Understanding how the use and allocation of water for agricultural, industrial, and other commercial purposes contributes to economic growth will be completed through gathering of water use and production information, followed by analytical techniques including water footprinting. Economic contribution, job creation, and average income levels of jobs created per unit of water used should be considered. This information, in conjunction with stakeholder input, can be used to make long term development recommendations regarding crop types, locational distribution of water, and allocation of water between economic sectors. These recommendations should encourage economically efficient water use that is aligned with the development preferences of the community. An analysis and long term recommendations should be formed by 2015 so they can be integrated into the next CMS.

5 Strategic Area 2: Sharing Water for Equity and Development

This strategic area focuses on the equity and efficiency aspects of the CMS associated with the availability and use the water resources, to ensure that these resources catalyse and support social and economic development. The five strategic measures and associated priority actions for this first edition CMS are summarised in the following table, and are motivated and expanded upon below.

Strategic Measures and Actions to Support *Sharing Water for Equity and Development*	
#	**Action**
Strategic Measure 2-A: Water Resources Assessment	
2-A.1	Conduct verification and validation (V&V) Studies
2-A.2	Conduct the Water Availability and Assessment Study (WAAS)
Strategic Measure 2-B: Water Conservation and Water Demand Management	
2-B.1	Require demand management practices as authorization condition
2-B.2	Investigate scheme / system operation for water resource conservation
2-B.3	Implement priority alien vegetation clearing projects for water conservation
2-B.4	Implement stringent urban demand management plans (through Water Services Development Plans / Integrated Development Plans)
Strategic Measure 2-C: Water (Supply) Availability Augmentation	
2-C.1	Manage / operate selected schemes for reduced assurance of irrigation supply
2-C.2	Investigate conventional augmentation options
2-C.3	Investigate non-conventional supply sources
Strategic Measure 2-D: Water Allocation Reform	
2-D.1	Identify, develop and support HDI project opportunities
2-D.2	Authorise HDI applications from water made available
2-D.3	Revise WAR strategy once verification and validation complete
Strategic Measure 2-E: Water Allocation	
2-E.1	Authorise water according to CMS allocation principles
2-E.2	Plan and develop urban water supplies
2-E.3	Review and establish general authorisation and licence conditions in priority catchments
Strategic Measure 2-F: Climate Change Resilience	
2-F.1	Adapt existing climate change strategies to water resources resilience in the Breede-Overberg

5.1 THE CURRENT WATER USE SITUATION / STATE & CHALLENGE

The National Water Act (Act 36 of 1998) (NWA) provides the legal framework for the effective and sustainable management of the country's water resources. One of the primary purposes of the NWA is to ensure that the nation's water resources are protected, used, developed, conserved, managed, and controlled in a sustainable and equitable manner for the benefit of all.

The water resources of the Breede and Overberg rivers are under already pressure with the existing infrastructure development and water use patterns. It seems that difficult decisions will need to be made to balance the water-dependent requirements of economic development, social justice and ecological sustainability in this region. Unfortunately, the currently available information is dated, and this poses an additional complexity for decisions around water resources development and use.

Availability of Water Resources

The mean annual runoff (MAR) of the Breede River is 1904 million m^3/a, while the total MAR of the Overberg rivers is 579 million m^3/a. The incremental contribution of each management zone is presented in Table 5.1.

Table 5.1. Incremental and cumulative MAR for management zones in the Breede-Overberg.

Management Zone	Sub-catchment	Catchment area (km^2)	Incremental MAR (million m^3/a)	Loss* (million m^3/a)	Cumulative MAR (million m^3/a)
Upper Breede			878 (46%)	-56	822
Central Breede			307 (16%)	-25	1104
Riviersonderend			481 (25%)	-24	1561
Lower Breede			238 (13%)	-16	1783
BREEDE TOTAL		**12 600**	**1904**	**-121**	
Overberg West	Palmiet		267	-8	259
	Bot		97	-30	67
	Onrus		14	-3	11
	Klein		68	-11	57
	Uilkraals/Ratels		15	-6	9
		3058	461	-58	403
Overberg East		4128	97	-14	83
OVERBERG TOTAL		**7186**	**558**	**-72**	**486**

* these losses include dam evaporation and alien vegetation (and some afforestation).

These values have been derived from the existing hydrological models for the Breede and Overberg catchments, but these have not been updated with recent hydrological information. They should therefore be interpreted as approximations of the water available in these catchments.

Various studies in the Breede-Overberg area have shown that there is considerable potential to increase the availability of water in the WMA by the removal of invasive alien plants. Indications are that further substantial losses in water availability are likely should the increased spread and densification of invasive alien plants not be prevented.

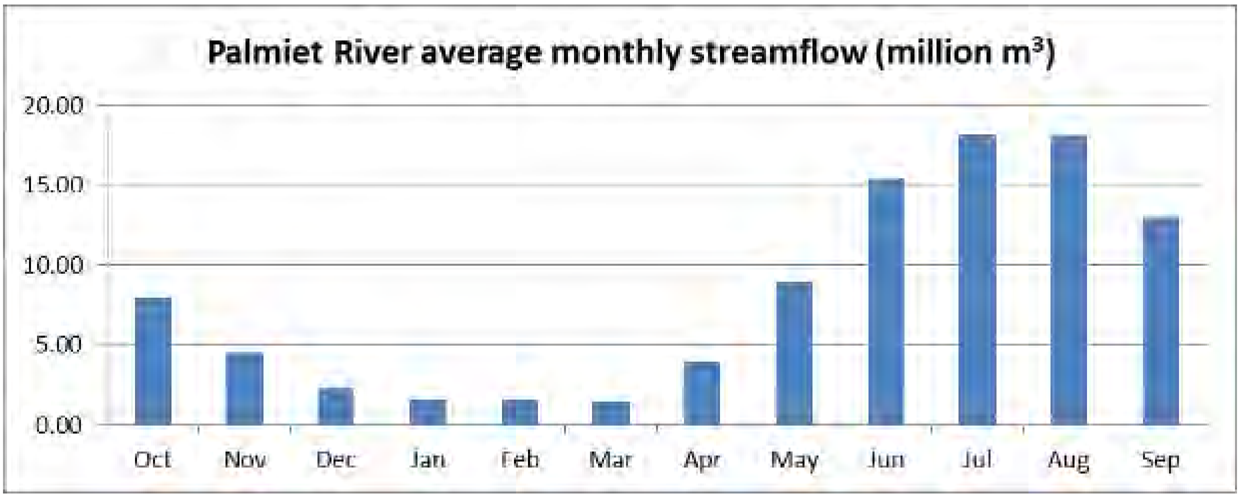


Figure 5.1. Average monthly streamflow in the Palmiet River catchment.

It is also important to recognise that the Breede-Overberg is primarily a winter rainfall region, so most of the streamflow occurs during the winter period from June to September.

Water Resources Infrastructure Development and Operation

Being in the winter rainfall area, numerous dams of various sizes are used to store winter run-off for use in summer in the Breede WMA. The Breede has been most intensively developed, with two largest impoundments being the Greater Brandvlei Dam and the Theewaterskloof Dam.

Brandvlei Dam was constructed in 1949 and was raised in 1972 and was extended by the construction of Kwaggaskloof Dam to form the Greater Brandvlei Dam. DWA owns and manages the dams. Greater Brandvlei Dam is filled mainly during the winter months with water from the Smalblaar River (i.e. the lower reaches of the Molenaars River) and the Holsloot River. During the summer irrigation period, water is released from the dam into the Breede River to supplement river flows for use by a number of downstream irrigation schemes.

Theewaterskloof Dam is owned and managed by DWA, to transfer water primarily to Cape Town and irrigation in the Berg WMA, as part of the extensive Western Cape water supply system. The purpose of the dam is to provide storage for the larger quantities of runoff that become available during the winter rainy season in the upper reaches of the Riviersonderend and by pumping through tunnels from the Berg River catchments. During the dry summer season water from the Theewaterskloof Dam can be transferred to the Berg River and Eerste River valleys.

The other major dams that are linked to urban supplies and/or irrigation schemes in the Breede catchment are presented in Table 5.2, indicating their capacity and yield - the amount of water that can reliably be supplied from the dam each year. In addition to these, there are a multitude of small farm dams operated by local farmers to augment their summer crop requirements.

Table 5.2. Major impoundments in the Breede River catchment

Dam name	Management Zone	Purpose	Capacity (million m^3)	Yield & assurance (million m^3)
Theewaterskloof	Riviersonderend	Urban / irrigation	434	204 million m^3/a
Greater Brandvlei	Central Breede	Urban / Irrigation	475	251 million m^3/a @ 95%
Ceres (Koekedouw)	Upper Breede (Ceres)	Urban / irrigation	17	17 million m^3/a @ 85%
Stettynskloof	Upper Breede	Urban	15	25 million m^3/a @ 98%
Lakenvallei	Central Breede (Hex)	Irrigation	10	7.9 million m^3/a
Roode Elsberg	Central Breede (Hex)	Irrigation	8	
Osplaas dam	Central Breede (Hex)	Urban / Irrigation	3	1.1 million m^3/a
Keerom	Central Breede	Irrigation	10	3.8 million m^3/a
Poortjieskloof	Central Breede	Irrigation	10	2 million m^3/a
Pietersfontein	Central Breede	Irrigation	2	0.7 million m^3/a
Elandskloof	Riviersonderend	Irrigation	11	13.6 million m^3/a
Buffeljags	Lower Breede	Irrigation	6	11 million m^3/a

Over time, numerous water supply schemes have been developed in the Breede River catchment. With the exception of the Lower Breede, the Breede and Riviersonderend catchments are crisscrossed by canals, pumps and pipelines supplying water for irrigation of commercial crops. Water for urban use is generally also impounded in dams and conveyed to towns by means of canals and pipelines.

About 58 irrigation boards or water user associations (primarily in the Breede catchment) administer numerous water abstraction and supply schemes of varying ages and degrees of sophistication. A large number of these irrigation boards or water user associations also manage water supply from common sources for both irrigation and urban use.

The Overberg catchments are less developed due to limited surface water available, although the western part of the Overberg (specifically the Palmiet River) is more intensively developed.

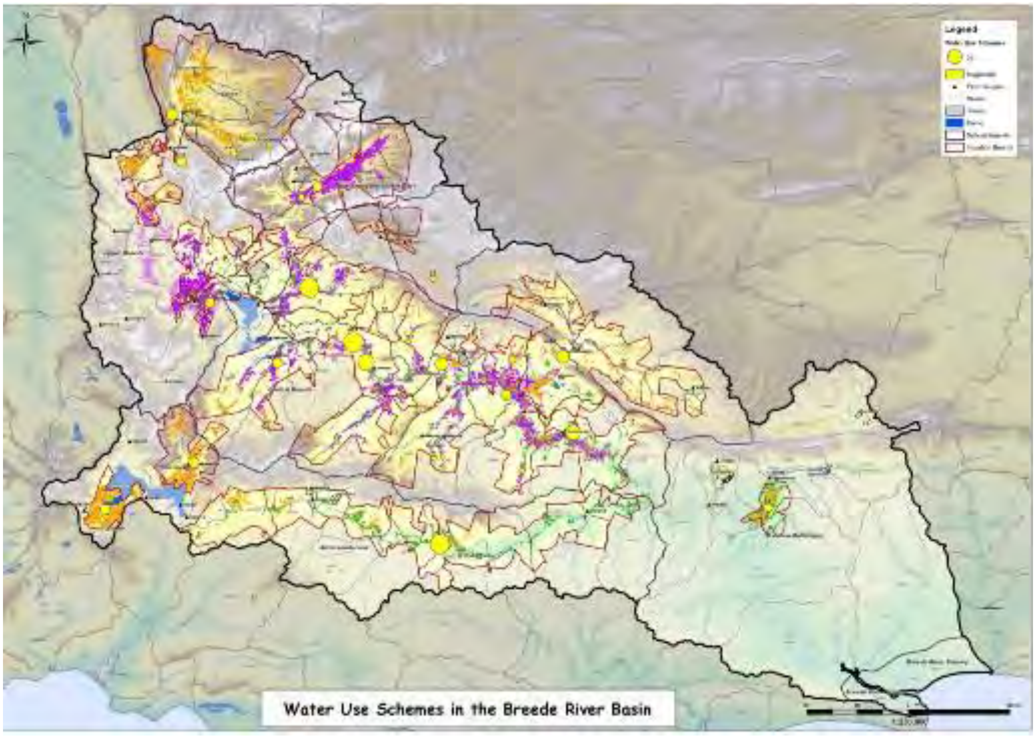


Figure 5.2. Distribution of water use schemes in the Breede River catchment.

The Palmiet pumped storage scheme comprises of two dams, the lower Kogelberg Dam on the Palmiet River and the upper Rockview Dam on the watershed between the Palmiet and Steenbras Rivers. A conduit between the two reservoirs conveys water to the reversible pump turbines on the bank of the Kogelberg reservoir. 22,5 million m^3/a of water also flows from Rockview Dam to Steenbras Dam to supplement the water supply of the City of Cape Town.

Eikenhof Dam with a storage capacity of 29 million m^3 provides water to the Groenland water user association that includes Grabouw.

The Overberg is also served by two rural water supply schemes, owned by the Overberg Water Board, namely the Rûensveld West Scheme and the Rûensveld East Scheme, which are operated by the Overberg Water Board with water supplied from Theewaterskloof Dam. The Rûensveld West water supply system supplies water to the region around Caledon, while the Rûensveld East Water Scheme supplies water to the Eastern part of the Overberg around Bredasdorp.

Current and Projected Water Use

The major demands on the Breede-Overberg WMA are from irrigation and the transfers to the Berg WMA, with relatively minor urban and industrial requirements. Independently estimated irrigation requirements are over 10 years old, and these are not consistent with the registered water use. Furthermore, anecdotal evidence indicates a significant expansion in both scheduled and unauthorised water use in the past decade.

Table 5.3. Estimates of irrigation use for the Breede and Overberg catchments.

