ANNEXURE B

1. SURFACE-WATER - QUANTITY COMPONENT FOR RIVERS

Proposed results for the Reserve determination and ecological categorisation for F60 and G30 catchments, where the Reserve amounts are expressed as a percentage of the NMAR for the respective catchments (cumulative) in terms of section 16(1).

Table 1.1: Reserve determination for the quantity component for the rivers which include the EWR & BHN for the priority sites.

Quaternary Catchment	Water Resource (Node/ EWR site)	PES	EIS	REC	NMAR (MCM)[1]	Ecological Reserve[3] (MCM)	BHN Reserve[4] (MCM)	Total Reserve[2] (% NMAR)
F60A	Lower Brak River – **EWR 1**	B	Moderate	B	0.07	0.019	0.001	28.59
F60B	Klein Goerap River at the confluence with the Sout River – Node 1	C	Moderate	B	0.07	0.019	0.009	43.28
F60C	Sout River at the confluence with the Klein Goerap River – Node 2	C	Moderate	C	0.255	0.046	0.004	39.36
F60D	Lower Groot River – **EWR 3**	C	Moderate	C	0.11	0.020	0.008	25.45
G30A	Lower Papkuils River – **EWR 15**	C/D	High	C	1.378	0.407	0.129	43.2
G30B	Bergvallei River at the confluence with the Kruismans River – Node 3	D/E	High	C	16.353	7.039	0.038	39.19
G30C	Upper Kruismans River at the confluence with the Bergvallei River – Node 4	D	High	C	11.457	4.510	0.004	19.67
G30D	Lower Kruimans River – **EWR 10**	D	High	C	27.813	11.279	0.004	42.2
G30D	Lower Krom Antonies River – **EWR 11**	C/D	High	C	7.318	2.730	0.001	39.1
G30E	Lower Verlorenvlei River – **EWR 12**	D	High	C	47.502	17.617	0.021	39.2
G30F	Lower Langvlei River – **EWR 8**	E	High	D	8.955	1.718	0.025	19.5
G30G	Lower Jakkals River – **EWR 7**	C/D	Moderate	D	2.315	0.685	0.131	37.4
G30H	Lower Sandlaagte River – **EWR 6**	C/D	Low	C	2.80	0.330	0.059	13.89

1) NMAR is the Natural Mean Annual Runoff.
2) The total Reserve amount accounts for both the Ecological Reserve and the Basic Human Needs Reserve (BHN).
3) This amount represents the long-term mean based on the NMAR. If the NMAR changes, this volume will also change.
4) Represents the Basic Human Needs (BHN).

2. SURFACE-WATER - QUALITY COMPONENT FOR RIVERS

Reserve determination for the Quality component at EWR sites

Table 2.1: Water quality Reserve Requirements for the Papkuils River (**G30A**)

Quality Constituent	Parameter	Ecological Reserve Requirements (PES)	Basic Human Needs Requirement	Reserve Requirement: water quality
General chemistry – Major Ions[1,2,3]	Sodium (mg/l)	N/A	<200	<200[4]
	Magnesium (mg/l)	N/A	<70	<70[4]
	Chloride (mg/l)	N/A	<200	<200[4]
	Calcium (mg/l)	N/A	<80	<80[4]
	Sulphate (mg/l)	N/A	<200	<200[4]
	Chloride (mg/l)	N/A	N/A	<0.35[4]
	Fluoride (mg/l)	N/A	< 1.5	<1.5[4]
	Manganese (µg/l)	N/A	<0.15	<0.15[4]
	Potassium (mg/l)	N/A	<50	<50[4]
Nutrients [1,2,3]	Phosphate (PO_4)(mg/l)	<0.2	N/A	<0.015 - 0.025
	Total Inorganic Nitrogen (mg/l)[3]	<0.5	<0.9	<0.7 – 1
Physical water quality	pH (pH units)	7.6	6 - 9	5th percentile 5.6 – 5.9/95th percentile 8.8 – 9.2
	Electrical conductivity (mS/m)	129	<70	≤129[5]
	Total Dissolve Solid (mg/l)	868	<450	≤868[5]
	Turbidity (NTU)	3.8	1 - 5	1 – 5
	Dissolve Oxygen (mg/l)	12.4		6 – 7
Toxics and complex mixtures[1]	Toxics (as listed in DWAF, 1996)	≤ TWQR	≤ TWQR	≤ TWQR
Microbiological Water Quality[3]	Faecal Coliforms (count per 100ml)	-	-	-
	Total Coliforms (count per 100ml)	-	<10	<10[4]

Table 2.2: Water quality Reserve Requirements for the Kruismans River (**G30D**)

Quality Constituent	Parameter	Ecological Reserve Requirements (PES)	Basic Human Needs Requirement	Reserve Requirement: water quality
General chemistry – Major Ions[1,2,3]	Sodium (mg/l)	N/A	<200	<200[4]
	Magnesium (mg/l)	N/A	<70	<70[4]
	Chloride (mg/l)	N/A	<200	<200[4]
	Calcium (mg/l)	N/A	<80	<80[4]
	Sulphate (mg/l)	N/A	<200	<200[4]
	Chlorine (mg/l)	N/A	N/A	<0.35[4]
	Fluoride (mg/l)	N/A	< 1.5	<1.5[4]

Quality Constituent	Parameter	Ecological Reserve Requirements (PES)	Basic Human Needs Requirement	Reserve Requirement: water quality
	Manganese (µg/l)	N/A	<0.15	<0.15[4]
	Potassium (mg/l)	N/A	<50	<50[4]
Nutrients [1,2,3]	Phosphate (PO_4)(mg/l)	<0.2	N/A	<0.015 - 0.025
	Total Inorganic Nitrogen (mg/l)[3]	<0.5	<0.9	<0.7 – 1
Physical water quality	pH (pH units)	7.19 – 7.35	6 - 9	5th percentile 5.6 – 5.9/95th percentile 8.8 – 9.2
	Electrical conductivity (mS/m)	650 - 990	<70	≤650 (wet season) ≤990 (dry season)[5]
	Total Dissolve Solid (mg/l)	4400 - 6800	<450	≤4400 (wet season) ≤6800 (dry season)[5]
	Turbidity (NTU)	1.8 – 19.2	1 - 5	1 – 5
	Dissolve Oxygen (mg/l)	13		6 – 7
Toxics and complex	Toxics (as listed in DWAF, 1996)	≤ TWQR	≤ TWQR	≤ TWQR
Microbiological Water Quality[3]	Faecal Coliforms (count per 100ml)	-	-	-
	Total Coliforms (count per 100ml)	-	<10	<10[4]

Table 2.3: Water quality Reserve Requirements for the Krom Antonies River (**G30D**)

Quality Constituent	Parameter	Ecological Reserve Requirements (PES)	Basic Human Needs Requirement	Reserve Requirement: water quality
General chemistry – Major Ions[1,2,3]	Sodium (mg/l)	N/A	<200	<200[4]
	Magnesium (mg/l)	N/A	<70	<70[4]
	Chloride (mg/l)	N/A	<200	<200[4]
	Calcium (mg/l)	N/A	<80	<80[4]
	Sulphate (mg/l)	N/A	<200	<200[4]
	Chlorine (mg/l)	N/A	N/A	<0.35[4]
	Fluoride (mg/l)	N/A	< 1.5	<1.5[4]
	Manganese (µg/l)	N/A	<0.15	<0.15[4]
	Potassium (mg/l)	N/A	<50	<50[4]
Nutrients [1,2,3]	Phosphate (PO_4)(mg/l)	<0.2	N/A	<0.015 - 0.025
	Total Inorganic Nitrogen (mg/l)[3]	<0.5	<0.9	<0.7 – 1
Physical water quality	pH (pH units)	7.65 – 7.78	6 - 9	5th percentile 5.6 – 5.9/95th percentile 8.8 – 9.2
	Electrical conductivity (mS/m)	29 - 157	<70	≤29 (wet season) ≤157 (dry season)[5]
	Total Dissolve Solid (mg/l)	202 - 1044	<450	≤202 (wet season) ≤1044 (dry season)[5]
	Turbidity (NTU)	1.4 – 18.2	1 - 5	1 – 5
	Dissolve Oxygen (mg/l)	10.8		6 – 7

