Classification of significant water resources in the three Vaal Water Management Areas

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PURPOSE OF THIS DOCUMENT

The purpose of this newsletter is to provide an update to stakeholders of the water resource classification process that has been initiated by the Department of Water Affairs in the three Vaal River Water Management Areas (WMAs).

Through this process significant water resources within the WMAs will be classified in accordance with the Water Resource Classification System.

Stakeholders are invited to participate in the process by corresponding with the public participation office or the technical team at the addresses provided below.

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BACKGROUND

The National Water Act (NWA) (No. 36 of 1998) is founded on the principle that the South African Government has overall responsibility for and authority over water resource management for the benefit of the public without seriously affecting the functioning of the water resource systems.

In order to achieve this objective, Chapter 3 of the NWA provides for the protection of water resources through the implementation of resource directed measures (RDM) which include the classification of water resources, as well as setting the Reserve and Resource Quality Objectives.

The Chief Directorate: Resource Directed Measures of the Department of Water Affairs (DWA) is responsible for the classification of water resources in terms of the Water Resource Classification System (WRCS) 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 DWA has identified the need to undertake the classification of significant water resources (rivers, wetlands, groundwater and lakes) in the three Vaal River Water Management Areas (Upper Vaal, Middle Vaal and Lower Vaal) in accordance with the WRCS and has commissioned Professional Service Providers to assist with the classification process.

WATER RESOURCE CLASSIFICATION SYSTEM

The Water Resource Classification System (WRCS) is guided by a set of procedures grouped together into seven steps (Figure 1) that, when applied to a specific catchment, will ultimately assist in the process of maintaining a balance between protecting our water resources and using them to meet economic and social goals.

Water resources must be classified into one of the following three Management Classes (MC):

- Class I water resource is one which is minimally used and the overall ecological condition of that water resource is minimally altered from its pre-development condition;
- Class II water resource is one which is moderately used and the overall ecological condition of that water resource is moderately altered from its pre-development condition; or
- Class III water resource is one which is heavily used and the overall ecological condition of that water resource is significantly altered from its pre-development condition.

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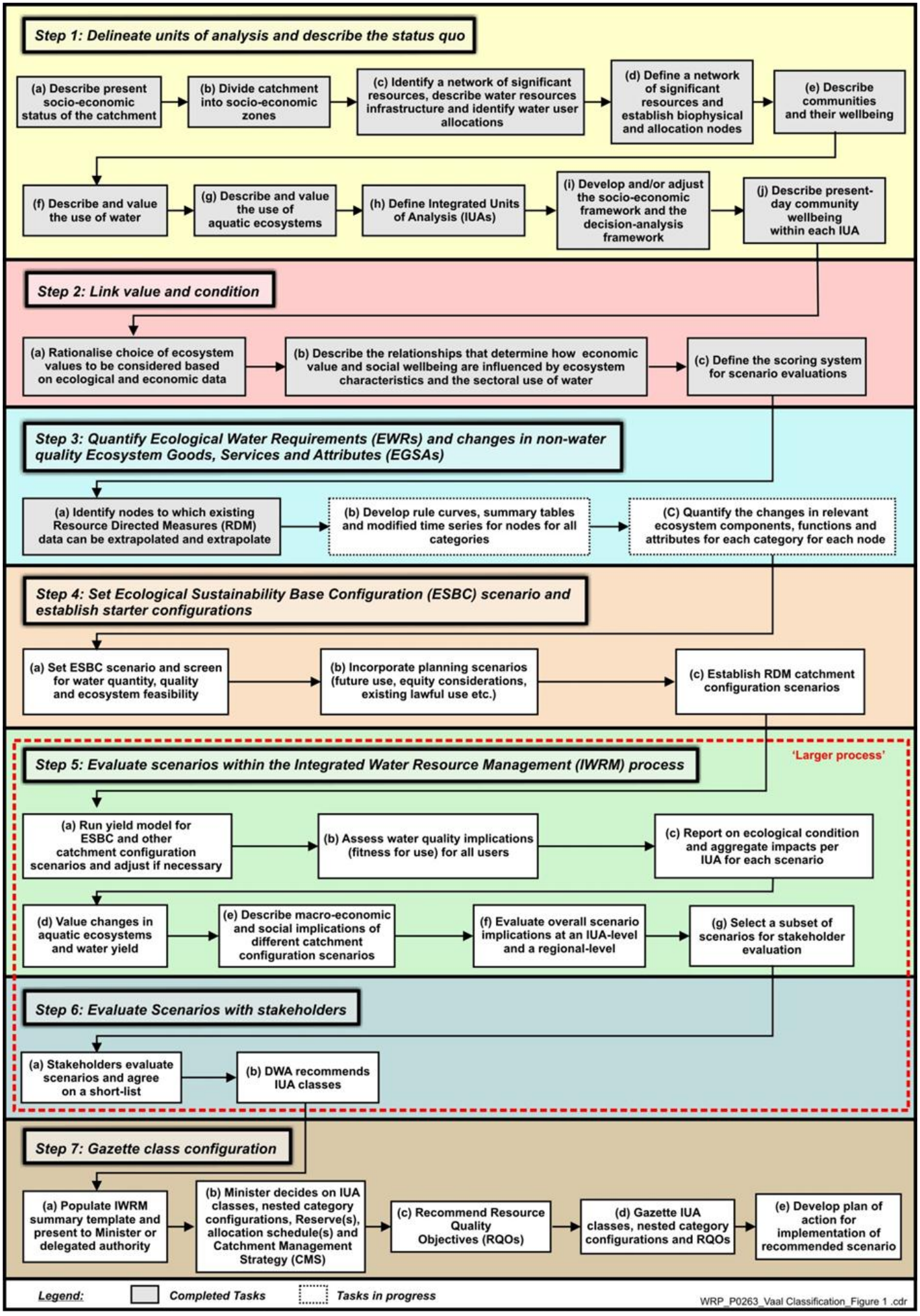