Management Zone	Digitised data from BRBS (2000)		Stats SA (2002)	DWAF Internal Strategic Perspective (2004)	WARMS Registered irrigation use (2010)		
	Ignoring fallow	With fallow			Surface	Ground water	Total
	km²	km²	km²	million m³/a	Million m³/a	Million m³/a	million m³/a
Upper Breede	211	281	242	495	124	80	204
Central Breede	402	510	278		386	47	433
Riviersonderend	119	139	62	91	104	3	107
Lower Breede	55	69	35	72	67	4	71
Total Breede	*787*	*1000*	*744*	*658*	*681*	*134*	*815*
Overberg West			97	64	65	10	75
Overberg East			4	-	6	2	8
Total Overberg			*101*	*64*	*71*	*12*	*83*

Table 5.3 presents different estimates of irrigation for the Breede and Overberg catchments. From this is may be concluded that there is between 750 km^2 and 800 km^2 of irrigation in the Breede, of which about 600 km^2 of irrigated land is scheduled on schemes in the Breede. Using application rates of between 5000 m^3/ha for table grapes up to 8000 m^3/ha for other crops gives an estimate of irrigated water use of about 580 million m^3/a (when the fallow land is ignored), or closer to 750 million m^3/a (when fallow land is included). The problem is that no reliable estimates of current actual or legal irrigation are available, which poses a major challenge for allocation and authorisation of water use, while meeting the imperatives of economic development, social redress and environmental sustainability.

This is critical for the allocation of water, because as it indicated in Table 5.4, irrigation represents at least three quarters of all water used from the Breede and Overberg catchments, with between 5% and 10% for local urban (domestic and industrial) supply. The irrigation figures in Table 5.4 have been estimated as a combination through the synthesis of a number of diverse sources to provide a reasonable estimate of irrigation – this highlights the importance of assessing the actual situation.

The uncertainty around irrigation complicates estimation of the portion of water that is currently used by historically disadvantaged individuals (particularly emerging black farmers), in terms of the water allocation reform process; from anecdotal evidence, this seems to be between 2% and 5%. The demand for increased irrigation will primarily be couple with allocation to emerging farmers and equity schemes to provide for redress of historical inequities. This will be constrained by estimates of the water available (particularly in the winter period), the current legal use and the economically viable infrastructure to store winter water. Opportunities do exist for commercial farmers to increase irrigation where development is shared in joint venture and equity schemes. On the other hand, the projected urban requirements in the Overberg is expected to almost double in the next 10 years, while urban requirements in the Breede will increase by a quarter.

Table 5.4. Average water use from the management zones in the Breede-Overberg.

Management Zone	Irrigation+ (million m^3/a)	Urban* (million m^3/a)	Transfers out# (million m^3/a)	TOTAL (million m^3/a)
Upper Breede	138	6	11.5	143
Central Breede	400	21		421
Riviersonderend	77	2	161.5	238
Lower Breede	43	1		43
BREEDE TOTAL	**658**	**30**	**173**	**871**
Overberg West	93	7.5	23	123.5
Palmiet	*52*	*1*	*23*	*76*
Bot	*19*	*3*		*22*
Onrus	*8*	*3*		*11*
Klein	*11*	*0.2*		*11.2*
Uilkraals/Ratels	*3*	*0.3*		*3.3*
Overberg East	2	3.5		5.5
OVERBERG TOTAL	**95**	**11**	**23**	**129**

+ Irrigation was approximated from a synthesis the WARMS, Internal Strategic Perspective, Breede Basin Study and WR90.
* Urban water use information derived from the 2010 All-towns Study and includes domestic and industrial use.
# Transfers out of the Breede Overberg WMA to the Berg and Olifants-Doorn WMAs information from the 2004 ISP.

Water Balance and Reconciliation of Supply and Demand

The water balance provides an indication of the available yield of the system against the current water requirements. The purpose of the water balance is to provide a tool to reconcile the water requirements and available water to enable an understanding of where there is surplus water available for future developments, where water is in balance, and where there is a deficit.

Table 5.5 presents the estimated yield of the Breede Overberg WMA with its current infrastructure development, at a 98% assurance of supply (implying that this yield will not be provided on average only every 50 years). This differs from the MAR presented in Table 5.1, in that a significant portion of the streamflow occurs in large infrequent floods that cannot be captured by the existing water resources infrastructure. However, it is important to recognise that the water available for use in an average year would exceed these yield estimates.

Table 5.5. Estimated yield of the Breede Overberg System from the ISP (2004).

Sub-zone	Natural resources		Usable return flows		Total local yield	Transfers in	Grand total
	Surface water	Ground-water	Irrigation	Urban			
Upper & Central Breede	382	94	74	11	561	0	561
Riviersonderend	249	5	9	1	264	0	264
Lower Breede	52	4	7	0	63	14*	77
Overberg East	1	1	0	0	2	2	4
Overberg West	88	3	6	2	99	2	101
TOTAL	**772**	**107**	**96**	**14**	**989**	**1**	**990**

* This includes the 10 million m^3/a that is reserved for salinity dilution.

Figure 5.3 indicates the water balance (reconciliation) of the water availability and requirements in the different management zones of the Breede-Overberg, based on an analysis from the ISP and other studies. This highlights the degree of balance in the system under current infrastructure development, and indicates that there is little water available at current assurance of supply levels.

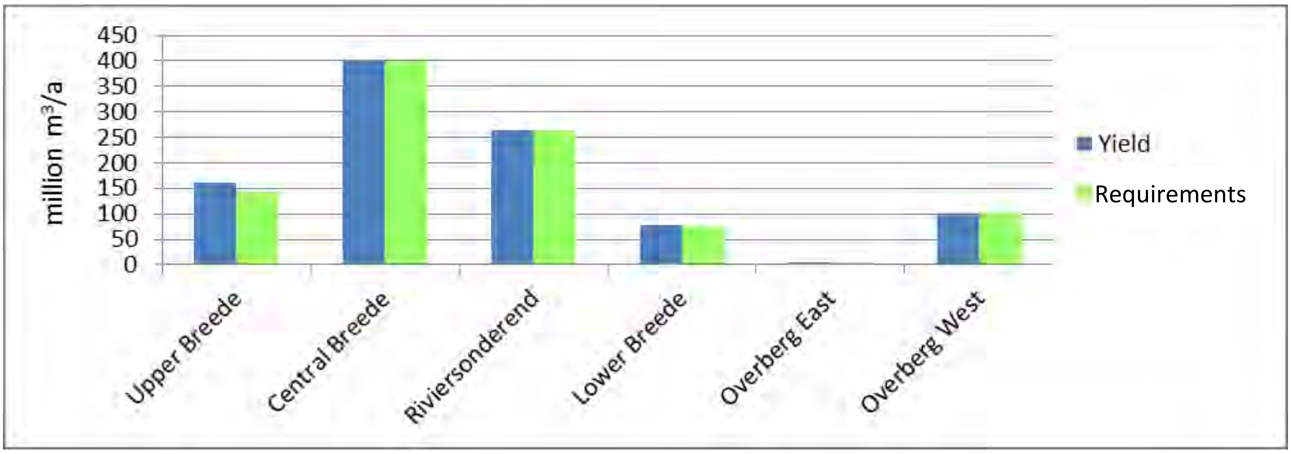


Figure 5.3. Reconciliation of water availability (yield) and requirements in the Breede-Overberg.

It is also important to note that this reconciliation does not reflect the full Reserve requirements for meeting the environmental flows in the system, as outlined in Chapter 4. Modelling of the hydrology and water requirements throughout the Breede River indicates that when environmental flow requirements are considered, there these are met in the upper and central Breede during summer and winter, but that in Riviersonderend and the lower Breede rivers, summer flows are too low and that even winter flows are too low for a portion of the time.

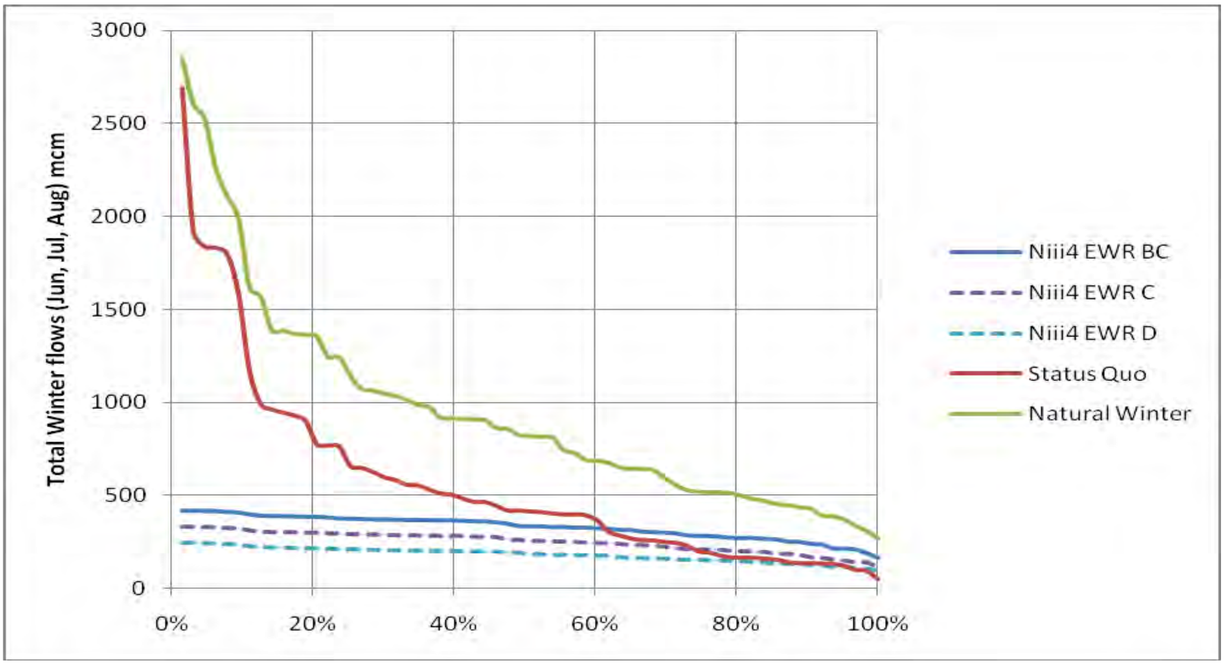
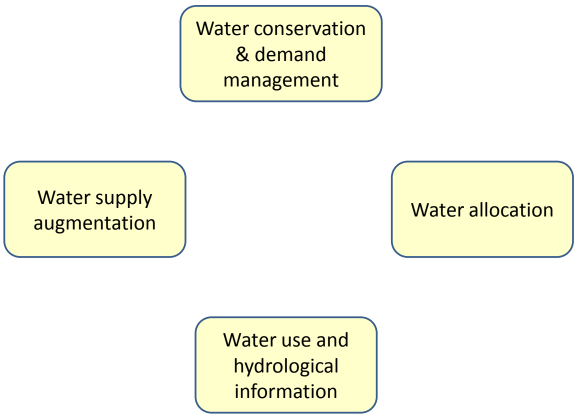


Figure 5.4. Winter period exceedance curves for naturalized and current day flows against environmental flows.

Figure 5.4 illustrates this in terms of the exceedance curves for the three winter months in Breede River just upstream of the estuary. This implies that there is water available in the more infrequent storm events in the Breede, but to be used these must be captured through the development of additional storage. The challenge is that this storage tends to be quite costly for each unit of water supplied and the limitation of reliable updated hydrological and water use information. While there seems to be some water available in some of the Overberg catchments, information is even more unreliable and the environmental flow requirements have not been determined.

The preceding discussion highlights the challenge of developing and allocating water resources to support the significant economic development (growth) and social justice (redress) imperatives, while maintaining the environmental sustainability that underlies social and economic use of these resources. This is further compounded by the uncertainty in the available information about water use and hydrology, even without considering the potential changes that may be brought about by climate variability, market forces and demographic shifts.



5.2 SOCIAL AND ECONOMIC DEVELOPMENT

Optimal sharing of the Breede-Overberg WMA's water resources to support social and economic development requires a sound understanding of how development opportunities and challenges may be influenced by water management.

Social aspects of water use

Water allocation decisions must be used to redress social inequities (while developing the economy) of the Breede-Overberg WMA. An understanding of the demographic characteristics of the region is therefore important in making these decisions.

Regional demographics

Population distribution and key demographic information will also form a backdrop when considering how to share water equitably and for social development. The information below is based on and analysis and extrapolation of the 2001 Census, the most current source available, and thus is limited in reflecting recent developments. Still, the underlying characteristics of the region have not changed substantially over the past decade.

The Central Breede had the largest population, followed by Overberg West. The five most populous towns include Worcester-Zweletemba (81 476), Caledon (33 267), Greater Hermanus (22 861), Grabouw (21 587), and Robertson / Nkqubela (21 597). Together, these towns account for about a third of the total population in the WMA. Another third of the population live in other small towns, whilst the remaining third reside in the rural areas. The Overberg had a considerably higher proportion of urban residents than the zones in the north of the WMA, most of who are located in the coastal towns. Table 5.6 outlines some of the key demographic characteristics of the Breede WMA's population.

Table 5.6. Key demographic statistics

	Upper Breede	Central Breede	Lower Breede	Riviers-onderend	Overberg West	Overberg East	Breede-Overberg WMA
Population size	86 300	203 000	26 200	31 200	142 300	26 500	515 500
Population density	43	38	9	14	36	7	25
Percentage rural	50%	25%	31%	55%	24%	17%	31%

Over the past decade, the unemployment rate ranged from 13%-17%, which is lower than the national average of 22%-25%. It is estimated that the income of 46% percent of the population is less than USD 2 per a day. As with the remainder of South Africa, these significant levels of absolute poverty coexist with highly unequal income distribution; three-quarters of the working age population earned less than the average. This indicates that even though work may be more available than in other parts of South Africa, the work is relatively low paid. Significant agricultural employment (particularly in the fruit sector) is seasonal and whilst individuals may be surveyed as being employed, they may only have work for a few months in the year, which would be reflected in a low annual income.

A critical consideration not reflected in this data is the rollout of social grants since 2001. It is likely that the proportion of the population living on less than US $2 a day observed here is overestimated as social grants have had a marked and well documented impact on alleviating poverty since 2001. Indeed, in confirming this perception many of the Integrated Development Plans cite a worrying and growing dependence on social grants.

Economic development and water use

The use of water should also be informed by water's contribution to the economy. Awareness of the role of water in economic growth first entails understanding the current state of sector contributions to the economy and regional variation in economic development, particularly the role of agriculture for the Breede-Overberg WMA. Based on this, the contribution of water to the economy can be ascertained.

Current state of economic sectors

The gross domestic product (GDPR) of the Breede-Overberg WMA was estimated to be R8.5 billion in 2004 (measured in constant 2000 prices), and may now be estimated to be about R17 billion (at 2010 prices). The primary agricultural sector accounts for 21% of economic activity, which is substantially higher than the agriculture share of the national (3.2%) and the Western Cape's economy (5.5%). The Breede and Overberg agriculture sector also has strong linkages to the secondary economy, in which value is added to primary agricultural goods through agro-processing (juicing, wine and processed fruit).

