Appendix A: Surface Water

Appendix B: Groundwater

Table B 1: Groundwater use as registered in WARMS, (total per GRU) per water use category, per major geological grouping, per GRU)

Name	Major	Water Use Sector	Number of Registrations	Sum of Registrations m^3/a
24 Rivers	Basement And Intrusive	AGRICULTURE	14	567673
		INDUSTRY	3	5976
		WATER SUPPLY SERVICE	2	246000
	Coastal Cenozoic Deposits	AGRICULTURE	7	631600
		WATER SUPPLY SERVICE	2	200000
	TMG	AGRICULTURE	7	335440
		INDUSTRY	2	10000
Atlantis	Basement And Intrusive	INDUSTRY	1	80912
	Coastal Cenozoic Deposits	AGRICULTURE	13	921108
		INDUSTRY	9	6508000
Cape Flats	Basement And Intrusive	AGRICULTURE	8	226000
		INDUSTRY	1	220752
		SCHEDULE 1	3	11152
		WATER SUPPLY SERVICE	1	5000
	Coastal Cenozoic Deposits	AGRICULTURE	94	7063975
		INDUSTRY	18	4096977
Helderberg	Basement And Intrusive	AGRICULTURE	31	1355302
		INDUSTRY	10	181564
		SCHEDULE 1	1	2000
		WATER SUPPLY SERVICE	2	5076
	Coastal Cenozoic Deposits	AGRICULTURE	33	1227318
		INDUSTRY	21	343495
		SCHEDULE 1	4	31612
		URBAN (EXCLUDING INDUSTRIAL &/OR DOMESTIC)	2	81924
		WATER SUPPLY SERVICE	4	99000
	TMG	INDUSTRY	1	3000
Malmesbury	Basement And Intrusive	AGRICULTURE	83	3594553
		INDUSTRY (URBAN)	11	180605
		MINING	1	42558
		SCHEDULE 1	2	6576
	Coastal Cenozoic Deposits	AGRICULTURE	91	6060659
		INDUSTRY (URBAN)	18	337652
		SCHEDULE 1	2	4696
		WATER SUPPLY SERVICE	5	256336
	TMG	AGRICULTURE	1	17000
Paarl-Upper Berg	Basement And Intrusive	AGRICULTURE	105	4143760
		INDUSTRY (NON-URBAN)	1	3600

Name	Major	Water Use Sector	Number of Registrations	Sum of Registrations m^3/a
		INDUSTRY (URBAN)	21	393261
		RECREATION	2	5692
		SCHEDULE 1	8	24456
		WATER SUPPLY SERVICE	5	82672
	Coastal Cenozoic Deposits	AGRICULTURE	142	5138399
		INDUSTRY (NON-URBAN)	1	1576
		INDUSTRY (URBAN)	18	355184
		SCHEDULE 1	6	55476
		WATER SUPPLY SERVICE	4	22376
	TMG	AGRICULTURE	12	541300
Peninsula	Basement And Intrusive	AGRICULTURE	1	11455
		INDUSTRY (URBAN)	1	1576
	Coastal Cenozoic Deposits	AGRICULTURE	2	58750
		INDUSTRY (URBAN)	2	12576
	TMG	AGRICULTURE	2	12920
		INDUSTRY (URBAN)	1	1576
Piketberg	Basement And Intrusive	AGRICULTURE	3	140000
	Coastal Cenozoic Deposits	AGRICULTURE	7	599026
	TMG	AGRICULTURE	49	5287936
		INDUSTRY (URBAN)	1	54240
		WATER SUPPLY SERVICE	4	114176
Tulbagh	Basement And Intrusive	AGRICULTURE	22	1028516
		INDUSTRY (NON-URBAN)	1	1576
		INDUSTRY (URBAN)	1	26000
		SCHEDULE 1	1	11280
		WATER SUPPLY SERVICE	2	13499
	Coastal Cenozoic Deposits	AGRICULTURE	58	3591969
		INDUSTRY (NON-URBAN)	1	209960
		INDUSTRY (URBAN)	3	40376
		SCHEDULE 1	6	10728
		WATER SUPPLY SERVICE	1	10000
	TMG	AGRICULTURE	7	711795
		SCHEDULE 1	1	1576
West Coast	Basement And Intrusive	AGRICULTURE	11	1349440
		INDUSTRY (URBAN)	1	148000
		WATER SUPPLY SERVICE	2	261576
	Coastal Cenozoic Deposits	AGRICULTURE	46	5980562
		INDUSTRY (URBAN)	7	386426
		WATER SUPPLY SERVICE	1	80300

Table B 2: Recharge total (GRAII, DWAF 2006) per major geological grouping, per GRU

Name	Major	Mm^3/A
24 Rivers	Other	0.16
	Basement And Intrusive	17.31
	Coastal Cenozoic Deposits	6.41
	TMG	35.73
Atlantis	Basement And Intrusive	2.51
	Coastal Cenozoic Deposits	13.85
Cape Flats	Other	1.10
	Basement And Intrusive	9.66
	Coastal Cenozoic Deposits	53.54
	TMG	1.83
Helderberg	Other	0.29
	Basement And Intrusive	26.93
	Coastal Cenozoic Deposits	39.29
	TMG	21.57
Malmesbury	Other	0.04
	Basement And Intrusive	29.08
	Coastal Cenozoic Deposits	19.22
	TMG	0.18
Paarl-Upper Berg	Other	2.24
	Basement And Intrusive	47.48
	Coastal Cenozoic Deposits	56.78
	TMG	90.64
Peninsula	Other	1.01
	Basement And Intrusive	4.84
	Coastal Cenozoic Deposits	14.40
	TMG	30.43
Piketberg	Basement And Intrusive	2.24
	Coastal Cenozoic Deposits	15.35
	TMG	13.97
Tulbagh	Other	0.66
	Basement And Intrusive	20.97
	Coastal Cenozoic Deposits	16.48
	TMG	12.74
West Coast	Other	0.31
	Basement And Intrusive	31.18
	Coastal Cenozoic Deposits	80.80
	TMG	0.08

Table B 3: Average water quality parameters for major geological groupings per GRU, compared to DWAF Drinking Water Quality Limits[1]

GRU	Geology	Number of locations	pH Value at 25^{0}C	Conductivity at 25^{0}C	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Fluoride (F)	Chloride (Cl)	Sulphate (SO_4)	Total Alkalinity ($CaCO_3$)	NO_3 -N
			mg/l	mS/m	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
		Drinking Water Quality Limits - DWAF, 1996; DWAF, DOH and WRC, 1998*										
		Class 1	*5-6 or 9-9.5*	*70-150*	*100-200*	*80-150*	*30-70*	*0.7-1*	*100-200*	*200-400*		*6-10*
		Class 2	*4-5 or 9.5-10*	*150-370*	*200-600*	*150-300*	*70-100*	*1-1.5*	*200-600*	*400-600*		*10-20*
		Class 3	*3.5-4 or 10-10.5*	*370-520*	*600-1200*	*>300*	*100-200*	*1.5-3.5*	*600-1200*	*600-1000*		*20-40*
Atlantis	Basement	17	7.70	758.43	1205.87	152.27	191.47	0.44	2273.68	217.89	260.45	6.20
	Coastal Cenozoic Sediments	141	7.51	185.43	242.18	77.50	35.37	0.26	479.51	59.92	146.98	0.99
Cape Flats	Basement	22	7.42	198.79	333.26	55.33	39.33	0.32	598.94	101.66	124.84	0.15
	Coastal Cenozoic Sediments	149	7.64	141.64	152.21	74.82	23.69	0.28	260.42	76.37	165.02	1.59
Peninsula	Basement	2	6.61	26.95	29.10	8.00	4.75	0.12	55.80	14.05	17.65	1.45
	Coastal Cenozoic Sediments	14	7.28	83.10	95.64	32.29	17.21	0.20	160.16	57.73	82.60	2.80
	TMG	4	6.61	53.88	67.55	9.48	8.35	0.19	115.65	45.23	11.03	0.40
Malmesbury	Basement	94	7.60	302.98	452.15	44.75	53.65	0.81	765.49	109.82	128.41	15.24
	Coastal Cenozoic Sediments	90	7.40	205.47	292.84	48.63	49.35	0.52	530.63	113.22	96.34	6.24
Piketberg	Coastal Cenozoic Sediments	2	6.69	54.47	73.82	7.56	10.32	0.25	140.81	15.02	9.14	0.93
	TMG	25	5.94	47.74	53.00	6.81	14.58	0.10	115.49	8.40	5.22	6.85
Paarl-Upper Berg	Basement	68	7.45	232.92	373.41	48.65	60.58	1.10	670.06	108.40	124.27	2.70
	Coastal Cenozoic Sediments	126	7.02	75.01	102.74	18.57	16.11	0.33	183.91	21.68	59.68	1.08

GRU	Geology	Number of locations	pH Value at 25^0C	Conductivity at 25^0C	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Fluoride (F)	Chloride (Cl)	Sulphate (SO_4)	Total Alkalinity ($CaCO_3$)	NO_3 -N
	TMG	16	6.44	8.94	8.67	2.37	1.44	0.14	15.87	4.00	8.53	0.30
Helderberg	Basement	21	7.00	65.30	94.13	18.61	11.98	0.76	165.91	21.74	53.57	2.24
	Coastal Cenozoic Sediments	37	7.00	146.95	223.32	58.18	40.98	0.72	448.35	63.27	87.96	2.74
24 Rivers	Basement	91	7.59	408.53	690.06	65.28	103.56	0.72	1261.48	169.43	150.36	3.23
	Coastal Cenozoic Sediments	20	7.20	307.88	425.19	73.33	82.89	0.34	923.22	113.42	83.82	4.56
	TMG	2	6.14	163.92	253.48	28.14	31.41	0.67	453.37	51.14	87.90	0.94
Tulbagh	Basement	29	7.43	446.75	736.29	53.90	127.52	0.73	1392.45	153.65	131.42	1.56
West Coast	Basement	143	7.50	527.16	863.22	93.97	132.23	0.72	1686.75	190.83	127.24	5.46
	Coastal Cenozoic Sediments	893	7.51	468.09	841.97	104.21	104.13	0.66	1569.89	208.88	147.26	4.23
	TMG	6	6.40	76.42	99.88	10.99	17.05	0.28	205.83	18.56	14.62	0.21

Table B 4: Legend for all Maps within Status Quo Assessment Tables

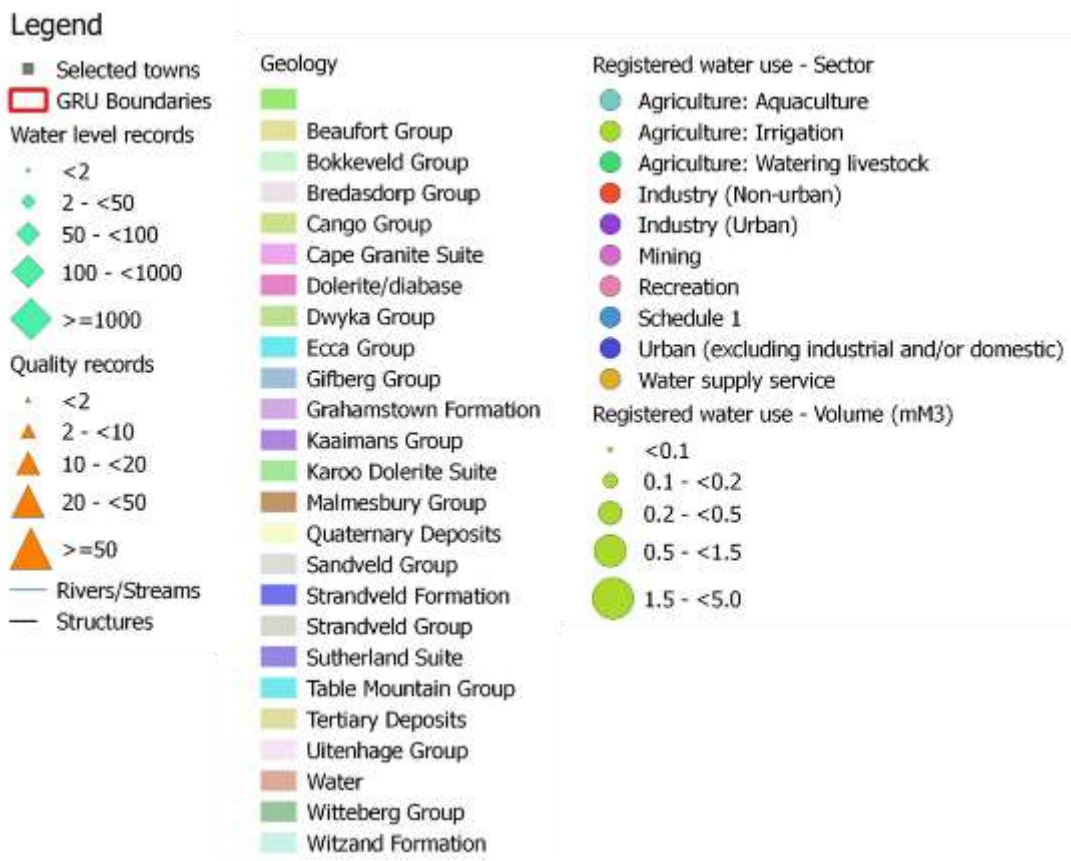
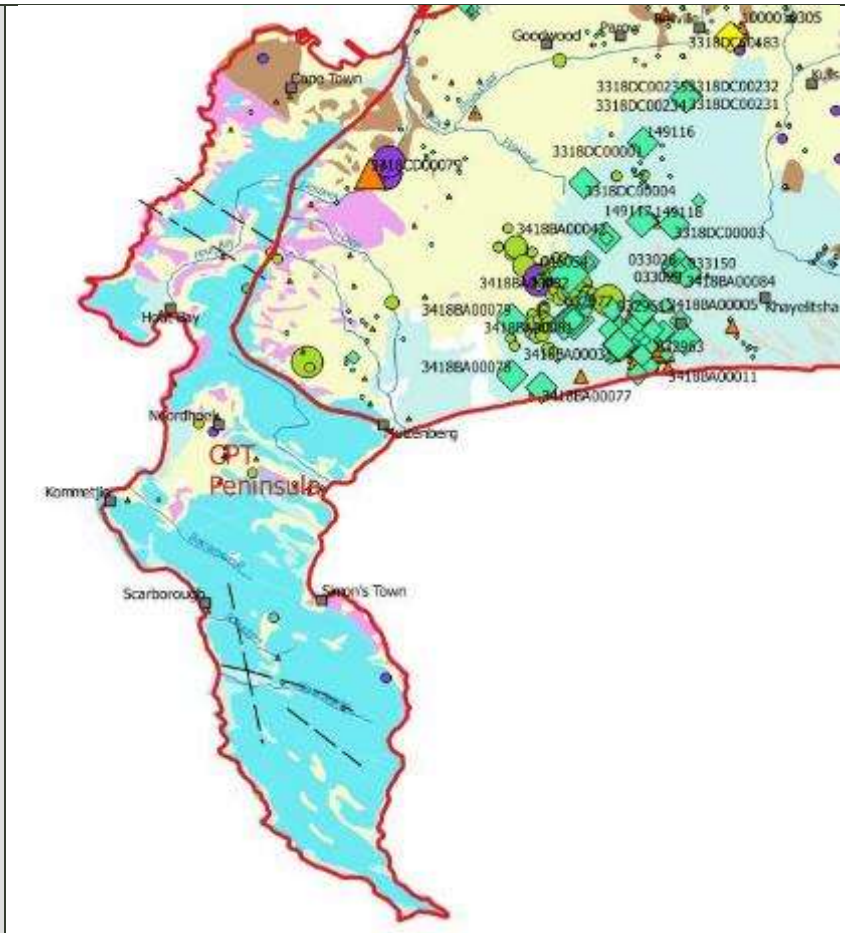


Table B 5. Detailed Status Quo assessment per Groundwater Resource Unit

Status Quo assessment for GRU 1 Peninsula

GRU name, main town	Greater Cape Town sub-catchment, GRU 1 Peninsula. Main town: Cape Town
GRU Boundary description	The Cape Peninsula is dominated by the presence of the Table Mountain Group, mostly Peninsula Formation, overlying basement, composed of Cape Granite Suite along the length of the Peninsula, and Malmesbury Group under the City Bowl and Devils Peak. This unconformity/nonconformity dips gently to the south, from around 400m in the north, around the city, to below sea level south of Fish Hoek. The TMG outcrop generates the rugged areas, which are mostly delineated within the Table Mountain National Park. Recharge in the GRU is mainly from rainfall, but may also occur from cloud moisture, especially from the south-east wind in summer. Although recharge on the Peninsula is significantly higher than surroundings, and the Peninsula Formation can form a significant aquifer, its geological setting in this GRU (as an exposed inselberg) means that aquifer storage is low; recharge leads to discharge within a short time frame (a year), as the aquifer decants as streams cascading off the steep cliffs of TMG. Some of these are permanent seeps, other mountain streams and wetlands may be localized groundwater flow systems. Scree aprons occur on the slopes of the Peninsula-formed mountain, especially around Table Mountain itself, and are recharged by the streams cascading off the steep cliffs. Various springs emanating from the scree aquifers (ultimately dependent on the Peninsula Formation aquifer) cumulatively discharge over 100L/s to the City Bowl and Newlands areas combined (GEOSS, 2015). Cenozoic sands occur in the Fish Hoek Valley where high water tables support wetlands and streams around Fish Hoek and Noordhoek. The boundary between GRU1 and GRU2 is based on the surface water catchment divide, and will represent a flow divide for at least shallow groundwater in the Peninsula Formation. Deep groundwater flow is unlikely to be significant, although some drainage from GRU1 may moves onto the Cape Flats (GRU2) and recharge surface water and groundwater.
Catchments	G22A and G22B
Domestic Groundwater use	None of the settlements within the GRU utilise groundwater for domestic supply.

Map[2]



Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Peninsula	TMG, Granite, Malmesbury, Quaternary	9	0.1	Industry:Urban, Agriculture: Irrigation	None	None

Available monitoring locations for trend analysis (recent data highlighted yellow)

No data

Water Level Graphs

No Data

Response to Bulk Abstraction

There is no bulk abstraction within the GRU

Water quality graphs

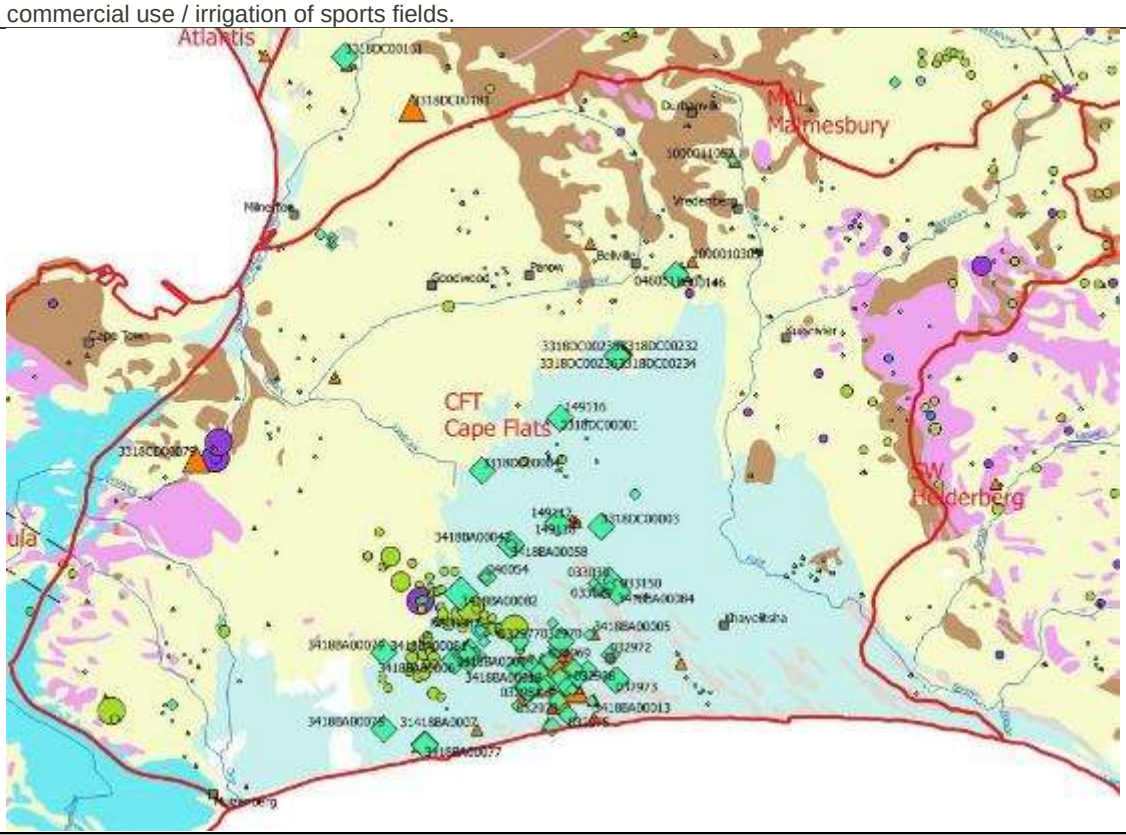
No recent water quality data.

Comments

The Peninsula is largely underlain by TMG. There is little registered groundwater user, and no long term water level or water quality monitoring within the database.

[2] Refer to Table B4 for legend to all GRU status quo table maps

Status Quo assessment for GRU 2 - Cape Flats

GRU name, main town	Greater Cape Town sub-catchment, GRU 2 – Cape Flats Main town: Philippi, Bellville, Kuilsrivier
GRU Boundary description	The Cape Flats is an area of subdued topography, where thick Sandveld Group deposits outcrop, overlying the basement (of Malmesbury Shale and Cape Granite Suite). The Sandveld Group forms a significant primary aquifer. Basement outcrops around the periphery of the GRU, and the thickness of the Sandveld Group increases towards the west of centre of the GRU. The thickness is greatest where the Sandveld group sediments infill palaeochannel(s) carved into the basement topography, one of which coincides with the Philippi Farms area (DWAF, 2008). Surface water and groundwater can be considered in hydraulic connection, with a high groundwater table (depth to water on average 3.4m, with a 1.9m average range, WRC, 2016b). Various wetlands across the Cape Flats are likely expressions of the water table. The effects of urbanization have significantly altered the Cape Flats aquifer: runoff is concentrated into modified natural drainage lines within which surface-groundwater interactions will be reduced from a natural state, and groundwater quality is affected from a variety of sources. Domestic water supplies are imported from elsewhere (GWRUs 9 & 11, and the Breede Gouritz), and groundwater may be recharged from leaks from reticulation and sewer networks, whilst hard surfaces will dramatically reduce recharge (WRC, 2016b). The boundaries of GRU2 are based on surface water divides, and shallow groundwater flow from the Cape Peninsula (GRU1) to the west and the Helderberg (GRU3) to the north-east and east is possible. The Cape Flats discharges to surface water (65% of recharge), to abstraction (17% of recharge), and by discharge to the coast (19% of recharge; WRC, 2016b).
Catchments	G22C, G22D and G22E
Domestic Groundwater use	None of the settlements within the GRU rely on groundwater as sole supply. The City of Cape Town utilises groundwater fed springs (Albion Spring) to augment the City's supply, but a relatively low yield is harvested and the groundwater does not enter the main recirculation network and is routed directly for commercial use / irrigation of sports fields.
Map	

Water use clusters for trend analysis

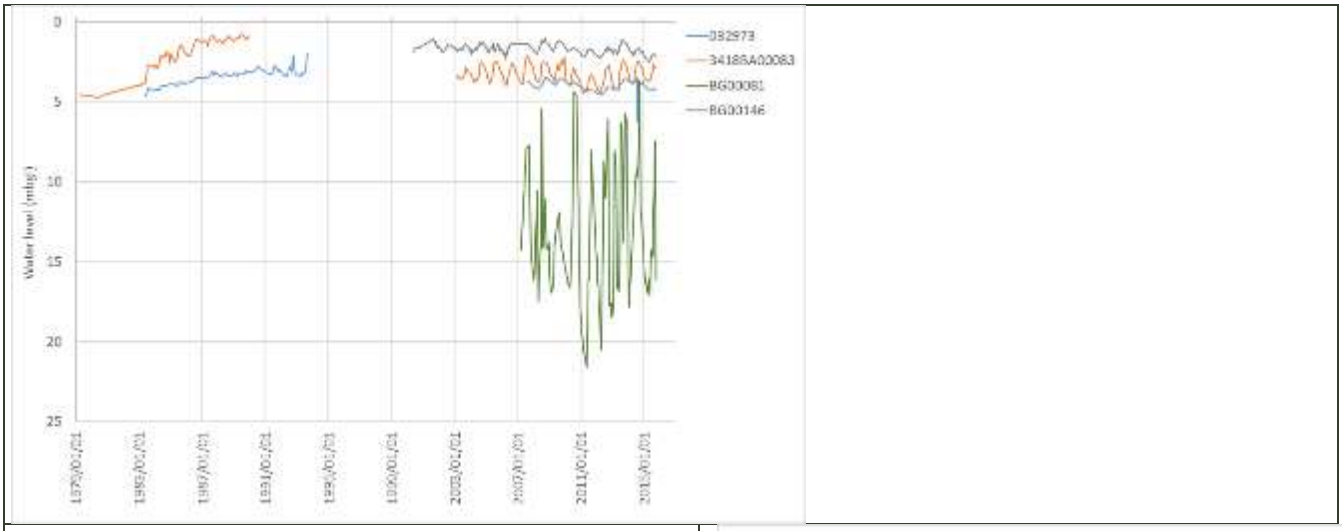
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Philippi	Witzand/ Quaternary	84	6.3	Agriculture: Irrigation; Industry: Urban	3418BA00083 (Witzand, away from water use)	3418BA00311 (Witzand, away from water use) 3418BA00002

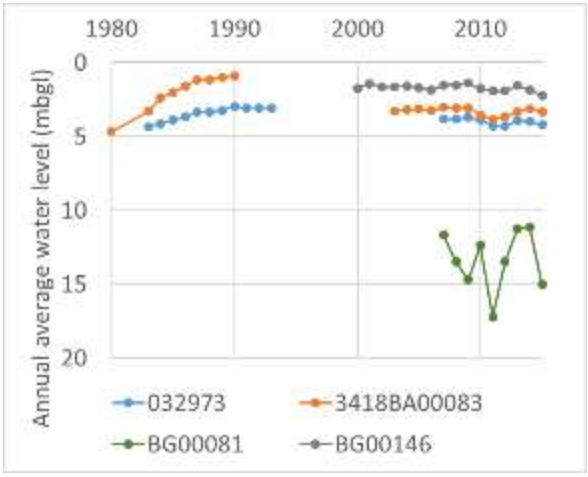
					032973(Sandveld, away from water use) BG00081 (Witzand, close to water use)	(Witzand, away from water use)
Kuilsrivier – Bellville	Malmesbury/ Granite/ Quaternary	31	1.0	Industry: Urban Agriculture: Irrigation	BG00146 (Quaternary, away from water use)	3318DC00182 (close to BG00146)
Southern suburbs	Malmesbury/ Granite/ Quaternary	10	4.3	Industry: Urban	None	3318CD00079 (spring, close to water use)

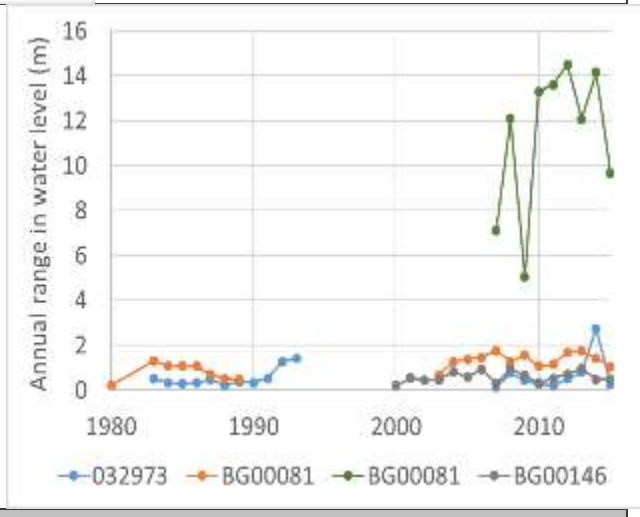
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3318DC00234	WL	Borehole	2001/02/15	2016/02/18	114	Witzand	22
033028	WL	Borehole	2003/02/28	2015/12/21	127	Witzand	
033029	WL	Borehole	2003/01/28	2015/12/21	122	Witzand	
BG00140	WL	Borehole	2008/05/29	2015/12/21	38	Witzand	25
3418BA00083	WL	Borehole	1979/04/06	2015/10/19	237	Witzand	15
BG00181	WL	Borehole	2012/10/21	2015/10/19	28	Witzand	107
046054	WL	Borehole	2001/02/12	2015/10/19	68	Witzand	
046053	WL	Borehole	2003/08/27	2015/10/19	105	Witzand	
032973	WL	Borehole	1983/05/13	2015/10/19	180	Sandveld	
032961	WL	Borehole	2004/03/31	2015/10/19	88	Witzand	
046051	WL	Borehole	2001/09/07	2015/10/19	75	Quaternary	
BG00081	WL	Borehole	2007/03/22	2015/10/19	77	Witzand	33
033150	WL	Borehole	2007/01/30	2015/10/19	95	Witzand	
BG00146	WL	Well Point	2000/06/07	2015/10/19	215	Quaternary	
033039	WL	Borehole	2006/08/29	2015/10/19	103	Witzand	
BG00153	WL	Borehole	2008/09/25	2015/10/19	75	Witzand	22
BG00180	WL	Borehole	2013/07/24	2015/10/19	28	Witzand	42
3418BA00084	WL	Borehole	1979/04/06	2015/09/25	205	Witzand	16
3318DC00236	WL	Borehole	2002/10/08	2015/08/21	123	Witzand	83
BG00139	WL	Borehole	2008/05/29	2015/07/22	25	Sandveld	25
046052	WL	Borehole	2004/04/01	2015/02/20	53	Quaternary	
046070	WL	Borehole	2003/03/27	2014/12/22	108	Witzand	
BG00152	WL	Borehole	2008/09/25	2014/12/22	65	Witzand	19
3318DC00231	WL	Borehole	2002/10/08	2012/05/25	79	Witzand	11
3318DC00232	WL	Borehole	2001/02/08	2011/07/29	52	Witzand	30
032970	WL	Borehole	1983/05/13	2010/09/28	119	Witzand	
046074	WL	Borehole	2003/01/28	2010/07/30	60	Witzand	
3318DC00276	WL	Borehole	2005/03/01	2008/02/26	9	Quaternary	
046073	WL	Borehole	2003/01/28	2005/12/27	17	Witzand	
032972	WL	Borehole	1983/05/13	2004/03/31	92	Witzand	
032974	WL	Borehole	1983/06/16	2003/10/30	15	Witzand	
033020	WL	Borehole	1986/03/09	2003/08/26	8	Witzand	
3418BA00081	WL	Borehole	1979/11/13	2003/03/27	138	Witzand	25
3318DC00183	Qual	Borehole	2001/06/01	2015/10/19	9	Quaternary	
3418BA00311	Qual	Borehole	1994/06/30	2015/10/13	14	Witzand	
3318CD00079	Qual	Spring	1994/01/04	2015/04/30	39	Quaternary	
3318DC00235	Qual	Borehole	2008/07/01	2015/04/29	6	Witzand	
3318DC00182	Qual	Borehole	2002/05/13	2015/04/29	10	Quaternary	
1000010305	Qual	Borehole	2004/11/12	2009/01/27	6	Quaternary	
1000011052	Qual	Borehole	2005/03/18	2008/02/26	6	Quaternary	
3418BA00002	Qual	Borehole	1985/10/15	2007/01/30	9	Witzand	

Water Level Graphs



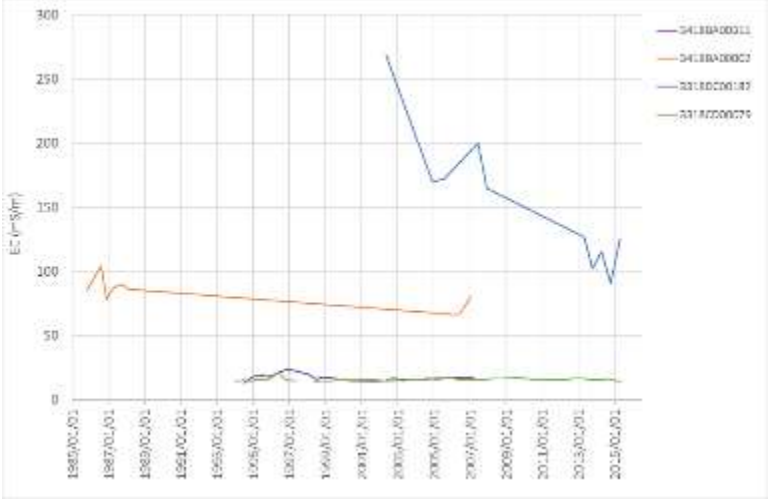


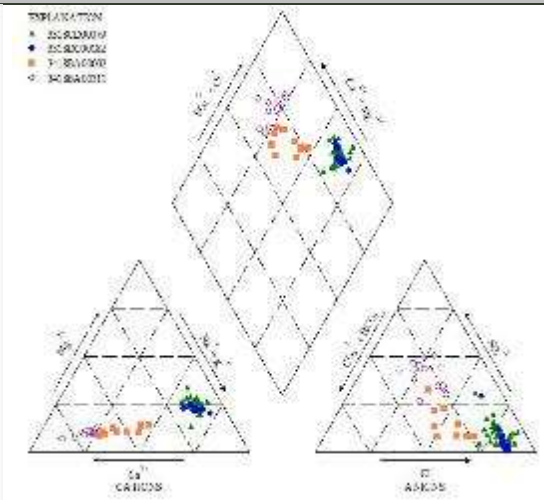


Response to Bulk Abstraction

The availability of monitoring of abstraction at Albion Spring is not known. This will be investigated should this GRU be prioritised for further investigation.

Water quality graphs





DWAF 1996 drinking water quality guideline
Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

Comments

Registered groundwater use is focussed in the Philippi agricultural area. Thre is also water use for industry and agriculture in the north-eastern part of the GRU, as well as on the lower eastern slopes of the Peninsula mountain range (Southern suburbs).

