

DEPARTMENT OF WATER AND SANITATION

NO. 356

13 APRIL 2017

**NATIONAL WATER ACT, 1998
(ACT NO 36 OF 1998)**

**PROPOSED RESERVE DETERMINATION OF WATER RESOURCES FOR THE
OLIFANTS-DOORN CATCHMENTS**

I, Nomvula Paula Mokonyane, in my capacity as Minister of Water and Sanitation, having complied with section 13 of the National Water Act, 1998 (Act No. 36 of 1998) ("the Act") and Regulation 3 of the Regulations for the Establishment of Water Resource Classification System (No. R. 810 Government Gazette No. 33541, 17 September 2010), and duly authorised in terms of section 16(1) of the Act, hereby publish, for public comment in accordance with section 16(3) of the Act, the proposed Reserve determination of water resources for catchments of the Olifants-Doorn, as set out in the Schedule to this Notice.

Any person who wishes to submit written comments with regard to the proposed Reserve determination should submit the comments within 60 days from the date of publication of this Notice to:

Director: Reserve Determination
Attention: Mr Yakeen Atwaru
Department of Water and Sanitation
Ndinaye Building 185 Francis Baard Street
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Pretoria
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Email: atwaruy@dws.gov.za



**MRS NP MOKONYANE
MINISTER OF WATER AND SANITATION**

DATE: 31.01.2017

RESERVE DETERMINATION OF WATER RESOURCES FOR THE CATCHMENTS OF THE OLIFANTS-DOORN IN TERMS OF SECTION 16(1) AND (2) OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

SCHEDULE

1. DESCRIPTION OF WATER RESOURCE

- 1.1 The Reserve is determined for all or part of every significant water resource within the catchments of the Olifants-Doorn as set out below:

Water Management Area:	Olifants-Doorn
Drainage Regions:	E Primary Drainage Region
Rivers:	Olifants -Doorn River System
Estuary:	Olifants

- 1.2 The Minister has in terms of section 12 of the National Water Act, 1998 (Act No.36 of 1998) ("the Act"), prescribed a system for classifying water resources by issuing Government Notice No. R. 810, published in Government Gazette No. 33541 dated 17 September 2010. In terms of section 16(1) of the Act, the Minister must, as soon as reasonably practicable after the class of all or part of a water resource has been determined, by Notice in the Gazette, determine the reserve for all or part of that water resource.

- 1.3 The Minister, in terms of section 16(3) of the Act, proposes, for the purpose of section 16(1) of the Act, the following Reserves for the catchments of Olifants-Doorn.

2. PROPOSED RESERVE DETERMINATION AS REQUIRED IN TERMS OF SECTION 16(1) AND (2) OF THE NATIONAL WATER ACT, 1998

A selected list of Acronyms and definitions set out under item 1.

A summary of the quantity component for the Rivers which include the EWR and the BHN in terms of section 16(1) of the Act for the Olifants-Doorn catchments is set out in Table 2.1.

A summary of the quality component for the River at EWR sites in terms of section 16(1) of the Act for the Olifants-Doorn catchments is set out in Table 3.1-3.6.

A summary of the EWR based on the natural flow contribution of the catchments upstream Olifants River Estuary in terms of section 16(1) of the Act for the Olifants-Doorn catchments is set out in Table 4.1-4.3.

A summary of the groundwater contribution to the Reserve for Water Quantity & Quality in terms of section 16(1) of the Act for the Olifants-Doom catchments is set out in Table 5.1-6.2.

The Reserve will apply from the date signed off as determined in terms of Section 16(1) of the Act , unless otherwise specified by the Minister.

1. ACRONYMS AND DEFINITIONS

1.1. Acronyms

BHN	Basic Human Needs
EcoSpecs	Ecological Specifications
EIS	Ecological Importance and Sensitivity
EWR	Ecological Water Requirement
GRAII	Groundwater Resource Assessment Phase II
GRDM	Groundwater Reserve Determination Methodology
GRUs	Groundwater Resource Units
MAR	Mean Annual Runoff
MCM	Million Cubic Metres
PES	Present Ecological Status
REC	Recommended Ecological Category
TEC	Target Ecological Category
TPCs	Thresholds of Potential Concern

1.2. Definitions

Baseflow is a sustained low flow in rivers during dry or fair weather conditions, but not necessarily all contributed by groundwater; includes contribution from delayed interflow and groundwater discharge.

EWR refers to the flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition.

Recharge the addition of water to the zone of saturation, either by downward percolation of precipitation or surface water and/ or the lateral migration of groundwater from adjacent aquifers.

Reserve the quantity and quality of the water required to satisfy the basic human needs by securing a basic water supply and to protect the aquatic ecosystem in order to secure ecologically sustainable development and use of the relevant water resource.

2. SURFACE-WATER - QUANTITY COMPONENT FOR RIVERS

Proposed results for the Reserve determination and ecological categorisation for the Olifants-Doring River System, where the Reserve amounts are expressed as a percentage of the MAR for the respective catchments (cumulative) in terms of section (16)(1).

Table 2.1: Summary of the quantity component for the Rivers which include the EWR & BHN.

Quaternary catchment	Water Resource	PES	EIS	REC	Ecological reserve (cumulative) (% MAR)	Basic human needs Reserve (% MAR)	MAR (MCM)	Total Reserve (%MAR)
E10A	Olifants	C	High	C	43.58	0.00	60.475	43.58
E10B	Olifants	C	High	C	44.26	0.01	129.003	44.27
E10C	Olifants	B	Very high	B	51.09	0.00	182.405	51.09
E10D	Olifants	C	Moderate	D	52.38	0.00	233.767	52.38
E10E	Olifants	C	Moderate	D	37.77	0.4	293.467	38.17
E10F (EWR 1)	Olifants	D	Moderate	D	37.77	0.03	355.557	37.8
E10G	Olifants	C	Moderate	D	26.59	0.03	437.273	26.62
E10G (EWR 3)	Rondegat	B	Moderate	B	42.75	0.03	7.411	42.78
E10H	Jan Dissels	D	Moderate	C	19.70	0.00	44.686	19.70
E10J& E10J (Q7)	Olifants	D	Moderate	D	14.90*	0.154	46.205*	15.054
E10K (EWR 2)**	Olifants	E	Moderate	E	9.32	0.00	505.716	9.32
E21A	Kruis	E	Low	C	41.98	0.07	39.425	42.05
E21B	Welgemoed	D	Low	D	23.56	0.161	1.230	23.72
E21C	Winkelhaak	D	Low	C	19.48	0.00	41.939	19.48
E21D	Houdenbeks	D	Low	D	27.72	0.092	50.217	27.81
E21E	Riet	B	Low	B	29.13	0.008	93.772	29.14
E21F	Riet	A/B	Low	B	21.72	0.00	95.862	21.72
E21G	Groot/ Leeu	D	Low	D	38.55	0.04	55.220	38.59
E21H	Twee	A/B	Low	B	70.21*	0.00	55.055*	70.21
E21H	Leeu	A/B	Low	B	64.3	0.00	138.715	64.3
E21J (EWR	Groot	B	Low	B	50.65	0.00	140.463	50.65

Quaternary catchment	Water Resource	PES	EIS	REC	Ecological reserve (cumulative) (% MAR)	Basic human needs Reserve (% MAR)	MAR (MCM)	Total Reserve (%MAR)
E21K	Maatjies	B	Low	B	62.86	0.00	1.819	68.86
E21L	Groot	B	Low	B	50.02	0.00	239.220	50.02
E22A	Doring	A/B	Low	B	47.5	0.012	4.138	47.512
E22B	Doring	B	Low	B	43.1	0.002	7.66	43.10
E22C	Tankwa	C	Low	A/B	47.47	0.984	2.704	48.45
E22D	Tankwa	A/B	Low	A/B	31.93	0.027	5.44	31.957
E22E	Doring	B	Low	B	43.11	0.0004	18.688	43.11
E22F	Doring	B	Low	B	43.11	0.00	20.894	43.11
E22G	Doring	B	Very high	B	50.42	0.00	266.606	50.42
E23A	Tankwa	A/B	Low	A/B	32.42	0.00	8.001	32.42
E23B	Tankwa	A/B	Low	A/B	32.42	0.00	15.403	32.42
E23C	Tankwa	A/B	Low	A/B	32.42	0.00	3.339	32.42
E23D	Tankwa	A/B	Low	A/B	32.42	0.00	26.617	32.24
E23E	Tankwa	A/B	Low	A/B	32.42	0.00	5.922	32.24
E23F	Tankwa	C	Low	B	26.38	0.00	37.503	26.38
E23G	Ongeluks	A/B	Low	A/B	32.42	0.018	7.844	32.44
E23H	Ongeluks	A/B	Low	A/B	32.42	0.00	69.30	32.42
E23J	Ongeluks	A/B	Low	A/B	32.42	0.00	61.673	32.42
E23K	Tankwa	B	Low	B	26.38	0.00	105.182	26.38
E24A	Tra-tra	B	Low	B	73.6	0.316	4.523	73.92
E24B	Tra-tra	B	Low	B	63.19	0.0324	12.803	63.22
E24C	Bos	B	Low	C	32.55	0.00	13.855	32.55
E24D	Bos	C	Low	C	17.71	0.00	31.475	17.71
E24E	Wolf	A/B	Low	A/B	32.54	0.00	11.855	32.54
E24F	Wolf	A/B	Low	A/B	32.54	0.00	22.140	32.54
E24G	Wolf	A/B	Low	A/B	32.54	0.00	33.327	32.54
E24H (EWR 4)	Doring	A/B	High	B	44.99	0.0098	420.425	44.99

Quaternary catchment	Water Resource	PES	EIS	REC	Ecological reserve (cumulative) (% MAR)	Basic human needs Reserve (% MAR)	MAR (MCM)	Total Reserve (%MAR)
E24J	Doring	B	High	B	48.47	0.00	439.475	48.47
E24K(EWR 5)	Doring	A/B	High	B	48.47	0.00	450.996	48.47
E24L	Brandewyn (Doringmain stem)	B	High	B	50.29	0.00	508.227	50.29
E24M	Doring	B	High	B	50.33	0.00	517.577	50.33
E31A-Q2	Sa raip se Laagte	B	Moderate	B	26.12	0.00	3.091	26.12
E31B	Kromme	B	Moderate	B	25.66	0.00	0.978	25.66
E31C	Kromme	B	Moderate	B	25.66	0.00	2.012	25.66
E31D	Kromme	B	Moderate	B	25.66	0.00	2.556	25.66
E31E	Kromme	B	Moderate	B	25.66	0.00	2.880	25.66
E31F	Hantams	B	Moderate	B	25.62	7.654	0.324	33.27
E31G	Kromme	B	Moderate	B	25.65	0.00	0.814	25.65
E31H	Hantams	B	Moderate	B	25.65	0.00	4.506	25.65
E32A	Kromme	B	Moderate	B	17.30	0.00	0.681	17.30
E32B	Hantams	B	Moderate	B	26.23	0.00	7.018	26.23
E32C	Hantams	B	Moderate	B	26.23	0.00	9.320	26.23
E32D	Hantams	B	Moderate	B	26.22	0.00	11.544	26.22
E32E	Hantams	B	Moderate	B	26.22	0.00	15.148	26.22
E33A	Sout	B	Moderate	C	26.03	0.017	20.579	26.05
E33B	Sout	C	Moderate	C	17.40	0.00	21.273	17.40
E33C	Vars	D	Moderate	C	17.04	0.327	1.009	17.37
E33D	Geelbek	C	Moderate	C	17.09	0.00	1.590	17.09
E33E	Sout	C	Moderate	C	17.39	0.023	25.197	17.413
E33F-Q1	Troe-troe	D	Moderate	D	11.22	1.366	4.530	12.586
E33G	Olifants	D	Moderate	D	12.14	0.032	1028.771	12.172
E33H	Olifants	D	Moderate	D	12.97	0.0102	1054.724	12.98
E40A	Oorlogskloof	C	Moderate	C	41.51	0.00	16.631	41.51
E40B	Oorlogskloof	C	Moderate	C	41.53	0.387	29.125	41.92

Quaternary catchment	Water Resource	PES	EIS	REC	Ecological reserve (cumulative) (% MAR)	Basic human needs Reserve (% MAR)	MAR (MCM)	Total Reserve (%MAR)
E40C	Oorlogskloof	C	High	C	51.84	0.042	38.491	51.882
E40D	Koebee	C	High	B	56.69	0.00	48.104	56.69
F60A	Brak		Moderate	B	26.33	5.223	0.201	31.55
F60B	Klein-Goerap	B	Moderate	B	26.37	4.89	0.174	31.26
F60C	Sout	B	Moderate	B	26.97	0.789	0.519	27.76
F60D	Sout	B	Moderate	B	27.07	0.00	0.799	27.07
F60E	Groot-goerap	B	Moderate	B	25.38	1.018	0.055	26.40