Figure 1: The 7-step process of the Water Resource Classification System

WATER RESOURCE INFORMATION SOURCING

The team of Professional Service Providers held its first meeting with the Department of Water Affairs (DWA) in November 2010.

The first step was to write an Inception Report to guide the project during its 24 month duration and it also describes the proposed work to be undertaken.

The purpose of the Inception Report is to define the extent of work and associated costs based on the proposed methodology and availability of information, data as well as initial evaluations that were carried out after the submission of the proposal.

It lists previous and current parallel studies that will be considered in this assignment, provides the information and data requirements, defines important study parameters including the Integrated Units of Analysis (IUAs), describes the extent of work, the proposed budget and finally, risks and uncertainties.

The Inception Report was approved by the DWA in April 2011.

WATER RESOURCE INFORMATION SOURCING

Numerous studies have been and are currently being undertaken on the Vaal River System.

The first few months of this project were spent on gathering data and collecting information from a wide variety of sources such as the Department of Water Affairs (DWA) itself and other Professional Service Providers.

An assessment of all the data provided by the DWA was undertaken and different summaries of the available information were compiled and the information availability table was updated accordingly.

The study has been structured and broken down into various tasks and the following articles look at two of these tasks: the **Ecological State** and **Socio-Economic Analysis**.

ECOLOGICAL STATE

SELECTION OF BIOPHYSICAL NODES

The key biophysical nodes are the Ecological Water Requirement (EWR) sites and the selection process of these sites is documented in the recent Reserve Studies (DWAF 2008e; DWAF 2009a and b).

Large sections of the catchment are still unaccounted for and additional biophysical nodes (referred to as desktop biophysical nodes) had to be selected.

Various tools and information such as the Desktop Eco-Classification results generated during the recent Reserve Studies and the National Freshwater Ecosystem Priority Areas (NFEPA) were used to identify additional nodes.

All attempts were made to select nodes that fairly represent the different conditions and operational procedures in the catchment.

A total of 115 biophysical nodes were selected in the three Water Management Areas (WMAs) of the Vaal River System.

DELINEATION OF INTEGRATED UNITS OF ANALYSIS

The identification and selection of the Integrated Units of Analysis (IUAs) were based on the following considerations:

- The resolution of the hydrological analysis and available water resource network configurations currently being modelled.
- Location of significant water resource infrastructure.
- Distinctive functions of the catchments in context of the larger system.
- Available budget for refinement of the existing network and undertaking scenario analysis of each IUA.
- The biophysical nodes and the Present Ecological State (PES) and Recommended Ecological Category (REC) for each node were also considered.

A properly calibrated higher resolution network water resource model is not available for use in the classification process of the Vaal River System. Furthermore, it has been recognised that the characteristics of individual small tributaries can significantly differ from the larger rivers and may warrant a different Management Class.

It was therefore proposed in the Inception Report that a practical qualitative evaluation method be applied where necessary, which only considers the ecological aspects as well as likely implications on goods and services in a qualitative manner. The identification of the tributary catchments formed part of the IUA delineation (Task 3a).

As already described in the approach to select biophysical nodes, the results (if available) of the current PES and Environmental Importance-Environmental Sensitivity (EI-ES) would also have contributed largely to the delineation of the IUAs as the proportions of the different Ecological Categories (EC) for all the river reaches could play a vital role in the delineation.

The IUAs for the three Vaal WMAs can be seen in the three maps at the end of this newsletter.

ECOLOGICAL STATUS

Two of the major impacts dominating the Vaal Catchment are water quality impacts and changes in the flow regime. Changes in the flow regime range from too little flow but the most severe impacts are from too much flow and changes in seasonality which mainly relate to transfers, releases, irrigation return flows, mining and urban runoff.

Areas of highest water quality impact across the Vaal River catchments are as follows:

- Rietspruit (C1Riet-Amers) – The quality is a D category, largely due to extensive agricultural activities with highly elevated nutrients and salts.
- The condition of the lower Klip River (north-west flowing Klip River) catchment is poor, with sites ranging from a D to a D/E category. The main land use is still agriculture, although there are discharges around certain urban areas (e.g. Vrede) which reduce the water quality category.
- Rietspruit and Klip River (Gauteng) – Note that the water quality state of this portion of the Upper Vaal catchment is severely impacted and improvements in present state cannot occur without addressing water quality related problems, e.g. through implementation of the Integrated Water Quality Management Plan set up for the Vaal (DWAF, 2009).
- Lower Suikerbosrand and Blesbokspruit – The quality of the Suikerbosrand River is driven by the poor quality of its main tributary the Blesbokspruit River. Impacts include mine water decants, diffuse runoff, urban runoff and point source discharges.
- Waterval catchment – Land use in the upper part of the catchment includes agricultural activities; Sasol petrochemical industry; Secunda town; coal mining in the Bethal to Secunda area (C11 and C12 tertiary catchments); and gold mining in the upper Waterval catchment. Impacts include elevated salts and nutrients, particularly phosphate. Some irrigation takes place in the lower part of the catchment, with issues related to elevated salts and nutrients, particularly phosphate. Water quality is poor across the area (D category) due to impacts from Sasol, Secunda town and pivot irrigation.
- EWR 5 downstream of the Vaal Barrage – The salinity and nutrient impacts from the Klip, Riet, Suikerbosrand and Waterval rivers are combined in the Vaal Barrage and released downstream to this site on the Vaal River.
- The impact of Grootvlei Mine results in water quality deterioration to a D on the Molspruit tributary of the Vaal River.
- Mooi River (Upper Vaal catchment) – The main impact in the area is the uranium-laden effluent from the Wonderfonteinspruit. Impacts across the area are due to agricultural activities, urban runoff and the discharge of mining effluent.
- Middle Vaal River: EWR 12 at Vermaasdrift – Elevated nutrients and salts contribute to the poor water quality state.
- Tributaries of the Middle Vaal - Water quality is poor across this area, i.e. from a D/E on the Koekemoerspruit to an E category elsewhere. Impacts are largely due to agriculture and urban / mining activities. The Schoonspruit also runs through the urban areas of Klerksdorp and Kanana as well as the gold mining impacted areas (AngloGold Ashanti Vaal River Operations and Harmony).
- Vaal River (EWR 13) downstream of the Schoonspruit, Koekemoerspruit, Renoster and Vierfonteinspruit confluences in the Middle Vaal catchment.
- Lower Sand catchment – Water quality in the area is worst where mining impacts around Welkom and Virginia dominate. Here water quality is a D category.
- Harts River (EWR 17 at Lloyds weir) – High salt and toxic concentrations due to agriculture and diamond mining impacts.
- Riet River – Impacts are high salts and high nutrient levels.

Due to the economic importance of this area and the important role the Vaal River System plays in conveying and supplying the water resource to this economic hub, it is understandable that most of the system is in a C Ecological Category or poorer condition.

The biophysical nodes that scored a high Environmental Importance are listed in **Table 1** below.

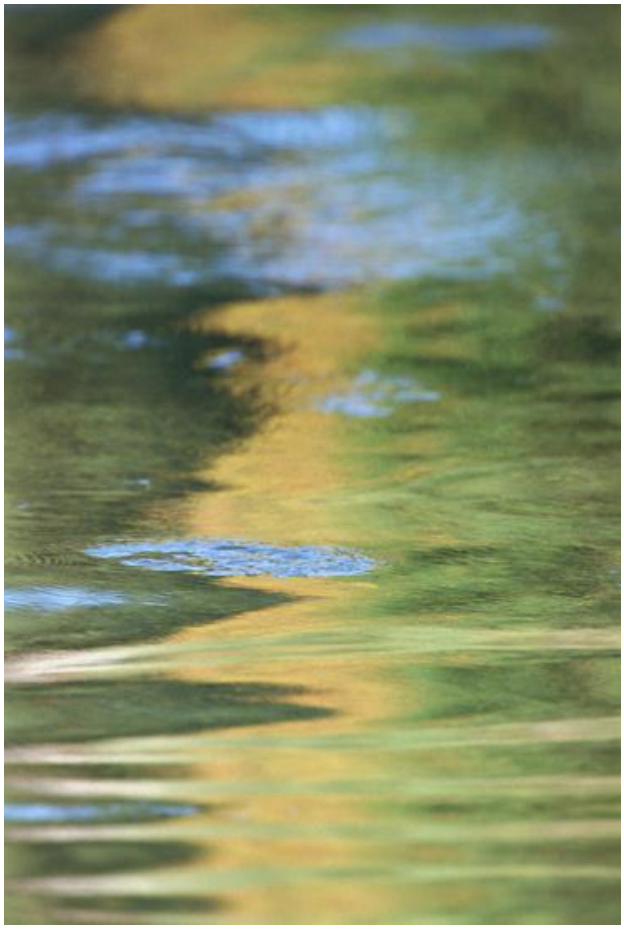


Table 1*: *Summary of the desktop biophysical nodes and EWR sites with a High Environmental Importance

