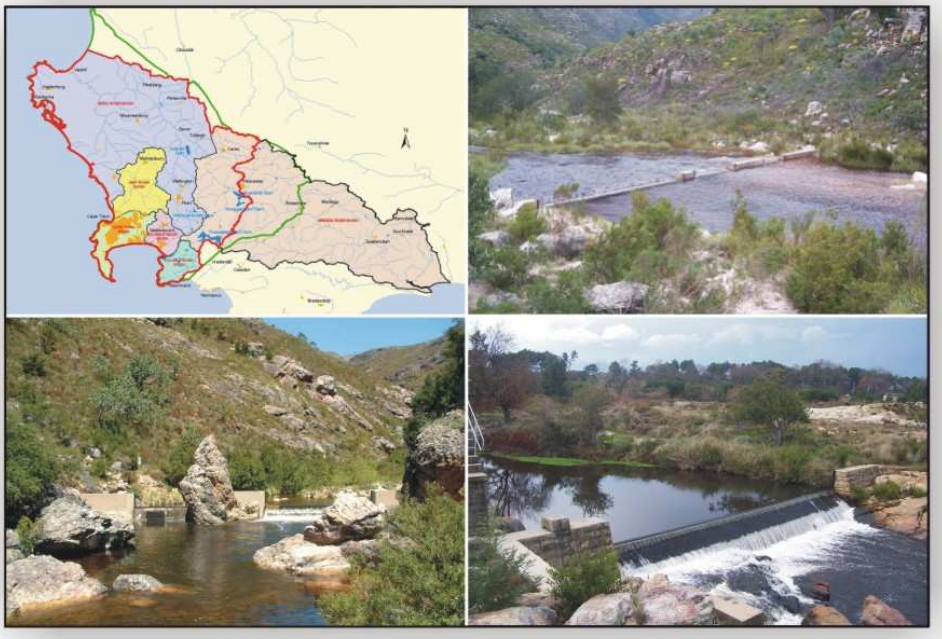
Ref No: P WMA19/000/00/0407

Department of Water Affairs and Forestry

Directorate: National Water Resource Planning

The Assessment of Water Availability in the Berg Catchment (WMA 19) by means of Water Resource Related Models

Report No. 5 : Update of Catchment Hydrology
Volume 2 : Upper Breede River



FINAL **May 2009**

Submitted by:
Ninham Shand (Pty) Ltd
in Association with
Umvoto Africa (Pty) Ltd

NINHAM SHAND
CONSULTING SERVICES

UMVOTO

DEPARTMENT OF
WATER AFFAIRS AND FORESTRY

DEPARTMENT OF WATER AFFAIRS AND FORESTRY

THE ASSESSMENT OF WATER AVAILABILITY IN THE UPPER BREEDE CATCHMENT (WMA 19) BY MEANS OF WATER RESOURCE RELATED MODELS

REPORT No. 5 : UPDATE OF CATCHMENT HYDROLOGY

Volume No. 2 : UPPER BREEDE RIVER

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APPROVAL

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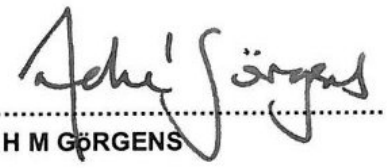

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DEPARTMENT OF WATER AFFAIRS AND FORESTRY
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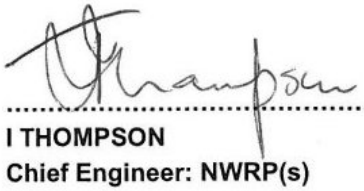

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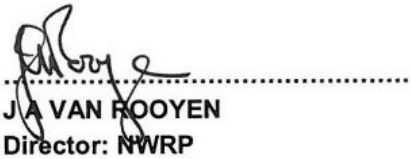

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J A VAN ROOYEN
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REPORT No	REPORT TITLE	VOLUME No.	VOLUME TITLE
1	Final Summary Report		
2	Rainfall Data Preparation and MAP Surface		
3	The Assessment of Flow Gauging Stations		
4	Land Use and Water Requirements	Vol 1	Data in Support of Catchment Modelling
		Vol 2	Invasive Alien Plant Mapping
		Vol 3	Water Use and Water Requirements
5	Update of Catchment Hydrology	Vol 1	Berg River
		Vol 2	Upper Breede River
		Vol 3	Peripheral Rivers
6	Water Quality	Vol 1	A Literature Review of Water Quality Related Studies in the Berg WMA, 1994 - 2006
		Vol 2	Updating of the ACRU Salinity Model for the Berg River
		Vol 3	Update Monthly FLOSAL Model to WQT
7	(Report No Not Used)		
8	System Analysis Status Report		
9	Groundwater Model	Vol 1	Overview of Methodology and Results
		Vol 2	Data Availability and Evaluation
		Vol 3	Regional Conceptual Model
		Vol 4	Regional Water Balance Model
		Vol 5	Cape Flats Aquifer Model
		Vol 6	Langebaan Road and Elandsfontein Aquifer System Model
		Vol 7	TMG Aquifer, Piketberg Model
		Vol 8	TMG Aquifer, Witzenberg – Nuy Model
		Vol 9	Breede River Alluvium Aquifer Model
10	Berg and Mhlathuze Assessment Studies (Refer to Report No.1)		
11	Applicability of the Sami Groundwater Model to the Berg WAAS Area		

THE ASSESSMENT OF WATER AVAILABILITY IN THE UPPER BREEDE CATCHMENT (WMA 19) BY MEANS OF WATER RESOURCE RELATED MODELS

REPORT No. 5 : UPDATE OF CATCHMENT HYDROLOGY

Volume No. 2 : Upper Breede River

EXECUTIVE SUMMARY

INTRODUCTION

The objective of the catchment hydrology task for the Berg WAAS is to present updated hydrology for subcatchments in the study area in order to support the determination of allocable water quantification, as well as to provide model-based assessment of water resource augmentation options in support of the Western Cape Reconciliation Strategy Study. Monthly simulated runoff sequences are produced which are used in the system yield analyses relating to present and future land-use development scenarios and scheme development options.

GENERAL APPROACH

The hydrology of previous studies, the Breede River Basin Study (BRBS) (DWAF, 2002) was evaluated and updated where necessary by re-configuring and re-calibrating the existing catchment model with present-day land and water use. This report presents the tasks relating to the catchment modelling of the Upper Breede River to Brandvlei Dam at flow gauge H4H006. The general approach followed in order to generate monthly flow sequences is outlined as follows:

- Capturing and processing spatial data for use in the Pitman model including rainfall, evaporation, irrigated areas and crop types, afforested areas and alien vegetation areas, water demands, abstractions and return flows, transfers and farm dam information.
- Subcatchment configuration informed by previous studies and availability of spatial data and observed flow gauge data.
- Calibration of the Pitman model in WRSM2000.
- Produce long-term naturalised flow sequences.

RESULTS

A summary of the calibration results for the Upper Breede River subcatchments is shown in Table 1.1 and the final Pitman parameters for each subcatchment are presented in Table 1.2. An acceptable calibration at flow gauge H4H006 was not possible due to the low accuracy rating of the flow gauge at this location. Therefore, the final Pitman parameters from the BRBS for catchment H4H017 were transferred to this catchment in order to generate naturalised and present-day flows for the WRYM.

The calibrated flows are based on longer flow records, wherever possible, than in previous studies and the naturalised flows (1927-2004) for the Upper Breede River subcatchments compare reasonably well (within about 10% of the BRBS figures) for subcatchments H1H006, H1H007 and H1H013. The

incremental naturalised flows in subcatchments H1H003 and H1H018 are considerably lower than in the previous study, and there are no comparable flows for the rest of the catchment to H4H006.

Table 1.1: Summary of the Upper Breede River subcatchment calibration results

FLOW GAUGE	MAP (mm)	CATCHMENT AREA (km^2)	PATCHED OBSERVED MAR (Mm^3/A)	CALIBRATION PERIOD	NATURALISED MAR (Mm^3/A) 1927-2004	NATURALISED RUNOFF COEFFICIENT
H1H003	732	592.3	63.5	1964 - 2004	81.8	19%
H1H006	2300	96.5	136.4	1964 - 2004	150.2	68%
H1H007	2080	85.5	126.8	1961 - 2004	131.7	74%
H1H012	1187	151.8	71.9	1963 - 1974	98.8	55%
H1H013	1042	53	22.6	1964 - 1997	34.2	62%
H1H018	1945	44.3	68.6	1991 - 2004	62.4	72%
H1H033	1945	68.4	97.5	1991 - 2004	86.8	65%
H4H006	863	875.4	62.8	1980 – 1989	215.0	26%

Table 1.2: Summary of the Upper Breede River final Pitman parameters

FLOW GAUGE	POW	SL	ST	FT	GW	ZMIN	ZMAX	PI	TL	GL	R
H1H003	2	0	650	21	0	0	550	1.5	0.25	0	0
H1H006	2	0	200	50	0	100	400	1.5	0.25	0	0
H1H007	2	0	150	90	0	0	250	0	0.2	0	0
H1H012	2	0	400	80	0	0	400	1.5	0	0	0
H1H013	2	0	100	55	0	0	200	1.5	0.99	0	0
H1H018	2	0	250	50	0	0	200	1.5	0.5	0	0
H1H033	2	0	250	20	0	0	300	1.5	0	0	0
H4H006*	2	0	300	4	0	100	900	1.5	0	0	0

* Parameters transferred from H4H017 in BRBS

CONCLUSIONS AND RECOMMENDATIONS

The key objective of this task was to extend the naturalisation of streamflow to the 2004 hydrological year, which has been achieved. Rainfall data is one of the most important data requirements for hydrological modelling. The rainfall surface was updated as a separate task in the Berg WAAS and it provides an improved estimation of catchment MAP in high-lying, mountainous areas of the Western Cape. There is however still some uncertainty surrounding estimations of MAP in these areas and therefore, it is important the rainfall gauging network in the high mountains be extended and improved in order to provide better estimates for the future, especially in light of the need to properly monitor the effects of climate change.

THE ASSESSMENT OF WATER AVAILABILITY IN THE UPPER BREEDE CATCHMENT (WMA 19) BY MEANS OF WATER RESOURCE RELATED MODELS

REPORT No. 5 : UPDATE OF CATCHMENT HYDROLOGY

Volume No. 2 : Upper Breede River

TABLE OF CONTENTS

Page No.

APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

BRBS	Breede River Basin Study
BRHS	Breede River Hydrological Study
CCWR	Computing Centre for Water Research
CSIR	Council for Scientific and industrial Research
DT	Discharge Table
DWAF	Department of Water Affairs and Forestry
GIS	Geographical Information System
GRDM	Groundwater Resource Directed Measures
IAP	Invasive Alien Plant
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
SD	Standard Deviation
SDFS	Skuifraam Dam Feasibility Study
SI	Seasonal Index
TMG	Table Mountain Group
VAFS	Voëlvlei Augmentation Feasibility Study
WAAS	Water Availability Assessment Study
WARMS	Water Use Authorisation and Registration Management System
WCRO	Western Cape Regional Office (DWAF)
WCSA	Western Cape System Analysis
WCWSS	Western Cape Water Supply System
WMA	Water Management Area
WRC	Water Research Commission
WRPM	Water Resources Planning Model
WRYM	Water Resources Yield Model

1 INTRODUCTION

This report documents the updated hydrological information for the Upper Breede River catchment which forms part of the study entitled *The Assessment of Water Availability in the Berg River Catchment (WMA19) by means of Water Resources Related Models*, (hereafter referred to as the Berg WAAS) commissioned by the Department of Water Affairs and Forestry (DWAF). The WRSM2000 model (Pitman *et al*, 2007) was configured and calibrated for this purpose. This study has been commissioned to assist in the determination of allocable water quantification as a prerequisite for compulsory licensing, and to provide model-based assessment of water resource augmentation options in support of the Western Cape Reconciliation Strategy Study.

Previous monthly hydrological modelling studies of the Upper Breede River include the *Breede River Hydrological Study* (DWAF, 1995) and more recently the *Breede River Basin Study* (DWAF, 2002). Both studies focussed on the water resource modelling of the Breede River as a whole and were a useful source of information. Further data on present-day water use was obtained from the *Breede Valley Municipality Bulk Water Supply Master Plan* (NS, 2007).

In accordance with the terms of reference (DWAF, 2005), the aforementioned studies were reviewed to acquire the datasets and relevant model configurations which will be used as basis for the development of the final network diagrams of the system and to redefine the catchments on a finer spatial scale where required. As with previous studies, particular attention will be given to the following issues:

- Growth in farm dam numbers over time,
- Winter runoff storage in farm dams with increasing capacity over time,
- Runoff from increasing farm dam sub-catchment areas as a result of increasing numbers,
- River abstractions for the purpose of topping-up farm dams in winter,
- Simulation of low flows.

The catchment area configured during this study extends from the Ceres valley to the town of Worcester (flow gauge H4H006). A map of the calibration catchments in the Upper Breede River is shown in Figure 1.1**.**

1.1 Aims and objectives

The overarching objective of this component of the study was to extend the naturalisation of streamflow forward to the 2004 hydrological year to capture the significant droughts of the past decade. Specific aims to meet this objective were as follows:

- To improve calibration of the WRSM2000 model at a number of gauging stations where the original calibration periods were relatively short and to update existing model calibrations at the rest of the gauging stations.
- To reflect improved quantification of the impacts of farm dams, winter abstractions and groundwater use on the historical streamflows.
- To improve the representation of groundwater contributions to streamflow in the monthly modelling process.

1.2 Report layout

This report will start with a brief description of the catchment which will be followed by the modelling strategy and procedure. Finally, the flow calibration results and naturalised flows will be presented.

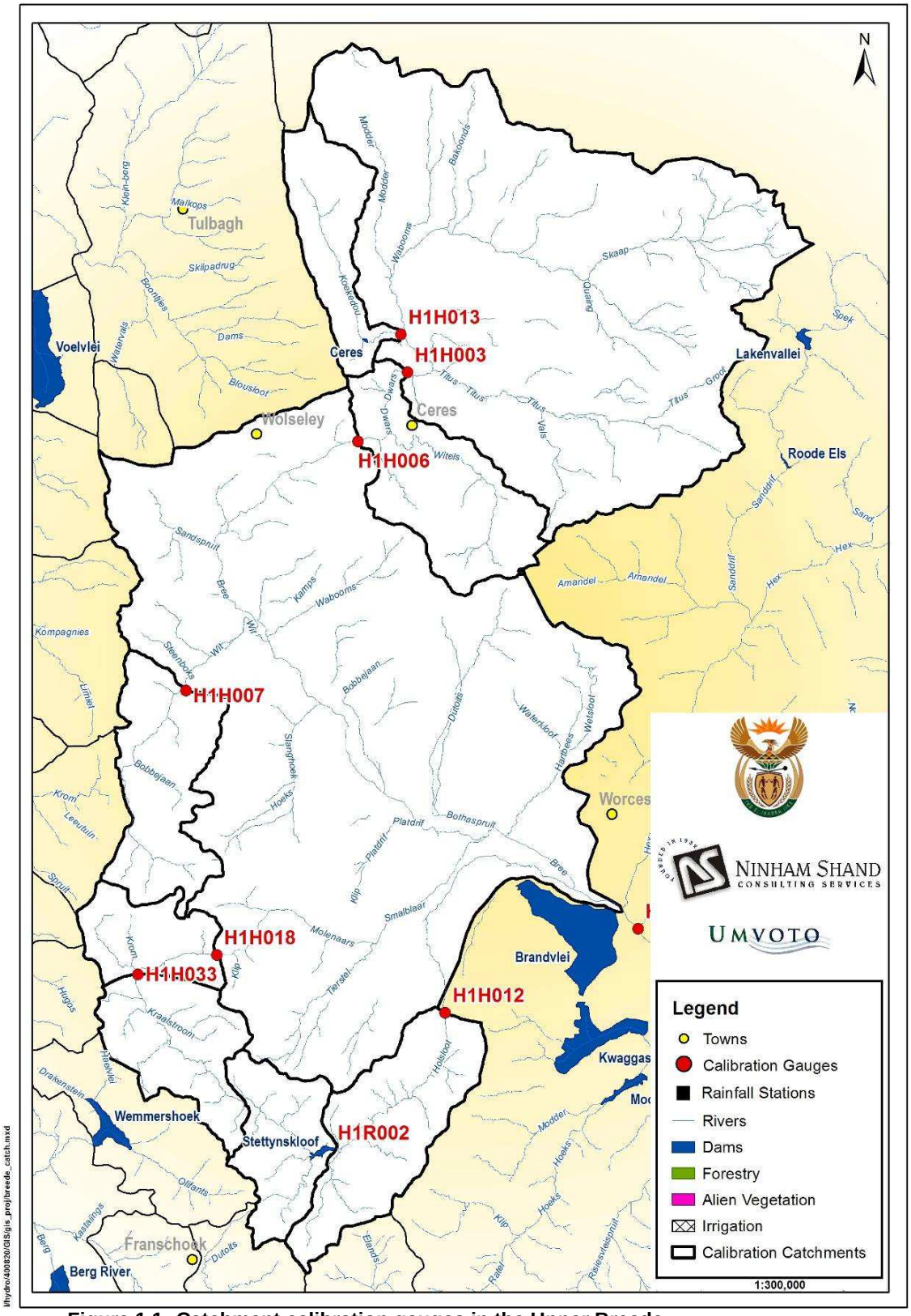


Figure 1.1: Catchment calibration gauges in the Upper Breede

2 CATCHMENT DESCRIPTION

2.1 Location

The Upper Breede catchment is situated in the Western Cape and the part of the catchment of interest lies between latitude 33°10' and 33°55' south and longitude 19°04' and 19°35' east. The river has its headwaters in the Du Toits, Slanghoek and Hexrivier mountains. The rivers from these various sources then merge in the Worcester valley and flows east past the Brandvlei Dam. The major tributaries are the Dwars, Wit, Molenaars, Holsloot, Du Toits and Hartbees rivers. The catchment area of the Upper Breede covered in this study is almost 3000 km^2.

2.2 Drainage, topography and land-use

The Breede River Basin consists of high mountainous regions on its northern, western and southern boundaries. These regions coincide with the catchment's highest rainfall zones. The central part of the catchment comprises a wide, flat alluvial floodplain.

Whilst the upper regions are relatively undeveloped, the floodplains are heavily irrigated, the most notable of which are the Worcester and Ceres valleys. These regions respectively focus on vineyards and orchards. There is little forestry in the catchment and due to the efforts of Working for Water, alien vegetation has been reduced to isolated patches along certain rivers.

Details of land use in the Berg River catchment is documented in a separate report entitled *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Report 4 (Land Use and Water Requirements): Volume 1 (Data in Support of Catchment Modelling)* (DWAF, 2007d). This report presents historical and present-day land use data in the Berg WAAS surface water area. Monthly records of localised water use and return flows as well as inter-basin transfers and diversions are also presented along with spatial data in the form of GIS coverages of all present-day land use.

2.3 Climate

The study area falls in the winter rainfall region of the Western Cape. Rainfall is highly seasonal with some 80% of the annual precipitation falling between April and September. Rainfall is also highly variable within the catchment, mainly due to variations in altitude.

Annual rainfall ranges from 2800 mm in the mountains to around 500 mm in the alluvial valleys. The inaccessibility of mountainous areas, however, contributes to the uncertainty in the estimation of the rainfall depth in those higher lying areas and as a result, an updated rainfall surface was prepared for these areas. The CCWR rainfall surface used in previous studies was updated to better account for the topographic effects of the mountainous regions on rainfall. Anomalies which were observed in the original surface generated by the CCWR were considered serious enough to potentially have a significant impact on the modelled streamflow. The specific reasons for the occurrence of these anomalies and the techniques used to accommodate them are explained in the report entitled *Rainfall Data Preparation and MAP Surface* (DWAF, 2007b).

The updated MAP surface for the Berg WAAS area is shown in Figure 2.1. As may be expected for a semi-arid region, the evaporation rates are significant during the summer months. Typically the monthly evaporation ranges from 40-50 mm during winter to 230-250 mm during summer.

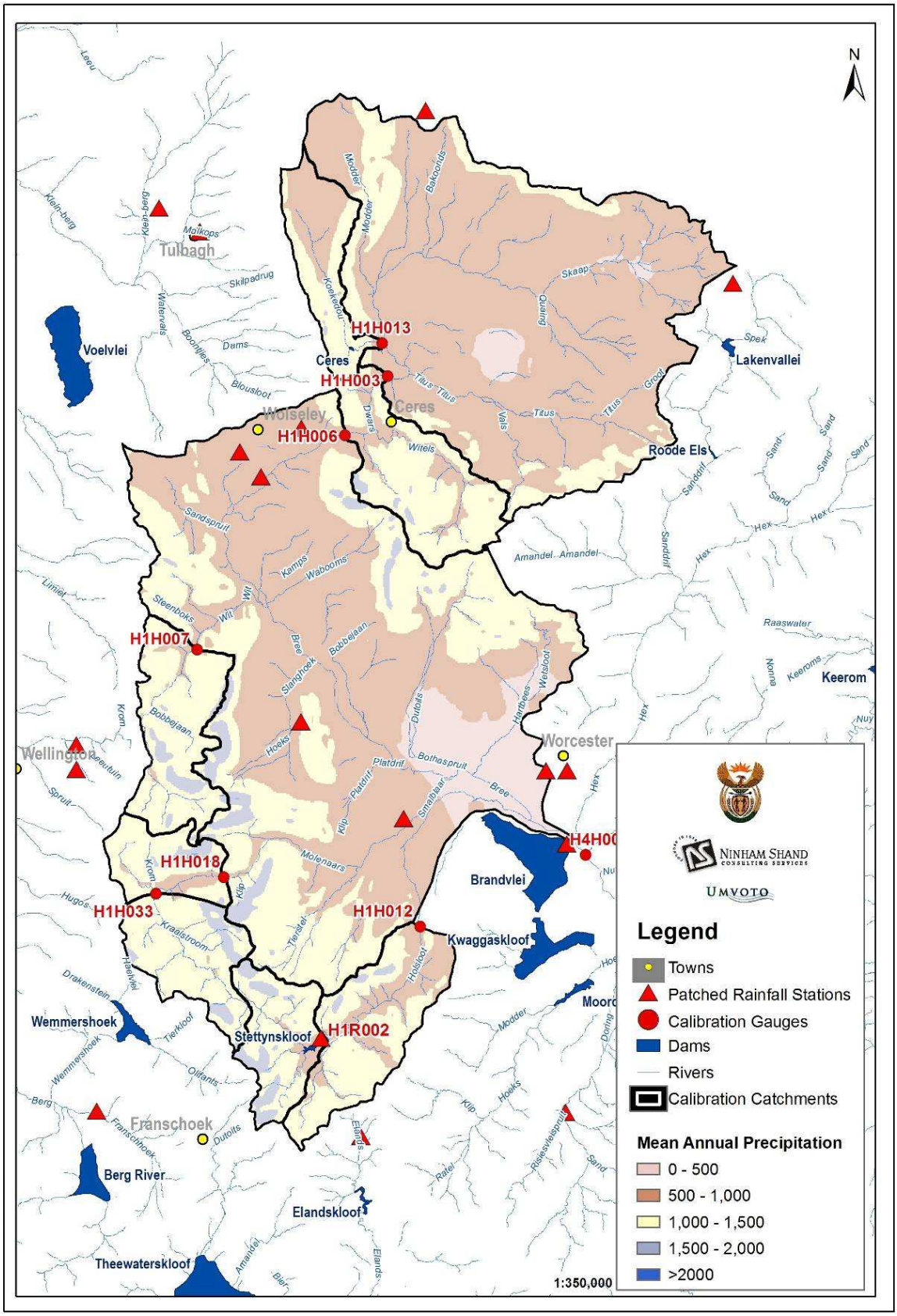


Figure 2.1: Updated rainfall surface produced for the Upper Breede catchment

3 MODELLING STRATEGY

The approach to modelling the streamflow in the Upper Breede River catchment was to:

i) Select appropriate streamflow gauging stations based on pre-determined quality criteria and then to calibrate the monthly rainfall-runoff model such that a representative streamflow time series is simulated at these gauges when compared to the observed streamflow. Suitably defined objective functions are used to quantify the goodness-of-fit between the simulated and observed records
ii) Prepare long-term flow sequences for the natural scenario.

3.1 Requirements for modelling developed catchments

To ensure realistic simulation of streamflow within a developed catchment such as the Berg, several development-related aspects need to be quantified beforehand. These aspects typically include:

- The volume of rainfall which could potentially be intercepted and the volume of soil water which is directly evaporated or which is lost through transpiration by natural or cultivated vegetation.
- The volume of water abstracted from the river or reservoirs to meet the irrigation or urban demands
- The volume of water captured by storages such as farm dams or large reservoirs.
- The volume of supplementary water used to fill up farm dams during winter.
- The volume of water transferred during inter-basin transfers.

All the aspects mentioned above were quantified before the modelling exercise and are summarised in the report entitled *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Land Use and Water Requirements: Data in Support of Catchment Modelling* (DWAF, 2007d).

For this study the recently-updated Water Resource Simulation Model (WRSM2000) (Pitman *et al*, 2007) was used. The model (previously called WRSM90) has had several enhancements including the incorporation of the Council for Scientific and Industrial Research (CSIR) algorithms for the streamflow reduction effects of alien vegetation, inclusion of the CSIR and Smoothed Gush/Pitman algorithms for the streamflow reduction effects of afforestation, incorporation of the WQT methodology for the irrigation modules, and the introduction of an additional surface water-groundwater interaction module and accompanying interface (Sami and Hughes methodology).

WRSM2000 operates on the network principle which allows water to be transferred from one module to the next depending on the user-specified configuration for the system. The modules currently available in WRSM2000 are the:

- runoff module (RU) (for surface water and groundwater routines)
- channel reach module (CR)
- reservoir module (RV)
- irrigation block module (RR)
- mine module (MM).

3.2 Modelling dynamic time varying catchments

The calibration process of the rainfall-runoff model at any particular flow gauging station could span a significant number of years during which the development in the catchment upstream of the gauge may have changed. To account for this change in development (e.g. farm dams, irrigation, afforested or alien vegetation areas), a geographical information system (GIS) was used to extract information at various time slices from aerial photographs. This information was then used to represent the dynamic nature of development within the catchment which could be used for the hydrological modelling process. The WRSM2000 model used in this study allows for the input of time-varying data (time slices) for the different land use classes resulting in the production of more representative simulated streamflows.

3.3 Modelling incremental sub-catchments

Incremental subcatchments are defined as catchments which are downstream of one or more flow gauging stations. By way of example, gauging station H4H006 measures the total flow generated in the catchment upstream of this gauge. Runoff from incremental subcatchment H4H006 (H4H006inc), however, would be obtained by subtracting all the upstream observed inflows from the observed flows at gauging station H4H006. In the example the upstream observed flows to be subtracted from the observed flows at H4H006 would be H1H006, H1H007, H1H012 and H1H018 resulting in an incremental observed flow record at H4H006.

Cumulative calibration of the flows at gauging station H4H006 could also be undertaken. This would involve accounting for all the upstream inflows (i.e. G1H007 H1H006, H1H007, H1H012 and H1H018) and comparing the cumulative runoff measured at H4H006. In the example the observed flows generated upstream of H1H018 may be significantly more than flow generated between gauging station H1H018 and H4H006 with the result that the flow-related Pitman parameters may become insensitive to adjustments of their values in this part of the catchment. Thus, the final parameters may not be representative of the incremental catchment.

With the implementation of the incremental calibration strategy the upstream inflows are subtracted from the flows at the gauging station of interest (H4H006 in the example) and negative flows may occur in the incremental observed record. This may be as a result of abstractions (irrigation or other), unaccounted for seepage, alluvial recharge or inaccuracies in the measured flows (DWAF, 1993). These negative flows are set to zero when preparing the final incremental observed record. If the number of zero values is significant, the incremental observed record may become unusable and the incremental calibration case would have to be abandoned for this subcatchment. This restriction is, however, more applicable to the daily modelling rather than the monthly case.

3.4 Representation of groundwater contributions to streamflow

The Berg WAAS team conducted a pilot investigation into the applicability of the explicit groundwater module in the WRSM2000 model for Western Cape catchments (DWAF, 2007a). Our conclusion was that it would be preferable to account for groundwater contributions to streamflow in an explicit empirical fashion in the WRSM2000 model and not to implement the Sami or Hughes methodology. This approach is described in Section 4.8.2.

4 MODELLING PROCEDURE

4.1 Evaluation of flow records

An evaluation of flow records within the Berg WAAS area was undertaken as a separate task and the reader is referred to *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models. Report No. 3 : The Assessment of Flow Gauging Stations* (DWAF, 2007c). The evaluation focused particularly on the gauges that were used for flow calibration during previous studies and those which have been opened subsequent to the last study. During this process the historical background to the gauge together with the availability of data was presented. Based on this information it was possible to quantify the number of days within each month when the discharge table was exceeded and the number of days when there were missing data. A recommendation was then made on whether the data measured at the gauging station was suitable for use in calibration of the model. The final flow gauges used for calibration in the Upper Breede catchment are shown in Table 4.1.

Observed flow records were obtained from the DWAF website (www.dwaf.gov.za\Hydrology) and flow records for each calibration gauge were patched using the PatchS methodology shown in Figure 4.1. For each flow gauge, the observed daily record was analysed for missing data and for a data gap of three days or more, the data was flagged as missing. For data gaps of less than three days, values were patched manually using linear interpolation. The daily record was then aggregated into a monthly record and checked against the monthly exceedence estimates provided by DWAF (E. Holemans, pers com 2006). The observed values that were flagged as exceeded were replaced with the DWAF estimate and their flags removed. The resultant manually patched file was used as input to the PatchS routine. Two or three representative flow gauges were grouped together for patching each other as well as their associated patched rainfall files which were used to generate catchment rainfall. The patched flow records for each calibration catchment are included in Appendix C.

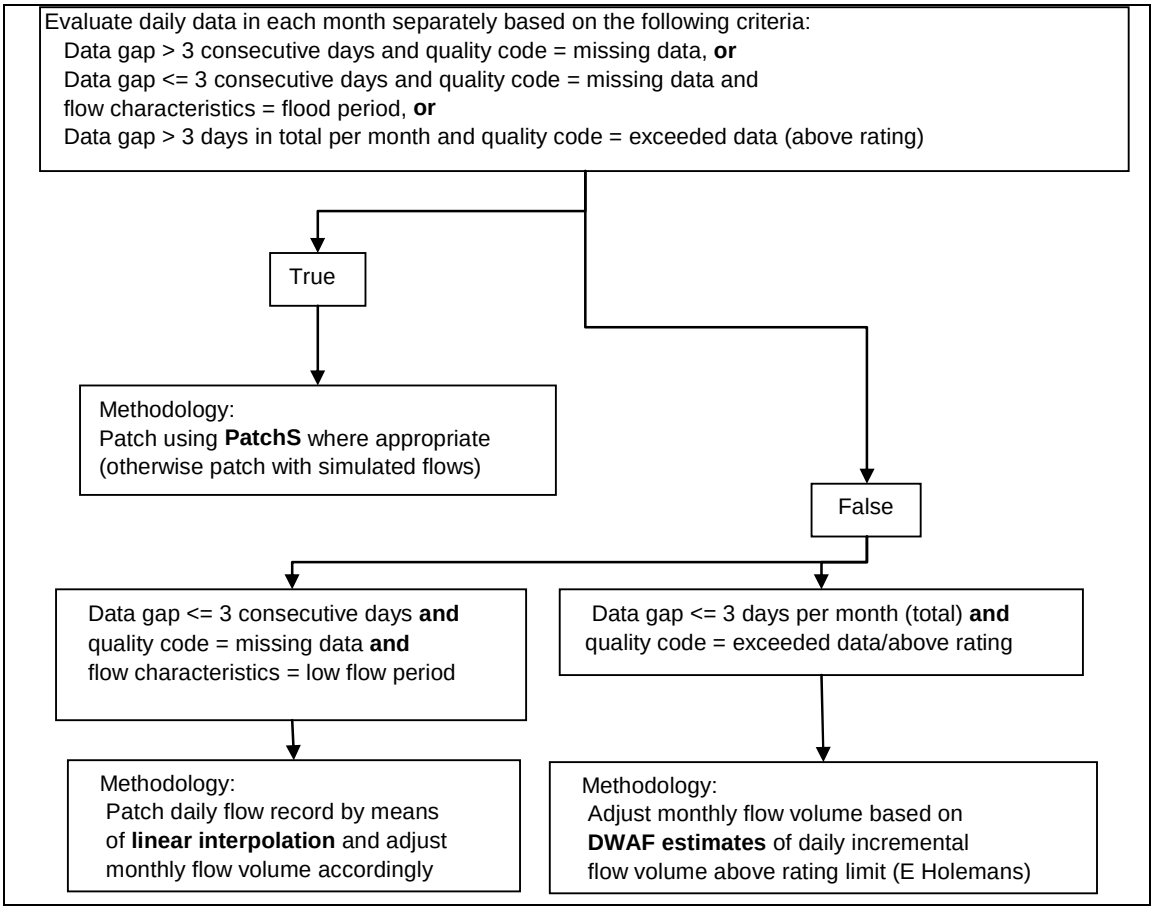


Figure 4.1: PatchS methodology

Table 4.1: List of final calibration gauges in the Upper Breede catchment

STATION	RIVER	PLACE OR DESCRIPTION	LATITUDE	LONGITUDE	CATCHMENT AREA (km^2)	DATE OPENED	DATE RECORDER INSTALLED	DATE CLOSED	RECORD PERIOD HYDROLOGICAL YEARS	STATION INSPECTED DURING WAAS
H1H003	Breede	Ceres Toeken Geb.	33 22' 50"	19 18' 06"	657	22/02/23	17/05/62	-	1923 – 2004	Yes
H1H006	Breede	Ceres Toeken Geb.	33 25' 18"	19 16' 02"	753	16/04/50	17/05/62	-	1950 – 2004	Yes
H1H007	Wit	Drosterkloof	33 34' 07"	19 08' 42"	84	10/04/50	17/05/62	-	1949 – 2004	Yes
H1H012	Holsloot	Daschbosch	33 45' 24"	19 19' 50"	146	16/03/63	16/03/63	18/04/86	1963 – 1986	
H1H013	Koekedouw	Ceres	33 21' 35"	19 17' 54"	53	24/02/65	24/02/65	-	1965 – 2004	
H1H018	Molenaars	Hawequas Forest Res.	33 43' 29"	19 10' 11"	113	26/02/69	26/02/69	-	1969 – 2004	
H1H033	Elands	Hawequas Forest Res	33 44' 12"	19 06' 53"	62	29/04/91	29/04/91	-	1991- 2005	

4.2 Evaluation of rainfall records

The generation of representative streamflow data requires reliable monthly rainfall records. In this study the Water Resources Information Management System (WR-IMS) (developed by the DWAF) which contains data for 12 748 rainfall stations in Southern Africa was used as the interface for selection of the appropriate rainfall stations. The ClassR and PatchR utilities which allow for the identification of outliers and appropriate groupings of source rainfall gauges in order to patch the missing records of selected rainfall gauges are also included as part of the interface. For a full description of the rainfall station selection, evaluation and patching processes, the reader is referred to *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models. Report No. 2 : Rainfall Data Preparation and MAP Surface* (DWAF, 2007b).

Catchment rainfall files were generated for each calibration catchment using patched rainfall station files, based on the groupings of rainfall stations used in the BRBS (DWAF, 2002) and updated where necessary. These groupings are presented in Section 5 for each calibration catchment and the catchment rainfall files are included in Appendix B.

4.3 Evaporation

S-pan evaporation values from the WR90 study were used in this project.

4.4 Land-use data and water demand sequences

For a full description of the land use survey undertaken the reader is referred to the report entitled *The Assessment of Water* Availability *in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Report 4 (Land Use and Water Requirements): Volume 1 (Data in Support of Catchment Modelling)* (DWAF, 2007d). This report presents historical and present-day land use data in the Berg WAAS surface water area. Monthly records of localised water use and return flows as well as inter-basin transfers and diversions are also presented along with spatial data in the form of GIS coverages of all present-day land use.

4.4.1 Irrigation demands

A total area of approximately 206 km^2 in the Upper Breede River catchment is irrigated, comprising orchards (apples, apricots, nectarines, peaches, pears, and plums), table grapes and vineyards for wine production. Dryland agriculture makes up for the remaining cultivated area. In the WRSM2000 model, the WQT methodology is used to estimate the irrigation demands in the Upper Breede River catchment allowing for the calculation of return flows which takes into account rainfall on irrigation areas.

In certain catchments it was found that the irrigation return flows were much larger than the irrigation demand. This is due to the Pitman parameters having an effect on the groundwater storage of each irrigated field. Care was thus taken to adjust the irrigation return flow parameters to eliminate these large return flows.

4.4.2 Forestry demands

Almost no forestry occurs in the catchment. Besides scattered pockets of trees the largest area under commercial forestry is found in the upper reaches of the H4H006 subcatchment and amounts to 7 km^2. There are no significant areas of indigenous forest in the Upper Breede

River catchment. In the WRSM2000 model, forestry is modelled as a Streamflow Reduction Activity using the Smoothed Gush/Pitman algorithms.

4.4.3 Alien vegetation demands

The present-day extent of invasive alien plants (IAPs) in the Upper Breede River catchment was updated based on the 2004 1:10 000 aerial photography supplied by DWAF. Species, density, age and size of IAPs were estimated as well as whether they were located in riparian or upland areas. There is approximately 20 km^2 (condensed area which is equivalent to 100% density) IAPs in the Upper Breede River catchment which is located primarily in the riparian areas. In the WRSM2000 model, IAPs are modelled as a Streamflow Reduction Activity using the CSIR methodology.

4.4.4 Urban demands and other users

Local municipal and irrigation abstractions, and return flows were obtained from local sources including municipalities, irrigation boards and Water Users Associations (WUAs). Municipal abstractions in the Upper Breede River catchment are included for Ceres, Worcester, Wolseley and Rawsonville. Irrigation abstractions made by irrigation boards or schemes are included for the Warmbokkeveld, Rooikloof, Rietvlei, Koekedouw, Wolseley and the Gawie se Water diversion. Return flows from the Ceres Power Station are also included.

4.5 Farm dam data

Information on farm dams was obtained by digitising the farm dam areas from the 2004 1: 10 000 aerial photography supplied by DWAF and then verifying it against the most recent 1: 50 000 topographical maps. The area-capacity relationship was based on the power curve regression shown below:

$$Area = A \times Capacity^{B}$$

During the WCSA study, an extensive evaluation was undertaken to determine the values of the A and B coefficients for the dummy dams and these coefficients have been accepted for the purposes of this study. Based on the aforementioned procedure, a total farm dam volume of 73 Mm^3 was estimated for the Upper Breede River catchment.

4.6 Winter filling of farm dams

Irrigation in the Upper Breede River is normally dependent on farm dams and it is unlikely that irrigators would not fill their farm dams with direct abstractions from nearby rivers during winter. Based on this assumption, a method for calculating the probable winter transfer volumes was implemented. This method was based on the one used in the WCSA and involved the following steps:

- Preliminary hydrological sub-system simulation and calibration without consideration of winter filling of farm dams.
- Analysis of simulated farm dam volume trajectories in each calibration catchment over the winter months (May to September) and the subsequent calculation of abstraction volumes required to fill the farm dams to their full supply capacities.
- Preparation of river flow abstraction time series for farm dam filling.
- Final calibration of the Pitman model parameters considering the effects of the winter abstractions to fill farm dams.

4.7 Subcatchment configuration in the WRSM2000 model

Each of the 8 calibration catchments in the Upper Breede catchment was configured in the WRSM2000 model. Each subcatchment has the same basic structure consisting of modules linked together to form a network, comprising *inter alia* a runoff-producing module, channels, farm dams and irrigation modules. Irrigation areas and farm dam areas are lumped together to make up one representative module in each network. Afforestation and alien vegetation areas are included in the runoff module as a streamflow reduction activity. Rainfall and evaporation inputs are included in each module and values for the Pitman calibration parameters are input to the runoff module.

4.8 Calibration of the Pitman model

During the calibration process the main aim is to produce monthly simulated flow records which are representative of the observed flow records. Quantification of this goodness-of-fit is then based on the calculation of a set of pre-defined Objective Functions for the simulated record for comparison with those calculated for the observed flow record. For this study the objective functions are as defined in Table 4.2.

Table 4.2: Objective functions used for Pitman calibrations

Objective Function	Limit of acceptability
Mean annual runoff (MAR)	< 4%
Standard deviation (SD) of annual flows	< 6%
Mean log annual runoff	< 4%
Standard deviation of logs of annual flows	<6%
Time series	As similar as possible
Seasonal distribution	As similar as possible
Storage vs. yield	As similar as possible

4.8.1 Definition of Pitman parameters

Table 4.3 lists a brief description of the Pitman parameters that are available for calibration as well as the relative effects that the adjustment of the parameter would have on the simulated runoff.

Table 4.3: Description of Pitman parameters and predicted effects of parameter adjustments on simulated flows

Pitman Parameters		Effect on simulated flow of increasing parameter		
Name	**Description**	**MAR**	**SD**	**SI**
Zmin	Minimum absorption rate (mm/month)	Down	Up*	Up*
Zmax	Maximum absorption rate (mm/month)	Down	Down*	Down*
POW	Power of the runoff vs. soil moisture capacity	Down	Up	Up
TL	Time lag of Runoff (months)	None	None	Down
ST	Maximum soil moisture capacity (mm)	Down	Down	Down
FT	Runoff rate from soil when soil moisture is at full capacity (mm/month)	Up	Down	Down
R	Controls rate at which evaporation reduces as soil moisture is depleted (Coefficient in the evaporation-soil moisture equation)	Up		Down
GW	Maximum groundwater runoff (mm/month)	None	Down	Down
GL	Lag of subsurface flow in the lower zone (months)	None	Down	Down
SL	Soil moisture state below which no runoff occurs (mm)	Down	Up	Up
PI	Interception storage (mm)	Down	Up	Up

*Effect uncertain when Zmin and Zmax are used in conjunction with a non-zero value of FT

4.8.2 Pitman calibration process

The procedure used for calibrating the simulated flows in the Pitman model was as follows:

i) Pitman parameters from the Breede River Basin Study (BRBS) or the Breede River Hydrological Study (BRHS) were used as the starting Pitman parameter set and the simulated runoff was then compared to the observed flows based on the goodness-of-fit criteria listed in Table 4.2.

ii) Once a preliminary calibration was obtained, the irrigation areas in each calibration catchment were reduced by a percentage based on the proportion of the demand satisfied by groundwater in that catchment. Groundwater use in each catchment is provided by the WARMS database and described in DWAF (2007d).

iii) Following the adjustment for groundwater use in the catchment, a defined inflow representing the groundwater baseflow component was added to the catchment flows. This inflow was obtained from the GRDM on a quaternary catchment scale as an annual average value. This annual value is input to the model in 12 equal portions. These GRDM inflows were adjusted proportionally for calibration catchment areas. The effect of this approach is that the Pitman parameters are devoid of the influence of long-term groundwater contributions from the large aquifers, such as the Table Mountain Group (TMG).

iv) The final addition to the calibration networks was the input of volumes required to fill the farm dams in winter as described in Section 4.6.

v) The Pitman parameters were then adjusted slightly in order to obtain the final calibration that is presented in Section 5.

4.9 Naturalised runoff sequences

A subcatchment configuration in which the Pitman parameters have been calibrated enables the production of naturalised flows from the catchment at the calibration gauge for the period

1927 – 2004, assuming all demands on the system are ignored. Naturalised flows for each calibration subcatchment in the Upper Breede catchment are included in Appendix D.

The observed flow record is naturalised by adding back the simulated demands and abstractions that were met in the simulation for the period of observed flow record. These include:

- Irrigation demand met by farm dams,
- Evaporation from farm dams,
- Irrigation demands met from run-of-river abstractions,
- Abstraction (urban and other specified flows),
- Afforestation and IAP streamflow reductions,
- Appropriate adjustments for inter-basin transfers.

5 CALIBRATION RESULTS AND DISCUSSION

5.1 H1H003: Breede River at Ceres Toeken Geb

5.1.1 Subcatchment data

For a detailed assessment of land and water use in subcatchment H1H003, the reader is referred to a separate report entitled *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of* Water *Resource Related Models: Report 4 (Land Use and Water Requirements): Volume 1 (Data in Support of Catchment Modelling)* (DWAF, 2007d). Table 5.1 presents a summary of the catchment data for the subcatchment H1H003. Catchment hydrological information for H1H003 is summarised in the Appendices (Table 5.2). Figure 5.1 shows detailed maps of the catchment.

Table 5.1: Summary of information for H1H003

H1H003	HIGH MAP	LOW MAP
Subcatchment area from GIS, km^2	53.4	538.9
Above farm dams	5.0	438.6
Below farm dams	48.4	97.0
Forestry area, km^2	-	1.4
Alien vegetation condensed area, km^2	-	1.9
Irrigation area, km^2 *	-	53.9
Agtertuin catchment: from farm dams	-	3.5
Agtertuin catchment: from river	-	24.4
H1H003(inc) catchment: from farm dams	-	23.5
H1H003(inc) catchment: from river	-	2.5
Farm dams: Area, km^2 / Volume, Mm^3	0.2 / 0.7	13.2 / 30.8
Agtertuin catchment	0.2 / 0.7	2.6 / 6.6
H1H003(inc) catchment	-	10.6 / 24.2
Subcatchment MAP, mm	1007	705
Groundwater baseflow contribution, Mm^3/a	8.1	
Calibration period (Hydrological years)	1964 – 2004	
Observed MAR for calibration period, Mm^3/a	61.1	
Patched observed MAR for calibration period, Mm^3/a	63.5	
Simulated MAR for calibration period, Mm^3/a	63.6	
Naturalised MAR (1927-2004), Mm^3/a	73.7	
Naturalised MAR including GW baseflow (1927-2004), Mm^3/a	81.8	
Runoff coefficient	18.9%	

* Excluding Koekedouw Irrigation Board

Table 5.2: Detailed catchment information for H1H003

APPENDIX	CONTENTS	FORMAT
A1	Hydrological information for model calibration	Table
B1	Catchment Rainfall File	Monthly time series
C1	Patched observed flow record (H1H003)	Monthly time series
D1	Naturalised flow sequence	Monthly time series

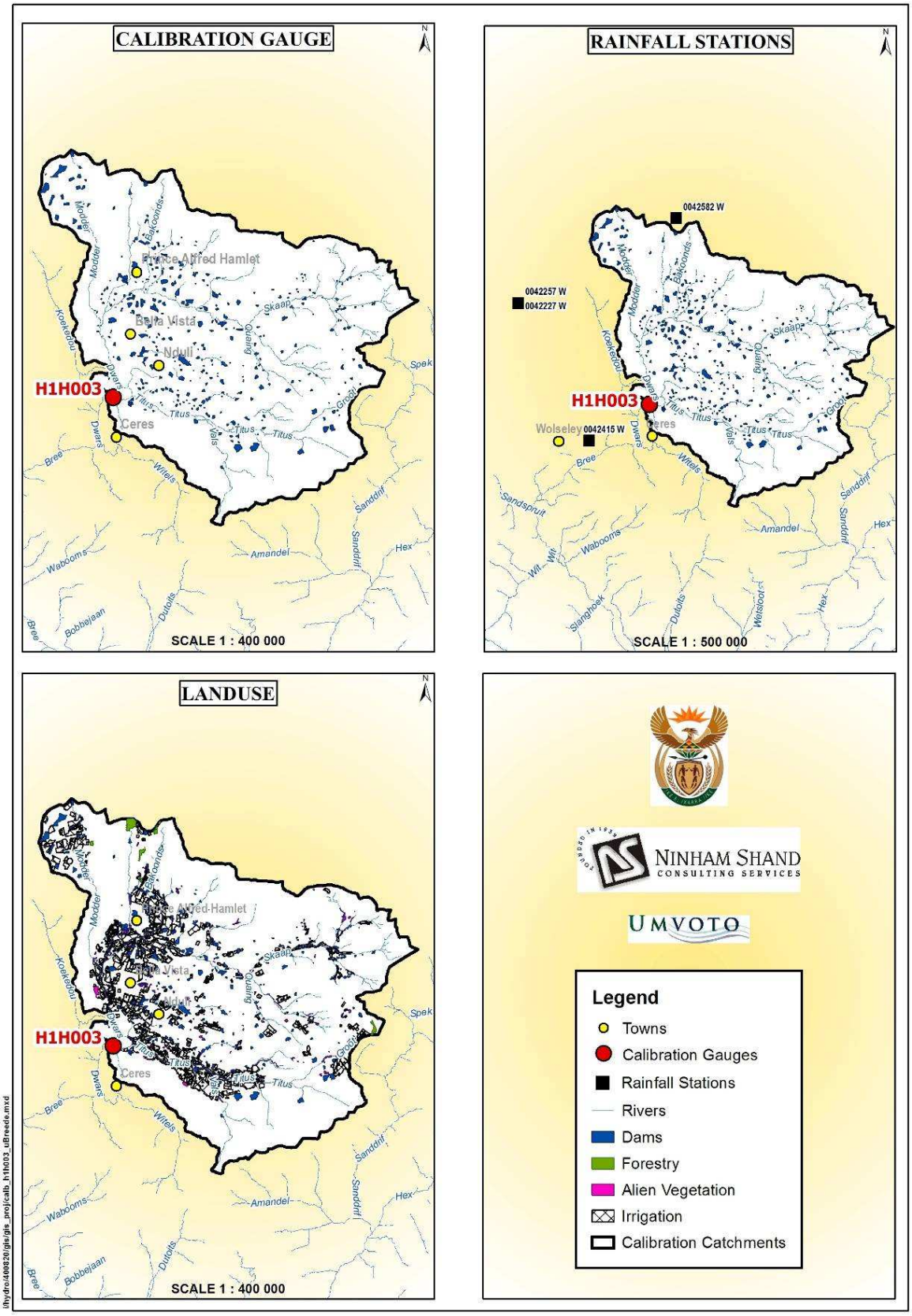


Figure 5.1: H1H003 Subcatchment hydrology information

5.1.2 Model configuration

Figure 5.2 shows the model configuration for subcatchment H1H003. The catchment was subdivided in terms of MAP into a high and low rainfall zone. Besides this a further subdivision was used in this study as in previous studies due to its benefit to a better calibration. This split occurs between the Agtertuin valley and the rest of the catchment (labelled H1H003inc).

