

CHAPTER 2 - OVERVIEW OF THE ISP AREA

2.1 INTRODUCTION

This ISP area has very little water of its own and the underlying geology also results in much of this being of very poor quality. The Kat and Koonap rivers, and to a lesser extent the Tarka River, are the only tributaries with significant own resources. The Orange-Fish-Sundays scheme, implemented in the 1970s, moves over 600 million m³ of water each year out of the Orange River Basin, primarily for irrigation in the Fish and Sundays catchments but with water going as far as Port Elizabeth. The hydrology, water balance and economy of the Fish-Sundays system are completely dominated by this imported water. A further allocation of 38 million m³ of water for the irrigation of an additional 4 000 ha of land by resource-poor farmers has been added to the region, but this allocation must still be implemented ⁽²⁶⁾. There are very significant losses through the transfer of water through the system, and saline return flows pose a serious problem for downstream users. Our knowledge of these losses, and the necessary releases and compensations that must be made, is poor, and is further complicated by the variable natural yield of the Fish and Sundays systems. Very significant work is required to improve our knowledge if this system is to be efficiently managed. Areas removed from the main rivers are mainly supplied from groundwater.

2.2 PHYSICAL FEATURES

2.2.1 Locality

For practical reasons the Fish to Tsitsikamma WMA was divided into two ISP areas, the Fish to Sundays area, which is the subject of this report, and the Tsitsikamma to Coega area which is covered in DWAF report P WMA 15/000/00/0304.

The *Fish to Sundays ISP area* forms the eastern part of the Fish to Tsitsikamma Water Management Area (WMA 15), as shown in **Figure 2.1** on the following page.

The main rivers of this ISP area are the Great Fish, Sundays, Bushmans, Kowie and Kariega Rivers, as shown in **Figure 2.2**. All these rivers drain to the Indian Ocean. Except for a small area that falls in the Northern Cape Province, the entire ISP area falls in the Eastern Cape Province.

2.2.2 Sub-areas

The Fish to Sundays ISP area was further sub-divided into three key areas as shown in **Figure 2.2**. These sub-areas are groupings of the 123 quaternary catchments of the P, Q and N primary drainage regions in the ISP area. The three key areas were demarcated in accordance with the National Water Resource Strategy (NWRS) as follows:



Figure 2.1: Locality map of the Fish to Tsitsikamma WMA and its ISP areas



Figure 2.2: Locality map of the Fish to Sundays ISP area

- The *Fish* sub-area, which corresponds to the catchment of the Fish River (Drainage Region Q) with 71 quaternary catchments;
- The catchment of the Sundays River, as the *Sundays* sub-area (Drainage Region N) with 36 quaternary catchments; and
- The *Albany Coast* sub-area, comprising the coastal catchments between the Fish and Sundays rivers (Drainage Region P) with 16 quaternary catchments.

Most of the Fish and Sundays sub-areas, particularly the upper basins, are situated in the arid Great Karoo. The Albany Coast sub-area consists of steep, bush covered hills with deeply incised river valleys. The drainage basins of the Great Fish and Sundays rivers comprise 85% of the quaternary catchments within this ISP area. These two sub-areas are supplied with water from the Orange River Development Project.

Only the Kat River, the Koonap River and the coastal catchments have significant natural runoff. In the rest of the catchments, the annual runoff is much lower than the mean annual runoff (MAR). In a small percentage of years higher runoff occurs, mainly in the form of floods.

2.2.3 Topography

The ISP area is dominated by the arid Great Karoo interior. This area is bounded in the north by the mountain ranges of the interior plateau and in the south by the higher rainfall coastal catchments. The topography is relatively flat and the basin soils are naturally highly erodible.

The upper parts of the Great Fish catchment, with a total area of about 30 000 km², have numerous small, and usually dry, tributaries that originate along the edge of the interior plateau. The Tarka River tributary rises in the northern slopes of the Winterberg Mountains, while the Little Fish River tributary drains the arid area to the southwest of Cradock. The Koonap River rises on the southern slopes of the Winterberg and flows through mountainous terrain to join the lower reaches of the Fish River. The Kat River catchment, with its headwaters in the vicinity of Seymour, has a fairly wide main valley. Only minor tributaries join the Great Fish River downstream of its confluence with the Kat River. The Great Fish River then flows for a further 100 km through deeply incised meanders in hilly terrain to its estuary 25 km east of Port Alfred. See **Figure 2.3** on the following page.

The Sundays River has its headwaters in the catchment of the Nqweba Dam ⁽²⁷⁾ (formally the Van Rynevelds Pass Dam) at Graaff-Reinet. Most of the Sundays basin is situated in the Great Karoo, where the topography consists of arid plains interspersed with steep rocky hills. The Sundays River basin covers an area of some 21 250 km² and discharges into Algoa Bay in the vicinity of Cannonvale.

The coastal catchments of the Albany Coast sub-area are situated in an area of approximately 5 300 km² between the basins of the Sundays and Great Fish rivers and the sea. This is an area of steep, bush covered hills with deeply incised river valleys. The main rivers are the Kariega, the Bushmans and the Kowie.

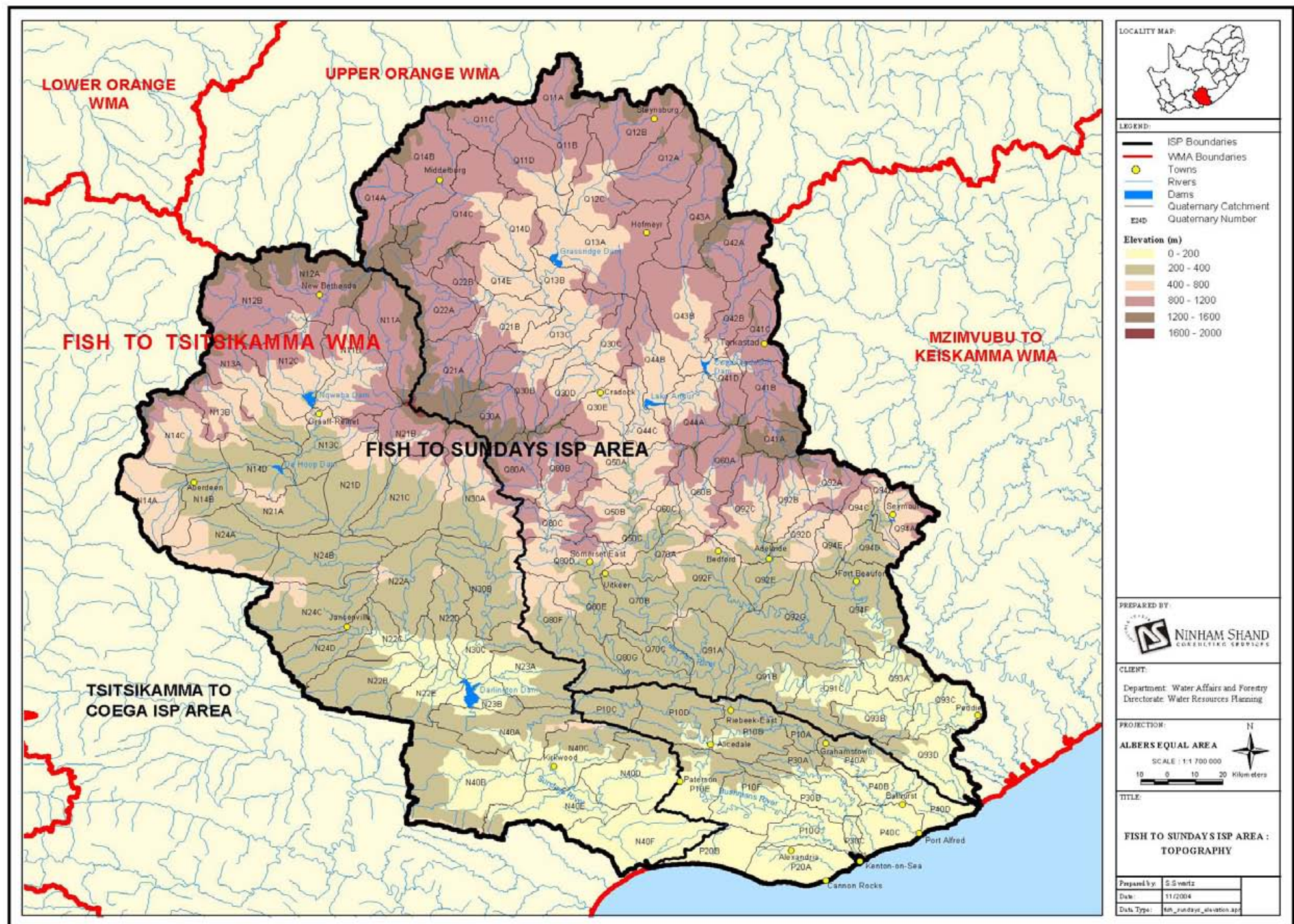


Figure 2.3: Topography



Figure 2.4 Great Fish River in the Grahamstown vicinity



Figure 2.5: Horseshoe bend in the Kowie River

2.2.4 Geology, hydrogeology and soils

A detailed review of the groundwater situation is contained in **Appendix 2**. Groundwater is also addressed from a resource perspective in Chapter 3. This section provides the background information to the presence, availability and utilisation of groundwater in the Fish to Sundays ISP area.

a. Geology and hydrogeology

i. Groundwater integrated resource management (GIWRM) domains

The ISP area has been categorised into two hydrogeological or ‘hydrogeotectonic’ provinces or domains, namely the Algoa-Albany Basin-and-Range province and the Sundays-Great Fish Uplands province. Integrated water resource management needs to take note of these distinctive domains when reconciling surface and groundwater availability and use.

