APPENDICES

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Urban Water Requirements (year 2000) - WMA 12: Mzimvubu to Keiskamma

Sub-area	Urban population	Domestic (direct)	Indirect	Urban Iosses	Total	Proportion indirect:	Urban per capita (domestic)	Urban return flow
			millio	n m³/a	direct	ℓ/c/d	%	
Mzimvubu	106 859	3.4	1.3	1.6	6.3	0.38	87	33
Mtata	213 763	6.6	4.6	3.7	14.9	0.69	85	43
Mbashe	32 421	1.1	0.4	0.5	2.0	0.38	93	41
Kei	219 837	8.6	4.6	4.4	17.6	0.54	107	34
Amatola	668 543	23.4	13.5	20.3	57.2	0.58	96	41
Wild Coast	15 099	0.6	0.2	0.3	1.1	0.38	113	39
Total	1 256 522	43.7	24.6	30.8	99.1	0.57	95	40

Rural Water Requirements (year 2000) - WMA 12: Mzimvubu to Keiskamma

Sub-area	Rural population	Domestic	Stock watering	Total	Rural human per capita	
			million m ³ /a		ℓ/c/d	
Mzimvubu	924 819	8.4	1.0	9.4	25	
Mtata	523 715	4.8	0.0	4.8	25	
Mbashe	557 798	5.1	0.5	5.6	25	
Kei	655 130	6.0	4.4	10.4	25	
Amatola	349 645	3.2	2.0	5.2	25	
Wild Coast	373 304	3.4	0.0	3.4	25	
Total	3 384 411	30.9	7.9	38.8	25	

Irrigation water requirements (year 2000) - WMA 12: Mzimvubu to Keiskamma

Sub-area	Irrigation area		Unit requirement	Irrigation	Convey- ance	Total ir requir	Irrigation return	
	Green cover	Harvested	Green cover	requirement	losses	No assurance	1:50 assurance	flows
	ha		m³/ha/a	million m ³ /a	nillion m³/a % million m³/a		n m³/a	%
Mzimvubu	3 550	3 550	4 300	15.3	15.0	17.6	15.3	10.0
Mtata	1 200	1 200	3 500	4.2	15.0	4.8	4.3	10.0
Mbashe	470	470	5 600	2.6	15.0	3.0	2.6	10.0
Kei	16 450	10 500	8 600	141.5	15.0	162.7	135.0	10.0
Amatola	5 440	3 536	6 200	33.7	15.0	38.8	33.0	5.0
Wild Coast	0	0	5 000	0.0	15.0	0.0	0.0	0.0
Total	27 110	19 256	7 278	197.3	15.0	226.9	190.2	9.1

Factors influencing runoff and yield (year 2000) - WMA 12: Mzimvubu to Keiskamma

	MAR Reserv (naturalised,		erve	e Alien vegetation			Afforestation			Sugar cane			River losses	Urban runoff
Sub-area	incremental)	Reduction	Reduction	Area	Reduction in	Reduction	Area	Reduction in	Reduction	Area	Reduction	Reduction	Reduction	Increase in
		In runoff	în yiêld		runott	în yield		runoff	în yield		In runoff	în yield	în yield	yield
	million m ³ /a	millio	n m³/a	ha	million	m³/a	ha	millior	n m³/a	ha	millio	n m³/a	millio	on m³/a
Mzimvubu	2 897	338	156	22 598	36	1	73 019	80	3	0	0	0	0	2
Mtata	836	163	29	4 788	8	4	28 974	37	28	0	0	0	0	2
Mbashe	1 126	203	20	1 360	2	0	24 571	19	0	0	0	0	0	2
Kei	1 027	154	35	30 736	32	12	23 383	17	11	0	0	0	0	2
Amatola	559	116	7	12 493	15	6	14 890	8	4	0	0	0	0	5
Wild Coast	796	148	26	1 062	2	0	2 945	4	0	0	0	0	0	0
Total	7 241	1 122	273	73 037	95	23	167 782	165	46	0	0	0	0	13

