

# Determining the Water Resource Classes and Resource Quality Objectives in the Upper Orange River Catchment

## Background Information Document

August 2024



water & sanitation

Department:  
Water and Sanitation  
REPUBLIC OF SOUTH AFRICA

### PURPOSE OF THIS DOCUMENT

The purpose of this background information document (BID) is to inform the Project Steering Committee (PSC) members about the study currently underway to determine water resource classes and Resource Quality Objectives (RQOs) for all significant water resources in the Upper Orange River catchment within the Vaal-Orange Water Management Area (WMA) in the Free State, Eastern Cape, and Northern Cape provinces.

This BID serves to provide baseline information to PSC members in preparation for the 1<sup>st</sup> meeting to be held in Bloemfontein on the 28<sup>th</sup> of August 2024, at which members input, guidance, and review is required on the first two steps of the water resource classification process that have been completed.

Further details or clarification can be obtained from the stakeholder engagement office or the technical team on the contact details provided below.

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### BACKGROUND

The National Water Act (NWA), Act No. 36 of 1998, is founded on the principle that National Government has overall responsibility for and authority over water resource management for the benefit of the public. It also requires that the nation's water resources be protected, used, developed, conserved, managed, and controlled in an equitable, efficient and sustainable manner. To achieve this objective, Chapter 3 of the NWA provides for the protection of water resources through the implementation of Resource Directed Measures (RDM).

The Chief Directorate: Water Ecosystems Management (CD: WEM) of the Department of Water and Sanitation (DWS) is responsible for the determination of RDM. This includes determining the class, the Resource Quality Objectives (RQOs) that will help to achieve the class set, and determination of the Reserve as set out in terms of the Water Resource Classification System (WRCS). This is to ensure that a balance is sought between the need to protect and sustain water resources on one hand and the need to develop and use them on the other.

The DWS is currently undertaking the process to classify all significant water resources (rivers, dams, wetlands, and groundwater) in the Upper Orange River catchment, of the Vaal-Orange Water Management Area (WMA04), referred to as the Upper Orange River catchment from here onwards. The study initiation was announced to stakeholders through various platforms encouraging participation earlier in 2024.

The same process is underway for the Lower Orange River catchment, and it is important to note that while the classification and determination of RQOs for water resources in the Upper Orange and Lower Orange River catchments are being undertaken as separate projects; the studies are being run in parallel to ensure relevant catchment links and continuity along the river system.

This Background Information Document (BID) relates to the Upper Orange River catchment and serves to provide an overview of the outcomes on the first two tasks of the water resource classification process in support of the upcoming first Project Steering Committee meeting.

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## UPPER ORANGE RIVER STUDY AREA DESCRIPTION

The previous Orange River WMA, (WMA 6) has recently been merged with the Vaal WMA and will be managed as one area, the Vaal-Orange WMA, WMA 4 (Figure 1). The Orange River catchment, comprising the Upper Orange and Lower Orange River catchments, is the largest catchment in the country. It comprises 50% of the country in land area and forms part of the Orange-Senqu River Basin which straddles four International Basin States (Lesotho, South Africa, Namibia and Botswana).

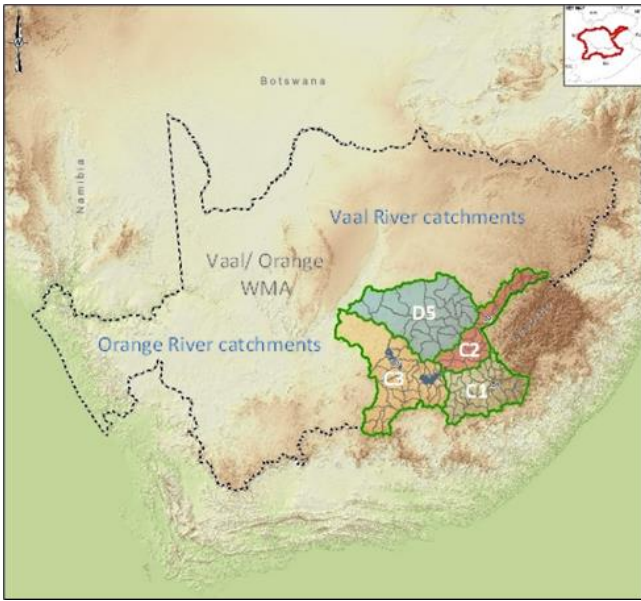


Figure 1: Orange River catchment within the Vaal/Orange WMA

The Orange River (main stem) originates in the Eastern Highlands of Lesotho, where it is known as the Senqu River. The main stem flows west approximately 2 200 km, where it flows into the Orange River Mouth and into the Atlantic Ocean at Alexander Bay.