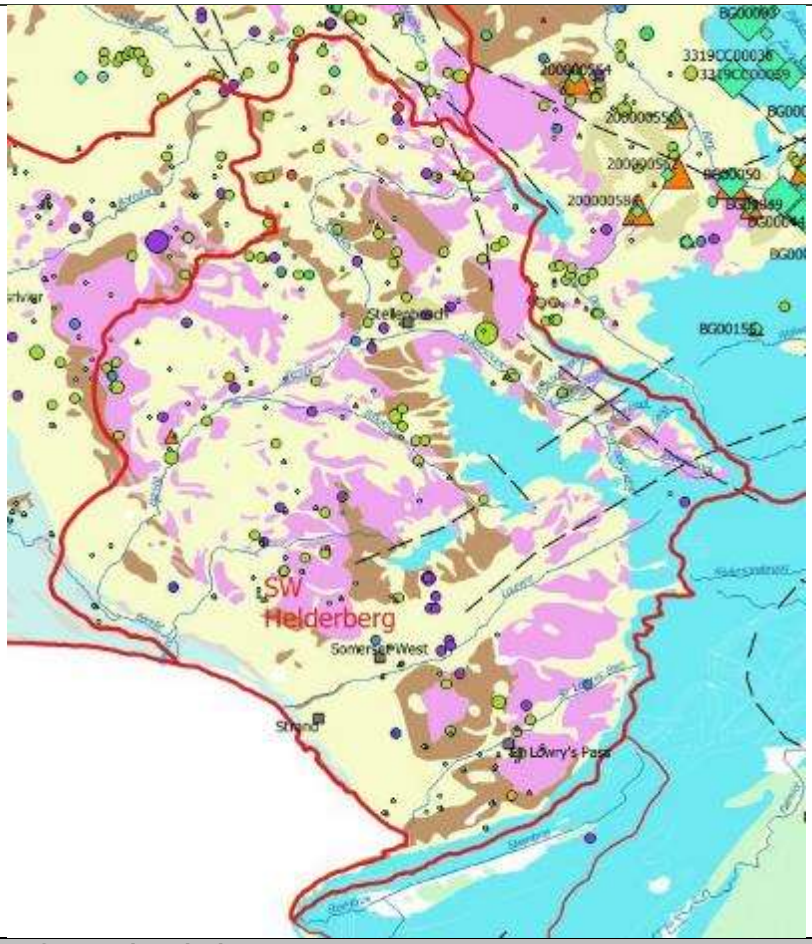
There is no water level monitoring in the southern suburbs, but water quality is monitored at a spring in the Newlands area (3318CD00079). Water quality at 3318CD00079 has been stable over 20 years of monitoring with an EC around 15 mS/m. Ionic composition is dominated by Na and Cl.

There is one water level monitoring point in the Kuils River-Bellville area. BG00146 is less than 1 km from a registered water supply. Water levels are generally around 2 mbgl and show a seasonal variation of <1 m. Over the long term, average annual water levels have shown some variability, and have shown a decline over the previous three years, but this could be within the range of normal variability. Water quality is monitored at 3318DC00182, located very close to BG00146. The EC at 3318DC00182 has shown a generally decreasing trend since monitoring began in 2002. Despite the much higher EC, and decrease in EC with time, the ionic composition has remained the same, and is very similar to water from the spring in Newlands.

Extensive water level monitoring, largely by DWS, has occurred in the centre south of the Cape Flats, in Philippi and in the Mitchell's plain suburb (east of the main abstraction at Philippi). These surface geology of these boreholes is Witzand Formation. Borehole BG00081 is within the Phillipi area, and is likely to be affected by groundwater extraction, whereas 3418BA00083 and 032973 are located away from registered water use. Water level in BG00081 (5 – 20 mbgl) is deeper than in 3418BA00083 and 032973 (<5 mbgl), and also shows much larger seasonal variations of 5 – 15 m difference between minimum and maximum water levels compared to <2 m seasonal difference in 3418BA00083 and 032973. Seasonal differences appear to have become more pronounced at 3418BA00083 between an initial monitoring period from 1979 to 1990, and more recent monitoring from 2003 to 2016. Annual average water levels at all locations vary by up to 4 m, and there is no long-term increasing or decreasing trend. Average annual water levels are likely to be higher during higher rainfall periods, and lower during lower rainfall periods.

Water quality in these boreholes (wuth surface geology in Witzand Formation) varies, with higher ECs measured at 3418BA00002 than at 3418BA00311, although these two locations are just 250 m apart. The EC measured at 3418BA00311 is very similar to that measured at spring 3318CD00079, but the ionic composition is very different. Water from the Witzand formation has relatively higher concentrations of Ca, bicarbonate and sulphate compared to water from the spring and the Kuils River Quaternary sediments.

Status Quo assessment for GRU 3 – Helderberg

GRU name, main town	Greater Cape Town sub-catchment, GRU 3 – Helderberg. Main town: Somerset West, Stellenbosch
GRU Boundary description	This area is underlain predominantly by Malmesbury Group and Cape Granite Suite plutons, the latter forming higher rocky hills, in contrast to the generally weathered lower rolling hills of the former. Rocks of the lower TMG suite, predominantly Peninsula Formation, outcrop to the west and form the Stellenbosch and Jonkershoek mountains in the east. The Peninsula Aquifer is unconfined in this GRU, and similarly to GRU1, although the Peninsula Formation can form a significant aquifer, its geological setting in this GRU means stored groundwater volumes are low, and recharge decants as mountain streams (the Lourens River originates in the Peninsula Formation mountains). In the basement formations, groundwater flow is mainly restricted to weathered zones or granite scree slopes on the pluton flanks and little regional flow can be expected.
Catchments	G22G; G22H; G22K and G22J
Domestic Groundwater use	There is no groundwater use for domestic supply within the GRU.
Map	

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Helderberg	Malmesbury, Cape Granite, TMG, Quaternary	108	3.3	Agriculture: irrigation Industry: Urban	None	None

Available monitoring locations for trend analysis (recent data highlighted yellow)

None

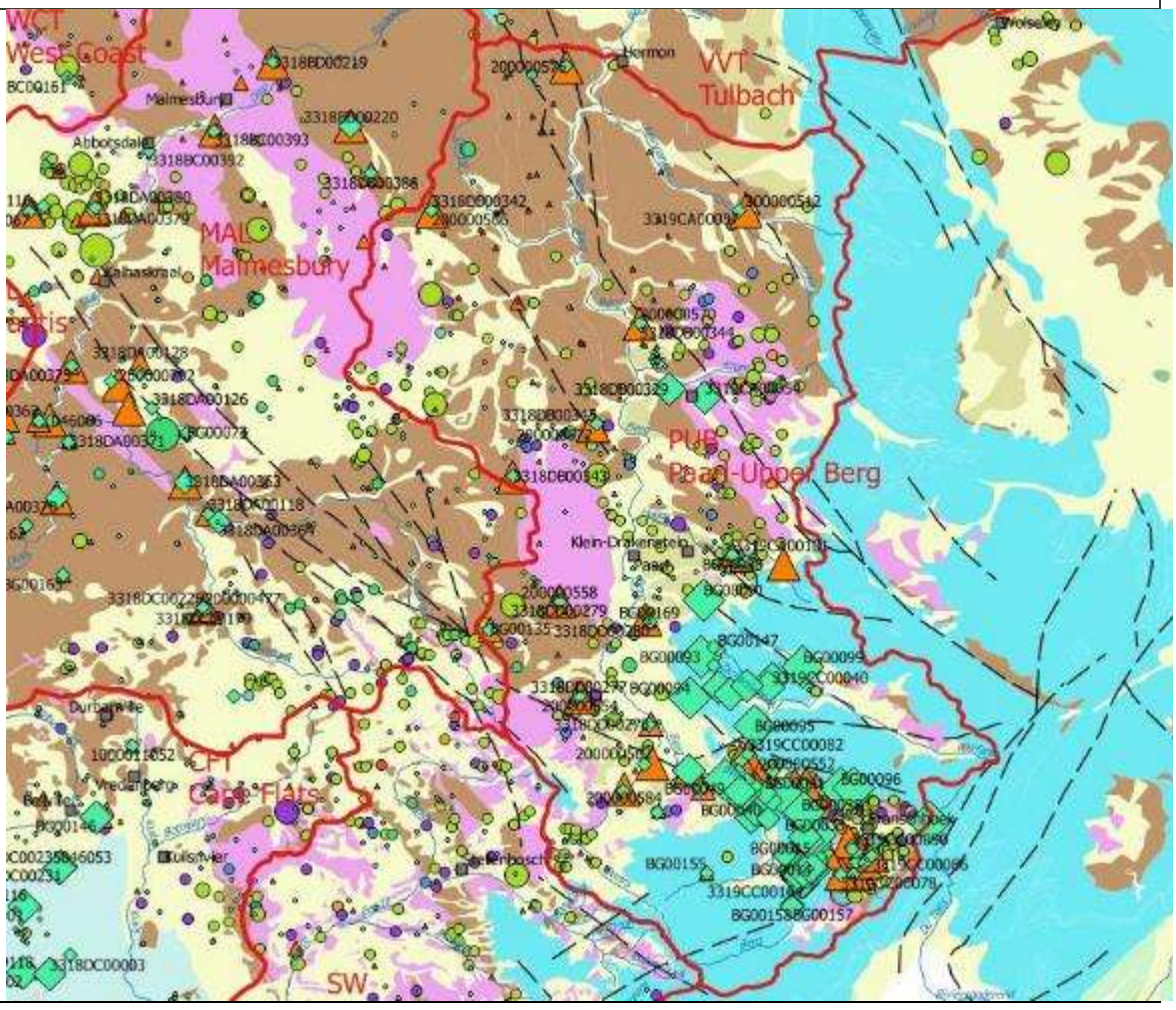
Water Level Graphs

No Data

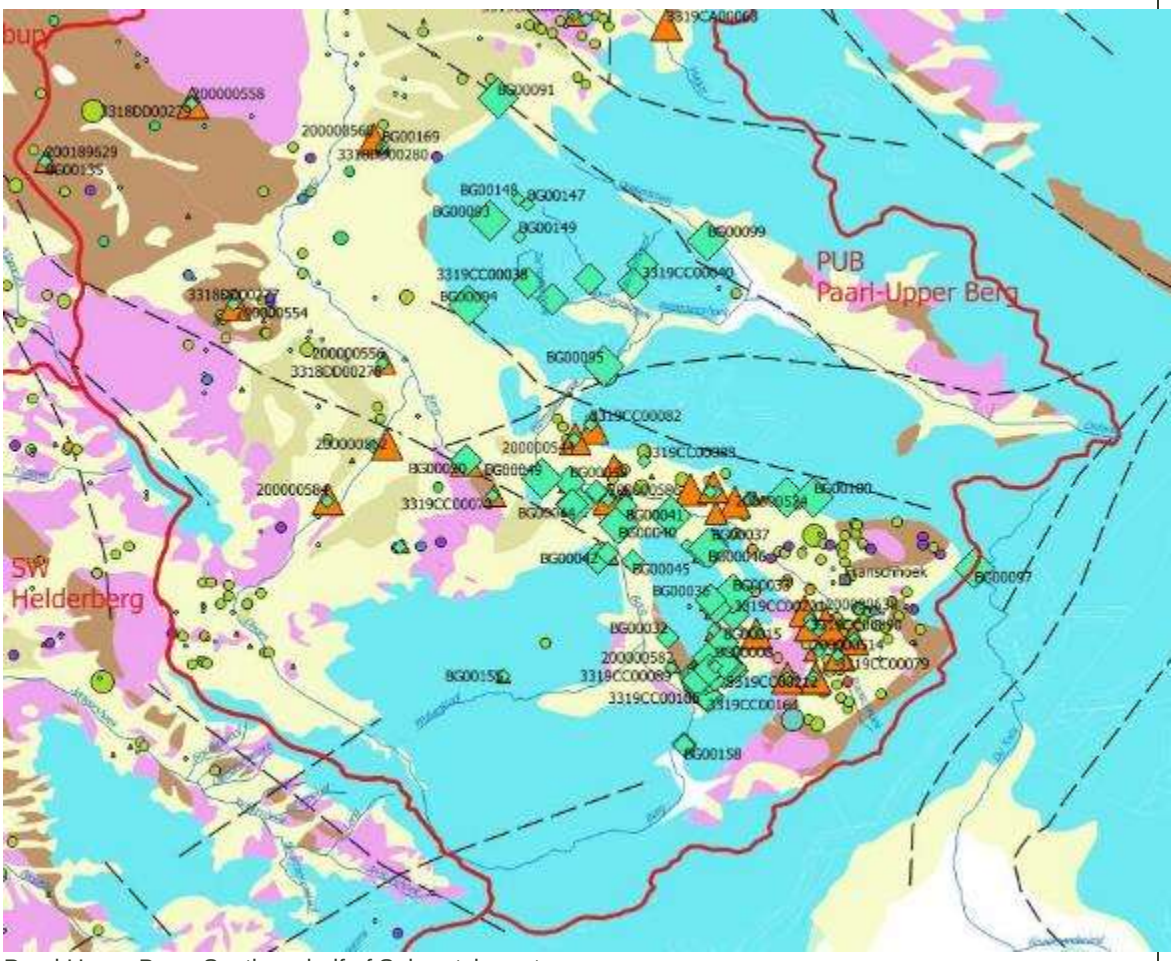
Response to Bulk Abstraction

There is no bulk abstraction within the GRU.
Water quality graphs
No recent water quality data.
Comments
The Helderberg GRU is underlain by Cape Granite, Malmesbury, TMG and Quaternary Deposits. There are no long term water level or water quality monitoring locations within this GRU.

Status Quo assessment for GRU 4 – Paarl – Upper Berg

GRU name, main town	Paarl Upper Berg sub-catchment, GRU 4 Paarl Upper Berg Main town: Paarl, Wellington, Franschhoek
GRU Boundary description	The GRU comprises sequences of basement rocks (Malmesbury Group, the Cape Granite Suite) dominating outcrop in the undulating northern areas, Table Mountain Group outcropping in the mountainous south east and on the eastern boundary, with younger Cenozoic sediments infilling valleys, more extensively in the southern part. Rainfall and direct recharge is high in the TMG formed mountains in the southeast of the GRU. The TMG is dominated by outcrop of Peninsula Formation, forming an unconfined aquifer (excluding an area of Nardouw Group outcrop surrounding the Wemmershoek valley, where the Peninsula Formation will form a confined aquifer at depth), overlying basement, with the contact sometimes visible in the base of the mountain slopes. The TMG generates discharges to mountain streams and rivers and several perennial rivers including the Berg River (and its tributaries including the dammed Wemmershoek) have their source in the Drakenstein and Franschhoek Mountains south of Franschhoek within the GRU. Alluvial sediments of the Sandveld Group are well developed around the Berg River in the Franschhoek valley as far as Paarl, and are likely to receive recharge from the TMG (interflow) where in connection, and discharge to the Berg River. In the basement formations, groundwater flow is focussed in weathered zones and little regional flow can be expected. Several tributaries to the Berg River traverse the basement outcrops, and groundwater will discharge to these. The south eastern boundary follows the quaternary catchment boundaries of the upper G10 catchment. The eastern boundary is limited to the Boland Mountain range (also the WMA boundary) and is associated with the topographic high. The divide between the G10D and G10F catchments forms the northern boundary. Shallow groundwater flow will generally adhere to these boundaries, and some deep flow from this GRU towards the east into the Breede-Gouritz is likely.
Catchments	G10A; G10B; G10C and G10D
Domestic Groundwater use	Groundwater makes up 13% (or 0.22 million m^3/a) of the total water supply to Franschhoek & Groendal, La Motte, Wemmershoek, and Robertsvlei.
Map	

Paarl Upper Berg: Complete Sub-catchment



Paarl Upper Berg: Southern half of Sub-catchment

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Paarl-Wellington	Malmesbury, Cape Granite, Tertiary, Quaternary	217	6.5	Agriculture: Irrigation Industry: Urban	BG00091 (Q/T, close to water supply) 3318DB00345 (Malmesbury, close to water use) 3318DB00343 (Malmesbury, away from water use) 3319CA00087 (Quaternary, away from water use)	200000572 (at 3318DB00345) 200000568 (at 3318DB00343) 200000512 (at 3319CA00087)
Franschhoek	TMG, Malmesbury, Cape Granite, Tertiary, Quaternary	109	4.2	Agriculture: Irrigation Industry: Urban Water Supply Agriculture: Aquaculture	BG00095 (TMG, away from water use) BG00096 (TMG, at water use) BG00008 (Quaternary, at water use) BG00039 (Quaternary, away from water use)	200000540 (TMG, close to water use) 3319CC00223 (close to BG00008) 200000586 (close to BG00039) 200000532 (Granite, close to water use)

Available monitoring locations for trend analysis (recent data highlighted yellow)

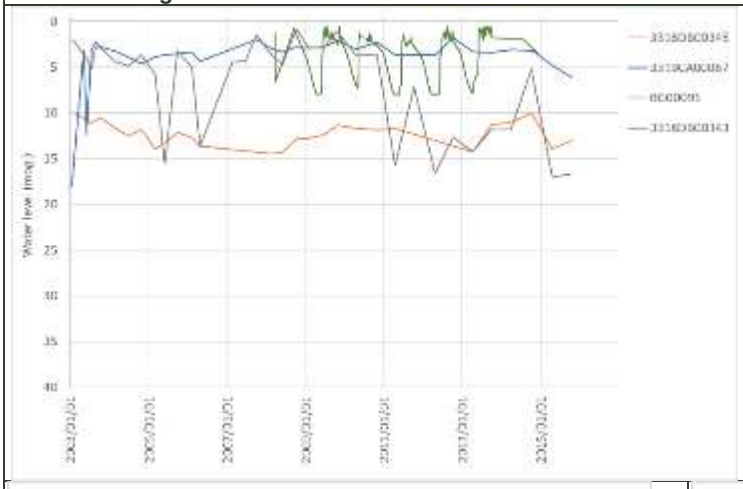
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
BG00008	WL	Borehole	2004/01/27	2016/02/19	128	Quaternary	28
BG00015	WL	Borehole	2004/01/27	2016/02/19	120	Quaternary	48
3319CC00221	WL	Well Point	2006/08/30	2016/02/19	100	Quaternary	10
BG00002	WL	Borehole	2003/12/22	2016/02/19	129	Malmesbury	30
BG00003	WL	Borehole	2003/12/22	2016/02/19	129	Malmesbury	24
BG00004	WL	Borehole	2003/12/22	2016/02/19	127	Malmesbury	24
3319CC00215	WL	Well Point	2006/08/30	2016/02/19	102	Quaternary	10
BG00007	WL	Borehole	2004/01/27	2016/02/19	118	Quaternary	27
3319CC00213	WL	Well Point	2006/07/25	2016/02/19	97	Quaternary	10
BG00009	WL	Borehole	2004/01/27	2016/02/19	118	Quaternary	28
BG00010	WL	Borehole	2003/12/22	2016/02/19	104	Quaternary	30
BG00011	WL	Borehole	2004/01/27	2016/02/19	128	Quaternary	26
BG00013	WL	Borehole	2004/01/27	2016/02/19	129	Quaternary	32
BG00014	WL	Borehole	2004/01/27	2016/02/19	128	Quaternary	27
3319CC00164	WL	Borehole	2004/01/27	2016/02/19	120	Quaternary	
BG00006	WL	Borehole	2003/12/22	2016/02/19	125	Quaternary	26
3319CC00174	WL	Borehole	2003/12/27	2016/02/19	126	Cape Granite	7
3319CC00165	WL	Borehole	2004/01/27	2016/02/19	125	Quaternary	
3319CC00166	WL	Borehole	2004/01/27	2016/02/19	125	Quaternary	
3319CC00167	WL	Borehole	2004/01/27	2016/02/19	126	Quaternary	
3319CC00168	WL	Borehole	2003/12/27	2016/02/19	130	Quaternary	5
3319CC00169	WL	Borehole	2003/12/27	2016/02/19	115	Cape Granite	16
3319CC00220	WL	Well Point	2006/08/30	2016/02/19	96	Quaternary	10
3319CC00173	WL	Borehole	2004/01/27	2016/02/19	114	Malmesbury	
BG00016	WL	Borehole	2004/01/27	2016/02/19	126	Malmesbury	14
3319CC00175	WL	Borehole	2003/12/27	2016/02/19	125	Quaternary	12
3319CC00176	WL	Borehole	2004/03/03	2016/02/19	99	Quaternary	31
3319CC00177	WL	Borehole	2004/03/03	2016/02/19	124	Quaternary	47
3319CC00185	WL	Borehole	2004/05/28	2016/02/19	123	Quaternary	23
3319CC00202	WL	Well Point	2004/10/19	2016/02/19	97	Quaternary	53
3319CC00212	WL	Well Point	2006/08/30	2016/02/19	99	Quaternary	9
3319CC00171	WL	Borehole	2004/01/01	2016/02/19	127	Malmesbury	40
BG00157	WL	Borehole	2009/10/29	2016/02/19	69	TMG	60
BG00051	WL	Borehole	2004/04/01	2016/02/19	108	Quaternary	10
BG00050	WL	Borehole	2004/03/25	2016/02/19	113	Quaternary	60
BG00048	WL	Borehole	2004/03/25	2016/02/19	123	Quaternary	18
BG00158	WL	Borehole	2009/10/29	2016/02/19	69	TMG	162
BG00156	WL	Borehole	2009/10/29	2016/02/19	68	TMG	20
BG00042	WL	Borehole	2004/03/25	2016/02/19	118	TMG	56
BG00046	WL	Borehole	2004/03/25	2016/02/19	1102	Quaternary	30
BG00038	WL	Borehole	2004/03/23	2016/02/19	128	Quaternary	26
BG00019	WL	Borehole	2004/06/28	2016/02/19	125	Quaternary	78

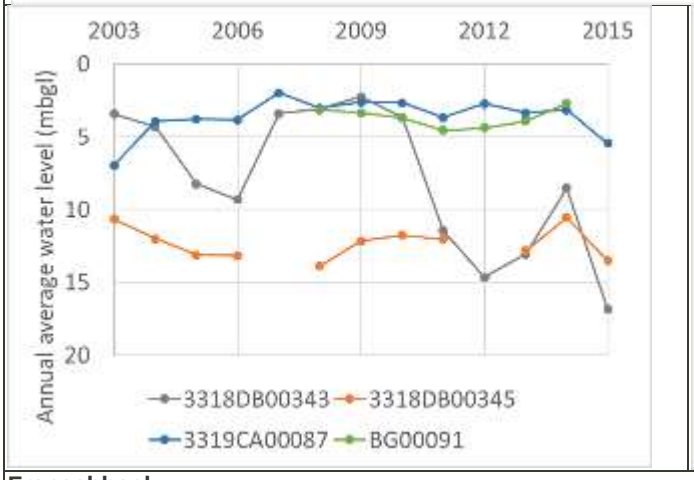
BG00036	WL	Borehole	2004/03/19	2016/02/19	115	TMG	30
BG00035	WL	Borehole	2004/03/08	2016/02/19	114	TMG	36
BG00020	WL	Borehole	2004/07/28	2016/02/19	123	Quaternary	11
BG00034	WL	Borehole	2004/03/03	2016/02/19	122	TMG	40
BG00037	WL	Borehole	2004/03/08	2016/02/19	103	Quaternary	25
BG00017	WL	Borehole	2004/01/27	2016/01/15	115	Quaternary	14
3319CC00170	WL	Borehole	2004/01/27	2016/01/15	116	Quaternary	20
BG00032	WL	Borehole	2003/10/06	2015/12/22	72	Malmesbury	300
BG00100	WL	Borehole	2008/02/29	2015/10/23	1597	TMG	128
BG00095	WL	Borehole	2008/01/15	2015/10/23	1568	TMG	135
BG00049	WL	Borehole	2004/03/25	2015/10/16	1579	TMG	30
BG00041	WL	Borehole	2004/03/25	2015/09/30	69	Quaternary	31
BG00033	WL	Borehole	2004/02/12	2015/09/30	1703	Quaternary	41
BG00044	WL	Borehole	2004/03/25	2015/08/20	1530	Quaternary	35
BG00039	WL	Borehole	2004/04/29	2015/04/28	1292	Quaternary	33
BG00045	WL	Borehole	2004/03/25	2015/04/24	62	Quaternary	36
BG00091	WL	Borehole	2008/03/25	2014/12/09	1603	Tertiary	68
BG00043	WL	Borehole	2004/03/25	2014/07/24	66	TMG	30
BG00099	WL	Borehole	2008/01/15	2014/07/18	1375	Quaternary	305
BG00094	WL	Borehole	2008/03/25	2013/10/09	1571	TMG	128
BG00096	WL	Borehole	2008/01/15	2013/10/09	1238	TMG	205
BG00040	WL	Borehole	2004/04/29	2013/10/09	1616	Quaternary	31
3319CC00214	WL	Well Point	2006/08/30	2013/08/22	64	Quaternary	9.5
BG00093	WL	Borehole	2008/01/15	2013/07/01	1476	TMG	128
BG00047	WL	Borehole	2004/03/25	2013/02/28	59	Quaternary	34
200000562	Qual	Borehole	2003/05/07	2015/10/13	32	Quaternary	
200000546	Qual	Borehole	2003/05/06	2015/10/12	30	Quaternary	
3319CA00063	Qual	Spring	1995/04/18	2015/09/30	33	Quaternary	
200000584	Qual	Borehole	2003/06/03	2015/04/23	29	Quaternary	
BG00051	Qual	Borehole	2004/04/01	2015/04/23	16	Quaternary	10
BG00050	Qual	Borehole	2004/04/01	2015/04/23	21	Quaternary	60
200000554	Qual	Borehole	2003/05/07	2015/04/23	29	Malmesbury	
BG00034	Qual	Borehole	2004/03/30	2015/04/23	18	TMG	40
BG00035	Qual	Borehole	2004/03/30	2015/04/23	17	TMG	36
BG00036	Qual	Borehole	2004/03/30	2015/04/23	16	TMG	30
BG00037	Qual	Borehole	2004/03/22	2015/04/23	17	Quaternary	25
BG00038	Qual	Borehole	2004/03/30	2015/04/23	17	Quaternary	26
200189629	Qual	Borehole	2008/02/28	2015/04/22	17	Malmesbury	
3319CA00101	Qual	Borehole	2007/06/27	2015/04/22	14	Cape Granite	
200000568	Qual	Borehole	2003/05/07	2015/04/22	30	Malmesbury	
200000572	Qual	Borehole	2003/05/07	2015/04/22	31	Malmesbury	
200000566	Qual	Borehole	2003/05/07	2015/04/22	22	Malmesbury	
200000512	Qual	Borehole	2003/05/08	2015/04/22	29	Malmesbury	
200000576	Qual	Borehole	2003/05/08	2015/04/22	26	Malmesbury	
200000550	Qual	Borehole	2003/05/06	2015/04/21	28	Quaternary	
3319CC00223	Qual	Borehole	2008/06/05	2015/04/21	13	Quaternary	
200000524	Qual	Borehole	2003/05/06	2015/04/21	25	Quaternary	
BG00169	Qual	Borehole	2011/04/19	2015/04/21	8	Tertiary	85
200000538	Qual	Borehole	2003/05/02	2015/04/21	20	Quaternary	
200000540	Qual	Borehole	2003/05/06	2015/04/21	28	TMG	
200000544	Qual	Borehole	2003/05/06	2015/04/21	24	Quaternary	
200000552	Qual	Borehole	2003/05/08	2015/04/21	19	Quaternary	
200000516	Qual	Borehole	2003/05/06	2015/04/20	24	Quaternary	
200000518	Qual	Borehole	2003/05/06	2015/04/20	27	Quaternary	
200000520	Qual	Borehole	2003/05/06	2015/04/20	31	Quaternary	
200000528	Qual	Borehole	2003/04/30	2015/04/20	32	Quaternary	
200000534	Qual	Borehole	2003/04/30	2015/04/20	29	Quaternary	
200000536	Qual	Borehole	2003/04/30	2015/04/20	30	Quaternary	

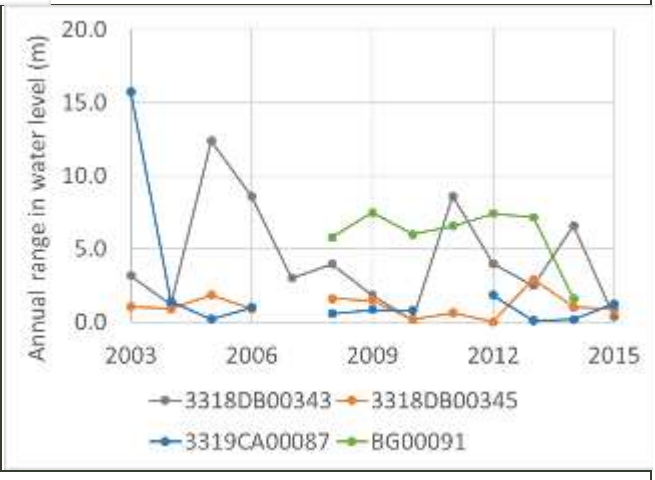
200000548	Qual	Borehole	2003/04/30	2015/04/20	33	Quaternary	
200000586	Qual	Borehole	2003/07/16	2014/10/14	26	Quaternary	
BG00046	Qual	Borehole	2004/03/30	2014/05/06	10	Quaternary	30
200000638	Qual	Borehole	2004/02/25	2014/04/16	9	Quaternary	
200000532	Qual	Borehole	2003/04/30	2014/04/04	25	Cape Granite	
BG00155	Qual	Borehole	2009/06/24	2014/04/04	8	TMG	
200000526	Qual	Borehole	2003/05/06	2014/04/04	15	Quaternary	
200000558	Qual	Borehole	2003/05/07	2011/04/19	21	Malmesbury	
200000530	Qual	Borehole	2003/05/02	2010/11/03	17	Quaternary	
3319CC00222	Qual	Spring/Eye	2008/06/04	2010/04/20	6	Quaternary	
200000570	Qual	Borehole	2003/05/07	2010/04/19	23	Quaternary	
200000514	Qual	Borehole	2003/04/30	2009/10/27	7	Cape Granite	
200000560	Qual	Borehole	2003/05/07	2009/10/26	22	Tertiary	
200000522	Qual	Borehole	2003/05/06	2008/10/08	16	Quaternary	
200000510	Qual	Borehole	2003/05/07	2007/10/03	14	Cape Granite	
BG00048	Qual	Borehole	2004/03/25	2006/12/01	11	Quaternary	18
BG00045	Qual	Borehole	2004/03/25	2006/04/27	9	Quaternary	36
BG00047	Qual	Borehole	2004/03/25	2006/04/27	9	Quaternary	34
BG00049	Qual	Borehole	2004/03/25	2006/04/27	8	TMG	30
BG00043	Qual	Borehole	2004/03/19	2006/04/27	10	TMG	30
BG00042	Qual	Borehole	2004/03/25	2006/04/27	9	TMG	56
BG00044	Qual	Borehole	2004/03/19	2006/04/27	10	Quaternary	35
200000582	Qual	Borehole	2003/06/04	2006/04/26	8	Quaternary	
200000556	Qual	Borehole	2003/05/07	2005/06/01	10	Quaternary	

Water Level Graphs

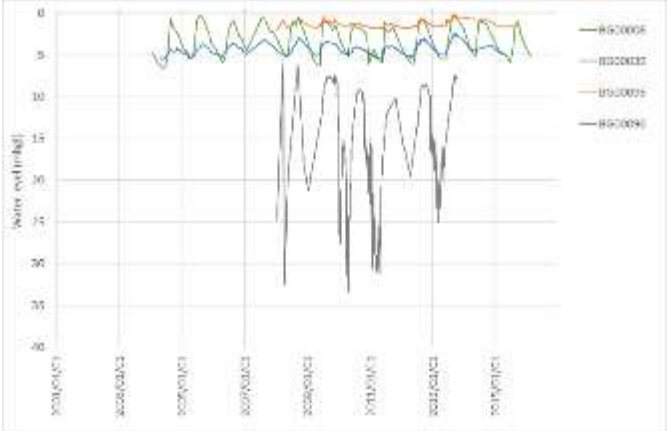
Paarl - Wellington

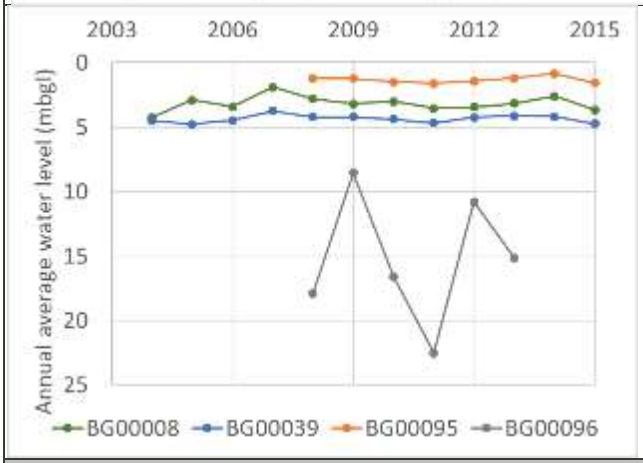


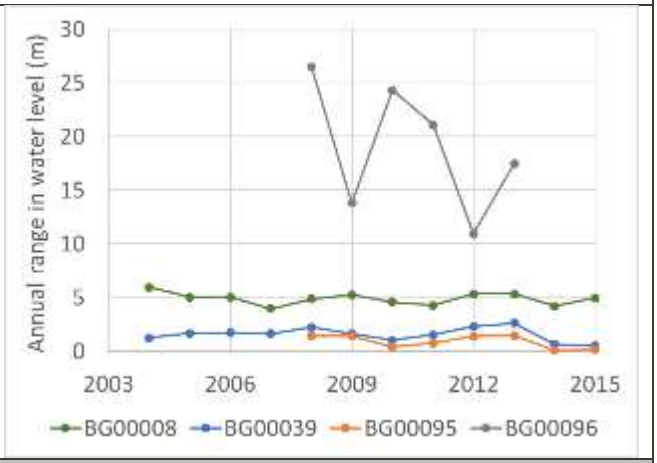




Franschhoek





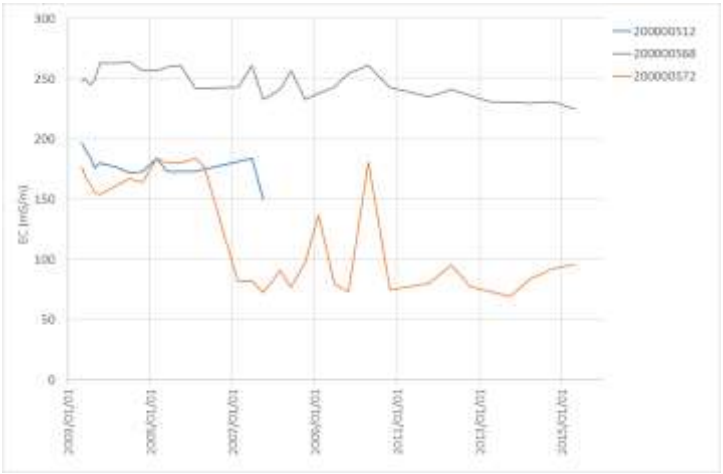


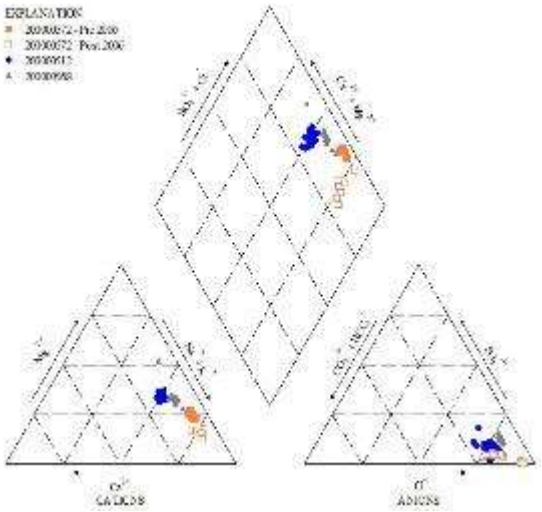
Response to Bulk Abstraction

The availability of municipal groundwater monitoring of abstraction at Franschhoek & Groendal, La Motte, Wemmershoek, Roberstvlei is not known. This will be investigated should this GRU be prioritised for further investigation