There is one import of water into this catchment, namely that of the Koekedouw Irrigation Board. It transfers water from the Koekedouw Dam (formerly Ceres Dam) to farm dams in the H1H003inc catchment. No accurate record was available for this; therefore the 4.85 km^2 which is supplied by this scheme was omitted from the irrigation area.

There are also a number of transfers within the catchment. Two dams namely the Ben Etive and the Rooikloof Dam are situated in the high MAP zone. Transfers are made from these dams via the Warmbokkeveld and Rooikloof Waterboards to fill farm dams in the low MAP zone. It is estimated that for each of these dams 5% of the water abstracted is used to fill farm dams in the Agtertuin catchment and the other 95% is transferred to the H1H003inc catchment. The Rietvlei Waterboard transfers water directly from the river in the Agtertuin catchment to the H1H003inc catchment.

As is implied by the large number of transfers in this region the area is intensely irrigated, mostly orchards with small areas of pasture, vegetables and vineyards. To this end surface water is not the only source to be extensively used. The WARMS database records that 21.85 Mm^3/a of groundwater is used in the whole catchment. It was calculated how much of the irrigated area could be supplied by this volume of water and this area was subsequently excluded from the model.

The winter filling of farm dams was modelled. The volumes involved were substantial enough to influence the calibration, especially the seasonal distribution.

Some alien vegetation is present, 42% of which is riparian. Minor areas of forestry exist in the present-day time slice.

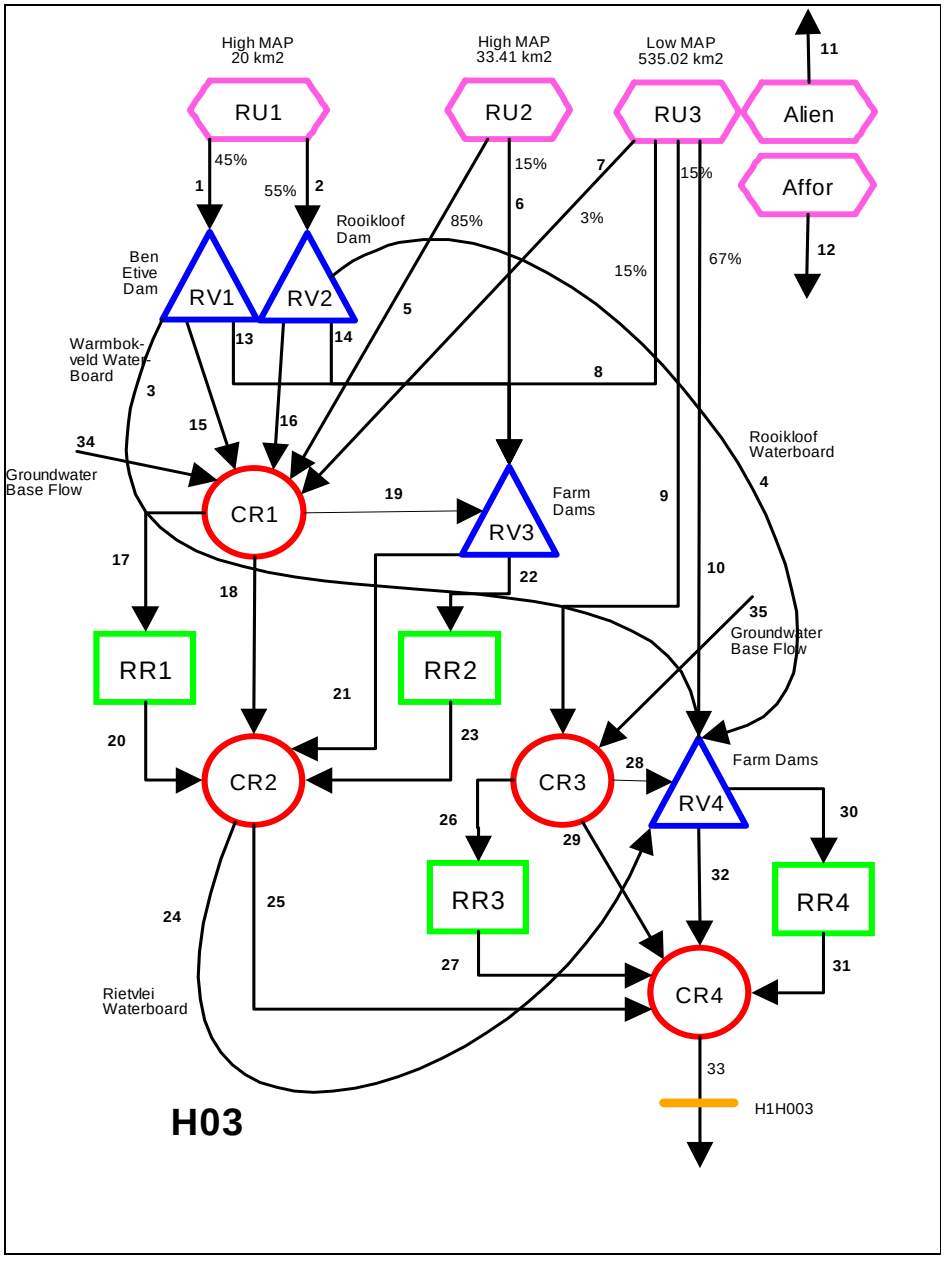


Figure 5.2: H1H003 Subcatchment Configuration

5.1.3 Evaluation and preparation of flow sequences

Observed flow data at H1H003 exists from 1923 to date. Due to this being an incremental catchment however this long record had to be cut to 1964 which is when the record at the upstream gauge, H1H013, begins. The record was patched using gauges H1H006 (including H1H022), H1H013 and the rainfall gauges used to generate the catchment rainfall file. The patched values were manually checked for consistency with the records they were patched from and edited manually if required. The patched observed flow record for H1H003 is shown in Appendix C1.

Detailed information for the flow gauge at H1H003 is presented in *The Assessment of Water Availability in the Berg Catchment (WMA 19) by* Means *of Water Resource Related Models, Report No. 3 : The Assessment of Flow Gauging Stations* (DWAF, 2007c).

5.1.4 Calibration (1964 - 2004)

Details of the rainfall stations used to generate catchment rainfall for H1H003 are shown in Table 5.3. The updated MAP for this catchment is estimated to be 1007 mm (high MAP), 705 mm (low MAP) compared to 1148 mm (high MAP) and 556 mm (low MAP) in the BRBS (DWAF, 2002).

Table 5.3: Rainfall stations for calibration at H1H003

RAINFALL STATION NUMBER	MAP	PERIOD OF RECORD	RECORD LENGTH
042227w	474	1927-2004	77
042257w	445	1961-2004	43
042415w	616	1927-1960	33
042582w	685	1933-2004	71

The BRBS (2002) Pitman parameters were used during initial model calibration. These parameters were then improved until an acceptable fit between the observed and simulated stream flow data was obtained. The final Pitman parameters for H1H003 are shown in Table 5.4 and Table 5.5 displays the patched observed and simulated statistics for H1H003. Graphs showing monthly, annual and mean monthly flows as well as a gross yield plot for each calibration are also included in Figure 5.3.

Table 5.4: H1H003 Final Pitman Parameters

POW	SL	ST	FT	GW	ZMIN	ZMAX	PI	TL	GL	R
2	0	650	21	0	0	550	1.5	0.25	0	0

Table 5.5: H1H003 Calibration Results (Statistical Indices)

	SIMULATED	OBSERVED	DIFFERENCE (%)
MAR (Mm^3)	63.6	63.5	-0.2
Mean (Log)	1.7	1.8	2.3
Std Dev	40.7	32.3	-20.7
Std Dev (Log)	0.3	0.2	-30.6
Seasonal index	39.6	40.8	3.1

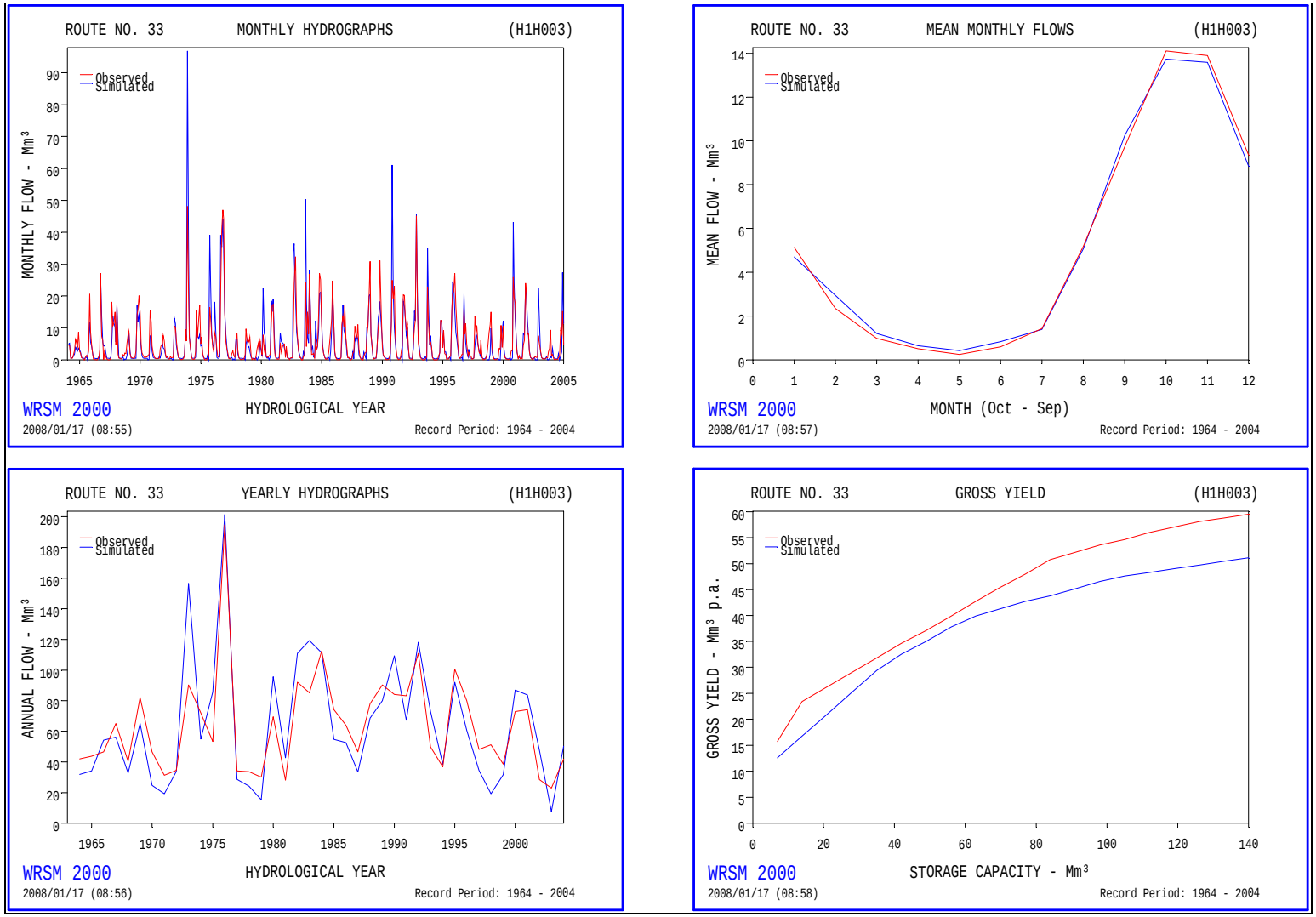


Figure 5.3: H1H003 Calibration Results (Graphical Comparison)

5.2 H1H006: Breede at Ceres Toeken Geb.

5.2.1 Subcatchment data

For a detailed assessment of land and water use in the H1H006 subcatchment the reader is referred to a separate report entitled *The* Assessment *of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Report 4 (Land Use and Water Requirements): Volume 1 (Data in Support of Catchment Modelling)* (DWAF, 2007d). Table 5.6 presents a summary of the catchment data for the subcatchment H1H006. Catchment hydrological information for H1H006 is summarised in the Appendices (Table 5.7). Figure 5.4 shows detailed maps of the catchment.

Table 5.6: Summary of information for H1H006

H1H006	
Subcatchment area from GIS, km^2	96.5
Above farm dams	-
Below farm dams	96.5
Forestry area, km^2	-
Alien vegetation condensed area, km^2	0.28
Irrigation area, km^2	-
From farm dams	-
From river	-
Farm dams: Area, km^2 / Volume, Mm^3	- / -
Groundwater baseflow contribution, Mm^3/a	2.0
Subcatchment MAP, mm	2300
Calibration period (Hydrological years)	1964 – 2004
Observed MAR for calibration period, Mm^3/a	135.7
Patched observed MAR for calibration period, Mm^3/a	136.4
Simulated MAR for calibration period, Mm^3/a	136.0
Naturalised MAR (1927-2004), Mm^3/a	148.2
Naturalised MAR including GW baseflow (1927-2004), Mm^3/a	150.2
Runoff coefficient	67.7%

Table 5.7: Detailed catchment information for H1H006

APPENDIX	CONTENTS	FORMAT
A2	Hydrological information for model calibration	Table
B2	Catchment Rainfall File	Monthly time series
C2	Patched observed flow record (H1H006)	Monthly time series
D2	Naturalised sequence	Monthly time series

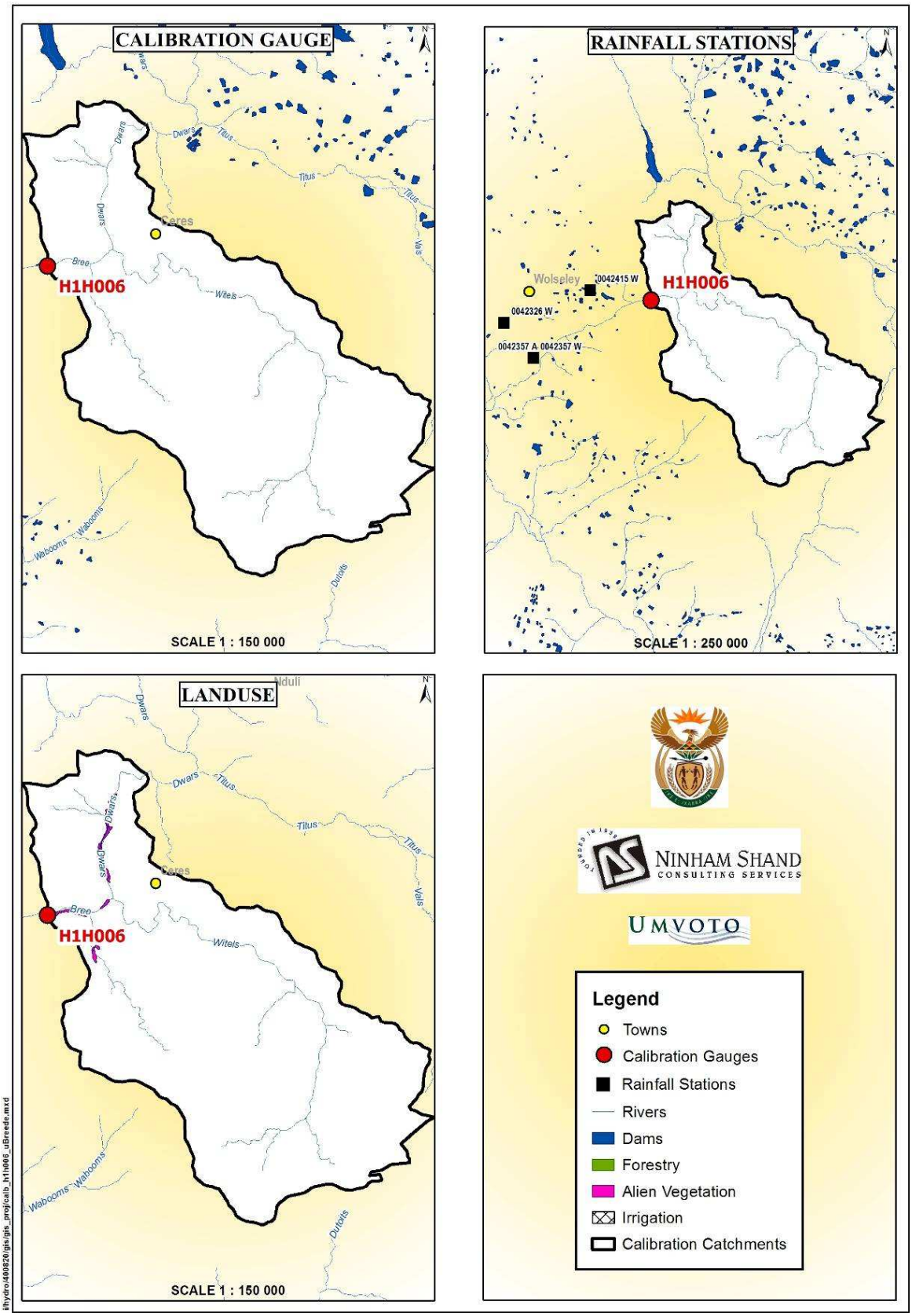


Figure 5.4: H1H006 Subcatchment hydrology information

5.2.2 Model configuration

The subcatchment configuration for H1H006 is shown in Figure 5.5. As can be seen from this simple diagram there is little activity in the catchment. The only major effect on the calibration is a diversion canal situated immediately upstream of the H1H006 gauge. The flows in this canal are recorded at H1H022 and are used to irrigate crops near Wolseley in the H4H006 subcatchment.

In the present-day time slice, little alien vegetation is present but in previous years up to 8 km^2 of aliens was encountered. Groundwater contributions are insignificant compared to the observed annual runoff.

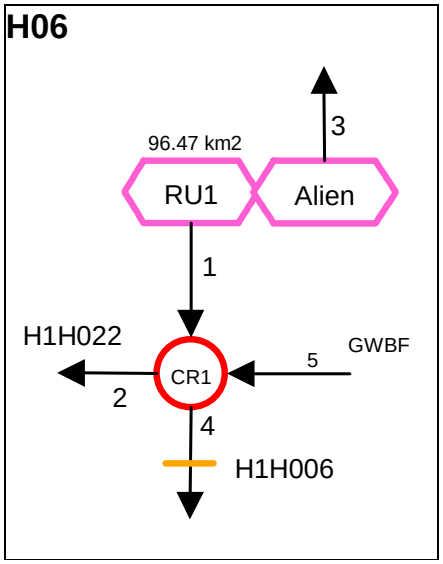


Figure 5.5: H1H006 Subcatchment Configuration

5.2.3 Evaluation and preparation of flow sequences

Observed flow data at H1H006 exists from 1950 to date. Due to this being an incremental catchment, however, this long record had to be cut to 1964. The record was patched using gauges H1H003, H1H013 and the rainfall gauges used to generate the catchment rainfall file. The patched values were manually checked for consistency with the records they were patched from and edited manually if required. The patched observed flow record for H1H006 is shown in Appendix C2.

A detailed assessment of the flow gauges in the Berg catchment was made and is documented in *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models, Report No. 3 : The Assessment of Flow Gauging Stations* (DWAF, 2007c). The patched observed flows at H1H006 were simulated for the period 1964 - 2004.

5.2.4 Calibration (1964 - 2004)

Details of the rainfall stations used to generate catchment rainfall for H1H006 are shown in Table 5.8. The updated MAP for this catchment is estimated to be 2300 mm compared to 2500 mm in the BRBS (2002). The MAP was however originally set at 1147 mm as extracted from the updated MAP rainfall surface. This in effect makes the MAP a calibration parameter. This can be justified by considering that the runoff coefficient for the catchment is unacceptably high should the MAP be set at 1147 mm.

Table 5.8: Rainfall stations for calibration at H1H006

RAINFALL STATION NUMBER	MAP	PERIOD OF RECORD	RECORD LENGTH
042326w	645	1927-2004	77
042357a	568	1929-1987	58
042357w	562	1927-1981	54
042415w	616	1927-1960	33

The BRBS (2002) Pitman parameters were used during initial model calibration. These parameters were then improved until an acceptable fit between the observed and simulated stream flow data was obtained. The final Pitman parameters are shown in Table 5.9 and Table 5.10 displays the patched observed and simulated statistics for H1H006. Graphs showing monthly, annual and mean monthly flows as well as a gross yield plot for each calibration are also included in Figure 5.6.

Table 5.9: H1H006 Final Pitman Parameters

POW	SL	ST	FT	GW	ZMIN	ZMAX	PI	TL	GL	R
2	0	200	50	0	100	400	1.5	0.25	0	0

Table 5.10: H1H006 Calibration Results (Statistical Indices)

	SIMULATED	OBSERVED	DIFFERENCE (%)
MAR (Mm^3)	136.0	136.4	0.3
Mean (Log)	2.1	2.1	-0.7
Std Dev	46.7	61.7	32.0
Std Dev (Log)	0.1	0.2	26.5
Seasonal index	43.9	41.9	-4.4

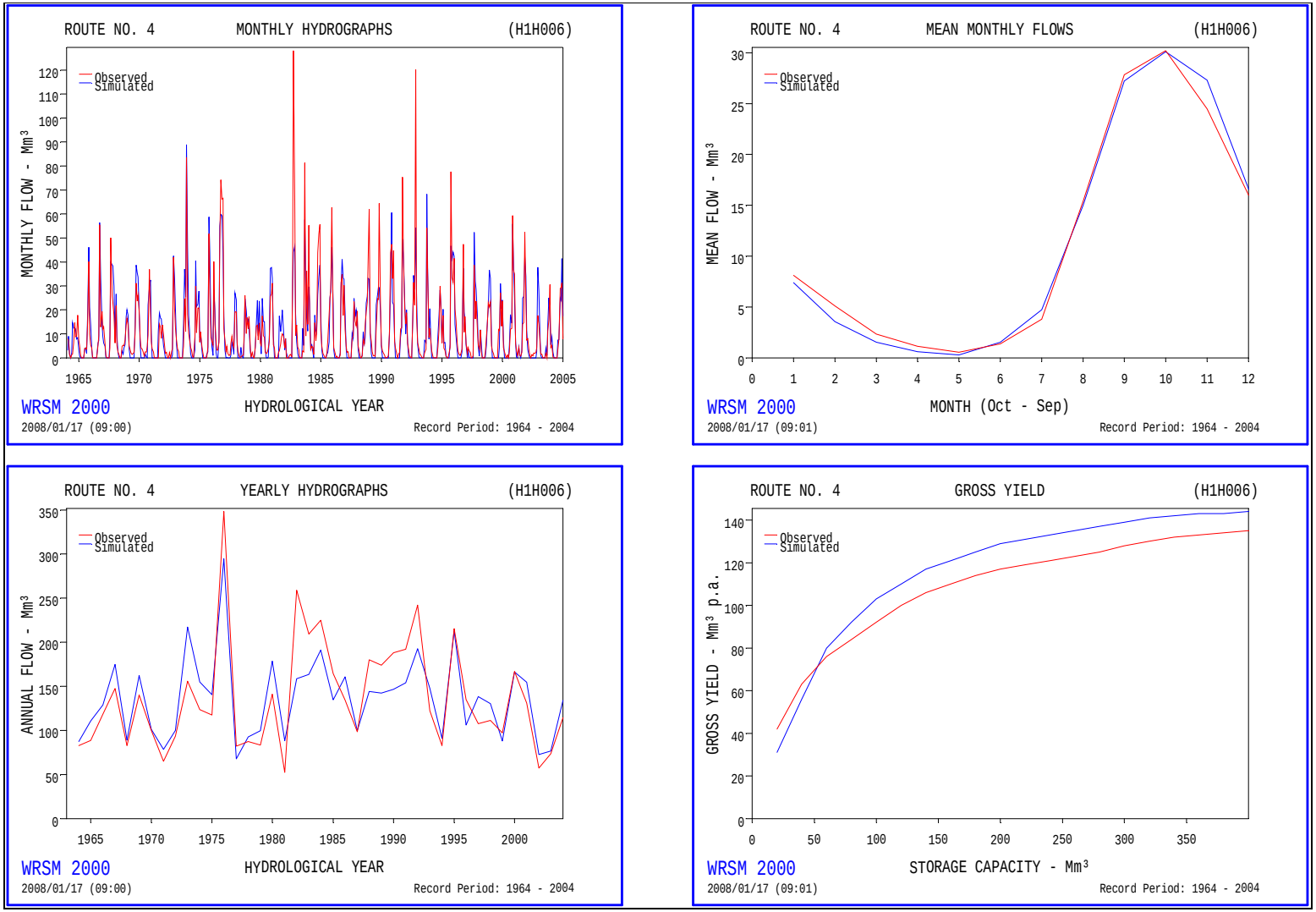


Figure 5.6: H1H006 Calibration Results (Graphical Comparison)

5.3 H1H007: Wit at Drosterkloof

5.3.1 Subcatchment data

For a detailed assessment of land and water use in subcatchment H1H007, the reader is referred to a separate report *entitled The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Report 4 (Land Use and Water Requirements): Volume 1 (Data in Support of Catchment Modelling)* (DWAF, 2007d). Table 5.11 presents a summary of the catchment data for the subcatchment H1H007. Details of the data used in the model calibration are given in Appendix A3 and are summarised in Table 5.12. Figure 5.7 shows detailed maps of the catchment.

Table 5.11: Summary of information for H1H007

H1H007	
Subcatchment area from GIS, km^2	85.5
Above H1H011	28.2
Below H1H011	57.3
Forestry area, km^2	-
Alien vegetation condensed area, km^2	0.1
Irrigation area, km^2	-
From farm dams	-
From river	-
Farm dams: Area, km^2 / Volume, Mm^3	- / -
Groundwater baseflow contribution, Mm^3/a	3.2
Subcatchment MAP, mm	2080
Calibration period (Hydrological years)	1961 – 2004
Observed MAR for calibration period, Mm^3/a	118.6
Patched observed MAR for calibration period, Mm^3/a	126.8
Simulated MAR for calibration period, Mm^3/a	126.0
Naturalised MAR (1927-2004), Mm^3/a	128.5
Naturalised MAR including GW baseflow (1927-2004), Mm^3/a	131.7
Runoff coefficient	74.1%

Table 5.12: Detailed catchment information for H1H007

APPENDIX	CONTENTS	FORMAT
A3	Hydrological information for model calibration	Table
B3	Catchment Rainfall File	Monthly time series
C3	Patched observed flow record (H1H007)	Monthly time series
D3	Naturalised sequence	Monthly time series

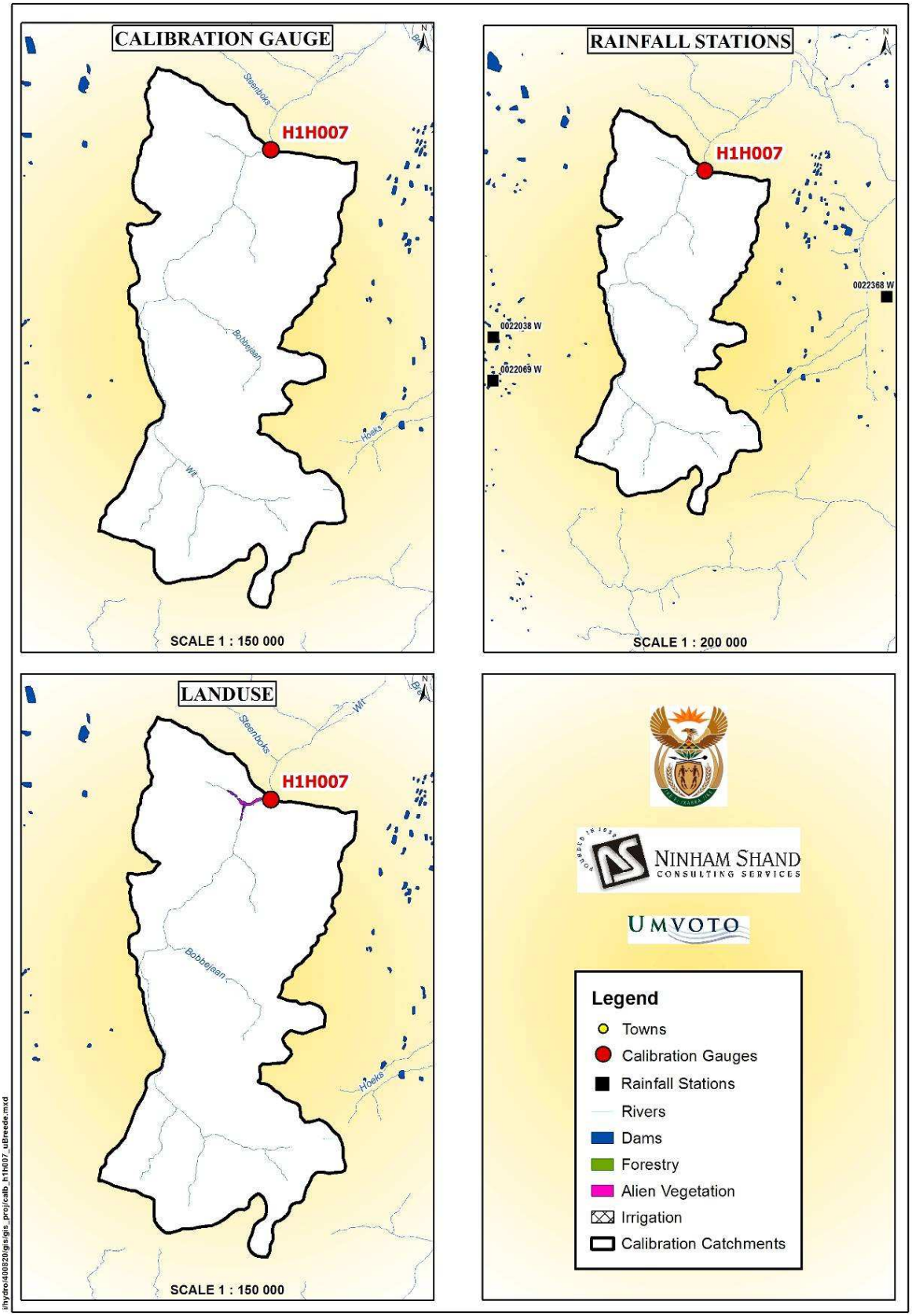


Figure 5.7: H1H007 Subcatchment hydrology information

5.3.2 Model configuration

Figure 5.8 shows the model configuration for subcatchment H1H007. The catchment can be split into two sub-catchments, namely the region upstream of gauge H1H011 and the region downstream. Even though there is no record for H1H011, it is the site of the "Gawie se Water" diversion to the Berg River catchment.

The catchment is undeveloped apart from small areas of alien invasive riparian vegetation. Groundwater contributions to baseflow are insignificant compared to annual observed runoff.

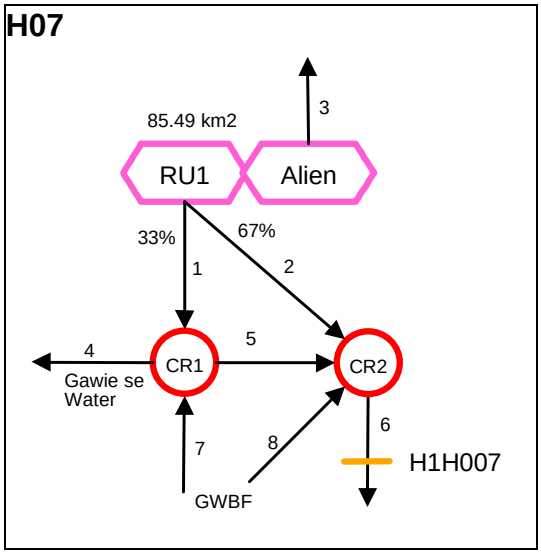


Figure 5.8: H1H007 Subcatchment Configuration

5.3.3 Evaluation and preparation of flow sequences

Observed data is available from 1950 to the present. An automatic recorder was installed in 1961 which was then chosen as the start date for the calibration. The record was patched using gauges H1H018, G1H037, G1H041 and the rainfall gauges used to generate the catchment rainfall file. The patched values were manually checked for consistency with the records they were patched from and edited manually if required. The patched observed flows at H1H007 were simulated for the period 1961-2004 and are included in Appendix C3.

A detailed assessment of the flow gauges in the Berg catchment was made and is documented in *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models, Report No. 3 : The Assessment of Flow Gauging Stations* (DWAF, 2007c).

5.3.4 Calibration (1961 - 2004)

Details of the rainfall stations used to generate catchment rainfall for H1H007 are shown in Table 5.13. The updated MAP for this catchment is estimated to be 2080 mm which is equal to the MAP used in the BRBS (DWAF, 2002). The MAP was however originally set at 1248 mm as extracted from the updated MAP rainfall surface. This in effect makes the MAP a calibration parameter. This can be justified by considering that the runoff coefficient for the catchment is unacceptably high should the MAP be set at 1248 mm.

Table 5.13: Rainfall stations for calibration at H1H007

RAINFALL STATION NUMBER	MAP	PERIOD OF RECORD	RECORD LENGTH
022038w	763	1997-2004	7
022069w	755	1927-1993	66
022368w	1009	1932-1976	44

The BRBS (2002) Pitman parameters were used during initial model calibration. These parameters were then improved until an acceptable fit between the observed and simulated stream flow data was obtained. The final Pitman parameters are shown in Table 5.14 and Table 5.15 displays the patched observed and simulated statistics for H1H007. Graphs showing monthly, annual and mean monthly flows as well as a gross yield plot for each calibration are also included in Figure 5.9.

Table 5.14: H1H007 Final Pitman Parameters

POW	SL	ST	FT	GW	ZMIN	ZMAX	PI	TL	GL	R
2	0	150	90	0	0	250	0	0.2	0	0

Table 5.15: H1H007 Calibration Results (Statistical Indices)

	SIMULATED	OBSERVED	DIFFERENCE (%)
MAR (Mm^3)	126.0	126.8	-0.6
Mean (Log)	2.1	2.1	-0.1
Std Dev	33.1	34.0	-2.9
Std Dev (Log)	0.1	0.1	-5.8
Seasonal index	36.0	38.9	-7.4

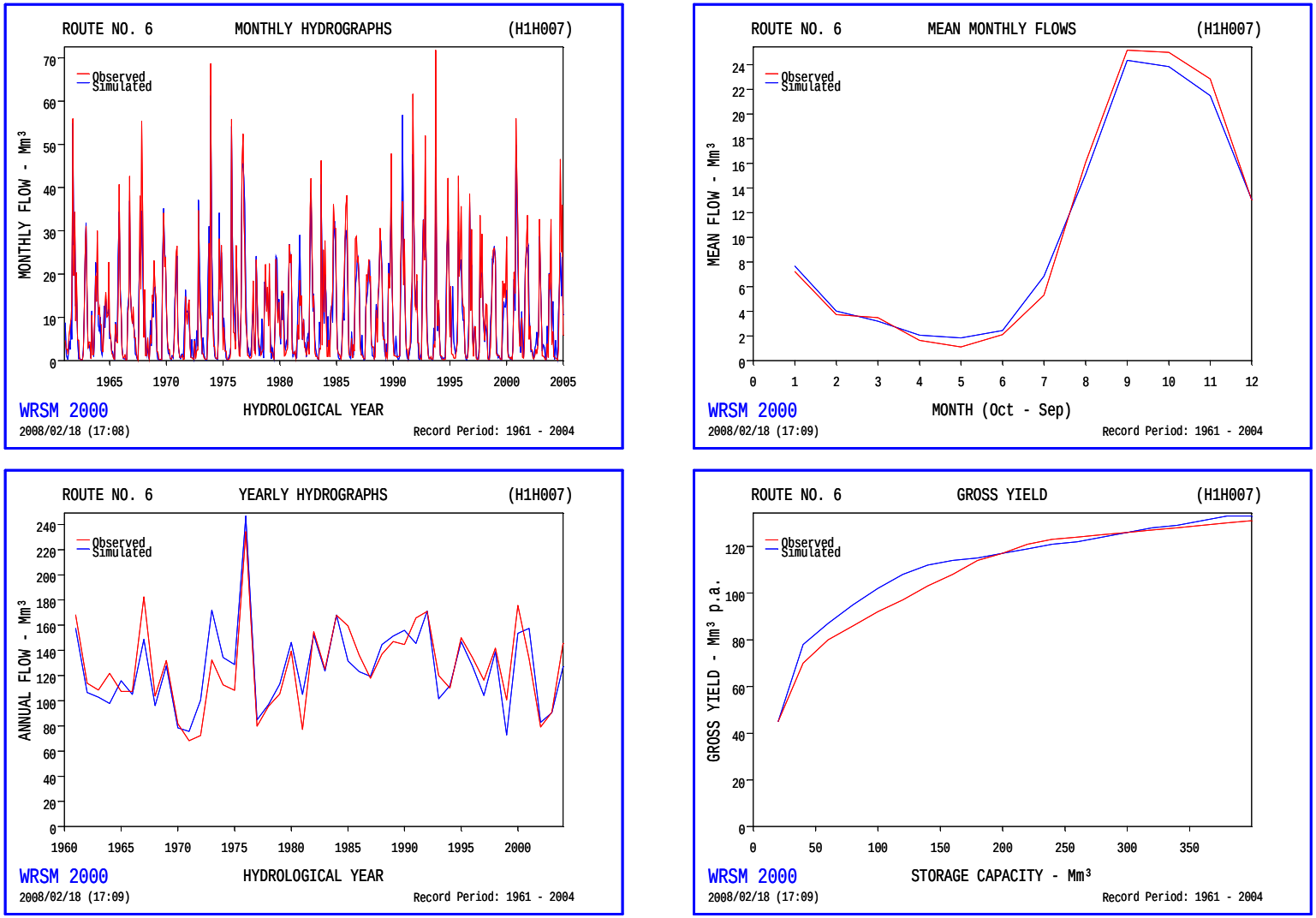


Figure 5.9: H1H007 Calibration Results (Graphical Comparison)

5.4 H1H012: Holsloot at Daschbosch

5.4.1 Subcatchment data

A detailed assessment of land and water use in the catchment upstream of H1H012 has been documented in a separate report entitled *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Report 4 (Land Use and Water Requirements): Volume 1 (Data in Support of Catchment Modelling)* (DWAF, 2007d). Table 5.16 presents a summary of the catchment data for the subcatchment H1H012. Details of the data used in the model calibration are given in Appendix A4 and are summarised in Table 5.17. Figure 5.10 shows detailed maps of the catchment.

Table 5.16: Summary of information for H1H012

H1H012	
Subcatchment area from GIS, km^2	151.8
Above H1R002*	56.2
Below farm dam	95.6
Forestry area, km^2	-
Alien vegetation condensed area, km^2	0.2
Irrigation area, km^2	0.16
From farm dams	-
From river	0.16
H1R002*: Area, km^2 / Volume, Mm^3	1.0 / 15.4
Groundwater baseflow contribution, Mm^3/a	6.0
Subcatchment MAP, mm	1187
Calibration period (Hydrological years)	1963 – 1974
Observed MAR for calibration period, Mm^3/a	70.9
Patched observed MAR for calibration period, Mm^3/a	71.9
Simulated MAR for calibration period Mm^3/a	71.5
Naturalised MAR (1927-2004), Mm^3/a	92.8
Naturalised MAR including GW baseflow (1927-2004), Mm^3/a	98.8
Runoff coefficient	54.8%

* Stettynskloof Dam

Table 5.17: Detailed catchment information for H1H012

APPENDIX	CONTENTS	FORMAT
A4	Hydrological information for model calibration	Table
B4	Catchment Rainfall File	Monthly time series
C4	Patched observed flow record (H1H012)	Monthly time series
D4	Naturalised sequence	Monthly time series

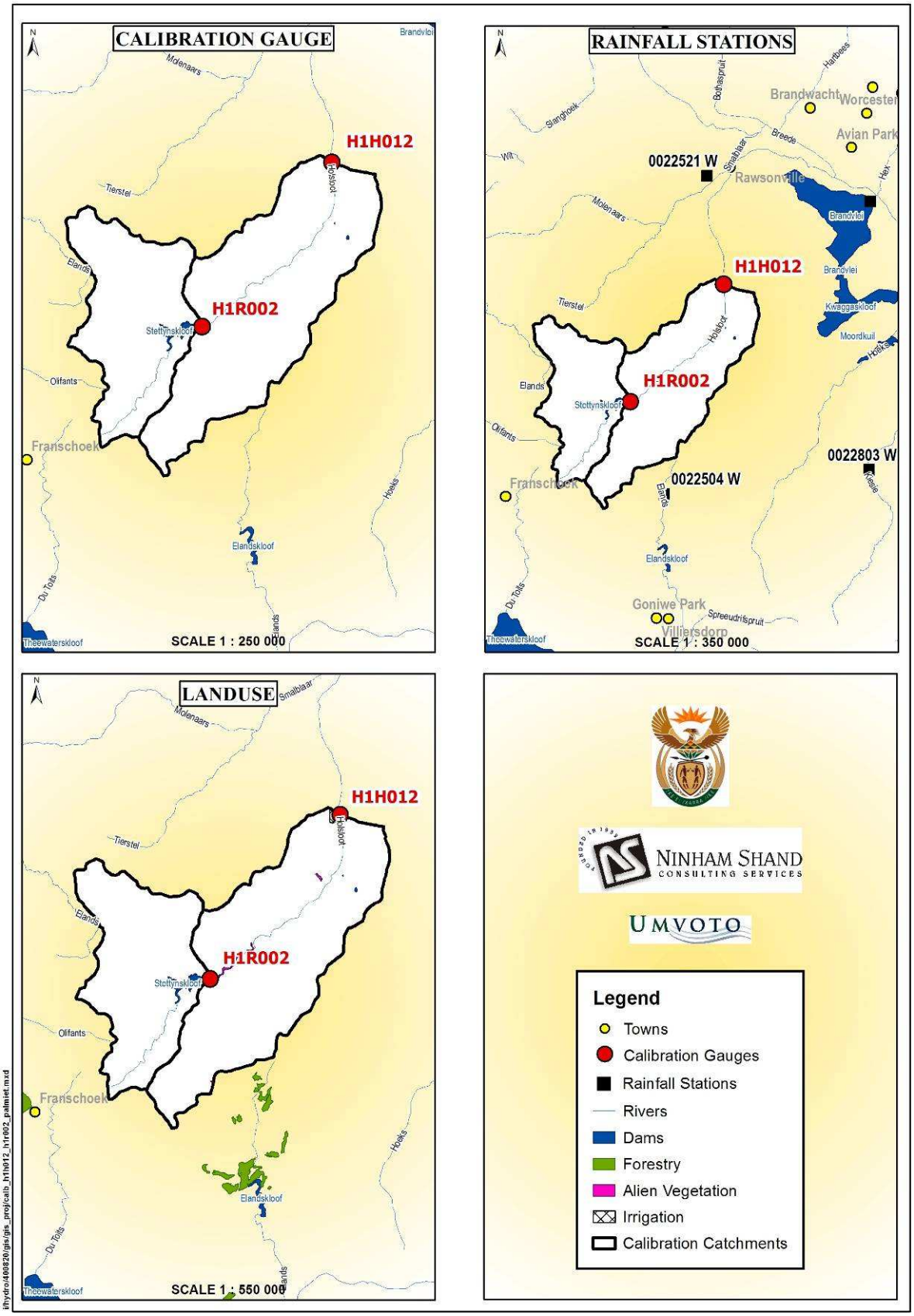


Figure 5.10: H1H012 Subcatchment hydrology information

5.4.2 Model configuration

Figure 5.11 shows the model configuration for subcatchment H1H012. The Stettynskloof Dam (H1R002) was modelled as part of the H1H012 catchment and not as a subcatchment on its own. The reason for this is that no reliable record for the compensation releases for this dam could be found, with the consequence that no accurate dam balance could be carried out.

The Stettynskloof Dam, which was built in 1958 and later raised in 1980, is used exclusively by the Worcester Municipality for its urban demand. This flow is transferred directly to Worcester via a gauged pipeline. The dam's incremental catchment contains almost no development. This is likewise the case in the remaining part of H1H012. Only small pockets of irrigation and alien vegetation are present. This irrigation does not abstract any flow from the river and is entirely supplied by groundwater.

