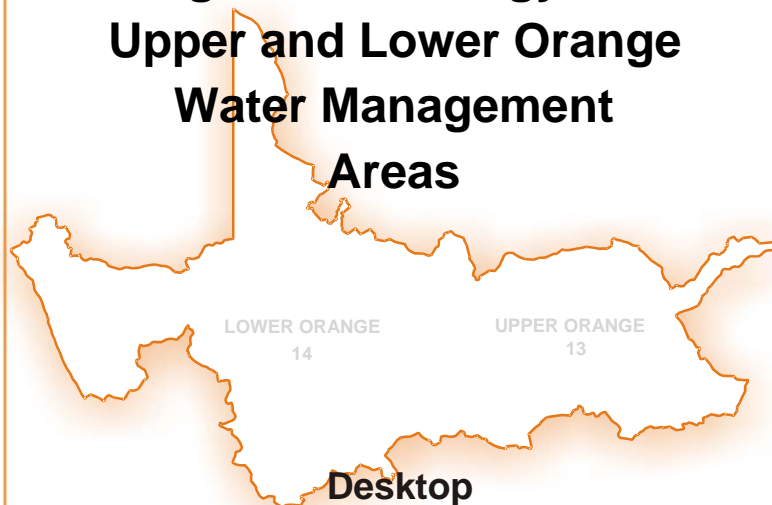




Water Resource Planning Systems

Water Quality Planning

Development of an Integrated Water Quality Management Strategy for the Upper and Lower Orange Water Management Areas

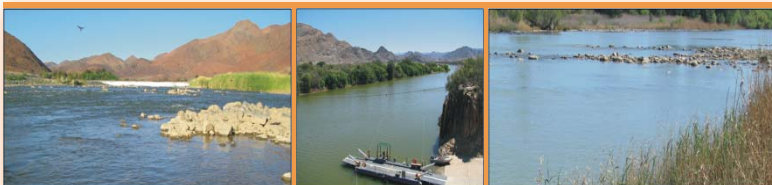


Desktop Catchment Assessment Study: Upper Orange Water Management Area (WMA 13)

Report No.: 2.1
(P RSA D000/00/7909/2)

August 2009

Edition 1



DEPARTMENT OF WATER AFFAIRS

Water Resource Planning Systems

**Development of an Integrated Water Quality Management
Strategy for the Upper and Lower Orange WMAs**

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Private Bag X313
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Tel: (012) 336 7500/ +27 12 336 7500

Fax: (012) 336 6731/ +27 12 336 6731

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DOCUMENT INDEX

Reports as part of this project:

REPORT NUMBER	REPORT TITLE
1*	Overview: Overarching Catchment Context: Upper and Lower Orange Water Management Areas (WMAs 13 and 14)
2.1*	Desktop Catchment Assessment Study: Upper Orange Water Management Area (WMA 13)
2.2*	Desktop Catchment Assessment Study: Lower Orange Water Management Area (WMA 14)
3**	Water Quality Monitoring and Status Quo: Upper and Lower Orange Water Management Areas (WMAs 13 and 14)
4.1*	Catchment Visioning: Upper Orange Water Management Area (WMA 13)
4.2*	Catchment Visioning: Lower Orange Water Management Area (WMA 14)
5**	Resource Water Quality Objectives (RWQOs): Upper and Lower Orange Water Management Areas (WMAs 13 and 14)
6**	Towards A Monitoring programme: Upper and Lower Orange Water Management Areas (WMAs 13 and 14)

* Reports produced by the Directorate, Water Resource Planning Systems, Sub-Directorate Water Quality Planning as part of the study titled *“Development of an Integrated Water Quality Management Strategy for the Upper and Lower Orange Water Management Areas”*.

