.00	1.0	1.0	G10-7irr.DEM										
MOL	H01		0.16	H Schoeman	68%	0.11	0.11	see F01			0.1								
MOL	H10		0.33	H Schoeman	100%	0.33	0.3	0.3	H10-7irr.DEM										
GLD	J01		0.11	H Schoeman	0%	0.00	0.00	see F01			0.1								
LET	D10		2.25	H Schoeman	100%	2.25	2.3	2.3	D10-7irr.DEM										
LET	D13		1.61	H Schoeman	100%	1.61	1.6	1.6	D13-7irr.DEM										
LET	D16		11.04	H Schoeman	94%	10.41	10.4	10.4	D16-7irr.DEM		0.6								
LET	D01		4.74	H Schoeman	29%	1.36	1.4	1.4	D01-7irr.DEM		3.4								
LET	D28		1.13	H Schoeman	72%	0.82	0.8	0.8	D28-7irr.DEM		0.3								
ML	B82A	Middle Letaba (upper reaches)	6.10	WRSM2000		6.10	6.1	6.1	na (min-max)	use uniform demand of 0.19m³/s									
ML	B82B	Koedoes	18.30	WRSM2000		18.30	18.3	18.3	na	use uniform demand of 0.58m³/s									

Code	Quinary	Description / Component	Total	Source	Ratio of local to total irrigation demand	Local (Mm³/a)					Groot Letaba Water Users' Association (Mm³/a)								
						Calculated (= d x f)	First consolidation to reduce number of demands	Second consolidation	Filename in WRYM	Comment	Theoretical estimate	Sub-totals		Gross allocation (from schedule)	Field edge allocation (77% of gross allocation)	Correction		Final GL (field edge)	Filename in WRYM
a	b	C	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
ML	B82C	Brandboontjies	12.99	WRSM2000		12.99	13.0	13.0	na	use uniform demand of 0.41m³/s									
ML	B82D	Middle Letaba Dam	see B82H (Nsami)			0.00	0.0	0.0		use uniform demand (as per gauge B8H054) 0.41m³/s									
KL	B82E	Klein Letaba	0.18	WRSM2000		0.18	0.2	0.2	na										
KL	B82F	Klein Letaba	0.62	WRSM2000		0.62	0.6	0.6	na										
KL	B82G		1.60	Annual Op Analysis 05/6 - WARMS		1.60	1.6	1.6	na										
KL	B82H	Nsami	11.60	Annual Op Analysis 05/6 - WARMS		11.60	11.6	11.6	na	Demand including urban and losses is 20Mm³/a (assume uniform distrib as per gauge B8H054) ie 0.63m³/s									
KL	B82J			Annual Op Analysis 05/6 - WARMS		0.00	0.0	0.0											
	Totals																		
GLA		Supplied	19			11	8.5	8.5			13							10.0	

Code	Quinary	Description / Component	Total	Source	Ratio of local to total irrigation demand	Local (Mm³/a)					Groot Letaba Water Users' Association (Mm³/a)								
						Calculated (= d x f)	First consolidation to reduce number of demands	Second consolidation	Filename in WRYM	Comment	Theoretical estimate	Sub-totals		Gross allocation (from schedule)	Field edge allocation (77% of gross allocation)	Correction		Final GL (field edge)	Filename in WRYM
a	*b*	*C*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*	*p*	*q*	*r*	*s*	*t*
		from upstream of Tzaneen																	
GLB		Tzaneen to Nwanedsi	70			9	9.5	9.5			55							40.0	
GLC		Namitwato EWR 3	22			4	3.9	3.9			18							11.6	
GLD		Below EWR 3	33			1	0.7	0.8			33							28.9	
PRS		Politsi, Ramadiepa and Selokwe	14			14	17.3	17.3			0							0.0	
LET		Letsitele	21			16	16.5	16.5			4							0.0	
NW		Nwanedsi	18			14	13.8	13.8			4							0.0	
MOL		Molototsi	3			3	3.0	2.9			0							0.0	
Sub-total for Groot Letaba								**73.1***										**90.5**	
ML		Middle Letaba	37			37	37.4	37.4			0							0.0	
KL		Klein Letaba	14			14	14.0	14.0			0							0.0	
		Grand total	252			124.5	124.5	124.5			128			117.7				90.5	

* Estimated field edge irrigation requirement (excluding losses) for the Groot Letaba Catchment is (73.1 + 90.5 =) 163.6 Mm³/a

* Estimated field edge irrigation requirement (excluding losses) for the Groot, Middle and Klein Letaba is (124.5 + 90.5 =) 215 Mm³/a

Appendix E : EWR Requirements used for different Scenarios in the WRYM

Appendix E1

File : 1C-T.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.28	0.44	0.54	0.41	1.87	0.75	1.12	0.41	0.36	0.35	0.44	0.56	7.5
1926	0.46	0.72	0.94	0.76	2.23	0.80	1.27	0.49	0.42	0.38	0.38	0.34	9.2
1927	0.58	1.47	1.68	1.54	5.01	1.19	2.47	0.82	0.75	0.68	0.66	0.60	17.5
1928	0.55	1.32	1.62	1.47	7.82	2.13	3.23	0.92	0.82	0.73	0.71	0.62	21.9
1929	0.56	1.46	3.01	1.54	6.32	2.09	3.23	0.92	0.83	0.75	0.72	0.63	22.1
1930	0.55	0.76	3.02	1.40	3.89	1.64	3.10	0.90	0.80	0.75	0.72	0.63	18.1
1931	0.57	1.52	2.51	1.02	3.71	1.67	2.97	0.87	0.80	0.75	0.71	0.61	17.7
1932	0.51	0.55	2.71	1.59	5.36	1.26	1.98	0.70	0.58	0.44	0.37	0.30	16.4
1933	0.27	1.54	2.84	1.57	7.87	2.04	3.20	0.92	0.83	0.75	0.72	0.63	23.2
1934	0.57	1.54	3.02	1.43	3.55	1.21	1.64	0.64	0.66	0.63	0.59	0.41	15.9
1935	0.34	0.44	0.51	0.55	4.24	1.85	3.06	0.88	0.81	0.75	0.72	0.63	14.8
1936	0.58	1.54	3.01	1.58	9.01	2.30	3.18	0.91	0.77	0.60	0.51	0.53	24.5
1937	0.49	0.55	2.76	1.42	4.06	1.00	3.13	0.92	0.82	0.75	0.72	0.63	17.3
1938	0.58	1.53	3.02	1.72	9.01	2.30	3.23	0.92	0.82	0.75	0.72	0.63	25.2
1939	0.58	1.54	3.02	1.35	4.46	1.80	3.07	0.89	0.81	0.75	0.72	0.63	19.6
1940	0.58	1.45	2.90	1.16	2.21	0.72	1.39	0.52	0.46	0.38	0.33	0.29	12.4
1941	0.30	0.42	0.62	0.58	1.56	1.51	2.96	0.80	0.75	0.72	0.71	0.63	11.5
1942	0.58	1.51	3.02	1.37	2.63	1.69	3.19	0.92	0.83	0.75	0.72	0.63	17.8
1943	0.58	1.53	2.22	1.02	7.86	1.84	2.92	0.83	0.74	0.69	0.66	0.55	21.4
1944	0.57	1.15	0.73	0.53	3.24	1.88	3.10	0.89	0.78	0.68	0.60	0.39	14.6
1945	0.44	0.74	0.79	1.56	6.18	1.68	2.89	0.82	0.74	0.65	0.59	0.38	17.4
1946	0.32	0.45	0.51	0.36	1.54	0.63	0.94	0.40	0.35	0.33	0.30	0.26	6.4
1947	0.28	0.94	2.43	0.94	2.82	2.30	3.23	0.92	0.83	0.74	0.68	0.56	16.7
1948	0.56	1.35	1.39	1.12	2.85	1.02	1.75	0.65	0.67	0.68	0.66	0.56	13.3
1949	0.49	1.17	2.21	1.17	7.29	1.90	3.05	0.89	0.82	0.75	0.72	0.63	21.1
1950	0.57	1.09	3.02	1.43	3.07	0.91	2.75	0.91	0.83	0.75	0.72	0.63	16.7
1951	0.58	1.48	1.49	0.57	1.93	0.70	1.04	0.42	0.37	0.38	0.41	0.38	9.7
1952	0.33	1.05	2.33	1.55	8.22	2.07	3.14	0.91	0.82	0.74	0.72	0.62	22.5
1953	0.56	1.50	2.96	1.60	7.24	1.68	3.01	0.90	0.81	0.74	0.71	0.62	22.3
1954	0.58	1.50	2.84	1.72	9.01	2.30	3.21	0.91	0.82	0.75	0.72	0.63	25.0
1955	0.58	1.51	2.98	1.27	9.33	2.30	3.21	0.91	0.80	0.73	0.69	0.63	24.9
1956	0.58	1.34	1.68	0.65	1.99	1.53	2.96	0.84	0.78	0.74	0.72	0.63	14.4
1957	0.58	1.52	2.55	1.72	8.95	1.88	2.91	0.81	0.62	0.47	0.39	0.41	22.8
1958	0.54	1.24	3.01	1.40	5.30	1.55	2.23	0.62	0.49	0.42	0.39	0.35	17.6
1959	0.34	1.54	3.01	1.30	5.25	1.55	2.60	0.84	0.79	0.73	0.70	0.62	19.3
1960	0.55	1.51	3.02	1.54	7.83	2.06	3.18	0.92	0.82	0.75	0.72	0.63	23.5
1961	0.58	1.41	1.78	1.02	2.23	0.74	1.28	0.57	0.56	0.45	0.38	0.30	11.3
1962	0.28	0.78	2.90	1.21	2.35	0.68	1.04	0.47	0.62	0.71	0.70	0.62	12.4
1963	0.52	0.94	0.92	0.67	2.08	0.67	0.94	0.39	0.34	0.31	0.26	0.22	8.2
1964	0.28	0.72	3.02	1.67	5.38	1.33	2.16	0.73	0.66	0.60	0.51	0.43	17.5
1965	0.41	1.18	1.03	1.05	5.48	1.67	2.28	0.51	0.38	0.35	0.32	0.28	14.9
1966	0.35	0.94	2.08	1.27	6.74	1.84	3.22	0.92	0.83	0.75	0.71	0.60	20.2
1967	0.50	1.47	2.04	0.57	1.57	0.59	0.94	0.42	0.45	0.47	0.49	0.39	9.9
1968	0.34	1.31	2.55	1.20	3.22	1.89	3.09	0.89	0.80	0.73	0.70	0.61	17.3
1969	0.58	1.53	2.78	1.00	1.89	0.66	0.92	0.38	0.34	0.32	0.30	0.27	11.0
1970	0.27	0.45	1.20	1.39	4.48	1.20	1.68	0.72	0.72	0.65	0.59	0.41	13.8
1971	0.57	1.53	2.81	1.72	9.33	2.30	3.23	0.92	0.83	0.75	0.71	0.62	25.3
1972	0.57	1.45	1.98	0.65	1.76	0.69	1.75	0.82	0.69	0.61	0.62	0.63	12.2
1973	0.58	1.54	3.02	1.72	9.01	2.30	3.21	0.91	0.82	0.74	0.72	0.63	25.2
1974	0.58	1.53	2.81	1.52	8.91	2.20	3.11	0.90	0.81	0.75	0.71	0.62	24.5
1975	0.54	0.59	3.02	1.66	8.64	2.30	3.23	0.92	0.83	0.75	0.72	0.63	23.8
1976	0.57	1.53	2.47	1.63	8.14	2.22	3.23	0.92	0.82	0.74	0.70	0.63	23.6
1977	0.58	1.44	3.00	1.72	9.01	2.18	3.22	0.91	0.80	0.70	0.66	0.55	24.8
1978	0.46	1.49	2.27	1.18	3.23	1.39	2.66	0.74	0.65	0.59	0.68	0.63	15.9
1979	0.58	1.52	2.81	1.37	8.62	2.04	2.97	0.85	0.73	0.59	0.59	0.59	23.3
1980	0.58	1.54	3.00	1.72	9.01	2.28	3.20	0.91	0.81	0.73	0.69	0.62	25.1
1981	0.58	1.52	2.43	0.87	1.89	0.66	1.03	0.47	0.49	0.44	0.37	0.33	11.1
1982	0.35	0.74	0.84	0.48	1.15	0.52	0.81	0.36	0.32	0.29	0.27	0.26	6.4
1983	0.30	0.90	1.24	0.54	1.44	0.64	1.15	0.48	0.43	0.72	0.72	0.63	9.2
1984	0.58	1.54	2.98	1.34	7.22	1.71	2.72	0.81	0.77	0.73	0.70	0.62	21.7
1985	0.58	1.42	1.62	0.77	2.24	0.83	3.14	0.92	0.82	0.75	0.71	0.61	14.4
1986	0.55	1.39	2.22	0.79	5.54	1.70	2.66	0.71	0.58	0.53	0.51	0.61	17.8
1987	0.58	1.48	2.99	1.26	7.57	2.13	3.22	0.92	0.83	0.75	0.72	0.63	23.1
1988	0.58	1.54	2.78	0.94	4.07	1.52	2.33	0.72	0.64	0.64	0.64	0.54	16.9
1989	0.49	1.52	2.97	1.53	5.38	1.54	2.79	0.87	0.79	0.72	0.69	0.60	19.9
1990	0.52	1.24	2.80	1.40	5.05	2.06	3.16	0.91	0.82	0.75	0.72	0.63	20.1
1991	0.57	0.78	0.62	0.36	0.88	0.36	0.52	0.27	0.24	0.21	0.19	0.17	5.2
1992	0.17	0.27	1.22	0.55	1.76	1.24	2.67	0.66	0.47	0.44	0.49	0.49	10.4
1993	0.44	1.45	2.98	1.21	3.24	1.22	1.64	0.52	0.41	0.36	0.34	0.32	14.1
1994	0.47	0.78	1.62	0.68	3.37	1.48	2.81	0.86	0.79	0.72	0.70	0.61	14.9
1995	0.55	1.54	3.01	1.72	9.33	2.30	3.16	0.92	0.83	0.75	0.72	0.63	25.4
1996	0.58	1.53	2.76	1.64	7.89	2.13	3.23	0.92	0.82	0.75	0.72	0.63	23.6
1997	0.58	1.53	2.75	1.59	5.87	1.32	2.03	0.62	0.49	0.49	0.64	0.62	18.5
1998	0.58	1.53	3.02	1.72	8.35	2.22	3.23	0.92	0.83	0.75	0.72	0.63	24.5
1999	0.58	1.53	2.88	1.69	8.23	2.03	3.12	0.91	0.82	0.75	0.72	0.63	23.9
2000	0.58	1.52	2.63	0.83	7.43	1.89	2.98	0.87	0.79	0.73	0.71	0.62	21.6
2001	0.58	1.54	3.02	1.34	3.33	0.97	1.40	0.49	0.44	0.45	0.51	0.47	14.6
2002	0.54	0.94	0.77	0.47	1.19	0.50	0.69	0.34	0.30	0.28	0.26	0.25	6.5
2003	0.30	0.52	0.65	0.46	5.01	2.07	3.22	0.92	0.83	0.75	0.72	0.63	16.1
2004	0.58	1.34	2.98	1.26	2.92	0.79	1.43	0.69	0.68	0.62	0.62	0.53	14.4
AVE :	0.50	1.22	2.26	1.19	5.08	1.53	2.47	0.76	0.68	0.63	0.60	0.53	17.5
SD :	0.11	0.39	0.85	0.43	2.72	0.59	0.86	0.19	0.18	0.16	0.15	0.13	5.6