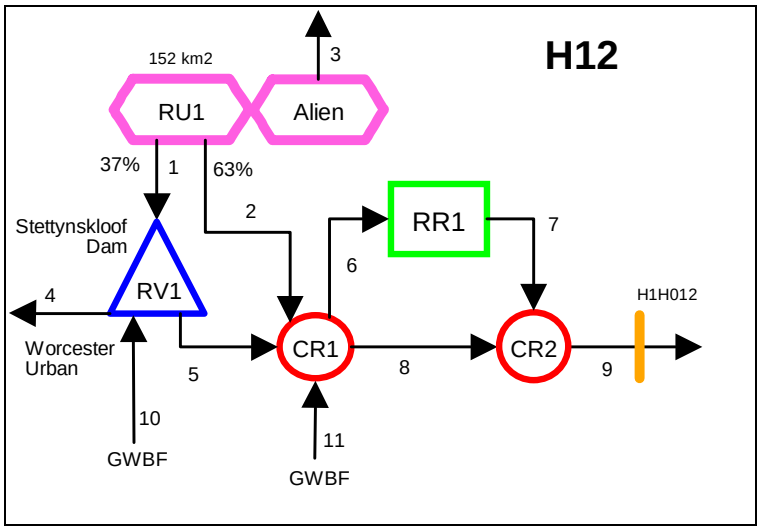


Figure 5.11: H1H012 Subcatchment Configuration

5.4.3 Evaluation and preparation of flow sequences

A detailed assessment of the flow gauges in the Berg catchment was made and is documented in *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models, Report No. 3 : The Assessment of Flow Gauging Stations* (DWAF, 2007c). The patched observed flows at H1H012 were simulated for the period 1963 - 1974. The record was patched using gauge H1H012 and the rainfall gauges used to generate the catchment rainfall file. The patched values were manually checked for consistency with the records they were patched from and edited manually if required. The patched observed flow record for H1H012 is shown in Appendix C4.

5.4.4 Calibration (1963 - 2004)

Details of the rainfall stations used to generate catchment rainfall for H1H012 are shown in Table 5.18. The updated MAP for this catchment is estimated to be 1187 mm compared to 1101 mm used in the BRBS (DWAF, 2002).

Table 5.18: Rainfall stations for calibration at H1H012

RAINFALL STATION NUMBER	MAP	PERIOD OF RECORD	RECORD LENGTH
022521w	613	1927-1994	67
022440w	916	1952-2004	52
022504w	760	1932-2000	68
022792w	265	1937-1978	41
022803w	247	1929-2004	75

The BRBS (2002) Pitman parameters for gauge H1H018 were used during initial model calibration. These parameters were then improved until an acceptable fit between the observed and simulated stream flow data was obtained. The final Pitman parameters are shown in Table 5.19 and Table 5.20 displays the patched observed and simulated statistics for H1H012. Graphs showing monthly, annual and mean monthly flows as well as a gross yield plot for each calibration are also included in Figure 5.12.

Table 5.19: H1H012 Final Pitman Parameters

POW	SL	ST	FT	GW	ZMIN	ZMAX	PI	TL	GL	R
2	0	400	80	0	0	400	1.5	0	0	0

Table 5.20: H1H012 Calibration Results (Statistical Indices)

	SIMULATED	OBSERVED	DIFFERENCE (%)
MAR (Mm^3)	71.5	71.9	0.6
Mean (Log)	1.8	1.8	0.5
Std Dev	29.7	25.0	-16.0
Std Dev (Log)	0.2	0.1	-12.3
Seasonal index	39.2	42.1	7.6

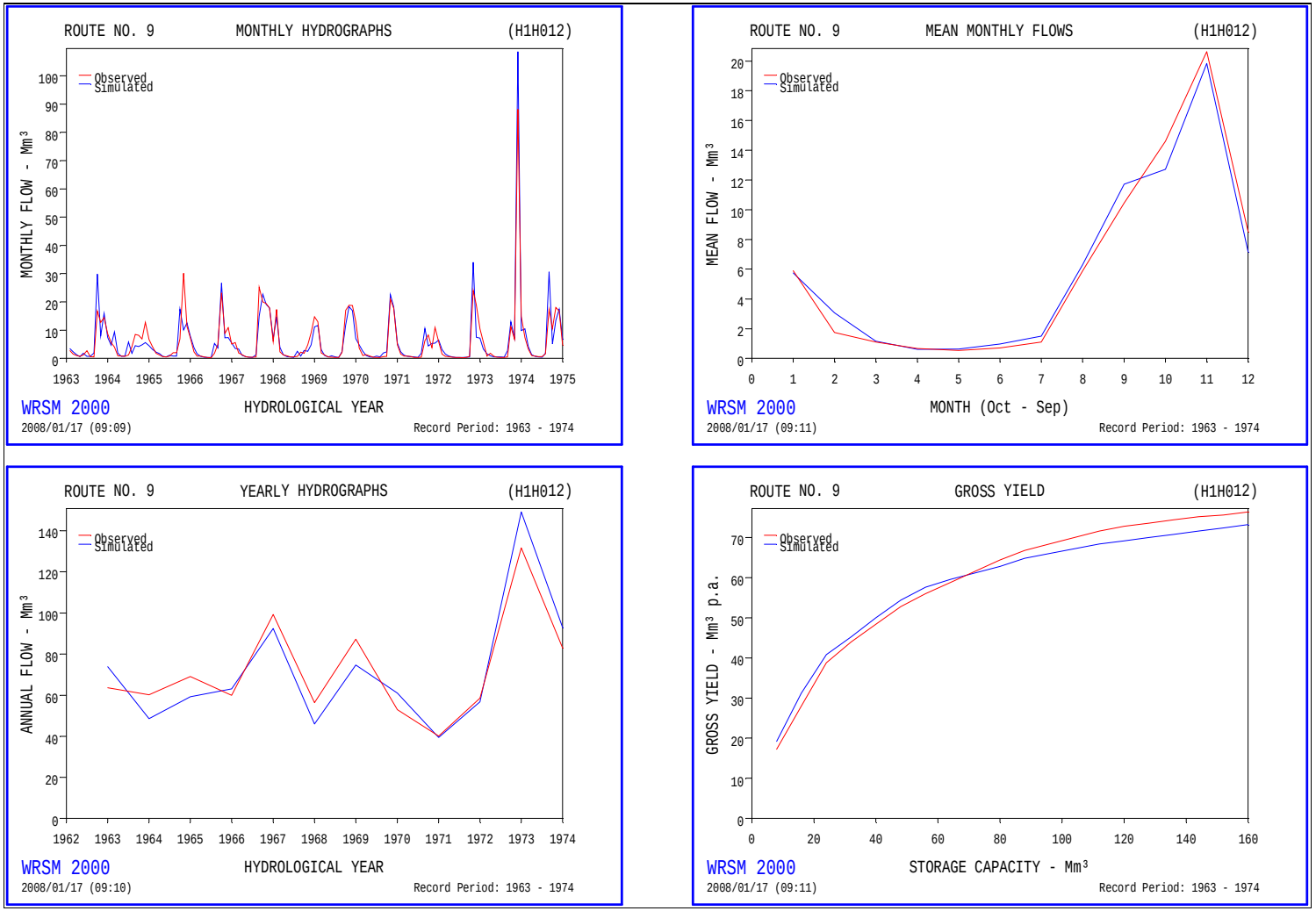


Figure 5.12: H1H012 Calibration Results (Graphical Comparison)

5.5 H1H013: Koekedouw at Ceres

5.5.1 Subcatchment data

Land use in the Upper Breede catchment has been documented in a separate report entitled *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Report 4 (Land Use and Water Requirements): Volume 1 (Data in Support of Catchment Modelling)* (DWAF, 2007d). Table 5.21 presents a summary of the catchment data for the subcatchment H1H013. Details of the data used in the model calibration are given in Appendix A5 and are summarised in Table 5.22. Figure 5.13 shows detailed maps of the catchment.

Table 5.21: Summary of information for H1H013

H1H013	HIGH MAP	LOW MAP
Subcatchment area from GIS, km^2	14.3	38.7
Above farm dams	0.3	0.7
Below farm dams	14.0	34.7
Below Koekedouw Dam	-	3.3
Forestry area, km^2	-	0.14
Alien vegetation condensed area, km^2	-	0.5
Irrigation area, km^2	-	9.9
From farm dams	-	8.3
From river U/S Koekedouw Dam	-	1.4
From river D/S Koekedouw Dam	-	0.1
Farm dams: Area, km^2 / Volume, Mm^3	- / -	1.2 / 4.4
Subcatchment MAP, mm	1246	966
Groundwater baseflow contribution, Mm^3/a	1.2	
Calibration period (Hydrological years)	1964 – 1997	
Observed MAR for calibration period, Mm^3/a	21.9	
Patched observed MAR for calibration period, Mm^3/a	22.6	
Simulated MAR for calibration period, Mm^3/a	22.6	
Naturalised MAR (1927-2004), Mm^3/a	33.0	
Naturalised MAR including GW baseflow (1927-2004), Mm^3/a	34.2	
Runoff coefficient	62.0%	

Table 5.22: Detailed catchment information for H1H013

APPENDIX	CONTENTS	FORMAT
A5	Hydrological information for model calibration	Table
B5	Catchment Rainfall File	Monthly time series
C5	Patched observed flow record (H1H013)	Monthly time series
D5	Naturalised sequence	Monthly time series

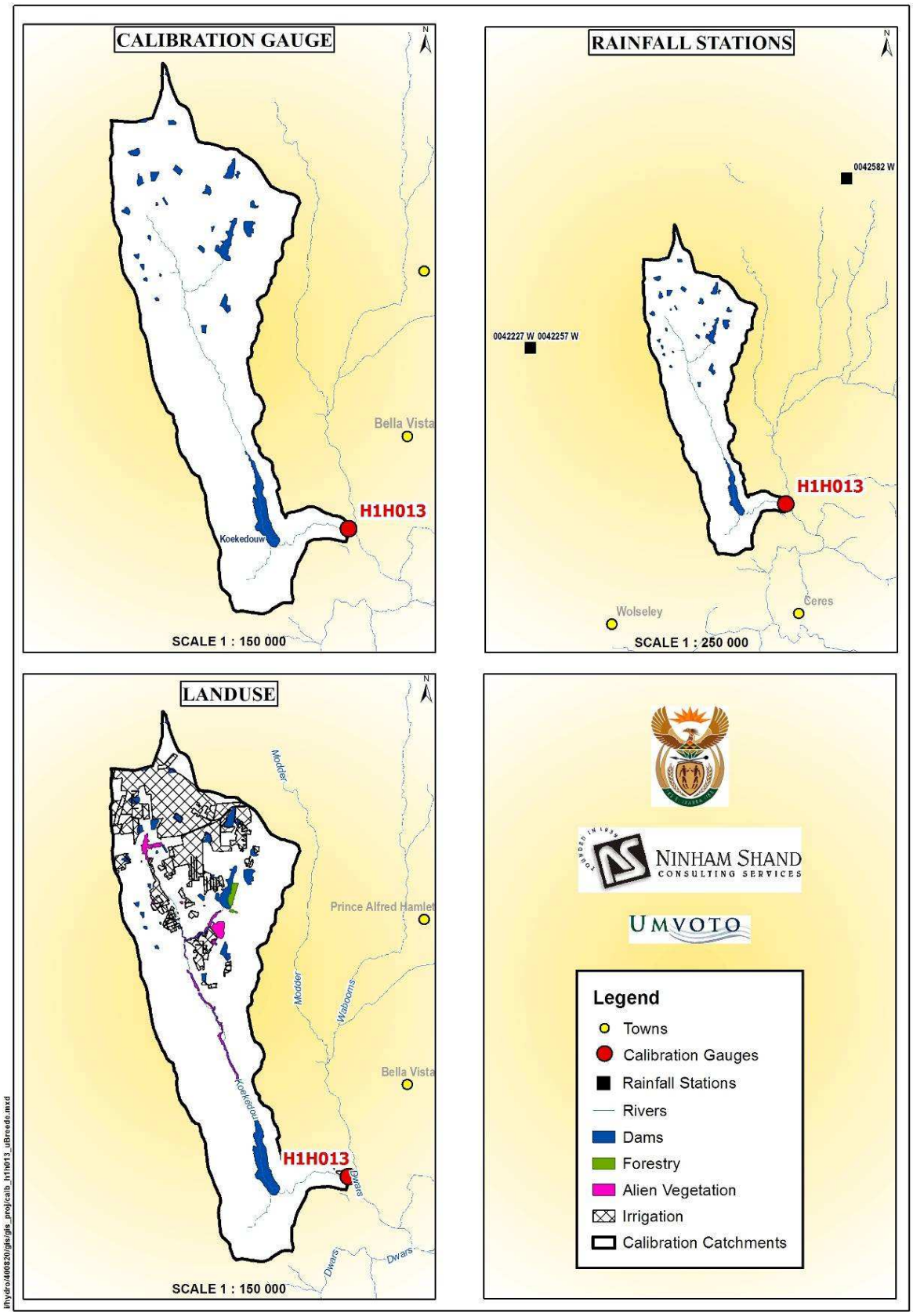


Figure 5.13: H1H013 Subcatchment hydrology information

5.5.2 Model configuration

Figure 5.14 shows the model configuration for subcatchment H1H013. The catchment is split between a high and a low MAP zone. Flows generated by the two runoff modules are split as shown. In the lower part of the catchment lies the Ceres Dam which was later raised to form the Koekedouw Dam. No record is available for this dam, hence it must be included as a reservoir in the model.

Certain releases are available for the dam, namely Water Board abstractions which also account for the urban use by Ceres as well as the use and eventual release of water by the Ceres Power Station. The Water Board abstractions are transferred to the H1H003 subcatchment.

Of the total irrigated area in this catchment, 78% is supplied by groundwater. Groundwater contributions to baseflow are small but significant compared to the annual observed flow.

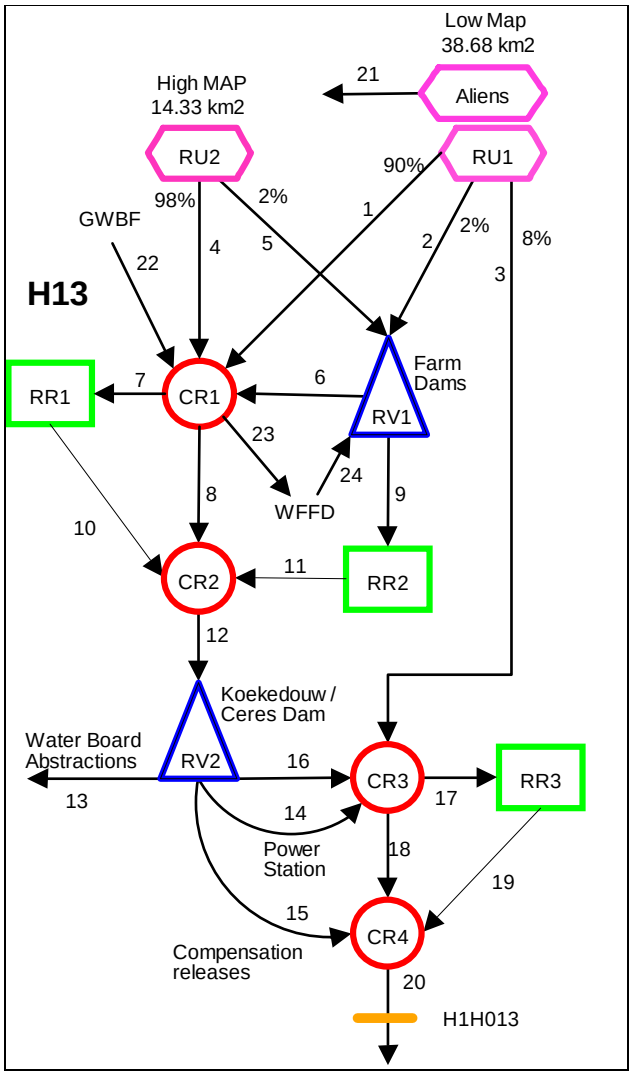


Figure 5.14: H1H013 Subcatchment Configuration

5.5.3 Evaluation and preparation of flow sequences

The incremental patched observed flows at H1H013 were simulated for the period 1964 – 1997. The record for H1H013 does however continue beyond this to the present-day. The reason the record was cut short in 1997 is that in 1998 the Ceres Dam was raised (from 0.3 Mm^3 to 13.7 Mm^3) and observed flows in subsequent years were heavily influenced by this large increase in storage capacity, so much so that the model was incapable of simulating the changes accurately.

A detailed assessment of the flow gauges in the Berg catchment was made and is documented in *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models, Report No. 3 : The Assessment of Flow Gauging Stations* (DWAF, 2007c). The record was patched using gauges H1H006 (including H1H022), H1H003 and the rainfall gauges used to generate the catchment rainfall file. The patched values were manually checked for consistency with the records they were patched from and edited manually if required. The patched record is included in Appendix C5.

5.5.4 Calibration (1964 - 1997)

Details of the rainfall stations used to generate catchment rainfall for H1H013 are shown in Table 5.23. The updated MAP for this catchment is estimated to be 1246 mm (high MAP) and 966 mm (low MAP) compared to 2006 mm (high MAP) and 846 mm (low MAP) in the BRBS (DWAF, 2002).

Table 5.23: Rainfall stations for calibration at H1H013

RAINFALL STATION NUMBER	MAP	PERIOD OF RECORD	RECORD LENGTH
042582w	685	1933-2004	71
042227w	474	1927-2004	77
042257w	445	1961-2004	43

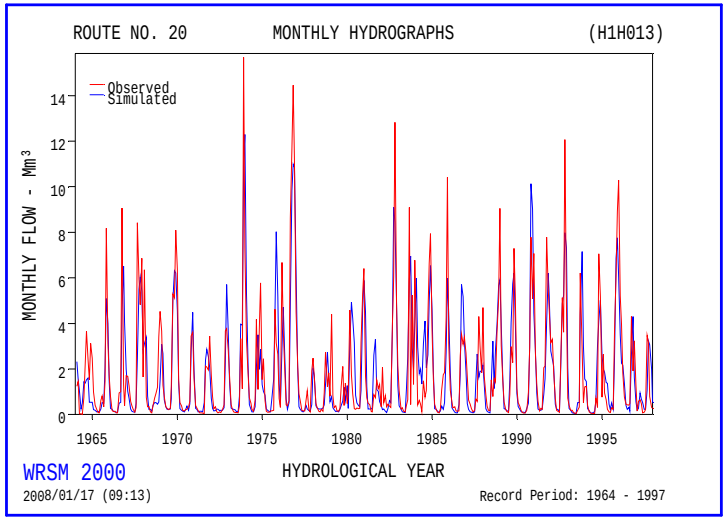
The BRBS (2002) Pitman parameters were used during initial model calibration. These parameters were then improved until an acceptable fit between the observed and simulated stream flow data was obtained. The final Pitman parameters are shown in Table 5.24 and Table 5.25 displays the patched observed and simulated statistics for H1H013. Graphs showing monthly, annual and mean monthly flows as well as a gross yield plot for each calibration are also included in Figure 5.15.

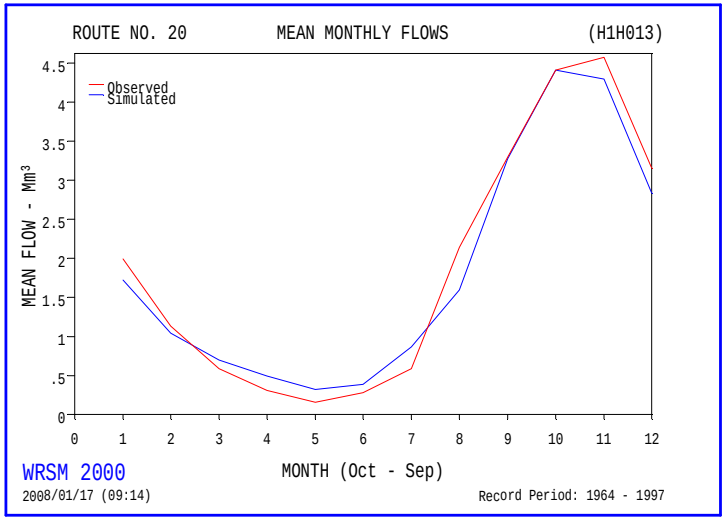
Table 5.24: H1H013 Final Pitman Parameters

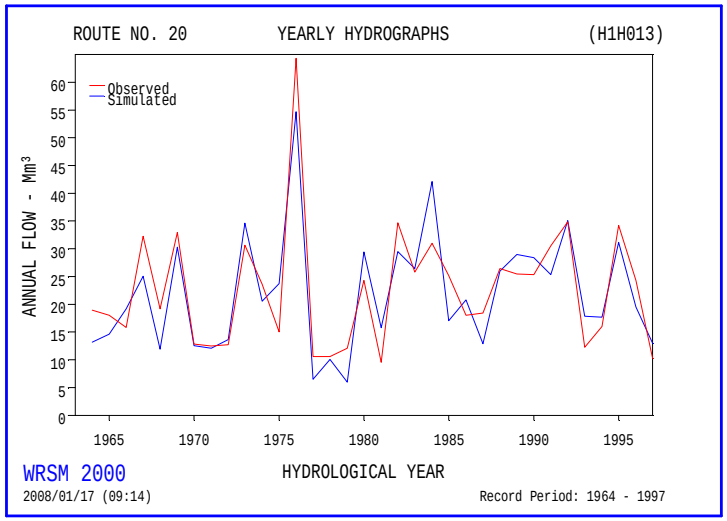
POW	SL	ST	FT	GW	ZMIN	ZMAX	PI	TL	GL	R
2	0	100	55	0	0	200	1.5	0.99	0	0

Table 5.25: H1H013 Calibration Results (Statistical Indices)

	SIMULATED	OBSERVED	DIFFERENCE (%)
MAR (Mm^3)	22.6	22.6	0.3
Mean (Log)	1.3	1.3	0.3
Std Dev	10.6	11.0	3.5
Std Dev (Log)	0.2	0.2	-6.7
Seasonal index	33.0	36.5	10.5







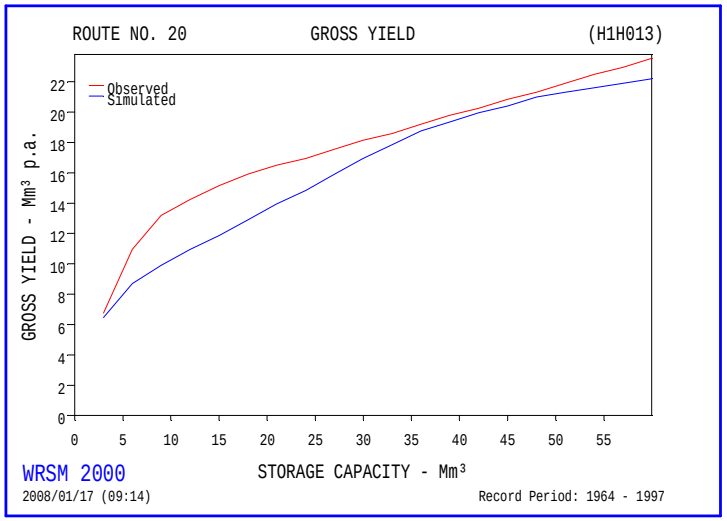


Figure 5.15: H1H013 Calibration Results (Graphical Comparison)

5.6 H1H018: Molenaars at Hawequas Forest Reserve

5.6.1 Subcatchment data

For a detailed assessment of land and water use in subcatchment H1H018, the reader is referred to a separate report entitled *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Report 4 (Land Use and Water Requirements): Volume 1 (Data in Support of Catchment Modelling)* (DWAF, 2007d). Table 5.26 presents a summary of the catchment data for the subcatchment H1H018. Details of the data used in the model calibration are given in Appendix A6 and are summarised in Table 5.27. Figure 5.16 shows detailed maps of the catchment.

Table 5.26: Summary of information for H1H018

H1H018	
Subcatchment area from GIS, km^2	44.3
Above farm dams	-
Below farm dams	44.3
Forestry area, km^2	-
Alien vegetation condensed area, km^2	0.5
Irrigation area, km^2	0.1
From farm dams	-
From river	0.1
Farm dam: Area, km^2 / Volume, Mm^3	- / -
Groundwater baseflow contribution, Mm^3/a	1.7
Subcatchment MAP, mm	1945
Calibration period (Hydrological years)	1991 – 2004
Observed MAR for calibration period, Mm^3/a	69.5 *
Patched observed MAR for calibration period, Mm^3/a	68.6
Simulated MAR for calibration period, Mm^3/a	68.7
Naturalised MAR (1927-2004), Mm^3/a	60.8
Naturalised MAR including GW baseflow (1927-2004), Mm^3/a	62.4
Runoff coefficient	72.4%

* See section 5.6.4

Table 5.27: Detailed catchment information for H1H018

APPENDIX	CONTENTS	FORMAT
A6	Hydrological information for model calibration	Table
B6	Catchment Rainfall File	Monthly time series
C6	Patched observed flow record (H1H018)	Monthly time series
D6	Naturalised sequence	Monthly time series

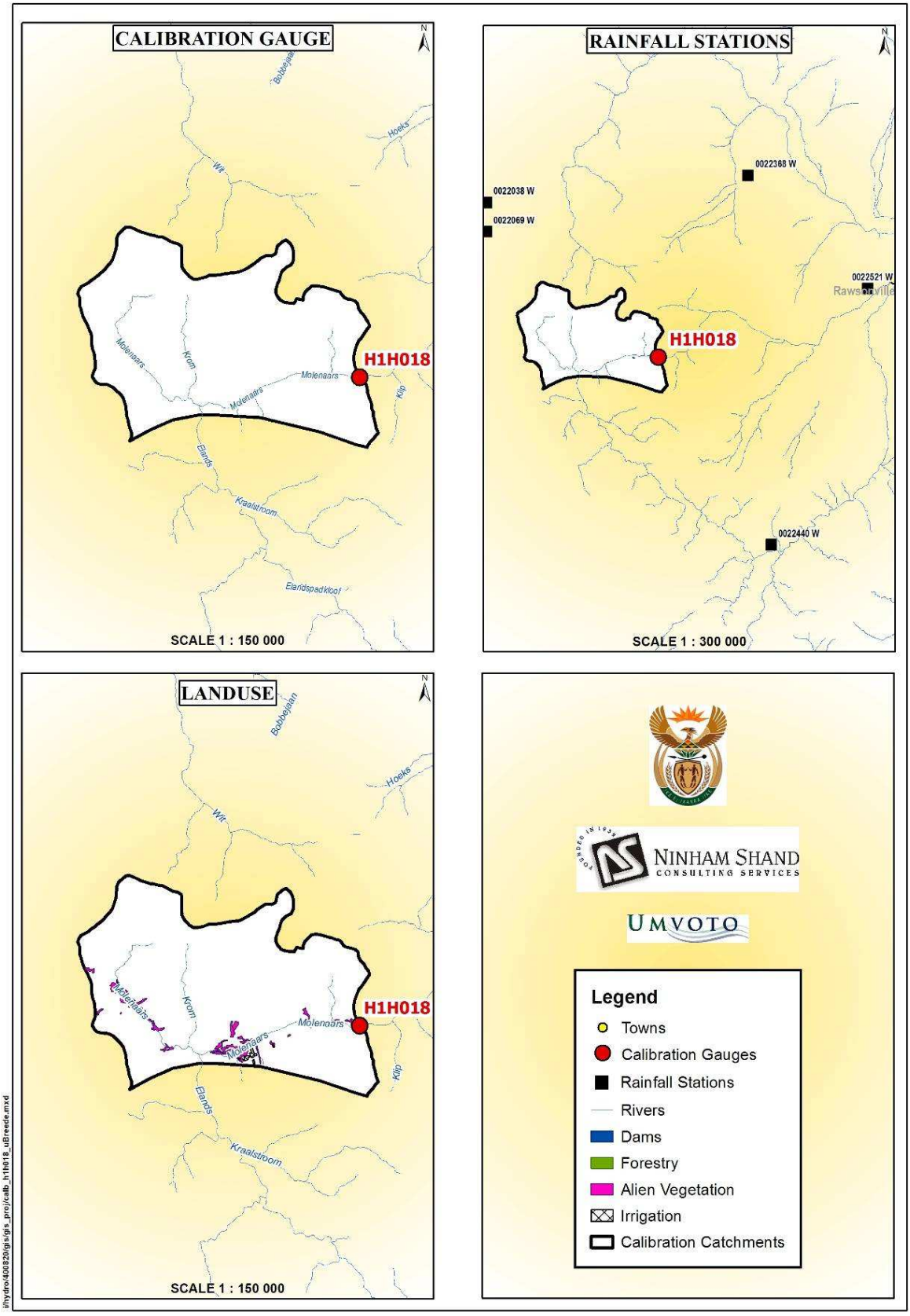


Figure 5.16: H1H018 Subcatchment hydrology information

5.6.2 Model configuration

Figure 5.17 shows the model configuration for subcatchment H1H018. Very little development occurs in the catchment. Apart from some small irrigated fields, which are entirely irrigated with groundwater, and scattered pockets of riparian alien vegetation the catchment is in its natural state.

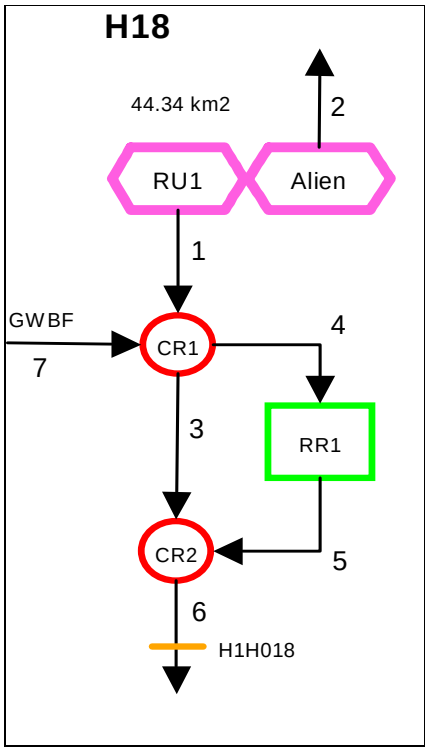


Figure 5.17: H1H018 Subcatchment Configuration

5.6.3 Evaluation and preparation of flow sequences

A detailed assessment of the flow gauges in the Upper Breede catchment was made and is documented in *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models, Report No. 3 : The Assessment of Flow Gauging Stations* (DWAF, 2007c). The observed flows at H1H018 were simulated for the period 1991 - 2004. The record was patched using gauge H1H033 and the rainfall gauges used to generate the catchment rainfall file. The patched values were manually checked for consistency with the records they were patched from and edited manually if required. The patched observed flow record for H1H018 is shown in Appendix C6.

5.6.4 Calibration (1991 - 2004)

Details of the rainfall stations used to generate catchment rainfall for H1H018 are shown in Table 5.28. The updated MAP for this catchment is estimated to be 1945 mm which is equal to the MAP used in the BRBS (DWAF, 2002). The MAP was however originally set at 1234 mm as extracted from the updated MAP rainfall surface. This in effect makes the MAP a calibration parameter. This can be justified by considering that the runoff coefficient for the catchment is unacceptably high should the MAP be set at 1234 mm.

Table 5.28: Rainfall stations for calibration at H1H018

RAINFALL STATION	MAP	PERIOD OF	RECORD

NUMBER		RECORD	LENGTH
022038w	763	1927-2004	77
022069w	755	1927-1993	66
022368w	1009	1932-1976	44
022521w	613	1927-1994	67
022440w	916	1952-2004	52

The BRBS (2002) Pitman parameters were used during initial model calibration. These parameters were then improved until an acceptable fit between the observed and simulated stream flow data was obtained. The final Pitman parameters are shown in Table 5.29 and Table 5.30 displays the patched observed and simulated statistics for H1H018. Graphs showing monthly, annual and mean monthly flows as well as a gross yield plot for each calibration are also included in Figure 5.18.

Note that in Table 5.26 the unpatched observed MAR is larger than the patched observed MAR. Usually the patched record MAR is larger than its unpatched counterpart, however in this instance this is not the case. This outcome is an effect of the patching process together with the incremental catchment subtraction procedure. In other words, the increase in MAR in the upstream gauge, H1H033, during the patching process was larger than the corresponding increase in the MAR of the downstream gauge, H1H018 (even though each monthly value in H1H033 is lower than its H1H018 counterpart). The incremental difference between the two therefore became larger, which resulted in the smaller MAR for the incremental H1H018.

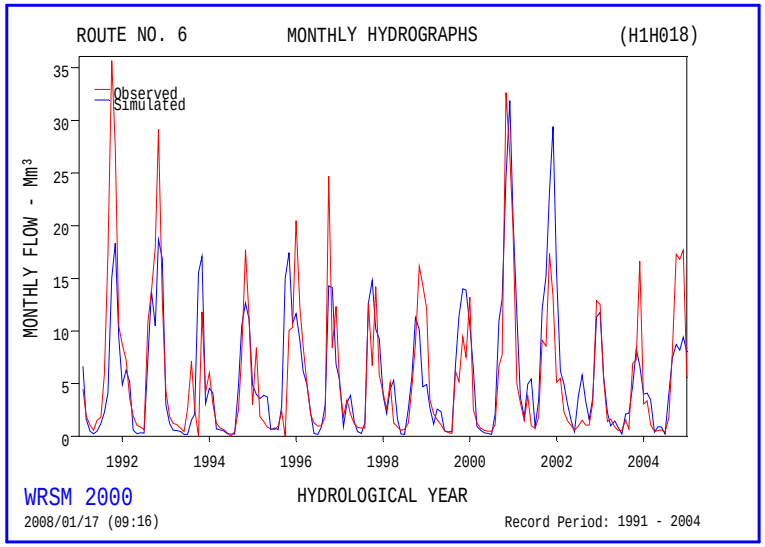
Also in Table 5.26 note that the naturalised MAR is lower than the observed MAR. This is due to the fact that the naturalised MAR is valid for the entire period from 1927 to 2004 whereas the observed MAR was calculated for the observed period only (1991-2004). This attribute is also present in the upstream gauge H1H033.

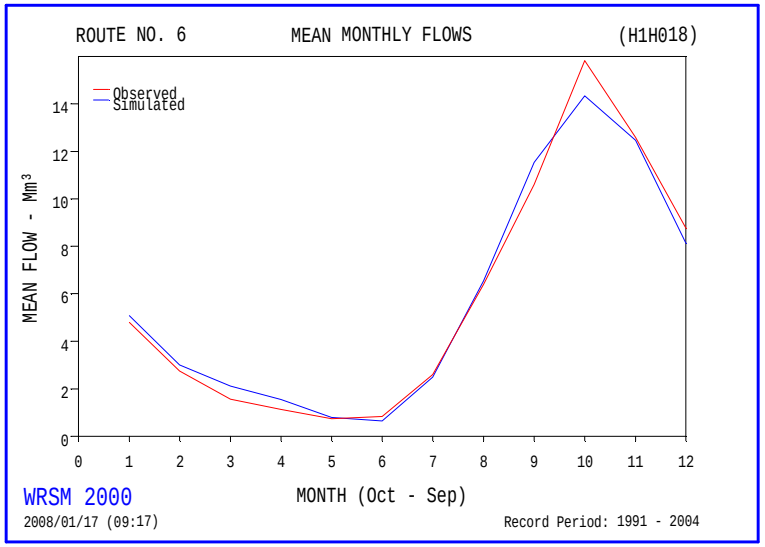
Table 5.29: H1H018 Final Pitman Parameters

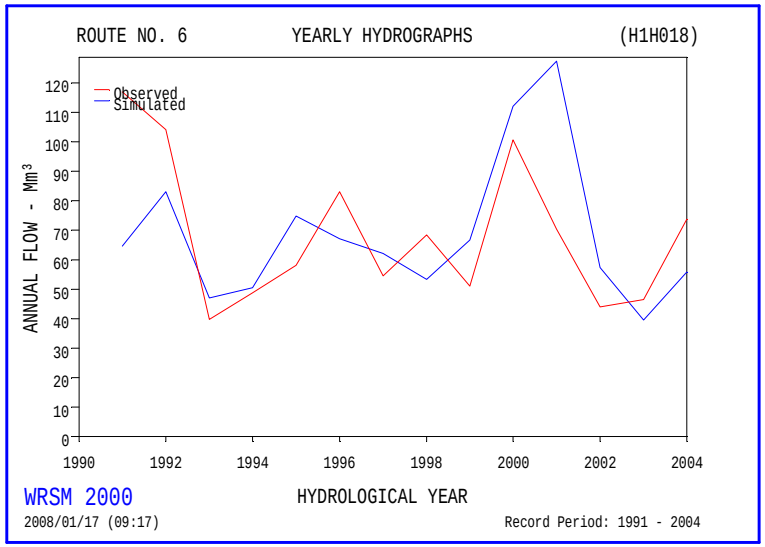
POW	SL	ST	FT	GW	ZMIN	ZMAX	PI	TL	GL	R
2	0	250	50	0	0	200	1.5	0.5	0	0

Table 5.30: H1H018 Calibration Results (Statistical Indices)

	SIMULATED	OBSERVED	DIFFERENCE (%)
MAR (Mm^3)	68.7	68.6	-0.2
Mean (Log)	1.8	1.8	-0.2
Std Dev	24.5	24.5	-0.2
Std Dev (Log)	0.1	0.1	7.4
Seasonal index	35.5	37.3	5.1







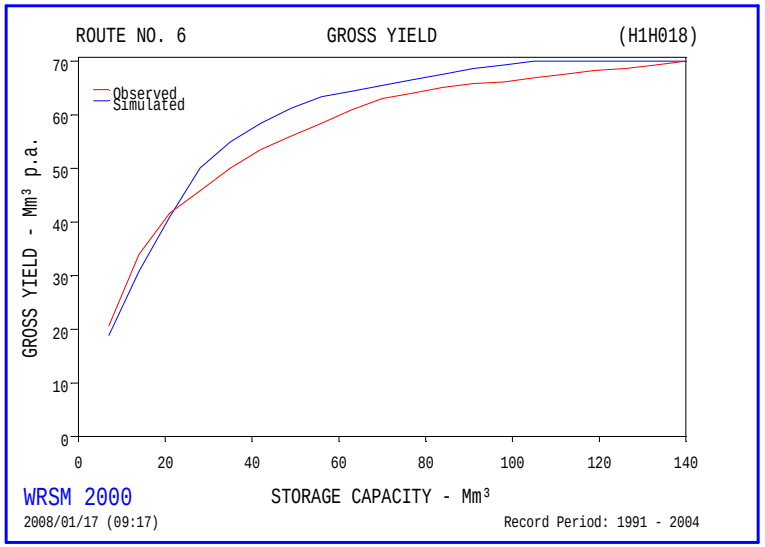


Figure 5.18: H1H018 Calibration Results (Graphical Comparison)

5.7 H1H033: Elands at Hawequas Forest Reserve

5.7.1 Subcatchment data

Land use in the Upper Breede catchment has been documented in a separate report entitled *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Report 4 (Land Use and Water Requirements): Volume 1 (Data in Support of Catchment Modelling)* (DWAF, 2007d). Table 5.31 presents a summary of the catchment data for the subcatchment H1H033. Details of the data used in the model calibration are given in Appendix A7 and are summarised in Table 5.32. Figure 5.19 shows detailed maps of the catchment.

Table 5.31: Summary of information for H1H033

H1H033	
Subcatchment area from GIS, km^2	68.4
Above farm dams	-
Below farm dams	68.4
Forestry area, km^2	-
Alien vegetation condensed area, km^2	0.3
Irrigation area, km^2	-
From farm dams	-
From river	-
Farm dam: Area, km^2 / Volume, Mm^3	- / -
Groundwater baseflow contribution, Mm^3/a	2.7
Subcatchment MAP, mm	1945
Calibration period (Hydrological years)	1991 - 2004
Observed MAR for calibration period, Mm^3/a	89.4
Patched observed MAR for calibration period, Mm^3/a	97.5
Simulated MAR for calibration period, Mm^3/a	98.4
Naturalised MAR (1927-2004), Mm^3/a	84.1 *
Naturalised MAR including GW baseflow (1927-2004), Mm^3/a	86.8 *
Runoff coefficient	65.2%

* See section 5.7.4

Table 5.32: Detailed catchment information for H1H033

APPENDIX	CONTENTS	FORMAT
A7	Hydrological information for model calibration	Table
B7	Catchment Rainfall File	Monthly time series
C7	Patched observed flow record (H1H033)	Monthly time series
D7	Naturalised sequence	Monthly time series

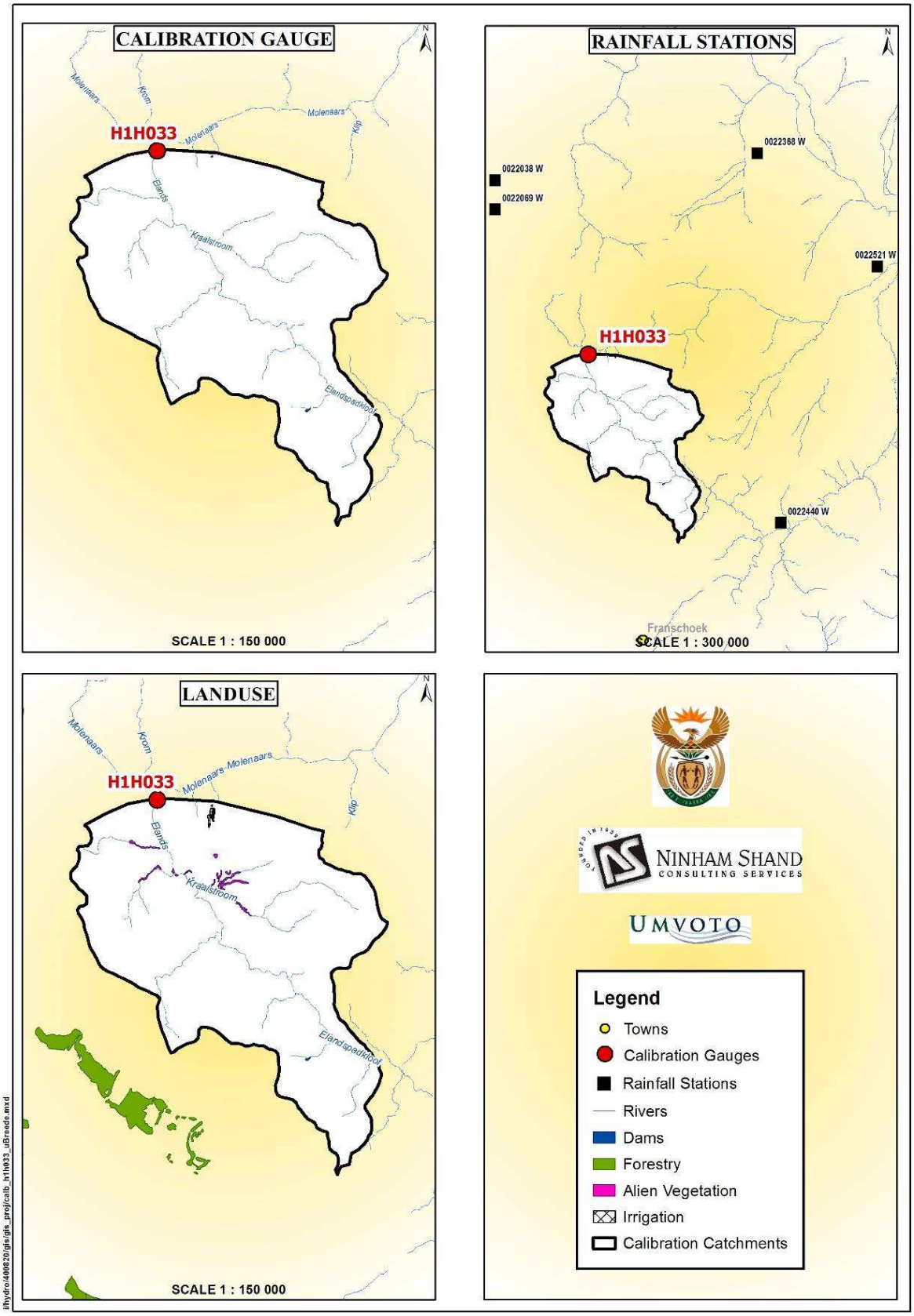


Figure 5.19: H1H033 Subcatchment hydrology information

5.7.2 Model configuration

Figure 5.20 shows the model configuration for subcatchment H1H033. Like its downstream counterpart, H1H018, this catchment is undeveloped. Some riparian vegetation encroaches the river channel in the present-day scenario, though it has been more widespread in the past. The groundwater contribution to baseflow is small.

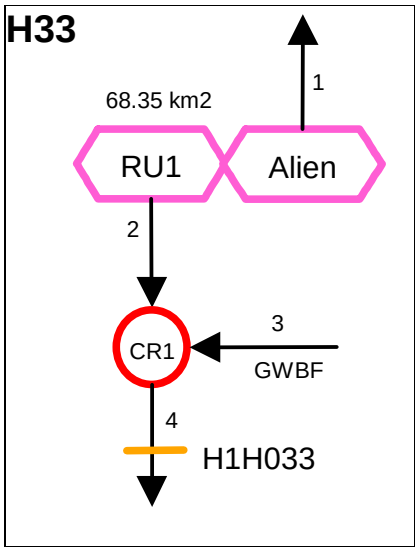


Figure 5.20: H1H033 Subcatchment Configuration

5.7.3 Evaluation and preparation of flow sequences

A detailed assessment of the flow gauges in the Upper Breede catchment was made and is documented in *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models, Report No. 3 : The Assessment of Flow Gauging Stations* (DWAF, 2007c). The incremental observed flows at H1H033 were simulated for the period 1991-2004. The record was patched using gauge H1H018 and the rainfall gauges used to generate the subcatchment rainfall file. The patched values were manually checked for consistency with the records they were patched from and edited manually if required. The patched incremental observed flow record for H1H033 is shown in Appendix C7.

5.7.4 Calibration (1991 - 2004)

Details of the rainfall stations used to generate catchment rainfall for H1H033 are shown in Table 5.33. The updated MAP for this catchment is estimated to be 1945 mm which is equal to the MAP used for H1H018 in the BRBS (DWAF, 2002). The MAP was however originally set at 1290 mm as extracted from the updated MAP rainfall surface. This in effect makes the MAP a calibration parameter. This can be justified by considering that the runoff coefficient for the catchment is unacceptably high should the MAP be set at 1290 mm.

Table 5.33: Rainfall stations for calibration at H1H033

RAINFALL STATION NUMBER	MAP	PERIOD OF RECORD	RECORD LENGTH
022038w	763	1927-2004	77
022069w	755	1927-1993	66
022368w	1009	1932-1976	44
022521w	613	1927-1994	67
022440w	916	1952-2004	52

The BRBS (DWAF, 2002) Pitman parameters for gauge H1H018 were used during initial model calibration. These parameters were then improved until an acceptable fit between the observed and simulated stream flow data was obtained. The final Pitman parameters are shown in Table 5.34 and Table 5.35 displays the patched observed and simulated statistics for H1H033. Graphs showing monthly, annual and mean monthly flows as well as a gross yield plot for each calibration are also included in Figure 5.21.

Note that in Table 5.31 the naturalised MAR is lower than the observed MAR. This is due to the fact that the naturalised MAR is valid for the entire period from 1927 to 2004 whereas the observed MAR was calculated for the observed period only (1991-2004). This attribute is also present in the downstream gauge H1H018.