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APPROVAL

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DATE: June 2009

AUTHORS: R. Stassen and S. Boshoff

REVIEWERS: J.J. van Wyk

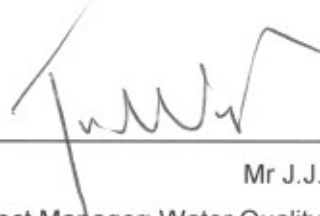
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Approved for the Department of Water Affairs by:



Mr J.J. van Wyk
Project Manager: Water Quality Planning



Mr P. Viljoen
Deputy Director: Water Quality Planning



Dr B. Mwaka
Director: Water Resource Planning Systems

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The following individuals are thanked for their contributions to the document:

Project Management Committee

Jurgo van Wyk	Department of Water Affairs	Project Manager
Retha Stassen	Department of Water Affairs	Project Co-ordinator
Samantha Boshoff	Department of Water Affairs	Project Co-ordinator
Pieter Viljoen	Department of Water Affairs	Project Director
Seef Rademeyer	Department of Water Affairs	Member
Sam Dywili	Department of Water Affairs	Member
Jackie van Bosch	Department of Water Affairs	Member

EXECUTIVE SUMMARY

This report documents a desktop level assessment of the Upper Orange Water Management Area (UOWMA). Due to this Water Management Area (WMA) covering a large area, the WMA was divided into four sub-areas: [1] Caledon River and its tributaries to Gariep Dam; [2] Orange River system from Lesotho to Gariep Dam; [3] Kraai River system; and [4] Gariep Dam to Marksdrift weir. The guidelines for these demarcations are provided.

The climate, geology, soils and characteristic vegetation of the UOWMA are discussed, emphasising the varying nature of this WMA described by high to low precipitation rates, with good precipitation in Lesotho also contributing to the basin. A preliminary examination of the hydrology of the system reveals that the tributaries to the main stem of the Orange River have medium to high mean annual runoffs. This has provided a strong motivation for the setting of Level 1 and 2 Resource Water Quality Objectives, i.e. for the main stem of the Orange River and its key tributaries.

The Orange River feeds several water supply schemes, which provide the livelihood for a range of activities in the catchment. These include rural, domestic and industrial activities. Water is also transferred out of the UOWMA to adjacent WMAs, such as to the Fish to Tsitsikamma WMA.

Unique characteristics for each of the sub-areas are discussed. These include water quality monitoring points, main towns, major weirs, dams or natural water features, key water uses and water users, and land use activities. Photographs and Google Earth images are provided to afford a visual overview of the WMA.

A discussion on the socio-economic profile and demographics of the region reveal that the UOWMA is a scarcely populated area, contributing a small percentage towards the Gross Domestic Product of South Africa.

The fact that the Upper Orange River is shared with Lesotho necessitates a careful consideration of international obligations and bilateral agreements. Key international stakeholders are identified in the Overarching Catchment Context (Report No. 1) and the need for international stakeholder engagement for future, higher confidence work is described.

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LIST OF ACRONYMS

CAS	Catchment Assessment Study
DTEEA	Department of Tourism, Environment, Economics and Agriculture
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
FSGDS	Free State Growth and Development Strategy
ISP	Internal Strategic Perspective
MAP	Mean Annual Precipitation
NWRP	National Water Resource Planning
NWA	National Water Act
NWRS	National Water Resource Strategy
UOWMA	Upper Orange Water Management Area
WMA	Water Management Area
WQP	Water Quality Planning
WWTW	Waste Water Treatment Works
WRPS	Water Resource Planning Systems

1 INTRODUCTION

The Upper Orange Water Management Area (UOWMA) consists of the main stem Orange River from where it exits Lesotho to the confluence with the Vaal River just downstream of the town of Douglas. This Water Management Area (WMA) lies mostly in the Free State province, but also includes portions of the Eastern and Northern Cape provinces. A number of smaller tributaries enter the Orange River with the Caledon and Kraai Rivers being the largest of these systems.

The Orange (Senqu) River originates in the Maluti mountains in Lesotho. However, Lesotho does not form part of this WMA. The Modder-Riet system is a tributary of the Vaal River, but forms part of this WMA. The total catchment area of the WMA is 103 671km².

Although a number of previous studies for the National Water Resource Planning (NWRP) directorate of the Department of Water Affairs (DWA) have been undertaken, no formal catchment assessment for water quality has been conducted for this WMA. The Water Resource Planning Systems (WRPS) directorate decided to undertake a desktop water quality Catchment Assessment Study (CAS) for the Orange River, including the Upper and Lower Orange WMAs. This report covers the results of the desktop water quality CAS that was undertaken for the Upper Orange WMA (UOWMA).

