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Water Affairs & Forestry
REPUBLIC OF SOUTH AFRICA

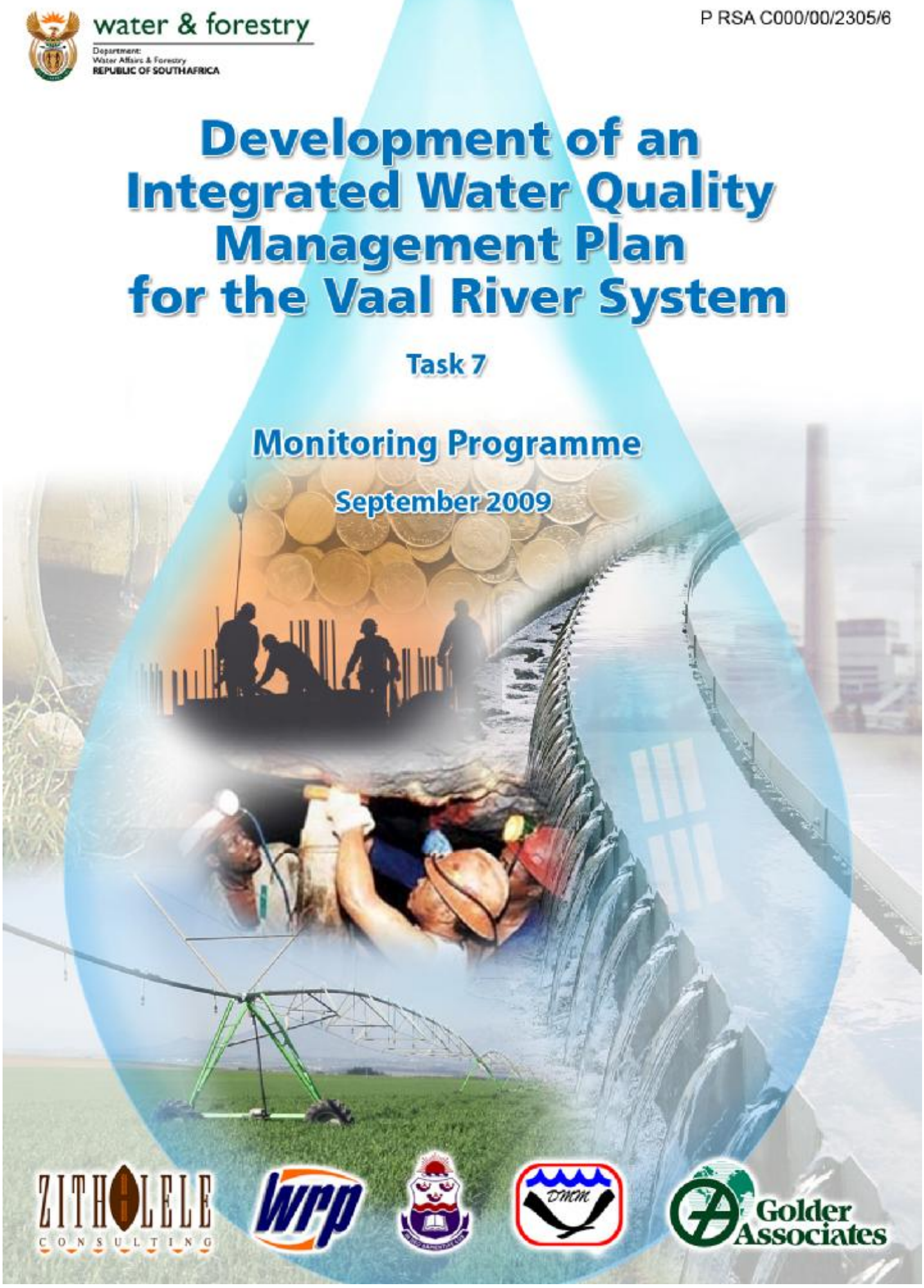
P RSA C000/00/2305/6

Development of an Integrated Water Quality Management Plan for the Vaal River System

Task 7

Monitoring Programme

September 2009



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Development of an Integrated Water Quality Management Plan for the Vaal River System

TASK 7:

MONITORING PROGRAMME

FINAL REPORT

Directorate National Water Resource Planning
Department of Water Affairs and Forestry

September 2009

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EXECUTIVE SUMMARY

Having water of the right quality is just as important as having enough water. Integrated water resource management in the Vaal River System can only be achieved if water quality and quantity are managed together to meet the requirements of water users (including the aquatic ecosystem) and their needs in terms of use of the resource. The more the water resource is used and gets re-used, and as quantities get scarce and feedback loops within this highly exploited and utilised water resource system get even tighter, it is water quality that begins to take on a dominant role. The Department realises that just as planning and management are taking place to supplement and control water quantities, they also need to take place around water quality.

The focus of this study is to develop an integrated water quality management plan (IWQMP) for the Vaal River System, which aims to identify management options that are technically, economically and socially feasible and which will support the continued fitness for use of the water resources for all users across the WMAs.

One of the basic principles of management is that "*you can only manage what you can measure*". This principle applies to any human endeavour and to the world that surrounds us, with the domain of water resource management being no different. Thus, in order that the water resources in the Vaal River System are effectively managed into the future with the Resource Water Quality Objectives (RWQOs) in place and sound strategies for water quality management, relevant information about water related conditions, issues and developments in the WMAs is needed to appropriately address the threats and problems that currently prevail. This "measurement" process of collating, processing and interpreting such information either takes the form of situation analyses, catchment studies or status quo assessments. Such status quo assessments are dependent of availability of water quality data and associated monitoring to support effective decision-making and management actions. Thus sound monitoring programmes to provide adequate and reliable water quality data forms the basis to all other tasks.

This task is a key supporting activity for the implementation of the IWQMP and has the objective of assessing the effectiveness and applicability of the management strategies that are to be implemented in the Vaal River System in the immediate, medium and long term. This report focuses on the implementation of a monitoring programme that supports and supplements the water quality management strategies by providing the requirements for obtaining the necessary water quality data needed. (Task 7 of the study).

The objective of the monitoring programme task as part of the study was to:

- undertake a gap analysis in terms of the prevailing water quality monitoring network;
- develop a revised monitoring programme based on the monitoring needs and requirements identified, and
- undertake a resource requirement evaluation in terms of implementation.

With respect to the current monitoring programmes and gaps identified a prioritised list of monitoring requirements and proposals are highlighted in terms of the water quality monitoring programme for the Vaal River System.

In addition a revised monitoring programme is proposed. A ranking system that indicates the degree of importance of the monitoring needs is applied to the additional requirements. The most important monitoring needs are ranked in order of priority along with the associated resources to provide an indication of which of the needs can be addressed by available resources.

The report forms the main deliverable from this task and includes the proposed revised monitoring programme.

DOCUMENT INDEX

Reports as part of this project:

Bold type indicates this report.

Report Index	Report number	Report title
1		Inception Report
2	P RSA C000/00/2305/1	Water Quality Status Assessment
3	P RSA C000/00/2305/2	Salinity Balance
4	P RSA C000/00/2305/3	Integration of Resource Water Quality Objectives
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7	**P RSA C000/00/2305/6**	**Monitoring Programme**
8	P RSA C000/00/2305/7	Water Quality Management Strategy

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LIST OF ACCRONYMS AND ABBREVIATIONS

CMA	Catchment Management Agency
CMS	Catchment Management Strategy
DIN	Dissolved inorganic nitrogen
DIP	Dissolved inorganic phosphorus
DMS	Dissolved Mineral Salts
DO	Dissolved oxygen
DWAF	Department of Water Affairs and Forestry
EC	Electrical Conductivity
ICM	Integrated Catchment Management
ISP	Internal Strategic Perspective
IWQMP	Integrated Water Quality Management Plan
IWRM	Integrated Water Resource Management
NWA	National Water Act
NWRS	National Water Resource Strategy
PES	Present Ecological State
RDM	Resource Directed Measures
RHP	River Health Programme
RQOs	Resource Quality Objectives
RO	Regional Office
RWQO	Resource Water Quality Objectives
SAWQGs	South African Water Quality Guidelines
TDS	Total Dissolved Salts
TOR	Terms of Reference
TP	Total Phosphorus
TWQR	Target Water Quality Range
WMA	Water Management Area

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1 INTRODUCTION

1.1 Water Resource Management Studies in the Integrated Vaal River System

In terms of the National Water Act (NWA) (Act No. 36 of 1998) and in line with the Department of Water Affairs and Forestry's (DWAF) obligation to ensure that the country's water resources are fit for use on an equitable and sustainable basis, it has adopted the approach of the progressive development and implementation of catchment management strategies (CMS) to fulfil this mandate. Each CMA is responsible for the progressive development of a CMS for its respective WMA that is developed in consultation with stakeholders within the area. The Department's eventual aim is to hand over certain water resource management functions to these CMAs. Until such time as the CMAs are established and are fully operational the Regional Offices of the Department will continue managing the water resources in their areas of jurisdiction with the support of the national office.

In terms of meeting this obligation, the Department has initiated the development of management strategies for the various WMAs within South Africa in an attempt to provide the framework and constraints within which the water resources will be managed into the foreseeable future. These various strategies and plans that arose out of the Internal Strategic Perspective (ISP) development process which identified the relevant water resource management issues and concerns in each of the WMAs. The Vaal River System WMAs, which include the Upper, Middle and Lower Vaal and the Modder Riet catchment of the Upper Orange WMA, are four such catchments for which management strategies are currently being developed. At present three major studies are underway in the Vaal River System, which specifically aim to introduce overarching management measures to reconcile water requirements and availability, and to ensure the continued fitness-for-use of the water resources. These studies are the Development of Large Bulk Water Supply Reconciliation Strategies (LBWSRS), Water Conservation and Water Demand Management Potential Assessment and the Development of an Integrated Water Quality Management Plan (IWQMP). The immediate objectives of the individual studies are to:

- Develop strategies for meeting the growing water requirements of the industrial and urban sectors served by the Integrated Vaal River System (Large Bulk Water Supply Reconciliation Study).
- Determine the potential for, and benefits of Water Conservation and Water Demand Management (WC/WDM) in the various water use sectors with the focus on the Upper and Middle Vaal WMAs.
- Develop water quality management measures to ensure continued fitness for use in the Vaal River System (IWQMP Study).

The management options identified through these studies aim to eventually feed into a reconciliation and water quality management strategy that will be determined for the Vaal River System (**Figure 1**). The strategy aims to support current and future water users and uses within the interdependent water resource systems of the Vaal WMAs and associated Modder Riet catchment.

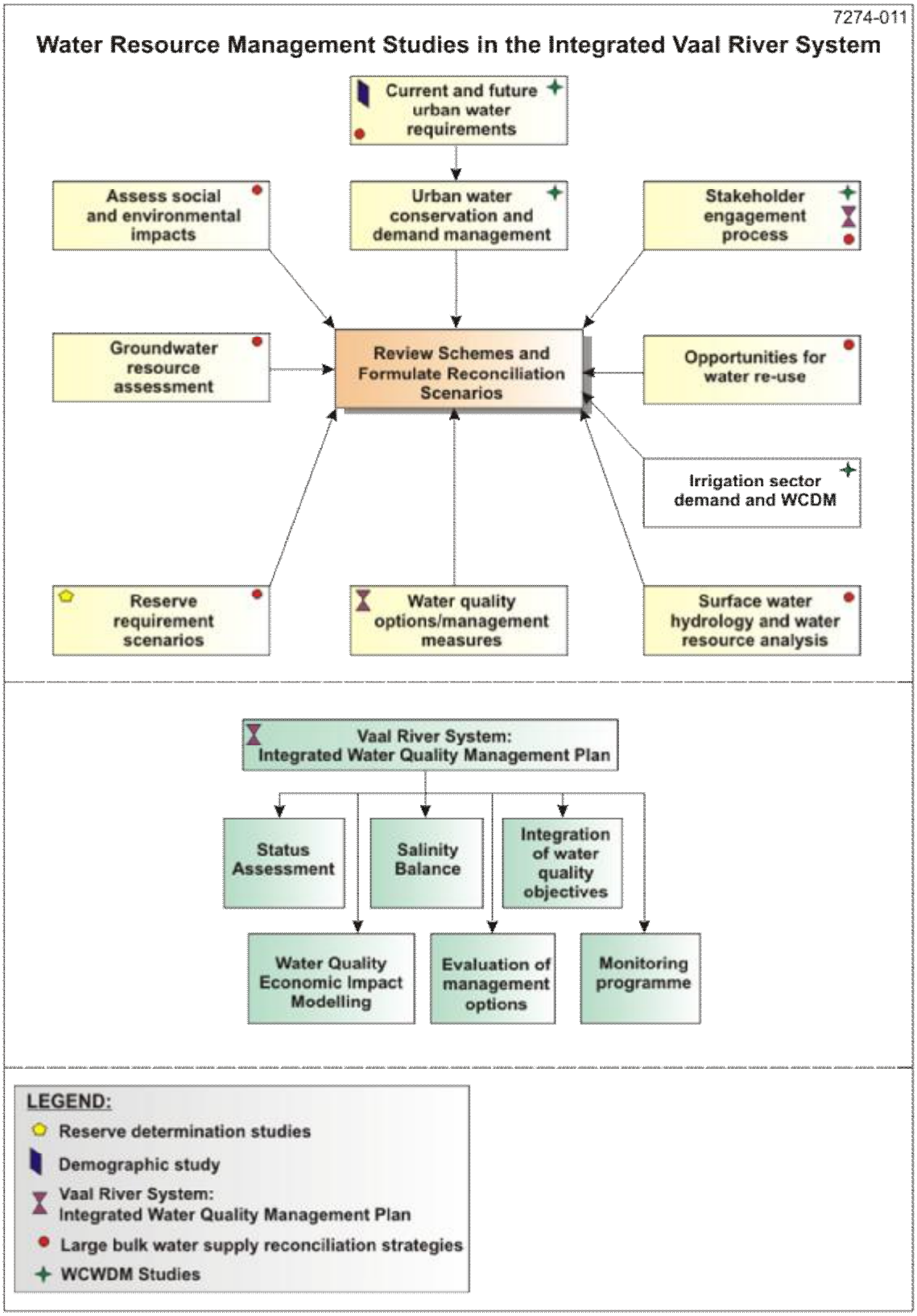


Figure 1: Water Resource Management Studies for the Integrated Vaal River System supporting the identification of reconciliation options (*adapted* DWAF, 2005a).

1.2 IWQMP Study description and context of monitoring programme task

Having water of the right quality is just as important as having enough water. Integrated water resource management in the Vaal River System can only be achieved if water quality and quantity are managed together to meet the requirements of water users (including the aquatic ecosystem) and their needs in terms of use of the resource. The more the water resource is used and gets re-used, and as quantities get scarce and feedback loops within this highly exploited and utilised water resource system get even tighter, it is water quality that begins to take on a dominant role. The Department realises that just as planning and management are taking place to supplement and control water quantities, they also need to take place around water quality. In response to the need to meet the objectives of integrated water resource management (IWRM), the Department has initiated this process to address the management of the water quality in the Vaal River System. This need was identified through the ISP process that specifically highlighted the necessity for an integrated management plan to manage water quality within the Vaal River system. The purpose of this initiative is to eventually develop a management plan for the Vaal River System, which will serve as a coherent approach for water management institutions and stakeholders to manage the water resources in the interdependent Vaal WMAs. In essence the integrated management plan developed would serve as a holistic and comprehensive business-plan for water quality management in and among the WMAs of the Vaal River System. The plan will also feed into the NWRS as part of the national guiding framework.

The focus of this study is thus to develop an integrated water quality management plan (IWQMP) for the Vaal River System, which aims to identify management options that are technically, economically and socially feasible and which will support the continued fitness for use of the water resources for all users across the WMAs.

The approach followed for the development of the IWQMP involved:

- The assessment of the Vaal River System to obtain a perspective of water quality (variables of concern), pollution sources and key water users. This included the identification of existing Resource Water Quality Objectives (RWQOs) and their establishment where they are not available. It also included an understanding of the salinity balance of the system to determine where the major contributions are originating from.
- Establishing how the system complies with the RWQOs, which was determined through analysis of available data and undertaking modelling of possible future scenarios. Determining an integrated set of RWQOs that were achievable, aligned to the system behaviour and prevented further deterioration of water quality.
- Identifying and developing management measures to improve the non-compliance cases, address water quality stresses and priorities and allow utilisation of available allocatable water quality to the benefit of the water users in the system. The management measures were evaluated on the basis of their technical, environmental (range of aspects), social and economic feasibility. The options identified were then formulated into a proposed strategy for implementation.

The IWQMP study comprises seven tasks which are depicted in **Figure 2.**

One of the basic principles of management is that "*you can only manage what you can measure*". This principle applies to any human endeavour and to the world that surrounds us, with the domain of water resource management being no different. Thus, in order that the water resources in the Vaal River System are effectively managed into the future with the RWQOs in place and sound strategies for water quality management, relevant information about water related conditions, issues and developments in the WMAs is needed to appropriately address the threats and problems that currently prevail. This "measurement" process of collating, processing and interpreting such information either takes the form of situation analyses, catchment studies or status quo assessments. Such status quo assessments are dependent of availability of water quality data and associated monitoring to support effective decision-making and management actions. Thus sound monitoring programmes to provide adequate and reliable water quality data forms the basis to all other tasks.

This task is therefore a key supporting activity for the implementation of the IWQMP and has the objective of assessing the effectiveness and applicability of the management strategies that are to be implemented in the Vaal River System in the immediate, medium and long term. This report focuses on the implementation of a monitoring programme that supports and supplements the water quality management strategies by providing the requirements for obtaining the necessary water quality data needed. (Task 7 of the study).