Quality Constituent	Parameter	Ecological Reserve Requirements (PES)	Basic Human Needs Requirement	Reserve Requirement: water quality
Toxics and complex mixtures[1]	Toxics (as listed in DWAF, 1996)	≤ TWQR	≤ TWQR	≤ TWQR
Microbiological Water Quality[3]	Faecal Coliforms (count per 100ml)	-	-	-
	Total Coliforms (count per 100ml)	-	<10	<10[4]

Table 2.4: Water quality Reserve Requirements for the Verlorenvlei River (**G30E**)

Quality Constituent	Parameter	Ecological Reserve Requirements (PES)	Basic Human Needs Requirement	Reserve Requirement: water quality
General chemistry – Major Ions[1,2,3]	Sodium (mg/l)	N/A	<200	<200[4]
	Magnesium (mg/l)	N/A	<70	<70[4]
	Chloride (mg/l)	N/A	<200	<200[4]
	Calcium (mg/l)	N/A	<80	<80[4]
	Sulphate (mg/l)	N/A	<200	<200[4]
	Chlorine (mg/l)	N/A	N/A	<0.35[4]
	Fluoride (mg/l)	N/A	< 1.5	<1.5[4]
	Manganese (µg/l)	N/A	<0.15	<0.15[4]
	Potassium (mg/l)	N/A	<50	<50[4]
Nutrients [1,2,3]	Phosphate (PO_4)(mg/l)	<0.2	N/A	<0.015 - 0.025
	Total Inorganic Nitrogen (mg/l)[3]	<0.5	<0.9	<0.7 - 1
Physical water quality	pH (pH units)	7.62	6 - 9	5th percentile 5.6 – 5.9/95th percentile 8.8 – 9.2
	Electrical conductivity (mS/m)	194	<70	<194[5]
	Total Dissolve Solid (mg/l)	1300	<450	<1300[5]
	Turbidity (NTU)	4.4	1 - 5	1 - 5
	Dissolve Oxygen (mg/l)	8.9		6 - 7
Toxics and complex mixtures[1]	Toxics (as listed in DWAF, 1996)	≤ TWQR	≤ TWQR	≤ TWQR
Microbiological Water Quality[3]	Faecal Coliforms (count per 100ml)	-	-	-
	Total Coliforms (count per 100ml)	-	<10	<10[4]

Table 2.5: Water quality Reserve Requirements for the Langvlei River (**G30F**)

Quality Constituent	Parameter	Ecological Reserve Requirements (PES)	Basic Human Needs Requirement	Reserve Requirement: water quality
General chemistry – Major Ions[1,2,3]	Sodium (mg/l)	N/A	<200	<200[4]
	Magnesium (mg/l)	N/A	<70	<70[4]

Quality Constituent	Parameter	Ecological Reserve Requirements (PES)	Basic Human Needs Requirement	Reserve Requirement: water quality
	Chloride (mg/l)	N/A	<200	<200[4]
	Calcium (mg/l)	N/A	<80	<80[4]
	Sulphate (mg/l)	N/A	<200	<200[4]
	Chlorine (mg/l)	N/A	N/A	<0.35[4]
	Fluoride (mg/l)	N/A	< 1.5	<1.5[4]
	Manganese (µg/l)	N/A	<0.15	<0.15[4]
	Potassium (mg/l)	N/A	<50	<50[4]
Nutrients [1,2,3]	Phosphate (PO_4)(mg/l)	<0.2	N/A	<0.025 – 0.125
	Total Inorganic Nitrogen (mg/l)[3]	1.98	<0.9	<1 - 4
Physical water quality	pH (pH units)	6.9	6 - 9	5th percentile 5.0 – 5.6/95th percentile 9.2 – 10.0
	Electrical conductivity (mS/m)	1214	<70	≤1214[5]
	Total Dissolve Solid (mg/l)	7998	<450	≤7998[5]
	Turbidity (NTU)	37	1 - 5	1 – 5
	Dissolve Oxygen (mg/l)	14		6 – 7
Toxics and complex mixtures[1]	Toxics (as listed in DWAF, 1996)	≤ TWQR	≤ TWQR	≤ TWQR
Microbiological Water Quality[3]	Faecal Coliforms (count per 100ml)	-	-	-
	Total Coliforms (count per 100ml)	-	<10	<10[4]

Table 2.6: Water quality Reserve Requirements for the Jakkals River (**G30G**)

Quality Constituent	Parameter	Ecological Reserve Requirements (PES)	Basic Human Needs Requirement	Reserve Requirement: water quality
General chemistry – Major Ions[1,2,3]	Sodium (mg/l)	N/A	<200	<200[4]
	Magnesium (mg/l)	N/A	<70	<70[4]
	Chloride (mg/l)	N/A	<200	<200[4]
	Calcium (mg/l)	N/A	<80	<80[4]
	Sulphate (mg/l)	N/A	<200	<200[4]
	Chlorine (mg/l)	N/A	N/A	<0.35[4]
	Fluoride (mg/l)	N/A	< 1.5	<1.5[4]
	Manganese (µg/l)	N/A	<0.15	<0.15[4]
	Potassium (mg/l)	N/A	<50	<50[4]
Nutrients [1,2,3]	Phosphate (PO_4)(mg/l)	<0.2	N/A	<0.015 - 0.025
	Total Inorganic Nitrogen (mg/l)[3]	<0.5	<0.9	<0.7 - 1
Physical water quality	pH (pH units)	7.12 – 7.39	6 - 9	5th percentile 5.6 – 5.9/95th percentile 8.8 – 9.2
	Electrical conductivity (mS/m)	2200 - 10100	<70	≤2200 (wet

Quality Constituent	Parameter	Ecological Reserve Requirements (PES)	Basic Human Needs Requirement	Reserve Requirement: water quality
				season) ≤10100 (dry season)[5]
	Total Dissolve Solid (mg/l)	14606 - 61200	<450	≤14606 (wet season) ≤61200 (dry season)[5]
	Turbidity (NTU)	0.88 - 14	1 - 5	1 - 5
	Dissolve Oxygen (mg/l)	N/A		6 - 7
Toxics and complex mixtures[1]	Toxics (as listed in DWAF, 1996)	≤ TWQR	≤ TWQR	≤ TWQR
Microbiological Water Quality[3]	Faecal Coliforms (count per 100ml)	-	-	-
	Total Coliforms (count per 100ml)	-	<10	<10[4]

NOTE: *Where a difference in the water quality values for the Ecological Reserve and Basic Human Needs Reserve was found, the stricter or more protective value was selected for the water quality component of the Reserve.*

[1] ***ref:*** *South African Water Quality Guidelines, Volume 1: Domestic Water Use, 2nd Ed. 1996. Department of Water Affairs and Forestry. Pretoria, South Africa.*

[2] ***ref:*** *South African Water Quality Guidelines, Volume 7: Aquatic Ecosystems, 2nd Ed. 1996. Department of Water Affairs and Forestry. Pretoria, South Africa.*

[3] ***ref:*** *South African National Standard 241:2011 Water Quality Standards*

[4] ***note:*** *Based on Basic Human Needs requirements. Water for domestic use should be treated to SANS 241: 2011 Water Quality Standards.*

[5] ***note:*** *The Reserve Requirement does not meet the Basic Human Needs requirements as it is a naturally high salinity system and would never meet the BHN requirements. Water for domestic use should be treated to SANS 241: 2011 Water Quality Standards*

3. SURFACE-WATER - ESTUARIES COMPONENT

3.1 QUANTITY

Table 3.1. Geographical boundaries of Estuaries

Estuaries	Quat	Estuary Type	Location of Estuary Head	Location of Estuary Mouth	Lateral boundaries
Verlorenvlei Estuary	G30E	Estuarine Lake	32°25'55.82"S; 18°29'57.78"E	32°18'58.34"S; 18°20'5.96"E	5 m contour above Mean Sea Level (MSL) along each bank
Wadrift Estuary	G30F	Predominantly Closed estuary	32°12'49.87"S; 18°22'37.15"E	32°12'15.54"S; 18°19'32.43"E	5 m contour above Mean Sea Level (MSL) along each bank
Jakkals Estuary	G30G	Temporarily Closed estuary	32°5'26.89"S; 18°20'1.32"E	32°5'5.39"S; 18°18'48.25"E	5 m contour above Mean Sea Level (MSL) along each bank
Sout (Noord) Estuary	F60D	Predominantly Closed estuary	30°28'17.92"S 17°22'32.83"E	30°28'20.54"S 17°21'34.07"E	5 m contour above Mean Sea Level (MSL) along each bank

Table 3.2. The ecological water requirements of Estuaries.

