Water Resource Planning Systems Series

SUB-SERIES NO. WQP 1.7.2.1

Resource Directed Management of Water Quality

MANAGEMENT INSTRUMENTS

Volume 4.2.1

Users' Guide

Resource Water Quality Objectives (RWQO) Model (Version 4.0)

> August 2006 Edition 2







Department: Water Affairs & Forestry REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF WATER AFFAIRS AND FORESTRY

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Volume 4.2.1 Users' Guide: Resource Water Quality Objectives (RWQOs) Model (Version 4.0)

> August 2006 Edition 2

Published by

Department of Water Affairs and Forestry Private Bag X313 PRETORIA, 0001 Republic of South Africa

Tel: (012) 336 7500/ +27 12 336 7500 Fax: (012) 336 6731/ +27 12 336 6731

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ISBN No. 0-621-3675-8

This report should be cited as:

Department of Water Affairs and Forestry, 2006. Resource Directed Management of Water Quality: Management Instruments. *Volume 4.2.1: Users' Guide: Resource Water Quality Objectives (RWQOs) Model (Version 4.0)*. Edition 2. Water Resource Planning Systems Series, Sub-Series No. WQP 1.7.2.1. ISBN No. 0-621-3675-8. Pretoria, South Africa.

Co-ordinated by: CSIR, Natural Resources and the Environment (NRE) PO Box 395 Pretoria 0001

DOCUMENT INDEX

Reports as part of this project:

REPORT NUMBER	REPORT TITLE
1.1	*Inception Report
1.2	*National and International Literature Survey and Contextual Review
1.3	Appendix E: Project Document. Glossary of terminology often used in the Resource Directed Management of Water Quality
1.4	Volume 1: Policy Document Series
1.4.1	Volume 1.1: Summary Policy
1.4.2	Volume 1.2: Policy
1.5	Volume 2: Strategy Document Series
1.5.1	Volume 2.1: Summary Strategy
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1.5.3	Volume 3: Institutional Arrangements
1.6	1st Edition Management Instruments Series (Prototype Protocol)
1.6.1	Appendix B: Project Document. Conceptual Review for water licence application from a Resource Directed Management of Water Quality (RDMWQ) perspective
1.6.2	**Guidelines on Catchment Visioning for the Resource Directed Management of Water Quality
1.6.3.1	**Guideline for determining Resource Water Quality Objectives (RWQOs), water quality stress and allocatable water quality
1.6.3.2	**Guideline on the conversion of the South African Water Quality Guidelines to fitness-for-use categories
1.6.3.3	**Guideline for converting Resource Water Quality Objectives (RWQOs) to individual end-of-pipe standards
1.6.3.4	Appendix D: Project Document. ACWUA Decision-making support system for Resource Directed Management of Water Quality (RDMWQ)
1.6.4	**Decision-support instrument for the Assessment of Considerations for Water Use Applications (ACWUA)
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1.7.2.1	Volume 4.2.1: Users' Guide. Resource Water Quality Objectives (RWQOs) Model (Version 4.0)
1.7.3	Volume 4.3: Guideline on Monitoring and Auditing for Resource Directed Management of Water Quality
1.7.4	Appendix A: Project Document: Philosophy of Sustainable Development
1.7.5	Appendix C: Project Document: Guidelines for Setting Licence Conditions for Resource Directed Management of Water Quality (RDMWQ)
1.7.6	Introduction

Bold type indicates this report.

*These reports are internal project management documents that are not available for publication.

**These reports are earlier versions that have been improved upon in the second edition and thus are not available for publication.

APPROVAL

TITLE:	Resource Directed Management of Water Quality: Management Instruments. Volume 4.2.1: Users' Guide: Resource Water Quality Objectives (RWQOs) Model (Version 4.0)
DATE:	August 2006
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LEAD CONSULTANT:	CSIR NRE
SUB-SERIES NO.:	WQP 1.7.2.1
ISBN NO.:	0-621-3675-8
FILE NO.:	16/3/4/96
FORMAT:	MSWord and PDF
WEB ADDRESS:	www.dwaf.gov.za

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ACKNOWLEDGEMENTS

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ACRONYIMS

- AEMC Attainable Ecological Management Class
- DWAF Department of Water Affairs & Forestry
- RDM Resource Directed Measures
- REC Recommended Ecological Category
- RWQOs Resource Water Quality Objectives
- WRC Water Research Commission



SUPPORT

For enquiries please contact the: Department of Water Affairs and Forestry, Tel (012) 336-7500 or Fax (012) 336-7044

Further supporting documentation may be obtained from <u>http://www.dwaf.gov.za/</u>

Developed for the Department of Water Affairs and Forestry by the





1. System

This guide provides assistance to users of the software package (RWQO Model vs. 4.0) for the determination of Resource Water Quality Objectives (RWQOs) for surface water resources. For detail on the methodology behind this system, the user is referred to the "Guideline for determining Resource Water Quality Objectives (RWQOs), Allocatable Water Quality and the Stress of the Water Resource" (DWAF, 2006), accessible from within the Model or on the enclosed CD. The software is freely available from the Department of Water Affairs and Forestry.

2. Setup

Software Version

This Users Guide is applicable to version 4.0 of the RWQOs Model, developed by the CSIR for the Department of Water Affairs and Forestry (DWAF).

Setting up

The RWQOs Model is a computer-based application which can be run either from the setup CD or from a computer. To run the Model from the CD locate and open the file run.bat. To run the Model from the computer, the user should copy the relevant folder and associated files from the CD and paste them into a folder created for the application.



The Model is a standalone application and requires no additional software to run. Should users wish to open any of the available documents within the Model [See Functions], they will need Acrobat Reader. The setup file for Acrobat Reader is enclosed on the attached CD or can be downloaded from <u>www.adobe.com</u>.

3. System Requirements

There are no specific system requirements to operate the RWQOs Model.

4. Quick Start

What you need to know and do to get started:

- 1. Copy the folder from the CD to your computer
- 2. Locate and Open the file run.bat
- 3. You are now ready to begin a new project, or an existing saved project.