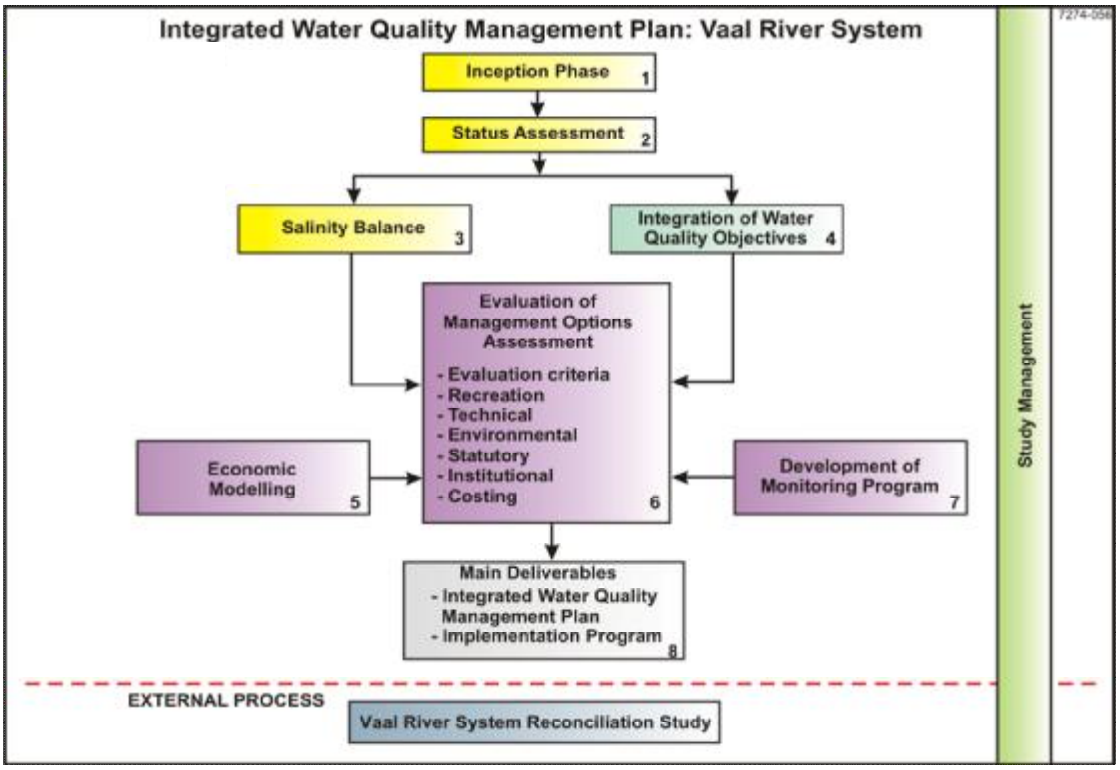


Figure 2: The study tasks comprising the development of the IWQM Plan for the Vaal River System (DWAF, 2005b)

1.3 Study Area

The study area for the IWQMP study includes the entire C drainage region within South Africa. This includes the Upper and Middle Vaal WMAs in their entirety, part of the Lower Vaal WMA (C31, C32, C33, C91 and C92 tertiary catchments), and part of the Upper Orange WMA (C51 and C52 tertiary catchments *i.e.* Modder Riet catchment) (**Figure 3**).

The extent and approach of the study and this monitoring task is focussed on:

- The main stem of the Vaal River as it flows from its origin in the Drakensberg escarpment to Douglas Barrage;
- All the major tributaries to the Vaal River. The tributaries were considered just upstream of their confluences with the Vaal River. This did not include the upper reaches of the tributary catchments.

Although the study considers the major tributaries of the Vaal River, the monitoring programme and recommendations do not address the specific requirements in each of the tributary sub-catchments. Rather the monitoring programme defined for the Vaal River will feed into the respective catchment management strategies and water quality management plans as they are developed or revised per sub-catchment.

1.4 Objective of the monitoring programme task

The objective of the monitoring programme task as part of the study was to:

- undertake a gap analysis in terms of the prevailing water quality monitoring network;
- develop a revised monitoring programme based on the monitoring needs and requirements identified, and
- undertake a resource requirement evaluation in terms of implementation.

1.4.1 Task 7a: Assessment of the current monitoring network

The first task involved undertaking an assessment of the current monitoring network. This entailed listing in tabular format and presenting on GIS maps the existing monitoring points, the types of monitoring undertaken and reflecting pertinent information regarding the custodian of the data. The information will reflect the current status of the monitoring network.

1.4.2 Task 7b: Identification of monitoring needs

Based on the feasible management options identified, related monitoring requirements were identified and described. A gap analysis was undertaken by comparing the needs with the existing monitoring

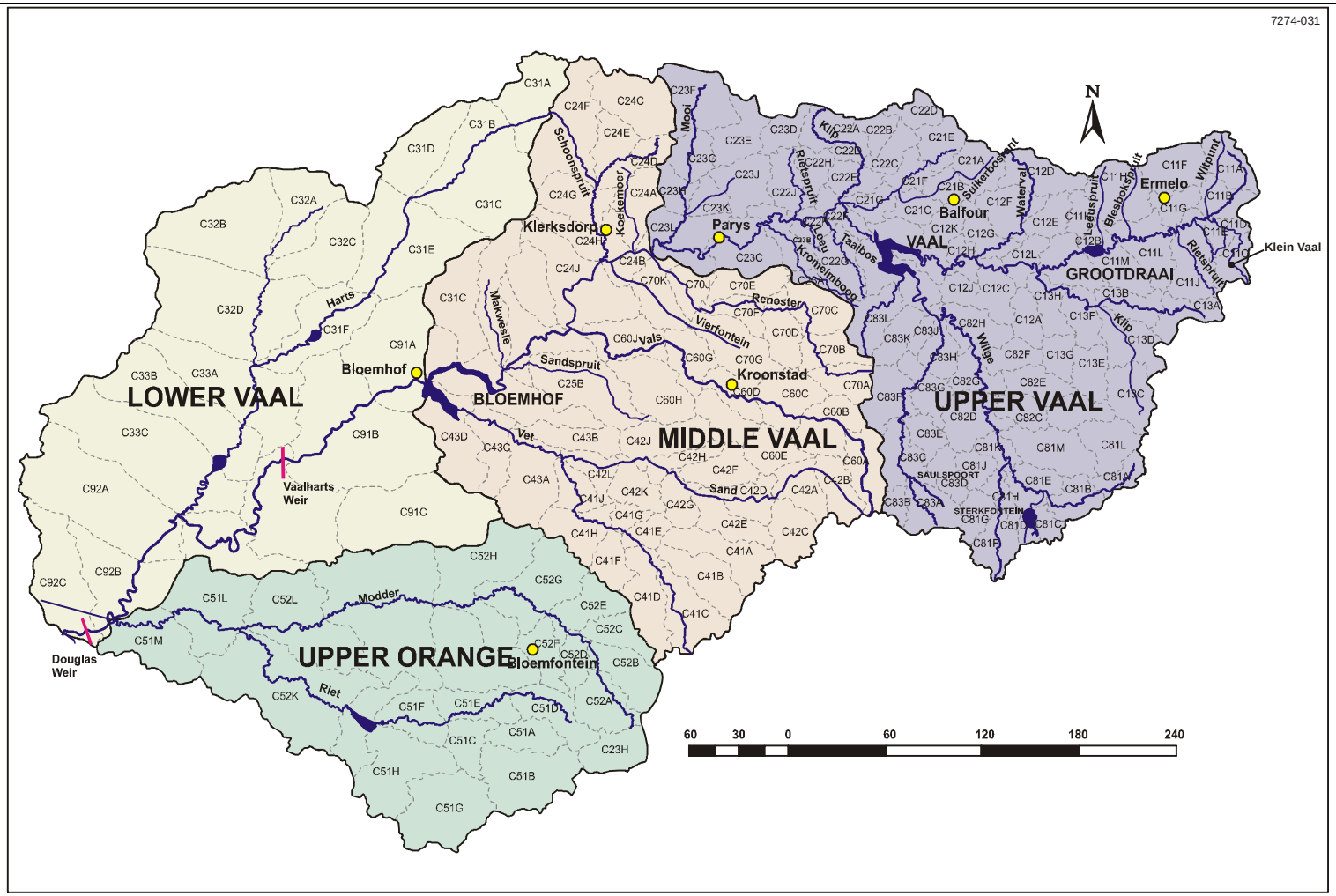


Figure 3: Study area of IWQMP study

network. Interviews with DWAF officials further assisted to identify additional monitoring needs.

1.4.3 Task 7c: Cursory resource requirement evaluation

A cursory resource requirement estimate and evaluation was for the proposed monitoring requirements identified from Task 7b. The intention is that the information will be used for the prioritisation of the monitoring needs and developing a monitoring implementation programme.

1.4.4 Task 7d: Prioritisation of monitoring requirements

It terms of the current monitoring programmes and gaps identified a prioritised list of monitoring requirements and proposals are highlighted in terms of the water quality monitoring programme for the Vaal River System.

In addition a revised monitoring programme is proposed. A ranking system that indicates the degree of importance of the monitoring needs is applied to the additional requirements. The most important monitoring needs are ranked in order of priority along with the associated resources to provide an indication of which of the needs can be addressed by available resources.

The report forms the main deliverable from this task and includes the proposed revised monitoring programme.

2 BACKGROUND

2.1 The need for monitoring

The design and implementation of effective monitoring networks and repository databases to ensure adequate quantification of the balance between sustainable water use and protection of water resources is pivotal to ensure that the goals of water resource management are being achieved in a catchment. This principle is recognised explicitly in Chapter 14 of the NWA, which requires monitoring of water resource quality to be an integral part of water resources management in South Africa. The NWA mandates the Minister of Water Affairs and Forestry to establish national monitoring systems that monitor, record, assess and disseminate information regarding, amongst many other things, the quality of water resources. The NWA however does not specify exactly, from a systems design perspective, what these national monitoring systems should be, or provide all the other details required to specify, design and implement such monitoring systems (DWAF, 2004).

Water quality is neither a static condition of a system, nor can it be defined by the measurement of only one parameter. Rather, it is variable in both time and space and requires routine monitoring to detect spatial patterns and changes over time. The National Water Resources Strategy (NWRS) recognises that no single monitoring programme can lead to a comprehensive expression of the "state of the water environment". The need for implementing and maintaining different monitoring systems to provide information on different aspects of water resource quality is confirmed by the reality that several water resource quality monitoring programmes exist currently both within the (DWAF) and in several other institutions involved in water resources management (DWAF, 2004).

For many people, and not only in South Africa, the phrase "water resource quality monitoring" means collecting and storing data related to the quality of water resources. Since the early 1970's those involved in conducting, but also particularly funding long term monitoring, identified one of their biggest problems being the "data-rich but information-poor syndrome". In other words the situation that their monitoring activities usually tend to generate large volumes of data that apparently find little application in the practice of water resource management. However, at the same time they faced continuous complaints from water resource planners and managers about the lack of relevant water resource quality information to support their planning and management information needs. This lack of relevant information is bad enough, but is compounded by the fact that at the same time masses of data were and still are being collected requiring significant time, effort and cost, seemingly without the expected benefits being derived from it (DWAF, 2004).

The "data-rich but information-poor syndrome" led several countries to fundamentally rethink the purpose of water resource quality monitoring, and consequently the process being used to design monitoring programmes. The purpose of monitoring was therefore redefined as: "Delivering the management information about water resource quality they require, to water resource managers, planners and other stakeholders". This statement of the purpose of monitoring may sound obvious. However, its implications for the design and maintenance of monitoring programmes are profound. Previously the design of monitoring programmes was dictated mainly by the consideration of how much water resource quality data (sites, frequency, attributes) could be collected with the available

resources and infrastructure. So monitoring involved the execution of two core functions, namely data acquisition and data management and storage (DWAF, 2004).

The shift in focus to the information user-centric approach currently being used to design monitoring programmes required that scope of monitoring be extended to a third, but crucial core function, in addition to the other two namely:

- Data acquisition (sampling, analysis, data capture).
- Data management and storage.
- Information generation and dissemination. (DWAF 2004)

The information user-centric approach also recognises that water resource management approaches and practices change with time. Therefore, in order to remain relevant, monitoring programmes need to be reviewed from time to time to confirm that they still meet their users' information requirements and be revised if necessary.

2.1.1 The demands for monitoring created by integrated resource management

Integrated water resource management is a corner stone of the new approach to water resources management adopted in South Africa and required by the NWA. Integration has to happen in several different dimensions, e.g. integration of the different components of the hydrological cycle (surface water, groundwater, estuaries and wetlands) and integration between statutory, economic, social, and resource quality objectives when making decisions about resource use. Water resource quality information users, who now have to make decisions and take actions that conform to the requirements of integrated water resources management, require both more resource quality information, and often also more sophisticated information concerning water resource quality (DWAF, 2004).

2.1.2 Water Quality

"Water quality" is a term used to express the suitability of water to sustain various uses or processes. Any particular use will have certain requirements for the physical, chemical or biological characteristics of water; for example limits on the concentrations of toxic substances for drinking water use, or restrictions on temperature and pH ranges for water supporting invertebrate communities. Consequently, water quality can be defined by a range of variables which limit water use by comparing the physical and chemical characteristics of a water sample with water quality guidelines or standards. Although many uses have some common requirements for certain variables, each use will have its own demands and influences on water quality (UNEP/WHO, 1996).

Quantity and quality demands of different users will not always be compatible, and the activities of one user may restrict the activities of another, either by demanding water of a quality outside the range required by the other user or by lowering quality during use of the water (e.g. discharges). Efforts to improve or maintain a certain water quality often compromise between the quality and quantity demands of different users. There is increasing recognition that ecosystems have a legitimate

place in the consideration of options for water quality management. This is both for their intrinsic value and because they are sensitive indicators of changes or deterioration in overall water quality, providing a useful addition to physical, chemical and other information.

The composition of surface and groundwater is dependent on natural factors (geological, topographical, meteorological, hydrological and biological) in the drainage basin and varies with seasonal differences in runoff volumes, weather conditions and water levels. Large natural variations in water quality may, therefore, be observed even where only a single watercourse is involved. Human intervention also has significant effects on water quality. Some of these effects are the result of hydrological changes, such as the building of dams, draining of wetlands and diversion of flow. More obvious are the polluting activities, such as the discharge of domestic, industrial, urban and other wastewaters into the watercourse (whether intentional or accidental) and the spreading of chemicals on agricultural land in the drainage basin.

Water quality is affected by a wide range of either or both natural influences and human activities. The most important of the natural influences are geological, hydrological and climatic, since these affect the quantity and the quality of water available. Their influence is generally greatest when available water quantities are low and maximum use must be made of the limited resource; for example, high salinity is a frequent problem in arid and coastal areas. If the financial and technical resources are available, seawater or saline groundwater can be desalinated but in many circumstances this is not feasible. Thus, although water may be available in adequate quantities, its unsuitable quality limits the uses that can be made of it.

Although the aquatic ecosystem is in harmony with natural water quality, any significant changes to water quality and quantity will usually be disruptive to the ecosystem. The availability of water and its physical, chemical, and biological composition affect the ability of aquatic environments to sustain healthy ecosystems: as water quality and quantity are eroded, organisms suffer and ecosystem services may be lost. The effects of human activities on water quality are both widespread and varied in the degree to which they disrupt the ecosystem and/or restrict water use. A single influence (e.g. faecal pollution, eutrophication or diffuse pollution) may give rise to a number of water quality problems, just as a problem may have a number of contributing influences.

2.1.3 Water Quality Monitoring

The extent of the human activities that influence the environment has increased dramatically during the past few decades; terrestrial ecosystems, freshwater and marine environments and the atmosphere are all affected. Large-scale mining and fossil fuel burning have started to interfere measurably with natural hydro-geochemical cycles, resulting in a new generation of environmental problems. The scale of socio-economic activities, urbanisation, industrial operations and agricultural production, has reached the point where, in addition to interfering with natural processes within the same catchments and basins, they also have a world-wide impact on water resources. As a result, very complex inter-relationships between socio-economic factors and natural hydrological and ecological conditions have developed. A pressing need has emerged for comprehensive and accurate assessments of trends in water quality, in order to raise awareness of the urgent need to address the consequences of present

and future threats of contamination and to provide a basis for action at all levels. Reliable monitoring data are the indispensable basis for such assessments.

Monitoring

Monitoring is defined by the International Organization for Standardization (ISO) as: "the programmed process of sampling, measurement and subsequent recording or signalling, or both, of various water characteristics, often with the aim of assessing conformity to specified objectives". (UNEP/WHO, 1996).

Monitoring includes three interconnected functions *viz*:

(1) Data acquisition

(2) Data management and storage and

(3) Information generation and dissemination.

This general definition can be differentiated into three types of monitoring activities that distinguish between long-term, short-term and continuous monitoring programmes as follows:

- Monitoring is the long-term, standardised measurement and observation of the aquatic environment in order to define status and trends.
- Surveys are finite duration, intensive programmes to measure and observe the quality of the aquatic environment for a specific purpose.
- Surveillance is continuous, specific measurement and observation for the purpose of water resource management and operational activities (UNEP/WHO, 1996).

Purpose of water quality monitoring

This purpose of water quality monitoring is most commonly related to water quality management, which aims to control the physical, chemical and biological characteristics of water resources. Elements of management may include control of pollution and impacts, use and abstraction of water, and land use. Specific management activities are determined by natural water quantity and quality, the uses of water in natural and socio-economic systems, and prospects for the future.

Water quality requirements or objectives can be usefully determined only in terms of suitability for a purpose or purposes, or in relation to the control of defined impacts on water quality. For example, water that is to be used for drinking should not contain any chemicals or micro-organisms that could be hazardous to health. Similarly, water for agricultural irrigation should have a low sodium concentrations, while that used for steam generation and related industrial uses should be low in certain other inorganic chemicals. Preservation of biodiversity and other conservation measures are being recognised increasingly as valid aspects of water use and have their own requirements for water

quality management. Water quality data are also required for pollution control, and the assessment of long-term trends and environmental impacts.

Many reasons can be listed for carrying out water quality monitoring. In many instances they will overlap and the information obtained for one purpose may be useful for another. Water quality monitoring data may be of use in the management of water resources at local, regional, national or international level. Where water bodies are shared by more than one country, a water quality monitoring programme can yield information that may serve as a basis for international agreements regarding the use of these waters, as well as for evaluation of compliance with any such agreements. Water quality monitoring is the foundation on which water quality management is based (UNEP/WHO, 1996).

Monitoring provides the information that permits rational decisions to be made on the following:

- Describing water resources and identifying actual and emerging problems of water pollution/ water quality deterioration.
- Formulating plans and setting priorities for water quality management.
- Developing and implementing water quality management programmes.
- Evaluating the effectiveness of management actions (UNEP/WHO, 1996).

The quality of water may be described in terms of the concentration and state (dissolved or particulate) of some or all of the organic and inorganic material present in the water, together with certain physical characteristics of the water. It is determined by *in situ* measurements and by examination of water samples on site or in the laboratory. The main elements of water quality monitoring are, therefore, on-site measurements, the collection and analysis of water samples, the study and evaluation of the analytical results, and the reporting of the findings. The results of analyses performed on a single water sample are only valid for the particular location and time at which that sample was taken. One purpose of a monitoring programme is, therefore, to gather sufficient data (by means of regular or intensive sampling and analysis) to assess spatial and/or temporal variations in water quality.

Complete assessment of the quality of the aquatic environment, therefore, requires that water quality, biological life, particulate matter and the physical characteristics of the water body be investigated and evaluated. This can be achieved through:

- chemical analyses of water, particulate matter and aquatic organisms (such as planktonic algae and selected parts of organisms such as fish muscle),
- biological tests, such as toxicity tests and measurements of enzyme activities,
- descriptions of aquatic organisms, including their occurrence, density, biomass, physiology and diversity (from which, for example, a biotic index may be developed or microbiological characteristics determined), and

- physical measurements of water temperature, pH, conductivity, light penetration, particle size of suspended and deposited material, dimensions of the water body, flow velocity, hydrological balance, etc. (UNEP/WHO, 1996).