The study area for this undertaking is the catchment of the Upper Orange River. It includes only the South African portion of the Upper Orange River and comprises 129 quaternary catchments, including secondary catchments D1, D2, D3 and C5 illustrated in Figure 1.

The Upper Orange River catchment is divided into four distinct sub-areas, stretching across the Northern Cape, Free State and Eastern Cape provinces and further across three ecoregions, the Eastern Escarpment Mountains, Nama Karoo and Highveld:

- The Caledon River from its headwaters and its tributaries up to its confluence with the Orange at Gariep Dam. It is called the Mohokare River along the Lesotho/ South Africa border and forms the north-western boundary of Lesotho with South Africa and is the first major tributary of the Orange River. Figure 2 illustrates a lower reach of the Caledon River.



Figure 2: Lower Caledon River

- The Orange River from the Lesotho Border to the Gariep Dam, including the main tributaries namely Kornetspruit, Sterkspruit, Stormbergespruit and Brandwaterspruit
- The Kraai River catchment, a lower portion illustrated in Figure 3, and



Figure 3: Lower Kraai River

- The Orange River from the Gariep Dam, through Vanderkloof Dam to Marksdrift weir, just before the confluence with the Vaal River, including the Seekoei River in the south, and the Modder-Riet River (main tributaries of the Vaal River system) in the north. Figure 4 is an image of a portion of the Orange River in the lower reach.



Figure 4: Orange River reach below Vanderkloof Dam

The main storage dams in the Orange River are Gariep and Vanderkloof dams. Smaller dams are Welbedacht Dam in the Caledon River, Rustfontein, Mockes, and Krugersdrift Dams in the Modder River with the Tierpoort and Kalkfontein Dams in the Riet River. The Gariep Dam, Vanderkloof Dam, Orange-Fish Tunnel, Orange Vaal transfer canal and Orange-Riet Canal system are all part of the Orange River Project.

The Orange River is of critical importance to South Africa in that it augments the Vaal River System through the Lesotho Highlands Water Project and supplies the economic heartland of South Africa. It also supplies thermal power stations on the Highveld, and irrigation schemes covering large areas along the Vaal, middle and lower Orange Rivers. Approximately 15 million people are dependent on water supply from this basin.

#### **Land-use**

Land use in the Upper Orange River catchments of the WMA is mainly under natural vegetation with livestock farming as the main economic activity and extensive areas under dry land cultivation, mostly to produce grains, in the north-eastern parts. The Modder-Riet catchment is dominated by agricultural activities, with limited mining, and a few urban centres. Large areas under irrigation for the growing of grain and fodder crops have been developed along the main rivers, mostly downstream of irrigation dams. Mangaung (Bloemfontein), Botshabelo and Thaba 'Nchu as well as Maletswai (Aliwal North) represent the main urban and industrial developments in the catchment. Smaller towns include Clarens, Ficksburg, Hobhouse, Fouriesburg, Hlohlolwane (Clocolan), Winnie Mandela (Brandfort), Ladybrand, Vanstadensrus, Wepener, Smithfield, Hanover and Noupoot.

#### **Hydropower**

Two large hydropower stations have been constructed at Gariep and Vanderkloof dams.

#### **Inter-basin transfers**

The surface water resources of the Upper Orange River catchment are used to support requirements for water in other parts of the country with large transfer schemes both from and within this WMA. These include transfers from the Senqu River (Lesotho Highlands Water Project) through the Katse and Mohale dams and the Polihali Dam currently under construction, to the Upper Vaal WMA, the Orange-Fish Tunnel from Gariep Dam to the Fish/Tsitsikamma WMA, transfer from Caledon River via Knellpoort Dam (off-channel) to the greater Bloemfontein area for domestic and industrial use, transfers from Vanderkloof Dam and at Marksdrift Weir to the Riet River catchment for mainly irrigation purposes and the Orange-Vaal Transfer to the Lower Orange WMA.

Transfer from Muela Dam in Lesotho to the Caledon River is used during droughts to supply water to Maseru and surrounding areas.

#### **Groundwater**

Groundwater occurrences in the Upper Orange River Catchment occurs predominantly as shallow (<65 m thick) aquifer systems in the Karoo Supergroup sedimentary sequence (as primary rock formation). In most of the water management area, secondary Karoo Dolerite intrusions in the form of (i) sub-vertical dikes and (ii) semi-horizontal sills are present which enhances the yield potential of the primary aquifer system which are comprised of predominantly fractured rock aquifers and fractured and intergranular aquifer types, as well as Karst rock aquifers, Intergranular Aquifers and Karoo Dolerite "Contact Zone" aquifers on a smaller scale.

Groundwater quality in the Upper Orange WMA varies from 'Ideal to Marginal' however there are several areas where the groundwater quality is characterised by high salinity due to natural conditions and may also be impacted by anthropogenic pollution, i.e., mining, agriculture, industrial and municipal waste.