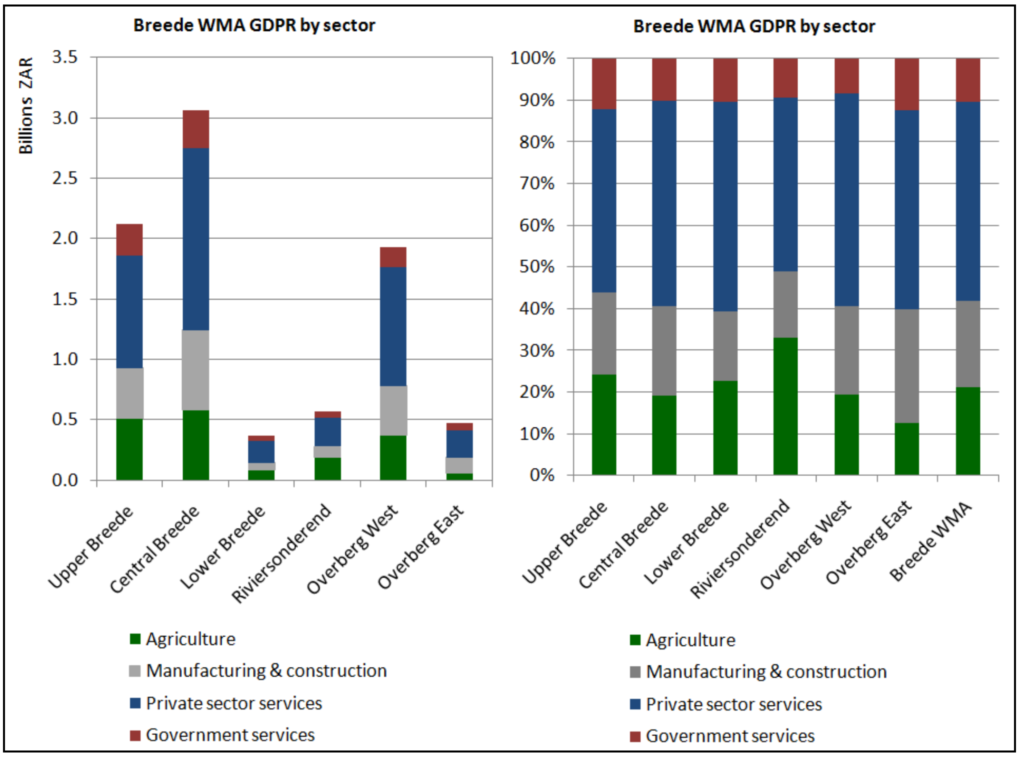


Figure 5.5. Regional gross domestic product in the Breede-Overberg WMA by sector

Private sector services, which account for almost 48% of economic activity in the Breede-Overberg WMA, are dominated by wholesale and retail trade, catering and accommodation, and finance and business services. These services are also strongly related to the agriculture sector because agriculture provides a base of economic activity and employment from which the rest of the economy can grow, The agriculture sector therefore supports the community that provides clients to, for example, the finance and business sectors.

Trade, catering and accommodation can be interpreted as a proxy for tourism, which is becoming an increasingly important contributor to the local economies in the Breede-Overberg WMA; namely 18% of GDPR, particularly in the southern coastal areas. Tourism in the non-coastal areas of the catchment has a strong dependence on the agriculture sector as tourists visit to taste the region's wines, stay at the guest houses and attend weddings and other events on the wine farms. On the other hand, coastal tourism and residential areas in the Overberg and Lower Breede are largely dependent upon the estuarine and marine environment, and therefore represent a small, but significant non-agricultural economy.

Regional variation

Economic activity in the WMA is not spread consistently across the six sub-catchments (see Figure 5.5). The economies of the Central Breede, Upper Breede and Overberg West are significantly greater than those of Riviersonderend, Overberg East and Lower Breede. Average per capita income for the sub-catchments does not, however, coincide with size of economy (see Figure 5.6). Although the Central Breede constitutes the largest share of GDPR, it ranks 4th out of six for its per capita income. In contrast, Riviersonderend contributes only 7% of GDPR but has the second highest per capita income.

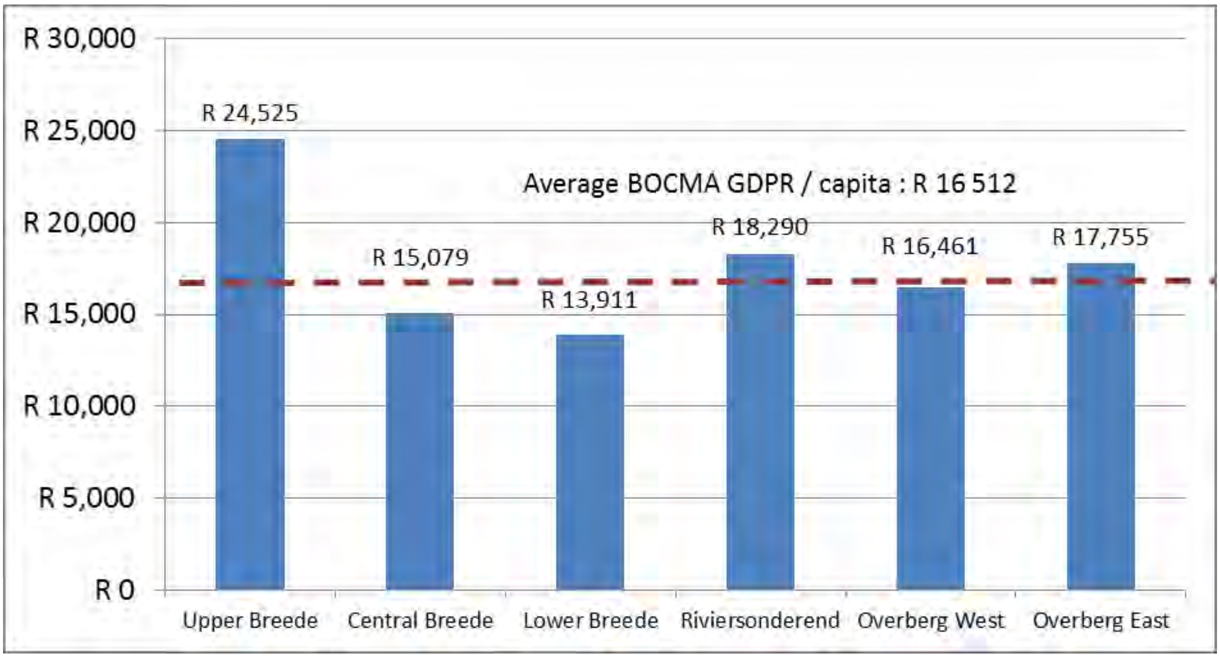


Figure 5.6. Average per capita income in each management zone (2000 prices).

Agricultural production, income and employment

The agriculture sector's significance to the economy and its dependence on water makes it imperative to understand the economics of this sector in more detail. The Breede-Overberg WMA has approximately 2 000 km^2 of agricultural land, with the gross farming income in the WMA being estimated at about R2 billion in 2000; inflation and gradual growth in the agriculture sector imply that these figures can be approximately doubled to provide 2011 gross farming income of about R4 billion. Rain fed and irrigated cereals (wheat and barley), apples, pears, peaches, wine grapes, table grapes and fodder crops constitute the majority of crops produced.

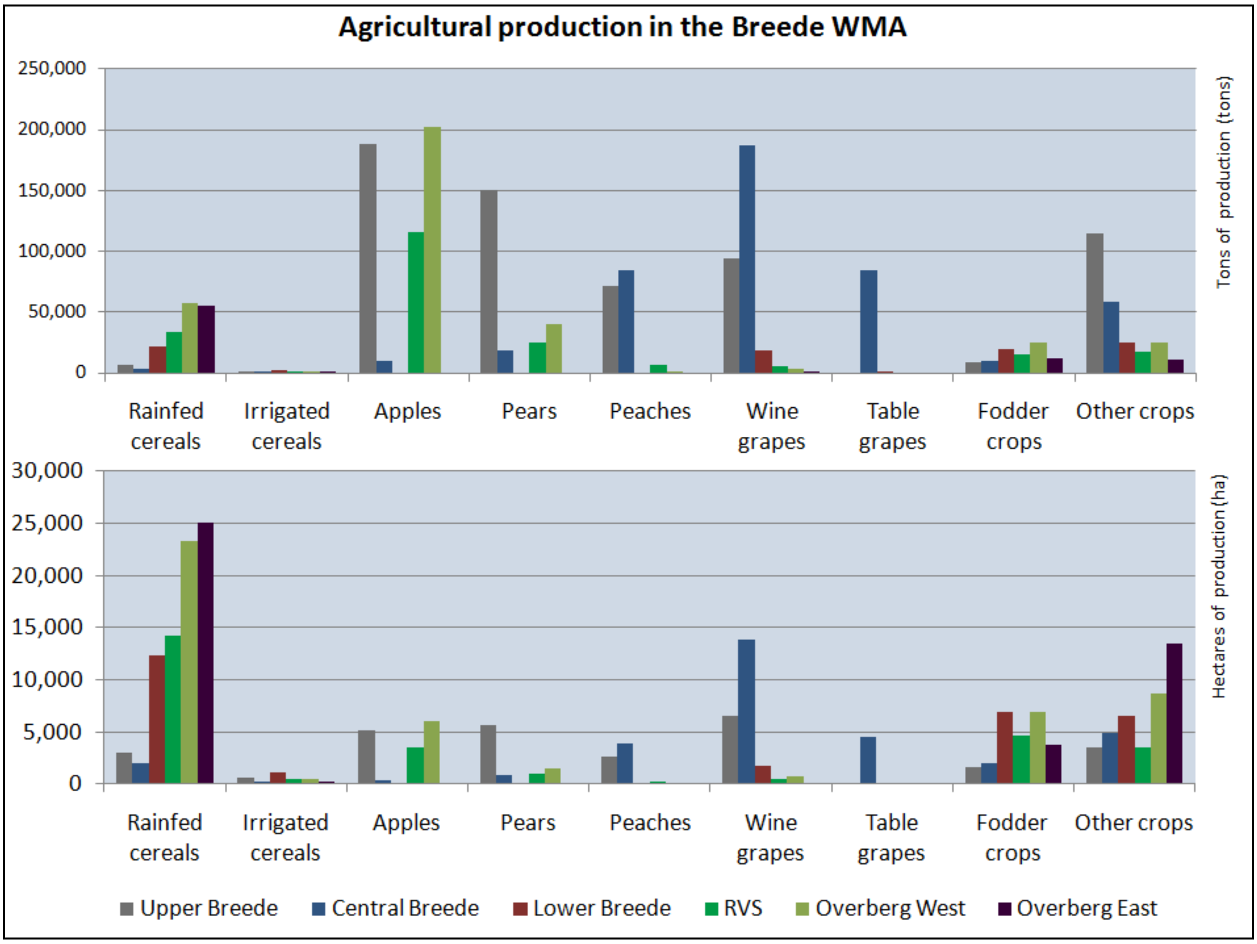


Figure 5.7. Agricultural land use areas and production levels

Rain fed cereals (barley and wheat) and fodder are grown in all six sub-catchments in the WMA and account for the greatest area of actively cultivated agricultural land at approximately 800 km^2. The majority of the rain fed cereals, however, are found in the southern sub-catchments of Riviersonderend, Overberg East and Overberg West. There is a similar area under active cultivation for irrigated crops, such as deciduous fruits and wine and table grapes, most of which is located in the Upper and Central Breede linked to irrigation schemes on the Breede River and its tributaries, with large pockets of apple production in the western parts of Overberg and the upper Riviersonderend catchment. The remainder of the agricultural land is fallow.

Understanding the economic impact of agriculture in the Breede-Overberg WMA in terms of gross farming income and direct farm employment illustrates that irrigated agriculture such as orchards and vineyards derive far higher economic value that cereals and fodder crops. This is reflected in both gross farming income and direct farm job. Thus, despite the lower cultivated area cultivated area under irrigated crops, such as deciduous fruits, wine and table grapes, these crops have a higher yield (tons produced per area of land cultivated) and contribute more than 50% of the WMA's gross farming income.

In addition to its contribution to GDPR and its linkages to the manufacturing and export sectors, agriculture plays a vital role in absorbing low and semi-skilled workers. One million Rand of agricultural activity in the Western Cape requires 21 jobs as opposed to the 15, 13 and 8 jobs that R1 million of economic activity requires in the construction, trade and manufacturing sectors respectively. Some agricultural subsectors such as deciduous fruit production are considerably more labour intensive than others and this will be reflected in higher labour absorption rates.

