ANNEXURE A

DESCRIPTION AND LAYOUT OF THE WESTERN CAPE WATER SUPPLY SYSTEM

A1. INTRODUCTION

The WCWSS supplies CCT, other local authorities and irrigators in the catchments of the Riviersonderend, Berg and Eerste Rivers. The main supply schemes are shown in Figure A1 and the key features of the main dams are summarized in Table A1 (See also Appendix A1).

Table A1: Main Dams of Western Cape Water Resources System

Main Dam	Type	Height (m)	Gross Capacity (million m^3)	Gross Yield (million m^3/a)	Owner
Palmiet Kogelberg Rockview	 Concrete Rockfill	 54 48	 (17)* (17)*	22,5	DWAF
Upper Steenbras	Earthfill	34	32	40	CCT
Lower Steenbras	Concrete	28	34		
Wemmershoek	Rockfill	55	59	54	CCT
Voëlvlei	Earthfill	10	172	105	DWAF
Theewaterskloof	Earthfill	38	480	241,2**	DWAF
TOTAL			777	462,7**	

* Capacity is mainly utilized for the Palmiet Pumped Storage Scheme.

** The yields of the Riviersonderend-Berg System and of the Western Cape Water System were previously stated to be 219 million m^3/annum and 440,5 million m^3/annum respectively. These figures exclude compensation and exchange releases of 22,2 million m^3/annum.

These dams are the main components of the City of Cape Town's Steenbras and Wemmershoek Schemes and of the Palmiet, Voëlvlei and Riviersonderend Berg Government Water Schemes. However it is the relatively large capacities of DWAF's tunnel system and of the City's pipelines from these dams, as well as the flexibility of the City's bulk reticulation system, that enables the dams to be operated as an integrated system.
The layout of the schemes comprising the Western Cape Water System is shown on Figure A1. Table A2, Appendix A1 and Figures A2 to A6 show the details and schematics of the main schemes which are described in Section 2 below.

Table A2: Main Features of Schemes of the Western Cape Water Resources System

Scheme	Diversions Dams	Bulk Raw Water Conveyance	Irrigators	Water Treatment Works (WTW)	Bulk Clear Water Conveyance
Palmiet Government Water Scheme (see Figure A2)	Kogelberg pumps to Rockview which releases to	12 m^3/s Canal & culvert to Steenbras Upper Dam			
Steenbras Scheme (see Figure A2)	Upper Steenbras releases to	Steenbras Pumped Storage 300 Mℓ/day Firlands Pumps & Pipeline		500 Mℓ/day Faure WTW	
	Upper Steenbras also releases to Lower Steenbras			150 Mℓ/day Steenbras WTW	Three Steenbras pipelines to Cape Town
Wemmershoek Scheme (see Figure A3)	Wemmershoek Dam release to			270 Mℓ/day Wemmershoek WTW	270 Mℓ/day Wemmershoek Pipeline supplying Cape Town, Paarl & Wellington
Voëlvlei Government Water Scheme (see Figure A4)	Klein Berg and 24 Rivers divert in winter	Release to irrigators	24 Rivers		
	into Voëlvlei Dam			270 Mℓ/day Voëlvlei WTW	Voëlvlei Pipelines to Cape Town

Scheme	Diversions Dams	Bulk Raw Water Conveyance	Irrigators	Water Treat-ment Works (WTW)	Bulk Clear Water Conveyance
	releases to:			30 Mℓ/day Swartland WTW	Pipeline to West Coast Towns
		Berg River	Lower Berg		
	Voëlvlei Dam also releases to Misverstand Dam	Berg River	Lower Berg	72 Mℓ/day Withoogte WTW	West Coast Withoogte Pipeline to Vredenburg/Saldanha
Riviersonderend Berg River Government Water Scheme (see Figure A5)	Banhoek and Wolwekloof divert in winter				
	into Theewaters-kloof Dam releases to:	Riviersonderend River	Riviersonderend	Overberg	
		Tunnel to Berg Siphon	Upper Berg		
		140 Mℓ/day Pipeline		270 Mℓ/day Wemmershoek WTW	270 Mℓ/day Wemmershoek Pipeline supplying Paarl & Wellington and Cape Town
	Theewaterskloof also releases to Kleinplaas Dam (Eerste River diversion) releases to:		Eerste		
		Tunnel to Stellenboschberg releases to	Stellenbosch Heldelberg	10 Mℓ/day Paradyskloof WTW	Additional supply to Stellenbosch
		500 Mℓ/day Faure Pipeline		500 Mℓ/day Faure WTW	Cape Town
		400 Mℓ/day Blackheath Pipeline		400 Mℓ/day Blackheath WTW	Cape Town
Berg Water Project (see Figure A6)	Supplement Scheme pumps to:				
	Berg Water Project Dam supplies:	Releases to irrigators, pumps into Dasbos Tunnel and via Tunnel System into Theewaterskloof Dam	Upper Berg		

The operating rules of the Western Cape Water System are discussed in Annexure H.

A2. MAIN SCHEMES

A2.1 Palmiet River Government Water Scheme (Figure A2)

The Palmiet River Government Water Scheme comprises the Kogelberg and Rockview Dams which are the main components of the Government Water Scheme and are connected by ESKOM's 400 Megawatt Palmiet Pumped Storage Scheme. These two dams serve respectively as the tail and headrace dams of the Pumped Storage Scheme which operates on a weekly cycle.

When there is adequate flow in the Palmiet River to meet the instream (environmental) flow requirements and also to transfer water, then the pumping hours of the Pumped Storage Scheme may be extended to deliver up to 3 million m^3 of additional water per week from Kogelberg Dam into Rockview Dam. This water can be released during the week into the Upper Steenbras Dam via the Department of Water Affairs and Forestry's 12 m^3/s canal, and the City of Cape Town's conduit.