Major dams data - WMA 12: Mzimvubu to Keiskamma

Dam name	Quaternary catchment	River	Year	Purpose	Natural MAR	FSC
					million m ³ /a	million m ³
Binfield Park	R10G				18.6	36.8
Bongolo	S31F	Bonkola	1908	Domestic	6.0	7.0
Bridle Drift	R20F	Buffalo	1968	Domestic	83.4	101.7
Bushmans Krantz	S32F			Irrigation	9.0	5.2
Cata	R10B	Cata	1980	Irrigation	38.5	12.1
Debe Dam - Ciskei	R10E			Domestic	67.3	6.0
Gubu	S60A	Gubu	1970	Domestic	39.3	9.3
Indwe	S20A			Domestic	11.4	17.9
Laing	R20E	Buffalo	1950	Information	65.0	19.9
Lubisi	S20C	Indwe	1968	Irrigation	50.0	157.9
Macubeni	S10F			Domestic	9.7	3.8
Mhlanga	T70A			Domestic	35.7	2.0
Mnyameni Dam	R10B			Domestic	38.5	2.1
Mtata	T20B	Mtata	1977	Domestic	215.3	253.7
Nahoon	R30E	Nahoon	1950	Domestic	26.8	19.9
Ncora	S50E	Tsomo	1976	Irrigation	176.8	150.1
Nwanedzi	R50A				20.5	5.5
Rooikrans	R20A	Buffalo	1951	Domestic	21.5	5.0
Sandile	R10B	Keiskamma		Irrigation	38.5	27.5
Tentergate	S32B			Information	15.2	1.9
Thrift	S32A			Irrigation	8.3	2.7
Tsojana	S50F			Domestic	6.4	13.2
Waterdown	S32E	Klipplaat	1958	Irrigation	51.3	38.4
Wriggleswade	S60B	Kubusi	1991	Domestic	61.8	93.2
Xilinxa	S70C	Xilinxa	1973	Domestic	16.3	16.0
Xonxa	S10E	White Kei	1974	Irrigation	41.7	135.1

Details of main inter-WMA transfers (year 2000) - WMA 12: Mzimvubu to Keiskamma

There are no transfers in or no transfers out in this Water Management Area.

ADDENDA

ADDENDUM 1	:	BACKGROUND ON DEMOGRAPHIC AND ECONOMIC STUDIES
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- ADDENDUM 2 : ECONOMIC SECTOR DESCRIPTION (for GGP and Labour Distribution)
- ADDENDUM 3 : YIELD, RELIABILITY, AVAILABLE WATER AND ASSURANCE OF SUPPLY
- ADDENDUM 4 : ECOLOGICAL COMPONENT OF RESERVE
- ADDENDUM 5 : RECONCILIATION INTERVENTIONS
- ADDENDUM 6 : PRIORITIES FOR ALLOCATING WATER
- ADDENDUM 7 : INTER CATCHMENT TRANSFER OF WATER

ADDENDUM 1 : BACKGROUND ON DEMOGRAPHIC AND ECONOMIC STUDIES

A detailed study of the expected demographic and socio-economic changes in the country, and the associated impacts on water requirements, was conducted to serve as background to the NWRS. The main outcome was the expectation of lower population growth rates than previous, mainly due to the impact of HIV/AIDS, as well as reduced reproduction rates linked to urbanisation and economic growth. High and low population scenarios were developed as reflected in Fig. 6.

Estimates of the future population were initially made for the country as a whole, and then subdivided into smaller geographic units to facilitate the estimation of future water requirements on a regional basis. Because of the trend towards urbanisation as well as the expected stronger economic growth in the major urban and industrial centres, the greatest long-term uncertainty about future water requirements exists with respect to these user sectors. Greater attention was consequently given to the main urban centres in the subdivision of population, with possible lesser substantiation of the population projections for smaller centres and some rural areas. The representatives of population projections for the latter areas should therefore be reconsidered during the development of catchment management strategies

Scenarios were also developed for economic growth, and of the influence of economic growth on future water requirements, in an attempt to cautiously narrow the uncertainties which the future holds. Multi-variate analyses were performed in order to develop scenarios of possible low and high economic growth for different geographic regions in the country. Gross Geographic Product (GGP) was considered the most relevant economic indicator for the purposes of the National Water Resource Strategy because of relationships which can be established to water usage. In general, economic growth is expected to be substantially higher in the larger urban and industrialised areas and which are favourably located with respect to resources and transportation routes than in the rural areas. Consideration was given to the trend towards growth in service and manufacturing industries, and the expected impact of changing trade patterns on manufacturing, transport infrastructure and export facilities.