Where: MAR is the Mean Annual Runoff

MCM is million cubic metres

*Incremental ecological requirement

**In terms of the RDM guidelines the Ecostatus Category should not be less than D (DWAF 1999)

3. SURFACE-WATER - QUALITY COMPONENT FOR RIVERS

Summary of the Quality component at EWR sites

Table 3.1. Ecospecs and TPCs for RU4-Olifants, as represented by EWR Site 1 (RU 4: CITRUSDAL TO CLANWILLIAM DAM)

DESCRIPTORS USED FOR ECOSPECS	TPCs
Water Quality	
<i>Salts</i>	
MgSO ₄ (mg/l)	>37
Na ₂ SO ₄ (mg/l)	>51
MgCl ₂ (mg/l)	>51
CaCl ₂	>105
NaCl (mg/l)	>389
Water temperature	Not specified.
pH	<6.5 – >9.0
EC (mS/m)	>15
DO (mg/l)	< 6.0
<i>Toxics</i>	
Ammonia as NH ₃ (mg/l)	>0.007
<i>Nutrients</i>	
Nitrates as N (mg/l)	>0.100
Phosphorous as PO ₄ -P(mg/l)	>0.020
Aquatic Invertebrates	
SASS5 Score	<100
ASPT	<7.5
Ephemeroptera: Baetidae	Fewer than 4 species present overall at site
Ephemeroptera: Leptophlebiidae	Absent from > 50% of samples
Ephemeroptera: Heptageniidae	Absent from SIC/SOC biotope in summer
Coleoptera and Trichoptera	Fewer than 3 families present
Odonata	Fewer than 1 family present in any sample
Plecoptera: Notonemouridae	Absent from > 50% of samples in SIC
Aquatic vegetation and SIC	Absent

Table 3.2. Ecospecs and TPCs for RU6-Olifants, as represented by EWR Site 2 (RU 6: BULSHOEK BARRAGE TO THE CONFLUENCE WITH THE DORING RIVER)

DESCRIPTORS USED FOR ECOSPECS	TPCs
Water Quality	
<i>Salts</i>	
MgSO ₄ (mg/l)	>37
Na ₂ SO ₄ (mg/l)	>51
MgCl ₂ (mg/l)	>51
CaCl ₂	>105
NaCl (mg/l)	>389
Water temperature	Not specified
pH	<6.5 – >9.0
EC (mS/m)	>25
DO (mg/l)	< 6.0
<i>Toxics</i>	
Ammonia as NH ₃ (mg/l)	>0.007
<i>Nutrients</i>	
Nitrates as N (mg/l)	>0.100
Phosphorous as PO ₄ -P (mg/l)	>0.015
Aquatic Invertebrates	
SASS5 Score	< 30
ASPT	< 4.5
Ephemeroptera: Baetidae	Absent from > 50% of samples
Hemiptera and Odonata	Fewer than two families from each order

Table 3.3. RONDEGAT RIVER - EWR SITE 3.

DESCRIPTORS USED FOR ECOSPECS	TPCs
Water Quality	
<i>Salts</i>	
MgSO ₄ (mg/l)	>23
Na ₂ SO ₄ (mg/l)	>33
MgCl ₂ (mg/l)	>30
CaCl ₂	>57
NaCl (mg/l)	>191
Water temperature	Not specified (no identified temperature dependencies for biota in this reach)
pH	<5.2 or >7.0
EC (mS/m)	>10
DO (mg/l)	< 6.0
<i>Toxics</i>	
Ammonia as NH ₃ (mg/l)	>0.007
<i>Nutrients</i>	
Nitrates as N (mg/l)	>0.020
Phosphorous as PO ₄ -P (mg/l)	>0.010
Aquatic Invertebrates	
SASS5 Score	< 170
ASPT	< 7.5
Ephemeroptera: Baetidae	Fewer than 7 species present overall at site (all biotopes combined)

DESCRIPTORS USED FOR ECOSPECS	TPCs
<i>Demoreptus capensis</i>	Absent in summer
Trichoptera	Fewer than 5 species present overall at site, representing at least two of the following families: Barbarochthonidae, Leptoceridae, Petrothrincidae, Sericostomatidae
Ephemeroptera: Leptophlebiidae	Present in less than 80% of samples (cumulative for site, taken over time)
Ephemeroptera: Heptageniidae	Fewer than Baetidae in summer samples
Coleoptera	Fewer than 3 families present
Blephariceridae and Notonemouridae	Absent in winter
Aquatic Vegetation (in and out of current); Submerged Vegetation; SIC	Habitats absent

Table 3.4. Ecospeps and TPCs for the RU4-Doring River, as represented by EWR Site 4. (RU 4: TANKWA/DORING RIVER CONFLUENCE TO DORINGBOS)

DESCRIPTORS USED FOR ECOSPECS	TPCs
Water Quality	
Salts	
MgSO ₄ (mg/l)	<23
Na ₂ SO ₄ (mg/l)	<33
MgCl ₂ (mg/l)	<30
CaCl ₂	<57
NaCl (mg/l)	<191
Water temperature	Adult fish: maximum daily mean = 40 °C (all year). Spawning: Minimum = 19 °C, ideal = 25-28 °C (November to January).
pH	6.5 – 8.5
EC (mS/m)	<20
DO (mg/l)	> 6.0
Toxics	
Ammonia as NH ₃ (mg/l)	<0.007
Nutrients	
Nitrates as N (mg/l)	<0.020
Phosphorous as PO ₄ -P (mg/l)	<0.020
Aquatic Invertebrates	
SASS5 Score	< 125
ASPT	< 6
Trichoptera: Ecnomidae, Philopotamidae (winter), Hydropsychidae, Hydroptilidae	Fewer than two taxa present
Ephemeroptera: Leptophlebiidae	Absent from > 20% of samples
Diptera: Simuliidae	Absent from > 50% of SIC samples
Aquatic Vegetation (out of current); Submerged Vegetation; SIC	Absent

Table 3.5. Ecospecs and TPCs for the RU5-Doring River, as represented by EWR Site 5. (RU 5: DORINGBOS TO OLIFANTS/DORING CONFLUENCE)

DESCRIPTORS USED FOR ECOSPECS	TPCs
Water Quality	
<i>Salts</i>	
MgSO ₄ (mg/l)	> 23
Na ₂ SO ₄ (mg/l)	> 33
MgCl ₂ (mg/l)	> 30
CaCl ₂	> 57
NaCl (mg/l)	> 191
Water temperature	Adult fish: maximum daily mean = 40 °C (all year). Spawning: Minimum = 19 °C, ideal = 25-28 °C (November to January).
pH	< 6.5 or > 8.5
EC (mS/m)	> 50
DO (mg/l)	< 6.0
<i>Toxics</i>	
Ammonia as NH ₃ (mg/l)	> 0.007
<i>Nutrients</i>	
Nitrates as N (mg/l)	> 0.020
Phosphorous as PO ₄ -P (mg/l)	> 0.020
Aquatic Invertebrates	
SASS5 Score	< 125
ASPT	< 6
Trichoptera: Ecnomidae, Philopotamidae (winter), Hydropsychidae, Hydroptilidae	Fewer than two taxa present
Ephemeroptera: Leptophlebiidae	Absent from > 20% of samples (cumulative for site, taken over time)
Diptera: Simuliidae	Absent from > 50% of SIC samples
Aquatic Vegetation (out of current); Submerged Vegetation; SIC	Habitats absent

Table 3.6. Ecospecs and TPCs for the RU2-Groot River, as represented by EWR Site 6. (RU 2: GROOT RIVER GORGE)

DESCRIPTORS USED FOR ECOSPECS	TPCs
Water Quality	
<i>Salts</i>	
MgSO ₄ (mg/l)	> 23
Na ₂ SO ₄ (mg/l)	> 33
MgCl ₂ (mg/l)	> 30
CaCl ₂	> 57
NaCl (mg/l)	> 191
Water temperature	Adult fish: maximum daily mean = 40 °C (all year). Spawning: Minimum = 19 °C, ideal = 25-28 °C (November to January).
pH	< 6.5 OR > 8.5
EC (mg/l)	> 20
DO (mg/l)	< 6.0
<i>Toxics</i>	

DESCRIPTORS USED FOR ECOSPECS	TPCs
Ammonia as NH_3 (mg/l)	> 0.007
<i>Nutrients</i>	
Nitrates as N (mg/l)	> 0.020
Phosphorous as $\text{PO}_4\text{-P}$ (mg/l)	> 0.020
<i>Aquatic Invertebrates</i>	
SASS5 Score	< 170
ASPT	< 7.5
Trichoptera: Ecnomidae, Philopotamidae (winter), Hydropsychidae, Hydroptilidae	At least 3 families of cased caddis present overall at site, with at least two of the following families: - Ecnomidae - Leptoceridae - Philopotamidae - Sericostomatidae
Ephemeroptera: Leptophlebiidae	Absent from > 10% of samples
Ephemeroptera: Heptageniidae	Absent from > 20% of samples
Megaloptera: Corydalidae	Absent from > 40% of samples
Coleoptera	< 3 families
Stones-in-current, including fast-flowing, turbulent riffle and run	Absent

4. Estuary component

Geographical boundaries of the Olifants Estuary

Downstream boundary: Estuary mouth (31° 42.00'S; 18°11.34'E).
 Upstream boundary: Extent of tidal influence, i.e. the causeway at Lutzville - about 36 km from the mouth (31°33.80'S; 18°19.78'E).
 Lateral boundaries: 5 m contour above Mean Sea Level (MSL) along each bank.

Table 4.1. The ecological water requirements of the Olifants Estuary.

Quaternary catchment	Water Resource	PES	EIS	REC	Ecological reserve (% MAR)	MAR (MCM)	Total Reserve (%MAR)
E33H Estuary	Olifants	C	Very high	B	56	1055	56

QUANTIFICATION OF ESTUARINE ECOLOGICAL RESERVE

RECOMMENDED ECOLOGICAL FLOW REQUIREMENT

The Olifants Estuary has been targeted as a Desired Protected Area (DWAF, 2004). According to the guidelines for assigning a recommended REC the estuary, therefore needs to be in a Category A or the Best Attainable State (BAS). However, with large dam developments already existing in the catchment (e.g. Clanwilliam Dam) it will be difficult to improve the Olifants Estuary to a Category of A. It is therefore recommended that the Olifants Estuary be improved to the minimum REC for a 'Highly Important estuary', namely a **Category B. Scenario 2**, i.e. the Present inflow scenario plus the Ecological Water Requirement releases of the River (MAR = $800.3 \times 10^6 \text{ m}^3$) is selected as the recommended Ecological Flow Requirement Scenario for the Olifants Estuary. The flow distributions are summarised below:

Table 4.2. Flow distribution for Scenario 2.

Percentiles	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
99%ile	48.13	32.08	21.50	37.21	24.46	7.77	96.73	194.20	550.92	472.06	230.02	153.70
90%ile	28.90	9.60	7.24	3.64	3.76	3.85	9.62	80.90	151.71	159.08	126.25	65.58
80%ile	16.05	4.30	2.06	1.75	1.68	2.21	4.85	22.01	93.83	104.19	79.44	48.08
70%ile	12.84	2.93	1.68	1.55	1.38	1.81	3.07	11.18	57.99	78.10	66.22	34.22
60%ile	11.49	2.93	1.51	1.51	1.37	1.46	2.88	8.24	42.45	58.26	50.45	25.66
50%ile	10.11	2.93	1.50	1.51	1.34	1.42	2.84	6.19	37.99	51.82	47.54	22.18
40%ile	9.01	2.49	1.50	1.51	1.34	1.42	2.49	3.57	36.22	39.92	44.77	16.34
30%ile	8.32	1.51	1.50	1.51	1.34	1.42	1.76	3.42	24.20	30.79	33.23	14.73
20%ile	6.36	1.43	1.18	1.51	0.91	1.11	1.41	2.05	15.78	21.17	28.07	11.21
10%ile	4.02	0.83	0.58	0.99	0.85	1.00	1.28	1.15	7.44	9.49	17.41	9.66
1%ile	1.01	0.15	0.00	0.99	0.34	0.00	0.04	0.29	0.82	2.07	5.35	4.04

ECOLOGICAL SPECIFICATIONS

Ecological Specifications are clear and measurable specifications of ecological attributes (in the case of estuaries - hydrodynamics, sediment dynamics, water quality and different biotic components) that define a specific ecological reserve category, in the case of the Olifants Estuary for a **Category B**. Thresholds of potential concern (TPC) are defined as measurable end points related to specific abiotic or biotic indicators that if reached (or when modelling predicts that such points will be reached) prompts management action.