The results of this study are based on existing information from previous reports, including the water resources situation assessment that was undertaken as part of the Internal Strategic Perspective (ISP) process, information gathered during catchment visits undertaken to the catchment of the UOWMA and discussions with various DWAF officials from NWRP and the Free State Regional Office.

The objectives of this desktop assessment are to report on the following:

- Overview of the UOWMA, including the main characteristics of the water resources;
- Main activities in the UOWMA (uses and the major water users);
- Main impacts of these uses on the water resources;
- Stakeholders/ interest groups in the catchment that should form part of the proposed visioning process and to be included when catchment forums are formed;
- Main results of the ecological Reserve determination studies that have been undertaken; and
- An international perspective as the UOWMA is a shared watercourse with Lesotho.

No specific water quality analysis was undertaken as part of this study as this forms part of a separate study, namely "*Report No. 3: Water Quality Monitoring and Status Quo: Upper and Lower Orange Water Management Areas (WMAs 13 and 14)*".

The output of this desktop assessment will be used as baseline information for the visioning process that is planned for the UOWMA as well as to provide guidance for the proposed monitoring programme and RWQO sites identification to be undertaken as part of the abovementioned study.

The UOWMA has been divided into four distinct sub-areas for this desktop CAS (Figure 1) and are:

[Sub-Area 1] Caledon River from its head waters and its tributaries to Gariep Dam.

[Sub-Area 2] Orange River from the Lesotho Border to Gariep Dam, including the main tributaries namely Kornetspruit, Sterkspruit, Stormbergespruit and Brandwaterspruit.

[Sub-Area 3] Kraai River catchment.

[Sub-Area 4] Orange River from Gariep Dam to MarksdriftWeir just before the confluence with the Vaal River, including the Seekoei River, but excluding the Modder-Riet River system. The Modder-Riet system forms part of another initiative undertaken by the Free State Regional Office to develop an IWQS.

The characteristics of the flows, water quality and the aquatic ecosystems of the water resources in a catchment are influenced by both the natural physical characteristics and by the human activities that are undertaken in the catchment. For the purposes of this study, only the characteristics of the water resources within South Africa were considered and excluded Lesotho.

Both the Orange and the Caledon Rivers have their source in the mountains of Lesotho at elevations exceeding 3 000m, sloping gradually to 1 200m at the confluence with the Vaal River. The rainfall in the UOWMA is strongly seasonal with the highest rainfall occurring in summer between October and April. The Mean Annual Precipitation (MAP) follows a similar pattern with rainfall exceeding 1 000mm in the mountainous areas to as low as 200mm at Marksdrift Weir.

FIGURE 1
WMA 13 : UPPER ORANGE
Sub - Areas



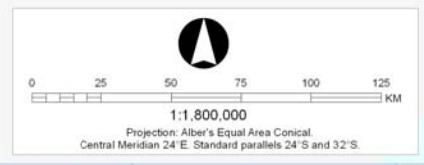
- LEGEND**
- Major City / Town
 - Town
 - Dam
 - River
 - Quaternary Drainage Region
 - Water Management Areas
 - Provincial Boundary
 - International Boundary

- Sub Areas**
- Sub Area 1
 - Sub Area 2
 - Sub Area 3
 - Sub Area 4

Data sources:
 Department: Land Affairs, Chief Directorate: Surveys and Mapping (Towns, Rivers, Dams and International Boundaries)
 Municipal Demarcation Board (Provincial Boundaries)
 Department: Water Affairs & Forestry (Water Management Areas and Drainage Boundaries)



Locality Map: WMA 13 (Upper Orange)



Map produced by:
 Department: Water Affairs and Forestry,
 Directorate: Spatial & Land Information Management
 March 2009 (Ref: GM08_078)

2 CLIMATE

The mean annual temperature ranges between 12°C in the east (mountains) to 18°C in the west (lower lying areas in the west) with the maximum temperature during summer in January and the minimum in July. Rainfall is predominantly characterised by summer thunderstorms. Annual precipitation rates are variable with the east of the WMA receiving approximately 1000mm/a and the west, as little as 200mm/a. Lesotho's rainfall, the main contribution of surface runoff to the Upper Orange Basin, experiences an annual rainfall of between 600 and 1500mm per annum (DWAF, 2004).