Appendix E2

File : 2D-T.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	1.51	1.32	1.08	2.28	5.40	7.09	3.43	2.37	1.78	1.62	1.36	1.18	30.4
1926	1.15	0.57	0.55	0.93	1.31	1.12	0.61	0.54	0.35	0.25	0.20	0.18	7.8
1927	1.59	2.11	1.68	5.35	9.20	5.46	2.94	2.10	1.53	1.37	1.01	0.90	35.3
1928	0.86	1.56	1.51	2.51	5.13	8.09	3.59	2.57	1.98	1.77	1.40	1.20	32.2
1929	1.45	1.80	3.14	3.56	3.91	7.95	3.63	2.65	2.06	1.86	1.48	1.27	34.8
1930	1.41	0.96	4.74	5.13	7.55	7.47	3.65	2.67	2.06	1.86	1.49	1.29	40.3
1931	1.57	2.21	1.93	2.85	3.16	3.06	2.19	1.78	1.45	1.32	0.82	0.57	22.9
1932	0.50	0.38	1.27	5.16	8.37	5.06	2.93	1.95	1.42	1.12	0.74	0.57	29.5
1933	0.42	2.69	4.72	5.06	8.40	8.20	3.59	2.59	2.01	1.81	1.43	1.19	42.1
1934	1.29	1.63	3.51	3.90	3.84	3.37	1.97	1.50	1.22	1.00	0.73	0.63	24.6
1935	0.66	0.38	0.41	1.68	6.12	7.80	3.49	2.56	2.03	1.83	1.47	1.27	29.7
1936	1.55	2.53	3.91	4.85	9.94	9.97	3.67	2.59	1.97	1.72	1.27	1.10	45.1
1937	1.14	0.55	1.96	4.25	4.09	3.04	3.68	2.67	2.06	1.86	1.49	1.29	28.1
1938	1.60	2.69	4.74	5.36	9.94	9.97	3.72	2.66	2.06	1.86	1.49	1.29	47.4
1939	1.60	2.69	4.74	4.76	5.74	8.11	3.66	2.66	2.06	1.86	1.49	1.29	40.7
1940	1.60	2.50	4.72	4.39	3.78	3.13	3.31	2.54	1.96	1.68	1.23	1.03	31.9
1941	1.02	0.66	1.20	1.92	1.77	7.19	3.47	2.30	1.81	1.66	1.27	1.22	25.5
1942	1.55	1.74	1.75	2.33	1.85	3.68	3.70	2.67	2.06	1.86	1.49	1.29	26.0
1943	1.60	2.08	1.65	2.87	9.68	9.24	3.59	2.51	1.96	1.81	1.44	1.17	39.6
1944	1.59	2.18	1.59	3.51	5.70	6.25	3.43	2.42	1.82	1.52	1.10	0.84	32.0
1945	1.09	0.98	0.99	5.36	9.21	8.32	3.60	2.58	1.97	1.72	1.26	0.99	38.1
1946	0.94	0.69	0.67	0.62	4.23	4.54	2.71	2.17	1.67	1.48	1.09	0.86	21.7
1947	0.90	1.34	4.67	4.29	4.97	9.97	3.72	2.67	2.06	1.85	1.47	1.24	39.1
1948	1.56	1.90	1.56	4.93	7.83	5.11	2.86	1.99	1.75	1.63	1.24	1.07	33.4
1949	1.04	1.15	1.90	2.74	3.86	5.54	3.52	2.63	2.06	1.86	1.49	1.27	29.1
1950	1.38	0.98	4.74	4.95	3.74	3.02	2.18	2.30	1.99	1.81	1.44	1.26	29.8
1951	1.59	1.94	1.38	1.15	1.62	1.40	0.77	0.81	0.53	0.48	0.39	0.31	12.4
1952	0.30	1.23	3.25	5.13	9.94	9.96	3.72	2.67	2.06	1.86	1.49	1.28	42.9
1953	1.47	1.81	2.43	4.77	8.07	8.12	3.53	2.59	2.02	1.81	1.44	1.23	39.3
1954	1.35	1.96	3.14	5.36	9.94	9.97	3.72	2.67	2.06	1.86	1.49	1.29	44.8
1955	1.57	2.61	4.74	4.92	10.30	9.97	3.72	2.66	2.06	1.86	1.49	1.29	47.2
1956	1.60	1.85	1.66	2.30	2.80	6.04	3.52	2.54	2.01	1.84	1.49	1.29	28.9
1957	1.60	2.29	1.68	5.36	9.30	5.87	3.22	2.33	1.72	1.46	1.05	1.08	36.9
1958	1.48	1.61	4.71	4.60	5.91	5.63	3.24	2.13	1.48	1.36	1.01	0.81	34.0
1959	0.90	2.11	3.92	3.59	5.81	5.33	3.20	2.41	1.93	1.74	1.34	1.14	33.4
1960	1.23	2.69	4.74	5.12	8.35	9.49	3.72	2.67	2.06	1.86	1.49	1.29	44.7
1961	1.60	1.74	1.42	2.26	2.14	1.89	0.96	1.27	0.93	0.62	0.36	0.23	15.4
1962	0.17	1.34	2.43	2.74	2.13	1.52	0.80	0.88	0.95	1.15	1.05	0.80	15.9
1963	0.78	0.71	1.00	1.24	1.92	1.50	0.74	0.69	0.44	0.30	0.16	0.08	9.6
1964	0.31	0.88	4.74	4.97	6.84	5.08	2.86	1.98	1.48	1.26	0.80	0.80	32.0
1965	0.94	0.88	0.78	3.22	5.41	4.68	2.30	1.53	1.05	0.68	0.44	0.38	22.3
1966	0.80	0.90	1.55	2.72	7.60	8.18	3.71	2.67	2.06	1.86	1.49	1.29	34.8
1967	1.53	1.76	1.63	1.27	1.52	1.69	1.60	1.71	1.56	1.61	1.24	1.04	18.2
1968	1.06	1.38	3.27	4.42	4.53	8.41	3.67	2.63	2.04	1.82	1.45	1.24	35.9
1969	1.60	2.56	3.62	3.54	2.92	2.55	0.95	0.91	0.59	0.53	0.41	0.30	20.5
1970	0.38	0.66	1.45	4.66	5.43	3.73	3.03	2.46	1.98	1.77	1.34	1.09	28.0
1971	1.51	2.07	2.54	5.36	10.30	9.97	3.72	2.67	2.06	1.86	1.49	1.27	44.8
1972	1.58	2.05	1.63	1.35	1.52	1.50	0.95	1.45	1.20	0.88	0.64	1.26	16.0
1973	1.60	2.60	4.73	5.27	9.94	9.81	3.72	2.66	2.06	1.86	1.49	1.29	47.0
1974	1.60	2.47	3.73	4.78	8.70	8.71	3.65	2.64	2.06	1.85	1.48	1.25	42.9
1975	1.29	0.90	4.74	5.36	9.87	9.97	3.72	2.67	2.06	1.86	1.49	1.29	45.2
1976	1.56	2.00	1.63	4.89	7.94	9.34	3.72	2.66	2.06	1.85	1.48	1.29	40.4
1977	1.58	1.71	2.78	5.36	9.35	9.18	3.71	2.65	2.04	1.82	1.44	1.20	42.8
1978	1.34	1.77	1.67	2.65	2.69	3.18	2.40	1.93	1.59	1.45	1.24	1.26	23.2
1979	1.57	2.06	3.43	4.53	9.78	9.44	3.60	2.53	1.92	1.67	1.28	1.25	43.1
1980	1.56	2.69	4.72	5.36	9.94	9.70	3.71	2.65	2.04	1.83	1.46	1.27	46.9
1981	1.55	2.17	1.98	2.90	2.50	1.68	0.81	0.91	0.73	0.62	0.40	0.29	16.5
1982	0.31	0.57	0.82	0.80	1.03	1.09	0.67	0.58	0.36	0.23	0.16	0.14	6.8
1983	0.26	0.96	1.19	1.05	1.32	2.41	2.04	1.53	1.10	1.19	1.27	1.24	15.6
1984	1.59	2.69	4.24	4.11	8.17	8.51	3.59	2.58	2.04	1.86	1.49	1.29	42.2
1985	1.60	2.04	1.67	2.24	2.12	2.10	3.38	2.58	2.00	1.76	1.36	1.15	24.0
1986	1.32	1.63	3.01	3.51	4.11	4.43	2.88	2.10	1.65	1.52	1.16	1.27	28.6
1987	1.58	1.79	4.72	4.43	9.68	9.97	3.72	2.63	2.02	1.85	1.49	1.29	45.2
1988	1.60	2.69	2.19	2.44	4.48	3.96	2.02	1.50	1.22	1.05	0.80	0.63	24.6
1989	0.82	2.08	3.50	4.62	6.37	6.35	3.46	2.47	1.90	1.66	1.24	1.03	35.5
1990	1.05	1.11	2.36	4.76	7.61	8.59	3.66	2.48	1.91	1.75	1.35	1.09	37.7
1991	0.96	0.75	0.67	0.47	0.72	0.65	0.40	0.33	0.21	0.13	0.08	0.03	5.4
1992	0.08	0.15	1.61	1.34	1.18	3.08	2.13	1.27	0.65	0.54	0.42	0.35	12.8
1993	0.32	1.91	3.12	3.47	2.85	2.37	1.01	0.97	0.57	0.43	0.27	0.18	17.5
1994	0.60	0.66	1.26	2.08	3.01	4.03	2.87	2.25	1.80	1.54	1.12	0.90	22.1
1995	0.78	2.69	4.73	5.25	10.30	9.97	3.67	2.66	2.06	1.86	1.49	1.29	46.8
1996	1.60	2.44	2.06	5.09	8.54	9.79	3.72	2.63	2.01	1.80	1.42	1.27	42.4
1997	1.58	2.50	2.24	5.24	8.49	4.12	2.14	1.51	1.01	0.83	0.82	0.87	31.4
1998	1.46	2.07	4.74	5.36	9.37	9.70	3.72	2.66	2.06	1.86	1.49	1.29	45.8
1999	1.57	2.07	4.58	5.23	9.05	8.62	3.67	2.61	2.04	1.84	1.48	1.27	44.0
2000	1.56	1.77	2.56	2.53	9.06	8.71	3.17	2.16	1.76	1.58	1.19	0.98	37.0
2001	1.26	2.69	4.73	4.35	3.98	3.12	1.58	1.17	0.71	0.71	0.51	0.45	25.3
2002	0.68	0.49	0.49	0.53	1.17	1.20	0.64	0.52	0.36	0.33	0.22	0.17	6.8
2003	0.25	0.37	0.47	0.69	9.19	9.81	3.72	2.66	2.06	1.86	1.49	1.28	33.9
2004	1.54	1.29	2.06	3.33	2.44	1.95	1.22	1.41	1.14	0.77	0.49	0.39	18.0
AVE :	1.20	1.66	2.64	3.62	5.85	6.00	2.86	2.12	1.63	1.45	1.13	0.98	31.1
SD :	0.46	0.73	1.45	1.55	3.13	3.12	1.07	0.68	0.55	0.52	0.43	0.39	11.5

Appendix E3

File : 3CD-B.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.43	0.85	0.46	1.37	2.01	2.01	1.78	0.66	0.48	0.42	0.36	0.34	11.2
1926	0.39	0.41	0.28	1.09	0.77	0.58	0.43	0.17	0.13	0.11	0.09	0.12	4.6
1927	0.51	1.44	1.07	2.20	2.42	1.82	1.54	0.63	0.49	0.38	0.30	0.30	13.1
1928	0.30	1.17	0.87	1.82	2.28	2.33	2.08	0.83	0.62	0.50	0.40	0.35	13.6
1929	0.48	1.38	1.79	2.02	2.20	2.32	2.08	0.85	0.65	0.51	0.41	0.36	15.0
1930	0.47	0.78	1.80	2.20	2.15	2.12	2.06	0.85	0.65	0.51	0.41	0.36	14.4
1931	0.50	1.48	1.50	1.45	1.54	1.64	1.43	0.59	0.50	0.41	0.28	0.24	11.5
1932	0.18	0.28	0.93	2.20	2.33	1.83	1.52	0.59	0.43	0.29	0.19	0.18	10.9
1933	0.07	1.50	1.80	2.20	2.38	2.30	2.04	0.84	0.64	0.51	0.40	0.34	15.0
1934	0.45	1.49	1.79	2.00	1.79	1.43	1.13	0.45	0.38	0.28	0.20	0.20	11.6
1935	0.14	0.20	0.18	0.77	2.34	2.30	2.02	0.81	0.64	0.51	0.41	0.36	10.7
1936	0.50	1.49	1.78	2.18	2.42	2.37	2.06	0.82	0.60	0.46	0.34	0.32	15.3
1937	0.38	0.31	1.67	2.03	1.88	1.25	2.08	0.85	0.65	0.51	0.41	0.36	12.4
1938	0.51	1.50	1.80	2.22	2.42	2.37	2.09	0.85	0.65	0.51	0.41	0.36	15.7
1939	0.51	1.50	1.80	2.11	2.09	2.28	2.06	0.84	0.65	0.51	0.41	0.36	15.1
1940	0.51	1.49	1.79	1.95	1.51	1.17	1.77	0.77	0.57	0.45	0.32	0.28	12.6
1941	0.27	0.31	1.13	1.05	0.56	2.24	2.02	0.73	0.59	0.48	0.39	0.36	10.1
1942	0.51	1.45	1.74	1.66	0.82	1.97	2.09	0.85	0.65	0.51	0.41	0.36	13.0
1943	0.51	1.45	1.28	1.48	2.49	2.33	1.95	0.76	0.58	0.48	0.37	0.33	14.0
1944	0.51	1.43	0.84	1.66	2.03	2.18	1.95	0.75	0.56	0.42	0.30	0.25	12.9
1945	0.33	0.77	0.52	2.21	2.40	2.28	1.95	0.80	0.60	0.47	0.35	0.30	13.0
1946	0.25	0.31	0.25	0.13	1.61	1.70	1.40	0.60	0.47	0.38	0.27	0.24	7.6
1947	0.22	1.08	1.76	1.90	1.89	2.37	2.09	0.85	0.65	0.51	0.39	0.33	14.0
1948	0.50	1.34	0.94	2.13	2.22	1.81	1.55	0.63	0.54	0.46	0.36	0.32	12.8
1949	0.35	0.98	1.45	1.51	2.10	2.20	2.01	0.84	0.65	0.51	0.41	0.36	13.4
1950	0.47	0.78	1.80	2.15	1.48	1.20	1.42	0.79	0.64	0.51	0.41	0.36	12.0
1951	0.51	1.42	0.89	0.65	0.65	0.66	0.53	0.21	0.17	0.14	0.13	0.16	6.1
1952	0.07	0.96	1.73	2.20	2.42	2.36	2.08	0.85	0.65	0.51	0.41	0.36	14.6
1953	0.47	1.36	1.64	2.17	2.35	2.20	1.92	0.81	0.63	0.50	0.39	0.34	14.8
1954	0.47	1.44	1.75	2.21	2.42	2.37	2.09	0.85	0.65	0.51	0.41	0.36	15.5
1955	0.50	1.49	1.80	2.13	2.51	2.37	2.09	0.84	0.64	0.51	0.41	0.36	15.7
1956	0.51	1.27	1.17	1.20	1.61	2.19	1.98	0.81	0.63	0.51	0.41	0.36	12.7
1957	0.51	1.48	1.47	2.22	2.41	2.19	1.83	0.72	0.55	0.43	0.30	0.32	14.4
1958	0.48	1.26	1.78	2.12	2.33	2.18	1.76	0.63	0.45	0.35	0.26	0.25	13.9
1959	0.24	1.48	1.78	1.83	2.31	2.07	1.79	0.78	0.62	0.50	0.40	0.34	14.1
1960	0.45	1.50	1.80	2.18	2.38	2.34	2.09	0.85	0.65	0.51	0.41	0.36	15.5
1961	0.51	1.27	0.92	1.04	0.84	0.79	0.75	0.38	0.35	0.18	0.12	0.12	7.3
1962	0.02	1.23	1.73	1.71	0.89	0.63	0.49	0.22	0.34	0.35	0.31	0.28	8.2
1963	0.26	0.48	0.53	0.60	0.67	0.61	0.42	0.16	0.12	0.08	0.05	0.01	4.0
1964	0.05	0.65	1.80	2.20	2.28	1.99	1.57	0.61	0.46	0.34	0.23	0.25	12.4
1965	0.28	0.63	0.38	1.76	2.24	2.05	1.34	0.45	0.30	0.16	0.12	0.15	9.9
1966	0.22	0.61	1.34	1.81	2.32	2.28	2.09	0.85	0.65	0.51	0.41	0.36	13.4
1967	0.47	1.35	1.26	0.47	0.48	0.60	0.72	0.44	0.44	0.42	0.32	0.30	7.3
1968	0.28	1.24	1.77	2.02	1.87	2.33	2.08	0.83	0.64	0.51	0.40	0.35	14.3
1969	0.51	1.49	1.71	1.60	1.10	0.88	0.56	0.20	0.16	0.13	0.11	0.12	8.6
1970	0.06	0.30	1.12	2.10	2.14	1.60	1.67	0.77	0.61	0.49	0.38	0.33	11.6
1971	0.49	1.48	1.64	2.22	2.51	2.37	2.09	0.85	0.65	0.51	0.41	0.36	15.6
1972	0.50	1.36	0.95	0.49	0.50	0.63	0.84	0.49	0.40	0.28	0.22	0.36	7.0
1973	0.51	1.50	1.80	2.22	2.42	2.37	2.08	0.85	0.65	0.51	0.41	0.36	15.7
1974	0.51	1.49	1.77	2.16	2.41	2.35	2.02	0.83	0.64	0.51	0.41	0.35	15.5
1975	0.44	0.59	1.80	2.22	2.50	2.37	2.09	0.85	0.65	0.51	0.41	0.36	14.8
1976	0.49	1.44	1.36	2.19	2.40	2.36	2.09	0.85	0.65	0.51	0.40	0.36	15.1
1977	0.51	1.31	1.75	2.22	2.41	2.35	2.09	0.84	0.63	0.50	0.39	0.34	15.3
1978	0.44	1.37	1.37	1.56	1.39	1.51	1.49	0.63	0.51	0.42	0.36	0.36	11.4
1979	0.51	1.45	1.73	2.11	2.50	2.35	2.00	0.80	0.59	0.46	0.35	0.35	15.2
1980	0.51	1.50	1.79	2.22	2.42	2.36	2.08	0.84	0.64	0.50	0.40	0.36	15.6
1981	0.49	1.47	1.53	1.38	0.90	0.67	0.50	0.23	0.29	0.19	0.13	0.14	7.9
1982	0.08	0.31	0.40	0.21	0.28	0.31	0.31	0.12	0.08	0.05	0.05	0.04	2.2
1983	0.04	0.84	0.67	0.32	0.39	0.83	1.01	0.41	0.31	0.38	0.39	0.36	5.9
1984	0.51	1.50	1.76	2.03	2.38	2.30	1.96	0.80	0.64	0.51	0.41	0.36	15.2
1985	0.51	1.43	1.35	0.88	0.97	0.97	2.05	0.85	0.64	0.50	0.39	0.34	10.9
1986	0.48	1.38	1.66	1.61	2.20	2.06	1.70	0.66	0.53	0.44	0.33	0.36	13.4
1987	0.51	1.39	1.80	2.11	2.49	2.37	2.09	0.85	0.64	0.51	0.41	0.36	15.5
1988	0.51	1.50	1.63	1.16	2.00	1.84	1.16	0.45	0.38	0.31	0.26	0.26	11.4
1989	0.36	1.48	1.77	2.13	2.25	2.08	1.87	0.78	0.59	0.47	0.36	0.33	14.5
1990	0.42	1.12	1.68	2.18	2.31	2.34	2.09	0.82	0.61	0.50	0.40	0.34	14.8
1991	0.42	0.69	0.30	0.09	0.22	0.21	0.19	0.07	0.05	0.04	0.03	0.00	2.3
1992	0.00	0.13	1.52	0.73	1.28	1.81	1.49	0.45	0.31	0.21	0.19	0.22	8.3
1993	0.21	1.44	1.78	1.83	1.67	1.37	0.92	0.28	0.17	0.13	0.10	0.12	10.0
1994	0.26	0.58	0.81	0.69	1.71	1.89	1.72	0.70	0.57	0.46	0.35	0.32	10.1
1995	0.40	1.50	1.80	2.22	2.51	2.37	2.05	0.85	0.65	0.51	0.41	0.36	15.6
1996	0.51	1.49	1.58	2.20	2.38	2.36	2.09	0.84	0.63	0.49	0.39	0.36	15.3
1997	0.51	1.49	1.58	2.20	2.33	1.66	1.09	0.35	0.19	0.18	0.22	0.29	12.1
1998	0.50	1.47	1.80	2.22	2.41	2.36	2.09	0.85	0.65	0.51	0.41	0.36	15.6
1999	0.51	1.49	1.78	2.21	2.51	2.37	2.09	0.84	0.64	0.51	0.41	0.36	15.7
2000	0.51	1.45	1.67	1.30	2.40	2.33	1.88	0.74	0.59	0.47	0.38	0.34	14.1
2001	0.48	1.50	1.80	2.04	1.76	1.27	0.91	0.28	0.22	0.21	0.19	0.22	10.9
2002	0.35	0.57	0.32	0.13	0.31	0.35	0.27	0.10	0.07	0.07	0.06	0.07	2.7
2003	0.06	0.28	0.84	0.43	2.43	2.36	2.09	0.85	0.65	0.51	0.41	0.36	11.3
2004	0.50	1.12	1.70	1.84	1.21	0.77	0.71	0.34	0.30	0.18	0.15	0.19	9.0
AVE :	0.39	1.14	1.39	1.67	1.86	1.82	1.62	0.66	0.51	0.40	0.32	0.29	12.1
SD :	0.16	0.44	0.50	0.65	0.70	0.66	0.58	0.24	0.18	0.14	0.11	0.09	3.5