Table 5.34: H1H033 Final Pitman Parameters

POW	SL	ST	FT	GW	ZMIN	ZMAX	PI	TL	GL	R
2	0	250	20	0	0	300	1.5	0	0	0

Table 5.35: H1H033 Calibration Results (Statistical Indices)

	SIMULATED	OBSERVED	DIFFERENCE (%)
MAR (Mm^3)	98.4	97.5	-0.9
Mean (Log)	2.0	1.9	-0.9
Std Dev	39.1	46.2	18.2
Std Dev (Log)	0.2	0.1	23.4
Seasonal index	40.7	41.7	2.6

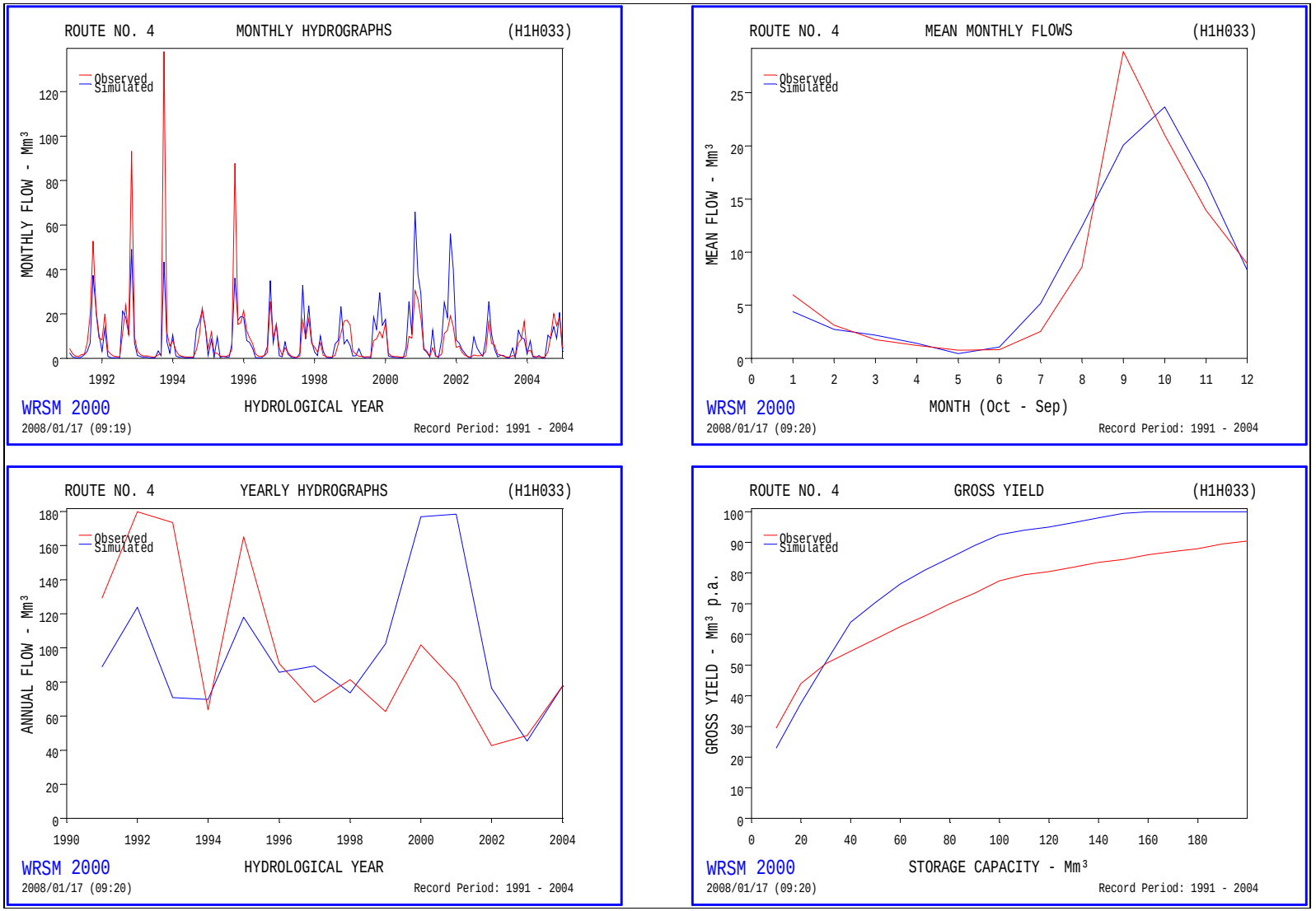


Figure 5.21: H1H033 Calibration Results (Graphical Comparison)

5.8 H4H006: Breede River at Lower Brandvlei

5.8.1 Subcatchment data

Land use in the Upper Breede catchment has been documented in a separate report entitled *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Report 4 (Land Use and Water Requirements): Volume 1 (Data in Support of Catchment Modelling)* (DWAF, 2007d). Table 5.36 presents a summary of the catchment data for the subcatchment H4H006. Details of the data used in the model calibration are given in Appendix A8 and are summarised in Table 5.37. Figure 5.22 shows detailed maps of the catchment.

Table 5.36: Summary of information for H4H006

H4H006	HIGH MAP	LOW MAP
Subcatchment area from GIS, km^2	306.4	569.0
Above farm dams	6.6	68.5
Below farm dams	299.8	500.5
Forestry area, km^2	-	6.5
Alien vegetation condensed area, km^2	1.3	14.9
Irrigation area, km^2	65.4	
From farm dams	17.1	
From river	48.3	
Farm dam: Area, km^2 / Volume, Mm^3	5.6 / 21.95	
Groundwater baseflow contribution, Mm^3/a	20.5	
Subcatchment MAP, mm	1211	675
Calibration period (Hydrological years)	1980 - 1989	
Patched observed incremental MAR for calibration period, Mm^3/a	62.8	
Simulated MAR for calibration period, Mm^3/a	N/A	
Naturalised incremental MAR (1927-2004), Mm^3/a	194.5	
Naturalised incremental MAR including GW baseflow (1927-2004), Mm^3/a	215.0	
Runoff coefficient	25.8%	

Table 5.37: Detailed catchment information for H4H006

APPENDIX	CONTENTS	FORMAT
A8	Hydrological information for model calibration	Table
B8	Catchment Rainfall File	Monthly time series
C8	Patched observed flow record (H4H006)	Monthly time series
D8	Naturalised flow sequence	Monthly time series

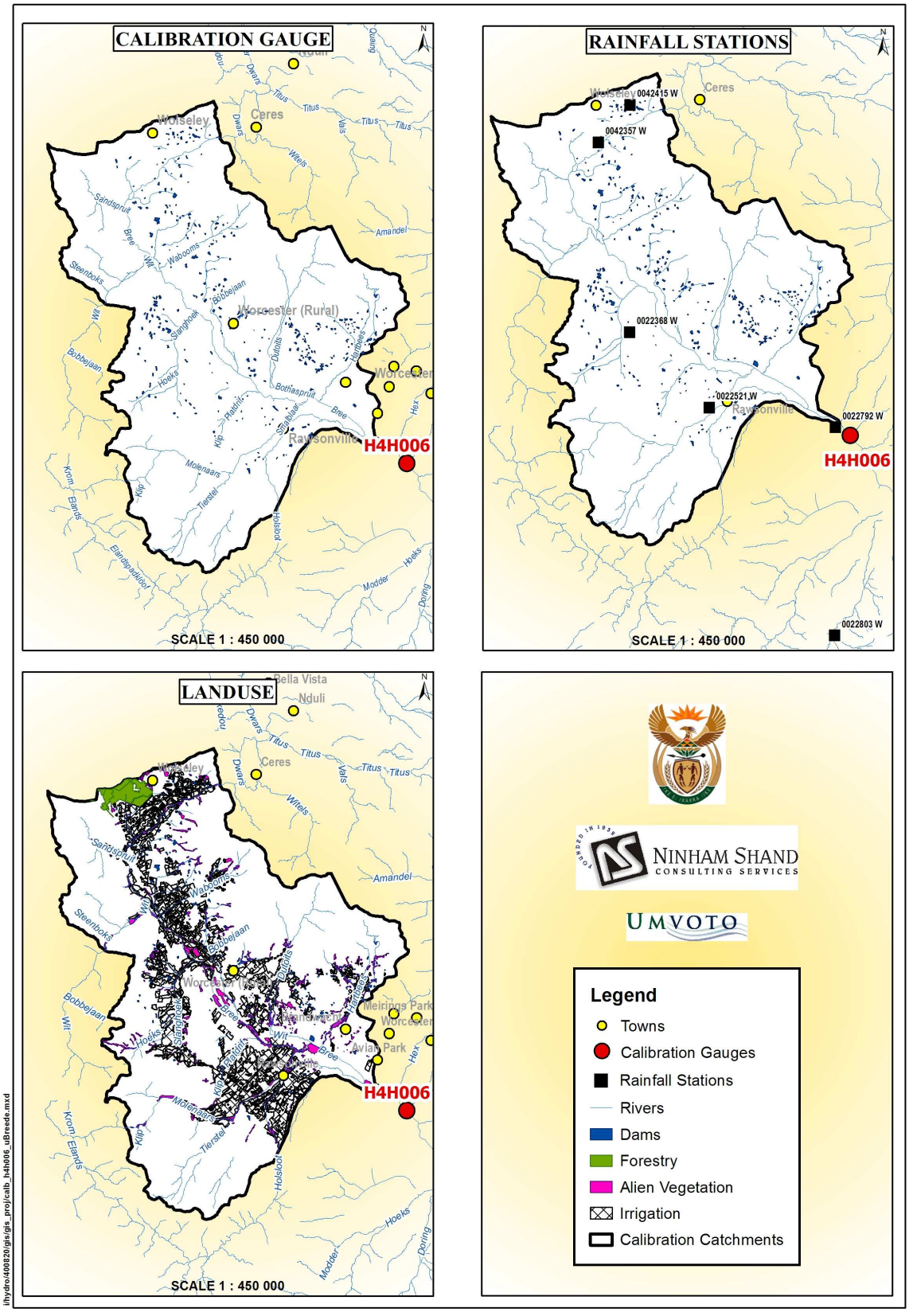


Figure 5.22: H4H006 Subcatchment hydrology information

5.8.2 Model configuration

Figure 5.23 shows the model configuration for subcatchment H4H006. The catchment was separated into a high MAP and a low MAP subcatchment area contributing to runoff. The catchment is well developed and has canal inflows from H1H022 upstream and an export to Brandvlei from the Holsloot and Smalblaar canal.

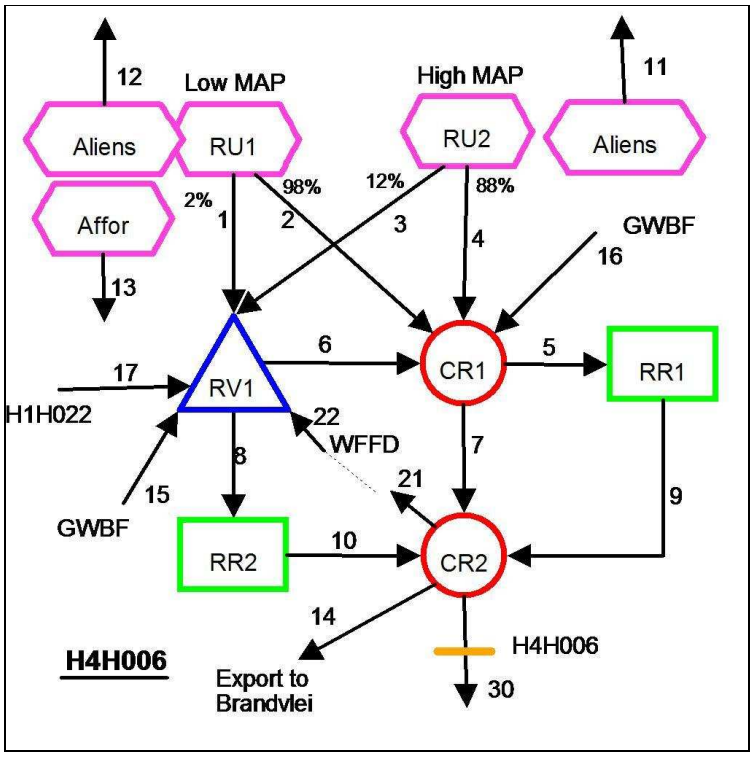


Figure 5.23: H4H006 Subcatchment Configuration

5.8.3 Evaluation and preparation of flow sequences

A detailed assessment of the flow gauges in the Upper Breede catchment was made and is documented in *The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models, Report No. 3 : The Assessment of Flow Gauging Stations* (DWAF, 2007c). It was recommended that calibration of flows be attempted at this flow gauge because one had not been achieved in previous studies. The patched incremental observed flow record for H4H006 is shown in Appendix C8.

5.8.4 Calibration (1980 - 1989)

Details of the rainfall stations used to generate catchment rainfall for H4H006 are shown in Table 5.38. The updated MAP for this catchment is estimated to be 1211 mm for the high MAP area and 675 mm for the low MAP area.

An attempt was made to calibrate the simulated flows at H4H006 but the simulated flows were consistently over-estimated compared to the observed flows, and an acceptable calibration was therefore not achieved. The observed flow record has a poor accuracy rating and the flow gauge is known to underestimate river flows due to being located in a wide section of the river. Therefore, in order to generate naturalised and current flows at this point in the catchment for the WRYM, the Pitman parameters for the calibrated subcatchments at H4H017 from the BRBS (DWAF, 2002) were transferred to this subcatchment and are shown in Table 5.39.

Table 5.38: Rainfall stations for calibration at H4H006

RAINFALL STATION NUMBER	MAP	PERIOD OF RECORD	RECORD LENGTH
022368w	1009	1932 to 1976	45
022521w	613	1927 to 1994	68
022792w	265	1937 to 1978	42
022803w	247	1929 to 2004	76
042357a	568	1929 to 1987	59
042415w	616	1927 to 1960	34

Table 5.39: H4H006 - Pitman Parameters transferred from BRBS

POW	SL	ST	FT	GW	ZMIN	ZMAX	PI	TL	GL	R
2	0	300	4	0	100	900	1.5	0	0	0

6 FLOW SEQUENCE GENERATION

6.1 Naturalised runoff sequences

After the completion of the calibration process, naturalised flow sequences can be produced at the location of each flow gauge. The procedure involves the following steps:

i) Simulate a natural runoff sequence for the entire period in the WRSM2000 model where all landuse components are set to zero
ii) Subtracting the simulated sequence modelled during the calibration process from this natural sequence. This then represents the water uses in the system
iii) Add the water uses to the patched observed record and, where there is no record, append the naturalised flow sequence.

A summary of the naturalised flows in the Upper Breede subcatchments compared to the naturalised flows obtained in the BRBS (DWAF, 2002) is presented in Table 6.1. The naturalised flow time series are included in Appendix D.

Table 6.1: Naturalised incremental runoff in the Upper Breede catchment

	BRBS (DWAF, 2002) Mm^3/a (1925-1990)	**WAAS Mm^3/a (1927-2004)**	**Percentage difference**
H1H003	123.9	81.8	-34.0%
H1H006	134.9	150.2	+11.3%
H1H007	125.4	131.7	+5.0%
H1H013	30.9	34.2	+10.7%
H1H018	144.1	62.4	-56.7%
H1H012	157.9*	98.8	+153.7%
H1H033		86.8	
H4H006		215.0	
TOTAL	**717.1**	**860.9**	+20.1%

7 CONCLUSIONS

This report presents the results of the catchment hydrological modelling for the Upper Breede River with the updated WRSM2000 model. The key objective of this task was to extend the naturalisation of streamflow to the 2004 hydrological year, which has been achieved. Wherever possible, the calibration of streamflow has been made on the most up-to-date period of record available at each flow gauge and most gauges had sufficient record length on which to calibrate. Additionally, the representation of groundwater contributions to streamflow has been made in the monthly modelling process.

Most subcatchments in the study area are adequately represented by suitable active rainfall stations except for those located in mountainous catchments. The MAPs generated from the new rainfall surface generally show an increase in both the CCWR and DWAF MAPs used previously. Some subcatchments in the mountainous regions are still under-represented in terms of their MAP due to the paucity of adequate rainfall stations in these regions.

8 REFERENCES

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Electronic File Path:
I:\HYDRO\400820 WC Modelling\WRSM2000\Reports\Vol 2 - Upper Breede\Final\Vol2 Hydrology_Final.doc

APPENDIX A:

HYDROLOGICAL INFORMATION FOR MODEL CALIBRATION

APPENDIX NUMBER	CALIBRATION GAUGE
A1	H1H003
A2	H1H006
A3	H1H007
A4	H1H012
A5	H1H013
A6	H1H018
A7	H1H033
A8	H4H006

GAUGE:	**H1H003**											
								SUB-CATCHMENT AREAS (km^2)				
Main Catchment:	Breede							Above farm dam boundary	4.99	1%	HIGH MAP	
Subcatchment:	Ceres (incremental)		*H1H013*						438.57	74%	LOW MAP	
River:	Breede							Below farm dam boundary	48.42	8%	HIGH MAP	
Location:	Ceres Toeken Gebied								97.02	16%	LOW MAP	
Subcatchment area:	589.00 km^2							**TOTAL AREA**	**589.00**			
LANDUSE					**YEAR**							
	1964	**1967**	**1976**	**1978**	**1988**	**1990**	**2004**					
Irrigation (km^2)	**31.58**	**32.94**	**41.67**	**43.23**	**53.31**	**56.43**	**53.92**					
Agtertuin: farm dams	1.66	1.75	2.31	2.44	3.19	3.40	3.54	**Low MAP**		orchard	88%	
Agtertuin: river	16.27	16.81	19.29	19.91	22.63	23.40	24.37	**Low MAP**		pasture	9%	
H1H003 (inc): farm dams	10.42	10.98	15.32	15.93	20.99	22.63	23.54	**Low MAP**		vegetable	1%	
H1H003 (inc): rivers	1.09	1.15	1.61	1.69	2.20	2.37	2.47	**Low MAP**		vineyard	2%	
Afforestation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.37**	**Low MAP**				
Alien Vegetation (km^2)	**1.00**	**1.15**	**2.38**	**1.94**	**6.60**	**7.10**	**1.87**	**Low MAP**		42% rip	100%TT	
											a	b
Ben Etive Dam: Vol	0.00	0.151	0.151	0.151	0.151	0.151	0.151	High MAP			0.391	1.018
Ben Etive Dam: Area	0.00	0.06	0.06	0.06	0.06	0.06	0.06			Catchment area = 9 km2		
Rooikloof Dam: Volume	0.00	0.00	0.151	0.151	0.151	0.500	0.500	High MAP			0.362	1.018
Rooikloof Dam: Area	0.00	0.00	0.05	0.05	0.05	0.18	0.18			Catchment area = 11 km2		
Agtertuin farm Dams: Vol	3.29	3.29	3.74	3.90	6.53	6.93	6.62	Low MAP				
Agtertuin farm Dams: Area	1.25	1.25	1.43	1.50	2.60	2.77	2.64					
H1H003inc Farm dams: Vol	14.12	14.12	17.74	17.82	23.55	25.37	24.23	Low MAP				
H1H003inc Farm dams:Area	5.93	5.93	7.57	7.61	10.25	11.10	10.57					

Area:	**a(cap)^b**
a	0.35
b	1.069

S-PAN (H10C)	152	189	233	244	205	184	116	72	49	49	63	95
A-PAN (H10C)	192	240	295	309	260	234	148	91	62	62	80	121

Data Sources
1995 (BRHS)
2002 (BRBS) 61% OF IRRIGATED AREA SUPPLIED BY GW
2004 (Berg WAAS)

Notes
Condensed alien veg area

GAUGE:	**H1H006**	
Main Catchment:	Breede	
Subcatchment:	Breede	
River:	Breede	
Location:	Witbrug	
Subcatchment area:	96.47	km^2

SUB-CATCHMENT AREAS (km^2)	
Above farm dam boundary	0.00
Below farm dam boundary	96.00
TOTAL AREA	**96.00**

LANDUSE	**YEAR**				
	1964	**1985**	**1990**	**2004**	
Irrigation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	
Afforestation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	
Alien Vegetation (km^2)	1.25	3.60	8.22	0.28	80.6% riparian 56%TT / 44%TS
Farm Dams: Volume (Mm^3)	0.00	0.00	0.00	0.00	
Farm Dams: Area (km^2)	0.00	0.00	0.00	0.00	

Area:	**a(cap)[b]**
Coefficient a	0
Coefficient b	0.00

S-PAN (H10D)	151	188	231	242	203	183	116	71	48	49	63	95
A-PAN (H10D)	191	238	293	307	258	232	147	90	61	62	80	120

Data Sources
1995 (BRHS)
2002 (BRBS)
2004 (Berg WAAS)
Notes
Condensed alien veg area

GAUGE:	**H1H007**		
Main Catchment:	Breede	**SUB-CATCHMENT AREAS**	
Subcatchment:	Wit	Above farm dam boundary	0
River:	Wit	Below farm dam boundary	84
Location:	Drosterskloof	**TOTAL AREA**	**84**
Subcatchment area:	85.49 km^2		

LANDUSE	**YEAR**				
	1964	**1985**	**1990**	**2004**	
Irrigation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	
Afforestation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	
Alien Vegetation (km^2)	1.60	2.31	5.10	0.09	All Riparian 57% TT / 43%TS
Farm Dams: Volume (Mm^3)	0.00	0.00	0.00	0.00	
Farm Dams: Area (km^2)	0.00	0.00	0.00	0.00	

Area:	**a(cap)[b]**
Coefficient a	0
Coefficient b	0.00

S-PAN (H10E)	147	184	226	237	199	179	113	70	47	48	61	93
A-PAN (H10E)	187	233	287	300	252	227	143	88	60	60	78	117

Data Sources
1995 (BRHS)
2002 (BRBS)
2004 (Berg WAAS)
Notes
Condensed alien veg area

GAUGE:	**H1H012 & H1R002**											
Main Catchment:	Breede					**SUB-CATCHMENT AREAS**						
Subcatchment:	Holsloot (incremental)					Above dam boundary		56	Stettynskloof Dam			
River:	Holsloot					Below dam boundary		96				
Location:	Daschboch River					**TOTAL AREA**		**152**				
Subcatchment area:	151.77	km^2										

LANDUSE	YEAR											
	1958	**1979**	**1980**	**1981**	**1984**	**1988**	**1990**	**2004**				
Irrigation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.16**	all vineyard			
Afforestation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**				
Alien Vegetation (km^2)	1.30	1.30	1.30	1.30	1.30	3.61	8.22	0.21	80.1% riparian		56%TT 44%TS	
Farm Dams: Volume (Mm^3)	5.00	5.00	15.39	15.39	15.39	15.39	15.39	15.39				
Farm Dams: Area (km^2)	0.52	0.52	0.98	0.98	0.98	0.98	0.98	0.98				

Area:	**a(cap)[b]**
Coefficient a	0.21
Coefficient b	0.57

S-PAN (H10K)	142	177	218	228	192	172	109	67	45	46	59	89
A-PAN (H10K)	179	223	275	288	242	218	137	85	57	58	75	113

Data Sources
1995 (BRHS)
2002 (BRBS)
2004 (Berg WAAS) 100% OF IRRIGATED AREA SUPPLIED BY GW

Notes
Condensed alien veg area

GAUGE:	**H1R002**											
Main Catchment:	Breede					**SUB-CATCHMENT AREAS**						
Subcatchment:	Holsloot					Above dam boundary	56	Stettynskloof Dam				
River:	Holsloot					Below dam boundary	0					
Location:	Stettynskloof Dam					**TOTAL AREA**	**56**					
Subcatchment area:	55.70	km^2										

LANDUSE		**YEAR**											
		1958	**1979**	**1980**	**1981**	**1984**	**1988**	**1990**	**2004**				
Irrigation (km^2)		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**				
Afforestation (km^2)		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**				
Alien Vegetation (km^2)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Farm Dams: Volume (Mm^3)		5.00	5.00	15.39	15.39	15.39	15.39	15.39	15.39				
Farm Dams: Area (km^2)		0.52	0.52	0.98	0.98	0.98	0.98	0.98	0.98				
Area:	**a(cap)[b]**												
Coefficient a	0.21												
Coefficient b	0.57												
S-PAN (H10K)	142	177	218	228	192	172	109	67	45	46	59	89	
A-PAN (H10K)	179	223	275	288	242	218	137	85	57	58	75	113	

Data Sources
1995 (BRHS)
2002 (BRBS)
2004 (Berg WAAS)
Notes
Condensed alien veg area

GAUGE:	**H1H013**											
					SUB-CATCHMENT AREAS							
Main Catchment:	Breede				Above farm dam boundary		0.29	High MAP				
Subcatchment:	Koekedouw						0.71	Low MAP				
River:	Koekedouw				Below farm dam boundary		14.04	High MAP				
Location:	Ceres						37.97	Low MAP			(3.3 km2 is D/S	
Subcatchment area:	53.00	km^2			**TOTAL AREA**		**53.00**				of Ceres Dam)	
LANDUSE				**YEAR**								
	1964	**1967**	**1976**	**1978**	**1988**	**1990**	**2004**					
Irrigation (km^2)	**1.77**	**1.77**	**2.12**	**2.34**	**2.89**	**2.89**	**9.85**					
Source = Farm dams	1.49	1.49	1.78	1.96	2.43	2.43	8.28		96% orchard			
Source = River	0.26	0.26	0.31	0.35	0.42	0.42	1.44		4% pasture (8% D/S of Ceres Dam)			
Source = River - D/S Ceres Dam	0.02	0.02	0.03	0.03	0.04	0.04	0.13					
Afforestation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.14**	Low MAP				
Alien Vegetation (km^2)	0.00	0.00	0.00	0.01	0.01	0.03	0.02	High MAP		100%TT		
	0.08	0.08	0.10	0.18	0.23	0.61	0.46	Low MAP		51%rip		
	0.08	**0.08**	**0.10**	**0.19**	**0.24**	**0.64**	**0.48**					
Farm Dams: Volume (Mm^3)	0.66	0.66	1.11	1.42	2.16	2.16	4.39					
Farm Dams: Area (km^2)	0.19	0.19	0.32	0.40	0.60	0.60	1.19					
Area:	**a(cap)^b**											
Coefficient a	0.287											
Coefficient b	0.96											
S-PAN (H10C)	152	189	233	244	205	184	116	72	49	49	63	95
A-PAN (H10C)	192	240	295	309	260	234	148	91	62	62	80	121

Data Sources
1995 (BRHS)
2002 (BRBS)
2004 (Berg WAAS)

78% OF IRRIGATED AREA SUPPLIED BY GW

Notes
Condensed alien veg area

GAUGE:	**H1H018**				
Main Catchment:	Breede		**SUB-CATCHMENT AREAS**		
Subcatchment:	Molenaars (incremental)	H1H033	Above farm dam boundary	0.00	0%
River:	Molenaars		Below farm dam boundary	44.34	100%
Location:	Hawequas Forest Reserve		**TOTAL AREA**	**44.34**	
Subcatchment area:	44.34 km^2				

LANDUSE	**YEAR**						
	1953	**1961**	**1968**	**1984**	**1990**	**2004**	
Irrigation (km^2)	**0.00**	**0.00**	**1.11**	**1.11**	**1.11**	**0.09**	
Source = Farm dams	0.00	0.00	0.00	0.00	0.00	0.00	
Source = River	0.00	0.00	1.11	1.11	1.11	0.09	
	0%	*0%*	*0%*	*0%*	*0%*	*0%*	
	0%	*0%*	*100%*	*100%*	*100%*	*100%*	
Afforestation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
Alien Vegetation (km^2)	**-**	**-**	**1.67**	**3.42**	**9.01**	**0.52**	3.3% riparian 56%TT 44%TS
Farm Dams: Volume (Mm^3)	0.00	0.00	0.00	0.00	0.00	0.00	
Farm Dams: Area (km^2)	0.00	0.00	0.00	0.00	0.00	0.00	

Area:	**a(cap)^b**											
Coefficient a												
Coefficient b												
S-PAN (H10J)	144	180	222	232	195	175	111	68	46	46	60	91
A-PAN (H10J)	182	227	280	293	246	221	140	86	58	59	76	115

Data Sources
1995 (BRHS)
2002 (BRBS)
2004 (Berg WAAS)

100% OF IRRIGATED AREA SUPPLIED BY GW

Notes
Condensed alien veg area

GAUGE: **H1H033**

Main Catchment:	Breede		**SUB-CATCHMENT AREAS**		
Subcatchment:	Molenaars		Above farm dam boundary	0.00	0%
River:	Molenaars		Below farm dam boundary	68.35	100%
Location:	Hawequas Forest Reserve		**TOTAL AREA**	**68.35**	
Subcatchment area:	68.35	km^2			

LANDUSE	**YEAR**											
	1953	**1961**	**1968**	**1984**	**1990**	**2004**						
Irrigation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.05**						
Source = Farm dams	0.00	0.00	0.00	0.00	0.00	0.00						
Source = River	0.00	0.00	0.00	0.00	0.00	0.05						
	0%	*0%*	*0%*	*0%*	*0%*	*0%*						
	0%	*0%*	*0%*	*0%*	*0%*	*100%*						
Afforestation (km^2)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**						
Alien Vegetation (km^2)	**-**	**-**	**0.46**	**1.30**	**8.21**	**0.30**	24.5% riparian		56%TT / 44%TS			
Farm Dams: Volume (Mm^3)	0.00	0.00	0.00	0.00	0.00	0.00						
Farm Dams: Area (km^2)	0.00	0.00	0.00	0.00	0.00	0.00						
Area:	**a(cap)^b**											
Coefficient a	0.7587											
Coefficient b	0.49588											
S-PAN (H10J)	144	180	222	232	195	175	111	68	46	46	60	91
A-PAN (H10J)	182	227	280	293	246	221	140	86	58	59	76	115

Data Sources
1995 (BRHS)
2002 (BRBS)
2004 (Berg WAAS)
Notes
Condensed alien veg area

GAUGE:	**H4H006**											
						SUB-CATCHMENT AREAS						
Main Catchment:	Breede					Above farm dam boundary			6.60	High MAP		
Subcatchment:	Breede (incremental)			*H1H006*	*H1H007*				68.50	Low MAP		
River:	Breede			*H1H018*	*H1H012*	Below farm dam boundary			299.80	High MAP		
Location:									500.54	Low MAP		
Subcatchment area:	875.44	km^2				**TOTAL AREA**			**875.44**			
LANDUSE			**YEAR**									
	1980	**1981**	**1988**	**1990**	**2004**							
Irrigation (km^2)	**61.6**	**63.1**	**73.6**	**76.0**	**137.3**			21%	orchard			
Source = Farm dams	15.9	16.3	19.2	19.8	35.8	Low MAP		5%	pasture			
Source = River	45.7	46.8	54.4	56.2	101.5	Low MAP		74%	vineyard			
Afforestation (km^2)	**7.9**	**7.8**	**7.8**	**3.9**	**6.5**	Low MAP						
Alien Vegetation (km^2)	0.5	0.5	0.9	1.3	1.3	High MAP		51% rip	25% TS	75% TT		
	5.8	6.1	10.8	15.5	14.9	Low MAP		66% rip	25% TS	75% TT		
	14.1	**14.0**	**24.5**	**29.2**	**16.2**							
Farm Dams: Volume (Mm^3)	9.63	9.68	11.75	11.85	21.95							
Farm Dams: Area (km^2)	2.52	2.54	3.06	3.08	5.57							
Area:	**a(cap)[b]**											
a	0.287											
b	0.96											
S-PAN (H10F,G,H)	149	185	228	239	201	181	114	70	48	48	62	94
A-PAN (H10F,G,H)	188	235	289	303	254	229	144	89	60	61	78	118

Data Sources
1950-1990 (WCSA)
1996 (VASF)
2004 (Berg WAAS)
2002 (BRBS)
Notes
Condensed alien veg area

APPENDIX B:

CATCHMENT RAINFALL FILES

APPENDIX NUMBER	CALIBRATION GAUGE
B1	H1H003
B2	H1H006
B3	H1H007
B4	H1H012
B5	H1H013
B6	H1H018
B7	H1H033
B8	H4H006

AVERAGE RAINFALL ON CATCHMENT H1H003

DETAILS OF RAINFALL STATIONS USED

042227W.NS	1927 TO 2004
042257W.NS	1961 TO 2004
042415W.NS	1927 TO 1960
042582W.NS	1933 TO 2004

RAINFALL INPUT AS PERCENT M.A.P.

	NO. GAUGES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1927	2	1.02	9.84	2.69	3.47	.00	3.88	.79	.35	29.34	8.53	10.03	10.07	80.01
1928	2	3.09	2.67	1.31	.00	.78	2.26	9.29	13.16	12.70	17.29	12.08	4.45	79.08
1929	2	3.03	2.07	5.51	3.61	5.67	1.84	3.98	1.30	1.68	10.61	10.51	22.67	72.49
1930	2	6.09	4.38	.71	.02	2.49	.93	12.13	15.93	4.20	10.09	24.48	11.41	92.87
1931	2	8.26	.27	3.42	2.18	23.74	.67	1.01	17.34	14.34	12.79	8.55	10.50	103.07
1932	2	3.38	1.01	2.05	1.64	3.45	3.11	.35	15.90	24.33	25.17	10.47	5.61	96.47
1933	3	3.61	1.47	3.45	2.59	1.18	4.91	.89	12.74	9.98	12.04	9.53	15.64	78.04
1934	3	14.21	7.17	.00	.47	2.96	5.67	8.93	14.48	13.88	14.66	16.05+	7.86+	106.34
1935	3	2.52	6.85	.48	6.08	.71	2.49	1.31	15.02	4.22	14.30	18.80	17.15	89.93
1936	3	4.42	3.31	8.48	.62	.17	8.10	7.71	12.67	24.43	25.06	6.54	1.14	102.63
1937	3	5.70	.28	2.85	6.71	.85	.86	12.14	20.80	7.49	8.59	11.17	16.14	93.58
1938	3	4.27	3.31	2.55	.00	6.26	.85	7.55	16.22	5.15	7.43	14.79	7.38	75.77
1939	3	.99	4.06	3.07	2.07	6.59	2.34	12.47	5.35	15.24	8.13	3.77	8.11	72.18
1940	3	3.68	7.20	1.31	8.06	.81	.36	14.46	30.85	26.13	12.20	15.64	26.13	146.82
1941	3	11.99	1.94	1.44	1.10	.00	.32	.98	20.23	42.76	7.11	14.08	2.60	104.56
1942	3	6.26	.35	1.88	5.38	4.95	5.73	4.75	4.69	15.92+	23.48	24.48	10.34	108.23
1943	3	6.05	7.69	.00	1.44	.00	3.70	6.85	22.20	33.38	5.80	23.37	12.17	122.66
1944	3	4.40	6.68	4.26	.00	.00	.18	10.19	30.02	32.93	22.29	17.68	.86	129.48
1945	3	9.23	2.65	3.07	.37	.35	3.39	6.07	8.23	5.14	7.51	8.74	26.13	80.88
1946	3	6.50	1.05	1.64	.00	.00	8.49	1.72	10.39	4.20	27.67	10.10	5.16	76.92
1947	3	7.06	2.04	.08+	.27*	2.77+	12.39+	8.55+	16.75+	11.22+	19.29+	4.64+	22.74+	107.80
1948	3	7.47+	1.04+	2.31+	1.39+	.00*	.19*	9.14+	8.21+	11.02+	13.59+	13.65+	13.65+	81.65
1949	3	11.81+	11.07+	2.42+	.00*	.00*	.87+	23.10+	1.99+	5.37+	29.36+	.32+	22.25+	108.56
1950	3	10.09+	13.98+	5.01+	7.93+	.00*	.00*	11.00	7.46	31.99	15.61	13.51	9.46+	126.03
1951	3	8.53	11.69	.00	.36	2.62	2.42	4.32	25.26	11.25	17.91	24.55	9.81	118.73
1952	3	4.51	12.08	2.22	.00	1.10	.88	26.56	22.11	5.90	21.47	15.76	.15	112.74
1953	3	9.53	6.19	3.93	1.09	.84	2.51	18.83	34.92	11.51	33.09	18.45	5.22	146.10
1954	3	6.69	3.83	7.30+	.00	10.75+	2.06	3.70	1.92	23.37+	22.22+	40.02+	2.13	123.97
1955	3	14.41+	10.71+	.96	2.01	2.74	1.24	1.61	13.61	19.58	15.67	13.40	3.18	99.11
1956	3	2.25	.00	1.84	.16	18.62+	4.80	3.47	33.88	20.13	23.98	15.03	8.00	132.17
1957	3	23.41+	.95	.00	.61	4.65	.58	5.47	15.59	9.37	1.39	16.06	3.97	82.05
1958	3	6.87	3.37	.00	.59	4.22	2.24	15.67	37.52	3.92	1.65	15.97	8.32	100.35
1959	3	10.37	.00	3.77	.29	.71	5.46	5.23	17.79	19.46	2.39	5.23	4.01	74.72
1960	3	2.10	1.98	3.14	5.09+	1.25+	2.09+	4.64+	11.61+	13.88+	9.76+	15.55+	17.33+	88.43
1961	3	1.54+	.00*	.56+	1.34	3.69	9.06	10.73	7.39	36.70	13.93	28.33	5.77	119.06
1962	3	23.77	7.56	.25	.23	.00	.90	.30	1.28	14.73	15.65	33.86	3.18	101.70
1963	3	1.99	10.51	3.93	.05	5.08+	.91	5.23	7.84	22.76	12.51	20.79	10.80	102.41
1964	3	5.98	10.85	.00	1.70	9.22	11.04	6.71	12.07	5.03	4.75	8.35	4.17	79.86
1965	3	6.13	1.57	3.52	.00	.21	9.05	4.94	5.24	20.22+	17.85	5.27	7.01	81.01
1966	3	.12	1.28	.22	.95	.77	.00	10.63	6.77	30.81	10.99	10.16	5.80	78.49
1967	3	9.30	4.70	.00	1.28	1.44	.00	10.44	19.29	20.07	16.25	14.29	.18	97.25
1968	3	22.74	1.84	1.47	1.43	.79	1.33	9.31	.87	7.26	4.02	10.72	11.47	73.26
1969	3	17.83	1.38	.34	.00	.94	.00	.10	15.90	25.53	14.40	19.86	7.46	103.76
1970	3	3.30	.00	1.13	.80	.61	6.49	.44	3.41	10.58	20.74	10.79	1.63	59.91
1971	3	.67	1.33	.93	4.21	1.05	1.70	12.65	14.54	9.68	12.13	5.22	6.76	70.88
1972	3	3.68	.00	7.11	.00	.60	4.41	.65	5.58	2.79	26.25	13.74	9.09	73.90
1973	3	5.44	1.81	5.48	.19	.00	2.02	3.07	18.94	17.31	12.01	53.79	10.58	130.65
1974	3	9.76	3.82	2.10	2.25	1.48	1.25	7.71	25.29	5.04	14.40	13.36	1.65	88.10
1975	3	11.38	.86	.69	1.38	2.42	1.99	14.01	4.78	35.48	18.95	7.35	4.34	103.64
1976	3	5.70	24.15	12.68	1.32	3.60	1.15	10.42	34.74	25.96	31.41	22.15	7.13	180.42
1977	3	3.98	1.16	4.04	1.28	.49	6.61+	5.19	2.21	2.96	1.07	19.34	12.08	60.40
1978	3	3.62	.47	6.34	3.62	6.74	1.79	1.45	11.25	19.57	10.54	6.59	8.93	80.91
1979	3	7.67	.90	.07	5.28	2.84	.25	5.31	12.83	13.19	2.69	13.04	2.02	66.09
1980	3	6.53	27.16	10.39	18.40	.51	3.89	4.60	2.07	6.21	24.69	17.54	22.28	144.27
1981	3	4.61	2.23	.11	6.98	.35	9.22	22.44	5.12	13.06	8.44	4.02*	.89	77.48
1982	3	9.31	3.24	3.57	.28	9.76	6.08	1.36	35.18	26.79	18.72	5.92	6.83	127.05
1983	3	2.31	3.63	1.54	.51	.73	17.32	7.86	38.82	2.32	13.22	5.97	27.78	121.99
1984	3	14.05	.15	13.21	8.94	7.66	21.83	10.13	9.29	15.19	22.50	18.31	10.52	151.77
1985	3	1.25	1.05	4.68	1.44	1.67	6.92	3.56	4.63	18.62	15.98	24.21	8.14	92.15
1986	3	1.96	2.88	.00	1.48	1.16	.89	7.71	23.85	20.60	11.81	12.52	7.32	92.18
1987	3	1.06	.00	3.42	.39	.05	4.78	19.16	5.50	17.67	7.55	13.52	10.88	83.97
1988	3	2.21	1.24	1.81	2.11	2.91	17.11	10.64	8.72	19.03	13.73	22.58	18.70	120.78
1989	3	8.10	5.56	.73	1.91	4.87	3.30	18.63	21.43	18.01	19.98	8.38	.60	111.50
1990	3	.56	4.70	4.41	2.09	.13	1.89	5.79	10.53	26.16	39.05	5.83	14.45	115.59
1991	3	7.29	3.18	2.16	.00	5.94	4.04	13.17	11.27	25.70	17.17	15.10	5.96+	110.98
1992	3	15.70	3.69	.73	.55	4.12	.97	21.32	21.47	15.70	33.73	7.64	1.78	127.39
1993	3	.29	3.18	2.01	.07	.00	.39	10.90	8.06	36.18	12.24	2.72	13.94	89.98
1994	3	3.27	.51	1.63	.68	.07	4.14	2.05	19.41	14.15	19.23	15.99	2.82	83.95
1995	3	15.12+	3.97	12.29	1.71	3.94	4.69	5.14	8.95	24.46	23.73	21.90	13.99	139.89
1996	3	8.22	11.60	10.71	2.35	.00	2.51	5.20	7.45	28.55	4.48	10.03	.24	91.35
1997	3	2.31	12.65	4.49	7.96	.00	.17	2.58	22.97	11.72	13.82	6.10	3.51	88.28
1998	3	3.44	12.43	5.09	.11	1.06	.00	8.96	7.93	8.88	6.97	15.42	17.35	87.65
1999	3	.11	2.07	3.25	1.25	.00	.49	1.65	3.90	10.73	24.15	9.78	19.16	76.55
2000	3	.52	2.19	.71	.62	2.36	.00	5.29	18.80	5.55	36.69	16.71	16.55	106.00
2001	3	6.86	4.27	1.05	9.67	3.12	2.88	9.30	22.60	8.16	25.22	19.23	12.55	124.91
2002	3	7.43	4.09	1.96	3.01	.41	5.71	4.54	4.75	1.28	3.45	30.57	8.98	76.19
2003	3	6.59	.04	5.26	4.86+	.01	.76	10.89	1.02	11.84	11.24	10.23	5.06	67.80
2004	3	12.96	1.55	.80	2.26	.38	.87	16.72	5.48	15.46	8.30	27.89	6.21	98.88
AVERAGE		6.67	4.42	2.95	2.21	2.62	3.57	7.87	13.79	16.07	15.45	14.72	9.34	99.68
ADJUSTED		6.69	4.43	2.96	2.22	2.63	3.58	7.89	13.84	16.12	15.50	14.77	9.37	100.001

AVERAGE RAINFALL ON CATCHMENT H1H006

DETAILS OF RAINFALL STATIONS USED

042326W.NS	1927 TO 2004
042357A.NS	1929 TO 1987
042357W.NS	1927 TO 1981
042415W.NS	1927 TO 1960

RAINFALL INPUT AS PERCENT M.A.P.