These hydrogeological provinces are summarised in **Table 2, Appendix 2**. The *Algoa-Albany Basin-and-Range* province incorporates the Algoa Basin and Albany Coastal Range, but has also been extended to include the “Southern Karoo Foreland” subprovince, where topography and drainage is structurally controlled by fold and fracture structures in lower Karoo strata.

The *Sundays-Great Fish Uplands* province is divided into generally an E/W-trending escarpment zone and an upland area consisting of the Great Fish headwaters. The sub-provinces are the Camdeboo-Winterberg Escarpment and the Upper Great Fish Basin. The base of the Katberg Formation sandstone is the main geological factor controlling this subdivision (see to the red lines in **Figure 2.6, Aquifer Types**).

ii. Physiography and hydrostratigraphy

The topography, drainage characteristics and groundwater quality of the area are closely related to the underlying geology (see **Appendix 2**).

In the **southern coastal belt** folded sedimentary rocks of the *Cape Supergroup* (Table Mountain, Bokkeveld and Witteberg Groups) and *lower Karoo Supergroup* (Dwyka and Ecca Groups) are the dominant bedrock units. This area constitutes the eastern part of “*Groundwater Region No. 52*” (Grootrivier-Klein Winterhoek-Suur-Katrivier Ranges) as defined by J.R. Vegter. There is also a minute portion of the adjacent *Groundwater Region No. 50* (Southern Cape Ranges) appearing along the crest of the divide at the southern boundary of the N40B and N40E quaternary sub catchments. The northern boundary of Groundwater Region No. 52 is drawn along the Witteberg-Dwyka (Cape-Karoo) stratigraphic contact.

Volcanics and volcanoclastic sediments of the Suurberg Group, overlain by generally shaley sediments of the Uitenhage Group, occupy a major fault-bounded basin (**Algoa Basin**) on the Sundays River coastal plain (N4 & P1 / P2 secondary catchments). This constitutes *Groundwater Region No. 64*. Coarse conglomerate and grit of the Enon Formation occurs in

the hanging wall of the major east-west border fault stretching from Paterson in the east to south of Wolwefontein in the west. Unconsolidated to semi-consolidated, palaeo-coastal calcareous sand and conglomerate deposits of the younger *Algoa Group* occur within the eastern portion of the Algoa Basin and the **Bushman's coastal plain**, overlain by Quaternary alluvium in much of the Sundays River valley south of Kirkwood. Recent and reworked coastal sands occur within a narrow dune zone between Cannonvale and Port Alfred.

The northern interior uplands are underlain by sedimentary rocks of the *middle Karoo Supergroup* (Beaufort Group, consisting of Adelaide [lower] and Tarkastad [upper] subgroups) and abundant intrusive dolerite sills and dykes of the Drakensberg Formation underlie the northern interior uplands. This region covers the eastern part of *Groundwater Region No. 42* (Eastern Great Karoo) and the western part of *Groundwater Region No. 43* (Ciskeian Coastal Foreland and Middle Veld), the common boundary of which is the Sundays/Great Fish drainage divide.

b. Soils

Moderately deep to deep clayey loams are found in the undulating terrain of the coast in the south-east and in the upper portion of the Fish River basin. Moderately deep to deep clayey loams are also found on the flat floor of the lower Sundays River. Predominantly moderately deep to deep sandy soils in undulating and steep terrain make up the rest of the Fish to Sundays ISP area. Refer to **Figure 2.4.1** of the *Fish to Tsitsikamma WMA WRSA Report P 15/000/00/0101* for a map of soils.

c. Aquifer classification

The greater part of the WMA is underlain by a shallow regolith aquifer (intergranular/weathered-and-fractured - yellow area in **Figure 2.6**). The true secondary fractured rock aquifers in this ISP area (green areas in **Figure 2.6**) occur in the southern coastal zone and include the quartz arenites of the Table Mountain Group (Peninsula Formation and Nardouw Sub-group) and the Witteberg Group. The Karoo dolerites occurring in the northern interior upland (principally to the north of the Fort Beaufort-Somerset East-Aberdeen line) represent another fractured rock system (black area in **Figure 2.6**). Primary/intergranular (porous sandy) aquifers are best developed within tertiary/quaternary sediments of the southernmost coastal belt of the WMA (purple area in **Figure 2.6**), including alluvium along the Sundays River, semi-consolidated calcareous sands and conglomerates of the palaeo-coastal Algoa Group, and the coastal sand dunes developed between Cannonvale and Port Alfred. Surface silcrete aquifers are limited to the African relict land-surface in an area north and east of Grahamstown.

d. Springs

The mapped distributions of boreholes and springs in the WMA (**Figure 5 in Appendix 2**) illustrate somewhat sporadic occurrences of springs, the main cluster of which is related to the interior escarpment east of the Great Fish River. In this northern part of the Q9 secondary catchment, springs cannot be directly correlated with structural geological controls, rather with

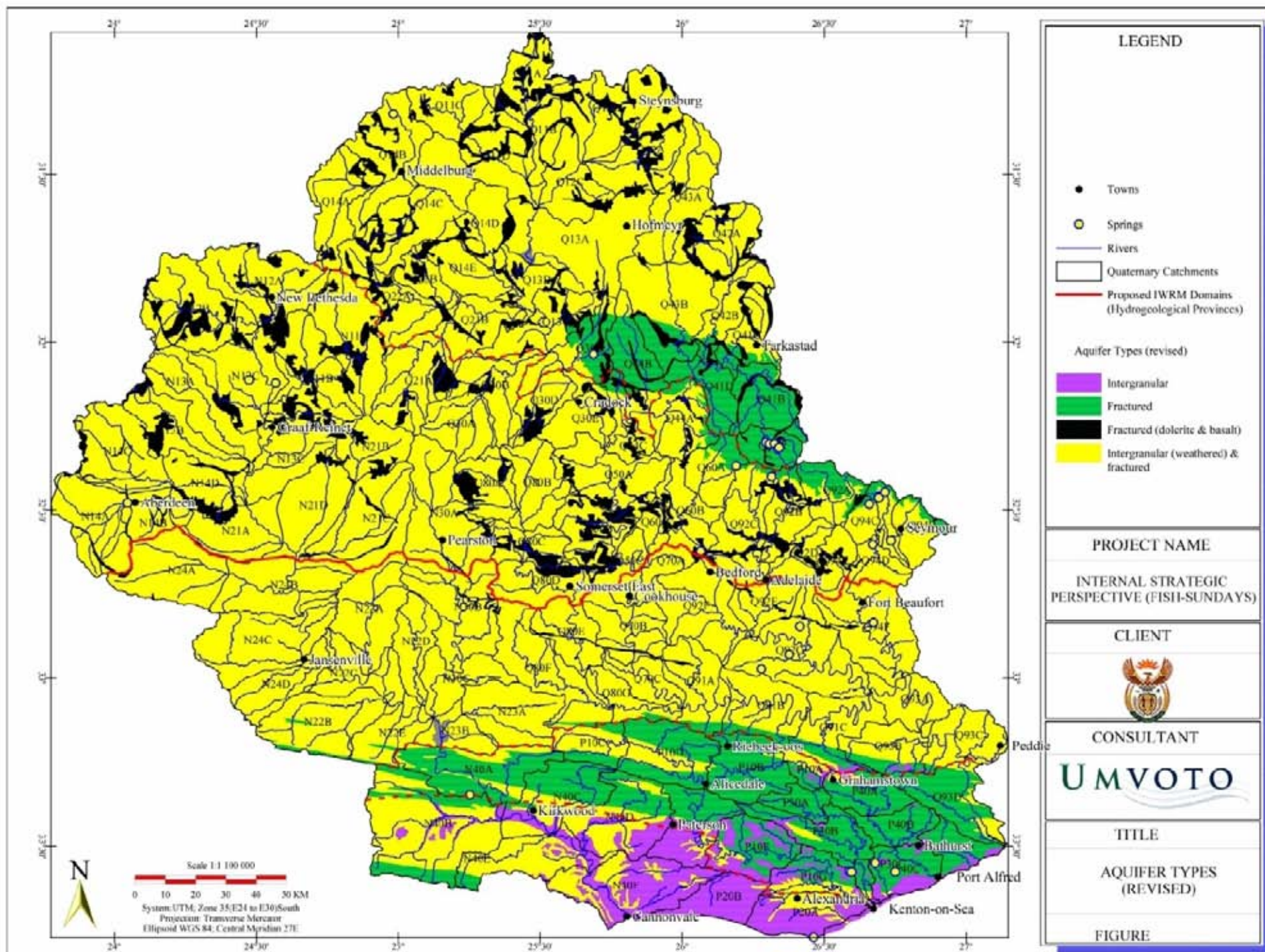


Figure 2.6: Aquifer types

topographic controls (**Figure 2 in Appendix 2**) and lithological changes. Springs in the Fort Beaufort and Seymour areas are associated with dolerite dykes and those in the Bedford area with dolerite sill intrusions. Springs north of Seymour lie along the escarpment edge and around the basal contact of the Katberg Formation. The NGDB appears incomplete and lacks site-specific detail, which is a general problem in the area. Notwithstanding this, the concentration of springs in the east-central part of the ISP area correlates with the relatively higher rates of recharge (25 to 50 mm/a; **Figure 4 in Appendix 2**) to groundwater, which supports the topographic/ orographic control interpretation. Additionally, the springs in the Albany Coast sub-area are expected to reflect baseflow from the Cenozoic Alexandria Formation conglomerate and equivalent palaeo-coastal deposits of the Algoa Group.