Table 4.3. The ecological specifications and associated TPCs

COMPONENT	ECOLOGICAL SPECIFICATION/	THRESHOLD OF POTENTIAL CONCERN
Birds	Retain the species richness, abundance and diversity of the bird community, representative of resident and migrant waders, wading birds and water fowl as under the Present State, except for that there would be an higher abundance of water fowl (increasing by about 10% from Present State numbers)	<p>1.1 Community composition or bird numbers deviates by more than 50% of average seasonal baseline counts for two consecutive summer or winter seasons, focusing on waders, wading birds, terns & water fowl (summer and winter), and specifically red data species which are supported by the system (e.g. Pelican, Oyster catchers, Chestnut banded plover)</p> <p>1.2 In the case of water fowl densities decline by 20% of average seasonal baseline counts for two consecutive summer or winter seasons</p>
Fish	Retain the following fish assemblages in the estuary: estuarine species (35%), partially estuarine dependent species (50-60%), obligate estuarine dependent (e.g. white steenbras) (>1%) and indigenous freshwater species (>1%). Exotic freshwater species (<0.5%)	<p>2.1 Level of estuarine species drop below 30% of total abundance</p> <p>2.2 Levels of obligate estuarine dependent species drop below 1% of total abundance</p> <p>2.3 Levels of partially estuarine dependent species drop below 50% or above 60% of total abundance</p> <p>2.4 Levels of exotic freshwater species above 0.5% (e.g. Mozambique tilapia out-competing resident species)</p> <p>2.5 Benthic dwellers species drop below 2% of total abundance in estuary above 18 km from the mouth</p>
	Maintain recruitment of adult and juvenile fish at Reference Condition levels. This requires maintaining sufficient flow for freshwater plume (temperature, salinity and oliphactory gradient) entering the sea. This implies that there should be a significant number of 0 -1 year old fish and no missing year classes.	2.6 There are a missing year class within a species

COMPONENT	ECOLOGICAL SPECIFICATION/	THRESHOLD OF POTENTIAL CONCERN
Invertebrates	Retain Present State species richness and mix (low species abundance, high dominance). However, under the present state one or two species are always present at high densities compared to others (e.g. <i>Pseudodiaptomus hessei</i> & <i>Ceratonereis keiskama</i>). For a B Category the higher densities need to be more variable in abundance during the year.	3.1 Species richness is greater than 30 for zooplankton and macroinvertebrates respectively (50% increase)
	Indicator species such as <i>Capitella capitata</i> , should not dominate benthic species at any site	3.2 <i>Capitella capitata</i> exceeds 50% abundance of benthic species at any site
	<i>Calianassa</i> and <i>Upogebia</i> distribution patterns as under Present State	3.3 Abundance levels or areas of distribution decreases by more than 50% (mainly lower sandy reaches)
Macrophytes	Maintain the present distribution (summer 2004) and abundance of the different plant community types (<i>Zostera capensis</i> (48 ha), intertidal salt marsh (92 ha), supratidal salt marsh (143 ha), floodplain salt marsh (797 ha), reeds and sedges (60 ha))	4.1 Greater than 20% change in the area covered by different plant community types
	Reduce the areas covered by water weeds in the upper reaches by 50% compared to the Present State (summer 2004). Therefore area covered by invasive waterweeds (<i>Azolla filiculoides</i>), nuisance filamentous algae (e.g. <i>Enteromorpha</i> , <i>Ulva</i> , <i>Cladophora</i>) and pondweed (<i>Potamogeton pectinatus</i>) should be 30 ha (half of channel)	4.2 Upper 15 km of estuary with greater than 50% of estuary water channel covered by invasive waterweeds (<i>Azolla filiculoides</i>), nuisance filamentous algae (e.g. <i>Enteromorpha</i> , <i>Ulva</i> , <i>Cladophora</i>) and pondweed (<i>Potamogeton pectinatus</i>).
	Control the spread of invasive aliens in the riparian zone (e.g. <i>Sesbania punicea</i> and <i>Eucalyptus</i> spp.).	4.3 Greater than 20 % increase in area covered by invasive plants.
	Maintain reed and sedge areas (60 ha) and brackish salt marsh (~10 ha) as for the Present State (summer 2004) (by preventing salinity of 20 ppt to move further upstream than 8.5 km and remain there for greater than 3 months).	4.4 Dieback of reeds and brackish salt marsh at 8.5 km and further upstream from the mouth.
	Prevent an increase in bareground in the floodplain salt marsh by maintaining groundwater salinity at <70 ppt and depth to the water table at < 1.5 m	4.5 Greater than 20% increase in bare ground in salt marsh.

COMPONENT	ECOLOGICAL SPECIFICATION/	THRESHOLD OF POTENTIAL CONCERN
Microalgae	Maintain a low phytoplankton biomass with a small REI (i.e. 10 ppt to river +1 ppt) zone	5.1 Phytoplankton biomass exceeds 15 µg/l chlorophyll a in summer and 10 µg/l chlorophyll a in winter 5.2 Blue-green algae exceeds 10% of phytoplankton cell counts
	Maintain microalgal group diversity as measured under Present State (2004)	5.3 Flagellates cease to be the dominant group and diatoms become less diverse (<10 taxa per site)
	Maintain intertidal and subtidal microphytobenthic biomass as measured under Present State (2004).	5.4 Benthic microphytobenthic biomass exceeds 40 mg/m ² chlorophyll a
	Maintain a low frequency of dinoflagellates	5.5 The frequency of dinoflagellates exceeds 5% of the total phytoplankton counts
Water quality	Salinity intrusion should not to cause exceedence of TPCs for fish, invertebrates, macrophytes and microalgae (see above)	6.1 Salinity greater than 20 ppt for greater than 3 months at 7 km upstream from the mouth (brackish saltmarsh, reeds and sedges & invertebrates)
		6.2 Salinity of groundwater increases to 50 ppt and depth to water table to 1 m. (flood plain salt marsh)
		6.3 Total dissolved solids (measure of 'salinity') of river inflow exceeds 3500 mg/l (phytoplankton)
		6.4 Salinity in estuary exceeds 35 ppt (prevent hyper-salinity) (for phytoplankton)
		6.5 Salinity greater than 10 ppt occurs above 16 km upstream of the mouth (for fish)
	System variables (Temperature, pH, turbidity, dissolved oxygen, suspended solids and turbidity) not to cause exceedence of TPCs for biota (see above)	6.6 River inflow: Summer temp < 20°C pH < 6.5 'Turbid' river inflow (to be determined) Dissolved oxygen < 4 mg/l
		6.7 Secchi disc reading above 8 km from the mouth is greater than 1 m (used as a proxy for turbidity concentrations in estuary)
		6.8 pH > 8.5 or < 6.5 in river inflow or in estuary
		6.9 Water column DO drops below 4 mg/l (1 m above bottom except in deep holes) (need to investigate DO level at night in dense macrophyte beds)

COMPONENT	ECOLOGICAL SPECIFICATION/	THRESHOLD OF POTENTIAL CONCERN
	Inorganic nutrient concentrations not to cause exceedance of TPCs for macrophytes and microalgae (see above).	<p>6.10 When average river inflow is less than 5 m³/s and average DIN concentrations exceed 100 µg/l in river inflow and average DIN concentrations in the upper reaches of the estuary (above 16 km from mouth) exceed 100 µg/l.</p> <p>6.11 During high flow season (flows > 20 m³/s) average DIN concentrations exceed 500 µg/l in river inflow and average DIN concentrations in the upper reaches of the estuary (above 16 km from mouth) exceed 500 µg/l</p> <p>6.12 Average DRP concentrations exceed 100 µg/l in river inflow and average DRP concentrations in the upper reaches of the estuary (above 16 km from mouth) exceed 100 µg/l.</p>
	Presence of toxic substances not to cause exceedance of TPCs for biota (see above).	6.13 For pesticides/herbicides baseline studies still need to be undertaken before TPCs can be set (special concern in upper reaches with extensive agricultural activities along banks of estuary)
Hydrodynamics	Maintain a flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality	<p>7.1 River inflow distribution patterns differ by more than 5% from that of Scenario 2 (i.e. recommended flow scenario for the Olifants)</p> <p>7.2 River inflow decreases to below 1.5 m³/s at any time</p> <p>7.3 River inflow below 2 m³/s persists for longer than 4 months</p>
Sediment dynamics	Flood regime to maintain the sediment distribution patterns and aquatic habitat (instream physical habitat) so as not to exceed TPCs for biota (see above)	<p>8.1 River inflow distribution patterns (flood components) differ by more than 10% (in terms of magnitude, timing and variability) from that of the Present State (2004)</p> <p>8.2 Suspended sediment concentration from river inflow deviates by more than 10% of the sediment load discharge relationship to be determine as part of baseline studies (Present State 2004)</p>

COMPONENT	ECOLOGICAL SPECIFICATION/	THRESHOLD OF POTENTIAL CONCERN
	Changes in sediment grain size distribution patterns not to cause exceedance of TPCs in benthic invertebrates (see above).	<p>8.3 The median bed sediment diameter deviates by more than a factor of two from levels to be determined as part of baseline studies (Present State).</p> <p>8.4 Sand/mud distribution in middle reaches (8-20 km) change by more than 20% from Present State (2004)</p> <p>8.5 Changes in the channel bathymetry in the upper reaches (above 20 km upstream of the mouth) change by more than 20% from Present State (2004)</p> <p>8.6 Changes in tidal amplitude below the Lutzville causeway of more than 20% from Present State (2004)</p>

5. GROUNDWATER - QUANTITY COMPONENT

Groundwater recharge is an important component of hydrogeological characterisation as it has a major influence on groundwater quantity (especially if aquifer transmissivity and storage is favourable) and groundwater quality. Across the Olifants-Doom WMA groundwater recharge ranges from 0 mm/a to 245 mm/a. The highest groundwater recharge occurs in the Upper Olifants sub-area, especially in the Winterhoek mountain area. Significant recharge also occurs in the Koue Bokkeveld, eastern Doring, and eastern Sandveld sub-areas. For the remaining areas groundwater recharge is quite limited.

The basic human needs Reserve provides for the essential needs of individuals served by the water resource in question and includes water for drinking, food preparation and for personal hygiene. A life-line amount of 25 litres per person per day was used. A summary of the groundwater quantity aspects in terms of BHN and EWR per quaternary is provided in Table 4.1.

Table 5.1: Groundwater Reserve Determination Results – Quantity Component.

Quaternary catchment	Area (km ²)	Recharge (Mm ³ /a) ¹⁾	Population ²⁾	EWR (Mm ³ /a)	BHN (Mm ³ /a)	Total Reserve (Mm ³ /a)
E10A	134	30.12	0	5.44	0	5.44
E10B	202	37.17	1523	6.78	0.013	6.79
E10C	192	24.79	0	5.66	0	5.66
E10D	235	24.35	0	5.74	0	5.74
E10E	366	30.67	15 627	7.35	0.143	7.49
E10F	386	28.28	1184	5.13	0.011	5.14

Quaternary catchment	Area (km ²)	Recharge (Mm ³ /a) ¹⁾	Population ²⁾	EWR (Mm ³ /a)	BHN (Mm ³ /a)	Total Reserve (Mm ³ /a)
E10G	508	26.88	1799	4.21	0.016	4.23
E10H	162	9.62	0	1.51	0	1.51
E10J	468	19.32	7797	1.63	0.071	1.70
E10K	235	6.67	0	0.36	0.0	0.36
E21A	190	14.14	2818	1.48	0.026	1.51
E21B	223	8.87	217	0.01	0.002	0.01
E21C	233	8.7	0	0.07	0	0.07
E21D	242	18.21	5024	1.88	0.046	1.93
E21E	293	8.44	797	0.09	0.007	0.10
E21F	379	8.76	0	0.15	0	0.15
E21G	266	18.95	2458	2.07	0.022	2.09
E21H	404	31.2	0	16.66	0	16.66
E21J	317	16.07	0	0.32	0	0.32
E21K	330	11.62	0	0.18	0	0.18