3 GEOLOGY, SOILS AND VEGETATION

The geology of the area consists mainly of extrusive igneous rocks of the Stormberg series described by mafic/basic lavas covering the eastern high lying areas with compact, dominantly argillaceous strata with small areas of tillite and sedimentary and extrusive rocks in the north-western part of the WMA. Fine sedimentary rocks of the Karoo system underlie the remainder of the WMA (DWAF, 2001).

Moderate to deep soils are present in the UOWMA with six main soil types, namely sandy-loam, clay, sandy and clay-loam (flat, steep and undulating relief). This, together with the climatic conditions supports the following main vegetation types: pure grassveld, false karoo, false bushveld and karoo and karroid (Acocks, 1988).

4 HYDROLOGY

The water resources of the UOWMA consist of the main stem Orange River with the Kraai, Kornetspruit, Sterkspruit, Stormbergespruit, Seekoei River and Caledon River as its main tributaries. The tributaries contributing to the flow in the Caledon River are the Little Caledon River, Grootsspruit, Meulsspruit, Moperi River, Leeusspruit, Skulpspruit and the Sandspruit. The four sub-catchments consist of a number of tertiary catchments, namely:

Sub-area 1 (Caledon): D21, D22, D23 and D24

Sub-area 2 (Upper Orange): D12, D14, D15 and D35

Sub-area 3 (Kraai): D13

Sub-area 4 (Middle Orange): D31, D32, D33 and D34

Note: Tertiary catchments in Lesotho and the Modder-Riet system are excluded from these sub-areas as it doesn't form part of this desktop assessment.

The natural Mean Annual Runoff (MAR) as simulated with the Pitman model and the catchment areas per sub-area as reported in the WR90 reports are provided in **Table 1**.

Table 1: Summary of catchment area and MAR per sub-area

Sub-catchment	Catchment area (km²)	MAR (million m³)
1. Caledon	21 884	650
2. Upper Orange	18 110	300
3. Kraai	9 354	656
4. Middle Orange	21 901	203
Total	71 249	1 809

5 MAJOR DAMS AND TRANSFER SCHEMES

The UOWMA is characterised by several large dams which provide a pivotal role in supplying water to users in the UOWMA as well as strategically important neighbouring catchments such as the Upper Vaal WMA. The major storage dams together with the major dams in Lesotho include:

- **Katse Dam:** Part of the Lesotho Highlands Water Project and used for transferring water to the Upper Vaal WMA.
- **Mohale Dam:** Part of the Lesotho Highlands Water Project and used for transferring water to the Upper Vaal WMA via Katse Dam.
- **Gariiep and Vanderkloof Dams:** Two of the largest reservoirs in South Africa and also supply hydro electric power.

The smaller dams include Armenia and Egmont Dams in the Caledon system, Welbedacht Dam on the main stem of the Caledon River and Knellpoort Dam – an off-channel storage dam supplementing water supply to Bloemfontein. Dams situated on the Modder River include Rustfontein, Mockes and Krugersdrift and on the Riet River – Tierpoort and Kalkfontein Dams.

Characteristic to the UOWMA are the large transfer schemes both from and within the WMA. Transfers out include the Lesotho Highlands Water Project (Upper Vaal WMA), the Orange-Fish Transfer (to the Fish / Tsitsikamma WMA) and the Orange-Vaal Transfer (to the Lower Orange WMA). Transfers within occur from the Orange and Caledon Rivers to the adjacent Modder / Riet catchment.

6 SPECIFIC FEATURES

A number of nature reserves and conservation areas exist in the UOWMA, with the Golden Gate National Park and the Tussen-2-Riviere Nature Reserve the most well-known. The famous Tiffendell Ski Resort also falls within the upper reaches of the Kraai (Bell) River on the border with Lesotho.