Water quality graphs

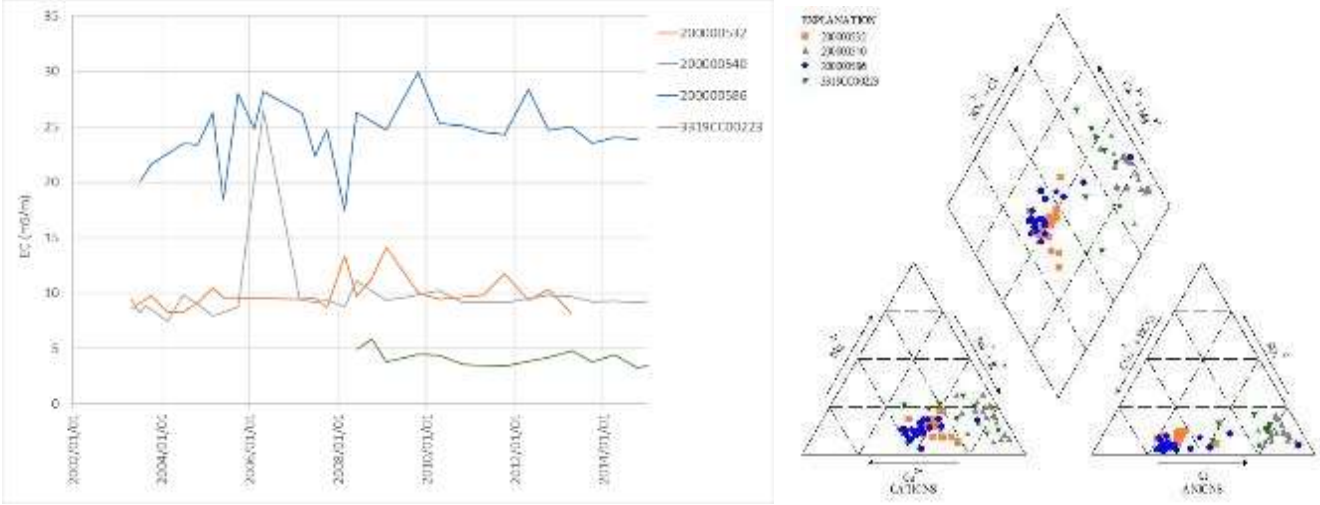
Paarl-Wellington





DWAF 1996 drinking water quality guideline
Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

Franschhoek



DWAF 1996 drinking water quality guideline
Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

Comments

There are two distinct clusters of water use within the Paarl Upper Berg GRU, namely the Paarl-Wellington area where groundwater is sourced from Malmesbury and Cape Granite rocks (basement), and overlying Tertiary and Quaternary deposits, and the Franschhoek area, where Quaternary deposits are surrounded by TMG mountains (and likely supported by lateral recharge from TMG units, or losing streams that decant from the TMG slopes and enter Quaternary deposits).
Long term water level monitoring has been conducted at several boreholes in the Paarl-Wellington cluster. BG00091 and 3319AC00087 were selected as they represent boreholes located on Tertiary/Quaternary deposits near to and away from water use respectively, and 3318DB00345 and 3318DB00343 are located on Malmesbury Group rocks, similarly near to and far from a registered water use. Water quality monitoring locations in close proximity to the water level monitoring locations were selected. Water levels in BG00091 and 3318DB00343 show strong seasonal variations, this is less obvious in 3319CA00087 and 3318DB00345. Water levels in 3318DB00343 are variable and an overall decreasing trend in annual average water levels is noted between 2003 and 2015, likely due to proximity to groundwater abstraction (although the decline does not alone indicate "unsustainability", section **Error! Reference source not found.**). No long term trends are evident in the other boreholes. Seasonal range in water levels is up to 15 m (impacted by seaosnal pumping), with higher ranges generally observed in 3318DB00343 and BG00091.
Water quality in the three selected boreholes varies from 70 to 250 mS/m. All locations show an apparent decrease in EC with time, with a gradual decrease from generally >250 mS/m prior to 2006 to <250 mS/m since 2011 in 200000568, and a step decrease from 150 – 200 mS/m prior to 2006 to generally <100 mS/m after 2006, observed in 200000572. The ionic composition has also shown a change, becoming more Na and bicarbonate rich as the EC decreases.

The Franschhoek area has been extensively monitored, with numerous long term water level monitoring points in both the Franschhoek valley, and the Wemmershoek mountains to the north. There are also numerous long term water quality monitoring points, but most of these are located within the Franschhoek valley, and few within the TMG mountainous area. Two water level monitoring locations in the TMG, one close to registered water use (BG00096) and one away from registered water use (BG00095) were selected, as well as two water level monitoring points within the valley, one close to registered water use (BG00008) and one away from registered water use (BG00039).
BG00096, located close to registered water use, shows a large range (10 – 27 m) in seasonal water level fluctuations, compared to BG00095 (<2 m). The water table at BG00096 (annual average 8 – 22 mbgl) is also much deeper than at BG00096 (1.5 mbgl). Within the valley, seasonal water table fluctuations are much greater at BG00008 (approx. 5m), which is close to a registered water use, than at BG00039 (<3 m), which is away from registered water use. The water table at BG00039 is slightly deeper than at BG0008, but both are <5 m bgl. Annual average water levels in BG00008, BG00039 and BG00095 show no long term increasing or decreasing trends. There is insufficient data available for BG00096 to determine if there are long term trends in groundwater levels.
Water quality within the Franschhoek valley is much fresher than in the Paarl-Wellington cluster (related to geology), with EC of all selected locations <30 mS/m. Althought the EC does fluctuate, there are no obvious long term trends in water quality. The ionic composition is variable, but appears to form a Na-Cl – Ca-bicarbonate continuum. Water from the TMG appears to be more Na-Cl dominant, with water from the valley having a stronger Ca-bicarbonate influence.

Status Quo assessment for GRU 5 – Tulbagh Valley

GRU name, main town	Tulbagh Valley sub-catchment, GRU 5 Tulbagh Valley Main town: Tulbagh, Riebeek-Wes / - Kasteel
GRU Boundary description	This area is predominantly underlain by Malmesbury Group with thin and discontinuous Cenozoic cover in only a few places, such as gravel terraces from the palaeo Breede River, in the Klein Berg catchment. In the east of the GRU, the Tulbagh Valley is bounded on east, west and north by slopes of the TMG (predominantly Peninsula Formation). The western wall of the Tulbagh valley (Waterval Mountains Nature Reserve) comprises a syncline of the TMG, exposing Nardouw Group in the centre. The valley is open to the south, continuing into the Breede River catchment, with a surface water catchment divide separating the north flowing Boontjies (tributary to Klein-Berg and in turn, Berg) from the south flowing . West of the Tulbagh valley, the GRU is dominated by Malmesbury Group outcrop. Groundwater in the basement aquifers is generally minimal, occurring only in the weathered zone and some deeper structures. Few natural wetlands would have occurred before agricultural development, other than in the streamlines. The boundaries of the GRU are related to surface water divides. Shallow groundwater flow will generally adhere to these boundaries, and some deep flow within the Peninsula Formation, from this GRU towards the east into the Breede-Gouritz, is likely.
Catchments	G10E and G10F
Domestic Groundwater use	Tulbagh and Riebeek Kasteel use minor quantities of groundwater as part of their domestic water supply: • Groundwater makes up ~4% (0.03 million m^3/a) of the supply source for Tulbagh • Groundwater makes up ~1% (0.003 million m^3/a) of the supply source for Riebek Kasteel
Map	

Water use clusters for trend analysis

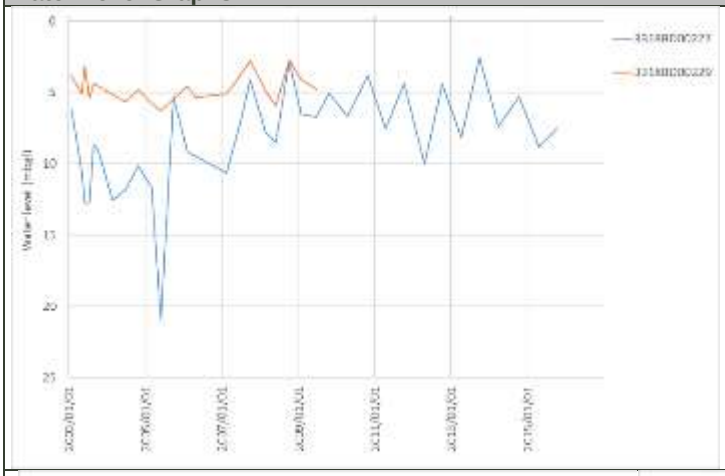
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Gouda-Riebeek-Kasteel	Malmesbury, TMG, Tertiary, Quaternary	17	0.6	Agriculture: irrigation	3318BD00229 (Malmesbury, close to water use)	200000578 (at 3318BD00229)

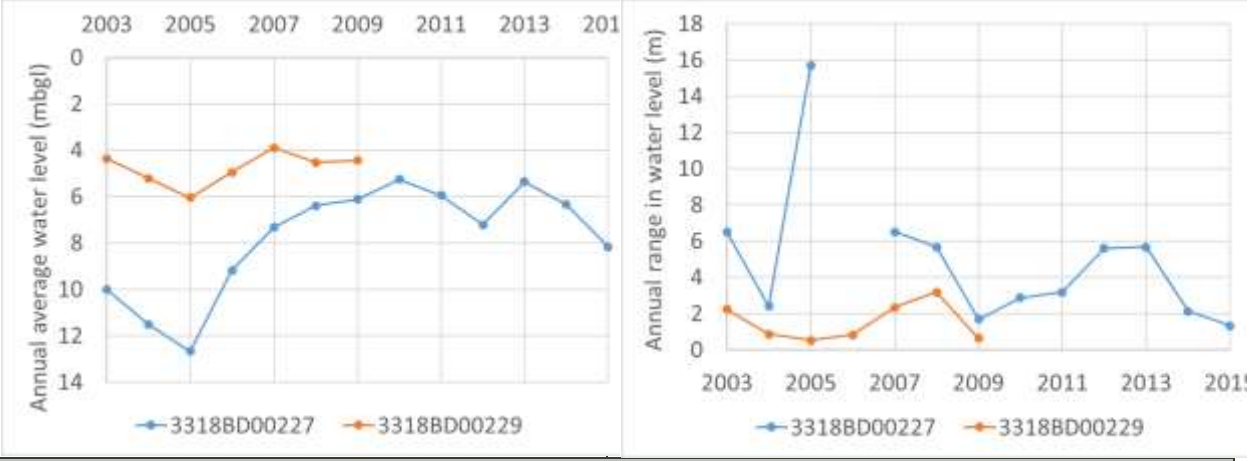
					3318BD00227 (Malmesbury, away from water use)	200000574 (at 3318BD00227)
Tulbagh	Malmesbury, TMG, Tertiary, Quaternary	83	3.1	Agriculture: irrigation Schedule 1 Industry Water supply	None	None

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3318BD00227	WL	Borehole	2003/01/29	2015/10/14	34	Malmesbury	
3318BD00229	WL	Borehole	2003/01/22	2009/06/22	20	Malmesbury	
200000574	Qual	Borehole	2003/05/08	2015/04/22	29	Malmesbury	
200000578	Qual	Borehole	2003/05/08	2006/04/25	11	Malmesbury	

Water Level Graphs

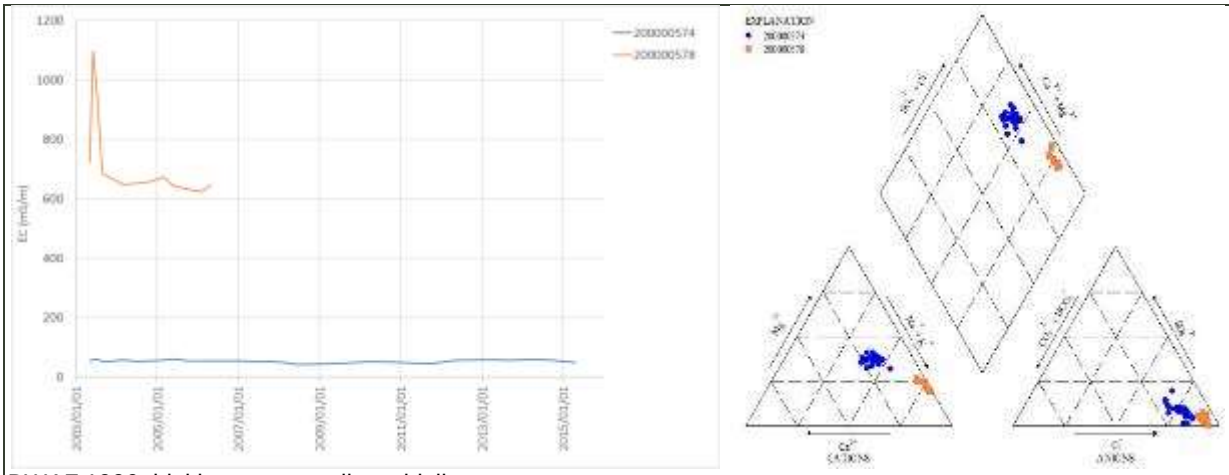




Response to Bulk Abstraction

The availability of municipal groundwater monitoring of abstraction Tulbagh and Riebek Kasteel is not known. This will be investigated should this GRU be prioritised for further investigation

Water quality graphs



DWAF 1996 drinking water quality guideline
Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

Comments

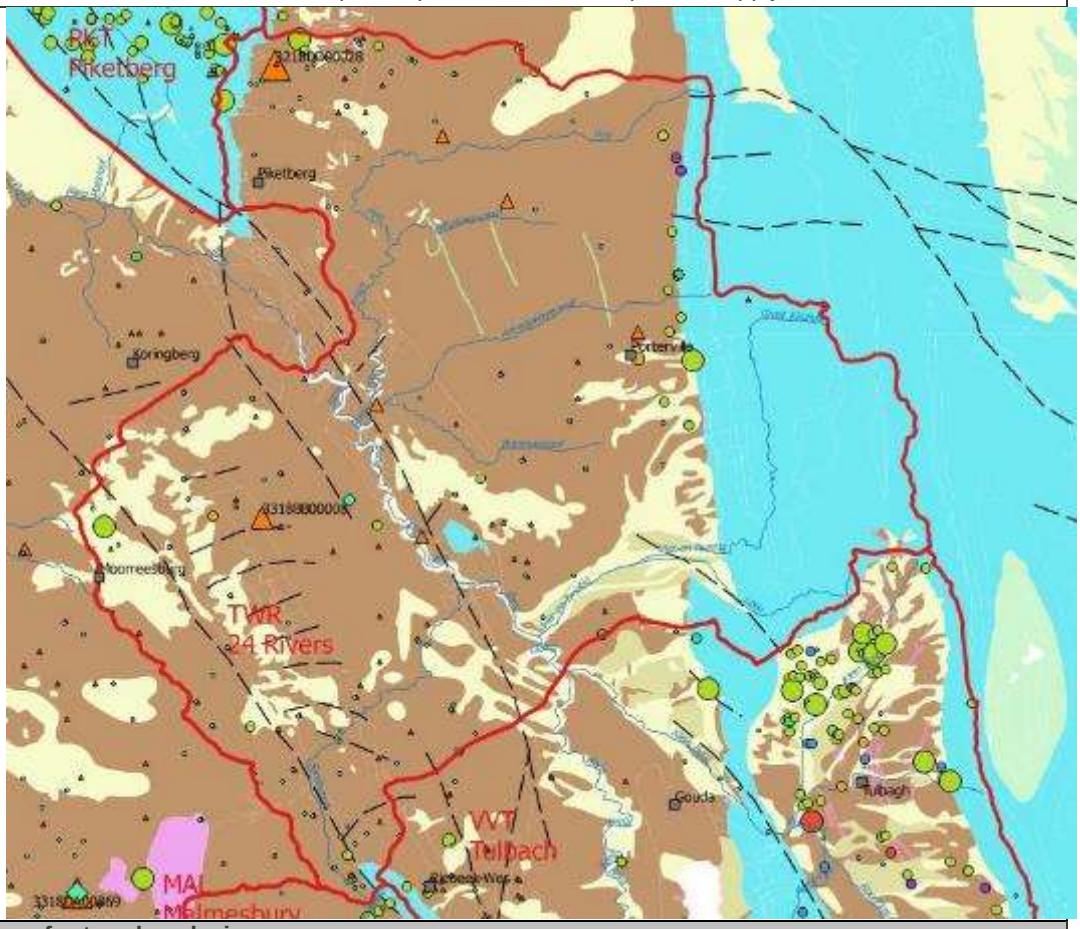
The Tulbagh GRU consists of the Tulbagh cluster of water use boreholes, located in an anticline with mountainous TMG limbs and an older Malmesbury core in the eastern part of the GRU, and the Gouda-Riebeeck West cluster, underlain largely by Malmesbury rocks, as well as overlying Quaternary and Tertiary Deposits.

Although most registered groundwater use in this GRU is within the Tulbagh cluster, there is no long term water quality or water level monitoring in the Tulbagh valley. Two long term paired groundwater level and quality monitoring locations are present in the Gouda-Riebeeck West area, namely 3318BD00227 (water level)/200000574 (water quality) located away from registered water use, and 3318BD00229 (water level)/200000578 (water quality) located close to registered water use.

Water levels at both locations show seasonal fluctuations, although these are more pronounced at 3318BD00227 (2 – 16 m) compared to 3318BD00227 (<4 m). Long term variations in annual average water level are evident, with a low annual average water level recorded in 2005 in both monitoring boreholes, followed by a gradual increase in water level over 2 – 3 years. These long term fluctuations are likely to be relate to changes in rainfall and hence recharge.

Water quality at 200000574 (approx. 50 mS/m) is much fresher than at 200000578 (generally 600 - 650 mS/m). The EC at both locations appears relatively stable with time, with no apparent increasing or decreasing trends. The water chemistry from the two locations is distinct, with water from 200000574 having a more Mg/Ca rich ionic composition compared to 200000578, which has relatively more Na.

Status Quo assessment for GRU 6 – 24 Rivers

GRU name, main town	6 – 24 Rivers sub-catchment, GRU 6 24 Rivers Main town: Porterville, Piketberg
GRU Boundary description	The GRU is dominated by outcrop of Malmesbury Formation in the centre and southwest, and by TMG outcrop of the Groot Winterhoek Wilderness Area in the east of the GRU. The TMG in the Groot Winterhoek has been folded into a syncline, exposing the Peninsula Formation in the limbs forming steep mountain sides to the valley, and the Nardouw Group at the centre, with the Groot-Kliphius River closely following the syncline axis. The folding continues to the west and an anticline structure exposes the base of the TMG (Piekenierskloof and Graafwater Formation) close to the eastern GRU boundary. The TMG aquifers are significant in the GRU, with high recharge and high discharge to surface water, as evidenced by the perennial Groot-Kliphius River. Limited transfer of groundwater from the TMG to basement aquifers is expected, because of the generally poor permeability of the Malmesbury Group. Exceptions are scree cones and minor weathered zones that receive TMG water and in turn decant to surface water systems. Some degree of groundwater flow in the Malmesbury basement aquifers is also evidenced by their use (see below), and by the several tributaries to the Berg that traverse the Malmesbury basement aquifer in the GRU (and are not connected to TMG). The Berg River itself drains the centre of the GRU and can be assumed to receive baseflow from the Malmesbury basement aquifer. The north-eastern GRU boundary, specifically where it traverses east-west across the Nardouw outcrop, is a surface water divide, and can be assumed to also reflect a shallow groundwater divide (note: a divide, but not hydraulic boundary). This will not act as a deep groundwater flow divide for the Nardouw Group aquifers nor the Peninsula Formation aquifer, both of which will be in hydraulic connection across the boundary.
Catchments	G10G; G10H and G10J
Domestic Groundwater use	None of the settlements within the GRU rely on groundwater as sole supply, however groundwater is used as part of the water supply in Piketberg and Porterville: • Groundwater makes up 25% (or 0.24 million m3/a) of the supply to Piketberg • Groundwater makes up 23% (or 0.20 million m3/a) of the supply to Porterville
Map	
Water use clusters for trend analysis	

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
24 Rivers	Malmesbury, TMG, Tertiary, Quaternary	36	2.0	Agriculture: irrigation Water supply	None	3218DD00028 (Malmesbury) 3318BB00008 (Malmesbury)

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3218DD00028	Qual	Spring	1994/01/05	2015/09/25	37	Malmesbury	
3318BB00008	Qual	Borehole	1992/07/08	2014/08/20	15	Malmesbury	

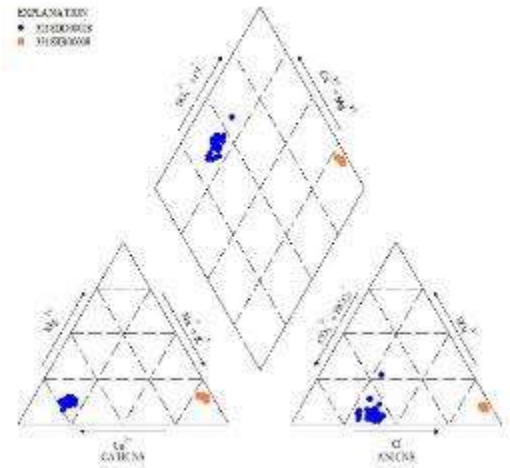
Water Level Graphs

No data.

Response to Bulk Abstraction

The availability of municipal groundwater monitoring of abstraction at Porterville and Piketberg is not known. This will be investigated should this GRU be prioritised for further investigation

Water quality graphs



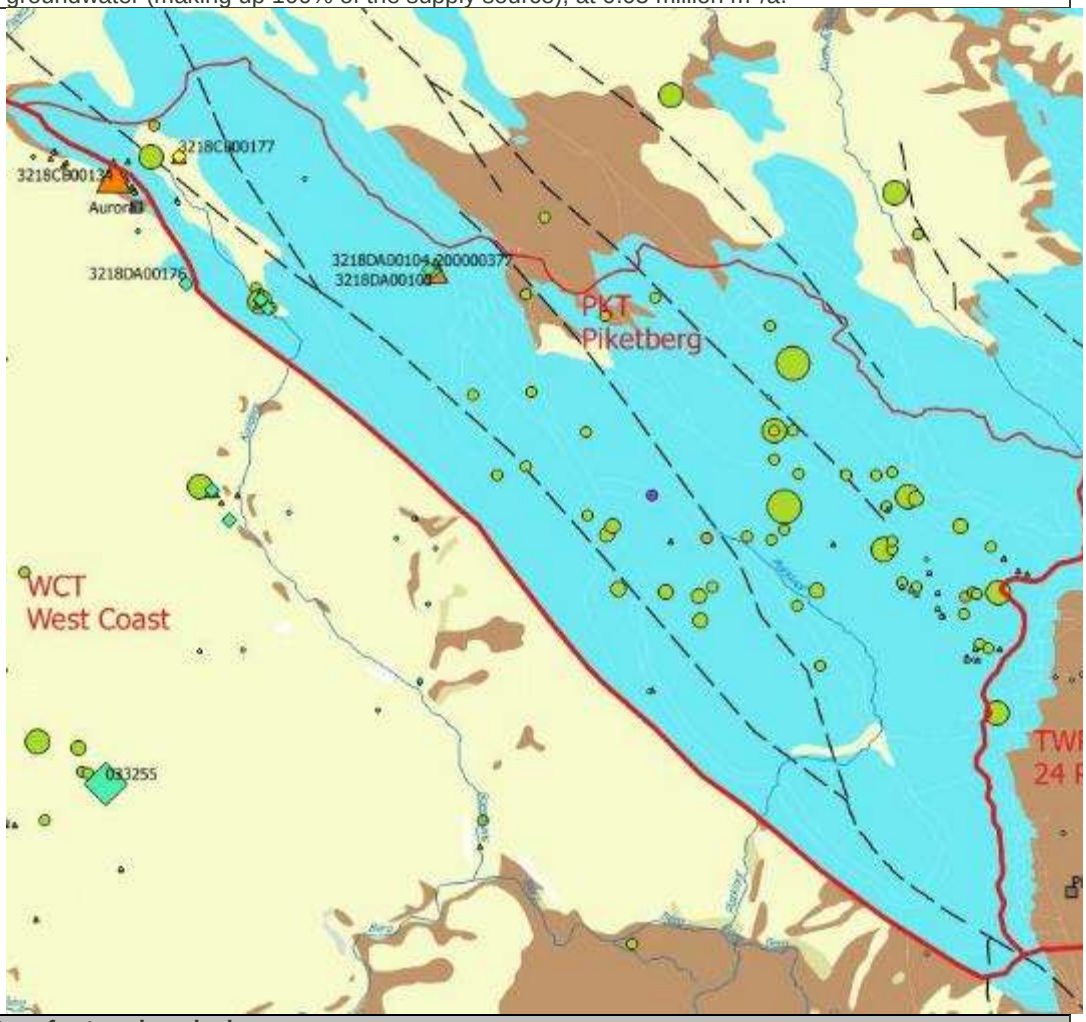
DWAF 1996 drinking water quality guideline
Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

Comments

The 24 River GRU is largely underlain by Malmesbury Group rocks. There is little registered water use, with most registered water use in areas adjacent to the TMG.

There is no long term water level monitoring in this GRU. There are two water quality monitoring locations, namely a spring, 3218DD00028, located near the Piketberg mountains in the north of the GRU, and a borehole, 3318BB00008, located on Malmesbury closer to Moorreesburg. The EC of spring water is consistently around 30 mS/m and shows no long term trends. Water from the borehole 3318BB00008 has an EC generally between 700 and 800 mS/m, but also no obvious long term trends. The ionic composition of the two water sources is very different, with spring water having a Ca-HCO3 signature, and the borehole being predominantly Na-Cl.

Status Quo assessment for GRU 7 – Piketberg

GRU name, main town	Piketberg sub-catchment, GRU 7 Piketberg Main town: (North of) Aurora
GRU Boundary description	This mountainous area is dominated in the south by the Table Mountain Group. Basement occurs at the base of the mountain on the eastern side - this forms a no-flow boundary for groundwater on the southeast of the Piketberg GRU, except for minor flow into screes and weathered zones of the Malmesbury Group. The Sandveld Group overlie flat areas and screes on the mountain slopes, and overlies the TMG and basement to the northwest of the GRU. The TMG is highly faulted here causing the Piekenierskloof and Peninsula Formations to be in contact in places. The general dip of strata is towards the west, and groundwater flow has been shown to largely flow to the northwest in the TMG (DWAF, 2008), but with much local variation due to topography, structure and rainfall gradients. The Aurora fault, part of a major fault system running NNW from Wellington, through the Swartland, forms the southern boundary of the Piketberg GRU. Although minor flow may occur in the fault system and into minor aquifer units in the abutting West Coast (GRU8), this boundary can be treated as a no-flow boundary. Groundwater will discharge from all aquifers to the various rivers and streams in the area, and eventually to the coastline.
Catchments	G30A and G30D
Domestic Groundwater use	No settlements within the Berg Study area of the Piketberg GRU utilise groundwater for domestic supply. Redelinghuys (beyond the Berg boundary, but within the Piketberg GRU) relies solely on groundwater (making up 100% of the supply source), at 0.05 million m^3/a.
Map	

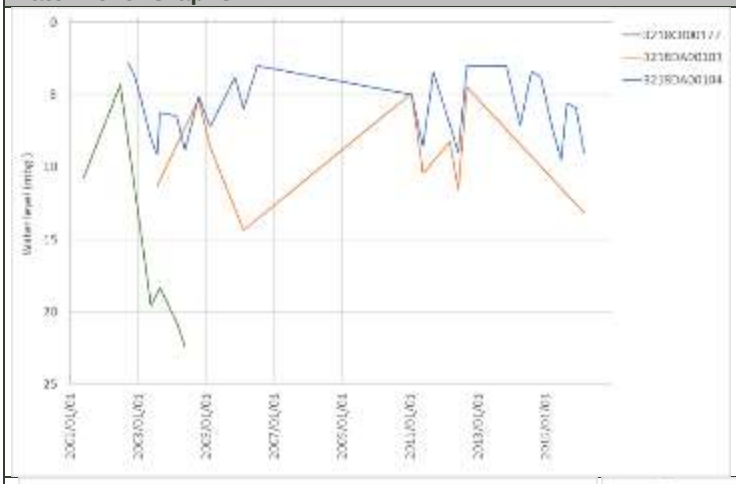
Water use clusters for trend analysis						
Water use cluster	**Geology**	**Approx no. water use locations**	**Total water use (Mm^3)**	**Predominant Water use**	**Representative WL locations**	**Representative Chemistry locations**

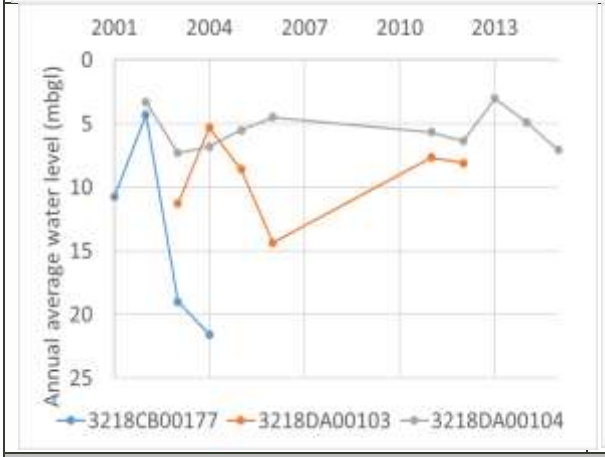
Piketberg	TMG, Malmesbury, Quaternary	64	6.2	Agriculture	3218DA00103 (TMG, away from water use) 3218DA00104 (TMG, away from water use) 3218CB00177 (Quaternary, close to water use)	200000377 (at 3218DA00103/4

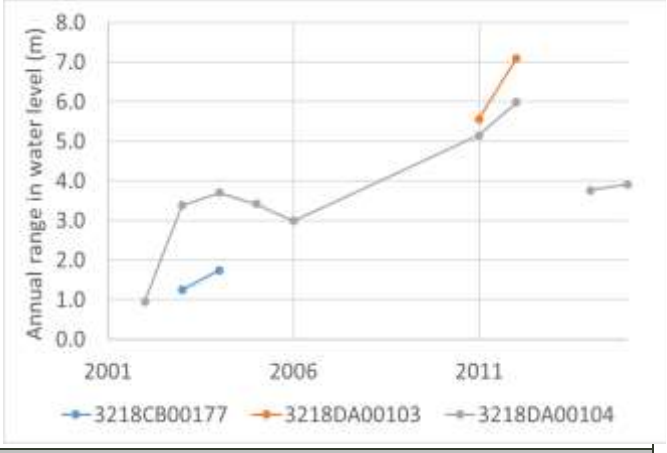
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3218DA00104	WL	Borehole	2002/09/23	2016/02/26	29	TMG	38
3218DA00103	WL	Borehole	2003/07/31	2016/02/26	10	TMG	120
3218CB00177	WL	Borehole	2001/06/01	2004/05/25	6	Quaternary	
200000377	Qual	Borehole	2002/09/23	2015/11/27	15	TMG	

Water Level Graphs



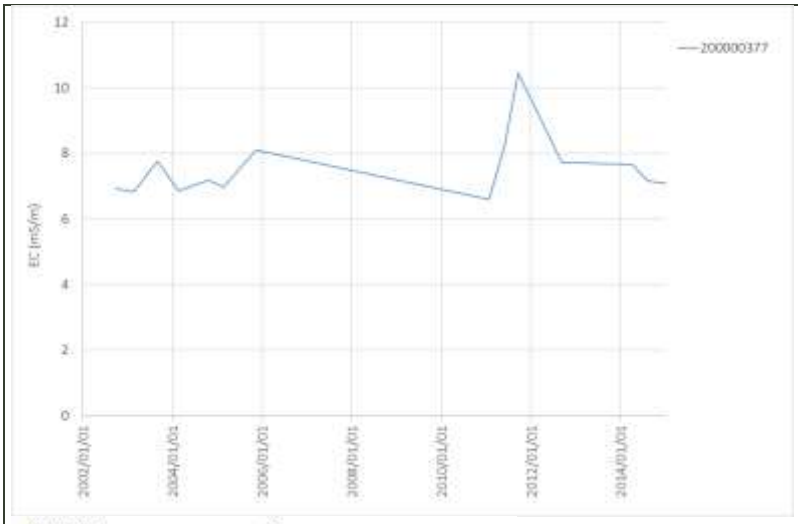


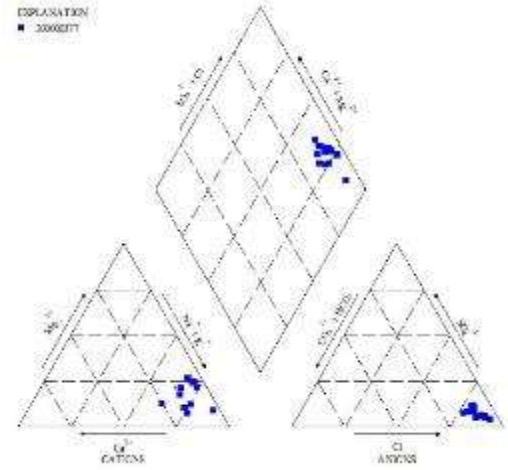


Response to Bulk Abstraction

The availability of municipal groundwater monitoring of abstraction at Redelinghuys is not known. This will be investigated should this GRU be prioritised for further investigation

Water quality graphs





DWAF 1996 drinking water quality guideline
Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

Comments

The Piketberg GRU is underlain by TMG, Malmesbury and Quaternary Deposits. However, registered groundwater use is largely restricted to the TMG.