#### **Wetlands**

There are several wetland types in the Upper Orange Catchment including floodplain, depression, unchanneled valley-bottom, and hillslope seep wetlands. Most of the wetland complexes have been impacted by cultivation, as described in the recently completed High Confidence Upper Orange River Reserve study, however there are some areas that are still natural. The wetlands include:

- Brandwater floodplain
- Soutpan depression wetland complex
- Philipstown unchanneled valley-bottom (UCVB) wetland complex
- Wolwespruit headwaters wetland complex
- Klein-Wildebeespruit wetland complex
- Luckhof depression wetland complex
- Kaalspruit wetland complex
- Aardoringspruit
- Rantsho wetland complex
- Jagersfontein discontinuous channelled valley-bottom (DCVB) wetland
- Barkley Pass wetland complex
- Tiffindell Seep

#### **Strategic Water Source Areas**

Strategic Water Source Areas (SWSAs) are defined as areas of land that either: (a) supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or (b) have high groundwater recharge

and where the groundwater forms a nationally important resource; or (c) areas that meet both criteria (a) and (b). They include transboundary Water Source Areas that extend into Lesotho and Swaziland. In the study area the following SWSA are relevant:

- Groundwater – Central Pan Belt in the Bloemfontein area, a national SWSA covering an area of 3 368 km<sup>2</sup>, and
- Surface water – Maloti Drakensberg area and the Eastern Cape Drakensberg.

**Socioeconomics**

The Upper Orange River catchment stretches across an area that covers parts of the Free State, Northern Cape, and Eastern Cape provinces, with the largest proportion within the Free State province. The catchment encompasses numerous local municipalities (Figure 5) and one metro, Mangaung Metropolitan Municipality (MM). There are small towns, farms and settlements composed of townships and villages and Bloemfontein is the only major city.

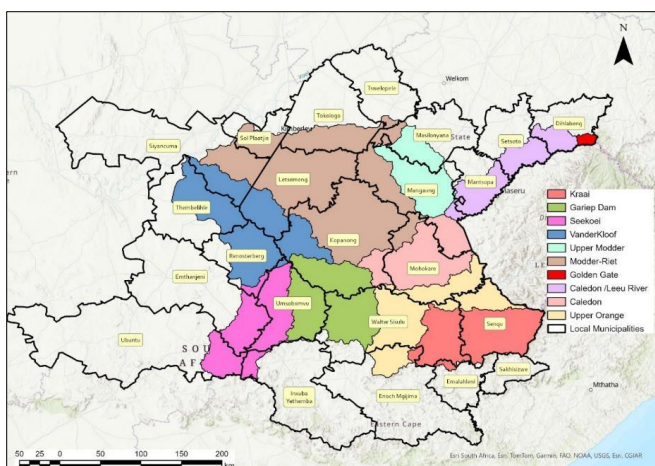


Figure 5: Local municipalities

The estimated total population of the Upper Orange River catchment study area was approximately 1.4 million in 2023 with about 476,000 households (Stats SA 2011 Census adjusted) (Figure 6).

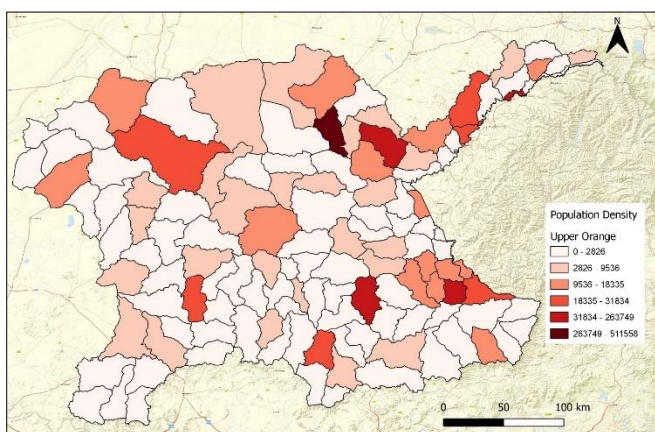


Figure 6: Population density

Agricultural activities are mainly located in the Northeast of the Upper Orange River catchment and along the mainstem Orange River. Irrigation is mainly related to maize, wheat and lucerne, and cattle and sheep as the livestock farmed.

There are mining activities in the region and a diamond mine in the Koffiefontein area. Another major economic project outside of Bloemfontein, although still within Mangaung MM, is the Letsatsi Solar PV Power project.

**THE WATER RESOURCE CLASSIFICATION SYSTEM**

The Water Resource Classification System (WRCS) is a set of procedures for determining the desired characteristics of a water resource and is represented by a water resource class. The class outlines the attributes that society requires of different water resources, and reflects the importance given to protection and/or development.