IUA	VAAL CLASSIFICATION (VC) NODE	PES	FLOW RELATED	NON FLOW RELATED	EIS	EI	REC
Vaal River Upstream of Grootdraai Dam (UV-A)	*8VF5*	*B/C*		*Yes*	*MODERATE*	*HIGH*	*B*
Vaal River Upstream of Grootdraai Dam (UV-A)	*EWR 1*	*B/C*	*Yes*	*Yes*	*HIGH*	*HIGH*	*B/C*
Klip River (Free State) (UV-B)	*UV Uklip*	*B*		*Yes*	*HIGH*	*HIGH*	*B*
Klip River (Free State) (UV-B)	*C13C*	*B/C*		*Yes*	*HIGH*	*HIGH*	*B*
Klip River (Free State) (UV-B)	*C1KLIP-UNSPE1*	*B/C*	*Yes*	*Yes*	*MODERATE*	*HIGH*	*B*
Klip River (Free State) (UV-B)	*C13E*	*B/C*	*Yes*	*Yes*	*MODERATE*	*HIGH*	*B*
Upper Wilge River (UV-C1)	*EWR 7*	*A/B*		*Yes*	*HIGH*	*HIGH*	*A/B*
Upper Wilge River (UV-C1)	*8WF1*	*B*		*Yes*	*MODERATE*	*HIGH*	*B*
Upper Wilge River (UV-C1)	*UV25*	*B*		*Yes*	*MODERATE*	*HIGH*	*B*
Wilge Rivier and tributaries (UV-C2)	*GG*	*B*		*Yes*	*MODERATE*	*HIGH*	*B*
Liebenbergsvlei River (UV-D)	*VC16*	*B/C*		*Yes*	*MODERATE*	*HIGH*	*B*
Liebenbergsvlei River (UV-D)	*VC17*	*B/C*		*Yes*	*MODERATE*	*HIGH*	*B*
Suikerbosrand River upstream of confluence with Blesbokspruit (UV-H)	*C21A*	*B/C*	*Yes*	*Yes*	*MODERATE*	*HIGH*	*B*
Suikerbosrand River upstream of confluence with Blesbokspruit (UV-H)	*EWR 9*	*C*	*Yes*	*Yes*	*HIGH*	*HIGH*	*B/C*
Vaal River reach from Vaal Dam to C23L (UV-M)	*EWR 4*	*C*	*Yes*	*Yes*	*HIGH*	*HIGH*	*B/C*
Vaal River reach from Vaal Dam to C23L (UV-M)	*EWR 5*	*C/D*	*Yes*	*Yes*	*HIGH*	*HIGH*	*C*
Lower Harts River (LV-A4)	*VC59*	*A/B*		*Yes*	*MODERATE*	*HIGH*	*A/B*
Vaal River from downstream of Bloemhof Dam to Douglas Weir (LV-B)	*VC60*	*A/B*		*Yes*	*MODERATE*	*HIGH*	*A/B*

As can be seen from Table 1, most of the High Ecological Importance (EI) nodes lie in the Upper Vaal, none in the Middle Vaal and two ephemeral small river reaches within the Lower Vaal.

Apart from ecological water requirements (EWR) sites 4, 5, and 9, all these sites are in a reasonable to good Present Ecological State (PES) and the majority of those in a B/C Ecological Category (EC) (that should improve to a B EC will require non-flow related intervention to achieve the required improvements.

In summary, the following can be noted:

- Some of the biggest water quality problems in South Africa occur within the study area.
- Many areas in the Vaal River System (especially the Upper Vaal) are dominated by more flow than the natural flow regime (elevated flows).
- Although this System is heavily utilised (generally in a C category or worse condition) some features warrant protection and improvements are required where at all possible.
- The Vaal River is one of the few large rivers in South Africa. This fact on its own makes the Vaal River important.
- Protection of the Vredefort Dome. The Vaal River is a key feature within the Vredefort Dome especially around the town of Parys. Water quality issues are a serious concern – especially from the human use perspective and all the recreational activities.
- The presence of the Red Data listed Barbus kimberleynsis (yellow fish) and various riparian vegetation species.
- Endangered bird species are found within the study area, especially in upper reaches of Vaal and Wilge river catchments which are dominated by oxbows and wetland features.
- Various wetlands in these WMAs fall under the Ramsar Convention on Wetlands such as Seekoeivlei on the Klip River, the Blesbokspruit wetland as well as the Barberspan and Leeupan in the Harts River catchment.
- The Wolwespruit Provincial Nature Reserve in the North West which includes the Vaal River.

All of the above-mentioned features result in an extremely complicated set of challenges to be dealt with in the Vaal Catchment. The scope for considering a varied set of scenarios to deal with in the classification system and the possibilities of trade-offs are limited.

PROCESS TO DETERMINE THE GOODS & SERVICES STATUS QUO

Information on the Goods and Services (G&S) of the Vaal River is available and has been used as a basis for this purpose. It should be noted that the objective in describing and valuing the use of aquatic ecosystems is to determine the way in which aquatic ecosystems are currently being used in each socio-economic zone, and to estimate the value generated by that use.

This provides the baseline against which the socio-economic and ecological implications of different catchment configuration scenarios can be compared.

The most important G&S associated with the overall system and likely to be impacted by changes in operational and management scenarios are the following:

- Recreational fishing;
- Subsistence fishing;
- Other recreational aspects associated with the rivers;
- Riparian vegetation usage;
- Waste water dilutions; and
- Floodplain agricultural usage of subsistence purposes.

Furthermore, each quaternary catchment has been examined in detail via the analysis of Socio-Cultural Importance.

The Socio-Cultural Importance (SCI) was determined from a site visit that covered points along the river, and extrapolation to sites not visited by reference to available literature as well as to exiting mapping.

SOCIO-ECONOMIC ANALYSIS

The socio-economic study is being done to determine the status quo of the economic situation in the Vaal River System.

The focus is on those sectors with high water usage, such as irrigation agriculture, mining, heavy industry and power generation. It is represented by an estimation of the gross domestic product (GDP) and the number of employment opportunities.

These impacts are determined in respect of the direct, indirect and induced effects which sums the total impacts.

Another indicator used, is the distribution of income which is provided by the economic activities. This was estimated for the high, medium and low income groups that sums the total household distribution.