There are three water level monitoring boreholes in the GRU, 3218DA00103 and 104 are a shallow/deep pair in the TMG, away from registered water use. Groundwater quality monitoring is undertaken at the same location (200000377). 3218CB00177 is located within a sediment filled valley, but it is not certain if it targets Quaternary sediments or TMG. There is a registered water use location within 1 km of this monitoring borehole.

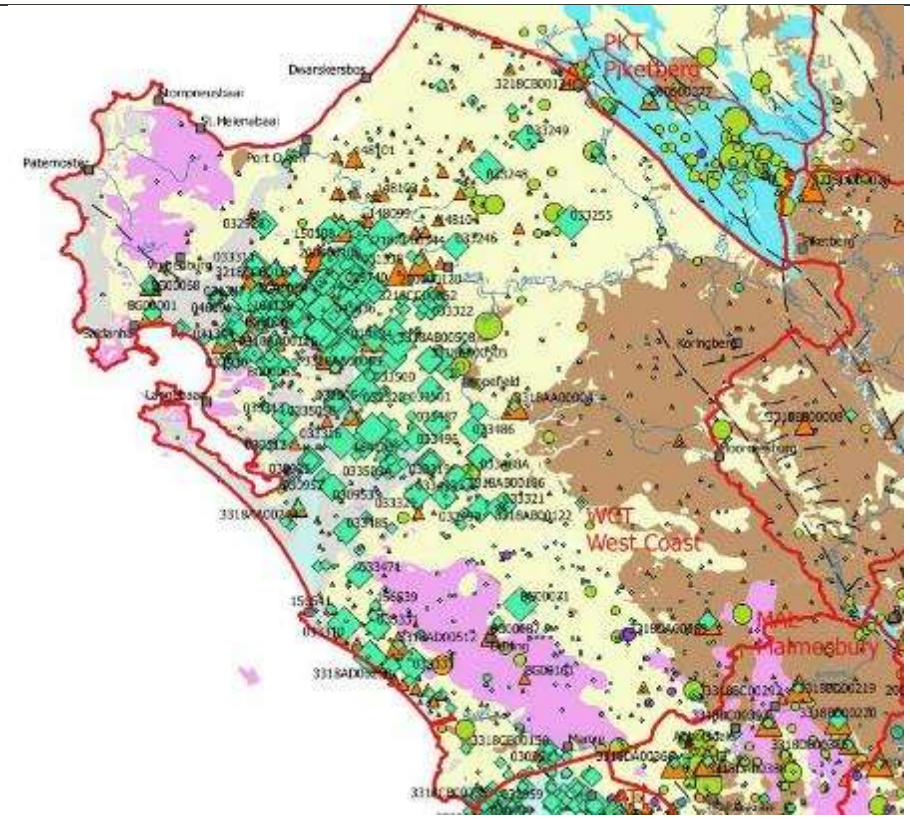
Although monitoring has been sporadic, seasonal cycles are observed in 3218DA00103 and 104. Annual average water levels at these two boreholes do not show any apparent trend with time. There is insufficient data at 3218CB00177 to identify any trends.

Groundwater from 200000377 has had a very low and consistent EC (7 - 11 mS/m) over the monitoring period. The ionic composition is Na-Cl dominated.

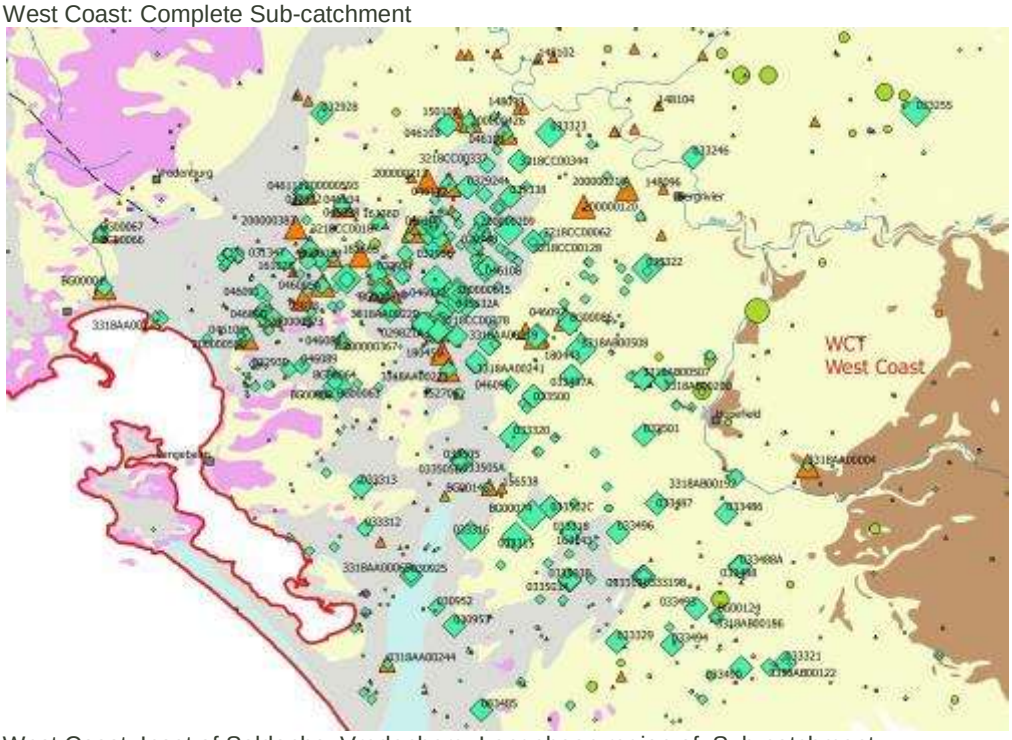
Status Quo assessment for GRU 8 – West Coast

GRU name, main town	West Coast sub-catchment, GRU 8 West Coast. Main town: Langebaan, Saldanha Bay, Vredenberg
GRU Boundary description &geology & aquifer types	The West Coast region is formed by basement (Malmesbury Group and various plutons of the Cape Granite Suite), overlain by the Sandveld Group which is laterally continuous over large areas, and also reaches significant thicknesses. Excluding the Berg River which traverses the GRU towards the ocean at St Helena Bay, surface water is limited in the region, related to low rainfall, subdued topography and the highly permeable sand-dominated geology. Several ephemeral streams emanate from the granite hills after heavy rain. Palaeo-courses of the Berg River, (DWAF, 2008) have generated incisions in the basement topography, which are infilled by fluvial sediment (the Elandsfontyn Formation, within the Sandveld Group), and represent high yielding aquifers. The hydraulic properties, areal extent and thickness of the Sandveld Group aquifers, make them a significant resource for the region. Previous research (summarised in WRC, 2016a), has divided the area spatially into the following aquifer systems: I. Grootwater Aquifer around Yzerfontein in quaternary catchment G21A II. Elandsfontein Aquifer System comprising a lower and upper sand aquifer separated by clay unit, between Hopefield and Langebaan Lagoon, discharging to Langebaan Lagoon and to the Berg River. The Elandsfontein Aquifer System and Grootwater Aquifer are separated only by a groundwater flow divide around the G10M and G21A catchment divide, but are in hydraulic connection. III. The Langebaan Road Aquifer System between the Berg River and Saldanha Bay, north of the Elandsfontein Aquifer System, also comprising a lower and upper sand aquifer separated by clay unit. The Langebaan Road Aquifer System discharges to Saldanha Bay, St Helena Bay and the Berg River. The division between the Langebaan Road Aquifer System and Elandsfontein Aquifer System should simply be considered a spatial one, as the two are in hydraulic connection in both the shallow and deep aquifers (WRC, 2016a). IV. The Adamboerskraal Aquifer System, north of the Berg River, also comprising a lower and upper sand aquifer separated by clay unit, and discharging to St Helena Bay and the Berg River. There is hydraulic connection between the Adamboerskraal Aquifer System and the Langebaan Road Aquifer System, beneath the Berg River (WRC, 2016a).
Catchments	G10K; G10M; G10L and G21A
Domestic Groundwater use	The following settlements utilise groundwater for domestic supply: • Aurora relies solely on groundwater for its supply, at 100% of the supply system, 0.06 million m^3/a • Hopefield has a wellfield making up 30% of water supply, 0.16 million m3/a • The Langebaan Road Wellfield provides 17% of the supply to the towns Langebaan, Langebaanweg and Saldanha, abstracting 1.35 million m^3/a

Map



West Coast: Complete Sub-catchment



West Coast: Inset of Saldanha, Vredenberg, Langebaan region of Sub-catchment

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Darling	Malmesbury, Granite, Quaternary,	28	1.1	Agriculture: irrigation Industry: urban Water supply	033333 (Quaternary, away from water use) 033476	3318AD00512 (Quaternary, away from water use)

					(Quaternary, away from water use) BG00071 (Granite, away from water use) 3318DA00369 (Malmesbury, away from water use)	BG00087 (Granite, away from water use) 3318DA00369 (Malmesbury, away from water use)
Hopefield/ Aurora	Malmesbury, Quaternary	33	1.2	Agriculture: irrigation	033255 (Quaternary, close to water use) 033248 (Quaternary, away from water use)	200000120 (Quaternary, away from water use) 3318AA00230 (Quaternary, away from water use)
Langebaan	Sandveld, Witzand	7	0.3	Agriculture: irrigation Industry: urban	029735 (Sandveld, close to water use) 046032 (Sandveld, away from water use) 030925 (Witzand, away from water use)	200000383 (Sandveld away from water use) 3218CC00296 (at 046032) BG00001 (Sandveld, away from water use)

Available monitoring locations for trend analysis (recent data highlighted yellow)

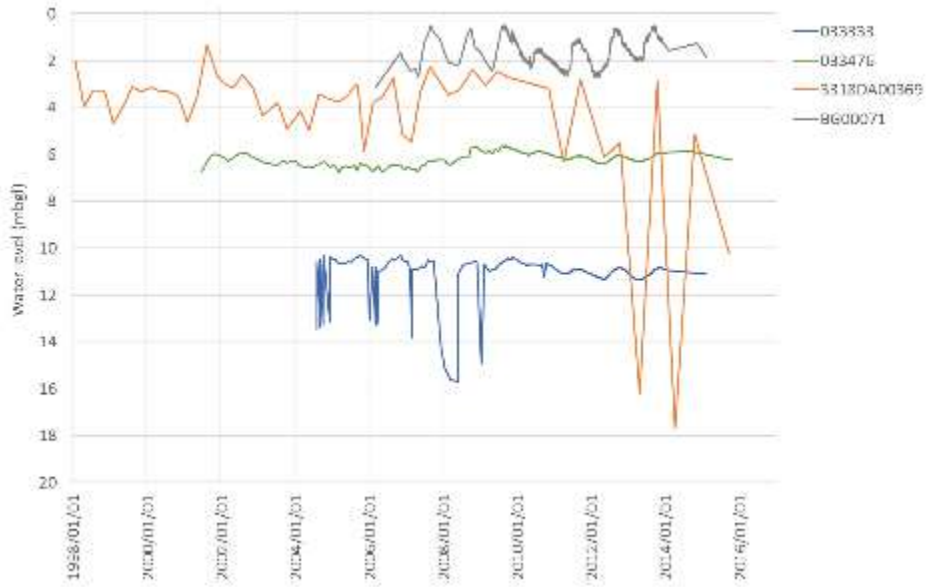
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3218CC00336	WL	Borehole	1998/09/02	2016/02/24	1667	Sandveld	30
BG00137	WL	Borehole	2008/05/27	2016/02/24	130	Sandveld	14
045632A	WL	Borehole	1998/09/02	2016/02/24	159	Sandveld	84
045633A	WL	Borehole	1998/09/02	2016/02/24	159	Sandveld	74
045634A	WL	Borehole	1998/09/02	2016/02/24	161	Sandveld	82
3218CC00334	WL	Dug Well	1984/09/20	2016/02/24	149	Sandveld	
3218CC00378	WL	Borehole	2000/05/05	2016/02/24	110	Sandveld	
3318AA00231	WL	Borehole	2000/06/05	2016/02/24	109	Sandveld	
3218CC00128	WL	Dug Well	2002/04/02	2016/02/23	109	Sandveld	
029740	WL	Borehole	2001/03/30	2016/02/23	104	Sandveld	
031338	WL	Borehole	2001/09/04	2016/02/23	110	Sandveld	
3218CC00086	WL	Dug Well	1984/08/27	2016/02/23	102	Quaternary	
3218CC00344	WL	Borehole	1998/09/02	2016/02/23	105	Quaternary	
3218CC00432	WL	Spring	2002/07/17	2016/02/23	105	Sandveld	
3218CC00038	WL	Dug Well	1984/09/28	2016/02/23	1030	Sandveld	
033246	WL	Borehole	2001/07/31	2016/02/23	113	Quaternary	
BG00086	WL	Borehole	1999/06/15	2016/02/22	144	Quaternary	20
3318AA00219	WL	Borehole	1999/07/19	2016/02/22	140	Quaternary	
3318AA00230	WL	Borehole	1999/11/04	2016/02/22	139	Quaternary	
3218CC00416	WL	Borehole	2002/06/03	2016/02/22	114	Sandveld	39
3318AB00507	WL	Borehole	1999/06/05	2016/02/22	138	Quaternary	
3318AB00505	WL	Borehole	1999/06/15	2016/02/22	126	Quaternary	
032936	WL	Borehole	1985/03/15	2016/02/22	189	Sandveld	
3218CC00338	WL	Dug Well	1998/08/26	2016/02/22	155	Sandveld	
032924	WL	Dug Well	1981/08/19	2016/02/22	140	Sandveld	
3218CC00330	WL	Dug Well	1998/08/26	2016/02/22	148	Sandveld	
3318AB00200	WL	Borehole	1982/08/16	2016/02/22	150	Quaternary	48
032932	WL	Borehole	1983/01/13	2016/02/03	162	Sandveld	
033471	WL	Borehole	1987/08/13	2016/02/02	101	Quaternary	
033502A	WL	Borehole	1988/01/13	2016/01/31	126	Quaternary	159
033502B	WL	Borehole	1987/08/10	2016/01/30	131	Quaternary	135
033502C	WL	Borehole	1988/01/13	2016/01/29	124	Quaternary	66
030953	WL	Borehole	1983/01/12	2016/01/28	165	Sandveld	
033485	WL	Borehole	1987/08/13	2016/01/28	119	Sandveld	
033488	WL	Borehole	1987/08/13	2016/01/27	118	Quaternary	
033487	WL	Borehole	1987/03/10	2016/01/27	109	Quaternary	
033319	WL	Borehole	1985/03/15	2016/01/27	151	Sandveld	
033488A	WL	Borehole	1987/08/13	2016/01/27	121	Quaternary	105
033490	WL	Borehole	1986/01/01	2016/01/27	129	Quaternary	
033493	WL	Borehole	1987/05/11	2016/01/27	132	Quaternary	

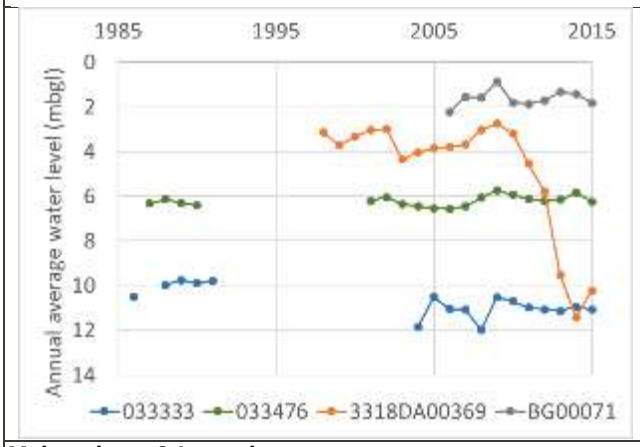
033494	WL	Borehole	1987/08/13	2016/01/27	115	Quaternary	
033321	WL	Borehole	1980/09/01	2016/01/27	132	Quaternary	
033318	WL	Borehole	1985/03/15	2016/01/27	134	Quaternary	
033497	WL	Borehole	2001/02/07	2016/01/27	120	Quaternary	
033496	WL	Borehole	1987/08/13	2016/01/27	108	Quaternary	
033319B	WL	Borehole	1985/03/15	2016/01/27	155	Sandveld	60
033486	WL	Borehole	1987/08/13	2016/01/27	110	Quaternary	
033501	WL	Borehole	1987/08/13	2016/01/27	128	Quaternary	
033503A	WL	Borehole	1988/04/12	2016/01/27	132	Sandveld	194
033503B	WL	Borehole	2001/02/09	2016/01/27	122	Quaternary	135
033497A	WL	Borehole	1987/08/12	2016/01/27	128	Quaternary	111
033317	WL	Borehole	1985/03/15	2016/01/26	146	Sandveld	
031347	WL	Borehole	1983/01/13	2016/01/26	155	Sandveld	
033320	WL	Borehole	1988/01/13	2016/01/26	1227	Sandveld	
033500	WL	Borehole	1987/08/12	2015/12/09	115	Quaternary	
3318AA00237	WL	Borehole	1998/08/26	2015/11/18	150	Sandveld	
033249	WL	Borehole	1984/11/06	2015/11/17	116	Quaternary	
033476	WL	Borehole	1987/08/14	2015/10/27	1620	Quaternary	
BG00063	WL	Borehole	2006/01/21	2015/10/22	1475	Sandveld	121
3318AA00221	WL	Borehole	1999/07/21	2015/09/25	3096	Sandveld	
032931	WL	Borehole	1981/09/23	2015/08/05	340	Sandveld	
046108	WL	Borehole	2003/03/05	2015/08/04	253	Sandveld	
045636	WL	Borehole	1998/03/25	2015/08/03	550	Sandveld	
045635A	WL	Borehole	1998/09/02	2015/08/03	179	Sandveld	80
033316	WL	Borehole	1985/04/19	2015/07/31	1806	Quaternary	
3318AB00508	WL	Borehole	1998/01/29	2015/06/30	3675	Quaternary	
033329	WL	Borehole	1986/10/02	2015/06/23	117	Quaternary	
032938	WL	Borehole	1983/01/13	2015/05/26	133	Sandveld	
033331	WL	Borehole	1985/10/01	2015/05/18	103	Quaternary	
033313	WL	Borehole	1985/03/15	2015/03/19	130	Sandveld	
033505	WL	Borehole	2001/05/28	2015/03/19	112	Sandveld	
033505A	WL	Borehole	2001/03/13	2015/03/19	116	Sandveld	133
033323	WL	Borehole	1985/03/15	2015/02/12	3438	Quaternary	
BG00074	WL	Borehole	2006/04/12	2015/02/10	1833	Sandveld	102
BG00071	WL	Borehole	2006/03/08	2015/02/09	1617	Cape Granite	121
033333	WL	Borehole	1986/02/13	2015/02/09	1571	Quaternary	
030925	WL	Borehole	1982/09/30	2014/12/01	159	Witzand	
3318AA00241	WL	Dug Well	2000/05/05	2014/04/10	112	Sandveld	
033255	WL	Borehole	1987/05/14	2014/04/10	1659	Quaternary	
3218CC00342	WL	Spring	1998/09/02	2014/02/12	139	Sandveld	
033310	WL	Borehole	1985/03/15	2013/12/09	1796	Quaternary	
033248	WL	Borehole	2001/01/23	2013/12/06	1519	Quaternary	
046032	WL	Borehole	1999/11/05	2013/12/04	3542	Sandveld	
046093	WL	Borehole	2002/09/20	2013/12/04	3376	Sandveld	
033322	WL	Borehole	1985/05/08	2013/12/04	1779	Quaternary	
033315	WL	Borehole	1985/03/15	2013/12/03	1791	Quaternary	
3318AA00236	WL	Borehole	1998/08/26	2012/08/20	136	Sandveld	
3218CC00331	WL	Dug Well	1998/09/02	2012/08/20	130	Sandveld	
032928	WL	Borehole	1981/09/24	2012/08/15	180	Quaternary	
3218CC00296	Qual	Borehole	1999/07/27	2015/04/15	38	Sandveld	
3318AA00221	Qual	Borehole	1999/07/16	2015/04/15	25	Sandveld	
3318AA00223	Qual	Borehole	1999/07/13	2015/04/15	39	Sandveld	
3318AA00231	Qual	Borehole	1999/07/16	2015/04/15	42	Sandveld	
3318AD00512	Qual	Borehole	1994/07/22	2015/04/15	33	Quaternary	
182665	Qual	Borehole	2000/03/09	2015/04/14	30	Quaternary	
3218CC00215	Qual	Borehole	1994/07/13	2015/04/14	34	Sandveld	
200000203	Qual	Borehole	2002/03/31	2015/04/14	34	Sandveld	
183307	Qual	Borehole	2000/09/06	2015/04/14	38	Sandveld	
200000108	Qual	Borehole	2000/08/11	2015/04/14	36	Sandveld	
161139	Qual	Borehole	1981/07/09	2015/04/14	30	Sandveld	
200000201	Qual	Borehole	2001/05/03	2015/04/14	22	Sandveld	
200000424	Qual	Borehole	2002/12/03	2015/04/14	30	Sandveld	

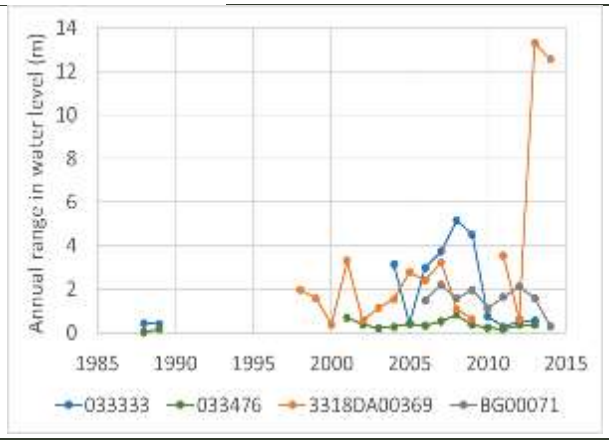
200000383	Qual	Borehole	2002/09/02	2015/04/14	32	Sandveld	
3318AA00219	Qual	Borehole	1999/06/18	2015/04/13	43	Quaternary	
93873	Qual	Borehole	1985/02/04	2015/04/13	39	Sandveld	
200000420	Qual	Borehole	2002/11/09	2015/04/13	31	Quaternary	
3318AA00004	Qual	Spring	1994/07/13	2015/04/13	25	Malmesbury	
3218CB00134	Qual	Spring	1999/03/09	2015/03/20	24	TMG	
3318DA00369	Qual	Borehole	1998/01/22	2014/10/20	43	Malmesbury	83
200000205	Qual	Borehole	2001/04/04	2014/10/14	35	Sandveld	
200000595	Qual	Borehole	2003/07/09	2014/10/14	28	Sandveld	
BG00001	Qual	Borehole	2003/07/11	2014/10/13	24	Sandveld	8
200000615	Qual	Borehole	2003/11/10	2012/10/03	21	Sandveld	

Water Level Graphs

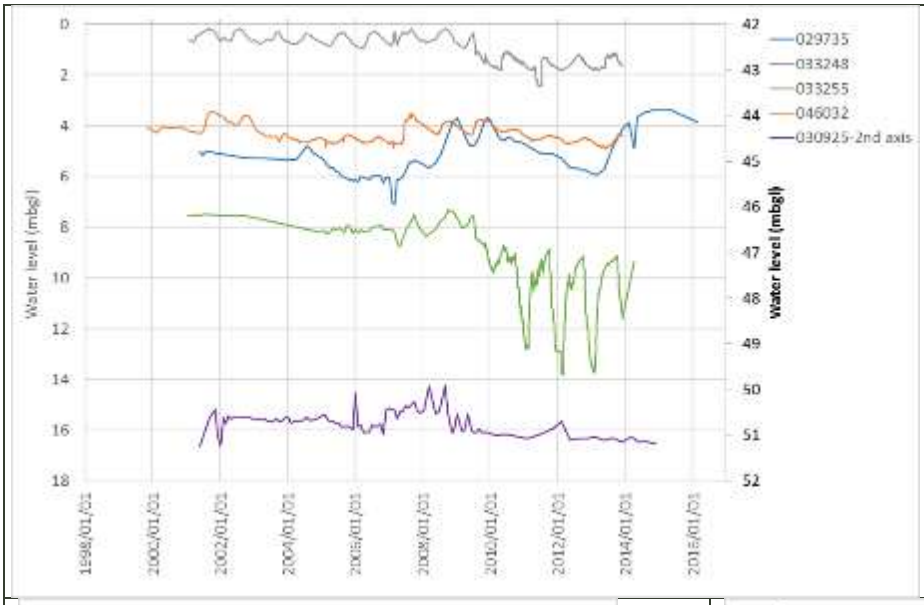
Darling

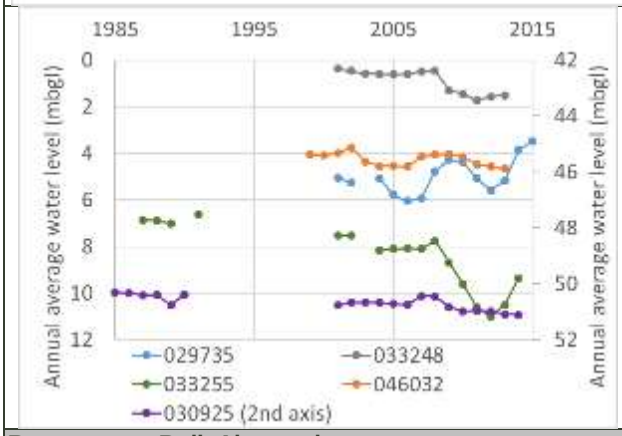


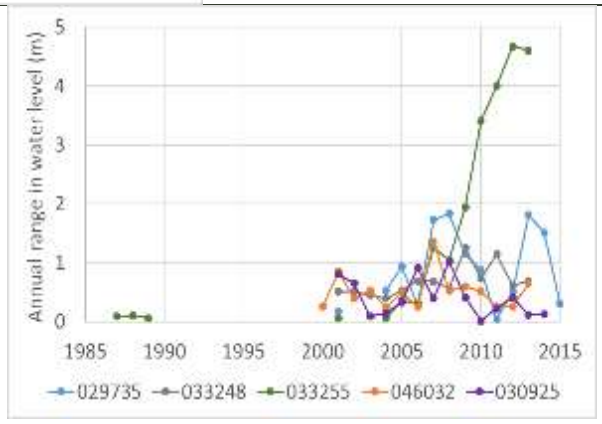




Malmesbury & Langebaan







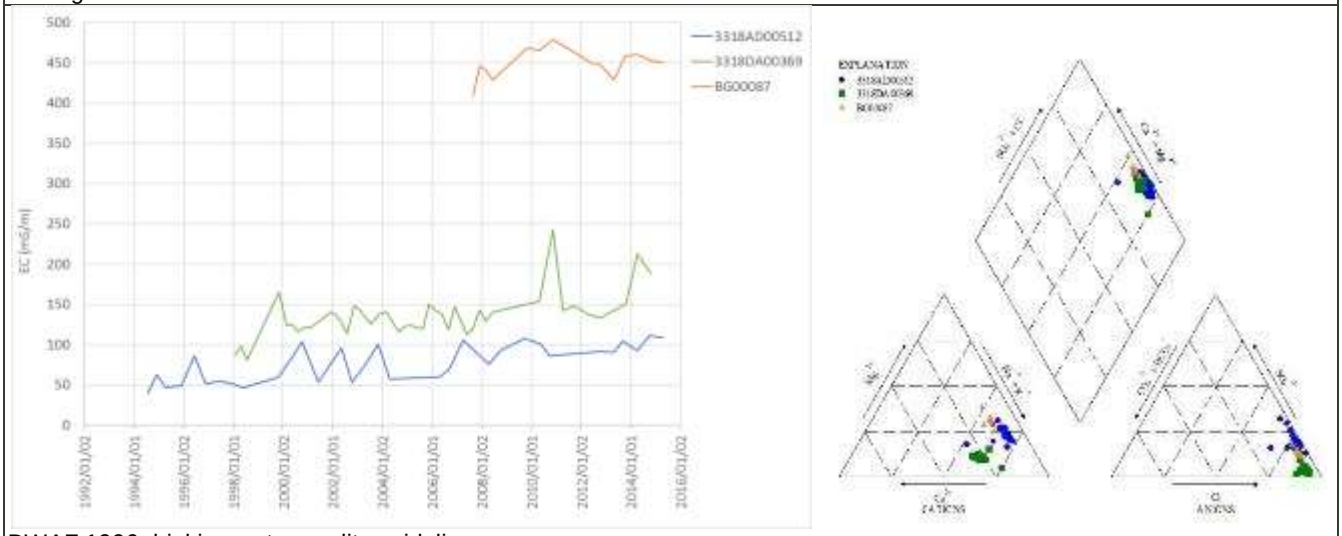
Response to Bulk Abstraction

The availability of municipal groundwater monitoring of abstraction at Hopefield and Aurora is not known. This will be investigated should this GRU be prioritised for further investigation.

Significant groundwater monitoring for the response to bulk abstraction is carried out at Langebaan Road Wellfield by the West Coast District Municipality (WCDM) and by DWS. The water level data presented for the area below intends to provide a regional / background trend, and these monitoring reports will be reviewed to report on the response to bulk abstraction should this GRU be prioritised for further investigation.

Water quality graphs

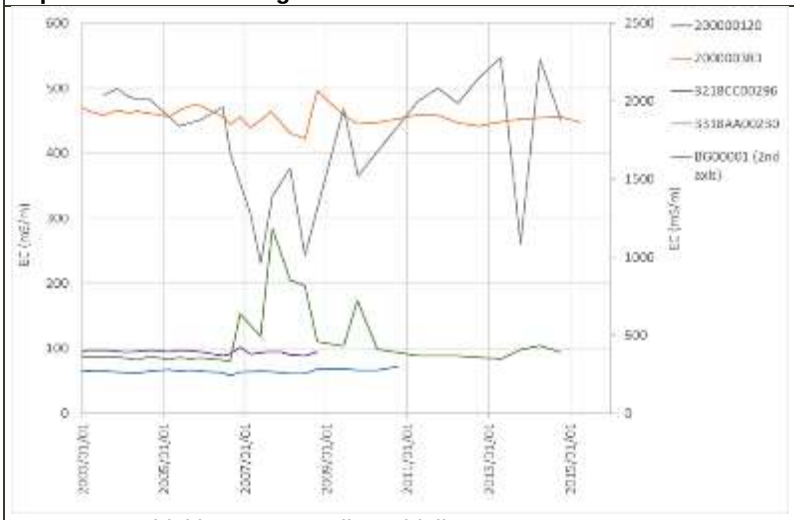
Darling

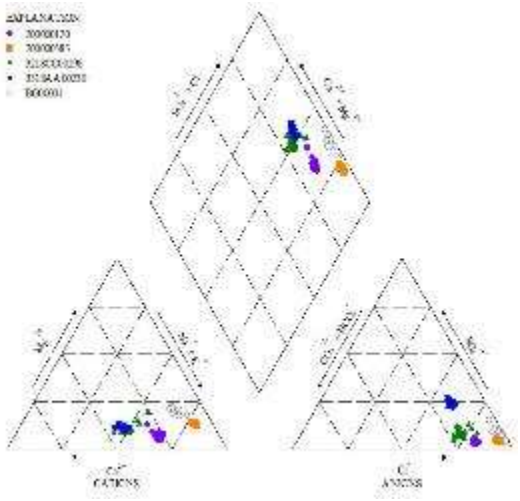


DWAF 1996 drinking water quality guideline

Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

Hopefield/Aurora & Langebaan





DWAF 1996 drinking water quality guideline
Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

Comments

The West Coast GRU is the largest GRU in the Berg River WMA, and covers an extensive area of unconsolidated Quaternary Deposits, older consolidated Sandveld and Witzand sediments, as well as outcrops of the underlying Cape Granite and Malmesbury Groups. The area has been divided into three water use clusters, namely:

- Darling, which includes the Darling Hills of Cape Granite, Malmesbury Group and the Quaternary Deposits overlying them.
- Aurora-Hopefield, which encompasses a large area of unconsolidated Quaternary Deposits in the north-east of the GRU
- Langebaan, which includes the areas underlain by the Sandveld Group aquifers.

Groundwater monitoring has largely been focussed in the Langebaan area, although this has the lowest registered water use of the three clusters. However, there is long term water level and water quality monitoring for all three clusters.

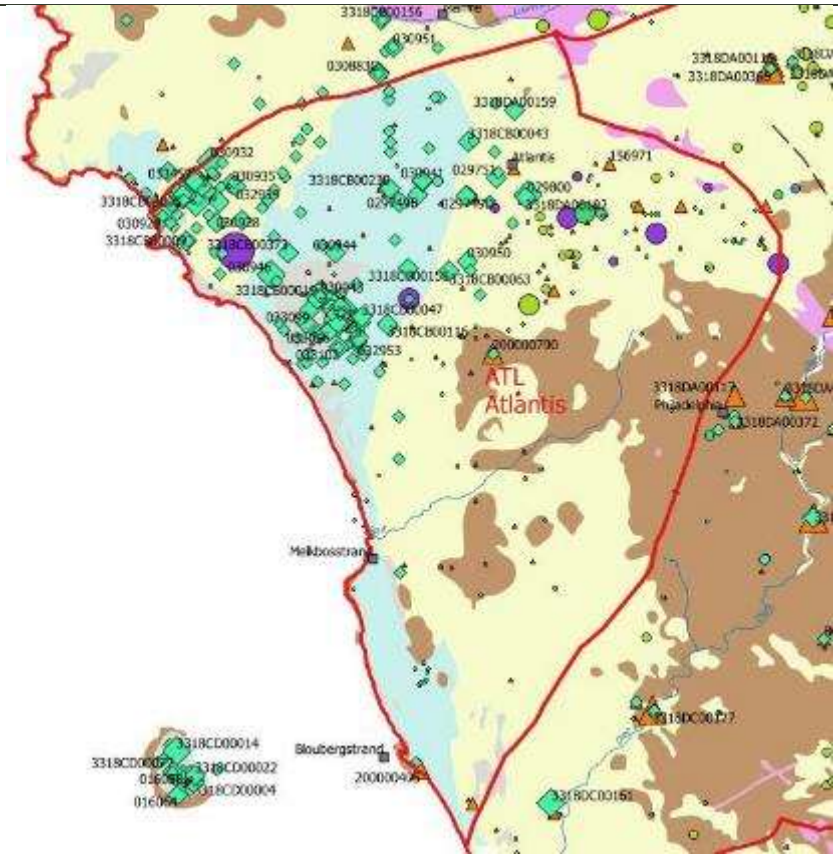
In the Darling area, four representative water level monitoring boreholes were selected, two in the Quaternary Deposits (033333, 033476), one in the Darling pluton (BG00071), and one in Malmesbury Group rocks (3318DA00369). None of the selected locations is close to registered water use. Water levels vary from <2 to 16 mbgl, and most locations show a strong seasonal water level fluctuation. The degree of seasonal fluctuation has decreased with time in 033333, and the seasonal fluctuations since 2010 have been lowest in the two boreholes in the Quaternary Deposits.
Water level fluctuations in BG00071, in granite, have been consistent, but water level fluctuations in 3318DA00369 have become larger with time. The average annual water level at 3318DA00369 also shows a sharp decline between 2009 and 2014, although there appears to have been some recovery in 2015. Average annual water levels have been consistent in 003479 and BG00071, but 033333 shows an apparent slight decrease between 2009 and 2015.
Water quality in the Darling cluster varies, with water in BG00087 (granite) having an EC around 450 mS/m, compared to 3318DA00512 (Quaternary) and 3318DA00369 (Malmesbury) which have EC<200 mS/m. The EC in 3318DA00512 and 3318DA00369 shows a gradual increase with time of about 50 mS/m over 8 years. The ionic composition of the water from the three locations is similar, although water from the Quaternary Deposits (3318DA00512) has a higher sulphate content.