The implementation of the WRCS therefore requires consideration of the social, economic, and environmental landscape in a catchment to assess the costs and benefits associated with utilisation versus protection of a water resource.

The water resource classification process is a consultative process that allows stakeholders to provide input in the setting of the water resource classes. The outcome of the classification process in the Upper Orange River catchment will be the gazetting of the water resource classes and RQOs approved by the Minister of Water and Sanitation. The gazetted classes and RQOs will be binding on all authorities or institutions when exercising any power or performing any duty under the National Water Act, 1998.

The Water Resource Class essentially describes the desired condition of the resource, along with the degree to which it can be utilised. A water resource class ranges from minimally used to heavily used (Figure 7).

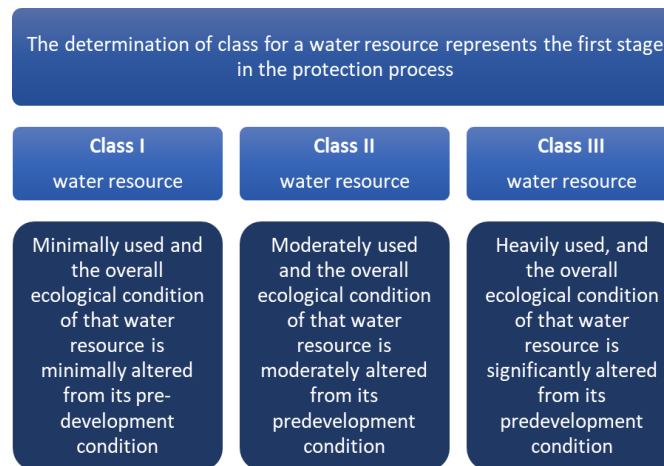


Figure 7: Water Resource Class descriptions

The class of a water resource sets the boundaries for the volume, distribution, and quality of the Reserve and Resource Quality Objectives, and therefore informs the determination of the allocatable portion of a water resource for use.

## RESOURCE QUALITY OBJECTIVES

Resource Quality Objectives (RQOs) are a set of narrative and/or numerical management objectives defined for any resource, and which are set to support the achievement of the water resource class. RQOs encompass four components of the resource:

- Water quantity
- Water quality
- Habitat integrity; and
- Biotic characteristics.

RQOs are important management objectives against which resource monitoring will be assessed. Monitoring will provide an indication of whether the water resource class is being maintained. In general, RQOs will form important indicators for water resource management.

## WHERE ARE WE IN THE CLASSIFICATION PROCESS?

To classify a water resource, the WRCS lays out a set of procedures grouped together in seven steps, that when applied to a specific catchment, will result in the determination of a water resource class. The 7-step classification procedure is illustrated in Figure 8 and further details can be obtained in supporting technical guideline documents available at: <https://www.dws.gov.za/wem/Documents.aspx>.

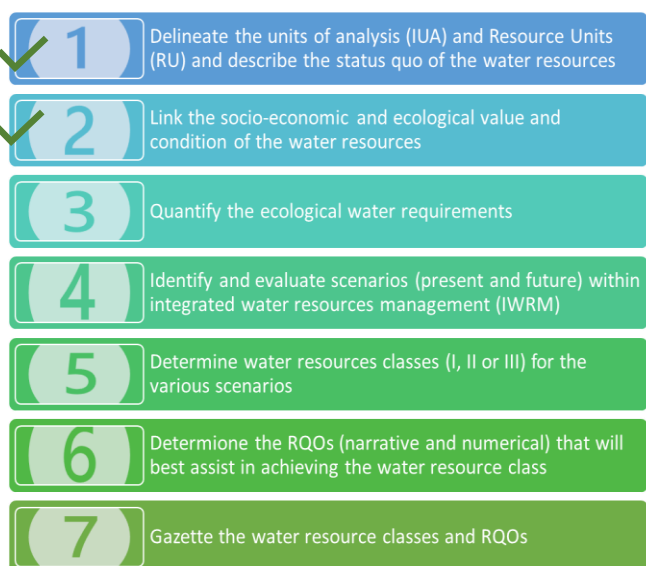


Figure 8: Steps for determining water resource classes and RQOs

The study is currently in Steps 1 and 2 of the water resource classification process. A detailed status quo assessment of the catchment (evaluation of water resource quality and quantity, ecology, water resource impacts, existing monitoring programmes, infrastructure, institutional environment, socioeconomics, sectoral water uses and users) has been undertaken to understand the current conditions.

Further to this, a socio-economic analysis of the catchment has been undertaken to understand the socio-economic conditions and the community well-being; and based on the analysis, Socio-Economic Zones (SEZs) for the Upper Orange catchment have been defined (Figure 9). SEZs are defined as zones of relatively homogenous socio-economic characteristics and dependencies to the services provided by associated aquatic ecosystems. In other words, areas that represent a relatively similar mix of social wellbeing and economic drivers for the purposes of providing input into Step 1 of the classification process.