Quaternary catchment	Water Resource	PES	EIS	REC	Ecological Reserve* (MCM)	Ecological Reserve (% NMAR)	Natural MAR (MCM)	Present MAR (MCM)
G30E	Verlorenvlei Estuary	D[1]	Important	C[2]	27.505	82.6	33.3	17.93
G30F	Wadrift Estuary	D	Important	C	3.658	77	4.75	3.2
G30G	Jakkals Estuary	D	Low to Average	D	0.804	57	1.41	0.96
F60D	Sout (Noord) Estuary	E	Average	D	-[3]	-[3]	0.46	0.46

[1] The observed Present (2022) was estimated to be E Category due to the extended drought, which together with the abstraction of water, caused persistent long-term exposure of the lake margins and bed (very low water levels). Assuming that recovery is possible after lake levels increase again, an evaluation of the 101-year Present simulation scenario indicated a PES = Category D.

[2] The Verlorenvlei Estuary was categorised as an "important estuary". It is a Ramsar site and a desired protected area in the Biodiversity Plan for the National Biodiversity Assessment. Therefore, according to the guidelines for assigning a REC, the condition of the estuary should be elevated to the Best Attainable State (BAS). The Best Attainable State for the estuary is B.

[3] The Sout Estuary assessment was undertaken at a desktop with hydrology that was of a very low confidence. It is recommended that the system should be restored from a E to a D. As most of the impacts are non-flow related the present-day flows should be maintained as the recommended flow.

3.2 ECOLOGICAL SPECIFICATIONS

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) prompt management action. In essence, TPCs should provide early warning signals of potential non-compliance to ecological specification (i.e. not the point of 'no return'). This implies that the indicators (or monitoring activities) selected as part of a long-term monitoring programme need to include biotic and abiotic components that are particularly sensitive to changes in river inflow. The TPCs associated with each of the ecological specifications are also provided in **Table 3.3 to Table 3.6**.

Table 3.3: Ecological Specifications and TPC associated with an Ecological Category B in the Verlorenvlei River Estuary

Abiotic/Biotic Component	Ecological Specification	Threshold of Potential Concern
Water quality	Salinity structure and the occurrence of different abiotic states should correspond as closely as possible with the Reference condition; State 5 (Closed, Low water level hypersaline) should not occur at all.	• Salinity in Zone A > 45 (for 3 years) • Salinity in Zone B > 3 • Salinity in Zone C > 1.5
	Water quality in **river inflow** does not detrimentally affect water quality conditions in estuary, specifically relating to inorganic nutrient enrichment and toxic substances	River inflow: • pH of river inflow exceeds 8.5 or is less than 5.5 • Dissolved oxygen (DO) less than 4 mg/ℓ • Turbidity persistently exceeds 10 NTU • Dissolved Inorganic Nitrogen (DIN) persistently greater than 200 µg/ℓ • Dissolved Inorganic Nitrogen (DIN) persistently greater than 50 µg/ℓ • Toxic substance concentrations (e.g. heavy metals and agrochemicals) exceed South African Water Quality guidelines (freshwater and coastal marine)
	Water quality **in estuary** does not detrimentally impact biotic health, specifically relating to nutrient enrichment and diurnal fluctuation in pH and (e.g. decreasing at night and increasing during day time), or acidification and potential hypoxia developing during algal decay.	Estuary: • pH drop below 6, or persistently above 9 • DO less than 4 mg/ℓ

Abiotic/Biotic Component	Ecological Specification	Threshold of Potential Concern
		• Turbidity persistently exceeds 20 NTU (e.g. as a result of persistent algal blooms) • Resultant DIN exceeds 100 µg/ℓ (in a closed system this would suggest excessive enrichment through remineralisation) • Resultant DIP exceeds 20 µg/ℓ) (in a closed system this would suggest excessive enrichment through remineralisation) • Toxic substance concentrations (e.g. metals and agrochemicals) exceed South African Water Quality guidelines (freshwater and coastal marine)
Hydrodynamic	Estuary should be allowed to function as naturally as possible with minimal human intervention	• The mouth is breached artificially • No connectivity between Zone A, B and C
Sediment dynamics	Flood and breaching regimes to maintain the sediment distribution patterns and aquatic habitat (instream physical habitat) so as not to exceed TPCs for biota	• As for hydrodynamics above
Microalgae	Phytoplankton communities should reflect a diverse community, with moderate to low biomass (measured as chlorophyll-a concentration), and reduced occurrence of HABs. Benthic microalgal communities should reflect moderate biomass and medium- (closed phase) to high (open phase) benthic diatom diversity.	• Phytoplankton biomass greater than 20 µg Chl-*a* l^{-1}. • High-biomass HABs (> 60 µg Chl-*a* l^{-1} dominated by a single taxa, e.g., cyanophytes) in spring/summer. • Subtidal benthic microalgal biomass greater than 100 mg Chl-*a* m^{-2}. • Benthic diatom diversity (*H'*) less than 2.
Macrophytes	Monitor the distribution of plant community types i.e. reeds and sedges, submerged macrophytes, salt marsh during water level fluctuations. Maintain reeds and sedges and open water habitat which supports associated biota. Reeds and sedges are dependant on groundwater discharge (See methods decribed in Verlorenvlei EWR report). Increases in upper reaches are in response to sediment and nutrient input. Monitor acidic soils as long-term effects on the recovery of macrophytes are unknown. Important risk factors are pH and salinity, particularly in the groundwater and sediment. Water column turbidity is important	• Greater than 20% change in the area covered by different macrophyte habitats. • Open water area below 1.2 ha (Zone A), 405 ha (Zone B) and 14.3 ha (Zone C) results in exposure to acidic soils. • Groundwater salinity above 10 to 5 reduces the growth of reeds and sedges.

Abiotic/Biotic Component	Ecological Specification	Threshold of Potential Concern
	for submerged macrophyte .	• Sediment salinity > 75 results in no significant growth. Seed germination hampered below 15.
Invertebrates	The estuary should contain a diverse invertebrate community that includes representatives of all functional groups listed in this report, particularly the freshwater and brackish species including the macroinvertebrates.	A decline in the abundance and diversity of crustacea and insect lavae in zooplankton (baseline to be determined).
Fish	Retain the following fish assemblages in the estuary (based on abundance): estuarine-resident species (20-30%), estuarine associated marine species (60-70%) and indigenous freshwater species (<1%). All numerically dominant indigenous species are represented by 0+ juveniles within 12 months of the system being open.	• Level of estuary-associated marine species drops below 50% of total abundance. • Occurrence of alien freshwater species in the estuary. • Absence of 0+ juveniles of any of the dominant fish species within 12 months of the system being open.
Birds	The estuary should contain a diverse avifaunal community that includes representatives of all functional guilds listed in this report, particularly the migratory waders and waterfowl. The estuary should support thousands of birds in summer and hundreds in winter.	• Reduced abundance of piscivores (< 3 species; or <100 birds). • Numbers of waterfowl drop below 600 or waders below 100 in summer. • Overall numbers of waterbirds drop below 2000 for 3 consecutive counts in summer.