	NO. GAUGES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1927	3	.76	11.26	3.64	3.08	.00	3.84	1.09	.20	33.05	6.94	13.60	10.82	88.28
1928	3	.72	1.79	1.08	.00	1.06	2.25	12.51	12.17	10.69	16.94	13.73	3.16	76.11
1929	4	1.70	1.65	4.95	3.66	2.51	1.24	3.68	1.25	1.46	9.57	13.98	19.89	65.56
1930	4	4.26	3.45	.95	.01	2.22	.01	11.21	14.93	3.99	7.61	28.96	10.51	88.11
1931	4	7.08	.55	2.07	3.09	19.96	1.51	1.76	16.45	13.15	13.87	6.94	8.26	94.71
1932	4	2.28	.47	1.76	2.00	3.17	2.34	.62	10.18	21.56	20.62	9.46	4.43	78.89
1933	4	5.01	1.49	4.76	1.59	2.06	5.50	2.23	10.97	9.77	8.40	9.54	12.52	73.84
1934	4	11.80	6.63	.00	.72	2.67	4.54	9.95	11.54	7.01	15.83	13.68	9.81	94.16
1935	4	2.04	5.40	.73	4.74	1.06	2.79	.91	9.37	3.55	10.26	15.58	11.35	67.77
1936	4	2.75	1.85	10.47	1.27	.02	5.87	7.19	13.53	20.79	24.75	6.03	1.55	96.06
1937	4	3.97	.39	2.60	9.88	1.50	1.13	10.54	20.13	8.45	7.17	10.63	11.51	87.89
1938	4	3.94	2.21	1.34	1.12	10.29	.96	7.18	16.62	4.21	7.68	17.49	8.30	81.35
1939	4	.61	3.52	5.20	1.14	5.52+	3.27	11.29	7.14	15.15	8.33	5.70	6.13+	73.00
1940	4	3.76	8.76+	1.12	6.82	1.22	.11	12.79+	27.06+	25.96+	14.07+	15.92	27.44	145.03
1941	4	10.57	1.49+	1.63+	1.17	.00+	.37	2.11+	19.61+	48.23	6.35	12.02	1.76	105.30
1942	4	5.81+	.44	3.32+	5.29	1.95	5.19+	6.10	6.36	14.53	21.28	22.24	12.79+	105.30
1943	4	4.31+	8.25+	.00+	2.69+	.00	3.46	8.15	16.93	36.44	8.74	17.81	9.32	116.11
1944	4	5.09	6.59	2.41	.00	.00	.39	6.99	25.61	32.38	18.06	15.15	1.37	114.05
1945	4	3.20	2.67	1.85	.00	.24	3.45	6.34	6.70	4.35	7.85	10.86	22.12	69.64
1946	4	5.89	1.00	1.17	.00	.00	8.12	2.75	6.69	4.38	26.26	9.24	3.99	69.50
1947	4	6.75	1.09	.00	.19	2.62	12.90	9.01	16.19	8.26	19.37	3.99	19.24	99.60
1948	4	7.62	1.55	1.33	.91	.00	.52	8.11	8.58	11.55	12.97	13.89	11.50	78.52
1949	4	10.67	9.42	1.90	.15	.00	.77	20.02	2.34	5.10	28.00	.28	15.86	94.51
1950	4	5.56	11.42	4.00	7.48	.00	1.23	11.78	9.03	31.05	14.70	9.66	9.90+	115.82
1951	4	7.31	11.15	.46	.48	4.22	3.40	5.13	22.75	10.73	13.14	25.88	11.24	115.89
1952	4	6.25	11.45	.34+	.18	.37	1.18	25.79	25.08	6.26	24.21	12.09	1.40	114.57
1953	4	2.23	7.39	4.86+	1.25	1.63	3.18	13.97	29.50	11.89	30.18	21.69	8.70	136.47
1954	4	5.20	1.30	5.88	.00	11.98	1.37	6.69	3.81	19.28	23.63	37.31	3.83	120.30
1955	4	12.07	10.70	2.74	1.78	3.06	2.53	2.46	13.79	24.93	15.72	15.41	4.64	109.82
1956	4	3.56	.07	1.15	.57	19.91	8.05	4.21	27.96	33.12	27.31	16.88	8.32	151.11
1957	4	19.55	.92	.00	.74	6.84	1.06	4.07	21.59	10.82	3.02	15.47	5.85	89.93
1958	4	6.20	5.68	.00	1.02	3.87	1.91	15.87	47.46	4.11	3.22	16.12	4.04	109.50
1959	4	14.39	.20	3.14	.60	1.64	3.76	7.52	20.11	22.85	3.50	3.56	4.26	85.54
1960	4	2.07	1.33	1.99	7.16	.87	1.92	5.59	12.17	13.24	9.61	16.05	19.31	91.30
1961	3	2.41	.00	1.43	2.50	6.68	7.48	8.64	5.45	53.99	16.55	30.03	5.84	141.01
1962	3	18.79	4.31	.25	2.71	.05	.57	2.13	2.61	13.65	17.59	33.16	2.75	98.57
1963	3	2.05	8.18	6.77	.05	9.75	1.16	8.82	10.74	27.15	13.48	26.61	5.29	120.06
1964	3	4.90	11.49	.96	3.65	8.68	16.07	10.59	10.20	8.23	5.34	7.01	4.03	91.16
1965	3	5.10	1.56	5.39	.11	.47	9.66	7.69	3.58	16.44	26.29	6.96	10.96	94.21
1966	3	.35	.91	1.05	3.82	.81	.11	11.28	9.07	36.33	10.98	7.56	7.08	89.36
1967	3	8.39	8.17	.51	2.28	1.25	.00	13.36	28.72	18.80	20.03	14.31	1.13	116.95
1968	3	24.03	2.79	8.21*	1.09	1.88	1.15	8.90	3.05	7.82	4.84	12.96	13.21	89.95
1969	3	13.13	2.02	.83	.83	2.43	.44	.41	16.15	25.93	17.02	18.52	10.14	107.87
1970	3	4.64	2.94	2.53	.74	.46	9.00	.51	6.35	18.20	15.71	18.12	1.82	81.02
1971	3	1.20	1.37	1.64	2.16+	1.78+	.96+	15.33+	15.12+	9.97+	9.93+	6.18+	5.69+	71.32
1972	3	5.79+	.00*	6.02+	.17	.03	5.85	.87	6.53	2.71	30.59	13.84	12.62	85.02
1973	3	4.07	1.43	4.73	.22	.26	1.09	.02	16.80	24.40	11.18	53.90	13.80	131.91
1974	3	12.13	11.06	1.16	3.84	1.75	1.20	9.25	30.51	6.93	14.88	15.76	1.84	110.30
1975	3	12.21	3.09	.83	.05	3.22	2.98	7.82	5.46	39.56	17.32	6.73	3.91	103.18
1976	3	1.99	26.76	12.74	4.05	4.65	1.42	12.94	37.84	28.09	29.16	20.01	7.75	187.39
1977	3	2.63	2.81	6.83	1.21	1.56	6.13	6.67	9.15	2.41	.31	22.52	12.76	74.99
1978	3	1.71	.36	3.14	3.70+	10.13+	.35+	1.17+	11.81+	18.37+	9.48+	8.91+	11.63+	80.76
1979	3	10.58+	.30+	.00*	5.09	2.10	.29	10.02	14.46	15.11	3.27	17.39	3.24	81.84
1980	3	4.81	23.64	11.31	15.56	.00	4.31	5.08	2.61	11.53	23.76	18.69	18.63	139.93
1981	3	3.09	2.56	1.25	6.80	.34	4.87	19.04	7.35	11.30	12.08	6.67	.97	76.33
1982	2	11.54	2.32	4.05	.00	5.17	4.20	2.03	28.48	22.88	23.69	6.12	6.39	116.88
1983	2	.40	1.90	.70	.54	.08	16.22	5.82	41.45	8.26	10.65	6.61	21.33	113.94
1984	2	13.29	.13	10.99	6.59	3.27	19.67	9.42	9.48	17.78	18.25	20.89	8.26	138.03
1985	2	1.75	.58	1.32	1.51	2.15	8.22	6.87	8.94	17.79	14.65	26.81	8.47	99.07
1986	2	2.31	2.78	.00	3.55	1.17	1.49	8.41	24.88	22.03	16.11	18.24	9.41	110.37
1987	2	.41	.34	4.53	.09	.00	1.84	14.54	8.48	18.18	7.80	13.65	9.93	79.78
1988	1	1.39	1.63	1.08	.23	7.75	14.41	7.36	9.28	16.32	13.87	19.57	18.44	111.33
1989	1	6.12	6.04	.00	1.24	4.18	3.49	23.13	16.89	17.46+	15.65+	9.64+	.62	104.47
1990	1	.31	3.80	4.96	.54	1.02	2.48	5.73	13.23	20.75	33.98	5.87	16.86	109.54
1991	1	4.40	2.36	.85	.00	4.91	5.84	12.72	10.82+	32.48	17.51	12.12	5.93	109.94
1992	1	17.74	3.95	.42	1.08	3.69	1.32	18.59	23.86	14.30	31.19	8.41	3.95	128.52
1993	1	.12	1.49	3.84	.12	.00	.79	12.37	8.21	44.94	11.30	3.66	16.91	103.74
1994	1	3.90	.84	1.64	.68	.87	2.00	.96	13.70	13.88	16.97	11.76	3.04	70.24
1995	1	19.23	.98	11.78	.64	3.83	4.23	4.06	10.13	31.33	18.05	24.34	21.96	150.55
1996	1	6.34	11.56	6.57	1.49	.42	1.89	3.63	8.03	27.02	5.52	11.45	.57	84.48
1997	1	1.41	9.58	2.53	5.08	.00	.59	3.69	40.95	10.91	17.11	7.41	3.30	102.55
1998	1	3.75	14.46	8.52	.00	2.32	.00	6.97	9.31	12.26	12.43+	22.48+	17.31+	109.82
1999	1	.00	.00	2.63	1.01	.00	1.78	.79	6.74	8.06	20.84	8.29	17.12	67.27
2000	1	.70	3.95	1.55	.31	2.17	.00	10.71	16.72	7.75	34.51	16.83	13.33	108.51
2001	1	4.00	3.80	.23	10.61	5.04	1.94	8.91	20.76	12.72	24.10	15.57	5.58	113.26
2002	1	5.58	4.96	4.03	2.01	.00	4.42	3.49	1.80	1.80	6.59	26.50	12.40	73.56
2003	1	7.67	.00	5.89	4.14+	.00	.39	9.92	1.39	15.60	13.95	8.10	4.96	72.01
2004	1	10.23	1.08	.31	2.48	.54	.00	12.09	8.99	17.04	11.31	24.79	6.12	94.99
AVERAGE		5.92	4.33	3.01	2.25	2.81	3.49	7.93	14.23	17.19	15.32	15.02	9.13	100.63
ADJUSTED		5.88	4.30	2.99	2.23	2.79	3.47	7.88	14.14	17.08	15.22	14.93	9.08	100.001

AVERAGE RAINFALL ON CATCHMENT H1H007

DETAILS OF RAINFALL STATIONS USED

022038W.NS	1927 TO 2004
022069W.NS	1927 TO 1993
022368W.NS	1932 TO 1976

RAINFALL INPUT AS PERCENT M.A.P.

	NO. GAUGES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1927	2	.82	9.68	2.65	3.32	.00	3.71	2.90	.54	21.61	7.03	10.77	11.01	74.04
1928	2	1.97	1.84	3.49	.00	.75	2.17	10.22	21.92	11.10	19.48	10.05	3.19	86.17
1929	2	1.70	2.88	5.24	2.66	3.27	1.44	6.54	1.21	1.03	12.78	12.27	21.29	72.31
1930	2	4.85	5.89	2.01	.00	4.37	.00	14.05	14.03	6.64	7.81	19.62+	14.74+	94.01
1931	2	7.81	.24	2.61	3.91	15.09	2.42	2.34	16.54	16.66	12.89	10.61	7.26	98.36
1932	3	2.97+	1.24	2.96	1.77	2.88	1.50	.84	8.67	31.92	18.12	9.17	3.68	85.71
1933	3	8.32	.41	2.02	.34	1.75	6.78	3.92	13.95	7.86	9.32	10.18	10.58	75.44
1934	3	6.56	5.78	.30	.29	1.81	2.91	10.03	9.74	8.43	14.36	11.47	8.34	80.00
1935	3	2.87	6.14	.29	6.16	1.63	2.50	.87	11.19	4.90	13.65	13.11	8.54	71.86
1936	3	2.88	2.64	8.36	1.09	.52	12.92	7.75	11.44	23.16	23.67	4.46	3.68	102.58
1937	3	3.02	1.22	1.42	7.85	2.49	1.09	13.72	16.47	6.99	10.91	9.62	10.46	85.26
1938	3	4.06	3.28	1.83	.00	5.23	1.22	7.54	15.93	5.86	8.61	15.73	8.71	78.01
1939	3	1.86	5.01	3.08	.32	5.51	3.66	11.78	11.42	16.90	6.59	6.23	9.13	81.48
1940	3	3.65	9.16	.76	6.14	2.63	1.16	17.63	28.75	25.13	14.11	13.67	28.29	151.09
1941	3	6.66	1.21	2.02	1.72	.33	.12	2.45	26.14	39.87	7.03	13.65	3.38	104.59
1942	3	4.71	.28	1.37	6.01	3.38	6.74	6.28	6.78	12.49+	18.44	19.17	11.56	97.21
1943	3	4.39	8.94	.00	2.82	.01	2.37	5.42	20.79	31.49	11.41	16.39	8.97	113.01
1944	3	6.64	6.39	6.19	.00	.06	1.05	7.75	22.48	32.66	24.26	16.82+	1.68	125.98
1945	3	3.14	3.01	2.62	.33	.06	3.65	10.66	12.53	7.04	11.16	15.49	19.39	89.08
1946	3	9.42	3.00	1.63	.00	.00	8.26	3.35	11.48	7.13	28.03	11.20	4.91	88.41
1947	3	4.31	2.81	.36	.62	1.30	5.92	6.63	15.83	9.88	19.31	10.03	17.17	94.17
1948	3	9.81	1.41	3.25	.75	.06	1.19	11.30	9.15	11.32	16.13	15.49	10.10	89.95
1949	3	7.58	8.20	2.17	.20	.00	1.20	16.58	1.97	8.39	28.07	2.06	14.10	90.52
1950	3	4.18	9.73	3.28	4.26	.14	.03	25.68	11.11	28.57	13.81	11.04	7.56	119.38
1951	3	5.93	9.79	.03	.15	1.85	3.22	5.76	17.75	8.50	13.75	28.15	19.45	114.33
1952	3	5.80	11.88	.89	.80	.62	2.27	25.30	27.03	9.00	20.68	18.37	1.40	124.04
1953	3	2.03	5.98	2.76	1.70	2.50	3.44	15.80	33.27	11.45	30.70	18.94	5.73	134.29
1954	3	8.02	1.42	5.61	.05	8.04	1.88	5.95	4.53	17.97	25.14	30.63	3.73	112.97
1955	3	11.37	6.54	1.79	.29	1.30	2.79	6.28	15.55	22.61	17.49	19.78	3.54	109.33
1956	3	3.75	.56	3.28	2.04	14.27	3.68	5.52	29.12	20.93	25.83	13.56	7.46	130.00
1957	3	14.69	1.47	.00	1.92	9.74	2.02	4.84	18.56	11.12	2.54	16.43	5.40	88.73
1958	3	6.38	5.97	.00	2.31	2.40	2.82	16.45	45.41	3.26	2.14	11.74	5.09	103.96
1959	3	8.03	1.50	1.47	.50	1.35	5.10	7.64	17.74	23.08	4.13	4.31	3.71	78.57
1960	3	5.38	.58	2.28	6.20	1.54	1.13	4.07	10.29	19.66	8.41	13.85	17.56	90.96
1961	3	4.47	.00	1.60	2.01	7.14	4.14	10.25	4.48	43.07	10.85	22.52	5.28	115.81
1962	3	14.65	1.95	.52	3.11	.73	1.05	1.28	5.05	9.84	19.99	21.20	6.05	85.40
1963	3	1.76	5.85	4.61	.01	12.89	1.49	3.28	7.02	19.13	13.07	13.84	4.22	87.18
1964	3	6.91	9.77	1.05	4.04	6.29	12.77	6.67	12.98	8.01	8.41	8.87	3.04	88.81
1965	3	6.14	1.28	4.83	.62	1.14	10.71	4.62	7.15	19.89	23.37	7.77	8.68	96.21
1966	3	.47	1.74	2.03	2.22	.06	1.99	13.16	11.96	28.27	6.19	7.69	7.66	83.42
1967	3	7.94	7.02	.37	4.20	.79	.13	17.32+	20.69	15.25	24.42+	11.19	2.21	111.51
1968	3	15.08	2.58	3.50	5.51	1.00	1.74	10.91	2.46	12.78	6.98	13.12	11.94	87.60
1969	3	5.13	.80	.63	.69	1.83	.45	1.44	20.84	25.18	14.26	15.75	7.12	94.11
1970	3	3.07	3.15	4.23	.51	.20	4.15	.81	6.54	12.82	13.42	17.20	2.14	68.23
1971	3	3.52	.98	2.16	4.45	3.74	2.82	9.60	14.12	8.11	8.67	8.53	7.06	73.76
1972	3	3.14	.00	7.41	.09	.00	7.61	1.36	8.66	2.75	30.63	11.36	8.86	81.86
1973	3	5.21	1.19	7.64	.83	.92	1.09	.10	18.60	22.93	12.11	44.35	8.90	123.87
1974	3	12.98	5.16	2.28	2.50	1.89	.68	9.07	28.29	7.91	19.24	12.14	1.82	103.96
1975	3	10.11	3.92	.66	.00	.84	3.69+	3.97	4.84	42.81	13.92	7.95	7.71	100.42
1976	3	3.86	19.59	10.64	5.36	5.25	2.61	13.14	34.61	28.27	26.10	22.13	8.07	179.64
1977	2	4.51	2.81	5.33	2.19	4.29	6.26	10.39	9.82	1.78	2.55	21.01	9.69	80.61
1978	2	3.78	1.40	5.75	2.92	11.17	1.20	2.57	17.61	11.47	8.93	10.95	7.84	85.59
1979	2	13.93	2.17	.07	6.02	3.12	.21	9.90	20.51	15.71	4.76	11.59	4.61	92.61
1980	2	4.24	14.64	7.91	14.86	.70	5.45	6.27	4.52	13.15	19.80	15.34	15.25	122.14
1981	2	2.30	1.67	4.49	4.54+	.61+	3.18+	14.02+	12.61	22.14	9.46	8.18	2.72	85.91
1982	2	9.73	4.25	6.20	1.15	7.61	7.37	3.80	26.04	25.96	12.69	6.68	12.36	123.84
1983	2	1.30	4.95	3.16	1.11	.44	10.88	3.86	34.16	7.90	10.17	5.68	16.40	100.01
1984	2	10.70	.05	11.76	4.98	5.37	12.27	11.23	7.44	22.66	20.88	14.43	8.25	130.03
1985	2	2.07	1.20	.74	2.85	2.00	7.19	11.09	7.98	22.42	19.37	17.76	8.67	103.34
1986	2	1.12	2.42	1.65	8.98*	2.32	3.95	7.42	15.35	14.41	16.46	15.99	11.94	102.02
1987	2	4.03	1.75	8.20	.08	.01	2.19	13.57	11.47	12.69	16.61	15.34	10.12	96.06
1988	2	3.28	1.73	3.56	1.13	7.00	13.27	8.59	12.59	14.52	20.13	17.99	13.97	117.75
1989	2	6.06	9.06	.55	2.79	6.62	.29	22.21	12.40	19.94	24.37	8.64	4.83	117.76
1990	2	.39	4.06	7.88	1.27	1.99	1.24	3.81	15.16	24.28	38.83	8.00	14.40	121.29
1991	2	6.34	2.17	2.15	.05	4.68	5.55	6.11	14.58	36.02	16.38	11.02	8.71	113.76
1992	2	15.49	2.55	.64	1.54	4.25	1.04	24.17	23.41	15.20	25.76	10.87	3.34	128.24
1993	2	.65	1.17	3.08	2.11	.59	1.37	9.64	4.86	38.04	6.06	5.22	11.50	84.30
1994	1	4.25	1.38	2.03	3.57+	1.36+	3.11+	2.14*	14.82+	20.22	20.32	14.72	1.85	89.76
1995	1	10.91	.93	17.60	1.31	5.77	3.41	4.68	9.83	23.99	11.64	15.37	16.28	121.71
1996	1	7.77	8.87	9.40	1.74	.09	.33	4.69	9.99	29.16	7.82	16.84+	1.57	98.29
1997	1	1.68	9.23	7.14	.79	.00	2.03	6.28	21.26	12.39	14.48	7.41	5.58	88.26
1998	1	4.52	8.76	7.12	.46	.00	.46	10.83	11.31	18.55	14.75	18.22	15.62	110.58
1999	1	.07	4.26	1.25	4.06	.05	1.38	1.42	9.32	11.67	9.00	9.18	12.54	64.19
2000	1	.00	4.00	1.97	1.70	1.70	.09	6.23	17.25	7.35	37.95	21.00	14.01	113.25
2001	1	7.18	7.47	2.04	12.58	5.69	.59	10.68	17.71	17.30	17.42	17.35	5.49	121.52
2002	1	5.90	2.44	4.95	2.95	1.44	5.57	5.64	7.18	2.88	6.92	22.78	9.94+	78.59
2003	1	7.54	.00	6.36	4.98+	.00	1.51	9.74	.90	18.68	12.52	9.23	4.48	75.93
2004	1	12.28	.96	.03	7.31	1.42	1.70	11.86	14.46	18.15	8.32	17.76	5.11	99.37
AVERAGE		5.67	4.07	3.40	2.60	2.84	3.37	8.38	14.51	17.05	15.30	13.90	8.70	99.80
ADJUSTED		5.68	4.08	3.41	2.60	2.85	3.37	8.40	14.54	17.09	15.34	13.93	8.72	100.001

AVERAGE RAINFALL ON CATCHMENT H1H012

DETAILS OF RAINFALL STATIONS USED

022521W.NS	1927 TO 1994
022440W.NS	1952 TO 2004
022504W.NS	1932 TO 2000
022792W.NS	1937 TO 1978
022803W.NS	1929 TO 2004

RAINFALL INPUT AS PERCENT M.A.P.

	NO. GAUGES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1927	1	.00	11.38	.00	.00	.00	3.52	.00	.00	35.56	17.20	8.09	12.42	88.17
1928	1	.00	1.66	.00	.00	.00	2.48	18.23	3.72	14.28	18.23	15.33	.00	73.92
1929	2	.30	.00	2.07	.73	1.65	.20	.00	.00	.94	1.04	5.28	9.33	21.54
1930	2	1.45	1.56	.00	.00	.86	.37	17.08	13.30	2.02	14.44	21.50	11.68	84.27
1931	2	14.44	.51	2.88	1.60	14.51	.52	.73	11.93	12.45	15.73	6.36	12.27	93.92
1932	3	2.37	.71	3.05	1.00	1.23	2.82	2.40	12.10	31.32	25.67	13.06	4.43	100.17
1933	3	3.40	2.12	4.07	1.92	4.50	1.59	.13	11.90+	15.02+	9.25+	12.15+	13.75	79.78
1934	3	12.61	1.28	.00	.33	1.35	1.66	11.30	16.40	12.98	11.15	9.40	7.71	86.18
1935	3	.45	8.20	.43	4.23	.12	.56	2.23	11.25	7.38	18.68	15.57	8.41	77.50
1936	3	1.35	11.89	14.10	.07	.14	6.76	10.00	15.82	24.05	20.21	2.51	4.82	111.73
1937	4	.51	1.68	1.12	4.61	.54	1.52	7.87	11.72	7.57	6.12	9.78	8.20	61.24
1938	4	2.05	2.88	3.30	3.33	8.61	4.27	6.74	14.26	3.95	5.39	18.09	5.47	78.34
1939	4	.00+	3.13	1.41	.10	4.86	.69	11.78	8.47	15.14	5.98+	3.24+	2.62	57.42
1940	4	1.39	11.45	.11	4.39	1.56	.00+	12.67	34.73	31.75	14.79	11.95	25.07	149.86
1941	4	6.67	2.87	1.66	3.51	.00	.00	.98	17.29	38.15	2.83	8.94	1.05	83.96
1942	4	4.06	.20	6.18	6.49	.17	9.15	6.03	4.66	15.96	16.35	15.10	10.89	95.26
1943	4	2.08	7.96	.42+	.49	.35	2.39	2.27	9.41	36.04+	8.80	16.57+	11.03+	97.80
1944	4	8.49+	3.25+	1.87+	.00*	.00*	.07+	7.57	24.85	30.56	32.86	20.50	3.06	133.08
1945	4	10.01	2.18	1.14	.00	.78	2.81	3.31	5.09	5.07	8.47	12.40	21.60	72.84
1946	4	4.27	.00	.77	.00	.00	10.54	1.83	8.48	6.28	25.61	8.92	3.92	70.63
1947	4	3.77	2.44	1.76	1.57	1.29	14.63	3.06	16.90+	10.26	15.34	4.04	24.33	99.38
1948	4	13.04	.20	.55	.03	.00	.61	9.01	7.95	10.59	13.33	14.23	11.70	81.25
1949	4	7.95	15.58	.46	.37	.08	.25	12.13	3.03	3.30	30.14	1.70	18.21	93.20
1950	4	8.33	12.06	2.93	11.05	.00	.47	15.10	4.45	27.21	14.46	8.17	15.31	119.56
1951	4	6.76	7.65	.19	.20	3.37	.54	2.53	21.63	11.32	18.19	23.03	18.10	113.50
1952	5	6.02	17.47	3.12	1.30	2.58	.37	28.16	18.11	4.34	18.20	8.86	1.88	110.40
1953	5	6.14	6.52	2.16	.35	1.39	5.84	8.99	35.34	16.44	34.84	21.53	5.71	145.26
1954	5	5.60	1.37	3.58	.00	23.47	.26	4.54	3.12	17.76	23.97	37.03	2.45	123.14
1955	5	10.39	7.16	1.14	2.21	2.17	1.14	1.02	15.94	25.92	13.97	15.42	4.88	101.36
1956	5	5.27	.08	5.84	.15	12.20	6.52	3.53	29.77	33.57	28.14	19.29	6.05	150.40
1957	5	12.33	.28	.00	.15	4.44	4.65	5.55	19.78	10.51	1.08	20.43	3.07	82.26
1958	5	9.94	5.71	.39	2.85	4.93	2.18	16.21	39.38	2.44	5.24	15.18	4.14	108.58
1959	5	14.64	.02	1.83	1.27	.13	2.66	3.39	11.49	20.70	5.32	1.29	6.28	69.02
1960	5	1.35	.71	3.94	4.43	.72	3.53	5.43	7.90	10.69	10.11	12.21	17.83	78.85
1961	5	2.19	.02	.90	4.34	3.15	2.90	8.64	3.86	43.44	12.04	36.86	2.42	120.77
1962	5	24.97	5.42	.37	3.72	.97	.81	1.54	8.22	9.48	17.51	25.25	2.82	101.07
1963	5	3.05	3.19	3.97	.15	8.45	1.63	3.37	7.21	27.28	10.43	15.71	5.88	90.31
1964	5	4.63	12.96	.05	1.13	4.98	12.71	5.00	9.66	6.93	6.49	7.16	4.18	75.88
1965	5	4.86	3.46	5.78	.52	.05	7.42	4.67	3.04	20.09	13.10	13.51	7.76	84.27
1966	5	.44	.43	.11	.43	.27	.71	13.95	9.33	24.80	8.75	7.75	3.66	70.63
1967	5	4.48	6.80	.10	1.56	.61	1.00	8.07	19.22	21.95	17.96	15.78	1.64	99.17
1968	5	16.07	3.69	.58	.67	1.43	.47	10.59	.98	8.61	5.07	8.73	13.86	70.77
1969	5	14.01	.38	.03	.03	6.34	.02	.09	10.27	16.53	18.78	16.34	4.96	87.78
1970	5	5.66	1.15	2.59	.19	.20	5.93	2.36	8.77	6.81	21.98	17.51	.30	73.45
1971	5	.71	.70	1.57	3.85	.68	1.10	8.98	16.20	7.73	7.39	6.15	8.47	63.52
1972	5	1.92	.19	2.85	.22	.59	1.31	1.20	2.09	3.06	32.42	11.25	9.53	66.62
1973	5	2.77	.88	3.23	.44	4.08	1.75	.27	10.70	17.32	10.34	73.50	6.57	131.85
1974	5	11.40	2.68	1.21	1.77	1.27	.63	9.19	29.25	8.12	14.89	16.20	3.29	99.91
1975	5	7.92	1.46	.07	.24	3.33	9.83	6.67	6.69	37.18	15.88	7.15	4.07	100.49
1976	5	5.44	21.58	11.82	3.45	5.97	.64	17.07	42.55	25.88	28.18	34.19	4.21	200.97
1977	5	.88	5.66	6.62	1.72+	.84	5.57	5.16	3.04	2.45	3.79	25.43	7.46+	68.62
1978	5	3.62	1.08	6.75+	2.29*	10.27	2.92	.86	10.89	21.30	11.18	9.60+	9.64*	90.41
1979	4	7.83*	.45	.19	3.62	1.24	.12	5.00	12.82	11.50	6.23*	11.70	4.22	64.93
1980	4	5.08	18.77+	6.10	34.10	3.29	4.77	6.52	2.68	5.04	19.28	18.56	22.86	147.06
1981	4	5.61+	2.69	1.99	2.68	.08	1.34	25.25	5.35	11.92	9.10	5.20	2.14	73.36
1982	4	5.21*	2.36	3.09	.43	5.05	5.73	4.18	26.34	26.64	28.54+	6.29	16.49	130.37
1983	4	1.13	.30	.25	1.34	.51	9.56	7.10	42.93	6.15	14.41	6.36	24.52	114.56
1984	4	15.71	.36	7.12	8.06	5.18	16.05	7.57	6.29	20.05*	24.63	18.57	6.64	136.21
1985	4	8.07	1.21	4.82	.36	1.95	7.61	5.96	5.27	19.69+	13.43	26.60	7.69	102.65
1986	4	3.82	4.58	.14	.50	.67	.40	8.35	24.85	17.65+	10.35	19.16	7.42	97.89
1987	4	.45	.13	3.14	.04	.24	2.81	15.08	7.29	14.56	6.50	17.62	5.83	73.70
1988	4	1.93	.83	1.56	.23	1.77	13.47	15.88	9.09	18.75	11.70	18.90	15.79	109.91
1989	4	7.38	3.00	.04	1.22	6.28	2.23	19.39	14.48	17.88	19.84	6.32	.88	98.94
1990	4	2.00	3.31	3.47	2.34	.25	2.93	4.72	14.20	24.64	30.79	4.30	17.62	110.55
1991	4	6.08	.97	.27	.07	2.60	3.78	11.12	8.37	30.58	19.86	12.07	3.62	99.40
1992	4	16.30	1.13	.04	.63	3.35	.11	43.29	15.31	13.21	47.32	6.11	2.78	149.58
1993	4	.00	.99	4.86	.26	.76	1.97	8.83	6.93	44.52	10.26	3.97	12.29	95.64
1994	4	2.65	.22	6.72	5.79	1.52	3.49	1.43	18.67	15.81	17.55	14.51	2.26	90.65
1995	3	13.91	3.89	20.27	.65	3.33	4.00	1.91	10.83	40.11	22.28	17.15	15.87	154.21
1996	3	15.35	12.63	6.56	.17	.00	.73	7.27	16.76	34.88	6.85	11.33	.15	112.68
1997	3	2.04	13.47	2.47	9.29	.90	3.21	7.23	37.25	7.67	17.16	6.45	3.19	110.34
1998	3	.93	14.18+	10.51	.31	.04	.05	8.26	11.73	19.89	.00	.00	5.95+	71.86
1999	3	2.68	2.33	13.59	2.13	1.22	7.79	2.15	16.09	16.38	33.05	11.76	12.76	121.91
2000	3	.92	2.88	1.72	2.10	1.07	.24	9.37	23.78	12.17	48.56	28.76	24.95	156.53
2001	2	11.89	4.04	.88	9.37	6.75	1.29	11.00	27.25	16.84	47.76	31.37	10.14	178.58
2002	2	9.10	6.88	8.63	1.78	.49	32.64	9.97	4.79	.67	8.72	29.77	10.47	123.91
2003	2	6.18	.09	2.67	5.09+	.00	2.00	12.41	.55	9.95	13.02	8.25	4.52	64.74
2004	2	23.99	.42	3.42	7.04	.11	.35	20.85	7.57	13.33	8.70	17.38	4.61	107.78
AVERAGE		6.14	4.18	3.02	2.37	2.57	3.61	8.07	13.46	17.06	16.19	14.66	8.51	99.85
ADJUSTED		6.15	4.19	3.03	2.38	2.57	3.62	8.08	13.48	17.09	16.22	14.68	8.53	100.001

AVERAGE RAINFALL ON CATCHMENT H1R002

DETAILS OF RAINFALL STATIONS USED

022521W.NS	1927 TO 1994
022440W.NS	1952 TO 2004
022504W.NS	1932 TO 2000
022792W.NS	1937 TO 1978
022803W.NS	1929 TO 2004

RAINFALL INPUT AS PERCENT M.A.P.

	NO. GAUGES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1927	1	.00	11.38	.00	.00	.00	3.52	.00	.00	35.56	17.20	8.09	12.42	88.17
1928	1	.00	1.66	.00	.00	.00	2.48	18.23	3.72	14.28	18.23	15.33	.00	73.92
1929	2	.30	.00	2.07	.73	1.65	.20	.00	.00	.94	1.04	5.28	9.33	21.54
1930	2	1.45	1.56	.00	.00	.86	.37	17.08	13.30	2.02	14.44	21.50	11.68	84.27
1931	2	14.44	.51	2.88	1.60	14.51	.52	.73	11.93	12.45	15.73	6.36	12.27	93.92
1932	3	2.37	.71	3.05	1.00	1.23	2.82	2.40	12.10	31.32	25.67	13.06	4.43	100.17
1933	3	3.40	2.12	4.07	1.92	4.50	1.59	.13	11.90+	15.02+	9.25+	12.15+	13.75	79.78
1934	3	12.61	1.28	.00	.33	1.35	1.66	11.30	16.40	12.98	11.15	9.40	7.71	86.18
1935	3	.45	8.20	.43	4.23	.12	.56	2.23	11.25	7.38	18.68	15.57	8.41	77.50
1936	3	1.35	11.89	14.10	.07	.14	6.76	10.00	15.82	24.05	20.21	2.51	4.82	111.73
1937	4	.51	1.68	1.12	4.61	.54	1.52	7.87	11.72	7.57	6.12	9.78	8.20	61.24
1938	4	2.05	2.88	3.30	3.33	8.61	4.27	6.74	14.26	3.95	5.39	18.09	5.47	78.34
1939	4	.00+	3.13	1.41	.10	4.86	.69	11.78	8.47	15.14	5.98+	3.24+	2.62	57.42
1940	4	1.39	11.45	.11	4.39	1.56	.00+	12.67	34.73	31.75	14.79	11.95	25.07	149.86
1941	4	6.67	2.87	1.66	3.51	.00	.00	.98	17.29	38.15	2.83	8.94	1.05	83.96
1942	4	4.06	.20	6.18	6.49	.17	9.15	6.03	4.66	15.96	16.35	15.10	10.89	95.26
1943	4	2.08	7.96	.42+	.49	.35	2.39	2.27	9.41	36.04+	8.80	16.57+	11.03+	97.80
1944	4	8.49+	3.25+	1.87+	.00*	.00*	.07+	7.57	24.85	30.56	32.86	20.50	3.06	133.08
1945	4	10.01	2.18	1.14	.00	.78	2.81	3.31	5.09	5.07	8.47	12.40	21.60	72.84
1946	4	4.27	.00	.77	.00	.00	10.54	1.83	8.48	6.28	25.61	8.92	3.92	70.63
1947	4	3.77	2.44	1.76	1.57	1.29	14.63	3.06	16.90+	10.26	15.34	4.04	24.33	99.38
1948	4	13.04	.20	.55	.03	.00	.61	9.01	7.95	10.59	13.33	14.23	11.70	81.25
1949	4	7.95	15.58	.46	.37	.08	.25	12.13	3.03	3.30	30.14	1.70	18.21	93.20
1950	4	8.33	12.06	2.93	11.05	.00	.47	15.10	4.45	27.21	14.46	8.17	15.31	119.56
1951	4	6.76	7.65	.19	.20	3.37	.54	2.53	21.63	11.32	18.19	23.03	18.10	113.50
1952	5	6.02	17.47	3.12	1.30	2.58	.37	28.16	18.11	4.34	18.20	8.86	1.88	110.40
1953	5	6.14	6.52	2.16	.35	1.39	5.84	8.99	35.34	16.44	34.84	21.53	5.71	145.26
1954	5	5.60	1.37	3.58	.00	23.47	.26	4.54	3.12	17.76	23.97	37.03	2.45	123.14
1955	5	10.39	7.16	1.14	2.21	2.17	1.14	1.02	15.94	25.92	13.97	15.42	4.88	101.36
1956	5	5.27	.08	5.84	.15	12.20	6.52	3.53	29.77	33.57	28.14	19.29	6.05	150.40
1957	5	12.33	.28	.00	.15	4.44	4.65	5.55	19.78	10.51	1.08	20.43	3.07	82.26
1958	5	9.94	5.71	.39	2.85	4.93	2.18	16.21	39.38	2.44	5.24	15.18	4.14	108.58
1959	5	14.64	.02	1.83	1.27	.13	2.66	3.39	11.49	20.70	5.32	1.29	6.28	69.02
1960	5	1.35	.71	3.94	4.43	.72	3.53	5.43	7.90	10.69	10.11	12.21	17.83	78.85
1961	5	2.19	.02	.90	4.34	3.15	2.90	8.64	3.86	43.44	12.04	36.86	2.42	120.77
1962	5	24.97	5.42	.37	3.72	.97	.81	1.54	8.22	9.48	17.51	25.25	2.82	101.07
1963	5	3.05	3.19	3.97	.15	8.45	1.63	3.37	7.21	27.28	10.43	15.71	5.88	90.31
1964	5	4.63	12.96	.05	1.13	4.98	12.71	5.00	9.66	6.93	6.49	7.16	4.18	75.88
1965	5	4.86	3.46	5.78	.52	.05	7.42	4.67	3.04	20.09	13.10	13.51	7.76	84.27
1966	5	.44	.43	.11	.43	.27	.71	13.95	9.33	24.80	8.75	7.75	3.66	70.63
1967	5	4.48	6.80	.10	1.56	.61	1.00	8.07	19.22	21.95	17.96	15.78	1.64	99.17
1968	5	16.07	3.69	.58	.67	1.43	.47	10.59	.98	8.61	5.07	8.73	13.86	70.77
1969	5	14.01	.38	.03	.03	6.34	.02	.09	10.27	16.53	18.78	16.34	4.96	87.78
1970	5	5.66	1.15	2.59	.19	.20	5.93	2.36	8.77	6.81	21.98	17.51	.30	73.45
1971	5	.71	.70	1.57	3.85	.68	1.10	8.98	16.20	7.73	7.39	6.15	8.47	63.52
1972	5	1.92	.19	2.85	.22	.59	1.31	1.20	2.09	3.06	32.42	11.25	9.53	66.62
1973	5	2.77	.88	3.23	.44	4.08	1.75	.27	10.70	17.32	10.34	73.50	6.57	131.85
1974	5	11.40	2.68	1.21	1.77	1.27	.63	9.19	29.25	8.12	14.89	16.20	3.29	99.91
1975	5	7.92	1.46	.07	.24	3.33	9.83	6.67	6.69	37.18	15.88	7.15	4.07	100.49
1976	5	5.44	21.58	11.82	3.45	5.97	.64	17.07	42.55	25.88	28.18	34.19	4.21	200.97
1977	5	.88	5.66	6.62	1.72+	.84	5.57	5.16	3.04	2.45	3.79	25.43	7.46+	68.62
1978	5	3.62	1.08	6.75+	2.29*	10.27	2.92	.86	10.89	21.30	11.18	9.60+	9.64*	90.41
1979	4	7.83*	.45	.19	3.62	1.24	.12	5.00	12.82	11.50	6.23*	11.70	4.22	64.93
1980	4	5.08	18.77+	6.10	34.10	3.29	4.77	6.52	2.68	5.04	19.28	18.56	22.86	147.06
1981	4	5.61+	2.69	1.99	2.68	.08	1.34	25.25	5.35	11.92	9.10	5.20	2.14	73.36
1982	4	5.21*	2.36	3.09	.43	5.05	5.73	4.18	26.34	26.64	28.54+	6.29	16.49	130.37
1983	4	1.13	.30	.25	1.34	.51	9.56	7.10	42.93	6.15	14.41	6.36	24.52	114.56
1984	4	15.71	.36	7.12	8.06	5.18	16.05	7.57	6.29	20.05*	24.63	18.57	6.64	136.21
1985	4	8.07	1.21	4.82	.36	1.95	7.61	5.96	5.27	19.69+	13.43	26.60	7.69	102.65
1986	4	3.82	4.58	.14	.50	.67	.40	8.35	24.85	17.65+	10.35	19.16	7.42	97.89
1987	4	.45	.13	3.14	.04	.24	2.81	15.08	7.29	14.56	6.50	17.62	5.83	73.70
1988	4	1.93	.83	1.56	.23	1.77	13.47	15.88	9.09	18.75	11.70	18.90	15.79	109.91
1989	4	7.38	3.00	.04	1.22	6.28	2.23	19.39	14.48	17.88	19.84	6.32	.88	98.94
1990	4	2.00	3.31	3.47	2.34	.25	2.93	4.72	14.20	24.64	30.79	4.30	17.62	110.55
1991	4	6.08	.97	.27	.07	2.60	3.78	11.12	8.37	30.58	19.86	12.07	3.62	99.40
1992	4	16.30	1.13	.04	.63	3.35	.11	43.29	15.31	13.21	47.32	6.11	2.78	149.58
1993	4	.00	.99	4.86	.26	.76	1.97	8.83	6.93	44.52	10.26	3.97	12.29	95.64
1994	4	2.65	.22	6.72	5.79	1.52	3.49	1.43	18.67	15.81	17.55	14.51	2.26	90.65
1995	3	13.91	3.89	20.27	.65	3.33	4.00	1.91	10.83	40.11	22.28	17.15	15.87	154.21
1996	3	15.35	12.63	6.56	.17	.00	.73	7.27	16.76	34.88	6.85	11.33	.15	112.68
1997	3	2.04	13.47	2.47	9.29	.90	3.21	7.23	37.25	7.67	17.16	6.45	3.19	110.34
1998	3	.93	14.18+	10.51	.31	.04	.05	8.26	11.73	19.89	.00	.00	5.95+	71.86
1999	3	2.68	2.33	13.59	2.13	1.22	7.79	2.15	16.09	16.38	33.05	11.76	12.76	121.91
2000	3	.92	2.88	1.72	2.10	1.07	.24	9.37	23.78	12.17	48.56	28.76	24.95	156.53
2001	2	11.89	4.04	.88	9.37	6.75	1.29	11.00	27.25	16.84	47.76	31.37	10.14	178.58
2002	2	9.10	6.88	8.63	1.78	.49	32.64	9.97	4.79	.67	8.72	29.77	10.47	123.91
2003	2	6.18	.09	2.67	5.09+	.00	2.00	12.41	.55	9.95	13.02	8.25	4.52	64.74
2004	2	23.99	.42	3.42	7.04	.11	.35	20.85	7.57	13.33	8.70	17.38	4.61	107.78
AVERAGE		6.14	4.18	3.02	2.37	2.57	3.61	8.07	13.46	17.06	16.19	14.66	8.51	99.85
ADJUSTED		6.15	4.19	3.03	2.38	2.57	3.62	8.08	13.48	17.09	16.22	14.68	8.53	100.001

AVERAGE RAINFALL ON CATCHMENT H1H013

DETAILS OF RAINFALL STATIONS USED

042582W.NS	1933 TO 2004
042227W.NS	1927 TO 2004
042257W.NS	1961 TO 2004

RAINFALL INPUT AS PERCENT M.A.P.

	NO. GAUGES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1927	1	.76	10.12	2.36	3.12	.00	3.42	.42	.17	28.32	8.96	9.38	7.78	74.82
1928	1	5.02	3.29	1.20	.00	.53	1.60	7.04	11.41	14.85	18.56	10.88	4.98	79.36
1929	1	2.95	1.88	5.59	2.64	6.26	2.15	2.47	1.35	1.46	8.12	6.81	23.22	64.89
1930	1	6.83	4.43	.49	.00	1.60	1.81	11.30	16.62	4.49	9.89	21.43	11.22	90.11
1931	1	6.92	.00	3.21	.86	21.70	.00	.00	14.57	14.61	13.88	8.31	11.60	95.66
1932	1	3.96	1.08	1.88	1.35	2.57	3.54	.00	19.44	23.16	28.03	8.77	6.47	100.26
1933	2	3.21	1.36	3.22	3.34	.80	3.86	.45	12.46	8.75	12.84	8.63	16.86	75.79
1934	2	15.41	6.78	.00	.43	2.77	5.19	8.08	14.68	15.62	12.96	16.15	5.86	103.95
1935	2	2.52	7.07	.24	6.38	.24	2.21	1.01	15.96	3.96	15.24	20.20	19.31	94.34
1936	2	5.42	3.99	8.18	.38	.21	7.84	7.19	11.99	25.50	25.32	6.40	.56	103.00
1937	2	5.92	.00	3.04	4.89	.67	.59	11.74	20.08	6.65	8.92	11.63	17.90	92.01
1938	2	4.14	3.67	2.53	.00	3.98	.35	8.05	15.35	6.14	6.68	13.28	7.58	71.76
1939	2	.72	4.60	3.47	2.26	6.92	.92	14.50	4.48	14.83+	7.68	2.51	8.79	71.69
1940	2	3.12	6.87	1.08	8.70	.55	.40	15.07	33.04	26.52	13.00	14.33	28.42	151.09
1941	2	11.64	2.08	1.25	.86+	.00+	.21	.54	20.63	41.68	7.12	14.04	2.62	102.67
1942	2	6.37	.38	1.23	4.80	6.09	5.95	3.02	4.05	14.68	25.67	27.24	9.53	109.02
1943	2	6.72	7.44	.00	.99	.00	3.94	5.33	24.80	29.87	3.54	24.48	13.26	120.37
1944	2	3.76	7.87	4.93	.00	.00	.11	10.82	31.93	34.53	23.30	19.55	.45	137.23
1945	2	12.40	2.80	3.12	.56	.19	3.57	6.53	7.54	5.02	6.05	8.13	27.10	83.00
1946	2	6.52	.80	1.55	.00	.00	8.58	1.17	12.13	3.58	28.09	9.68	5.14	77.25
1947	2	7.58	2.60	.12	.40	2.51	11.44	7.67	16.33	11.53	19.80	4.38	25.95	110.32
1948	2	7.41	.94	2.46	1.30	.00	.24	9.11	7.80	10.66	12.89	12.56	14.89	80.26
1949	2	11.91	12.58	2.48	.00	.00	.95	24.83	1.82	5.81	28.44	.12	24.32	113.27
1950	2	10.94	14.52	5.05	6.62	.00	.00	9.35	6.47	33.84	16.30	15.39	9.50	127.97
1951	2	8.88	13.23	.00	.32	1.60	1.66	4.05	29.38	11.32	19.43	24.20	9.17	123.25
1952	2	3.34	11.61	3.06	.00	1.46	.63	26.97	21.53	5.85	20.38	17.58	.23	112.65
1953	2	13.84	5.45	3.32	1.00	.53	1.78	20.94	40.28	11.93	35.88	19.63	5.02	159.60
1954	2	7.76	4.88	8.81	.00	11.21	1.88	2.41	1.17	25.51	22.22	41.91	2.00	129.75
1955	2	16.58	9.39	1.42	1.77	2.86	.58	1.05	14.73	18.46	15.43	13.37	2.58	98.22
1956	2	1.42	.00	2.64	.00	18.35	3.90	3.36	35.56+	18.10	21.46	14.22	7.85	126.86
1957	2	25.81	1.02	.00	.47	3.32	.00	6.29	12.59	8.97	.79	18.55+	3.16	80.98
1958	2	6.72	2.11	.00	.58	4.38	2.49	16.45+	31.34	3.86	.95	17.19	10.43	96.50
1959	2	9.48	.00	3.62	.00	.32	6.27	3.99	16.01	17.14	2.06	6.01	3.72	68.62
1960	2	1.79	1.00	3.72	4.19	1.12	1.43	4.48	10.34	14.79	9.88	16.18	16.74	85.67
1961	3	1.54	.00	.56	1.34	3.69	9.06	10.73	7.39	36.70	13.93	28.33	5.77	119.06
1962	3	23.77	7.56	.25	.23	.00	.90	.30	1.28	14.73	15.65	33.86+	3.18	101.70
1963	3	1.99	10.51	3.93	.05	5.08	.91	5.23	7.84	22.76+	12.51	20.79+	10.80	102.41
1964	3	5.98	10.85+	.00	1.70	9.22	11.04	6.71	12.07	5.03	4.75	8.35	4.17	79.86
1965	3	6.13	1.57	3.52	.00	.21	9.05	4.94	5.24	20.22	17.85	5.27	7.01	81.01
1966	3	.12	1.28	.22	.95	.77	.00	10.63	6.77	30.81	10.99	10.16	5.80	78.49
1967	3	9.30	4.70	.00*	1.28	1.44	.00	10.44	19.29+	20.07	16.25+	14.29	.18	97.25
1968	3	22.74	1.84	1.47	1.43	.79	1.33	9.31	.87	7.26	4.02	10.72	11.47	73.26
1969	3	17.83	1.38	.34	.00	.94	.00	.10	15.90	25.53	14.40	19.86	7.46	103.76
1970	3	3.30	.00	1.13	.80	.61	6.49	.44	3.41	10.58	20.74	10.79	1.63	59.91
1971	3	.67	1.33	.93	4.21	1.05	1.70	12.65	14.54	9.68	12.13	5.22	6.76	70.88
1972	3	3.68	.00	7.11	.00	.60	4.41	.65	5.58	2.79	26.25	13.74	9.09	73.90
1973	3	5.44	1.81	5.48	.19	.00	2.02	3.07	18.94	17.31	12.01	53.79	10.58	130.65
1974	3	9.76	3.82	2.10	2.25	1.48	1.25	7.71	25.29	5.04	14.40	13.36	1.65	88.10
1975	3	11.38	.86	.69	1.38	2.42	1.99	14.01	4.78	35.48	18.95	7.35	4.34	103.64
1976	3	5.70	24.15	12.68	1.32	3.60	1.15	10.42	34.74	25.96	31.41	22.15	7.13	180.42
1977	3	3.98	1.16	4.04	1.28	.49	6.61	5.19	2.21	2.96	1.07	19.34	12.08	60.40
1978	3	3.62	.47	6.34	3.62	6.74	1.79	1.45	11.25	19.57	10.54	6.59	8.93	80.91
1979	3	7.67	.90	.07	5.28	2.84	.25	5.31	12.83	13.19	2.69	13.04	2.02	66.09
1980	3	6.53	27.16	10.39	18.40	.51	3.89	4.60	2.07	6.21	24.69	17.54	22.28	144.27
1981	3	4.61	2.23	.11	6.98	.35	9.22	22.44	5.12	13.06	8.44	4.02	.89	77.48
1982	3	9.31	3.24	3.57	.28	9.76	6.08	1.36	35.18	26.79	18.72	5.92	6.83*	127.05
1983	3	2.31	3.63	1.54	.51	.73	17.32	7.86	38.82	2.32	13.22	5.97	27.78	121.99
1984	3	14.05	.15	13.21	8.94	7.66	21.83	10.13	9.29+	15.19	22.50	18.31	10.52	151.77
1985	3	1.25	1.05	4.68	1.44	1.67	6.92	3.56	4.63	18.62	15.98	24.21	8.14	92.15
1986	3	1.96	2.88	.00	1.48	1.16	.89	7.71	23.85	20.60	11.81	12.52	7.32	92.18
1987	3	1.06	.00	3.42	.39	.05	4.78	19.16	5.50	17.67	7.55	13.52+	10.88	83.97
1988	3	2.21	1.24	1.81	2.11	2.91	17.11	10.64	8.72	19.03	13.73	22.58	18.70	120.78
1989	3	8.10	5.56	.73	1.91	4.87	3.30+	18.63	21.43	18.01	19.98	8.38	.60	111.50
1990	3	.56	4.70	4.41	2.09	.13	1.89	5.79	10.53	26.16	39.05	5.83	14.45	115.59
1991	3	7.29	3.18+	2.16+	.00	5.94	4.04	13.17	11.27	25.70	17.17	15.10	5.96	110.98
1992	3	15.70	3.69	.73	.55	4.12	.97	21.32	21.47	15.70	33.73	7.64	1.78	127.39
1993	3	.29	3.18+	2.01	.07	.00	.39	10.90	8.06	36.18	12.24	2.72	13.94	89.98
1994	3	3.27	.51	1.63	.68	.07	4.14	2.05	19.41	14.15	19.23*	15.99	2.82	83.95
1995	3	15.12	3.97+	12.29	1.71+	3.94	4.69	5.14+	8.95	24.46	23.73	21.90*	13.99*	139.89
1996	3	8.22	11.60	10.71	2.35	.00	2.51	5.20	7.45	28.55	4.48	10.03	.24	91.35
1997	3	2.31+	12.65	4.49	7.96+	.00	.17	2.58	22.97*	11.72	13.82+	6.10	3.51	88.28
1998	3	3.44	12.43	5.09+	.11	1.06	.00	8.96	7.93	8.88	6.97	15.42	17.35	87.65
1999	3	.11	2.07	3.25	1.25	.00	.49	1.65	3.90	10.73	24.15	9.78	19.16	76.55
2000	3	.52	2.19	.71	.62	2.36	.00	5.29	18.80	5.55	36.69	16.71	16.55	106.00
2001	3	6.86	4.27	1.05	9.67	3.12	2.88	9.30	22.60	8.16	25.22	19.23	12.55	124.91
2002	3	7.43	4.09	1.96	3.01	.41	5.71	4.54	4.75	1.28	3.45	30.57	8.98	76.19
2003	3	6.59*	.04	5.26	4.86+	.01	.76	10.89	1.02	11.84	11.24	10.23	5.06	67.80
2004	3	12.96	1.55	.80	2.26	.38	.87	16.72	5.48	15.46	8.30	27.89	6.21	98.88
AVERAGE		6.85	4.45	2.98	2.12	2.51	3.47	7.75	13.81	16.02	15.47	14.72	9.50	99.65
ADJUSTED		6.88	4.47	2.99	2.13	2.52	3.48	7.78	13.86	16.08	15.52	14.77	9.53	100.001

AVERAGE RAINFALL ON CATCHMENT H1H018

DETAILS OF RAINFALL STATIONS USED

022038W.NS	1927 TO 2004
022069W.NS	1927 TO 1993
022368W.NS	1932 TO 1976
022521W.NS	1927 TO 1994
022440W.NS	1952 TO 2004

RAINFALL INPUT AS PERCENT M.A.P.