Introduction	nput	BestAEMC	References	Monthly-Flow	End-of-Pipe	Rep	ort			
	· .									
Project Name Study Unit Name										
an 153	8 8	2.020				Use	r	Existing?	Future?	Category
Recommended e	cologica	al category		Select	International o	obligat	ions			Ideal 💌
					Strategic use					Ideal 🔻
		ea ta cat tha	Ecological Res	onvo Catoriony	C Ecological	Rese	rve			Α 🔻
		30 10 361 (IIC	Leological NESI	sive category	Ecological	irements			Nat 🔻	
tananoment ela	e				Basic Human I	Needs	ŧ.			Ideal 💌
nandyement tiðs	Natu	rai		•	Domestic use					Ideal 💌
	🖌 U	se to set the	Category for ot	her users	Agriculture - Stock watering					Ideal 💌
					Agriculture - Irrigation					Ideal 💌
Spatial extent	Wat	er managem	ent area	-	Agriculture - Aquaculture					Ideal 💌
					Industrial - Cat	tegory	/1			Ideal 💌
				hit Flow Table	Industrial - Cat	tegory	12			Ideal 💌
					Industrial - Cat	tegory	3			Ideal 💌
				Select	Industrial - Cat	tegory	4			Ideal 💌
lemporal extent	Annu	ıal		-	Recreation - Full contact Recreation - Intermediate contact					Ideal 💌
-low assurance	10		- %	1						Ideal 💌
	10				Recreation - N	lon-co	ntact			Ideal 💌
arget flow	-		m ³ /s	ec	Select All		Select None	- Ani		
					Jucotti		50000000	- HP		5
report created by	•									
					1	Prese	nt State			Refi
Category	Variabl	e Ui	nits Bound	In Report	Value		Percentile		Value	
Physical Clarity		NTU	Lower		1					A
				and the second			1 1			

5. Overview

The RWQOs Model (vs 4.0) provides users with a standard approach to consistently setting Resource Water Quality Objectives (RWQOs) for surface water resources in South Africa. By selecting the water resource and user requirements, the Model generates RWQOs that are based on a database of provided and entered water quality parameters.

The Model provides a quick approach to setting RWQOs based on the guidelines for determining Resource Water Quality Objectives (RWQOs), Allocatable Water Quality and the Stress of the Water Resource (DWAF, 2006).



6. Functions

The Model provides two levels of functions; these are accessible through the Toolbar and through the Tabs.



 Resource Water Quality Objectives Beta

 File
 Tools
 Help

 Intr
 Flow Unit Converter
 References
 Monthly-Flow

 Flow from volume Calculator
 Volume from flow Calculator
 Monthly-Flow

The 'Tools' dropdown menu on the toolbar, allows users to easily convert a number of flow units into the required flow format of m^3/s and vice versa.

Resou	rce Water	· Quality O	bjectives	; Beta
ile <u>T</u> ools	Help			
Introductio	Supporting	Documents	ferences	Monthly-Flow
	<u>H</u> elp <u>A</u> bout this s	oftware		

The 'Help' dropdown menu on the toolbar, allows users to access supporting documents, e.g. guidelines, legislation; access to on-line help; and information about the software version.

Tabs

F

The 'Tabs' provide an overview of each of the working screens in the Model, namely:

- Introduction
- Input
- Best AEMC
- References

- Monthly-Flow
- End-of-Pipe
- Report



Introduction

The 'Introduction' tab provides users with a brief overview and background to the Model.

Input

The 'Input' tab is the main input screen in the Model. Here users are required to:

- 1) Select (or enter) the Recommended Ecological Category (Best AEMC) for the water resource management unit;
- 2) Select the desired management class for the water resource management unit;
- 3) Set the spatial extent of the water resource management unit;
- 4) Select the desired target flows to support the determination of loads;
- 5) Select the desired water user categories (current and future); and
- 6) Enter present and reference water quality for selected parameters of concern.

Resource W	/ater Quality	Objectives	; Beta						_ [
<u>File Tools H</u> elp										
Introduction In	out BestAEMC	References	Monthly-Flow	End-of-Pipe	Report				_	
						(5) S	elect de	sired		
Designed Manua	6					water	user cat	egory		
Project Name	-							$\overline{\langle}$		
Study Unit Name									~	
Recommende (1)	Select Best A	EMC		International o	User		Existing?	Future?	Category	
(econinentie			Select	Strategic use	uliyaduns					all
					Reserve				ů v	1
	✓ Use to set the	Ecological Res	erve Category	Ecological	Requirement	ts			Nat 🔻	
				Basic Human M	Veeds				Ideal 💌	āl
Management class	Natural		*						Ideal 💌	i
	✓ Use to set the	Category for ot	her users	(2) Select r	managem	ent			Ideal 💌	
				cl	ass				Ideal 💌	ī
Spatial extent	Water manageme	ent area	-	Agriculture - A	quaculture				Ideal 💌	
	1			Industrial - Cat	egory 1				Ideal 💌	
(0) 0 a la st sa		E	dit Flow Table	Industrial - Cat	egory 2				Ideal 💌	1
(3) Select spa	atial extent		Calant	Industrial - Cat	egory 3				Ideal 💌	
-	1		Select	Industrial - Cat	egory 4				Ideal 💌	
remporal extent	Annual		-	Recreation - Fu	ull contact				Ideal 💌	
Flow assurance	10	~ % <u>~</u>		Recreation - In	termediate o	ontact			Ideal 💌	
Target flow		m ³ /s		Recreation - No	on-contact				Ideal 💌	4
	24		(4) Sele	CT FIOW CT All	Select	t None	Appl	У	5	
Report created by:										
				-	Present State	e			Refi	-1
Category V	ariable	(6) Proc	ont and	Value	F	Percentile		Value		
Physical Clarity	TN F	(U) FIES	vater quality						•	
Physical Colour	Pt									
4										*

Each of these steps is briefly unpacked below.

v Recommended ecological category

The Recommended ecological category (REC) (sourced from the Best AEMC) provides the starting default category for the ecological Reserve category [*under Users*]. To select the REC the user should go to the BestAEMC tab and select the appropriate quaternary catchment. By doing so, the Best AEMC will automatically be filled into the Input screen.

