CHAPTER 3
SUB-AREA PERSPECTIVES

This chapter contains detailed information on each of the six sub-areas within the Olifants/Doorn WMA. It outlines the defining physical characteristics, discusses the water balance and future requirements, and highlights the main perspectives that drive the strategies relating to each sub-area, and to smaller sub-management areas (e.g. rivers) within it.

3.1 UPPER OLIFANTS SUB-AREA (E10A-G)

3.1.1 Location

The Olifants River (E10A-G) rises in the Cederberg Mountains at the southern edge of the WMA and provides the most significant contribution to available water in the WMA. The Upper Olifants has a catchment of 2 888 km^2 which drains to the Clanwilliam Dam. The sub-area falls within the Cederberg Municipality (see **Figure 3.1**).

3.1.2 Groundwater

The area is dominated by the Table Mountain Group which forms the high ridges of the Cederberg. The TMG fractured-rock aquifers provide an important base flow contribution to surface water drainage. There is evidence that groundwater in the coastal plain of the WMA is linked to the high mountain-recharge water found in this sub-area. This relationship should be considered when contemplating groundwater utilisation in the Upper Olifants sub-area. Groundwater quality varies significantly depending on the aquifer it is being drawn from and hot springs in the area indicate deep groundwater flow.

The groundwater yield (groundwater in use) was estimated in the NWRS to be 4 million m^3/a. In reviewing the groundwater literature it appears that the NWRS figures account for the resource in alluvial and fractured rock aquifers only and do not include the resource available from the deep aquifers in the Table Mountain Group Sandstones. Based on the studies and best understanding and knowledge within the Department, it was agreed that 20 million m^3/a should be used (see **Section 4.1** and **Appendix 4**).

UPPER OLIFANTS SUB-AREA MAIN FEATURES:

Main Rivers:
- Olifants River (E10);
- Rondegat River (E10G)
- Boontjies River (E10D)

Towns: Citrusdal, Clanwilliam.

Main dams:
- Clanwilliam Dam (122 million m³) in E10G;

Some identified schemes:
- Groundwater schemes
- Raising of Clanwilliam Dam
- Rosendaal Dam
- Grootfontein Dam

Transfers:
- Transfer to the Lower Olifants

Major conservation areas:
- Cederberg Conservancy
- Cederberg Wilderness Area
- Groot Winterhoek Nature Reserve
- Cederberg (Hexberg) Nature Reserve

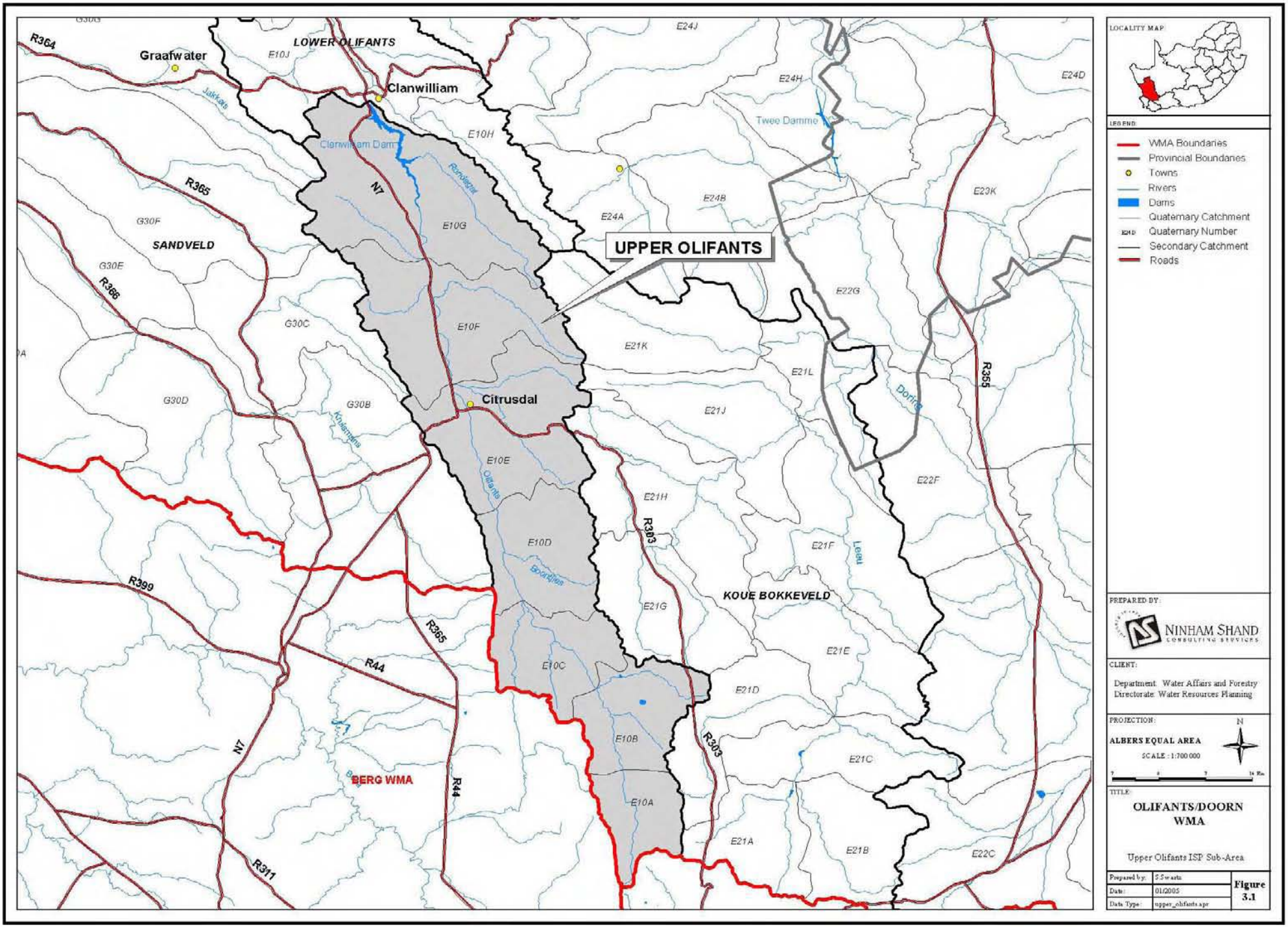

Figure 3.1: Upper Olifants Sub-area

Appendix 4 summarises findings of recent studies and details the arguments for groundwater availability to be significantly higher than given in the NWRS. The estimates of unused groundwater potential in this sub-area and the rural nature of the population suggest that groundwater could contribute to widespread provision of water for the basic human needs, as well as an allocation for irrigation via a conjunctive-use scheme with or without the raising of the Clanwilliam Dam.