A2.2 Steenbras Scheme (Figure A2)

The Upper and Lower Steenbras Dams are both situated on the Steenbras River and are the main storage units of the Steenbras Scheme which is wholly owned by the City of Cape Town.

A2.2.1 <u>Upper Steenbras Dam</u>

The Upper Steenbras Dam stores water from its own catchment as well as water transferred by the Palmiet Pumped Storage Scheme. It also serves as the headrace dam of the 160 Megawatt Steenbras Pumped Storage Scheme which is owned by the City of Cape Town's Electrical Engineering Department.

Water from the Upper Steenbras Dam can be released to the Lower Steenbras Dam and conveyed to the City's Faure Water Treatment Works. In the latter case, the water is delivered to the Lower Reservoir of the Steenbras Pumped Storage Scheme allowing the generating hours of this Scheme to be extended. From there it is pumped to the City's 500 Mℓ/day Faure Water Treatment Works (which mainly treats water from the Riviersonderend Berg River Government Water Scheme) via the Firlands Pump Station and a steel pipeline with a capacity of 300 Mℓ/day.

A2.2.2 <u>Lower Steenbras Dam</u>

The Lower Steenbras Dam supplies water to the 150 Mℓ/day Steenbras Water Treatment Works. From there, the three Steenbras Pipelines normally convey water by gravity to the higher lying zones of the City of Cape Town. However, the combined capacity of the pipelines can be increased to 160 ℓ/day with booster pumps on two of the pipelines.

A2.3 Wemmershoek Scheme (Figure A3)

The Wemmershoek Scheme is also owned by the City of Cape Town. It comprises the Wemmershoek Dam, the 270 Mℓ/day Wemmershoek Water Treatment Works and the Wemmershoek Pipeline which delivers water to the City and also to the branch pipeline supplying the towns of Paarl and Wellington of the Drakenstein Municipality. The Wemmershoek Water Treatment Works can also be supplied with 140 Mℓ/day of water via a pipeline connection from the Theewaterskloof Tunnel at the Berg River Siphon.

A2.4 Voëlvlei Government Water Scheme (Figure A4)

A2.4.1 <u>Voëlvlei Dam</u>

Voëlvlei Dam is an off-channel dam with a small catchment area of only 38 km^2. The main inflows are provided by two diversion canals:

- A weir on the Klein Berg River diverts water during the winter months into the 8 km long canal with a capacity of 20 m^3/s.
- Weirs on the Twenty-Four Rivers and on the Leeu River divert up to 34 m^3/s into the 29 km long canal to fill Voëlvlei Dam during the winter months and supply irrigators during the summer.

The City of Cape Town's 270 Mℓ/day Voëlvlei Water Treatment Works is supplied directly from the dam via a low lift pump station. A high lift pump station delivers water to the City via the 80 km long Voëlvlei prestressed concrete pipeline. A few small users abstract water from this pipeline.

Water is pumped from the outlet of Voëlvlei Dam to the 30 Mℓ/day Swartland Water Treatment Works of the West Coast District Municipality. From there the water is distributed to various towns.

Water is also released from the dam into a canal which flows into the Berg River to supply water to irrigators during the summer months and to supply the West Coast District Municipality's Withoogte Water Treatment Works which abstracts water at Misverstand Dam.

A2.4.2 <u>Misverstand Dam</u>

Misverstand Dam does not form part of the Voëlvlei Scheme, however its operation is directly linked to the releases from Voëlvlei Dam. The dam has a storage capacity of 7 million m^3, but this is not utilized as it is necessary to maintain the level at about 0,3 m below full supply level in order to prevent cavitation of the pumps at Withoogte.

The main purpose of Misverstand Dam is to divert water to the West Coast District Municipality's pump station which delivers water to the 72 Mℓ/day Withoogte Water Treatment Works and thence to the Vredenberg/Saldanha area. The dam also provides some regulation of the summer releases from Voëlvlei Dam which are re-released at Misverstand to downstream irrigators.

A2.5 Riviersonderend-Berg River Government Water Scheme (Figures A5 and A6)

The Riviersonderend-Berg River Government Water Scheme comprises Theewaterskloof Dam, the Riviersonderend-Berg River Tunnel System and Kleinplaas Dam. The Scheme supplies irrigators in the Riviersonderend, Berg and Eerste River catchments, and also the City of Cape Town, Stellenbosch and Overberg Water.

A2.5.1 Theewaterskloof Dam

Theewaterskloof Dam is the largest storage dam of the Western Cape Water System. It is filled by runoff from its own catchment and by the diversions during the winter months of the Wolwekloof and Banhoek Rivers into the Riviersonderend-Berg River Tunnel System. In future it will also receive water pumped during the winter months from the proposed Berg River Dam at Skuifraam.

The main irrigation demands from Theewaterskloof Dam comprise the following:

- Direct abstractions from the dam by riparian irrigators and releases into the Riviersonderend River for downstream irrigators and Overberg Water.
- Releases via the Riviersonderend-Berg Tunnel System to irrigators in the catchments of the Berg and Eerste Rivers and for the City of Cape Town.

A2.5.2 The Riviersonderend-Berg River Tunnel System

The Riviersonderend-Berg River Tunnel currently conveys water from the Wolwekloof and Banhoek winter diversions (and in future water pumped from the Berg Water Project Dam) into Theewaterskloof Dam and abstracts water from the Dam to supply users as follows:

- The Upper Berg River irrigators are currently supplied with releases at the Berg River Siphon (where the tunnel system crosses under the Berg River), but will in future be supplied with releases from the Berg River Dam at Skuifraam.
- The Eerste River irrigators from Kleinplaas Dam, and
- The Helderberg and Stellenbosch irrigators as well as the City of Cape Town and Stellenbosch Municipality via the Stellenboschberg Tunnel from Kleinplaas Dam.