These two outputs of steps 1 and 2 serve as the basis and the primary inputs to the next steps of the classification process.

## STAKEHOLDER CONSULTATION

The classification and RQO study process is supported by comprehensive stakeholder engagement throughout the study process, aligned to the technical steps of the study. Stakeholders representing relevant interests and sectors of society, and organs of state in the catchment, form part of the process and have been invited to participate. One of the key platforms is the Project Steering Committee (PSC), which has a role to:

- Provide strategic direction and guidance on the study process and tasks
- Guide the study team on the desired state of water resources within the Lower Orange catchment
- Provide input to the technical process
- Provide direction on the significant water resources to be classified and RQOs determined, and
- Serve as representatives of the stakeholder bodies and organisations and report back to them on an ongoing basis regarding the study decisions and results.

PSC representatives for the study have been identified to serve as members for the duration of this project. The PSC members are key stakeholder representatives of the stakeholder bodies and/or organisations within the catchment.

## STEP 1 OUTCOME: INTEGRATED UNITS OF ANALYSIS

Step 1 indicated in Figure 8 of the classification process is to delineate the Integrated Units of Analysis (IUAs) - the spatial units that will be defined as a network of significant water resources. Each IUA represents a homogenous area which requires its own specification of the water resource class. The delineation of a catchment into IUAs is done primarily according to several socio-economic criteria, drainage region boundaries and land use characteristics.

IUAs are therefore a combination of socioeconomic zones, of which five have been delineated (Figure 9) and watershed boundaries. Ecological information also plays a role in their delineation, as well as the assessment of the present state of water resources and impacts, and key modelling points in the system.

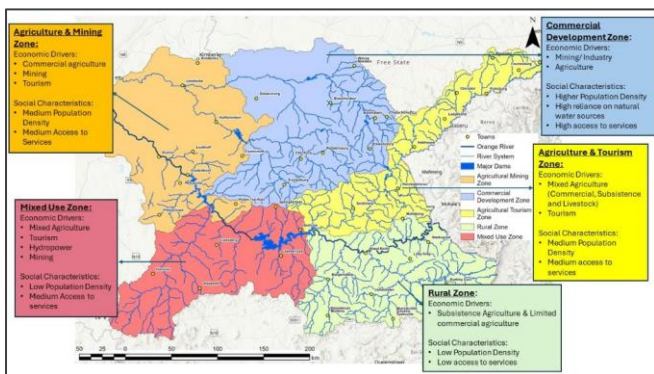


Figure 9: Socio-economic zones

### IUA Delineation Results

Based on the SEZs described, and the assessment of the information and considerations of the status quo assessment, ten IUAs have been delineated for the Upper Orange River catchments. These are set out in Table 1 and illustrated in Figure 12 included towards the end of the document. Details of these IUAs will be presented at the first PSC meeting.

Table 1: Preliminary Integrated Units of Analysis

IUA	Description	Quaternary
1	Golden Gate	D21D and a portion of D21A along South Africa/ Lesotho border
2	Caledon/ Leeu River	D21E, D21F, D21G; portion of D21C; D22A, D22B; portions of D21H and D22C along the SA/ Lesotho border; Portions of D22D, D22G, D22H, D22L, Portion of D23A, D23C, D23D and portion of D23E
3	Caledon River	D23F, D23G, D23H, D23J, D24A, D24B, D24C, D24D, D24E, D24F, D24G, D24H, D24J, D24K and D24L
4	Kraai River	D13A – D13M

IUA	Description	Quaternary
5	Upper Orange River	D12A – D12F, D14A – D14K, Portions of D15G, D15H, D18K and D18L
6	Gariiep Dam	D34A, D34B, D34C, D34D, D34E, D34F, and D34G, D35A, D35B, D35C, D35D, D35E, D35F, D35J, D35G, D35H, D35K
7	Seeikoei River	D32A, D32B, D32C, D32D, D32E, D32F, D32G, D32H, D32J, D32K
8	Vanderkloof Dam	D33A – D33K (along main stem Orange River); D31A – D31E
9	Upper Modder River	C52A, C52B, C52C, C52D, C52E, C52F and C52G
10	Modder/ Riet River	C51A, C51B, C51C, C51D, C51E, C51F, C51G, C51H, C51J, C51K, C51L, C51M, C52H, C52J, C52K and C52L

## STEP 2: OUTCOME: LINKING THE SOCIOECONOMICS AND ECOLOGICAL VALUE OF WATER RESOURCES

Step 2 of the water resource classification process illustrated in Figure 8, requires that the quantification of the relationships that link the change in the configuration of scenarios to a resulting change in economic value and social wellbeing as they relate to the water resources, be defined.