3.1.3 Water Resources Availability

A summary of the water resources is given in **Table 3.1.** The cumulative MAR for the Upper Olifants sub-area is 437 million m^3/a. The average mean annual precipitation (MAP) for the key area is about 460 mm. The current estimates of the average annual volume of flows required satisfying the ecological water requirements of the preliminary Reserve are as shown in **Table 4.2** and **Appendix 3**.

Updates since the NWRS: Reserve

The 2003, *Olifants Doring River Basin Study Phase 2* provided a rapid Reserve. This figure was adopted rather than the desktop estimate used by the NWRS as it is more accurately calculated for the conditions in this WMA. Refer to the discussion in **Chapter 4**.

Table 3.1: Upper Olifants Yield Balance

Resource	*Million m^3/a at 1:50 yr assurance*
Water Availability	
Gross surface water yield	**188**
Subtract	
- Ecological Reserve	**14**
- Invasive alien plants	**5**
Net surface water yield	**169**
Groundwater	**20**
Return flows	**8**
Total local yield	**197**
Transfer in	**0**
Total Available Water	**197**
Requirements	
Irrigation	**100**
Urban	**1**
Rural	**1**
Industrial / mining	**0**
Afforestation	**1**
Total local requirements	**103**
Transfer out	**94**
Total Water Requirements	**197**
Reconciliation	
Yield Balance	**0**

Invasive Alien Plant Control: Invasive alien plants occur mainly in the riparian zone. The impact of invasive alien plants on the yield in this sub-area is 5 million m^3/a. Although infestation is not heavy in most parts of the sub-area, the mountainous nature of the area makes it costly to clear invasive alien plants. As part of good catchment management invasive alien plant infestations should be systematically removed to limit future impact. Eradication would provide the benefit of increasing the base flows of the rivers. The cost of eradication should be borne by direct beneficiaries or, if none can be identified, by catchment management charges.

Figure 3.2: Irrigation release from Clanwilliam Dam

3.1.4 Current Water Requirements and Use

Irrigation: In the upper reaches of the Olifants River numerous small farm dams have been constructed for the irrigation of fruit and vegetables. A large proportion of irrigated land is under citrus, with a small proportion under deciduous fruit, which is the economic mainstay in the Olifants River Valley. The area under irrigation is approximately 11 100 ha at a scheduled quota of 11 100 m^3/ha/a. There are limited measurements to determine abstracted water volumes used by irrigated agriculture. Ongoing efforts to enhance the efficiency of irrigation should be encouraged to maximise the available resource.

Groundwater is being increasingly used to supplement summer shortfalls in irrigation water supplied from the river, particularly in the river reach upstream of the Clanwilliam Dam (E10D-F). The 94 million m^3/a let out from the dam to the Lower Olifants sub-area is considered a transfer from this sub-area.

Supply to towns: The main towns in the catchment are Clanwilliam and Citrusdal. Clanwilliam is supplied from Clanwilliam Dam and the Jan Dissels River, whereas Citrusdal is supplied from the Olifants River. Citrusdal has experienced periods of failure in surface water supply from the Olifants River in summer, and now augments supply from high-yielding boreholes (>20 ℓ/s) in the Boschkloof wellfield. Urban use accounts for 1 million m^3/a.

Commercial forestry: Approximately 766 ha of commercial forestry occurs in this sub-area. No further forestry is envisaged. Further forestry licences should not be recommended.

3.1.5 Yield Balance

The yield balances in the sub-area are shown in **Table 3.1**. The total available yield in this sub-area is 197 million m^3/a. The requirements are 197 million m^3/a. The sub-area is therefore in balance.

3.1.6 Future Water Requirements

Irrigation

There is demand for growth in agriculture in the Upper Olifants. There is pressure from resource-poor farmers to be given land and water allocations. Water trading should be encouraged to accommodate this need or further resource development should be undertaken. There is insufficient storage to provide for agricultural use during the dry summer and the low flows are pressurised by ongoing peak demand. A higher percentage of existing lawful use should be stored during winter high flows in off-channel storage dams instead of using scarce summer flows. No further licences for additional use are being encouraged until the EWRs have been established.

Urban use

The towns of Citrusdal and Clanwilliam are in this sub-area. There is moderate pressure for growth. The investigations into the raising of Clanwilliam Dam and groundwater sources will provide options for augmenting town supplies.

3.2 KOUE BOKKEVELD SUB-AREA [E21]

3.2.1 Location

The sub-area forms part of the southern boundary of the WMA. It lies between the Koue Bokkeveld and southern Cederberg mountain ranges on the west (E10 boundary), and the Swartruggens Mountain Range on the east (E22 boundary). There is only the small town of Op-die-Berg in this sub-area. There is intensive agricultural development, mainly deciduous fruit and vegetables.

The Koue Bokkeveld has several rivers which feed into the Doring River. The most notable of these are the **Groot River** (E21F), **Matjies River** (E21L) and the **Riet River** (E21). The Koue Bokkeveld has a catchment of 3072 km^2.

3.2.2 Groundwater

The sub-area is underlain by formations of the Table Mountain Group (TMG), Bokkeveld Group and Witteberg Group. Younger alluvial deposits occur in restricted areas around the river flood plains. The most important aquifers are the Peninsula, the Nardouw and the Witteberg quartzites. These aquifers range between 100 – 200 meters thick thus having significant storage potential. High rates of recharge occur in the fractured rock aquifers from rainfall and snow melt.

The groundwater quality varies, depending on the aquifer being utilised, but is of fairly good quality if not being drawn from the Karoo rocks. Numerous boreholes have been drilled around the TMG-Bokkeveld contact here. There is potential to increase the utilisation of the deeper Peninsula and Witteberg Aquifers. Groundwater for the sub-area is discussed in detail in **Appendix 4.**

KOUE BOKKEVELD SUB-AREA MAIN FEATURES:

Main Rivers:
- Groot River (E21F)
- Matjies River (E21L)
- Riet River (E21)

Towns: Op-die -Berg

Main dams:
- Jakkals Dam in E21C
- Lochlynne Dam in E21A

Some identified schemes:
- None

Transfers:
- None

Major conservation areas:
- Cederberg Wilderness Area & Conservancy
- Matjiesrivier Nature Reserve
- Hottentotskloof
- Swartruggens Conservancy

3.2.3 Water Resources Availability

The average MAP for this sub-area is 413 mm and the cumulative natural MAR is 279 million m^3/a. The resource availability is summarised in **Table 3.2.**