A2.5.3 Kleinplaas Dam

Kleinplaas Dam is located on the Eerste River at Jonkershoek. The Dam has a very small capacity and is operated as follows:

- The water level is normally maintained at about 0,8 m below full supply level. When the level falls below this level then the three needle valves progressively come into operation and release water from the tunnel system into the dam, ie when the demands exceed the inflow from the Eerste River then water is released from the Tunnel System.
- During the summer most of the supply to the City of Cape Town and the irrigators passes through the dam.
- During the winter months a considerable proportion of the flow in the Eerste River is temporarily stored in Kleinplaas Dam and diverted to the City of Cape Town.

A2.5.4 City of Cape Town Raw Water Pipelines

The City of Cape Town operates two raw water pipelines which are connected to the outlet of the Stellenboschberg Tunnel.

- The Faure pipeline supplies the City's 500 Mℓ/day Water Treatment Works and during the summer months the Helderberg and Stellenbosch irrigators.
- The Blackheath pipeline serves the 400 Mℓ/day Blackheath Water Treatment Works.

A3. MINOR SCHEMES

A3.1 Introduction

The Main Schemes of the Western Cape Water are operated in an integrated way, whereas the Minor Schemes supply individual local authorities, limited areas of the City of Cape Town or irrigators.

A3.2 Local Authorities

Table A3 shows those local authorities that are entirely dependant on their own supplies and those that are partially dependant on the Main Schemes described in the previous sections of this Annexure.

Table A3: Local Authority Schemes

Scheme Name	Local Schemes			Main Schemes	
	Raw Water Source	Areas Supplied	Scheme Capacity million m^3/a	Scheme	Capacity million m^3/a
Paarl	Nantes Dam Bethel Dam Berg River Pumpstation	Paarl	2,8	Wemmershoek	17
Wellington	Antoniesvlei (supplementing supply from Wemmershoek)	Wellington	0,5		
Stellenbosch	Eerste River at Jonkershoek	Stellenbosch	5,5	RSE Berg	3
Piketberg	Voëlvlei Dam and Local Sources	7 750 people	1,0	Voëlvlei	
Saron	Twenty-four Rivers Canal	Saron	0,34	Voëlvlei	
Porterville	Local Sources	4 350 people	0,6		
Tulbagh	Local Sources	4 700 people	0,6		
Franschhoek	Local Sources	4 500 people	0,6		
Pniel	Local Sources	2 150 people	0,04		

A3.3 Minor Schemes Supplying the City of Cape Town

Table A4 shows the minor schemes which supply limited areas of the City of Cape Town, with augmentation from the major schemes.

Table A4: Minor Supply Schemes

Scheme Name	Raw Water Source	Area Supplied	Scheme Capacity	
			million m^3/a	limiting factor
Table Mountain and Southern Peninsula Water Supply Scheme	Hely Hutchinson Dam De Villiers Dam Victoria Damn Alexandra Dam Woodhead Dam Albion Spring	Cape Metropolitan Area	5	Raw water yield
	Kleinplaas Dam Lewis Gay Dam	Simon's Town Simon's Town	1,8	Raw water yield
Atlantis	36 Boreholes	Atlantis Mamre	6,0	Raw water yield
Somerset West	Land-en-Zeezicht Dam 4 Boreholes	Somerset West	2,0	Raw water yield
Strand	Lourens River	Strand	0,8	Raw water yield

A3.4 Other Irrigation Schemes

The irrigators can be divided into three main categories:

- Irrigators that are entirely reliant on the Main Schemes as described in Section 2 above.
- Irrigators whose quotas are partly supplied by the Main Schemes, partly by run of river flows in the main rivers and tributaries, or partly by their own storage dams.
- Irrigators that are entirely reliant on their own minor schemes such as farm dams.

The irrigation supplies are shown in Table A5 below.

Table A5: Sources of Supply to Irrigators in 2000

Water Management Area	River	Irrigators Reliant on Own Minor Schemes (million m^3/a)	Irrigators Entirely Reliant on or Partly Supplied by Main Schemes (million m^3/a)	Total Irrigation Requirements (million m^3/a)
Berg	Upper Berg Lower Berg	149 40	50 31	199 71
	Kuils, Eerste, Lourens, Sir Lowrys	21	20	41
Breede	Riviersonderend	12	44	56
	Palmiet	56	-	56
TOTAL		278	145	423