Quaternary catchment	Area (km ²)	Recharge (Mm ³ /a) ¹⁾	Population ²⁾	EWR (Mm ³ /a)	BHN (Mm ³ /a)	Total Reserve (Mm ³ /a)
E21L	195	2.53	0	0.14	0	0.14
E22A	750	7.53	553	0.39	0.005	0.40
E22B	638	6.33	86	0.43	0.001	0.43
E22C	490	4.43	2919	0.33	0.027	0.36
E22D	496	4.21	16	0.26	0	0.26
E22E	1013	9.85	8	1.78	0	1.78
E22F	400	1.3	0	0.21	0	0.21
E22G	367	1.27	0	0.43	0	0.43
E23A	762	5.81	0	1.05	0	1.05
E23B	705	5.08	0	0.97	0	0.97
E23C	318	2.03	0	0.44	0	0.44
E23D	750	3.29	0	1.03	0	1.03
E23E	564	2.99	0	0.6	0	0.60
E23F	473	0.95	0	0.51	0	0.51
E23G	747	2.84	152	0.8	0.001	0.80
E23H	660	2.71	0	0.91	0	0.91
E23J	895	1.87	0	0.96	0	0.96
E23K	572	1.08	0	0.61	0	0.61
E24A	255	6.01	1568	0.47	0.014	0.48
E24B	468	5.09	455	0.86	0.004	0.86
E24C	784	3.68	0	0.75	0	0.75
E24D	997	1.77	0	0.96	0	0.96
E24E	671	2.74	0	1.58	0	1.58
E24F	582	2.23	0	1.07	0	1.07
E24G	633	2.2	0	1.16	0	1.16
E24H	483	0.92	0	0.56	0.004	0.56
E24J	1078	5.13	0	1.24	0	1.24
E24K	652	3.22	0	0.75	0	0.75
E24L	516	9.01	0	1.01	0	1.01

Quaternary catchment	Area (km ²)	Recharge (Mm ³ /a) ¹⁾	Population ²⁾	EWR (Mm ³ /a)	BHN (Mm ³ /a)	Total Reserve (Mm ³ /a)
E24M	529	8.41	0	0.71	0	0.71
E31A	2865	1.2	0	0.02	0	0.02
E31B	1476	2.23	0	0.09	0	0.09
E31C	1572	0.89	0	0.09	0	0.09
E31D	839	0.48	0	0.05	0	0.05
E31E	478	0.38	0	0.03	0	0.03
E31F	525	0.92	2716	0.03	0.025	0.05
E31G	1238	0.68	0	0.07	0	0.07
E31H	726	1.09	0	0.04	0	0.04
E32A	1118	4.63	0	0.4	0	0.40
E32B	828	1.52	0	0.3	0	0.30
E32C	638	2.9	0	0.23	0	0.23
E32D	616	1.08	0	0.22	0	0.22
E32E	1001	3.86	0	0.36	0	0.36
E33A	1355	1.84	394	0.08	0.004	0.08
E33B	702	0.8	0	0.06	0.0	0.06
E33C	980	1.37	366	0	0.003	0.00
E33D	1559	2.04	0	0.14	0	0.14
E33E	1282	1.59	632	0.06	0.006	0.07
E33F	725	15.87	7573	0.05	0.069	0.12
E33G	894	7.19	35 929	0	0.328	0.33
E33H	719	3.05	11 768	0.01	0.107	0.12
E40A	941	4.44	0	0.9	0	0.90
E40B	707	3.41	12 350	0.68	0.113	0.79
E40C	530	3.02	1771	0.11	0.016	0.13
E40D	544	3.09	0	1	0	1.00
F60A	572	0.43	116	0.02	0.001	0.02

Quaternary catchment	Area (km ²)	Recharge (Mm ³ /a) ¹⁾	Population ²⁾	EWR (Mm ³ /a)	BHN (Mm ³ /a)	Total Reserve (Mm ³ /a)
F60B	320	0.24	933	0.02	0.009	0.03
F60C	622	0.47	446	0.04	0.004	0.04

Quaternary catchment	Area (km ²)	Recharge (Mm ³ /a) ¹⁾	Population ²⁾	EWR (Mm ³ /a)	BHN (Mm ³ /a)	Total Reserve (Mm ³ /a)
F60D	481	0.36	0	0.03	0	0.03
F60E	795	0.6	61	0.01	0.001	0.01
G30A	761	11.87	14 135	0.82	0.129	0.95
G30B	658	16.85	4196	1.49	0.038	1.53
G30C	351	9.21	387	1.98	0.004	1.98
G30D	534	13.12	0	1.27	0	1.27
G30E	352	4.56	2291	0.6	0.021	0.62
G30F	780	14.23	2723	1.05	0.025	1.07
G30G	647	10.48	14 329	0.41	0.131	0.54
G30H	1077	15.9	6477	0.59	0.059	0.65

1) Recharge is extracted from The Classification of Significant Water Resources in the Olifants-Doom Water Management Area Final Technical Report.

2) Population data estimated from 2011 Census.

6. GROUNDWATER - QUALITY COMPONENT

The ambient groundwater quality was compared to the Class 1 recommended value (SANS 241:2006). The lowest or more conservative value of the two is selected. In instances where the ambient value is selected, it is increased by 10 per cent. In instances where the ambient quality, of geological origin exceeds the recommended value, the ambient water quality is used. These poor water quality areas will become exclusion zones in determining the Basic Human Needs Reserve Requirement. The groundwater quality must comply with the target water quality ranges as shown in Table 5.1. Table 5.2 shows a summary of the results for the quality aspects at quaternary level in terms of the BHN. Table 5.3 illustrates the groundwater quality class and parameters of concern for each quaternary catchment.

Table 6.1: Classification for the assessment of the suitability of borehole water for portable use.

Constituent/Parameter	Target Water Quality Ranges ¹				
	Units	Class 0	Class I	Class II	Class III
Calcium as Ca	mg/l	0 - 80	80 - 150	150 - 300	> 300
Magnesium as Mg	mg/l	0 - 30	30 - 70	70 - 100	> 100
Sodium as Na	mg/l	0 - 100	100 - 200	200 - 400	> 400
Chloride as Cl	mg/l	0 - 100	100 - 200	200 - 600	> 600
Sulphate as SO ₄	mg/l	0 - 200	200 - 400	400 - 600	> 600
Nitrate as NO ₃ -N	mg/l	0 - 6	6 - 10	10 - 20	> 20
Flouride as F	mg/l	0 - 1	1 - 1.5	1.5 - 3.5	> 3.5
Faecal coliforms	counts/100ml	0	0 - 1	1 - 10	> 10
pH (pH Units)		6 - 9	5 - 6 & 9 - 9.5	4 - 5 & > 9.5 - 10	< 4 or > 10
Total Dissolved Solids	mg/l	0 - 450	450 - 1000	1000 - 2450	> 2450
Electrical Conductivity	mS/m	0 - 70	70 - 150	150 - 300	> 370

1) Ref: South African Water Quality Guidelines, Volume 1: Domestic Water Use, 2nd Ed. 1996. Department of Water Affairs and Forestry, Pretoria, South Africa.

NOTE:

- Class 0** This is ideal water quality, suitable for lifetime use, with no adverse health effects on the user. This class is essentially the same as the target water quality range in the 2nd edition of the *South African Water Quality Guidelines for Domestic Use* (DWAF, 1996).
- Class I** Water in this class is safe for lifetime use, but falls short of the ideal water quality in that there may be instances of adverse health effects, but these are usually mild, and overt health effects are almost sub-clinical and difficult to demonstrate. Water in Class I does not cause health effects under normal circumstances. Aesthetic effects may, however, be apparent.
- Class II** Water in this class is defined as that where adverse health effects are unusual for limited short-term use. Adverse health effects may become more common particularly with prolonged use over many years, or with lifetime use. This class represents water suitable for short-term or emergency use only, but not necessarily suitable for continuous use over a lifetime.
- Class III** This water has constituents in a concentration range where serious health effects might be anticipated, particularly in infants or elderly people with short-term use, and even more so with longer term use. The water in this class is not suitable for use as drinking water without adequate treatment to shift the water into a lower and safer class.

Table 6.2: The results of the Groundwater Component – Quality Aspects

Chemical Parameter	Unit	Quaternary Catchments E10A and E10B			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		8	7.57	5.0 – 9.5	8.33
Electrical Conductivity	mS/m	8	20.2	<150	22.22
Calcium as Ca	mg/l	8	13.15	<150	14.47
Magnesium as Mg	mg/l	8	4.7	<100	5.17
Sodium as Na	mg/l	8	10.55	<200	11.61
Total Alkalinity as CaCO ₃	mg/l	8	33.65	N/A	37
Chloride as Cl	mg/l	8	17.8	<200	19.58
Sulphate as SO ₄	mg/l	8	6.55	<400	7.21
Nitrate as NO _x -N	mg/l	8	0.04	<10	0.04
Fluoride as F	Mg/l	8	0.14	<1.0	0.15
Chemical Parameter	Unit	Quaternary Catchment E10C			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		8	5.16	5.0 – 9.5	5.68
Electrical Conductivity	mS/m	8	7.15	<150	7.87
Calcium as Ca	mg/l	8	1.25	<150	1.38
Magnesium as Mg	mg/l	8	1.24	<100	1.36
Sodium as Na	mg/l	8	5.97	<200	6.57
Total Alkalinity as CaCO ₃	mg/l	8	4	N/A	4.4
Chloride as Cl	mg/l	8	14.5	<200	15.95
Sulphate as SO ₄	mg/l	8	3.25	<400	3.58
Nitrate as NO _x -N	mg/l	8	0.7	<10	0.77
Fluoride as F	Mg/l	8	0.05	<1.0	0.05

Chemical Parameter	Unit	Quaternary Catchment E10D			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		100	6.87	5.0 – 9.5	7.56
Electrical Conductivity	mS/m	100	9	<150	9.9
Calcium as Ca	mg/l	97	2.4	<150	2.64
Magnesium as Mg	mg/l	97	1.96	<100	2.16
Sodium as Na	mg/l	95	8.22	<200	9.04
Total Alkalinity as CaCO ₃	mg/l	97	10.55	N/A	11.61
Chloride as Cl	mg/l	96	16.44	<200	18.08
Sulphate as SO ₄	mg/l	97	2	<400	2.2
Nitrate as NO _x -N	mg/l	96	0.24	<10	0.26
Fluoride as F	Mg/l	94	0.11	<1.0	0.12
Chemical Parameter	Unit	Quaternary Catchment E10E			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		153	6.23	5.0 – 9.5	6.85
Electrical Conductivity	mS/m	152	11.32	<150	12.45
Calcium as Ca	mg/l	153	1.41	<150	1.55
Magnesium as Mg	mg/l	153	1.9	<100	2.09
Sodium as Na	mg/l	146	12.35	<200	13.58
Total Alkalinity as CaCO ₃	mg/l	153	5	N/A	5.5
Chloride as Cl	mg/l	153	23.7	<200	26.07
Sulphate as SO ₄	mg/l	153	2	<400	2.2
Nitrate as NO _x -N	mg/l	153	0.34	<10	0.37
Fluoride as F	Mg/l	148	0.05	<1.0	0.05

Chemical Parameter	Unit	Quaternary Catchment E10F			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		92	6.73	5.0 – 9.5	7.4
Electrical Conductivity	mS/m	92	16.01	<150	17.61
Calcium as Ca	mg/l	92	4.76	<150	5.24
Magnesium as Mg	mg/l	92	2.85	<100	3.14
Sodium as Na	mg/l	88	14	<200	15.4
Total Alkalinity as CaCO ₃	mg/l	92	15.58	N/A	17.14
Chloride as Cl	mg/l	92	27.31	<200	30.04
Sulphate as SO ₄	mg/l	92	4.31	<400	4.74
Nitrate as NO _x -N	mg/l	92	0.41	<10	0.45
Fluoride as F	Mg/l	90	0.1	<1.0	0.11
Chemical Parameter	Unit	Quaternary Catchment E10G			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		107	6.27	5.0 – 9.5	6.9
Electrical Conductivity	mS/m	105	16.9	<150	18.59
Calcium as Ca	mg/l	102	1.68	<150	1.85
Magnesium as Mg	mg/l	103	2.87	<100	3.16
Sodium as Na	mg/l	100	16.2	<200	17.82
Total Alkalinity as CaCO ₃	mg/l	103	4	N/A	4.4
Chloride as Cl	mg/l	104	28.95	<200	31.85
Sulphate as SO ₄	mg/l	104	2	<400	2.2
Nitrate as NO _x -N	mg/l	102	0.88	<10	0.97
Fluoride as F	Mg/l	99	0.05	<1.0	0.05