2.1.4 Monitoring programme

A monitoring programme is defined as a management mechanism which addresses the three core functions: data acquisition, data management and storage and information generation and dissemination in order to deliver a coherent set of information. The information is tailored to meet the needs of the users for a specific water quality/resource management requirement(s).

The core activities of the three core functions include the following (DWAF, 2004):

Data acquisition:

- Acquisition of data
- Liaison with other organisations to influence their monitoring or data transfer standards
- Measurements, sample collection or analysis.

Data storage and management:

- Control of maintenance, security and access to data
- Specification of data formats
- Provision of access through a suitable/appropriate media
- Preparation and delivery of data on a regular basis
- And other similar related activities.

Information generation and dissemination

- Conversion of data to information
- Distribution of information to users in required formats using agreed upon media
- Data storage and management of processed information
- Preparation and distribution of reports
- Modelling
- Statistical analysis
- Patching of missing data
- Other related activities.

One will seldom find that a single monitoring programme will produce information that can meet all the requirements of the water quality information user. Monitoring programmes are therefore typically designed to deliver a coherent set of information that is agreed upon with the information users to meet a specific sub-set of information requirements (DWAF, 2004).

In terms of the information generated by monitoring programmes a range of types can be defined:

- Compliance monitoring programmes (monitoring that can lead to law enforcement);
- Performance (audit) monitoring programmes (comparisons of water resource quality to predetermined management objectives e.g. resource water quality objectives);
- Status and trend monitoring programmes (monitoring that provides long terms information primarily on what the water quality is and how is it changing);
- Impact assessment monitoring programmes (monitoring that provides information on why the water quality is the way it is and why is it changing or what is the expected change), and
- Survey programmes (typically once of programmes, irregularly performed, or regularly performed with periods of inactivity of several years).

A monitoring system refers to a grouping of the different monitoring programme types according to some logical criteria (DWAF, 2004).

Water quality monitoring is a complex endeavour. Monitoring programmes can be viewed from many different perspectives, and as a consequence, people involved in the design and management of monitoring programmes often describe them in many different ways.

Some examples of how monitoring programmes are currently being described (categorised) in South Africa are according to (DWAF, 2004):

- Types of water resource quality attributes being addressed, e.g. hydrological monitoring, microbiological monitoring, inorganic chemical monitoring, etc.
- Type of water resource quality problem being addressed, e.g. toxicity monitoring, eutrophication monitoring, radioactivity monitoring, etc.
- The type of water resource being monitored, e.g. surface water, groundwater, estuaries, etc.
- Geographic scale, e.g. national (where the word “national” has a geographic interpretation of SA-wide geographic coverage), regional, catchment, etc.
- Institutional responsibility, e.g. national (where the word “national” usually has the interpretation that it is the monitoring which is the primary responsibility of the national DWAF rather than a regional or local water management institution), regional monitoring (the responsibility of cluster / regional DWAF offices), catchment monitoring (the responsibility of CMA’s), monitoring done by Water Boards, etc.

- The primary information objectives of the monitoring programme, e.g. status & trend monitoring, monitoring for the purpose of impact assessment, monitoring for the purpose of compliance assessment, monitoring for quality assurance purposes, etc.
- The scope of monitoring, e.g. some would refer to "monitoring" as only the data acquisition component of a monitoring programme while others would understand the word "monitoring" to describe the complete process consisting of the three core functions of monitoring namely: data acquisition; data management and storage; and the generation (which includes assessment) and dissemination of information.

There are a few important observations to be made concerning these descriptions or categorisations, namely:

- It is obvious that none of these categorisations or descriptions of water resource quality monitoring programmes are mutually exclusive.
- None of them are necessarily a better description or categorisation than the other. It depends on what the purpose of the description is, and / or who the audience is.
- Also, the different groups of people (often in different organisational units or different organisations) involved in the design, implementation and operation of monitoring programmes have developed their preferred ways of describing and categorising the monitoring programmes they are responsible for.

One has to recognise that water resource quality information is needed at different levels of spatial and temporal resolution depending largely on the nature of the management function for which the information is required (**Figure 4**).

Networks for water quality monitoring must conform to programme objectives. A clear statement of objectives is necessary to ensure collection of all necessary data and to avoid needless and wasteful expenditure of time, effort and money. Furthermore, evaluation of the data collected will provide a basis for judging the extent to which programme objectives were achieved and thus justify the undertaking. Before observations begin, it is also essential to specify the location of sampling stations, the frequency of sampling and the water quality variables to be determined.

Monitoring programmes should be periodically reviewed to ensure that information needs are being met. As greater knowledge of conditions in the aquatic system is gained, a need for additional information may become apparent. Alternatively, it may be concluded that some of the information being collected is unnecessary. In either case, an updated monitoring programme document must be prepared and distributed to the information users. If such users are not kept fully informed of the exact scope of the programme they may expect more than it can deliver and may not support its continuation (UNEP/WHO, 1996).

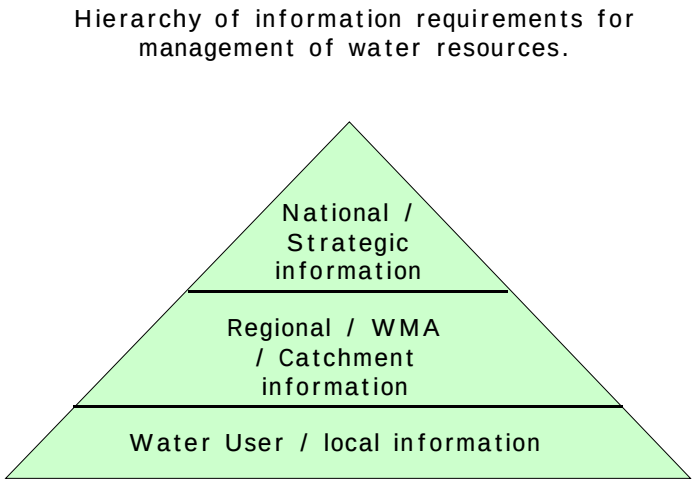


Figure 4: : Diagram to illustrate that different information requirements exist at different water management levels ranging from the most detailed information (on spatial and temporal scales) being required at the local level less detailed information being required at the national / strategic level (DWAF, 2004).

Monitoring for management

The elements of water quality monitoring and assessment described are only part of a wider picture of water quality and quantity management, environmental protection and policy formulation and of development concerns. The critical element stressed is the development of objectives. It may be that long-term objectives (such as integrated monitoring for environmental and health protection) may be set for the monitoring programme but that the programme operates, and is practically structured, to meet specified short-term objectives (such as monitoring for immediate user priorities). This illustrates that water quality monitoring operates within a larger structure of policy decisions and management priorities. A programme may need to be flexible to meet short-term objectives but still be capable of developing over longer periods to meet new concerns and priorities.

The elements outlined should be implemented flexibly according to the different priorities of the monitoring programmes. The initial phases of surveys and design may extend over periods of months or even years before a clear idea of needs and priorities is achieved. The time required for other elements of the monitoring and assessment process varies. Sampling missions may take several days, as may sample transport to the laboratory. Complete chemical analysis of a sample may take a week. Data treatment can take weeks, depending on the amount of data that is to be dealt with, while interpretation of results and the writing and publication of reports can take from a few months to a few years. If operational surveillance is one of the aspects of a multipurpose monitoring programme, the field work, data assessment and reporting should be accomplished within a time limit appropriate to the operational requirements. For example, reports on the surveillance of water qality for drinking water should be made very quickly so that corrective actions can be taken when a contaminated supply threatens public health (UNEP/WHO, 1996).

The importance of the use of information cannot be over emphasised. There is little point in generating monitoring data unless they are to be used. It is essential that the design, structure, implementation and interpretation of monitoring systems and data are conducted with reference to the final use of the information for specific purposes. In some countries, water quality standards may be laid down by national legislation. A government authority is then charged with monitoring the extent to which the standards are fulfilled. This is particularly common for water intended for drinking and is carried out as a public health protection measure. The monitoring objectives in this case will be concerned with detecting any deterioration in raw water quality so that appropriate source protection or treatment can be applied. In other instances, it may be necessary to develop a new water source in order to meet increasing demands; the objective may then become that of monitoring the quality and quantity of sources that might fulfil this need.

Where water quality legislation is rudimentary or non-existent, the water regulator's mandate may be to develop legislation and regulations appropriate to the country's economic development plans. In this case the monitoring objectives will probably focus, in the first instance, on acquiring background information on water quality. The objectives will change as information on water quality is accumulated, as problems emerge and solutions are developed, and as new demands are made on the water resources.

Monitoring and assessment

Monitoring, as a practical activity, provides the essential information which is required for an assessment of water quality. However, assessments require additional information, such as an understanding of the hydro- dynamics of a water body, information on geochemical, atmospheric and anthropogenic influences and the correct approaches for analysis and interpretation of the data generated during monitoring (UNEP/WHO, 1996).

2.2 Water quality monitoring of the Vaal River System

The Vaal River catchment ranges from semi-arid to arid from east to west across the catchment. Intensive urban, industrial, mining and irrigation development loads the system with large quantities of effluent. These same activities impose substantial water demands that remove much of the potential diluting water from the resource. Further concentration of pollutants in the river system is caused by cascading re-use along the river course and evaporative concentration in impoundments. This is particularly important with respect to salts and nutrients. This has resulted in serious salinisation and eutrophication problems in the Vaal River system.

The most significant pollution sources in the catchment upstream of Vaal Dam are the Waterval River, which includes gold mining and the largest oil-from-coal petrochemical industry in the world and the coalmines in the northeastern portion of the catchment that support coal export and feed major power stations. Extremely high point and diffuse pollution loads emanate from the heavily developed Vaal Barrage catchment. Smaller, but still very significant, pollution loads emanate from the Midvaal and Freestate Goldfields mining areas between Vaal Barrage and Bloemhof Dam. Irrigation at Vaalharts and in the Sand-Vet GWS and along the lower Vaal River to Douglas cause further

concentration of salts. The Modder and Riet River irrigation schemes consume large amounts of fresh water and raise salinity levels in the depleted river flow to extremely high levels, further adding to the pollution of the lower Vaal River at Douglas.

Since 1983 the impact of atmospheric deposition of sulphur salts has been identified as a potentially significant long-term salinity problem. Even the large quantities of low TDS fresh water imported to the Vaal Dam catchment via the Tugela-Vaal, Lesotho Highlands, Heyshope Dam and Zaaihoek Dam schemes have failed to suppress rising salinity levels in Vaal Dam.

Blending and dilution schemes have ameliorated salinity in the Rand Water supply, but have done little to alleviate salinity and eutrophication problems experienced further downstream at the Midvaal and Sedibeng raw water intakes, along the rest of the Middle Vaal River, in Bloemhof Dam and escalating along the Lower Vaal River towards Douglas Weir and the confluence with the Orange River. Efforts are also being made to reduce pollution loads at source.

Freshwater is a finite resource as essential to agriculture and industry as it is to basic human existence. Water quality monitoring is a fundamental tool in the management of freshwater resources (UNEP/WHO, 1996).

Water quality and quantity are intimately linked although not often measured simultaneously. Extensive and reliable information regarding stream flow, in-stream water quality and discharge loads, is essential to readily identify and prioritise problem areas and assess the water resource situation. It was therefore of importance to assess the existing water quality monitoring systems active in the Vaal River System with the objectives of (i) evaluating the monitoring systems in place (ii) identifying key information gaps and (iii) recommending proposals for improvement. The monitoring information will support more effective management.

2.2.1 Salinity, nutrient (eutrophication) and algal monitoring of the Vaal River

The key for the success of the management strategies policies in providing solutions to the problems of pollution is the ability to conduct continuous and routine monitoring. The strengthening of salinity and nutrient (eutrophication) and algal monitoring is considered essential for the following reasons:

- Salinity and eutrophication is very costly to urban and industrial users. Salinity adversely affects crop yield, increase treatment costs and leads to increased water demand. Eutrophication adversely affects biodiversity and leads to increased primary productivity, excessive growth of algae and aquatic weeds.
- Proper operation and evaluation of the Rand Water blending and dilution schemes and other ameliorative actions require ongoing salinity and nutrient monitoring.
- Monitoring is required to evaluate the salinity and eutrophication status of dams and rivers and to evaluate compliance with water quality objectives.
- Salinity and nutrient modelling is integral to the planning and management of the system. Good water quality monitoring data is essential to this.

- Load balances cannot be carried out without reliable monitoring.
- Mass balances are indispensable in assessing salinity balances. This implies the need to monitor both salt concentration and flow.
- Load balances cannot be carried out without reliable nutrient monitoring.
- Emergency incidents indicating a severe environmental problems continuously being experienced in the Vaal River System need to be supported by adequate monitoring which will serve as an early warning system. Continuous monitors of dissolved oxygen can serve as an early warning system in the Vaal River for fish-kills.
- Monitoring of cyanobacterial taxa and population densities (cell numbers and biomass) can provide an excellent basis for assessing risk (hazards to human and animal health), particularly if supported periodically with toxicity test or toxin analysis.

3 ASSESSMENT OF CURRENT SURFACE WATER MONITORING NETWORK OF THE VAAL RIVER

3.1 Current Monitoring: Water Quality

Various organizations have water quality monitoring programmes in the Vaal River and tributary its catchments. They include:

- DWAF, Directorate Resource Quality Services
- DWAF Gauteng Regional Office
- DWAF Free State Regional Office
- Rand Water
- Midvaal Water
- Sedibeng Water

The water quality monitoring programmes of these organisations in the Vaal River vary considerably in spatial and temporal scales and are suited to meet the user's objectives. The most extensive sources of data/monitoring programmes are from DWAF, which has national (strategic), regional (catchment level) and local (water user) information requirements for the management of water resources. Rand Water has a catchment level water quality monitoring programme that focuses on regional and local water quality management in the Upper Vaal WMA. Midvaal Water and Sedibeng Water have localised water quality monitoring networks that support their management of the water resources in their immediate areas of distribution.

The water quality data generated by the monitoring programmes of these various organisations/sources has different:

- Times scales of analysis.
- Sampling frequencies.
- Variables monitored.
- Analytical laboratories.
- Analysis methods.

While some local authorities do undertake localised water quality monitoring these are not considered in context of the Vaal River System. The monitoring is very much localised, very much focused on compliance monitoring and does support the in-stream water quality monitoring network to a any significant degree. In addition it was very difficult to obtain much information from these organisations.

Many large industries also undertake some in-stream water quality monitoring, however this is primarily linked to compliance monitoring upstream and downstream of their discharges and abstractions. These monitoring networks were found not be significant in terms of the monitoring of the Vaal River as a system.

The majority of the data was obtained from Departmental databases, with only limited information being obtained from the Water Boards based on specific requests. Midvaal Water supplied the most data with limited data from the other two Water Boards. It was evident that each organization had its own programme which served its purposes, with no integration with the others.

The Departmental monitoring programmes and that of the Water Boards are described and discussed below. The sampling points, variables monitored and duration of monitoring and duration of monitoring are indicated per organization where available.

3.1.1 Department of Water Affairs and Forestry

The Department as the regulator monitors the water quantity and quality in the Vaal River System. A National monitoring system is currently in place and is coordinated by the Department's Resource Quality Services. The DWAF has a National Chemical Monitoring Programme (NCMP) in place which aims to provide regular reporting on the chemical quality of South Africa's surface waters. All data collected for the National monitoring programmes are stored on the Department's database and information management system, *i.e.* the Water Management System (WMS). In some instances the Directorate Hydrological Information and/or the Regional Offices collect the samples for the RQS for the National monitoring programmes. The Regional Offices also have their own regional water quality monitoring programmes for which they are the lead agents. These programmes are not always integrated into the WMS. The Gauteng Regional Office has an extensive water quality monitoring programme in place which supports the national programme, while the Free State Regional Office has recently initiated a regional monitoring programme, which is not yet integrated into the National system, as WMS is not yet used by the Region. The Northern Cape Regional Office has also recently initiated a regional monitoring network which has some integration with the National system be it to a minimal degree.

The current national water quality chemical monitoring network of DWAF for the Vaal River system is listed in Table A.1 and the points are indicated on Figure A.1 in Appendix A. Currently the monitoring network includes this includes 612 points. However the monitoring at these points varies considerably and does not support an integrated water quality monitoring programme.

Many of the monitoring points are inactive or are sampled irregularly. The sampling frequencies vary considerably as well the extent of the water quality variables. There are vast gaps in data as well as a lack of integration in the monitoring programme to generate the information required. For most part the chemical monitoring programmes includes the following water quality variables that are monitored. The suite of variables monitored per monitoring point is inconsistent:

- Aluminium
- Chloride (dissolved)
- Chromium
- Dissolved Major Salts (DMS)
- Electical Conductivity
- Magnesium
- Manganese
- Ammonium
- Nitrate/Nitrite
- Sodium
- Total Phosphorus
- Orthophosphate
- Lead
- Sulphate
- Temperature
- pH

The recently initiated monitoring programme of the DWAF Free State Regional Office is listed in Appendix B in Table B.1 (points are included in the DWAF strategic monitoring points for the Vaal River System discussed below). This monitoring programme is undertaken in association with MidVaal Water.

The Gauteng Regional Office's monitoring network also includes monitoring stations that monitor the wastewater discharges from point sources. This network is a compliance monitoring network to assist the Gauteng Regional Office in determining if industries, mines, wastewater treatment plants, etc. in the catchment are complying with the discharge standards stipulated in their water use authorisations. However during data gathering many of the datasets for dischargers did not volumes available. The data sets in the database were not always complete or up to date. The supply of data is dependent both on the water users themselves and Department's own compliance monitoring network, thus the heart of the problem lies primarily with the Department not updating the WMS on receipt of the data as its own compliance monitoring provides data even if the water users don't. With regard to this situation the industries in the catchment did indicate that they did in fact diligently submit their data to the Department as and when required.

Strategic Monitoring Points

In addition the national network of water quality monitoring stations, DWAF (National) and the Gauteng, Free State and Northern Cape Regional Offices identified the need to select strategic monitoring points in the Vaal River System. The identification of monitoring points within the Vaal River System where based on them being strategically located and sufficiently widespread to provide an adequate indication of the prevailing water quality status. These strategic monitoring points were used as the basis for the IWQMP study. These strategic points are part of the national DWAF monitoring network and include the points of the Free State Office's regional monitoring programme.

Strategic monitoring points were selected at two levels:

- Level 1: Points on the Vaal River from its origin to Douglas Barrage; and
- Level 2: Points on the major tributaries of the Vaal River just upstream of their confluences.

Level 1 Points

The Level 1 strategic monitoring points refer to the monitoring points that are located on the Vaal River. Twenty Level 1 strategic points were identified and their locations are indicated on **Figure 5** and listed in **Table 1** .