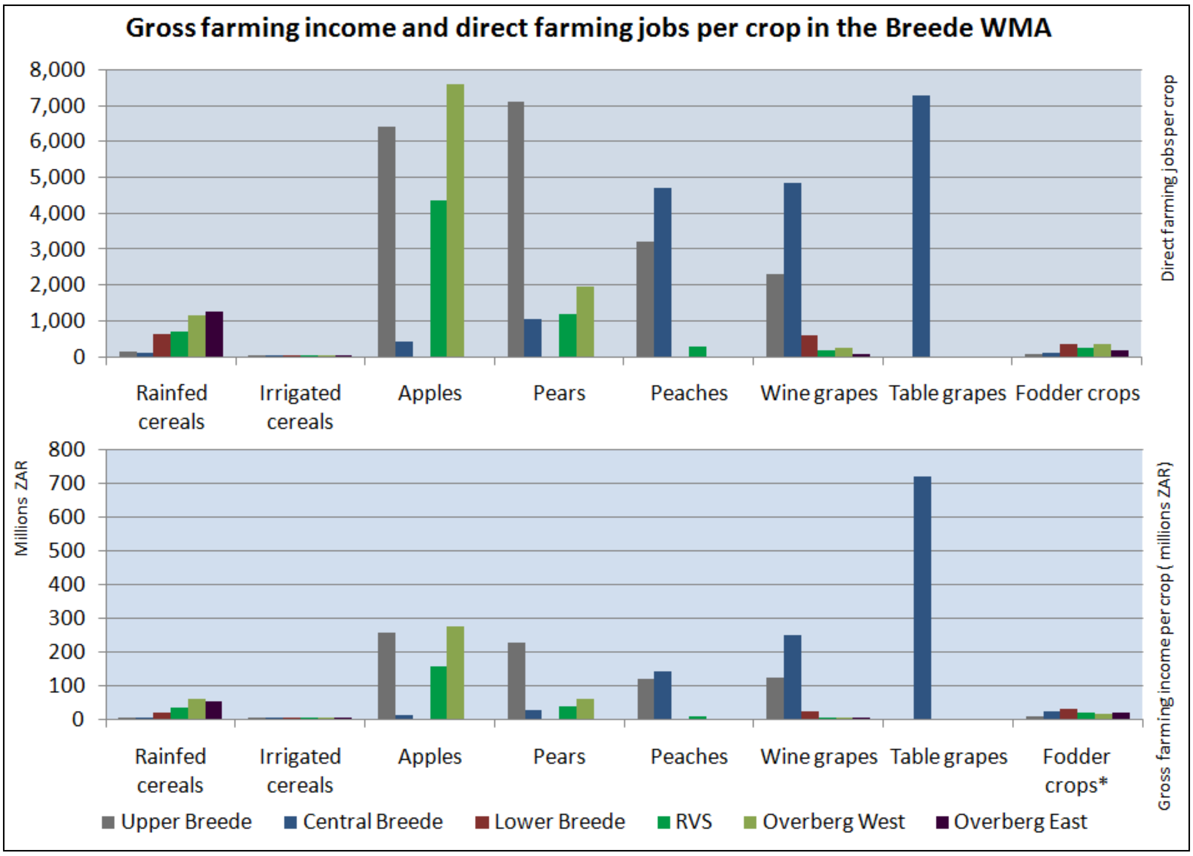


Figure 5.8. Gross farming income and direct farming jobs by crop type

The future of agricultural employment is, however, uncertain. Factors such as stagnant real growth in agriculture since 2000, a strong rand, falling profitability, concerns about worker productivity, greater mechanisation in production, issues surrounding land claims and worker housing have led to uncertainty and a falling rate of investment in commercial agriculture. This has contributed to a loss of farming jobs and migration from rural areas to the towns.

Economic use of water through footprinting

Building off of this overall understanding of the economy in the Breede-Overberg WMA, the specific role of water in the economy can be investigated. One method of analysis is to develop a water footprint, which connects economic indicators with water consumption metrics, and is therefore able to provide economic value of water indicators that can be used to assist in water planning and allocation. This economic understanding can then augment social development and ecological preservation goals.

A water footprint estimates the volume of water that is indirectly or directly used to produce a product along its supply chain. For the Breede-Overberg WMA, water footprinting was first used to compare the water consumption between economic sectors. Then, more detailed footprinting was done on the agriculture sector to compare the impact of water consumption on income and jobs supported between different sub-catchments and different crops.

This analysis captures both the blue and green components of water consumption. Blue water refers to surface and groundwater that is used in the cultivation of a crop (net abstraction less return flow), and should be the focal point of the CMA because blue water is allocated. Green water refers to the consumption of rainwater that is evapotranspirated from soil moisture.

Regional and crop type variation in economic use of water

Table 5.8 shows the total water footprint of the Breede WMA. Two trends emerge from this data. First, it is clear that agriculture (91%), and particularly irrigated agriculture (69.4%), dominate water consumption in the Breede-Overberg WMA. Second, water consumption is not equally distributed across the catchment and is highly correlated with economic activity.

The relationship between water consumption and economic activity is clear. In the same way that they dominate the economy of the WMA, the Upper Breede (270.4 million m^3), the Central Breede (289.7 million m^3) and the Overberg West (176.9 million m^3), use the major share of water consumption in the WMA. This is particularly true with blue water consumption. The ratio of blue water use to green water use in the major economic centres of the Upper and Central Breede (and to a lesser extent Overberg West) are far higher than those in the poorer, southern sub-catchments which do not have major rivers to support irrigation. Because irrigated agriculture earns more income than rain fed agriculture, and has greater knock-on effects in the secondary and tertiary economy, it is unsurprising that catchments with a higher blue water footprint also have relatively larger economies.

Table 5.8. Water footprint of the Breede-Overberg WMA (million m^3)

Million m^3	Total	Upper Breede	Central Breede	Lower Breede	RVS	Overberg West	Overberg East
Green WF*							
Rainfed crops & fodder	222.5	8.2	4.9	37.0	35.1	70.2	67.0
Irrigated crops & fodder	166.1	56.6	46.7	10.1	17.8	33.9	1.0
Green WF	388.6	64.8	51.7	47.1	52.8	104.1	68.0
Blue WF*							
Rainfed crops & fodder	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Irrigated crops & fodder	541.2	187.5	226.0	16.5	53.0	56.7	1.4
Blue WF	541.2	187.5	226.0	16.5	53.0	56.7	1.4
Total crops & fodder WF	929.8	252.3	277.7	63.7	105.8	160.8	69.4
Water for livestock**	1.6	0.0	0.5	0.1	0.1	0.6	0.3
Industrial use**	33.06	13.62	10.56	1.12	1.72	6.03	0.01
Rural	0.25	0.22	0.03	0.00	0.00	0.00	0.00
Urban	32.8	13.4	10.5	1.1	1.7	6.0	0.0
Residential**	21.5	4.4	1.5	0.6	3.0	10.0	2.0
TOTAL	984.4	270.4	289.7	65.4	110.6	176.9	71.4

*: Own calculations
**: WARMS data

When considering allocation, it is important to recognise that the water footprint will vary considerably over the course of the year both from a residential and agricultural standpoint, and peak demands must be planned for. For example, the Overberg West has a disproportionately high residential water footprint during holiday periods because it is the location of a series of coastal towns that experience a massive increase in population over peak holidays. Agricultural use of blue water will also change significantly based on season, with much of the blue water use occurring during the dry summer season.

Figure 5.9 shows the total water footprint of the main crops in the WMA and the embedded water per ton of crop. Wine grapes, apples, pears and fodder crops have the highest water footprint in the WMA.

Interestingly, deciduous fruits such as apples, pears and peaches have relatively low embedded water content per ton of crop because of their comparatively higher yield. Fodder crops, rain fed cereals and irrigated cereals have the highest embedded water content per ton of crop because of their lower yields.

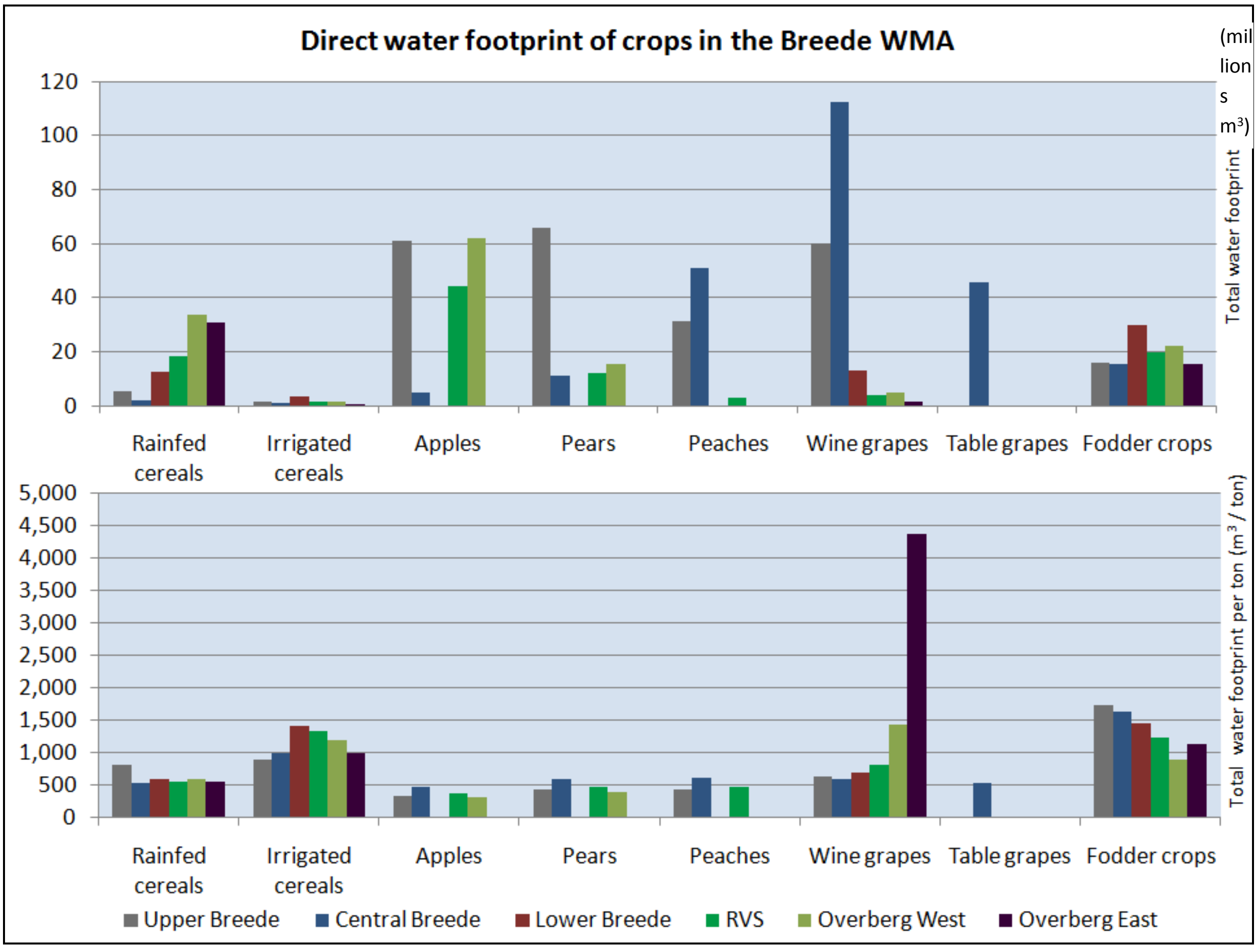


Figure 5.9. Total and per ton water footprint of crops in the Breede-Overberg WMA

Income, employment and trade impacts of water use

This understanding of water consumption by crop, and income and employment by crop, can be now linked together to illustrate water use to the economy. Figure 5.10 reveals the economic impact of water use by crop in the Breede WMAs, showing clear differences in the value and employment created between different crops. This figure represents only blue water use because water planner can influence blue water use through allocation decisions. Even when blue and green water are both considered, the key messages do not change.

Table grapes offer farmers the highest gross income per cubic meter of water followed by the other deciduous fruits of apples, pears and peaches. Interestingly, wine grapes which consume the most of amount of water in the WMA have a relatively lower economic productivity. Table grape farming and pear farming in certain areas also creates the highest number of jobs per unit of embedded water. Importantly apples, pears and peaches create significantly higher number jobs (more than 100 per a million m^3), than irrigated cereals and fodder crops (less than 40% of fruit).

Beneficiation of these crops increases the value per unit water, with the production of wine at R5/m^3 (from R2/m^3 for wine grapes), apple juice at R2.3/m^3 (from apples for R1.7/m^3) and milk at R3/m^3 (from irrigated fodder from R0.4/m^3).

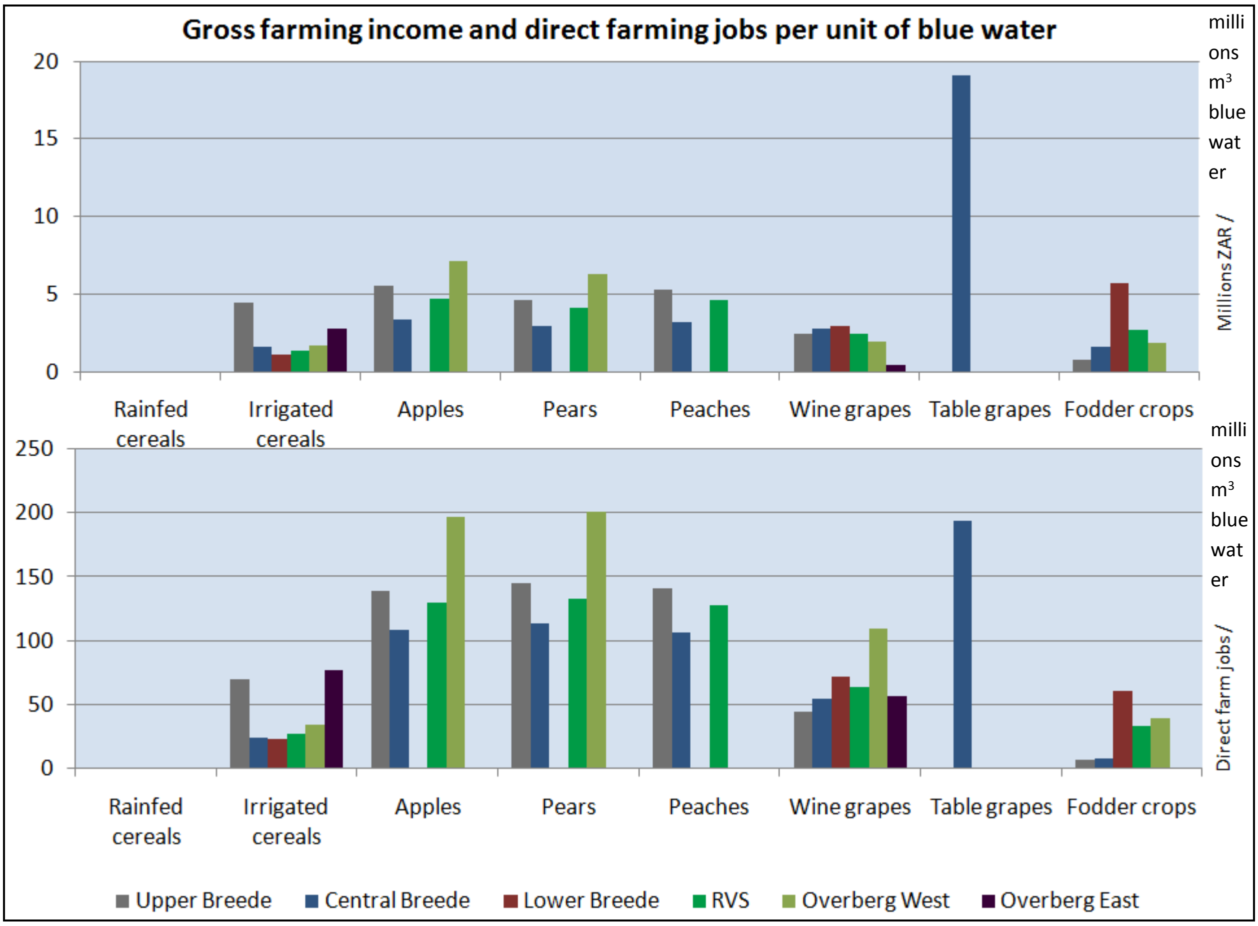


Figure 5.10. Economic productivity of blue water use in the Breede-Overberg WMA

A further consideration is the quantity of these goods that are exported from the basin. About 20% of the export value from the Western Cape as a whole is derived from agriculture. Figure 5.11 indicates the quantity of water exported from the Breede-Overberg CMA in selected crops. This highlights the importance of agricultural and food export in supporting economic inflows to the WMA and thereby the regionally and globally connected nature of this economy.