e. Boreholes

The borehole distributions documented in the NGDB and in the DWAF Eastern Cape records (**Figure 5 in Appendix 2**) show dense localised concentrations of boreholes around the larger population centres (e.g. Graaff-Reinet and Middelburg) in the northern interior upland of the WMA, which demonstrates the dominance of groundwater usage in the Eastern Great Karoo (derived from shallow primary intergranular-weathered and secondary fractured-dolerite aquifers). Similar borehole concentrations are centred about the smaller agricultural centres of Somerset East, Cookhouse, Bedford, Adelaide, Fort Beaufort and Seymour, situated along the foot of the Middleveld escarpment. North of the divide, in the east-central part of the Fish-Sundays ISP area, a more evenly dispersed pattern of (agricultural) boreholes prevails, disrupted only by axial concentrations along the Middle to Upper Fish (Q3, Q5 and Q7) and Tarka catchments. Except in these instances of boreholes associated with alluvium along the principal distributaries, there appears to be little or no correlation between the borehole distribution pattern and expected geological controls, e.g. the outcrop and subcrop distribution of dolerite sills and dykes, although this may reflect the inadequate representation and/or outcrop expression of dolerites at this map scale.

South of the Middleveld/Eastern Karoo escarpment, boreholes are more uniformly distributed although borehole concentration apparently increases closer to the coast (see **Figures 3.5 and 3.6**). The Albany Coast south and east of Grahamstown has an elevated borehole concentration, consistent with high groundwater use in this arid coastal belt. In this area there is a relatively strong correlation between the borehole distribution and the aquifer type, with most boreholes situated in the fractured Witteberg Aquifer, and to a lesser degree, within the primary intergranular Algoa Aquifer and coastal dune belt.

2.2.5 Climate and Rainfall

The distribution of rainfall and evaporation is shown in **Figure 2.7**. The climate of the southern part of the ISP area is strongly influenced by warm coastal currents of the Indian Ocean. The coastal band of this area also forms the southern boundary of South Africa's subtropical coast with wet, humid summers. The climate inland is typically Karoo with cool, dry winters and hot summers with some rain, with frost occurring during the winter months. Rainfall in the ISP area generally occurs very late in summer over the inland region. The coastal region receives rainfall throughout the year, with most during the summer months.



Figure 2.7: Average annual rainfall and evaporation

There is a great variation of rainfall throughout the ISP area. The mean annual precipitation (MAP) along the coastal band ranges from 400 mm at the Sundays River mouth to 700 mm at the Fish River mouth. The area around the Bushmans River mouth receives a MAP of 700 mm to 800 mm. Rainfall varies between 300 mm and 400 mm in the northern escarpment region and between 150 mm and 400 mm in the interior. The highest rainfall of about 900 mm occurs in the upper Kat River catchment.

Mean annual evaporation in the ISP area ranges from 1 450 mm in the south-east to 2 050 mm in the north-west.

2.2.6 Vegetation

a. Natural vegetation

Systematic Conservation Planning is now being widely implemented in the Eastern Cape. The Succulent Karoo Ecosystem (SKEP) and the Thicket Biome (STEP) C-plans are particularly relevant to the Fish Sundays ISP area. These plans, housed with the Eastern Cape Department of Economic Affairs, Environment and Tourism, reflect the conservation value of landscape in terms of biodiversity and other features, and are a very useful tool in identifying areas in need of protection and in understanding the potential impacts of any planned development.

A simplified description of the vegetation types and a natural vegetation map has been included as **Figure 2.5.2 of the Fish to Tsitsikamma WMA WRSA Report P 15/000/00/0101**. In brief, five types of vegetation have been recorded, according to the Acocks classification system, as follows:

- ⇒ *Coastal Tropical Forest Types* include lush rain forests, thornveld and bushveld. This veld type is typically confined to the coastal area or immediate vicinity between the Sundays to Fish River estuaries.
- ⇒ *Karoo and Karroid Types* are found mostly in the western interior of the ISP area. The flora is characteristically low, typically less than one meter high, and includes scrub, bushes, dwarf trees and a few grasses.
- ⇒ *False Grassland Types* close to the coastal areas and the nearby inland areas occur on either sandy or stoney soils. Farming activities have impacted on much of this veld type.

False Karoo Types and *Pure Grassveld Types* occur in the upper eastern part of the Sundays and Fish River catchments. *False Karoo* vegetation is typically low vegetation, but contains numerous grassy elements. *Pure Grassveld* represents the true grassveld, and occurs on the upper plateau and the mountain tops which are too dry or experience frost too regularly for the development of any kind of forest. Farming activities have impacted on much of this veld type.

b. Invasive alien plants (IAPs)

Substantial infestation by alien plants occurs in the Albany Coast sub-area, especially in the Kowie and Kariega River catchments. Lower levels of infestation are experienced in the upper and lower parts of the Great Fish River, the Kat River and in the middle Sundays River. In the rest of the ISP area, infestation is generally low. More detailed information on IAPs and their water use has been included under the *Managing invasive alien plants Strategy*, Strategy 7.4.

c. Aquatic weeds

Waterweeds are problematic in the Grahamstown supply dams and in the New Years Dam in a tributary of the Bushmans River, although this problem tends to be cyclic ⁽²³⁾. No other problems are reported.

2.2.7 Environmental protection and sensitive areas

A vital requirement for ensuring sustainable conservation practices is the identification of conservation worthy habitats or sensitive ecosystems. The Greater Addo National Park, incorporating the Addo Elephant National Park ⁽⁵¹⁾ and Zuurberg Reserve, Shamwari Game Reserve (private) Mountain Zebra National Park ⁽⁵³⁾, Alexandria State Forest, Thomas Baines Nature Reserve and the Mananga Cycad Colony are some of the protected sites that fall within the ISP area. A coastal strip is planned to become part of the Greater Addo National Park.

A southern coastal strip that incorporates the Alexandria Dune Field, making up the largest coastal dune field in the world is set to become part of the Addo Elephant National Park. Groundwater seeps to sea in this area, resulting in a unique form of plankton blooms that should be monitored and protected. This proposed extension of the nature reserve to the coast may have an impact on the current abstraction of water from the Colchester dunes.

All the rivers and tributaries should be properly managed to protect indigenous species. The permanently open estuary of the Fish River is ecologically significant ⁽¹⁹⁾. Little is known about wetlands in this ISP area.

Land-use practices in the former Ciskei area have caused land degradation and soil wash-off. A lack of post-farming rehabilitation leads to increased erosion.

The Archeology Department of the Albany Museum in Grahamstown serves as the Archaeological Data Recording Centre and official repository for archaeological collections from the Eastern Cape Province of South Africa. This department has also published the "*Southern African Field Archaeology*" journal which has provided a forum for publishing archaeological site reports.

Table 2.6.1 in the *Fish to Tsitsikamma WMA WRSA Report P 15/000/00/0101* contains a list of the protected areas within the Fish to Tsitsikamma WMA.



Figure 2.8: Addo Elephant National Park



Figure 2.9: Mountain zebra

2.3 DEMOGRAPHY, LAND USE AND DEVELOPMENT

There is little communal land in the ISP area, with land outside urban areas and nature reserves mainly owned by commercial farmers.

2.3.1 Population

The population, divided between urban and rural areas, is shown in **Table 2.1**. Approximately half a million people reside in the Fish-Sundays ISP area, with more than half of these living in the Great Fish River basin. Approximately 70% of the population resides within the urban areas. The population of the Fish and Sundays sub-areas is expected to decline after 2005. This is attributable to the lack of economic stimulants together with the impacts of HIV/AIDS⁽¹⁹⁾. A small growth in urban population is foreseen in the Albany Coast sub-area.

Table 2.1: Population

| Sub-area | Population (1000s) | | |
|--------------------------|--------------------|------------|------------|
| | Urban | Rural | Total |
| Sundays | 67 | 30 | 96 |
| Albany Coast | 109 | 27 | 136 |
| Fish | 147 | 88 | 234 |
| Total in ISP area | 323 | 145 | 466 |

2.3.2 Land use

Figure 2.10 shows land use in the ISP area.