August 2006



v Desired management class

The Management Class, for the water resource management unit, provides the starting or default category for the other Water Users [*under Users*] - [Natural=Ideal; Moderately used/impacted=Acceptable; Heavily used/impacted=Tolerable]. The Management Class can be selected from the available drop down menu.



v Spatial extent of the water resource management unit

The spatial extent defines the water resource management unit for the study. This is used for supporting information and is not used in any of the calculations to determine the RWQOs.

			Extent
Spatial extent	Water management area	•	

v Target flows and flow assurance

The flow is used in the Model to determine the allocatable load and the end-of-pipe discharges. Once flows have been entered in the Monthly-Flow tab, the desired temporal extent and flow assurance should be selected. This will automatically insert the target flow into the required field. Flows may be edited by clicking on the Edit Flow Table button.

		Edit Flow Table	Select Temporal Extent
		Select	<u> </u>
Temporal extent	Annual		
Flow assurance	10	• %	
Target flow	0.18	m ³ /sec	

v Desired water user categories (current and future)

The desired water user categories, both existing and future are fundamental to determining the RWQOs.



User	Existing?	Future?	Category	
International obligations		~	Acc 💌	Ecological Reserve
Strategic use			Acc 💌	category may be
O Ecological Reserve			C 🕶	changed from default
Ecological Requirements	~	~	Good 💌	
Basic Human Needs			Acc 🔻	
Domestic use			Acc 💌	
Agriculture - Stock watering			Acc 💌	
Agriculture - Irrigation		~	Acc 💌	
Agriculture - Aquaculture			Acc 💌	
Industrial - Category 1		~	Acc 🔻	Water User categories
Industrial - Category 2	1	~	Acc 💌	may be changed from
Industrial - Category 3		~	Acc 💌	uerauli
Industrial - Category 4		~	Acc 🔻	
Recreation - Existing and future			Acc 💌	
Recreation - water users should			Acc 💌	
Recreation - be selected			Acc 🔻	
Select All Select None	Арр	oly		

v Present and reference water quality for selected parameters of concern

The present water quality is used to determine the water resource stress [See Reports], while the reference water quality provides data to assess the feasibility of the determined RWQOs.

Introducti	on Input Best/	EMC Re	ferences	Monthly-Flow En	id-of-Pipe Report			
				Presen	t State	Refe	reace	1
Category	Variable	Units	Bound	Value	Percentile	Value	Percentile	
Physical	Clarity	NTU	Lower					6
Physical	Celour	Pt-Co	Upper	Ν				
Physical	Odour	TON	Upper					
Physical	Temperature	°C	Upper					
			Lower					
Physical	Hardness (CaCO ₂)	mat	Upper	Pre	sent and referer	ice		
Physical	155	mgi	Upper	wa	iter quality can b	e		11
Physical	Turbidity	NTU	Upper	en	tered by the use	er		
Chemical	Alkalinity (CaCO_)	mgt	Upper					
Chemical	Ammonia (NH ₅ -N)	mgt	Upper					IH
Chemical	Calcium	mgit	Upper					Ш
Chemical	Chloride	mgi	Upper				1	
Chemical	Chiorine (OHCI)	1.gu	Upper					
			Lower				1	
Chemical	Conductivity	mSim	Upper				B	
Chemical	Fluoride	mgt	Upper					10
Chemical	Magnesium	mgt	Upper				1	
Chemical	NO_2 and NO_9	mail	Upper					
Chemical	NO ₃ (NO ₃ -N)	mgi	Upper				1	Ш
Chemical	NO	mgt	Upper					Ш
Chemical	NO2	mgt	Upper	1				
Chemical	TIN	mail	Upper					- 10

Best AEMC

The 'Best Achievable Ecological Management Category (Best AEMC)' tab allows users to automatically select the *Recommended Ecological Category* for a given quaternary

catchment. The Best AEMC was determined by specialists with local knowledge of the various catchments (Kleynhans, 1999).

Resourc File Tools H	e Wate	r Quality	Objectives	Beta					<u>- 🗆 ×</u>
Introduction	Input	BestAEMC	References	Monthly-Flow	End-of-Pipe	Report	1		
Best AEMC	for the s	elected qu	aternary cat	chment is us	ed to set the	e default r	ecommended	l ecological catego	ory
	Order by	:		Quat	ernary		\bigcirc	Stream Name	
Quate	rnary 🔪		Rivers	8	EISC		PESC	Best AEMC	
A10A		Len	-	HIGH		CLASS C: I	MODERATELY	CLASS B	-
410B		Llaara		hohotioolly	NAL	CLASS C: I	MODERATELY	CLASS B	E
410C		Users	can son aip	nabetically	NAL	CLASS B: L	ARGELY NATU	CLASS A	
421A		by qua	aternary cat	chment or	NAL	CLASS C: I	MODERATELY	CLASS B	
A21B		ł	by stream n	ame		CLASS C: I	MODERATELY	CLASS B	
421C			<u> </u>			CLASS D: I	ARGELY MODI	CLASS C	
A21D		BLOUBAN	KSPRUIT	MODERATE		CLASS C: I	MODERATELY	CLASS B	
421E		CROCODI	LE	MODERATE		CLASS C: I	MODERATELY	CLASS B	
421F		MAGALIES		MODERATE		CLASS C: I	MODERATELY	CLASS B	
421G		SKEERPO	ORT	MODERATE		CLASS C: I	MODERATELY	CLASS B	
A21H		CROCODI	LE	MODERATE		CLASS C: I	MODERATELY	CLASS B	
421J		CROCODI	LE	MODERATE		CLASS C: I	MODERATELY	CLASS B	
421K		STERKST	ROOM	MODERATE		01400.01		CLASS B	
421L		CROCODI	hE	MODERATE	Categor	v selecte	d provides	CLASS B	
A22A	Select d	esired		MODERATE	the d	, efault Ec	ological	CLASS B	
A22B dua	ternary	ratchment	VER	MODERATE			bagoru	CLASS B	
A22C quu	tornary	Satorinioni		MODERATE		serve Ca	legory	CLASS B	
422D		SELONS		MODERATE		CLASS C: I		CLASS B	
422E		ELANDS R	<u> </u>	MODERATE		CLASS C: I	MODERATEL	CLASS B	
422F		ELANDS		MODERATE	8	CLASS D: I	ARGELY MODI	CLASS C	
422G		HEX RIVER	२	MODERATE		CLASS C: I	MODERATELY	CLASS B	
422H		HEX RIVER	२	MODERATE		CLASS D: I	ARGELY MODI	CLASS B	
422J		HEX		MODERATE		CLASS C: I	MODERATELY	CLASS B	
A23A		PIENAARS	()	MODERATE		CLASS C: I	MODERATELY	CLASS B	

