ANNEXURE C

OPERATING RULES

This Annexure describes the operation of the main components of the Western Cape Water System that have already been described in Annexure A.

C.1. OPERATION OF THE INTEGRATED SYSTEM

The main storage dams are the Theewaterskloof and Voëlvlei Government Water Scheme Dams; the Wemmershoek, Upper Steenbras and Lower Steenbras Dams owned by the City of Cape Town; and the Berg River Dam (see Annexure A). These will be operated in an integrated manner to maximize the stored water available for essential uses during droughts and other disasters. The effects of droughts are mitigated by minimizing spillage and wastage during the wetter years and restricting the supply to less essential uses during droughts. Various other measures have been introduced to mitigate the impact of other disasters, such as the closure of the tunnel from Theewaterskloof Dam towards Cape Town.

The Western Cape Water System is situated in a winter rainfall area which is characterised by wet winters and dry summers. The dams are filled during the wet winter months (April to September) when about 90% of the annual runoff occurs and water demands comprise only about 30% of the annual demand.

During the dry summer months (October to March) inflows to the dams are small and irrigation demands and garden watering demands in the urban areas are large. Approximately half of the storage in the dams is required to store water during the winter in order to meet the high water demands during the summer. The other half of the dam storage is required to provide long-term carry over storage for drought.

C.1.1 Minimize spillage

During the winter filling of the dams, the demands of the City of Cape Town (CCT) are shifted onto those dams that appear more likely to spill. This avoids the situation where one dam spills while there is storage available in another dam. A spreadsheet is currently used to adjust the demands on the system and to estimate the probability of the system spilling.

The City of Cape Town has co-operated to help minimize spillage by:

- Introducing additional capacity in its water treatment works and bulk water pipelines to enable flexibility in the allocation of the demands on the different dams and to provide interconnectivity between the various sources.

- Reducing the demands on their own dams (Wemmershoek and Steenbras) although it might be more beneficial for them to use water from their own dams preferentially and only use the other dams as backup during drier periods. However, this would increase spills and reduce the system yield.

If it seems probable that the system will spill even without the contributions from the existing Palmiet River transfer and from the transfer from the Berg River Supplement Scheme at Bien Donne to the Berg River Dam, then these transfers may be stopped to reduce unnecessary pumping costs.

C.1.2 Minimize wastage

Water demand management measures have been adopted by the Municipalities and are being used to reduce wastage and to conserve more water for drier periods. The target is to reduce the projected demand.

In the agricultural sector it is proposed that Water User Associations and Irrigation Boards ensure that accurate meters are installed on all their members' pumping schemes and that these are calibrated every five years. Savings are encouraged if water is charged per m^3 consumed, though an additional availability charge may be necessary to ensure that irrigation rights are taken up or sold. All consumers must pay water resource management charges on their total registered use, while those consumers that receive releases from storage or who abstract stored water during summer (October to March) must pay additional scheme related charges in accordance with the Department of Water and Sanitation's Raw Water Pricing Strategy.

The Municipalities monitors urban consumption on a monthly basis and agricultural consumption should be monitored by DWS and compared with the allocated demands to identify excessive demands, which may not be sustainable for the entire season.

C.1.3 Restrict demand

One of the main principles for optimising the operation of the WCWS is that supplies to users should be progressively restricted during periods when supplies are reduced by droughts or when the demands outgrow the supplies before additional source of supply is commissioned.

The water storage in the system is evaluated towards the end of the wet season (September to November), to assess whether supplies must be restricted to ensure that sufficient water remains during droughts for the more essential uses such as basic human needs and industry.

The Water Resources Planning Model (WRPM) of the Western Cape Water System is normally run annually on the 1st November, but sometimes earlier using the current system storage and the latest demand projections to determine if restrictions will be necessary in the coming year. The model also forecasts a set of storage trajectories for the coming year under different inflow scenarios (median and above / below average inflow conditions) and indicates the different levels of restrictions that should be imposed. If restrictions seem likely the matter is discussed at a meeting of the Western Cape Planning Model Committee, comprising DWS and all the major urban and agricultural stakeholders.

If the Committee agrees that it is necessary to impose water restrictions, the Minister will decide and impose the restrictions. DWS is responsible for informing all users what their allocations will be from the various Government Water Schemes and for ensuring that all users comply with the restricted allocations imposed on them. Such restrictions will apply until the Committee deems that they can be lifted, whereafter the Minister will decide and announce the lifting of restrictions. This decision will be conveyed to the users by DWS.