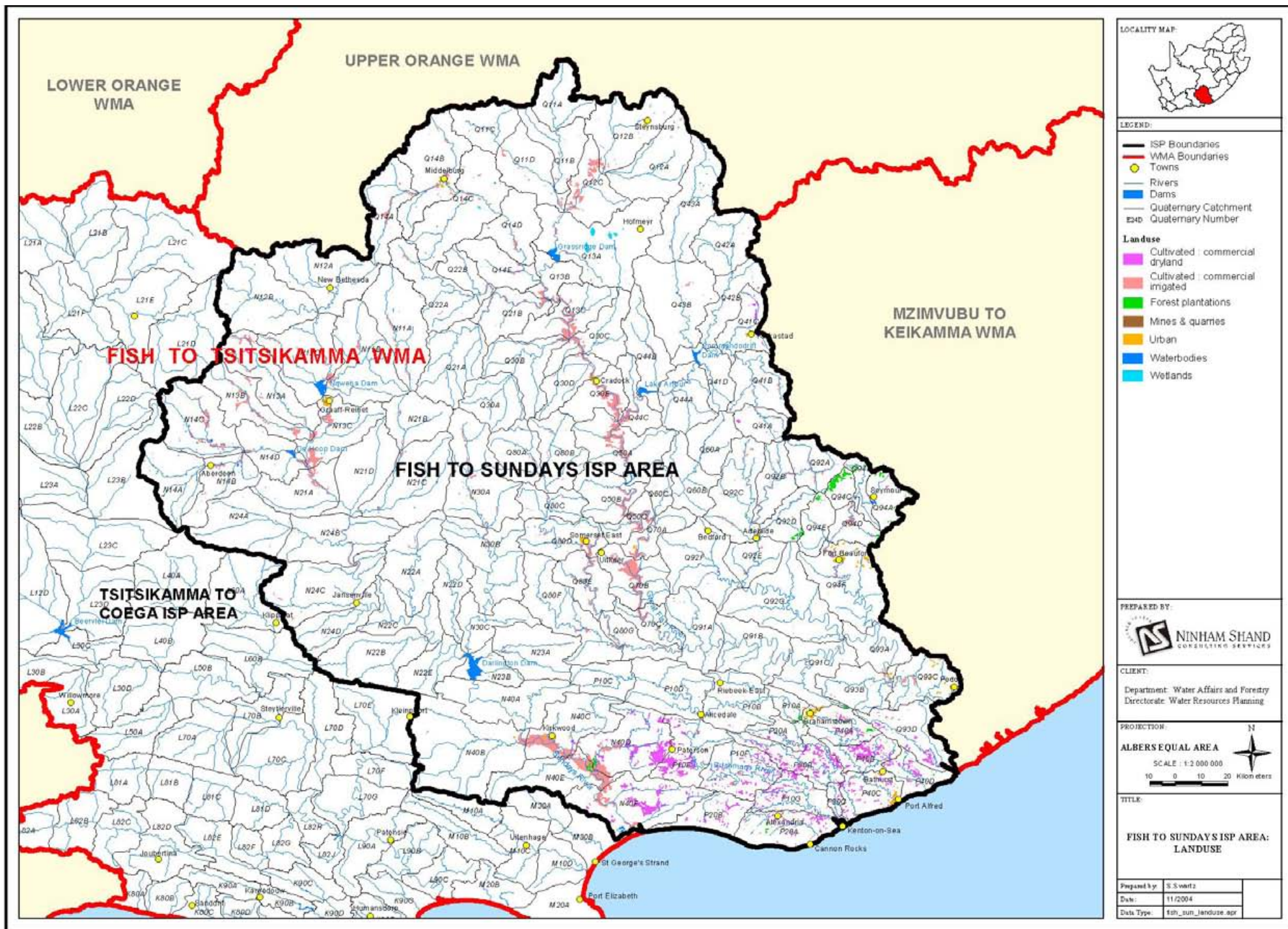


Figure 2.10: Land use map

Within the Fish River basin, land use is predominantly grazing for livestock (94%), particularly sheep⁽¹⁷⁾. Cattle ranching is the main land use in the Lower Fish catchment. As a result of the transfer of Orange River water, there is intensive cultivation and irrigation of land in the valleys of the Teebus and Groot Brak tributary rivers and along the main stem of the Great Fish River. Prior to the implementation of the ORP the latter area relied on the Grassridge Dam and Lake Arthur. Orange River water is transferred to the Sundays River from the Fish River via the Fish-Sundays Canals Transfer Scheme. There is intensive irrigation along the route of the transfer canals as well as along the Little Fish River. Lucerne is the dominant crop. Crops cultivated to a lesser degree are wheat, oats, vegetables and maize.

Irrigated citrus farming is also practised in the Kat River catchment, using local resources. There are some indigenous forests in the Kat River catchment. There is also significant irrigation from local resources along the Tarka River, below the Commando Drift Dam, and along the Koonap River.

Most of the Sundays River catchment is situated in the arid Great Karoo. The land-use is mainly sheep, mohair and game farming. Natural and stocked wildlife are found in this area and seems to be increasing in popularity. In the lower Sundays River there are mainly citrus orchards, with lucerne and vegetables making up the balance, mainly based on the use of transferred Orange River water. There is also irrigation in the upper and middle Sundays River catchments from natural river flows. Irrigated agriculture occupies 1.3% of the Sundays River catchment. Agricultural practices however lead to increased salinity due to the leaching of salts out of the profile and the use of fertilisers.

Land-use in the Albany coastal catchment is predominantly grazing for cattle and dairy farming, mohair goats and sheep, but pineapples are grown on a large scale without irrigation along the coast. Chicory is also extensively grown as a dryland crop, especially around Alexandria.



Figure 2.11: Grahamstown

The main urban and industrial centre in the ISP area is Grahamstown. Kaolin is mined close to the town. As there are not many large urban centres, pollution and other impacts due to urbanisation tend to be fairly limited in the ISP area. In Grahamstown there are some informal settlements without adequate services.

Effluent from the smaller towns in the ISP area typically evaporates from maturation ponds, or may be absorbed by irrigation and infiltration⁽²³⁾.

Only a very small portion of the ex-Ciskei area falls within this ISP area. Land degradation and soil wash-off is a problem in these former Ciskei areas due to poor land-use practices.

Refer to **Figure 2.14**, the map of Municipalities in the ISP area, which shows the former Ciskei homeland area.

Siltation is naturally high in many parts of the ISP area and has already impacted heavily on many dams. **Figure 6.5.1** in the *Fish to Tsitsikamma WMA WRSA Report P 15/000/00/0101* shows the potential for sediment accumulation in reservoirs.

2.3.3 International links and links with other WMAs

The ISP area has no international borders and is not directly linked to any other country through the transfer of water. The large quantities of water transferred into the Fish to Sundays ISP area from the Upper Orange WMA increase the 1:50 year yield of the ISP area by 575 million m³/a. The Orange River is an international river shared by four countries (South Africa, Lesotho, Botswana and Namibia). The transfer is a national issue which also forms part of South Africa's normal and ongoing liaison with basin states.

Quaternary Q93C (Peddie), in the Fish to Tsitsikamma WMA, has access to water from the Keiskamma to Mzimvubu WMA through a regional water supply scheme for dense rural settlements ⁽²³⁾.

Limited amounts of water that have been earmarked for resource-poor farmer schemes will in future be transferred, as well as small amounts that have been reserved for urban growth.

2.3.4 Economic Development

The Fish-Sundays ISP area contributes slightly less than 20% of the gross geographic product (GGP) of R21.8 billion (1997) generated by the Fish to Tsitsikamma WMA. The Orange-Fish-Sundays Scheme however provides growth and job opportunities. Despite this, unemployment in the area is high. Of the potential workforce of 680 000 in the Fish to Tsitsikamma WMA in 1994, 39% were unemployed. The Government, agriculture and manufacturing sectors dominate the regional economy. Government services play a significant role in the economy, providing 28% of formal employment. Unemployment is higher in the small Karoo towns where many farm workers have lost their jobs during the past decade, attributable to a shift to less labour-intensive farming, typically the shift from sheep to game farming. The economy of this ISP area is heavily dependent on irrigation.

a. Strategic water use

There is no large-scale power generation in the ISP area and no pumped storage schemes. A small 600 kVA hydropower station is situated at the Orange-Fish tunnel outlet at Teebus. Provision has also been made to extend its capacity to 1 200 kVA. This was originally intended to feed power into the national power grid, but apart from periodic testing until 1990 (when it was damaged) has been unused since it was installed. Power from the national grid is being used instead.

Some irrigators have permits for small hydropower plants, which they use for their own power needs.

b. Mining

The area is not mineral rich. There are no significant mining activities and mining operations are limited to quarrying for building materials. The main quarrying operations are for kaolin for brick making from weathered shales of the Witteberg Group in the vicinity of Grahamstown.

c. Industry

The larger regional industries of the WMA consist of manufacturing, construction, trade, transport and finance. These sectors account for the employment of about a quarter of the workforce. Manufacturing in the ISP area is centred on agro-processing. Food and dairy processing are present in the larger towns, while small businesses and craft co-operatives in the small towns of the Karoo produce mohair products, mostly hand-knitted. Leather and leather goods are a small local industry, with its base in Grahamstown. There is opportunity to expand this industry with respect to automotive seat leather, especially with the automotive industry being so well established both in East London (Daimler-Chrysler), Uitenhage (Volkswagen) and Port Elizabeth (Delta/General Motors).