This linkage step is used to inform the evaluation of scenarios in step 4 of the classification process. Linkages are assessed through an Integrated Economic Model (IEM) (Figure 10). The aim of this step has been to demonstrate the linkages between the socio-economic and ecological value and condition of water resources as they currently stand in the Upper Orange River catchment.

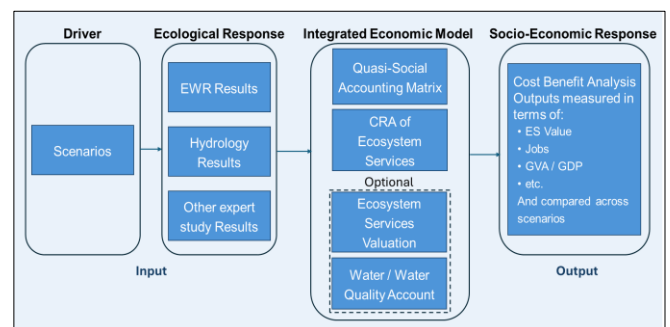


Figure 10: Approach to the development of the Integrated Economic Model that Demonstrates the Socio-Economic Linkages in the Upper Orange River Catchment (Arrows indicate flow of data from input to output)

The ten proposed IUAs defined in Step 1, broadly represent diverse socio-economic drivers, well-being and characteristics of beneficiaries of ecosystem services in the catchment. Based on variation in distribution of ecological infrastructure:

- each IUA benefits to varying degrees from flow and direct use of ecosystem services, and
- variation between beneficiaries is further subdivided into formal and informal users.

Key ecosystem services identified and prioritised across the Upper Orange catchment include:

- Fresh Water Provisioning (predominant)
- Water Quantity Regulation
- Food, Raw Materials and Wild Collected Products Provisioning
- Erosion Regulation
- Water Quality Regulation: purification and waste management
- Tourism, Recreational and Amenity Services, and
- Biodiversity Support.

Important ecological infrastructure supporting these ecosystem services includes several national parks, nature reserves (both provincial and private) and protected areas, water resources infrastructure represented by surface water (rivers and streams), groundwater, strategic water resources areas (SWSA) and various types of wetlands.

The ecosystem linkages between the ecosystem benefits and the beneficiaries identified for the Upper Orange Catchment are presented in Table 2.

## THE WAY FORWARD

This BID has presented an overview of the outcomes of the first two tasks of the water resource classification process being undertaken in the Upper Orange River catchment. The full volume of information available for these milestones is available as study reports to be shared with the PSC members following the meeting.

## DEFINITIONS AND ACRONYMS

**Ecological Infrastructure:** refers to functioning ecosystems that deliver valuable services to people such as fresh water, water and climate regulation, cultural services and soil formation.

**Ecological Water Requirements (EWR):** The flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition. This term is used to refer to both the quantity and quality components. The EWRs as determined during preliminary Reserve studies will be applied in this study.

**Ecological Water Requirement Sites:** EWR sites are set at specific points on the river. These sites provide sufficient indicators for the specialists to assess environmental flows and information about the variety of conditions in a river reach. An EWR site consists of a length of river which may consist of various cross-sections for both hydraulic and ecological purposes.

**Integrated Units of Analysis (IUAs):** The basic unit of assessment for the classification of water resources. The IUAs incorporates socio-economic zones and is defined by catchment area boundaries.

**Resource Quality Objectives (RQOs):** RQOs provide numerical and narrative descriptors of quality, quantity, habitat, and biotic conditions as a basis from which management actions can be implemented for the sustainable use of all water resources.

**Socioeconomic Zones (SEZ)** Zones of relatively homogenous socio-economic characteristics and dependencies to the services provided by associated aquatic ecosystems.

<b>BID</b>	Background Information Document
<b>CD: WEM</b>	Chief Directorate: Water Ecosystems Management
<b>CRA</b>	Comparative Risk Assessment
<b>DCVB</b>	Discontinuous channelled valley bottom
<b>DWS</b>	Department of Water and Sanitation
<b>EWR</b>	Ecological Water Requirement
<b>IEM</b>	Integrated Economic Model
<b>IUA</b>	Integrated Unit of Analysis
<b>RDM</b>	Resource Directed Measures
<b>RQO</b>	Resource Quality Objectives
<b>SWSA</b>	Strategic Water Source Area
<b>UCVB</b>	Unchanneled valley bottom
<b>WMA</b>	Water Management Area