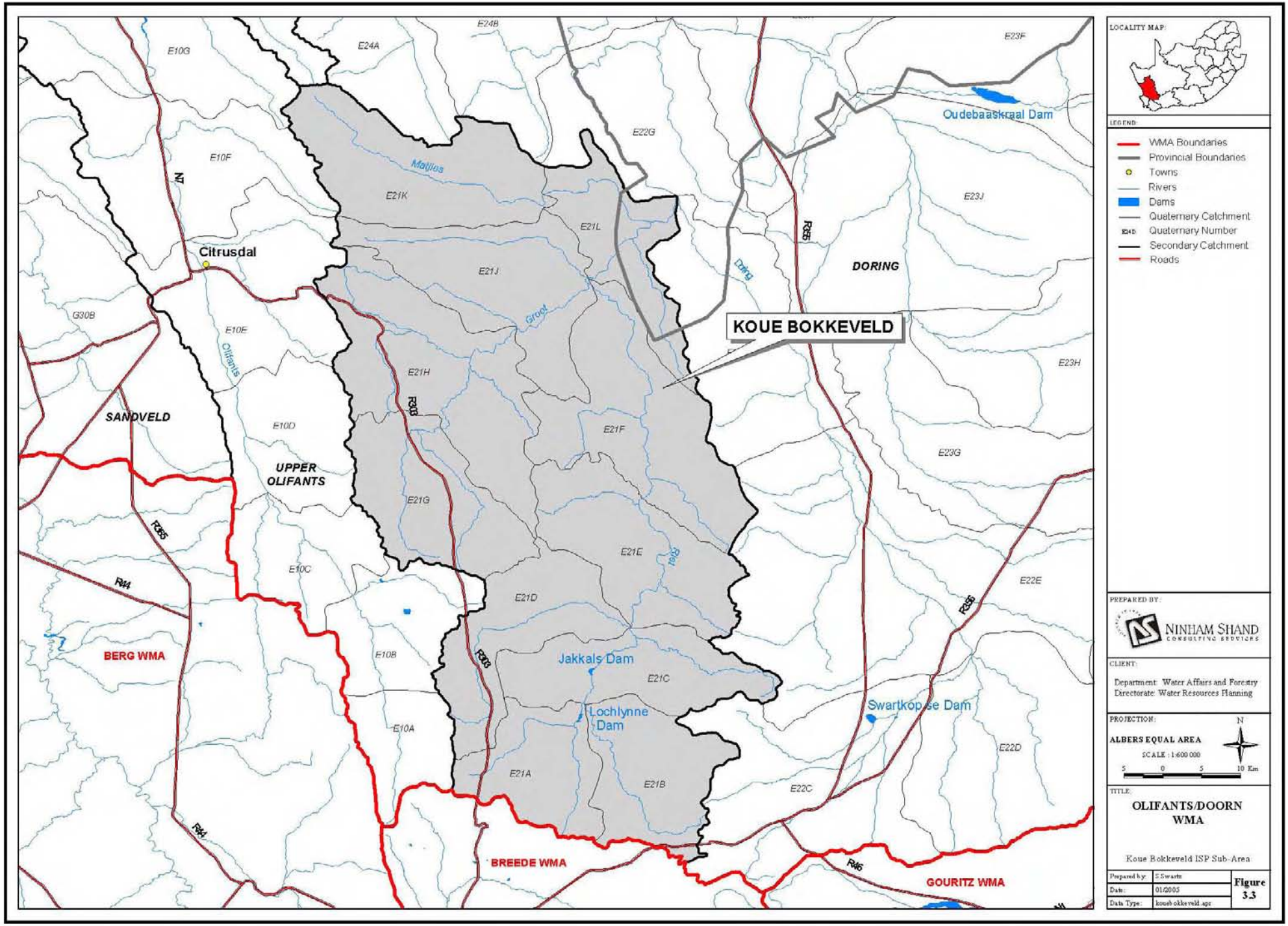

Figure 3.3: Kouebokkeveld Sub-area

Invasive Alien Plant Control: Invasive alien plant infestations account for 1 million m^3/a impact on the yield. Black wattle infestations in the Middleberg Pass and Pine infestations in the Groot River are significant. As part of good catchment management IAPs should be controlled, as this area is prone to rapid invasion of the mountainous terrain which would lead to costly removal.

Table 3.2: Koue Bokkeveld Yield Balance

Resource	*Million m^3/a at 1:50 yr assurance*
Water Availability	
Gross surface water yield	**60**
Subtract	
- Ecological Reserve	**0**
- Invasive alien plants	**1**
Net surface water yield	**59**
Groundwater	**5**
Return flows	**3**
Total local yield	**67**
Transfer in	**0**
Total Available Water	**67**
Requirements	
Irrigation	**65**
Urban	**0**
Rural	**1**
Industrial / mining	**0**
Afforestation	**0**
Total local requirements	**66**
Transfer out	**0**
Total Water Requirements	**66**
Reconciliation	
Yield Balance	**1**

3.2.4 Current Water Requirements and Use

Irrigation: The Koue Bokkeveld catchment has been extensively developed for the cultivation of deciduous fruits and vegetables. Irrigation constitutes 98% of water use in the sub-area. Irrigation water is stored in a large number of farm dams and accounts for the total gross surface water resource as shown in **Table 3.2**.

Supply to towns: There is only the small town of Op-die-Berg in the Koue Bokkeveld.

3.2.5 Water Balance

The water availability and water requirements are approximately in balance. The agricultural sector is the largest water use sector in the catchment using 98% of the water. The total yield available in the sub-area is calculated as 67 million m^3/a and the total current requirements are estimated at 66 million m^3/a. The sub-area therefore has a small surplus of 1 million m^3/a and can be regarded as essentially in balance.

Figure 3.4: Many of the mountain streams of the Koue Bokkeveld are pristine.

Figure 3.5: The Cederberg and Swartruggens are rich in San rock art.

3.2.6 Future Water Requirements

Irrigation

There is increasing demand in the area for agricultural expansion. In the Olifants Doring River Basin Study Phase 1 (1998) the cost benefit ratio for the Koue Bokkeveld farm developments was substantially higher than that calculated for other proposed schemes.

However, in the Basin Study report it was recommended that a total limit of 950 ha should be placed on the approval of further irrigation licences. A period of seven years (1998-2005) was allowed for setting the Reserve for the re-assessment of the major developments along the Doring River, after which the situation would be reviewed.

Once the EWR has been determined the potential for increased storage of winter water can be assessed. The groundwater-surface water interactions need to be considered prior to contemplating increased groundwater use. However, there is potential in the deeper TMG aquifers. The limiting of new irrigation licences (to a total of 950 ha) should be reconsidered before the end of 2005.

3.3 DORING SUB-AREA [E22, E23, E24, E40A – D]

3.3.1 Location

The sub-area forms part of the southern and eastern boundaries of the WMA. The Doring River rises in the E22 catchments. It meets with the Olifants River (E23F-H) below the Bulshoek Weir. This sub-area incorporates the Doring River, the Tankwa River and the Oorlogskloof River catchments. The sub-area has a catchment area of 20 970 km^2 (see **Figure 3.6**).