The points are:

- numbered from 1 to 20 from the most upstream point to the most downstream point in the Vaal catchment; and
- preceded by the letters 'VS' which implies 'Vaal System' (for example VS 10)

Level 2 Points

The Level 2 strategic monitoring points refer to the monitoring points that are located on the major tributaries of the Vaal River, just upstream of their confluences. Twenty six level 2 strategic points were identified and their locations are indicated on **Figure 6** and listed in **Table 2.**

Currently the 20 strategic monitoring points identified on the main stem of the Vaal River (indicated above), are fairly well representative of the river. However, the quantity and quality of the chemical data contrast very much and ranged from poor to very good (see list below in **Table 3**).

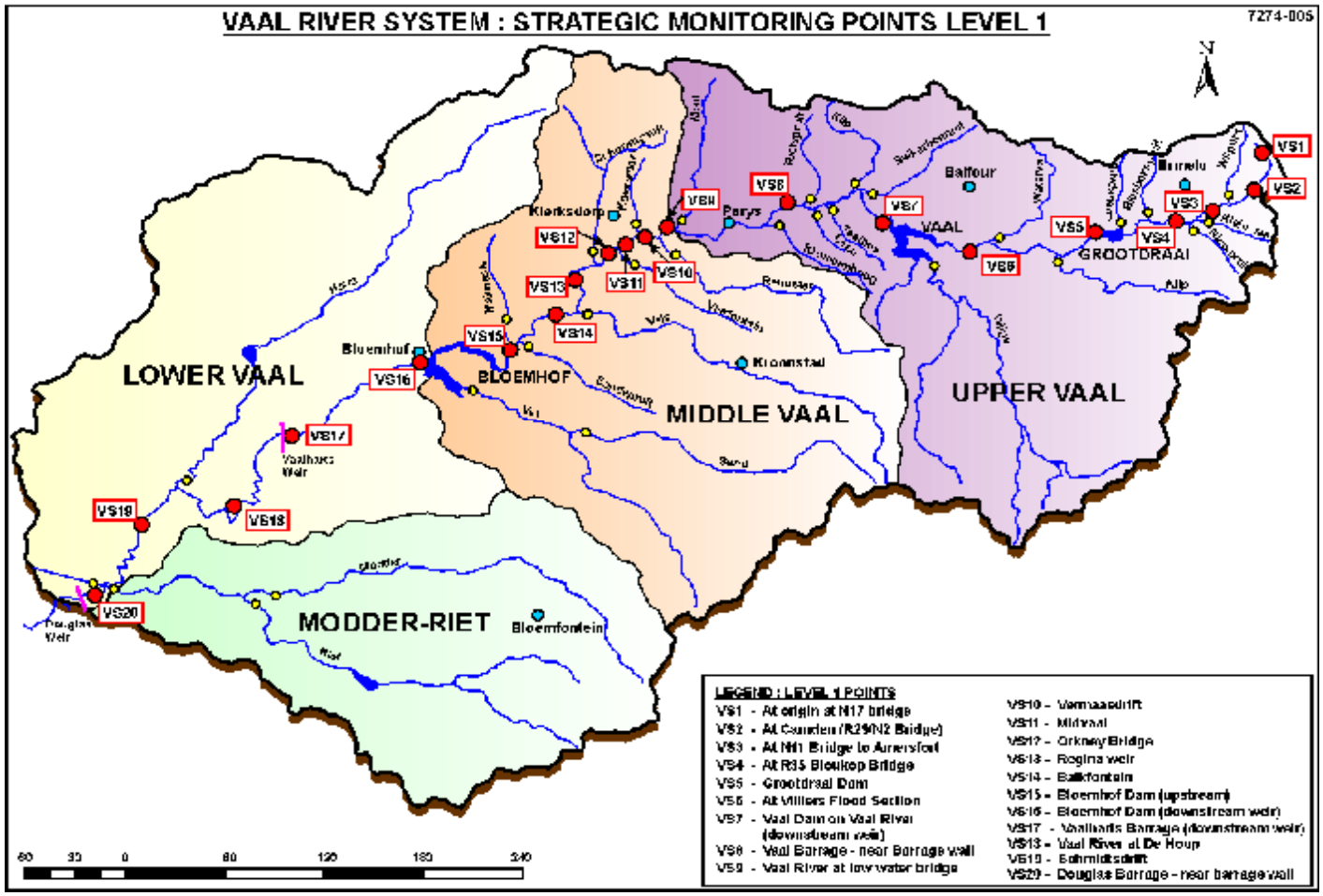


Figure 5: Location of Level 1 strategic monitoring points in Vaal River System

Table 1: Level 1 Strategic Monitoring Points identified for the Vaal River System

Strategic Monitoring Points: Level 1						
WMA	**Monitoring Point ID**	**VS number**	**Monitoring Point Name**	**Tertiary Drainage Region**	**Latitude**	**Longitude**
Upper Vaal	177935	**VS1**	**VS1 GDDC01 VAAL RIVER ORIGIN AT N17 BRIDGE**	C11	-26.3625	30.108056
	177949	**VS2**	**VS2 GDDC10 VAAL RIVER AT R29/N2 BRIDGE AT CAMDEN**	C11	-26.647222	30.151667
	100001098	**VS3**	**VS3 VAAL RIVER ON N11 BRIDGE TO AMERSFORT**	C11	-26.778611	29.920833
	177950	**VS4**	**VS4 GDDC11 VAAL RIVER AT R35 BLOUKOP BRIDGE**	C11	-26.854722	29.698056
	90612	**VS5**	**VS5 C1R002Q01 GROOTDRAAI DAM vs**	C11	-26.918056	29.295
	90597	**VS6**	**VS6 C1H017Q01 VAAL RIVER AT VILLIERS FLOOD SECTION**	C12	-27.0225	28.594444
	90678	**VS7**	**VS7 C2H122Q01 VAAL DAM ON VAAL RIVER: DOWN STREAM WEIR**	C21	-26.854167	28.121111
	90780	**VS8**	**VS8 C2R008Q01 VAAL BARRAGE ON VAAL RIVER NEAR BARRAGE WALL**	C22	-26.765556	27.684722
	90763	**VS9**	**VS9C2H260Q01 VAAL RIVER AT LOW WATER BRIDGE**	C23	-26.887222	26.926944
Middle Vaal	*RO WQ point	**VS10**	**VS10 VERMAASDRIFT**	C24	-26.933	26.852
	*RO WQ point	**VS11**	**VS11 MIDVAAL WATER COMPANY**	C24	-27.935	26.808
	90656	**VS12**	**VS12 C2H007Q01 VAAL RIVER AT PILGRIMS ESTATE/ORKNEY**	C24	-26.956667	26.651111
	*RO WQ point	**VS13**	**VS13 REGINA BRIDGE**	C24	-27.1028	26.528
	90645	**VS14**	**VS14 C2H061Q01 BALKFONTEIN/SEDIBENG (VAAL RIVER AT KLIPPLAATDRIFT)**	C25	-27.3875	26.4625
	*RO WQ point	**VS15**	**VS15 UPSTREAM BLOEMHOF DAM (MAKWASSIE AT GREYLINGSDRIFT BRIDGE)**	C25	-27.6	26.094
Lower Vaal	90908	**VS16**	**VS16 C9H021Q01 BLOEMHOF DAM ON VAAL RIVER: DOWN STREAM WEIR**	C91	-27.669167	25.618056
	90898	**VS17**	**VS17 C9H008Q01 VAALHARTS BARRAGE ON VAAL RIVER: DOWN STREAM WEIR**	C91	-28.114167	24.915278
	90899	**VS18**	**VS18 C9H009Q01 VAAL RIVER AT DE HOOP**	C91	-28.515833	24.601111
	101770	**VS19**	**VS19 C9H024Q01 AT SCHMIDTSDRIFT (WEIR) ON VAAL RIVER**	C92	-28.711111	24.073333
	101787	**VS20**	**VS20 C9R003Q01 DOUGLAS BARRAGE ON VAAL RIVER: NEAR BARRAGE WALL**	C92	-29.043333	23.836944

*RO WQ point (Regional Office Water Quality point): This monitoring point does not form part of the Department's national chemical monitoring network, but is rather a monitoring point that is managed by the Regional Office only. However these points should eventually be registered on the Department's national chemical monitoring network (on the Water Management System).

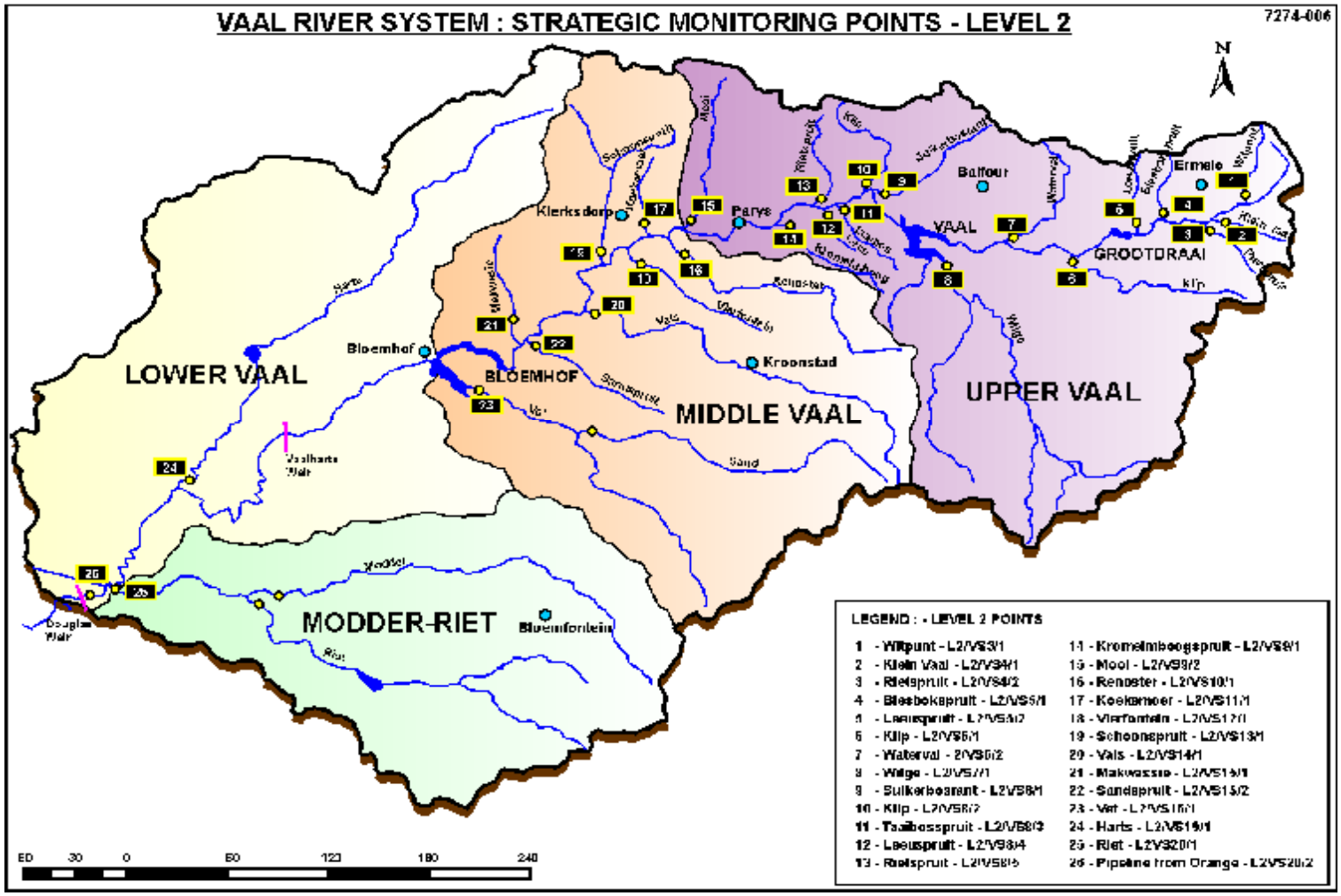


Figure 6: Location of Level 2 strategic monitoring points in Vaal River System

Table 2: Level 2 Strategic Monitoring Points identified for the Vaal River System

Strategic Monitoring Points: Level 2							
WMA	**Monitoring Point ID**	**Tributary number**	**Tributary name**	**Monitoring Point Name**	**Drainage Region**	**Latitude**	**Longitude**
Upper Vaal	177947	L2/VS3/1	Witpuntspruit	GDC09 WITPUNTSPRUIT AT R29/N2 CAMDEN BRIDGE	C11	-26.592778	30.096944
	100001153	L2/VS4/1	Klein Vaal	KLEIN VAAL	C11	-26.788611	30.1288333
	100001044	L2/VS4/2	Rietspruit	RIETSPRUIT AT N11 TAPFONTEIN BRIDGE	C11	-26.913056	29.872222
	177951	L2/VS5/1	Blesbokspruit	C1H006Q01 BLESBOKSPRUIT AT R39 BRIDGE RIETVLEY	C11	-26.755556	29.543333
	177962	L2/VS5/2	Leeuspruit	C1H005Q01 LEEUSPRUIT AT WELBEDACHT	C11	-26.854167	29.325278
	100000521	L2/VS6/1	Klip	C1H002Q01 KLIP RIVER AT STERKFONTEIN/DELANGESDRIFT	C13	-27.169444	29.233889
	90591	L2/VS6/2	Waterval	C1H030Q01 WATERVAL AT WOLWEFONTEIN U/S VAAL	C12	-28.969444	28.727778
	90859	L2/VS7/1	Wilge	C8H001Q01 WILGE RIVER AT FRANKFORT	C83	-27.273889	28.49
	90615	L2/VS8/1	Suikerbosrant	C2H004Q01 SUIKERBOS AT UITVLUGT	C21	-26.67075	28.03044444
	90624	L2/VS8/2	Klip	C2H015Q01 KLIP RIVER AT WALDRIFT/VEREENIGING	C22	-26.705	28.937222
	90623	L2/VS8/3	Taaibosspruit	C2H014Q01 TAAIBOSSPRUIT AT VERDUN (RW/T1)	C22	-26.823889	27.925833
	100000949	L2/VS8/4	Leeuspruit	LTS13 LEEUSPRUIT AT R59 BRIDGE	C22	-26.409722	28.098611
	90616	L2/VS8/5	Rietspruit	C2H005Q01 RIETSPRUIT AT KAAL PLAATS	C22	-26.729722	27.717778
	100000958	L2/VS9/1	Kromelmboog	LTS30 KROMELMBOOGSPRUIT ON R59 BRIDGE	C23	-26.848889	27.6557222
	90668	L2/VS9/2	Mooi	C2H085Q01 MOOI RIVER AT HOOGEKRAAL/KROMDRAAI	C23	-26.880278	26.965
Middle Vaal	90853	L2/VS10/1	Renoster	C7H006Q01 RENOSTER RIVER AT ARRIESRUST	C70	-27.044444	27.005
		L2/VS11/1	Koekemoer	C2H132 WEIR ON KOEKEMOERSPRUIT BUFFELFONTEIN	C24	-26.545800	26.490200
		L2/VS12/1	Vierfontein	C2H274 NEW WEIR - RECENTLY INSTALLED	C24		
	90656	L2/VS13/1	Schoonspruit	C2H073Q01 SCHOONSPRUIT AT GOEDGENOEG	C24	-26.956667	26.651111
	90846	L2/VS14/1	Vals	C6H002Q01 VALS RIVER AT GROOTDRAAI/BOTHAVILLE	C60	-27.398611	26.614722
		L2/VS15/1	Makwassie	C2H066Q01 MAKWASSIE SPRUIT AT VLIEGEKRAAL	C25	-27.495556	26.074722
		L2/VS15/2	Sandspruit	C2H067Q01 AT LEEGTE ON SANDSPRUIT	C25	-27.560278	26.233333
	90795	L2/VS16/1	Vet	C4H004Q01 AT FAZANTKRAAL NOOITGEDACHT ON VET RIVIER	C43	-27.935000	26.126667
Lower Vaal	90788	L2/VS19/1	Harts	C3H016Q01 HARTS RIVER AT DELPORTSHOOP LLOYDS WEIR	C33	-28.376940	24.303056
	90835	L2/VS20/1	Riet	C5H048Q01 RIET RIVER AT ZOUTPANSDRIFT	C51	-29.033330	23.983330
		L2/VS20/2	Canal from Orange	C9H025 ORANGE-VAAL CANAL AT ST CLAIR/DOUGLAS BARRAGE	C51	-29.045833	23.841389

Table 3: Quality and quantity of chemical data at the 20 strategic points selected on the Vaal River

<table>
<tr><th colspan="4">DATA QUALITY</th></tr>
<tr><th>Very Good</th><th>Good</th><th>Fair</th><th>Poor</th></tr>
<tr><td>VS 6: At Villiers - DWAF data, fortnightly</td><td>VS4: Bloukop - monthly</td><td rowspan="6">VS1: Origin N17 bridge;
VS2: At Camden;
VS3: Bridge at Amersfoort

– gaps in data</td><td>VS8: Vaal Barrage - which in a hotspot area, but with almost no data since 1999</td></tr>
<tr><td>VS7: Vaal Dam - downstream weir: weekly</td><td rowspan="4">VS5: Grootdraai Dam - monthly</td><td rowspan="3">VS9: Kromdraai;
VS15: Bloemhof Dam, upstream
– no data</td></tr>
<tr><td>VS10: Schoemansdrift -weekly</td></tr>
<tr><td>VS11: Midvaal Water Company data - daily to weekly</td></tr>
<tr><td>VS12: Orkney Bridge - weekly</td></tr>
<tr><td>VS14: Klipplaatdrift</td><td rowspan="2">VS17: Vaalharts Barrage = monthly</td><td rowspan="2">VS18: De Hoop; and
VS19: Schmidtsdrift
– vast gaps in data.</td></tr>
<tr><td>VS16: Bloemhof Dam - downstream weir: weekly</td></tr>
<tr><td>VS20: Douglas Barrage - weekly</td><td></td><td></td></tr>
</table>

3.1.2 Water Boards

Limited information was made available regarding the monitoring programmes of the Water Boards. Rand Water and Sedibeng Water were not willing to share much information. Requests for data from Rand Water were at a cost or in the case of Sedibeng Water were not resulted only in minimal data being provided.

There is no alignment to the Departmental monitoring system, or between the different Water Boards themselves.

Rand Water

The Rand Water surface water, water quality monitoring network is confined to the Upper Vaal WMA (their area of supply). The monitoring is focused on the Vaal Dam and Vaal Barrage catchments. Rand Water conducts very intensive monitoring in the Vaal River catchment including the tributary catchments. The monitoring points are in the Vaal River and Vaal Barrage catchment is listed below in **Table 4**.

Midvaal Water

Midvaal Water Company provides drinking water to the neighbouring towns (Klerksdorp, Orkney & Stilfontein), the surrounding mines (AngloGold Ashanti Vaal River Operations, Simmer & Jack Mines Limited, Buffelsfontein Gold Mine & Harmony) and industries. They extract water from the Vaal River downstream of Vermaasdrift.

Midvaal Water has a monitoring programme with sampling points in the Koekemoerspruit and the Vaal River. Samples are taken on a weekly basis and analysed on site by their own laboratory (accredited). Variables analysed range between physical parameters, metals, micro and macro elements, organics, nutrients, biological parameters and faecal coliforms.