7 CATCHMENT CHARACTERISATION

The main catchment developments, water uses and users as well as the impacts, especially impacts on the water quality are described in this section of the report. These are described for each of the sub-areas separately.

7.1 [Sub-Area 1] Caledon System

Several towns are situated in this sub-area, supporting, mainly the agricultural and tourism sectors. The main towns that are dependant on the surface water resources for domestic use are Clarens, Fouriesburg, Ficksburg, Clocolan, Ladybrand and Wepener. Both the Little Caledon (a tributary to the Caledon River) and the Caledon Rivers (Figure 2) form a border between the Kingdom of Lesotho and the Republic of South Africa. Maseru, the capital of Lesotho, relies on the water from the Caledon System for domestic and industrial use, as well as local stock watering.

The main agricultural produce is asparagus, cherries, maize, wheat, lucern, other fruit and vegetables and pastures. Cattle farming are also a major activity in this sub-catchment. A number of dams in the catchment have been constructed on tributaries to provide water for irrigation purposes, especially in the Leeuspruit catchment where the Armenia Dam provides water for the Leeu River Irigation Board. Other dams in the sub-area are the Meulspruit (Figure 3), Lovedale, Egmont, Newbury and Moperi dams.

Welbedacht Dam is the largest dam in this sub-catchment and provides domestic water for the larger Bloemfontein area via the off-channel Knellpoort Dam in the upper reaches of the Modder River (NOVO scheme). Water is abstracted at Tienfontein pump station just upstream of the dam to Knellpoort Dam. A pipeline also exists from Welbedacht dam that transfers water to the Bloemfontein area (Caledon-Bloemfontein transfer scheme).

The transfer canal from Katse Dam to the Ash River outfall can be used to release water into the Little Caledon River during periods of no flows in the Caledon River to supplement the transfer schemes to Bloemfontein.

The main impacts on the quality of the water resources are localized nutrient enrichment from return flows of Waste Water Treatment Works (WWTW) of the towns that are either not effectively operated or where upgrading of the infrastructure is required. Some return flows from the irrigation could also impact on the water quality of the rivers.

However, sedimentation is the biggest problem in this catchment (Figure 4), especially in the main stem Caledon River. This is due to erosion problems such as over-grazing and land use practices within South Africa and Lesotho. The sedimentation problem has resulted in the loss of almost 100% of the full supply capacity of Welbedacht Dam that was reduced from 114 million m³ to 15 million m³.



Figure 2: Gauging weir on the Caledon River, at the confluence with the Little Caledon River.



Figure 3: Meulspruit Dam. The Meulspruit is a tributary to the Caledon River, downstream of the town Ficksburg.



Figure 4: Caledon River upstream of Ficksburg (bordering with Lesotho) showing partially eroded banks and the consequences of high sedimentation rates.

7.2 [Sub-Area 2] Upper Orange River system

This catchment is relatively un-developed and sparsely populated with only a number of communities situated in the upper reaches of the Sterkspruit, the greater Hershell area (Figure 5). The Kornetspruit (also Makhaleng River) (Figure 6) forms the border with Lesotho and a number of communities in Lesotho are in close proximity of the river.

Other towns situated in Sub-Area 2 are Burgersdorp, Aliwal North, Molteno, Bethulie, Jamestown, Venterstad and Springfontein. In these towns domestic water supply is mainly from the rivers supplemented by groundwater when necessary.

The main agricultural produce is maize, wheat and pastures. Cattle and sheep farming are also a major activity in this sub-area, with a number of game farms.

The Jozanna's Hoek Dam has been constructed in the head waters of the Sterkspruit to supply water to the greater Hershell area. The only other dam in this sub-area is Gariep Dam (Figures 7 and 8). Water is transferred from Gariep Dam to the Eastern Cape via the Orange-Fish transfer scheme. The inlet for this scheme is at Oviston on the banks of the dam. Water is also released from Gariep Dam for hydro power generation during peak use of electricity.

The main impacts on the quality of the water resources are in the greater Hershell area on the Sterkspruit and its tributaries. Nutrient enrichment from return flows of Waste Water Treatment Works (WWTW) of the other towns, e.g. Burgersdorp (Stormbergespruit) in the sub-area could also be a problem.