3.3.2 Groundwater

This area is on the boundary between Cape Fold Mountain rocks and those of the Karoo. It is underlain by formations of the Witteberg Group, Dwyka Formation, Ecca Group, and lower Beaufort Group. The Dwyka and the Ecca Formations form fractured rock aquifers. Rainfall patterns in this region are such that infrequent flood events recharge the aquifers. Baseflow into the rivers is ecologically important to species which over-summer in pools in the riverbed. There is uncertainty regarding the groundwater usage in the area. Much of the groundwater is of very poor quality and given the relatively low yield estimates would be capital intensive to develop for any large-scale supply. However, for small-scale supply some parts of the sub-area are reliant on groundwater and it is believed that further exploitation potential exists. Groundwater for the sub-area is discussed in detail in **Appendix 4.**

DORING SUB-AREA MAIN FEATURES:

Main Rivers:
- Doring River (E24)
- Tankwa River (E23)
- Tra-Tra River (E23K)
- Groot River (E22)
- Biedou River (E24J)
- Koebee River (E24M)
- Brandewyn River (E24M)
- Oorlogskloof (E40A)

Towns: Calvinia, Niewoudtville, Wuppertal.

Main dams:
- Oudebaaskraal (34 million m^3) in E23F

Some identified schemes:
- Aspoort Dam
- Melkboom Dam/ Melkbosrug Dam
- Brandewyn Dam

Transfers:
- Inter-basin transfer via the Inverdoorn Canal

Major conservation areas:
- Tankwa Karoo National Park
- Akkerendam Nature Reserve
- Swartruggens Conservancy

3.3.3 Water Resources Availability

The MAP in this sub-area varies from 199 mm in the E23 catchments to 256 mm in the E40 catchments. The incremental MAR is about 229 million m^3/a.

In the E22 catchment, an inter-basin water transfer of 2.5 million m^3/a is undertaken from the catchment of Lakenvallei Dam in the Breede WMA via the Inverdoorn canal into the Upper Doring River catchment for irrigation. The privately owned Oudebaaskraal Dam on the Tankwa River supplies water for irrigation of a maximum of 320 ha.

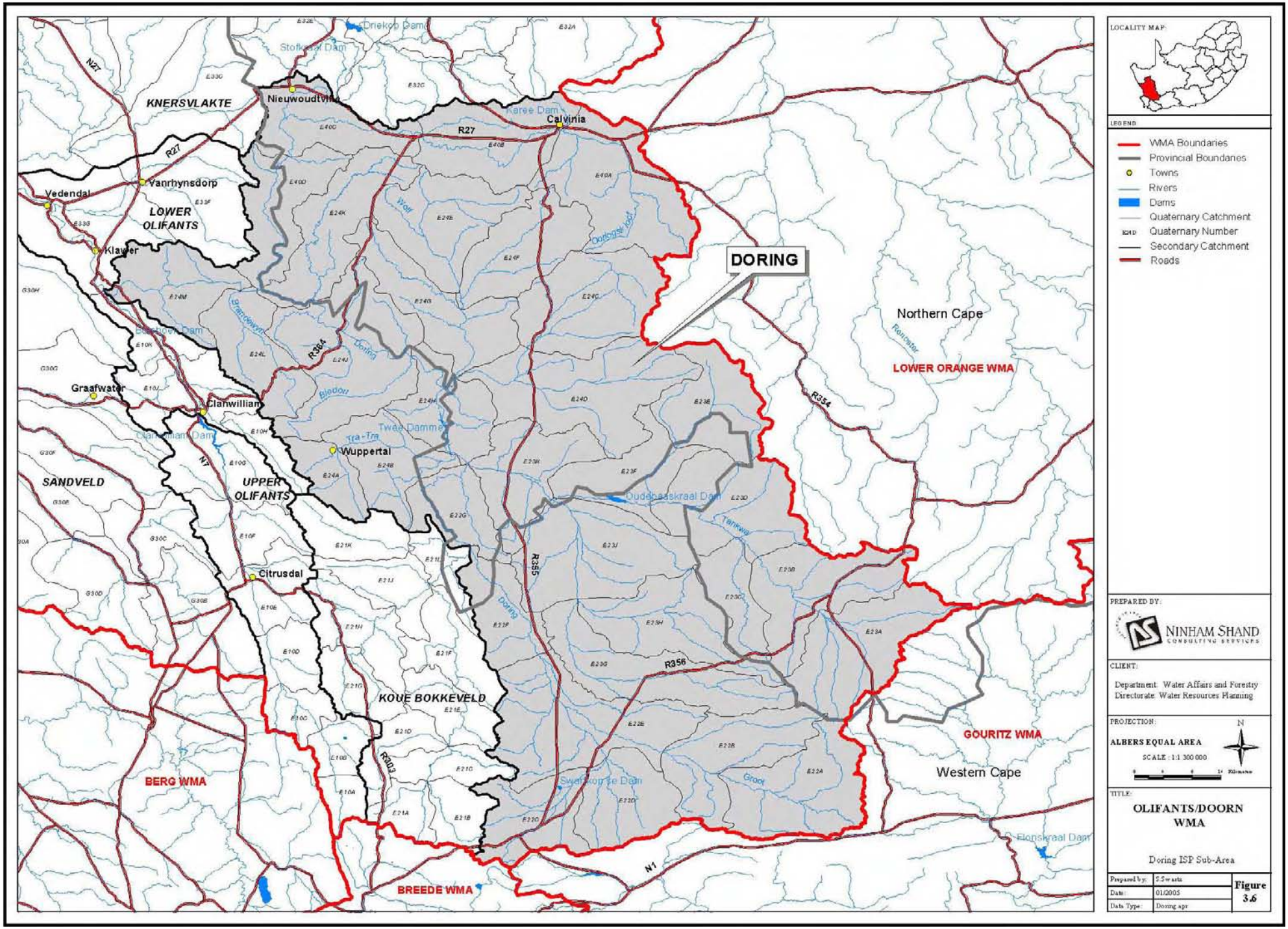

Figure 3.6: Doring Sub-area

Invasive Alien Plant Control: Invasive alien plant infestations are not yet significant in terms of water consumption but occurrences should be controlled in accordance with good catchment management, as the riparian areas are prone to rapid invasion. Prevention of infestation would provide the benefits of maintaining the base flows of the rivers.

3.3.4 Current Water Requirements and Use

Table 3.3 provides a summary of the water resources.

Irrigation: The E23 catchment is located in a dry climate. Lucerne and pastures are grown under irrigation. At the confluence of the Tankwa and Doring rivers, water is abstracted from the Doring River for the irrigation of 350 ha of land from the water works of the Elandskaroo Irrigation Board.