Table 4: Rand Water Company monitoring programme in the Vaal Dam and Barrage Catchments

Primary Catchment	Sample point	Sample point description	River	Sub-catchment	Variables monitored (at all sites)	Frequency
Vaal Dam	C - WAE	Waterval River @ Elandslaagte	Waterval	Waterval		
Vaal Dam	C-WAB	Bossespruit @ Sasol Secunda	Bossiespruit	Waterval	**Physical Constituents**	
Vaal Dam	C-WAT	Trachardtspruit @ Secunda	Tricahardtspruit	Waterval	Conductivity (COND ms/m)	
Vaal Dam	C-WAR	Waterval River @ Roodebank	Waterval	Waterval	Hardness (HARDNESS mg/l CaCO3)	
Vaal Dam	C-WAW	Winkelhaakspruit @ Secunda	Winkelhaak	Waterval	M Alk (M_ALK mg/l CaCO3)	
Vaal Dam	C - VDS	Vaal River downstream of Standerton	Vaal River	Vaal Dam resevoir	P Alk (P_ALK mg/l CaCO3)	
Vaal Dam	C - VS	Vaal River @ Standerton	Vaal River	Vaal Dam resevoir	pH (PH -)	
Vaal Dam	C-VGB	Vaal River @ Gladdedrift Bridgeat Villiers	Vaal River	Vaal Dam resevoir	Temperature (Temperature °C)	
Vaal Dam	C-VD1	Vaal Dam integrated 1	Vaal Dam	Vaal Dam resevoir	Turbidity (TURB NTU)	
Vaal Dam	C-VD2	Vaal Dam integrated 2	Vaal Dam	Vaal Dam resevoir		
Vaal Dam	C-VD3	Vaal Dam integrated 3	Vaal Dam	Vaal Dam resevoir		
Vaal Dam	C-VD4	Vaal Dam integrated 4	Vaal Dam	Vaal Dam resevoir	**Macro Elements**	
Vaal Dam	C - MOL	Molspruit @ Vaal Dam	Molspruit	Vaal Dam resevoir	Aluminium (AL mg/l)	weekly
Vaal Dam	C - WF	Wilge River @ Frankfort	Wilge river	Vaal Dam resevoir	Boron (B mg/l)	
Vaal Dam	C - ND Leeu	Leeuspruit @ New Denmark Colliery	Leeuspruit	Grootdraai Dam	Br (BR mg/l)	
Vaal Dam	C - VBS	Vaal River Blesbokspruit @ Skaapkraal	Blesbok	Grootdraai Dam	Calcium (CA mg/l)	
Vaal Dam	C - VB	Blesbokspruit @ Vaal River confluence	Blesbok	Grootdraai Dam	Clorine (CL mg/l)	
Vaal Dam	C - VGK	Geelspruit below Amersfoort	Geelspruit	Grootdraai Dam	Copper (CU mg/l)	
Vaal Dam	C - VAS	Vaal River above Standerton	Vaal River	Grootdraai Dam	F (F mg/l)	
Vaal Dam	C - VK	Kafferspruit before Vaal River	Kafferspruit	Grootdraai Dam	Iron (FE mg/l)	
Vaal Dam	C - VRA	Rietspruit below Amersfoort	Rietsprui	Grootdraai Dam	K (K mg/l)	
Vaal Dam	C - VKV	Klein Vaal River @ Goodehoop	Klein Vaal	Grootdraai Dam	Mg (MG mg/l)	
Vaal Dam	C - VKK	Klein Kafferspruit below Ermelo	Klein Kafferspruit	Grootdraai Dam	Mn (MN mg/l)	
Vaal Dam	C - VKR	Vaal River Kafferspruit @ Riverside	Kafferspruit	Grootdraai Dam	Na (NA mg/l)	
Vaal Dam	C - VBB	Blesbok below Bethal	Blesbok	Grootdraai Dam		
Vaal Dam	C - ZD	Zaaihoek Dam Outfall		Upper Vaal/Klip		

Primary Catchment	Sample point	Sample point description	River	Sub-catchment	Variables monitored (at all sites)	Frequency
Vaal Dam	C - KSV	Spruitonderdrift below Vrede	Onderdrift	Upper Vaal/Klip		
Vaal Dam	C - KW	Klip River @ Winkelhaak	Klip river	Upper Vaal/Klip	**Macro Elements (continued)**	
Vaal Dam	C - KD	Klip River @ Delangesdrift	Klip river	Upper Vaal/Klip	NH4 (NH4 mg/l)	
Vaal Dam	C - VSS	Sandspruit below Vaal River @ Klipplaatsdrift	Sandspruit	Upper Vaal/Klip	NO2 (NO2 mg/l)	
Vaal Dam	C - KB	Klip River @ Barnardskop	Klip river	Upper Vaal/Klip	NO3 (NO3 mg/l)	
Vaal Dam	C - VSV	Sandspruit above Volkrust	Sandspruit	Upper Vaal/Klip	P (P mg/l)	
Vaal Dam	C - WAF	Wilge River above Frankfort	Wilge river	Wilge	PO4 (PO4 mg/l)	
Vaal Dam	C - WL	Liebenberg River @ Fredericksdal Weir	Liebenbergsvlei	Wilge	S (S mg/l)	
Vaal Dam	C - WJ	Jordaanspruit below Bethlehem	Jordaanspruit	Wilge	Si (SI mg/l)	
Vaal Dam	C - WLB	Liebenberg River @ Bethlehem	Liebenbergsvlei	Wilge	SO4 (SO4 mg/l)	
Vaal Dam	C - WJA	Jordaanspruit above Bethlehem	Jordaanspruit	Wilge	TKN (TKN mg/l)	
Vaal Dam	C - WLA	Lesotho Highlands Ash River Outfall	Ash river	Wilge	Zn (ZN mg/l)	
Vaal Dam	C-WLS	Liebenbergsvlei @ Saulspoort Dam	Liebenbergsvlei	Wilge		
Vaal Dam	C-WLR	Liebenbergsvlei @ Reitz	Liebenbergsvlei	Wilge	**Micro Elements**	weekly
Vaal Dam	CWLBB	Liebenbergsvlei @ Below Bethlehem	Liebenbergsvlei	Wige	As (AS ug/l)	
Vaal Dam	C - EQQ	Elands River downstream of Qwaqwa	Elands river	Wilge	Cd (CD ug/l)	
Vaal Dam	C - WE	Elands River @ Aberfeldy	Elands river	Wilge	CN (CN mg/l)	
Vaal Dam	C - WH	Wilge River below Harrismith	Wilge river	Wilge	Co (CO mg/l)	
Vaal Dam	C - SD	Sterkfontein Dam	Sterkfontein Dam	Wilge	Cr (CR mg/l)	
Vaal Dam	C - WAH	Wilge River above Harrismith	Wilge river	Wilge	Mo (MO mg/l)	
Vaal Dam	C - WN	Nuwejaarspruit below Sterkfontein Dam	Nuwejaarspruit	Wilge	Ni (NI mg/l)	
Vaal Dam	C - MR	Muel River downstream of Ribbokspruit	Muel river	Wilge	Pb (PB mg/l)	
Vaal Dam	C - WM	Muel River @ Kafferstad	Muel river	Wilge	Se (SE ug/l)	
Vaal Dam	C - WMW	Wilge River @ Waaiwater	Wilge river	Wilge	V (V mg/l)	
Vaal Dam	C - WC	Cornelius River @ Warden	Corneliusspruit	Wilge		
Vaal Barrage	C - B11	Bridge on R42 @ Nigel	Vaal River	Vaal Barrage	**Organic**	
Vaal Barrage	C- B10	Blesbokspruit at Heidelberg	Blesbokspruit	Suikerbosrant	COD (COD mg/l)	
Vaal Barrage	C-B5	Blesbokspruit at Welgedacht	Blesbokspruit	Suikerbosrant	Disolved Oxygen (DO mg/l O2)	
Vaal Barrage	C-B17	Blesbokspruit - Marievale bird sanctuary	Blesbokspruit	Suikerbosrant	DOC (DOC mg/l)	

Primary Catchment	Sample point	Sample point description	River	Sub-catchment	Variables monitored (at all sites)	Frequency
Vaal Barrage	C-B15	Blesbokspruit at Springs N17 Toll Road Bridge	Blesbokspruit	Suikerbosrant	**Other** CN-Total (CN-Total ug/l) Sb (SB ug/l) SS (SS mg/l) Total Silica (Total Silica mg/l)	weekly
Vaal Barrage	C-K19	Klip River Weir (Grootvlei Railway Bridge)	Klip River	Klip		
Vaal Barrage	C-RV2	Rietspruit Weir above Barrage.	Rietspruit	Rietspruit		
Vaal Barrage	C - S1	Suikerbosrant River at Balfour between Vaal	Suikerbosrant	Suikerbosrant		
Vaal Barrage	C-S2	Suikerbosrant River Weir above Three River	Suikerbosrant	Suikerbosrant		
Vaal Barrage	C-V17	Barrage Outlet (Vaal River)	Vaal River	Vaal Barrage		
Vaal Barrage	C-LS1	Leeuspruit @Sasolburg	Leeuspruit	Leeu/Taaibosspruit		
Vaal Barrage	C- T1	Taaibosspruit Weir	Taaibosspruit	Leeu/Taaibosspruit		
Vaal Barrage	C- VRB24	Vaal River at 24km	Vaal River	Vaal Barrage		
Vaal Barrage	C- VRB37	Vaal River at 37km	Vaal River	Vaal Barrage		

The monitoring programme is summarised in **Table 5.** They supply the water quality data in electronic format free of charge.

Midvaal and DWAF regional Bacteriological Monitoring Programme has been implemented since early 2004 as a result of Cholera incidents in the study area (DWAF, 2006c).

Table 5: Midvaal Water Company monitoring programme in Koekemoer Spruit and Vaal River

Sampling point name	River	Sampling frequency	Variables
Midvaal Intake	Vaal River	Monthly	Colour, pH, EC, SS, TDS, COD, DOC, TOC, THM, Phenols, TKN, Nitrate, Ammonia, Orthophosphate, chlorine, Faecal coliforms, Total coliforms, Free CN, Total alkalinity, Total hardness, Oxygen absorbed, Ca, K, Na, F, Zn, Al, Sb, As, Cd, Cr, Co, Cu, Si, Fe, Pb, Mn, Hg, Ni, Se, V, Sulphates.
Vermaasdrift	Vaal River	Monthly	Colour, pH, EC, Iron, Manganese, Nitrate as N, Ammonia as N, Orthophosphate as P, TOC, Faecal coliforms, total alkalinity, Aluminium, Sulphate, Sodium, Potassium, Magnesium, Chloride, Calcium
Regina	Vaal River	Monthly	Colour, pH, EC, Iron, Manganese, Nitrate as N, Ammonia as N, Orthophosphate as P, TOC, Faecal coliforms, total alkalinity, Aluminium, Sulphate, Sodium, Potassium, Magnesium, Chloride, Calcium
Fountain 9	Seepage into Vaal River (from upstream pollution sites)	Monthly	Colour, pH, EC, Turbidity, Iron, Manganese, Nitrate as N, Ammonia as N, Orthophosphate as P, TOC, Total chlorophyll, Faecal coliforms
Midvaal WWTW	Discharge to Vaal River	Monthly	pH, EC, SS, COD, Nitrate as N, Ammonia as N, Orthophosphate as P, Oxygen absorbed, Faecal coliforms, Total chlorine, Oil and grease
Enviroclear	Discharge to Koekemoer Spruit	Monthly	Colour, pH, EC, Turbidity, Iron, Manganese, Nitrate as N, Ammonia as N, Orthophosphate as P, TOC, Total chlorophyll, Faecal coliforms
Koekemoer Spruit after Enviroclear	Koekemoer Spruit downstream of Enviroclear inflow	Monthly	Colour, pH, EC, Turbidity, Iron, Manganese, Nitrate as N, Ammonia as N, Orthophosphate as P, TOC, Total chlorophyll, Faecal coliforms
Koekemoer Spruit before Enviroclear	Koekemoer Spruit upstream of Enviroclear inflow	Monthly	Colour, pH, EC, Turbidity, Iron, Manganese, Nitrate as N, Ammonia as N, Orthophosphate as P, TOC, Total chlorophyll, Faecal coliforms
Balancing dam	Waste water balancing dam	Monthly	pH, EC, Turbidity, Suspended solids, Na, Iron as Fe, Mn, Cu, Cd, Zn, Pb, Cr, Mercury as Hg, As, Se, B, CN, Nitrate, Ammonia, F, Cl, Sulphate, Oxygen absorbed, Orthophosphate, COD, TOC, DOC, Total chlorophyll, Faecal coliforms, total chlorine, Oil and grease

Sedibeng Water

Information on the water quality monitoring of Sedibeng Water could not be obtained despite numerous attempts to obtain the information. It is known that Sedibeng Water does undertake some in-stream water quality monitoring in the vicinity of the Balkfontein abstraction. However some algae data was provide for the status assessment task.

3.2 Biological Monitoring

The Department of Water Affairs and Forestry (DWAF) initiated the River Health Programme (RHP) in 1994. The main purpose of the programme is that it should serve as a source of information regarding the overall ecological status of river ecosystems in South Africa. For this reason, the RHP primarily makes use of in-stream and riparian biological communities (e.g. fish, invertebrates, vegetation) to characterise the response of the aquatic environment to multiple disturbances. The rationale is that the integrity or health of the biota inhabiting the river ecosystems provides a direct and integrated measure of the health of the river as a whole.

To date, the implementation of the RHP has largely been driven by provincial implementation teams consisting of amongst others, DWAF Regional Offices, provincial departments of the environment, conservation agencies, universities and municipalities. Implementation in the provinces has largely been voluntary and is influenced by various factors such as the enthusiasm of provincial champions and provincial task teams, buy-in from their respective organisations, as well as the availability of financial and human resources. This makes the Programme very vulnerable and affects its long-term sustainability. The River Health Programme is being coordinated by the CSIR for DWAF and on a regional basis by a number of Regional Champions.

The goal of the RHP is to serve as a source of information regarding the ecological state of river ecosystems in South Africa, in order to support the rational management of these natural resources.

The objectives of the RHP are to:

- Measure, assess and report on the ecological state of aquatic ecosystems;
- Detect and report on spatial and temporal trends in the ecological state of aquatic ecosystems;
- Identify and report on emerging problems regarding aquatic ecosystems;
- Ensure that all reports provide scientifically and managerially relevant information for national aquatic ecosystem management.

According to DWAF's River Health Programme (RHP) the following aspects are suggested as possible biomonitoring techniques for an in-stream monitoring programme (DWAF, 2006c):

- South African Scoring System 5 (SASS5 – on a seasonal basis

- Habitat Assessment Matrix (HAM) - on a seasonal basis
- Habitat Quality Index (HQI) - on a seasonal basis
- Invertebrate Habitat Assessment System (IHAS) - on a seasonal basis
- Riparian Vegetation Index (RVI)
- Fish Assessment Index (FAI) – once per year
- Fish Health Assessment Index (FHAI)

The usage of these in-stream biological indicators of the biological integrity of a river depends on available resources (money and manpower). At present the following biological assessment techniques are developed to a state that they are recommended for South African rivers:-

- South African Scoring System 5
- Habitat Assessment Matrix (HAM)
- Habitat Quality Index (HQI)
- Invertebrate Habitat Assessment System (IHAS)
- Fish Assessment Index (FRAI)

Biological monitoring in the Vaal River System is limited. The Free State DWAF Regional Office has initiated a biomonitoring in the Vaal River including the Modder River and is actively supporting the RHP. In the Lower and Upper Vaal WMAs a biomonitoring programme is still to be initiated.

A Comprehensive Reserve Determination study is currently underway for the Integrated Vaal River System (by Chief Directorate Resource Directed Measures). As part of the study the biological assessment is being done. A final output of the study will be a recommended monitoring programme for the biological parameters of the Vaal River. The study will be completed by March 2010.

As part of the RHP biomonitoring sites were identified and selected in each of the WMAs (**Table 6**). This was done in May 2005. Three types of sites were identified. These have been differentiated as follows (Dallas, 2005):

- **Existing sites (E)** – these are mostly monitoring sites that existed, mostly as provincial or local monitoring sites. Supporting attribute data for many of these sites have been provided by regional experts, although in some instances data are missing.
- **Proposed macro sites (P)** - macro site locations were identified at the river reach scale when no sites existed. Supporting attribute data for these sites was generally not available and specific site locations for these sites will be determined during groundtruthing and site validation.
- **Reference sites (R)** – these are existing sites that represent the “least impacted” condition and which may be used to generate future reference conditions for specific eco-regions,

longitudinal zones and/or river types. Reference conditions enable the degree of degradation or deviation from natural conditions to be ascertained, and thereby serve as a foundation for developing biocriteria and evaluating monitoring sites. The process by which reference conditions are derived will vary with biotic component, i.e. invertebrates, fish, riparian vegetation. It is likely that additional reference sites will need to be identified within ecoregions which are not represented or under represented.

Table 6: Summary RHP site information for each of the WMAs (Dallas, 2005)

WMA Name	Number of sites (total)	Number of existing sites	Number of proposed macro sites	Number of reference sites (Existing)
Upper Vaal	39	10	29	1
Middle Vaal	26	12	14	0
Lower Vaal	11	5	6	0

The above RHP sites in the Vaal River System are listed and indicated in Appendix C.

Limited biomonitoring is done as part of the water quality monitoring programme of DWAF.

4 IDENTIFICATION OF MONITORING NEEDS

The following gaps and inadequacies were identified during this task with regard to water quality monitoring, monitoring data and monitoring programmes:

- There are differences in:

  - Variables analysed
  - Time periods and scales of the monitoring
  - Timescales of databases
  - Analytical methods
  - Laboratories used for the analysis
  - Differences in data collection and storage formats and databases

  Thus what is required is integration /alignment of the above to ensure that there is a standardised system of sampling, measurement and analysis. This would then allow the interpretation of the data to be consistent, sound, credible and defensible.

- There is a lack of integration between the monitoring programmes of the National Programme and Regional Offices. There is also a lack of integration among the three Regional Offices with regards to the monitoring programmes and monitoring. There is at present no co-ordination between the RQS and the Departmental Regional Offices regarding the location of monitoring stations, sampling frequency and analyses performed. A national co-ordinator is required to manage an integrated programme.
- There is also no integration or co-operation between the Department and the Water Boards with regard to monitoring of the Vaal River. Efforts are duplicated, uncoordinated and isolated. This is not necessarily a waste of time as the requirements (license and operational requirements) and variables analyzed are different. It is, however, recommended that DWAF and the Water Boards coordinate their sampling programmes in the Vaal River System. The implementation committee established to ensure the implementation of the IWQMP strategy could address this aspect. It would be more cost effective and beneficial if resources and systems were pooled to obtain a value added information product if the organisations worked together. This would also be of benefit to the future established CMAs.