The Hopefield/Aurora cluster is represented by boreholes 033255 and 033248, both in Quaternary Deposits. 033255 is located close to a registered water use, and 033248 is located away from any registered water use. Both locations show seasonal fluctuations in water level that are becoming more pronounced with time, particularly in 03325, which is close to a registered water use. The average annual water levels in both locations show a step decrease of 2 – 3 m in 2008 from which water levels have not yet recovered.
Water quality in the Hopefield/Aurora cluster is good, with EC generally <100 mS/m in both locations (200000120 and 3318AA00230), and no apparent long term trends in EC. The water in 3318AA00230 has relatively higher Ca and sulphate compared to 200000120, which has higher Na and Cl.

Water levels in the Langebaan cluster vary considerably, with levels in 029735 and 043062 in the Sandveld Group ranging from approximately 3 to 7 mbgl, and water levels in 030925 in the Witzand Formation at a depth of 50 – 52 mbgl. Seasonal variations are apparent in 029735 and 046032, but less so in 030925. The range in seasonal fluctuation has not increased with time in these locations, but 0046032 and 030925 show an apparent decrease in average annual water level with time.

Water quality in the Langebaan cluster is also variable, with EC in the Sandveld Group ranging from 100 to 2200 mS/m. Even within one location, EC Is variable with time, but no long term trends are obvious. Water from the three locations is ionically distinct, but all tending to Na-Cl dominance.

Status Quo assessment for GRU 9 – Atlantis

GRU name, main town	Atlantis sub-catchment, GRU 9 Atlantis. Main town: Atlantis, Melkbosstrand, Bloubergstrand
GRU Boundary description	The GRU is an area of subdued topography, where thick Sandveld Group deposits outcrop, overlying the basement (of Malmesbury Shale and Cape Granite Suite). The Sandveld Group forms a significant primary aquifer. Basement outcrops in the higher lying areas east of the GRU, from where the Sout River originates. Some surface water drainage from the basement hills of the Malmesbury (GRU10) may increase recharge. Groundwater will discharge to the Sout River, minor wetlands in coastal dunes are sustained by groundwater, and to submarine discharge. Major groundwater abstraction occurs for Atlantis water supply and some artificial recharge of stormwater/treated wastewater occurs in constructed basins. Iron-rich biofouling on borehole screens reduced borehole efficiency. The boundaries of the GRU are formed by quaternary catchment boundaries. The various aquifer units are continuous across these boundaries hence they can be considered groundwater flow divides (but not hydraulic boundaries).
Catchments	G21B
Domestic Groundwater use	The City of Cape Town operates a wellfield in Atlantis..
Map	

Water use clusters for trend analysis

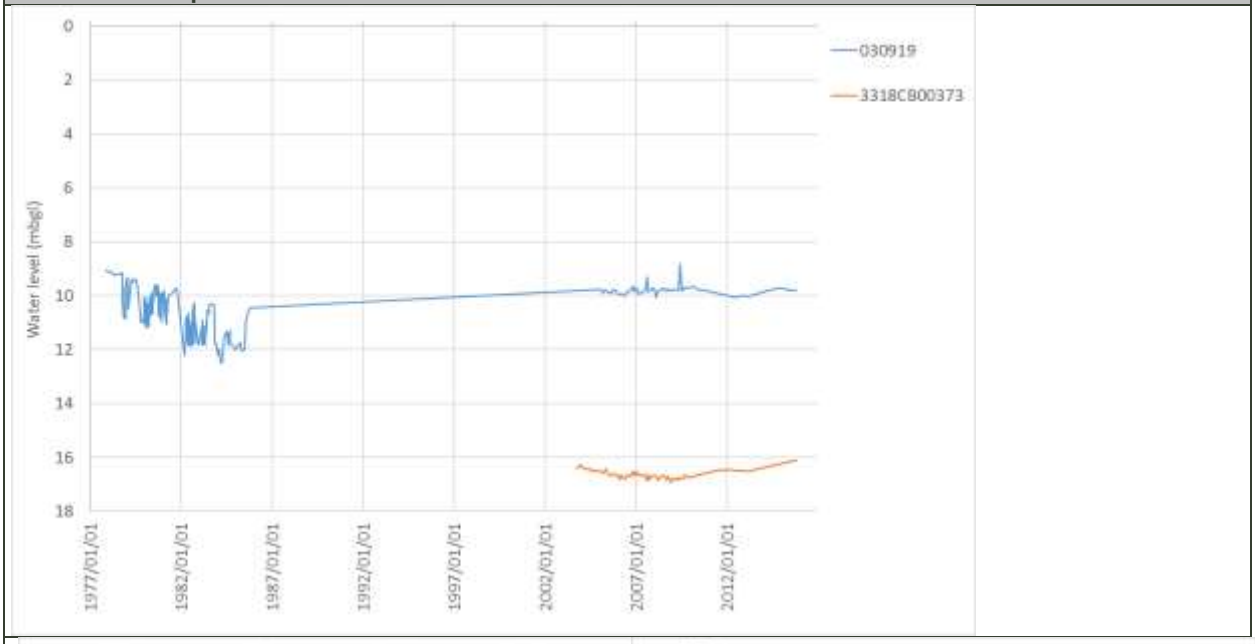
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations

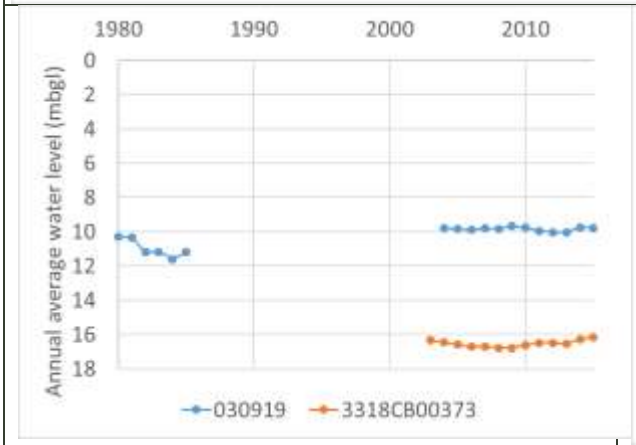
Available monitoring locations for trend analysis (recent data highlighted yellow)

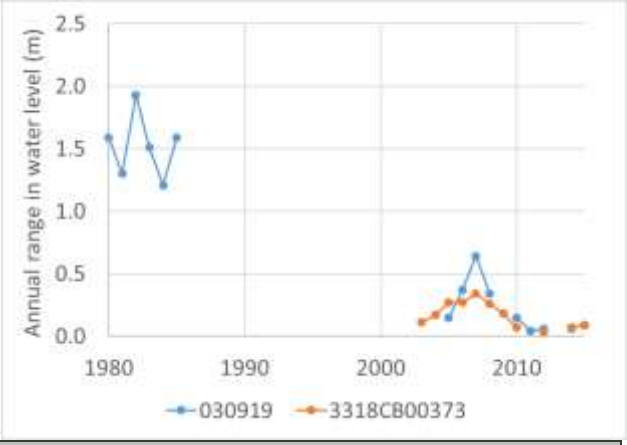
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3318CB00373	WL	Well Point	2003/10/09	2015/10/21	96	Witzand	
034031	WL	Borehole	2002/05/02	2015/10/21	112	Quaternary	

033457	WL	Borehole	1986/12/17	2015/10/21	134	Quaternary	
030919	WL	Borehole	1977/11/15	2015/10/21	816	Quaternary	
3318CB00376	WL	Borehole	2004/10/30	2015/10/02	22	Malmesbury	30
046086	WL	Borehole	2007/08/30	2015/10/02	13	Witzand	
200000790	Qual	Borehole	2005/09/15	2014/10/21	17	Malmesbury	
200000405	Qual	Borehole	2006/03/29	2014/10/21	10	Malmesbury	

Water Level Graphs



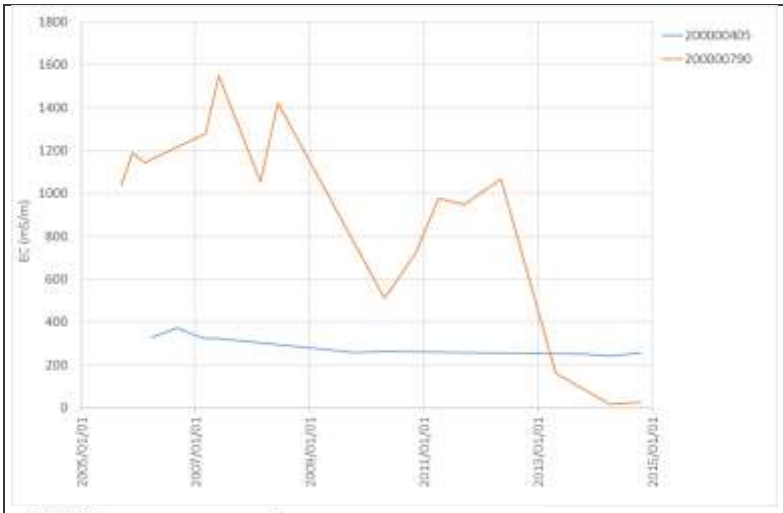


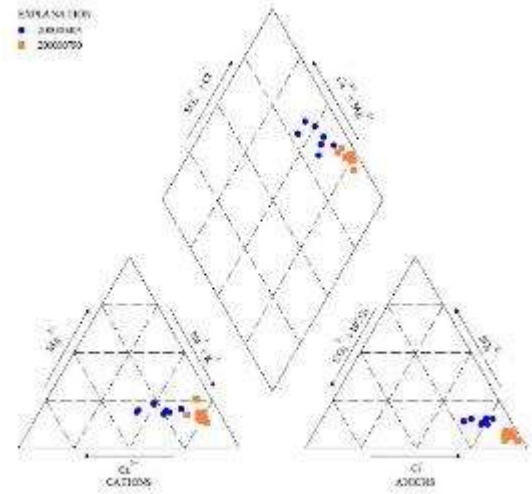


Response to Bulk Abstraction

The City of Cape Town undertakes extensive monitoring at the Atlantis wellfield. This data will be reviewed should the GRU be identified for further study.

Water quality graphs





DWAF 1996 drinking water quality guideline
Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

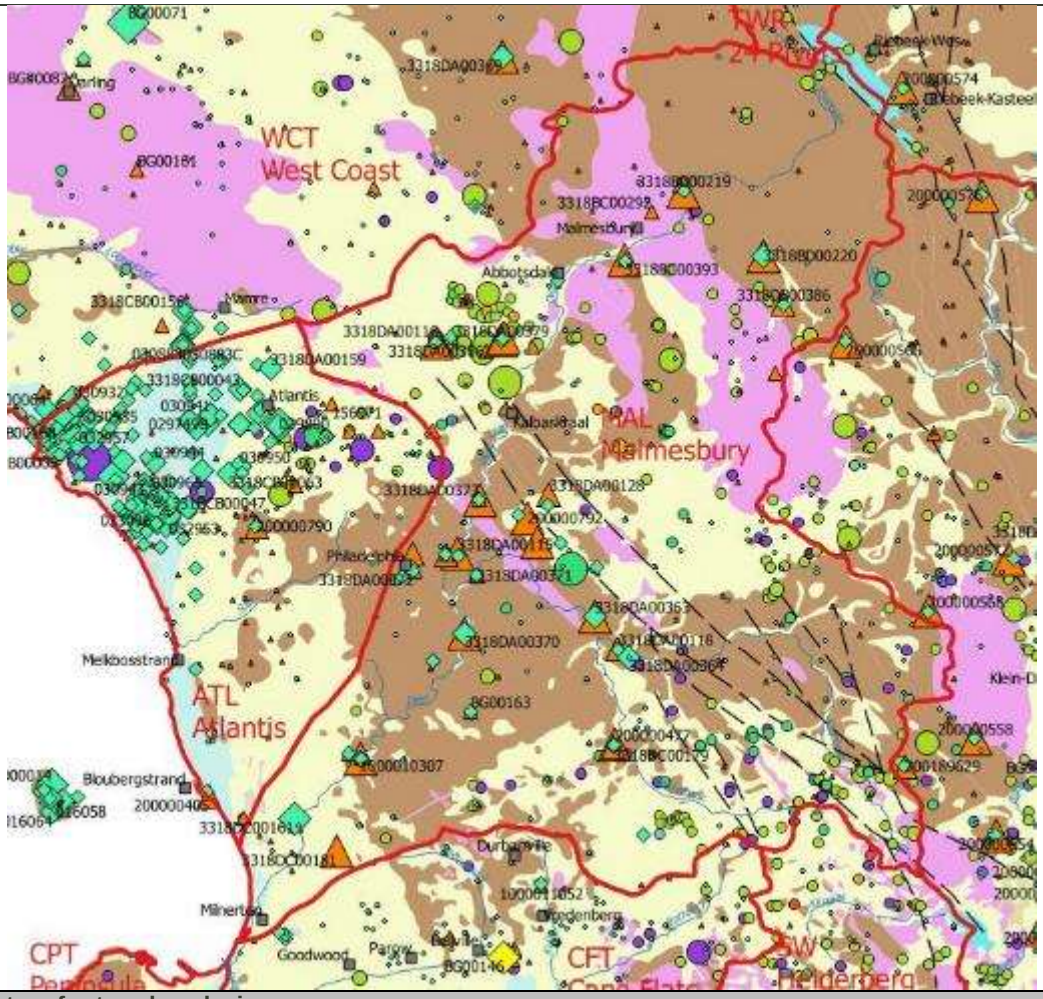
Comments

Groundwater use in the Atlantis GRU is dominated by the Atlantis Water Supply Scheme (AWSS) in the north-western section of the GRU.

Groundwater level monitoring in the GRU is focussed around the AWSS. Two boreholes have been selected as representative of the water levels in the AWSS, namely 030919 located within the northern Silwerstroom wellfield, and 3318CB00373 located in the Atlantis wellfied. The water levels are 10-12 mbgl in 030919, and 16-17 mbgl in 3318CB00373. Initial monitoring of 030919 between 1977 and 1985 showed variations in water level of 1 – 2 m, but recent monitoring in both 3318CB00373 and 030919 show annual ranges in water level to be less than 0.5 m. Water levels are higher now at 030919 than during the 1970s and 1980s. No long term water level trend is noted.

There are only two groundwater quality monitoring points within the database (the database does not currently include data collected by the City of Cape Town). These both reflect water quality in boreholes drilled into Malmesbury Group rocks, and not water quality at the AWSS. Both locations have EC higher than ideal water quality (>70 mS/m) for most of the monitoring period. Both also show an improvement in quality with time, with EC at 200000790 approximatley 50 times lower in 2014 than when first measured in 2007. The EC at 200000405 was originally between 350 and 400 mS/m and reduced to approximately 240 mS/m by 2014. The ionic composition has remained relatively constant.

Status Quo assessment for GRU 10 – Malmesbury

GRU name, main town	Malmesbury sub-catchment, GRU 10 Malmesbury Main town: Malmesbury
GRU Boundary description &geology & aquifer types	The GRU is underlain predominantly by Malmesbury Group intruded by Cape Granite Suite plutons, the latter forming higher rocky hills, in contrast to the generally weathered lower rolling hills of the former. Groundwater flow is mainly restricted to weathered zones or granite scree slopes on the pluton flanks and little regional flow can be expected. However, the relatively extensive use of the basement aquifers, and the existence of the Malmesbury Hot Spring, (about 4L/s of 34ºC water), indicates that deep fracture systems exist and are capable of reasonable yields. The Malmesbury Hot Spring has been associated with major regional fractures (the "Du Toitskloof-Moorreesburg Megafault Zone (DMM), an extension between the Du Toits Fault and the Malmesbury Fault"; DWAF, 2008), and its chemistry, with high sulphur content, confirms derivation of water from Malmesbury Group (UCT, 1995). Relatively thin and laterally discontinuous outcrops of the Sandveld Group scatter the GRU. Groundwater mostly discharges to streamflow along the various streams and perennial rivers (notably the Diep River) in this very agriculturally dominated area.
Catchments	G21C; G21D and G21E
Domestic Groundwater use	Malmesbury and Abbotsdale receive a minor portion of their supply (1%), from groundwater.
Map	

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations

Dassenberg	Quaternary	35	3.9	Agriculture: irrigation Water supply	3318DA00366 (Quaternary, close to water supply) 3318DA00379 (Quaternary, close to water supply)	3318DA00366 (Quaternary, close to water supply) 3318DA00380 (Quaternary, close to water supply)
Perdeberg	Malmesbury, Granite, Quaternary	62	3.4	Agriculture: irrigation Agriculture: stock watering Industry: Urban	3318BC00393 (Quaternary, away from water supply); 3318BD00220 (Quaternary/Malmesbury, away from water supply)	3318BC00393 (Quaternary, away from water supply); 3318BD00220 (Quaternary/Malmesbury, away from water supply)
Klipheuwel	Malmesbury, Quaternary	99	2.7	Agriculture: irrigation Agriculture: stock watering Industry: Urban	3318DA00370 (Malmesbury, away from water supply); 3318DA00363 (Malmesbury, away from water supply); 3318DA00364 (Malmesbury near to water supply)	3318DA00370 (Malmesbury, away from water supply); 3318DA00363 (Malmesbury, away from water supply);

Available monitoring locations for trend analysis (recent data highlighted yellow)

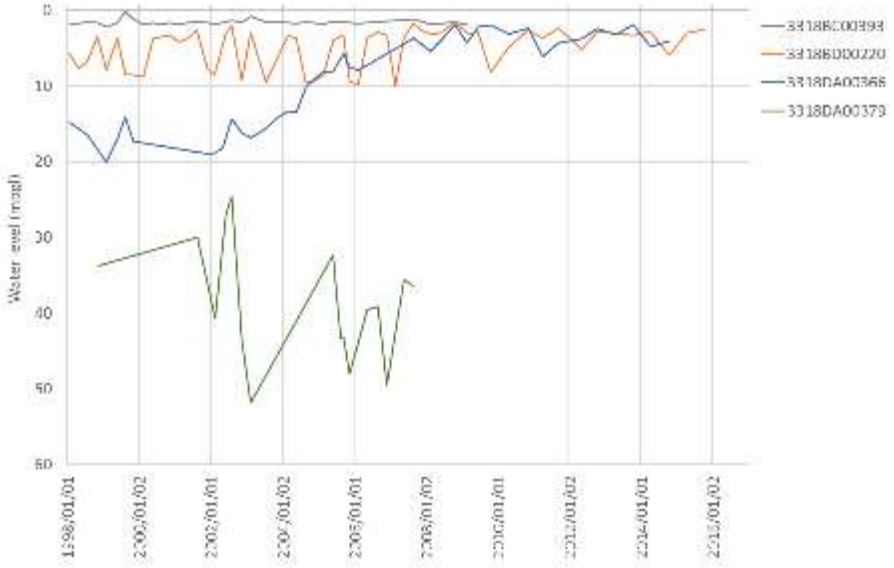
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3318DC00241	WL	Borehole	2004/11/23	2015/10/02	27	Quaternary	
3318DA00363	WL	Borehole	1998/01/21	2015/10/02	58	Malmesbury	30
046068	WL	Borehole	2002/02/12	2015/10/01	33	Malmesbury	
BG00073	WL	Borehole	2006/03/24	2015/10/01	20	Quaternary	54
3318BC00392	WL	Dug Well	1998/07/23	2015/10/01	29	Quaternary	2
3318BD00220	WL	Borehole	1998/01/22	2015/10/01	58	Quaternary	75
046066	WL	Borehole	2002/02/12	2015/10/01	35	Malmesbury	
3318DB00386	WL	Borehole	2006/05/19	2015/10/01	22	Quaternary	40
3318DA00370	WL	Borehole	1998/01/21	2015/04/17	50	Malmesbury	40
3318DA00364	WL	Borehole	1998/01/21	2015/04/16	56	Quaternary	61
3318DA00366	WL	Borehole	1998/01/22	2014/10/20	41	Quaternary	50
BG00072	WL	Borehole	2006/03/20	2014/04/11	25	Quaternary	130
BG00163	WL	Borehole	2009/10/21	2013/10/18	8	Malmesbury	
3318BD00219	WL	Borehole	1998/04/22	2013/10/11	23	Malmesbury	
3318DC00303	WL	Borehole	2007/02/27	2012/10/12	16	Quaternary	
3318DA00118	WL	Borehole	2003/02/13	2012/10/12	25	Malmesbury	
3318DC00177	WL	Borehole	1998/01/21	2012/10/11	42	Quaternary	110

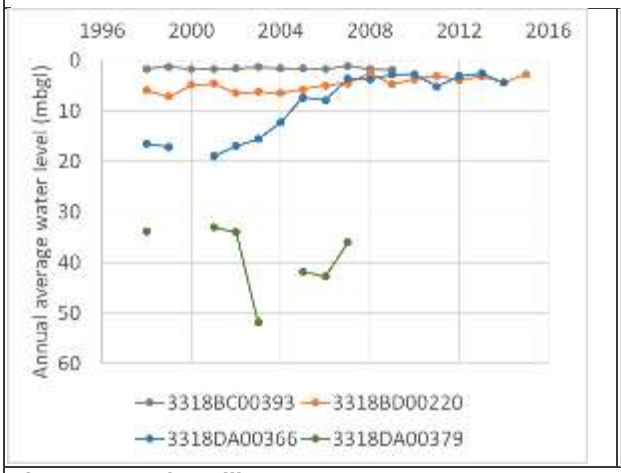
3318DA00373	WL	Borehole	1998/01/20	2011/10/14	34	Malmesbury	12
046067	WL	Borehole	2001/11/28	2010/11/10	21	Quaternary	
3318DA00126	WL	Borehole	2005/09/15	2009/10/20	12	Quaternary	
3318BC00393	WL	Dug Well	1998/01/22	2009/02/23	39	Quaternary	
3318DC00226	WL	Borehole	2004/05/20	2008/10/21	13	Quaternary	
3318DA00379	WL	Borehole	1998/11/05	2007/08/30	17	Quaternary	
3318DC00179	WL	Borehole	1998/01/21	2003/07/17	20	Quaternary	17
3318DA00362	WL	Borehole	1998/01/21	2002/11/11	15	Malmesbury	12
3318DA00371	WL	Borehole	1998/01/20	2001/08/15	13	Malmesbury	16
3318DA00372	WL	Borehole	1998/01/27	2000/08/07	8	Malmesbury	13
3318DA00380	Qual	Borehole	1998/11/05	2015/10/01	32	Quaternary	
3318DC00181	Qual	Well Point	2000/05/29	2015/04/17	33	Quaternary	5
3318BD00220	Qual	Borehole	1998/04/23	2015/04/17	43	Quaternary	75
3318DA00117	Qual	Borehole	2001/11/28	2015/04/17	10	Malmesbury	
3318DA00370	Qual	Borehole	1998/04/23	2015/04/17	44	Malmesbury	40
BG00163	Qual	Borehole	2010/04/28	2015/04/17	9	Malmesbury	
1000010307	Qual	Borehole	2004/10/18	2015/04/17	7	Quaternary	
3318DA00363	Qual	Borehole	1998/04/22	2015/04/16	37	Malmesbury	30
200000477	Qual	Borehole	2003/02/13	2015/04/16	32	Quaternary	
200000792	Qual	Borehole	2005/09/15	2015/04/16	23	Quaternary	
200000794	Qual	Borehole	2005/09/15	2015/04/16	23	Malmesbury	
3318BD00219	Qual	Borehole	1998/04/22	2015/04/16	38	Malmesbury	
3318DA00115	Qual	Borehole	2001/11/07	2015/04/16	32	Malmesbury	
3318DA00366	Qual	Borehole	1998/04/22	2015/04/16	38	Quaternary	50
3318DA00128	Qual	Borehole	2006/03/15	2014/10/21	14	Quaternary	
3318DA00379	Qual	Borehole	1999/11/02	2014/10/20	30	Quaternary	
3318DA00118	Qual	Borehole	2002/02/12	2012/10/12	18	Malmesbury	
3318DB00386	Qual	Borehole	2006/05/30	2012/10/11	15	Quaternary	40
3318DC00177	Qual	Borehole	1998/04/23	2012/10/11	37	Quaternary	110
3318DA00373	Qual	Borehole	1998/04/22	2011/04/06	29	Malmesbury	12
3318DA00116	Qual	Borehole	2001/11/19	2010/11/10	18	Quaternary	
3318BC00393	Qual	Dug Well	1998/04/23	2010/11/10	30	Quaternary	

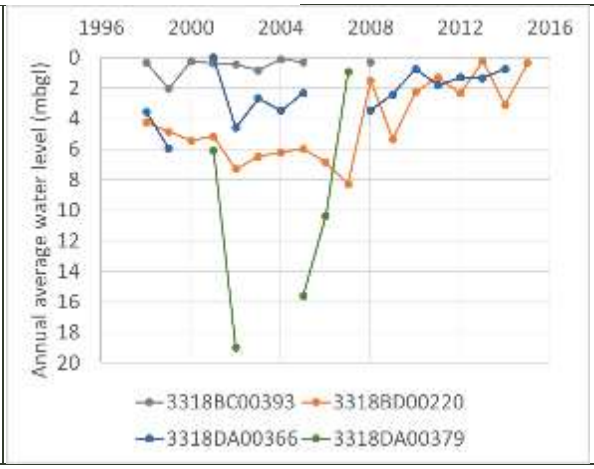
3318DA00362	Qual	Borehole	1998/04/22	2002/11/11	11	Malmesbury	12
3318DA00371	Qual	Borehole	1998/04/23	2001/08/15	8	Malmesbury	16
3318DC00179	Qual	Borehole	1998/04/23	2001/02/06	12	Quaternary	17
3318DA00372	Qual	Borehole	1998/04/23	2000/05/24	6	Malmesbury	13

Water Level Graphs

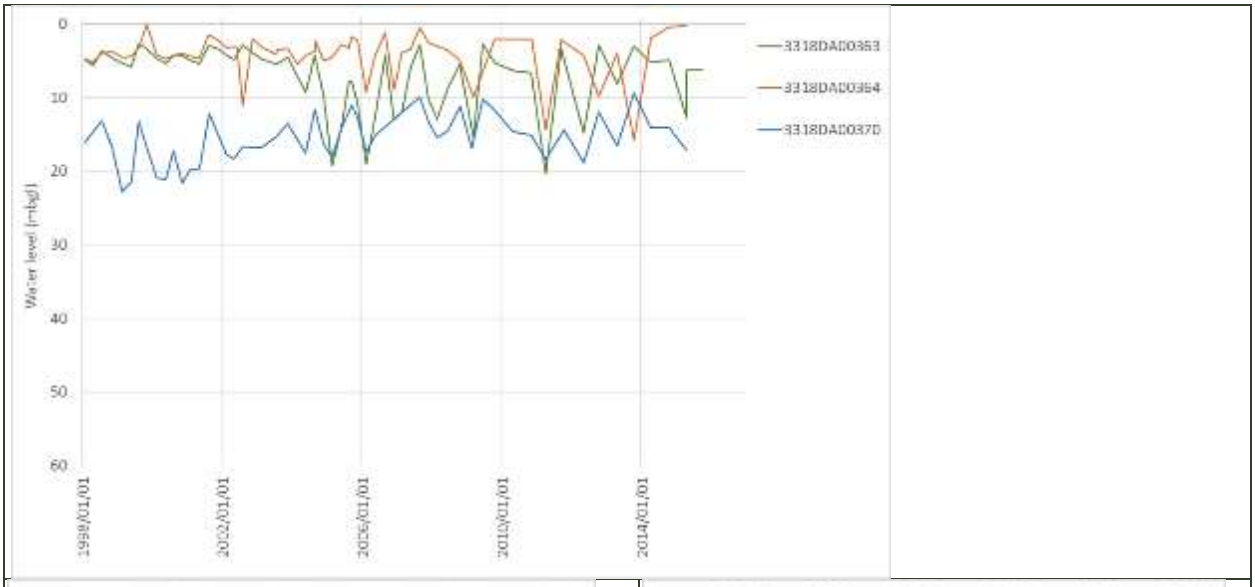
Dassenberg & Perdeberg

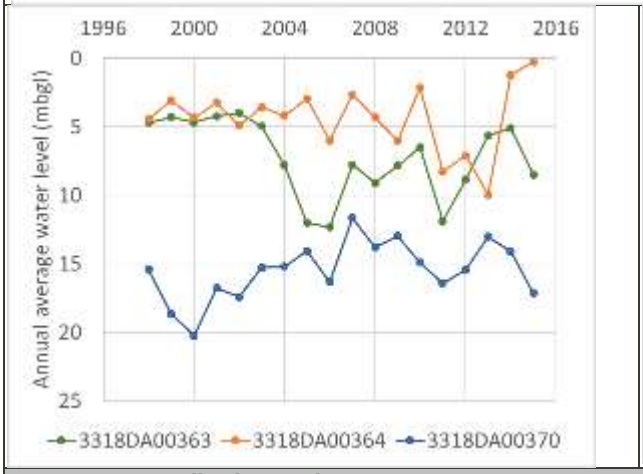


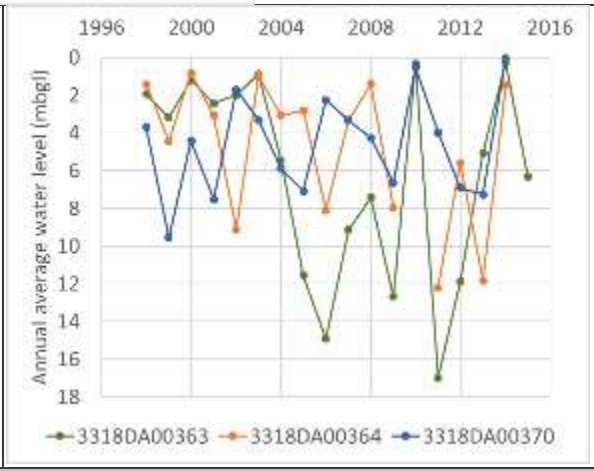




Klapmuts-Durbanville





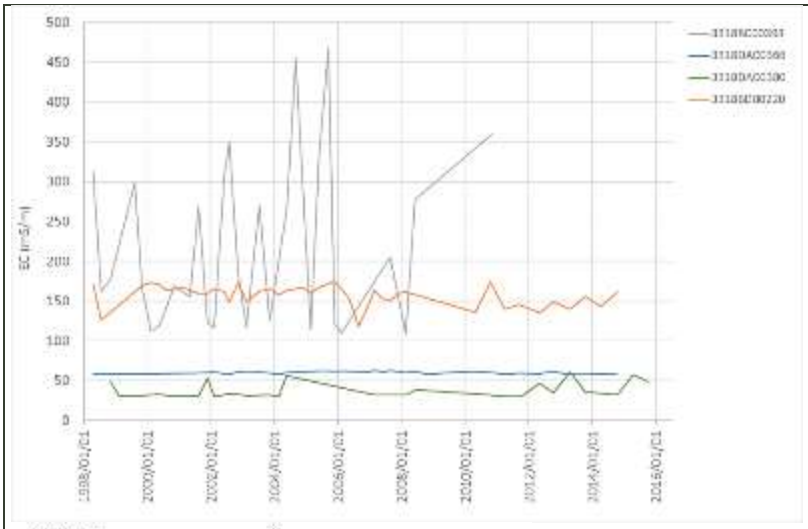


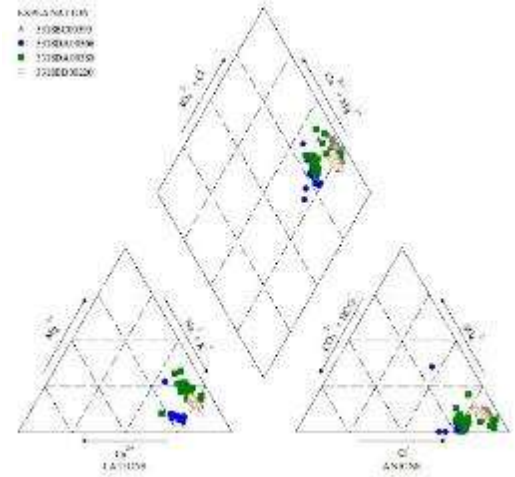
Response to Bulk Abstraction

The status of municipal monitoring at Malmesbury is unknown and will be investigated should the GRU be prioritised.