References

The 'Reference tab' provides the input water quality data for various water user types, and is used to determine the RWQOs. For certain water users, the water quality data are automatically provided in the Model [Reference tab], based on the South African Water Quality Guidelines (DWAF, 1996) (e.g. Domestic Use, Agriculture, Industrial, and Recreation) – these are accessible under Help > Supporting Documents. In addition, default water quality data are provided for Ecological Requirements (in the absence of an ecological reserve) (Palmer *et al.*, 2005) and Basic Human Needs (Class 1) (WRC, 1998).

If applicable to the catchment, users are required to enter the water quality in the 'Reference' tab for:

- International obligations;
- Strategic use; and
- Ecological Reserve.



Eile Tool	ource Wate	r Quality (Objectives					_	
Introduct	ion Input	BestAEMC	References	Monthly-Flow	End-of-Pipe	Report			
					Domestic use		Agricu	lture - Stock wat	terin
Category	Variable	Units	Bound	Ideal	Acceptable	Tolerable	Ideal	Acceptable	-
Physical	Clarity	NTU	Lower						-
Physical	Colour	Pt-Co	Upper						
Physical	Odour	TON	Upper						
Physical	Temperature	°C	Upper						
Physical Physical	Hardness (CaC TSS	Referer from th Water Q	nce water q e South Af	uality rican 200 elines	300) 600			
Physical	Turbidity			0.1	1	1 20			
Chemical	Alkalinity (CaC	03) mg/l	Upper						
Chemical	Ammonia (NH3	I-N) mg/l	Upper	1					
Chemical	Calcium	mgA	Upper	80.00	150.00) 300.00	1000.00	1500.00	
Chemical	Chloride	mgA	Upper	100.00	200.00	600.00	1000.00	1750.00	
Chemical	Chlorine (OHCl) µдл	Upper Lower	0.60 0.30	0.80) 1.00) 0.10			
Chemical	Conductivity	mS/m	Upper	70.00	150.00	370.00			
Chemical	Fluoride	mgA	Upper	0.70	1.00) 1.50	2.00	4.00	
Chemical	Magnesium	mgA	Upper	70.00	100.00	200.00	500.00	750.00	
Chemical	NO2 and NO3	mgA	Upper	6.00	10.00	0 20.00			

The ecological Reserve water quality data are entered for the selected ecological Reserve category, as determined from the Reserve process.

Eile Tool	ource Water Qua s <u>H</u> elp	ality Object	tives							×
Introduct	tion Input BestA	EMC Referen	nces Mont	hly-Flow	End-of-Pipe	Report				
Ecological Reserve										
Category	Variable	Units Bou	ind	A	В		С	D	Natural	
Physical	Clarity	NTU Low	ver							-
Physical	Colour	Pt-Co Upp	er 🛛							
Physical	Odour	TON Upp	ier							
Physical	Temperature	°C Upp	er 🛛							
		Low	ver							=
Physical	Hardness (CaCO3)	mg/l Upp)er							
Physical	TSS	mg/l Upp	er 🛛							
Physical	Turbidity	NTU Upp	er !							
Chemical	Alkalinity (CaCO3)	mg/l Upp	er 🛛							
Chemical	Ammonia (NH3-N)	mg/l Upp	er						0.015	
Chemical	Calcium	mg/l Upp	ier 🛛							
Chemical	Chloride	mg/l Upp	er 🛛	Wate	er quality to	be				
Chemical	Chlorine (OHCI)	µg/l Upp	ier 🛛	entered	d for the sele	ected			0.4	
		Low	ver	ecolo	ogical Reser	ve				
Chemical	Conductivity	mS/m Upp	ier		category					
Chemical	Fluoride	mg/l Upp	er 🛛					2.183	1.500	
Chemical	Magnesium	mg/l Upp	ier					147		
Chemical	NO2 and NO3	mg/l Upp	er 🛛							
Chemical	NO3 (NO3-N)	mg/l Upp	ier					1.21		
Chemical	NO3	ma/l Upp	er							
Chemical	NO Additional v	ariables ma	y be 📃							
Chemical	TIN added to t	he Referenc	es					1	0.25	
Chemical	рн which will ap	ppear in the	Input 📃					7.6	8.0	
	and Repo	ort workshee	ets					5.8	6.50	
Chemical	Potassiur	тдл Орр	er							-
	\mathcal{V}		4							•
Add Va	riable	ОК	Cancel							
		h.	and here							



If an Ecological Reserve has not been set for the water resource management unit, the Model will automatically use the 'Ecological Requirements' (Palmer *et al.*, 2005) for the default Ecological Reserve Category, as determined from the Best AEMC.

Monthly Flow

Target flows and flow assurances are used to set the 'Allocatable Load', i.e. the water quality over and above that required for the RWQOs, i.e. that which can be allocated for use.

The flows are entered into the 'Monthly Flow' tab. This can be done in two possible ways, either by:

- Typing the monthly flows into a given flow assurance column, e.g. 10%, or
- Importing the monthly flows as derived from the SPATSIM database (*.rul file), i.e. the output of the Reserve process.



What units should the flows be in? The monthly flows can be imported as either m^3 /s or Mm^3 /month. If the SPATSIM *.rul file is being imported, it is important that the header rows remain in the file. The Model will read these lines, to determine the import flow units.