Within the spectrum of population and economic growth scenarios, a base scenario was selected for estimating the most likely future water requirements. This comprises the high scenario of population growth and higher average levels of urban domestic water requirements resulting from a more equitable distribution of wealth. The ratio of domestic to commercial, communal and industrial water use for urban centres in the year 2000 is maintained. A possible upper limit scenario is also proposed. This scenario is based on the same assumption of high population growth and a high standard of service provision flowing from rapid socio-economic development, with the distinction that these be combined with strong economic growth in which commercial, communal and industrial water use increases in direct proportion to growth in GDP. The upper scenario is intended to serve as a conservative indicator to prevent the occurrence of possible unexpected water shortages. No adjustments have been made to reflect the impact increased water use efficiency would have.

Caution should be exercised that possible temporary migration from rural areas to towns, which may be an interim step towards migration to cities, not wrongly be interpreted as a long term sustainable growth.

ADDENDUM 2 : ECONOMIC SECTOR DESCRIPTION (for GGP and Labour Distribution)

From Urban Econ – Reference 5

- **Agriculture :** This sector includes agriculture, fishing, forestry, hunting and related services. It comprises activities such as growing of crops, market gardening, horticulture, mixed farming, production of organic fertiliser, forestry, logging and related services and fishing, operation of fish hatcheries and fish farms.
- **Mining :** This section entails the mining and quarrying of metallic minerals (coal, lignite, gold, cranium ore, iron ore, etc); extraction of crude petroleum and natural gas, service activities incidental to oil and gas extraction; stone quarrying; clay and sand pits; and the mining of diamonds and other minerals.
- **Manufacturing :** Manufacturing includes, inter alia, the manufacturing of food products, beverages and tobacco products; production, processing and preserving of meat, fish, fruit, vegetables, oils and fats, dairy products and grain mill products; textile and clothing; spinning and weaving; tanning and dressing of leather, footwear, wood and wood products; paper and paper products; printing and publishing; petroleum products; nuclear fuel; and other chemical substances.
- Electricity & Water : Utilities comprise mainly three elements, namely electricity, water and gas. The services rendered to the economy include the supply of electricity, gas and hot water, the production, collection and distribution of electricity, the manufacture of gas and distribution of gaseous fuels through mains, supply of steam and hot water, and the collection, purification and distribution of water.
- **Construction :** This sector includes construction; site preparation and building of complete constructions or parts thereof; civil engineering; building installation; building completion; and the renting of construction or demolition equipment with operators all form part of the construction sector.
- **Trade :** Trade entails wholesale and commission trade; retail trade; repair of personal household goods; sale; maintenance and repair of motor vehicles and motor cycles; hotels; restaurants; bars canteens, camping sites and other provision of short-stay accommodation.
- **Transport & Comms :** The transportation and communication sector comprises land transport; railway transport; water transport; transport via pipelines; air transport; activities of travel agencies; post and telecommunications; courier activities; and storage.
- **Finance :** The economic activities under this category include, inter alia, financial intermediation; insurance and pension funding; real estate activities; renting of transport equipment; computer and related activities; research and development; legal; accounting, book-keeping and auditing activities; architectural, engineering and other technical activities; and business activities not classified elsewhere.
- **Government :** This sector includes public administration, defence and other government services at central, provincial and local level. (Note: for Labour figures this sector is included under Community Services below)
- Community Services : This sector includes social and related community services (education, medical, welfare and religious organisations), recreational and cultural services and personal and household services.
- **Other :** Private households, extraterritorial organisations, representatives of foreign governments and other activities not adequately defined. (Note: for Labour figures there is no "Other" category)

The labour distribution provides information on the sectoral distribution of formal economic activities, as do the GGP figures, but in addition, information is provided on the extent of informal activities, as well as dependency. Dependency may be assessed from unemployment figures, as well as by determining the proportion of the total population that is economically active.