The levels of restrictions to be imposed on the various users will depend on the allocations and assurances of supply i.e., 97% for domestic and industrial users (100% for 90% of the time and 70% for 10% of the time) and 91% for irrigation (100% for 70% of the time and 70% for 30% of the time). The progressive curtailment of demands during droughts as modelled in the WRPM in order to correspond with these average levels of assurance of supply is then implemented.

The drought operating rules for the WCWSS are based on the principle that light restrictions should be applied more frequently and more severe restrictions less frequently. The curtailments originally determined for the Western Cape Water System for application in the WRPM are shown in Table C1.

Table C1: Original Curtailments Adopted for the Western Cape Water System.

User Category	Approximate % of total demand	Percentage of normal demand supplied at different recurrence intervals			
		1 in 10 years	1 in 20 years	1 in 100 years	1 in 200 years
Domestic	53	100	90	70	50
Industrial	19	100	100	90	60
Agricultural	28	100	75	50	20
Total	100	100	88	69	44

These curtailments levels were revised due to the difficulty in achieving these restriction levels in practice. The revised levels are shown in Table C2. (These curtailments are typical for urban and industrial supplies but provide a higher-level assurance than normal for irrigation on account of the formal agreement between the CCT and DWS which states that the irrigators will receive the same assurance of supply as the CCT until such time as the irrigators make full use of their water allocations.) The principle of applying increasingly more severe restrictions enables the abstractions from the system to be maximised while ensuring that the dams will never be emptied. In order to be able to implement restrictions successfully, it is necessary to determine the demands of each user and to be certain that each user can successfully implement restrictions, which will ensure that demands are reduced as required.

Table C2: Current restriction levels for the WCWSS.

Demand Category	Approximate % of total demand	Percentage of normal demand supplied at different recurrence intervals			
		1 in 10 years	1 in 20 years	1 in 100 years	1 in 200 years
Urban reliability components					
Urban: Domestic	47	100	88	76	57
Urban: Industrial	32	100	97	89	71
Urban: UAW	21	100	100	100	100
Urban: Overall	100		93	85	71
Agriculture reliability components					
Agricultural		100	90	70	50

Although DWS understands that the Theewaterskloof, Voëlvlei and Misverstand Dams are also used for recreational purposes, there is no formal agreement limiting the drawdown of these dams, especially during times of drought. If the dams are drawn down below 10% storage, then the effect on the fish population is discussed with the Western Cape Provincial Department of Environmental Affairs and Tourism.

C.1.4 Disaster Management

Disaster Management Plans endeavour to implement cost effective measures that reduce, to acceptable levels, the risk of potential impacts due to the disruption of the supply of water.

Once the potential impacts have been identified (e.g., sabotage, earthquake, plant malfunction) the following classes of measures can be adopted:

- Infrastructure to reduce impact (eg. provide alternative sources of supply)
- Measures to reduce probability (eg. increase security to reduce probability of sabotage and a regular maintenance program to reduce probability of a plant malfunction)

- Monitoring to reduce impact (eg. inspections and telemetry to monitor water volumes and presence of poisons)
- Contingency measures once problem is identified. (Eg If Theewaterskloof tunnel fails then impose restrictions and switch to alternative sources of supply)

The Western Cape Water System is heavily reliant on the water supplied via the Riviersonderend Berg River Tunnel from the Theewaterskloof Dam.

At present the CCT supplies about 900-1100 Mλ/day of treated water during summer and 600-800 Mλ/day during winter, so that the tunnel cannot be closed for routine maintenance during summer.

Routine closure of the tunnel during winter must be carefully planned by DWS consulting all affected parties:

i) Eerste River, Stellenbosch and Helderberg Irrigators and the Stellenbosch Municipality. To meet their needs no portion of the tunnel can currently be closed in summer.

ii) Berg River Irrigators. To meet their needs the Franschhoekberg portion of the tunnel cannot be closed during summer.

iii) City of Cape Town. Ideally the City requires notice during the preceding winter that the tunnel is going to be closed in the following winter. The city must adjust the demands on the dams to ensure that there is adequate storage in those dams supplying water while the water in Theewaterskloof Dam is unavailable. The City must also schedule the routine closure of WTW for maintenance around the tunnel closure to ensure that there is sufficient water treatment capacity.