Return flows from the irrigation, especially next to the main stem Orange River impact on the water quality of the Orange River as well as Gariep Dam where algal blooms have been reported.

Sedimentation is also a problem in this catchment, especially in the main stem Orange River. This is due to erosion problems such as over-grazing and land use practices within South Africa and Lesotho (Figure 6). Large areas of the Sterkspruit catchment also show signs of erosion, and will contribute to the sediment problems in the Orange River.

Figures 5 to 7 provide an indication of the activities in sub-area 2.



Figure 5: Upper reaches of the Upper Orange River System showing a rural community in the foreground and the Lesotho mountains in the background.



Figure 6: Kornetspruit illustrating eroded banks and high sediment loads.



Figure 7: The impressive Gariep Dam Wall



Figure 8: Oviston inlet tower situated on Gariep Dam.

7.3 [Sub-Area 3] Kraai system

The Kraai River system is un-developed in terms of any major towns, irrigation or industrial activities. Only small scale irrigation occurs along the banks of the Kraai River and its tributaries. Most of the irrigation is rain-fed with irrigation supplementing during dry periods.

The main towns that are dependant on the surface water resources for domestic use are Rhodes, Barkly East and Lady Grey. Boreholes are also used as a supplement for domestic use if required.

The main agricultural produce is maize, wheat, lucern and pastures. Cabbage and potatoes are also produced on a small scale in some of the areas. The main agricultural developments are along the lower reaches of the Kraai River. Water for irrigation purposes are abstracted from the Orange River and any return flows will impact on the Orange River rather than the Kraai River.

No large dams are currently in this catchment, although the possibility of a dam in the lower part of the Kraai River, close to the confluence with the Orange River is being investigated.

The water quality of the resources of the Kraai sub-area is in a near pristine state (Figure 9). The main impacts on the quality of the water resources are localized nutrient enrichment from return flows of Waste Water Treatment Works (WWTW) of the towns, especially from Barkly East as the works are not effectively operated. Some return flows from the irrigation could also impact on the water quality of the rivers.

An overview of the catchment is provided in **Figures 9 & 10**.



Figure 9: Near pristine state of the Kraai River

7.4 [Sub-Area 4] Middle Orange River System

This area is relatively un-developed and sparsely populated. No major towns are situated in this area. The main development within this sub-area is irrigation, mainly with water from the Orange River. Most of the irrigation occurs in close proximity of the river. The main produce is maize, wheat and lucern. Pecan nuts, soya and vegetables are produced in some areas.

The main towns that are dependant on the surface water resources for domestic use are Colesberg, Hopetown, Vanderkloof, Orania, Koffiefontein, Jacobsdal and Luckhoff.

Small scale diamond mining also occurs at Koffiefontein and along the banks of the Orange River from Hopetown to Douglas (Figure 10).

Vanderkloof Dam is the largest Dam in this sub-catchment (Figure 11) and supplies water for a number of irrigation schemes and also releases water for hydro power generation. The main transfer schemes are:

- Orange-Riet scheme where water is released from Vanderkloof Dam into the Orange-Riet canal for irrigation and urban supply at Koffiefontein, Ritchie and Jacobsdal.
- Orange-Vaal transfer scheme that transfers water from Marksdrift to the Vaal River for irrigation purposes.

The impacts on the quality of the water resources are localized nutrient enrichment (Figure 12) from return flows of Waste Water Treatment Works (WWTW) of the towns that are either not effectively operated or where upgrading of the infrastructure is required. Return flows from the irrigation impacts on the water quality of the Orange River with subsequent algal blooms in the river. Marksdrift (Figure 13) weir was used as the “boundary” between the UOWMA and the Lower orange WMA.