- **Total :** The total economically active population consists of those employed in the formal and informal sectors, and the unemployed.
- Formal sector : Includes employers, employees and self-employed who are registered taxpayers.
- **Informal sector :** Includes people who are employers, employees or self-employed in unregistered economic activities, i.e. businesses not registered as such.

Unemployed : Includes people who are actively looking for work, but are not in any type of paid employment, either formal or informal.

ADDENDUM 3 : YIELD, RELIABILITY, AVAILABLE WATER AND ASSURANCE OF SUPPLY

The yield from a water resource system is the volume of water that can be abstracted at a certain rate over a specified period of time (expressed in million m³/a for the purposes of the NWRS). For domestic, industrial and mining use water is required at a relatively constant rate throughout the year, whereas strong seasonality occurs with respect to irrigation. Because of the typically large fluctuations in stream flow in South Africa, as demonstrated over a 12-month period in the diagram below, the highest yield that can be abstracted at a constant rate from an unregulated river is equal to the lowest flow in the river. By regulating stream flow by means of dams, water can be stored during periods of high flow for release during periods of low flow, as shown by the dotted lines on the diagram, This increases the rate at which water can be abstracted on a constant basis and, consequently, the yield. The greater the storage, the greater the yield that can be abstracted, within certain limits.



Diagrammatic presentation of stream flow and storage

Because rainfall, runoff and thus stream flow vary from year to year, low flows (and floods) are not always of the same duration and severity. The amount of water that can be abstracted without failure (the yield) therefore also varies from year to year. A yield that can be abstracted for 98 out of 100 years on average is referred to as a yield at a 98 per cent assurance of supply. Implicit in this is the acceptance that some degree of failure with respect to supplying the full yield will on average occur two years out of every 100 years. For a specific river and water resource infrastructure, the higher the assurance of supply required (or the smaller the risk of failure that can be tolerated), the smaller the yield that can be abstracted, and vice versa. For the purposes of the NWRS all quantities have been adjusted to a 98 per cent assurance, where applicable, to facilitate the legitimate numerical comparison and processing thereof. (Yields or water requirements are not directly comparable when at different assurances of supply, but first need to be normalised to a common standard.)

Available water refers to all water that could be available for practical application to desired uses. The total yield locally available includes the yield from both local surface water and groundwater resources, as well as contributions to the yield by usable return flows from the non-consumptive component of upstream water use in the area under consideration. Total water available includes the total local yield plus water transferred from elsewhere.

ADDENDUM 4 : ECOLOGICAL COMPONENT OF RESERVE

The ecological component of the Reserve refers to that portion of streamflow which needs to remain in the rivers to ensure the sustainable healthy functioning of aquatic ecosystems, while only part of the remainder can practically and economically be harnessed as usable yield. (Refer Addendum 2)

A summary of the mean annual runoff and the estimated average annual requirements for the ecological component of the Reserve per sub-area is given in Table 4. In the determination of water available for abstraction, allowance was made for maintaining the ecological flow requirements as pertain to drought conditions, which closely relates to the impact of the ecological component of the Reserve on the yield. All quantities relate to a particular sub-area only, that is, quantities reflect water that originates or is required in that particular sub-area. Where more than one sub-area or water management area is located along the same river, such as along the Vaal and Orange Rivers, the quantities from upstream have to be added to those of the area under consideration to reflect the actual, cumulative situation for the area under consideration.