The basis for the fishing industry is squid, with some recreational and commercial fishing for line fish.

d. Agriculture and irrigation

Agriculture is of major importance to the region and has linkages to several other economic sectors. Almost 60% of the world's mohair and much of the country's wool is produced in the water management area and surrounding areas. Citrus, vegetables as well as cash and fodder crops are grown under irrigation, while the area is also known for its production of pineapples, chicory and dairy products near the coast. Agriculture and supporting industries dominate the economy of the ISP area. Small-stock farming predominates in the dry Karoo interior.

Cattle and dairy farming are strongly represented in the areas around Grahamstown, Cookhouse and Alexandria. The areas around Peddie are also excellent cattle farming areas. Deciduous fruit and citrus are exported through Port Elizabeth. The main challenge of this area is to both expand agricultural production and to diversify the economy and add value to agricultural production by building agro-processing industries. Agriculture has been in relative decline for the past decade, primarily due to falling small-stock production. Many farmers have converted to game farming, which is now a major industry.

Dryland crop farming is a significant contributor to the agricultural sector, especially around the higher rainfall regions of the Albany Coastal catchment areas, where chicory and pineapples are farmed.

Some 51 000 ha of irrigated lands in the Fish and Sundays basins rely largely on water transferred from the Orange River. The main crops irrigated in the Fish River Basin are lucerne, maize and pastures, while citrus, lucerne and vegetables are the main crops cultivated in the Sundays River.

The allocated 4 000 ha for resource-poor farmer irrigation schemes creates limited opportunities for new development. Potential exists for irrigation to be expanded in the Fish and Sundays River catchments, where there are opportunities for further citrus production and high value horticultural production (vegetables, flowers, etc.). The potential for new large-scale schemes, involving *inter alia* the irrigated growing of cotton and sugar beet and their associated industries, have been identified in the central Fish River basin.

An important feature of irrigation outside of the GWSs is that most areas are only irrigated when water is available from natural runoff, which is very variable. In many years therefore, only parts of the total developed areas for irrigation will actually be irrigated. As a consequence, much water use by irrigation is highly variable from year to year, with much of it very opportunistic and at a low assurance of supply.

Irrigation efficiencies are low at some schemes and potential exists for a move towards more efficient irrigation methods. Flood irrigation is for example still widely used for lucerne and pastures. Exceptionally large conveyance losses are experienced from unlined canals in the Fish and Sundays sub-areas. Refer to the *Agricultural water conservation and demand management Strategy*, Strategy 8.2 for a more detailed description.

The water supply infrastructure of some irrigation schemes needs to be rehabilitated, especially in the former Ciskei areas. Typical problems are badly designed schemes, illegal connections, high non-payment and inadequate metering.

e. Forestry

Commercial forests cover approximately 83 km² in the ISP area, of which the largest part (73 km²) is in the northern Kat River catchment and some 6 km² is in the Albany Coast sub-area, south of Grahamstown ⁽¹⁷⁾. There is biophysical potential for some limited expansion of forestry, but the impact that expansion would have on other existing users precludes the likelihood of any further forestry water use licences being issued. The potential in this sector therefore lies primarily in the processing of wood products (crafts and furniture) using existing resources. The Kat River also has 32 km² of indigenous forest ⁽¹⁷⁾. The Albany Coast area has coastal tropical forests, but they do not provide marketable timber beyond the craft market.

f. Tourism

Tourism is well established, with a network of tourism routes, and is on the increase. Tourism attractions include the well-known Addo Elephant National Park, Mountain Zebra National Park near Cradock and the Mohair Route. Coastal towns such as Port Alfred also draw tourists. Farm tourism is beginning to develop in the Karoo, and Graaff-Reinet and

Grahamstown are visited for their history and architecture. Annual events are the Grahamstown Arts Festival and the Fish River canoe marathon. Game farming is becoming a major tourism activity, with top game farms such as Shamwari being located in the ISP area.

Tourism has large potential for growth. It is expected that the Addo Elephant National Park and the Fish River Reserve will be expanded, and will increase the attraction of other game reserves in the district. A strong base in beach, marina and sports tourism, including surfing, can be developed further. A number of major arterial routes traverse the area with the potential to develop rest stops and “stop-overs” combined with eco-tourism for motorists passing through.



Figure 2.12: Valley of Desolation near Graaff-Reinet

g. Identified poor areas

Poverty is seen as the denial of opportunities and choices most basic to human development, to lead a long, healthy, creative life and to enjoy a decent standard of living with dignity. In terms of a basic needs analysis, priorities for rural poor and urban poor differ significantly, with poverty usually the highest in both the more populated metropolitan areas (highly urbanised and relatively well serviced) and former homelands areas (rural with minimal services).

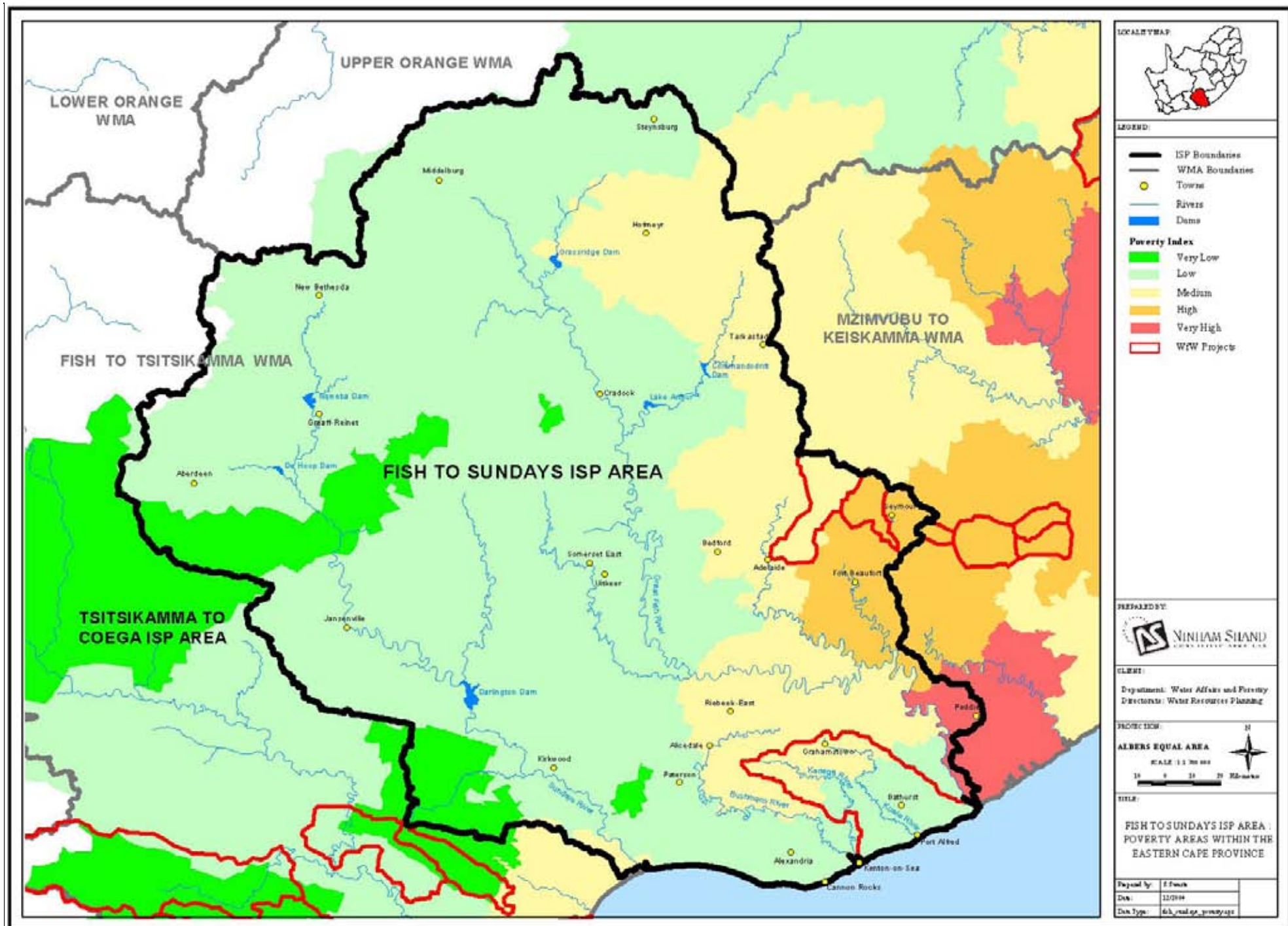


Figure 2.13: Eastern Cape Poverty Areas

Based on an overall poverty analysis conducted as part of the provincial economic analysis (DEAET, 2002), the Eastern Cape came out as the province with the highest poverty levels in the country, the measures being highest unemployment and lowest standards of living, as shown in **Figure 2.13** ⁽⁴²⁾. Certain areas, particularly in the eastern part of the province, display higher unemployment rates relative to the rest of the province. In this ISP area the eastern part of the Amatole District Municipality within the Fish River basin has high to very high poverty levels, this to a great extent being in the ex-Ciskei areas, falling within Ngqushwa (very high) and Nkonkobe (high) Local Municipality areas. The assessment for the rest of the ISP area varies from relatively low poverty levels in the west and north to medium in the central parts of the area.

h. Resource-poor farmers

A total of 5 000 ha of identified future Orange River allocations have been reserved for new irrigation by resource-poor farmers in the Eastern Cape, 4 000 ha through the Orange-Fish transfer tunnel (38 million m³/a) and 1 000 ha in the Upper Orange WMA respectively ⁽²⁶⁾. The Eastern Cape Province can however influence where this development will take place, if well motivated. The general approach would be that this water should be beneficially used where it will provide the most benefit and be most effective in eradicating poverty. Such decisions, to be recommended by the Co-ordinating Committee for Agricultural Water (CCAW), should also preferably be in line with the Eastern Cape Growth and Development Plan. An area of 180 ha has already been approved near Addo for resource-poor farmers in the Sundays River Municipal area. The proposed Tamboekiesvlei Scheme in the Kat River catchment, of which the feasibility study is under way, initially aims to develop 35 ha under drip irrigation for the benefit of successful land claim recipients ⁽²⁷⁾.