Supply to towns: The two main towns of the sub-area are small. Calvinia (small dam and 3 boreholes) and Nieuwoudtville (1 borehole) are reliant on groundwater.

Table 3.3: Doring Yield Balance

Resource	*Million m^3/a at 1:50 yr assurance*
Water Availability	
Gross surface water yield	**10**
Subtract	
- Ecological Reserve	**2**
- Invasive alien plants	**0**
Net surface water yield	**8**
Groundwater	**3**
Return flows	**0**
Total local yield	**11**
Transfer in	**3**
Total Available Water	**14**
Requirements	
Irrigation	**13**
Urban	**1**
Rural	**1**
Industrial / mining	**0**
Afforestation	**0**
Total local requirements	**15**
Transfer out	**0**
Total Water Requirements	**15**
Reconciliation	
Yield Balance	**(1)**

3.3.5 Water Balance

The total yield available in the sub-area is calculated as 14 million m^3/a and the total current requirements are estimated at 15 million m^3/a. The sub-area therefore has a small deficit of only 1 million m^3/a and can be regarded as essentially in balance.

3.3.6 Future Water Requirements

Irrigation: There is a demand for increased agriculture aimed at poverty alleviation. An investigation of the potential of a dam at Aspoort was undertaken by the Northern Cape Province in the 1990s. Various initiatives were investigated further in the Olifants Doring River Basin Study (1998) such as dams further down the Doring River at Melkbosrug and Melkboom.

Figure 3.7: The Draaikraal River, like many of the Doring's tributaries, is dry in summer.

The study indicated that the Aspoort and Melkboom dams would have potential for irrigation developments on a relatively large scale. It was however indicated that considerably more work was needed to verify the assumptions used.

The Northern Cape Department of Agriculture originally proposed to undertake a pilot scheme to verify some of the assumptions used for the Aspoort Scheme. However, the pilot scheme has not yet been undertaken. The Western Cape Department of Agriculture initiated the Western Cape Provincial Government Olifants Doring River Irrigation Study (WODRIS) which has investigated the Melkboom and Melkbosrug dams in more detail. A development cap was put in place for a period of seven years, up to the end of 2005, to ensure that *ad hoc* development did not preclude the development of any of these schemes by the Northern Cape. At the end of 2005 DWAF should reconsider the situation in the light of new information available at that stage.

Recently private farmers proposed a project entitled the Tankwa-Karoo Empowerment Project. The project proposes to develop 600 ha of dates, taking winter surplus from the Doring River via a 33 km pipeline to the Oudebaaskraal Dam. There are however significant environmental concerns surrounding the construction of any dams on the Doring River which has resulted in the evaluation of an off-channel storage dam on the Brandewyn River. The EWRs, which would have to be released if any dam was constructed, has also been of concern. The Department commenced a Comprehensive Reserve Determination Study of the Olifants and Doring Rivers, which is expected to be complete by the end of 2005 (refer to **Section 2.1.8** and **Strategy 7.1**).

Urban use: There is limited storage and the supplies to towns require augmentation. Future supply will need to be secured and additional storage is required.

3.4 KNERSVLAKTE SUB-AREA [E31A-H, E32, E33A-E, F60B-E]

3.4.1 Location

The sub-area forms the northern part of the eastern boundary of the WMA. It comprises the Hantams, the Kromme and the Goerap catchments, as well as the Sout River tributary of the Lower Olifants River. The sub-area extends from the escarpment range (Lower Orange WMA boundary) to the coastline. The Kromme portions of the sub-area has an endoreic drainage pattern (E31A sub-catchment), which is thought to have been connected many of millions of years ago to an extensive palaeo-drainage system in the southern part of the Lower Orange WMA. The Knersvlakte has a catchment of 16 710 km^2 (see **Figure 3.8**).

3.4.2 Groundwater

The sub-area is dependent on groundwater, the key uses being for stock watering and domestic use. Groundwater is drawn from primary aquifers, fractured rock aquifers, and dolerite dykes. The groundwater quality is generally poor and volumes are limited. Rainfall is low and there is little recharge other than during flood events.

Recharge processes and patterns and their relationship to historical weather patterns limit the groundwater potential. This relationship and the aquifer storage potential are currently not well understood, therefore predictions must be conservative. There is limited further groundwater development potential in this sub-area. Reports of declining water levels in the supplies to small towns support this. Groundwater for the sub-area is discussed in detail in **Appendix 4**.

KNERSVLAKTE SUB-AREA MAIN FEATURES:

Main Rivers:
- Hantams River (E32E);
- Krom River (E31C)
- Sout River (E33C)
- Geelbeks River (E33D)
- Groot Goerap (F60D)

Towns: Loeriesfontein, Nuwerus, Bitterfontein

Main dams:
- Driekop Dam in E32D
- Stofkraal Dam in E32E

Future identified schemes:
- None

Transfers:
- Transfers to Namakwa-Sands and towns

Major conservation areas:
- None

Figure 3.8: Knersvlakte Sub-area

3.4.3 Water Resources Availability

The MAP in this key area varies between 118 mm in the E31 catchments and 198 mm in the E32 catchments. The cumulative MAR for the area is about 27 million m^3/a. The climate is very dry and opportunities for surface water resource development are limited. The total available water resource and the corresponding preliminary ecological water requirements are summarised in **Table 3.4.**

Table 3.4: Knersvlakte Yield Balance

Resource	*Million m^3/a at 1:50 yr assurance*
Water Availability	
Gross surface water yield	**1**
Subtract	
- Ecological Reserve	**0**
- Invasive alien plants	**0**
Net surface water yield	**1**
Groundwater	**3**
Return flows	**0**
Total local yield	**4**
Transfer in	**4**
Total Available Water	**8**
Requirements	
Irrigation	**3**
Urban	**0**
Rural	**1**
Industrial / mining	**3**
Afforestation	**0**
Total local requirements	**7**
Transfer out	**0**
Total Water Requirements	**7**
Reconciliation	
Yield Balance	**1**

There are no major dams in the sub-area. There is a transfer of 2.4 million m^3/a into the sub-area from the Olifants River Canal near Lutzville (E33H) to the Namakwa Sands Mine (F60D). The distribution loss of 1 million m^3/a, due to this transfer, forms part of the total transfer shown in the table.

Invasive Alien Plant Control: Invasive alien plants are mainly situated in riparian areas. However, due to dry climate they are not a regional priority for eradication, as the impact on yield is negligible. IAP infestations do influence the yield potential of primary aquifers and eradication should be encouraged as a good catchment management practice.

3.4.4 Current Water Requirements and Use

In the F60 catchments, water is required mainly for urban, rural and mining uses.