- Data from the monitoring stations have in many instances proved to be incomplete (information gaps) or insufficient (limited data sets). The data sets were fragmented and their reliability was questionable. A revision of the monitoring programmes is required.
- Monitoring stations were not always suitably located and thus in some instances the most downstream point on the tributaries were too high up in the catchment. Thus the lower catchment impacts on the Vaal were thus not accounted for (e.g. Klip River – Free State).
- With regard to salinity, the Gauteng Regional monitoring programme monitors EC, while the National programme and that of the Free State Region monitors TDS.
- Analysis of data between various monitoring stations is not always possible because of differing water quality variables analysed and discrepancies in the analytical techniques used by different testing laboratories.
- The water quality monitoring variables currently analysed is largely concentrated on chemical constituents. At present very little information is available of the aquatic health of the water resources of the catchment, microbiological quality and data on metals.
- Available Departmental data varies in completeness, accuracy and reliability, which have resulted in difficulty in isolating and quantifying specific pollution sources.
- Not all monitoring points include flow measurements which limited the extent of water quality analysis at some points, and the determination of loads.
- The microbiology and pathogen monitoring data is inadequate for the whole study area.
- No validation processes are in place to verify the data that has been captured (no validation of methods, sampling, analysis, etc.). This therefore sometimes raises questions about the validity of the data that is available on the Department databases.
- With regard to the strategic sites selected :

    - The water quality in the Vaal River changes significantly between the Vaal Barrage (VS8) and Kromdraai (VS9). For example, the average NO_3–N concentration drops from 2.015 mg/L at the Vaal Barrage to 0.705 mg/L at Kromdraai (below Parys), which is ascribed to denitrification. Denitrification is apparently a major sink for nitrogen and a key process to understanding and managing eutrophication in the Vaal River (Roos, 2007). Thus, the distance between these two monitoring points (VS8 & VS9) is too big (approximately 125 km river length) and an additional monitoring point should be included in-between at Parys. The Vaal River at Parys is quite unique with numerous rapids; it is also extraordinary wide (300 – 400 m) with several islands.

    - The DWAF sampling point (VS7, weir downstream of Vaal Dam) is not considered to be representative of conditions in the Vaal Dam. For example, compare chlorophyll-a data of

Vaal Dam (DWAF) with chlorophyll-a data by Rand Water (**Figure 7**). The chlorophyll concentrations in the downstream weir (average 11 µg/L) were significantly lower than in the dam (average 20 µg/L). This underestimate of algal biomass in the downstream weir could be ascribed to releases of deep level water with low algal biomass from the Vaal Dam.

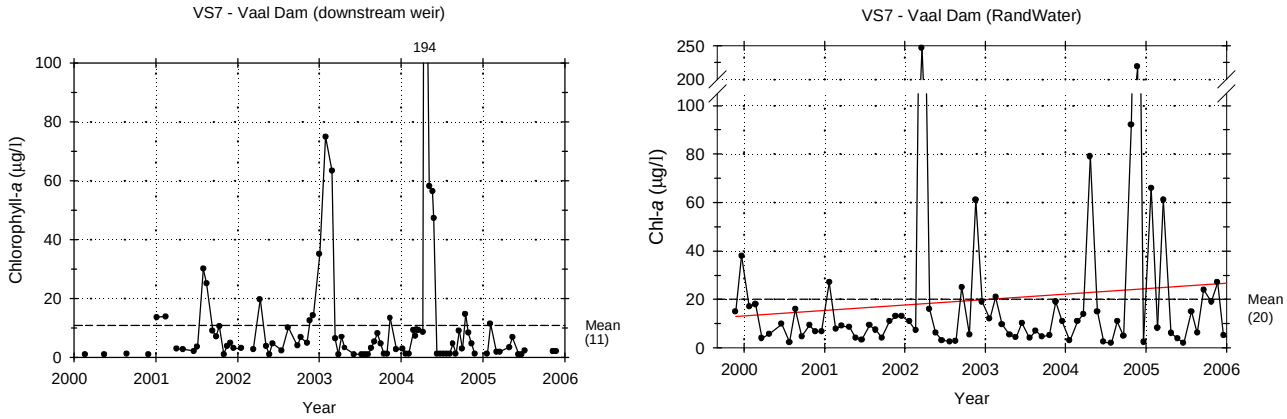


Figure 7: Variation in Chlorophyll-*a* concentration in a weir downstream of the Vaal Dam (DWAF data) (left) and in the Vaal Dam [confluence of Vaal River and Wilge River (Rand Water data) (right).

- It is suggested that the concept of a centralised database be investigated. The approved data would have to be submitted to the central storage space in a user-friendly format. If the WMS from DWAF is easily accessible via e-mail this system could be used to add and interrogate data. If this data-base is not user-friendly then a local data base should be developed that is accessible to all in the catchments.
- Linkages between surface and groundwater sampling need to be determined. These linkages are important in this study area as groundwater decants into the Vaal River at several known points. The behaviour of these decants and future closure strategies are dependant on this information.
- No light measurement is included in current monitoring programmes:
  - Because light is a driving force for primary production (algal growth), changes in light attenuation will have a direct influence on the trophic dynamics of aquatic ecosystems. Unfortunately DWAF's monitoring programme does not include any light measurement (Secchi, turbidity or suspended solids). Turbidity indicates the extent to which water lacks clarity or a measure of water cloudiness due to suspended solids.

- Turbidity is of fundamental significance in natural waters, not merely because of its effect on visual appearance, but because the resultant light scattering can have profound effects on the penetration of solar radiation with implications for the thermal properties and primary productivity of a water body. The colour and the turbidity of water determine the depth to which light is transmitted. This, in turn, controls the amount of primary productivity that is possible by controlling the rate of photosynthesis of the algae present (Chapman, 1996). Lower turbidity resulted in a bigger euphotic zone, higher under water climate, and usually higher algal growth.

- Thus, turbidity (measured in Nepholemetric turbidity units, NTU), is a rapid and low-cost method which should be introduced at all the monitoring points in the Vaal River.

- Chlorophyll-a (algal biomass)

  - The concept of trophic status is based on the fact that changes in nutrient levels causes changes in algal biomass (measures by chlorophyll-*a*). Thus, a main consequence of eutrophication is an increase in algal biomass. The green pigment chlorophyll is present in all photosynthetic organisms and provides an indirect measure of algal biomass and an indication of the trophic status of a water body. Chlorophyll is usually included in assessment programmes for lakes and reservoirs and is important for the management of water abstracted for drinking water supply, since excessive algal growth makes water unpalatable or more difficult to treat (Chapman, 1996).

  - However, only limited and fragmented chlorophyll-a data is available on the Vaal River. DWAF has only restricted data at four sites (dams only), i.e. Grootdraai Dam, Vaal Dam, Bloemhof Dam, and Douglas weir. Rand Water has data on the Vaal Dam and Vaal Barrage, but is unfortunately not freely available. Midvaal Water Company has only Chl-a data until 1999, thereafter unfortunately only total Chl-a concentrations, which make it impossible to compare with other monitoring points. Sedibeng Water has chl-a data, but a complete set only from 2005.

  - To understand the dynamics of eutrophication in the Vaal River, the Chl-a measurements should be extended to all the monitoring sites on the main stem.

- Toxic algae:

  - Although toxic cyanobacteria (blue-green algae) has always been a potential threat to public health, it became an issue of greater concern in the Vaal River during recent years. The occurrence of cyanobacteria in freshwater is of special importance to the drinking water suppliers as several genera of cyanobacteria can produce offensive taste and odour compounds, as well as cyanotoxins that can affect human health (Du Preez *et al.*, 2007). The

Vaal River is the primary sources used by Rand Water for drinking water to some 10 million consumers within the supply area.

- Monitoring of cyanobacterial taxa and population densities (cell numbers and biomass) can provide an excellent basis for assessing risk (hazards to human and animal health), particularly if supported periodically with toxicity test or toxin analysis. Thus, algal identification (genus level) and enumeration in Vaal River samples are essential.

- Continuous monitors

  - Limited continuous monitoring of water quality is practised in the Vaal River and its tributaries. In impacted catchments the continuous monitoring of key water quality variables such as EC is needed for use with the flow monitoring stations to accurately assess the loads and compliance with RWQOs.

  - Oxygen is essential to all forms of aquatic life, including those organisms responsible for self-purification processes in natural waters. Fish kills are reported regularly from the Vaal River, especially in the Vaal Barrage area, some probably associated with low oxygen concentrations. Usually, when fish kills occur, it is an emergency situation; indicating a severe environmental problem, such as low oxygen or a toxic chemical. To detect these emergency conditions, it is recommended that a computerised continuous monitoring of inter alia oxygen concentrations is implemented upstream (where sewerage and chemical spills usually occur) and in the Vaal Barrage, which can serve as an early warning system.

  - A subset of meters is telemetered real-time connected to a web site. It measures water quality parameters every 15 minutes () and provides temporal resolution for evaluating water quality criteria.

5 CURSORY RESOURCE REQUIREMENT EVALUATION

Water quality and quantity are intimately linked although not often measured simultaneously. Water quantity is often measured by means of remote hydrological monitoring stations which record water level, discharge, and velocity. Monitoring of water quantity can be undertaken, to a certain degree, with a minimal amount of human intervention, once a monitoring station has been set up. In contrast, water quality is usually determined by analysing samples of water collected by teams of personnel visiting monitoring stations at regular intervals. The cost associated with monitoring the many parameters that influence water quality, when compared to those associated with monitoring only a few water quantity variables, usually means that water quality monitoring is not undertaken as frequently as water quantity monitoring. However, the results of water quality monitoring are vital to being able to track both spatial and temporal trends in surface and ground waters.

Implementing a revised monitoring programme in the Vaal River System requires evaluation of current resources. It is important that the resource requirements for the following key components are accounted for and given due consideration in the short, medium and long-term strategy:

- Operational requirements
- Data acquisition, storage, management and information management
- Human resource development and training
- Funding
- Institutional structures and implementation
- Monitoring and evaluation

These are discussed briefly in the sections below.

5.1 Operational resources

5.1.1 Laboratory Facilities

The DWAF RQS is primary laboratory responsible for the analytical services in terms of the national monitoring programme which includes many of the Vaal strategic monitoring points identified as well as other WQ monitoring stations in the system. The Regional Offices use this monitoring network but also rely on private laboratories to undertake water quality analyses. The analytical services that support the Vaal River System water quality monitoring must refined to suit the needs identified. Some of the relevant considerations that must be borne in mind include:

- *Variables to be analysed:* The suite of variables and water quality parameters to be analysed need to be revised to suit the objectives of the monitoring and the information needs for management of the Vaal River. This has implications on the analysis required as well as the current monitoring network and data acquisition. In general monitoring programmes must be integrated. A change in the variables will impact on the resources required.
- *Sampling frequency, location of stations and number of sampling stations.* The frequency with which samples must be taken and the number of sampling stations involved need to be revised which will obviously influence the volume of work necessary and, hence, the staff and facilities required. A further consideration in terms of resourcing is the change location of the stations. Not all stations are appropriately situated in terms of obtaining representative water quality. A refinement/change in the location could impact on the resources required (human and financial).
- *Existing laboratory facilities*: The current laboratory facilities used must be assessed to evaluate if all comply with the requirements and standards of DWAF to ensure credibility of the analysis and data. This may have an influence on the facilities available.

It is important that in the implementation of the programme there is co-ordination and consistency in the laboratories used. Whatever final decisions are made in terms of the facilities selected (DWAF and regional), it is essential that procedures are established for quality control of analytical work. This is of particular importance in relation to all aspects of field work, including sampling, sample handling and transport, as well as onsite testing. This is a key resource consideration to address the discrepancies in variables analysed, time periods and scales of the monitoring; timescales of databases; analytical methods; laboratories used for the analysis and differences in data collection and storage formats and databases.

5.1.2 Staffing

While staffing of the water quality monitoring programme is not the responsibility of the DWAF water resource managers for the system it is key component that determines the success of the programme and influences data acquisition, processing, storage, management and dissemination. Staff on the water quality monitoring programme may include personnel for programme management, field staff, laboratory staff and data processors. The numbers required in each category will depend on the size and scope of the final monitoring programme that is agreed upon. This component must be considered as part of the whole resource evaluation process as a significant indirect cost.

Programme manager

It is a key requirement that the water quality monitoring programme of the Integrated Vaal River System has a dedicated programme manager. This required to ensure that the objectives of the programme are achieved and to ensure, that there is proper implementation, operations run smoothly, proper data analysis and manipulation, preparation of reports, staff training and resourcing and

programme co-ordination (if other organizations are eventually involved in the programme). The co-ordination tasks may become quite complex if future programme implementation depends on other organisations (e.g. Water Boards, industries and municipalities in the Vaal River System). Currently much of the disintegration, discrepancies and shortcomings in the current water quality programme are due to the absence of a programme manager from the water resource management side.

The responsibilities are some of what may be expected of the manager of the monitoring programme for the Vaal River System:

- Planning of water quality monitoring activities.
- Integration of the monitoring activities;
- Co-ordination with DWAF Directorates, regional offices, collaborating Water Boards and other organisations, participating laboratories and others not under DWAF direct control.
- Organising and managing the facilities for the storage, handling, interpretation and distribution of data.
- Reviewing and evaluating monitoring procedures.
- Preparation of reports and dissemination of the findings of the monitoring programme
- Procurement of necessary equipment and consumable supplies.
- Recruitment and training of staff.
- Preparation of training manuals.
- Preparation of standard operating procedures (SOPs).

Currently while a dedicated programme manager at the DWAF, RQS is available for the national monitoring programme this individual is not focused on the Vaal River only. Due to inter-relatedness and inter-dependence of the Vaal WMAs, it is critical that a programme manager/national co-ordinator is considered for the future for the management of the Vaal water quality data.

Field staff

Another component that has an influence on the data acquisition component of the Vaal River System water quality programme is the field staff. Currently many of the gaps in data are the result of insufficient field staff to undertake sampling as well as the use of unskilled resources (insufficient or no training). Revision of the water monitoring programme or a step towards improving the current programme requires field staff be recruited for field work and sampling. Training of the staff in water quality monitoring and new methods or procedures and field testing may be required especially as new variables, methods, procedures are included (which is being proposed). It is identified that an

assessment of current field staff and samplers must be undertaken to assess the current situation (e.g. current resourcing, current gaps, training needs, operational hurdles etc.).

Training for field staff may require, for example ((UNEP/WHO, 1996).

- Objectives of the water quality monitoring programme.
- The importance of samples being of good quality and representative of the water body from which they are taken.
- How to ensure that samples are of good quality.
- Planning of sampling exercises.
- Map-reading and making field notes.
- Maintaining up-to-date descriptions of sampling sites and stations.
- Flow measurements.
- Microbiological field testing of samples (membrane filter method).
- Chemical tests in the field.

It is currently unclear the current field staff available for sampling as well the extent of their technical expertise. It is proposed that DWAF assess the current situation for the Vaal River System monitoring programme to improve the current monitoring and to address issues of data gaps, quality control, credibility of sampling (sampling, handling, storage, etc.). This is necessary to ensure that the results and information generated in valid and sound.

It is not clear who in DWAF is the lead agent in the training of field staff, but this aspect needs to be raised at the appropriate forum.

Laboratory staff

While the DWAF RQS and the private laboratories used for the analysis of the samples are primarily responsible for the laboratory staff it is important for the future success of the monitoring programme that laboratories are adequately and technically resourced, personnel have the appropriate training and experience and that the analysis requirements are met. It is therefore important that these aspects are monitored to ensure the continuous running and operation of the Vaal River System monitoring programme. This could be the responsibility of the proposed monitoring programme manager or could with the water resource manager of the System. It is important that the DWAF Directorates, Regional Offices and RQS work closely on this issue and address problems proactively.

Quality assurance officer

A key consideration for the water quality monitoring programme for the Vaal River is that a dedicated quality assurance officer (QAO) is appointed to manage the integrated programme. This is a key gap and many questions are raised around quality control of the current data (currently data varies in completeness, accuracy and reliability). This aspect is linked to the field sampling, transport of samples, lab analysis and methods, data processing, storage and management. The QAO would be responsible for aspects such as:

- Reporting to the programme manager on matters concerning quality assurance.
- Monitoring the quality of analytical work in the laboratory and in the field.
- Auditing reports, laboratory analysis, field notebooks and other laboratory documentation to ensure that information is correct and complete.

If the appointment of a dedicated QAO in DWAF for the Vaal River water quality monitoring programme is not feasible the responsibility for quality assurance may be delegated to a member of staff in the RQS or the programme manager.

5.2 Data acquisition, storage, management and Information management

Data acquisition in DWAF for the monitoring of the Vaal River System is fairly well established however a revision of existing systems is required. In terms of data acquisition many of the existing programmes need to merged, consolidated or integrated. This requires much interaction within DWAF as well as with other external organisations (Water Boards). A further priority is for data acquisition is laboratory accreditation as monitoring results affect key decisions. DWAF needs to consider the cost implications of accreditation and must ensure that laboratories used are compliant with and use standards set by it in order for them to be used as service providers in performing the data acquisition function.

With respect to data management and storage DWAF needs to adopt a system or move towards a system that ensures the storage and dissemination of water quality data is in a common, readily useable format. This requires alignment and integration within DWAF as well as with the external collaborating organisations (e.g. Water Boards). The water management system (WMS) is meant to serve as this platform and further efforts need to be made to ensure that all water quality managers integrate their data into the system. The WMS should also be made available to external organisations that undertake monitoring. The importance of a shared information management system is crucial to meeting the needs of all end users of the data. This has significant resource implications however it must become a key consideration.

More attention needs to be given to information management (generation, dissemination and use). This component of the monitoring programme requires skills in data interpretation and appropriate packaging for use by managers and decision makers. There is in many instances a discrepancy between the information needs of users/water quality managers and the data collection and management effort by monitors. This needs to be addressed by reducing the demand for irrelevant information and aligning to the needs of the users. It is therefore important that the DWAF water quality manages ensure that the revised monitoring programme is designed to suite their information needs and requirements and support the decision making required for the management of the Vaal River. This requirement may in all likelihood require a re-assessment of the information management component of the monitoring programme and has a key resource implication.

5.3 Human resource development and Training

A further indirect resource implication for the Vaal River System water quality monitoring programme is availability of skilled and trained personnel to support all the components of the monitoring programme. Sustainable WQM requires that available knowledge be translated and implemented and as a result, monitors, analysts and their managers and users should have the necessary skills to undertake the implementation of these activities. A variety of skills exist within DWAF, research institutions, water boards and in some organisations. However, there has not been an effort to try and match the skills with the needs of the monitoring programmes. While the skills requirements might be related, the existing skills may not fit the requirements of the new monitoring programme.