2.3.5 Water institutions

Water Services Authorities, which are all the local municipalities in the Cacadu, Chris Hani and Amatole district municipalities (DMs), are responsible for ensuring access to water services. The map of municipalities (**Figure 2.14**) shows the DMs, local municipalities (LMs) and metropolitan municipalities in the ISP area.

Three DMs manage most of the ISP area. They are the Cacadu DM (6 LMs), Chris Hani DM (2 LMs) and the Amatole DM (3 LMs). The Ukhahlamba DM manages a much smaller area, whilst the Central Karoo DM and Nelson Mandela Metropolitan Municipality (NMMM) boundaries just extend into this ISP area. Some other municipalities cover small portions of the ISP area.

The water services authorities are responsible for drafting water services development plans. A water services authority is any municipality responsible for ensuring access to water services, while a water services provider provides water services to consumers or to another water services institution. The five LMs within the Cacadu DM are all water services authorities. For the remainder of the ISP area, the DMs act as the water service authorities.

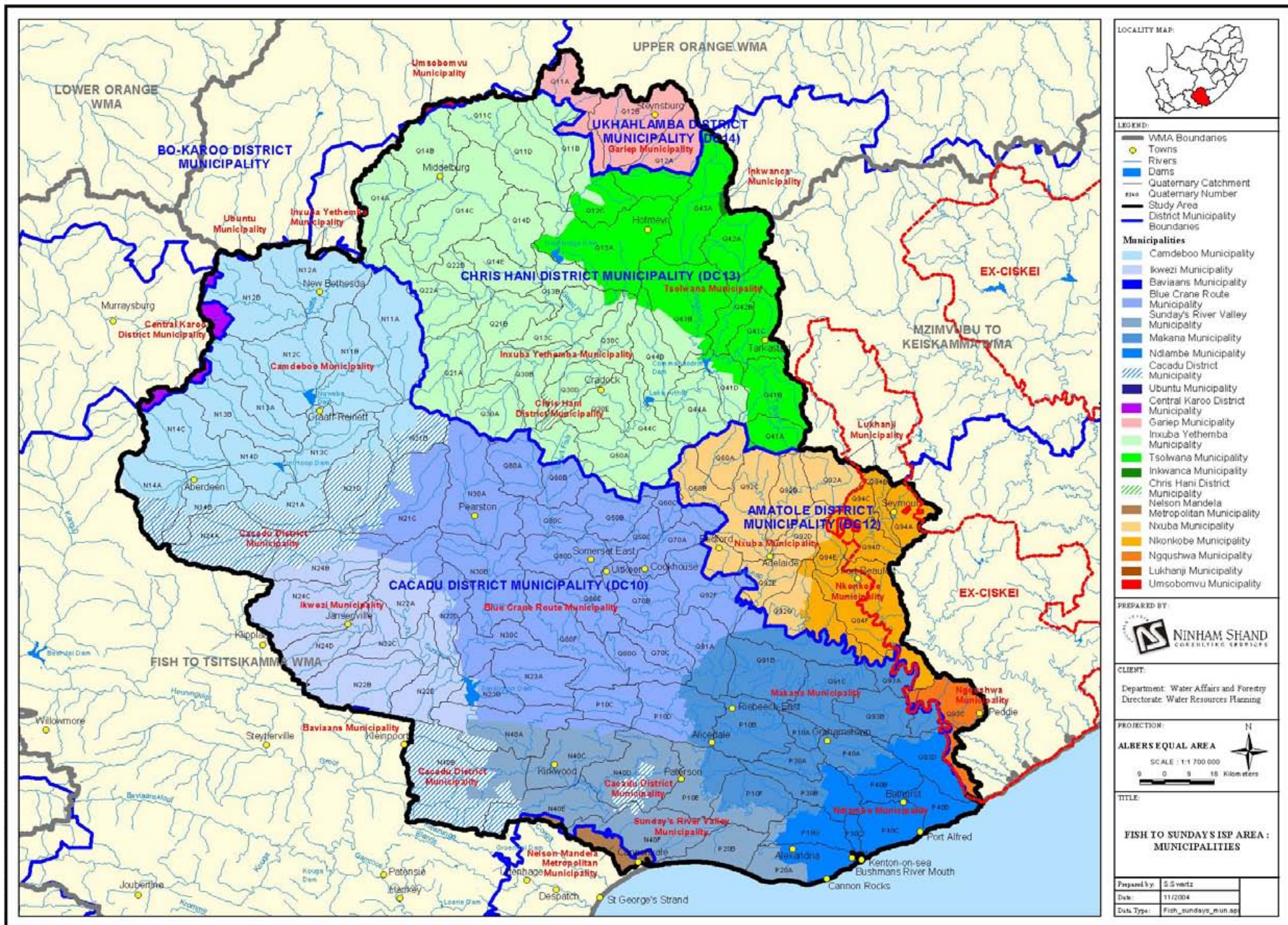


Figure 2.14: Municipalities in the ISP area

The Albany Coast Water Board, the only water board in the ISP area, supplies water to Bushmans River Mouth and Kenton-on-Sea.

The Great Fish River WUA (including Sub-Boards), Kat River WUA and the Sundays River WUA have been established by transforming the respective irrigation boards. Establishment of the Tyhefu WUA has not progressed satisfactorily due to inadequate support to the community. The Kat River Catchment Forum is the only catchment forum to have been established in the ISP area.

2.4 WATERWORKS

2.4.1 Major infrastructure and transfer schemes

a. The Orange-Fish-Sundays Transfer Scheme

Figure 2.15 on the following page shows a schematic diagram of the transfer scheme, which shows the main infrastructure components. Detailed information relating to other water infrastructure is also contained in the Appendices.

Irrigation along the Fish, Sundays and Tarka rivers started in the 1920s, with the construction of a number of dams and canal schemes. Dams included Grassridge, Commando Drift, van Ryneveld's Pass, Lake Arthur and Lake Mentz. Some of these schemes were developed on private initiative, while others were Government assisted. Extensive areas were put under irrigation from these dams. However, water shortages occurred regularly and the available water became saline due to salts in the catchment formations and irrigation return flows. The reliable yields of the dams further diminished over time, due to reduced catchment run-off to the dams as well as loss of dam storage capacity because of siltation. It is interesting to note that the catchment rehabilitation/ soil conservation measures, implemented by the Department of Agriculture during the 1950s, played an important role in the reduction of catchment run-off.

Because of the progressive decrease in water volumes and increase in salinity, irrigated agriculture became a high-risk activity and many farmers went out of business. Good examples are Golden Valley in the upper Fish River catchment and the Kendrew area in the upper Sundays River catchment. This strongly influenced the Government's decision in the early 1960s to build the Orange-Fish-Sundays transfer scheme, although this has not saved all the original irrigation regions. For example the more than 3 000 ha of irrigation previously supplied from the van Ryneveld's Pass Dam (now Nqweba Dam) no longer exists because the area is not supplied with Orange River water. So too, the large-scale irrigation that previously existed along the Tarka River has dwindled drastically. These days all the significant irrigation (about 51 000 ha) in the region is totally dependent on Orange River water.

This system supplies Orange River water to the Great Fish River valley and thence to the Sundays River valley, to supplement local water supply. Some water is also transferred to the NMMM via this system. From the Orange-Fish Tunnel outlet at Teebus, down to the NMMM is a distance of approximately 500 km. The impact of the transferred water on the yields of the

Great Fish and Sundays river catchments is 575 million m³/a (in accordance with the Upper Orange WMA ISP Report), although larger volumes are transferred on average, including freshening transfers. Actual water use is on average less than allocated use, notably so in the lower Sundays River.