Table 3.4: Ecological Specifications and TPC associated with an Ecological Category B in the Wadrift River Estuary

Abiotic/biotic Component	Ecological Specification	Threshold of Potential Concern
Water quality	Salinity structure and the occurrence of different abiotic states should correspond as closely as possible with the Reference condition; State 5 (Closed, Low water level hypersaline) should not occur at all.	• Salinity in any part of the estuary exceeds 65
	Water quality in **river inflow** does not detrimentally affects water quality conditions in estuary, specifically relating to inorganic nutrient enrichment and toxic substances	River inflow: • pH of river inflow exceeds 8.5 or decrease below 5.5 • Dissolved oxygen (DO) less than 4 mg/ℓ

Abiotic/biotic Component	Ecological Specification	Threshold of Potential Concern
		• Turbidity persistently exceeds 10 NTU • Dissolved Inorganic Nitrogen (DIN) persistently greater than 200 µg/ℓ • Dissolved Inorganic Nitrogen (DIN) persistently greater than 50 µg/ℓ • Toxic substance concentrations (e.g. metals and agrochemicals) exceed South African Water Quality guidelines (freshwater and coastal marine). A comprehensive baseline sampling will have to be conducted to determine the substances to be incorporated in long term monitoring programme.
	Water quality **in estuary** does not detrimentally impact biotic health, specifically relating to nutrient enrichment and diurnal fluctuation in pH and (e.g. decreasing at night and increasing during day time), or acidification and potential hypoxia developing during algal decay.	Estuary: • pH drop below 6, or persistently above 9 • DO less than 4 mg/ℓ • Turbidity persistently exceeds 20 NTU (e.g. as a result of persistent algal blooms) • Resultant DIN exceeds 100 µg/ℓ (in a closed system this would suggest excessive enrichment through remineralisation) • Resultant DIP exceeds 20 µg/ℓ) (in a closed system this would suggest excessive enrichment through remineralisation) • Toxic substance concentrations (e.g. metals and agrochemicals) exceed South African Water Quality guidelines (freshwater and coastal marine)
Hydrodynamics	Estuary should be allowed to function as naturally as possible with minimal human intervention	• No connectivity between Zone A and B (culvert levels in bridges raised above the floor ground)
Sediment dynamics	Flood and breaching regimes to maintain the sediment distribution patterns and aquatic habitat (instream physical habitat) so as not to exceed TPCs for biota	• As for hydrodynamics above

Abiotic/biotic Component	Ecological Specification	Threshold of Potential Concern
Microalgae	Phytoplankton communities should be maintained to reflect a diverse community, with moderate biomass (measured as chlorophyll-*a* concentration), and limited occurrence of HABs. Benthic microalgal communities should reflect moderate levels of biomass and diversity during the closed phase, and improve during periods of increased river inflow.	• Phytoplankton biomass greater than 20 µg Chl-*a* l^{-1}. • Frequent and monospecific (>90% relative abundance) high-biomass HABs (>60 µg Chl-*a* l^{-1}) • Subtidal benthic microalgal biomass greater than 100 mg Chl-*a* m^{-2}. • Benthic diatom diversity (*H'*) less than 2.
Macrophytes	Maintain the distribution, extent and diversity of plant community types, salt marsh and any remaining reed and sedges. Although peat swamps in the upper reaches will not return, increased freshwater inflow will increase habitat diversity and reduce terrestrial species that have now replaced lost habitat.	• Greater than 20% change in the area covered by different macrophyte habitats for baseline open and closed mouth conditions.
Benthic Invertebrates Zooplankton	Retain the present invertebrate assemblages	• Baseline to be determined
Fish	Retain the present fish assemblages.	• No fish present • Occurrence of alien freshwater species in the estuary.
Birds	The estuary should contain a rich avifaunal community that includes representatives of all the original groups, significant numbers of migratory waders and terns, as well as a healthy breeding population of resident waders. The estuary should support thousands of birds in summer and hundreds in winter.	• Numbers of waterfowl drop below 600, waders below 100 in summer, and terns below 250 • Overall numbers of bird species drop below 1000 for 3 consecutive counts.

Table 3.5: Ecological Specifications and TPC associated with an Ecological Category D in the Jakkals River Estuary

Abiotic/Biotic Component	Ecological Specification	Threshold of Potential Concern
Water quality	Salinity structure and the occurrence of different abiotic states should correspond as closely as possible with the Present State; State 1 (Closed, Low water level hypersaline) should not occur more than at present	• Salinity in any part of the estuary exceeds 35
	Water quality in river inflow does not detrimentally affect water quality conditions in estuary, specifically relating to inorganic nutrient enrichment and toxic substances	River inflow: • pH of river inflow exceeds 8.5

Abiotic/Biotic Component	Ecological Specification	Threshold of Potential Concern
		• Dissolved oxygen (DO) less than 4 mg/ℓ • Turbidity persistently exceeds 10 NTU • Dissolved Inorganic Phosphate (DIP) persistently greater than 200 µg/ℓ • Dissolved Inorganic Nitrogen (DIN) persistently greater than 50 µg/ℓ • Toxic substance concentrations (e.g. metals and agrochemicals) exceed South African Water Quality guidelines (freshwater and coastal marine). Comprehensive baseline sampling will have to be conducted to determine the substances to be incorporated in long term monitoring programme.
	Water quality in estuary does not detrimentally impact biotic health, specifically relating to nutrient enrichment and diurnal fluctuation in pH and (e.g. decreasing at night and increasing during day time), or acidification and potential hypoxia developing during algal decay.	Estuary: • pH drop below 6, or persistently above 9 • DO less than 4 mg/ℓ • Turbidity persistently exceeds 20 NTU (e.g. as a result of persistent algal blooms) • Resultant DIN exceeds 100 µg/ℓ (in a closed system this would suggest excessive enrichment through remineralisation) • Resultant DIP exceeds 20 µg/ℓ) (in a closed system this would suggest excessive enrichment through remineralisation) • Toxic substance concentrations (e.g. metals and agrochemicals) exceed South African Water Quality guidelines (freshwater and coastal marine). Comprehensive baseline sampling will have to be conducted to determine the substances to be incorporated in long term monitoring programme.

Abiotic/Biotic Component	Ecological Specification	Threshold of Potential Concern
Hydrodynamics	Estuary should be allowed to function as naturally as possible	• >11% occurrence in State 1:Closed marine/hypersaline, indicated by extensive exposure of Zone B and C. • >72% occurrence in State 2:Closed marine • <5% occurrence of open mouth conditions • Overwash does not occur for 6 months
Sediment dynamics	Flood and breaching regimes to maintain the sediment distribution patterns and aquatic habitat (instream physical habitat) so as not to exceed TPCs for biota	• As for hydrodynamics above
Microalgae	Phytoplankton communities should be maintained to reflect a diverse community, with moderate biomass (measured as chlorophyll-*a* concentration), and limited occurrence of HABs. Benthic microalgal communities should reflect moderate levels of biomass and diversity during the closed phase, and improve during periods of increased river inflow.	• Phytoplankton biomass greater than 20 µg Chl-*a* l^{-1}. • Monospecific (>90% relative abundance) high-biomass HABs (>60 µg Chl-*a* l^{-1}) • Subtidal benthic microalgal biomass greater than 100 mg Chl-*a* m^{-2}. • Benthic diatom diversity (*H'*) less than 2.
Macrophytes	Maintain the distribution, extent and diversity of plant community types, salt marsh and any remaining reed and sedges. Although peat swamps in the upper reaches will not return, increased freshwater inflow will increase habitat diversity and reduce terrestrial species that have now replaced lost habitat.	• Greater than 20% change in the area covered by different macrophyte habitats for baseline open and closed mouth conditions.
Benthic Invertebrates Zooplankton	Retain the present invertebrate assemblages	• Baseline to be determined
Fish	Retain the present fish assemblages.	• Less than 2 of the 5 expected species of fish observed • Occurrence of alien freshwater species in the estuary. • Absence of 0+ juveniles of any of the dominant fish species.