R30E	_mcm.ru	l - WordF	Pad							_ 🗆 ×
File Edit	View Ins	ert Format	Help							
	1 <u>8</u> <u>R</u>	M X P		5						
Desktop Summary Determi Regiona Data an	p Version y of IFR ination b al Type : re given	2, Print rule curv ased on s E.Cape in m^3 *	ed on 200 es for : ite speci ERC = 10^6 mont	6/06/20 R30E WR90 fic param B hly flow	Incr. eters fro volume	m SPATSIM	I database	T sho	hese head ould not be n the impo	er rows e deleted rt *.rul file
	% Points									
Month	10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
Oct	1.083	1.041	0.953	0.805	0.609	0.410	0.255	0.165	0.127	0.122
Nov	4.965	3.931	2.460	1.730	1.130	0.854	0.529	0.346	0.272	0.110
Dec	1.167	1.005	0.853	0.692	0.465	0.321	0.197	0.119	0.086	0.070
Jan	0.675	0.651	0.601	0.514	0.391	0.255	0.140	0.069	0.040	0.020
Feb	0.831	0.803	0.744	0.640	0.492	0.327	0.184	0.094	0.055	0.010
Mar	2.019	1.654	1.329	1.012	0.600	0.384	0.219	0.127	0.089	0.020
Apr	1.024	0.985	0.900	0.758	0.571	0.380	0.231	0.145	0.090	0.070
May	0.386	0.371	0.341	0.290	0.222	0.153	0.100	0.069	0.056	0.054
Jun	0.289	0.277	0.249	0.205	0.152	0.103	0.069	0.051	0.044	0.043
Jul	0.341	0.326	0.294	0.244	0.182	0.124	0.082	0.060	0.051	0.049
Aug	1.048	0.670	0.460	0.360	0.290	0.240	0.210	0.150	0.123	0.100
Sep	0.888	0.854	0.782	0.660	0.440	0.330	0.211	0.137	0.107	0.100
	12.1									_
For Help, p	ress F1									

To import flow data, click the **Import** button in the 'Monthly-Flow' tab. This will take users to an 'Open' screen where you can locate the file for import.



Resource Water Quality Objectives	Beta							
Introduction Input BestAEMC References	Monthly-Flow	End-of-Pipe	Report					
Monthly Flows		<u></u>						
 ◆ Data may be entered directly (units must be m³/s), or ◆ Data (as extracted from SPATSIM database) may be imported (units as m³/s or x10⁶ m³/month). Data imported as x10⁶ m³/month will automatically be converted to m³/s (ensure that headings in file remain) 								
Wointh 10% 20% 30% October November December January February March April	docs jre1.5.0_0 projects reports stage thirdparty R30E_m3	6 Loca for	ncm.rul te *.rul file · import					
June July August September OK Canc	File <u>N</u> ame: Files of <u>T</u> ype:	R30E_m3s.rul IPR rule files (.	rul)	Open Cancel				
-	Ш			•				

Once imported, the 'Monthly-Flow' tab will be populated with flow assurance values to be used in the Input Tab.

Resou	rce Wat	er Quality	Objective	es Beta						
Introduction	n Input	BestAEMC	References	Monthly	-Flow End	1-of-Pipe R	eport			
Edit										
Time frame	10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
Annual	0.467	0.399	0.316	0.251	0.176	0.123	0.077	0.048	0.036	0.024
Annual - Le	0.466	0.398	0.316	0.251	0.176	0.123	0.077	0.048	0.036	0.024
October	0.404	0.389	0.356	0.300	0.227	0.153	0.095	0.061	0.047	0.045
November	1.916	1.517	0.949	0.667	0.436	0.330	0.204	0.133	0.105	0.042
December	0.436	0.375	0.319	0.258	0.174	0.120	0.074	0.044	0.032	0.026
January	0.252	0.243	0.225	0.192	0.146	0.095	0.052	0.026	0.015	0.007
ebruary	0.343	0.332	0.307	0.264	0.204	0.135	0.076	0.039	0.023	0.004
February	0.343	0.332	0.307	0.264	0.204	0.135	0.076	0.039	0.023	0.004
March	0.754	0.618	0.496	0.378	0.224	0.143	0.082	0.047	0.033	0.007
April	0.395	0.380	0.347	0.292	0.220	0.146	0.089	0.056	0.035	0.027
May	0.144	0.139	0.127	0.108	0.083	0.057	0.037	0.026	0.021	0.020
June	0.112	0.107	0.096	0.079	0.059	0.040	0.027	0.020	0.017	0.016
July	0.127	0.122	0.110	0.091	0.068	0.046	0.031	0.022	0.019	0.018
August	0.391	0.250	0.172	0.134	0.108	0.090	0.078	0.056	0.046	0.037
September	0.343	0.329	0.302	0.255	0.170	0.127	0.081	0.053	0.041	0.039
Autumn	0.577	0.501	0.423	0.336	0.222	0.144	0.085	0.051	0.034	0.017
Winter	0.194	0.155	0.126	0.103	0.080	0.058	0.043	0.031	0.026	0.023
Spring	0.374	0.359	0.329	0.278	0.199	0.140	0.088	0.057	0.044	0.042
Summer	0.737	0.616	0.449	0.345	0.239	0.170	0.101	0.060	0.044	0.020
Summer	0.734	0.614	0.448	0.344	0.239	0.169	0.101	0.060	0.044	0.020





Monthly flow data are sourced from the SPATSIM database, obtainable from the Chief Directorate RDM. Flows should be requested for the point or catchment for which the RWQOs are being set.

If you need to edit the monthly flows after having imported the *.rul file, you can do this by clicking on the Edit Flow Table button in the 'Input' tab or by clicking on the Edit button in the Monthly-Flow tab.

• End-of-pipe

The 'End-of-Pipe' tab, allows users to work back to point source effluent discharges, to determine the end-of-pipe discharge(s) that may be allowed in order to achieve the RWQOs. The 'End-of-Pipe' tab makes use largely of data that have already been entered within the other tabs. The only data to be entered in the 'End-of-Pipe' tab are the data for 'Effluent Flow'.