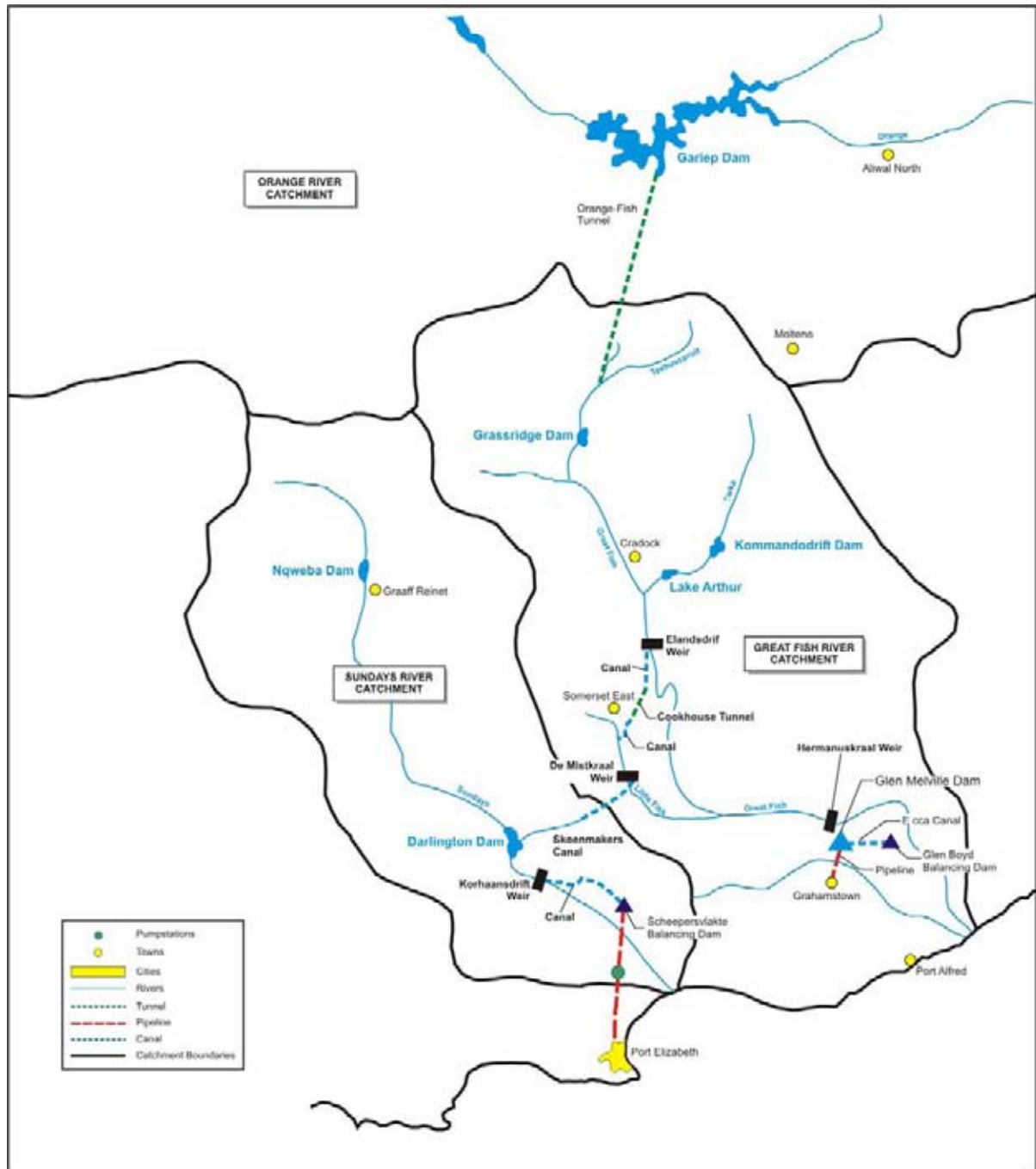


Figure 2.15: Schematic diagram of the Orange-Fish-Sundays Transfer Scheme

Any farmer is only entitled to his/her allocation. The amount transferred is however determined by *(allocated quantity + allowed canal distribution losses + river losses + freshening releases (if any) – expected return flows)*. Irrigation water distribution from the

main canals to field edge in all the small schemes and most of the large schemes along the Great Fish River is via earth canals. Canal losses are very significant and DWAF allows for a loss of 25% in the Fish River basin and 15% in the lower Sundays at no cost to the irrigator^(17, 23). The historic situation has put no incentives on irrigators to be more effective, and there is a need to especially curtail operating losses.

The natural quality of water in the Fish Sundays system deteriorates downstream through natural salinity. The water transferred from the Orange River System is of high quality but overall the quality gets progressively worse, as is common for irrigation schemes in relatively arid areas, through the leaching of salts and consequent saline return flows. A significant volume of additional water is required each year from the Orange River, purely to provide for freshening releases to keep the rivers within an acceptable quality.

It is the task of the water managers to see that downstream quality is suitable for irrigators and others users, although this would also be defined by natural quality. The Reserve requires that a sufficient quantity of water, of a quality which reasonably mimics the natural situation, remains in the river at all times. This also guides management.

i. Orange-Fish infrastructure

The small power plant at the Teebus tunnel outlet has never been used for the production of electricity and the DWAF is at present evaluating the possibility of implementing a public/private partnership for its future operation. Any potential future operation must not influence the operation of the tunnel system.

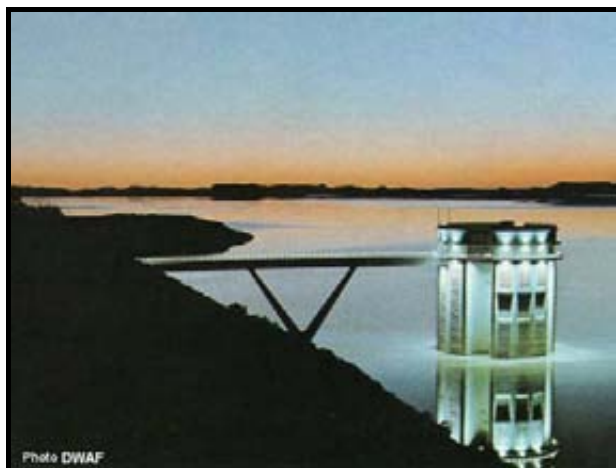


Figure 2.16: Intake tower at Gariep Dam

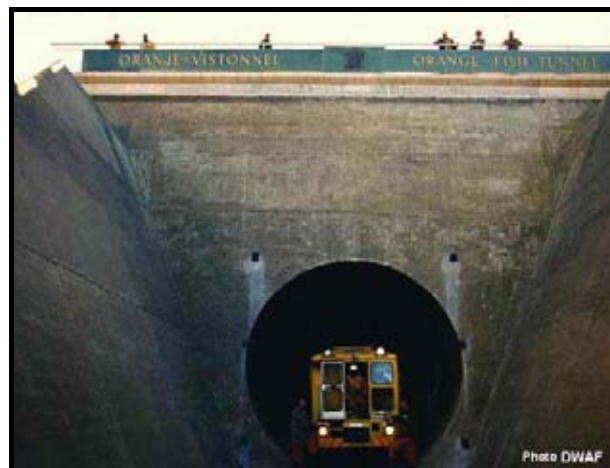


Figure 2.17: Orange-Fish tunnel outlet

Orange River water is transferred from the Gariep Dam through the 83 km long Orange-Fish Tunnel to be discharged into the Teebus Spruit, a tributary of the Great Fish River, and runs down into the Grassridge balancing dam. The tunnel is one of the largest water supply tunnels in the world. The maximum original capacity of the tunnel was 54 m³/s at full supply level in the Gariep Dam, and has since decreased by approximately 10%. Most of the water supplied

through the tunnel is used for irrigation purposes, although transferred water is also used for evapo-river losses, transport of salts, urban supply, groundwater recharge and distribution (canal) losses. The volume of water transferred fluctuates on an annual basis according to local catchment yield and crop mix, areas irrigated, requirements for freshening and availability of Orange River water to be transferred.

Transferred water (see **Table 3.6** and **Figure 3.7** for annual transfer volumes) released from the Grassridge Dam is used by the various sub-areas of the Great Fish River WUA for irrigation along the Great Fish River, down to the confluence with the Little Fish River. Irrigation along part of the lower Tarka River also falls under this scheme. Due to natural catchment salinity and especially irrigation return flows, water in the river becomes progressively more saline downstream. Elandsdrift Weir is another balancing dam upstream of the confluence with the Little Fish tributary. At the confluence with the Little Fish River the water quality reaches the point where it is, on average, no longer suitable for irrigation use.

Riparian owners downstream of the confluence with the Little Fish River abstract water on an opportunistic basis. Grahamstown and the Tyhefu Irrigation Scheme along the lower Fish River are however supplied with water of suitable quality through pulse releases from the Elandsdrift Weir, diverted from the Hermanuskraal Weir through a tunnel to the Glen Melville off-channel storage dam. From there irrigation water is supplied by means of canals and pipelines. Water is also purified at the dam and pumped to Grahamstown.

Water is also released from Elandsdrift Weir into the Great Fish River to supply users of the Lower Fish River Scheme (which consists of the Hermanuskraal diversion weir in the Great Fish River and a tunnel to divert water into the Glen Melville Dam on the Eccariver), and to serve users in the Grahamstown area. The distribution system for irrigation consists of a weir in the Eccariver below the Glen Melville Dam, which diverts water into a canal leading to the Glen Boyd balancing dam. From there, pipelines divert the water to the irrigable land on both sides of the river. A municipal pumping scheme conveys water from a treatment works at the Glen Melville Dam to Grahamstown (1 million m³/a is currently transferred for their use).

ii. Fish-Sundays infrastructure

At the Elandsdrift Weir about 163 million m³/a is diverted for eventual use in the lower Sundays River valley. The Elandsdrift Weir is the start of the Fish-Sundays transfer scheme. The scheme consists of a 19 km canal to the 13 km Cookhouse tunnel through the Bosberg mountain chain and a further 14 km canal to the stepped chute near Somerset East which discharges into the Little Fish River. About 40 km further down the Little Fish the water is picked up at De Mistkraal Weir into the 26 km Schoenmakers Canal which discharges 123 million m³/a into the Schoenmakers River, a tributary of the Sundays River, which feeds into the Darlington Dam. All along the way water is used for irrigation.