Chemical Parameter	Unit	Quaternary Catchment E10H			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		7	6.56	5.0 – 9.5	7.22
Electrical Conductivity	mS/m	7	19.6	<150	21.56
Calcium as Ca	mg/l	7	2.79	<150	3.07
Magnesium as Mg	mg/l	7	3.73	<100	4.1
Sodium as Na	mg/l	7	11.6	<200	12.76
Total Alkalinity as CaCO ₃	mg/l	7	4	N/A	4.4
Chloride as Cl	mg/l	7	47.22	<200	51.94
Sulphate as SO ₄	mg/l	7	2	<400	2.2
Nitrate as NO _x -N	mg/l	7	0.04	<10	0.04
Fluoride as F	Mg/l	7	0.05	<1.0	0.05
Chemical Parameter	Unit	Quaternary Catchment E10J			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		71	6.4	5.0 – 9.5	7.04
Electrical Conductivity	mS/m	71	50.4	<150	55.44
Calcium as Ca	mg/l	65	6.49	<150	7.14
Magnesium as Mg	mg/l	65	8.85	<100	9.74
Sodium as Na	mg/l	65	63	<200	69.3
Total Alkalinity as CaCO ₃	mg/l	67	6.2	N/A	6.82
Chloride as Cl	mg/l	66	112.96	<200	124.26
Sulphate as SO ₄	mg/l	66	13.95	<400	15.95
Nitrate as NO _x -N	mg/l	68	2.6	<10	2.86
Fluoride as F	Mg/l	64	0.15	<1.0	0.17

Chemical Parameter	Unit	Quaternary Catchment E10K			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		5	6.74	5.0 – 9.5	7.41
Electrical Conductivity	mS/m	5	175	<150	175
Calcium as Ca	mg/l	5	13.9	<150	15.29
Magnesium as Mg	mg/l	5	55.6	<100	61.16
Sodium as Na	mg/l	5	207	<200	207
Total Alkalinity as CaCO ₃	mg/l	5	2	N/A	2.2
Chloride as Cl	mg/l	5	471	<200	471
Sulphate as SO ₄	mg/l	5	30.3	<400	33.33
Nitrate as NO _x -N	mg/l	5	2.4	<10	2.64
Fluoride as F	Mg/l	5	0.14	<1.0	0.15
Chemical Parameter	Unit	Quaternary Catchment E21A			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		50	7.63	5.0 – 9.5	8.39
Electrical Conductivity	mS/m	50	24.1	<150	26.51
Calcium as Ca	mg/l	50	13.3	<150	14.63
Magnesium as Mg	mg/l	50	5.65	<100	6.22
Sodium as Na	mg/l	50	18.2	<200	20.02
Total Alkalinity as CaCO ₃	mg/l	50	35.6	N/A	39.16
Chloride as Cl	mg/l	50	37.25	<200	41
Sulphate as SO ₄	mg/l	50	12.25	<400	13.48
Nitrate as NO _x -N	mg/l	50	0.02	<10	0.02
Fluoride as F	Mg/l	50	0.11	<1.0	0.12

Chemical Parameter	Unit	Quaternary Catchment E21B			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		17	7.5	5.0 – 9.5	8.25
Electrical Conductivity	mS/m	17	89.2	<150	98.12
Calcium as Ca	mg/l	17	65.6	<150	72.16
Magnesium as Mg	mg/l	17	27	<100	29.7
Sodium as Na	mg/l	17	64.6	<200	71.06
Total Alkalinity as CaCO ₃	mg/l	17	76	N/A	83.6
Chloride as Cl	mg/l	17	150.3	<200	165.33
Sulphate as SO ₄	mg/l	17	99.1	<400	109.01
Nitrate as NO _x -N	mg/l	17	0.11	<10	0.12
Fluoride as F	Mg/l	17	0.22	<1.0	0.24
Chemical Parameter	Unit	Quaternary Catchment E21C			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		9	7.45	5.0 – 9.5	8.19
Electrical Conductivity	mS/m	9	13.7	<150	15.07
Calcium as Ca	mg/l	9	4.9	<150	5.39
Magnesium as Mg	mg/l	9	5	<100	5.5
Sodium as Na	mg/l	9	10	<200	11
Total Alkalinity as CaCO ₃	mg/l	9	15.3	N/A	16.83
Chloride as Cl	mg/l	9	23.3	<200	25.63
Sulphate as SO ₄	mg/l	9	6.7	<400	7.37
Nitrate as NO _x -N	mg/l	9	0.02	<10	0.02
Fluoride as F	Mg/l	9	0.1	<1.0	0.11

Chemical Parameter	Unit	Quaternary Catchment E21D			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		38	7.53	5.0 – 9.5	8.28
Electrical Conductivity	mS/m	38	21.85	<150	24.04
Calcium as Ca	mg/l	38	11.75	<150	12.93
Magnesium as Mg	mg/l	38	4.05	<100	4.46
Sodium as Na	mg/l	38	15.28	<200	16.08
Total Alkalinity as CaCO ₃	mg/l	38	31.75	N/A	34.93
Chloride as Cl	mg/l	38	26.08	<200	28.69
Sulphate as SO ₄	mg/l	38	5.8	<400	6.38
Nitrate as NO _x -N	mg/l	38	0.1	<10	0.11
Fluoride as F	Mg/l	38	0.05	<1.0	0.05
Chemical Parameter	Unit	Quaternary Catchments E21E, E21F, E21L & E22F			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		10	6.93	5.0 – 9.5	7.62
Electrical Conductivity	mS/m	10	12.5	<150	13.75
Calcium as Ca	mg/l	10	2.35	<150	2.59
Magnesium as Mg	mg/l	10	2.8	<100	3.08
Sodium as Na	mg/l	10	10.5	<200	11.55
Total Alkalinity as CaCO ₃	mg/l	10	7.55	N/A	8.31
Chloride as Cl	mg/l	10	16.95	<200	18.65
Sulphate as SO ₄	mg/l	10	6.3	<400	6.93
Nitrate as NO _x -N	mg/l	9	0.07	<10	0.07
Fluoride as F	Mg/l	10	0.15	<1.0	0.16

Chemical Parameter	Unit	Quaternary Catchment E21G			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		44	6.59	5.0 – 9.5	7.25
Electrical Conductivity	mS/m	43	104	<150	114.4
Calcium as Ca	mg/l	44	2.76	<150	3.04
Magnesium as Mg	mg/l	44	2.39	<100	2.63
Sodium as Na	mg/l	42	8.76	<200	9.64
Total Alkalinity as CaCO ₃	mg/l	44	8.64	N/A	9.5
Chloride as Cl	mg/l	44	14.64	<200	16.11
Sulphate as SO ₄	mg/l	44	6.06	<400	6.67
Nitrate as NO _x -N	mg/l	44	0.6	<10	0.66
Fluoride as F	Mg/l	42	0.1	<1.0	0.11
Chemical Parameter	Unit	Quaternary Catchment E21H			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		29	5.82	5.0 – 9.5	6.4
Electrical Conductivity	mS/m	29	3.1	<150	3.41
Calcium as Ca	mg/l	29	0.5	<150	0.55
Magnesium as Mg	mg/l	29	0.75	<100	0.83
Sodium as Na	mg/l	27	2.72	<200	3
Total Alkalinity as CaCO ₃	mg/l	29	4	N/A	4.4
Chloride as Cl	mg/l	27	5	<200	5.5
Sulphate as SO ₄	mg/l	29	2	<400	2.2
Nitrate as NO _x -N	mg/l	29	0.1	<10	0.11
Fluoride as F	Mg/l	27	0.05	<1.0	0.05

Chemical Parameter	Unit	Quaternary Catchment E21J			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		22	7.47	5.0 – 9.5	8.22
Electrical Conductivity	mS/m	22	18.19	<150	20
Calcium as Ca	mg/l	22	8.99	<150	9.9
Magnesium as Mg	mg/l	22	3.6	<100	3.96
Sodium as Na	mg/l	22	16.8	<200	17.93
Total Alkalinity as CaCO ₃	mg/l	22	26.86	N/A	29.55
Chloride as Cl	mg/l	22	30.59	<200	33.65
Sulphate as SO ₄	mg/l	22	9.78	<400	10.76
Nitrate as NO _x -N	mg/l	22	0.25	<10	0.28
Fluoride as F	Mg/l	21	0.12	<1.0	0.13
Chemical Parameter	Unit	Quaternary Catchment E21K			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		10	7.6	5.0 – 9.5	8.36
Electrical Conductivity	mS/m	10	20.15	<150	22.17
Calcium as Ca	mg/l	10	20.22	<150	22.24
Magnesium as Mg	mg/l	10	1.3	<100	1.43
Sodium as Na	mg/l	10	11.91	<200	13.1
Total Alkalinity as CaCO ₃	mg/l	10	80.86	N/A	88.95
Chloride as Cl	mg/l	10	6.5	<200	7.15
Sulphate as SO ₄	mg/l	10	4.7	<400	5.17
Nitrate as NO _x -N	mg/l	10	0.05	<10	0.05
Fluoride as F	Mg/l	10	0.17	<1.0	0.18

Chemical Parameter	Unit	Quaternary Catchment E22A			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		13	8.12	5.0 – 9.5	8.93
Electrical Conductivity	mS/m	13	171	<150	171
Calcium as Ca	mg/l	13	78.4	<150	86.24
Magnesium as Mg	mg/l	13	46.8	<100	51.48
Sodium as Na	mg/l	13	198.1	<200	198.1
Total Alkalinity as CaCO ₃	mg/l	13	271.4	N/A	271.4
Chloride as Cl	mg/l	13	345.1	<200	345.1
Sulphate as SO ₄	mg/l	13	109.5	<400	120.45
Nitrate as NO _x -N	mg/l	13	0.29	<10	0.32
Fluoride as F	Mg/l	13	0.98	<1.0	0.98
Chemical Parameter	Unit	Quaternary Catchment E22B			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		10	7.82	5.0 – 9.5	8.6
Electrical Conductivity	mS/m	10	278.7	<150	278.7
Calcium as Ca	mg/l	10	127	<150	136.7
Magnesium as Mg	mg/l	10	67.9	<100	74.69
Sodium as Na	mg/l	10	271.8	<200	271.8
Total Alkalinity as CaCO ₃	mg/l	10	225.35	N/A	225.35
Chloride as Cl	mg/l	10	614.55	<200	614.55
Sulphate as SO ₄	mg/l	10	197.75	<400	217.53
Nitrate as NO _x -N	mg/l	10	0.6	<10	0.66
Fluoride as F	Mg/l	10	0.9	<1.0	0.9

Chemical Parameter	Unit	Quaternary Catchment E22C			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		13	7.69	5.0 – 9.5	8.46
Electrical Conductivity	mS/m	13	64.9	<150	71.39
Calcium as Ca	mg/l	13	39	<150	42.9
Magnesium as Mg	mg/l	13	15	<100	16.5
Sodium as Na	mg/l	13	50.3	<200	55.33
Total Alkalinity as CaCO ₃	mg/l	13	93.6	N/A	102.96
Chloride as Cl	mg/l	13	77.2	<200	84.92
Sulphate as SO ₄	mg/l	13	42.1	<400	46.31
Nitrate as NO _x -N	mg/l	13	0.08	<10	0.08
Fluoride as F	Mg/l	13	0.2	<1.0	0.22
Chemical Parameter	Unit	Quaternary Catchment E22D			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		6	7.97	5.0 – 9.5	8.77
Electrical Conductivity	mS/m	6	548	<150	548
Calcium as Ca	mg/l	6	161.05	<150	161.05
Magnesium as Mg	mg/l	6	203.55	<100	203.55
Sodium as Na	mg/l	6	634.9	<200	634.9
Total Alkalinity as CaCO ₃	mg/l	6	186.3	N/A	186.3
Chloride as Cl	mg/l	6	1624.45	<200	1624.45
Sulphate as SO ₄	mg/l	6	437.9	<400	437.9
Nitrate as NO _x -N	mg/l	6	1.13	<10	1.24
Fluoride as F	Mg/l	6	1	<1.0	1

Chemical Parameter	Unit	Quaternary Catchments E22E, E22G & E23A-E23D			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		12	7.92	5.0 – 9.5	8.71
Electrical Conductivity	mS/m	12	129.15	<150	142.07
Calcium as Ca	mg/l	12	61.8	<150	67.98
Magnesium as Mg	mg/l	12	23.65	<100	26.02
Sodium as Na	mg/l	12	186.53	<200	186.53
Total Alkalinity as CaCO ₃	mg/l	12	170	N/A	187
Chloride as Cl	mg/l	12	299.95	<200	299.95
Sulphate as SO ₄	mg/l	12	49.1	<400	54.01
Nitrate as NO _x -N	mg/l	12	0.05	<10	0.05
Fluoride as F	Mg/l	12	0.63	<1.0	0.69
Chemical Parameter	Unit	Quaternary Catchment E23E-E23H, E23J			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		3	8.37	5.0 – 9.5	9.21
Electrical Conductivity	mS/m	3	185.00	<150	185.00
Calcium as Ca	mg/l	3	25.90	<150	28.49
Magnesium as Mg	mg/l	3	4.80	<100	5.28
Sodium as Na	mg/l	3	414.10	<200	414.10
Total Alkalinity as CaCO ₃	mg/l	3	285.60	N/A	314.16
Chloride as Cl	mg/l	3	344.70	<200	344.70
Sulphate as SO ₄	mg/l	3	88.80	<400	97.68
Nitrate as NO _x -N	mg/l	3	0.02	<10	0.02
Fluoride as F	mg/l	3	2.77	<1.0	3.05