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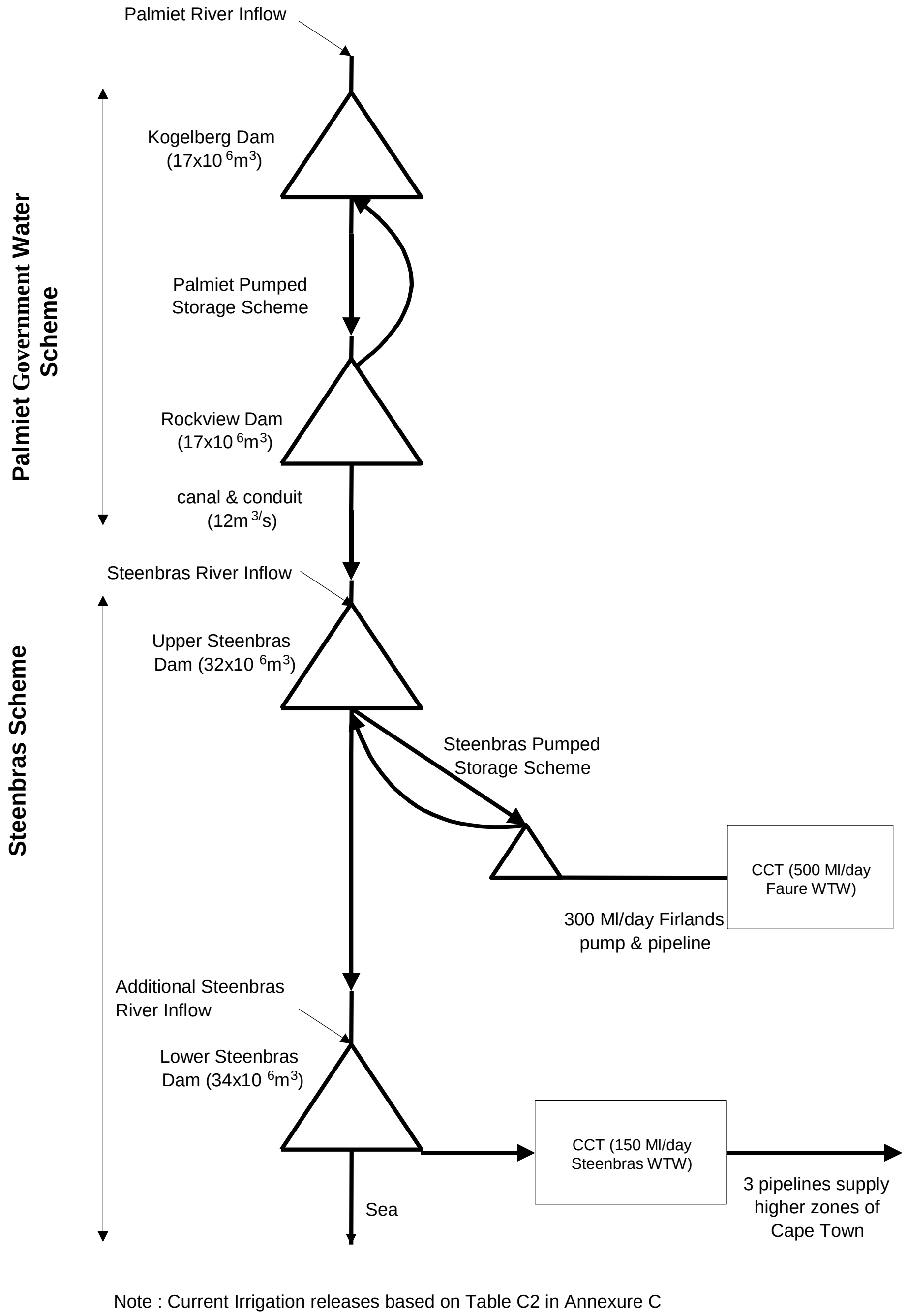