The importance of these indicators is that they can inform the water allocation process and can point to which crops grown in which locations generate higher economic returns per unit of water used. This can lead to more efficient water use and higher economic growth. For example, within a single crop type, one million cubic meters of water used in the production of apples in Overberg West creates more jobs and generates more income than one million cubic meters of water used in apple production in the Central Breede. Similarly, between different crop types, apple farming or table grape farming generates more jobs and income per a volume of water than wine grape production.

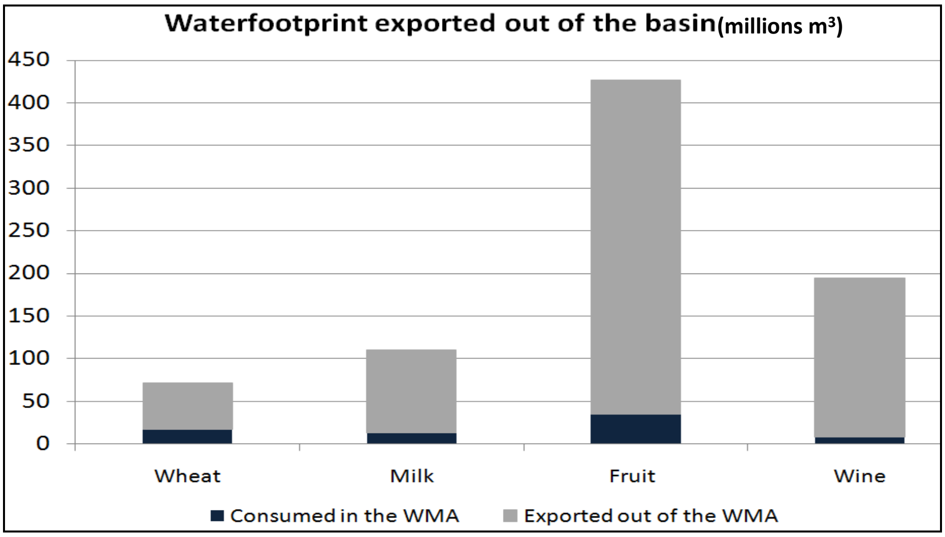


Figure 5.11. Water footprint consumed within versus exported from the Breede-Overberg WMA.

This analysis is not meant to be comprehensive or account for all factors, so allocation discussions should consider secondary and softer factors not included here. Additionally, very real limitations are introduced in that water managers do not have influence over rain fed agriculture or direct authorisation control over which crops to irrigate. However, advocacy with agricultural unions and water user associations may assist in improving these economic decisions to use water more efficiently.

5.3 Measure 2-A: Water Resources Assessment

Background and Context

It is clear that the water resources of the Breede and Overberg system are heavily utilised, but there may be opportunities to further develop the resources in some areas. Unfortunately, the modelled hydrological information on the Breede River is based on the Breede River Basin Study, which used data prior to 1990, except for the catchment upstream of Brandvlei which used data until 2000.

Apart from the Palmiet, the information in the Overberg catchments is even more uncertain, being based primarily on WR90 estimates. Similarly, no water use information is available for the past decade, which poses a challenge with the alleged expansion of water use in parts of the WMA. Making any material water resources decisions in catchments under possible stress with limited updated or reliable information poses a serious management challenge.

The water resources information must be improved in the Breede-Overberg WMA through a comprehensive assessment study, with a focus on the following areas:

- Hydrological variability, considering land use changes, recent extreme events, possible shifts related to climate variability (temperature and rainfall) and the interplay between ground and surface water.
- Irrigation water use, noting variations between different locations and seasons, as well as the legality of this water use. Irrigation water supplied from outside of controlled irrigation areas (government schemes and WUAs) is estimated to be about 25% of the total irrigation from the Breede catchment. There is some uncertainty regarding the legality and magnitude of this water use from run of river, farm dams and boreholes, but this must be clarified.

- Yield of the system in supplying water (reconciliation of hydrology and requirements), considering existing and potential infrastructure developments and the environmental flow requirements.

Management Objectives

The objective of the water use, hydrological and systems assessment will be to gain a comprehensive understanding of current water use, estimate surface and ground water availability, and to consider uncertainties such as climate change and changes in land use. This assessment will provide the basis for water allocation and water resources development decisions.

> *The Objective for Water Resources Assessment is:*
>
> - ❑ *Provide updated and reliable water resources management information to support decision making and the development of the 2nd Breede-Overberg catchment management strategy.*

Management Actions

Priority areas for verifying water use relate to existing conflicts and inconsistencies, including Upper Breede, Hex, Riviersonderend, Onrus and Bonnievale/Suurbraak. Hydrological updates and system analysis is required on the Breede and Overberg catchments. The following activities should be done as strategic interventions for water resource assessment and allocations:

➢ ***Action 2-A.1: Conduct verification and validation studies***

Milestone: Priority catchments by 2013

Roles: BOCMA in collaboration with DWA and WUAs

The process of verification and validation (V&V) of surface water and groundwater use must be started in stressed catchments. The Upper Breede Management Zone is recommended as a priority area. By undertaking both of these processes in parallel the Breede-Overberg CMA will be able to better understand how much water could be available to allocate to Resource Poor Farmers and/or to commercial irrigated agriculture and to urban use.

➢ ***Action 2-A.2: Conduct a Water Availability and Assessment Study***

Milestone: Complete by 2014

Roles: Roles: DWA in collaboration with BOCMA

A Water Availability Assessment Study (WAAS) must be done in order to update the hydrology, land use and water requirements before any new larger scale allocations of water are made from the Breede River system. Classification of the water resources is needed to refine this study. Monitoring and management of groundwater use should be done on quaternary catchment scale. Consideration of artificial groundwater recharge should be included in the management process.

5.4 MEASURE 2-B: WATER CONSERVATION AND WATER DEMAND MANAGEMENT

Background and Context

Water availability to meet the present needs and future growth in the Breede-Overberg WMA is limited. In this context it is important to use water efficiently and reduce the requirement for water by the various users. Efficient water use contributes directly to ecological sustainability, economic efficiency, social development and social equity. Most of the available water resources are already allocated to existing water users whilst some water is needed for the ecological requirements of our ecosystems, and for future growth, with special emphasis on re-allocation of water use to historically disadvantaged groups.

The implementation of water conservation and water demand management (WC/WDM) principles is essential in meeting the national goals of basic water supply and equitable water use for all South Africans and the sustainable use of water resources. One of the key thrusts of the new paradigm for water management in South Africa is the requirement for efficient water management and use.

BOCMA is the key institution responsible for the promotion of water conservation and water demand management (WC/WDM) within the Breede-Overberg WMA. It is the responsibility of BOCMA to evaluate the *status quo* with respect to WC/WDM, to establish sectoral WC/WDM strategies and policies, and to address priority areas of inefficient or uneconomical water use.

Analysis and experience indicates that implementation of WC/WDM remains more cost-effective than the development of new schemes and needs. Water conservation and demand management strategies are now required by policy, as a prerequisite to considering infrastructure-related augmentation of water supply. Attention needs to be devoted to managing the demand for water, encouraging the efficient and effective use thereof, and minimising loss or waste of water. A water conservation and demand management culture must be created amongst water users and within all water management and water services institutions.

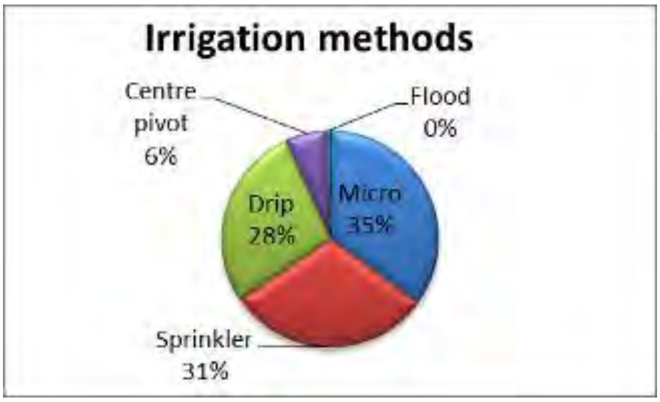
A responsible authority (currently DWA) can attach conditions to general authorisations or licences specifying management practices and general requirements for any water use, including water conservation measures and the requirement for the preparation and approval of and adherence to a water management plan. This must be encouraged for at least all larger users.

WC/WDM can be promoted and achieved in the agriculture and urban sectors through various strategies.

Agricultural water use efficiency

Irrigation in the Breede-Overberg WMA constitutes approximately 95% of the in-catchment water requirement, making this the most important sector on which to focus savings. The water available to virtually all the existing irrigation water supply schemes in the WMA is fully allocated, and agricultural water users must be encouraged to use water much more efficiently. Water thus saved could either be used to expand existing operations (an incentive to farmers) or could be re-allocated for the ecological Reserve or to Resource Poor Farmers, on a voluntary basis or in the event of compulsory licensing.

The Breede WMA has a large number of irrigation boards and water user associations. Proper local water management is needed due to the low summer flows and the need for shared storage to be built to provide water during the dry summer season. The most significant losses in this WMA are evaporation losses and conveyance losses. Some distribution canals are in bad state due to age, inadequate maintenance whilst intakes are not being restricted. Canal systems from irrigation boards on tributaries range from good concrete canals to old earth canals with high losses. Although some of these water losses seep back to the rivers, evaporation and groundwater infiltration reduce these quantities. Proper maintenance and upgrading of ageing water distribution infrastructure serving the irrigation boards and WUAs, can significantly reduce conveyance losses.



Actual irrigation technologies are, for the most part, modern and sophisticated and do not leave much room for improvement for on-farm applications. The types of irrigation systems being used according to the WARMS registration is shown in the chart on the right. These are also supported by control measures and good management typically needed for the high value crops grown in the area.

System operational efficiency

It is possible that improved management of the releases from large dams may contribute to water savings. This may be achievable through the use of short-term demand projections, taking soil moisture and crop requirements into account, with release volumes being adjusted accordingly. Relevant WC/WDM interventions for the Breede-Overberg WMA include:

- upgrading the irrigation conveyance and distribution systems to reduce losses;
- improved scheduling at irrigation schemes;
- the improved timing of releases, through for example, the introduction of short-term demand projections by farmers;
- improved monitoring of abstraction within irrigation schemes; and
- improved on-farm salinity management to reduce the dilution flushing requirements.

Urban sector water conservation and demand management

Preliminary review of towns and villages in the Breed-Overberg WMA indicate water losses (unaccounted for water) of between 30% and 40% of consumption. The opportunity to use water more efficiently in the urban sector offers local authorities a cost effective means of taking full advantage of their available water resources and avoiding the financial loss associated with unbilled water. Water resources and particularly potable water have an economic value and there are significant costs associated to its supply that can be reduced through proper water conservation mechanisms.

The Water Services Act (Act 108 of 1997) deals mainly with water services or potable (drinkable) water and sanitation services supplied by municipalities to households and other municipal water users. One of the primary objectives of the Water Services Act is the promotion of effective water resource management and conservation. Section 12 of the Water Services Act requires that every Water Service Authority prepare a Water Services Development Plan.

A Water Services Development Plan aims to progressively ensure efficient, affordable, economical, and sustainable access to water services. The Water Services Development Plan provides the platform for the Department to encourage and assist local authorities in the implementation of WC/WDM. A Water Conservation/Water Demand Management Strategy should be a component of the Water Services Development Plan of the Water Service Authority. Realistic WC/WDM targets need to be identified in the Water Services Development Plans of local authorities and progress needs to be closely monitored by the DWA and the CMA to establish its implementation success.

The urban water users within the Berg WMA (notably the City of Cape Town) are the largest beneficiaries of approximately 184 million m^3/a water transferred for urban use from the Breede catchment to the Berg WMA. The City of Cape Town is actively implementing WC/WDM through its approved 10 year WC/WDM strategy and programme. The urban water requirement within the Breede-Overberg WMA accounts for about 5% of the total in-catchment water use. More efficient water use by the urban sector should still be regarded as a priority as significant water savings can be achieved.

The All Towns Reconciliation Strategies being developed by DWA have identified WC/WDM as the most important intervention to prioritise and implement in the all towns in the Breede-Overberg WMA. These strategies contain estimates of the "unaccounted for" water in all the towns within the Breede-Overberg WMA. In some of the towns up to 30% to 40% losses of the water supplied are experienced. Water Service Authorities must set realistic targets for water use efficiency that needs to be closely monitored by the DWA and the CMA to ensure its success in implementation.

It is imperative that all of the Water Service Authorities demonstrate that they are effectively implementing WC/WDM as it is unlikely that the DWA will license any new water resource development until the existing supply is efficiently used.

As water is a scarce resource, it needs to be used in an efficient and effective manner. The objective is to ensure the optimal use of water and to minimise water wastage. This could be achieved through a number of generic interventions, namely:

- Improved efficiency
    - Efficient appliances (washing machines, toilet cisterns etc.)
    - Low flow shower heads
    - Water efficient gardens
- Loss management
    - Pressure management
    - Retrofitting and removal of wasteful devices
    - Improved management (sectorisation, metering, billing, legislation)
    - Mains replacement
    - Leak detection and repair

The WC/WDM measures should not be considered individually, but rather as a part of an overall strategy, to achieve a specific objective. Some of the larger towns within the Breede-Overberg WMA do re-use some of their treated effluent for irrigating sports fields and golf courses as an intervention to reduce the use of potable supply for these purposes. Technical assistance must be provided by DWA and the BOCMA to local authorities for managing their supply schemes and to implement WC/WDM measures, where appropriate and possible.

Removal of Invasive Alien Vegetation

Previous studies in the Breede-Overberg WMA have shown that there is considerable potential to increase the availability of water by the removal of invasive alien plants. Indications are that further substantial losses in water availability are likely should the increased spread and densification of invasive alien plants not be actively and timeously prevented. The following five quaternary catchments were found to have the highest priorities in the Breede catchment: H10E; H60B; H60A; H10D; H10K. These catchments are all located in the upper reaches of the Breede River, and are shown in Figure 5.12.