Input BestAEMC References Monthly-Flow End-of-Pipe Report Automatically filled from target flow (lnput tab) 0.399 Automatically filled from target flow (lnput tab) Mixing Effluent Flow (Qx) 0.013 0.013 Concentration (Cx) Concentration (Cx) Flow (Qr) Concentration (Cr) Ratio Hardness (CaCO3) mg4 0.412 00.000 0.033 TSS mg4 0.412 00.000 0.033 Alkalinity (CaCO3) mg4 0.412 00.000 0.033 Chloride mg4 0.6628.754 0.412 0.033 Chloride mg4 0.23 0.000 0.033 Chloride mg4 0.23 0.000 0.033 Kuomatically filled mg4 0.412 0.003 0.033 Kuomatically filled mg4 0.412 0.000 0.033 Chloride mg4 0.23 0.000 0.412 0.003 NO2 and NO3 mg4 Automatically filled from present water<	Tana Tan	v.			12		
Automatically filled from target flow (Input tab) Effluent Flow (Ox) 0.013 On 13 e entered by user Upriver Effluent Concentration (Cs) Concentration (Cw) Flow (Or) Concentration (Cr) Ratio Hardness (CaCO3) mg/l On 0.013 On 0.013 On 0.013 On 0.013 On 0.013 Hardness (CaCO3) mg/l Occentration (Cs) Concentration (Cw) Flow (Or) Concentration (Cr) Ratio Hardness (CaCO3) mg/l On 0.013 On 0.013 On 0.013 On 0.013 Chorine (NH3-N) mg/l On 0.013 On 0.013 On 0.013 On 0.013 Chorine (OHCl) ug/l Internation (Cs) Concentration (Cs) Con 0.033 Ma	troduction Input	BestAE	MC References	Monthly-Flow End-	of-Pipe Report		
Upriver Flow (Qs) 0.399 Effluent Flow (Qw) 0.013 ee entered by user Concentration (Cs) Concentration (Cw) Flow (Qr) Concentration (Cr) Ratio Hardness (CaC03) mg/l 0.412 100.000 0.033 TSS mg/l 0.412 25.000 0.033 Alkalinity (CaC03) mg/l 0.412 300.000 0.033 Ammonia (NH3-N) mg/l 0.412 300.000 0.033 Chorine (OHCl) µg/l 0.669.392 0.412 100.00 0.033 Chorine (OHCl) µg/l 0.000 0.412 100.00 0.033 Magnesium mg/l 68.7 4,229.900 0.412 100.00 0.033 NO2 mg/l 0.412 100.00 0.033 0.412 100.00 0.033 NO3 (NO3-N) mg/l 68.7 4,229.900 0.412 200.00 Automatically filled from present water quality (Input tab) 0.412 0.003 0.033 NO2 mg/l 0.41			Automati target fl	cally filled from ow (Input tab)			
Effluent Flow (Qw) 0.013 e entered by user Upriver Effluent Downriver Mixing Hardness (CaC03) mg/l 0.412 100.000 0.033 100.000 10.03	Upriver Flow (Qs)	0.399					
e entered by user Upriver Effluent Downriver Mixing Hardness (CaCO3) mg/l 0.000 0.033 40.412 100.000 0.033 40.412 100.000 0.033 40.412 25.000 0.033 40.412 20.000 0.033 40.412 300.000 0.033 40.412 300.000 0.033 40.412 300.000 0.033 40.412	Effluent Flow (Qw)	0.013					
Concentration (Cs) Concentration (Cw) Flow (Qr) Concentration (Cr) Ratio Hardness (CaCO3) mgA 0.412 100.000 0.033 1 0.412 100.000 0.033 1 0.033	e entered by us	er	Upriver	Effluent	Dow	nriver	Mixing
Hardness (CaCO3) mg/l 0.412 100.000 0.033 TSS mg/l 0.412 25.000 0.033 Alkalinity (CaCO3) mg/l 0.412 300.000 0.033 Ammonia (NH3-N) mg/l 0.412 300.000 0.033 Calcium mg/l 93.8 6,628.754 0.412 300.000 0.033 Chloride mg/l 102.1 669.392 0.412 120.000 0.033 Chloride mg/l 2.3 0.000 0.412 1.000 0.033 Fluoride mg/l 2.3 0.000 0.412 200.000 0.033 NO2 and NO3 mg/l 0.412 200.000 0.033 0.033 NO3 (NO3-N) mg/l Automatically filled Calculated by Model based on input data 0.033 Potassium mg/l 0.412 100.000 0.033 SAR mmoM 0.412 15.000 0.033 Sodium mg/l 0.412 15.000 0.033 Solum mg/l 0.412 10.000 0			Concentration (Cs)	Concentration (Cw)	Flow (Qr)	Concentration (Cr)	Ratio
TSS mg/l 0.412 25.000 0.033 Alkalinity (CaCO3) mg/l 0.412 300.000 0.033 Ammonia (NH3-N) mg/l 0.412 300.000 0.033 Calcium mg/l 93.8 6,628.754 0.412 300.000 0.033 Chloride mg/l 102.1 669.392 0.412 120.000 0.033 Chloride mg/l 2.3 0.000 0.412 1000 0.033 Fluoride mg/l 2.3 0.000 0.412 200.000 0.033 NO2 and NO3 mg/l 4,229.900 0.412 200.000 0.033 NO2 and NO3 mg/l Automatically filled from present water Quality (Input tab) Quality Quality <td>Hardness (CaCO3)</td> <td>mg/l</td> <td></td> <td></td> <td>0.412</td> <td>100.000</td> <td>0.033 📤</td>	Hardness (CaCO3)	mg/l			0.412	100.000	0.033 📤
Alkalinity (CaCO3) mg/l 0.412 300.000 0.033 Ammonia (NH3-N) mg/l 0.412 0.033 Calcium mg/l 93.8 6,628.754 0.412 0.000 0.033 Calcium mg/l 102.1 669.392 0.412 120.000 0.033 Chloride mg/l 102.1 669.392 0.412 1.000 0.033 Chloride mg/l 2.3 0.000 0.412 1.000 0.033 Magnesium mg/l 68.7 4,229.900 0.412 200.00 0.033 NO2 and NO3 mg/l Automatically filled Calculated by Model based on Automatically filled NO3 mg/l Automatically filled from present water quality (Input tab) 0.412 0.033 PO4 mg/l 0.011 0.012 0.013 0.033 SAR mmol/l 0.012 15.000 0.033 SOdium mg/l 0.013 0.013 0.033 SOdium mg/l 0.014 15.000 0.033 <t< td=""><td>TSS</td><td>mg/l</td><td></td><td></td><td>0.412</td><td>25.000</td><td>0.033</td></t<>	TSS	mg/l			0.412	25.000	0.033
Ammonia (NH3-N) mg/l 0.412 0.033 Calcium mg/l 93.8 6,628.754 0.412 0.000 0.033 Chloride mg/l 102.1 669.392 0.412 120.000 0.033 Chloride mg/l 2.3 0.000 0.412 1.000 0.033 Fluoride mg/l 2.3 0.000 0.412 1.500 0.033 Magnesium mg/l 68.7 4,229.900 0.412 20.000 0.033 NO2 and NO3 mg/l 0.4112 20.000 0.033 0.003 NO2 and NO3 mg/l Automatically filled from present water quality (Input tab) 0.412 0.003 0.033 NO2 mg/l Automatically filled from present water quality (Input tab) 0.412 0.033 0.033 PO4 mg/l 0.011 0.012 100.000 0.033 0.033 Sodium mg/l 0.011 15.000 0.033 0.033 0.013 0.0133 0.013 0.033	Alkalinity (CaCO3)	mg/l			0.412	300.000	0.033
Calcium mg/l 93.8 6,628.754 0.412 300.000 0.033 Chloride mg/l 102.1 669.392 0.412 120.000 0.033 Chloride mg/l 2.3 0.000 0.412 1.000 0.033 Fluoride mg/l 2.3 0.000 0.412 1.500 0.033 Magnesium mg/l 68.7 4,229.900 0.412 20.000 0.033 NO2 and NO3 mg/l 0.412 20.000 0.033 0.003 NO3 (NO3-N) mg/l Automatically filled from present water quality (Input tab) 0.412 20.000 Automatically filled from present water quality (Input tab) 0.412 0.033 PO4 mg/l 0.013 0.412 0.033 0.033 SAR mmol/l 0.0141 15.000 0.033 SO4 mg/l 0.412 0.033 0.033 SUphide (H2S) mg/l 0.412 0.033 0.033	Ammonia (NH3-N)	mg/l			0.412		0.033