Appendix E4

File : 3CD-T.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.37	0.73	0.40	1.88	7.42	7.20	1.57	0.56	0.41	0.36	0.31	0.29	21.5
1926	0.33	0.36	0.25	1.67	0.96	0.80	0.37	0.15	0.11	0.09	0.08	0.10	5.3
1927	0.44	1.56	2.51	6.08	18.29	5.57	1.35	0.53	0.41	0.33	0.26	0.25	37.6
1928	0.26	1.08	1.94	3.19	14.21	26.51	1.83	0.71	0.53	0.42	0.34	0.30	51.3
1929	0.41	1.40	4.59	4.08	9.46	23.11	1.82	0.72	0.55	0.44	0.35	0.31	47.3
1930	0.40	0.67	4.63	5.89	8.97	9.02	1.80	0.73	0.55	0.44	0.35	0.31	33.8
1931	0.43	1.60	3.20	1.94	3.48	4.52	1.26	0.50	0.43	0.35	0.24	0.20	18.1
1932	0.15	0.23	2.17	6.06	17.03	5.60	1.34	0.51	0.37	0.25	0.16	0.16	34.0
1933	0.06	1.63	4.62	5.98	21.28	20.75	1.78	0.72	0.54	0.43	0.34	0.29	58.4
1934	0.39	1.62	4.61	3.98	5.32	3.60	1.00	0.39	0.33	0.24	0.17	0.17	21.8
1935	0.12	0.17	0.15	0.97	13.47	20.14	1.76	0.69	0.55	0.44	0.35	0.31	39.1
1936	0.43	1.62	4.57	5.56	27.34	41.41	1.79	0.70	0.51	0.39	0.29	0.27	84.9
1937	0.32	0.27	4.10	4.13	6.10	2.81	1.82	0.73	0.55	0.44	0.35	0.31	21.9
1938	0.44	1.63	4.63	6.77	27.34	41.41	1.84	0.72	0.55	0.44	0.35	0.31	86.4
1939	0.44	1.63	4.63	4.66	7.76	18.47	1.79	0.72	0.55	0.44	0.35	0.31	41.7
1940	0.44	1.62	4.61	3.77	3.49	2.51	1.56	0.66	0.49	0.38	0.27	0.24	20.0
1941	0.23	0.26	2.65	1.59	0.56	14.76	1.75	0.63	0.50	0.41	0.34	0.31	24.0
1942	0.44	1.58	4.46	2.55	1.10	6.51	1.83	0.73	0.55	0.44	0.35	0.31	20.8
1943	0.44	1.57	2.98	1.96	25.13	26.07	1.70	0.65	0.49	0.41	0.32	0.28	62.0
1944	0.44	1.55	1.81	2.56	7.58	10.76	1.70	0.64	0.47	0.36	0.26	0.21	28.3
1945	0.28	0.65	0.46	6.61	23.66	17.71	1.70	0.68	0.51	0.40	0.30	0.26	53.2
1946	0.21	0.26	0.22	0.12	3.94	4.82	1.24	0.51	0.40	0.33	0.23	0.21	12.5
1947	0.19	0.97	4.52	3.54	5.79	41.41	1.84	0.73	0.55	0.43	0.34	0.29	60.6
1948	0.42	1.34	2.19	4.88	10.25	5.48	1.37	0.54	0.46	0.39	0.31	0.28	27.9
1949	0.30	0.84	3.15	1.98	8.38	12.27	1.74	0.72	0.55	0.44	0.35	0.31	31.0
1950	0.40	0.67	4.63	5.09	3.31	2.59	1.25	0.67	0.55	0.43	0.35	0.31	20.3
1951	0.44	1.50	2.03	0.73	0.65	0.92	0.45	0.18	0.14	0.12	0.12	0.13	7.4
1952	0.06	0.82	4.44	6.13	26.68	38.77	1.82	0.72	0.55	0.44	0.35	0.30	81.1
1953	0.40	1.37	3.98	5.29	18.53	12.26	1.67	0.70	0.54	0.43	0.34	0.30	45.8
1954	0.40	1.56	4.47	6.61	27.34	41.41	1.84	0.73	0.55	0.44	0.35	0.31	86.0
1955	0.43	1.62	4.63	4.89	28.31	41.41	1.84	0.72	0.55	0.44	0.35	0.31	85.5
1956	0.43	1.21	2.73	1.75	3.94	11.18	1.72	0.69	0.54	0.44	0.35	0.31	25.3
1957	0.44	1.60	3.17	6.77	25.62	11.84	1.60	0.62	0.47	0.36	0.26	0.27	53.0
1958	0.41	1.19	4.58	4.75	16.97	10.60	1.55	0.54	0.39	0.30	0.22	0.21	41.7
1959	0.21	1.61	4.58	3.26	11.31	8.15	1.57	0.66	0.53	0.43	0.34	0.29	32.9
1960	0.38	1.63	4.63	5.60	21.26	30.14	1.84	0.73	0.55	0.44	0.35	0.31	67.9
1961	0.44	1.22	2.15	1.55	1.13	1.33	0.65	0.33	0.30	0.16	0.10	0.10	9.5
1962	0.02	1.16	4.41	2.78	1.27	0.87	0.42	0.19	0.29	0.30	0.26	0.24	12.2
1963	0.22	0.41	0.51	0.62	0.68	0.85	0.36	0.14	0.10	0.07	0.05	0.01	4.0
1964	0.04	0.55	4.63	5.93	13.96	6.76	1.38	0.52	0.39	0.29	0.19	0.21	34.9
1965	0.23	0.54	0.33	2.98	11.91	7.83	1.18	0.38	0.25	0.13	0.10	0.13	26.0
1966	0.18	0.52	3.04	3.18	16.30	17.31	1.83	0.73	0.55	0.44	0.35	0.30	44.7
1967	0.41	1.35	2.96	0.48	0.47	0.84	0.62	0.38	0.38	0.36	0.28	0.25	8.8
1968	0.24	1.17	4.54	4.09	6.07	25.09	1.82	0.71	0.55	0.43	0.34	0.30	45.3
1969	0.44	1.62	4.34	2.33	1.81	1.61	0.48	0.17	0.13	0.11	0.09	0.10	13.2
1970	0.05	0.26	2.62	4.58	8.78	4.32	1.47	0.65	0.52	0.42	0.32	0.28	24.3
1971	0.42	1.60	3.95	6.77	28.31	41.41	1.84	0.73	0.55	0.44	0.35	0.30	86.7
1972	0.43	1.37	2.21	0.49	0.49	0.88	0.73	0.41	0.34	0.24	0.18	0.31	8.1
1973	0.44	1.63	4.63	6.77	27.34	39.96	1.83	0.72	0.55	0.44	0.35	0.31	85.0
1974	0.44	1.62	4.54	5.25	25.00	30.85	1.75	0.71	0.55	0.44	0.35	0.30	71.8
1975	0.38	0.51	4.63	6.77	26.18	41.41	1.84	0.73	0.55	0.44	0.35	0.31	84.1
1976	0.42	1.56	3.06	5.78	23.40	38.42	1.84	0.73	0.55	0.44	0.34	0.31	76.8
1977	0.43	1.28	4.48	6.77	25.29	33.56	1.83	0.72	0.54	0.43	0.33	0.29	75.9
1978	0.37	1.38	3.06	2.16	2.93	3.93	1.31	0.54	0.44	0.36	0.31	0.30	17.1
1979	0.43	1.58	4.45	4.67	26.68	33.68	1.74	0.68	0.51	0.39	0.30	0.30	75.4
1980	0.43	1.63	4.61	6.77	27.34	38.10	1.82	0.72	0.55	0.43	0.34	0.30	83.0
1981	0.42	1.59	3.35	1.89	1.29	0.94	0.43	0.19	0.25	0.16	0.11	0.12	10.8
1982	0.07	0.27	0.34	0.20	0.26	0.38	0.26	0.10	0.06	0.05	0.04	0.03	2.1
1983	0.03	0.72	1.10	0.32	0.37	1.45	0.89	0.35	0.26	0.32	0.33	0.30	6.4
1984	0.44	1.63	4.50	4.16	20.91	20.23	1.71	0.69	0.55	0.44	0.35	0.31	55.9
1985	0.44	1.55	3.04	1.22	1.48	1.89	1.78	0.73	0.54	0.43	0.33	0.29	13.7
1986	0.41	1.41	4.10	2.39	9.54	8.12	1.50	0.56	0.45	0.38	0.28	0.30	29.4
1987	0.44	1.43	4.63	4.63	25.08	41.37	1.84	0.72	0.55	0.44	0.35	0.31	81.8
1988	0.44	1.63	3.91	1.72	7.26	5.67	1.02	0.38	0.32	0.26	0.22	0.22	23.1
1989	0.31	1.61	4.53	4.87	12.32	8.36	1.64	0.66	0.51	0.40	0.31	0.28	35.8
1990	0.36	1.02	4.17	5.52	16.11	28.23	1.83	0.70	0.52	0.43	0.34	0.29	59.5
1991	0.36	0.59	0.26	0.08	0.20	0.24	0.17	0.06	0.04	0.03	0.03	0.00	2.1
1992	0.00	0.11	3.30	0.90	2.44	5.48	1.31	0.38	0.26	0.18	0.16	0.19	14.7
1993	0.18	1.57	4.55	3.27	4.20	3.31	0.81	0.24	0.15	0.11	0.08	0.10	18.6
1994	0.22	0.50	1.70	0.81	4.51	6.00	1.51	0.60	0.49	0.39	0.30	0.28	17.3
1995	0.34	1.63	4.62	6.77	28.31	41.41	1.79	0.72	0.55	0.44	0.35	0.31	87.2
1996	0.44	1.62	3.62	5.98	20.96	37.86	1.84	0.72	0.54	0.42	0.34	0.31	74.6
1997	0.44	1.62	3.61	6.06	17.14	4.58	0.96	0.30	0.16	0.15	0.19	0.25	35.5
1998	0.43	1.59	4.63	6.77	24.79	36.96	1.84	0.73	0.55	0.44	0.35	0.31	79.4
1999	0.44	1.62	4.57	6.56	28.31	41.41	1.84	0.72	0.55	0.44	0.35	0.31	87.1
2000	0.44	1.57	4.12	1.83	23.26	24.57	1.64	0.63	0.50	0.41	0.32	0.29	59.6
2001	0.41	1.63	4.63	4.22	5.01	2.87	0.80	0.24	0.19	0.18	0.16	0.19	20.5
2002	0.30	0.49	0.28	0.12	0.30	0.44	0.23	0.08	0.06	0.06	0.05	0.06	2.5
2003	0.05	0.24	1.80	0.44	19.25	38.36	1.84	0.73	0.55	0.44	0.35	0.31	64.4
2004	0.43	1.03	4.30	3.30	2.09	1.28	0.62	0.29	0.25	0.16	0.13	0.16	14.0
AVE :	0.33	1.16	3.33	3.72	12.66	16.41	1.42	0.56	0.43	0.35	0.27	0.25	40.9
SD :	0.13	0.51	1.48	2.18	10.02	15.10	0.51	0.20	0.15	0.12	0.10	0.08	27.4