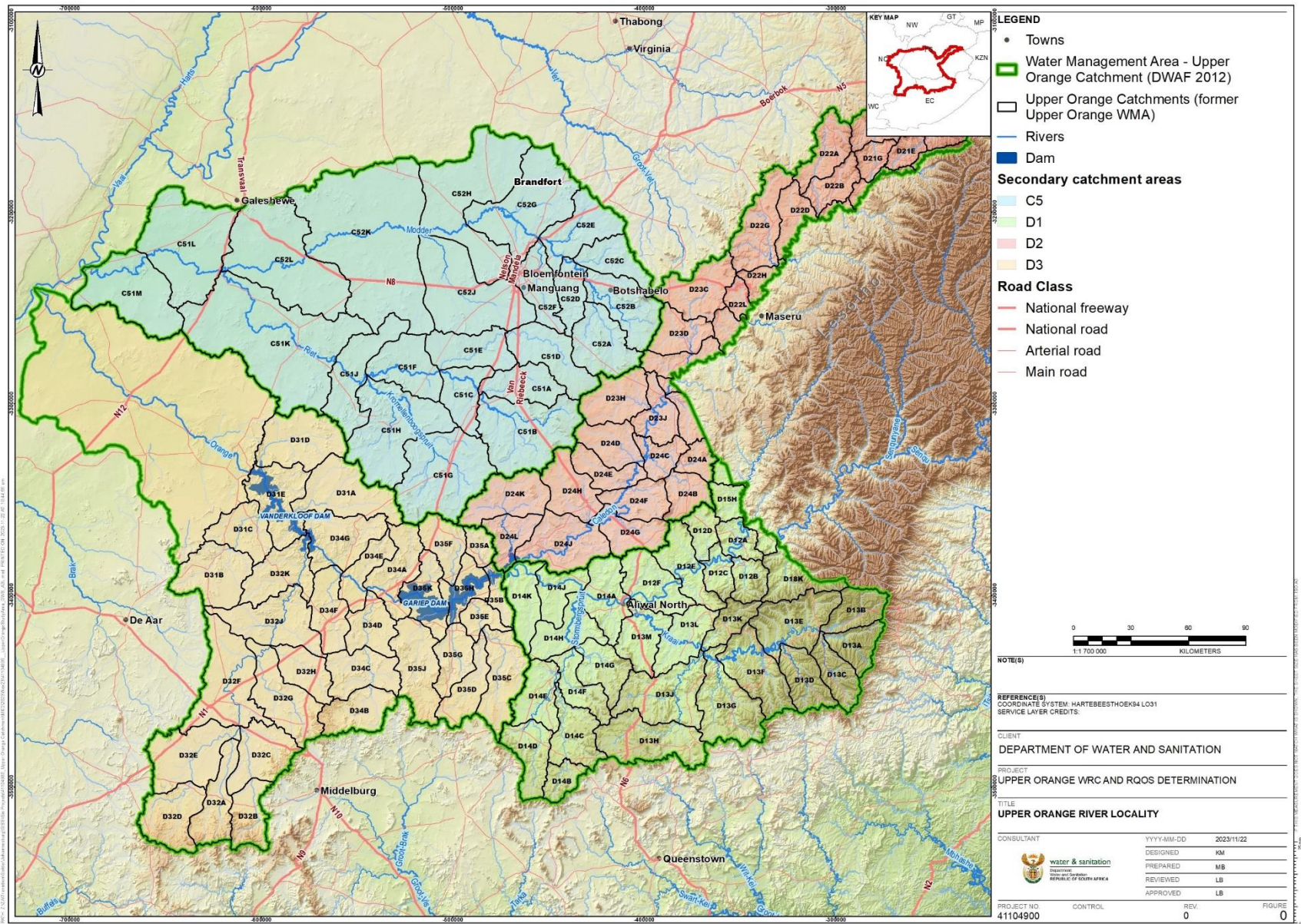


Figure 11: Upper Orange River catchments

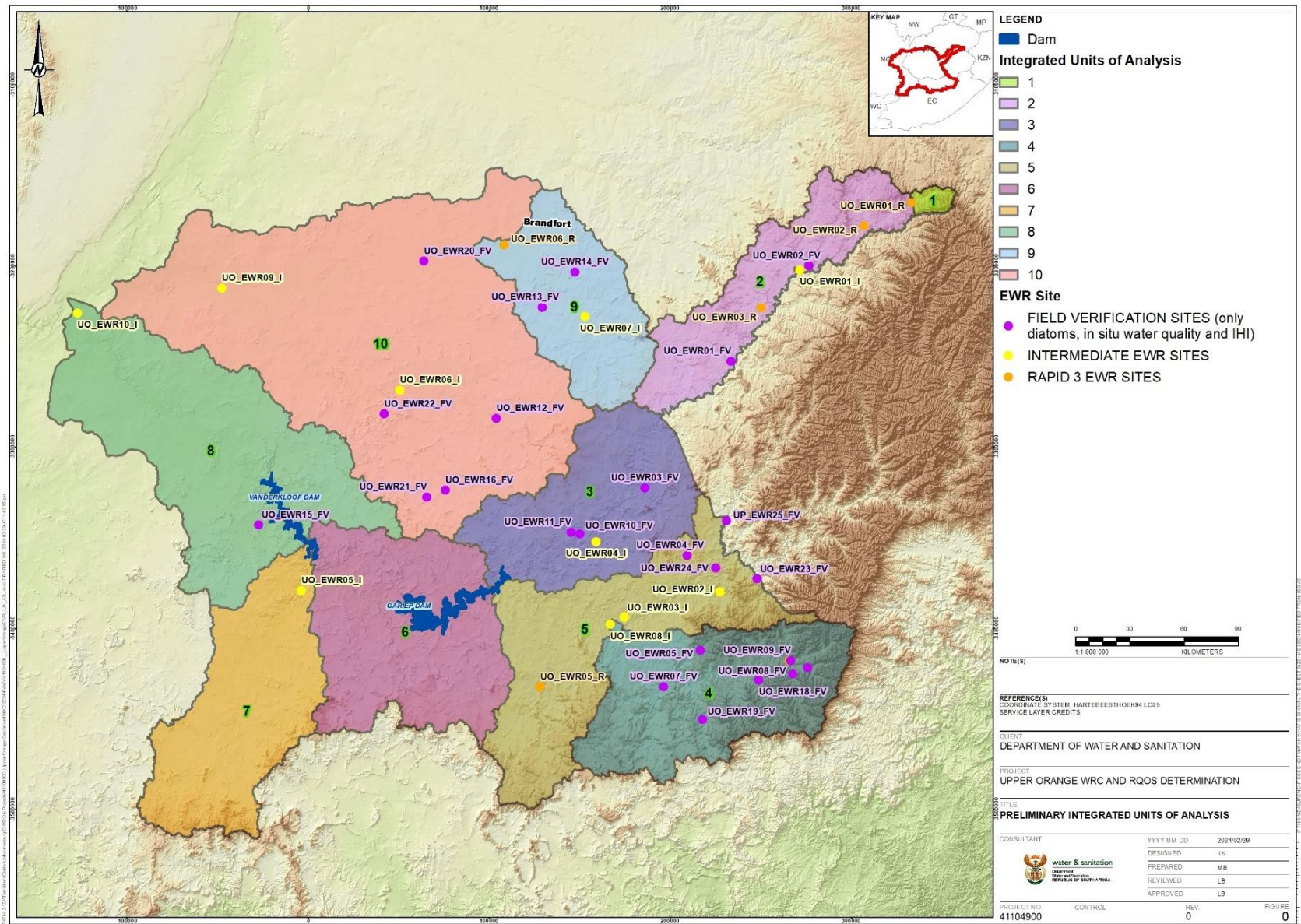


Figure 12: Preliminary Integrated Units of Analysis

Table 2: Ecosystem Services Linkages with beneficiaries in the Upper Orange River catchment

Intermediate Ecosystem Service	Final Ecosystem, Services	General Sector	QSAM Beneficiary Class	
Water Quality Regulation Water Quantity Regulation Erosion and Soil Regulation	Food Provisioning	Informal Households	Informal, illicit, non-profit, and households	
		Agriculture	Agriculture	
	Fresh Water (water quantity) Provisioning	Households (formal and informal)		Informal, illicit, non-profit, and households
				Households
		Agriculture (irrigation)	Agriculture	
		Mining	Stone	
		Manufacturing		Meat, fish, fruit, vegetables, oils and fats, dairy, grain and animal feeds, other food products, beverages, tobacco
				Textiles; Other textiles; Knitted fabrics; Wearing apparel; Leather; Footwear; Sawmilling of wood
				Wood products; Paper; Publishing; Printing and reproduction; Basic chemicals; other chemicals Rubber; Plastic; Glass; Non-metallic minerals
			Iron and steel; Casting of metals; Structural metal; Other fabricated metal	
	Manufacturing		General purpose machinery; Special purpose machinery; Household appliances; Computing machinery; Electric motors; Other electric components; Television and radios; Medical appliances; Motor vehicles; Vehicle bodies; Vehicle parts; Equipment; Furniture; Other manufacturing and recycling.	
	Government Services		Electricity; Water; Sewage and refuse	
	Raw Materials Provisioning	Informal Households	Informal, illicit, non-profit, and households	
	Medicinal resources Provisioning	Informal Households	Informal, illicit, non-profit, and households	
	Tourism, Recreational and Amenity Services	Catering & accommodation		Hotels; Restaurants
			Real estate activities (Lease and Fee basis)	
Households			Informal, illicit, non-profit, and households	
			Households	
Community, social & personal services		Recreation (Sporting and other recreational activities)		