Chloride mg/l 102.1 669.392 0.412 120.000 0.033 Chlorine (OHCl) µg/l 0.000 0.412 1.000 0.033 Fluoride mg/l 2.3 0.000 0.412 1.500 0.033 Magnesium mg/l 68.7 4,229.900 0.412 20.000 0.033 NO2 and NO3 mg/l 0.412 20.000 0.033 0.003 NO3 (NO3-N) mg/l 0.412 20.000 Automatically filled from calculated from calculated from present water quality (Input tab) 0.412 0.033 NO2 mg/l Automatically filled from present water quality (Input tab) 0.412 0.033 PO4 mg/l 0.0141 100.000 0.033 SAR mmol/l 0.0141 15.000 0.033 SO4 mg/l 0.412 0.033 0.033 Sulphide (H2S) mg/l 0.412 0.033 Sulphide (H2S) mg/l 0.412 0.033	Calcium	mg/l	93.8	6,628.754	0.412	300.000	0.033
Chlorine (OHCl) µg/l 0.412 1.000 0.033 Fluoride mg/l 2.3 0.000 0.412 1.500 0.033 Magnesium mg/l 68.7 4,229.900 0.412 200.000 0.033 NO2 and NO3 mg/l 0.412 200.000 0.033 0.033 NO2 and NO3 mg/l 0.412 200.000 0.033 NO3 (NO3-N) mg/l Automatically filled from present water quality (Input tab) Calculated by Model based on input data 0.033 NO2 mg/l Automatically filled from present water quality (Input tab) 0.412 0.033 PO4 mg/l 0.013 0.013 0.033 SAR mmol/l 0.0141 0.000 0.033 Sodium mg/l 0.0141 15.000 0.033 Sodium mg/l 0.0141 0.000 0.033 Sulphide (H2S) mg/l 0.013 0.013 0.033 Sulphide (H2S) mg/l 0.013 0.0133 0.033	Chloride	mg/l	102.1	669.392	0.412	120.000	0.033
Fluoride mg/l 2.3 0.000 0.412 1.500 0.033 Magnesium mg/l 68.7 4,229,900 0.412 200.000 0.033 NO2 and NO3 mg/l 0.412 200.000 0.033 0.412 NO3 (NO3-N) mg/l 0.412 20.000 Automatically filled from calculated from calculated from present water quality (Input tab) 0.412 0.033 P04 mg/l 0.412 0.000 0.033 SAR mmol/l 0.412 0.033 0.033 Sodium mg/l 0.412 0.033 0.033 Sodium mg/l 0.011 0.000 0.033 Suphide (H2S) mg/l 0.011 0.010 0.033 TDS mg/l 0.011 0.412 0.033	Chlorine (OHCl)	µgA			0.412	1.000	0.033
Magnesiummg/l68.74,229,9000.412200.0000.033NO2 and NO3mg/l0.41220.000Automatically filled from calculated RWQOs (Report tab)NO3mg/lAutomatically filled from present water quality (Input tab)Calculated by Model based on input dataAutomatically filled from calculated 0.033P04mg/l0.4120.0000.033SARmmol/l0.4120.033Sodiummg/l0.4120.033SO4mg/l0.4120.033Sulphide (H2S)mg/l0.4120.033TDSmg/l0.4120.033	Fluoride	mg/l	2.3	0.000	0.412	1.500	0.033
NO2 and NO3mg/l0.41220.000Automatically filled from calculated RWQOS (Report tab)NO3mg/lAutomatically filled from present water quality (Input tab)Calculated by Model based on input dataAutomatically filled from calculated 0.033P04mg/l0.4120.033P04mg/l0.4120.033SARmmol/l0.4120.033Sodiummg/l0.4120.033SO4mg/l0.4120.033Sulphide (H2S)mg/l0.4120.033TDSmg/l0.4120.033	Magnesium	mg/l	68.7	4,229.900	0.412	200.000	0.033
NO3 (NO3-N)mg1Automatically filled from calculated by Model based on input dataAutomatically filled from calculated RWQOS (Report tab)NO2mg1Automatically filled from present water quality (Input tab)0.4120.033P04mg10.4120.033SARmm01/0.4120.033Sodiummg10.4120.033SO4mg10.4120.033Sulphide (H2S)mg10.4120.033TDSmg10.4120.033	NO2 and NO3	mg/l	N		0.412	20.000	
NO3mg1Calculated by Model based on input datafrom calculated RWQOs (Report tab)NO2mg1Automatically filled from present water quality (Input tab)Model based on input data0.033P04mg10.4120.003SARmmol/I0.4120.033Sodiummg10.4120.033SO4mg10.4120.033Sulphide (H2S)mg10.4120.033TDSmg10.4120.033	NO3 (NO3-N)	mg/l			culated by	Automa	atically filled
NO2 mg1 Automatically filled from present water quality (Input tab) Intervention of table of table input data RVVQOS (Report tab) TIN mg1 from present water quality (Input tab) 0.412 0.003 P04 mg1 0.412 0.003 SAR mm0/I 0.412 15.000 0.033 Sodium mg1 0.412 15.000 0.033 Sodium mg1 0.412 15.000 0.033 Soluphide (H2S) mg1 0.013 0.412 0.033 TDS mg1 0.013 0.412 0.033	NO3	mg/l		Mod	el based on	Trom DW/OO	calculated
mg/ from present water quality (Input tab) input data 0.033 Potassium mg/ quality (Input tab) 0.412 100.000 0.033 PO4 mg/ 0.412 0.013 0.412 0.033 SAR mmol/ 0.412 15.000 0.033 Sodium mg/ 0.412 15.000 0.033 SO4 mg/ 0.412 90.000 0.033 Sulphide (H2S) mg/ 0.412 0.412 0.033 TDS mg/ 0.013 0.412 0.000 0.033	NO2	mg/l	Automatically	filled in	nut data	RWQUS	(Report tab)
Potassium mg/l quality (input tab) 0.412 100.000 0.033 PO4 mg/l 0.412 0.033 0.432 0.033 SAR mmol/l 0.412 15.000 0.033 Sodium mg/l 0.412 15.000 0.033 SO4 mg/l 0.412 15.000 0.033 SUphide (H2S) mg/l 0.412 0.412 0.033 TDS mg/l 0.412 450.000 0.033	TIN	mg/l	from present	water "	puruuu		0.033
PO4 mg/l 0.412 0.033 SAR mmol/l 0.412 15.000 0.033 Sodium mg/l 0.412 15.000 0.033 SO4 mg/l 0.412 90.000 0.033 Sulphide (H2S) mg/l 0.412 0.412 0.033 TDS mg/l 0.000 0.033	Potassium	mg/l	quality (Input	t tab)	0.412	100.000	0.033
SAR mmol/l 0.412 15.000 0.033 Sodium mg/l 0.412 115.000 0.033 SO4 mg/l 0.412 90.000 0.033 Sulphide (H2S) mg/l 0.412 0.013 0.033 TDS mg/l 0.412 450.000 0.033	PO4	mg/l			0.412		0.033
Sodium mg/l 0.412 115.000 0.033 SO4 mg/l 0.412 90.000 0.033 Sulphide (H2S) mg/l 0.412 0.013 0.033 TDS mg/l 0.412 450.000 0.033	SAR	mmol/l			0.412	15.000	0.033
SO4 mg/l 0.412 90.000 0.033 Sulphide (H2S) mg/l 0.412 0.033 TDS mg/l 0.412 450.000 0.033	Sodium	mgA			0.412	115.000	0.033
Sulphide (H2S) mg/l 0.033 TDS mg/l 0.412 0.033	S04	mg/l	16- 20-		0.412	90.000	0.033
TDS mg/ 0.412/450.000 0.033	Sulphide (H2S)	mgA			0.412		0.033
	TDS	mg/			0.412	450.000	0.033