Appendix E5

File : 4CD-B.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.94	0.87	0.47	1.49	2.03	1.99	1.75	1.58	1.15	1.15	0.84	0.47	14.7
1926	0.78	0.44	0.26	0.95	0.68	0.56	0.44	0.43	0.29	0.26	0.22	0.18	5.5
1927	1.15	1.41	1.08	2.16	2.37	1.78	1.49	1.49	1.12	0.85	0.63	0.36	15.9
1928	0.64	1.14	0.83	1.78	2.24	2.29	2.04	1.99	1.69	1.55	1.04	0.51	17.7
1929	1.06	1.37	1.76	1.99	2.17	2.27	2.04	2.02	1.76	1.62	1.08	0.56	19.7
1930	1.03	0.77	1.77	2.16	2.12	2.07	2.02	2.02	1.76	1.62	1.37	1.12	19.8
1931	1.11	1.45	1.48	1.33	1.41	1.59	1.38	1.41	1.22	1.03	0.59	0.28	14.3
1932	0.45	0.36	1.02	2.16	2.29	1.81	1.49	1.42	0.95	0.66	0.36	0.23	13.2
1933	0.27	1.47	1.76	2.16	2.34	2.25	2.00	2.00	1.73	1.59	1.05	0.49	19.1
1934	0.98	1.46	1.76	1.97	1.68	1.39	1.08	1.07	0.80	0.61	0.35	0.24	13.4
1935	0.37	0.24	0.18	0.83	2.31	2.25	1.99	1.96	1.74	1.61	1.08	0.61	15.2
1936	1.12	1.47	1.74	2.14	2.38	2.33	2.01	1.97	1.64	1.39	0.78	0.43	19.4
1937	0.78	0.39	1.63	1.99	1.78	1.22	2.04	2.02	1.76	1.62	1.08	0.81	17.1
1938	1.32	1.47	1.77	2.18	2.38	2.33	2.06	2.01	1.76	1.62	1.37	1.13	21.4
1939	1.32	1.47	1.77	2.05	2.04	2.24	2.01	2.01	1.76	1.62	1.37	1.13	20.8
1940	1.26	1.46	1.76	1.94	1.40	1.17	1.72	1.83	1.55	1.26	0.69	0.34	16.4
1941	0.60	0.39	1.40	1.19	0.57	2.23	1.99	1.78	1.62	1.52	1.03	0.53	14.8
1942	1.14	1.42	1.70	1.57	0.74	1.94	2.05	2.02	1.76	1.62	1.37	1.13	18.5
1943	1.32	1.42	1.24	1.32	2.44	2.29	1.91	1.77	1.57	1.44	0.87	0.44	18.0
1944	1.14	1.39	0.80	1.59	1.97	2.13	1.90	1.74	1.47	1.07	0.63	0.29	16.1
1945	0.67	0.72	0.51	2.18	2.35	2.24	1.91	1.92	1.65	1.42	0.80	0.38	16.7
1946	0.59	0.39	0.26	0.26	1.46	1.65	1.35	1.42	1.03	0.86	0.55	0.28	10.1
1947	0.52	1.08	1.72	1.89	1.81	2.33	2.06	2.02	1.76	1.59	1.01	0.47	18.3
1948	1.10	1.33	0.94	2.10	2.18	1.78	1.52	1.50	1.45	1.37	0.84	0.44	16.6
1949	0.70	1.03	1.44	1.42	2.05	2.16	1.97	1.99	1.76	1.62	1.08	0.52	17.7
1950	0.99	0.71	1.77	2.10	1.33	1.18	1.37	1.88	1.73	1.59	1.07	0.52	16.2
1951	1.14	1.38	0.86	0.73	0.66	0.66	0.58	0.56	0.34	0.31	0.28	0.20	7.7
1952	0.29	0.98	1.71	2.16	2.38	2.32	2.04	2.02	1.76	1.62	1.08	0.52	18.9
1953	1.00	1.35	1.59	2.13	2.30	2.15	1.86	1.95	1.69	1.55	0.99	0.50	19.1
1954	0.99	1.41	1.72	2.17	2.38	2.33	2.06	2.02	1.76	1.62	1.21	0.64	20.3
1955	1.11	1.47	1.77	2.08	2.46	2.33	2.06	2.00	1.75	1.61	1.08	0.71	20.4
1956	1.14	1.23	1.22	1.21	1.64	2.15	1.94	1.96	1.72	1.62	1.26	1.13	18.2
1957	1.32	1.45	1.45	2.18	2.37	2.16	1.79	1.70	1.51	1.17	0.65	0.44	18.2
1958	1.03	1.21	1.75	2.08	2.28	2.14	1.74	1.52	1.02	0.81	0.56	0.30	16.4
1959	0.57	1.45	1.75	1.78	2.29	2.06	1.76	1.88	1.68	1.58	1.04	0.49	18.3
1960	0.95	1.47	1.77	2.14	2.34	2.30	2.05	2.02	1.76	1.62	1.37	1.13	20.9
1961	1.14	1.24	1.03	1.00	0.80	0.80	0.81	1.00	0.75	0.42	0.24	0.18	9.4
1962	0.21	1.25	1.70	1.67	0.81	0.61	0.52	0.57	0.69	0.82	0.68	0.35	9.9
1963	0.59	0.48	0.52	0.59	0.65	0.59	0.42	0.39	0.26	0.23	0.18	0.16	5.1
1964	0.25	0.64	1.77	2.16	2.23	1.95	1.53	1.47	1.02	0.76	0.41	0.30	14.5
1965	0.61	0.57	0.36	1.77	2.21	2.02	1.32	1.09	0.59	0.32	0.24	0.19	11.3
1966	0.53	0.56	1.30	1.80	2.28	2.24	2.05	2.02	1.76	1.62	1.10	0.52	17.8
1967	1.03	1.34	1.24	0.50	0.47	0.59	0.73	1.07	0.98	1.10	0.71	0.36	10.1
1968	0.62	1.23	1.74	2.00	1.81	2.29	2.05	1.99	1.74	1.59	1.05	0.50	18.6
1969	1.32	1.46	1.67	1.52	0.95	0.85	0.59	0.50	0.32	0.29	0.23	0.18	9.9
1970	0.26	0.37	1.17	2.04	2.09	1.55	1.60	1.80	1.66	1.52	0.90	0.45	15.4
1971	1.08	1.45	1.60	2.18	2.46	2.33	2.06	2.02	1.76	1.62	1.08	0.52	20.2
1972	1.11	1.34	0.91	0.50	0.48	0.61	0.84	1.16	0.85	0.63	0.40	0.84	9.7
1973	1.32	1.47	1.77	2.18	2.38	2.33	2.04	2.01	1.76	1.62	1.16	1.12	21.2
1974	1.14	1.47	1.73	2.13	2.37	2.30	1.99	1.99	1.75	1.61	1.08	0.51	20.1
1975	0.93	0.56	1.77	2.18	2.45	2.33	2.06	2.02	1.76	1.62	1.37	0.86	19.9
1976	1.09	1.40	1.32	2.15	2.35	2.32	2.06	2.02	1.76	1.61	1.07	0.64	19.8
1977	1.14	1.28	1.71	2.18	2.37	2.31	2.05	2.00	1.72	1.57	0.99	0.48	19.8
1978	0.95	1.36	1.37	1.50	1.30	1.49	1.46	1.50	1.30	1.09	0.84	0.52	14.7
1979	1.14	1.42	1.70	2.05	2.46	2.31	1.97	1.94	1.65	1.41	0.85	0.52	19.4
1980	1.14	1.47	1.76	2.18	2.38	2.32	2.04	2.00	1.74	1.58	1.04	0.51	20.2
1981	1.10	1.44	1.50	1.26	0.81	0.65	0.53	0.59	0.56	0.40	0.26	0.18	9.3
1982	0.29	0.38	0.37	0.29	0.27	0.30	0.28	0.26	0.21	0.20	0.18	0.17	3.2
1983	0.22	0.87	0.67	0.40	0.39	0.83	1.00	1.01	0.60	0.86	0.96	0.52	8.3
1984	1.32	1.47	1.72	2.04	2.34	2.26	1.92	1.94	1.75	1.62	1.14	0.80	20.3
1985	1.22	1.41	1.35	0.85	0.87	0.95	2.00	2.02	1.71	1.55	0.96	0.47	15.4
1986	1.03	1.35	1.62	1.53	2.14	2.02	1.66	1.57	1.38	1.27	0.75	0.52	16.8
1987	1.16	1.41	1.77	2.08	2.45	2.33	2.06	2.02	1.76	1.62	1.37	1.13	21.2
1988	1.32	1.47	1.60	1.07	1.95	1.82	1.16	1.11	0.83	0.74	0.59	0.32	14.0
1989	0.89	1.47	1.76	2.09	2.22	2.07	1.86	1.92	1.66	1.49	0.94	0.47	18.8
1990	0.96	1.18	1.67	2.14	2.28	2.30	2.05	1.97	1.68	1.59	1.08	0.51	19.4
1991	0.95	0.74	0.34	0.22	0.22	0.22	0.20	0.19	0.16	0.17	0.15	0.15	3.7
1992	0.15	0.16	1.52	0.81	1.21	1.77	1.47	1.13	0.68	0.51	0.39	0.28	10.1
1993	0.56	1.43	1.75	1.86	1.63	1.42	0.98	0.83	0.36	0.30	0.23	0.18	11.6
1994	0.65	0.62	0.80	0.89	1.69	1.90	1.74	1.73	1.62	1.46	0.91	0.47	14.5
1995	0.92	1.47	1.77	2.18	2.46	2.33	2.03	2.02	1.76	1.62	1.37	1.13	21.1
1996	1.32	1.46	1.57	2.16	2.34	2.32	2.06	2.01	1.75	1.60	1.07	0.71	20.4
1997	1.18	1.47	1.62	2.16	2.28	1.63	1.06	0.88	0.37	0.39	0.42	0.37	13.8
1998	1.10	1.45	1.77	2.18	2.37	2.32	2.06	2.02	1.76	1.62	1.37	1.13	21.1
1999	1.20	1.46	1.75	2.17	2.46	2.33	2.06	2.02	1.76	1.62	1.31	1.13	21.3
2000	1.15	1.44	1.65	1.24	2.35	2.28	1.86	1.83	1.64	1.52	1.00	0.49	18.5
2001	1.10	1.47	1.77	2.09	2.00	1.47	1.07	0.94	0.69	0.64	0.46	0.32	14.0
2002	0.82	0.62	0.38	0.31	0.37	0.43	0.32	0.26	0.22	0.24	0.20	0.18	4.4
2003	0.30	0.38	0.85	0.49	2.41	2.32	2.06	2.02	1.76	1.62	1.23	0.85	16.3
2004	1.12	1.16	1.67	1.82	1.18	0.81	0.78	0.88	0.63	0.43	0.31	0.24	11.0
AVE :	0.91	1.13	1.37	1.65	1.82	1.79	1.60	1.58	1.33	1.20	0.84	0.53	15.8
SD :	0.33	0.41	0.49	0.61	0.69	0.64	0.56	0.55	0.53	0.51	0.37	0.29	4.7

Appendix E6

File : 4CD-T.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.82	0.76	0.42	2.40	8.96	9.88	6.21	1.98	1.09	1.00	0.73	0.41	34.7
1926	0.68	0.39	0.23	1.76	0.79	0.89	0.39	0.38	0.25	0.23	0.19	0.16	6.3
1927	1.00	1.70	2.65	10.82	35.13	6.81	4.05	1.80	1.04	0.74	0.54	0.31	66.6
1928	0.55	1.15	1.81	4.36	18.91	28.82	7.91	2.86	2.14	1.48	0.90	0.44	71.3
1929	0.92	1.50	7.90	7.55	12.70	25.55	7.91	2.92	2.35	1.62	0.94	0.49	72.4
1930	0.90	0.67	7.91	10.76	11.56	12.56	7.76	2.92	2.35	1.62	1.22	0.97	61.2
1931	0.97	2.28	3.61	2.30	3.24	5.32	3.54	1.65	1.20	0.90	0.51	0.24	25.8
1932	0.40	0.32	2.47	10.83	31.36	7.02	4.10	1.67	0.83	0.57	0.31	0.20	60.1
1933	0.24	6.91	7.91	10.70	66.07	23.56	7.58	2.92	2.28	1.57	0.91	0.43	131.1
1934	0.85	2.93	7.91	7.36	4.70	3.96	2.34	0.98	0.70	0.53	0.31	0.21	32.8
1935	0.32	0.26	0.15	1.41	18.63	23.37	7.40	2.78	2.30	1.62	0.94	0.53	59.7
1936	0.98	4.36	7.87	10.33	79.74	32.46	7.71	2.81	2.02	1.25	0.68	0.38	150.6
1937	0.68	0.34	4.37	7.53	5.63	2.88	7.91	2.92	2.35	1.62	0.94	0.71	37.9
1938	1.26	5.59	7.91	11.08	79.74	32.46	7.92	2.92	2.35	1.62	1.22	0.98	155.0
1939	1.26	6.91	7.91	8.13	7.70	21.91	7.70	2.92	2.35	1.62	1.22	0.98	70.6
1940	1.17	3.27	7.91	6.84	3.28	2.55	5.96	2.44	1.79	1.10	0.60	0.30	37.2
1941	0.52	0.34	3.45	2.21	0.58	20.71	7.47	2.37	1.95	1.42	0.90	0.46	42.4
1942	0.99	1.79	4.96	2.94	0.97	8.06	7.92	2.92	2.35	1.62	1.22	0.98	36.7
1943	1.26	1.73	3.10	2.29	74.78	28.69	6.94	2.36	1.83	1.32	0.76	0.38	125.4
1944	0.99	1.59	1.71	3.06	7.39	14.58	6.90	2.30	1.63	0.93	0.54	0.25	41.9
1945	0.58	0.63	0.47	11.05	71.53	21.30	6.94	2.64	2.02	1.30	0.69	0.33	119.5
1946	0.51	0.34	0.22	0.26	3.57	5.75	3.41	1.66	0.90	0.74	0.48	0.25	18.1
1947	0.45	1.00	6.54	6.02	5.53	32.46	7.92	2.92	2.35	1.58	0.88	0.41	68.1
1948	0.96	1.40	2.26	9.01	14.36	6.77	4.29	1.83	1.59	1.23	0.73	0.39	44.8
1949	0.61	0.90	3.54	2.36	9.58	16.20	7.26	2.89	2.35	1.62	0.94	0.45	48.7
1950	0.86	0.61	7.91	9.23	2.96	2.59	3.48	2.52	2.27	1.58	0.93	0.46	35.4
1951	0.99	1.55	1.96	1.10	0.68	1.10	0.51	0.50	0.30	0.27	0.24	0.18	9.4
1952	0.25	0.85	5.67	10.84	78.37	32.43	7.91	2.92	2.35	1.62	0.94	0.45	144.6
1953	0.87	1.41	4.14	9.90	39.11	16.12	6.72	2.75	2.16	1.48	0.86	0.43	85.9
1954	0.86	1.70	6.18	11.00	79.74	32.46	7.92	2.92	2.35	1.62	1.06	0.56	148.4
1955	0.97	4.25	7.91	8.55	82.58	32.46	7.92	2.92	2.35	1.62	0.94	0.62	153.1
1956	0.99	1.36	3.04	2.22	4.38	15.85	7.14	2.77	2.26	1.62	1.11	0.98	43.7
1957	1.26	2.32	3.55	11.08	76.84	16.46	6.38	2.24	1.70	1.02	0.56	0.38	123.8
1958	0.90	1.32	7.88	8.43	29.12	15.05	6.13	1.85	0.88	0.71	0.48	0.26	73.0
1959	0.50	2.28	7.88	4.37	16.91	12.20	6.24	2.53	2.12	1.55	0.90	0.43	57.9
1960	0.83	6.91	7.91	10.39	66.60	30.16	7.92	2.92	2.35	1.62	1.22	0.98	139.8
1961	0.99	1.37	2.50	1.93	1.16	1.50	1.34	0.92	0.65	0.37	0.21	0.16	13.1
1962	0.19	1.37	5.02	3.60	1.17	0.99	0.46	0.50	0.60	0.71	0.59	0.30	15.5
1963	0.52	0.42	0.51	0.66	0.66	0.94	0.38	0.34	0.23	0.20	0.16	0.14	5.2
1964	0.22	0.56	7.91	10.66	18.52	8.51	4.40	1.75	0.89	0.66	0.36	0.26	54.7
1965	0.53	0.49	0.32	4.25	16.40	10.67	3.29	1.02	0.51	0.28	0.21	0.16	38.2
1966	0.46	0.49	3.24	4.64	28.35	21.58	7.92	2.92	2.35	1.62	0.95	0.45	75.0
1967	0.89	1.40	3.11	0.55	0.47	0.95	1.06	0.99	0.85	0.95	0.62	0.31	12.2
1968	0.54	1.37	7.87	7.63	5.88	28.71	7.92	2.88	2.32	1.58	0.92	0.43	68.0
1969	1.26	3.62	4.75	2.63	1.62	1.65	0.52	0.44	0.28	0.25	0.20	0.16	17.4
1970	0.23	0.33	2.90	8.07	10.79	5.08	5.01	2.39	2.06	1.43	0.78	0.39	39.5
1971	0.94	2.19	4.17	11.08	82.58	32.46	7.92	2.92	2.35	1.62	0.94	0.45	149.6
1972	0.97	1.40	2.15	0.56	0.48	1.00	1.45	1.16	0.73	0.55	0.35	0.73	11.5
1973	1.26	5.78	7.91	11.08	79.74	32.44	7.91	2.92	2.35	1.62	1.02	0.98	155.0
1974	0.99	4.62	7.01	10.11	75.42	30.40	7.37	2.86	2.35	1.62	0.94	0.44	144.1
1975	0.81	0.49	7.91	11.08	78.68	32.46	7.92	2.92	2.35	1.62	1.22	0.75	148.2
1976	0.95	1.65	3.29	10.51	71.07	32.43	7.92	2.92	2.35	1.62	0.93	0.55	136.2
1977	0.99	1.38	5.96	11.08	75.86	31.35	7.92	2.92	2.26	1.52	0.86	0.42	142.5
1978	0.82	1.46	3.38	2.48	2.83	4.65	3.83	1.83	1.35	0.95	0.73	0.45	24.8
1979	0.99	1.76	4.97	8.19	79.69	31.59	7.30	2.71	2.02	1.28	0.74	0.45	141.7
1980	0.99	6.91	7.91	11.08	79.74	32.42	7.91	2.90	2.32	1.55	0.91	0.45	155.1
1981	0.95	1.98	3.74	2.26	1.19	1.06	0.47	0.52	0.49	0.35	0.22	0.16	13.4
1982	0.25	0.34	0.33	0.28	0.25	0.37	0.27	0.23	0.18	0.17	0.16	0.14	3.0
1983	0.19	0.76	1.16	0.42	0.38	1.58	2.03	0.92	0.52	0.74	0.83	0.45	10.0
1984	1.26	6.91	6.06	8.06	66.51	23.97	7.04	2.72	2.35	1.62	0.99	0.70	128.2
1985	1.11	1.70	3.34	1.44	1.36	1.93	7.58	2.92	2.22	1.49	0.83	0.41	26.3
1986	0.90	1.41	4.31	2.68	12.02	10.78	5.51	1.96	1.47	1.11	0.65	0.45	43.2
1987	1.03	1.68	7.91	8.62	77.15	32.46	7.92	2.92	2.35	1.62	1.22	0.98	145.9
1988	1.26	6.91	4.21	2.13	7.28	7.12	2.66	1.05	0.72	0.65	0.52	0.28	34.8
1989	0.77	6.91	7.90	8.97	17.01	12.56	6.74	2.63	2.06	1.39	0.82	0.41	68.2
1990	0.84	1.24	4.73	10.31	22.18	29.44	7.92	2.81	2.13	1.58	0.94	0.44	84.6
1991	0.82	0.65	0.30	0.21	0.21	0.26	0.19	0.16	0.14	0.14	0.13	0.13	3.4
1992	0.13	0.19	3.84	1.32	2.43	6.71	3.87	1.09	0.59	0.44	0.34	0.24	21.2
1993	0.49	1.83	7.89	5.65	4.32	4.20	1.99	0.75	0.31	0.26	0.20	0.16	28.1
1994	0.57	0.54	1.71	1.59	4.79	7.76	6.14	2.29	1.97	1.34	0.79	0.41	29.9
1995	0.80	6.91	7.91	11.08	82.58	32.46	7.89	2.92	2.35	1.62	1.22	0.98	158.7
1996	1.26	3.47	4.05	10.80	66.52	32.42	7.92	2.92	2.35	1.59	0.93	0.61	134.8
1997	1.05	5.39	4.26	10.81	28.28	5.58	2.26	0.80	0.32	0.34	0.37	0.32	59.8
1998	0.96	2.01	7.91	11.08	74.93	32.41	7.92	2.92	2.35	1.62	1.22	0.98	146.3
1999	1.08	3.46	7.90	11.02	82.58	32.46	7.92	2.92	2.35	1.62	1.16	0.98	155.5
2000	1.01	2.00	4.51	2.24	71.02	27.75	6.72	2.45	2.01	1.42	0.87	0.42	122.4
2001	0.96	6.91	7.91	8.91	8.20	4.50	2.30	0.86	0.60	0.55	0.40	0.28	42.4
2002	0.72	0.54	0.34	0.31	0.37	0.63	0.30	0.23	0.20	0.21	0.18	0.15	4.2
2003	0.26	0.33	1.91	0.53	59.58	32.43	7.92	2.92	2.35	1.62	1.08	0.74	111.7
2004	0.98	1.20	4.73	4.99	2.33	1.54	1.22	0.80	0.54	0.38	0.27	0.21	19.2
AVE :	0.80	2.22	4.64	6.23	30.73	16.07	5.45	2.11	1.62	1.14	0.73	0.46	72.2
SD :	0.31	2.09	2.69	4.05	32.44	12.46	2.77	0.93	0.81	0.52	0.33	0.25	52.3