Priority must be given to human resources development through continuous education, in-service training, career development, and short-and long -term training. This will require that the DWAF Planning Directorates (directorates involved in monitoring), DWAF Regional Offices and the Directorate RQS work closely with the Directorate Human Resource Development. The human resources development plans for monitoring programmes must be incorporated within the broader strategic human resources development strategy of the department. Monitoring programmes must be kept abreast of developments even after the establishment of CMAs, and the delegation of the monitoring responsibility should be closely regulated (DWAF, 2004).

Adequate human resource development and training is a priority if the objectives of the Vaal River System water quality monitoring programme are to be successfully achieved.

5.4 Funding

Adequate funding is a key component of any water quality monitoring programme. From the above list of resourcing required it is evident that the monitoring programme can become costly as a result of the need for equipment (both laboratory and field), operation and maintenance of such equipment, chemicals, salaries, and the process of information dissemination. Since the ready availability of the requisite resources and facilities is invariably constrained, the cost-effectiveness of the monitoring

programme proposed must be very carefully considered. Beyond cost effectiveness, there must be proper budgeting for all activities. The current budget the various monitoring programmes are not a true reflection of the cost of monitoring. The budgets are presented in terms of the analytical costs, coordination and administration. Staff remuneration is typically budgeted for elsewhere.

The costs for training and development must also be considered and accounted for. It is important that while an existing system will be used to build upon/revise, the costs of the monitoring must be truly evaluated to determine the most effective options.

Potential areas of consideration/evaluation for the proposed monitoring programme for the Vaal River System need to include:

- A detailed process of costing of the salary component of the revised monitoring programme/s;
- The cost of the required equipment (operation and maintenance);
- The cost of recruiting training of staff;
- The cost of additional/improved sampling and analysis;
- The costs of improved databases and information management;
- The cost of information dissemination and awareness;
- The cost of transport and courier services; and
- Strategic rationalisation of resources with collaborating organisations and institutions (sharing of monitors, equipment, labs and information).

5.5 Institutional structures and implementation

DWAF does remain fully responsible for the implementation of the water quality monitoring programme in the Vaal River System however there are other institutions such as CMAs, Water Boards, industries, municipalities, etc. that could share the responsibility for monitoring and implementation thereof by adoption of a co-ordinating and collaborative strategy. The process will have to be open and transparent and stakeholders must be brought in as part of the institutional structure that will support the implementation of the programme. Such a structure is accepted in many countries where there are large programmes dealing with water quality monitoring.

Such collaboration and integration will support many of the resourcing needs and contribute to the cost-effectiveness of the programme. DWAF needs to work towards collaborating more intensively with the Water Boards and industries especially in the Vaal River System to achieve this objective. Much of the duplication and overlap in monitoring efforts can be eliminated and outputs/information

products optimised if the DWAF and organisations worked towards an integrated monitoring programme.

A further advantage would be the adoption of a shared IT infrastructure. This would enable DWAF and other water management institutions to benefit from sharing infrastructure and human resource capacity to perform certain core monitoring functions. The same IT platform and infrastructure could be shared for performing many tasks related to:

- Data acquisition
- Data management and storage
- Information generation and dissemination (e.g. assessment tools such as statistical methods, mathematical models, etc.).

The promotion of the concept of every water management institution involved in water quality monitoring in the Vaal River System having the same IT infrastructure should be initiated by DWAF. DWAF should take the initiative by establishing such an infrastructure and offering the use of it on attractive terms to other organizations and institutions.

This would assist in improving the information and value added products that can be generated using the water quality monitoring data.

5.6 Monitoring and Evaluation

A key component of the monitoring programme is periodic review and evaluation to determine if it is indeed meeting the monitoring objectives and that the investments made in monitoring are delivering the desired outcomes. While the true efforts in a monitoring programme are only observed in the long term it is important that the monitoring programme for the Vaal River System is monitored and evaluated over the short term to assess intermediate outcomes, successes and failures.

6 PRIORITISATION OF MONITORING REQUIREMENTS

There exists a need to integrate and improve the monitoring network in the Vaal River System to adequately address the current information needs of water resource managers and decision-makers in DWAF. It is evident that strengthening of the water quality monitoring programme of the Vaal River is required. The key for the success of the management strategies in providing solutions to the water quality problems in the Vaal River is the ability to conduct continuous and routine monitoring of salinity and nutrient (eutrophication) and algal monitoring.

Some general monitoring principles of these parameters that are required are described below. The principles guide and underpin the monitoring priorities, requirements and the programme proposed.

6.1 General monitoring principles

6.1.1 Salinity monitoring

Salinity is generally measured in three different ways:

- One of the most reliable methods is to measure the concentrations of the most significant salts, from which the Dissolved Mineral Salts (DMS) is calculated. This method is particularly adopted by the DWAF for the national chemical monitoring programme - which routinely analyses for the most important salts.
- The Total Dissolved Solids (TDS) is measured gravimetrically by evaporation of a small sample of water. This method suffers from the problem that it includes the measurement of some suspended solids and at lower TDS concentrations the dried sample can absorb moisture from the atmosphere before weighing, thereby adversely affecting the estimate. Lower TDS concentrations also entail having to calculate the TDS from the subtraction of relatively large numbers, which inevitably reduces the accuracy.
- The salinity can also be estimated from the Electrical Conductivity (EC). EC generally correlates extremely well with DMS. It is also amenable to automatic continuous monitoring by probe and data logger capture. Proper use of this method requires control sampling (although at a considerably lower frequency than that of the data logger). This is required to detect changes in the EC/DMS regression and to check the veracity of the data logger probe. In this regard special care has to taken in the choice of equipment, its siting, protection and maintenance and checking. In measuring EC it is essential to record the temperature to which it is corrected. DWAF corrects EC to 25°C, but some organisations (such as Rand Water) correct to 20°C, while many other outside organisations (such as municipalities and Industries) do not specify anything. Correlation with DMS goes a long way towards eliminating the ensuing errors, but this is of no help when only EC is measured (as is the case for many polluters). It should also be noted that some organisations rely solely on their own hand held EC instruments, which are seldom calibrated.

Sampling has to be carried out at a high enough frequency to make reliable estimates of load fluctuations. Ideally this can be achieved through high frequency monitoring, usually of the easily

measured surrogate parameter EC. Judicious use can also be made of the tools available for patching gaps between less frequently monitored sample points. The required sampling frequency is strongly dependent of the nature of the resource being monitored. River stations generally require a higher sampling frequency than do reservoir stations where salinity fluctuations are more damped. Well-regulated reaches of larger rivers require less frequent sampling than do smaller streams where floods can rise and fall more rapidly.

6.1.2 Nutrients and algal monitoring

Phosphorus and nitrogen are considered to be the primary drivers of eutrophication of aquatic ecosystems, where increased nutrient concentrations lead to increased primary productivity, thus the following nutrients are generally measured:

- The concentration of dissolved inorganic phosphorus (PO_4-P) and total phosphorus (TP), usually indicates the potential for algal and plant productivity. The dissolved inorganic nitrogen (DIN), i.e. NH_4-N, NO_3-N and NO_2-N is also an important driving nutrient.
- Chlorophyll-*a*, the green pigment, is present in all photosynthetic organisms and provides an indirect measure of algal biomass and an indication of the trophic status of a water body. Algal identification (genus level) should also be introduced.
- Turbidity of water determines the depth to which light is transmitted. This, in turn, controls the amount of primary productivity that is possible by controlling the rate of photosynthesis of the algae present.
- Changes in dissolved oxygen (DO) concentration provide valuable information about the biological and biochemical reactions occurring in waters. Fish kills are reported regularly from the Vaal River, especially in the Vaal Barrage area, some probably associated with low oxygen concentrations.

6.2 Prioritisation

A number of gaps in the current monitoring programmes and systems for the Vaal River have been discussed in **Section 4** and the requirements for different resource components (current and new) are described in **Section 5**. In this chapter the key monitoring requirements for the water quality monitoring programme for the Vaal River System are highlighted. These listed in **Table 7** below (Priority ranking: A priority of 1 is the highest):

Table 7: Prioritisation of monitoring requirements

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
With the strategic monitoring points, Level 1 and Level 2 having been confirmed through this study, a comprehensive and integrated monitoring programme for these points can be agreed upon between the RQS and Regional Offices, which would serve the needs of the Vaal River System. The current "fragmented" programmes can be built upon to ensure that all the monitoring points deliver the same information needs, as required, in a consistent and co-ordinated manner. This would include agreement on the suite of variables, sampling frequency, time periods, analysis methods, etc.	1	Operational resources	Yes (facilities available)
		Staffing	No (A dedicated programme manager is required. Additional field staff may be needed)
		Human resource development and training	Yes
		Funding	Yes (may require some re-budgeting)
		Data acquisition, storage, management and information management	Yes (with improved quality control)
		Institutional structures and implementation	Yes (but requires better co-ordination and integration)
The location of the monitoring gauges, especially those at level 2 points must be reviewed to ensure that they in fact are located at the most downstream point just before confluence with the Vaal River. There also needs to be monitoring gauges installed in the upper reaches of all the tributaries to determine background water qualities.	2	Operational resources	Yes (will require discussions within DWAF)
		Funding	Yes
		Institutional structures and implementation	Yes (requires co-ordination)

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
Water quality monitoring must be consistently carried out at all monitoring points according to the agreed upon monitoring programme to enable all strategic points to build up credible data sets. This is specifically needed for the Middle Vaal River (points VS9 to VS 15), and for many of the tributaries (level 2 points).	1	Operational resources	No (Additional sites, samples, frequencies, variables, analysis are required. However it can be included in current monitoring network)
		Staffing	No (A dedicated programme manager is required. Additional laboratory and field staff may be needed. Resources available need to be assessed).
		Funding	No (Additional funding may be required. However can be budgeted for in next financial year)
		Data acquisition, storage, management and information management	No (additional data and information. Requires more resources, facilities, quality control, additional data processing, and information management. However can be accommodated quite easily. Requires extension of programme)
		Institutional structures and implementation	Yes (Requires co-ordination and integration)
Consideration should be given to continuous monitoring of flow and water quality wherever possible.	1	Operational resources	No (need to invest in continuous flow meters)
		Staffing	No (may required additional more field staff)

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
		Human resource development and training	No (may require more skilled and experienced staff)
		Funding	No (Will require additional funding to purchase and maintain equipment)
To maximise the monitoring in the system, the Department and the Water Boards, and other key water users should co-ordinate their monitoring programmes/sampling programmes to support effective and efficient capacity and resource utilisation. The Department and the Water Boards should also enter into co-operative agreements regarding sharing of water quality information (free of charge).	2	Operational resources	Yes
		Staffing	Yes (requires collaboration)
		Funding	Yes (requires co-ordination, collaboration and co-operative agreements)
		Data acquisition, storage, management and information management	Yes (requires co-ordination, collaboration and co-operative agreements)
		Institutional structures and implementation	Yes (requires co-ordination, collaboration and co-operative agreements)
The water quality monitoring variables currently analysed is largely concentrated on chemical constituents. The monitoring system therefore needs to be extended to include biological and microbiological parameters, as well as metals. Chlorophyll *a* and total phosphorus, total nitrogen, chemical oxygen demand and dissolved oxygen	1	Operational resources	Yes (facilities available – however will have to be extended to incorporate variables)
		Staffing	Yes (can be accommodated with current field staff)
		Funding	No (however will require some re-budgeting/ planning)

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
levels should also be included as variables to be monitored.		Data acquisition, storage, management and information management	Yes (can be managed in current database)
		Institutional structures and implementation	Yes
Monitoring of either TDS or EC should be adopted for the entire system. Both variables could be monitored however it should be consistent through the Vaal River System.	1	Operational resources	Yes (facilities available)
		Funding	Yes
		Data acquisition, storage, management and information management	Yes (can be managed in current database)
Stream flow monitoring must be resumed and/or initiated at all Level 1 and 2 water quality monitoring points to allow for trend analysis and determination of loads.	2	Operational resources	Yes (will require discussions within DWAF)
		Staffing	No (may require additional field staff – however can be accommodated)
		Funding	No (will require funding)
		Data acquisition, storage, management and information management	Yes (can be managed in current databases)
		Institutional structures and implementation	Yes (requires co-ordination)
Data capturing needs to be improved as many of the stations are missing recent monitoring data, or have gaps	1	Data acquisition, storage, management and information management	Yes (requires quality control and improved processing and management)

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
of a few years in the information.		Human resource development and training	Yes (however may require more training of staff)
The standard WMS database should be used by all Departmental Offices to ensure consistency in storage, format and analysis. In this regard there should be maintenance of the central water quality database that would hold all the data from the Level 1 and 2 strategic monitoring points in the Vaal River System.	2	Funding	Yes (needs to be co-ordination within DWAF)
		Human resource development and training	Yes (however may require more training/skilling of staff)
		Data acquisition, storage, management and information management	Yes (can be managed in current databases)
		Institutional structures and implementation	Yes (requires co-ordination)
Compliance monitoring and the capturing of compliance data should be revitalised/re-emphasised, in order to determine the true extent of the impacts on the water resources of the Vaal River System. This would include monitoring of the point source discharges from mines, industries, wastewater treatment works, irrigation canals, etc. that report to the Vaal River or to its major tributaries.	1	Operational resources	Yes (facilities available)
		Data acquisition, storage, management and information management	Yes (can be managed in current databases)
		Institutional structures and implementation	Yes (requires co-ordination)
Installation of air quality monitoring devices especially in	3	Operational resources	No

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
the Vaal Dam and Grootdraai Dam catchments in order to start determining the impact of atmospheric deposition on the water quality.		Staffing	No
		Human resource development and training	No (Will require skilled/trained resources)
		Funding	No
		Data acquisition, storage, management and information management	No
		Institutional structures and implementation	No
A key requirement for monitoring is an understanding of the future of the mine decants of the system (when and where). This requires a monitoring programme be devised in collaboration with DME to ensure that the impacts are understood and strategies are put in place.	2	Operational resources	No (however existing facilities can be expanded)
		Staffing	No (however existing staff can be used to support programme. A dedicated task team is needed to manage component)
		Funding	No
		Data acquisition, storage, management and information management	Yes (maybe accommodated with current database/information management)
		Institutional structures and implementation	No (requires collaboration and co-ordination between DWAF and DEAT)
Biomonitoring should become a monitoring priority of the	3	Operational resources	Yes (facilities available)

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
Vaal River System to understand the health and behaviour of the ecosystem. This however will to some extent be addressed by the integrated Vaal River Comprehensive Reserve determination study.		Staffing	Yes (however additional field staff may be needed)
		Human resource development and training	Yes to some extent (However does require skilled/trained resources)
		Funding	Yes (may require some re-budgeting)
		Data acquisition, storage, management and information management	Yes (with improved quality control)
		Institutional structures and implementation	Yes (but requires better co-ordination and integration)
Improvement of the sample frequency at VS2; VS3; Vaal Barrage (VS8) (the Barrage is a hotspot area with no DWAF data from 1999); VS9; VS15; VS18, and VS19 (at least monthly).	1	Operational resources	Yes (facilities available. Revision of sampling design is required)
		Staffing	Yes
		Funding	Yes (may require some re-budgeting)
		Data acquisition, storage, management and information management	Yes (with improved quality control)
		Institutional structures and implementation	Yes
Add an additional monitoring point to the existing monitoring points, *i.e.* at Parys (at bridge; S26.90105,	1	Operational resources	Yes (facilities available)

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
E27.44630). Significant changes (physical, chemical and biological) are taking place here, but no monitoring is taking place.		Staffing	Yes
		Funding	Yes
Monitoring of dissolved inorganic nitrogen (DIN); dissolved inorganic phosphorus (DIP), total phosphorus (TP) and suspended solids is a priority requirement at all strategic monitoring points in the Vaal River (VS 1 to VS 20).	1	Operational resources	Yes (facilities available – however programme design will have to be extended/revised to incorporate variables)
		Staffing	Yes (can be accommodated with current field staff)
		Funding	No (however will require some re-budgeting – for analysis/sampling)
		Data acquisition, storage, management and information management	Yes (can be managed in current database)
		Institutional structures and implementation	Yes
Add turbidity as a physical parameter, which indicates transparency and light availability for primary producers in the water-column, at all monitoring points in the Vaal River.	1	Operational resources	Yes (facilities available – need to extend to additional points)
		Staffing	Yes (can be accommodated with current field staff)
		Funding	No (however will require some re-budgeting – for analysis/sampling)

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
		Data acquisition, storage, management and information management	Yes
		Institutional structures and implementation	Yes
Continuous monitoring of oxygen in the Barrage is required.	1	Operational resources	Yes (facilities available)
		Staffing	Yes (may required additional more skilled field staff)
		Funding	Yes (Will require purchasing and maintenance of equipment – however this can be accommodated)
Expand the algal monitoring: Algal biomass (chlorophyll-*a* concentration) and algal identification (genus level) should also be introduced at: the Vaal Dam (close to dam wall), Vaal Barrage, Parys, Midvaal, Vaalharts weir, and Schmidtsdrift. Ideally, chlorophyll-*a* concentrations should be monitored weekly.	1	Operational resources	Yes (facilities available – however programme design will have to be extended/revised to incorporate variable at sites identified)
		Staffing	Yes (can be accommodated with current field staff)
		Human resource development and training	Yes to some extent (However does require skilled/trained resources)
		Funding	Yes (however will require some re-budgeting – for analysis/sampling)
		Data acquisition, storage, management and information management	Yes (can be managed in current database)

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
		Institutional structures and implementation	Yes
Incorporation of new technology in existing monitoring programme, *i.e.* Continuous monitors: (Temperature, Turbidity, Dissolved Oxygen, EC, Chl *a*, and pH) telemetered real-time connected to web site with rapid response to changes, including pollution. Event based monitoring – fish kills and algal blooms impacts – could serve as an early warning system in the Vaal River. Important locations are the Vaal Dam, Vaal Barrage, Midvaal or Sedibeng and Orkney.	2	Operational resources	No (need to invest in continuous flow meters)
		Staffing	No (may required additional more skilled field staff)
		Funding	No (Will require additional funding to purchase and maintain equipment)
The following is required to ensure the collection of sufficient data to support effective salinity compliance monitoring, modelling and load balance estimates: - Catchments have to be divided into logical catchments, taking account of actual and potential pollution sources and modelling requirements. - DMS is the recommended method of measuring the salinity. This implies measurement of the major salts, including Na, Mg, Ca, K, F, Cl, SO_4,	1	Operational resources	Yes (facilities available – however programme design will have to be extended/revised to incorporate additional sites identified)
		Staffing	Yes (however may require additional field staff for sampling – needs assessment)
		Funding	Yes (however will require some re-budgeting – for analysis/sampling)

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
NO_3, NO_2, PO_4, TAL, NH_4 and Si. The surrogate EC is used to measure salinity at a higher frequency. - Mass balance evaluation and salinity modelling require monitoring at key points deeper into the tributary catchments.		Data acquisition, storage, management and information management	Yes
		Institutional structures and implementation	Yes
It is proposed that where cases of unstabilised acid mine drainage are identified it may be necessary to include metals such as iron in the monitoring programme.	2	Operational resources	Yes (facilities available – however programme design will have to be extended/revised to incorporate variables at sites identified)
		Staffing	Yes (can be accommodated with current field staff)
		Funding	Yes
		Data acquisition, storage, management and information management	Yes
Modelling and mass balance evaluation require the monitoring of both flow and salt concentration for river stations and all point inputs, including effluent and inter-basin water transfers. Abstraction and impoundment	1	Operational resources	No (will require discussions within DWAF. Extension of programme required. Additional sites)
		Staffing	No (requires additional field staff)

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
storage state data is also essential. The importance of the water abstraction, importation and effluent input data cannot be over-emphasised since it is often inadequately addressed in monitoring systems.		Human resource development and training	Yes to some extent (However does require skilled/trained resources)
		Funding	No (will require additional funding)
		Data acquisition, storage, management and information management	Yes (can be managed in current databases)
		Institutional structures and implementation	Yes (requires co-ordination and collaboration)
The future monitoring programme should include monitoring of diffuse pollution impacts.	3	Operational resources	Yes (facilities available – programme will have to be extended though)
		Staffing	No (Additional field staff may be needed)
		Human resource development and training	Yes (however may require some training of personnel)
		Funding	No (Requires additional funding)
		Data acquisition, storage, management and information management	Yes (current system can be extended)
		Institutional structures and implementation	No (requires establishment of structures)
The monitoring needs can be phased into immediate, medium term and long term plans to ensure that the	1	Institutional structures and implementation	Yes (Needs co-ordination/agreement in DWAF (National and Regions).