Figure 3.9: Looking west across the Knersvlakte from Van Rhyn's Pass

Figure 3.10: The Sout River

Irrigation: Limited irrigation is undertaken in this sub-area. It does however comprise 43% of the total water use. Agricultural activities are predominantly grazing, due to low rainfall.

Mining: The estimated requirement for mining use is 2.5 million m^3/a. This requirement is primarily for the Namakwa Sands Mine.

Urban Use: The towns in this catchment include Bitterfontein, Nuwerus and Loeriesfontein which rely on groundwater.

3.4.5 Water Balance

The total yield from the sub-area is estimated to be 8 million m³/a and the total requirements 7 million m³/a. Therefore with a surplus of 1 million m³/a the sub-area is approximately in balance.

3.4.6 Future Water Requirements

Irrigation: The irrigation requirements in the sub-area are not anticipated to expand.

Mining: The mining activities in the sub-area are not anticipated to expand significantly.

Urban use: All rural and urban supplies in this area are based on groundwater. The towns in this sub-area are stressed and are looking for other sources or increased groundwater resources.

3.5 LOWER OLIFANTS SUB-AREA (E10H – K, E33G, E33F, E33H)

3.5.1 Location

The Olifants River flows from Clanwilliam Dam for 35 km to the Bulshoek Weir, below which the Doring River (E33F-H) joins it and together they flow to the sea at the Olifants Estuary. The Lower Olifants has a catchment area of 8 216 km^2.

3.5.2 Groundwater

The E33F-H catchments are underlain mainly by low-grade metamorphic schists, limestone and marbles of the Nama and Gariep Groups, locally overlain by aeolian, shallow-marine and alluvial terrace deposits. The E10J-K catchments are underlain by gently folded and faulted TMG units, with localized outcrops of lower Bokkeveld Group around Clanwilliam (E10J).

The groundwater usage is predominantly in the primary aquifer along the coast, with some further use from the deeper aquifers. There is great uncertainty regarding the actual groundwater use. It is necessary to establish potential groundwater usage and baseflow estimates in this water stressed area.

Appendix 4 details the models estimating groundwater recharge and availability.

LOWER OLIFANTS SUB-AREA MAIN FEATURES:

Main Rivers:
- Olifants River (E10);
- Doring River (E24)
- Jan Dissels River (E10H)
- Sout River (E33C)

Towns: Vredendal, Vanrhynsdorp, Papendorp, Lutzville, Ebenhaezer, Koekenaap, Klawer

Main dams:
- Bulshoek Weir (18 million m³) in E10J;

Some identified schemes:
- None

Transfers:
- Transfer to Namakwa-Sands
- Transfer to Sandveld sub-area.

Major conservation areas:
- Olifants River Estuary
- Lutzville Conservation Area
- Moedverloren Nature Reserve

3.5.3 Water Resources Availability

At 144 mm, this catchment has the lowest average MAP in this WMA. The incremental natural MAR is 41 million m^3/a. The catchment receives a large transfer of 94 million m^3/a from the Upper Olifants but a deficit of 29 million m^3/a still exists. Irrigated agriculture is the largest water user with estimated requirements of about 140 million m^3/a (i.e. about 95% of the total requirements in the catchment).

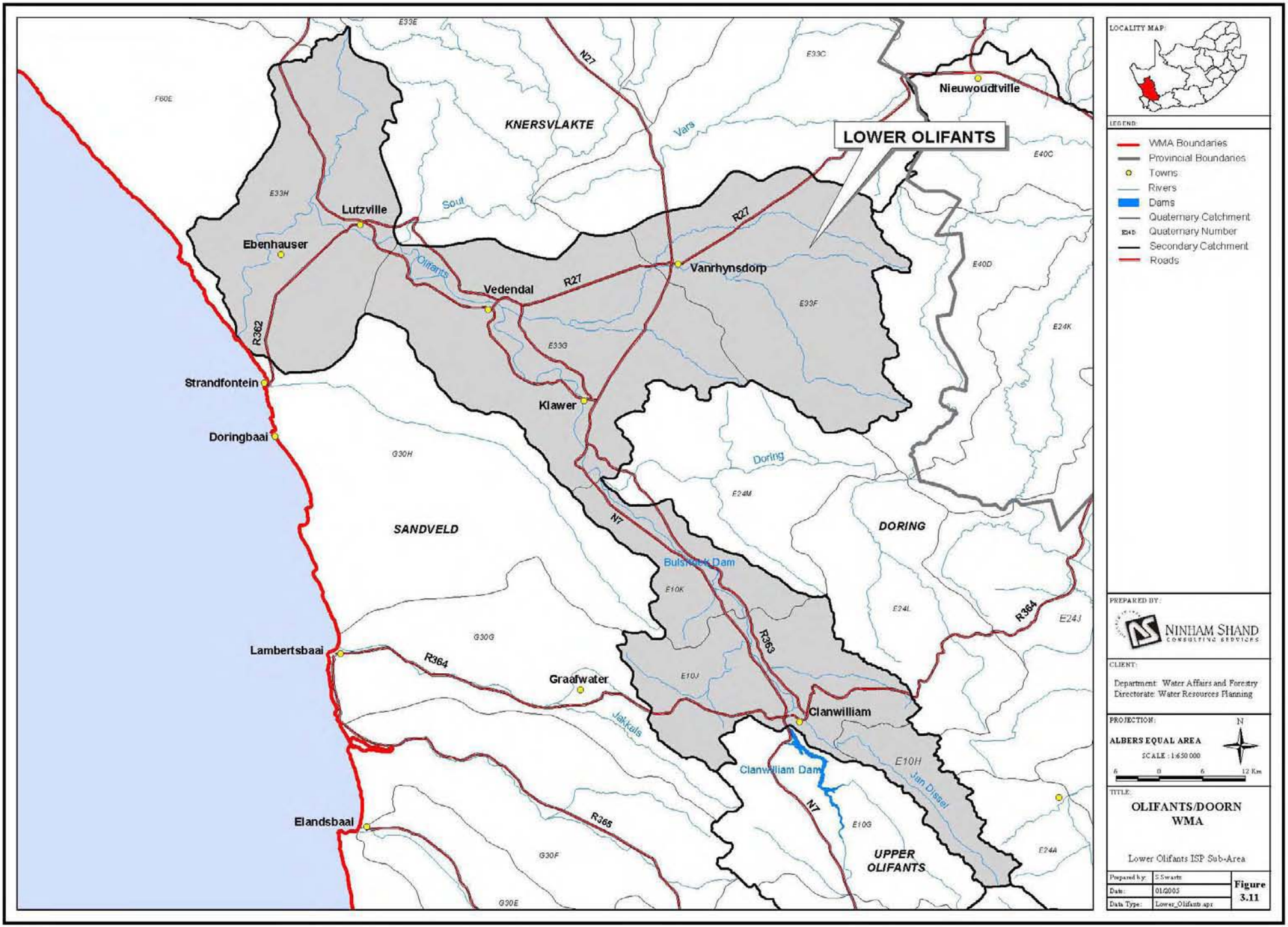

Figure 3.11: Lower Olifants Sub-area

The estuary is considered to be important and freshwater requirements for the estuarine Reserve are being determined in the Reserve Determination Study (refer to **Section 2.1.9**).