The Berg Water Project provided an opportunity to improve the resilience of the system by:

- Increasing the storage on the Cape Town side of the tunnel. To be accessible even if the Jonkershoek and Stellenboschberg components of the tunnels failed (as opposed to the Franschhoekberg component) then this storage would have to be linked directly to the existing Wemmershoek WTW or a new WTW, as planned. The Berg River Irrigators can be supplied directly from the Berg River Dam so that if there is sufficient water in storage, they will be unaffected by the tunnel closure.

- The Berg River Dam will however not help the Eerste River, Stellenbosch and Helderberg Irrigators, if the Jonkershoekberg or Stellenboschberg portions of the tunnel fail.

C.2. OPERATION OF INDIVIDUAL DAMS

Within the broad operating framework of the integrated system, it is still necessary to take the operating requirements of the individual dams into account.

C.2.1 Voëlvlei Dam (Annexure A Figure A4)

C.2.1.1 <u>Inflows</u>

The Voëlvlei Dam is an off-channel dam supplied during the winter months (April to September) by diversions from the Klein Berg River into the Klein Berg Canal and from both the Twenty-Four Rivers and the Leeu River into the Twenty-Four Rivers Canal.

During the summer months, releases are made from Voëlvlei Dam to supply consumers along the Lower Berg River, however during winter these consumers mainly abstract water from the unregulated flow in the Berg River.

At the start of the winter the quality of the water from the Klein Berg River is poor and may contribute to the algal blooms in Voëlvlei Dam. The reasons for these algal blooms are being investigated, as is the proposal that the early winter flows should not be diverted into Voëlvlei Dam.

Voëlvlei Dam is an off-channel dam which has a full supply capacity of 172 million m³. It is owned by DWS and provides water to the CCT and the West Coast District Municipality which distributes water to local authorities and other consumers in the area of from Malmesbury to St Helena Bay. The dam`s natural catchment is only 31 km^2 in extent and provides relatively little runoff.

Misverstand Dam has a storage of 7 million m³. 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 hence to the Vredenburg/Saldanha area. The dam also provides very limited regulation of the summer release from Voëlvlei Dam which are released at Misverstand to downstream irrigators.

During winter, the weirs on the Twenty-Four Rivers and on the Leeu River divert up to 34 m^3/s into Voelvlei Dam. Similarly, a weir on the Klein Berg River, a short distance downstream of flow gauge G1H008, diverts up to 20 m^3/s of water into Voëlvlei Dam.

Water is released from Voëlvlei Dam into a canal which discharges into the Berg River downstream of Sonqwasdrift to supply irrigators during the summer months and to supply the West Coast District Municipality`s Withoogte Water Treatment Works, which abstracts water at Misverstand Dam.

Water is conveyed from the CCT`s high lift pumpstation at the Voëlvlei Water Treatment Works, which has a capacity of 273 Ml/d, to the Plattekloof Reservoir on the outskirt od Cape Town through a 80 km long, 1 525mm diameter pre-stressed concrete pipeline. A few small users abstract water from this pipeline.

Water is also released 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.

C.2.1.2 Consumers

Voëlvlei supplies some consumers directly from the dam while others are supplied via releases made into the Berg River. The Misverstand Dam, located downstream of Voëlvlei Dam, helps to regulate abstractions from the Berg River.

Direct Supply: The following consumers are supplied from Voëlvlei Dam:

- West Coast District Municipality (Allocation 4.2 million m^3/a via Swartland Water Treatment Works)
- City of Cape Town (Allocation of 70,4 million m^3/a via their own Water Treatment Works.
- Vogelvlei Yacht Club (Allocation 600 m³/a)

In-Direct Supply: The following consumers are supplied from Voëlvlei Dam with Berg River Dam allocation:

- West Coast District Municipality (Swartland Municipality (Allocation 4.0 million m^3/a via Swartland Water Treatment Works))

Supply via Berg River: The following consumers abstract releases made into the Berg River:

- West Coast District Municipality (Allocation 17.44 million m^3/a via abstractions at Misverstand Dam to the Withoogte Water Treatment Works)
- Berg River Municipality (Allocation 704 075 m^3/a)
- PPC (Allocation 835 850 m^3/a)
- Lime Sales (Allocation 73 000 m^3/a)
- Serdyn (Allocation 36 000 m^3/a)
- Lower Berg River Irrigators (Allocation 18.1 million m^3/a via releases from Voelvlei Dam and Misverstand Dam)

In-Direct Supply: The following consumers are supplied from Misverstand Dam with Berg River Dam allocation:

- West Coast District Municipality (Saldanha Bay Municipality (Allocation 6.0 million m^3/a via Withoogte Water Treatment Works))

- Berg River Estuary. In future additional environmental releases may be required to meet the reserve requirements of the Berg River Estuary.