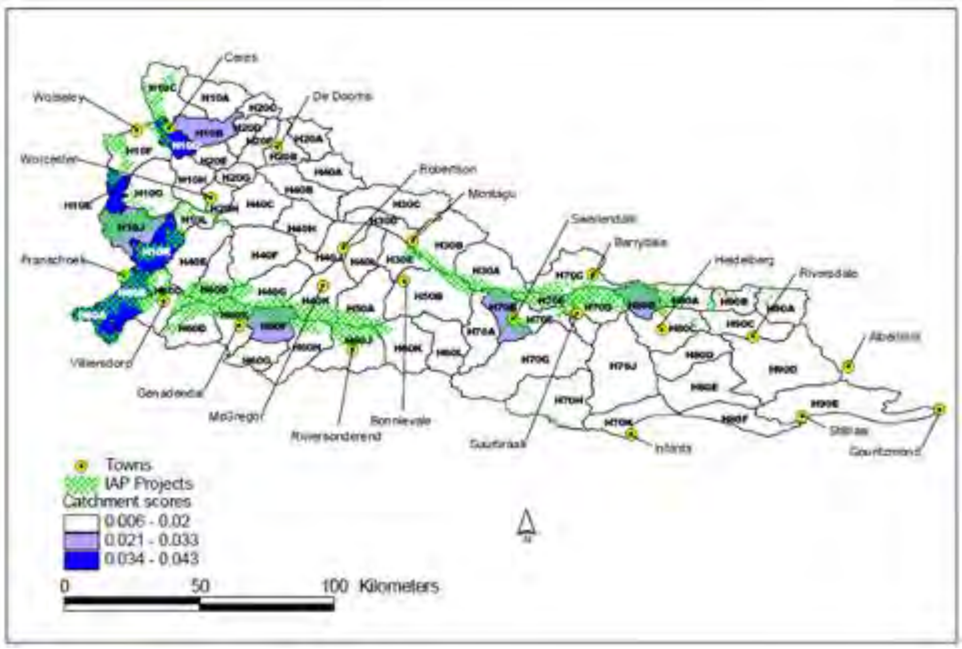


Figure 5.12. Priority catchments for clearing invasive alien plants in Breede River

The following five quaternary catchments were found to have the highest priorities in the Overberg catchments (Forsyth et al, 2009): G40A; G50K; G40B; G40D; G40C. Three of these catchments are located in the high rainfall area of the Hottentots Holland Mountains, while the other two are on the coast where conservation factors are important. Figure 5.13 shows the location of these high priority catchments, as well as the areas in which Working for Water has worked and plans to undertake clearing.

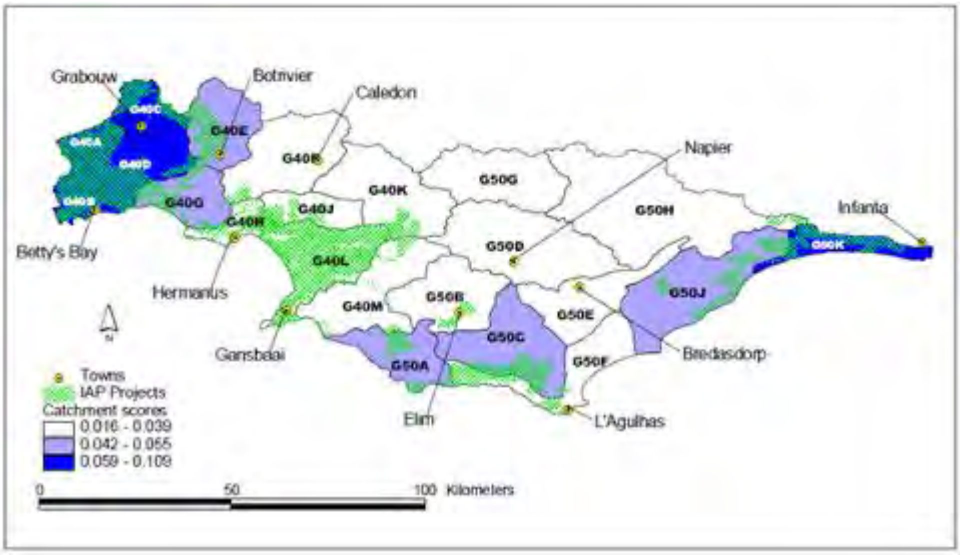


Figure 5.13. Priority catchments for clearing invasive alien plants in Overberg catchments.

There is considerable variation in the estimates of the level of infestation of invasive alien plants in the WMA and a verification process is required to establish a reliable data set on which to base further calculations of the impact of invasive alien plants on water resources in the WMA. It is clear that the current impact on yield is significant, and will continue to grow if clearing is not undertaken on an ongoing basis. Continued attention to this aspect by Working for Water and the CMA is important.

Management Objectives

The adoption of an active strategy on water conservation and water demand management is a key component for the integrated management of our water resources. The objective of this strategy is to create a culture of water conservation among all water users, and implement water conservation and demand management measures to promote efficient use of water and reduce water losses by each user group. The concept of efficient water use must also be entrenched by local authorities, most particularly in areas where water shortages are experienced and where new supply schemes may otherwise have to be developed.

The Objective for Conservation and Demand Management is:

- ❑ *Improve the technical efficiency of urban water use and the economic efficiency of agricultural water use (continually over the next 5 years).*

Management Actions

Water conservation and demand management interventions indicate technically realistic and economically viable actions to make water available for other users. The priority areas of focus are agricultural conveyance, system operation, urban supply systems and invasive alien plans. The actions for some of these are relatively clear, while others require further investigation to guide action.

➢ ***Action 2-B.1: Demand management practices as authorisation condition***

Milestone: By 2011, linked to national WC/WDM

Roles: DWA in consultation with BOCMA

Specify management practices and general requirements for all water users, including water conservation measures and water management plans for all licences and general authorisations. Implementation with immediate effect, following the ongoing National DWA initiatives around WC/WDM regulations and bylaws, with a focus on irrigation and agro-processing.

➢ ***Action 2-B.2: Investigate scheme / system operation for water resource conservation***

Milestone: By 2015, linked to WAAS study

Roles: DWA in collaboration with BOCMA and WUAs

Following the Water Availability Assessment Study, an investigation may be conducted around the possibility of adopting more sophisticated scheme operating rules to conserve water in the Breede catchment, including possible rehabilitation of the conveyance systems and potential management of salinity return flows.

➢ ***Action 2-B.3: Implement priority alien vegetation clearing projects for water conservation***

Milestone: Ongoing

Roles: Working for Water and other implementing agents, supported by BOCMA and DWA

Clearing of Invasive Alien Plants in the Breede WMA should be prioritised (through a BOCMA invasive alien plants water plan) to optimise water conservation and implementation intensified.

➢ ***Action 2-B.4: Implement stringent urban demand management plans***

Milestone: By 2014

Roles: Local Government supported by BOCMA and DWA

Local government needs to actively engage the development of water demand management plans as part of the Working for Water / Integrated Development Plan process. These plans together with implementation and monitoring should be required before any further allocation of water resources to meet urban supplies is allowed.

5.5 MEASURE 2-C: WATER AVAILABILITY AUGMENTATION

Background and Context

A cornerstone of the vision for this CMS is the sharing of available water to maintain existing activities, support new development and ensure redress. The aim of this measure is to match the water requirements in the Breede-Overberg WMA with an adequate supply, which may involve augmentation projects that increase the water available for social and productive economic uses. The assessment of the availability of water resources in the Breede-Overberg has revealed that only limited water is available for further use without specific augmentation interventions (although this needs to be verified through the improves information and assessment) and most of this is available only during higher flow events during winter. A range of potential augmentation projects have been identified (which are in addition to the water conservation and demand management initiatives outlined above), including:

1) Surface water storage
    a. Increase winter pump capacity to existing storage
    b. Create additional off-channel storage
2) Decrease assurance of supply of existing users
3) Tap groundwater supply, including local sources and the Table Mountain Group aquifer
4) Desalination of sea water
5) Waste water re-use, particularly municipal and industrial effluent
6) Enforce compliance by illegal users following validation & verification

The Western Cape System is also investigating possible transfer options from the Breede to supply future requirements in Cape Town, particularly the Mitchells Pass scheme. However, these have been conditioned on a comprehensive investigation of the impacts of this transfer on the whole system through the water availability assessment, including environmental flows for the estuary. This provides an important precedent and the same rigour should be applied to local schemes.

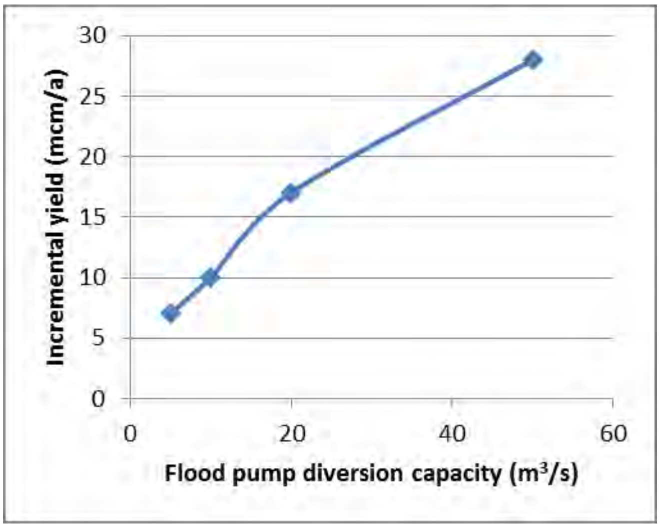
Augmentation of Greater Brandvlei Dam

Utilising the existing spare capacity in Greater Brandvlei Dam (133 million m^3) is the optimum development option for irrigation expansion in the Breede River. This off-channel storage dam is currently filled via diversions from the Holsloot and Smalblaar rivers up to a level of 207,12 m above sea level, corresponding to a capacity of 342 million m^3. A further 133 million m^3 of storage is available up to the full supply level of 210,5 m. In order to effectively utilise the full storage capacity of the dam, diversion into the dam could be augmented by one or more dedicated schemes.

Water in the Greater Brandvlei Dam is mainly used for agriculture irrigation along the Breede River downstream of the dam. Irrigation water is distributed by a system of canals receiving water directly from the dam as well as pumps and canals abstracting released water downstream.

The augmentation of the Greater Brandvlei Dam was considered, taking the environmental water requirements downstream of Brandvlei Dam into account. It is important to note that even under current conditions, the ecological water requirements of the estuary are not always met during the low flow periods.

The potential increase in the yield of Brandvlei Dam with an increased pumping capacity at Papenkuils Pump Station was estimated, and is presented in Figure 5.14(a). The winter low flow environmental water requirements just downstream of Brandvlei Dam would be met and only surplus winter water abstracted. Significant additional pumping capacity would have to be installed in order to obtain additional yield. This indicates that about 10 million m^3/a additional yield would be gained from installing a 10 m^3/s pump.



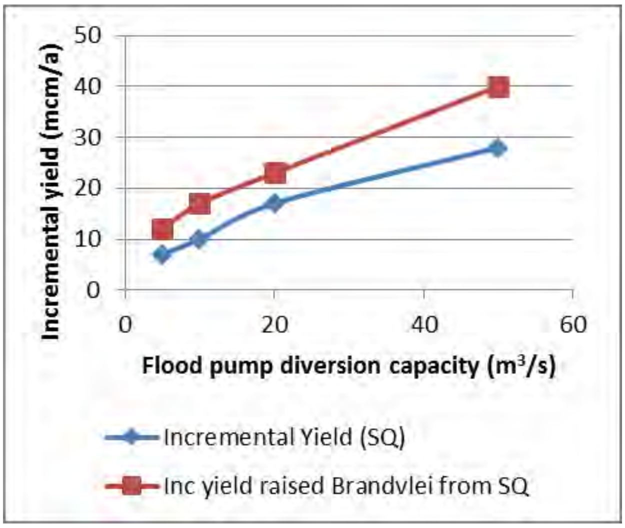


Figure 5.14. Incremental Yield from Brandvlei dam with additional (a) pumping and (b) storage and pumping

An analysis was also undertaken to assess the implications of raising Brandvlei by 5m from a current capacity of 492 million m^3 to a capacity of 610 million m^3, also against increase pumping capacity presented in Figure 5.14(b). The winter low flow environmental water requirements are met just downstream of Brandvlei Dam and only surplus winter water would be abstracted. In this case an additional 17 million m^3/a yield could be obtained for the 10 m^3/s pump with additional storage capacity, but at a high cost.

Raising of Buffeljags Dam

The second most viable development option for in-catchment supplies appears to be the raising of the existing Buffeljags Dam by 10m, doubling its current yield from 11 to 22 million m^3/a. The water, which is of good quality, could be used to expand irrigation downstream, offering potential to establish resource poor farmers in the area. The challenge is that the stream flow from this river contributes disproportionately to the environmental flow requirement in the Brede estuary.

Other possible surface water resource augmentation schemes

Other possible surface water interventions which have been proposed are shown in the Table 5.9. It must be noted that the yields shown were taken from the Breede River Basin Study and would need to be reviewed in light of the need to comply with the environmental flow requirements that have been established for the Breede River.

It is worth noting that the cost of water is at 2000 prices, which would have at least doubled. This implies that most of these schemes are too expensive for most irrigation purposes at more than R1/m^3. This is the consequence of developing storage in a winter rainfall region.

Table 5.9. Potential infrastructure augmentation options in the Breede catchment

Producing area	Water resource	Develop-ment type	Cost of water (R/m³)	IRR%		Water demand (million m³/a)
				2000	2002	
Breede, Central	Le Chasseur Dam	Expansion				
Riviersonderend	Bromberg Dam	Expansion				22,0
Riviersonderend	Reenen Weir	Expansion	0,27	12,3	19,9	1,5
Riviersonderend	Kwartel River	Expansion	0,33	12,1	19,7	12,0
Breede, Goudini, Rawsonville	Raising of Stettynskloof Dam	Expansion	1,03	9,5	12,8	15,0
Breede, Goudini, Rawsonville	Worcester Irrigation Scheme	Expansion	1,40	*	12,6	44,2
Breede, Goudini, Rawsonville	Tierstel Dam	Expansion	2,05	8,0	11,2	3,3
Hex River Valley	Amandel River	Expansion	1,33	4,6	8,7	3,1
Suurbraak	Off-channel storage	New	0,84	4,2	7,4	2,5
Moordkuil, Robertson	Rooiberg Dam/pump	New	1,16	3,8	6,3	5,6
Ceres catchment	Titus River	New	0,59	4,0	6,0	7,6
Ceres catchment	Groundwater wellfield	New	0,83	2,6	4,5	0,8

When viewed in isolation, the yields and environmental impacts of these new water supply schemes are likely to be small compared to the yields and environmental impacts of the larger regional schemes. However, the development of increasing numbers of small water supply schemes will have a cumulative impact on the low flows as many of these schemes are based on run-of-river abstractions, which could place additional strain on the already depleted winter low flows in the system.