Appendix E7

File : 5C-B.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.47	0.53	0.59	0.75	0.86	0.88	0.77	0.59	0.49	0.52	0.42	0.34	7.2
1926	0.32	0.38	0.11	0.85	0.68	0.29	0.43	0.19	0.14	0.20	0.12	0.12	3.8
1927	0.47	0.52	0.30	0.88	0.80	0.65	0.63	0.34	0.26	0.31	0.21	0.21	5.6
1928	0.22	0.35	0.14	0.85	0.86	0.90	0.79	0.63	0.56	0.56	0.44	0.38	6.7
1929	0.41	0.53	0.83	0.84	0.83	0.88	0.80	0.72	0.62	0.60	0.47	0.39	7.9
1930	0.42	0.46	0.83	0.87	0.68	0.80	0.77	0.63	0.54	0.58	0.45	0.38	7.4
1931	0.41	0.53	0.33	0.17	0.32	0.32	0.59	0.34	0.29	0.35	0.19	0.17	4.0
1932	0.18	0.34	0.52	0.88	0.86	0.75	0.70	0.41	0.30	0.35	0.19	0.17	5.7
1933	0.11	0.53	0.82	0.88	0.86	0.90	0.80	0.72	0.62	0.59	0.45	0.39	7.7
1934	0.44	0.53	0.76	0.18	0.43	0.55	0.58	0.27	0.21	0.26	0.15	0.13	4.5
1935	0.11	0.16	0.06	0.51	0.87	0.86	0.70	0.41	0.37	0.44	0.31	0.26	5.1
1936	0.32	0.51	0.77	0.86	0.87	0.91	0.79	0.70	0.61	0.58	0.44	0.37	7.7
1937	0.37	0.42	0.82	0.87	0.73	0.63	0.80	0.70	0.54	0.51	0.35	0.37	7.1
1938	0.41	0.45	0.83	0.88	0.87	0.91	0.80	0.74	0.64	0.60	0.47	0.41	8.0
1939	0.47	0.53	0.82	0.22	0.57	0.90	0.80	0.71	0.62	0.60	0.47	0.40	7.1
1940	0.45	0.53	0.83	0.32	0.36	0.46	0.59	0.30	0.20	0.23	0.13	0.11	4.5
1941	0.11	0.24	0.10	0.20	0.22	0.91	0.80	0.53	0.54	0.57	0.44	0.38	5.0
1942	0.43	0.53	0.44	0.12	0.33	0.85	0.80	0.71	0.59	0.58	0.46	0.40	6.2
1943	0.43	0.51	0.22	0.50	0.89	0.85	0.73	0.49	0.41	0.45	0.32	0.25	6.1
1944	0.47	0.49	0.16	0.14	0.25	0.19	0.42	0.21	0.14	0.20	0.12	0.10	2.9
1945	0.11	0.26	0.46	0.88	0.85	0.80	0.75	0.55	0.42	0.45	0.31	0.24	6.1
1946	0.24	0.27	0.09	0.09	0.84	0.70	0.28	0.16	0.12	0.19	0.11	0.10	3.2
1947	0.10	0.18	0.82	0.41	0.74	0.91	0.80	0.74	0.63	0.60	0.46	0.39	6.8
1948	0.47	0.51	0.33	0.88	0.83	0.77	0.74	0.53	0.45	0.48	0.34	0.28	6.6
1949	0.26	0.49	0.32	0.46	0.80	0.87	0.79	0.70	0.60	0.58	0.44	0.35	6.7
1950	0.34	0.42	0.83	0.29	0.27	0.90	0.76	0.64	0.59	0.56	0.40	0.37	6.4
1951	0.46	0.48	0.18	0.78	0.60	0.31	0.50	0.20	0.16	0.24	0.13	0.11	4.1
1952	0.11	0.44	0.81	0.88	0.87	0.90	0.80	0.74	0.63	0.60	0.47	0.40	7.6
1953	0.41	0.53	0.78	0.86	0.82	0.81	0.77	0.64	0.57	0.55	0.39	0.33	7.5
1954	0.32	0.47	0.81	0.87	0.87	0.90	0.80	0.72	0.62	0.60	0.47	0.39	7.8
1955	0.44	0.53	0.83	0.40	0.90	0.91	0.80	0.74	0.64	0.60	0.47	0.40	7.7
1956	0.45	0.48	0.49	0.64	0.85	0.87	0.78	0.69	0.61	0.59	0.46	0.39	7.3
1957	0.46	0.49	0.80	0.88	0.87	0.87	0.79	0.70	0.61	0.58	0.44	0.38	7.9
1958	0.42	0.47	0.83	0.87	0.83	0.84	0.76	0.55	0.44	0.47	0.32	0.26	7.1
1959	0.26	0.52	0.80	0.12	0.85	0.81	0.74	0.56	0.52	0.52	0.36	0.29	6.4
1960	0.33	0.53	0.83	0.71	0.87	0.90	0.80	0.73	0.64	0.60	0.47	0.41	7.8
1961	0.46	0.49	0.37	0.30	0.37	0.62	0.69	0.44	0.35	0.38	0.22	0.21	4.9
1962	0.24	0.53	0.82	0.15	0.25	0.23	0.56	0.31	0.32	0.44	0.31	0.24	4.4
1963	0.27	0.34	0.14	0.22	0.42	0.24	0.24	0.17	0.12	0.17	0.10	0.09	2.5
1964	0.20	0.52	0.82	0.75	0.73	0.70	0.67	0.37	0.26	0.31	0.18	0.17	5.7
1965	0.11	0.20	0.11	0.76	0.84	0.75	0.60	0.26	0.17	0.21	0.12	0.12	4.3
1966	0.18	0.28	0.77	0.54	0.86	0.88	0.78	0.68	0.59	0.56	0.40	0.32	6.8
1967	0.32	0.53	0.35	0.11	0.29	0.22	0.46	0.28	0.28	0.36	0.23	0.19	3.6
1968	0.18	0.53	0.81	0.85	0.72	0.91	0.80	0.68	0.59	0.57	0.41	0.34	7.4
1969	0.47	0.53	0.64	0.12	0.56	0.47	0.41	0.18	0.14	0.21	0.12	0.11	4.0
1970	0.18	0.34	0.82	0.88	0.75	0.69	0.77	0.60	0.53	0.50	0.34	0.28	6.7
1971	0.46	0.53	0.78	0.88	0.90	0.91	0.80	0.74	0.64	0.60	0.47	0.41	8.1
1972	0.47	0.51	0.27	0.12	0.21	0.25	0.56	0.27	0.19	0.26	0.15	0.31	3.6
1973	0.47	0.51	0.83	0.88	0.87	0.91	0.80	0.74	0.64	0.60	0.47	0.41	8.1
1974	0.47	0.53	0.82	0.78	0.87	0.90	0.79	0.71	0.62	0.59	0.45	0.38	7.9
1975	0.37	0.41	0.83	0.88	0.90	0.91	0.80	0.74	0.64	0.60	0.47	0.41	8.0
1976	0.46	0.53	0.68	0.88	0.87	0.91	0.80	0.74	0.64	0.60	0.47	0.41	8.0
1977	0.47	0.53	0.82	0.88	0.87	0.90	0.80	0.74	0.64	0.60	0.47	0.41	8.1
1978	0.45	0.53	0.57	0.41	0.71	0.83	0.75	0.55	0.46	0.47	0.35	0.33	6.4
1979	0.42	0.50	0.75	0.85	0.90	0.90	0.78	0.69	0.60	0.57	0.44	0.39	7.8
1980	0.44	0.53	0.76	0.88	0.87	0.91	0.80	0.74	0.64	0.60	0.47	0.41	8.1
1981	0.47	0.53	0.78	0.16	0.48	0.62	0.63	0.38	0.32	0.37	0.22	0.19	5.1
1982	0.20	0.24	0.09	0.11	0.15	0.31	0.23	0.14	0.11	0.16	0.10	0.10	1.9
1983	0.13	0.42	0.13	0.09	0.15	0.69	0.40	0.17	0.12	0.40	0.28	0.27	3.3
1984	0.46	0.53	0.42	0.54	0.76	0.83	0.73	0.52	0.51	0.52	0.36	0.41	6.6
1985	0.45	0.49	0.81	0.13	0.58	0.52	0.80	0.70	0.51	0.49	0.34	0.30	6.1
1986	0.39	0.53	0.82	0.25	0.80	0.79	0.74	0.55	0.48	0.48	0.33	0.31	6.5
1987	0.00	0.02	0.83	0.88	0.90	0.91	0.17	0.00	0.00	0.00	0.00	0.00	3.7
1988	0.47	0.53	0.01	0.02	0.14	0.08	0.00	0.00	0.00	0.00	0.00	0.00	1.3
1989	0.05	0.49	0.79	0.52	0.51	0.04	0.07	0.00	0.00	0.00	0.00	0.00	2.5
1990	0.00	0.10	0.09	0.88	0.87	0.80	0.73	0.00	0.00	0.00	0.00	0.00	3.5
1991	0.00	0.03	0.03	0.04	0.07	0.05	0.12	0.00	0.00	0.00	0.00	0.00	0.3
1992	0.00	0.02	0.82	0.77	0.86	0.91	0.02	0.00	0.00	0.00	0.00	0.00	3.4
1993	0.00	0.51	0.63	0.09	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.3
1994	0.00	0.01	0.02	0.04	0.79	0.88	0.12	0.02	0.00	0.00	0.00	0.00	1.9
1995	0.00	0.10	0.05	0.88	0.90	0.91	0.00	0.00	0.00	0.00	0.00	0.00	2.8
1996	0.00	0.09	0.05	0.14	0.60	0.23	0.18	0.00	0.00	0.00	0.00	0.00	1.3
1997	0.03	0.07	0.03	0.32	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.2
1998	0.04	0.03	0.80	0.88	0.86	0.87	0.77	0.00	0.00	0.00	0.00	0.00	4.2
1999	0.00	0.17	0.81	0.88	0.90	0.91	0.80	0.02	0.00	0.00	0.00	0.00	4.5
2000	0.00	0.11	0.08	0.05	0.87	0.91	0.13	0.02	0.00	0.00	0.00	0.00	2.2
2001	0.00	0.53	0.83	0.86	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.3
2002	0.00	0.00	0.01	0.03	0.05	0.05	0.13	0.00	0.00	0.00	0.00	0.00	0.3
2003	0.03	0.01	0.82	0.85	0.15	0.91	0.80	0.00	0.00	0.00	0.00	0.00	3.6
2004	0.00	0.00	0.17	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
AVE :	0.28	0.39	0.54	0.54	0.65	0.67	0.59	0.41	0.35	0.36	0.26	0.23	5.3
SD :	0.18	0.18	0.31	0.34	0.28	0.30	0.28	0.28	0.25	0.23	0.18	0.16	2.3