	NO. GAUGES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1927	3	.54	10.25	1.77	2.21	.00	3.64	1.93	.36	26.26	10.42	9.88	11.48	78.75
1928	3	1.31	1.78	2.33	.00	.50	2.27	12.89	15.86	12.16	19.06	11.81	2.12	82.09
1929	3	1.13	1.92	4.88	2.26	3.28	1.09	4.36	.81	1.31	9.21	11.70	20.41	62.37
1930	3	4.20	4.96	1.34	.00	3.35	.00	14.00	17.64	5.33	8.52	21.37	15.76	96.48
1931	3	7.63	.16	2.43	3.30	13.45	1.96	2.04	15.17	15.52	15.29	10.80	6.84	94.58
1932	4	2.84	.93	3.24	1.80	2.78	1.68	.91	8.98	32.57	19.70	8.35	4.25	88.02
1933	4	7.42	.54	1.88	.55	1.74	6.05	3.03	12.71	8.98	8.23	10.39	10.56	72.09
1934	4	7.77	4.78	.22	.22	1.66	2.60	9.41	10.60	9.93	13.45	11.36	8.39	80.40
1935	4	2.15	6.77	.21	5.35	1.22	1.88	1.05	10.75	5.50	15.85	13.94	8.43	73.11
1936	4	2.44	3.28	9.77	.87	.39	12.49	9.39	12.81	26.24	22.82	4.23	3.27	108.00
1937	4	2.73	.91	1.38	9.09	2.34	1.17	12.26	17.11	7.88	10.25	11.25	9.93	86.30
1938	4	3.46	3.56	2.00	.00	5.48	1.80	8.04	15.99	5.69	9.20	15.22	9.12	79.55
1939	4	1.40	5.92	3.33	.34	5.17	2.95	15.15	11.26	17.05	6.74	6.76	7.73	83.80
1940	4	3.20	9.56	.57	5.43	2.34	.87	16.18	36.73	27.23	16.02	15.07	33.13	166.32
1941	4	7.58	.91	2.35	3.05	.25*	.09	2.35	24.89	47.19	6.80	13.38	2.82	111.66
1942	4	4.41	.21	2.84	5.41	2.54	8.01	5.75	7.05	14.10	20.26	20.69	11.62	102.89
1943	4	4.17	8.88	.00	2.58	.01	2.85	5.41	18.44	32.84	13.46	17.64	8.53	114.83
1944	4	6.21	5.88	5.37	.00	.04	.79	7.52	21.95	36.62	28.91	18.18	1.26	132.73
1945	4	3.81	2.77	3.11	.25	.56	3.46	9.65	11.41+	6.89	10.70	17.26	20.12	89.99
1946	4	8.57	2.25	1.77	.00	.00	7.98	3.19	9.96	7.34	28.54	11.75	4.49	85.84
1947	4	4.65	2.76	.27	.62	1.29	7.20	6.54	15.19	12.05	19.56	9.71	20.01	99.85
1948	4	8.93	1.26	2.54	.57	.04	.89	10.13	8.97	12.17	15.60	16.08	11.06	88.25
1949	4	8.20	8.99	2.09	.16	.00	.96	15.25	1.48	7.70	27.51	1.78	14.81	88.94
1950	4	3.19	10.35	3.25	4.96	.11	.02	24.43	10.17	30.28	13.90	10.52	8.81	119.99
1951	4	5.89	9.69	.06	.31	2.17	2.70	4.87	19.65	8.26	13.89	26.72	18.88	113.09
1952	5	6.39+	11.30+	1.68+	.84+	.63+	1.62	26.82	25.93	7.20	19.05	15.55	1.53	118.54
1953	5	2.68	5.36	2.45	1.18	1.79	3.99	14.01	36.38	12.37	32.25	20.53	5.99	138.99
1954	5	7.83	1.32	5.34	.03	9.82	1.33	4.85	3.47	16.83	23.27	33.79	3.31	111.20
1955	5	10.86	6.74	1.62	.55	1.31	2.44	4.33	14.14	23.38	17.06	18.79	4.20	105.41
1956	5	3.97	.42	4.22	1.38	13.93	4.11	4.63	28.19	23.04	29.82	14.70	6.13	134.54
1957	5	14.59	1.16	.00	1.30	7.40	1.93	4.47	18.04	10.21	2.22	16.72	4.60	82.63
1958	5	7.21	6.43	.03	1.95	2.66	2.36	14.84	44.56	2.99	2.40	11.82	4.24	101.48
1959	5	8.29	.92	1.74	.44	.94	4.28	6.61	15.09	22.16	3.82	3.24	4.95	72.47
1960	5	3.70	.65	3.11	4.71	1.30	1.77	4.65	9.53	17.93	8.62	13.93	16.50	86.41
1961	5	3.45	.02	1.60	2.39	5.28	3.79	8.77	3.60	43.01	11.15	24.51	4.39	111.95
1962	5	16.84	2.17	.41	3.51	.51	1.21	1.37	4.57	9.90	18.33	22.31	5.43	86.54
1963	5	1.85	4.55	4.11	.01	13.01	1.15	3.09	5.88	21.63	11.70	14.47	4.17	85.62
1964	5	5.21	8.34	.68	2.87	5.46	12.32	6.57	11.72	7.66	7.30	8.82	4.10	81.05
1965	5	4.83	1.69	5.03	.60	.71	10.06	4.92	5.58	20.19	20.75	8.48	8.69	91.54
1966	5	.44	1.24	1.33	1.65	.12	1.24	10.90	10.39	27.08	7.75	7.48	6.99	76.61
1967	5	6.50	6.59	.32	3.12	.66	.83	14.07	22.82	15.56	22.73	12.37	1.98	107.55
1968	5	16.64	2.39	2.65	3.77	.93	1.22	10.70	1.90	10.62	6.53	12.62	13.11	83.07
1969	5	7.63	.63	.41	.45	3.07	.30	.93	18.13	22.23	15.30	16.07	6.29	91.44
1970	5	3.17	2.73	3.13	.50	.31	3.88	.71	6.71	9.50	15.30	17.02	1.45	64.41
1971	5	2.55	.94	1.57	4.00	2.62	2.19	8.35	13.97	7.63	7.86	7.26	7.03	65.97
1972	5	2.84	.11	6.16	.08	.07	5.34	1.33	6.39	2.10	34.38	12.15	9.21	80.18
1973	5	5.07	1.38	5.87	.71	.93	1.05	.29	13.92	21.24	11.51	52.36	7.80	122.14
1974	5	10.86	4.47	2.13	2.18	2.04	.80	11.30	28.05	8.03	17.67	12.90	2.54	102.96
1975	5	9.62	3.13	.46	.24	1.24	4.48	6.05	5.37	38.62	16.50	6.51	5.99	98.23
1976	5	3.17	20.82	11.33	5.32	4.66	1.89	15.36	36.63	30.41	26.75	27.65	6.35	190.35
1977	4	2.54	3.98	3.88	2.14+	2.53	5.07	6.97	6.72	1.69	2.59	21.92	7.87	67.89
1978	4	3.21	1.11	5.25	2.40	9.02	4.25+	1.53	13.51	17.81	7.82	9.23	6.83	81.97
1979	4	10.57	1.14	.05	4.14	2.50	.19	6.38	16.60	12.12	5.63	10.90	4.06	74.26
1980	4	4.72	14.39	5.42+	16.67	.37	4.41	4.51	3.68	9.25	16.97	16.62	21.55	118.57
1981	4	2.32	2.34	3.50	4.00	.30	2.18	14.20	9.86	16.52	8.62	5.48	2.35	71.67
1982	4	7.62	3.37	5.12	.68	5.54	6.31	3.85	25.09	27.29	22.99	7.06	12.84	127.76
1983	4	1.17	2.68	1.71	.73	.49	9.76	5.28	40.44	7.00	13.80	6.76	21.13	110.93
1984	4	12.28	.21	8.78	6.00	4.03	14.41	9.54	7.24	22.02	19.67	17.95	7.17	129.29
1985	4	3.37	.83	2.10	1.69	1.20	6.80	8.13	7.85	19.81	16.36	20.67	7.78	96.60
1986	4	1.41	3.57	.84	4.78	1.33	2.15	6.78	23.15	16.32	13.96	16.82	9.32	100.44
1987	4	2.18	.95	5.86	.05	.18	2.83	15.53	9.87	13.76	11.98	15.78	8.04	87.00
1988	4	2.27	1.21	2.92	.70	4.63	11.63	9.50	11.89	16.07	15.88	17.97	13.08	107.75
1989	4	5.48	6.21	.28	1.95	6.67	.97	18.91	12.44	16.27	23.79	6.55	2.77	102.30
1990	4	1.11	3.41	5.53	1.39	1.16	1.01	3.63	14.79	26.01	33.63	5.90	17.17	114.74
1991	4	5.42	1.58	1.09	.03	3.82	5.48	7.35	10.81	35.82	18.85	11.20	5.81	107.26
1992	4	15.62	1.89	.35	.97	2.94	.56	23.94	21.12	14.00	40.26	7.51	2.82	131.98
1993	4	.33	1.20	3.44	1.11	.74	.91	7.45	4.49	41.71	8.32	4.04	12.49	86.23
1994	3	2.14	.63	3.69	1.44	1.34	1.76	1.21	16.61	18.93	21.45	13.47	2.28	84.97
1995	2	11.55	1.15	13.27	.84	4.19	3.11	3.36	10.10	35.60	15.64	17.61	17.60	134.04
1996	2	10.78	10.45	8.25	1.12	.05	.24	5.17	9.19	34.64	7.52	15.03	1.00	103.45
1997	2	1.36	10.86	5.58	3.30	.92	2.09	6.24	33.19	11.58	20.55	7.98	5.47	109.12
1998	2	3.10	13.08	6.80	.48	.06	.31	10.28	11.70	24.55	7.37	9.11	7.81	94.65
1999	2	1.87	4.05	8.10	3.60	.24	3.36	1.45	20.90	15.63	26.49	14.01	17.19	116.90
2000	2	.64	2.76	1.86	1.98	1.41	.32	8.61	26.80	13.36	52.81	30.84	25.63	167.03
2001	2	6.97	6.15	1.91	15.66	4.72	1.59	11.77	26.06	19.01	44.14	32.44	9.24	179.66
2002	2	9.41	7.37	5.57	2.85	1.01	12.92	8.43	5.85	2.11	11.07	23.21	11.38	101.18
2003	2	7.01	.09	4.63	4.66+	.00	1.44	8.36	1.00	15.13	11.98	9.96	3.92	68.19
2004	2	10.46	.60	1.31	4.81	.82	1.21	13.50	11.96	16.12	9.51	18.56	5.24	94.09
AVERAGE		5.47	4.00	3.12	2.35	2.49	3.31	8.05	14.61	17.55	16.46	14.52	8.85	100.78
ADJUSTED		5.43	3.97	3.10	2.33	2.47	3.29	7.98	14.50	17.41	16.33	14.41	8.79	100.001

AVERAGE RAINFALL ON CATCHMENT H1H033

DETAILS OF RAINFALL STATIONS USED

022038W.NS	1927 TO 2004
022069W.NS	1927 TO 1993
022368W.NS	1932 TO 1976
022521W.NS	1927 TO 1994
022440W.NS	1952 TO 2004

RAINFALL INPUT AS PERCENT M.A.P.

	NO. GAUGES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1927	3	.54	10.25	1.77	2.21	.00	3.64	1.93	.36	26.26	10.42	9.88	11.48	78.75
1928	3	1.31	1.78	2.33	.00	.50	2.27	12.89	15.86	12.16	19.06	11.81	2.12	82.09
1929	3	1.13	1.92	4.88	2.26	3.28	1.09	4.36	.81	1.31	9.21	11.70	20.41	62.37
1930	3	4.20	4.96	1.34	.00	3.35	.00	14.00	17.64	5.33	8.52	21.37	15.76	96.48
1931	3	7.63	.16	2.43	3.30	13.45	1.96	2.04	15.17	15.52	15.29	10.80	6.84	94.58
1932	4	2.84	.93	3.24	1.80	2.78	1.68	.91	8.98	32.57	19.70	8.35	4.25	88.02
1933	4	7.42	.54	1.88	.55	1.74	6.05	3.03	12.71	8.98	8.23	10.39	10.56	72.09
1934	4	7.77	4.78	.22	.22	1.66	2.60	9.41	10.60	9.93	13.45	11.36	8.39	80.40
1935	4	2.15	6.77	.21	5.35	1.22	1.88	1.05	10.75	5.50	15.85	13.94	8.43	73.11
1936	4	2.44	3.28	9.77	.87	.39	12.49	9.39	12.81	26.24	22.82	4.23	3.27	108.00
1937	4	2.73	.91	1.38	9.09	2.34	1.17	12.26	17.11	7.88	10.25	11.25	9.93	86.30
1938	4	3.46	3.56	2.00	.00	5.48	1.80	8.04	15.99	5.69	9.20	15.22	9.12	79.55
1939	4	1.40	5.92	3.33	.34	5.17	2.95	15.15	11.26	17.05	6.74	6.76	7.73	83.80
1940	4	3.20	9.56	.57	5.43	2.34	.87	16.18	36.73	27.23	16.02	15.07	33.13	166.32
1941	4	7.58	.91	2.35	3.05	.25*	.09	2.35	24.89	47.19	6.80	13.38	2.82	111.66
1942	4	4.41	.21	2.84	5.41	2.54	8.01	5.75	7.05	14.10	20.26	20.69	11.62	102.89
1943	4	4.17	8.88	.00	2.58	.01	2.85	5.41	18.44	32.84	13.46	17.64	8.53	114.83
1944	4	6.21	5.88	5.37	.00	.04	.79	7.52	21.95	36.62	28.91	18.18	1.26	132.73
1945	4	3.81	2.77	3.11	.25	.56	3.46	9.65	11.41+	6.89	10.70	17.26	20.12	89.99
1946	4	8.57	2.25	1.77	.00	.00	7.98	3.19	9.96	7.34	28.54	11.75	4.49	85.84
1947	4	4.65	2.76	.27	.62	1.29	7.20	6.54	15.19	12.05	19.56	9.71	20.01	99.85
1948	4	8.93	1.26	2.54	.57	.04	.89	10.13	8.97	12.17	15.60	16.08	11.06	88.25
1949	4	8.20	8.99	2.09	.16	.00	.96	15.25	1.48	7.70	27.51	1.78	14.81	88.94
1950	4	3.19	10.35	3.25	4.96	.11	.02	24.43	10.17	30.28	13.90	10.52	8.81	119.99
1951	4	5.89	9.69	.06	.31	2.17	2.70	4.87	19.65	8.26	13.89	26.72	18.88	113.09
1952	5	6.39+	11.30+	1.68+	.84+	.63+	1.62	26.82	25.93	7.20	19.05	15.55	1.53	118.54
1953	5	2.68	5.36	2.45	1.18	1.79	3.99	14.01	36.38	12.37	32.25	20.53	5.99	138.99
1954	5	7.83	1.32	5.34	.03	9.82	1.33	4.85	3.47	16.83	23.27	33.79	3.31	111.20
1955	5	10.86	6.74	1.62	.55	1.31	2.44	4.33	14.14	23.38	17.06	18.79	4.20	105.41
1956	5	3.97	.42	4.22	1.38	13.93	4.11	4.63	28.19	23.04	29.82	14.70	6.13	134.54
1957	5	14.59	1.16	.00	1.30	7.40	1.93	4.47	18.04	10.21	2.22	16.72	4.60	82.63
1958	5	7.21	6.43	.03	1.95	2.66	2.36	14.84	44.56	2.99	2.40	11.82	4.24	101.48
1959	5	8.29	.92	1.74	.44	.94	4.28	6.61	15.09	22.16	3.82	3.24	4.95	72.47
1960	5	3.70	.65	3.11	4.71	1.30	1.77	4.65	9.53	17.93	8.62	13.93	16.50	86.41
1961	5	3.45	.02	1.60	2.39	5.28	3.79	8.77	3.60	43.01	11.15	24.51	4.39	111.95
1962	5	16.84	2.17	.41	3.51	.51	1.21	1.37	4.57	9.90	18.33	22.31	5.43	86.54
1963	5	1.85	4.55	4.11	.01	13.01	1.15	3.09	5.88	21.63	11.70	14.47	4.17	85.62
1964	5	5.21	8.34	.68	2.87	5.46	12.32	6.57	11.72	7.66	7.30	8.82	4.10	81.05
1965	5	4.83	1.69	5.03	.60	.71	10.06	4.92	5.58	20.19	20.75	8.48	8.69	91.54
1966	5	.44	1.24	1.33	1.65	.12	1.24	10.90	10.39	27.08	7.75	7.48	6.99	76.61
1967	5	6.50	6.59	.32	3.12	.66	.83	14.07	22.82	15.56	22.73	12.37	1.98	107.55
1968	5	16.64	2.39	2.65	3.77	.93	1.22	10.70	1.90	10.62	6.53	12.62	13.11	83.07
1969	5	7.63	.63	.41	.45	3.07	.30	.93	18.13	22.23	15.30	16.07	6.29	91.44
1970	5	3.17	2.73	3.13	.50	.31	3.88	.71	6.71	9.50	15.30	17.02	1.45	64.41
1971	5	2.55	.94	1.57	4.00	2.62	2.19	8.35	13.97	7.63	7.86	7.26	7.03	65.97
1972	5	2.84	.11	6.16	.08	.07	5.34	1.33	6.39	2.10	34.38	12.15	9.21	80.18
1973	5	5.07	1.38	5.87	.71	.93	1.05	.29	13.92	21.24	11.51	52.36	7.80	122.14
1974	5	10.86	4.47	2.13	2.18	2.04	.80	11.30	28.05	8.03	17.67	12.90	2.54	102.96
1975	5	9.62	3.13	.46	.24	1.24	4.48	6.05	5.37	38.62	16.50	6.51	5.99	98.23
1976	5	3.17	20.82	11.33	5.32	4.66	1.89	15.36	36.63	30.41	26.75	27.65	6.35	190.35
1977	4	2.54	3.98	3.88	2.14+	2.53	5.07	6.97	6.72	1.69	2.59	21.92	7.87	67.89
1978	4	3.21	1.11	5.25	2.40	9.02	4.25+	1.53	13.51	17.81	7.82	9.23	6.83	81.97
1979	4	10.57	1.14	.05	4.14	2.50	.19	6.38	16.60	12.12	5.63	10.90	4.06	74.26
1980	4	4.72	14.39	5.42+	16.67	.37	4.41	4.51	3.68	9.25	16.97	16.62	21.55	118.57
1981	4	2.32	2.34	3.50	4.00	.30	2.18	14.20	9.86	16.52	8.62	5.48	2.35	71.67
1982	4	7.62	3.37	5.12	.68	5.54	6.31	3.85	25.09	27.29	22.99	7.06	12.84	127.76
1983	4	1.17	2.68	1.71	.73	.49	9.76	5.28	40.44	7.00	13.80	6.76	21.13	110.93
1984	4	12.28	.21	8.78	6.00	4.03	14.41	9.54	7.24	22.02	19.67	17.95	7.17	129.29
1985	4	3.37	.83	2.10	1.69	1.20	6.80	8.13	7.85	19.81	16.36	20.67	7.78	96.60
1986	4	1.41	3.57	.84	4.78	1.33	2.15	6.78	23.15	16.32	13.96	16.82	9.32	100.44
1987	4	2.18	.95	5.86	.05	.18	2.83	15.53	9.87	13.76	11.98	15.78	8.04	87.00
1988	4	2.27	1.21	2.92	.70	4.63	11.63	9.50	11.89	16.07	15.88	17.97	13.08	107.75
1989	4	5.48	6.21	.28	1.95	6.67	.97	18.91	12.44	16.27	23.79	6.55	2.77	102.30
1990	4	1.11	3.41	5.53	1.39	1.16	1.01	3.63	14.79	26.01	33.63	5.90	17.17	114.74
1991	4	5.42	1.58	1.09	.03	3.82	5.48	7.35	10.81	35.82	18.85	11.20	5.81	107.26
1992	4	15.62	1.89	.35	.97	2.94	.56	23.94	21.12	14.00	40.26	7.51	2.82	131.98
1993	4	.33	1.20	3.44	1.11	.74	.91	7.45	4.49	41.71	8.32	4.04	12.49	86.23
1994	3	2.14	.63	3.69	1.44	1.34	1.76	1.21	16.61	18.93	21.45	13.47	2.28	84.97
1995	2	11.55	1.15	13.27	.84	4.19	3.11	3.36	10.10	35.60	15.64	17.61	17.60	134.04
1996	2	10.78	10.45	8.25	1.12	.05	.24	5.17	9.19	34.64	7.52	15.03	1.00	103.45
1997	2	1.36	10.86	5.58	3.30	.92	2.09	6.24	33.19	11.58	20.55	7.98	5.47	109.12
1998	2	3.10	13.08	6.80	.48	.06	.31	10.28	11.70	24.55	7.37	9.11	7.81	94.65
1999	2	1.87	4.05	8.10	3.60	.24	3.36	1.45	20.90	15.63	26.49	14.01	17.19	116.90
2000	2	.64	2.76	1.86	1.98	1.41	.32	8.61	26.80	13.36	52.81	30.84	25.63	167.03
2001	2	6.97	6.15	1.91	15.66	4.72	1.59	11.77	26.06	19.01	44.14	32.44	9.24	179.66
2002	2	9.41	7.37	5.57	2.85	1.01	12.92	8.43	5.85	2.11	11.07	23.21	11.38	101.18
2003	2	7.01	.09	4.63	4.66+	.00	1.44	8.36	1.00	15.13	11.98	9.96	3.92	68.19
2004	2	10.46	.60	1.31	4.81	.82	1.21	13.50	11.96	16.12	9.51	18.56	5.24	94.09
AVERAGE		5.47	4.00	3.12	2.35	2.49	3.31	8.05	14.61	17.55	16.46	14.52	8.85	100.78
ADJUSTED		5.43	3.97	3.10	2.33	2.47	3.29	7.98	14.50	17.41	16.33	14.41	8.79	100.001

APPENDIX C:

PATCHED OBSERVED FLOW SEQUENCES

APPENDIX NUMBER	CALIBRATION GAUGE
C1	H1H003
C2	H1H006
C3	H1H007
C4	H1H012
C5	H1H013
C6	H1H018
C7	H1H033
C8	H4H006

Patched observed flows at H1H003

File : H1H003.NSI
Units : Mm3
Descrip. : From DWAF for 1964 to 2005

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1964	4.600	4.530	0.490	0.420	0.580	1.820	2.870	6.400	5.090	3.960	8.660	2.580	42.0
1965	2.080	0.670	0.530	0.080	0.020	0.990	1.440	0.960	2.690	20.650	8.890	4.710	43.7
1966	1.570	0.150	0.080	0.070	0.000	0.030	1.050	3.300	27.150	7.310	5.960	0.000	46.7
1967	2.860	1.030	0.250	0.060	0.010	0.100	0.640	18.160	10.670	11.680	14.940	4.570	65.0
1968	17.130	1.760	0.590	0.420	0.340	0.310	1.560	1.140	2.110	1.900	5.250	7.900	40.4
1969	9.000	1.870	0.800	0.650	0.470	0.640	0.740	2.930	14.200	15.560	20.080	15.170	82.1
1970	4.680	2.230	1.440	0.820	0.560	0.870	0.980	1.500	1.640	15.590	11.770	4.400	46.5
1971	2.120	0.890	0.470	0.390	0.310	0.420	0.520	3.470	4.670	4.520	7.710	5.830	31.3
1972	2.040	0.760	1.060	0.270	0.240	1.060	0.670	0.710	0.770	10.530	10.170	6.290	34.6
1973	3.070	0.700	0.540	0.110	0.060	0.110	0.330	1.120	9.490	5.870	48.110	20.800	90.3
1974	6.880	3.760	0.870	0.260	0.150	0.280	2.750	15.440	7.080	12.350	17.170	4.980	72.0
1975	7.140	2.030	0.700	0.090	0.000	0.060	0.570	1.230	16.470	13.290	7.840	3.890	53.3
1976	2.370	8.490	7.210	3.460	1.080	0.840	2.910	21.830	40.960	47.000	44.150	14.410	194.7
1977	5.900	3.310	2.290	0.410	0.330	0.520	1.950	2.820	1.450	0.890	5.670	8.500	34.0
1978	3.050	0.660	0.190	0.030	0.130	0.250	0.280	1.720	9.710	5.800	6.100	5.650	33.6
1979	7.180	1.140	0.100	0.400	0.070	0.040	1.160	3.530	5.150	2.230	5.810	3.230	30.0
1980	1.690	7.840	3.240	5.100	1.270	0.790	0.910	1.200	1.860	11.290	17.020	17.400	69.6
1981	4.120	1.260	0.230	0.350	0.130	0.290	5.210	2.380	3.800	4.700	4.860	0.730	28.1
1982	4.100	0.620	0.540	0.090	0.540	0.660	0.660	9.800	23.830	32.320	11.550	7.320	92.0
1983	2.990	0.750	0.750	0.000	0.000	1.280	1.090	24.200	4.210	14.930	8.090	26.860	85.2
1984	14.070	1.660	1.800	2.070	0.600	6.380	3.330	4.450	14.640	27.130	25.180	10.970	112.3
1985	4.390	2.060	0.880	0.240	0.120	0.640	2.510	6.110	8.930	12.970	24.850	10.450	74.2
1986	2.970	0.890	0.050	0.070	0.070	0.080	0.720	10.940	13.760	10.440	17.070	6.990	64.1
1987	3.520	0.670	0.710	0.020	0.010	0.180	2.150	2.440	10.580	7.990	7.170	11.090	46.5
1988	3.280	1.040	0.190	0.000	0.000	1.220	2.050	2.480	7.050	10.470	19.370	30.880	78.0
1989	7.750	4.490	0.820	0.260	0.460	0.560	3.570	10.590	12.500	31.100	14.400	3.870	90.4
1990	1.780	1.010	0.420	0.060	0.040	0.120	0.470	1.980	10.940	24.990	19.280	23.090	84.2
1991	8.090	2.930	0.420	0.090	0.110	0.300	2.980	4.310	20.400	20.240	13.560	9.750	83.2
1992	11.360	4.770	0.500	0.160	0.250	0.060	5.290	10.210	12.240	45.080	15.790	5.230	110.9
1993	2.140	0.650	0.410	0.000	0.000	0.000	0.280	0.920	22.870	12.000	5.020	5.460	49.8
1994	3.910	0.850	0.100	0.000	0.000	0.000	0.080	1.360	2.230	12.350	12.250	3.720	36.9
1995	9.300	1.970	1.640	0.120	0.220	0.300	0.830	1.320	15.390	20.950	21.340	27.150	100.5
1996	16.610	12.000	5.090	1.100	0.440	0.750	1.710	1.720	16.300	8.010	11.420	4.840	80.0
1997	1.360	2.320	1.540	1.010	0.220	0.250	0.580	13.830	8.330	10.730	5.520	2.490	48.2
1998	1.890	6.110	1.050	0.100	0.060	0.170	0.570	2.230	4.650	8.500	11.000	14.930	51.3
1999	4.030	1.150	0.250	0.100	0.070	0.310	0.450	3.570	3.350	10.810	3.860	10.680	38.6
2000	1.880	0.730	0.220	0.180	0.090	0.240	0.410	2.740	3.070	25.940	19.610	17.730	72.8
2001	4.990	2.370	0.380	1.310	0.350	0.460	0.310	4.680	6.060	24.030	21.180	7.970	74.1
2002	8.040	2.640	0.900	0.330	0.100	0.330	0.810	1.040	0.780	0.850	7.620	5.000	28.4
2003	2.840	0.850	0.360	0.230	0.260	0.420	0.620	0.610	2.480	3.540	9.350	1.430	23.0
2004	1.660	0.440	0.090	0.080	0.140	0.140	0.610	1.020	9.380	8.060	15.290	4.870	41.8
2005	2.370	1.030	0.200	0.150	0.040	0.170	0.430	9.530	6.640	5.220	13.180	4.380	43.3
AVE :	5.07	2.31	0.96	0.50	0.24	0.58	1.41	5.28	9.66	13.90	13.88	9.24	63.0
SD :	3.94	2.46	1.36	0.97	0.28	1.00	1.29	5.91	8.29	10.87	9.34	7.56	32.0

Patched observed flows at H1H006

File : H1H006.NSI
Units : Mm3
Descrip. : From DWAF for 1964 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1964	7.960	7.110	1.150	0.000	1.320	1.570	6.160	14.560	8.750	9.110	17.780	7.510	83.0
1965	5.180	0.880	0.000	0.000	0.000	4.030	4.040	3.610	15.660	40.160	9.870	5.310	88.7
1966	4.180	0.050	0.000	0.000	0.000	0.000	5.080	9.290	55.600	12.870	19.320	12.060	118.5
1967	13.020	5.970	1.210	0.050	0.000	0.000	4.110	50.140	26.000	23.020	17.820	6.110	147.5
1968	21.720	5.000	2.450	1.290	0.000	0.000	4.760	5.250	5.060	7.470	13.510	16.440	83.0
1969	13.720	5.020	3.220	2.000	1.410	1.960	2.290	10.060	31.220	23.620	26.170	19.330	140.0
1970	7.770	4.080	3.720	2.430	0.730	2.410	2.430	4.920	9.510	36.850	18.310	6.810	100.0
1971	3.860	2.450	0.050	0.000	0.000	0.000	0.000	14.050	12.710	8.140	13.780	9.830	64.9
1972	5.080	1.960	2.310	0.000	0.000	2.290	0.000	2.710	3.800	42.000	20.500	12.860	93.5
1973	7.370	3.690	2.730	0.000	0.000	0.000	0.000	4.860	24.630	10.860	83.580	18.280	156.0
1974	10.440	7.840	4.540	2.980	0.310	0.360	8.680	29.790	10.480	20.670	20.860	6.490	123.4
1975	10.800	4.800	2.400	0.000	0.000	0.000	0.370	4.550	51.750	27.260	8.540	6.910	117.4
1976	5.330	40.150	13.990	7.530	3.240	3.190	6.560	48.870	74.220	66.150	66.640	12.300	348.2
1977	7.600	2.530	4.880	1.720	1.060	1.200	6.010	9.000	5.400	4.250	19.180	19.150	82.0
1978	6.520	2.970	0.550	0.280	0.210	0.850	1.110	9.920	26.030	10.110	16.720	12.120	87.4
1979	17.180	3.820	0.540	2.160	0.170	0.000	4.610	13.190	13.640	7.370	14.530	6.160	83.4
1980	5.230	17.410	9.220	8.560	2.280	1.780	2.460	3.760	6.950	25.540	26.660	31.130	141.0
1981	5.390	4.090	0.000	0.000	0.000	2.200	2.860	5.800	8.780	9.960	9.240	4.150	52.5
1982	8.070	0.000	0.000	0.000	1.030	1.460	0.510	31.550	128.140	65.240	9.270	13.710	259.0
1983	4.460	3.400	0.380	0.000	0.000	2.890	2.450	81.320	9.110	36.290	13.900	55.300	209.5
1984	15.660	3.420	4.880	4.370	1.460	14.680	7.150	10.770	43.930	51.680	55.630	11.280	224.9
1985	4.900	1.920	1.290	0.210	0.000	2.130	7.200	18.120	24.730	28.700	62.640	12.640	164.5
1986	4.290	2.400	0.170	0.600	0.000	0.000	1.110	31.350	34.880	17.730	30.240	11.700	134.5
1987	4.790	2.300	2.510	0.000	0.000	0.000	8.010	9.030	23.450	15.470	13.330	19.450	98.3
1988	5.170	2.800	0.660	0.000	0.750	7.350	5.710	13.250	19.210	23.120	40.020	61.940	180.0
1989	10.290	6.910	2.580	0.850	1.060	0.580	12.300	24.640	24.320	64.450	20.440	5.390	173.8
1990	2.930	2.130	1.070	0.000	0.120	0.340	0.950	11.420	43.770	47.390	33.060	44.770	188.0
1991	6.729	4.213	2.190	0.000	1.660	2.290	12.074	12.670	75.367	39.216	21.549	14.173	192.1
1992	18.819	6.210	3.050	0.740	0.360	0.000	15.750	31.562	21.914	120.187	17.042	6.389	242.0
1993	3.520	1.620	1.390	0.060	0.000	0.000	2.220	3.620	54.120	35.076	8.421	12.350	122.4
1994	6.530	2.830	0.330	0.000	0.000	0.040	0.000	4.580	11.740	29.879	20.770	6.140	82.8
1995	17.680	4.010	3.050	0.480	0.000	0.000	1.900	4.340	77.720	33.495	31.443	41.486	215.6
1996	20.371	15.423	6.750	2.890	1.520	0.920	1.840	3.702	47.439	10.673	17.321	5.980	134.8
1997	1.860	4.370	3.130	2.140	0.000	0.000	0.860	38.750	16.295	23.599	11.384	5.350	107.7
1998	3.600	11.600	2.680	0.000	0.000	0.000	2.170	8.510	15.050	23.030	21.250	23.320	111.2
1999	4.970	2.830	1.890	0.130	0.060	0.000	0.000	11.780	11.350	27.176	13.157	23.820	97.2
2000	4.289	2.403	0.887	0.000	1.266	0.000	2.744	11.860	12.305	59.354	36.710	34.910	166.7
2001	5.780	3.280	1.050	4.360	1.020	0.780	2.260	14.100	14.680	52.422	23.793	7.470	131.0
2002	7.950	3.540	1.410	0.000	1.390	0.890	2.000	1.950	2.230	4.295	17.660	14.056	57.4
2003	6.790	1.550	1.590	0.000	0.000	0.000	1.830	0.000	11.110	15.977	30.634	4.260	73.7
2004	5.140	0.340	0.000	0.000	0.000	0.000	3.310	7.790	29.031	29.324	31.271	8.050	114.3
AVE :	8.12	5.11	2.34	1.12	0.55	1.37	3.80	15.39	27.85	30.22	24.49	16.02	136.4
SD :	5.10	6.65	2.70	2.00	0.77	2.60	3.64	16.25	25.80	22.61	16.48	13.79	61.7

Patched observed flows at H1H007

File : H1H007.NSI
Units : Mm3
Descrip. : From DWAF for 1961 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1961	4.590	2.600	2.600	1.450	5.870	7.930	9.860	14.150	55.930	19.640	34.330	9.220	168.2
1962	20.360	4.740	4.740	0.450	0.290	0.300	0.300	1.780	10.000	25.790	31.140	14.180	114.1
1963	2.860	4.350	4.350	0.470	10.480	1.330	1.420	9.210	19.570	13.720	30.050	10.670	108.5
1964	12.330	8.350	8.350	2.140	2.060	9.880	12.260	15.790	10.130	10.470	22.740	7.180	121.7
1965	5.340	1.580	1.580	0.510	0.320	8.480	5.240	4.120	13.350	40.750	14.140	12.010	107.4
1966	2.480	0.670	0.670	1.350	0.190	0.270	10.770	13.220	42.640	16.140	10.450	8.530	107.4
1967	12.420	5.280	5.280	2.100	0.870	0.090	8.460	38.080	16.600	55.360	32.660	5.380	182.6
1968	16.430	1.120	1.120	5.280	1.280	0.290	5.870	3.980	15.130	13.660	23.160	16.400	103.7
1969	14.210	2.010	2.010	0.320	0.290	0.340	0.280	19.280	34.160	21.660	23.910	13.700	132.2
1970	4.550	2.600	2.600	0.590	0.330	0.760	0.990	3.730	9.080	24.340	26.470	5.650	81.7
1971	2.800	0.730	0.730	0.840	1.370	0.290	0.490	14.730	10.890	8.440	12.770	14.110	68.2
1972	2.910	0.710	0.710	0.460	0.300	4.550	0.420	2.430	2.480	34.710	13.670	9.010	72.4
1973	5.240	1.620	1.620	0.570	0.360	0.380	0.340	6.220	27.120	9.710	68.670	10.670	132.5
1974	11.030	3.290	3.290	0.830	0.480	0.460	6.270	28.220	13.770	26.660	15.890	2.530	112.7
1975	7.640	2.210	2.210	0.400	0.300	0.360	0.600	2.180	55.850	23.870	6.570	6.220	108.4
1976	2.740	26.630	16.800	6.750	1.150	1.050	12.410	45.210	52.410	33.340	26.820	8.920	234.2
1977	5.820	1.200	1.200	0.650	0.580	0.890	8.430	18.480	2.460	1.590	23.330	15.120	79.8
1978	5.630	3.140	3.140	1.270	2.000	2.450	2.580	16.880	22.270	11.410	16.950	8.090	95.8
1979	22.460	1.980	1.980	1.920	0.760	0.390	9.710	23.420	14.400	8.760	13.550	6.220	105.6
1980	5.140	16.060	16.060	8.090	1.100	1.300	2.270	2.780	12.670	26.840	22.650	24.560	139.5
1981	2.700	1.640	1.640	2.060	0.460	4.200	8.280	4.960	18.550	12.760	15.020	4.920	77.2
1982	9.370	3.040	3.040	1.230	2.470	4.300	1.570	35.380	42.160	25.020	12.310	14.950	154.8
1983	2.070	1.050	1.050	0.560	0.330	2.880	2.670	46.240	3.630	25.600	11.270	27.770	125.1
1984	11.300	0.950	0.950	4.730	0.900	10.970	12.870	16.260	36.120	30.600	30.590	11.650	167.9
1985	2.780	1.500	1.500	0.810	0.320	2.870	14.160	19.420	26.860	35.480	38.220	15.610	159.5
1986	1.750	1.220	1.220	5.190	0.640	3.660	2.260	28.230	28.750	22.710	24.010	16.530	136.2
1987	3.480	1.320	1.320	0.910	0.370	0.430	10.420	19.890	18.360	23.380	18.450	19.530	117.9
1988	3.950	3.180	3.180	0.380	0.920	11.680	4.350	15.670	17.030	30.620	25.140	20.860	137.0
1989	5.890	4.790	4.790	0.460	1.870	0.690	20.240	16.800	20.240	47.830	19.040	4.430	147.1
1990	1.170	1.090	1.090	0.790	0.930	1.000	1.140	22.340	32.720	36.830	17.480	28.150	144.7
1991	6.030	2.680	2.680	0.410	2.930	3.090	12.780	18.330	61.610	30.240	13.100	11.800	165.7
1992	19.930	4.140	4.140	0.580	0.560	0.360	16.450	32.510	23.280	51.980	12.390	4.600	170.9
1993	1.160	0.480	0.480	0.970	0.320	0.320	3.650	3.210	71.830	15.590	8.060	14.020	120.1
1994	5.650	1.190	1.190	0.310	0.240	0.230	0.330	6.570	24.070	42.180	22.480	5.500	109.9
1995	17.200	1.490	1.490	0.670	0.530	0.550	2.660	4.540	42.720	19.480	23.010	35.640	150.0
1996	14.660	12.580	12.360	1.690	0.610	0.420	0.840	4.920	38.590	11.580	30.330	5.990	134.6
1997	1.030	7.860	7.860	0.540	0.290	0.370	1.920	33.600	14.570	29.270	10.460	8.500	116.3
1998	4.690	13.090	12.860	0.510	0.220	0.250	3.180	12.110	20.050	25.570	26.040	23.180	141.8
1999	1.940	1.210	1.210	1.230	0.520	0.360	0.250	18.440	14.680	17.910	14.460	28.670	100.9
2000	2.370	0.850	0.850	0.440	0.860	0.270	2.610	20.480	15.590	56.050	44.210	31.220	175.8
2001	7.880	3.360	3.360	9.830	0.780	0.550	3.890	20.530	26.800	33.580	17.750	4.990	133.3
2002	8.000	2.560	2.560	0.620	0.380	1.220	2.550	1.730	2.760	6.940	32.710	17.060	79.1
2003	9.590	1.060	1.060	0.720	0.290	0.290	3.870	0.800	19.950	16.550	32.720	3.780	90.7
2004	6.730	0.920	0.920	0.590	0.450	0.140	2.580	19.680	46.540	25.190	35.920	5.980	145.6
AVE :	7.23	3.73	3.50	1.65	1.10	2.11	5.33	16.06	25.19	25.00	22.84	13.04	126.8
SD :	5.66	4.93	3.98	2.18	1.76	3.08	5.12	11.95	16.83	13.01	11.37	8.25	34.0

Patched observed flows at H1H012

File : H1H012.NSI
Units : Mm3
Descrip. : From DWAF for 1963 to 1974

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1963	2.800	1.460	0.970	0.740	1.190	2.700	0.640	0.580	16.710	12.690	14.390	8.660	63.5
1964	5.580	4.000	0.910	0.820	0.680	1.190	4.110	8.420	8.180	6.880	12.780	6.660	60.2
1965	4.160	1.820	1.230	0.650	0.540	0.880	2.040	2.070	6.910	30.190	11.370	7.250	69.1
1966	2.360	0.820	0.760	0.480	0.310	0.250	1.800	5.030	23.260	8.890	10.890	5.100	60.0
1967	5.570	1.890	1.250	0.610	0.420	0.420	0.600	25.210	20.060	19.480	17.830	6.040	99.4
1968	17.370	2.360	1.220	0.930	0.580	0.480	0.750	2.180	1.770	4.870	9.130	14.780	56.4
1969	12.920	1.900	1.240	0.520	0.420	0.380	0.330	2.150	17.000	18.780	18.720	12.970	87.3
1970	3.730	1.090	1.320	0.770	0.450	0.400	0.360	0.630	0.700	21.050	17.660	4.830	53.0
1971	1.510	0.760	0.800	0.610	0.350	0.370	0.440	6.260	8.310	3.790	10.950	5.880	40.0
1972	1.530	0.680	0.610	0.430	0.350	0.350	0.220	0.270	0.700	23.990	18.950	10.500	58.6
1973	5.760	0.860	1.840	0.680	0.410	0.380	0.330	0.490	11.180	6.750	88.190	14.900	131.8
1974	7.420	3.310	1.060	0.820	0.620	0.610	1.630	17.330	10.570	18.070	16.730	4.860	83.0
AVE :	5.89	1.75	1.10	0.67	0.53	0.70	1.10	5.89	10.45	14.62	20.63	8.54	71.9
SD :	4.78	1.05	0.33	0.15	0.24	0.68	1.14	7.81	7.55	8.50	21.55	3.82	25.0