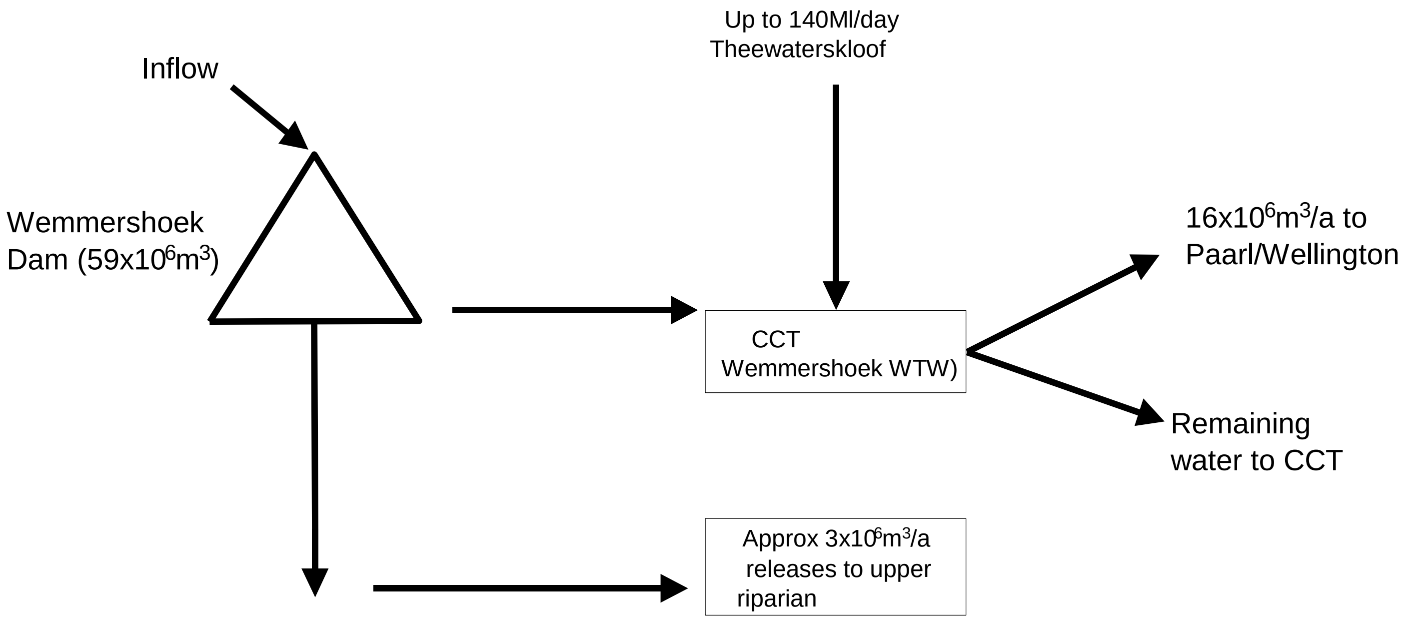
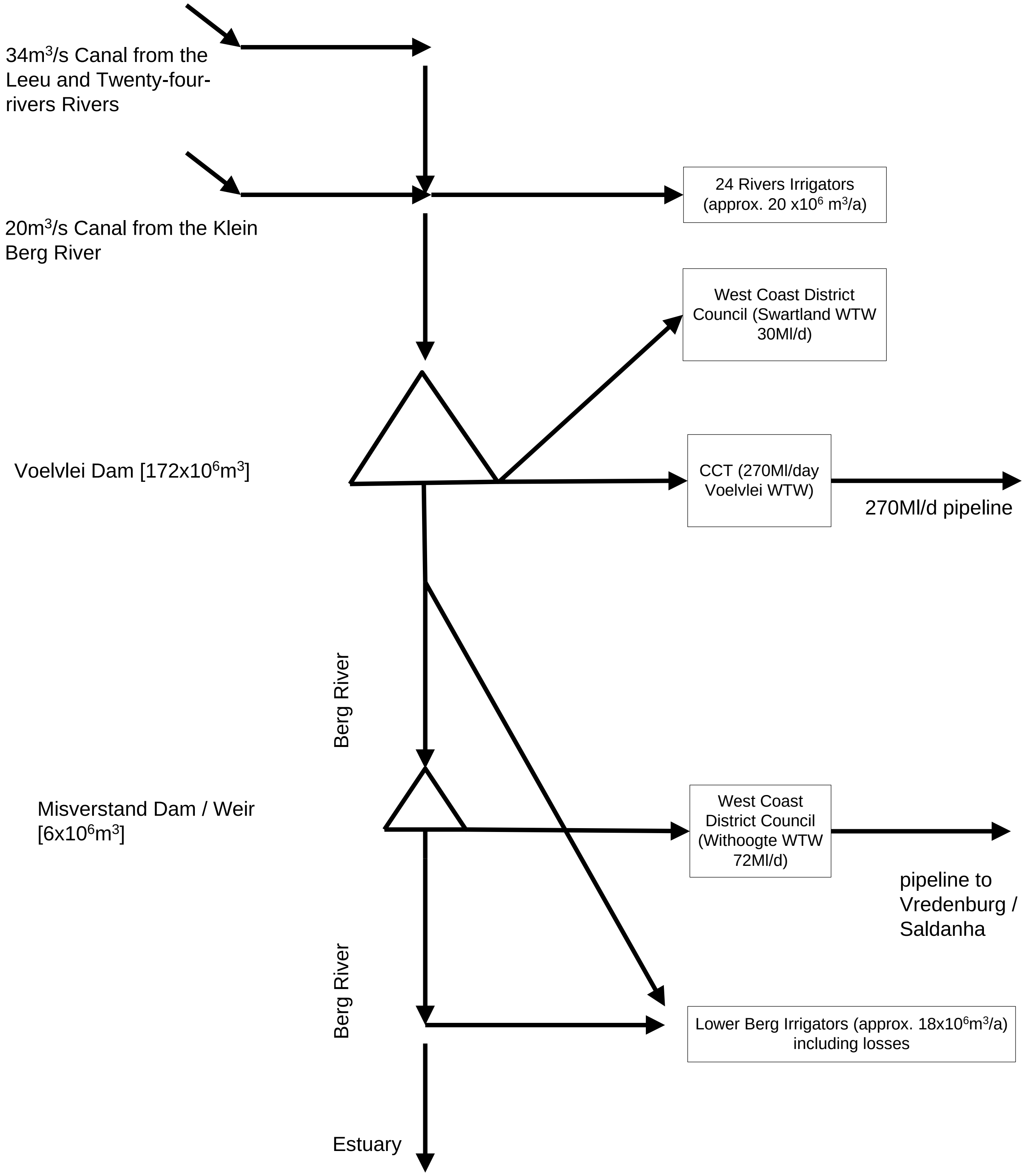