Appendix E8

File : 5C-T.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.65	2.22	1.29	1.49	4.91	2.20	1.42	0.93	0.77	0.78	0.61	0.51	17.8
1926	0.55	0.94	0.31	1.85	1.86	0.84	0.88	0.42	0.35	0.46	0.26	0.27	9.0
1927	0.65	2.09	0.62	2.62	2.52	1.29	1.10	0.68	0.55	0.58	0.43	0.38	13.5
1928	0.44	0.74	0.41	1.97	5.03	3.88	1.54	0.94	0.81	0.79	0.62	0.53	17.7
1929	0.59	2.31	2.18	1.68	3.53	2.41	1.72	1.00	0.86	0.81	0.65	0.56	18.3
1930	0.61	1.47	2.18	2.38	1.86	1.83	1.42	0.94	0.81	0.80	0.64	0.54	15.5
1931	0.60	2.34	0.69	0.41	0.77	0.90	1.00	0.68	0.59	0.62	0.42	0.33	9.3
1932	0.39	0.68	1.16	3.14	4.93	1.61	1.25	0.72	0.60	0.61	0.42	0.33	15.8
1933	0.30	2.65	2.04	2.99	4.78	2.74	1.68	1.00	0.86	0.81	0.64	0.55	21.0
1934	0.62	2.65	1.67	0.44	1.11	1.14	0.99	0.58	0.48	0.52	0.32	0.28	10.8
1935	0.29	0.42	0.17	1.03	4.01	2.10	1.24	0.72	0.65	0.68	0.47	0.43	12.2
1936	0.54	1.96	1.69	2.20	7.05	5.29	1.58	0.99	0.85	0.80	0.62	0.53	24.1
1937	0.57	1.17	2.06	2.36	2.11	1.23	2.24	0.98	0.81	0.77	0.58	0.53	15.4
1938	0.59	1.32	2.18	2.83	6.75	6.11	2.26	1.01	0.87	0.82	0.65	0.56	25.9
1939	0.65	2.65	2.04	0.56	1.56	3.76	1.77	1.00	0.86	0.82	0.65	0.56	16.9
1940	0.63	2.24	2.16	0.72	0.91	1.04	1.02	0.63	0.45	0.49	0.27	0.25	10.8
1941	0.28	0.54	0.28	0.50	0.58	9.51	2.39	0.85	0.81	0.79	0.62	0.54	17.7
1942	0.61	2.16	0.99	0.22	0.82	2.03	2.15	1.00	0.83	0.81	0.64	0.56	12.8
1943	0.62	1.93	0.51	1.02	5.22	2.05	1.30	0.76	0.69	0.70	0.49	0.43	15.7
1944	0.65	1.71	0.43	0.32	0.62	0.60	0.88	0.47	0.35	0.46	0.25	0.25	7.0
1945	0.29	0.56	1.05	3.14	4.55	1.81	1.34	0.89	0.70	0.69	0.47	0.41	15.9
1946	0.45	0.58	0.22	0.17	3.60	1.45	0.80	0.39	0.33	0.45	0.25	0.24	9.0
1947	0.26	0.46	2.15	0.86	2.04	9.51	2.39	1.01	0.87	0.82	0.64	0.55	21.6
1948	0.65	1.89	0.69	3.03	3.39	1.70	1.31	0.84	0.73	0.73	0.55	0.46	16.0
1949	0.48	1.71	0.67	0.95	2.76	2.13	1.62	0.98	0.84	0.80	0.62	0.52	14.1
1950	0.55	1.14	2.16	0.68	0.67	2.78	1.39	0.94	0.83	0.79	0.61	0.53	13.1
1951	0.64	1.65	0.46	1.55	1.64	0.88	0.91	0.43	0.38	0.50	0.28	0.25	9.6
1952	0.28	1.29	2.02	2.88	6.05	2.94	1.85	1.01	0.87	0.82	0.65	0.56	21.2
1953	0.60	2.31	1.78	2.20	3.30	1.84	1.42	0.94	0.82	0.78	0.60	0.51	17.1
1954	0.55	1.57	1.99	2.45	6.42	4.22	1.76	1.00	0.86	0.82	0.65	0.55	22.8
1955	0.62	2.38	2.18	0.85	7.31	7.55	1.92	1.01	0.87	0.82	0.65	0.56	26.7
1956	0.64	1.63	1.10	1.26	4.66	2.16	1.48	0.97	0.86	0.81	0.64	0.55	16.8
1957	0.64	1.78	1.90	3.14	7.05	2.17	1.57	0.99	0.85	0.80	0.62	0.53	22.1
1958	0.61	1.51	2.18	2.44	3.53	1.98	1.37	0.91	0.72	0.71	0.49	0.43	16.9
1959	0.48	2.11	1.90	0.25	3.46	1.84	1.33	0.92	0.80	0.77	0.60	0.47	14.9
1960	0.55	2.18	2.18	1.40	6.63	4.03	1.78	1.01	0.87	0.82	0.65	0.56	22.7
1961	0.64	1.74	0.80	0.69	0.94	1.22	1.22	0.73	0.64	0.64	0.43	0.38	10.1
1962	0.45	2.17	2.06	0.37	0.63	0.70	0.96	0.67	0.61	0.68	0.47	0.41	10.2
1963	0.50	0.68	0.41	0.56	1.08	0.71	0.78	0.40	0.33	0.43	0.24	0.23	6.4
1964	0.41	2.12	2.08	1.50	2.10	1.45	1.18	0.69	0.56	0.58	0.38	0.33	13.4
1965	0.30	0.49	0.31	1.51	3.73	1.62	1.03	0.56	0.41	0.47	0.26	0.27	10.9
1966	0.39	0.59	1.73	1.09	4.86	2.22	1.49	0.95	0.83	0.79	0.60	0.50	16.1
1967	0.55	2.65	0.74	0.19	0.71	0.67	0.90	0.61	0.57	0.62	0.44	0.36	9.0
1968	0.39	2.65	2.00	1.90	1.99	9.51	2.30	0.96	0.83	0.79	0.61	0.51	24.4
1969	0.65	2.15	1.38	0.26	1.54	1.06	0.87	0.41	0.35	0.47	0.26	0.25	9.6
1970	0.39	0.68	2.13	2.59	2.26	1.41	1.41	0.94	0.80	0.75	0.56	0.46	14.4
1971	0.64	2.46	1.75	3.14	6.56	7.26	2.39	1.01	0.87	0.82	0.65	0.56	28.1
1972	0.65	1.93	0.57	0.20	0.55	0.74	0.95	0.58	0.44	0.52	0.33	0.49	8.0
1973	0.65	1.92	2.18	2.58	7.05	5.96	1.99	1.01	0.87	0.82	0.65	0.56	26.2
1974	0.65	2.65	2.08	1.55	6.09	2.71	1.56	1.00	0.86	0.81	0.64	0.54	21.1
1975	0.57	1.09	2.17	3.14	6.45	9.40	2.39	1.01	0.87	0.82	0.65	0.56	29.1
1976	0.64	2.45	1.46	3.01	7.05	9.51	2.39	1.01	0.87	0.82	0.65	0.56	30.4
1977	0.65	2.20	2.15	3.14	7.05	3.86	2.04	1.01	0.87	0.82	0.65	0.56	25.0
1978	0.64	2.41	1.25	0.86	1.95	1.94	1.34	0.89	0.74	0.72	0.59	0.51	13.8
1979	0.61	1.83	1.59	1.91	5.95	2.65	1.51	0.97	0.84	0.80	0.62	0.55	19.8
1980	0.62	2.65	1.66	3.14	7.05	9.24	2.39	1.01	0.87	0.82	0.65	0.56	30.7
1981	0.65	2.65	1.78	0.39	1.28	1.22	1.10	0.70	0.61	0.63	0.43	0.35	11.8
1982	0.41	0.54	0.24	0.18	0.42	0.88	0.74	0.38	0.31	0.43	0.24	0.25	5.0
1983	0.32	1.17	0.37	0.17	0.43	1.44	0.87	0.40	0.33	0.65	0.46	0.45	7.1
1984	0.64	2.57	0.94	1.08	2.31	1.94	1.30	0.81	0.79	0.77	0.60	0.56	14.3
1985	0.64	1.71	1.99	0.29	1.58	1.11	2.39	0.99	0.79	0.74	0.56	0.47	13.3
1986	0.58	2.51	2.08	0.62	2.74	1.76	1.30	0.90	0.76	0.73	0.53	0.49	15.0
1987	0.02	0.13	2.18	3.14	7.26	9.51	0.50	0.04	0.03	0.03	0.02	0.02	22.9
1988	0.65	2.38	0.10	0.11	0.40	0.34	0.16	0.04	0.03	0.03	0.02	0.02	4.3
1989	0.17	1.68	1.87	1.06	1.39	0.24	0.26	0.04	0.03	0.03	0.02	0.02	6.8
1990	0.02	0.31	0.24	3.14	6.55	1.81	1.29	0.04	0.03	0.03	0.02	0.02	13.5
1991	0.02	0.15	0.12	0.15	0.25	0.26	0.32	0.04	0.03	0.03	0.02	0.02	1.4
1992	0.02	0.13	2.13	1.54	4.79	5.05	0.19	0.04	0.03	0.03	0.02	0.02	14.0
1993	0.02	1.96	1.37	0.17	0.34	0.15	0.16	0.04	0.03	0.03	0.02	0.02	4.3
1994	0.02	0.11	0.12	0.15	2.56	2.40	0.32	0.26	0.03	0.03	0.02	0.02	6.0
1995	0.02	0.31	0.16	2.72	7.31	9.51	0.16	0.04	0.03	0.03	0.02	0.02	20.3
1996	0.02	0.28	0.16	0.31	1.63	0.70	0.57	0.04	0.03	0.03	0.02	0.15	3.9
1997	0.13	0.24	0.13	0.72	2.06	0.15	0.16	0.04	0.03	0.03	0.02	0.02	3.7
1998	0.15	0.15	1.89	2.66	5.12	2.18	1.39	0.04	0.03	0.03	0.02	0.02	13.7
1999	0.02	0.44	2.01	3.07	7.31	9.51	2.39	0.26	0.03	0.03	0.02	0.02	25.1
2000	0.02	0.32	0.20	0.15	6.83	9.51	0.35	0.26	0.03	0.03	0.02	0.02	17.7
2001	0.02	2.65	2.18	2.07	0.26	0.15	0.16	0.04	0.03	0.03	0.02	0.02	7.6
2002	0.02	0.10	0.10	0.15	0.20	0.26	0.36	0.04	0.03	0.03	0.02	0.02	1.3
2003	0.13	0.12	2.15	1.87	0.42	9.51	2.39	0.04	0.03	0.03	0.02	0.02	16.7
2004	0.02	0.10	0.45	0.19	0.00	0.15	0.16	0.04	0.03	0.03	0.02	0.02	1.2
AVE :	0.44	1.49	1.31	1.47	3.34	3.06	1.30	0.65	0.55	0.55	0.41	0.36	14.9
SD :	0.23	0.88	0.79	1.08	2.44	2.99	0.67	0.37	0.33	0.31	0.24	0.21	7.2

Appendix E9

File : 6C-B.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.55	0.52	0.33	1.00	1.09	1.04	0.91	0.81	0.77	0.61	0.60	0.50	8.7
1926	0.45	0.27	0.18	0.86	0.56	0.39	0.33	0.27	0.38	0.21	0.17	0.12	4.2
1927	0.59	0.66	0.55	1.17	1.17	0.90	0.77	0.67	0.73	0.52	0.48	0.38	8.6
1928	0.39	0.52	0.43	1.03	1.14	1.15	1.02	0.92	0.83	0.69	0.64	0.54	9.3
1929	0.55	0.66	0.94	1.08	1.08	1.14	1.02	0.94	0.81	0.71	0.66	0.56	10.1
1930	0.54	0.44	0.94	1.17	1.04	1.06	1.01	0.94	0.81	0.71	0.66	0.57	9.9
1931	0.57	0.67	0.71	0.66	0.78	0.80	0.73	0.63	0.76	0.56	0.47	0.31	7.7
1932	0.24	0.20	0.55	1.18	1.15	0.92	0.79	0.65	0.72	0.44	0.36	0.24	7.4
1933	0.13	0.68	0.94	1.17	1.15	1.13	1.01	0.93	0.81	0.70	0.64	0.53	9.8
1934	0.53	0.68	0.93	1.03	0.83	0.74	0.64	0.53	0.71	0.41	0.35	0.25	7.6
1935	0.19	0.12	0.12	0.68	1.15	1.13	0.99	0.90	0.82	0.70	0.65	0.56	8.0
1936	0.57	0.68	0.92	1.16	1.17	1.17	1.01	0.91	0.84	0.67	0.59	0.47	10.2
1937	0.46	0.25	0.89	1.10	0.89	0.69	1.02	0.94	0.81	0.71	0.65	0.57	9.0
1938	0.59	0.68	0.94	1.18	1.17	1.18	1.03	0.94	0.81	0.71	0.66	0.57	10.4
1939	0.59	0.68	0.94	1.09	1.03	1.13	1.01	0.93	0.81	0.71	0.66	0.57	10.1
1940	0.59	0.68	0.94	1.03	0.76	0.66	0.88	0.85	0.83	0.58	0.50	0.35	8.7
1941	0.29	0.20	0.94	1.10	0.44	1.15	1.01	0.85	0.85	0.68	0.64	0.56	8.7
1942	0.58	0.66	0.89	0.73	0.49	1.00	1.02	0.94	0.81	0.71	0.66	0.57	9.1
1943	0.59	0.65	0.55	0.80	1.20	1.14	0.96	0.85	0.84	0.66	0.60	0.45	9.3
1944	0.59	0.62	0.42	0.95	1.01	1.07	0.96	0.83	0.79	0.55	0.45	0.30	8.5
1945	0.41	0.38	0.34	1.18	1.16	1.11	0.96	0.88	0.85	0.66	0.57	0.40	8.9
1946	0.32	0.20	0.17	0.30	0.87	0.85	0.71	0.62	0.73	0.50	0.42	0.29	6.0
1947	0.24	0.49	0.93	1.05	0.93	1.18	1.03	0.94	0.81	0.70	0.64	0.52	9.4
1948	0.58	0.61	0.52	1.16	1.09	0.91	0.82	0.73	0.82	0.65	0.59	0.46	8.9
1949	0.43	0.51	0.70	0.85	1.04	1.09	0.99	0.92	0.81	0.71	0.65	0.56	9.2
1950	0.51	0.41	0.94	1.13	0.74	0.86	0.77	0.88	0.82	0.70	0.64	0.56	9.0
1951	0.59	0.62	0.46	0.72	0.57	0.43	0.40	0.33	0.49	0.28	0.26	0.18	5.3
1952	0.14	0.48	0.92	1.17	1.17	1.17	1.02	0.94	0.81	0.71	0.66	0.56	9.7
1953	0.53	0.64	0.86	1.14	1.14	1.09	0.96	0.90	0.83	0.69	0.63	0.52	9.9
1954	0.51	0.63	0.92	1.17	1.17	1.18	1.03	0.94	0.81	0.71	0.66	0.57	10.3
1955	0.57	0.68	0.94	1.11	1.21	1.18	1.03	0.93	0.81	0.71	0.66	0.57	10.4
1956	0.58	0.56	0.59	0.86	1.03	1.09	0.98	0.91	0.82	0.71	0.66	0.57	9.4
1957	0.59	0.67	0.80	1.18	1.17	1.09	0.94	0.85	0.84	0.63	0.53	0.48	9.8
1958	0.54	0.56	0.94	1.15	1.13	1.08	0.90	0.74	0.73	0.53	0.48	0.34	9.1
1959	0.32	0.67	0.92	0.90	1.17	1.08	0.91	0.87	0.84	0.69	0.63	0.52	9.5
1960	0.49	0.68	0.94	1.16	1.16	1.16	1.02	0.94	0.81	0.71	0.66	0.57	10.3
1961	0.59	0.57	0.63	0.62	0.54	0.51	0.56	0.54	0.71	0.36	0.25	0.13	6.0
1962	0.09	0.67	0.92	0.91	0.49	0.41	0.38	0.34	0.71	0.53	0.52	0.38	6.3
1963	0.36	0.28	0.29	0.43	0.49	0.40	0.31	0.25	0.32	0.17	0.10	0.04	3.4
1964	0.12	0.48	0.94	1.16	1.10	0.97	0.80	0.65	0.73	0.48	0.40	0.32	8.1
1965	0.33	0.31	0.22	1.01	1.10	1.03	0.72	0.54	0.63	0.30	0.21	0.16	6.5
1966	0.27	0.32	0.69	1.01	1.14	1.13	1.02	0.94	0.81	0.71	0.66	0.55	9.2
1967	0.53	0.66	0.57	0.38	0.43	0.40	0.48	0.53	0.73	0.57	0.52	0.38	6.2
1968	0.35	0.67	0.94	1.11	0.88	1.16	1.02	0.92	0.81	0.70	0.64	0.53	9.7
1969	0.59	0.68	0.88	0.70	0.70	0.52	0.40	0.30	0.43	0.24	0.19	0.12	5.7
1970	0.13	0.20	0.79	1.14	1.06	0.81	0.88	0.86	0.84	0.68	0.61	0.46	8.5
1971	0.57	0.68	0.86	1.18	1.21	1.18	1.03	0.94	0.81	0.71	0.66	0.56	10.4
1972	0.58	0.61	0.50	0.38	0.42	0.41	0.54	0.56	0.72	0.42	0.38	0.57	6.1
1973	0.59	0.68	0.94	1.18	1.17	1.17	1.02	0.94	0.81	0.71	0.66	0.57	10.4
1974	0.59	0.68	0.92	1.14	1.17	1.16	0.99	0.92	0.81	0.70	0.65	0.54	10.3
1975	0.49	0.36	0.94	1.18	1.21	1.18	1.03	0.94	0.81	0.71	0.66	0.57	10.1
1976	0.57	0.67	0.66	1.17	1.17	1.18	1.03	0.94	0.81	0.71	0.66	0.57	10.1
1977	0.59	0.61	0.93	1.18	1.17	1.17	1.02	0.94	0.81	0.70	0.65	0.54	10.3
1978	0.53	0.66	0.69	0.86	0.76	0.84	0.79	0.73	0.80	0.59	0.60	0.55	8.4
1979	0.58	0.65	0.90	1.11	1.21	1.17	0.99	0.90	0.84	0.67	0.61	0.55	10.2
1980	0.58	0.68	0.93	1.18	1.17	1.17	1.02	0.93	0.81	0.70	0.65	0.56	10.4
1981	0.58	0.68	0.81	0.62	0.58	0.44	0.39	0.38	0.66	0.35	0.26	0.17	5.9
1982	0.17	0.20	0.21	0.30	0.34	0.31	0.24	0.19	0.21	0.13	0.10	0.06	2.5
1983	0.09	0.45	0.35	0.34	0.39	0.55	0.61	0.49	0.61	0.54	0.61	0.54	5.6
1984	0.59	0.68	0.90	1.15	1.15	1.13	0.97	0.90	0.82	0.71	0.66	0.57	10.2
1985	0.59	0.64	0.80	0.49	0.65	0.57	1.01	0.94	0.82	0.69	0.62	0.50	8.3
1986	0.54	0.66	0.89	0.82	1.06	1.03	0.89	0.79	0.82	0.62	0.56	0.55	9.2
1987	0.58	0.59	0.94	1.17	1.21	1.18	1.03	0.93	0.82	0.70	0.66	0.57	10.4
1988	0.59	0.68	0.75	0.45	0.89	0.88	0.61	0.44	0.63	0.36	0.34	0.25	6.9
1989	0.42	0.68	0.93	1.13	1.09	1.03	0.93	0.85	0.83	0.62	0.54	0.40	9.5
1990	0.43	0.51	0.87	1.17	1.15	1.15	1.02	0.88	0.84	0.67	0.60	0.46	9.8
1991	0.42	0.29	0.17	0.24	0.28	0.23	0.17	0.12	0.11	0.09	0.07	0.02	2.2
1992	0.02	0.08	0.88	0.66	0.90	1.05	0.70	0.45	0.53	0.27	0.24	0.18	6.0
1993	0.17	0.66	0.93	1.00	0.79	0.69	0.51	0.34	0.43	0.21	0.15	0.09	6.0
1994	0.22	0.21	0.36	0.44	0.93	1.01	0.84	0.77	0.82	0.60	0.53	0.39	7.1
1995	0.41	0.68	0.94	1.18	1.21	1.18	1.01	0.93	0.81	0.71	0.66	0.57	10.3
1996	0.59	0.67	0.74	1.17	1.15	1.17	1.03	0.92	0.84	0.67	0.60	0.54	10.1
1997	0.58	0.68	0.81	1.16	1.12	0.76	0.55	0.34	0.44	0.24	0.26	0.29	7.2
1998	0.54	0.62	0.94	1.18	1.16	1.17	1.02	0.94	0.81	0.71	0.66	0.57	10.3
1999	0.58	0.67	0.93	1.18	1.21	1.18	1.03	0.94	0.81	0.70	0.66	0.56	10.4
2000	0.58	0.63	0.83	0.52	1.16	1.17	0.93	0.82	0.83	0.63	0.56	0.42	9.1
2001	0.54	0.68	0.94	1.14	1.01	0.70	0.55	0.37	0.53	0.32	0.28	0.24	7.3
2002	0.34	0.21	0.18	0.29	0.36	0.32	0.23	0.16	0.17	0.14	0.10	0.06	2.6
2003	0.08	0.16	0.78	0.58	1.19	1.18	1.03	0.94	0.81	0.70	0.65	0.55	8.6
2004	0.55	0.49	0.87	0.93	0.59	0.42	0.40	0.35	0.51	0.25	0.19	0.13	5.7
AVE :	0.45	0.54	0.74	0.93	0.95	0.93	0.83	0.74	0.73	0.57	0.52	0.42	8.4
SD :	0.17	0.18	0.25	0.29	0.27	0.29	0.25	0.24	0.17	0.18	0.18	0.17	2.1