Figure 3.12: The extensive salt marsh at the Olifants River Estuary provides habitat for many rare species.

Invasive Alien Plant Control: Invasive alien plants occur mainly in the riparian zone. The impact on yield is very small.

Table 3.5: Lower Olifants Yield Balance

Resource	*Million m^3/a at 1:50 yr assurance*
Water Availability	
Gross surface water yield	**26**
Subtract	
- Ecological Reserve	**8**
- Invasive alien plants	**0**
Net surface water yield	**18**
Groundwater	**1**
Return flows	**6**
Total local yield	**25**
Transfer in	**94**
Total Available Water	**119**
Requirements	
Irrigation	**140**
Urban	**3**
Rural	**1**
Industrial & mining	**0**
Afforestation	**0**
Total local requirements	**144**
Transfer out	**4**
Total Water Requirements	**148**
Reconciliation	
Yield Balance	**(29)**

3.5.4 Current Water Requirements and Use

A summary of the water resources is given in **Table 3.5.**

Irrigation: Agriculture is the major user in this sub-area with a requirement of 140 million m^3/a. The scheduled area under irrigation is approximately 11 920 ha, at a scheduled quota of 12 200 m^3/ha/a, although the average quota used is only about 11 000 m^3/ha/a. Approximately 11 000 ha is irrigated from the GWS canals supply, although only 9 211 ha is scheduled. The crops grown in the catchment are grapes (wine, table and raisins), deciduous fruits and vegetables.

Figure 3.13: Cultivation of table grapes and wine grapes is wide spread in the Lower Olifants.

Figure 3.14: The irrigation canal snakes down the Olifants River Valley.

Grapes are the dominant crop. These crops are mainly irrigated from water conveyed from Bulshoek Weir by means of a 186 km canal.

Urban Use: The main towns in this catchment are Vredendal, Vanrhynsdorp, Lutzville, Ebenhaezer and Klawer. These abstract and treat water from the canal for urban use. The water available for use is constrained by the physical limitations of the canal and water conservation and demand management initiatives such as the upgrading of the canal to reduce losses, must be investigated. Urban use accounts for 3 million m^3/a. Water is also transferred out of the sub-area for urban use in the northern Sandveld (0.4 million m^3/a).

Mining Use: Water (2.4 million m^3/a) is transferred out of the sub-area to serve the Namakwa-Sands mine.

3.5.5 Water Balance

The total yield from the sub-area, including the transfer, was calculated as 119 million m³/a, consisting of 25 million m³/a local yield and a "transfer" from the Upper Olifants sub-area of 94 million m³/a. The total requirements are 148 million m³/a. The sub-area therefore has a deficit of 29 million m³/a (assuming that the Upper Olifants sub-area is in balance) taking into account the impact of the Reserve. If the impact of the Reserve on the yield is not taken into account, which is the current actual situation, the deficit is only 5 million m³/a.

3.5.6 Future Water Requirements

Irrigation: There is a requirement for a better assurance of supply for agriculture and for growth. There is pressure to allocate additional water to resource-poor farmers in this area. The Lower Olifants River WUA is engaged in facilitating water trading to ensure that provision is made for poverty alleviation. The sub-area is stressed and no further abstraction licences should be issued.

Urban use: There are several towns in the Lower Olifants area. Limited growth of these towns is anticipated.

3.6 SANDVELD SUB-AREA [G30]

3.6.1 Location

The sub-area forms part of the western coastal boundary of the WMA. The Sandveld has several small rivers which flow towards the sea. The most notable of these are the **Verlorevlei River** (G30F) and the **Langvlei River** (G30G). It is bounded on the west by the Atlantic coastline, on the east by the Olifants mountain range, and on the south by the Berg WMA. The Sandveld has a catchment of 4 590 km^2 (see **Figure 3.15**).

The Sandveld sub-area is divided between the Cederberg Municipality, incorporating the towns of Elandsbaai (G30E), Lambertsbaai and Graafwater (G30G), and the Matzikama Municipality, incorporating the coastal settlements of Strandfontein and Doringbaai (G30H). Apart from fishing and eco-tourism around the coastal resort towns, potato farming primarily under centre-pivots, is the economic mainstay of the G30 coastal plain. Activities are predominantly dependent on groundwater, except in a restricted northern part of the G30H, where a pipeline from the Olifants River Government Scheme supplies Strandfontein and Doringbaai. The Verlorevlei catchment (G30B-E) is fed by perennial stream flows from the Olifants Mountains and northern Piketberg.

3.6.2 Groundwater

The area is underlain by Malmesbury Group Shales with overlying Piekenierskloof, Graafwater and Peninsula Formations of the Table Mountain Group. Numerous other major faults and fracture zones crosscut the sub-area. Along the coastal plain, young wind-deposited sands cover older marine and fluvial deposits. The groundwater in the Sandveld is from the shallow primary aquifer and from the deeper TMG Aquifer. There is evidence that water flow in the TMG in the Upper Olifants sub-area is linked to the water in the Sandveld[4]. Recharge occurs from local rainfall as well as the postulated linkages with the fractured-rock aquifers to the east. Water for agricultural purposes is obtained almost entirely from groundwater.

The DANIDA study reported that the G30F catchment is stressed. The groundwater resources are utilised by individual users without co-ordinated wellfield management. Outside of G30F the contamination of groundwater by seawater could be attributed to poor aquifer management rather than a lack of available groundwater.

SANDVELD SUB-AREA MAIN FEATURES:

Main Rivers:
- Jakkals River (G30G);
- Langvlei River (G30F)
- Verlorevlei River (G30E)
- Hol River (G30D)

Towns: Graafwater, Lambertsbaai, Elandsbaai, Doringbaai, Leipoldtville and Strandfontein

Main dams:
- None

Future identified schemes:
- None

Transfers:
- Transfer from Lower Olifants

Major conservation areas:
- Verlorevlei Ramsar Site
- Rocherpan Nature Reserve
- Elandsbaai Nature Reserve

[4] This relationship is still under investigation.