Patched observed flows at H1H013

File : H1H013.NSI
Units : Mm3
Descrip. : From DWAF for 1964 to 1997

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1964	1.240	1.460	0.030	0.040	0.010	0.770	2.200	3.660	2.390	1.520	3.120	2.490	18.9
1965	0.990	0.420	0.230	0.090	0.070	0.630	0.820	0.350	1.460	8.180	3.140	1.690	18.1
1966	0.810	0.200	0.130	0.140	0.070	0.070	0.940	1.010	9.070	1.310	0.380	1.700	15.8
1967	1.670	1.270	0.590	0.380	0.240	0.100	0.310	8.420	5.980	4.820	6.860	1.650	32.3
1968	6.350	0.750	0.350	0.360	0.110	0.070	0.400	0.720	0.920	1.200	3.430	4.540	19.2
1969	3.650	1.280	0.800	0.350	0.280	0.220	0.270	1.220	5.280	5.120	8.110	6.370	33.0
1970	1.550	0.540	0.380	0.180	0.170	0.210	0.230	0.330	0.580	3.450	3.620	1.600	12.8
1971	0.400	0.290	0.180	0.070	0.070	0.060	0.050	2.130	2.100	1.960	3.450	1.750	12.5
1972	0.790	0.260	0.350	0.130	0.080	0.120	0.090	0.210	0.430	3.670	3.770	2.830	12.7
1973	1.720	0.440	0.240	0.120	0.090	0.090	0.080	0.400	3.330	1.130	15.690	7.300	30.6
1974	3.270	1.770	0.740	0.500	0.230	0.140	0.630	4.190	1.110	3.680	5.790	1.540	23.6
1975	2.450	0.610	0.150	0.100	0.100	0.160	0.170	0.200	4.630	3.140	2.650	0.710	15.1
1976	0.320	6.680	3.700	1.830	0.430	0.380	0.610	8.640	11.660	14.470	11.070	4.500	64.3
1977	2.160	0.900	0.620	0.200	0.160	0.170	0.600	1.050	0.220	0.120	1.920	2.480	10.6
1978	1.630	0.490	0.310	0.140	0.110	0.230	0.150	0.950	2.730	1.210	1.830	0.810	10.6
1979	4.400	0.840	0.310	0.390	0.170	0.150	0.280	1.230	2.110	0.400	1.380	0.480	12.1
1980	0.880	4.590	1.750	0.900	0.260	0.240	0.290	0.260	0.280	3.190	5.260	6.410	24.3
1981	1.670	0.740	0.490	0.440	0.130	0.120	0.880	0.740	1.520	1.150	1.330	0.350	9.6
1982	2.080	0.520	0.840	0.340	0.460	0.370	0.320	3.910	6.050	12.830	4.850	2.150	34.7
1983	1.070	0.250	0.300	0.140	0.110	0.410	0.650	9.090	0.440	5.240	1.330	6.780	25.8
1984	3.440	0.430	0.630	0.450	0.130	1.490	0.770	1.070	4.350	6.640	7.940	3.650	31.0
1985	1.560	0.450	0.210	0.100	0.080	0.250	1.090	1.750	1.850	4.280	10.430	3.150	25.2
1986	1.060	0.560	0.310	0.350	0.170	0.140	0.160	2.570	3.540	3.080	3.400	2.710	18.1
1987	1.670	0.640	0.460	0.260	0.120	0.190	0.680	0.580	4.300	2.990	1.830	4.700	18.4
1988	1.690	0.880	0.370	0.200	0.180	1.520	0.790	1.580	1.430	3.650	5.080	9.060	26.4
1989	3.050	1.500	0.560	0.230	0.130	0.090	0.870	2.990	2.280	7.310	5.280	1.160	25.5
1990	0.530	0.370	0.190	0.090	0.060	0.080	0.200	0.970	2.950	7.790	5.080	7.070	25.4
1991	2.660	1.380	0.580	0.170	0.270	0.240	2.050	2.130	7.790	5.500	4.620	3.150	30.5
1992	3.310	1.860	0.730	0.190	0.140	0.100	2.290	5.140	3.620	12.080	4.690	0.720	34.9
1993	0.410	0.190	0.190	0.090	0.060	0.050	0.190	0.330	6.220	2.810	0.540	1.210	12.3
1994	1.240	0.400	0.110	0.070	0.050	0.050	0.050	0.730	0.320	7.060	5.180	0.760	16.0
1995	2.650	0.950	0.660	0.240	0.120	0.090	0.310	0.230	3.570	6.170	8.910	10.290	34.2
1996	5.210	3.950	1.840	0.760	0.460	0.430	0.420	0.480	4.310	1.920	3.240	1.300	24.3
1997	0.170	0.590	0.650	0.480	0.080	0.100	0.210	3.480	3.180	0.800	0.320	0.270	10.3
AVE :	1.99	1.13	0.59	0.31	0.16	0.28	0.59	2.14	3.29	4.41	4.57	3.16	22.6
SD :	1.43	1.37	0.68	0.33	0.11	0.35	0.58	2.45	2.67	3.54	3.36	2.65	11.0

Patched observed flows at H1H018

File : H1H018.NSI
Units : Mm3
Descrip. : From DWAF for 1991 to 2005

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1991	4.500	1.930	1.050	0.580	1.520	1.790	5.920	17.230	35.690	27.470	10.450	8.730	116.9
1992	7.240	3.610	1.920	1.030	0.860	0.620	10.850	13.740	17.910	29.120	12.840	4.330	104.1
1993	1.850	1.220	1.130	0.760	0.430	2.640	7.100	2.670	0.000	11.810	4.160	6.030	39.8
1994	3.070	1.240	0.790	0.620	0.340	0.000	0.440	2.530	7.710	17.720	11.350	2.970	48.8
1995	8.400	1.900	1.410	0.850	0.690	0.620	0.970	2.370	0.000	10.070	10.330	20.480	58.1
1996	12.210	8.590	4.940	2.020	1.290	0.980	1.020	1.850	24.720	8.410	12.320	4.750	83.1
1997	1.850	3.470	2.090	1.190	0.840	0.790	0.800	12.630	6.690	14.200	5.800	4.140	54.5
1998	2.600	5.080	1.250	0.850	0.570	0.660	1.260	4.710	8.830	16.130	14.360	12.110	68.4
1999	3.500	2.120	1.570	1.100	0.520	0.360	0.260	6.170	5.190	9.450	7.550	13.220	51.0
2000	2.540	1.280	0.750	0.590	0.500	0.480	1.120	6.670	7.760	32.630	26.640	19.670	100.6
2001	4.970	3.190	1.460	3.820	1.010	0.750	1.800	9.120	8.560	17.340	13.240	5.140	70.4
2002	5.520	2.340	1.480	1.020	0.570	0.960	1.510	1.050	1.040	3.170	12.880	12.510	44.1
2003	5.430	1.410	1.630	0.860	0.540	0.560	1.540	0.680	6.910	7.260	16.620	3.060	46.5
2004	3.350	1.070	0.440	0.530	0.610	0.400	1.800	8.140	17.300	16.800	17.690	5.610	73.7
2005	5.960	4.730	1.710	1.220	0.890	1.080	2.440	32.430	17.650	17.500	24.540	0.000	110.2
AVE :	4.87	2.88	1.57	1.14	0.75	0.85	2.59	8.13	11.06	15.94	13.38	8.18	71.3
SD :	2.81	2.04	1.03	0.83	0.33	0.64	2.99	8.38	9.90	8.39	6.16	6.13	25.9

Patched observed flows at H1H033

File : H1H033.NSI
Units : Mm3
Descrip. : From DWAF for 1991 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1991	4.310	2.150	1.120	0.780	1.700	1.910	7.150	19.850	52.670	19.930	9.390	8.330	129.3
1992	20.080	3.420	1.850	1.030	0.810	0.750	11.400	23.800	10.330	93.180	9.810	3.370	179.8
1993	1.680	1.070	1.180	0.930	0.600	0.600	1.570	2.290	137.950	11.780	5.630	8.170	173.4
1994	3.710	1.520	0.930	0.720	0.580	0.700	0.660	3.910	10.200	22.660	13.670	4.520	63.8
1995	11.810	2.490	2.300	0.990	0.810	0.820	1.580	3.760	87.680	15.360	16.020	21.520	165.1
1996	12.350	9.390	6.630	2.000	0.980	0.880	1.170	2.620	25.650	9.130	15.200	4.830	90.8
1997	1.450	4.770	2.760	1.080	0.540	0.510	1.070	17.220	9.290	17.560	6.640	5.160	68.1
1998	2.900	6.960	1.320	0.800	0.520	0.520	1.460	6.590	11.380	16.730	17.260	14.950	81.4
1999	3.150	1.850	0.960	0.870	0.720	0.750	0.740	7.900	8.740	11.970	9.180	15.770	62.6
2000	2.360	1.100	0.780	0.780	0.690	0.540	1.120	9.860	9.120	30.460	26.570	18.400	101.8
2001	4.540	3.290	1.120	4.690	0.990	0.830	1.900	11.230	12.670	19.150	14.340	4.960	79.7
2002	5.520	2.720	1.290	0.830	0.670	1.540	1.210	1.170	1.540	3.130	16.390	6.770	42.8
2003	5.970	1.850	1.580	0.910	0.530	0.610	1.360	0.750	7.070	8.470	16.610	2.960	48.7
2004	3.720	1.130	0.760	0.720	0.600	0.500	2.970	9.440	20.030	14.730	18.210	4.890	77.7
AVE :	5.97	3.12	1.76	1.22	0.77	0.82	2.53	8.60	28.88	21.02	13.92	8.90	97.5
SD :	5.25	2.42	1.52	1.05	0.31	0.41	3.03	7.25	38.90	21.82	5.48	6.11	46.2

Patched observed flows at H4H006

File : H4H006.NSI
Units : Mm3
Descrip. : From DWAF for 1980 to 1989

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1980	0.000	0.000	0.000	0.000	2.000	0.000	0.000	0.000	0.000	0.000	0.000	55.780	57.8
1981	0.000	1.880	12.630	7.600	10.170	0.000	0.000	0.000	0.000	0.000	0.000	0.000	32.3
1982	1.460	11.780	9.770	12.780	6.430	6.290	2.820	0.000	0.000	64.900	0.000	0.000	116.2
1983	0.000	5.520	11.090	10.890	15.160	0.000	0.000	59.780	0.000	50.400	0.000	23.370	176.2
1984	15.990	2.040	5.090	0.000	0.370	0.000	0.000	0.000	2.080	9.660	0.000	0.000	35.2
1985	0.000	0.000	4.590	4.440	1.540	0.000	0.000	0.000	0.000	0.000	49.460	0.000	60.0
1986	0.000	2.560	6.680	1.660	7.250	2.240	0.000	0.000	0.000	0.000	11.410	0.000	31.8
1987	0.000	5.610	3.700	11.910	12.470	7.190	0.000	0.000	0.000	0.000	0.000	0.000	40.9
1988	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.940	10.9
1989	0.000	0.000	10.330	14.980	10.400	5.790	0.000	5.420	0.000	0.000	19.560	0.000	66.5
AVE :	1.75	2.94	6.39	6.43	6.58	2.15	0.28	6.52	0.21	12.50	8.04	9.01	62.8
SD :	5.03	3.78	4.50	5.92	5.42	3.05	0.89	18.79	0.66	24.23	16.03	18.15	49.0

APPENDIX D:

NATURALISED INCREMENTAL FLOW SEQUENCES

APPENDIX NUMBER	CALIBRATION GAUGE
D1	H1H003
D2	H1H006
D3	H1H007
D4	H1H012
D5	H1H013
D6	H1H018
D7	H1H033
D8	H4H006

Incremental Naturalised Flows at H1H003

File : H1H003.NAT
Units : Mm3
Descrip. : Simulated for 1927 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1927	3.260	3.810	2.590	1.670	1.220	1.050	0.930	0.870	22.760	9.840	3.650	3.780	55.4
1928	3.360	2.690	1.920	1.330	1.000	0.870	1.200	2.620	5.280	9.990	7.160	4.840	42.3
1929	3.970	3.030	2.340	1.680	1.550	1.250	1.080	1.030	1.000	1.620	1.840	14.390	34.8
1930	7.100	2.730	1.930	1.320	1.010	0.880	2.330	6.320	3.450	3.250	13.250	9.050	52.6
1931	5.480	3.870	2.550	1.690	11.580	4.960	1.350	4.430	6.120	6.710	5.420	6.290	60.5
1932	5.110	3.570	2.380	1.590	1.200	1.070	0.960	8.370	16.640	28.900	13.180	6.430	89.4
1933	5.440	3.980	2.690	1.850	1.340	1.150	1.010	2.960	2.740	4.330	4.060	8.470	40.0
1934	9.560	5.810	3.220	1.930	1.360	1.280	1.730	4.790	7.100	6.780	9.510	7.010	60.1
1935	5.000	4.220	2.850	2.120	1.490	1.140	0.990	5.120	2.900	5.500	12.420	14.510	58.3
1936	7.800	4.440	3.710	2.380	1.490	1.670	1.770	3.350	19.150	25.550	11.460	5.880	88.7
1937	5.070	3.730	2.480	1.840	1.350	1.050	2.620	10.070	5.230	3.600	5.240	10.640	52.9
1938	6.790	4.010	2.750	1.780	1.340	1.080	1.520	5.040	3.240	2.560	5.150	4.550	39.8
1939	3.380	2.650	2.000	1.460	1.520	1.190	4.130	2.520	5.090	4.030	3.010	3.610	34.6
1940	3.160	2.830	2.050	2.140	1.470	1.040	4.430	35.230	32.380	13.660	10.550	33.550	142.5
1941	18.960	8.180	4.820	2.770	1.720	1.210	1.010	9.840	60.000	22.480	7.680	6.130	144.8
1942	4.950	3.710	2.410	1.750	1.600	1.530	1.320	1.290	4.640	20.050	29.510	13.520	86.3
1943	6.740	5.570	3.640	2.150	1.410	1.170	1.230	16.390	32.740	12.510	19.600	13.760	116.9
1944	7.460	5.780	4.060	2.500	1.580	1.130	2.310	31.740	49.270	30.380	21.160	11.800	169.2
1945	9.730	6.880	4.170	2.520	1.600	1.260	1.430	1.800	1.780	2.000	2.660	22.270	58.1
1946	10.420	3.350	2.210	1.460	1.070	1.570	1.200	2.850	2.010	23.230	11.170	4.180	64.7
1947	4.110	3.220	2.150	1.420	1.080	2.500	2.150	6.080	5.330	11.730	7.210	22.480	69.5
1948	12.220	5.140	3.260	2.040	1.380	1.040	1.720	1.900	2.900	4.690	5.730	7.940	50.0
1949	7.430	7.070	4.260	2.320	1.490	1.110	16.190	6.690	2.050	24.560	10.830	18.270	102.3
1950	10.980	8.390	5.140	3.160	2.060	1.400	2.020	1.940	36.460	19.460	10.410	8.400	109.8
1951	7.250	8.050	4.860	2.500	1.590	1.210	1.150	25.340	11.830	11.420	21.900	12.460	109.6
1952	6.930	6.890	4.490	2.510	1.600	1.200	20.240	18.520	6.840	12.790	14.220	8.430	104.7
1953	8.670	6.210	3.780	2.350	1.540	1.160	10.340	56.340	22.610	45.810	30.800	12.640	202.3
1954	8.910	6.750	5.250	3.200	3.480	2.240	1.530	1.350	17.870	19.340	64.520	25.460	159.9
1955	11.300	8.420	4.690	2.710	1.800	1.330	1.100	4.340	9.180	8.810	7.940	5.660	67.3
1956	4.200	3.030	2.060	1.410	7.360	3.510	1.410	40.350	21.950	16.810	13.060	9.180	124.3
1957	25.450	12.870	4.570	2.580	1.690	1.270	1.350	3.360	3.160	2.330	8.850	5.260	72.7
1958	3.380	2.690	1.850	1.270	1.090	0.980	5.450	31.590	12.340	3.040	8.390	7.020	79.1
1959	5.760	4.060	2.620	1.720	1.200	1.260	1.160	5.340	8.360	4.400	3.150	3.080	42.1
1960	2.690	2.080	1.600	1.320	1.060	0.910	0.960	2.100	4.990	4.150	7.550	10.260	39.7
1961	6.070	3.440	2.210	1.470	1.170	1.810	2.700	2.350	44.020	20.570	28.640	14.820	129.3
1962	20.980	11.960	5.100	2.860	1.730	1.240	1.020	0.930	4.230	6.580	38.710	15.840	111.2
1963	4.040	4.430	3.060	1.850	1.470	1.170	1.170	1.660	13.470	8.620	13.730	9.660	64.3
1964	6.150	6.050	3.870	2.180	2.370	3.150	2.450	3.810	3.100	2.800	3.530	3.400	42.9
1965	3.240	2.590	1.900	1.350	1.010	1.650	1.380	1.300	9.770	11.020	5.680	4.300	45.2
1966	3.640	2.640	1.790	1.240	0.980	0.840	2.020	1.740	28.820	13.200	5.280	4.770	67.0
1967	5.000	3.970	2.590	1.660	1.200	0.980	2.060	8.840	12.790	10.800	9.660	6.690	66.2
1968	17.190	8.970	3.490	2.150	1.440	1.110	1.850	1.420	1.630	1.630	2.970	4.170	48.0
1969	9.070	4.880	2.180	1.420	1.050	0.880	0.800	4.840	19.100	11.200	13.080	8.410	76.9
1970	5.290	3.810	2.440	1.580	1.140	1.260	1.050	0.990	2.270	10.950	6.940	3.590	41.3
1971	2.760	2.090	1.510	1.230	1.010	0.880	2.910	5.010	3.850	4.710	4.000	3.830	33.8
1972	3.440	2.600	2.240	1.550	1.090	1.020	0.930	1.080	1.070	18.950	10.880	4.930	49.8
1973	3.880	2.930	2.270	1.580	1.120	0.940	0.900	7.800	9.230	6.320	93.400	37.230	167.6
1974	8.220	6.020	3.810	2.360	1.590	1.210	1.550	17.490	7.750	6.040	7.410	5.310	68.8
1975	5.720	4.070	2.440	1.590	1.190	1.010	3.760	2.360	40.420	23.260	7.730	5.480	99.0
1976	4.920	18.280	10.830	3.880	2.190	1.580	2.530	38.970	33.120	40.710	32.740	15.580	205.3
1977	9.500	6.660	4.240	2.590	1.660	1.580	1.500	1.350	1.340	1.330	8.810	6.600	47.2
1978	3.430	2.330	1.980	1.520	1.530	1.230	1.020	2.470	9.540	6.250	3.970	4.440	39.7
1979	4.410	3.270	2.130	1.620	1.270	1.030	1.100	3.250	4.610	2.940	4.760	3.660	34.1
1980	3.060	22.330	10.680	9.460	4.540	1.930	1.690	1.540	1.790	17.020	13.950	18.090	106.1
1981	9.740	4.800	3.070	2.330	1.600	2.040	12.990	6.070	4.960	4.770	4.110	3.650	60.1
1982	4.090	3.160	2.210	1.520	2.130	1.760	1.280	39.150	34.200	17.880	8.890	6.950	123.2
1983	5.840	4.330	2.880	1.830	1.260	6.330	3.700	49.500	19.020	6.170	5.490	26.100	132.5
1984	16.200	6.650	6.330	4.550	3.160	12.860	7.300	4.350	7.640	17.880	19.080	12.950	118.9
1985	8.420	5.580	3.650	2.320	1.550	1.600	1.380	1.370	8.070	8.850	19.550	10.790	73.1
1986	5.490	4.000	2.630	1.670	1.200	0.990	1.390	14.800	15.570	8.370	7.450	6.600	70.2
1987	5.160	3.620	2.420	1.620	1.150	1.080	8.140	4.080	7.680	5.260	6.390	6.680	53.3
1988	4.960	3.460	2.310	1.570	1.210	6.160	4.410	3.030	9.750	8.820	17.870	18.980	82.5
1989	11.000	6.780	4.300	2.560	1.840	1.480	7.920	14.240	12.860	15.480	10.340	7.140	95.9
1990	5.510	4.080	2.910	1.960	1.360	1.070	1.190	2.370	19.630	57.220	21.640	9.270	128.2
1991	7.640	5.220	3.400	2.090	1.670	1.390	3.610	3.930	19.760	15.020	11.270	8.260	83.3
1992	10.710	7.180	3.940	2.330	1.620	1.260	10.910	15.200	10.660	40.830	19.250	7.550	131.4
1993	5.910	4.220	2.800	1.790	1.230	0.950	2.210	2.120	42.280	18.620	4.780	7.110	94.0
1994	5.360	3.470	2.290	1.530	1.100	1.000	0.940	8.350	7.030	10.950	10.880	6.550	59.5
1995	8.500	5.730	5.360	3.200	1.890	1.580	1.520	2.230	16.760	21.810	20.890	14.540	104.0
1996	9.540	8.400	6.860	3.980	2.260	1.570	1.480	1.860	24.360	10.630	4.740	4.110	79.8
1997	3.230	4.740	3.120	2.410	1.650	1.150	1.000	13.150	7.570	6.080	4.820	3.960	52.9
1998	3.480	4.880	3.310	1.890	1.300	1.010	1.670	1.880	2.320	2.430	6.230	9.940	40.3
1999	5.590	3.020	2.130	1.490	1.110	0.900	0.840	0.880	2.210	15.830	8.190	10.950	53.1
2000	6.330	3.140	2.120	1.420	1.090	0.910	1.010	7.740	3.990	44.080	22.830	11.960	106.6
2001	8.120	5.330	3.460	3.190	2.130	1.500	2.170	13.530	7.140	19.880	18.320	11.840	96.6
2002	8.540	6.150	3.960	2.470	1.640	1.460	1.360	1.410	1.350	1.380	28.430	12.540	70.7
2003	3.820	2.840	2.120	1.680	1.250	0.990	2.230	1.520	2.920	3.740	4.010	3.390	30.5
2004	5.290	3.580	2.070	1.440	1.090	0.900	5.590	3.010	5.470	4.270	24.620	12.020	69.3
AVE :	7.06	5.22	3.30	2.13	1.73	1.63	2.85	8.81	12.75	13.04	13.31	9.95	81.8
SD :	4.19	3.27	1.66	1.07	1.42	1.63	3.48	12.05	12.85	11.35	13.62	6.73	39.9

Incremental Naturalised Flows at H1H006

File : H1H006.NAT
Units : Mm3
Descrip. : Simulated for 1927 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1927	0.920	8.230	3.580	0.820	0.410	0.440	0.480	0.390	40.350	23.130	21.590	19.210	119.5
1928	6.100	1.200	0.490	0.250	0.200	0.250	9.810	14.700	17.710	28.940	27.620	9.340	116.6
1929	2.510	1.170	1.020	0.840	0.610	0.430	0.580	0.740	0.780	6.590	20.520	33.280	69.1
1930	11.890	2.390	0.970	0.340	0.250	0.230	7.710	17.340	8.710	10.530	46.610	27.830	134.8
1931	9.100	2.780	0.780	0.460	20.390	7.610	0.750	16.090	21.960	25.340	15.170	11.410	131.8
1932	4.840	1.340	0.500	0.320	0.400	0.460	0.400	6.600	30.360	41.010	23.670	7.540	117.4
1933	3.850	2.100	1.230	0.680	0.400	1.080	1.020	8.490	13.850	14.620	15.780	19.410	82.5
1934	17.180	7.360	1.830	0.440	0.300	0.700	6.690	13.470	11.850	24.970	26.740	17.970	129.5
1935	5.810	2.290	1.090	0.800	0.530	0.420	0.400	5.490	3.930	12.510	25.630	21.350	80.3
1936	6.860	1.620	7.080	2.800	0.370	1.120	3.260	14.880	34.770	48.530	20.540	4.790	146.6
1937	2.330	1.240	0.560	5.840	2.450	0.450	6.960	25.620	19.040	12.630	16.700	18.480	112.3
1938	7.110	1.960	0.780	0.340	6.320	2.630	2.710	18.550	10.200	10.830	27.560	17.710	106.7
1939	4.860	1.360	1.320	0.750	1.090	0.960	8.630	7.430	21.940	18.150	9.900	7.330	83.7
1940	4.070	6.070	2.570	2.190	1.100	0.360	10.050	37.960	51.410	34.170	29.560	47.280	226.8
1941	24.380	5.110	0.890	0.360	0.220	0.180	0.240	20.180	80.940	33.450	18.760	7.690	192.4
1942	3.350	1.810	0.760	1.060	0.750	1.070	2.300	3.880	20.200	38.420	44.200	28.070	145.9
1943	8.280	5.670	2.320	0.530	0.290	0.350	3.800	19.820	62.730	31.410	29.200	19.540	183.9
1944	6.640	4.000	1.910	0.560	0.230	0.180	2.030	31.500	60.830	43.840	30.860	9.690	192.3
1945	2.250	1.340	0.700	0.320	0.200	0.310	1.840	3.820	4.110	10.680	17.380	35.010	78.0
1946	13.960	2.550	0.770	0.280	0.190	3.200	1.860	3.020	3.660	40.110	25.830	7.240	102.7
1947	4.930	2.600	0.730	0.240	0.250	10.210	9.050	21.300	17.000	31.790	14.010	26.900	139.0
1948	14.670	3.430	0.850	0.330	0.210	0.180	3.320	6.410	16.350	23.080	25.410	20.630	114.9
1949	14.970	10.180	3.250	0.590	0.230	0.190	20.320	8.350	2.930	42.310	16.360	18.090	137.8
1950	9.110	10.680	4.520	3.330	1.430	0.370	8.690	9.180	48.890	37.430	20.200	15.620	169.5
1951	8.730	10.880	3.950	0.500	0.480	0.650	1.370	26.810	23.960	23.460	45.020	27.450	173.3
1952	8.560	10.910	4.090	0.490	0.210	0.200	28.540	43.060	19.290	38.880	29.290	8.060	191.6
1953	2.010	3.470	2.280	0.870	0.390	0.420	12.180	43.990	30.240	52.220	48.110	21.370	217.6
1954	6.450	2.170	1.750	0.820	8.830	3.510	2.330	2.370	24.490	44.460	70.750	22.830	190.8
1955	13.070	12.650	4.020	0.770	0.480	0.500	0.570	12.310	39.600	35.280	29.800	11.080	160.1
1956	3.480	1.540	0.510	0.240	20.000	10.700	2.970	36.880	63.900	60.010	38.890	17.750	256.9
1957	26.770	9.350	0.810	0.260	1.830	1.050	0.780	23.960	22.940	8.140	21.880	12.590	130.4
1958	5.460	3.680	1.470	0.410	0.430	0.470	14.820	74.700	28.050	4.620	22.810	10.490	167.4
1959	16.570	6.460	0.890	0.400	0.270	0.450	3.170	24.550	42.130	15.830	4.520	3.940	119.2
1960	2.780	1.300	0.560	2.290	1.150	0.410	1.250	10.850	21.190	19.050	26.750	33.930	121.5
1961	11.120	1.470	0.480	0.330	1.840	3.670	6.280	4.880	85.900	52.980	54.390	21.460	244.8
1962	24.320	9.560	1.300	0.480	0.280	0.210	0.260	0.490	12.320	28.760	59.720	20.110	157.8
1963	2.600	4.650	3.910	1.330	5.680	2.410	4.780	10.740	43.500	33.500	46.810	18.570	178.5
1964	4.470	10.370	4.030	0.730	4.360	16.830	13.620	14.060	13.610	9.270	9.960	5.600	106.9
1965	3.690	2.060	1.480	0.710	0.270	5.370	5.490	3.290	20.940	47.340	22.710	15.820	129.2
1966	5.930	1.060	0.390	0.420	0.370	0.240	7.810	8.770	57.710	34.590	14.620	9.980	141.9
1967	8.740	7.150	2.490	0.570	0.320	0.230	10.800	40.820	40.130	39.680	30.850	9.220	191.0
1968	28.410	11.170	4.590	1.870	0.460	0.310	4.550	2.930	5.780	7.060	18.990	22.490	108.6
1969	19.740	6.240	0.920	0.320	0.280	0.270	0.220	14.970	40.660	37.270	35.430	21.550	177.9
1970	6.900	2.250	1.020	0.440	0.240	4.440	2.060	2.210	22.780	30.590	33.920	11.340	118.2
1971	2.090	0.910	0.440	0.330	0.310	0.280	13.770	20.670	18.440	17.690	11.450	6.960	93.3
1972	4.800	2.180	1.700	0.800	0.270	1.070	0.820	2.270	2.480	44.250	34.390	22.530	117.6
1973	7.860	1.910	1.160	0.580	0.260	0.200	0.190	15.830	38.260	27.270	90.750	46.890	231.2
1974	18.820	13.410	4.010	0.810	0.510	0.360	5.070	41.910	22.660	23.880	29.370	10.020	170.8
1975	11.680	5.280	1.050	0.340	0.310	0.460	3.480	3.640	60.610	45.750	17.230	5.770	155.6
1976	2.700	31.240	21.390	4.850	1.310	0.810	10.690	57.000	61.240	60.300	44.670	18.810	315.0
1977	5.060	1.670	2.490	1.210	0.410	1.410	2.950	8.010	5.070	2.670	28.690	26.180	85.8
1978	7.570	1.270	0.560	0.560	6.410	2.670	0.480	9.040	26.240	21.280	15.750	17.690	109.5
1979	14.760	4.610	0.670	0.730	0.600	0.350	6.080	16.210	25.740	10.460	25.170	10.990	116.4
1980	3.460	27.640	18.090	17.770	5.580	0.790	1.420	1.660	10.730	39.300	39.380	34.860	200.7
1981	11.010	1.900	0.770	1.960	0.990	0.800	19.860	12.760	16.510	21.620	13.570	4.750	106.5
1982	10.200	4.580	1.220	0.540	0.810	0.980	0.890	34.170	46.060	48.310	20.100	8.340	176.2
1983	3.510	1.110	0.450	0.240	0.190	14.730	7.000	60.100	31.080	18.070	12.510	31.310	180.3
1984	24.640	6.280	7.920	4.630	1.470	20.440	13.470	12.140	27.950	35.320	40.170	20.250	214.7
1985	5.170	1.250	0.450	0.280	0.290	3.560	4.040	8.260	27.060	29.730	47.760	23.700	151.6
1986	5.390	1.600	0.640	0.410	0.350	0.300	3.910	32.070	43.590	35.140	34.420	20.190	178.0
1987	5.450	1.010	0.700	0.440	0.230	0.210	12.640	9.970	27.110	19.280	22.120	17.880	117.0
1988	5.750	1.290	0.510	0.260	2.780	13.720	8.160	10.180	25.340	27.600	34.930	34.940	165.5
1989	12.370	4.040	1.590	0.430	0.500	0.680	25.540	29.820	32.030	31.340	20.680	6.410	165.4
1990	1.490	0.860	1.100	0.650	0.300	0.300	1.330	12.470	34.040	63.860	25.410	24.300	166.1
1991	10.060	2.190	0.820	0.300	0.620	1.560	11.300	14.870	53.070	42.630	25.820	11.160	174.4
1992	22.530	8.890	1.230	0.390	0.410	0.420	18.600	37.010	31.090	55.440	27.610	6.760	210.4
1993	2.420	0.960	0.620	0.400	0.220	0.180	9.380	8.170	71.560	39.820	8.780	22.870	165.4
1994	9.880	1.860	0.660	0.300	0.220	0.250	0.280	11.640	20.120	30.090	24.680	8.230	108.2
1995	22.730	8.760	9.240	3.440	0.600	0.820	1.170	7.760	49.470	42.670	45.860	43.370	235.9
1996	14.870	11.310	5.940	1.510	0.430	0.280	0.520	4.180	39.630	20.210	17.400	7.090	123.4
1997	1.650	6.040	2.700	1.130	0.620	0.270	0.430	54.250	33.420	29.710	17.860	5.930	154.0
1998	2.880	14.100	9.290	2.170	0.450	0.280	2.090	6.970	17.810	22.690	38.970	34.980	152.7
1999	9.740	1.010	0.410	0.300	0.220	0.220	0.240	2.040	6.050	32.500	21.500	26.130	100.4
2000	9.340	1.570	0.780	0.350	0.260	0.230	6.990	19.780	15.600	56.690	42.340	25.500	179.4
2001	8.320	2.270	0.930	6.860	3.390	0.980	5.010	26.460	26.300	42.550	34.780	12.760	170.6
2002	4.860	3.060	1.690	0.790	0.350	0.530	0.830	0.990	1.070	3.220	39.500	29.120	86.0
2003	11.120	3.060	1.660	1.150	0.540	0.260	5.850	2.990	15.660	25.280	17.130	7.090	91.8
2004	10.370	4.390	0.760	0.330	0.260	0.200	8.930	9.020	25.550	24.070	42.300	18.780	145.0
AVE :	9.03	5.00	2.37	1.23	1.53	2.00	5.77	16.95	28.88	30.23	28.82	18.33	150.2
SD :	6.63	5.37	3.46	2.28	3.47	3.96	6.07	15.59	19.12	14.69	14.46	10.26	47.2

Incremental Naturalised Flows at H1H007

File : H1H007.NAT
Units : Mm3
Descrip. : Simulated for 1927 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1927	1.280	8.600	3.010	1.300	0.560	1.300	1.360	0.850	24.070	13.530	14.360	15.650	85.9
1928	5.070	1.280	1.390	0.590	0.310	0.540	9.130	27.190	19.040	27.290	18.540	6.620	117.0
1929	2.320	1.470	3.090	1.510	1.260	0.730	4.530	2.000	0.960	13.170	17.080	29.120	77.2
1930	10.890	5.380	1.800	0.460	1.800	0.750	13.710	18.260	10.360	10.220	26.080	23.840	123.5
1931	12.410	2.840	0.890	1.600	15.340	4.700	1.080	17.710	23.720	20.530	16.770	11.110	128.7
1932	4.310	1.330	1.050	0.670	0.910	0.640	0.450	7.230	40.540	32.600	17.220	6.720	113.7
1933	8.890	2.780	0.690	0.380	0.430	4.610	3.020	15.040	11.740	12.560	14.500	14.960	89.6
1934	9.060	5.640	1.500	0.350	0.430	0.910	9.090	11.660	11.060	19.170	18.090	12.760	99.7
1935	4.650	4.890	1.530	3.770	1.410	0.800	0.570	10.460	6.460	16.560	19.620	13.510	84.2
1936	4.740	1.770	6.920	2.090	0.370	12.170	9.370	13.270	30.750	37.150	13.490	5.100	137.2
1937	2.980	1.230	0.560	5.870	2.210	0.580	13.440	21.380	11.790	14.460	14.430	14.670	103.6
1938	6.220	2.460	1.010	0.410	2.650	1.090	5.750	18.530	9.990	10.980	21.320	14.640	95.1
1939	4.350	3.360	1.830	0.590	2.990	2.160	11.600	14.540	22.670	12.560	8.750	11.650	97.1
1940	5.290	8.850	2.570	3.800	1.720	0.600	18.370	38.870	40.100	26.090	21.730	39.820	207.8
1941	15.880	2.800	0.810	0.550	0.360	0.290	0.630	29.770	58.560	21.920	18.990	7.880	158.4
1942	4.450	1.570	0.520	3.590	2.060	4.950	5.640	6.820	15.170	25.900	29.780	20.010	120.5
1943	7.260	8.930	2.480	0.820	0.440	0.600	3.220	24.040	45.310	24.610	24.190	15.600	157.5
1944	8.850	6.420	5.320	1.390	0.310	0.310	5.840	26.870	47.540	41.840	29.590	8.490	182.8
1945	2.700	1.780	1.140	0.490	0.300	1.210	9.980	15.430	10.350	14.640	22.020	28.370	108.4
1946	16.080	4.260	0.990	0.400	0.280	6.290	2.990	11.690	9.810	36.560	22.970	8.790	121.1
1947	4.630	2.190	0.710	0.340	0.350	3.520	5.660	18.350	15.180	26.360	18.320	23.760	119.4
1948	15.690	3.730	1.340	0.590	0.310	0.330	10.290	11.120	14.450	22.500	24.060	16.640	121.1
1949	10.400	9.020	2.610	0.490	0.290	0.320	16.900	5.590	8.130	36.460	12.350	16.730	119.3
1950	7.290	9.780	3.560	2.140	0.780	0.310	28.400	18.670	38.100	26.440	18.120	11.810	165.4
1951	7.330	10.390	2.770	0.360	0.430	1.070	3.850	20.380	14.050	18.680	39.800	33.410	152.5
1952	11.880	13.260	3.560	0.430	0.310	0.570	28.290	39.440	18.770	28.380	29.800	8.790	183.5
1953	2.060	4.220	1.930	0.690	0.750	1.340	16.530	44.650	24.010	42.780	34.490	12.870	186.3
1954	9.580	2.990	3.430	1.130	6.070	2.120	3.930	3.860	21.230	36.650	47.840	14.950	153.8
1955	13.270	8.140	1.990	0.450	0.360	0.810	4.360	17.700	31.410	28.930	30.710	10.590	148.7
1956	3.820	1.370	1.170	0.770	13.980	5.080	3.910	35.350	34.460	39.740	25.990	13.010	178.7
1957	18.530	5.270	0.610	0.470	8.260	2.740	2.730	21.070	17.660	6.340	19.930	10.340	113.9
1958	7.040	5.720	1.530	0.620	0.730	0.980	17.190	61.990	18.440	3.590	13.450	8.020	139.3
1959	8.820	2.890	0.680	0.370	0.360	2.600	6.680	21.120	32.990	12.270	5.820	4.420	99.0
1960	4.970	1.770	0.750	3.920	1.430	0.460	1.750	10.130	25.350	15.720	19.260	25.410	110.9
1961	9.320	1.750	0.560	0.540	5.060	3.100	9.840	5.480	55.670	27.480	31.830	13.220	163.9
1962	17.810	5.380	0.700	0.930	0.520	0.360	0.410	2.850	10.370	26.380	32.700	13.680	112.1
1963	3.580	4.280	3.250	0.910	12.100	3.590	1.340	5.860	23.420	21.390	20.980	8.730	109.4
1964	7.370	10.610	2.850	1.650	4.390	13.290	8.220	14.960	11.820	11.510	12.500	5.630	104.8
1965	5.790	2.120	2.530	0.930	0.380	9.450	4.940	6.720	24.760	35.240	17.250	12.220	122.3
1966	3.890	0.960	0.660	0.660	0.390	0.480	12.760	15.460	37.730	16.410	10.820	10.410	110.6
1967	9.720	7.570	1.900	1.730	0.740	0.330	17.740	27.910	24.020	35.410	22.090	6.620	155.8
1968	16.990	5.530	1.670	3.380	1.180	0.520	9.960	3.930	13.820	10.760	17.300	17.710	102.8
1969	7.900	1.950	0.510	0.320	0.440	0.360	0.410	22.640	36.060	25.600	24.250	13.020	133.5
1970	4.490	2.080	2.230	0.810	0.320	1.610	0.830	4.660	14.750	19.140	25.090	8.360	84.4
1971	3.020	1.240	0.710	2.010	1.890	1.290	8.650	17.130	12.310	11.900	12.170	9.840	82.2
1972	4.240	1.200	5.380	1.640	0.310	5.490	1.960	7.510	3.870	37.950	23.570	13.650	106.8
1973	6.960	2.010	5.850	1.800	0.370	0.360	0.320	19.510	31.950	21.710	62.270	25.720	178.8
1974	17.190	7.210	1.740	0.880	0.650	0.420	7.520	35.040	17.240	25.880	21.070	6.570	141.4
1975	10.530	4.630	0.990	0.350	0.300	1.280	2.080	3.560	55.110	31.240	14.110	10.820	135.0
1976	5.090	22.050	15.190	5.530	3.660	1.630	13.090	45.530	46.430	43.180	37.250	16.990	255.6
1977	6.260	2.370	3.310	1.380	1.950	4.530	10.650	12.120	4.440	2.500	24.990	17.160	91.7
1978	5.780	1.620	3.540	1.750	10.290	3.070	0.940	19.030	17.420	13.430	15.480	11.780	104.1
1979	17.450	5.190	0.690	3.560	1.890	0.590	8.540	25.090	24.330	10.130	14.950	7.990	120.4
1980	4.310	15.840	10.120	16.370	4.180	3.070	5.100	4.110	15.130	27.770	25.310	23.320	154.6
1981	6.980	1.420	2.200	2.560	0.880	1.020	14.150	16.750	29.940	18.350	12.560	5.360	112.2
1982	10.240	4.840	4.680	1.460	5.630	6.890	3.280	30.690	39.850	24.380	12.130	16.290	160.4
1983	5.320	3.200	1.830	0.660	0.340	9.600	4.270	41.720	19.370	14.240	9.290	20.830	130.7
1984	16.330	3.770	10.900	5.240	3.670	12.410	13.790	9.530	28.750	33.190	25.040	14.160	176.8
1985	4.370	1.160	0.470	0.790	0.680	5.210	11.740	10.000	28.560	31.120	28.770	15.920	138.8
1986	4.270	1.320	0.700	7.310	2.520	1.760	6.160	17.990	20.820	24.420	25.080	19.270	131.6
1987	6.970	1.840	6.610	1.940	0.310	0.520	13.300	14.990	17.210	23.810	24.170	16.660	128.3
1988	5.690	1.590	1.480	0.690	4.840	14.060	10.780	15.140	20.070	29.180	29.100	22.770	155.4
1989	10.010	9.670	2.590	0.840	4.530	1.490	24.110	19.210	27.150	36.950	18.890	7.820	163.3
1990	2.560	2.090	6.480	1.970	0.580	0.470	1.550	16.230	33.210	58.650	23.400	19.830	167.0
1991	10.310	2.740	0.940	0.420	2.090	3.720	5.040	16.630	49.410	32.530	19.200	13.390	156.4
1992	19.870	5.920	0.810	0.440	1.770	0.840	26.730	34.170	25.330	37.400	22.270	7.280	182.8
1993	2.160	0.780	1.000	0.750	0.420	0.390	8.270	5.320	48.460	19.450	7.660	14.380	109.0
1994	6.650	1.740	0.760	1.310	0.700	1.030	0.950	15.430	27.600	31.460	25.090	7.650	120.4
1995	11.640	3.600	18.240	5.050	3.440	2.120	2.850	10.030	31.050	21.650	22.670	24.520	156.9
1996	12.890	10.040	10.160	2.630	0.410	0.290	2.170	9.820	37.770	18.580	23.170	7.970	135.9
1997	1.890	8.180	7.210	1.720	0.340	0.480	4.160	24.900	20.310	21.230	13.210	7.840	111.5
1998	4.910	8.570	7.200	1.710	0.330	0.280	9.610	13.600	24.470	23.590	27.380	24.820	146.5
1999	6.470	2.390	0.960	1.630	0.680	0.380	0.450	8.120	14.280	13.120	13.040	17.070	78.6
2000	5.050	2.060	1.030	0.570	0.500	0.360	3.910	19.570	12.220	50.640	39.420	24.210	159.5
2001	11.560	8.080	2.350	11.930	6.380	1.310	9.630	21.860	25.390	26.870	27.360	11.640	164.4
2002	6.710	2.570	2.860	1.570	0.650	3.200	4.390	7.040	3.920	7.270	29.360	18.670	88.2
2003	10.340	2.650	4.160	3.500	0.960	0.420	8.410	2.950	20.660	19.700	14.480	7.130	95.4
2004	14.110	4.220	0.530	5.110	1.710	0.540	11.160	18.190	25.320	15.340	24.330	11.040	131.6
AVE :	8.05	4.60	2.90	1.95	2.13	2.45	7.77	17.44	24.05	23.91	21.96	14.49	131.7
SD :	4.61	3.80	3.27	2.53	3.08	3.20	6.61	11.64	13.09	10.98	9.11	7.03	33.6

Incremental Naturalised Flows at H1H012

File : H1H012.NAT
Units : Mm3
Descrip. : Simulated for 1927 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1927	2.660	6.080	1.640	0.850	0.620	0.740	0.630	0.590	41.040	14.970	6.640	11.120	87.6
1928	4.700	2.390	1.220	0.730	0.580	0.620	14.030	1.910	10.070	18.150	16.100	6.250	76.8
1929	3.440	1.770	1.060	0.750	0.650	0.590	0.550	0.540	0.540	0.570	1.120	3.520	15.1
1930	1.660	1.190	0.800	0.600	0.550	0.540	12.120	8.190	2.860	11.240	24.250	11.760	75.8
1931	14.870	4.570	2.120	1.190	8.890	1.350	0.940	5.840	8.000	14.440	7.020	11.480	80.7
1932	5.410	2.780	1.560	0.960	0.720	0.750	0.780	5.920	36.560	30.910	14.250	7.940	108.5
1933	5.320	3.000	1.910	1.160	1.190	0.900	0.740	5.540	10.980	6.630	10.780	13.880	62.0
1934	12.440	4.540	1.880	0.930	0.700	0.660	4.780	12.550	9.920	9.810	9.500	8.410	76.1
1935	4.930	4.600	1.930	1.350	0.860	0.660	0.680	4.850	3.250	17.640	15.360	8.670	64.8
1936	5.100	8.000	10.340	2.030	0.990	1.760	4.190	12.330	27.300	24.000	7.780	6.180	110.0
1937	3.910	2.120	1.200	1.180	0.790	0.680	2.180	6.070	4.260	4.600	7.470	7.160	41.6
1938	4.460	2.650	1.680	1.220	2.880	1.560	2.350	9.860	3.700	4.200	17.980	6.310	58.9
1939	3.920	2.280	1.330	0.810	1.050	0.740	5.340	3.670	12.090	5.580	4.900	3.950	45.7
1940	2.740	6.320	1.730	1.290	0.900	0.700	6.270	41.250	39.670	16.320	14.020	33.750	165.0
1941	9.270	4.840	2.230	1.390	0.880	0.650	0.600	12.630	47.050	4.750	6.830	4.450	95.6
1942	3.340	1.960	1.960	2.040	1.020	3.090	2.130	2.180	12.700	15.650	15.990	11.730	73.8
1943	6.120	5.160	2.180	1.040	0.700	0.680	0.720	3.300	43.500	7.060	17.400	11.440	99.3
1944	8.570	4.480	2.160	1.080	0.690	0.580	1.880	25.090	36.460	43.350	26.710	8.800	159.9
1945	9.110	4.190	1.930	0.980	0.680	0.720	0.840	1.360	1.840	4.010	8.980	24.160	58.8
1946	5.760	2.970	1.370	0.790	0.600	3.880	1.090	3.060	3.000	28.590	8.000	5.870	65.0
1947	4.310	2.630	1.470	0.930	0.730	8.770	1.550	13.240	6.880	14.720	6.710	29.350	91.3
1948	13.050	4.450	1.820	0.920	0.640	0.570	2.710	2.870	5.920	10.770	13.950	11.950	69.6
1949	8.170	14.480	3.100	1.290	0.770	0.620	5.570	1.530	1.720	34.500	4.110	17.530	93.4
1950	6.700	9.040	2.940	5.580	1.490	0.890	9.630	2.280	30.380	13.570	8.730	16.470	107.7
1951	7.720	5.920	2.470	1.100	0.920	0.730	0.750	19.660	6.960	18.280	28.280	22.030	114.8
1952	8.250	17.470	3.590	1.650	1.080	0.800	29.700	15.970	4.390	18.370	8.850	5.920	116.0
1953	4.920	4.050	2.060	1.070	0.750	1.340	3.230	42.440	15.890	47.180	29.030	10.270	162.2
1954	7.270	3.790	2.050	1.090	22.390	1.390	1.410	1.420	14.630	26.820	50.160	7.850	140.3
1955	8.890	5.540	2.460	1.280	0.940	0.760	0.690	10.770	28.100	12.580	16.550	7.730	96.3
1956	5.820	3.030	2.250	1.130	5.890	2.330	1.730	33.550	42.350	37.180	25.470	10.310	171.0
1957	12.620	4.590	1.820	0.900	1.010	1.170	1.600	17.590	7.100	4.270	21.370	5.430	79.5
1958	7.200	4.210	1.980	1.150	1.310	0.980	11.400	49.260	4.740	4.780	14.090	6.040	107.1
1959	13.150	3.630	1.660	0.980	0.700	0.690	0.840	5.300	19.920	4.930	4.070	4.310	60.2
1960	2.980	1.710	1.300	1.240	0.840	0.880	1.380	2.850	6.020	7.220	10.900	19.920	57.2
1961	6.070	2.940	1.370	1.190	1.000	0.930	2.880	1.830	55.320	10.800	50.590	8.270	143.2
1962	30.220	5.660	2.480	1.430	0.940	0.720	0.680	2.450	4.270	15.830	30.460	6.610	101.7
1963	4.430	2.770	1.850	1.030	2.580	1.070	1.080	2.370	30.020	8.270	16.310	7.740	79.5
1964	5.630	9.790	2.520	1.150	1.270	6.700	2.210	4.910	4.470	5.100	6.000	5.010	54.8
1965	4.160	2.770	2.330	1.180	0.740	1.900	1.420	1.420	18.270	10.420	12.900	8.340	65.8
1966	4.880	2.370	1.160	0.720	0.590	0.560	7.710	4.080	27.010	7.600	7.770	5.920	70.4
1967	4.520	3.990	1.830	0.980	0.720	0.630	2.220	16.490	22.960	19.380	18.120	7.440	99.3
1968	15.700	4.540	2.080	1.030	0.750	0.640	4.040	1.260	3.380	2.950	5.270	11.640	53.3
1969	12.680	3.820	1.600	0.840	1.480	0.800	0.650	3.820	12.830	18.640	17.290	7.420	81.9
1970	5.820	3.150	1.670	0.950	0.660	1.270	0.910	3.080	3.080	22.840	18.450	5.850	67.7
1971	3.350	1.820	1.070	1.010	0.740	0.640	2.790	11.980	4.720	5.600	5.730	6.970	46.4
1972	4.280	2.240	1.320	0.840	0.640	0.600	0.600	0.660	0.850	36.810	7.810	7.550	64.2
1973	4.480	2.460	1.480	0.910	0.960	0.790	0.690	4.270	14.180	7.490	108.460	10.410	156.6
1974	11.600	4.910	2.200	1.160	0.820	0.670	2.950	32.370	5.510	13.890	17.810	7.330	101.2
1975	6.780	3.470	1.570	0.840	0.810	3.520	2.360	2.960	46.410	16.570	8.920	6.830	101.0
1976	5.360	22.490	8.120	2.530	2.230	1.260	12.830	54.460	31.860	38.170	52.080	9.930	241.3
1977	5.710	3.760	3.080	1.500	0.920	1.340	1.520	1.450	1.530	1.870	27.260	5.710	55.7
1978	4.090	2.360	2.400	1.260	4.130	1.440	1.090	4.920	21.100	9.230	9.200	9.580	70.8
1979	7.600	3.700	1.580	1.110	0.820	0.660	1.050	6.880	7.030	4.940	9.650	5.770	50.8
1980	4.660	17.700	3.700	40.360	2.550	2.020	2.540	2.020	2.520	18.290	19.670	28.190	144.2
1981	7.520	4.100	2.020	1.220	0.810	0.670	25.060	2.580	7.710	6.930	5.860	4.550	69.0
1982	3.850	2.430	1.540	0.930	1.160	1.510	1.400	27.820	30.870	36.860	9.440	18.900	136.7
1983	6.340	2.970	1.350	0.830	0.650	3.140	2.350	54.270	5.580	13.660	7.780	30.450	129.4
1984	17.260	4.850	3.440	3.390	2.090	11.750	3.840	3.770	20.390	30.240	23.050	9.810	133.9
1985	8.360	4.090	2.410	1.230	0.840	2.120	1.930	2.190	18.400	11.660	33.850	9.600	96.7
1986	6.250	3.930	1.870	0.940	0.680	0.590	2.320	25.230	16.340	9.160	22.410	9.280	99.0
1987	5.390	2.530	1.450	0.880	0.640	0.680	9.440	3.130	11.200	5.710	18.440	7.310	66.8
1988	4.730	2.490	1.310	0.810	0.670	7.200	11.560	5.340	18.910	11.380	22.890	19.070	106.4
1989	9.150	4.790	2.080	1.030	1.600	1.010	16.300	10.690	17.740	23.240	9.070	6.170	102.9
1990	3.760	2.420	1.630	1.090	0.760	0.760	1.120	8.800	26.670	39.260	7.860	19.540	113.7
1991	7.270	3.730	1.630	0.860	0.740	0.890	4.830	3.770	36.320	22.630	13.410	7.780	103.9
1992	16.510	4.290	1.800	0.920	0.860	0.690	53.080	12.080	11.260	66.550	10.450	7.360	185.9
1993	4.250	2.140	1.680	0.960	0.690	0.660	2.730	2.510	57.330	9.290	6.650	11.200	100.1
1994	5.290	2.710	2.470	1.980	1.140	1.050	0.900	15.230	12.890	17.890	15.580	7.060	84.2
1995	12.520	4.420	19.290	2.090	1.300	1.250	1.050	4.890	50.630	26.350	20.560	19.360	163.7
1996	17.770	12.090	4.970	2.010	0.980	0.710	1.880	12.680	43.180	7.230	10.980	5.900	120.4
1997	3.540	9.180	2.280	3.770	1.330	1.070	2.220	45.170	5.900	17.730	8.050	6.100	106.3
1998	3.830	10.150	6.000	1.800	0.920	0.670	2.330	6.030	19.290	4.210	2.970	3.260	61.5
1999	2.550	1.750	8.040	1.510	0.960	2.260	1.210	11.660	14.110	42.770	13.260	14.580	114.7
2000	6.480	3.350	1.740	1.060	0.780	0.640	3.030	23.750	8.890	67.330	40.140	35.680	192.9
2001	14.130	6.130	2.630	3.870	2.550	1.380	5.080	30.240	16.580	67.740	48.080	13.570	212.0
2002	10.520	6.490	5.230	2.060	1.090	36.770	5.290	3.410	2.770	4.880	36.210	10.060	124.8
2003	6.680	3.380	1.680	1.540	0.910	0.740	6.090	1.500	4.570	9.430	6.770	5.420	48.7
2004	27.220	3.810	1.950	2.350	1.090	0.740	18.230	3.470	9.810	7.160	18.750	7.270	101.9
AVE :	7.59	4.81	2.55	1.84	1.49	1.93	4.75	11.15	17.11	17.58	17.25	10.82	98.9
SD :	5.10	3.77	2.49	4.49	2.68	4.41	7.75	13.32	14.87	14.99	15.47	7.09	42.0