The GDP indicator represents the economic growth evolving from these user groups. The employment and the income distributor indicators signify the alleviation of poverty.

SOCIO-ECONOMIC ASSESSMENT

The economic modelling systems used are the Water Impact Model (WIM) as well as the Production Industry Model (PIM), based on the South African Inter-industry Model (SAFRIM), which were made applicable to the three Vaal River WMAs.

Both these models are underpinned by a Social Accounting Matrix (SAM) to determine the different economic impacts on the applicable Integrated Units of Analysis (IUAs).

Details of the procedure to be followed and the applied Scoring System for the classification are summarised below. The purpose of the Scoring System is to develop an objective evaluation system to reflect changes in water volumes on the classification of the river system, be it positive or negative.

The elements used are: Ecological Condition, Economic Impact and Social Impact.

Approach to the Scoring System

The original concept was developed in a pilot project in the Olifants-Doorn River for the DWA. For this study the concept is adapted for a highly industrialised basin.

The eventual choice of the different ecosystem values will be based on a matrix that allows attaining the maximum value for both users, in and out of a stream.

The methodology proposed, is the Delphi approach where a number of criteria are defined for evaluation. The values for each criterion are calculated or defined by specialist knowledge to populate the value matrix.

The outcome is a relative score for each scenario which will serve as a guide to compare the consequences thereof.

Water re-allocation situational analysis

The evaluation of the results of the three different sets of analysis, namely ecological, goods and services and socio–economic is to establish the baseline per individual section of the Vaal River main stem or tributary.

If during the analysis, it appears that the ecological situation of certain river zones have deteriorated to a point where corrective action is necessary, it might involve an increase in water in the specific river section.

A negative economic impact or a cost increase may occur, when a water availability curtailment is required due to a higher priority of another sector demand.

In this regard the following methods have been developed and will be applied in the calculation of the possible socio–economic consequences:

- Main Stem: If in any zone problems arise, the water will be augmented.
- Tributary: If in any tributary a shortage of water is experienced it will most likely result in a restriction of water use from the catchment (for example a reduction in water for irrigation agriculture).

An important consideration for selecting these methods was the availability of data and the need for consistency with other economic evaluation methods applied by DWA for planning investigations of the Vaal River System.

If in a section of the main stem of the river more water is necessary to maintain or improve the status of the ecology of that specific river section, the water will be supplied from the present available sources.

However the possibility exists that this could influence the implementation date of subsequent augmentation schemes to support the Vaal River System in future.

The proposed approach to the estimation of the costs of bringing the augmentation schemes forward will rest on the principle of "time is money".

The estimated cost of earlier implementation will result in the money being spent earlier and the impact on the consumer in increased rates will be payable earlier.

The change in the implementation date will be derived from water resource simulation analysis with the DWA Water Resource Planning Model (WRPM) configured for the Integrated Vaal River System.

The outcome of this procedure is augmentation costs for alternative scenarios to be used for comparison purposes.

Tributary - Economic Impact

The assumption governing the situation in a tributary rests on the supposition that the augmentation option will not be available and if more water is necessary for the ecology it will be provided from present sources. If there is a shortage it will be reallocated from the current use.

The water reallocation volumes will be determined by water resource analysis where appropriate configurations are available and simplified comparative calculations in the small catchments.

The macro-economic impact of the reallocation of water will be calculated as a measure of the consequences and for comparing scenarios.

Water Quality

Undesirable levels of water quality not only impact negatively on irrigation crop yields and quality, but also have an adverse impact on industrial water use.

For example, should there be a deterioration of the water quality within the Grootdraai Dam Sub-system; more water has to be provided to the industrial users through the Vaal River Eastern Sub-system Augmentation Project (VRESAP) pipeline to ensure effective utilisation of the cooling systems which receive water from this sub-system.

Furthermore, extra costs might be necessitated by bulk water suppliers such as Rand Water that provides water to urban centres for domestic and industrial use. The costs associated with bringing the quality of the water to acceptable levels will be sourced from previous studies.

Where the specific option is not available the cost to the user will be used as the ball park figure.

The costs of these processes will be sourced from previous studies and indicated where necessary.

SOCIO-ECONOMIC STATUS

The socio-economic status for the different IUAs was determined by the modelling processes. Refer to the three maps at the end of this newsletter for the identification of each Integrated Unit of Analysis (IUA).

The Upper Vaal WMA includes a large concentration of the main economic activities found in the Waterval River (UV-E) area due to the mining, power generation and petro-chemical industries contributing 25.2% GDP, 26.3% employment opportunities and 22.5% of the household income.

UV-E is closely followed by Vaal River reach upstream of Vaal Dam and downstream of Grootdraai Dam (UV-G), Vaal Dam to Middle Vaal (UV-M incl. UV-J, UV-K), Suikerbosrand River upstream of confluence with Blesbokspruit (UV-H and UV-I: C21D-C21G) and Klip River, Gauteng (Partly UV-I: C22A-C22E; C22H & C22J) respectively. These areas represent the main industrial hub in Gauteng and partly in Mpumalanga.

The GDP contribution for the whole Upper Vaal WMA is R386 507 million, the employment opportunities generated is 1 281 597 and the total income contribution to households is R221 398 million.