Transfer of water to the Berg WMA

Two water transfer schemes have been identified as potential water augmentation options to the Berg WMA, namely the Mitchell's Pass Diversion Scheme (in the Upper Breede), and further augmentation of Steenbras Dam from the Palmiet River (Western Overberg). Neither of these supply options will make additional water available to the Breede-Overberg WMA.

It is not anticipated that the proposed additional transfers from the Palmiet River to the Steenbras Dam transfer scheme will have any negative impact on the Palmiet River as the determination of available yield already makes allowance for the proposed environmental water requirements in the Palmiet River.

Decrease in Assurance of Supply

At present the agricultural water users from Brandvlei Dam experience an approximate 95% level of supply assurance (1 in 20 years) providing a yield of 251 million m^3 (including the downstream contributions). A decrease in the level of supply assurance from the current 95% levels would make more water available which could be allocated to water resource poor farmers. Figure 5.15 indicates the additional yield available if the level of supply assurance to existing irrigated agriculture from Brandvlei dam were to decrease from historical firm yield (HFY), 98% and 95% to alternate supply assurances. This implies that an additional 5 million m^3 of water would be available from Brandvlei if reductions in supply to irrigators in the Central Breede were accepted every 10 years rather than the current 20 year assurance. This increases dramatically to 20 million m^3 if the assurance were to drop to 1 in 7 year (85% assurance).

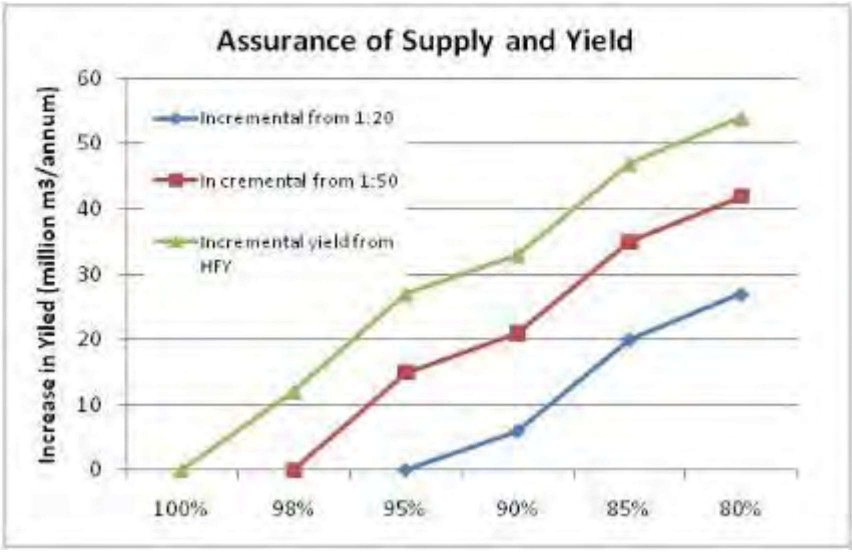


Figure 5.15. Increased yield from Brandvlei through reduction in the assurance of supply

Groundwater

Groundwater is a significant source of water in the Breede- Overberg WMA. The registered abstraction volume is 146 million m^3/a (WARMS, 2010). There is considerable potential to increase the use of groundwater in certain areas of the WMA, but other areas are currently being overexploited. Future groundwater developments can be considered in the Overberg and the northern parts of the Central Breede Management Zone linked to the deep Table Mountain Group aquifer.

Figure 5.16 indicates the allocable groundwater in the WMA, highlighting that many quaternary catchments in the Breede are already over allocated, but that there remains some opportunity for local use of relatively shallow groundwater aquifers (less than 100m deep).

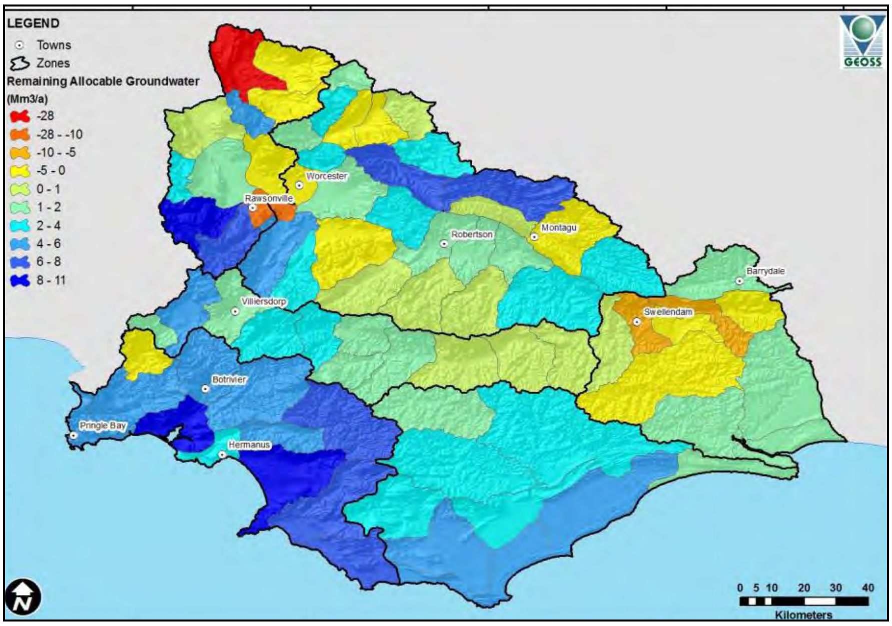


Figure 5.16. Allocable groundwater in the Breede-Overberg WMA

The over abstraction that is occurring in a number of catchments is a concern, and needs to be addressed by the CMA, particularly in the Upper Breede Management Zone. In spite of the high harvest potential in the Hex River Valley, it has been established that the safe yield of the valley has been exceeded and that brackish water intrusion occurs. The high recharge rates in the mountains do not imply that all this water is available to groundwater users in the surrounding valleys, as the majority of this water enters mountain streams before the groundwater reaches the valley bottom. This recharge often takes place in inaccessible mountain areas, and is not available for exploitation.

Water Re-use

Treated effluent water can be re-used in a number of different ways. It is either: planned (reuse through an engineered system) or unplanned (discharged into a river); used directly (effluent returned to the system) or indirectly (through a receiving water body); potable (treated for drinking) or non-potable (for industry, irrigation, etc.).

Many water supply projects in the WMA actually fall into the unplanned indirect potable re-use category, since towns in the upper reaches of catchments discharge treated effluent into the river, and towns downstream abstract water from the river, treat it, and supply it as potable water. Water re-use has been studied as part of numerous different projects undertaken for the City of Cape Town and DWA over the years. Some of the main conclusions of these investigations are summarised below:

- Direct re-use of treated effluent for irrigation and some industrial applications was cost-effective, and it was recommended that this be actively pursued to maximise its potential.
- There is considerable scope for direct re-use for non-potable purposes if some form of tertiary treatment could be undertaken to improve the quality.
- Re-use for potable purposes was found to be too expensive still, but the recommendations were to continue with the necessary investigations to keep this as a potential future option.

More recently the All Towns Strategies undertaken for DWA also identified water re-use as a future supply option to augment water supply to the towns in the Breede-Overberg WMA.

Desalination

Desalination of sea water remains a supply alternative for towns situated along the Western and Eastern Overberg coastline. Desalination is a process that removes the excess salt and other minerals from water (in this case seawater) in order to obtain fresh water suitable for domestic consumption. The preferred technology to achieve this is Reverse Osmosis, during which the salts are separated from the eventual product water by forcing the sea water through a membrane under very high pressure. The salts and other minerals will stay behind on the one side of the membrane (brine) and the purified water will go through the membrane.

Desalination of sea water will be a possible augmentation option to implement where the potential for a surface water augmentation scheme, groundwater augmentation scheme, water re-use or removal of alien vegetation is limited. However, currently the energy needs of this technology are high, which increases the cost to above R3/m^3.

Management Objectives

The Objective for Water Supply Augmentation is:

- ❑ *Ensure adequate availability of water at an agreed assurance of supply to supply existing and new allocations.*

Management Actions

The following activities should be done as strategic interventions for urban water allocations:

- ***Action 2-C.1: Manage/operate system for reduced assurance of irrigation supply***

Milestone: By 2013

Roles: DWA in collaboration with BOCMA and WUAs

Investigation into the viability and agreement by key rolplayers of reduced asurance from a scheme allows some reallocation to other users. In the Cental Breede a reduction in assurance of supply has been proposed to make water available for emerging farmers. This must be done in consultation with with existing irrigation water users as operators of the schemes.

- ***Action 2-C.2: Investigate conventional augmentation options***

Milestone: By 2015, following the Water Availability Assessment Study

Roles: DWA in collaboration with BOCMA

Upon completion of the proposed Water Availability Assessment Study, update the yields and costs of the interventions identified as part of the Breede River Basin Study or any other studies and formulate scenarios for reconciling future supplies and water requirements. Completion after the Water Availability Assessment Study within 4 years.

- ***Action 2-C.3: Investigate non-conventional supply sources***

Milestone: Ongoing

Roles: DWA in collaboration with BOCMA and Local Government

Investigate conjunctive use of groundwater, re-use of treated effluent and desalination in localised situations (primarily for urban supplies).

5.6 MEASURE 2-D: WATER ALLOCATION REFORM

Background and Context

Redressing social inequities through water reallocation to emerging farmers is a central issue for the Breede-Overberg WMA. Water Allocation Reform (WAR) describes a range of processes aimed at equitable, productive, and sustainable allocation of water. The focus is on activities to promote applications that address race and gender reform, as well as those that support the establishment of viable water using enterprises. Water Allocation Reform also includes actions to facilitate the authorisation of those water uses that represent the most beneficial use of our resources in the public interest. The strategic intent of water allocation reform is ultimately to achieve the following:

- Redress past imbalances both for race and gender
- Sustainable and efficient water use
- Support socio-economic initiatives
- Support of government programmes aimed at poverty eradication, job creation, economic development and rural development, i.e. broad government development objectives

National Principles for Water Allocation Reform:

- *The primary focus of water allocation processes will be to redress past imbalances in water allocations to Historically Disadvantaged Individuals (HDI).*
- *The water allocation process must be supported by capacity development programmes that support the use of water to improve livelihoods and to support the productive and responsible use of water by all users. These capacity development programmes should also help HDIs and the poor to participate equitably in the process of informing the allocation of water.*
- *The water allocation process will contribute to Broad-Based Black Economic Empowerment (BBBEE) and gender equity by facilitating access by black- and women-owned enterprises to water.*
- *The water allocation process will respond to local, provincial and national planning initiatives, as well as to South Africa's international obligations and regional SADC initiatives.*
- *The water allocation process will be undertaken in a fair, reasonable and consistent manner and existing lawful uses will not be arbitrarily curtailed.*
- *The water allocations process will give effect to the protection of water resources as outlined in the National Water Act by promoting the phased attainment of both developmental and environmental objectives.*
- *Innovative mechanisms that reduce the administrative burden of authorising water use, while still supporting its productive use, as well as the effective management and protection of water resources will be developed.*

DWA, together with stakeholders, developed national principles for water allocation reform which serve as the base for changing the way water is allocated in South Africa. The Breede-Overberg CMA should use the national principles as the base for allocating water fairly and equitably in its WMA, and for development of catchment specific water allocation principles. Most importantly, these principles must be developed together with all the affected stakeholders.

The national water allocation reform target is 30% by 2014. In the Breede-Overberg WMA challenges are introduced by constrained water resources and economic value of water used for different crops. The most critical economic consideration is that the highest value crops per unit of water require the greatest technical knowledge and infrastructure development. Water allocation reform in the context of agriculture in the Breede and Overberg will therefore need to explore innovative ways to provide financial support and managerial capacity to beneficiaries, so that economic development is maintained while fostering the social and political imperatives of water reallocation.

The catchment management strategy provides the intent and actions describing how water resources will be managed in the Breede WMA. One of the key priorities is water allocation reform. There are specific catchment management drivers that demand a need for water allocation reform in the Breede WMA. The drivers include:

- An existence of HDI communities who are existing or potential emerging farmers and require water for agricultural purposes;

- The reserve for the Breede WMA is currently not met;
- Existing lawful users who are using more than their authorised allocations;
- The catchment is in some parts currently over-allocated with water uses; and
- A certain volume of water needs to be made available in the catchment for freshening purposes to retain an acceptable water quality.

BOCMA supports the government objectives of achieving water allocation reform. However, it is important to understand the context and challenges within which this objective must be achieved in the Water Management Area. The context and challenges include the following:

- The Water Management Area produces high value agricultural products that are exported to overseas markets and local markets therefore contributing significantly to the country's economy. The cost of water that is used to produce is very expensive due to being situated in the winter rainfall zone where water needs to be stored at high cost for summer needs. There is high investment input towards water use efficiency. The implications are that, water allocated through reform processes should continue along the same vein of sustainable and beneficial use of water. The implications are that all stakeholders including public and private sector must play a dedicated role in supporting HDI agricultural activities.
- Access to agricultural water is linked to land availability. Additional land in this WMA is not available as most of it was land owned prior to the Natives Land Act of 1913. Therefore land to HDIs will mostly be through redistribution (not restitution) processes. It may therefore be difficult for government to buy significant blocks of the land. Added to this challenge are the difficulties currently experienced with land reform processes and the shifts in national policy.
- The current articulated water requirements by HDIs within the catchment seems to be restricted by challenges around access to land, infrastructure, finance and management support. Although there are pockets of areas where water requirements have been identified, there is however limited information, e.g. water requirements, hectares, agricultural activity and pathways.
- There is limited information available about water that is already in the HDI hands either through equity schemes, land reform processes or other government processes, although estimates range from 2% to 5% of agricultural water use.

Taking into account this context and the associated challenges, a phased approach is proposed to achieve water allocation reform. Within the first five years of the strategy, there are specific targets that will be achieved. Based on the gains made within the first five years, proposals will be made on the next cycle of the strategy. The first five years of the strategy involves a number of activities contributing to achieving the reallocation target.