Quantification of the water requirements for the ecological component of the Reserve, is based on the currently still incomplete understanding of the functioning of ecosystems and their habitat requirements. These figures are therefore subject to improvement as better insights are gained through monitoring, studies and improved assessment methodologies. Current provisional assessments indicate that, as a national average, about 20 per cent of the total river flow is required as ecological Reserve which needs to remain in the rivers to maintain a healthy biophysical environment. This proportion, however, varies greatly across the country, from about 12 per cent in the drier parts to 30 per cent in the wetter areas. Owing to a lack of better factual data, it has provisionally been assumed that provision of the ecological water requirements in the lowest reach of a river will be sufficient to meet estuarine freshwater requirements as well.

The component of the Reserve required for basic human needs has to be abstracted from the water resource and is therefore catered for under water requirements in Section 4.

ADDENDUM 5 : RECONCILIATION INTERVENTIONS

In line with the objectives of equitable and sustainable social and economic development, government has progressively adopted a more comprehensive and holistic approach to the planning of interventions to resolve problems of inadequate water availability. This approach accords with the requirements of national policies and legislation relating to the environment, and is informed by internationally accepted best practice.

Whenever there is a water shortage, all possible solutions will be investigated, taking account of the availability of surface and groundwater and the interactions between them, and the integration of water quality and water quantity issues. Options will include the following:

- Demand-side measures to increase water availability and improve the efficiency of water use, considered from the start of the planning process in parallel with other solutions.
- Re-allocations of water, including the possibility of moving water from lower to higher benefit uses by trading water use authorisations.
- The construction of new dams and related infrastructure, including inter-catchment transfers. Where infrastructure construction is indicated as an optimal solution, a range of alternative developments, including the implications of no development, will be presented.

The significant impacts of all development options and other interventions will be assessed and social and environmental considerations will be accorded the same attention as those of a technical, financial and economic nature. The social, environmental and economic impacts of all development options will be evaluated to ensure that the benefits arising from such actions will exceed the costs, that the benefits will be distributed equitably and that the negative impacts will be minimised or mitigated so that no-one is disadvantaged to any unreasonable extent.

In terms of the NWA comprehensive impact assessments may be required to determine the effect of proposed water uses on the water resource, and will be mandatory before a major government water work is constructed. Impact assessments will be undertaken in accordance with the regulations to the Environment Conservation Act, 1989, which are still in force under the National Environmental Management Act, 1998, until replaced by new regulations.

Water users, other stakeholders and the public a need to be involved at all stages of a development project or a scheme.

The main reconciliation interventions as given in the National Water Resource Strategy are :

- Demand management
- Improved water resource management
- Managing groundwater resources
- Re-use of water
- Control of invasive alien vegetation
- Re-allocation of water
- Development of surface water resources
- Inter-catchment transfers

Water quality considerations

ADDENDUM 6 : PRIORITIES FOR ALLOCATING WATER

Water is one of the most fundamental natural resources and it is one of the primary principles of the National Water Act that the nation's water resources are managed in such a manner that their use will achieve optimum long-term social and economic benefits for all people. Water is also a finite resource, and it is recognised that water allocations may have to change over time to meet this objective on an ongoing basis.

The NWA gives highest priority to water for the Reserve, which includes water for basic human needs and for the natural environment. Thereafter international obligations as agreed with neighbouring countries must be respected and honoured.

Beyond this, water should be allocated to ensure that the greatest overall social and economic benefits are achieved. But consideration must not only be given to this primary aim, but also to potential disbenefits to society where water is made available to competing optional uses. This applies both to long-term allocations for water use as well as to short-term curtailments in supply during periods of drought and temporary shortage. Where surplus or unused water exists, prioritisation need not apply, provided that the water is not used wastefully.

To facilitate the most beneficial utilisation of water, a general guide on priorities for water use is given below. The priorities are listed in descending order of importance, although the order may vary under particular circumstances.

- Provision for the Reserve.
- International agreements and obligations.
- Water for social needs, such as poverty eradication, primary domestic needs and uses that will contribute to maintaining social stability.
- Water for Strategic use.
- Water for general economic use, which includes commercial irrigation and forestry. In this
 category, allocation is best dictated by the economic efficiency of use. With the introduction of
 water trading, demand will automatically adjust over time to reflect the value of water in
 particular uses.
- Uses of water not measurable in economic terms. This may include convenience uses and some private water uses for recreational purposes, which are likely to be of low priority.