The Middle Vaal WMA accommodates vast irrigation agriculture enterprises. A large concentration of the main economic activities is found in the Schoonspruit and Koekemoerspruit (MV-C) area with industries contributing 43.6% GDP, 43.6% employment opportunities and 35% of the distribution to household income.

The GDP contribution for the Middle Vaal WMA is R24 729 million, the employment opportunities generated is 149 712 and the total income contribution to households is R13 937 million.

The Lower Vaal WMA hosts mining, manufacturing and irrigation agriculture sectors. The main economic activities are found in the Vaal River from the Bloemhof Dam to the Douglas Weir area (LV-B) contributing 51% GDP, 55% employment opportunities and 54% of the total household income.

The GDP contribution for the Lower Vaal WMA is R14 315 million, the employment opportunities generated is 95 677 and the total income contribution to households is R8 636 million.

The socio-economic study therefore identifies the current economic activities in the three WMAs.

In step five of the Classification Process (Figure 1) these results will be used in scenario evaluation which will be reported on at a later stage.

FURTHER STUDY ACTIVITIES

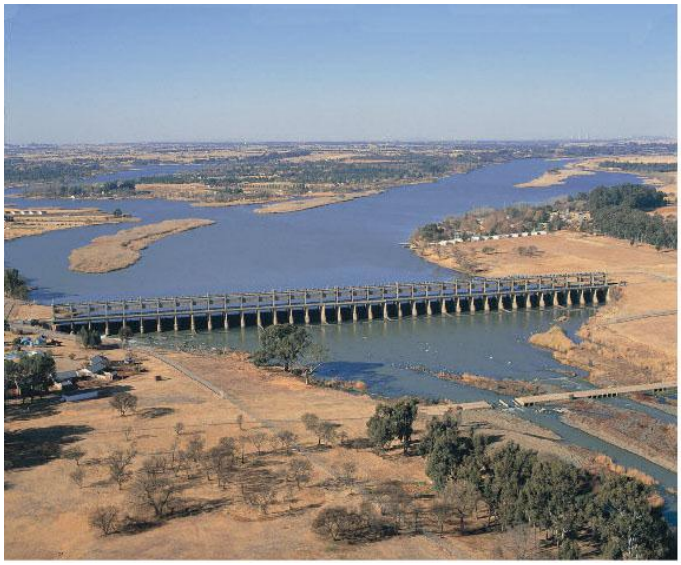
With the above components of the classification process being completed, the next step in the Water Resource Classification System (WRCS) is the determination of the ecologically sustainable base configuration (ESBC) scenario and starter catchment configuration scenarios for the three Vaal WMAs.

The ESBC scenario is defined as the lowest theoretical level of protection required for the sustainable use of the entire catchment.

This step has recently been initiated by the study team. It is envisaged that an ESBC and starter catchment configuration scenarios will be available by the end of October 2011.

This will be presented to the Project Steering Committee (PSC) for evaluation and assessment at a meeting to be scheduled in November 2011.

Stakeholders will be kept abreast of the proposed the ESBC and starter catchment configuration scenarios, study developments and the outcomes of the PSC meeting.



WHY SHOULD YOU REMAIN INVOLVED IN THE STUDY?

It is important to understand that this study will eventually impact on you as a water user, as it will determine the management measure your organisation may have to implement, it may result in stricter controls, it will determine the limits with regard to discharges and disposal of waste and wastewater, it will impact on the costs relating to the above, and will have a bearing on future water uses.