Incremental Naturalised Flows at H1H013

File : H1H013.NAT
Units : Mm3
Descrip. : Simulated for 1927 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1927	0.380	1.050	1.210	0.530	0.280	0.200	0.190	0.130	3.880	6.050	4.060	3.220	21.2
1928	2.160	1.160	0.540	0.260	0.150	0.130	0.450	1.630	3.500	5.620	5.920	3.870	25.4
1929	1.950	0.890	0.560	0.450	0.480	0.490	0.290	0.220	0.200	0.720	1.420	4.280	11.9
1930	5.180	2.440	1.030	0.410	0.210	0.150	1.090	3.340	3.470	2.600	5.020	6.100	31.0
1931	3.930	1.920	0.780	0.370	2.790	3.610	1.270	1.980	3.920	4.850	4.400	3.810	33.6
1932	2.900	1.290	0.540	0.260	0.180	0.200	0.200	2.430	6.310	9.530	8.590	4.660	37.1
1933	2.400	1.060	0.480	0.310	0.220	0.200	0.200	1.310	2.430	3.220	3.680	4.460	20.0
1934	5.590	4.120	1.810	0.680	0.320	0.340	0.820	2.480	4.480	5.190	5.700	4.750	36.3
1935	2.340	1.330	0.870	0.600	0.510	0.250	0.170	1.870	2.670	3.070	5.810	7.510	27.0
1936	5.600	2.420	1.450	1.020	0.410	0.620	1.070	2.000	5.510	9.290	7.750	3.630	40.8
1937	1.740	0.940	0.430	0.360	0.310	0.170	1.150	3.980	4.480	3.080	3.470	5.030	25.1
1938	4.390	1.880	0.810	0.360	0.250	0.220	0.600	2.450	3.100	2.200	3.070	3.470	22.8
1939	2.050	0.980	0.560	0.330	0.490	0.540	1.730	2.320	2.770	3.510	2.320	1.910	19.5
1940	1.620	1.090	0.770	0.860	0.880	0.370	1.740	6.870	10.890	9.370	6.940	8.520	49.9
1941	8.340	4.170	1.530	0.580	0.260	0.150	0.120	2.590	9.680	10.460	6.310	4.330	48.5
1942	2.170	1.170	0.490	0.340	0.510	0.680	0.580	0.450	2.010	6.110	9.960	8.650	33.1
1943	4.560	2.500	1.340	0.530	0.240	0.210	0.390	3.640	8.910	7.890	6.680	7.450	44.3
1944	4.440	2.240	1.410	0.670	0.290	0.160	0.980	5.730	11.650	12.740	10.800	6.830	57.9
1945	3.810	2.600	1.040	0.460	0.220	0.190	0.470	1.010	1.250	1.310	1.800	5.340	19.5
1946	6.210	2.660	1.000	0.400	0.200	0.650	0.820	1.490	1.910	4.920	6.870	3.990	31.1
1947	2.380	1.470	0.630	0.270	0.180	1.100	1.850	3.050	4.290	5.580	5.240	5.980	32.0
1948	6.300	2.790	1.060	0.440	0.220	0.140	0.720	1.450	2.180	3.500	4.460	5.070	28.3
1949	4.910	4.170	2.710	1.000	0.400	0.200	3.280	4.400	1.940	5.100	6.130	5.630	39.9
1950	6.240	4.740	3.320	1.590	0.870	0.360	0.820	1.360	5.810	9.250	7.630	5.810	47.8
1951	3.820	3.410	2.530	0.920	0.380	0.210	0.230	4.220	6.750	6.350	8.540	7.570	44.9
1952	3.840	2.570	1.990	0.780	0.330	0.180	3.620	7.560	5.900	5.370	7.180	5.180	44.5
1953	3.450	2.850	1.280	0.540	0.260	0.160	2.640	9.380	10.610	10.650	12.140	7.600	61.6
1954	3.680	2.040	1.480	1.120	1.350	1.450	0.600	0.310	3.530	7.730	12.400	11.200	46.9
1955	6.100	4.720	2.350	0.880	0.400	0.230	0.150	1.650	4.500	5.990	5.910	4.110	37.0
1956	1.810	0.740	0.340	0.210	2.190	2.940	1.200	5.550	9.380	8.780	8.120	5.550	46.8
1957	6.240	5.720	2.030	0.730	0.350	0.230	0.390	1.700	2.740	2.040	3.300	3.770	29.2
1958	1.980	1.170	0.510	0.240	0.230	0.260	1.980	6.930	7.150	3.000	3.330	4.370	31.2
1959	3.470	2.100	0.850	0.400	0.200	0.370	0.530	2.150	4.780	4.170	2.210	1.500	22.7
1960	0.900	0.450	0.290	0.300	0.250	0.170	0.240	1.130	3.090	4.010	4.750	6.080	21.7
1961	4.470	1.720	0.640	0.280	0.220	0.790	1.830	2.100	6.720	9.710	9.580	8.190	46.3
1962	6.570	5.880	2.500	0.900	0.360	0.190	0.130	0.120	1.660	4.140	8.550	8.480	39.5
1963	3.400	2.120	1.680	0.710	0.430	0.350	0.350	0.860	3.950	6.080	6.710	6.590	33.2
1964	3.940	2.700	1.890	0.710	0.910	1.890	1.950	2.260	2.400	1.620	1.790	1.800	23.9
1965	1.340	0.900	0.450	0.270	0.160	0.700	1.060	0.820	3.200	6.230	5.200	2.990	23.3
1966	1.760	0.750	0.330	0.180	0.130	0.110	0.940	1.630	5.440	7.720	5.310	3.610	27.9
1967	2.590	1.880	0.870	0.370	0.200	0.130	0.920	3.560	6.340	7.150	6.660	4.470	35.1
1968	4.650	4.540	1.640	0.620	0.280	0.160	0.770	1.020	0.900	1.090	1.840	3.090	20.6
1969	4.580	3.850	1.410	0.530	0.240	0.150	0.120	1.810	5.880	7.480	7.360	6.160	39.6
1970	3.080	1.300	0.520	0.240	0.150	0.370	0.460	0.300	1.180	4.240	5.660	3.530	21.0
1971	1.540	0.630	0.280	0.240	0.230	0.150	1.300	3.280	3.750	3.800	3.380	2.300	20.9
1972	1.580	0.800	0.670	0.610	0.270	0.250	0.250	0.370	0.520	3.980	6.810	5.100	21.2
1973	3.070	1.470	0.760	0.480	0.230	0.150	0.170	2.420	5.340	5.570	12.110	14.160	45.9
1974	7.070	3.460	1.360	0.550	0.270	0.170	0.550	4.030	5.190	4.030	4.950	3.710	35.3
1975	2.600	2.020	0.780	0.330	0.200	0.170	1.530	2.200	6.200	10.070	7.070	3.670	36.8
1976	1.980	4.100	5.670	3.140	1.170	0.510	1.060	6.170	10.860	12.370	12.470	8.360	67.9
1977	3.850	1.610	0.700	0.370	0.200	0.410	0.650	0.540	0.420	0.390	2.680	4.700	16.5
1978	3.190	1.350	0.770	0.620	0.610	0.580	0.290	1.150	3.960	5.180	3.750	2.900	24.4
1979	2.500	1.520	0.610	0.410	0.370	0.230	0.310	1.620	3.420	3.040	2.910	2.770	19.7
1980	1.560	4.500	5.930	4.920	3.780	1.390	0.720	0.490	0.620	4.050	7.320	8.130	43.4
1981	6.250	2.500	0.950	0.680	0.600	0.880	3.770	4.420	3.300	3.540	2.560	1.480	30.9
1982	1.400	1.310	0.640	0.340	0.870	1.270	0.750	5.260	10.600	10.200	6.900	3.660	43.2
1983	2.030	0.960	0.470	0.240	0.150	2.020	3.120	7.250	8.440	4.730	3.760	5.870	39.0
1984	7.620	4.280	2.760	2.780	1.960	3.790	4.810	3.300	3.830	6.470	8.130	6.660	56.4
1985	3.650	1.430	0.660	0.390	0.210	0.460	0.610	0.530	2.740	5.450	7.590	7.060	30.8
1986	3.450	1.410	0.590	0.270	0.160	0.130	0.530	3.780	7.270	6.840	5.510	4.250	34.2
1987	2.310	0.960	0.440	0.260	0.150	0.220	2.510	3.460	3.760	4.350	4.060	4.400	26.9
1988	2.930	1.220	0.500	0.250	0.200	2.040	3.520	2.840	4.210	5.790	7.120	8.350	39.0
1989	6.130	3.030	1.320	0.520	0.360	0.360	2.400	5.800	7.180	7.740	6.540	3.470	44.9
1990	1.470	0.700	0.510	0.350	0.200	0.150	0.340	1.310	5.100	11.570	10.840	6.270	38.8
1991	4.510	2.210	0.900	0.390	0.400	0.480	1.590	2.970	5.770	8.050	7.300	5.160	39.7
1992	4.190	3.410	1.330	0.510	0.310	0.250	2.730	6.330	6.970	9.580	9.430	4.460	49.5
1993	1.850	0.760	0.380	0.210	0.130	0.110	0.980	1.850	6.610	9.280	5.230	3.820	31.2
1994	3.130	1.310	0.530	0.250	0.150	0.190	0.230	2.500	4.910	6.080	7.020	4.970	31.3
1995	3.720	3.120	2.320	1.950	0.800	0.510	0.520	1.100	4.500	8.450	9.670	8.390	45.1
1996	5.390	3.600	3.170	2.000	0.750	0.340	0.350	0.820	4.850	6.240	3.770	2.620	33.9
1997	1.170	1.670	1.900	1.240	0.910	0.380	0.220	3.060	5.280	4.920	4.140	2.390	27.3
1998	1.300	1.780	1.960	0.870	0.360	0.190	0.710	1.440	1.910	2.190	3.500	5.570	21.8
1999	4.360	1.660	0.680	0.330	0.180	0.130	0.120	0.200	1.220	4.880	6.310	5.980	26.1
2000	4.810	1.830	0.700	0.300	0.180	0.150	0.270	2.580	3.610	7.240	10.460	8.220	40.4
2001	5.560	2.570	1.070	1.100	1.140	0.530	0.930	3.960	5.120	6.250	8.640	7.330	44.2
2002	4.660	2.320	0.990	0.450	0.250	0.340	0.490	0.550	0.540	0.480	4.710	6.920	22.7
2003	3.770	1.800	0.840	0.610	0.390	0.200	1.020	1.340	1.700	3.030	3.510	2.860	21.1
2004	2.820	2.430	0.930	0.390	0.210	0.140	1.940	2.830	3.150	3.870	6.390	6.970	32.1
AVE :	3.60	2.21	1.23	0.67	0.49	0.53	1.06	2.63	4.57	5.75	6.12	5.30	34.1
SD :	1.76	1.27	1.03	0.72	0.60	0.73	1.01	2.02	2.72	2.87	2.70	2.26	11.3

Incremental Naturalised Flows at H1H018

File : H1H018.NAT
Units : Mm3
Descrip. : Simulated for 1927 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1927	0.510	3.110	3.030	0.350	0.260	0.480	0.550	0.260	9.080	12.120	6.230	6.820	42.8
1928	4.190	0.710	0.470	0.310	0.170	0.230	3.930	8.790	8.800	10.400	10.650	4.770	53.4
1929	1.120	0.640	1.080	1.020	0.530	0.450	0.740	0.770	0.290	2.640	6.060	10.590	25.9
1930	7.980	1.990	1.220	0.280	0.420	0.410	4.260	9.850	6.890	3.740	10.070	13.070	60.2
1931	7.860	2.630	0.530	0.580	4.340	4.180	0.370	4.890	9.720	10.160	8.760	5.710	59.7
1932	2.750	0.910	0.620	0.510	0.390	0.370	0.230	2.430	14.040	18.560	9.580	3.900	54.3
1933	3.300	2.410	0.450	0.270	0.210	1.320	1.520	4.110	6.340	4.950	5.730	6.760	37.4
1934	5.710	3.270	1.150	0.250	0.190	0.310	2.690	5.510	5.930	7.300	8.160	6.420	46.9
1935	3.200	2.210	1.810	1.100	1.070	0.250	0.240	3.090	4.140	6.330	9.840	7.310	40.6
1936	3.220	1.070	3.180	2.810	0.210	3.690	6.120	6.400	13.150	17.480	9.570	2.270	69.2
1937	1.520	0.840	0.380	2.490	2.550	0.310	3.660	9.040	7.680	5.410	6.930	6.940	47.8
1938	4.020	1.390	0.820	0.320	1.080	1.130	2.120	7.030	6.410	4.130	7.970	8.130	44.6
1939	3.430	1.810	1.740	0.530	0.990	1.160	4.950	8.000	9.000	7.640	4.010	4.410	47.7
1940	3.070	3.430	2.900	1.160	1.180	0.300	5.120	18.490	23.250	15.480	11.140	18.090	103.6
1941	15.130	2.860	0.620	0.550	0.400	0.170	0.240	8.570	26.500	20.150	6.640	5.410	87.2
1942	1.820	1.250	0.520	1.260	1.210	2.190	3.130	2.890	6.210	11.540	14.510	11.510	58.0
1943	5.140	3.620	2.710	0.380	0.300	0.320	1.220	6.960	17.960	16.610	10.950	9.210	75.4
1944	4.670	3.200	2.490	1.190	0.200	0.160	1.820	9.040	20.890	24.290	17.390	7.510	92.9
1945	1.650	1.260	0.790	0.470	0.180	0.430	2.930	5.910	5.100	5.100	9.300	13.140	46.3
1946	9.880	3.140	0.640	0.300	0.170	1.990	2.250	3.090	4.650	12.150	14.260	5.270	57.8
1947	2.390	1.570	0.590	0.230	0.180	1.720	3.060	6.200	8.520	10.550	10.050	10.400	55.5
1948	10.010	3.210	0.620	0.370	0.180	0.160	2.800	5.100	6.080	8.900	10.760	9.290	57.5
1949	6.220	5.080	2.850	0.370	0.180	0.160	4.720	4.820	2.110	11.660	10.320	5.510	54.0
1950	5.590	3.700	3.440	1.270	0.960	0.180	8.240	11.060	13.780	15.660	8.360	6.500	78.7
1951	4.520	4.460	3.010	0.260	0.240	0.370	1.030	7.240	8.770	6.930	14.370	16.600	67.8
1952	8.770	5.430	3.730	0.360	0.200	0.190	9.260	18.140	11.050	8.720	12.190	6.250	84.3
1953	1.280	1.680	1.390	0.390	0.250	0.630	4.740	17.580	17.370	16.090	19.660	9.620	90.7
1954	4.450	2.770	1.370	1.130	2.720	2.730	0.920	1.250	5.900	13.630	20.980	13.890	71.7
1955	4.590	5.250	1.970	0.330	0.200	0.280	0.800	4.950	12.390	13.970	12.670	8.030	65.4
1956	2.230	1.220	0.880	0.740	4.290	4.750	1.350	10.640	17.960	19.230	16.540	7.450	87.3
1957	7.020	5.350	0.510	0.240	1.800	1.860	0.830	6.500	8.880	3.600	6.190	6.850	49.6
1958	3.220	3.600	1.730	0.300	0.360	0.400	4.720	21.400	17.510	1.220	4.370	4.840	63.7
1959	3.450	2.680	0.430	0.260	0.170	0.660	2.020	6.160	12.330	8.590	1.800	2.080	40.6
1960	2.020	1.000	0.560	1.070	0.870	0.250	0.850	3.320	8.510	8.520	7.340	10.490	44.8
1961	6.610	1.120	0.410	0.330	1.120	1.410	2.760	2.820	16.810	19.950	12.620	10.300	76.3
1962	7.140	6.230	0.600	0.540	0.480	0.190	0.200	0.800	3.460	8.880	14.020	9.510	52.0
1963	2.130	1.370	1.470	0.730	3.910	3.930	0.430	1.520	8.510	11.080	8.750	6.110	49.9
1964	2.460	3.610	2.470	0.430	1.260	4.590	5.080	4.990	5.610	4.200	4.850	3.790	43.3
1965	2.160	1.430	1.200	1.010	0.200	2.780	3.540	1.990	7.930	14.060	10.090	5.640	52.0
1966	3.280	0.670	0.340	0.250	0.200	0.170	3.110	5.940	12.430	11.880	4.690	4.430	47.4
1967	3.900	3.440	1.810	0.470	0.390	0.180	4.290	11.880	12.810	13.240	12.470	5.130	70.0
1968	6.370	6.030	0.730	0.770	0.580	0.210	3.050	3.160	3.260	4.720	5.750	8.440	43.1
1969	6.580	2.510	0.400	0.200	0.350	0.360	0.170	5.840	13.280	12.670	10.760	7.560	60.7
1970	2.680	1.160	0.800	0.480	0.190	0.540	0.560	1.580	4.100	7.600	10.810	6.430	36.9
1971	1.070	0.680	0.350	0.650	0.740	0.400	2.270	6.400	6.370	4.350	4.440	4.220	31.9
1972	2.670	0.820	1.500	1.380	0.170	1.000	1.050	1.490	1.640	12.800	16.550	6.950	48.0
1973	4.210	1.570	1.500	1.320	0.200	0.180	0.170	4.230	11.240	10.730	24.290	23.220	82.9
1974	6.100	4.460	1.190	0.440	0.340	0.250	3.270	12.950	12.070	8.390	10.550	5.260	65.3
1975	3.730	3.460	0.670	0.240	0.180	0.730	1.880	2.300	15.440	20.090	7.770	3.850	60.3
1976	2.500	7.720	10.350	4.360	1.770	0.930	4.920	18.210	24.600	21.100	20.710	12.940	130.1
1977	2.920	1.450	1.300	0.760	0.410	1.080	2.480	3.200	1.900	0.730	7.950	9.900	34.1
1978	3.040	0.930	1.210	1.170	2.540	2.950	0.780	4.240	9.960	8.200	5.260	4.980	45.3
1979	5.360	3.630	0.430	0.670	0.750	0.300	1.420	6.580	8.990	5.200	4.990	4.550	42.9
1980	2.120	5.650	5.660	6.360	5.390	0.770	1.340	1.230	3.120	8.280	11.450	13.510	64.9
1981	8.440	1.080	0.840	0.990	0.640	0.260	4.440	7.040	8.180	8.060	4.180	2.180	46.3
1982	2.750	2.650	1.490	1.070	1.140	2.350	1.860	9.130	18.370	18.130	10.810	6.930	76.7
1983	5.040	0.950	0.570	0.280	0.180	2.660	3.550	16.010	16.990	6.560	6.710	9.620	69.1
1984	11.630	4.440	2.610	3.510	1.780	4.930	7.010	4.460	9.410	14.530	13.440	8.880	86.6
1985	3.230	1.120	0.480	0.330	0.230	1.580	3.520	4.040	8.670	12.270	13.060	10.040	58.6
1986	3.140	1.110	0.720	0.910	0.870	0.280	1.660	9.310	13.220	10.160	10.700	9.110	61.2
1987	3.760	0.880	1.450	1.290	0.180	0.300	5.000	7.550	7.140	8.270	9.370	8.060	53.3
1988	3.170	0.850	0.560	0.400	0.800	4.010	5.900	6.150	8.870	10.750	11.860	11.000	64.3
1989	6.130	3.080	1.720	0.320	1.590	1.550	6.180	9.830	9.130	13.890	10.650	2.960	67.0
1990	1.240	0.900	1.570	1.220	0.240	0.190	0.500	4.960	13.630	21.670	14.530	8.040	68.7
1991	7.620	1.880	0.510	0.240	0.530	1.450	2.750	4.870	16.370	19.910	10.600	5.730	72.5
1992	7.120	5.720	0.560	0.240	0.350	0.340	8.080	15.070	11.660	20.060	18.060	3.470	90.7
1993	1.290	0.600	0.590	0.500	0.190	0.170	1.810	2.450	16.380	18.200	3.600	5.200	51.0
1994	4.680	0.770	0.680	0.580	0.230	0.230	0.230	5.310	11.470	13.770	12.190	5.450	55.6
1995	4.430	3.970	4.280	4.100	0.700	0.880	0.700	3.210	15.930	18.500	11.710	12.640	81.1
1996	9.930	6.780	5.370	2.330	0.240	0.160	0.950	3.310	15.060	14.870	7.420	5.770	72.2
1997	0.950	3.480	4.250	1.490	0.480	0.260	1.450	13.210	15.570	10.890	9.900	4.270	66.2
1998	2.330	4.770	5.680	1.740	0.210	0.160	2.850	6.170	11.880	10.670	5.110	5.340	56.9
1999	2.920	1.190	2.750	2.500	0.550	0.440	0.470	6.990	11.930	14.600	14.490	11.100	69.9
2000	6.710	0.960	0.590	0.350	0.270	0.190	2.240	11.390	13.510	25.100	32.510	21.350	115.2
2001	11.940	3.880	1.850	5.100	5.630	0.940	3.550	12.400	15.520	23.730	29.890	15.980	130.4
2002	6.380	5.090	3.180	1.460	0.410	3.900	5.950	3.450	1.640	3.730	11.560	12.010	58.8
2003	5.860	2.320	1.020	1.480	0.840	0.200	2.180	2.220	4.860	8.430	6.840	4.060	40.3
2004	4.160	3.490	0.400	0.910	0.870	0.200	4.100	7.540	8.800	8.240	9.500	8.080	56.3
AVE :	4.59	2.67	1.65	1.02	0.88	1.09	2.73	6.76	10.58	11.62	10.78	8.06	62.4
SD :	2.84	1.74	1.63	1.15	1.17	1.29	2.11	4.67	5.51	5.78	5.47	4.13	20.3

Incremental Naturalised Flows at H1H033

File : H1H033.NAT
Units : Mm3
Descrip. : Simulated for 1927 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1927	0.460	6.930	0.410	0.370	0.240	0.680	0.340	0.280	25.390	7.710	8.460	10.600	61.9
1928	1.070	0.610	0.460	0.260	0.230	0.340	9.870	13.560	9.760	21.130	12.930	1.360	71.6
1929	0.840	0.540	1.410	0.420	0.600	0.290	1.050	0.340	0.360	5.820	9.090	19.550	40.3
1930	1.940	1.950	0.480	0.270	0.590	0.250	11.120	15.580	2.320	6.180	24.670	16.600	81.9
1931	4.860	0.740	0.490	0.620	10.540	0.430	0.400	12.630	13.470	15.230	11.530	4.890	75.8
1932	1.310	0.610	0.660	0.340	0.460	0.310	0.270	5.400	33.240	21.720	8.610	2.070	75.0
1933	4.530	0.720	0.420	0.260	0.290	2.230	0.600	9.860	5.940	5.760	10.520	9.490	50.6
1934	4.980	1.890	0.450	0.260	0.280	0.410	5.890	7.490	7.090	12.760	12.080	6.850	60.4
1935	1.160	3.350	0.420	1.680	0.300	0.320	0.270	7.440	2.110	14.000	14.350	7.080	52.5
1936	1.220	0.970	6.450	0.350	0.250	9.380	5.980	10.170	27.100	28.020	3.460	1.610	95.0
1937	1.160	0.560	0.340	5.500	0.430	0.290	9.170	15.020	4.860	9.410	11.720	8.760	67.2
1938	1.530	1.130	0.490	0.270	1.740	0.340	4.340	13.720	2.630	7.290	16.580	8.020	58.1
1939	1.060	2.500	0.790	0.300	1.520	0.540	12.560	8.390	15.480	6.540	5.900	5.780	61.4
1940	1.420	6.520	0.460	1.760	0.420	0.280	13.660	38.360	30.710	18.740	16.900	38.890	168.1
1941	4.880	0.810	0.510	0.560	0.260	0.230	0.350	23.740	52.570	7.250	14.160	1.540	106.9
1942	1.820	0.600	0.540	1.740	0.460	4.300	2.150	3.580	11.970	22.800	24.430	11.440	85.8
1943	1.850	5.800	0.460	0.440	0.250	0.450	1.740	16.480	34.910	15.580	19.880	7.460	105.3
1944	3.350	2.700	1.970	0.340	0.240	0.230	3.690	20.480	40.030	36.110	20.870	1.290	131.3
1945	1.400	0.800	0.670	0.280	0.240	0.620	6.170	8.440	3.690	9.040	19.210	21.810	72.4
1946	5.970	0.960	0.470	0.270	0.230	4.190	0.630	6.680	4.050	31.630	12.870	2.240	70.2
1947	2.090	0.930	0.380	0.250	0.250	3.360	2.810	12.850	9.690	22.160	10.320	21.130	86.2
1948	6.390	0.830	0.550	0.280	0.230	0.230	6.660	5.540	9.580	14.940	18.120	10.500	73.9
1949	5.470	6.040	0.630	0.300	0.230	0.230	12.550	0.430	4.160	27.690	1.450	13.610	72.8
1950	1.470	7.460	0.840	1.480	0.300	0.240	23.120	7.070	31.620	16.130	11.070	7.320	108.1
1951	3.060	6.800	0.480	0.260	0.330	0.430	1.360	17.860	5.240	13.620	32.150	20.460	102.1
1952	3.600	8.710	0.590	0.310	0.250	0.270	25.940	25.380	4.570	22.130	17.600	1.300	110.7
1953	1.040	2.010	0.560	0.310	0.300	0.840	11.230	37.990	11.750	40.000	24.210	4.450	134.7
1954	5.010	0.780	1.810	0.310	6.320	0.330	1.360	0.820	14.810	24.690	41.830	1.740	99.8
1955	8.460	3.540	0.550	0.290	0.260	0.380	1.030	11.480	22.600	18.880	21.600	2.170	91.2
1956	1.710	0.630	1.050	0.320	11.060	1.010	1.320	27.940	24.400	37.330	16.540	4.270	127.6
1957	12.830	0.840	0.360	0.270	3.570	0.370	1.140	16.020	7.480	1.310	16.450	2.530	63.2
1958	4.330	3.210	0.460	0.340	0.430	0.390	12.160	48.460	1.510	1.370	10.690	2.090	85.4
1959	5.510	0.750	0.420	0.260	0.240	0.960	2.830	12.680	21.320	3.170	1.720	2.470	52.3
1960	1.590	0.630	0.630	1.260	0.310	0.310	1.210	6.180	16.230	7.160	14.950	17.080	67.5
1961	1.570	0.620	0.360	0.390	1.620	0.820	5.260	0.990	46.800	12.680	29.020	2.460	102.6
1962	15.420	0.980	0.400	0.670	0.260	0.260	0.270	1.160	6.650	16.810	25.360	3.750	72.0
1963	1.100	1.500	1.080	0.300	9.980	0.330	0.570	2.240	20.390	10.660	15.820	2.080	66.1
1964	2.470	5.200	0.480	0.510	1.780	9.290	2.960	8.970	4.690	6.180	8.510	1.990	53.0
1965	2.170	0.740	1.580	0.310	0.250	6.580	1.480	2.120	18.880	23.490	8.780	7.060	73.4
1966	0.980	0.510	0.330	0.300	0.230	0.250	7.560	7.200	26.930	7.760	6.860	4.890	63.8
1967	3.610	3.360	0.470	0.570	0.260	0.240	11.210	21.570	13.800	27.240	13.640	1.340	97.3
1968	14.970	0.930	0.600	0.810	0.290	0.270	7.350	0.480	7.540	3.400	11.500	12.790	60.9
1969	4.840	0.750	0.340	0.250	0.500	0.240	0.240	15.890	21.050	14.880	18.080	4.570	81.6
1970	1.400	0.860	0.690	0.290	0.240	0.770	0.270	2.910	6.270	13.410	18.430	1.300	46.8
1971	1.010	0.510	0.340	0.850	0.450	0.370	4.690	11.400	4.530	5.970	6.590	4.930	41.6
1972	1.310	0.570	2.420	0.290	0.230	1.620	0.310	2.640	0.600	35.590	12.620	7.930	66.1
1973	2.400	0.740	2.230	0.320	0.260	0.250	0.230	11.040	19.810	9.220	66.030	6.700	119.2
1974	8.520	1.720	0.580	0.410	0.350	0.260	8.040	27.690	5.170	19.900	14.300	1.460	88.4
1975	6.910	1.060	0.400	0.250	0.250	1.070	2.310	1.930	41.120	19.350	6.260	3.600	84.5
1976	1.400	19.500	8.450	1.840	1.320	0.410	12.800	38.340	35.720	33.240	33.690	4.890	191.6
1977	1.230	1.250	0.980	0.420	0.430	1.490	3.260	3.210	0.780	0.920	21.040	6.360	41.4
1978	1.420	0.640	1.700	0.450	5.440	1.070	0.390	10.740	16.120	6.330	9.050	4.780	58.1
1979	8.180	0.800	0.350	0.910	0.420	0.260	2.540	14.330	9.630	3.340	11.020	1.990	53.8
1980	2.100	12.160	2.050	14.380	0.370	1.080	1.210	0.940	6.110	15.730	18.940	23.530	98.6
1981	1.300	0.770	0.790	0.910	0.280	0.340	11.400	6.680	14.750	7.960	4.400	1.360	50.9
1982	4.570	1.100	1.700	0.330	1.820	2.550	0.940	24.270	29.420	28.250	7.000	12.130	114.1
1983	1.060	0.750	0.410	0.270	0.230	6.220	1.720	43.050	4.560	15.110	6.360	22.350	102.1
1984	10.280	0.810	5.280	2.320	0.960	11.720	6.280	3.910	21.710	23.840	20.580	5.790	113.5
1985	1.480	0.630	0.430	0.320	0.260	2.950	4.510	4.420	18.570	18.250	24.310	6.680	82.8
1986	1.050	1.010	0.370	1.280	0.300	0.350	2.980	21.950	14.670	15.670	18.900	8.400	86.9
1987	1.170	0.580	2.180	0.300	0.230	0.440	12.920	6.700	11.570	11.800	17.470	6.710	72.1
1988	1.190	0.600	0.580	0.280	1.160	8.460	6.170	9.170	14.420	18.220	20.480	13.150	93.9
1989	2.740	2.990	0.460	0.350	2.830	0.310	16.820	9.730	14.580	28.530	6.370	1.470	87.2
1990	0.870	0.890	1.930	0.350	0.270	0.250	0.690	12.170	25.600	41.020	5.540	17.420	107.0
1991	2.730	0.790	0.390	0.250	0.750	1.780	3.660	7.830	39.210	22.750	12.200	3.630	96.0
1992	14.010	0.930	0.390	0.270	0.480	0.250	22.580	19.730	12.100	51.010	7.580	1.490	130.8
1993	0.830	0.450	0.690	0.290	0.240	0.240	3.620	1.250	44.830	8.260	2.600	11.580	74.9
1994	1.190	0.570	0.800	0.310	0.270	0.300	0.270	14.190	17.270	22.990	15.020	1.410	74.6
1995	9.120	0.730	10.450	0.350	0.950	0.580	0.680	6.850	37.330	18.270	20.020	18.720	124.1
1996	8.510	7.780	4.900	0.410	0.260	0.230	1.510	5.730	35.930	7.370	16.250	1.230	90.1
1997	0.780	7.800	2.050	0.700	0.300	0.340	2.450	33.870	9.330	24.600	8.170	3.030	93.4
1998	1.380	10.570	3.270	0.360	0.250	0.230	6.830	8.680	23.940	6.810	8.870	6.000	77.2
1999	1.110	1.240	4.560	0.810	0.290	0.600	0.310	19.170	13.600	30.310	15.670	17.940	105.6
2000	1.050	0.750	0.420	0.350	0.280	0.240	4.920	26.150	11.250	66.770	37.910	29.300	179.4
2001	4.220	3.010	0.590	13.120	1.360	0.380	8.670	25.470	18.760	56.330	40.040	8.500	180.5
2002	6.850	4.220	2.160	0.610	0.300	9.900	4.910	2.460	0.870	8.490	25.950	11.150	77.9
2003	4.160	0.720	1.290	1.260	0.280	0.270	4.660	0.390	12.660	9.540	8.930	1.920	46.1
2004	7.990	0.740	0.370	1.310	0.280	0.260	10.570	9.070	14.270	8.970	20.740	3.440	78.0
AVE :	3.62	2.42	1.28	0.95	1.07	1.43	5.23	12.53	16.49	17.83	15.95	7.97	86.8
SD :	3.49	3.25	1.79	2.21	2.17	2.53	5.66	10.94	12.53	12.75	10.27	7.48	31.6

Incremental Naturalised Flows at H4H006

File : H4H006.NAT
Units : Mm3
Descrip. : Simulated for 1927 to 2004

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1927	2.330	2.460	2.020	1.800	1.740	1.740	1.740	1.730	38.700	37.180	23.430	27.230	142.1
1928	3.820	2.580	1.980	1.780	1.730	1.730	3.500	2.600	11.050	52.070	46.640	4.390	133.9
1929	3.270	2.350	1.940	1.810	1.760	1.740	1.740	1.740	1.740	1.820	2.280	4.260	26.5
1930	3.020	2.360	1.920	1.760	1.730	1.720	3.190	3.620	2.980	16.930	79.890	28.480	147.6
1931	11.900	3.210	2.160	1.860	5.640	2.110	1.890	3.710	8.850	41.200	14.660	19.760	117.0
1932	3.590	2.490	1.960	1.800	1.760	1.760	1.760	2.160	43.220	90.140	42.940	4.530	198.1
1933	3.680	2.670	2.050	1.830	1.780	1.780	1.770	2.300	3.070	9.720	28.590	26.160	85.4
1934	14.090	3.160	2.180	1.810	1.750	1.750	2.150	3.610	10.230	38.550	34.120	15.590	129.0
1935	3.690	2.710	2.090	1.850	1.780	1.740	1.740	2.150	2.170	5.550	45.030	21.010	91.5
1936	3.550	2.740	2.840	2.060	1.790	1.850	2.080	4.120	59.090	107.300	7.790	4.260	199.5
1937	3.300	2.370	1.910	1.920	1.830	1.760	1.920	4.620	4.120	15.910	24.140	12.500	76.3
1938	3.390	2.520	2.010	1.820	1.940	1.850	1.910	4.260	2.960	3.260	52.290	9.270	87.5
1939	3.330	2.420	1.990	1.790	1.760	1.760	2.230	2.330	10.860	13.220	5.970	3.480	51.1
1940	2.900	2.790	2.150	1.870	1.790	1.740	2.370	52.870	144.470	73.110	64.370	129.740	480.2
1941	4.540	3.190	2.170	1.860	1.770	1.730	1.720	7.100	153.170	11.180	28.190	4.330	220.9
1942	3.380	2.470	2.010	1.910	1.810	1.880	1.970	2.100	4.220	54.560	64.580	34.310	175.2
1943	4.030	3.170	2.270	1.850	1.750	1.740	1.780	2.960	98.970	44.000	92.230	19.300	274.0
1944	4.370	3.220	2.280	1.870	1.750	1.730	1.800	17.130	126.000	175.980	103.800	4.480	444.4
1945	3.700	2.760	2.070	1.810	1.730	1.730	1.790	1.940	2.130	2.590	19.430	64.970	106.7
1946	4.150	2.850	2.030	1.790	1.730	1.970	1.870	2.050	2.280	63.440	26.400	4.280	114.8
1947	3.490	2.580	1.980	1.790	1.750	3.130	2.150	7.600	24.210	56.610	8.750	94.250	208.3
1948	13.550	3.230	2.140	1.820	1.730	1.720	1.960	2.150	3.070	31.250	44.070	23.030	129.7
1949	4.830	5.020	2.680	1.940	1.770	1.730	3.840	2.190	2.240	64.190	4.150	33.040	127.6
1950	4.220	4.240	2.680	2.400	1.960	1.780	4.440	2.550	70.800	69.450	24.910	20.120	209.6
1951	4.350	3.440	2.360	1.850	1.780	1.760	1.780	11.530	17.360	49.570	128.240	65.340	289.4
1952	4.250	5.660	2.750	1.960	1.780	1.740	23.300	48.390	9.150	89.570	39.100	4.310	232.0
1953	3.330	2.700	2.170	1.860	1.760	1.770	2.350	72.750	48.240	200.760	117.790	11.150	466.6
1954	4.070	2.870	2.120	1.850	6.480	2.100	1.970	2.010	6.780	89.510	237.610	4.600	362.0
1955	4.280	3.460	2.420	1.910	1.800	1.760	1.760	4.740	53.270	56.290	81.060	4.580	217.3
1956	3.680	2.600	2.000	1.800	4.500	2.210	2.090	43.150	153.900	177.940	104.700	9.640	508.2
1957	18.020	3.190	2.100	1.800	1.780	1.810	1.840	8.460	16.540	3.570	42.320	4.080	105.5
1958	3.790	3.020	2.180	1.830	1.790	1.790	3.970	124.060	4.770	5.140	49.620	4.540	206.5
1959	19.790	3.160	2.140	1.840	1.750	1.740	1.790	4.260	43.540	11.370	3.940	3.580	98.9
1960	2.970	2.250	1.910	1.830	1.780	1.760	1.790	2.100	3.210	8.450	33.150	51.460	112.7
1961	3.920	2.610	1.960	1.820	1.810	1.810	2.010	2.080	154.180	73.410	226.410	4.590	476.6
1962	56.650	3.640	2.310	1.870	1.770	1.730	1.730	1.840	2.420	19.650	95.630	4.570	193.8
1963	3.510	2.630	2.120	1.830	2.020	1.870	1.850	2.110	43.760	31.810	76.050	4.660	174.2
1964	3.850	4.470	2.520	1.900	1.840	3.250	2.270	2.640	2.980	5.930	11.540	3.340	46.5
1965	2.950	2.420	2.030	1.820	1.740	1.800	1.870	1.940	8.470	53.720	37.430	15.410	131.6
1966	3.770	2.490	1.920	1.760	1.730	1.710	3.280	2.700	81.940	26.750	20.650	4.510	153.2
1967	3.700	3.020	2.220	1.830	1.750	1.730	1.910	10.600	63.930	93.920	78.280	4.360	267.3
1968	22.570	3.370	2.380	1.940	1.780	1.740	2.390	2.020	2.330	2.580	3.250	32.650	79.0
1969	14.030	2.880	2.030	1.780	1.760	1.760	1.730	2.510	17.260	57.930	79.730	5.320	188.7
1970	3.870	2.750	2.090	1.830	1.730	1.800	1.810	2.000	2.710	45.430	63.560	4.300	133.9
1971	3.170	2.330	1.910	1.810	1.760	1.730	2.260	4.580	4.400	16.990	11.710	15.100	67.8
1972	3.280	2.370	1.930	1.780	1.730	1.730	1.730	1.740	1.800	46.270	32.450	17.440	114.3
1973	3.730	2.600	2.010	1.810	1.760	1.760	1.730	2.510	17.300	29.460	435.740	12.800	513.2
1974	14.020	3.440	2.330	1.880	1.770	1.740	2.200	52.420	14.760	45.590	85.970	4.500	230.6
1975	3.970	2.910	2.050	1.790	1.750	2.040	2.090	2.240	114.150	88.770	15.970	4.570	242.3
1976	3.710	23.090	3.900	2.440	2.040	1.870	5.640	143.640	173.230	176.470	183.780	4.660	724.5
1977	3.600	2.660	2.300	1.950	1.780	1.800	1.890	1.990	2.050	2.100	34.680	14.970	71.8
1978	3.370	2.460	2.050	1.880	2.330	1.930	1.830	2.240	24.590	32.230	19.210	13.200	107.3
1979	3.920	2.800	2.000	1.820	1.780	1.730	1.790	2.790	3.760	9.550	36.090	3.880	71.9
1980	3.320	18.870	2.900	65.670	3.000	2.300	2.210	2.230	2.450	37.630	71.830	115.650	328.1
1981	4.460	3.170	2.210	1.900	1.790	1.750	26.320	3.300	26.240	28.090	9.950	3.820	113.0
1982	3.310	2.650	2.080	1.820	1.780	1.800	1.850	35.190	119.490	184.660	15.250	43.790	413.7
1983	3.890	2.580	1.950	1.780	1.730	3.230	2.110	114.220	7.380	48.160	11.440	105.550	304.0
1984	29.050	3.390	2.460	2.260	2.020	4.880	2.600	2.890	53.730	121.110	111.260	9.910	345.6
1985	4.130	2.910	2.130	1.850	1.760	1.840	2.000	2.200	20.150	43.280	137.130	19.910	239.3
1986	4.090	2.900	2.100	1.800	1.750	1.730	1.920	24.740	66.360	60.270	106.060	15.190	288.9
1987	3.750	2.470	1.960	1.790	1.730	1.730	2.880	2.280	17.430	17.080	45.740	6.700	105.5
1988	3.540	2.440	1.920	1.760	1.730	2.740	8.170	6.600	61.740	43.180	114.890	67.810	316.5
1989	4.330	3.090	2.140	1.810	1.870	1.820	11.900	21.750	57.490	111.070	4.770	3.870	225.9
1990	2.940	2.260	1.930	1.810	1.750	1.760	1.820	2.700	56.120	158.600	4.750	59.550	296.0
1991	4.220	2.860	2.010	1.780	1.750	1.760	2.650	2.490	78.670	133.020	42.640	4.450	278.3
1992	22.320	3.240	2.120	1.800	1.750	1.730	138.090	55.730	50.450	288.230	15.800	4.360	585.6
1993	3.180	2.270	1.940	1.810	1.730	1.730	2.500	2.360	148.660	39.610	4.770	23.790	234.4
1994	3.910	2.620	2.170	2.270	1.940	1.830	1.800	10.980	23.630	35.280	51.810	4.400	142.6
1995	13.650	3.420	85.470	2.990	2.110	1.980	1.920	2.540	76.250	132.810	62.670	19.410	405.2
1996	28.180	6.820	3.020	2.100	1.790	1.750	2.090	35.180	122.870	23.200	30.590	4.220	261.8
1997	3.200	4.160	2.350	5.060	2.080	1.890	2.110	57.590	4.150	13.150	4.000	3.380	103.1
1998	2.580	2.460	4.260	2.120	1.810	1.740	1.760	2.510	2.630	2.690	2.430	11.720	38.7
1999	3.060	2.250	2.910	2.020	1.840	1.960	1.940	1.940	2.360	68.550	17.420	4.100	110.4
2000	3.090	2.290	1.910	1.770	1.730	1.710	1.800	2.030	2.230	90.240	108.590	10.090	227.5
2001	31.990	3.510	2.260	1.830	2.010	1.830	2.000	8.430	34.090	105.070	75.920	10.420	279.4
2002	4.010	2.820	2.660	2.010	1.780	89.970	3.670	3.440	3.120	2.870	116.700	15.610	248.7
2003	4.150	2.850	2.050	1.880	1.800	1.750	5.570	2.330	2.500	19.370	10.440	3.690	58.4
2004	140.320	3.550	2.310	2.610	1.960	1.780	19.530	3.110	21.410	15.220	43.730	4.360	259.9
AVE :	8.73	3.44	3.29	2.76	1.97	3.04	4.99	14.29	38.27	57.08	57.63	19.57	215.1
SD :	17.40	2.98	9.43	7.23	0.76	9.98	15.86	27.81	46.79	55.95	65.41	26.55	139.9