Water quality graphs

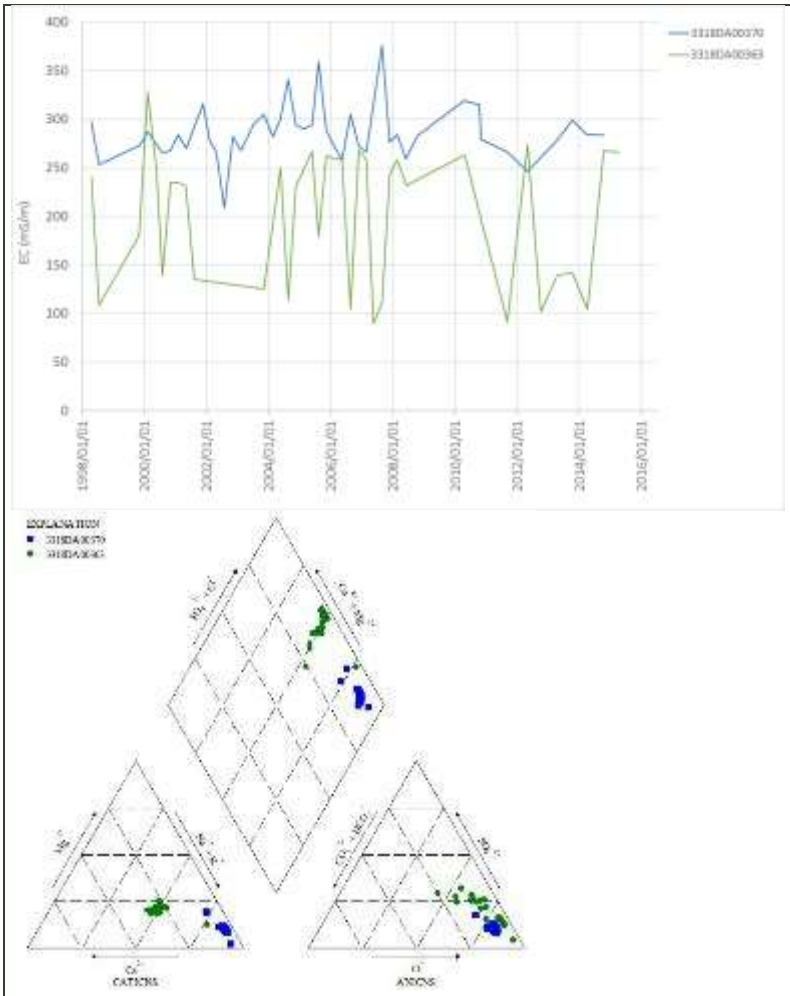
Dassenberg & Perdeberg





DWAF 1996 drinking water quality guideline
Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

Klapmuts



DWAF 1996 drinking water quality guideline
Class 1: 70 to 150 mS/m
Class 2: 150 to 370 mS/m
Class 3: 370 to 520 mS/m

Comments

Groundwater use is sporadic within the Malmesbury GRU with the exception of the Dassenberg area, to the north-east of Kalbaskraal, where a concentration of registered groundwater use boreholes is noted. Dassenberg, which is underlain by Quaternary sediments, is considered as a groundwater cluster, and an additional two groundwater clusters are identified, namely Perdeberg to the north-east of the Klapmuts and Mosselbank rivers which is underlain by granite, Malmesbury and Quaternary sediments, and Klipheuwel, to the south-west of the Klapmuts River, which is underlain largely by Malmesbury rocks. There is extensive groundwater quality and water level data for this GRU.

Groundwater is used predominantly for irrigation within the Dassenberg water cluster. Three boreholes were selected to represent the area, namely 3318DA00366 (water level and quality data), 3318DA00379 (water level) and 3318DA00380 (quality). All three are located close to registered water use boreholes. The water level in 3318DA00366 has increased from 15-20 mbgl between 1998 and 2002 to 2-6 mbgl since 2008. This may be due to changes in abstraction practices at this borehole. As the water level has recovered, the degree of seasonal fluctation has decreased from almost 6 m range per year to <2 m per year suggesting a cessation (or at least reduction) of seasonal pumping. The water level at 3318DA00379 was very variable between 30 and 50 mbgl for the period the borehole was monitored. Water quality at both locations has remained constant over 18 years of monitoring with the EC of both locations being <100 mS/m. They have a generally similar ionic composition, although 3318DA00380 has a relatively higher Mg content.

Groundwater monitoring in the Perdeberg cluster includes several paired water level and water quality boreholes. Two have been selected, namely 3318BC00393, a dug well, and 3318BD00220, a 75 m deep borehole in Malmesbury Group rocks. Both locations are away from registered groundwater use. The water level in 3318BC00393 is very shallow (<2 mbgl). Seasonal variations are slight. In contrast, the water level at 3318BD00220 is deeper and demonstrates strong seasonal variation in water level (2 – 8 m range over a year). The average annual water level at 3318BC00393 varies between 1.2 and 1.9 mbgl, but does not show a declining trend. At 3318BD00220, the average annual water table has increased from 4.5 – 7 mbgl between 1998 and 2004 to

consistently <5 mbgl since 2008. The annual range in water level has also decreased from 4-8 m range prior to 2008 to 0 – 6 m since 2008.
Water quality in 3318BD00220 shows a strong seasonality, with EC between 100 and 150 mS/m in November to February and EC between 250 and 500 mS/m July to September. This shallow dug well is likely to be susceptible to water quality changes caused by seasonal flushing of salts which accumulate in soils during dry periods. The EC in 3318BD00220 also shows a seasonal change but with much lower amplitude and a delay in the peaks compared to the shallow well. The ionic composition of the water in the two wells is quite similar, and no long term increasing or decreasing EC trends are noted.

Three boreholes were selected to represent the Klipheuwel cluster, namely 3318DA00370 (water level and quality), 3318DA00363 (water level and quality) and 3318DA00364 (water level only). All the boreholes are located in the Malmesbury Group rocks, and the first two are located away from a water supply, while 3318DA00364 is located close to a registered water supply.
The water levels in all three boreholes show a pronounced seasonal trend. The annual range in water levels increased in 3318DA00363 and 3318DA00364 from about 2003 from being less than 4 m in annual range, to 4 – 17 m in annual range. The annual average water level in both of these locations became more variable from 2004, and was 3 – 7 m lower in 3318DA00363 for the period 2004 – 2013 than prior to 2004. However, water levels in both boreholes appeared to recover somewhat in 2014. The only long term trend that is discernible is one towards greater variability. The water levels in 3318DA00370 have also been highly variable, but appear to show a general increase in water level with time. Water quality is highly variable, with large seasonal ranges in EC (up to 200 mS/m). The EC over time does not appear to be increasing in either 3318DA00370 or 3318DA00363. The EC in 3318DA00370 is higher than in 3318DA00363, and it also has a higher Na-Cl dominance, while 3318DA00363 has relatively more Ca and SO4.

Appendix C: Water Quality

Berg WMA Rivers Present Water Quality Status (Data period 2010 – present)

		Chloride				TDS				EC				NH4-N				NO3+NO2-N				pH				PO4-P				SO4			
Station	IUA	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95
G1H023Q01	A1	33	222	277.6	362.2	19	501	608.7	774.2	33	90.4	117.3	145.4	33	0.05	0.05	0.118	33	0.05	0.608	2.384	33	7.772	7.922	8.083	33	0.012	0.033	0.096	33	36.258	45.169	57.39
G1HO24Q01	A1	50	1633	8945	19286	31	4662	13672	34760	51	1922	3330	4740	53	0.31	0.497	0.866	53	0.05	0.729	2.445	53	7.888	7.985	8.1	53	0.039	0.072	0.108	52	566.56	1259.12	2591.9
BERG R27	A1	0				0				5	463	4750	4780	5	0.15	0.15	0.15	5	0.15	0.15	0.15	5	7.7	7.86	8.79	5	0.12	0.25	2.68	0			
BE-05 KER	A1	0				0				0				8	0.05	0.082	0.131	8	0.1	0.297	1.79	0				8	0.1	0.1	0.1	0			
BE-01 LAA	A1	0				0				0				7	0.192	0.234	0.269	7	0.1	0.286	0.638	0				7	0.1	0.1	0.1	0			
G201/01A1	A3	1	17659	17659	17659	1	32440	32440	32440	1	4140	4140	4140	1	0.546	0.546	0.546	1	0.025	0.025	0.025	1	7.835	7.835	7.835	1	0.172	0.172	0.172	1	4076.3	4076.32	4076.3
G201/02B1	A3	1	51599	51599	51599	1	1E+05	1E+05	1E+05	1	11440	11440	11440	1	0.299	0.299	0.299	1	0.025	0.025	0.025	1	7.722	7.722	7.722	1	0.124	0.124	0.124	1	7618.3	7618.3	7618.3
G201/08C1	A3	1	42949	42949	42949	1	81233	81233	81233	1	9490	9490	9490	1	0.347	0.347	0.347	1	0.025	0.025	0.025	1	7.977	7.977	7.977	1	0.162	0.162	0.162	1	5754.9	5754.9	5754.9
G201/04B1	A3	1	854.8	854.8	854.8	1	1689	1689	1689	1	298	298	298	1	0.278	0.278	0.278	1	0.025	0.025	0.025	1	7.956	7.956	7.956	1	0.58	0.58	0.58	1	139.76	139.756	139.76
G201/06A1	A3	1	968.4	968.4	968.4	1	2157	2157	2157	1	457	457	457	1	0.025	0.025	0.025	1	0.025	0.025	0.025	1	8.436	8.436	8.436	1	0.005	0.005	0.005	1	174.04	174.036	174.04
G201/07A1	A3	1	96.71	96.71	96.71	1	398.9	398.9	398.9	1	57.7	57.7	57.7	1	0.025	0.025	0.025	1	2.015	2.015	2.015	1	8.063	8.063	8.063	1	1.395	1.395	1.395	1	98.649	98.649	98.649
G1H013Q01	B4	64	43.18	62.93	76.86	39	120.5	162.9	299.8	64	20.58	31.02	39.5	64	0.025	0.05	0.117	62	0.531	1.004	1.976	64	7.51	7.661	7.858	64	0.032	0.052	0.098	63	8.3	12.987	17.873
G1H029Q01	B4	19	8.645	9.333	12.88	14	22.18	23.49	44.31	19	4.654	5.58	8.01	20	0.025	0.06	0.198	20	0.038	0.07	0.2	20	5.743	6.185	7.167	20	0.005	0.012	0.03	20	1.5	1.5	2.55
G1H031Q01	B4	65	68.18	104.4	146.3	42	181.1	254.1	370.6	65	35.9	49	69.8	65	0.025	0.05	0.072	65	0.238	0.823	2.569	65	7.642	7.761	8.004	65	0.019	0.039	0.07	65	13.949	22.63	35.11
G1H034Q01	B4	41	182.6	251.4	357.7	19	412.2	466.5	663.2	46	822.5	1118	1408	48	0.05	0.157	0.495	48	0.05	0.564	3.103	48	8.332	8.503	8.716	48	0.328	0.487	1.031	46	308.43	352.398	413.41
G1H035Q01	B4	28	122.3	168.3	266.9	19	240.9	296.4	460.6	28	402.5	509.5	751	28	0.05	0.074	0.162	28	0.219	1.8	4.785	28	8.206	8.327	8.584	28	0.037	0.094	0.192	26	191.02	219.696	402.4
G1H040Q01	B4	29	372.5	484.4	932.5	17	861.9	1254	1994	29	144.2	208.5	280.8	30	0.05	0.167	1.131	26	1.112	3.588	14	30	8.151	8.3	8.488	30	0.021	0.059	0.199	28	65.27	83.3055	120.77
G1H043Q01	B4	18	1963	3712	5560	12	524.9	729.7	909.1	21	993	1190	1319	21	0.132	0.241	0.705	21	0.025	1.52	3.474	21	8.26	8.466	8.716	21	0.177	0.256	0.387	21	450.62	580.037	670.39
G1R001Q01	B4	13	21.09	22.1	23.98	8	48.05	51.39	58.93	14	10.09	10.58	11.88	14	0.05	0.05	0.244	14	0.125	0.182	0.244	14	7.328	7.436	7.708	14	0.01	0.01	0.049	13	3.24	4.217	6.488
G1R003Q01	B4	2	166.2	181.5	181.5	2	355.1	394.8	394.8	3	57.3	71.5	71.5	3	0.025	0.025	0.025	3	0.605	1.8	1.8	3	7.791	7.841	7.841	3	0.006	0.048	0.048	3	26.9	29.537	29.537
DIE BOORD	B4	0				0				0				0				0				82	7	7.2	7.7	0				0			
SARON	B4	0				0				0				0				0				86	6.8	7.2	7.6	0				0			
GROEN R307	B4	0				0				2	903.5	1600	1600	2	0.375	0.6	0.6	2	0.15	0.15	0.15	2	8.14	8.41	8.41	2	0.855	1.14	1.14	0			
SOUT R307	B4	0				0				1	1600	1600	1600	1	0.15	0.15	0.15	1	0.15	0.15	0.15	1	8.19	8.19	8.19	1	0.77	0.77	0.77	0			
SOUT TRIB	B4	0				0				5	3880	4140	6240	5	0.15	0.15	4.5	5	0.15	0.15	0.15	5	8.33	8.5	8.85	5	0.025	0.06	0.09	0			
SOUT R45	B4	0				0				5	2010	2020	2290	5	0.15	0.15	0.15	5	0.15	0.15	0.15	5	8.1	8.41	9.06	5	1.09	2.64	2.68	0			
BOESMANS	B4	0				0				3	45.8	60	60	3	0.15	0.15	0.15	3	0.15	0.15	0.15	3	7.1	7.83	7.83	3	0.025	0.025	0.025	0			
G103/01A1	B4	1	86.43	86.43	86.43	1	419	419	419	1	59.6	59.6	59.6	1	1.157	1.157	1.157	1	0.025	0.025	0.025	1	8.164	8.164	8.164	1	4.936	4.936	4.936	1	1.5	1.5	1.5
G103/02A1	B4	1	74167	74167	74167	1	2E+05	2E+05	2E+05	1	16040	16040	16040	1	0.985	0.985	0.985	1	0.025	0.025	0.025	1	8.06	8.06	8.06	1	0.228	0.228	0.228	1	10282	10281.6	10282

		Chloride				TDS				EC				NH4-N				NO3+NO2-N				pH				PO4-P				SO4			
Station	IUA	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95
G103/03A1	B4	1	53848	53848	53848	1	1E+05	1E+05	1E+05	1	11740	11740	11740	1	0.548	0.548	0.548	1	0.025	0.025	0.025	1	7.926	7.926	7.926	1	0.138	0.138	0.138	1	5953.3	5953.3	5953.3
G1H008Q01	C5	66	37.66	46.44	54.69	42	111.5	124	153.1	66	20.25	23.9	31.3	67	0.025	0.05	0.071	66	0.172	0.42	1.305	67	7.602	7.744	7.943	67	0.011	0.026	0.093	65	6.444	8.205	9.441
G1H009Q01	C5	61	725.5	842	1375	33	1496	1818	2508	62	263.2	286.3	336.5	62	0.025	0.05	0.108	59	0.05	0.179	2.56	61	8.275	8.462	8.612	62	0.01	0.025	0.085	58	80.333	89.144	108.17
G1H010Q01	C5	36	78.11	200.5	243	23	150	479.6	547	37	35.6	79.5	101.8	37	0.05	0.05	0.051	38	0.1	0.358	1.009	38	7.546	7.928	8.078	37	0.01	0.01	0.028	38	12.046	30.719	52.4
G1H012Q01	C5	68	14.91	16.83	20.27	41	32.69	36.3	47	67	6.7	7.67	9.3	68	0.025	0.05	0.057	68	0.05	0.058	0.143	69	5.528	5.978	6.95	68	0.006	0.01	0.027	68	1.5	1.5	3.061
G1H021Q01	C5	68	4.666	5.18	6.441	44	21.51	29.51	39.67	61	4.31	5.35	6.96	68	0.025	0.05	0.088	68	0.056	0.091	0.125	68	7.206	7.363	7.643	68	0.006	0.01	0.026	66	1.5	1.5	3
G1H028Q01	C5	36	5.902	6.745	8.889	27	17.51	21.33	29.33	34	3.925	4.7	6.08	37	0.025	0.05	0.088	37	0.025	0.05	0.116	37	6.063	6.712	7.466	37	0.005	0.01	0.019	36	1.5	1.5	1.5
KBERG TULBAGH	C5	0				0				0				0				0				81	6.9	7.2	7.5	0				0			
EDELWEIZ	C5	0				0				6	8	11.5	15.6	6	0.15	0.15	0.15	6	0.85	1.5	3.1	6	7.035	7.05	7.1	6	0.2	0.2	0.4	0			
LA PLAISA	C5	0				0				6	11.45	15.5	16.9	6	0.15	0.15	0.15	6	0.155	0.94	1.8	6	7.205	7.27	7.51	6	0.2	0.2	0.3	0			
RIOOL RIV	C5	0				0				3	9.3	10.4	10.4	3	0.7	0.86	0.86	3	0.1	0.1	0.1	3	7.42	8.48	8.48	3	0.5	0.6	0.6	0			
EILANDPLA	C5	0				0				9	12.7	27	32	9	0.15	0.15	0.58	9	0.1	1.4	3.7	9	6.91	7.14	7.33	9	0.2	0.2	0.2	0			
OEWERBR UG	C5	0				0				8	13	25.35	33.1	8	0.15	0.215	0.8	8	0.2	2.55	4.1	8	7.12	7.31	7.57	8	0.2	0.2	0.8	0			
RIOOLPLAA	C5	0				0				9	29.4	36	64	9	0.15	0.2	1.4	9	0.46	2.3	3.1	9	7.17	7.26	7.87	9	0.2	0.4	1.3	0			
G2H015Q01	D6	65	79.3	94.78	108.6	37	305.7	338.2	436.9	65	50.4	57.6	66.1	65	0.594	2.305	8.14	57	2.43	5.333	10.24	65	7.785	7.979	8.218	65	1.014	1.586	2.673	63	20.564	24.343	29.256
G2H020Q01	D6	64	47.01	53.76	61.4	41	173.8	205	237.7	63	28.48	33.19	41.7	64	0.05	0.224	0.953	61	0.142	0.344	0.648	63	7.706	7.952	8.102	64	0.012	0.039	0.09	64	8.9355	11.0575	15.67
G2H029Q01	D6	1	19.51	19.51	19.51	1	50.29	50.29	50.29	1	10.83	10.83	10.83	1	0.211	0.211	0.211	1	0.05	0.05	0.05	1	7.355	7.355	7.355	1	0.01	0.01	0.01	1	1.5	1.5	1.5
G2H038Q01	D6	59	27.85	46.31	72.4	32	86.54	111.4	293.9	60	16.33	26	41.9	60	0.05	0.053	0.238	57	0.37	0.527	0.745	60	7.578	7.791	8.1	59	0.01	0.017	0.093	58	5.3055	8.112	15.829
G2H039Q01	D6	46	51.56	61.64	74.13	32	160.6	195	251.2	46	29.19	33.84	45.4	46	0.05	0.541	1.31	47	0.424	0.584	1.144	47	7.622	7.754	7.972	47	0.025	0.051	0.233	45	11	15.264	20.293
G4R001Q01	D6	51	18.97	20.44	25.35	36	41.99	49.19	58.52	49	9	9.6	13.71	51	0.025	0.05	0.08	51	0.05	0.154	0.424	51	5.973	6.475	7.133	51	0.005	0.01	0.042	51	1.5	3.496	7.495
G2H037Q01	D6	1	20.78	20.78	20.78	1	49.29	49.29	49.29	1	11.65	11.65	11.65	1	0.025	0.025	0.025	1	0.025	0.025	0.025	1	6.968	6.968	6.968	1	0.005	0.005	0.005	1	4.733	4.733	4.733
ZANDVLIET	D6	0				0				0				0				0				87	7.2	7.4	7.9	0				0			
UNDER KAY	D6	0				0				0				0				0				85	7	7.1	7.4	0				0			
ER720B2	D6	0				0				3	37.2	38.2	38.2	3	0.15	0.7	0.7	3	0.15	0.15	0.15	3	7.2	7.7	7.7	3	0.19	3.4	3.4	0			
B0720A1	D6	0				0				7	52.3	56.6	70.3	7	0.15	0.15	0.15	7	1	1.8	2.4	7	7.22	7.56	7.64	7	0.14	0.18	2	0			
B0720B1	D6	0				0				9	13.4	38.2	99.8	9	0.15	0.15	0.8	9	0.15	0.15	0.7	9	6.9	7.02	7.77	9	0.06	0.15	0.25	0			
LOURENS	D6	0				0				12	20.6	227.5	2080	12	0.15	0.15	0.5	12	0.15	0.45	0.8	12	7.665	7.86	8.36	12	0.025	0.075	0.14	0			
SLOWRY	D6	0				0				5	49.5	89.4	109	5	0.15	0.15	0.15	5	0.15	0.15	0.4	5	7.46	7.65	8.43	5	0.025	0.025	0.07	0			
KR720A	D6	0				0				7	27	71.5	78.4	7	0.15	0.15	0.15	7	0.15	0.9	1.2	7	7.59	7.79	7.81	7	0.025	0.12	0.12	0			

		Chloride				TDS				EC				NH4-N				NO3+NO2-N				pH				PO4-P				SO4			
Station	IUA	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95
KR720A1	D6	0				0				7	26.4	30.3	33	7	0.15	0.15	0.15	7	0.15	0.15	0.9	7	7.44	7.81	7.81	7	0.025	0.08	0.08	0			
KR720B	D6	0				0				7	30.3	39.1	41.5	7	0.15	0.15	0.15	7	0.15	0.15	0.15	7	7.4	7.56	8.09	7	0.025	0.12	0.12	0			
PR720A	D6	0				0				7	75.1	87.6	96.8	7	0.15	0.15	0.15	7	0.15	0.7	3.2	7	7.46	7.65	7.9	7	0.12	0.23	0.28	0			
PR720B	D6	0				0				9	75.2	85.4	89	9	0.15	0.15	5.9	9	0.15	1.3	3.7	9	7.1	7.17	7.2	9	0.28	0.33	0.53	0			
PR720C	D6	0				0				7	47.3	52.9	65.1	7	0.7	1	2.9	7	0.15	0.5	0.56	7	7.06	7.19	7.26	7	0.12	0.28	0.3	0			
VR720A	D6	0				0				7	44.9	47	50.7	7	0.15	0.6	1.7	7	0.5	0.8	2	7	7.1	7.22	7.75	7	0.14	0.19	0.24	0			
VR720B	D6	0				0				5	85.7	87.1	93	6	5.35	15.1	28.9	6	2.15	2.6	5.3	6	7.1	7.32	7.6	6	0.72	2.73	5.1	0			
VR720C	D6	0				0				7	76.4	84.2	84.3	8	15.95	24.55	29	8	0.525	1.7	2.8	8	7.235	7.385	7.7	8	2.495	3.38	10.6	0			
ER720A1	D6	0				0				7	5.77	7	7.23	7	0.15	0.15	0.15	7	0.15	0.15	0.15	7	7.27	7.37	7.49	7	0.025	0.025	0.08	0			
ER720B	D6	0				0				7	8.48	9.33	9.76	7	0.15	0.15	0.5	7	0.15	0.15	0.15	7	7.04	7.12	7.39	7	0.025	0.025	0.025	0			
ER720D	D6	0				0				8	47.2	55.7	57	8	0.475	9.35	17.3	8	1.1	3.45	13.1	8	7.235	7.48	7.71	8	1.065	1.855	2.48	0			
ER720E	D6	0				0				7	38.5	50.9	53.5	7	0.4	5.9	12.5	7	1.8	2.6	4.8	7	7.19	7.3	7.61	7	0.71	1.4	1.62	0			
ER720F	D6	0				0				6	79.95	81.7	87.1	6	4.5	7.4	11.1	6	1.9	3.3	6.5	6	7.325	7.6	7.92	6	1.58	2.9	5.4	0			
DIEP ODP	D6	0				0				15	133	210	292	15	0.15	0.15	2.3	15	0.5	2.1	2.5	15	7.62	7.94	9.86	15	0.78	3.1	9.1	0			
BL720A	D6	0				0				4	18.2	21.85	23.7	4	0.15	0.15	0.15	4	0.15	0.15	0.15	4	7.115	7.515	7.83	4	0.043	0.075	0.09	0			
G1H003Q01	D7	13	27.81	43.42	50.1	7	102.3	108.1	151.2	13	22.65	35.9	47	13	1.057	2.653	14.44	13	1.038	10.65	18.34	13	7.413	7.556	8.319	13	0.396	2.422	3.965	13	7.43	8.45	46.851
G1H004Q01	D7	24	6.067	6.887	8.041	7	16.4	17.65	19.59	24	3.42	3.915	4.67	24	0.025	0.025	0.025	24	0.039	0.096	0.133	24	6.413	6.84	7.183	24	0.005	0.005	0.027	24	1.5	1.5	1.5
G1H019Q01	D7	11	17.36	19.03	20.77	5	28.36	42.49	49.33	11	9.94	11.4	16.6	11	0.025	0.025	0.1099	11	0.355	0.511	0.963	11	6.922	7.264	7.477	11	0.005	0.005	0.005	10	1.5	1.5	3.67
G1H020Q01	D7	64	16.46	19.33	25.45	38	59.88	77.61	84.28	63	10.42	12.98	15.2	64	0.05	0.073	0.15	60	0.459	0.881	1.227	64	7.283	7.46	7.623	64	0.025	0.046	0.075	64	4.013	6.1955	8.003
G1H038Q01	D7	10	5.13	5.467	8.556	6	13.05	16.08	20.34	10	3.306	3.55	4.26	10	0.025	0.025	0.057	10	0.025	0.025	0.091	10	5.755	6.205	6.521	10	0.005	0.005	0.005	10	1.5	1.5	1.5
G1H064Q01	D7	8	6.144	7.489	8.383	5	16.6	16.8	23.79	9	3.608	4.87	10.31	9	0.025	0.025	0.025	9	0.025	0.062	0.401	9	6.156	6.566	7.198	9	0.005	0.005	0.053	9	1.5	1.5	1.5
G1R002Q01	D7	1	11.63	11.63	11.63	1	26.87	26.87	26.87	1	7.2	7.2	7.2	1	0.025	0.025	0.025	1	0.052	0.052	0.052	1	4.413	4.413	4.413	1	0.005	0.005	0.005	1	1.5	1.5	1.5
FRANSCHHOEK	D7	0				0				0				0				0				87	6.9	7.1	7.5	0				0			
DIEP ODPB	D7	0				0				0				0				0				85	7.2	7.3	7.5	0				0			
BERG KERSF	D8	0				0				4	1895	4455	5260	4	0.15	0.15	0.15	4	0.15	0.325	0.5	4	7.665	8.48	9.01	4	0.043	0.125	0.19	0			
G1H007Q01	D8	1	31.22	31.22	31.22	1	80.14	80.14	80.14	1	17.93	17.93	17.93	1	0.055	0.055	0.055	1	0.136	0.136	0.136	1	7.249	7.249	7.249	1	0.005	0.005	0.005	1	5.759	5.759	5.759
G1H036Q01	D8	68	35.72	44.73	54.38	44	117.7	143.7	178.7	67	21.4	25.61	30.18	68	0.05	0.076	0.3005	68	1.09	1.477	2.387	68	7.479	7.688	7.936	68	0.105	0.177	0.318	66	8.526	12.312	17.889
G1H039Q01	D8	48	720.8	1197	1754	32	2272	3089	3828	47	303.7	463	599	48	0.05	0.061	0.468	44	1.444	3.781	7.379	48	8.127	8.385	8.602	48	0.078	0.187	0.622	48	155.6	202.222	293.61
G1H041Q01	D8	60	40.53	54.64	102.4	41	103.7	145.1	196.1	60	21.23	28.59	43	60	0.05	0.05	0.115	59	0.067	0.26	1.451	60	7.47	7.702	7.893	60	0.005	0.01	0.131	60	8.3795	12.9595	20.439

		Chloride				TDS				EC				NH4-N				NO3+NO2-N				pH				PO4-P				SO4			
Station	IUA	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95
BERG DS PWWTW	D8	0				0				0				0				0				87	6.9	7.2	7.5	0				0			
BERG WWWTW	D8	0				0				0				0				0				89	6.7	6.9	7.3	0				0			
BERG IMBEQ	D8	0				0				0				0				0				81	6.7	6.9	7.3	0				0			
G2H042Q01	D9	43	515.9	634.4	819.5	29	1294	1503	1728	44	224.2	256.7	293	44	0.057	0.165	1.019	44	2.009	3.471	6.152	44	8.066	8.237	8.383	44	0.89	1.322	1.908	43	100.4	114.73	158.02
G2H012Q01	D9	36	631.8	897.8	1604	22	1428	1973	2385	37	254.1	328.1	404	36	0.038	0.058	0.558	37	0.31	2.001	6.254	37	8.121	8.269	8.501	36	0.03	0.105	0.636	35	88.531	118.019	149.24
DIEP DS MWWTW	D9	0				0				0				0				0				84	7.3	7.4	7.7	0				0			
MR720A	D9	0				0				4	81.65	89.5	96.7	4	2.45	4.15	4.3	4	1.125	2.45	2.8	4	7.635	8	8.11	4	1.43	1.545	1.57	0			
MR720B	D9	0				0				12	96.5	117.5	138	12	0.525	5.6	8.9	12	1.65	4.2	6.6	12	7.56	8.515	9.55	12	2.15	5.305	8.4	0			
MR720D	D9	0				0				12	111.5	137	160	12	1.7	3.9	45.6	12	3.9	5.9	8.3	12	7.305	7.455	9.86	12	3.345	6.7	17.3	0			
MR720G	D9	0				0				4	316	417	426	4	0.15	0.15	0.15	4	0.425	2.35	4	4	7.79	8.025	8.12	4	0.455	0.675	0.84	0			
MR720H	D9	0				0				10	139	166	237	10	0.15	0.15	44.3	10	3.05	4.2	4.9	10	7.72	7.9	8.3	10	1.675	4.29	7.9	0			
MR720L	D9	0				0				4	70.1	86.05	102	4	0.15	0.15	0.15	4	3.4	4.3	4.6	4	7.555	7.915	8.2	4	0.5	1.06	1.49	0			
DIEP PBERG	D9	0				0				4	326	443	486	4	0.15	0.275	0.4	4	0.325	2.4	4.3	4	8.285	8.335	8.35	4	0.57	0.74	0.84	0			
DIEP US MAL	D9	0				0				4	205	299.5	351	4	0.15	0.275	0.4	4	2.65	5.8	8.6	4	8.13	8.37	8.42	4	0.355	0.615	0.87	0			
DIEP IN MAL	D9	0				0				4	211	324	389	4	0.15	0.15	0.15	4	1.925	5.955	8.2	4	8.12	8.245	8.29	4	0.31	0.34	0.37	0			
DIEP ABBOT	D9	0				0				15	198	261	320	15	0.15	1.2	12.7	15	2.6	3.5	11.7	15	7.65	7.83	9.55	15	0.79	3.35	7.6	0			
DIEP KALBAS	D9	0				0				7	222	256	282	7	0.15	0.15	1.5	7	1.9	2.8	3.1	7	7.8	7.98	8.14	7	0.53	2.43	2.84	0			
DIEP MBANK	D9	0				0				5	159	249	259	5	0.15	0.15	0.15	5	2.3	3.9	5.1	5	7.72	7.97	7.97	5	1.29	1.32	1.39	0			
DIEP GOED	D9	0				0				5	175	231	274	5	0.15	0.15	0.15	5	2.2	2.4	4.7	5	7.96	7.98	8.08	5	1.15	1.16	1.22	0			
DIEP N7	D9	0				0				5	290	329	338	5	0.15	0.15	0.8	5	0.15	2.5	3.7	5	7.9	8.03	8.15	5	0.85	1.11	1.18	0			
SWART GROEN	D9	0				0				4	162.5	171	176	4	0.15	0.325	0.5	4	1	1.55	1.7	4	7.435	7.835	8.1	4	0.025	0.053	0.08	0			
DIEP TRIB	D9	0				0				4	619	699	712	4	2.525	6.85	8.8	4	1.2	2.15	3	4	7.74	8	8.16	4	1.085	2.255	3.18	0			
DIEP TABVIEW	D9	0				0				8	222	286	480	8	0.15	0.275	1.6	8	0.325	1.3	5.1	8	7.8	8.27	9.5	8	0.875	1.23	10.2	0			
G203/12A2	E10	1	1002	1002	1002	1	2012	2012	2012	1	340.7	340.7	340.7	1	0.025	0.025	0.025	1	0.025	0.025	0.025	1	8.447	8.447	8.447	1	0.133	0.133	0.133	1	162.7	162.699	162.7
G203/13A	E10	1	78.4	78.4	78.4	1	239.2	239.2	239.2	1	37.8	37.8	37.8	1	0.025	0.025	0.025	1	0.025	0.025	0.025	1	7.708	7.708	7.708	1	0.005	0.005	0.005	1	80.4	80.4	80.4
G203/18A1	E10	1	31.49	31.49	31.49	1	56.96	56.96	56.96	1	10.2	10.2	10.2	1	0.071	0.071	0.071	1	0.025	0.025	0.025	1	5.274	5.274	5.274	1	0.005	0.005	0.005	1	1.5	1.5	1.5
G203/19A1	E10	1	98.79	98.79	98.79	1	293	293	293	1	44.06	44.06	44.06	1	0.025	0.025	0.025	1	0.066	0.066	0.066	1	7.428	7.428	7.428	1	0.005	0.005	0.005	1	19.5	19.5	19.5
G203/01A1	E10	1	138.5	138.5	138.5	1	259	259	259	1	50.25	50.25	50.25	1	0.025	0.025	0.025	1	0.025	0.025	0.025	1	6.664	6.664	6.664	1	0.005	0.005	0.005	1	1.5	1.5	1.5
G203/04A1	E10	1	506.9	506.9	506.9	0				1	176.4	176.4	176.4	1	0.025	0.025	0.025	1	0.025	0.025	0.025	1	4.613	4.613	4.613	1	0.016	0.016	0.016	1	137.26	137.263	137.26