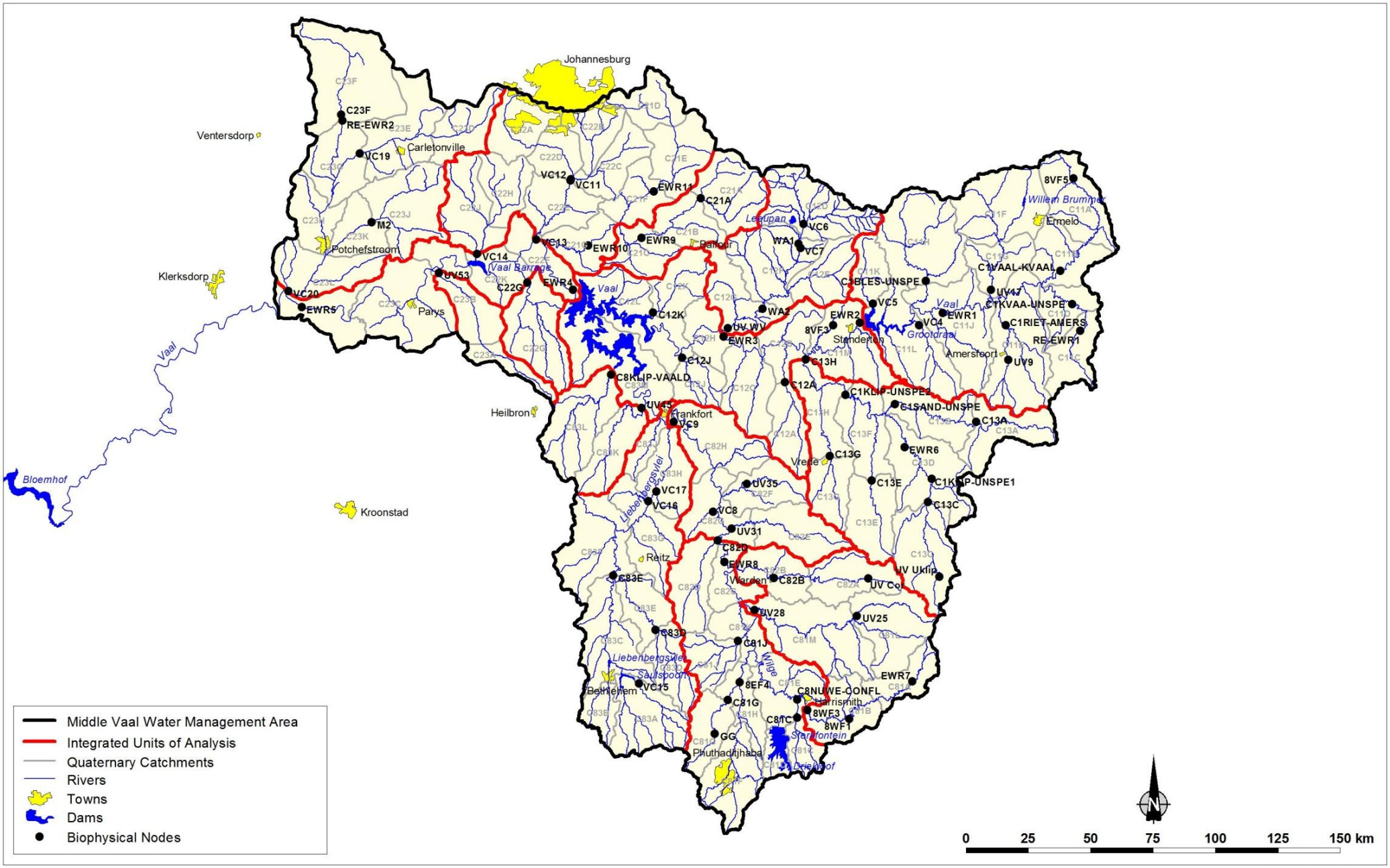
These measures are not meant to be restrictive but rather to sustainably manage the Vaal River System catering for all water users including the aquatic ecosystem.

Since this is your catchment, it is important that you become involved in the stakeholder engagement process and technical process.

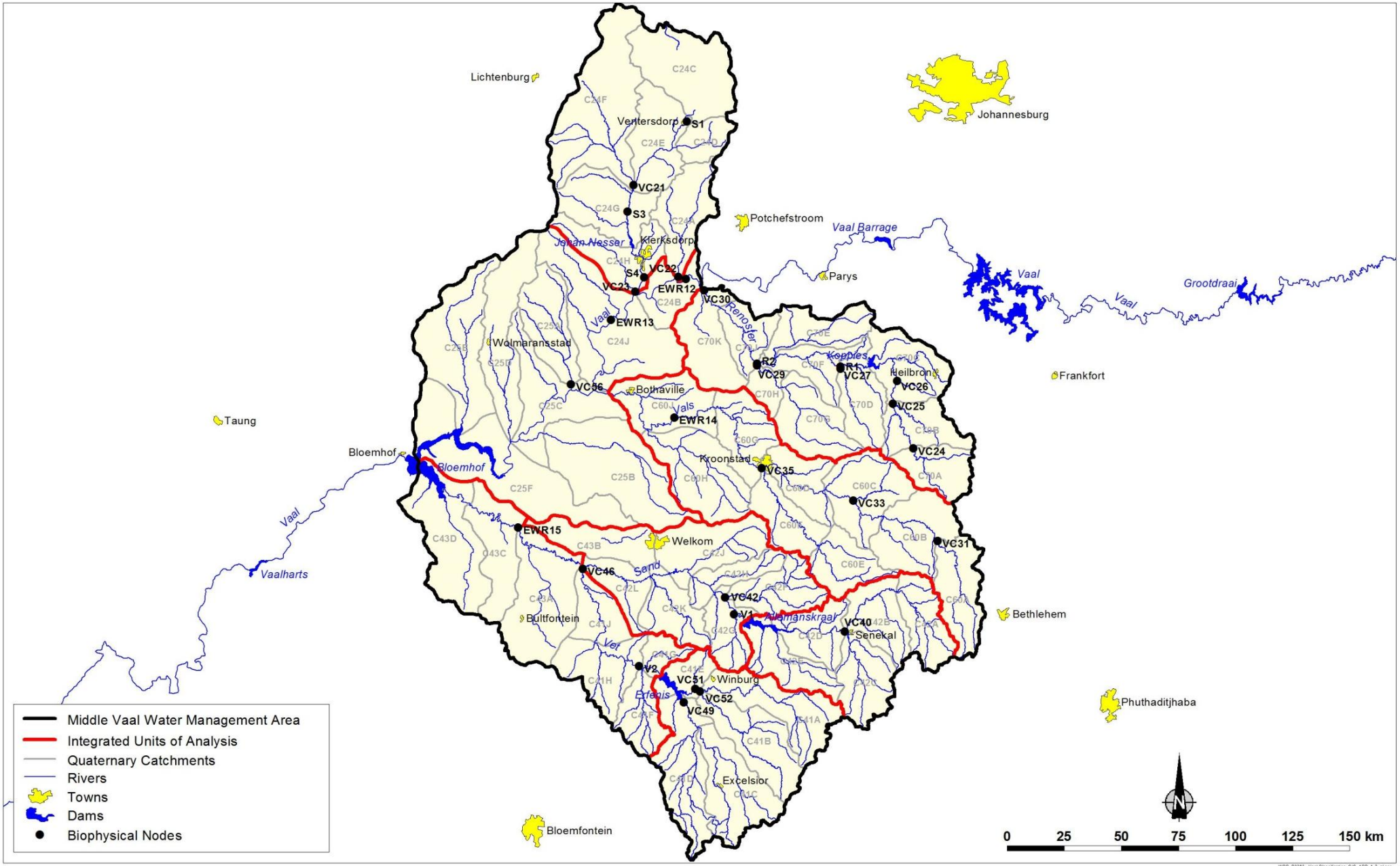
Stakeholders are invited to participate in the process by contributing information at meetings, workshops or to requests by the study team, by communicating with a PSC member or by corresponding with the public participation office with queries and comments.