Appendix E10

File : 6C-T.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	1.00	1.19	0.67	3.77	17.16	1.66	5.13	1.29	1.22	1.12	0.96	0.79	36.0
1926	0.97	0.93	0.32	3.22	1.58	0.63	0.60	0.43	0.60	0.33	0.28	0.19	10.1
1927	1.03	1.74	2.82	6.26	30.10	1.42	3.96	1.06	1.16	0.93	0.77	0.60	51.8
1928	0.94	1.20	1.72	4.08	32.19	1.83	5.94	1.46	1.43	1.32	1.01	0.86	54.0
1929	1.00	1.82	5.83	4.56	15.38	1.80	5.94	1.49	1.92	1.36	1.04	0.90	43.0
1930	1.00	1.10	5.87	6.31	12.14	1.68	5.88	1.49	1.80	1.36	1.05	0.90	40.6
1931	1.01	2.20	3.69	2.01	3.14	1.27	3.55	1.00	1.20	1.01	0.74	0.49	21.3
1932	0.85	0.80	2.83	6.93	40.97	1.45	4.14	1.02	1.15	0.78	0.56	0.38	61.9
1933	0.74	4.33	5.80	6.39	41.41	1.80	5.83	1.48	1.58	1.34	1.02	0.85	72.6
1934	1.00	2.87	5.74	4.10	3.86	1.18	2.58	0.84	1.13	0.71	0.55	0.40	25.0
1935	0.81	0.53	0.20	2.10	23.89	1.80	5.76	1.42	1.49	1.34	1.03	0.89	41.3
1936	1.01	2.81	5.64	5.62	55.06	1.86	5.86	1.45	1.39	1.26	0.93	0.75	83.6
1937	0.98	0.90	5.33	4.74	4.62	1.10	5.97	1.49	1.84	1.35	1.04	0.90	30.3
1938	1.03	2.96	5.87	6.93	55.06	1.87	6.00	1.49	1.97	1.36	1.05	0.90	86.5
1939	1.03	4.33	5.86	4.61	9.09	1.79	5.87	1.48	2.07	1.36	1.05	0.90	39.4
1940	1.03	4.33	5.83	4.12	3.12	1.05	4.89	1.34	1.31	1.06	0.79	0.55	29.4
1941	0.90	0.82	5.87	4.77	0.98	1.83	5.89	1.35	1.35	1.31	1.01	0.89	27.0
1942	1.02	1.80	5.27	2.43	1.18	1.58	5.99	1.49	2.07	1.36	1.05	0.90	26.1
1943	1.03	1.69	2.81	2.86	45.75	1.82	5.52	1.35	1.33	1.26	0.95	0.72	67.1
1944	1.03	1.57	1.63	3.58	9.22	1.70	5.47	1.32	1.25	0.98	0.72	0.47	29.0
1945	0.94	1.07	0.74	6.93	43.97	1.77	5.53	1.40	1.36	1.24	0.91	0.63	66.5
1946	0.91	0.83	0.30	0.53	4.31	1.35	3.30	0.98	1.15	0.88	0.67	0.46	15.7
1947	0.85	1.13	5.74	4.26	5.20	1.87	6.00	1.49	1.88	1.34	1.01	0.82	31.6
1948	1.02	1.50	2.64	5.82	17.23	1.44	4.34	1.15	1.31	1.21	0.94	0.73	39.3
1949	0.96	1.17	3.62	3.15	12.33	1.73	5.73	1.47	1.81	1.36	1.04	0.88	35.2
1950	1.00	1.08	5.87	5.00	2.87	1.36	3.99	1.39	1.52	1.33	1.02	0.89	27.3
1951	1.03	1.55	2.00	2.39	1.58	0.69	0.77	0.52	0.77	0.46	0.41	0.28	12.4
1952	0.77	1.12	5.69	6.50	51.11	1.86	5.94	1.49	2.03	1.36	1.04	0.89	79.8
1953	1.00	1.67	4.82	5.31	32.20	1.73	5.47	1.44	1.44	1.32	0.99	0.83	58.2
1954	1.00	1.62	5.65	6.53	55.06	1.87	6.00	1.49	2.07	1.36	1.05	0.90	84.6
1955	1.01	3.05	5.85	4.82	57.03	1.87	6.00	1.48	1.80	1.36	1.04	0.90	86.2
1956	1.02	1.32	3.01	3.22	11.60	1.73	5.65	1.44	1.54	1.35	1.05	0.90	33.8
1957	1.03	1.92	4.22	6.93	55.06	1.74	5.32	1.35	1.33	1.16	0.84	0.75	81.7
1958	1.00	1.30	5.84	5.40	30.22	1.72	5.05	1.18	1.16	0.96	0.76	0.54	55.1
1959	0.91	2.00	5.68	3.39	31.27	1.72	5.12	1.38	1.41	1.32	1.00	0.82	56.0
1960	1.00	3.91	5.87	5.58	44.78	1.84	5.99	1.49	2.07	1.36	1.05	0.90	75.8
1961	1.03	1.34	3.24	1.87	1.50	0.81	1.91	0.85	1.13	0.62	0.40	0.21	14.9
1962	0.54	2.16	5.71	3.42	1.15	0.65	0.71	0.54	1.13	0.95	0.82	0.60	18.4
1963	0.92	0.94	0.58	1.25	1.14	0.64	0.56	0.39	0.51	0.26	0.16	0.06	7.4
1964	0.68	1.13	5.86	5.87	18.91	1.54	4.19	1.03	1.16	0.85	0.63	0.51	42.4
1965	0.91	0.98	0.41	3.88	20.47	1.64	3.37	0.85	1.00	0.50	0.33	0.25	34.6
1966	0.88	1.00	3.56	3.94	33.89	1.79	5.99	1.49	2.07	1.36	1.04	0.88	57.9
1967	1.00	1.81	2.93	0.94	0.90	0.64	1.32	0.85	1.15	1.04	0.83	0.60	14.0
1968	0.92	2.01	5.83	4.85	4.48	1.84	5.99	1.46	1.55	1.33	1.01	0.84	32.1
1969	1.03	2.64	5.15	2.24	2.42	0.83	0.77	0.47	0.68	0.38	0.30	0.18	17.1
1970	0.72	0.82	4.19	5.31	13.30	1.29	4.88	1.36	1.38	1.30	0.96	0.73	36.2
1971	1.01	2.27	4.85	6.93	56.53	1.87	6.00	1.49	2.07	1.36	1.04	0.89	86.3
1972	1.02	1.52	2.44	0.96	0.88	0.65	1.76	0.89	1.13	0.73	0.60	0.90	13.5
1973	1.03	3.12	5.87	6.93	55.06	1.86	5.94	1.49	1.98	1.36	1.05	0.90	86.6
1974	1.03	4.33	5.68	5.23	47.51	1.84	5.76	1.46	1.77	1.35	1.03	0.86	77.9
1975	1.00	1.06	5.87	6.93	49.46	1.87	6.00	1.49	2.07	1.36	1.05	0.90	79.1
1976	1.01	1.88	3.39	6.29	53.79	1.87	6.00	1.49	2.07	1.36	1.04	0.90	81.1
1977	1.03	1.49	5.74	6.93	50.08	1.85	5.99	1.48	1.66	1.34	1.02	0.85	79.5
1978	1.00	1.84	3.58	3.24	3.09	1.33	4.15	1.15	1.26	1.07	0.94	0.87	23.5
1979	1.02	1.68	5.35	4.86	52.03	1.86	5.73	1.44	1.38	1.27	0.96	0.88	78.5
1980	1.02	4.33	5.78	6.93	55.06	1.86	5.94	1.48	1.79	1.35	1.03	0.89	87.5
1981	1.01	3.10	4.33	1.88	1.70	0.70	0.73	0.60	1.05	0.60	0.42	0.27	16.4
1982	0.79	0.81	0.39	0.59	0.59	0.50	0.40	0.30	0.33	0.21	0.16	0.09	5.2
1983	0.54	1.10	0.90	0.74	0.74	0.86	2.27	0.77	0.98	0.97	0.97	0.86	11.7
1984	1.03	4.33	5.54	5.53	41.53	1.79	5.57	1.42	1.54	1.36	1.04	0.90	71.6
1985	1.03	1.63	4.21	1.44	2.11	0.90	5.87	1.49	1.47	1.31	0.98	0.79	23.2
1986	1.00	1.74	5.30	2.96	13.82	1.64	4.95	1.25	1.29	1.14	0.88	0.88	36.9
1987	1.02	1.42	5.87	5.93	49.58	1.87	6.00	1.47	1.52	1.35	1.04	0.90	78.0
1988	1.03	3.91	3.94	1.34	4.85	1.40	2.24	0.69	0.99	0.62	0.54	0.40	22.0
1989	0.95	4.33	5.79	4.97	16.22	1.64	5.29	1.34	1.32	1.14	0.86	0.63	44.5
1990	0.96	1.18	4.93	6.20	39.06	1.82	5.95	1.40	1.33	1.27	0.96	0.74	65.8
1991	0.95	0.95	0.28	0.40	0.47	0.37	0.26	0.19	0.18	0.15	0.10	0.03	4.3
1992	0.24	0.32	5.12	2.03	5.05	1.66	3.25	0.71	0.85	0.44	0.38	0.29	20.3
1993	0.79	1.75	5.72	3.83	3.41	1.09	1.55	0.53	0.68	0.33	0.24	0.14	20.1
1994	0.84	0.85	0.94	1.30	6.40	1.60	4.53	1.22	1.31	1.10	0.84	0.63	21.6
1995	0.95	4.33	5.81	6.73	57.03	1.87	5.87	1.48	2.07	1.36	1.05	0.90	89.4
1996	1.03	2.07	3.87	5.98	41.30	1.86	6.00	1.46	1.39	1.27	0.96	0.86	68.1
1997	1.02	2.92	4.39	5.89	25.64	1.20	1.82	0.55	0.70	0.38	0.41	0.46	45.4
1998	1.00	1.56	5.87	6.92	45.07	1.86	6.00	1.49	1.95	1.36	1.05	0.90	75.0
1999	1.02	2.19	5.75	6.74	57.03	1.87	6.00	1.48	1.56	1.35	1.04	0.90	86.9
2000	1.02	1.59	4.54	1.55	45.55	1.85	5.26	1.30	1.31	1.16	0.90	0.67	66.7
2001	1.00	4.33	5.87	5.27	9.29	1.11	1.86	0.58	0.85	0.53	0.44	0.39	31.5
2002	0.92	0.85	0.31	0.51	0.67	0.52	0.38	0.25	0.27	0.23	0.16	0.09	5.2
2003	0.52	0.65	4.08	1.77	42.09	1.86	6.00	1.49	1.70	1.34	1.03	0.88	63.4
2004	1.00	1.13	4.96	3.52	1.74	0.67	0.78	0.55	0.81	0.39	0.30	0.20	16.0
AVE :	0.94	1.92	4.15	4.23	23.68	1.48	4.41	1.18	1.38	1.06	0.82	0.67	45.9
SD :	0.14	1.13	1.92	2.04	21.01	0.45	1.95	0.39	0.46	0.37	0.29	0.27	26.5