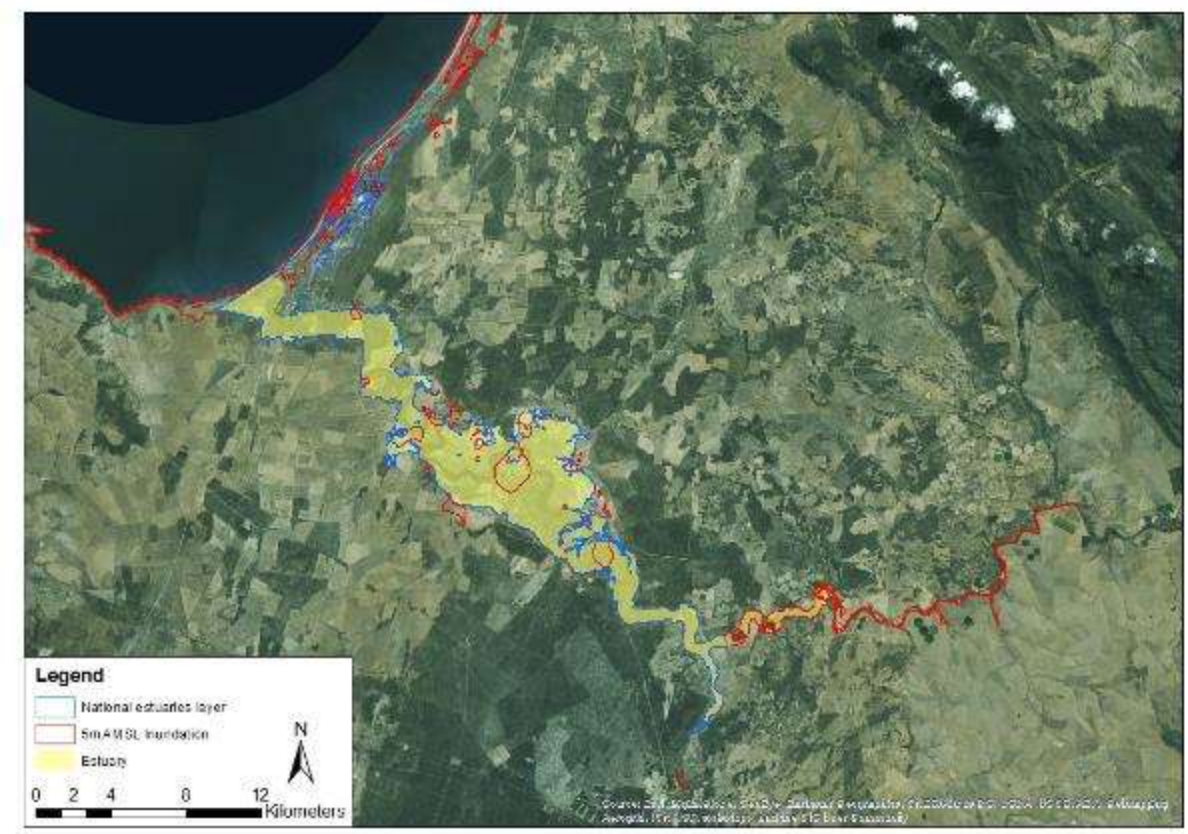
		Chloride				TDS				EC				NH4-N				NO3+NO2-N				pH				PO4-P				SO4			
Station	IUA	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95	N	50	75	95
G203/05A1	E10	1	158	158	158	1	297	297	297	1	62.6	62.6	62.6	1	0.025	0.025	0.025	1	0.025	0.025	0.025	1	4.187	4.187	4.187	1	0.137	0.137	0.137	1	22.296	22.296	22.296
ELSE	E10	0				0				11	72.6	91.1	96.9	11	0.15	0.15	0.5	11	0.15	0.15	0.15	11	7.67	8.14	8.3	11	0.025	0.025	0.025	0			
SILVERM	E10	0				0				11	35.8	70.4	342	11	0.15	0.15	0.4	11	0.15	0.15	0.15	11	7.24	7.64	7.7	11	0.025	0.025	0.15	0			
HOUTBAY	E10	0				0				12	39.05	52.75	67.3	12	0.15	0.65	2.1	12	0.15	0.15	1	12	7.275	7.4	7.69	12	0.13	0.2	0.68	0			
KUILS DS BWWTW	E11	0				0				0				0				0				88	7.5	7.65	8.2	0				0			
G204/02A1	E11	1	120.7	120.7	120.7	1	685.6	685.6	685.6	1	103.2	103.2	103.2	1	0.025	0.025	0.025	1	2.042	2.042	2.042	1	8.019	8.019	8.019	1	0.813	0.813	0.813	1	75.245	75.245	75.245
SANDVLEI	E11	0				0				1	1270	1270	1270	1	0.15	0.15	0.15	1	0.15	0.15	0.15	1	9	9	9	1	0.19	0.19	0.19	0			
SANDVLEI YC	E11	0				0				14	744	1290	2270	14	0.15	0.15	1.2	14	0.15	0.15	0.8	14	8.335	8.99	10.22	14	0.09	0.16	0.3	0			
SANDVLEI OV	E11	0				0				13	60.9	72.9	99.2	13	0.15	0.7	2.7	13	0.15	0.8	1.8	13	7.72	8.1	9.2	13	0.14	0.21	1.17	0			
SAND	E11	0				0				12	78.15	621.5	1160	12	0.15	0.15	0.15	12	0.15	1.2	1.7	12	8.21	8.84	9.4	12	0.043	0.08	0.15	0			
ZEEKO BPD	E11	0				0				14	94	113	119	14	1.05	7	28.4	14	1	3.4	5.7	14	7.835	8.01	8.79	14	5.4	6.7	10.5	0			
ZEEKO OUT	E11	0				0				3	99.9	119	119	3	0.15	0.15	0.15	3	0.15	0.15	0.15	3	8.7	8.94	8.94	3	0.91	4.09	4.09	0			
MNANDI SW	E11	0				0				11	89	94	96.2	11	0.15	0.8	1.8	11	7.6	9.4	10.7	11	7.66	8.2	8.5	11	0.36	0.44	1.43	0			
MONW PS	E11	0				0				14	92.35	108	624	14	5.2	6.9	10.2	14	0.7	1.6	8.4	14	7.52	8	9.35	14	0.81	0.88	1.32	0			
BLACK US	E11	0				0				12	92.75	100.3	118	12	1.05	1.6	3.5	12	3.5	7.2	9.7	12	7.33	7.85	7.97	12	1.8	3.17	5.3	0			
SALT TB	E11	0				0				12	92.05	109	114	12	0.95	1.2	3.4	12	3.95	6.85	7.7	12	7.73	8.01	9.74	12	2.055	3.69	20	0			
LLOTUS	E11	0				0				14	67.95	87.5	113	14	0.15	0.5	2.5	14	0.75	1.9	6	14	7.8	8.35	9.1	14	0.13	0.21	1.27	0			
BLOTUS	E11	0				0				14	76.85	119	129	14	0.7	3.9	10.4	14	1.95	2.7	9.5	14	7.825	8	8.36	14	0.665	0.86	1.43	0			
KEYSERS	E11	0				0				14	55.25	63.5	80.7	14	0.15	0.15	0.7	14	0.15	0.4	1	14	7.635	7.7	8.33	14	0.135	0.38	0.66	0			

Appendix D: Estuaries

Delineation of significant estuaries

Great Berg

The Great Berg is the by far the largest estuary in the Berg WMA, the estuary functional zone (EFZ) estimated at 9 197.37 ha and open water area at 643.8 ha. Coordinates of the upstream and downstream boundaries of the Berg estuary are listed in **Error! Reference source not found.**. The location of the upstream boundary of this estuary as defined in the RDM study for this system (DWA 2010) is further upstream than it is on the National Estuaries Layer (http://bgis.sanbi.org/) but corresponds more or less with the 5 m AMSL contour. The built up and transformed areas surrounding Velddrif have also been excised as these areas no longer contain natural vegetation. The boundaries of the EFZ for this estuary have thus been redrawn accordingly.



Extent of the Berg Estuary.

Langebaan

The EFZ for Langebaan lagoon was based on the National Estuary Layer and is indicated below. The size of the EFZ for this system (6 260.8ha) makes it the second largest estuary in the Berg WMA, even though the extent of the open water area is larger than that of the Berg (4112.9 ha).

Extent of the Langebaan Lagoon.

Diep

The EFZ for the Diep estuary as delineated on the National Estuary Layer includes some lateral areas that have been completely transformed by residential development. These areas contain little or no estuarine vegetation or fauna and are no longer functionally linked to the estuary and were thus excluded in the current delineation. The area of the EFZ in terms of this delineation is estimated at 834 ha with total open water area is estimated at 229.1 ha.

Extent of the Diep Estuary.

Wildevoelvlei

The extent of the EFZ for Wildevöel estuary (266.4 ha) is shown below. Open water area for this system is estimated at 22.0 ha. The National Estuary Layer for Wildvoelvlei (http://bgis.sanbi.org/) included the Goeiehoop estuary and backwater lagoon at the north of Noordhoek beach as well as the areas below 5 m behind this estuary. These areas are not hydrologically linked to Wildevöelvlei and so were excised along some higher lying ground between the two estuaries. The mouth area was also decreased to exclude the rocky shore.

Extent of the Wildvöelvlei Estuary.

Sand

The EFZ for the Zandvlei estuary as delineated on the National Estuary Layer includes extensive area around the upper reaches of this system that have been completely transformed by residential development. These areas contain little or no estuarine vegetation or fauna and are no longer functionally linked to the estuary and were thus excluded in the current delineation. The area of the EFZ in terms of this delineation is estimated at 307.33 ha. Total open water area is estimated at 119.0 and includes the Marina da Gama canal system which is hydrologically integrated with the estuary.

Extent of the Sand Estuary.

Zeeköe

Total area of the Zeekoe estuary EFZ is estimated at 366.48 ha (as defined on the National Estuary Layer), while the open water area was almost the same size (327.34 ha) as it includes Zeekoevlei (**Error! Reference source not found.**). The Zeekeovlei sewage works has been excluded from the EFZ for this system in spite of the fact that it lies below the 5 m contour, along with other low lying developed areas. Rondevlei has been added to the extent of the estuary as it is functionally linked to the estuary and contains many estuarine habitats.

Extent of the Zeekoe Estuary.

Eerste

The EFZ for the Eerste estuary was estimated at 55.6 ha, making it the second smallest significant estuary in the Berg WMA (**Error! Reference source not found.**). Extensive areas of low lying land to the east of the main channel outlet were originally included in the National Estuary Layer for the Eerste estuary. These areas are no longer hydrologically or functionally linked with the system due to land transformation and road construction and have been excised in the current delineation (**Error! Reference source not found.**). The open water area of the estuary is estimated at just 9.0 ha.

Extent of the Eerste Estuary.

Lourens

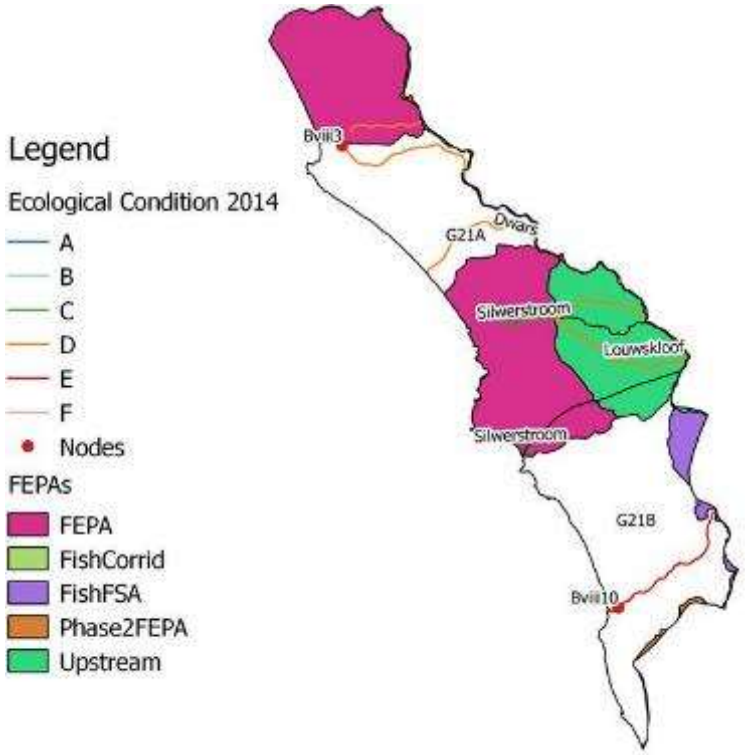
The size of the EFZ for the Lourens estuary is estimated at 38.2 ha, making it the smallest significant estuary in the Berg WMA. Total open water area for this system was estimated at just 2.0 ha. The National Estuary Layer for the Lourens estuary included extensive low lying area to the northwest and southeast of the main channel outlet. The areas to the northwest of the estuary drain into the Lourens via a canal that does not possess any estuarine characteristics, hence the reason for excluding this area. Similarly the areas to the southeast have been completely transformed for urban development and do possess any estuarine characteristics. As such, these two areas were excised from the delineation. Historically, the Lourens used to discharge into the sea much further to the west (i.e. included the Wagenveldsluit), a feature which is still below the 5 m contour and is functionally linked to the estuary. This area has thus been included in the current delineation of the EFZ for this estuary (**Error! Reference source not found.**).

Extent of the Lourens Estuary.

Appendix E: Wetlands

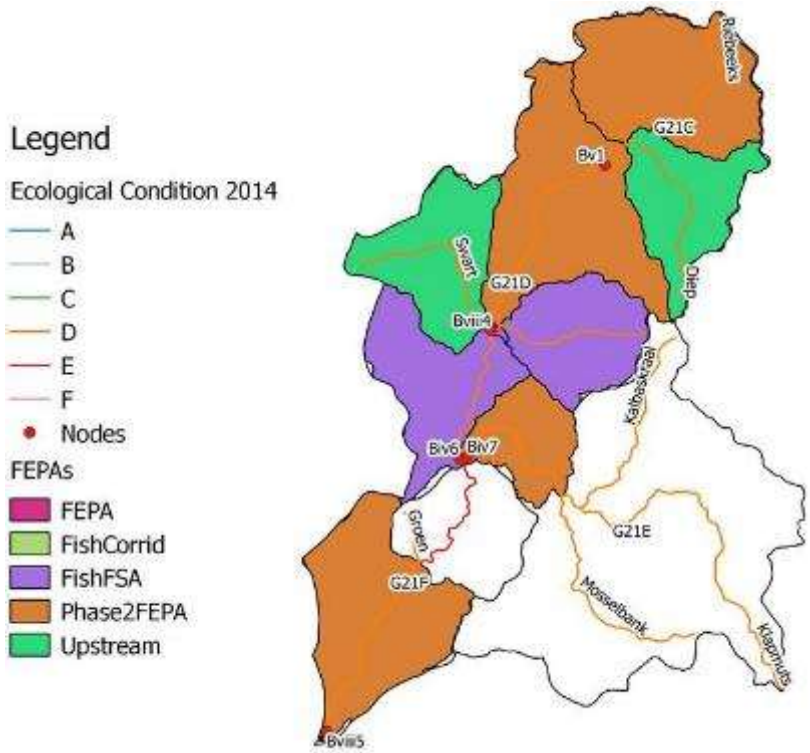
Appendix F: Rivers

Dwars-Mosselbank



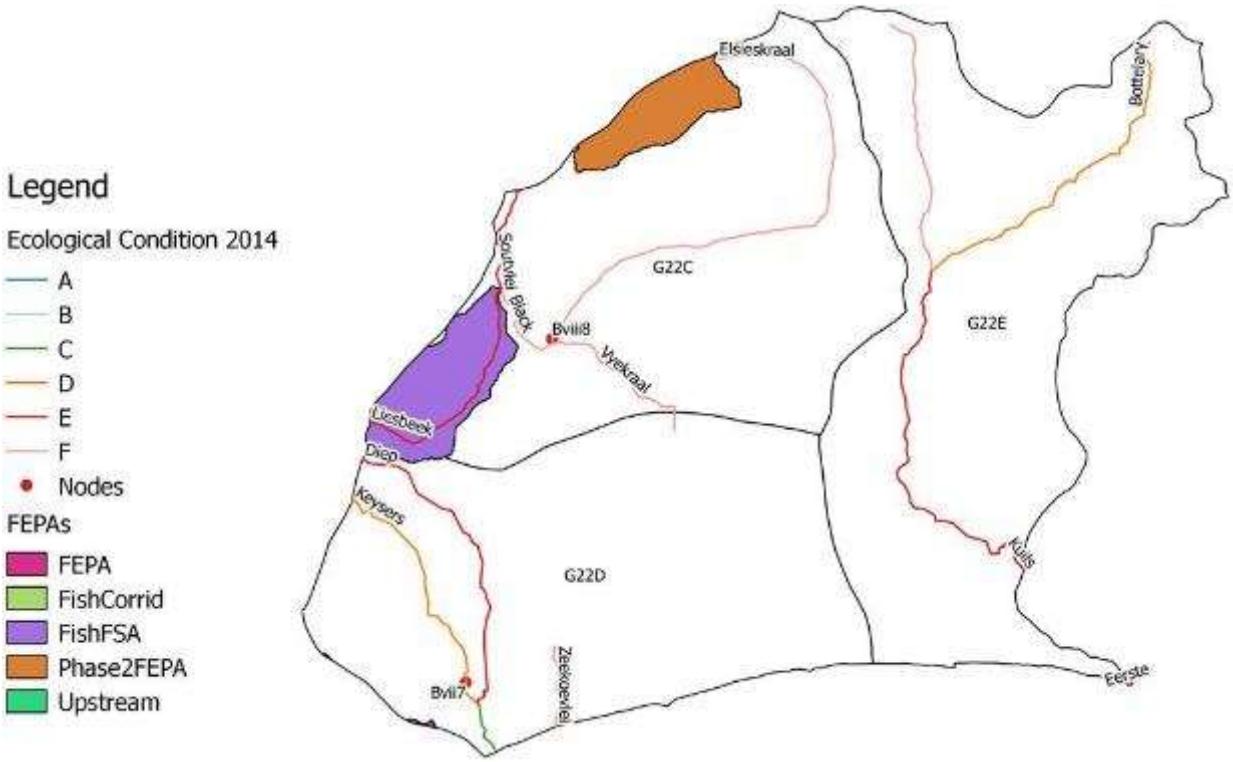
Ecological condition 2014 of nodes and location of river FEPAs in Dwars-Mosselbank IUA

Diep-Mosselbank



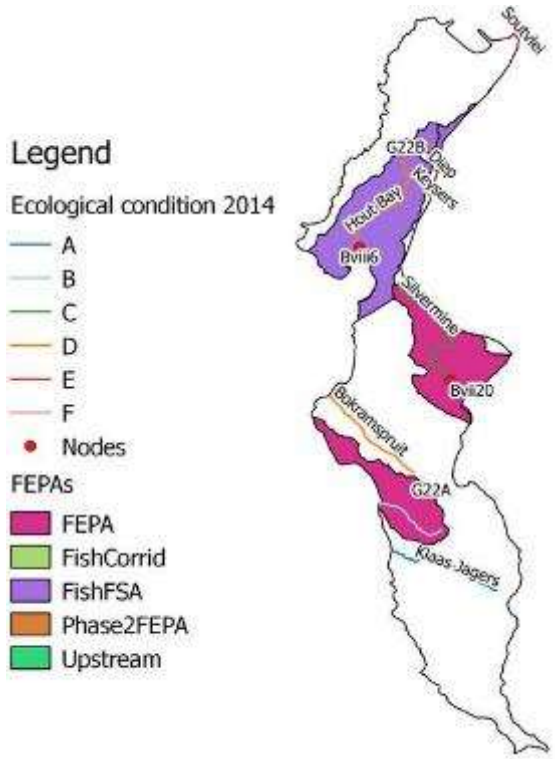
Ecological condition 2014 of nodes and location of river FEPAs in Diep-Mosselbank IUA

Cape Flats



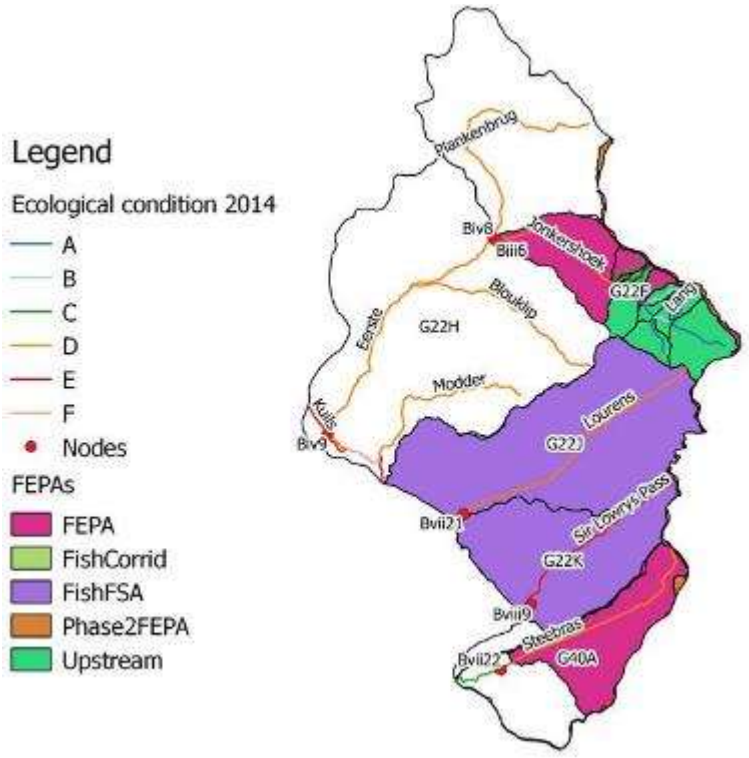
Ecological condition 2014 of nodes and location of river FEPAs in Cape Flats IUA

Peninsula



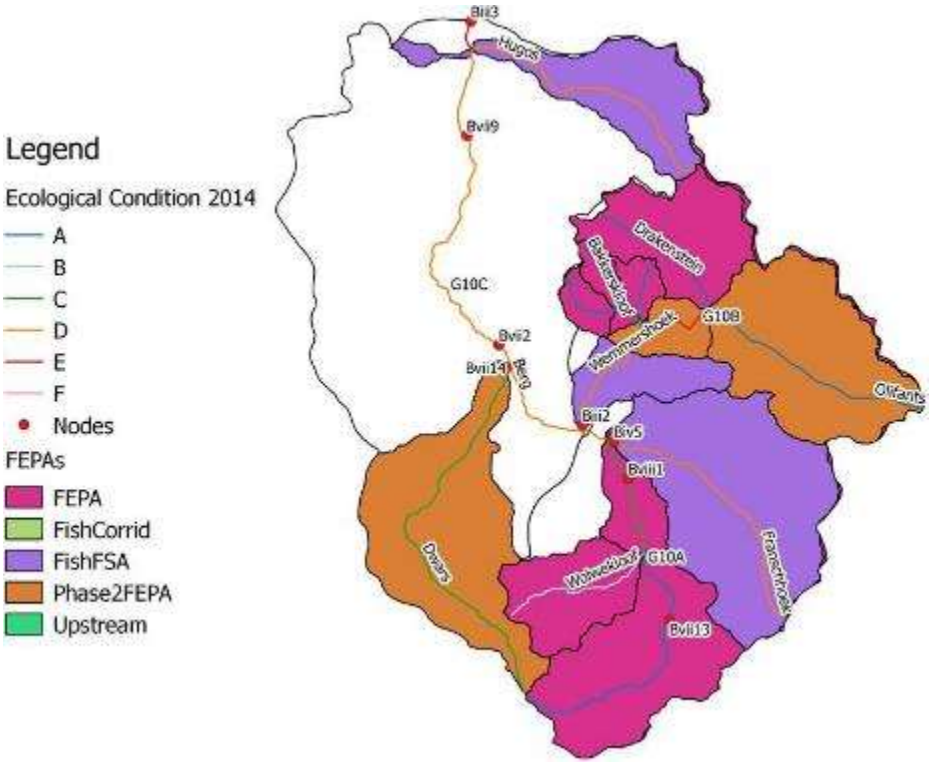
Ecological condition 2014 of nodes and location of river FEPAs in Peninsula IUA

Lourens-Eerste



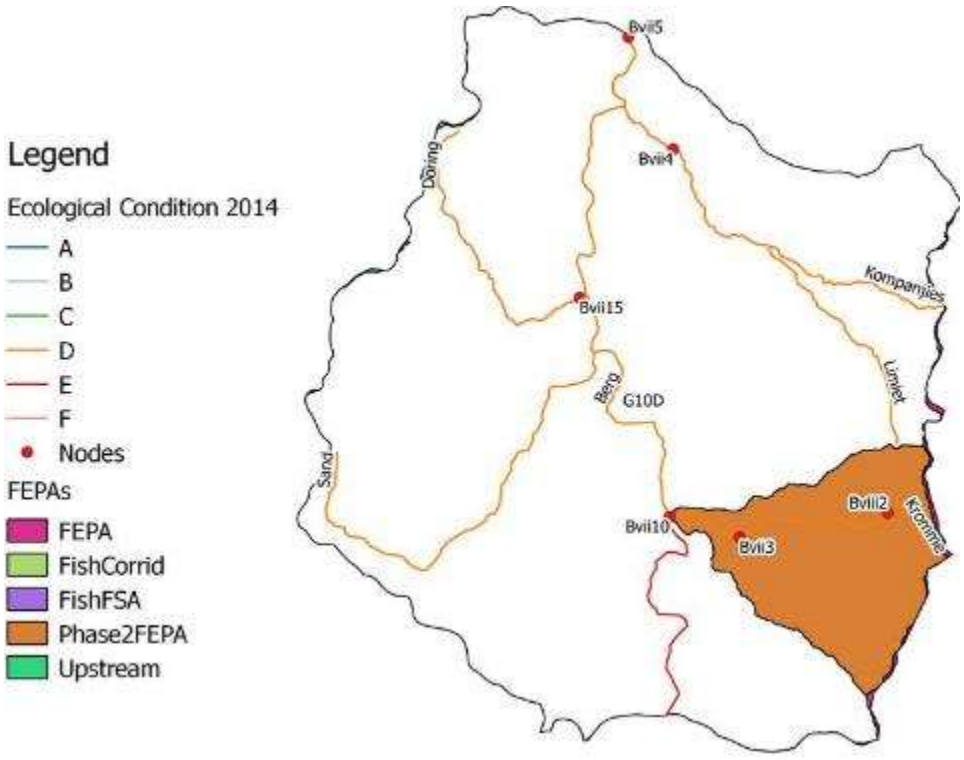
Ecological condition 2014 of nodes and location of river FEPAs in Lourens Eerste IUA

Upper Berg



Ecological condition 2014 of nodes and location of river FEPAs in Upper Berg IUA

Middle Berg



Ecological condition 2014 of nodes and location of river FEPAs in Middle Berg IUA

Lower Berg

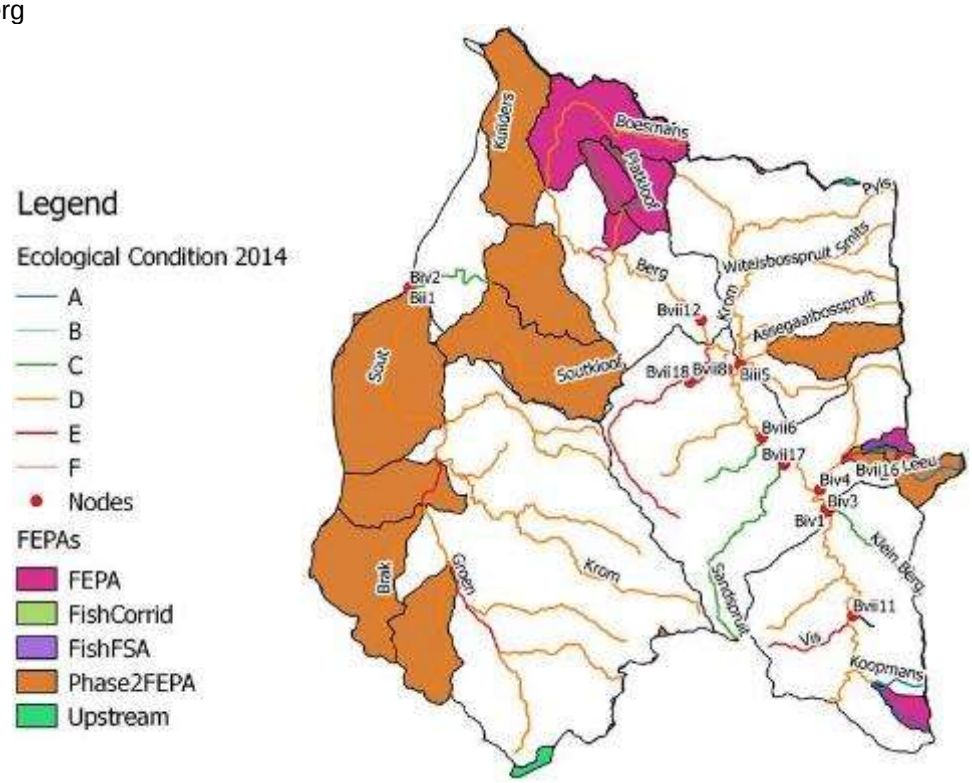
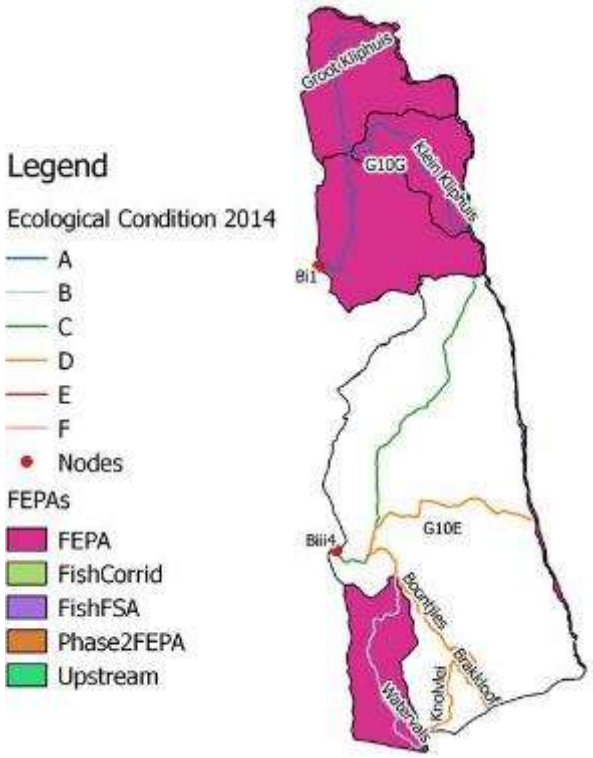


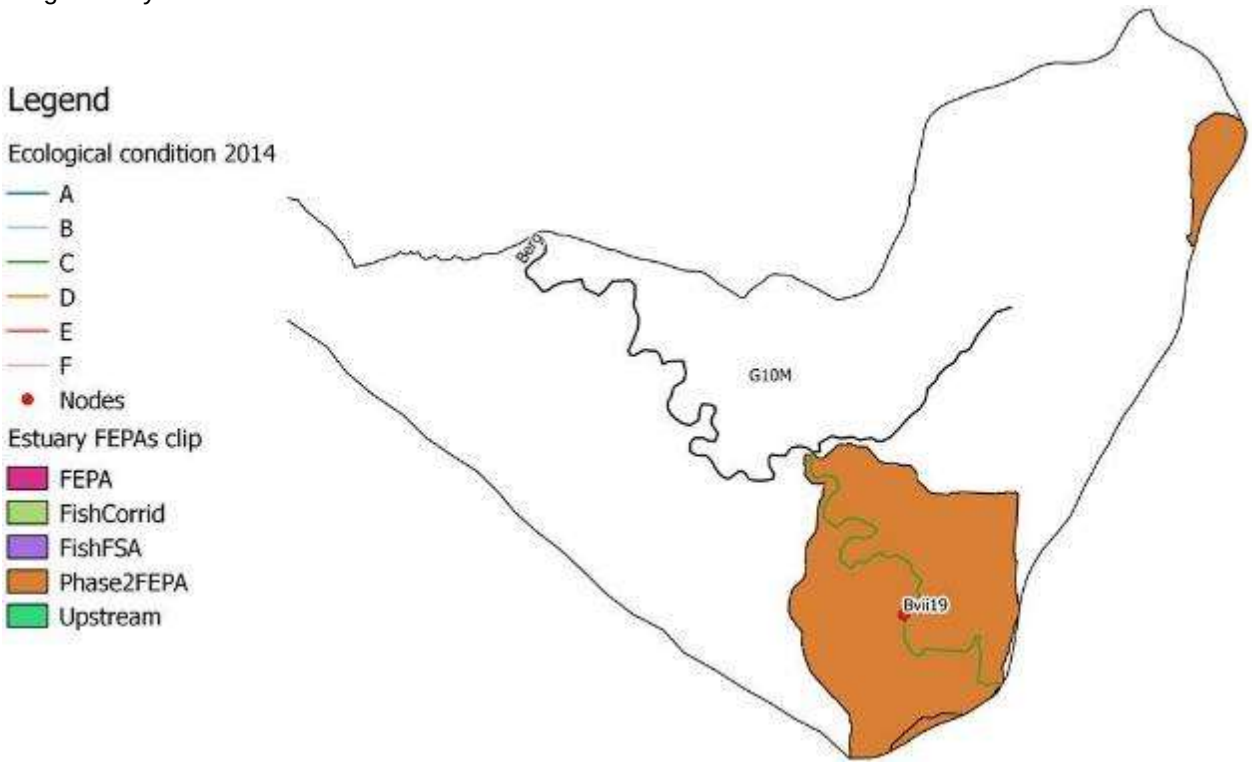
Figure Error! No text of specified style in document.**.1 Ecological condition 2014 of nodes and location of river FEPAs in Lower Berg IUA**

Berg Tributaries



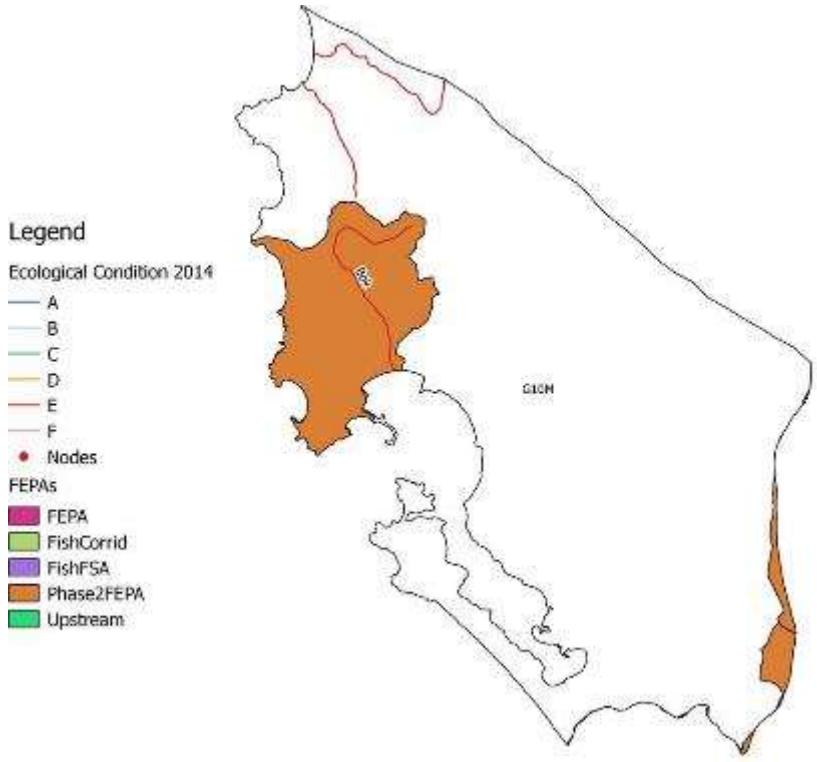
Ecological condition 2014 of nodes and location of river FEPAs in Berg Tributaries IUA

Berg Estuary



Ecological condition 2014 of nodes and location of the Phase2 FEPA in Berg Estuary IUA

Langebaan



Ecological condition 2014 of nodes and location of river FEPAs in Langebaan IUA

Appendix E: Socio-economics

SEZ 1: West Coast

Some of the largest towns in the West Coast socio-economic zone are Atlantis, Langebaan and Velddrif (Figure E1). The GVA in 2015 was estimated to be R19 billion, representing 5.2% of total GVA in the Berg WMA (Table E1). While much of the land area of the zone is taken up with dryland agriculture as well as natural veld, the main economic activities are finance, insurance, real estate and business services followed by wholesale trade, catering and accommodation sector (Figure E1, Table E1). Numerous tourist destinations exist within this zone, including the West Coast National Park and popular Langebaan town. The manufacturing sector is also economically important, especially within the towns of Atlantis and Saldanha (Table E1).