Previous information sent out on this study comprises a background information document (BID) and a brochure on the Water Resource Classification System.

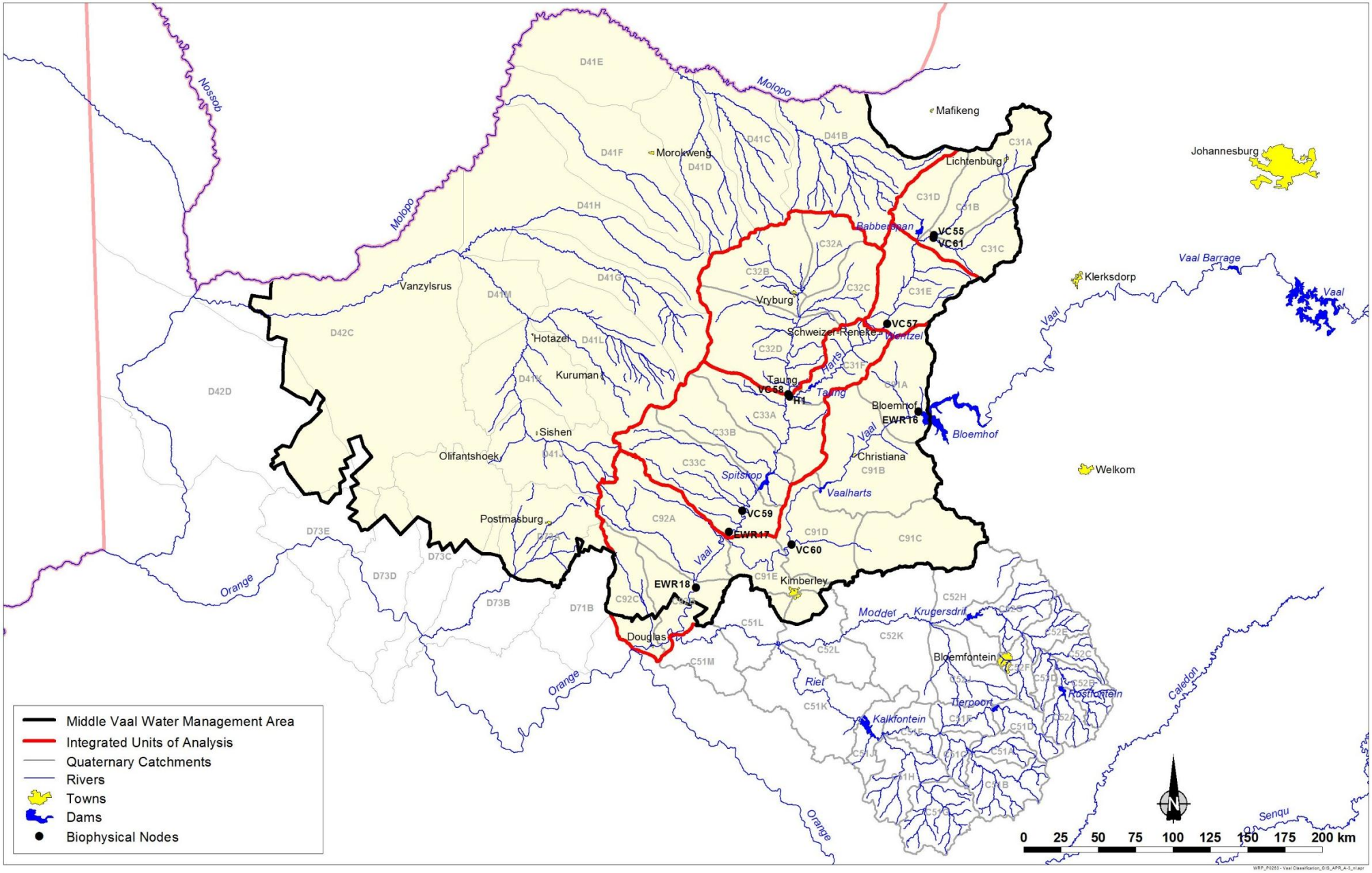
Should you wish to review these documents and completed study reports, you are welcome to access them on the DWA website: http://www.dwa.gov.za/rdm/WRCS/default.aspx.



The Upper Vaal Water Management Area with the Integrated Units of Analysis marked in red



The Middle Vaal Water Management Area with the Integrated Units of Analysis marked in red



The Lower Vaal Water Management Area with the Integrated Units of Analysis marked in red