Abiotic/Biotic Component	Ecological Specification	Threshold of Potential Concern
Birds	The estuary should contain a diverse although seasonally stochastic avifaunal community that includes representatives of functional guilds listed in this report, particularly the migratory waders and waterfowl. The estuary should support a few hundred waterbirds in summer in winter.	• Reduced abundance of piscivores (< 2 species; or <10 birds). • Numbers of waterfowl or waders drop below 50 in summer. • Overall numbers of waterbirds drop below 200 for 3 consecutive counts in summer, and less than 10 species are recorded in consecutive counts

Table 3.6: Ecological Specifications and TPC associated with an Ecological Category D in the Sout River Estuary

Abiotic/Biotic Component	Ecological Specification	Threshold of Potential Concern
Water quality	Extreme hypersalinity should be prevented	• Upper reaches: >120 psu (hyper salinity) • Middle Reaches: > 80 psu (hyper salinity) • Lower reaches: > 60 psu (hyper salinity)
	Water quality in estuary does not detrimentally impact biotic health, specifically relating to nutrient enrichment and potential hypoxia developing during algal decay.	• DIN: Entire estuary, average >0.1 mg/ℓ • DIP: Entire estuary, average >0.01 mg/ℓ • DO: Entire estuary, average $\underline{>6}$ mg/ℓ • Turbidity: Entire estuary, average >10 NTU except during floods • Toxic substance concentrations (e.g. metals and agrochemicals) exceed South African Water Quality guidelines (freshwater and coastal marine) Comprehensive baseline sampling will have to be conducted to determine the substances to be incorporated in long term monitoring programme.
Hydrodynamics	Estuary should be allowed to function as naturally as possible	Improved connectivity with the different water bodies and restored connectivity with the catchment through removal/modification of weir at the head of the estuary.
Sediment dynamics	Flood and breaching regimes to maintain the sediment distribution patterns and aquatic habitat (instream physical habitat) so as not to exceed TPCs for biota	• The flood regime maintains the sediment distribution patterns and aquatic habitat (instream physical habitat).The suspended sediment concentration from river inflow does not deviate by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion

Abiotic/Biotic Component	Ecological Specification	Threshold of Potential Concern
		patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined). • Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (levels to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five-year average.
Microalgae	Phytoplankton communities should be maintained to reflect a diverse community, with moderate biomass (measured as chlorophyll-*a* concentration), and limited occurrence of HABs. Benthic microalgal communities should reflect moderate levels of biomass and diversity during the closed phase, and improve during periods of increased river inflow.	Maintain the distribution of different phytoplankton groups and low biomass in the lower reaches (< 10 µg l^{-1} (Baseline to be determined).
Macrophytes	Maintain the distribution, extent and diversity of plant community types, salt marsh and any remaining reed and sedges. Although peat swamps in the upper reaches will not return, increased freshwater inflow will increase habitat diversity and reduce terrestrial species that have now replaced lost habitat.	• >20 % change in the area covered by different macrophyte habitats (accounts for natural changes due to the dynamic nature of estuaries). • Water column salinity not greater than 50 in the lower reaches to limit salt accumulation and dieback of salt marsh (*Sarcocornia pillansii*). • Prevent further disturbance and development in the salt marsh and floodplain habitat through salt works activities.
Benthic Invertebrates Zooplankton	Retain the present invertebrate assemblages	• Unincysted Brine shrimp should be present in the system for < 75% of the time. • Baseline to be determined
Fish	Not applicable. Hyper saline system.	• Not applicable. Hyper saline system.
Birds	The estuary should contain a diverse although seasonally stochastic avifaunal community that includes representatives of functional guilds listed in this report, particularly the migratory waders and waterfowl. The estuary should support a few hundred waterbirds in summer in winter.	• Including flamingos, more than 10 species of waders and water birds that feed on brine shrimp should be present < 75% of the time (During 40 – 150 and brine shrimp available). • The occurrence and cause of bird mortalities needs to be verified.

4. SURFACE-WATER - QUANTITY COMPONENT FOR WETLAND

Proposed EWR sites were selected within each of the Wetland Resource Units during the reconnaissance field survey undertaken in March 2022. The EWR sites were selected together with the EWR sites/reaches for the River Resource Units to facilitate integration.

Table 4.1 identifies the priority wetlands in the F60 and G30 catchments and summarises the PES, EIS, REC for the identified wetlands.

Table 4.1: Table showing results of the prioritised wetlands**.**

Quat	EWR site/ Node	Water Resource	Geographic coordinates		PES	EIS	REC
			Latitude	Longitude			
F60A	EWR 2	North West Fynbos depression Wetland	30°57'15.89"S	17°46'43.61"E	A/B	High	A/B
F60C	EWR 4	Knersvlakte depression Wetland	31° 7'12.48"S	17°54'33.50"E	B	Moderate	B
F60E	EWR 5	Sandveld depression Wetland	31°24'10.86"S	17°59'24.11"E	C	Moderate	C
G30F	EWR 9	Wadrift Wetland	32°12'52.21"S	18°22'31.50"E	F	High	D
G30A	EWR13	Isolated depression/ duneslack wetland	32°22'39.14"S	18°19'48.28"E	C	High	C
G30A	EWR14	Rocherpan	32°36'49.34"S	18°17'55.89"E	D	High	C
G30A	EWR16	Papkuilsvlei / Rietvlei	32°38'1.26"S	18°29'56.29"E	C	High	C

5. GROUNDWATER - QUANTITY COMPONENT

5.1 GROUNDWATER RESERVE – WATER QUANTITY COMPONENT

Delineation of the groundwater system within the G30 catchment followed the existing quaternary boundaries (**Figure 2**) as they do tend to each incorporate a single valley that relates well with perceived groundwater flow and surface water contribution. The G30D quaternary catchment was split into a northern and southern GRU. This was based on a large difference in the rainfall received evidently increasing from north to south. The southern portion of the quaternary catchment experiences much higher rainfall in comparison to that of the north. Where the southern mountainous area comprises sedimentary bedrock cross-cut by fault structures and fractured zones, linked to higher percentages of recharge. G30F has also been split into a northern and southern GRU as this quaternary catchment includes two valleys that each have a separate paleochannel type feature.

Taking into account the nature of the groundwater system within the F60 catchments, the existing quaternary boundaries (**Figure 3**) were also followed as they do tend to each incorporate a single surface water system and as the RQOs will be on that level and actual groundwater boundaries are not known, the quaternary boundaries will act as sufficient separation. Due to the presence of karst type aquifers in F60E`s coastal areas, it was attempted to divide the catchment. Due to a lack of data that could indicate exactly how far up the coast the karst aquifers stretch, it was decided to ultimately leave the boundaries of the GRU as is until sufficient data becomes available. Delineation areas in G30 catchments.

Table 5.1: Determination of the Groundwater Reserve

Sub-catchments used to calculate recharge	River System	Area (km^2)	MAP (mm)	Estimated Recharge (% of total annual flow)	Calculated recharge (Mm^3)	Total abstracted for Town supply (million m^3)	Reserve (BHN + Springflow + Baseflow Contributions)	Total abstracted for irrigation (million m^3)	Groundwater Balance (million m^3)
G30A1	Papkuils	131.1	292	3.5%	1.34				
G30A2	Papkuils Lower	10.0	292	3.5%	0.10				
G30A_Groundwater		604.3	260	3.5%	5.50				
G30A_Total					**6.94**	**0**	**0.252981875**	**6.79956**	**-0.11070**
G30B1	Upper Kruismans	23.7	505	23.0%	2.75				
G30B1	Upper Kruismans	92.4	300	5.0%	1.39				
G30B2	Soutkloof	17.8	415	23.0%	1.69				
G30B2	Soutkloof	194.5	300	5.0%	2.92				
G30B3	Huis tributary	53.8	505	23.0%	6.25				
G30B3	Huis tributary	288.5	300	5.0%	4.33				
G30B_Total					**19.32**	**0.053676**	**3.5056685**	**2.1537**	**13.61017**
G30C1	Kleinvlei	64.3	404	23.0%	5.98				
G30C2	Jansekraal	62.6	404	23.0%	5.81				
G30C3	Bergvallei	218.2	383	3.5%	2.92				
G30C_Total					**14.72**	**0.074207**	**1.541531375**	**6.33080**	**6.76926**
G30D1	KA upper	64.8	517	23.0%	7.71				
G30D1	KA lower	55.1	366	5.0%	1.01				