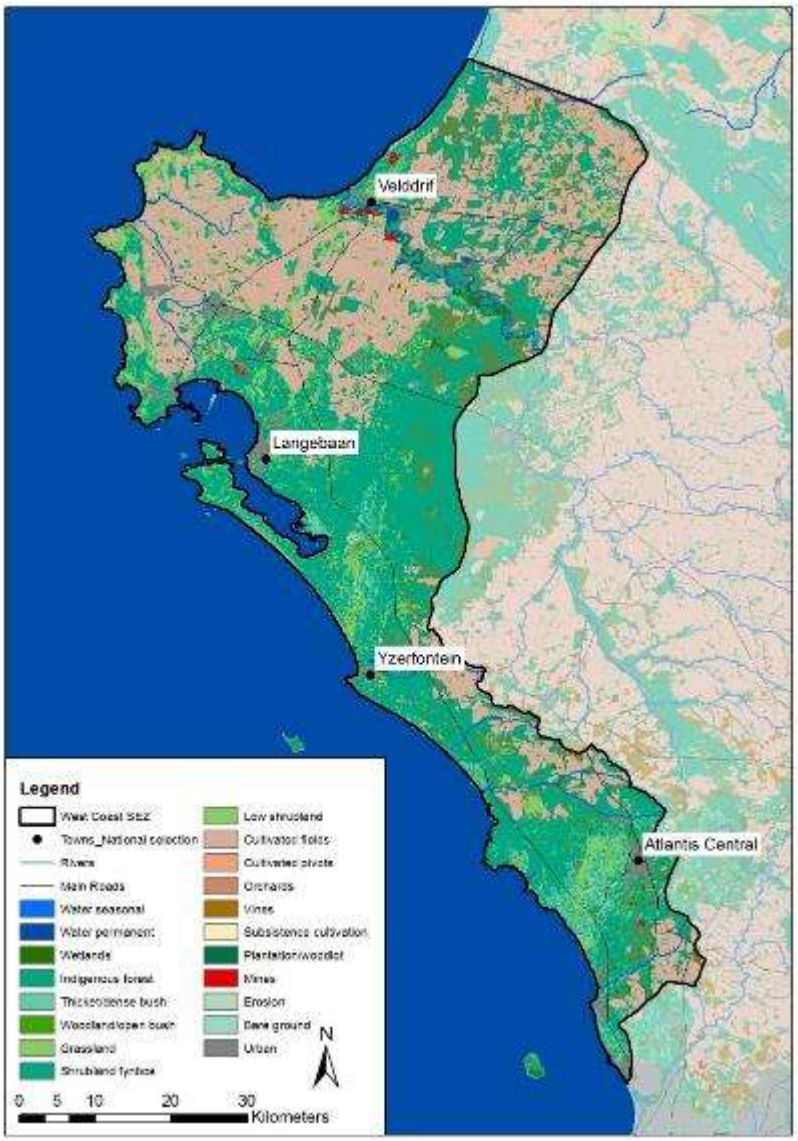


Figure E1. Land use in the West Coast socio-economic zone (Source: DEA, National Land Cover 2013/14)

A total of 15% of dryland crops and only 1% of irrigated crop land occurring within in the WMA are located within this socio-economic zone. Wine grapes cover the largest area and represent 75% of the irrigated crop with grains (22%) and stone fruit (10%) covering the next largest areas within the socio-economic zone. All of the wine grapes in this socio-economic zone are found in IUA A2 (Table E2). In IUA A1, grains were the most important irrigated crop, covering 167 ha of land (**Error! Reference source not found.**). There are approximately 65 700 ha of dryland crops in the West Coast, with grains and planted pasture accounting for 91% of this (Table E2).

Table E1. GVA per sector in 2015 (R million, nominal 2015 prices) for the West Coast socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	829	4%
Mining and Quarrying	149	1%
Manufacturing	3 532	19%
Electricity, Gas and Water	952	5%
Wholesale and Retail Trade, Catering and Accommodation	3 783	20%
Transport, Storage and Communication	2 191	12%
Finance, Insurance, Real Estate and Business Services	4 579	24%
Community, Social and Government Services	2 988	16%
Total	**19 005**	

Table E2. The total area of irrigated crops within each IUA of the West Coast SEZ (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA A1: Berg Estuary	IUA A2: Dwars Mosselbank	IUA A3: Langebaan	Total
Grains	167	-	-	167
Planted pastures	41	-	-	41
Stone fruit	6	46	21	73
Tree fruit - other	-	11	-	11
Vegetables	58	-	-	58
Grapes - Wine	-	565	-	565
Grapes - Table	-	2	-	2
Total	**105**	**624**	**21**	**750**
Dryland Crop Type				
Grains	17 098	3 489	10 781	31 367
Grains, Lupines	55	-	237	292
Lupines	3 578	279	1 490	5 347
Oil seeds	236	300	27	563
Planted pastures	10 290	6 642	11 222	28 154
Vegetables	-	4	-	4
Total	**31 257**	**10 713**	**23 757**	**65 727**

Much of the gross economic output within the West Coast socio-economic zone comes from tourism and fisheries, whereas a large chunk of value added, and employment related to water affected economic activities comes from irrigated agriculture as well (Table E3 and Table E4). The average

income and percentage of poor households was average compared with other zones in the Berg WMA socio-economic zones (Table E5).

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in **Error! Reference source not found.** and **Error! Reference source not found.**. Population and income statistics are summarised in Table E5.

Table E3. Gross economic output (R million) in each IUA in the West Coast socio-economic zone in 2015 for each water affected economic activity

Economic activity	IUA A1: Berg Estuary	IUA A2: Dwars Mosselbank	IUA A3: Langebaan	SEZ Total
Irrigated fruit	1	47	5	52
Irrigated crops	11	-	-	11
Tourism & recreation	76	321	309	706
Estuary small scale fisheries	13	0	0	13
Marine inshore fisheries	348	301	41	691
Total	**436**	**669**	**355**	**1 460**

Table E4. Direct value added, total valued added and total employment in 2015 for the West Coast socio-economic zone for water affected economic activities

Economic activity	Gross Economic Output (R millions)	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	52	26.0	41.9	393
Irrigated crops	11	4.3	7.2	48
Tourism & recreation	706	26	59	76
Estuary small scale fisheries	13	4	8	67
Marine inshore fisheries	691	112	215	348
Total	**1 460**	**168**	**323**	**866**

Table E5. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	265 988
Average household income	R230 619
% poor households	13.9%
% unemployed	16.8%
% households with piped water	96.2%
% households dependant on river water	0.6%

SEZ 2: Lower Berg

The Lower Berg socio-economic zone is a predominately grain growing area in the north of the Berg WMA (Figure E2). Mooreesberg and Piketberg are some of the largest towns within this socio-economic zone. The GVA in 2015 was estimated to be R4.6 billion, representing only 1.2% of total GVA in the Berg WMA (Table E6).

The main economic activities are within the finance, insurance, real estate and business services sector followed by the agriculture and the wholesale trade, catering and accommodation sectors (Table E6). The towns of Riebeek-Kasteel and Darling also have reasonably sized wine and tourism industries.

Dryland crops cover approximately 266 800 ha of land and represent 62% of the total dryland crop area in the WMA. The most extensive dryland crops include grains (60%) and planted pastures (32%; Table E7). There are close to 16 000 ha of irrigated crop land in this zone, accounting for 22% of irrigated crops in the WMA (Table E7). Grapes are the by far the most extensive and economically important crop grown in this region, making up 64% of the irrigated crop (Wine grapes 48%, Table Grapes 18%; Table E7). After grapes, irrigated grains are the most extensive crop, accounting for 13% of the irrigated crops in this zone.

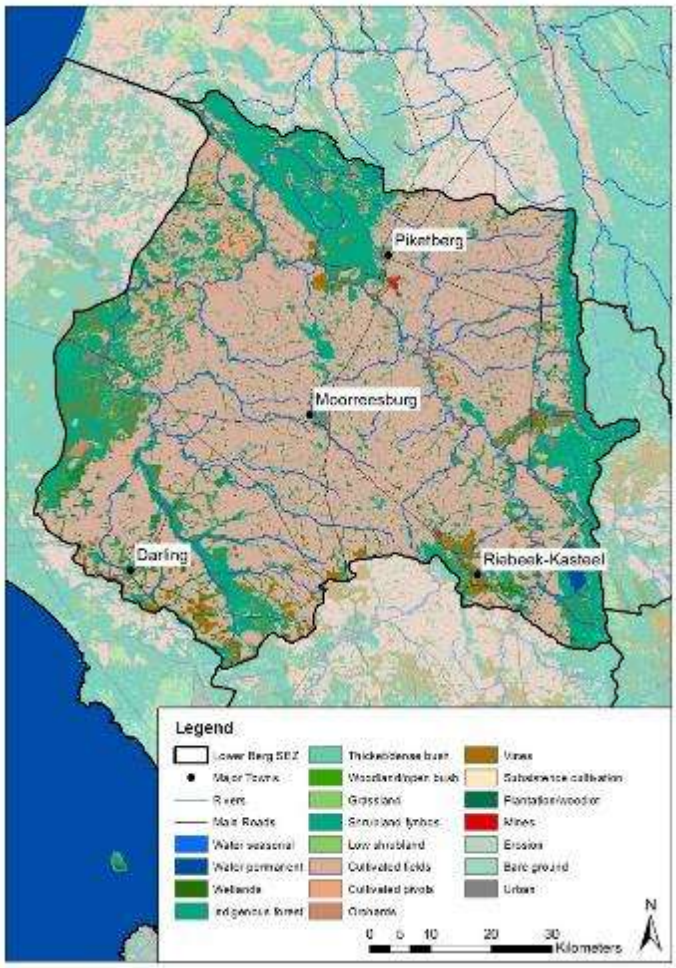


Figure E2. Land use in the Lower Berg socio-economic zone (Source: DEA, National Land Cover 2013/14)

Table E6. GVA per sector in 2015 (R million, nominal 2015 prices) for the Lower Berg socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	869	19%
Mining and Quarrying	10	0%
Manufacturing	697	15%
Electricity, Gas and Water	71	2%
Wholesale and Retail Trade, Catering and Accommodation	809	18%
Transport, Storage and Communication	255	6%
Finance, Insurance, Real Estate and Business Services	1 074	23%
Community, Social and Government Services	787	17%
Total	**4 573**	

Table E7. The total area of irrigated crops within the only IUA of the Lower Berg SEZ (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA B4: Lower Berg
Berries	107
Citrus fruits	736
Flowers	4
Grains	2 010
Pepo	16
Planted pastures	472
Pome fruit	436
Prickly pears	1
Stone fruit	914
Sub-tropical fruit	1
Tree fruit - other	533
Vegetables	446
Grapes - Wine	7 247
Grapes - Table	2 905
Total	**15 830**
Dryland Crop Type	
Flowers	405
Grains	159 287
Grains, Lupines	257
Herbs / Essential oils	80
Industrial	32
Lupines	15 199
Oil seeds	7 001
Oil seeds, Grains	31
Oil seeds, Lupines	35
Planted pastures	84 137
Teas	127
Vegetables	165
Grapes - Table	17
Total	**266 773**

Much of the gross economic output, value added, and almost all of the employment related to water affected economic activities within the Lower Berg socio-economic zone comes from irrigated fruit agriculture (Table E8 and Table E9). The average income was one of the lowest of all the Berg WMA socio-economic zones (Table E10). The percentage of poor households however, was the lowest of all the socio-economic zones (Table E10**Error! Reference source not found.**).

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in **Error! Reference source not found.** and **Error! Reference source not found.**. Population and income statistics are summarised in Table E10.

Table E8. Gross economic output (R million) in each IUA in the Lower Berg socio-economic zone in 2015 for each water affected economic activity

Economic activity	IUA B4: Lower Berg
Irrigated fruit	1677
Irrigated crops	97
Plantation forestry	16
Tourism & recreation	148
Total	**1 938**

Table E9. Direct value added, total valued added and total employment in 2015 for the Lower Berg socio-economic zone for water affected economic activities

Economic activity	Gross Economic Output (R million)	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	1677	831	1 341	10 898
Irrigated crops	97	37	64	435
Plantation forestry	16	4	10	37
Tourism & recreation	148	51	114	148
Total	**1 938**	**922**	**1 529**	**11 519**

Table E10. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	110 058
Average household income	R125 786
% poor households	8%
% unemployed	9.2%
% households with piped water	97.6%
% households dependant on river water	4.7%

SEZ 3: Tulbagh Fruit Area

The Tulbagh Fruit Area socio-economic zone is located in the Tulbagh basin on the eastern edge of the Berg WMA. The Basin is surrounded by mainly untransformed mountainous areas including the Outeniqua Mountains to the west, the Winterhoek Mountains to the north and Witzenberg Mountains to the east (Figure E3). The GVA of the zone in 2015 was estimated to be R0.7 billion, representing only 0.2% of total GVA in the Berg WMA (Table E11). The only major town in the zone is Tulbagh itself. The highest contributor to the GVA of the zone was the agricultural sector (Table E11). While wine has been grown in this region for many years, the area is now starting to grow with respects to wine-related tourism (Tulbagh Wine Route 2016).

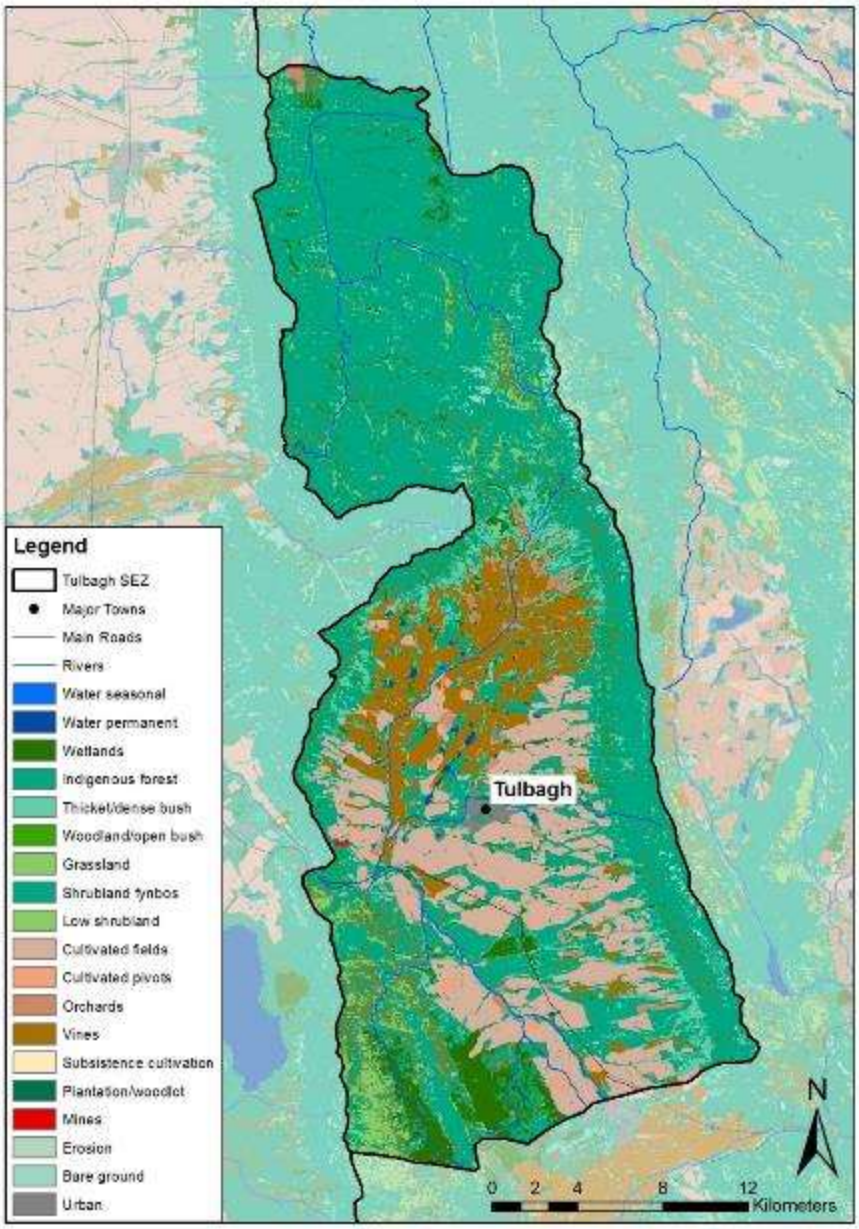


Figure E3. Land use in the Tulbagh socio-economic zone (Source: DEA, National Land Cover 2013/14)

Table E11. GVA per sector in 2015 (R million, nominal 2015 prices) for the Tulbagh Fruit Area socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	280	39%
Mining and Quarrying	0	0%
Manufacturing	54	7%
Electricity, Gas and Water	7	1%
Wholesale and Retail Trade, Catering and Accommodation	78	11%
Transport, Storage and Communication	27	4%
Finance, Insurance, Real Estate and Business Services	166	23%
Community, Social and Government Services	108	15%
Total	**721**	

Approximately 8 500 ha of land is used for farming in this zone, with 60% of this being dryland crops and 40% irrigated crops (Table E12). Stone fruit and wine grapes represent 49% and 29% of the irrigated crop land. Dryland crops mainly consist of grains and planted pastures (Table E12).

Table E12. The total area of irrigated and dryland crops within the only IUA of the Tulbagh Fruit Area SEZ (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA C5: Berg Tributaries
Berries	44
Citrus fruits	27
Grains	17
Nuts	6
Planted pastures	103
Pome fruit	494
Stone fruit	1 622
Tree fruit - other	9
Vegetables	15
Grapes - Wine	962
Total	**3 299**
Dryland Crop Type	
Flowers	22
Grains	2 881
Lupines	303
Oil seeds	72
Planted pastures	1 856
Vegetables	16
Grapes - Wine	9
Total	**5 159**

Much of the gross economic output, value added, and employment related to water affected economic activities within the Tulbagh Fruit Area socio-economic zone comes from irrigated fruit agriculture (Table E13 and Table E14). The average income was the lowest of all the Berg WMA socio-economic zones (Table E15). The percentage of poor households and unemployment however, were much lower than some of the other socio-economic zones (Table E15).

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E13 and Table E14. Population and income statistics are summarised in Table E15.

Table E13. Gross economic output (R million) in each IUA in the Tulbagh socio-economic zone in 2015 for each water affected economic activity

Economic activity	IUA C5: Berg Tributaries
Irrigated fruit	565
Irrigated crops	6
Plantation forestry	16
Tourism & recreation	46
Total	**633**

Table E14. Direct value added, total valued added and total employment in 2015 for the Tulbagh socio-economic zone for water affected economic activities

Economic activity	Gross Economic Output (R million)	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	565	274	451	3 829
Irrigated crops	6	3	5	36
Plantation forestry	16	5	11	39
Tourism & recreation	46	16	35	35
Total	**633**	**297**	**501**	**3 939**

Table E15. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	24 264
Average household income	R90 160
% poor households	10%
% unemployed	8.2%
% households with piped water	86.2%
% households dependant on river water	2.4%

SEZ 4: Winelands

The Winelands socio-economic zone is situated to the north-east of Cape Town (Figure E4). The zone includes two sections of coast line, one in Table Bay at the Diep/Rietvlei Estuary and the other along the coast of False Bay from the Eerste Estuary to the edge of the WMA (Figure E4). The zone extends north to the town of Malmesbury. Other major towns include Paarl, Wellington and Stellenbosch and Franschhoek. The area is primarily a wine-growing region with a significant tourism industry, however also houses a large population of close to a million people in a number of urban centres. The GVA of the zone in 2015 was estimated to be R72.2 billion, representing almost 20% of total GVA in the Berg WMA (Table E16). The main sectors contributing to the GVA of the region were the finance, insurance, real estate and business services sector followed by wholesale trade, catering and accommodation sector (Table E16). The community, social and government services sector also plays a major role in this zone (Table E16).

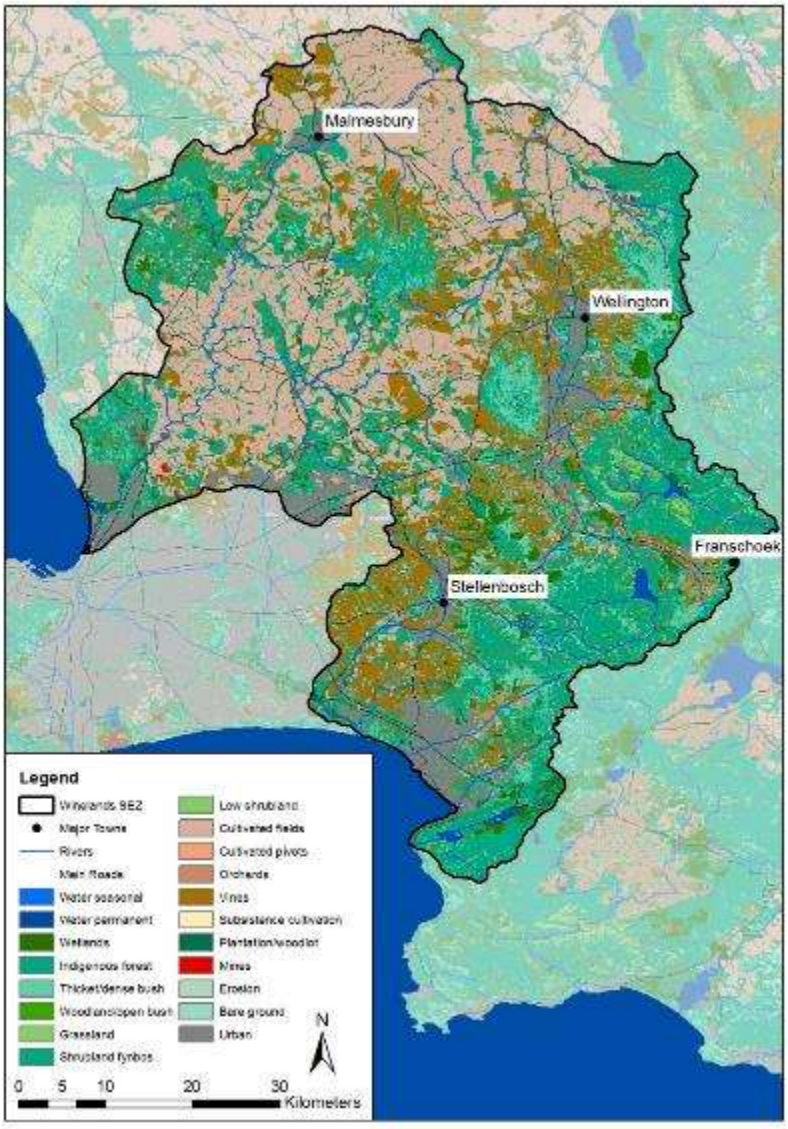


Figure E4. Land use in the Winelands socio-economic zone (Source: DEA, National Land Cover 2013/14)

Table E16. GVA per sector in 2015 (R million, nominal 2015 prices) for the Winelands socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	4 132	6%
Mining and Quarrying	271	0%
Manufacturing	9 501	13%
Electricity, Gas and Water	3 159	4%
Wholesale and Retail Trade, Catering and Accommodation	15 469	21%
Transport, Storage and Communication	5 267	7%
Finance, Insurance, Real Estate and Business Services	23 278	32%
Community, Social and Government Services	11 122	15%
Total	**72 200**	

Agricultural crops cover approximately 136 000 ha of land within the socio-economic zone. Dryland crops represent 65% of this and irrigated crops 35% (Table E17). Irrigated crops mainly consist of wine grapes (80%) followed by stone fruit (9%). This pattern was quite similar across all four IUAs. Planted pasture and grains were the largest contributors to dryland crops (48% and 42% respectively;Table E17).

Much of the gross economic output, value added, and employment related to water affected economic activities within the Winelands socio-economic zone comes from irrigated fruit agriculture as well as tourism and recreation (Table E18 and Table E19). The average income was the second highest of all the Berg WMA socio-economic zones (Table E20). The percentage of poor households was also second highest behind Cape Town (Table E20).

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E18 and Table E19. Population and income statistics are summarised in Table E20.

Table E17. The total area of irrigated and dryland crops within each IUA of the Winelands socio-economic zone (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA D6: Lourens Eerste	IUA D7: Upper Berg	IUA D8: Middle Berg	IUA D9: Diep Mosselbank	Total
Berries	82	83	-	-	165
Citrus fruits	107	473	166	82	828
Grains	-	2	31	371	404
Oil seeds	-	-	-	41	41
Other crops	-	-	1	-	1
Pepo	6	2	-	-	8
Planted pastures	27	-	1	165	193
Pome fruit	377	165	14	5	561
Prickly pears	-	-	-	8	8
Stone fruit	562	1 570	1 627	622	4 381
Tree fruit - other	31	151	293	258	733
Vegetables	48	-	7	368	423
Grapes - Wine	11 784	5 602	10 297	10 537	38 220
Grapes - Table	19	211	1 381	58	1 669
Total	**13 043**	**8 258**	**13 818**	**12 516**	**47 635**
Dryland Crop Type					
Flowers	90	100	40	57	287

Irrigated Crop Type	IUA D6: Lourens Eerste	IUA D7: Upper Berg	IUA D8: Middle Berg	IUA D9: Diep Mosselbank	Total
Grains	217	46	11 831	30 631	42 726
Grains, Vegetables	2	-	-	-	2
Herbs / Essential oils	2	46	-	7	55
Herbs / Essential oils, Vegetables	-	2	-	-	2
Lupines	-	-	125	1 122	1 247
Oil seeds	-	-	1 492	4 270	5 762
Oil seeds, Grains	-	-	89	89	178
Other crops	-	4	200	5	208
Planted pastures	1 964	1 388	6 516	27 571	37 439
Teas	1	-	-	-	1
Vegetables	48	49	73	64	234
Vegetables, Pepo	-	2	-	-	2
Grapes - Table	-	-	6	-	6
Total	**2 323**	**1 637**	**20 372**	**63 818**	**88 149**

Table E18. Gross economic output (R million) in each IUA in the Winelands socio-economic zone in 2015 for each water affected economic activity

Economic activity	IUA D6: Lourens Eerste	IUA D7: Upper Berg	IUA D8: Middle Berg	IUA D9: Diep Mosselbank	SEZ Total
Irrigated fruit	956	939	1358	857	4 110
Irrigated crops	7	-	1	56	64
Plantation forestry	27	18	9	9	63
Tourism & recreation	725	390	130	364	1 609
Marine inshore fisheries	12	-	-	47	58
Total	**1 727**	**1 347**	**1 499**	**1 332**	**5 904**

Table E19. Direct value added, total valued added and total employment in 2015 for the Wheat Belt socio-economic zone for water affected economic activities

Economic activity	Gross Economic Output (R million)	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	4 110	2 037	3 284	29 926
Irrigated crops	64	27	45	301
Plantation forestry	63	19	38	137
Tourism & recreation	1 609	551	1 244	5 895
Marine inshore fisheries	58	19	36	313
Total	**5 904**	**2 653**	**4 648**	**36 570**

Table E20. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	960 670
Average household income	R290 874
% poor households	16.1%
% unemployed	14.7%
% households with piped water	93.1%
% households dependant on river water	0.6%

SEZ 5: Cape Town

The Cape Town socio-economic zone encompasses the metropolitan area of the City of Cape Town (Figure E5). This zone has a population of over 3 million people and the GVA was estimated to be R269.6 billion in 2015, which makes up over 73% of the total GVA of the Berg WMA (Table E21). The main sectors contributing to the GVA of the region were the finance, insurance, real estate and business services sector followed by wholesale trade, catering and accommodation sector (Table E21). The community, social and government services sector also plays a major role in this zone (Table E21). The most common land cover type is by far urban areas, with exception to the large tracts of natural vegetation along the peninsula. Small pockets of agriculture do exist and are more prevalent towards the border with the Winelands socio-economic zone (**Error! Reference source not found.**).

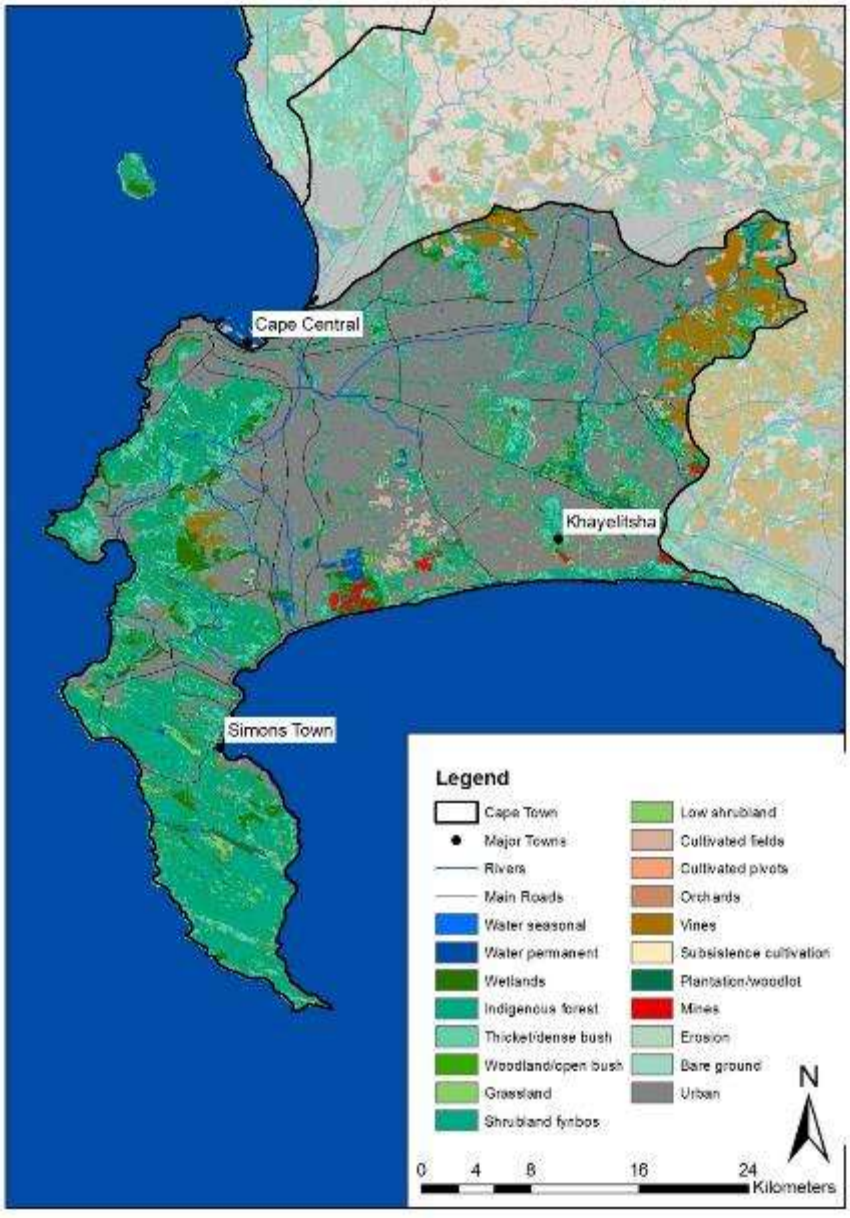


Figure E5. Land use in the Cape Town socio-economic zone (Source: DEA, National Land Cover 2013/14)

Table E21. GVA per sector in 2015 (R million, nominal 2015 prices) for the Cape Town socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	2 379	1%
Mining and Quarrying	349	0%
Manufacturing	32 547	12%
Electricity, Gas and Water	4 806	2%
Wholesale and Retail Trade, Catering and Accommodation	53 485	20%
Transport, Storage and Communication	28 226	10%
Finance, Insurance, Real Estate and Business Services	97 332	36%
Community, Social and Government Services	50 477	19%
Total	**269 600**	

There are a total of 6 575 ha of land under crop agriculture in this zone, over 75% of the agriculture that occurs within this zone was irrigated, and almost entirely occurring within the Cape Flats IUA (Table E22**Error! Reference source not found.**). Most of the irrigated agricultural land is made up of wine grapes, whereas most of the dryland agriculture is either planted pasture or vegetables (Table E22).

Table E22. The total area of irrigated and dryland crops within each IUA of the Cape Town SEZ (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA E10: Peninsula	IUA E11: Cape Flats	Total
Citrus fruits	-	0	0
Flowers	-	5	5
Grains	-	25	25
Herbs / Essential oils, Vegetables	-	5	5
Pepo	-	0	0
Planted pastures	-	0	0
Stone fruit	-	42	42
Tree fruit - other	-	72	72
Vegetables	-	565	565
Grapes - Wine	50	4 322	4 373
Total	**50**	**5 038**	**5 088**
Dryland Crop Type			
Flowers	-	64	64
Grains	-	41	41
Herbs / Essential oils	-	6	6
Herbs / Essential oils, Vegetables	-	28	28
Planted pastures	7	618	626
Vegetables	-	723	723
Total	**7**	**1 480**	**1 487**

Much of the gross economic output, value added, and employment related to water affected economic activities within the Cape Town socio-economic zone come from tourism and recreation related activities (T and **Error! Reference source not found.**). While the average income was the highest of all the Berg WMA socio-economic zones, so were the unemployment rate and the percentage of poor households (**Error! Reference source not found.**).

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E23 and Table E24. Population and income statistics are summarised in Table E25.

Table E23. Gross economic output (R million) per IUA in the Cape Town socio-economic zone in 2015 for each water affected economic activity

Economic activity	IUA E10: Peninsula	IUA E11: Cape Flats	SEZ Total
Irrigated fruit	3	279	282
Irrigated crops	-	69	69
Tourism & recreation	2 809	1 172	3 981
Marine inshore fisheries	563	12	575
Total	**2 812**	**1 520**	**4 906**

Table E24. Direct value added, total valued added and total employment in 2015 for the Cape Town socio-economic zone for water affected economic activities

Economic activity	Gross Economic Output (R million	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	282	142	226	2 231
Irrigated crops	69	31	50	319
Tourism & recreation	3 981	962	3 078	4 292
Marine inshore fisheries	575	180	355	64
Total	**4 906**	**1 314**	**3 709**	**6 905**

Table E25. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	3 073 703
Average household income	R291 544
% poor households	17.8%
% unemployed	24%
% households with piped water	90.5%
% households dependant on river water	0.6%