Appendix E11

File : 7C-B.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	0.67	0.80	0.34	1.41	1.95	1.74	1.36	1.22	0.90	0.82	0.75	0.65	12.6
1926	0.65	0.39	0.12	1.16	0002E 66	0.30	0.26	0.22	0.23	0.18	0.19	0.18	4.5
1927	0.69	1.15	0.76	1.74	2.12	1.43	1.09	0.95	0.78	0.74	0.71	0.63	12.8
1928	0.60	0.80	0.53	1.48	2.06	1.97	1.56	1.42	1.27	1.14	0.75	0.65	14.2
1929	0.67	1.17	1.49	1.57	1.92	1.93	1.56	1.45	1.33	1.17	0.76	0.66	15.7
1930	0.67	0.69	1.50	1.74	1.83	1.78	1.55	1.45	1.33	1.17	0.76	0.67	15.1
1931	0.68	1.19	1.05	0.79	1.17	1.24	1.01	0.89	0.86	0.79	0.68	0.51	10.9
1932	0.37	0.24	0.77	1.75	2.10	1.48	1.13	0.91	0.71	0.61	0.51	0.40	11.0
1933	0.20	1.21	1.49	1.74	2.11	1.93	1.53	1.44	1.31	1.15	0.75	0.65	15.5
1934	0.67	1.20	1.47	1.48	1.31	1.09	0.83	0.69	0.59	0.55	0.49	0.42	10.8
1935	0.29	0.10	0.06	0.82	2.07	1.93	1.51	1.39	1.29	1.16	0.75	0.65	12.0
1936	0.68	1.20	1.45	1.71	2.15	2.00	1.54	1.41	1.25	1.08	0.75	0.65	15.9
1937	0.65	0.35	1.41	1.61	1.45	0.96	1.57	1.45	1.33	1.17	0.75	0.66	13.4
1938	0.69	1.20	1.50	1.75	2.15	2.00	1.57	1.45	1.33	1.17	0.76	0.67	16.3
1939	0.69	1.21	1.50	1.58	1.79	1.92	1.55	1.44	1.33	1.17	0.76	0.67	15.6
1940	0.69	1.21	1.50	1.48	1.15	0.90	1.30	1.31	1.10	0.80	0.72	0.58	12.7
1941	0.44	0.25	1.50	1.61	0.38	1.97	1.55	1.32	1.23	1.12	0.75	0.65	12.8
1942	0.68	1.16	1.40	0.92	0.49	1.63	1.57	1.45	1.33	1.17	0.76	0.67	13.2
1943	0.69	1.13	0.76	1.05	2.19	1.95	1.46	1.31	1.15	1.07	0.75	0.65	14.2
1944	0.69	1.05	0.51	1.33	1.75	1.81	1.44	1.26	0.96	0.78	0.67	0.50	12.8
1945	0.63	0.60	0.35	1.75	2.12	1.90	1.46	1.37	1.23	1.04	0.75	0.64	13.8
1946	0.50	0.26	0.11	0.11	1.41	1.36	0.96	0.85	0.72	0.70	0.62	0.48	8.1
1947	0.36	0.75	1.48	1.51	1.53	2.00	1.57	1.45	1.33	1.16	0.75	0.65	14.6
1948	0.68	1.00	0.70	1.72	1.95	1.47	1.17	1.06	1.09	0.98	0.75	0.65	13.2
1949	0.64	0.78	1.03	1.14	1.84	1.85	1.51	1.43	1.33	1.17	0.75	0.65	14.1
1950	0.67	0.64	1.50	1.66	1.10	1.37	1.09	1.36	1.30	1.15	0.75	0.65	13.2
1951	0.69	1.04	0.58	0.91	0.66	0.39	0.37	0.30	0.31	0.31	0.34	0.28	6.2
1952	0.21	0.74	1.46	1.74	2.14	1.99	1.56	1.45	1.33	1.17	0.76	0.65	15.2
1953	0.67	1.11	1.34	1.69	2.06	1.84	1.44	1.40	1.27	1.13	0.75	0.65	15.4
1954	0.67	1.08	1.45	1.74	2.15	2.00	1.57	1.45	1.33	1.17	0.76	0.66	16.0
1955	0.68	1.20	1.50	1.63	2.22	2.00	1.57	1.44	1.33	1.17	0.75	0.66	16.2
1956	0.69	0.88	0.82	1.16	1.82	1.85	1.49	1.41	1.31	1.17	0.76	0.67	14.0
1957	0.69	1.18	1.23	1.75	2.15	1.85	1.41	1.32	1.15	0.86	0.73	0.65	15.0
1958	0.67	0.87	1.50	1.69	2.05	1.83	1.33	1.09	0.78	0.77	0.71	0.57	13.9
1959	0.50	1.19	1.46	1.24	2.13	1.83	1.35	1.35	1.26	1.14	0.75	0.65	14.9
1960	0.67	1.21	1.50	1.71	2.12	1.98	1.57	1.45	1.33	1.17	0.76	0.67	16.1
1961	0.69	0.90	0.90	0.71	0.62	0.56	0.67	0.70	0.58	0.46	0.33	0.21	7.3
1962	0.12	1.19	1.47	1.25	0.48	0.33	0.33	0.31	0.56	0.76	0.73	0.63	8.2
1963	0.55	0.40	0.28	0.37	0.47	0.31	0.24	0.19	0.18	0.12	0.06	0.04	3.2
1964	0.17	0.75	1.50	1.72	1.96	1.58	1.14	0.92	0.74	0.67	0.58	0.53	12.3
1965	0.51	0.47	0.17	1.43	1.98	1.70	0.98	0.70	0.47	0.35	0.24	0.24	9.2
1966	0.42	0.49	1.01	1.45	2.07	1.92	1.57	1.45	1.33	1.17	0.75	0.65	14.3
1967	0.67	1.17	0.80	0.26	0.31	0.31	0.52	0.69	0.72	0.80	0.73	0.63	7.6
1968	0.54	1.19	1.50	1.63	1.44	1.98	1.57	1.42	1.31	1.15	0.75	0.65	15.1
1969	0.69	1.20	1.39	0.86	1.00	0.59	0.37	0.25	0.27	0.23	0.21	0.17	7.2
1970	0.19	0.25	1.22	1.69	1.86	1.26	1.29	1.33	1.25	1.11	0.75	0.65	12.9
1971	0.68	1.19	1.34	1.75	2.22	2.00	1.57	1.45	1.33	1.17	0.76	0.65	16.1
1972	0.68	1.02	0.66	0.26	0.31	0.33	0.64	0.74	0.61	0.56	0.55	0.67	7.0
1973	0.69	1.20	1.50	1.75	2.15	2.00	1.56	1.45	1.33	1.17	0.76	0.67	16.2
1974	0.69	1.21	1.46	1.68	2.13	1.98	1.52	1.42	1.32	1.17	0.75	0.65	16.0
1975	0.67	0.57	1.50	1.75	2.21	2.00	1.57	1.45	1.33	1.17	0.76	0.67	15.7
1976	0.68	1.17	0.95	1.74	2.14	2.00	1.57	1.45	1.33	1.17	0.75	0.67	15.6
1977	0.69	1.00	1.47	1.75	2.14	1.99	1.57	1.44	1.32	1.16	0.75	0.65	15.9
1978	0.67	1.17	1.02	1.17	1.14	1.33	1.13	1.06	0.99	0.81	0.75	0.65	11.9
1979	0.68	1.12	1.41	1.63	2.22	1.99	1.51	1.40	1.25	1.09	0.75	0.65	15.7
1980	0.68	1.21	1.48	1.75	2.15	2.00	1.56	1.44	1.33	1.16	0.75	0.65	16.2
1981	0.68	1.20	1.25	0.72	0.71	0.40	0.35	0.38	0.51	0.45	0.35	0.27	7.3
1982	0.25	0.25	0.17	0.13	0.13	0.10	0.13	0.11	0.10	0.07	0.06	0.08	1.6
1983	0.12	0.70	0.38	0.18	0.21	0.64	0.77	0.60	0.45	0.77	0.75	0.65	6.2
1984	0.69	1.21	1.43	1.71	2.11	1.92	1.47	1.39	1.31	1.17	0.76	0.67	15.8
1985	0.69	1.09	1.23	0.47	0.87	0.69	1.55	1.45	1.28	1.13	0.75	0.65	11.8
1986	0.67	1.15	1.40	1.08	1.88	1.71	1.31	1.18	1.05	0.83	0.75	0.65	13.7
1987	0.68	0.95	1.50	1.73	2.21	2.00	1.57	1.43	1.30	1.17	0.76	0.67	16.0
1988	0.69	1.21	1.14	0.41	1.47	1.41	0.77	0.50	0.47	0.46	0.49	0.42	9.4
1989	0.64	1.21	1.48	1.66	1.94	1.71	1.39	1.30	1.13	0.83	0.74	0.64	14.7
1990	0.64	0.79	1.36	1.74	2.10	1.96	1.56	1.37	1.18	1.09	0.75	0.65	15.2
1991	0.64	0.43	0.10	0.08	0.09	0.05	0.07	0.04	0.04	0.04	0.02	0.02	1.6
1992	0.03	0.04	1.38	0.80	1.48	1.74	0.95	0.52	0.36	0.29	0.30	0.29	8.2
1993	0.25	1.16	1.47	1.42	1.21	0.95	0.58	0.30	0.26	0.18	0.15	0.13	8.1
1994	0.34	0.28	0.39	0.39	1.57	1.65	1.21	1.14	1.08	0.82	0.73	0.63	10.2
1995	0.64	1.21	1.49	1.75	2.22	2.00	1.55	1.44	1.33	1.17	0.76	0.67	16.2
1996	0.69	1.19	1.11	1.73	2.11	1.99	1.57	1.42	1.25	1.09	0.75	0.65	15.6
1997	0.68	1.20	1.26	1.73	2.01	1.12	0.65	0.32	0.27	0.23	0.34	0.48	10.3
1998	0.67	1.04	1.50	1.75	2.12	1.99	1.57	1.45	1.33	1.17	0.76	0.67	16.0
1999	0.68	1.19	1.48	1.75	2.22	2.00	1.57	1.44	1.31	1.16	0.75	0.66	16.2
2000	0.68	1.07	1.29	0.53	2.13	1.99	1.39	1.24	1.10	0.88	0.75	0.64	13.7
2001	0.67	1.21	1.50	1.68	1.76	0.99	0.66	0.36	0.36	0.38	0.37	0.40	10.3
2002	0.53	0.27	0.12	0.10	0.18	0.13	0.12	0.07	0.07	0.09	0.06	0.08	1.8
2003	0.11	0.16	1.18	0.65	2.18	2.00	1.57	1.45	1.32	1.16	0.75	0.65	13.2
2004	0.67	0.75	1.36	1.30	0.72	0.36	0.38	0.32	0.34	0.24	0.21	0.19	6.8
AVE :	0.58	0.90	1.11	1.30	1.61	1.49	1.20	1.09	0.98	0.87	0.63	0.55	12.3
SD :	0.18	0.36	0.47	0.53	0.67	0.62	0.46	0.45	0.41	0.36	0.22	0.19	3.9

Appendix E12

File : 7C-T.NSI
Units : [Mm3/a]
Descrip. : EWR Requirements for 1925 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1925	1.00	1.19	0.67	4.69	17.16	2.74	5.85	1.86	1.34	1.23	1.12	0.97	39.8
1926	0.97	0.95	0.32	3.26	1.58	0.45	0.60	0.33	0.34	0.27	0.29	0.28	9.6
1927	1.03	1.74	2.82	7.59	30.10	2.21	3.96	1.42	1.16	1.10	1.09	0.95	55.2
1928	0.94	1.20	1.72	4.98	32.37	3.12	6.83	2.17	1.89	1.69	1.12	0.97	59.0
1929	1.00	1.82	6.94	5.42	15.38	3.07	6.82	2.23	1.98	1.75	1.13	0.98	48.5
1930	1.00	1.10	6.99	7.64	12.14	2.81	6.75	2.24	1.98	1.75	1.13	1.00	46.5
1931	1.01	2.20	3.69	2.23	3.14	1.89	3.55	1.33	1.29	1.18	1.05	0.77	23.3
1932	0.86	0.81	2.83	8.21	41.95	2.29	4.25	1.36	1.06	0.91	0.77	0.60	65.9
1933	0.74	4.40	6.91	7.71	42.42	3.06	6.69	2.20	1.96	1.72	1.12	0.97	79.9
1934	1.00	2.87	6.85	5.00	3.86	1.68	2.58	1.03	0.88	0.82	0.73	0.63	27.9
1935	0.81	0.47	0.20	2.31	23.89	3.06	6.60	2.10	1.92	1.73	1.12	0.98	45.2
1936	1.01	2.81	6.74	7.07	55.98	3.20	6.73	2.16	1.87	1.61	1.12	0.97	91.3
1937	0.98	0.92	6.05	5.73	4.62	1.50	6.86	2.24	1.98	1.75	1.13	0.99	34.7
1938	1.03	2.96	6.99	8.21	55.98	3.21	6.90	2.23	1.98	1.75	1.13	1.00	93.4
1939	1.03	4.40	6.98	5.51	9.09	3.06	6.74	2.21	1.98	1.75	1.13	1.00	44.9
1940	1.03	4.40	6.94	5.01	3.12	1.39	5.54	1.96	1.64	1.20	1.10	0.87	34.2
1941	0.90	0.84	6.99	5.78	0.98	3.12	6.76	1.97	1.84	1.67	1.12	0.98	33.0
1942	1.02	1.80	5.87	2.59	1.18	2.59	6.88	2.24	1.98	1.75	1.13	1.00	30.0
1943	1.03	1.69	2.81	2.95	46.57	3.10	6.31	1.96	1.72	1.60	1.12	0.97	71.8
1944	1.03	1.57	1.63	4.20	9.22	2.85	6.25	1.90	1.44	1.16	1.02	0.74	33.0
1945	0.94	1.07	0.74	8.21	44.78	3.01	6.31	2.07	1.84	1.55	1.12	0.95	72.6
1946	0.91	0.86	0.30	0.45	4.31	2.06	3.30	1.27	1.07	1.05	0.94	0.72	17.2
1947	0.85	1.13	6.85	5.14	5.20	3.21	6.90	2.24	1.98	1.73	1.12	0.97	37.3
1948	1.02	1.50	2.64	7.23	17.23	2.27	4.59	1.60	1.62	1.46	1.12	0.97	43.2
1949	0.96	1.17	3.62	3.19	12.33	2.92	6.56	2.19	1.98	1.75	1.13	0.98	38.8
1950	1.00	1.08	6.99	6.19	2.87	2.08	3.99	2.04	1.94	1.71	1.12	0.98	32.0
1951	1.03	1.55	2.00	2.56	1.58	0.58	0.77	0.44	0.46	0.46	0.51	0.43	12.4
1952	0.77	1.12	6.79	7.81	51.82	3.19	6.82	2.23	1.98	1.75	1.13	0.98	86.4
1953	1.00	1.67	4.82	6.62	32.38	2.91	6.25	2.13	1.90	1.69	1.12	0.97	63.5
1954	1.00	1.62	6.75	7.84	55.98	3.21	6.90	2.23	1.98	1.75	1.13	0.98	91.4
1955	1.01	3.06	6.96	5.88	57.98	3.21	6.90	2.21	1.98	1.75	1.13	0.99	93.1
1956	1.02	1.32	3.01	3.26	11.60	2.92	6.46	2.14	1.95	1.75	1.13	1.00	37.6
1957	1.03	1.92	4.22	8.21	55.98	2.93	6.07	1.98	1.71	1.29	1.11	0.97	87.4
1958	1.00	1.30	6.95	6.75	30.22	2.89	5.76	1.65	1.16	1.14	1.09	0.85	60.8
1959	0.91	2.00	6.79	3.70	31.27	2.89	5.84	2.03	1.88	1.70	1.12	0.97	61.1
1960	1.00	3.96	6.99	7.01	45.53	3.15	6.89	2.24	1.98	1.75	1.13	1.00	82.6
1961	1.03	1.34	3.24	2.04	1.50	0.85	1.91	1.05	0.87	0.69	0.50	0.32	15.3
1962	0.54	2.16	6.82	3.78	1.15	0.49	0.71	0.46	0.84	1.13	1.11	0.94	20.1
1963	0.92	0.96	0.58	1.25	1.14	0.46	0.56	0.28	0.27	0.18	0.10	0.06	6.8
1964	0.68	1.13	6.98	7.28	18.91	2.49	4.34	1.38	1.11	1.00	0.87	0.80	47.0
1965	0.92	0.99	0.41	4.79	20.47	2.70	3.37	1.05	0.71	0.51	0.37	0.38	36.7
1966	0.89	1.01	3.56	4.85	34.23	3.05	6.89	2.24	1.98	1.75	1.13	0.98	62.5
1967	1.00	1.81	2.93	0.90	0.90	0.46	1.32	1.03	1.07	1.19	1.11	0.94	14.7
1968	0.92	2.01	6.94	5.93	4.48	3.15	6.88	2.18	1.95	1.72	1.12	0.97	38.3
1969	1.03	2.64	5.53	2.43	2.42	0.90	0.77	0.38	0.40	0.34	0.33	0.28	17.4
1970	0.72	0.84	4.19	6.63	13.30	1.93	5.52	1.99	1.86	1.66	1.12	0.97	40.7
1971	1.01	2.27	4.85	8.21	57.46	3.21	6.90	2.24	1.98	1.75	1.13	0.98	92.0
1972	1.02	1.52	2.44	0.92	0.88	0.50	1.76	1.11	0.91	0.84	0.83	1.00	13.7
1973	1.03	3.13	6.99	8.21	55.98	3.19	6.83	2.23	1.98	1.75	1.13	1.00	93.5
1974	1.03	4.40	6.78	6.51	48.04	3.15	6.60	2.18	1.98	1.75	1.12	0.97	84.5
1975	1.00	1.06	6.98	8.21	50.02	3.20	6.90	2.24	1.98	1.75	1.13	1.00	85.5
1976	1.01	1.88	3.39	7.61	54.64	3.21	6.90	2.24	1.98	1.75	1.13	0.99	86.7
1977	1.03	1.49	6.85	8.21	50.74	3.17	6.88	2.22	1.97	1.73	1.12	0.97	86.4
1978	1.00	1.84	3.58	3.31	3.09	2.02	4.26	1.60	1.49	1.20	1.12	0.97	25.5
1979	1.02	1.68	6.10	5.95	52.72	3.19	6.56	2.13	1.86	1.62	1.12	0.97	84.9
1980	1.02	4.40	6.89	8.21	55.98	3.19	6.83	2.22	1.98	1.74	1.12	0.98	94.5
1981	1.01	3.12	4.33	2.06	1.70	0.61	0.73	0.56	0.76	0.67	0.52	0.41	16.5
1982	0.79	0.83	0.39	0.52	0.59	0.15	0.40	0.17	0.15	0.10	0.09	0.12	4.3
1983	0.54	1.10	0.90	0.68	0.74	0.98	2.27	0.89	0.68	1.15	1.12	0.97	12.0
1984	1.03	4.40	6.64	6.94	42.53	3.06	6.37	2.10	1.95	1.75	1.13	0.99	78.9
1985	1.03	1.63	4.21	1.48	2.11	1.06	6.74	2.24	1.92	1.68	1.12	0.97	26.2
1986	1.00	1.74	5.95	3.04	13.82	2.71	5.65	1.79	1.57	1.24	1.12	0.97	40.6
1987	1.02	1.42	6.99	7.32	50.15	3.21	6.90	2.20	1.94	1.74	1.13	0.99	85.0
1988	1.03	3.96	3.94	1.35	4.85	2.17	2.24	0.75	0.69	0.69	0.73	0.63	23.0
1989	0.95	4.40	6.89	6.13	16.22	2.72	6.03	1.95	1.69	1.24	1.11	0.95	50.3
1990	0.96	1.18	4.93	7.54	39.87	3.11	6.83	2.06	1.76	1.62	1.12	0.97	72.0
1991	0.95	0.97	0.28	0.33	0.47	0.07	0.26	0.06	0.06	0.05	0.04	0.02	3.6
1992	0.24	0.26	5.47	2.25	5.05	2.75	3.25	0.78	0.54	0.44	0.45	0.44	21.9
1993	0.79	1.75	6.83	4.75	3.41	1.48	1.55	0.45	0.39	0.27	0.23	0.21	22.1
1994	0.84	0.88	0.94	1.30	6.40	2.62	4.91	1.73	1.62	1.22	1.11	0.95	24.5
1995	0.95	4.40	6.92	8.02	57.98	3.21	6.73	2.21	1.98	1.75	1.13	1.00	96.3
1996	1.03	2.07	3.87	7.36	42.31	3.19	6.90	2.18	1.87	1.63	1.12	0.97	74.5
1997	1.02	2.92	4.39	7.30	25.64	1.72	1.82	0.47	0.41	0.35	0.52	0.72	47.3
1998	1.00	1.56	6.99	8.20	45.79	3.19	6.89	2.23	1.98	1.75	1.13	1.00	81.7
1999	1.02	2.19	6.85	8.03	57.98	3.21	6.90	2.22	1.96	1.74	1.13	0.98	94.2
2000	1.02	1.59	4.54	1.62	46.23	3.17	6.00	1.88	1.64	1.31	1.12	0.96	71.1
2001	1.00	4.40	6.99	6.57	9.29	1.53	1.86	0.54	0.54	0.56	0.56	0.60	34.5
2002	0.92	0.87	0.31	0.43	0.67	0.20	0.38	0.10	0.11	0.13	0.10	0.12	4.3
2003	0.52	0.61	4.08	1.91	43.08	3.20	6.90	2.23	1.97	1.73	1.12	0.98	68.3
2004	1.00	1.13	5.00	4.04	1.74	0.53	0.78	0.48	0.50	0.36	0.33	0.30	16.2
AVE :	0.94	1.93	4.65	5.01	23.98	2.35	4.95	1.66	1.47	1.30	0.95	0.83	50.0
SD :	0.14	1.15	2.37	2.57	21.38	1.00	2.33	0.70	0.61	0.54	0.32	0.27	28.7