Figure A2: The Palmiet Government Water Scheme and the Steenbras Schemes



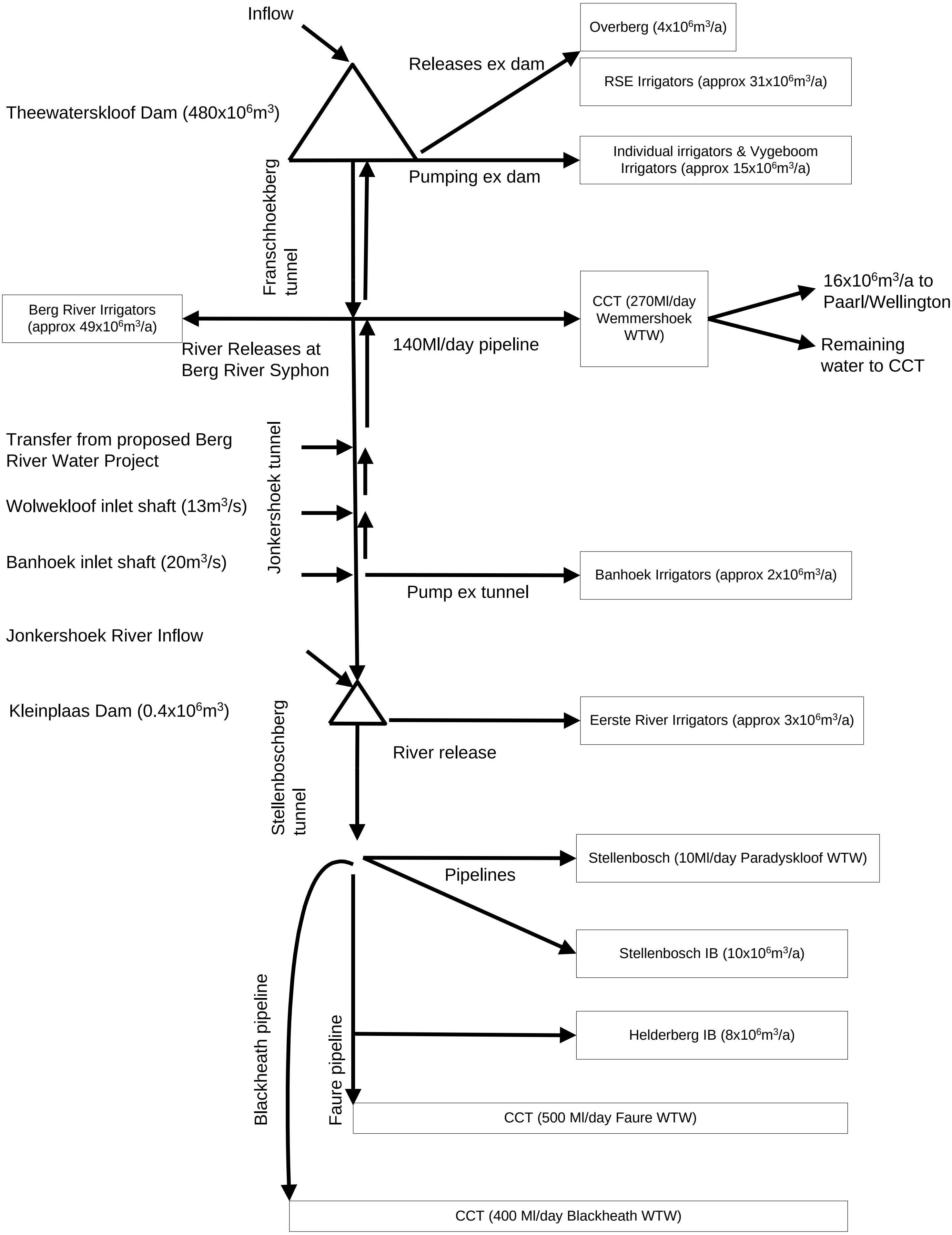
Note : Current Irrigation releases based on Table C2 in Annexure C

Figure A3: The Wemmershoek Scheme



Note : Current Irrigation releases based on second table in Annexure C

Figure A4: The Voëlvlei Government Water Scheme



Note : Current Irrigation releases based on second table in Annexure C

Figure A5: The Existing Berg River Government Water Scheme (Prior to Berg Water Project)