Existing HDI ownership

The current indications are that, about 2-5% of water within the WMA is already used by HDIs. However this figure is only an estimate that must be confirmed through various processes, i.e. equity schemes and redistribution. WUAs have already been engaged to assist in quantifying this percentage. As an illustration, Groenland WUA indicated the following Black Economic Empowerment ownership, i.e. m^3 of water in black hands

IRRIGATION FARMING m^3					
Own source	Eikenhof summer	Eikenhof Winter	Total		
38 414 143	**21 701 000**	**10 748 000**	**70 863 143**		
Black Economic Empowerment component				**7 049 620**	**9.95%**
AGRI-INDUSTRY m^3					
Own source	Eikenhof summer	Eikenhof Winter	Total		
738 000	**857 000**	**6 51 000**	**2 246 000**		
Black Economic Empowerment component				**74 100**	**3.3%**
TOTAL AGRICULTURAL USE					
Own source	Eikenhof summer	Eikenhof Winter	Total		
39 152 143	**22 558 000**	**11 399 000**	**73 109 143**		
Black Economic Empowerment component				**7 123 720**	**9.74%**

Ongoing Land Reform and Agriculture processes

The process of water allocation reform is closely linked to the land reform process in the area. Land received via any form of land reform programme is likely to have water implications in it. The land reform process is therefore likely to contribute to water allocation reform process. While there is this identified opportunity; there are currently no restitution claims that have been identified in the Breede WMA. The majority of the land has been released to HDI through redistribution programmes. As indicated earlier most of the land was taken prior to the Natives Land Act of 1913. Through land redistribution programme, the Land Redistribution for Agricultural Development (LRAD), Settlement and Production Land Acquisition Grant (SPLAG) and Proactive Land Acquisition Strategy (PLAS) projects have been identified in the WMA. Interaction with the Department of Rural Development and Land Reform (DRDLR) revealed that that there are specific projects that have been identified through these programmes that may have water implications included. The water requirements within these projects could not, however, be identified or quantified at this stage.

The Department of Rural Development and Land Reform is currently undergoing a strategic change in focus. Most of the new proposed land reform programmes have been discontinued. All land reform projects will now be implemented under the Proactive Land Acquisition Strategy. Projects under various programmes, particularly Land Redistribution for Agricultural Development are now being migrated to the Proactive Land Acquisition Strategy. While the department has taken a decision to implement land reform projects under the Proactive Land Acquisition Strategy, it should be noted that these projects are on hold pending the availability of finance to implement them. It is currently not clear when these will be started again. Based on the current land reform status, the considerations for the CMS are the following:

- Further investigation of land reform projects that have water implications included needs to be done. The department could not yet identify or quantify land reform projects with water allocations. The Department of Rural Development and Land Reform should also consider an indication of when these projects are likely to be implemented to plan accordingly from a CMS perspective. Close cooperation with BOCMA is required. There is a need to investigate land reform project that has already been completed and have water allocation.

- The current inactivity of project implementation within the Proactive Land Acquisition Strategy implies that BOCMA may consider water requirements for Proactive Land Acquisition Strategy projects in the next cycle of the strategy. Such considerations should be based on the continued joint discussions between the CMA and the department.

Initiatives under the CMS

The third element of achieving water allocation reform is through the WMA driven processes. The processes will be based on the ongoing work that is done by the CMA. This is the core of the CMS water allocation reform strategy.

Management Objectives

The Objective for Water Allocation Reform is:
❑ *Allocate 15% of agricultural water use to emerging farmers by 2015.*

This translates approximately to 12 000 ha or about 100 million m^3 of water per year.

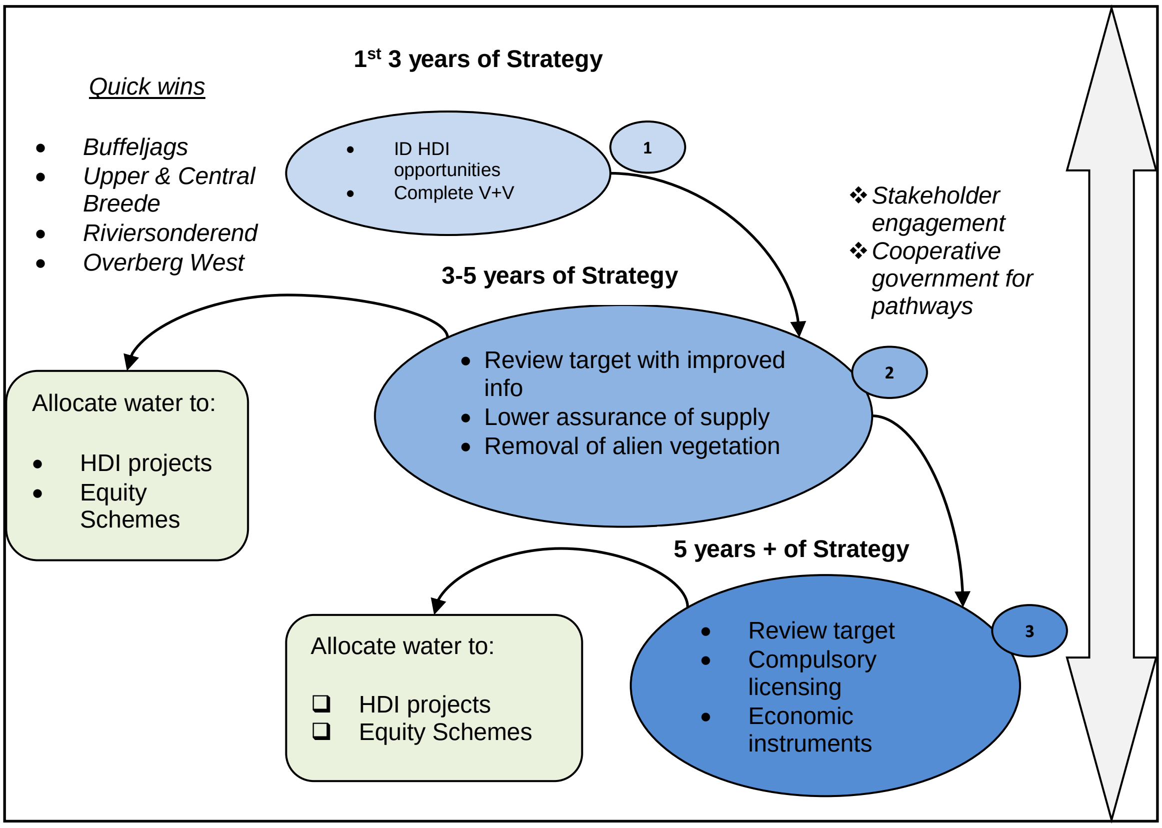
Management Actions

The WMA driven process entails the following steps.

1) Identify and support HDI user opportunities (First 3 years of the strategy)
2) Complete the verification and validation process in key areas (First 3 years of the strategy)
3) Revise the proposed WAR 15% target with improved information (3-5 years of the strategy)
4) Allocate water using lower assurance of supply and aliens removal (3-5 years of the strategy)
5) Revise target and Implement more comprehensive approaches to WAR (5 year + of strategy)

The activities within the five years of the strategy should be able to provide a clear indication of how much water is available, how much is required by HDIs and where there will be uptake by HDIs. Water made available would have already been allocated to the areas where there are requirements by HDIs. The outcomes should also be able to provide the base for reviewing targets after the first five years of the strategy. New targets will be set up moving forward.

Depending on the water requirements, HDI requirements should be partially addressed during this time; particularly where there are identified quick wins. Importantly, the CMS in this period will consider implementing much more comprehensive instruments for Water Allocation Reform, such as compulsory licensing and economic instruments. During the implementation of these instruments, the objective should not be focused only on addressing HDI water requirements, but should also consider other objectives particularly ecological water requirements (Reserve).



➢ *Action 2-D.1: Identify, develop and support HDI project opportunities*

Milestone: By 2012

Roles: BOCMA in collaboration with WUAs, DWA, DRDLR and Dept. of Agriculture.

Currently there are a number of HDI water users or opportunities that require access to water. During the CMS development process there are a number of opportunities that were identified. However it is proposed that these opportunities should be where there will be quick wins. Based on the current understanding the focus for the opportunities should be in the Upper and Central Breede, Riviersonderend, Buffeljags and Overberg West areas. Within these identified areas, there will be a need to assess and allocate water to deserving HDI applications, e.g. HDI projects and Equity Schemes. There may be a need to develop criteria for awarding licences taking into account that there will be competing needs. In order to achieve this, BOCMA will have to work closely with individuals in these opportunities for support to processes and pathways. Secondly work closely with DWA to process applications and ensure that the criteria encourage black economic empowerment.

➢ *Action 2-D.2: Authorise HDI applications from water made available*

Milestone: Ongoing

Roles: DWA in collaboration with BOCMA

In the 3-5 year period of the strategy, the objective would be to introduce other instruments of water allocation as a way of making more water available. The proposed instruments include lower levels of assurance of supply. The process involves voluntary reallocation of water by existing lawful users. The process will require close cooperation between BOCMA and existing lawful users on how the process will be implemented. Currently there are technical investigations into how much water can be made available by the removal of alien vegetation and the areas where this can be implemented within the catchment. The outcome of the investigations should be implemented during this time.

While these instruments are implemented, there should be an ongoing process of consolidation of water requirements by the HDI, where water made available through these processes will be allocated. The process should also investigate the opportunities for beneficial use of water. Predominantly water should be allocated to equity schemes and HDI projects.

- ***Action 2-D.3: Revise Breede Overberg WAR strategy once verification and validation is complete***

Milestone: By 2013

Roles: BOCMA in consultation with stakeholders

While providing water to deserving HDI opportunities, through quick wins projects, the first three years of the strategy will generate a wealth of information that will help influence and improve the 15% target for Water Allocation Reform. This will be enhanced through the verification and validation process and where necessary compulsory licensing will be considered.

5.7 Measure 2-E: Water Allocation

Background and Context

At the heart of the CMS is the allocation plan, which must outline the principles for allocating water between sectors and ultimately water users. For this 1st edition of the Breede Overberg CMS, too many uncertainties remain to allow the development of a clear and comprehensive allocation plan. Rather a more precautionary approach is needed, but on that enables redress through water allocation reform.

A more precautionary approach is rather needed, but that still enables redress through water allocation reform.

Allocation of water must promote the general growth and development of the agricultural and urban sectors whilst ensuring sustainability of water resources. General authorisations must be used as a tool to ensure small scale development but revised where it can lead to over utilization of resources. A cap on general authorisations for groundwater abstraction should for example be considered where properties are large due to adjacent mountain areas. License conditions should be used vigorously to ensure monitoring and efficiency.

Commercial irrigation must be supported and as a catalyst for growth and development in the area and enabler for water allocation reform.

Breede Overberg Water Allocation Principles

- *Meet legal (holistic) requirements of the Reserve, based on the Resource Directed Measures' policy of achieving current status (with some improvement where below D-status), but recognising that this may be phased over time.*
- *Meet urban requirements in the Breede-Overberg towns from appropriate local sources, with requirements for vigorous water demand (efficiency) management.*
- *Reallocate water to Reserve and HDI farmers through various innovative regulatory, economic and technical mechanisms, following improved understanding of the water use and hydrology of the system.*
- *Authorise new agricultural irrigation with greater than 50% HDI component, while considering applications with greater than 30% HDI, requiring strict water use efficiency.*
- *Promote commercial agricultural development through improvement of efficiency, sharing in joint ventures and equity schemes with HDIs and transfer of validated lawful water use entitlements.*
- *Assess the impacts of any new infrastructure development and associated increased allocation on the downstream ecological impacts and opportunity costs on other users, with a focus on winter water.*
- *Integrated water quality management with allocation planning to achieve fitness for use by agriculture, tourism and the environment, while maximising available water and reducing dilution requirements.*

Applications for water use by emerging farmer irrigation in the Overberg West, Upper Breede and Lower Breede should be considered, while restricting applications in the Central Breede and Riviersonderend to gains from invasive alien removal, water demand management gains, reduction in assurance of supply or additional storage.

Management Objectives

The Objective for Water Allocation is:

- ❑ *Authorisation of water use to meet legitimate requirements reflecting the specified allocation principles without exceeding the agreed assurance of supply or environmental flow requirements.*

Management Actions

The following activities should be done as strategic interventions for urban water allocations:

➢ ***Action 2-E.1: Authorise water according to CMS allocation principles***

Milestone: Ongoing

Roles: DWA in consultation with BOCMA

The framework for authorising water is provided by the Allocation Principles, and new license applications should be evaluated against these.

➢ ***Action 2-E.2: Plan and develop urban water supplies***

Milestone: Following All-Towns strategies

Roles: DWA in collaboration with Local Government and BOCMA

Groundwater, re-use and desalination are resources which could be considered. The conjunctive use of these resources in addition to surface water resources can provide more resilience to climate variation and changes.

- ***Action 2-E.3: Review and establish general authorisations and license conditions in priority catchments***

Milestone: By 2014

Roles: BOCMA in collaboration with DWA

An understanding should be gained about the additional taking (extraction) of water through general authorisations and licenses to inform whether more stringent conditions are necessary. Conditions should be reformed accordingly.

5.8 Measure 2-F: Climate Change Resilience

Background and Context

Impact of climate change and variability

Anticipated changes in climate introduce significant uncertainties that must be considered in the management of water resources in the Breede-Overberg WMA. Climate change will impact upon water availability primarily through changes in temperature and rainfall patterns, potentially leading to increased levels of evapotranspiration and changes in hydrology.

An increase in temperature may increase levels of evapotranspiration, thus affecting the amount of water available particularly for agriculture. Temperature increases are expected and have already been observed in the Western Cape, and farmers have begun shifting production to higher value and less water-intensive crops, such as table grapes, as a result.

Changes in rainfall patterns would lead to changes in hydrology by affecting the amount of water available from surface and groundwater sources. It is unclear whether the Breede-Overberg WMA will become wetter or drier overall, but is expected that changes in rainfall will differ by region. Coastal areas, for example, will likely become drier. This will cause further strain on the coastal tourism areas and surrounding agriculture. Orographic rainfall, on the other hand, is likely to increase and thus cause mountain areas to be wetter. Additionally, extreme events, including floods and droughts, will likely become more frequent, leading to challenges in supply and sanitation.

Building resilience

As explained above, though climate changes are expected, the exact nature and degree of change is unknown. Therefore, the best preparation for climate change will be to build physical resilience through natural resources and infrastructure, and to build institutional resilience. This will enable the Breede-Overberg WMA to respond to conditions that do result.