Figure 10: Alluvial diamond prospecting on the banks of the Orange River



Figure 11: Vanderkloof Dam



Figure 12: Intensive algae growth on the Seekoei River indicative of localised nutrient enrichment



Figure 13: Marksdrift Weir on the main stem of the Orange River

8 SOCIO-ECONOMIC PROFILE AND DEMOGRAPHICS

The UOWMA contributes approximately 5% to the Gross Domestic Product (GDP) of South Africa. The largest contributing sectors in terms of Gross Geographic Product (GGP) (as per 1997 figures) are (DWAF, 2004):

- Government	24.6%
- Finance	16.0%
- Trade	15.7%
- Transport	14.4%

The capital city of the Free State is Bloemfontein and serves as an economic hub for the LOWMA, generating nearly 64% of the GGP for the LOWMA. Bloemfontein is centrally situated providing a favourable stopover for Cargo transported around the country, and hence, is likely to be stimulated by increasing economic activity elsewhere in the country (2003). The town also provides a key functional role for this WMA through governmental services, such as tertiary institutions, the Appeal Court and major hospitals. The Free State area in general has a large number of towns, which has implications for the improvement of water provision and water services, including water supply and sanitation.

Statistics for the Free State Province, a large portion of which is contained within the UOWMA reveal that it has a high unemployment rate – 38.9%, just below the national average of 40.8% and close to 49% of the population are living in poverty. This is corroborated by the relatively low per capita income level of R11 854 compared to R17 164 for South Africa and R32 356 for Gauteng (2002 statistics - FSGDS, 2005). Provincial percentages further reveal that the majority of the population (53%) live in secondary or small towns, whereas 20% live in metropolitan areas and 27% in rural areas (2000 statistics – Elsenburg, 2005).

The Free State Growth and Development Strategy (FSGDS, 2005) further outlines primary development objectives focusing on, amongst others, economic growth and social development. These are briefly discussed in Report No.1, *Overarching Catchment Context for the Upper and Lower Orange WMAs*.

9 RELEVANT STAKEHOLDERS

A number of stakeholders/ interest groups were identified that should be involved during the visioning process and to be invited to catchment forums when established. These stakeholders should have a good understanding of the catchment and be able to provide information and assist with the formulation of the catchment visions that will be developed.

A list of initial stakeholders was identified to be included as part of the visioning process and are listed in **Table 2**.

Table 2: List of identified stakeholders

Sub-Area 1	Sub-Area 2	Sub-Area 3	Sub-Area 4
Caledon	Upper Orange	Kraai	Middle Orange
DWAF: WRPS	DWAF: WRPS	DWAF: WRPS	DWAF: WRPS
DWAF: NWRP	DWAF: NWRP	DWAF: NWRP	DWAF: NWRP
DWAF: Free State Regional Office	DWAF: Free State Regional Office	DWAF: Free State Regional Office	DWAF: Free State Regional Office
DTEEA	Breakaway Trials DTEEA	DWAF: Eastern Cape Regional Office	DWAF: Vanderkloof Dam
Bloemwater	Maletswai, Gariep Municipalities	DTEEA	DTEEA: Environment
Dihlabeng, Setsoto, Mantsopa Municipalities	Eskom	Senqu Municipality Barkly Oos Agricultural Union	Eskom Vanderkloof Boat Club
Lesotho – Letseng Diamonds	Bloemwater	Barkly Oos Farmers Association	Bloemwater
Leeuspruit Irrigation Board	Agricultural Unions	Bell River Farmers Association	University of Free State
Vrystaatse Watersake	Farmer associations	Rhodes Agricultural Union	Thembelihle, Letsemeng Municipalities
Oewerbesproeiings kommittee			Orania Vanderkloof Farmers Association

10 RESERVE DETERMINATION STUDIES

The purpose of a Reserve determination study is to provide the ecological requirements of the water resources that will assist managers to protect the water resources while allowing economic development. The results provide information on the quantity of water and timing, requirement for water quality, habitat and biota.

These studies can be undertaken at various levels of detail and confidence. These studies can be on a desktop, rapid, intermediate or comprehensive level.

Only desktop and rapid Reserve determination studies have been undertaken for the water resources of the UOWMA and are summarised in Table 3 below. The status of surface water Reserve determinations is presented visually in Appendix A.

Table 3: Summary of Surface Water Reserve Determinations for the Upper Orange WMA.