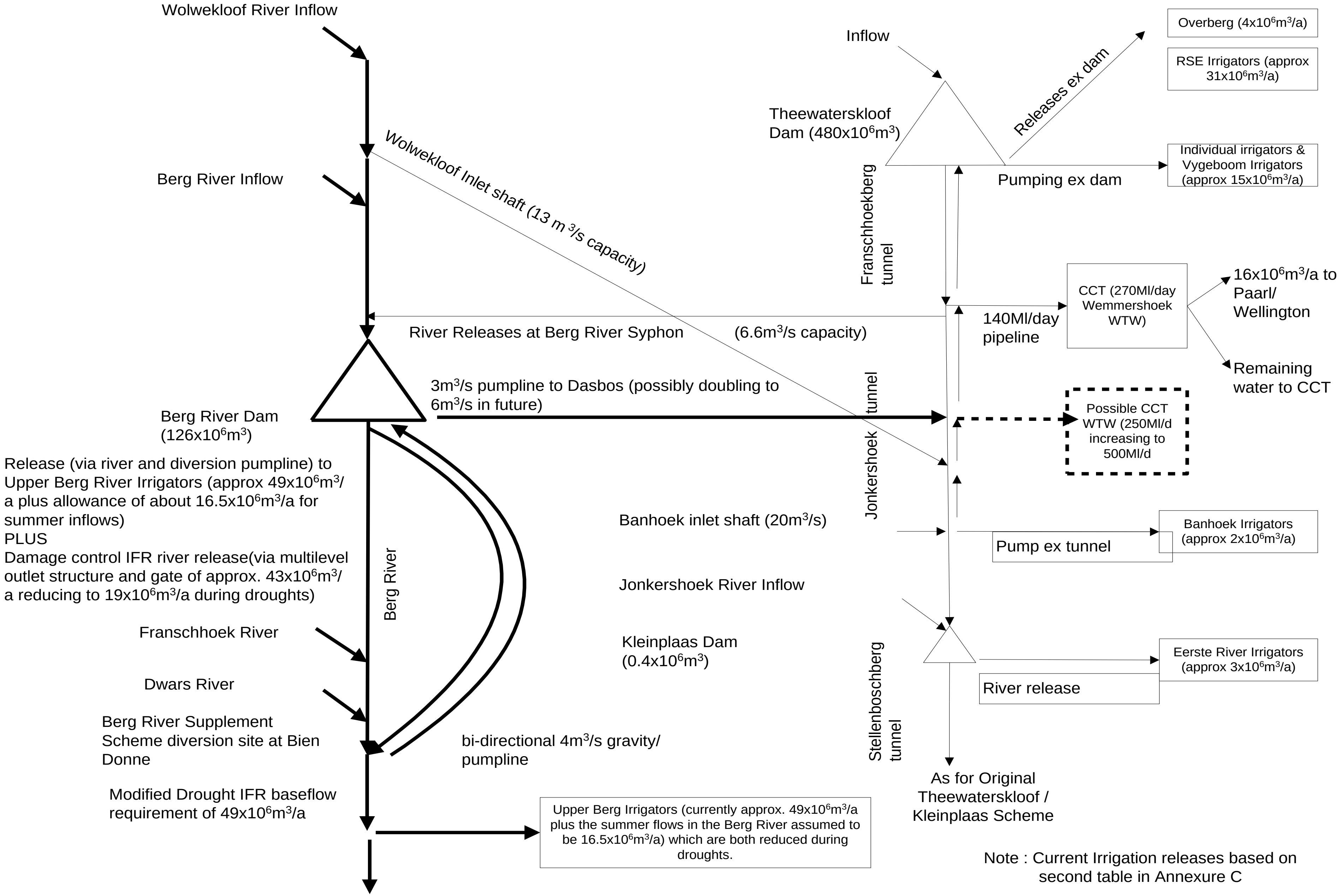


Figure A6: Proposed Berg Water Project

WESTERN CAPE WATER SYSTEM

DETAILS OF MAIN SCHEMES

Positions of schemes are shown on Figure A1

Palmiet River Government Water Scheme: Principal Features

DAMS		
Name of dam	Kogelberg	Rockview
Nearest town	Grabouw	Grabouw
Distance (km)	14	9
Owner	DWAF	DWAF
Completion date	1987	1986
Type of wall	Mass concrete arch gravity with separate earth saddle embankment	Rockfill (main embankment) Sandfill (northern embankment)
Wall height (m)	54	48 (main) 33 (northern)
Crest length (m)	850 (earth embankment) 186,0 (concrete wall)	670 (northern embankment) 1300 (main embankment)
Spillway type	Uncontrolled overflow	None
Full supply capacity ($m^3 \times 10^6$)(% MAR)	17,278	17,486
Active capacity ($m^3 \times 10^6$)	16,841	16,400
Surface area at FSC (ha)	142,6	77,8
Reduced level of FSL (m.a.s.l.)	246,0	531,0
Outlet works	1. River outlet comprising two 1200 mm diameter pipes ending in 610 mm diameter sleeve valves, with 700 mm diameter branches ending in 380 mm diameter sleeve valves, cast into the concrete wall. 2. Tailworks comprising bellmouth, control tower, twin gates and tailrace tunnels leading to pump-turbines.	1. Concrete headworks and 6,2 m diameter headrace conduit of the power system under the main embankment. 2. Two 1500 mm diameter concrete encased pipes under northern embankment.
POWER SYSTEM WATERWAYS		
Headrace conduit	6,2 m diameter steel lined, concrete encased cut and cover conduit 739 m long	
Surge tank	Cylindrical free standing concrete structure 21 m internal diameter 61 m high	
Inclined shaft	6,2 m diameter steel lined tunnel 123 m long at 55E inclination to the horizontal	
Pressure tunnel	6,2 m diameter steel lined tunnel 502 m long at slope of 1:10	
Penstock	5,4 m diameter buried steel pipe 561 m long bifurcating to two steel lined penstorck shafts 3,9 m diameter tapering to 2,6 m, one 135 m long, the other 125 m long	
POWER STATION **Pump-turbines:**		
Number	2	
Type	single-stage reversible Francis	
Rated power output at shaft per machine	203,5 MW	
Range of net head for generation using 2 machines	245,5 m to 285,6 m	
Range of pumping head using 2 machines	264,7 m to 306,2 m	

Palmiet River Government Water Scheme: Principal Features (continued)

GENERATOR MOTORS	
Number	2
Continuous rating of each machine of for generation	200 MW at 0,8 power factor
Rated voltage	16,5 Kv
Rated MVA	250,00 MVA
Speed	300 r/min
Tailrace tunnels	Two concrete lined tunnels of 5 m internal diameter, one 84 m long and the other 57 m long
OPERATING DATA	
Generation energy equivalent to 15 $m^3 \times 10^6$ capacity of Rockview Dam	approx. 10 GWh
Time required to pump 15 $m^3 \times 10^6$ of water from lower to upper reservoir	approx. 32 hours
Average pumping capacity	approx. 130 m^3/s
Average generating flow at full load	approx. 165 m^3/s
Operational cycle	weekly
Cycle efficiency	77,9%
ROCKVIEW/STEENBRAS CANAL AND CHUTE/PIPELINE	
Capacity	12,0 m^3/s
Length	approx. 3,4 km

Steenbras Scheme: Principal Features

Name of dam	Lower Steenbras	Upper Steenbras
Nearest town	Gordon's Bay	Gordon's Bay
Distance (km)	9	13
Completion date	1921, 1928*, 1954*	1977
River	Steenbras	Steenbras
Catchment area (km^2)	68,6**	29,7
Type of wall	Concrete gravity/arch	Earthfill
Wall height (m)	28	34
Crest length (m)	389	550 & 390 (Two embankments)
Spillway type	Uncontrolled overflow	Uncontrolled overflow
Full supply capacity (m^3 x 10^6)	33,725	31,770
Active capacity (m^3 x 10^6)	33,725	26,26
Surface area at FSC (ha)	370	263
Reduced level of FSL (m)	346,5	370,0
Outlet works	Octagonal concrete tower located 700 m from the dam wall. One 610 mm dia and two 762 mm dia scours are located in the dam wall. An 813 mm dia cement mortar lined steel pipe runs from the outlet tower through a tunnel to the treatment plant.	1. Concrete outlet tower with 1225 mm dia cement mortar lined steel pipe encased in reinforced concrete passing beneath the embankment. 2. Pumped storage scheme tunnel intake consisting of 19 m x 9 m screened bellmouth leading to a control tower with a 3 m x 4,4 m gate at the entrance to the 4,5 m diameter, 850 m long low pressure tunnel. This tunnel discharges to a high pressure shaft, tunnnel and penstock leading to the power station turbines.