Chemical Parameter	Unit	Quaternary Catchment E23K			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		14	8.55	5.0 – 9.5	9.40
Electrical Conductivity	mS/m	14	177.50	<150	177.50
Calcium as Ca	mg/l	14	9.70	<150	10.67
Magnesium as Mg	mg/l	14	4.75	<100	5.23
Sodium as Na	mg/l	14	357.00	<200	357.00
Total Alkalinity as CaCO ₃	mg/l	14	220.35	N/A	242.39
Chloride as Cl	mg/l	14	416.75	<200	416.75
Sulphate as SO ₄	mg/l	14	28.80	<400	31.68
Nitrate as NO _x -N	mg/l	14	0.11	<10	0.12
Fluoride as F	mg/l	14	1.04	<1.0	1.04
Chemical Parameter	Unit	Quaternary Catchments E24C-E24D			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		7	8.19	5.0 – 9.5	9.01
Electrical Conductivity	mS/m	7	96.00	<150	105.60
Calcium as Ca	mg/l	7	7.00	<150	7.70
Magnesium as Mg	mg/l	7	2.00	<100	2.20
Sodium as Na	mg/l	7	240.30	<200	240.30
Total Alkalinity as CaCO ₃	mg/l	7	331.60	N/A	364.76
Chloride as Cl	mg/l	7	129.00	<200	141.90
Sulphate as SO ₄	mg/l	7	11.97	<400	13.17
Nitrate as NO _x -N	mg/l	7	0.04	<10	0.04
Fluoride as F	mg/l	7	2.98	<1.0	2.98

Chemical Parameter	Unit	Quaternary Catchment E24E			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		8	7.99	5.0 – 9.5	8.78
Electrical Conductivity	mS/m	8	227.65	<150	227.65
Calcium as Ca	mg/l	8	143.25	<150	157.58
Magnesium as Mg	mg/l	8	106.05	<100	106.05
Sodium as Na	mg/l	8	201.55	<200	201.55
Total Alkalinity as CaCO ₃	mg/l	8	191.65	N/A	210.82
Chloride as Cl	mg/l	8	268.40	<200	268.40
Sulphate as SO ₄	mg/l	8	554.50	<400	554.50
Nitrate as NO _x -N	mg/l	8	3.22	<10	3.54
Fluoride as F	mg/l	8	0.85	<1.0	0.94
Chemical Parameter	Unit	Quaternary Catchment E24F			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		3	7.90	5.0 – 9.5	8.69
Electrical Conductivity	mS/m	3	275.20	<150	275.20
Calcium as Ca	mg/l	3	110.80	<150	121.88
Magnesium as Mg	mg/l	3	94.40	<100	103.84
Sodium as Na	mg/l	3	361.40	<200	361.40
Total Alkalinity as CaCO ₃	mg/l	3	213.90	N/A	235.29
Chloride as Cl	mg/l	3	543.90	<200	543.90
Sulphate as SO ₄	mg/l	3	378.40	<400	416.24
Nitrate as NO _x -N	mg/l	3	3.28	<10	3.61
Fluoride as F	mg/l	3	0.92	<1.0	1.01

Chemical Parameter	Unit	Quaternary Catchments E24G-E24H			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		6	7.95	5.0 – 9.5	8.75
Electrical Conductivity	mS/m	6	320.00	<150	320.00
Calcium as Ca	mg/l	6	116.00	<150	127.60
Magnesium as Mg	mg/l	6	84.25	<100	92.68
Sodium as Na	mg/l	6	446.00	<200	446.00
Total Alkalinity as CaCO ₃	mg/l	6	213.55	N/A	234.91
Chloride as Cl	mg/l	6	795.40	<200	795.40
Sulphate as SO ₄	mg/l	6	174.10	<400	191.51
Nitrate as NO _x -N	mg/l	6	1.11	<10	1.22
Fluoride as F	mg/l	6	0.82	<1.0	0.90
Chemical Parameter	Unit	Quaternary Catchments E24J			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		56	7.31	5.0 – 9.5	8.04
Electrical Conductivity	mS/m	56	138.50	<150	152.35
Calcium as Ca	mg/l	56	46.30	<150	50.93
Magnesium as Mg	mg/l	56	30.50	<100	33.55
Sodium as Na	mg/l	54	166.55	<200	183.21
Total Alkalinity as CaCO ₃	mg/l	56	92.05	N/A	101.26
Chloride as Cl	mg/l	56	311.85	<200	311.85
Sulphate as SO ₄	mg/l	56	63.60	<400	69.96
Nitrate as NO _x -N	mg/l	56	0.06	<10	0.06
Fluoride as F	mg/l	54	0.23	<1.0	0.26

Chemical Parameter	Unit	Quaternary Catchment E24K			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		6	7.85	5.0 – 9.5	8.64
Electrical Conductivity	mS/m	6	324.50	<150	356.95
Calcium as Ca	mg/l	6	172.25	<150	189.48
Magnesium as Mg	mg/l	6	110.75	<100	121.83
Sodium as Na	mg/l	6	269.35	<200	296.29
Total Alkalinity as CaCO ₃	mg/l	6	188.55	N/A	207.41
Chloride as Cl	mg/l	6	801.65	<200	881.82
Sulphate as SO ₄	mg/l	6	206.95	<400	227.65
Nitrate as NO _x -N	mg/l	6	5.54	<10	6.09
Fluoride as F	mg/l	6	0.52	<1.0	0.57
Chemical Parameter	Unit	Quaternary Catchments E24L			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		40	5.52	5.0 – 9.5	6.07
Electrical Conductivity	mS/m	40	14.55	<150	16.01
Calcium as Ca	mg/l	40	3.35	<150	3.69
Magnesium as Mg	mg/l	40	2.80	<100	3.08
Sodium as Na	mg/l	40	16.00	<200	17.60
Total Alkalinity as CaCO ₃	mg/l	40	3.00	N/A	3.30
Chloride as Cl	mg/l	40	29.60	<200	32.56
Sulphate as SO ₄	mg/l	40	6.45	<400	7.10
Nitrate as NO _x -N	mg/l	40	1.20	<10	1.32
Fluoride as F	mg/l	40	0.11	<1.0	0.12

Chemical Parameter	Unit	Quaternary Catchment E24M			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		25	6.67	5.0 – 9.5	7.34
Electrical Conductivity	mS/m	25	165.00	<150	165.00
Calcium as Ca	mg/l	22	19.65	<150	21.62
Magnesium as Mg	mg/l	22	44.15	<100	48.57
Sodium as Na	mg/l	22	207.70	<200	207.70
Total Alkalinity as CaCO ₃	mg/l	25	9.50	N/A	10.45
Chloride as Cl	mg/l	22	436.60	<200	436.60
Sulphate as SO ₄	mg/l	22	50.25	<400	55.28
Nitrate as NO _x -N	mg/l	25	3.61	<10	3.97
Fluoride as F	mg/l	22	0.17	<1.0	0.19
Chemical Parameter	Unit	Quaternary Catchments E31E			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		6	8.16	5.0 – 9.5	8.98
Electrical Conductivity	mS/m	6	430.50	<150	430.50
Calcium as Ca	mg/l	6	148.12	<150	162.93
Magnesium as Mg	mg/l	6	95.09	<100	104.59
Sodium as Na	mg/l	6	605.64	<200	605.64
Total Alkalinity as CaCO ₃	mg/l	6	301.77	N/A	331.94
Chloride as Cl	mg/l	6	1124.69	<200	1124.69
Sulphate as SO ₄	mg/l	6	329.66	<400	362.62
Nitrate as NO _x -N	mg/l	6	2.55	<10	2.80
Fluoride as F	mg/l	6	1.47	<1.0	1.62

Chemical Parameter	Unit	Quaternary Catchment E31F			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		67	8.05	5.0 – 9.5	8.86
Electrical Conductivity	mS/m	67	190.00	<150	190.00
Calcium as Ca	mg/l	64	84.20	<150	92.62
Magnesium as Mg	mg/l	64	61.67	<100	67.83
Sodium as Na	mg/l	63	209.10	<200	209.10
Total Alkalinity as CaCO ₃	mg/l	64	250.25	N/A	275.28
Chloride as Cl	mg/l	65	295.30	<200	295.30
Sulphate as SO ₄	mg/l	65	221.90	<400	244.09
Nitrate as NO _x -N	mg/l	65	0.15	<10	0.16
Fluoride as F	mg/l	62	1.29	<1.0	1.29
Chemical Parameter	Unit	Quaternary Catchments E31G			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		12	8.10	5.0 – 9.5	8.91
Electrical Conductivity	mS/m	12	436.45	<150	436.45
Calcium as Ca	mg/l	11	163.80	<150	163.80
Magnesium as Mg	mg/l	11	147.20	<100	147.20
Sodium as Na	mg/l	11	584.30	<200	584.30
Total Alkalinity as CaCO ₃	mg/l	12	211.75	N/A	232.93
Chloride as Cl	mg/l	11	1161.90	<200	1161.90
Sulphate as SO ₄	mg/l	11	364.50	<400	364.50
Nitrate as NO _x -N	mg/l	12	4.46	<10	4.91
Fluoride as F	Mg/l	11	1.92	<1.0	1.92

Chemical Parameter	Unit	Quaternary Catchment E31H			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		8	7.98	5.0 – 9.5	8.77
Electrical Conductivity	mS/m	8	438.00	<150	438.00
Calcium as Ca	mg/l	8	87.55	<150	96.31
Magnesium as Mg	mg/l	8	107.10	<100	107.10
Sodium as Na	mg/l	8	611.10	<200	611.10
Total Alkalinity as CaCO ₃	mg/l	8	198.55	N/A	218.41
Chloride as Cl	mg/l	8	1159.35	<200	1159.35
Sulphate as SO ₄	mg/l	8	349.00	<400	383.90
Nitrate as NO _x -N	mg/l	8	6.09	<10	6.69
Fluoride as F	Mg/l	8	2.10	<1.0	2.10
Chemical Parameter	Unit	Quaternary Catchment E32A			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		6	7.88	5.0 – 9.5	8.67
Electrical Conductivity	mS/m	6	77.40	<150	85.14
Calcium as Ca	mg/l	6	50.50	<150	55.55
Magnesium as Mg	mg/l	6	26.20	<100	28.82
Sodium as Na	mg/l	6	83.85	<200	92.24
Total Alkalinity as CaCO ₃	mg/l	6	204.65	N/A	225.12
Chloride as Cl	mg/l	6	83.15	<200	91.47
Sulphate as SO ₄	mg/l	6	44.20	<400	48.62
Nitrate as NO _x -N	mg/l	6	0.22	<10	0.24
Fluoride as F	Mg/l	6	0.74	<1.0	0.81

Chemical Parameter	Unit	Quaternary Catchment E32B			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		14	7.74	5.0 – 9.5	8.51
Electrical Conductivity	mS/m	14	181.60	<150	181.60
Calcium as Ca	mg/l	14	109.95	<150	120.95
Magnesium as Mg	mg/l	14	74.95	<100	82.45
Sodium as Na	mg/l	14	150.65	<200	165.72
Total Alkalinity as CaCO ₃	mg/l	14	192.10	N/A	211.31
Chloride as Cl	mg/l	14	295.15	<200	295.15
Sulphate as SO ₄	mg/l	14	278.75	<400	306.63
Nitrate as NO _x -N	mg/l	14	1.76	<10	1.93
Fluoride as F	Mg/l	14	0.84	<1.0	0.92
Chemical Parameter	Unit	Quaternary Catchment E32C			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		15	7.75	5.0 – 9.5	8.53
Electrical Conductivity	mS/m	15	162.70	<150	162.70
Calcium as Ca	mg/l	15	80.20	<150	88.22
Magnesium as Mg	mg/l	15	60.80	<100	66.88
Sodium as Na	mg/l	15	185.10	<200	185.10
Total Alkalinity as CaCO ₃	mg/l	15	211.40	N/A	232.54
Chloride as Cl	mg/l	15	203.00	<200	203.00
Sulphate as SO ₄	mg/l	15	303.30	<400	333.63
Nitrate as NO _x -N	mg/l	15	2.32	<10	2.55
Fluoride as F	Mg/l	15	0.96	<1.0	0.96