The inlet works of the Withoogte Water Treatment Works have been modified to eliminate cavitation of the pumps when Misverstand Dam is below FSL. Misverstand can now be maintained at about 300 mm below FSL and farmers downstream of Misverstand now receive releases rather than uncontrolled spills. The releases from Misverstand will need to be measured to differentiate between the supply to irrigation and to the environment. Plans are in place to construct a low flow gauging weir below the Dam and to improve the outlet works.

Supply to Irrigators from Twenty-Four Rivers Canal: The 24 Rivers Canal also supplies approximately 20 million m^3/a to irrigators.

The releases at the Berg River Irrigation Release Works are adjusted in response to the demands of irrigators to maintain a minimum summer flow of about 0,5 m^3/s at Sonquasdrift.

C.2.2 Proposed Berg River- Voëlvlei Augmentation Scheme (BRVAS) (Annexure A Figure 1)

C.2.2.1 <u>Inflow</u>

The proposed Berg River-Voëlvlei Augmentation Scheme BRVAS) involves the transfer of 20-23 million m^3/a water from the Berg River to the existing Voëlvlei Dam in winter. The BRVAS will entail the abstraction the abstraction of surplus winter water (after provision for the Environmental Water Requirements (EWRs and downstream users) from a proposed low level diversion weir (less than 5 m high) across the Berg River and the pumping of the water via a 1.7 m diameter x 6.3 km long rising main into Voëlvlei Dam.

The components of BRVAS include:

Construction of a diversion weir and abstraction works in the Berg River including a crump weir, a soil embankment on the right bank, a canoe chute or portage facility and a pump station.

Construction of the water transfer system at a discharge rate of 4 m^3/s (i.e. pump station and 1.7 m diameter 6.3 km long pipeline). The system must allow for releases from the Voëlvlei Dam to the Berg River and downstream users, including West Coast District Municipality Water Treatment Works.

C.2.2.2 Consumers

As the additional water generated by the BRVAS will be delivered into, and operated within, the Western Cape Water Supply System on an integrated supply basis in order to maximise the yield of the system, water users will not necessarily draw their BRVAS allocation from the BRVAS itself.

For purposes of levying water use charges, the yield of the Government Water Schemes within the Western Cape Water Supply System will be allocated to users by DWS on an annual basis according to existing lawful water use or any future licencing allocations and such annual yield allocations will be communicated to the Users in writing.

If DWS implements further water resource developments which are funded off-budget, in addition to the BRVAS, DWS will enter into a written agreement with the Users for the levying of capital charges in respect of any such Government Water Scheme, provided that such agreements shall accommodate the User`s obligation to pay the BRVAS Capital Charge.

The proposed BRVAS will supply according to the allocations list.

- Berg River Municipality = 0.09 million m^3/a.
- City of Cape Town = 15.00 million m^3/a.
- Drakenstein Municipality = 0.16 million m^3/a.
- Saldanha Municipality = 3.28 million m^3/a.
- Stellenbosch Municipality = 0.39 million m^3/a.
- Swartland Municipality = 1.08 million m^3/a.
- Lower Berg River Irrigators = 3.00 million m^3/a.

C.2.2.3 Environmental Water Requirements (EWRs)

The scheme operation has been planned based on winter abstraction from the river whilst still being able to meet the downstream EWRs for the river and the estuary in both summer and winter. A 4.0 m^3/s stepped pumping rule and a 6.0 m^3/s abstraction by means of variable speed drive pumps were considered.

The proposed weir site would be located on a bend in the Bergt River which would be advantageous from a sedimentation management perspective, as well as being the only reach within this area where rock outcrops are visually evident. This is beneficial both from a weir foundation perspective as well as for the construction of the proposed pump station.