Wemmershoek Scheme: Principal Features

Name of dam	Wemmershoek
Nearest town	Franschhoek
Distance (km)	15
Owner	Cape Town
Completion date	1957
River	Wemmers
Catchment area (km^2)	84,2
Type of wall	Earthfill
Wall height (m)	55
Crest length (m)	518
Spillway type	Gate-controlled discharge with chute
Full supply capacity ($m^3 \times 10^6$)	58,863
Active capacity ($m^3 \times 10^6$)	58,776
Surface area at FSC (ha)	296
Reduced level of FSL (m)	296,7
Outlet works	Circular reinforced concrete tower with two 1067 mm diameter outlet pipes and one 1067 mm diameter scour pipe in a culvert through the right flank of the dam.

Voëlvlei Government Water Scheme: Principal Features

DAM			
Name of dam	Voëlvlei		Misverstand Weir
Nearest town	Gouda		Piketberg
Distance (km)	7		20
Owner	DWAF		DWAF
Completion date	Raised 1970		1977
River	Off channel storage		Berg
Catchment area (km²)	31		3967
Type of wall	Earth embankment		Central arch portion Straight gravity on sides
Wall height (m)	9,7		23,4
Crest length (m)	2905 m (north embankment) 1073 m (south embankment)		153,93 m (spillway) ± 200,0 m (total)
Spillway type	None		Ogee
Full supply capacity (m^3 x 10^6)	172,168		7,737
Active capacity (m^3 x 10^6)	164,095		5,2
Surface area at FSC (ha)	1573		255,24
Reduced level of FSL (m)	79,33		26,13
Outlet works **Outlet capacity**	Rectangular reinforced concrete outlet tower and 2 m diameter concrete lined tunnel Limited by delivery pipeline (273 Mℓ/day)		
DIVERSION WORKS	Klein Berg River	Twenty-four Rivers	Leeu River
Weir type	Hollow buttress	Mass gravity	Slab buttress
Max. height of overflow section (m)	4,1	5,9	
Structure length (m)	126	90	
Canal type	Concrete lined parabolic	Concrete lined trapezoidal	Concrete lined trapezoidal
Length (km)	8,2	29,0	
Capacity (m^3/s)	20,0	34,0	18,4

Riviersonderend/Berg River Government Water Scheme: Principal Features

STORAGE RESERVOIRS				
Name of dam	Theewaterskloof		Kleinplaas	
Nearest town	Villiersdorp		Stellenbosch	
Distance (km)	10		8	
Owner	DWAF		DWAF	
Completion date	1980		1981	
River	Riviersonderend		Jonkershoek	
Catchment area (km^2)	500		31	
Type of wall	Earthfill		Composite concrete gravity /rockfill	
Wall height (m)	37,5		21,5	
Crest length (m)	646		345	
Spillway type	Uncontrolled side channel		Uncontrolled overflow	
Full supply capacity (m^3 x 10^6)	480,406		0,376	
Active capacity (m^3 x 10^6)	480,19 432,176 (above tunnel outlet)		0,358	
Surface area at FSC (ha)	5082		7,6	
Reduced level of FSL (m)	308,5		267,0	
Outlet works	1. Octagonal reinforced concrete tower and pipe and culvert under embankment. 2. Concrete inlet/outlet structure to tunnel system.		Outlet works in concrete wall comprising two river discharges and a connection to a conduit leading to the Stellenboschberg Tunnel Portal.	
DIVERSION WEIRS				
Name of weir	Wolwekloof		Banhoek	
Maximum height of weir	8,7 m		11,5 m	
Spillway crest level	335,5 m		434,0 m	
Diameter of shaft to tunnel system	4,0 m		1,8 (upper 80 m) 8,0 (lower 80 m)	
Length of shaft	70 m		160 m	
Diversion capacity of shaft with water weir FSL	22,0 m^3/s		16,4 m^3/s	
TUNNELS				
Name of tunnel	Franschhoekberg	Jonkershoek	Dasbos	Stellenboschberg
Length (km)	12,0	22,6	4,8	5,0
Internal dimensions	3,96 x 4,27 m horseshoe	4,3 & 3,5 m dia.	3,5 m dia.	3,5 m diameter
Design capacity (m^3/s)	33,5	27,4 and 13,3	14,1	15,7
PIPELINES	**BERG RIVER SIPHON**		**STELLENBOSCHBERG/ BLACKHEATH**	**STELLENBOSCHBERG OUTLET/FAURE (PROPOSED)**
Length	200 m		17,8 km	12 km
Diameter	3,5 m		1,5 m	1,8m/1,7 m
Capacity	33,5 m^3/s		5,15 m^3/s	11,6 m^3/s

PROJECT DESCRIPTION OF THE BRVAS

The BRVAS Project involves the pumped abstraction of winter water from the Berg River once the ecological water requirements of the river and the estuary have been met and consists of the following:

- the pumped abstraction of water in winter from the Berg River to increase the yield of the Voëlvlei Dam by approximately 23 million cubic metres per annum;
- a low-level weir and pump station is proposed to be located at the Lorelei site on the Berg River; and
- a 6.3 km long pipeline to deliver the water into the dam. The pipeline will be designed for reverse operation during summer so that releases can be made from the Voëlvlei Dam to the downstream users, including meeting ecological water requirements of the estuary.

PROJECT LAYOUT OF THE BRVAS [INSERT PROJECT LAYOUT]