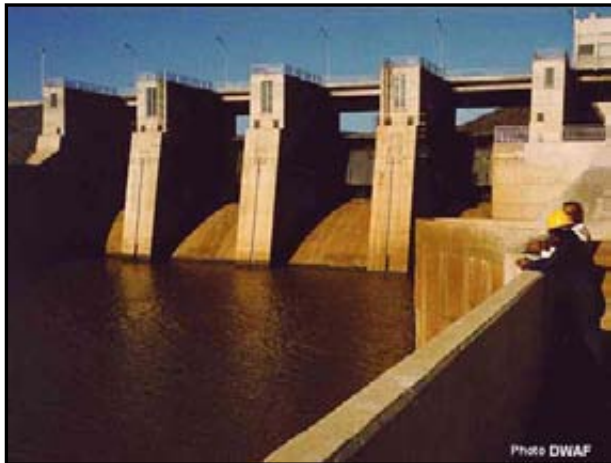


Figure 2.18: Elandsdrift Weir



Figure 2.19: De Mistkraal Weir

Figure 2.20 on the following page is a simplified schematic diagram of the Orange-Fish-Sundays Water Supply System, which also shows the deterioration of water quality as it flows through the system.

Before the construction of the Orange River Project, natural water quality in Darlington Dam was often poor in the past, because the base flow in the Sundays River is heavily mineralised. Water from Darlington Dam is released down the river to the Korhaansdrift Weir, which diverts water into the Lower Sundays main irrigation canal. Most of the water is used for irrigation and some flows to the Scheepersvlakte Dam from where the remainder is transported to the Nooitgedacht purification works on the right bank of the Sundays River by gravity pipeline. From there it is conveyed to Motherwell Reservoir by a pumping main and gravity pipeline to serve users in the urban areas of Port Elizabeth (the final remainder of 11 million m³/a of the transferred water).

The Tsitsikamma to Coega ISP addresses the water requirements of the NMMM through the *NMMM future augmentation Strategy* and the operation of the relevant portion of the Orange-Fish-Sundays Water Supply System (OFSWSS) infrastructure through the *Algoa System Management Strategy*. The current 25.6 million m³/a capacity of supply of Orange River water to the NMMM, via the Sundays River, is limited by the treatment capacity and could, if necessary, be substantially increased in the future by extending the treatment works and increasing the capacity of the delivery pipelines and some sections of the raw water conveyance system. At present, water treatment capacity of approximately 20 million m³/a has been constructed, the intention being to increase both the treatment and conveyance capacity as dictated by future water requirements.

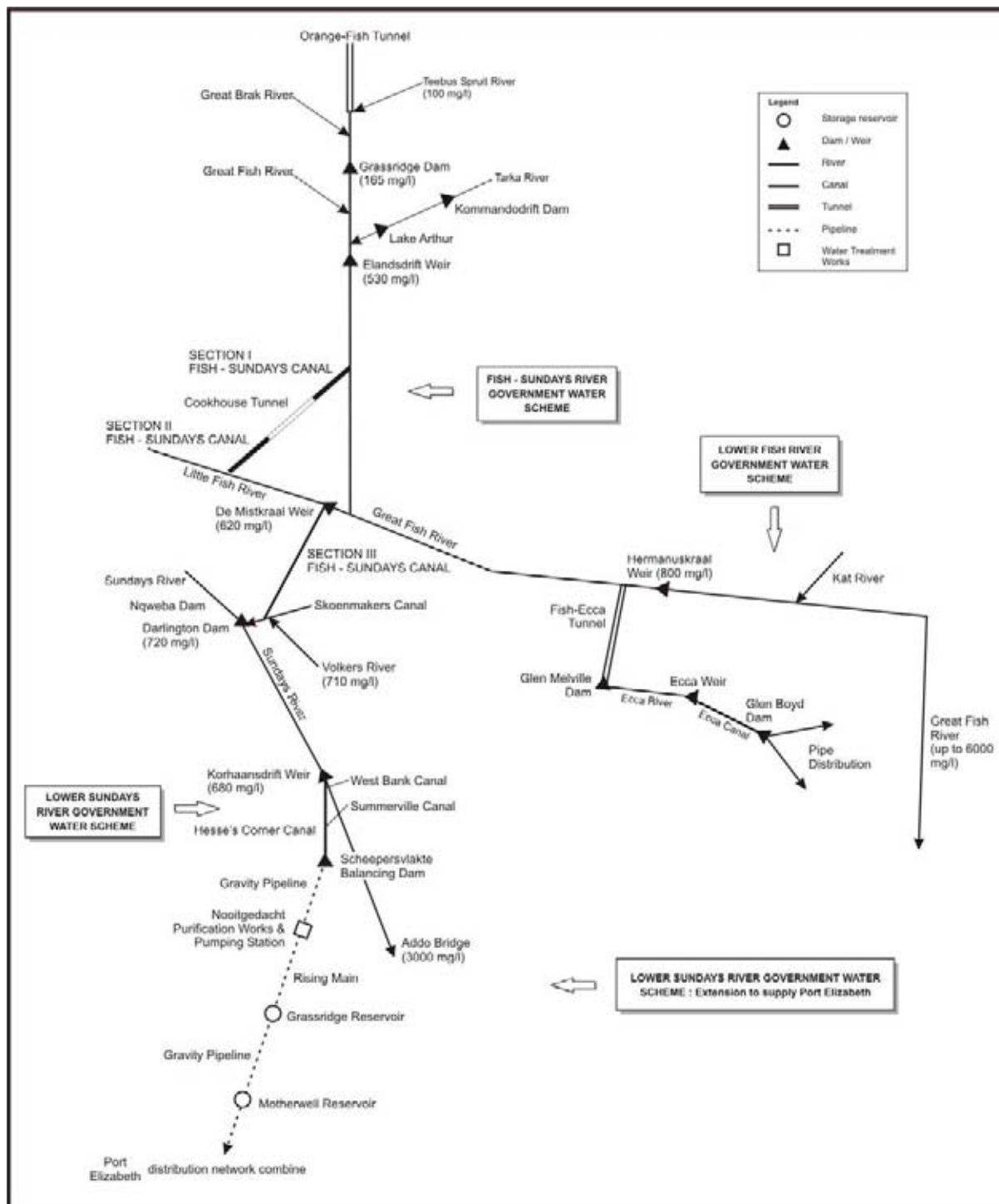


Figure 2.20: Simplified schematic diagram of the O-F-S Transfer Scheme



Figure 2.21: Darlington Dam wall

b. Other significant infrastructure

Separate irrigation schemes exist on the Tarka and Kat Rivers.

The Kat River Dam Water Supply Scheme supplies raw water to the towns of Seymour and Fort Beaufort, as well as for the irrigation of 1 130 ha of land (1 600 ha is scheduled), with citrus being the predominant crop.

The Tarka River Government Water Scheme obtains water from the Commando Drift Dam. Some Orange River water is also supplied, by means of a pump and canal, to the lower reaches of the scheme below Lake Arthur. Only about 180 ha are still irrigated from Lake Arthur itself. Owing to loss of storage capacity as a result of siltation, together with the building of farm dams, abstraction works and anti-erosion structures in its catchment, the yield of Lake Arthur is now negligible and it is essentially operated as a weir.

c. Potential future schemes

Potential future schemes have been identified in the Kat and the Koonap rivers. The proposed Foxwood Dam in the Koonap River has a potential yield of 25 million m³/a, although this water would be expensive. Groundwater holds significant potential, as is explained in Section 3.1.2. The water source for the proposed Tamboekiesvlei Scheme will likely be from a small tributary in the Kat River catchment, and from fountains.

2.4.2 Local water supply schemes



Figure 2.22: Graaff-Reinet

Several towns use transferred Orange River water. These include Grahamstown, Enon, Kirkwood, Cookhouse, Bedford and Cradock. A scheme to supply water to Steynsburg from the Orange-Fish tunnel was recently initiated.

The towns of Nieu Bethesda, Aberdeen, Jansenville, Riebeeck East, Alexandria, Boknes, Cannon Rocks, Paterson, Kenton-on-Sea, Tarkastad, Hofmeyr, Steynsburg and Middelburg all rely solely on borehole supplies. Borehole development is prominent not only in these towns but also around them (**Figure 5 in Appendix 2**).

Towns supplied by local dams are Graaff-Reinet (Nqweba Dam, previously known as Van Rynevelds Pass Dam), Alicedale (New Years Dam), Port Alfred and in Bathurst (Mansfield and Sarel Hayward dams), Seymour and Fort Beaufort (Kat River Dam), Adelaide (off-channel storage on the Koonap River) and Peddie (Khewekazi Dam). Peddie forms part of a regional water supply system that receives Keiskamma River water from the Peddie Regional Scheme, along with many dense rural settlements. Grahamstown also receives water from a number of local dams.

The water supply status, need for augmentation, and possible and expected future sources of towns are discussed in the table that form part of the *Supply to local authorities strategy*, Strategy 5.4.