Chemical Parameter	Unit	Quaternary Catchment E32D			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		25	7.75	5.0 – 9.5	8.53
Electrical Conductivity	mS/m	25	170.80	<150	170.80
Calcium as Ca	mg/l	25	101.90	<150	112.09
Magnesium as Mg	mg/l	25	57.30	<100	63.03
Sodium as Na	mg/l	25	201.40	<200	201.40
Total Alkalinity as CaCO ₃	mg/l	25	192.90	N/A	212.19
Chloride as Cl	mg/l	25	239.40	<200	239.40
Sulphate as SO ₄	mg/l	25	256.30	<400	281.93
Nitrate as NO _x -N	mg/l	25	0.49	<10	0.54
Fluoride as F	Mg/l	25	1.33	<1.0	1.33
Chemical Parameter	Unit	Quaternary Catchment E32E			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		15	7.80	5.0 – 9.5	8.58
Electrical Conductivity	mS/m	15	273.00	<150	273.00
Calcium as Ca	mg/l	15	106.30	<150	116.93
Magnesium as Mg	mg/l	15	88.50	<100	97.35
Sodium as Na	mg/l	15	303.10	<200	303.10
Total Alkalinity as CaCO ₃	mg/l	15	188.00	N/A	206.80
Chloride as Cl	mg/l	15	748.30	<200	748.30
Sulphate as SO ₄	mg/l	15	137.20	<400	150.92
Nitrate as NO _x -N	mg/l	15	2.23	<10	2.45
Fluoride as F	Mg/l	15	0.82	<1.0	0.90

Chemical Parameter	Unit	Quaternary Catchment E33A			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		10	8.10	5.0 – 9.5	8.90
Electrical Conductivity	mS/m	10	433.00	<150	433.00
Calcium as Ca	mg/l	10	155.85	<150	155.85
Magnesium as Mg	mg/l	10	118.55	<100	118.55
Sodium as Na	mg/l	10	659.45	<200	659.45
Total Alkalinity as CaCO ₃	mg/l	10	178.25	N/A	196.08
Chloride as Cl	mg/l	10	1327.85	<200	1327.85
Sulphate as SO ₄	mg/l	10	305.25	<400	335.78
Nitrate as NO _x -N	mg/l	10	5.42	<10	5.96
Fluoride as F	Mg/l	10	2.14	<1.0	2.14
Chemical Parameter	Unit	Quaternary Catchment E33B			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		6	8.18	5.0 – 9.5	8.99
Electrical Conductivity	mS/m	6	998.20	<150	998.20
Calcium as Ca	mg/l	6	232.15	<150	232.15
Magnesium as Mg	mg/l	6	240.60	<100	240.60
Sodium as Na	mg/l	6	1780.80	<200	1780.80
Total Alkalinity as CaCO ₃	mg/l	6	250.95	N/A	276.05
Chloride as Cl	mg/l	6	3063.90	<200	3063.90
Sulphate as SO ₄	mg/l	6	717.85	<400	717.85
Nitrate as NO _x -N	mg/l	6	4.51	<10	4.96
Fluoride as F	Mg/l	6	1.77	<1.0	1.77

Chemical Parameter	Unit	Quaternary Catchment E33C			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		11	8.23	5.0 – 9.5	9.05
Electrical Conductivity	mS/m	11	482.00	<150	482.00
Calcium as Ca	mg/l	11	76.10	<150	83.71
Magnesium as Mg	mg/l	11	131.70	<100	131.70
Sodium as Na	mg/l	11	674.60	<200	674.60
Total Alkalinity as CaCO ₃	mg/l	11	260.80	N/A	286.88
Chloride as Cl	mg/l	11	1472.40	<200	1472.40
Sulphate as SO ₄	mg/l	11	215.50	<400	237.05
Nitrate as NO _x -N	mg/l	11	1.76	<10	1.94
Fluoride as F	Mg/l	11	1.49	<1.0	1.49
Chemical Parameter	Unit	Quaternary Catchment E33D			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		149	7.79	5.0 – 9.5	8.57
Electrical Conductivity	mS/m	149	636.10	<150	636.10
Calcium as Ca	mg/l	143	111.54	<150	122.69
Magnesium as Mg	mg/l	143	121.40	<100	121.40
Sodium as Na	mg/l	143	1055.72	<200	1055.72
Total Alkalinity as CaCO ₃	mg/l	144	180.56	N/A	198.62
Chloride as Cl	mg/l	144	1799.25	<200	1799.25
Sulphate as SO ₄	mg/l	144	357.20	<400	392.92
Nitrate as NO _x -N	mg/l	143	0.24	<10	0.26
Fluoride as F	Mg/l	143	1.84	<1.0	1.84

Chemical Parameter	Unit	Quaternary Catchment E33E			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		32	7.65	5.0 – 9.5	8.41
Electrical Conductivity	mS/m	32	585.60	<150	585.60
Calcium as Ca	mg/l	32	142.45	<150	142.45
Magnesium as Mg	mg/l	32	168.40	<100	168.40
Sodium as Na	mg/l	32	857.70	<200	857.70
Total Alkalinity as CaCO ₃	mg/l	32	155.10	N/A	170.61
Chloride as Cl	mg/l	32	1712.00	<200	1712.00
Sulphate as SO ₄	mg/l	32	301.65	<400	331.82
Nitrate as NO _x -N	mg/l	32	1.50	<10	1.64
Fluoride as F	Mg/l	32	2.18	<1.0	2.18
Chemical Parameter	Unit	Quaternary Catchment E33F			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		672	8.00	5.0 – 9.5	8.80
Electrical Conductivity	mS/m	672	185.80	<150	185.80
Calcium as Ca	mg/l	667	102.50	<150	112.75
Magnesium as Mg	mg/l	666	45.27	<100	49.80
Sodium as Na	mg/l	627	183.38	<200	183.38
Total Alkalinity as CaCO ₃	mg/l	669	165.69	N/A	182.26
Chloride as Cl	mg/l	665	402.61	<200	402.61
Sulphate as SO ₄	mg/l	647	96.46	<400	106.10
Nitrate as NO _x -N	mg/l	671	1.06	<10	1.17
Fluoride as F	Mg/l	626	0.27	<1.0	0.30

Chemical Parameter	Unit	Quaternary Catchment E33G			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		75	8.13	5.0 – 9.5	8.95
Electrical Conductivity	mS/m	75	160.00	<150	160.00
Calcium as Ca	mg/l	74	87.31	<150	96.04
Magnesium as Mg	mg/l	74	40.51	<100	44.56
Sodium as Na	mg/l	69	170.39	<200	187.43
Total Alkalinity as CaCO ₃	mg/l	75	226.57	N/A	249.22
Chloride as Cl	mg/l	74	323.58	<200	323.58
Sulphate as SO ₄	mg/l	70	101.70	<400	111.87
Nitrate as NO _x -N	mg/l	75	0.63	<10	0.69
Fluoride as F	Mg/l	68	0.45	<1.0	0.49
Chemical Parameter	Unit	Quaternary Catchment E33H			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		10	7.78	5.0 – 9.5	8.55
Electrical Conductivity	mS/m	10	372.80	<150	372.80
Calcium as Ca	mg/l	10	51.85	<150	57.04
Magnesium as Mg	mg/l	10	80.00	<100	88.00
Sodium as Na	mg/l	10	551.25	<200	551.25
Total Alkalinity as CaCO ₃	mg/l	10	150.50	N/A	165.55
Chloride as Cl	mg/l	10	1015.30	<200	1015.30
Sulphate as SO ₄	mg/l	10	133.65	<400	147.02
Nitrate as NO _x -N	mg/l	10	0.67	<10	0.74
Fluoride as F	Mg/l	10	0.72	<1.0	0.79

Chemical Parameter	Unit	Quaternary Catchment E40A			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		132	7.99	5.0 – 9.5	8.79
Electrical Conductivity	mS/m	132	183.10	<150	183.10
Calcium as Ca	mg/l	132	91.90	<150	101.09
Magnesium as Mg	mg/l	132	68.60	<100	75.46
Sodium as Na	mg/l	132	235.60	<200	235.60
Total Alkalinity as CaCO ₃	mg/l	132	219.90	N/A	241.89
Chloride as Cl	mg/l	132	333.30	<200	333.30
Sulphate as SO ₄	mg/l	132	165.25	<400	181.78
Nitrate as NO _x -N	mg/l	132	0.34	<10	0.38
Fluoride as F	Mg/l	132	1.10	<1.0	1.10
Chemical Parameter	Unit	Quaternary Catchment E40B			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		123	7.87	5.0 – 9.5	8.66
Electrical Conductivity	mS/m	123	200.50	<150	200.50
Calcium as Ca	mg/l	120	100.30	<150	110.33
Magnesium as Mg	mg/l	119	58.40	<100	64.24
Sodium as Na	mg/l	119	181.60	<200	199.76
Total Alkalinity as CaCO ₃	mg/l	120	208.25	N/A	229.08
Chloride as Cl	mg/l	122	358.00	<200	358.00
Sulphate as SO ₄	mg/l	122	141.86	<400	156.04
Nitrate as NO _x -N	mg/l	122	0.70	<10	0.77
Fluoride as F	Mg/l	119	0.64	<1.0	0.70

Chemical Parameter	Unit	Quaternary Catchment E40C			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		6	7.57	5.0 – 9.5	8.32
Electrical Conductivity	mS/m	6	91.05	<150	100.16
Calcium as Ca	mg/l	6	24.35	<150	26.79
Magnesium as Mg	mg/l	6	8.55	<100	9.41
Sodium as Na	mg/l	6	112.20	<200	123.42
Total Alkalinity as CaCO ₃	mg/l	6	110.60	N/A	121.66
Chloride as Cl	mg/l	6	193.30	<200	193.30
Sulphate as SO ₄	mg/l	6	11.30	<400	12.43
Nitrate as NO _x -N	mg/l	6	0.34	<10	0.38
Fluoride as F	Mg/l	6	0.28	<1.0	0.31
Chemical Parameter	Unit	Quaternary Catchment E40D			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		8	7.23	5.0 – 9.5	7.95
Electrical Conductivity	mS/m	8	17.60	<150	19.36
Calcium as Ca	mg/l	8	3.35	<150	3.69
Magnesium as Mg	mg/l	8	4.10	<100	4.51
Sodium as Na	mg/l	8	28.45	<200	31.30
Total Alkalinity as CaCO ₃	mg/l	8	17.85	N/A	19.64
Chloride as Cl	mg/l	8	40.40	<200	44.44
Sulphate as SO ₄	mg/l	8	7.75	<400	8.53
Nitrate as NO _x -N	mg/l	8	1.55	<10	1.70
Fluoride as F	Mg/l	8	0.23	<1.0	0.25

Chemical Parameter	Unit	Quaternary Catchment F60A			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		49	7.10	5.0 – 9.5	7.81
Electrical Conductivity	mS/m	49	770.00	<150	770.00
Calcium as Ca	mg/l	49	165.20	<150	165.20
Magnesium as Mg	mg/l	49	202.90	<100	202.90
Sodium as Na	mg/l	49	1298.90	<200	1298.90
Total Alkalinity as CaCO ₃	mg/l	49	102.60	N/A	112.86
Chloride as Cl	mg/l	49	2502.80	<200	2502.80
Sulphate as SO ₄	mg/l	49	370.20	<400	370.20
Nitrate as NO _x -N	mg/l	49	0.04	<10	0.04
Fluoride as F	Mg/l	49	0.89	<1.0	0.98
Chemical Parameter	Unit	Quaternary Catchment F60B			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		149	7.78	5.0 – 9.5	8.56
Electrical Conductivity	mS/m	149	636.10	<150	636.10
Calcium as Ca	mg/l	149	155.40	<150	155.40
Magnesium as Mg	mg/l	149	178.00	<100	178.00
Sodium as Na	mg/l	149	962.60	<200	962.60
Total Alkalinity as CaCO ₃	mg/l	149	180.64	N/A	198.70
Chloride as Cl	mg/l	149	1878.80	<200	1878.80
Sulphate as SO ₄	mg/l	149	369.82	<400	369.82
Nitrate as NO _x -N	mg/l	149	1.54	<10	1.69
Fluoride as F	Mg/l	149	1.50	<1.0	1.50