Additional factors to be considered in assessing priorities for the allocation of water are the level of assurance of supply required, the consumptiveness of use and the quality of return flows.

It is important to realise that all water use by a particular sector or user is unlikely to be of the same priority. Water to maintain primary production functions, for example, would be of higher value and priority than the additional water required for other uses in the same enterprise. This also relates to the efficiency of water use, with greater efficiency leading to a higher value of water. The same principle applies to a greater or lesser extent to all uses of water.

ADDENDUM 7 : INTER-CATCHMENT TRANSFER OF WATER

The National Water Act recognises both the relative scarcity of water in South Africa and the uneven and often unfavourable distribution of water resources in both space and time. The national government is therefore entrusted with the responsibility to effect the equitable allocation of water for beneficial use and to ensure that sufficient water is available to support the continued growth and wellbeing of the country. This includes the preparation of guidelines for the spatial redistribution of water as well as the actual implementation of inter-catchment transfer projects, where applicable.

An inherent benefit of linking the country's water resources over a large geographic area is that it can, in certain circumstances, help to manage the consequences of climatic variability through the transfer of water supplies to areas that may be suffering from severe drought conditions, from areas where the prevailing conditions are less critical. This not only helps to prevent disasters, but also provides the opportunity of operating the available resources in a systems context, thereby achieving an overall yield that is greater than the sum of the component parts.

The same technical, environmental, social and economic considerations as are applicable to any water resource development and use of water are applicable to inter-catchment transfers of water. Key considerations and items of specific relevance to inter-catchment transfers can be summarised as follows:

- Priorities for water use are stipulated in the NWA and are also contained in the NWRS. The highest
 priority in a catchment is to be afforded to the provision of water for the Reserve and to honouring
 international rights and obligations. Thereafter, consideration is to be given to the most beneficial use of
 water (actual and potential), both within the source and the (potential) recipient basins.
- The allocation of water away from a catchment can only be justified if it results in an overall benefit from a national perspective. Any negative impacts, or the loss of opportunity as a result of the transfer, must be outweighed by the advantages that are created. Full consideration must be given to any possible negative impacts in the source basin and all reasonable measures must be taken to mitigate such impacts in the interest of those affected.
- The maintenance of environmental integrity is of particular importance in all water resource developments. The inter-catchment transfer of water may have unique impacts on natural ecosystems that extend beyond those associated with in-catchment developments, and these need to be considered and provided for. In addition to comprehensive environmental impact assessments being undertaken in both the source and receiving areas, specific consideration must be given to the possible transfer of organisms and changes in habitat conditions.
- Interbasin transfers will only be permitted subject to water conservation and demand management by the relevant authorities and user organisation in the receiving region, conforming to the applicable criteria in this regard. Similarly, inefficient or non-beneficial use of water in a source basin cannot serve as reason for not transferring water.
- The transfer of water for the express purpose of meeting the requirements of the ecological component of the Reserve in the receiving catchment will not be considered.
- Water should not unduly be reserved over long periods of time for possible future use within or outside a
 catchment, in this way foregoing opportunities for the interim beneficial use of such water. Where
 appropriate, water use licences of short duration may be issued.
- In determining the volumes of water to be transferred from one catchment to another, water that is not
 already gainfully utilised and water resource potential still to be developed will be considered first. The
 re-allocation and inter-sectoral redistribution of water from existing to more beneficial uses should only
 be effected where merit can be demonstrated clearly on an economic and social basis.
- Conforming to the principle in the NWA that water is a national resource that belongs to all people, no
 payment is to be made to a source catchment for the actual water transferred. A portion of the water
 resource management charge raised in the recipient catchment will, however, revert to the source
 catchment and opportunities will be sought to mitigate any negative impact that may result.
- All costs associated with the transfer of water will be borne by the users of the transferred water. These include normal water use charges in terms of the prevailing pricing policy together with project and operational costs, as well as the cost of possible mitigatory measures.
- The national government will normally initiate, plan and authorise inter-water management area transfers.