Effluent Concentration (Cw)

The Effluent Concentration (Cw) calculated in the Model is the total allocatable effluent quality – this may be assigned to a single user or to multiple users. It is up to the user to determine how the effluent concentration will be assigned within a catchment or river reach.

Report

Having entered all of the necessary data into the input screen, the user may view the results in the 'Report' tab. The report provides a:

(1) review of the present and reference water quality, and

(2) results of:

- RWQOs;
- Resource stress;,
- The allocatable water quality and associated confidence; and
- The allocatable loads.

≝ Resource wat Eile <u>T</u> ools <u>H</u> elp	er Q	uanty	Objec	tives				-					
Introduction Input	Bes	TAEMC	Refere	ences	Monthly-I	Flow	End-of-F	Pipe F	Report				
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Parameters of Concern

For the RWQOs of a particular variable to appear in the 'Report' tab, that variable must have been selected in the 'Input' tab as a parameter of concern. This should be done by \swarrow the required variable.



The Model determines the RWQOs by selecting the lowest or most sensitive water quality, for each variable of concern, for each selected water user (existing and future). The water quality requirements are extracted from entered water quality data (Reserve, International Obligations, Strategic Use) and default SA Water Quality Guideline data.



How is Stress determined by the Model? The stress of the resource is the difference between the proposed RWQOs and the present water quality.

RWQOs > Present = unstressed (water quality available for allocation) RWQOs < Present = stressed (no water quality available for allocation)



Saving and Exporting the results

Reports that have been generated for a project can be saved or printed, allowing users to modify input criteria and assess the impact of these changes on the resultant RWQOs.

The results can be exported as either 'tab delimited text' or in 'comma separated format'. The 'tab delimited text' option allows users to open the report in e.g. Notepad, MS Word, WordPerfect, while the 'comma separated format' allows users to open the report in e.g. MS Excel.

To export or save the report, go to >> File >> Save Report. Select either 'As tab delimited text' or 'In comma separated format'.

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7. Data requirements

To determine RWQOs, the Model requires the following input data:

- Ecological category from a Reserve or Best AEMC
- Management Class from a catchment visioning exercise
- Target flows from Reserve output *.rul files
- Existing and future water users within the water resource management unit
- Present water quality 5th and 95th percentiles
- Reference water quality 5th and 95th percentiles

8. References

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ISBN No. 0-621-3675-8 RP185/2006