Chemical Parameter	Unit	Quaternary Catchment F60C			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		49	7.10	5.0 – 9.5	7.81
Electrical Conductivity	mS/m	49	770.00	<150	770.00
Calcium as Ca	mg/l	49	165.20	<150	165.20
Magnesium as Mg	mg/l	49	202.90	<100	202.90
Sodium as Na	mg/l	49	1298.90	<200	1298.90
Total Alkalinity as CaCO ₃	mg/l	49	102.60	N/A	112.86
Chloride as Cl	mg/l	49	2502.80	<200	2502.80
Sulphate as SO ₄	mg/l	49	370.20	<400	370.20
Nitrate as NO _x -N	mg/l	49	0.04	<10	0.04
Fluoride as F	Mg/l	49	0.89	<1.0	0.98
Chemical Parameter	Unit	Quaternary Catchment F60D			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		5	7.83	5.0 – 9.5	8.61
Electrical Conductivity	mS/m	5	1255.00	<150	1255.00
Calcium as Ca	mg/l	5	288.70	<150	288.70
Magnesium as Mg	mg/l	5	270.70	<100	270.70
Sodium as Na	mg/l	5	2136.50	<200	2136.50
Total Alkalinity as CaCO ₃	mg/l	5	180.40	N/A	198.44
Chloride as Cl	mg/l	5	4249.60	<200	4249.60
Sulphate as SO ₄	mg/l	5	592.20	<400	592.20
Nitrate as NO _x -N	mg/l	5	0.59	<10	0.65
Fluoride as F	Mg/l	5	2.00	<1.0	2.00

Chemical Parameter	Unit	Quaternary Catchment F60E			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		20	7.60	5.0 – 9.5	8.35
Electrical Conductivity	mS/m	20	1181.00	<150	1181.00
Calcium as Ca	mg/l	20	186.30	<150	186.30
Magnesium as Mg	mg/l	20	220.60	<100	220.60
Sodium as Na	mg/l	20	2338.36	<200	2338.36
Total Alkalinity as CaCO ₃	mg/l	20	152.10	N/A	167.31
Chloride as Cl	mg/l	20	4071.45	<200	4071.45
Sulphate as SO ₄	mg/l	20	593.10	<400	593.10
Nitrate as NO _x -N	mg/l	20	0.18	<10	0.20
Fluoride as F	Mg/l	20	2.00	<1.0	2.00
Chemical Parameter	Unit	Quaternary Catchment G30A			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		60	6.68	5.0 – 9.5	7.35
Electrical Conductivity	mS/m	60	217.50	<150	217.50
Calcium as Ca	mg/l	60	23.55	<150	25.91
Magnesium as Mg	mg/l	60	57.54	<100	63.30
Sodium as Na	mg/l	57	278.40	<200	278.40
Total Alkalinity as CaCO ₃	mg/l	59	28.10	N/A	30.91
Chloride as Cl	mg/l	60	500.78	<200	500.78
Sulphate as SO ₄	mg/l	60	168.10	<400	184.91
Nitrate as NO _x -N	mg/l	59	0.15	<10	0.17
Fluoride as F	Mg/l	58	0.15	<1.0	0.16

Chemical Parameter	Unit	Quaternary Catchment G30B			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		127	7.13	5.0 – 9.5	7.84
Electrical Conductivity	mS/m	127	44.10	<150	48.51
Calcium as Ca	mg/l	123	11.60	<150	12.76
Magnesium as Mg	mg/l	123	9.30	<100	10.23
Sodium as Na	mg/l	122	52.95	<200	58.25
Total Alkalinity as CaCO ₃	mg/l	122	48.05	N/A	52.85
Chloride as Cl	mg/l	124	96.60	<200	106.26
Sulphate as SO ₄	mg/l	124	12.85	<400	14.13
Nitrate as NO _x -N	mg/l	122	4.59	<10	5.05
Fluoride as F	Mg/l	121	0.16	<1.0	0.18
Chemical Parameter	Unit	Quaternary Catchment G30C			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		45	6.43	5.0 – 9.5	7.07
Electrical Conductivity	mS/m	44	45.30	<150	49.83
Calcium as Ca	mg/l	45	5.60	<150	6.16
Magnesium as Mg	mg/l	45	9.60	<100	10.56
Sodium as Na	mg/l	43	50.10	<200	55.11
Total Alkalinity as CaCO ₃	mg/l	45	9.45	N/A	10.39
Chloride as Cl	mg/l	45	102.60	<200	112.86
Sulphate as SO ₄	mg/l	45	10.30	<400	11.33
Nitrate as NO _x -N	mg/l	45	3.05	<10	3.36
Fluoride as F	Mg/l	44	0.10	<1.0	0.11

Chemical Parameter	Unit	Quaternary Catchment G30D			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ¹⁾
pH		109	7.33	5.0 – 9.5	8.06
Electrical Conductivity	mS/m	109	86.90	<150	95.59
Calcium as Ca	mg/l	108	26.65	<150	29.32
Magnesium as Mg	mg/l	108	21.03	<100	23.14
Sodium as Na	mg/l	105	113.60	<200	124.96
Total Alkalinity as CaCO ₃	mg/l	107	43.72	N/A	48.09
Chloride as Cl	mg/l	108	217.11	<200	217.11
Sulphate as SO ₄	mg/l	109	36.10	<400	39.71
Nitrate as NO _x -N	mg/l	107	0.53	<10	0.58
Fluoride as F	Mg/l	103	0.16	<1.0	0.17
Chemical Parameter	Unit	Quaternary Catchment G30E			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		216	7.19	5.0 – 9.5	7.90
Electrical Conductivity	mS/m	216	151.75	<150	151.75
Calcium as Ca	mg/l	213	50.70	<150	55.77
Magnesium as Mg	mg/l	214	28.29	<100	31.12
Sodium as Na	mg/l	200	212.61	<200	212.61
Total Alkalinity as CaCO ₃	mg/l	212	52.17	N/A	57.39
Chloride as Cl	mg/l	213	352.44	<200	352.44
Sulphate as SO ₄	mg/l	214	53.50	<400	58.85
Nitrate as NO _x -N	mg/l	211	3.86	<10	4.24
Fluoride as F	Mg/l	205	0.20	<1.0	0.22

Chemical Parameter	Unit	Quaternary Catchment G30F			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		286	6.40	5.0 – 9.5	7.04
Electrical Conductivity	mS/m	286	77.45	<150	85.20
Calcium as Ca	mg/l	283	8.90	<150	9.79
Magnesium as Mg	mg/l	285	16.80	<100	18.48
Sodium as Na	mg/l	271	102.72	<200	112.99
Total Alkalinity as CaCO ₃	mg/l	285	10.52	N/A	11.57
Chloride as Cl	mg/l	284	199.74	<200	199.74
Sulphate as SO ₄	mg/l	285	17.10	<400	18.81
Nitrate as NO _x -N	mg/l	285	2.91	<10	3.20
Fluoride as F	Mg/l	276	0.11	<1.0	0.12
Chemical Parameter	Unit	Quaternary Catchment G30G			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		177	7.02	5.0 – 9.5	7.72
Electrical Conductivity	mS/m	177	125.60	<150	138.16
Calcium as Ca	mg/l	172	13.68	<150	15.05
Magnesium as Mg	mg/l	172	27.55	<100	30.30
Sodium as Na	mg/l	171	203.70	<200	203.70
Total Alkalinity as CaCO ₃	mg/l	170	21.76	N/A	23.94
Chloride as Cl	mg/l	172	348.69	<200	348.69
Sulphate as SO ₄	mg/l	172	32.74	<400	36.01
Nitrate as NO _x -N	mg/l	170	0.07	<10	0.08
Fluoride as F	Mg/l	163	0.17	<1.0	0.18

Chemical Parameter	Unit	Quaternary Catchment G30H			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		91	7.43	5.0 – 9.5	8.17
Electrical Conductivity	mS/m	91	299.00	<150	299.00
Calcium as Ca	mg/l	85	45.20	<150	49.72
Magnesium as Mg	mg/l	85	69.00	<100	75.90
Sodium as Na	mg/l	85	434.90	<200	434.90
Total Alkalinity as CaCO ₃	mg/l	88	50.25	N/A	55.28
Chloride as Cl	mg/l	85	863.50	<200	863.50
Sulphate as SO ₄	mg/l	86	99.70	<400	109.67
Nitrate as NO _x -N	mg/l	89	1.59	<10	1.75
Fluoride as F	Mg/l	84	0.24	<1.0	0.26
Chemical Parameter	Unit	Quaternary Catchment E31A			
		No. of Samples	Ambient GW quality or median ¹⁾	BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾
pH		42	7.84	5.0 – 9.5	8.62
Electrical Conductivity	mS/m	42	673.00	<150	673.00
Calcium as Ca	mg/l	37	410.44	<150	410.44
Magnesium as Mg	mg/l	36	103.15	<100	103.15
Sodium as Na	mg/l	37	884.62	<200	884.62
Total Alkalinity as CaCO ₃	mg/l	37	185.91	N/A	204.50
Chloride as Cl	mg/l	37	1734.30	<200	1734.30
Sulphate as SO ₄	mg/l	38	549.78	<400	549.78
Nitrate as NO _x -N	mg/l	37	45.60	<10	45.60
Fluoride as F	Mg/l	37	1.89	<1.0	1.89

Table 5.3: A summary of the groundwater quality class and parameters.

Catchment	Area(km ²)	Water Quality Class (WRC. 1998 & SANS 241:2006)	Water Quality parameters of concern
E10A	134	0	
E10B	202	0	
E10C	192	I	pH
E10D	235	0	
E10E	366	0	
E10F	386	0	
E10G	508	0	
E10H	162	0	
E10J	468	0	
E10K	235	II	Cl, Na,EC
E21A	190	0	
E21B	223	I	EC
E21C	233	0	
E21D	242	0	
E21E	293	0	
E21F	379	0	
E21G	266	I	EC
E21H	404	I	pH
E21J	317	0	
E21K	330	0	
E21L	195	0	
E22A	750	II	EC,Cl
E22B	638	III	Cl
E22C	490	0	
E22D	496	III	Cl, Na, Mg
E22E	1013	II	Cl
E22F	400	0	

Catchment	Area(km ²)	Water Quality Class (WRC, 1998 & SANS 241:2006)	Water Quality parameters of concern
E22G	367	II	Cl
E23A	762	II	Cl
E23B	705	II	Cl
E23C	318	II	Cl
E23D	750	II	Cl
E23E	564	III	Na
E23F	473	III	Na
E23G	747	III	Na
E23H	660	III	Na
E23J	895	III	Na
E23K	572	II	F, Na
E24A	255	III	Cl, Na
E24B	468	III	Cl, Na
E24C	784	II	F, Na
E24D	997	II	F, Na
E24E	671	III	Mg
E24F	582	II	Cl, Na, EC
E24G	633	III	Cl, Na
E24H	483	III	Cl, Na
E24J	1078	II	Cl
E24K	652	III	Cl, Mg
E24L	516	I	pH
E24M	529	II	Cl, Na, EC
E31A	2865	III	Ca, Cl, Na, EC, NO ₃ , Mg
E31B	1476	III	Cl, Na, EC, SO ₄
E31C	1572	III	Cl, Na, EC, Mg
E31D	839	III	Cl, Na, EC, Mg
E31E	478	III	Cl, Na, EC
E31F	525	II	Cl, Na, EC
E31G	1238	III	Cl, Na, EC
E31H	726	III	Cl, Na, EC

Catchment	Area(km ²)	Water Quality Class (WRC, 1998 & SANS 241:2006)	Water Quality parameters of concern
E32A	1118	I	EC, F
E32B	828	II	Cl, EC
E32C	638	II	Cl, EC
E32D	616	II	Cl, EC, Na, F
E32E	1001	III	Cl
E33A	1355	III	Cl, EC, Na
E33B	702	III	Cl, EC, Na, Mg, SO ₄
E33C	980	III	Cl, EC, Na
E33D	1559	III	Cl, EC
E33E	1282	III	Cl, EC, Na
E33F	725	III	Cl
E33G	894	II	Cl, EC
E33H	719	III	Cl, EC, Na
E40A	941	II	Cl, EC, Na, F
E40B	707	II	Cl, EC
E40C	530	I	Cl, EC, Na
E40D	544	0	
F60A	572	III	Cl, EC, Na, Mg
F60B	320	III	Cl, EC, Na
F60C	622	III	Cl, EC, Na, Mg
F60D	481	III	Cl, EC, Na, Mg
F60E	795	III	Cl, EC, Na, Mg
G30A	761	II	Cl, EC, Na
G30B	658	0	
G30C	351	I	Cl
G30D	534	II	Cl
G30E	352	II	Cl, EC, Na
G30F	780	I	Cl, EC, Na
G30G	647	II	Cl, Na
G30H	1077	III	Cl, Na