Sub-catchments used to calculate recharge	River System	Area (km^2)	MAP (mm)	Estimated Recharge (% of total annual flow)	Calculated recharge (Mm^3)	Total abstracted for Town supply (million m^3)	Reserve (BHN + Springflow + Baseflow Contributions)	Total abstracted for irrigation (million m^3)	Groundwater Balance (million m^3)
G30D2	Hol upper	51.7	517	23.0%	6.15				
G30D2	Hol lower	102.6	366	5.0%	1.88				
G30D3	Matroosfontein	128.2	347	3.5%	1.56				
G30D4	Verlorenvlei	151.8	347	3.5%	1.84				
G30D_Total					**20.14**	**0.03798867**	**3.286462**	**10.53787**	**6.27765**
G30E1	Kruisfontein	90.4	286	3.5%	0.91				
G30E2	Verlorenvlei	44.9	286	3.5%	0.45				
G30E3	Verlorenvlei	35.3	286	3.5%	0.35				
G30E4	Verlorenvlei	190.5	286	5.0%	2.72				
G30E_Total					**4.43**	**0.443172**	**0.791505375**	**2.9434064**	**0.25440**
G30F1	Langvlei	194.2	352	3.5%	2.39				
G30F2	Lambertshoek	98.9	352	23.0%	8.01				
G30F3		397.8	236	3.5%	3.29				
G30F4		30.2	212	3.5%	0.22				
G30F_Groundwater_North		20.2	175	3.5%	0.12				
G30F_Groundwater_South		59.1	212	3.5%	0.44				
G30F_Total					**14.47**	**0.98592**	**1.713247375**	**18.43323**	**-5.10282**
G30G1	Jakkals	134.4	268	xx	11.15				

Sub-catchments used to calculate recharge	River System	Area (km^2)	MAP (mm)	Estimated Recharge (% of total annual flow)	Calculated recharge (Mm^3)	Total abstracted for Town supply (million m^3)	Reserve (BHN + Springflow + Baseflow Contributions)	Total abstracted for irrigation (million m^3)	Groundwater Balance (million m^3)
G30G2	Peddies	49.4	268	23.0%	3.05				
G30G3		317.5	208	3.5%	2.31				
G30G4		21.7	138	3.5%	0.10				
G30G_Groundwater_West		89.8	138	3.5%	0.43				
G30G_Groundwater_East		44.2	208	3.5%	0.32				
G30G_Total					**17.37**	**0.203213**	**0.670242125**	**3.616832**	**12.87576**
G30H1		580.8	204	3.5%	4.15				
G30H_Groundwater		495.4	138	3.5%	2.39				
G30H_Total					**6.53**	**0**	**0.059102625**	**2.31426**	**4.16041**
F60A	Brak	386	103	3.5%	**1.39**	**0**	**0.0010585**		**1.39047**
F60B	Klein-Goerap	320	129	3.5%	**1.44**	**0.183146**	**0.008513625**		**1.25314**
F60C	Sout	622	114	3.5%	**2.48**	**0**	**0.00406975**		**2.47771**
F60D	Groot-Goerap	481	120	3.5%	**2.02**	**0**	**0**		**2.02020**
F60E		120	116	3.5%	**0.49**	**0**	**0.000556625**		**0.48664**

5.2 GROUNDWATER RESERVE – WATER QUALITY COMPONENT

Groundwater Quality component of the Reserve Determined with the template that uses 10% above median as the Reserve. Please take note that groundwater quality naturally changes within a catchment, as well as seasonally. The groundwater quality should comply with the target water quality ranges as shown in **Table 5.2**. In preliminary determinations of the quality component the ambient groundwater quality is compared to the Class 1 potability value (SANS 241:1 2011). 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. The overall water quality of the resource units is well within the drinking water quality guidelines.

Table 5.2: General Chemistry

Chemical Parameter	**Target Water Quality Ranges**[1]				
	Units	**Class 0**	**Class I**	**Class II**	**Class III**
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
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_x- 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

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

NOTE:

Class 0: Water is classed as ideal drinking water, suitable for lifetime use. The values are essentially the same as the target water guideline in the South African Water Quality Guideline for Domestic Use.

Class I: Water is still safe for lifetime use; however, some mild health effects may, in very rare cases, occur. They may also be some aesthetic effects.

Class II: Water allowable for limited short term or emergency use. Health effects may be felt more commonly, as compared to Class I, especially by those who are long term users of the water. Therefore, it is not recommended that the water be used continuously for life. This is only class in the guideline which is not specific in terms of the exact duration that the water can be used for. It states that it can be used for short term use; but does not define what length of time “short term” refers to.

Class III: Class III water will cause serious health effects, particular in infants and elderly people. Use of this water is not recommended for drinking purposes.

Table 5.3. Preliminary Groundwater Quality Component of the Reserve.

Quaternary catchment		Ca (mg/L)	Cl (mg/L)	EC (mS/m)	F (mg/L)	Mg (mg/L)	No3 + No2 (mg/L)	Na (mg/L)	SO4 (mg/L)	TAL	pH
F60A	No of Sample Sites	10	10	10	10	10	10	10	10	10	10
	Median	121.25	3386	1058.5	0.64	210.5	0.3125	1848.6	514.95	152.1	7.595
	Average	135.08	3405.97	980.8	0.924	218.11	0.7714	1896.43	466.39	153.24	7.519
	95 percentile	315.03	8000.025	2088.25	2.3515	537.91	2.66535	4385.295	1067.57	229.75	8.2755
	5 percentile	15.8	314.345	112.75	0.2	27.18	0.02	159.39	22.575	57.2	6.445
	Groundwater Quality Reserve	133.375	3724.6	1164.35	0.704	231.55	0.34375	2033.46	566.445	167.31	8.2709
F60B	No of Sample Sites	71	71	71	71	71	64	64	71	71	71
	Median	152.2	2005.3	656	1.415	187.1	1.535	1034.443	394	174.6	7.77
	Average	200.1151	2484.776	792.9345	1.47331	237.066	5.507414	1304.9	460.5053	166.7894	7.633296
	95 percentile	507.85	4896.65	1415	2.5475	551	25.2245	1926.473	911.925	285.55	8.39
	5 percentile	50.45	445	146	0.53	54.5	0.02	698.06	60	52.4	6.975
	Groundwater Quality Reserve	167.42	2205.83	721.6	1.5565	205.81	1.6885	1137.887	433.4	192.06	8.396625
F60C	No of Sample Sites	32	32	32	32	32	32	32	32	32	32
	Median	142.3	2462.85	765	1.075	195.45	0.16	1280.5	361.9	103.4	7.175
	Average	184.0891	2705.688	838.1688	1.22375	220.4469	3.301219	1344.302	404.7125	101.1922	7.2025
	95 percentile	385.545	5112.41	1543.6	2.3345	435.815	13.707	2453.865	670.39	202.935	7.8325
	5 percentile	48.385	635.55	223.76	0.37775	53.96	0.02	336.215	109.305	11.15	6.5685
	Groundwater Quality Reserve	156.53	2709.135	841.5	1.1825	214.995	0.176	1408.55	398.09	113.74	7.92275