	River Name	Determined for Quaternary Catchments:
Desktop Surface Water Reserves	Tierpoort	C51D, C51E
	Riet	C51K, C51L, C51M
	Modder	C52B, C52E, C52G, C52K, C52L
	Unnamed tributary to the Orange River	D12B
	Renosterpruit	C52F
	Orange	D12F, D14A, D14J, D31E, D35H
	Bell	D13B
	Rifle	D13C
	Langkloof	D13D
	Kraai	D13E, D13F, D13G, D13H, D13M
	Holspruit	D13J
	Stormbergspruit	D14C
	Barnardspruit	D14G
	Lesotho	D18G
	Leeuspruit	D23C
	Caledon	D24G
	Seekoei	D32K
Vanderwaltsfonteinpruit	D34F	
Brakspruit	D35G	
Intermediate Surface Water Reserves	Fouriespruit	C51A
	Riet	C51G
	Little Caledon	D21D, D21E
	Grootspruit	D21G
	Caledon	D21H, D22H, D24E
	Meulspruit	D22A, D22B
	Leeuspruit	D23D
	Rietspruit	D23H
Orange	D34G	

11 AN INTERNATIONAL PERSPECTIVE

The UOWMA forms part of the Orange-Senqu River Basin and hence, is a shared water course, not only with Lesotho in the upper reaches, but also with Botswana and Namibia in the Lower Orange WMA. Hence, a consideration of the international obligations and bilateral agreements is imperative. These are outlined in the Overarching Catchment Context (Report No.1 of this series). Due to the logistical and political implications of international stakeholder engagement, and due to the foundational nature of this report series, a decision was taken to engage international stakeholders only as part of future work in the catchment, once a comprehensive terms of reference is established for a higher confidence study such as the establishment of an Integrated Water Quality Management Strategy for the Orange River Basin. However, the Overarching Catchment Context (Report No.1) still serves as a useful tool in identifying the relevant stakeholders that would need to be part of such engagements.

12 CONCLUSION

The particular report constitutes a desktop assessment of the Upper Orange Water Management Area and serves to highlight and summarise some key aspects of the area. However, it is necessary that this report be followed-up with a higher resolution investigation that is seen to culminate in an integrated water quality management strategy for the Upper and Lower Orange WMAs.

13 REFERENCES

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APPENDIX A: STATUS OF SURFACE WATER RESERVE DETERMINATIONS: WMA 13, UPPER ORANGE

Status of Surface Water Reserve Determinations WMA 13 Upper Orange

Map Description:
This map depicts the current status of surface water Reserve determinations for the defined region (see version information below). The map should be interpreted together with the associated tables. Where Quaternary catchments are shaded it serves only as an indication that one or more Reserve has been approved within that catchment, and should not be interpreted as representative of the entire area.

- LEGEND**
- City / Town
 - Dam
 - River
 - Provincial Boundary
 - International Boundary
 - WMA Boundary
 - Roads**
 - National Road
 - Arterial Road
 - Main Road
 - Drainage Regions**
 - Primary Drainage Region
 - Secondary Drainage Region
 - Tertiary Drainage Region
 - Quaternary Drainage Region
 - Reserves**
 - Comprehensive
 - Intermediate
 - Rapid
 - Desktop
 - EWR Site on Comprehensive
 - EWR Site on Intermediate
 - EWR Site on Rapid Level
 - EWR Site on Desktop Level
 - Gauging Station

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Data on provincial boundaries was obtained from the Municipal Demarcation Board (Feb2006).
Data on Drainage Regions and Water Management Areas is available from the Department of Water Affairs and Forestry.
Data on reserve determinations was prepared by the Directorate Resource Directed Measures, Department of Water Affairs and Forestry.

Disclaimer:
Although the greatest care has been taken to ensure that this map is up to date and accurate, the Department of Water Affairs and Forestry gives no warranty, express or implied, as to the accuracy, reliability, completeness or utility of this information.



Locality Map : WMA 13: Upper Orange

This map was designed for:
Resources Directed Measures (RDM)
by:
Spatial & Land Information Management (SUM)
Geographic Information and Archiving
Cartographic Services

Surface Water Reserve Status Map:
Task: GM07_266
WMA: 13
Version: 2
RDM Audit Date : November 2007
Map Date: December 2007
Plotfile: RDM_WMA13_v2_2007.jpg