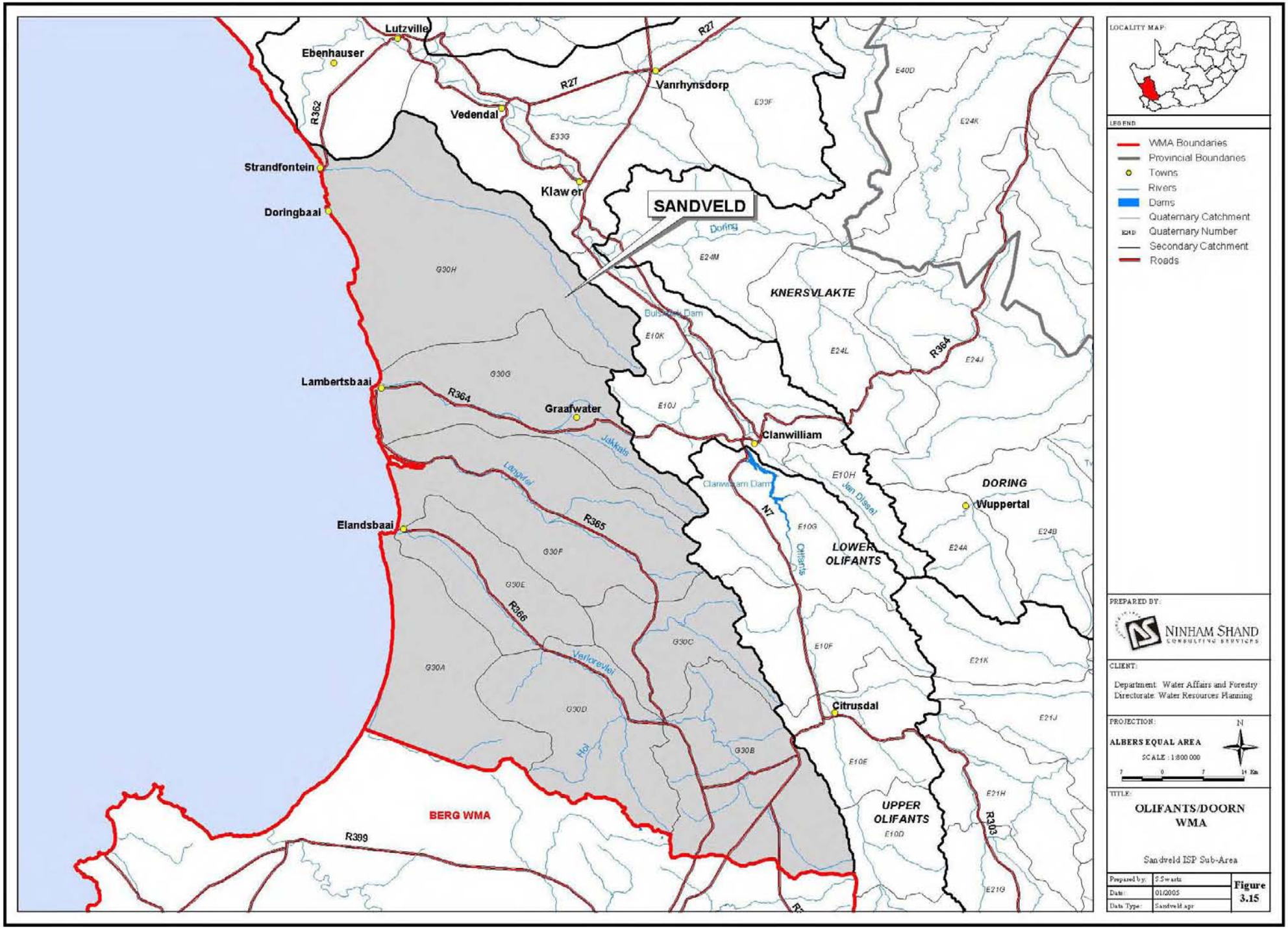

Figure 3.15: Sandveld Sub-area

3.6.3 Water resources availability

The MAP across the Sandveld area is about 295 mm and the cumulative natural MAR is approximately 55 million m^3/a. The primary source of water in this catchment is groundwater. Rapid agricultural development has already lead to over-exploitation of the groundwater resource. A summary of the water resources for this sub-area is given in **Table 3.6**.

There are no major dams in the sub-area. There is a transfer of 0.4 million m^3/a of water from the Olifants River Canal near Ebenhaezer (E33H) to Strandfontein and Doringbaai (G30H) and rural domestic consumers in the vicinity.

Invasive Alien Plant Control: Invasive alien plants are mainly situated in riparian areas and areas throughout the catchment. Eradication is an important element of catchment management. The current impact of invasive alien plants on the 1:50 yield is approximately 3 million m^3/a. There is concern that the impact of IAPs on primary aquifers in the Sandveld has been underestimated.

Table 3.6: Sandveld Yield Balance

Resource	*Million m^3/a at 1:50 yr assurance*
Water Availability	
Gross surface water yield	**5**
Subtract	
- Ecological Reserve	**0**
- Invasive alien plants	**3**
Net surface water yield	**2**
Groundwater	**30**
Return flows	**0**
Total local yield	**32**
Transfer in	**0.4**
Total Available Water	**32**
Requirements	
Irrigation	**35**
Urban	**2**
Rural	**1**
Industrial & mining	**0**
Afforestation	**0**
Total local requirements	**38**
Transfer out	**0**
Total Water Requirements	**38**
Reconciliation	
Yield Balance	**(6)**

3.6.4 Current water requirements and use

Agriculture: Agriculture is by far the largest water use sector with estimated requirements of approximately 35 million m^3/a (i.e. about 92% of the total requirements). The primary crop in the catchment is potatoes. The fastest growing irrigation development in the catchment occurs in quaternary catchment G30F.

Figure 3.16: Looking east across the Sandveld towards Clanwilliam. Dust from newly prepared fields fills the air.

Supply to towns: The main towns in the catchment are Graafwater, Lambertsbaai, Elandsbaai, Doringbaai, Leipoldtville and Strandfontein. Strandfontein and Doringbaai are supplied, in addition to groundwater, with 0.4 million m^3/a piped from the Olifants River Scheme that is fed from the Clanwilliam Dam. The other three towns rely on groundwater.

3.6.5 Water Balance

The total yield from the sub-area is estimated at 32 million m^3/a and the total requirements as 38 million m^3/a. The catchment is stressed with an estimated deficit of 6 million m^3/a.

3.6.6 Future water requirements

Irrigation: Although there is increasing demand for agricultural development the surface and groundwater resources in this area are already stressed, especially in the G30F catchment area. Based on the yield balance estimates no further growth in the agricultural sector can be supported from the currently developed resource.

Urban use: The urban use is currently supplied by coastal aquifers and a small transfer from the Lower Olifants sub-area. The coastal groundwater sources in most cases are in danger of being over-abstracted with a risk of causing seawater intrusion. There are seasonal peaks relating to tourism influx which will need to be provided for.