Quaternary catchment		Ca (mg/L)	Cl (mg/L)	EC (mS/m)	F (mg/L)	Mg (mg/L)	No3 + No2 (mg/L)	Na (mg/L)	SO4 (mg/L)	TAL	pH
F60D	No of Sample Sites	5	5	5	5	5	5	5	5	5	5
	Median	288.7	4249.6	1255	2	270.7	0.59	2136.5	592.2	180.4	7.83
	Average	254.56	3955.46	1189.6	1.99	284.48	3.9268	2079.22	606.46	161.6	7.804
	95 percentile	372.24	4786.36	1432	2.528	429.14	12.9508	2609.34	763.1	204.5	8.042
	5 percentile	116.84	2664.02	808	1.576	161.86	0.02	1454.82	407.3	97.66	7.556
	Groundwater Quality Reserve	317.57	4674.56	1380.5	2.2	297.77	0.649	2350.15	651.42	198.44	8.5844
F60E	No of Sample Sites	13	13	13	5	13	13	13	13	5	13
	Median	461	8812.8	2565	3.08	620	1.13	4289.9	1264.4	112.5	7.5
	Average	486.6308	9206.658	2595.846	2.736	724.1154	2.535077	4568.458	1340.038	123.2	7.685385
	95 percentile	1047.8	17630.12	4686	3.638	1546.6	9.9626	8138.7	2409.52	190.78	8.74
	5 percentile	40.8	2537.42	802.58	1.272	82.4	0.012	1328.22	333.98	50.2	7.02
	Groundwater Quality Reserve	507.1	9694.08	2821.5	3.388	682	1.243	4718.89	1390.84	123.75	8.453923
G30A	No of Sample Sites	46	46	46	46	46	46	46	46	46	46
	Median	38.9	928.6	325.5	0.41	79.55	0.09	510.55	105	59.55	6.705
	Average	66.80552	1329.66	429.7391	0.698424	112.3196	5.865696	718.1763	215.989	83.26383	6.678076
	95 percentile	186.325	3593.05	1119.075	1.685	288.35	5.2575	1981.125	794.6	269.8	7.5975
	5 percentile	7.825	201.519	86.45	0.106	13.7735	0.02	118.3	17.075	2	4.825
	Groundwater Quality Reserve	42.79	1021.46	358.05	0.451	87.505	0.099	561.605	115.5	65.505	7.345884
G30A	No of Sample Sites	71	71	71	71	71	71	71	71	71	71
	Median	26.5	460.4	191	0.29	37.6	1.617	273.4	41.6	73.4	7.49

Quaternary catchment		Ca (mg/L)	Cl (mg/L)	EC (mS/m)	F (mg/L)	Mg (mg/L)	No3 + No2 (mg/L)	Na (mg/L)	SO4 (mg/L)	TAL	pH
	Average	40.59099	717.4127	259.1075	0.371592	62.67571	5.757516	380.602	82.58715	89.5521	7.377781
	95 percentile	154.65	2602.6	817	0.895	237.55	20.1255	1279.85	253.45	204.35	7.915
	5 percentile	3.949167	25.77848	22.2	0.115	3.856292	0.02	16.11025	5.85	10.5746	6.66
	Groundwater Quality Reserve	29.15	506.44	210.1	0.319	41.36	1.7787	300.74	45.76	80.74	8.115559
G30C	**No of Sample Sites**	23	23	23	23	23	23	23	23	23	23
	Median	5.6	102.6	45.6	0.1045	9.6	2.898	52.5	10.3	5.8	6.24
	Average	7.493304	126.4481	51.1913	0.118891	11.67498	3.403674	65.37291	15.65283	13.14391	6.124261
	95 percentile	23.81	284.05	107.01	0.249	25.61	8.40435	145.83	31.95	52.89	7.439
	5 percentile	1.51	32.22	17.8	0.05	3	0.3131	16.99	2	0	4.904
	Groundwater Quality Reserve	6.16	112.86	50.16	0.11495	10.56	3.1878	57.75	11.33	6.38	6.736687
G30E	**No of Sample Sites**	54	54	54	54	54	54	54	54	54	54
	Median	30.11667	327.375	131.225	0.28	24.55	3.0675	179.9172	45.15	47.9	7.25
	Average	88.55904	2385.89	588.3099	0.318939	168.7501	5.32966	1283.713	316.2033	89.15064	7.031156
	95 percentile	395.7825	14167.74	3614.135	0.85875	1026.97	16.31963	7557.27	1947.528	277.875	8.284
	5 percentile	5.7135	53.66765	30.915	0.063325	5.565	0.05325	32.225	4.655	2	4.361
	Groundwater Quality Reserve	33.12833	360.1125	144.3475	0.308	27.005	3.37425	197.9089	49.665	52.69	7.734272
G30G	**No of Sample Sites**	5	5	5	5	5	5	5	5	5	5
	Median	32.0305	512.9	183	0.2255	40.417	0.8905	251.5	69.736	35.209	6.2125
	Average	33.4133	730.7937	258.9	0.3231	59.5455	3.4445	387.1535	90.5404	56.2873	6.5516
	95 percentile	57.1609	1359.691	444.6	0.778	107.8285	11.5959	704.3425	140.8546	134.2851	7.5442

Quaternary catchment		Ca (mg/L)	Cl (mg/L)	EC (mS/m)	F (mg/L)	Mg (mg/L)	No3 + No2 (mg/L)	Na (mg/L)	SO4 (mg/L)	TAL	pH
	5 percentile	11.78	284.6361	110.1	0.1	26.04	0.126	139.8467	48.664	17.48	6.008
	Groundwater Quality Reserve	35.23355	564.19	201.3	0.24805	44.4587	0.97955	276.65	76.7096	38.7299	7.20676
G30H	**No of Sample Sites**	36	36	36	36	36	36	36	36	36	36
	Median	42.6	853.35	268.5	0.265	66.15	2.199	424.7	95.65	44.65	7.135
	Average	64.71111	1187.418	362.7333	0.368833	98.79306	2.543806	580.0542	140.0961	48.27183	6.874111
	95 percentile	203.575	3309.05	1013.55	0.8	306.875	6.615	1628.675	367.85	114.85	7.78
	5 percentile	9.15	203.7	64.3	0.095	17.35	0.0515	128.25	24.925	2	4.09
	Groundwater Quality Reserve	46.86	938.685	295.35	0.2915	72.765	2.4189	467.17	105.215	49.115	7.561522
Northern G30D	**No of Sample Sites**	18	18	18	18	18	18	18	18	18	18
	Median	12.75	141.8	65.625	0.125	13.925	1.3535	78.65	21.4	19.7	6.83
	Average	13.45342	170.1839	71.14167	0.203167	14.91925	2.985611	91.82153	22.25411	34.35392	6.858528
	95 percentile	34.295	329.31	129.585	0.4985	31.14	8.0653	174.11	46.1011	107.755	7.6645
	5 percentile	4.615	81.855	38.88	0.05	4.27	0.02	44.64	2	7.185	6.241
	Groundwater Quality Reserve	14.025	155.98	72.1875	0.1375	15.3175	1.48885	86.515	23.54	21.67	7.544381
Southern G30D	**No of Sample Sites**	42	42	42	42	42	42	42	42	42	42
	Median	42.7	181.6	83.75	0.19	18.35	0.043	94.05	36.45	79.1	7.655
	Average	58.15952	322.6998	130.0214	0.18881	31.87619	1.21831	143.7095	59.50143	86.12857	7.553095
	95 percentile	152.735	1027.355	333.3	0.4085	94.49	5.87915	459.58	231.98	189.52	8.355
	5 percentile	4.345	48.93	33.145	0.05	5.15	0.02	31.405	8.403	2.1	6.6

Quaternary catchment		Ca (mg/L)	Cl (mg/L)	EC (mS/m)	F (mg/L)	Mg (mg/L)	No3 + No2 (mg/L)	Na (mg/L)	SO4 (mg/L)	TAL	pH
	Groundwater Quality Reserve	46.97	199.76	92.125	0.209	20.185	0.0473	103.455	40.095	87.01	8.308405
Northern G30F	**No of Sample Sites**	56	56	56	56	56	56	56	56	56	56
	Median	9.27925	223.45	85.825	0.12	18.65	2.2695	113.8	12.65	6.8	5.99
	Average	27.05899	602.7451	191.9863	0.140286	57.26182	3.307402	282.4382	52.72972	14.45998	5.967598
	95 percentile	80.47775	3112.516	911.1	0.269625	247.9615	10.24425	1470.474	244.3508	54.42938	7.1725
	5 percentile	2.13125	55.95	23.75	0.05	4.425	0.055	32.05	2	2	4.6475
	Groundwater Quality Reserve	10.20718	245.795	94.4075	0.132	20.515	2.49645	125.18	13.915	7.48	6.564358
Southern G30F	**No of Sample Sites**	46	46	46	46	46	46	46	46	46	46
	Median	8.6445	183.7023	62.45	0.135	13.65	1.838	98.675	21.218	13.1	6.575
	Average	30.21916	444.8984	144.0739	0.218978	31.81539	2.471087	240.6488	64.96715	35.54945	6.50562
	95 percentile	146.275	1464.35	514.3	0.485	95.8	5.6125	768.1	232.925	134.075	7.69
	5 percentile	3.875	84.55	34.775	0.05	5.825	0.025	44.95	5.975	2.55	5
	Groundwater Quality Reserve	9.50895	202.0725	68.695	0.1485	15.015	2.0218	108.5425	23.3398	14.41	7.156182

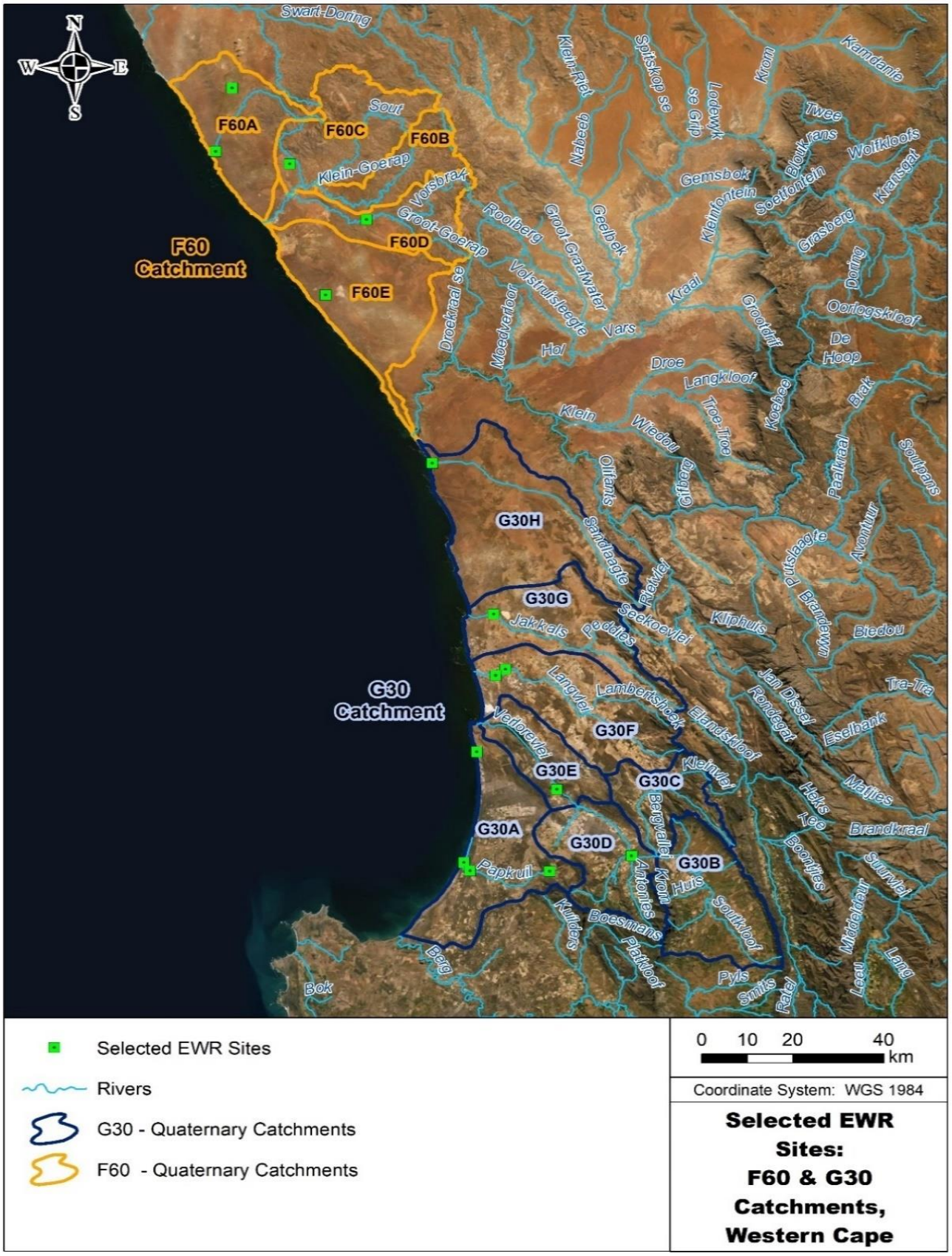

Figure 1: Locality map for the F60 and G30 catchments showing EWR sites and Quaternary Catchments.

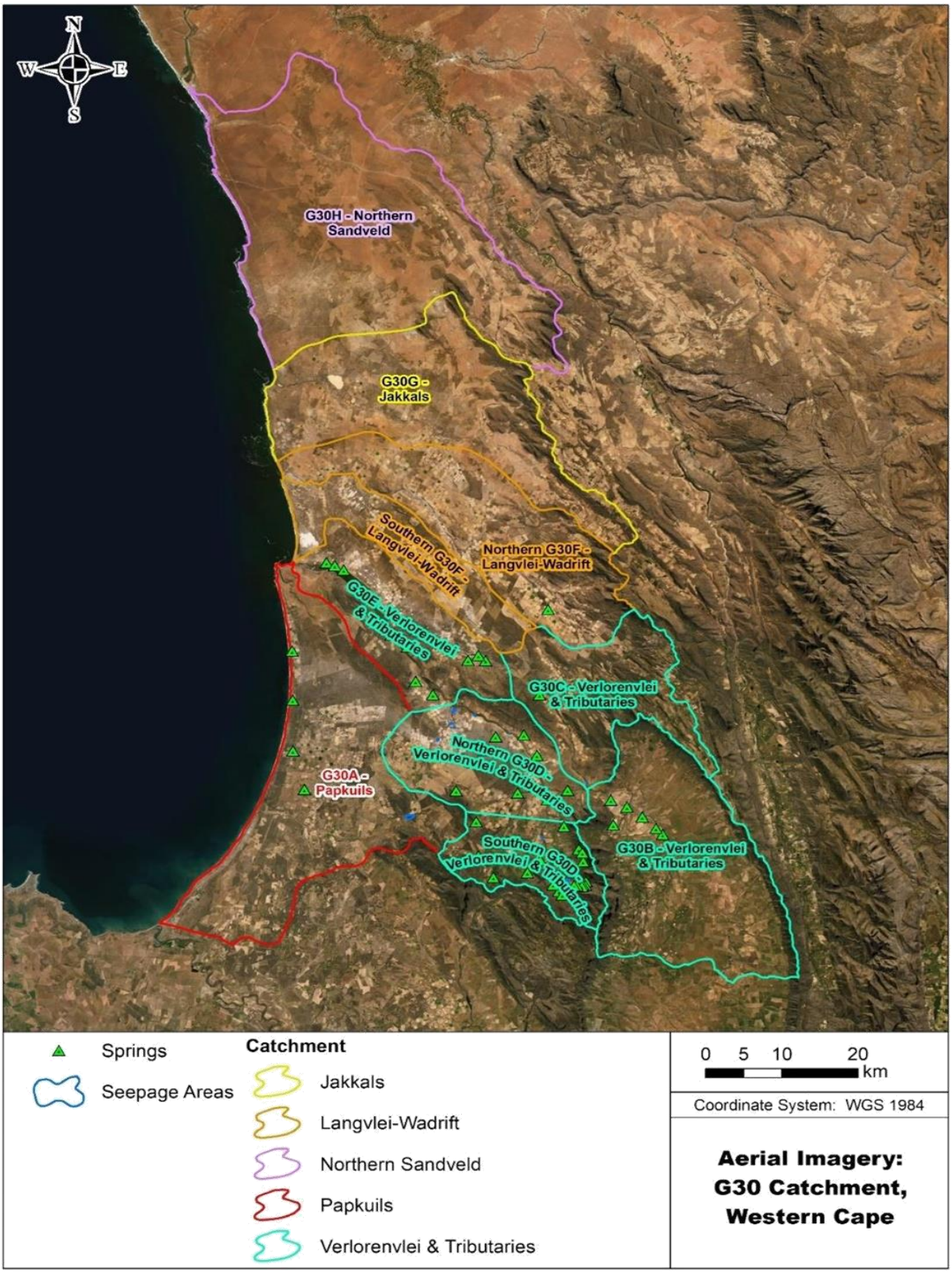

Figure 2: Combined map of delineated GRUs for the G30 catchment

Figure 3: Combined map of delineated GRUs for the F60 catchment