Monitoring Requirement	*Priority ranking	Resource Requirements	Ability to be implemented currently (with resources available)
information needs are achieved.			Implementation committee established at end of study can be tasked with function.

*** Priority ranking: A priority of 1 is the highest.**

The monitoring needs can be phased into immediate, medium term and long term plans to ensure that the information needs are achieved.

The implementation committee established to take the IWQM strategy for the Vaal River System forward will have to look at the integration, co-ordination and alignment of the monitoring programmes of the different organisations.

6.3 Recommended monitoring programme

The proposed monitoring programme for the Vaal River system for salinity and nutrient (eutrophication) monitoring is shown in Appendix D. The proposed monitoring frequencies, salinity parameters and primary reasons for their selection are given in Table D.1, and for nutrient parameters are given Table D.2. A brief outline of the key programme requirements are described below in **Table 8**.

Table 8: Key programme components and requirements

Monitoring Programme Component	Requirement
Objective	• Monitoring in the Vaal River System is required: - to evaluate the salinity and eutrophication status of dams and rivers, - to evaluate compliance with resource water quality objectives, and - to detect signs of deterioration in water quality. A revised monitoring programme of the Vaal River System is required (continuous and routine) to strengthen salinity and nutrient (eutrophication) and algal monitoring (to support the above).
Monitoring variables	**Nutrients:** • DIN • DIP • TP • Chl-*a*

	• Turbidity
	Salts: • DMS (including Na, Mg, Ca, K, F, Cl, SO_4, NO_3, NO_2, PO_4, TAL, NH_4 and Si) • EC (used for measurement at higher frequencies)
Monitoring points	**Nutrients:** • As a priority all Level 1 strategic points • (Level 2 points can be phased in later on).
	Salinity • All level 1 points and main tributaries (Level 2 points) • At key nodes for mass balance evaluation and salinity modelling
Monitoring frequency	**Nutrients:** • Preferably weekly otherwise bi-weekly (fortnightly)
	Salinity • Daily, Weekly or monthly depending on the reason for monitoring
Sampling network	Fixed
Sampling	Rivers should be grab-sampled as far away from the bank as can conveniently be reached from the bank. (Continuous monitoring if new technology can be implemented. If not continuous monitoring of oxygen at Vaal Barrage).
Analysis	An accredited laboratory should be used.
Information expectations	• Description and interpretation of water quality changes with respect to time. • Detection of short term and long term trends • Identification of rivers and river reaches that do

	not meet the desired water quality objectives. • Description of contaminating variable (s).
Data management (acquisition, processing, storage and management)	• Registration of the revised monitoring programme (monitoring points, monitoring frequency, etc.). (Registration of the programme and individual monitoring points on WMS is done using standard application forms obtained from the Directorate RQS. • Management of the sampling (schedules for monitors and laboratories, sample tags, etc.), • Receipt of analytical results (measured either in a laboratory or on-site) • Data capturing of results on the central database Water Management System (WMS) • Dissemination of data/databases - making it available for subsequent processing
Quality assurance and quality control	It is recommended that the ISO 9001:2000 (SABS, 2000) quality management system be applied to the monitoring programme. The principles that underpin this system are customer focus, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision making, and mutually beneficial supplier relationships. Continual improvement is a particularly critical principle and is based on the cyclical plan, implement, check and review.

7 CONCLUSION

It must be recognised that the appropriate use and reporting of monitoring data is a vital part of the overall monitoring and assessment programme. Without clear reporting of understandable and relevant results to programme managers and eventually to the water resource managers, little will have been achieved. That requirement can only be met if it is fully taken into account at the very earliest stages of the overall programme objective definition and subsequent design finalisation. It is also essential to understand that at every stage of the monitoring process, the data needs of the analysis and reporting stages are recognised. Without good data, no useful information may be reportable, no matter how good the underlying analysis may have been.

Thus it is essential that the adopted monitoring programme for the Vaal River System ultimately supports the information needs of the users. In terms of the monitoring programme for the Vaal River it is envisaged that the proposals made will support the data needs in terms of the current management objectives of the system.

8 REFERENCES

Dallas, 2005: Inventory of National River Health Programme Monitoring Sites: Volume. Prepared for: Environmentek (CSIR) and Resource Quality Services, Department of Water Affairs and Forestry. November 2005.

Davis, J.R. and Koop, K. 2006: Eutrophication in Australian rivers, reservoirs and estuaries – a southern hemisphere perspective on the science and its implications, Review. *Hydrobiologia* 559: 23 – 76.

DWAF, Department of Water Affairs and Forestry, 1996: *South African Water Quality Guidelines*. Second Edition. Volumes 1-8.

DWAF, 2004: Department of Water Affairs and Forestry, Directorate Resource Quality Services. *Strategic Framework for National Water Resource Quality Monitoring Programmes.* Report No. N/0000/REQ0204. ISBN 0-621-35069-9. Pretoria. South Africa.

DWAF, 2005a: Department of Water Affairs and Forestry, Directorate National Water Resource Planning. *Vaal River System: Large Bulk Water Supply Reconciliation Strategies and Water Conservation and Demand Management: Inception Report.* Report No. P C000/00/??05

DWAF, 2005b: Department of Water Affairs and Forestry, Directorate National Water Resource Planning. *Vaal River System: Development of an Integrated Water Quality Management: Inception Report.*

DWAF, 2006a: Department of Water Affairs and Forestry. *Resource Directed Management of Water Quality: Management Instruments. Volume 4.2: Guideline for Determining Resource Water Quality Objectives (RWQOs), Allocatable Water Quality and the Stress of the Water Resource.* Edition 2. Water Resource Planning Systems Series, Sub-Series No. WQP 1.7.2. ISBN No. 0-621-36793-1. Pretoria, South Africa.

DWAF, 2006b: Department of Water Affairs and Forestry. *Resource Directed Management of Water Quality: Volume 1.2: Policy.* Edition 1. Water Resource Planning Systems Series, Sub-Series No. WQP 1.4.2. ISBN No. 0-621-36788-5. Pretoria, South Africa.

DWAF, 2006c: Department of Water Affairs and Forestry, Free State Region. *Development of a Catchment Management Strategy for the Schoonspruit and Koekemoerspruit Catchments in the Middle Vaal Management Area Phase II: Monitoring Programme*. March 2006. 16/2/7/Report Volume 5/Schoonspruit and Koekemoerspruit Catchment Management Strategy/Monitoring networks.

Republic of South Africa, 1998. *National Water Act* (Act 36 of 1998).

UNEP/WHO (1996). *Water Quality Monitoring – A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes.* Published on behalf of United Nations Environment Programme and the World Health Organization. Edited by Jamie Bartram and Richard Balance. ISBN 0 419 22320 7 (Hbk) 0 419 21730 4 (Pbk).

WHO, World Health Organization (1999). *Toxic Cyanobacteria in Water: A guide to their public health consequences, monitoring and management.* Chorus, I. And Bartram, J. (eds.). E & FN Spon Publishing, an imprint of Routledge, London, ISBN 0-419-23930-8, 400 pp.

APPENDIX A

INVENTORY OF DWAF MONITORING POINTS IN THE VAAL RIVER SYSTEM

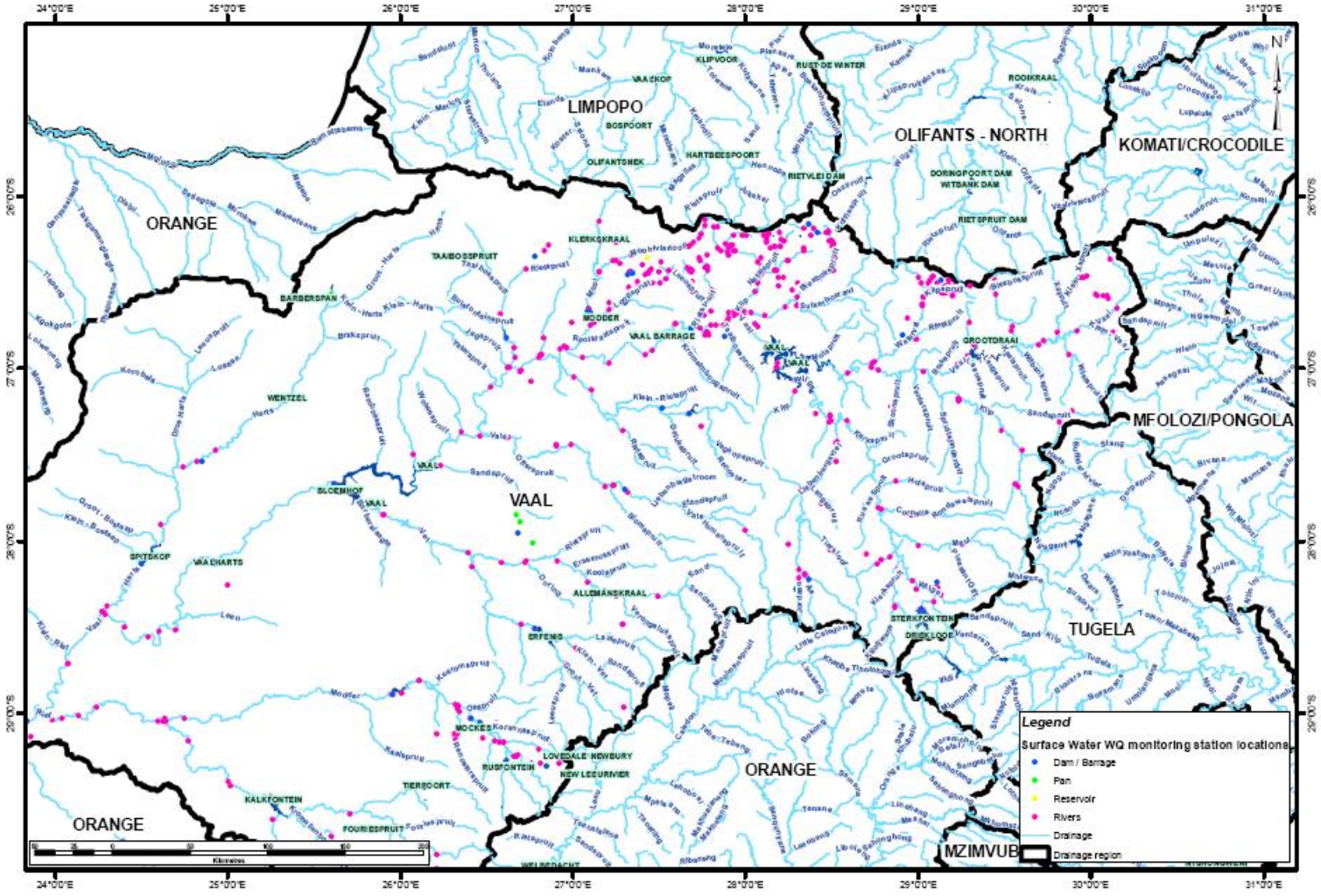


Figure A.1: Location of DWAF WQ monitoring stations in the Vaal catchment as part of the current monitoring network

Table A.1: List of the WQ monitoring stations in the Vaal catchment as part of the current monitoring network (national chemical programme)

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
VILLIERS	VAAL	Rivers	-27.010278	28.626111	C12
LANGVERWYL STANDERTON	VAAL	Rivers	-26.941944	29.264167	C11
C1H030 WOLWEFONTEIN U/S VAAL CONFLUENCE ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.969444	28.727778	C12
GLADDEDRIFT U/S CONFL.WATERVAL	VAAL	Rivers	-26.991389	28.729722	C12
SECUNDA (RESM21) BOSSIESPRUIT DAM	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.560833	29.145556	C12
C1H036 @ ROODEBANK ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.627778	29.021111	C12
VAALBANK (LM7) U/S CONFL.WATERVAL	TRIBUTARY OF WATERVALRIVIER - DRAINAGE REGION C11	Rivers	-26.583611	29.030278	C12
SECUNDA (RESM5) U/S CONFL.KLIPSPR.	TRICHARDSPRUIT - DRAINAGE REGION C12D	Rivers	-26.529722	29.150556	C12
WONDERFONTEIN	MOOIRIVIERLOOP	Rivers	-26.323333	27.414722	C23
WELVERDIEND	MOOIRIVIERLOOP	Rivers	-26.368889	27.255	C23
KIEL	MOOIRIVIERLOOP	Rivers	-26.45	27.145833	C23
MUISKRAAL	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.433333	27.116667	C23
GERHARDMINNEBRON	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.516667	27.116667	C23
KILLARNEY COMMANDODRIFT	VAAL	Rivers	-27.480278	26.221667	C25
ELANDSFONTEIN ENGELBRECHTSDRIFT	VAAL	Rivers	-26.819722	28.063611	C22
C2H251 PARYS	VAAL	Rivers	-26.894167	27.461111	C23
C2H254 POTCHEFSTROOM WILGEBOOM	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.751389	27.099722	C23
TAUNG	DROE HARTSRIVIER - DRAINAGE REGION C32	Rivers	-27.559444	24.706667	C32

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
PAARDEVALLEI PRINS WILLIE	VETRIVIER - DRAINAGE REGION C4	Rivers	-28.473333	26.685833	C41
FLOORSDRIFT HOOPSTAD	VETRIVIER - DRAINAGE REGION C4	Rivers	-27.845833	25.908889	C43
VIRGINIA	SAND (C42)	Rivers	-28.113056	26.909167	C42
PAARDEVALLEI SAS WEIR	VETRIVIER - DRAINAGE REGION C4	Rivers	-28.473333	26.685833	C41
W.PRETORIUS NAT.PA	SAND (C42)	Rivers	-28.287778	27.145833	C42
FLOORSDRIFT HOOPSTAD	VETRIVIER - DRAINAGE REGION C4	Rivers	-27.845833	25.908889	C43
C4H015 VAALKOPPIES ON VET	VETRIVIER - DRAINAGE REGION C4	Rivers	-28.141944	26.417778	C41
EBANI	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.447222	25.088333	C51
THONGROVE KALKWAL	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.845	26.19	C52
MAZELSPOORT	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.044167	26.406667	C52
BOOMPLAATS	KROMELLENBOOGSPRUIT	Rivers	-29.834167	25.646944	C51
PERDEBERG	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.988333	25.083333	C52
LIKATLONG SANNASPOS	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.05	26.4625	C52
KALKFONTEIN D/S KALKFONTEINDAM	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.489167	25.193611	C51
KALKFONTEIN D/S KALKFONTEINDAM	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.491944	25.188611	C51
KNOFFELFONTEIN D/S RITCHIE	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.016667	24.508611	C51
KNOFFELFONTEIN D/S RITCHIE	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.013611	24.501944	C51
PAARDEBERG ON MODDER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.988333	25.083333	C52
EBANI	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.447222	25.088333	C51
THORNGROVE KALKWAL	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.845	26.19	C52

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
PAARDEBERG ON MODDER RIVER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.988333	25.083333	C52
C5H049 PHILIPPIA KALKFONTEIN DAM WEIR FOR SPILWAY DISCHARGE ON RIET	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.472222	25.206667	C51
ROODEWAL	VALS	Rivers	-27.441389	26.986389	C60
C6H006 TWEEFONTEIN BOTHAVILLE ON VALS	VALS	Rivers	-27.475278	26.658611	C60
THERONS BRIDGE KROONSTAD	VALS	Rivers	-27.610833	27.101667	C60
LINDLEY	VALS	Rivers	-27.871944	27.915278	C60
JUNCTION	RENOSTER - DRAINAGE REGION C70 A B C	Rivers	-27.265278	27.172778	C70
SCHIETLAAGTE A	RENOSTER - DRAINAGE REGION C70 A B C	Rivers	-27.167222	27.1075	C70
CLAREMONT	MEUL	Rivers	-27.968889	28.899444	C81
VOGELFONTEIN 69	LIEBENBERGSVLEI	Rivers	-28.190556	28.31	C83
ROODEKRAAL	LIEBENBERGSVLEI	Rivers	-27.689167	28.378333	C83
REWARD REWARD DAM	LIEBENBERGSVLEI	Rivers	-27.794722	28.318611	C83
C9H001 WARRENTON	VAAL	Rivers	-28.093333	24.871111	C91
C9H002 ST CLAIRE DOUGLAS	VAAL	Rivers	-29.043333	23.837222	C92
C9H005 DE HOOP	VAAL	Rivers	-28.498611	24.603611	C91
C9H006 BLOEMHOF	VAAL	Rivers	-27.654167	25.593889	C91
C9H020 SCHOOLPLAATS (VAAL- HARTS STORAGEWEIR)	VAAL	Rivers	-28.115278	24.925833	C91
C9H022 ST CLAIRE DOUGLAS	VAAL	Rivers	-29.043333	23.837222	C92
ZKOEK-BUF KOEKEMOER SPRUIT AT BUFFELSFONTEIN	KOEKEMOER SPRUIT (C2)	Rivers	-26.933333	26.819167	C24
ZKOEK-KH KOEKEMOER SPRUIT AT BRIDGE TO KHUMA MINE	KOEKEMOER SPRUIT (C2)	Rivers	-26.852222	26.835556	C24

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
ZBLES-BEN BLESBOK SPRUIT TRIBUTARY/MAIN REEF ROAD R29 TO B	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.183889	28.391944	C21
ZDILA-SAP DISCHAR AERATION LAG SAPPI ENST SEE POINT 179287	COWLES DAM ON BLESBOKSPRUIT - DRAINAGE REGION C21D	Dam / Barrage	-26.208889	28.454167	C21
ZDWR01B DOUGLAS WEIR - 150M UP/STR OF WALL (SEE C9R003Q01	DOUGLAS BARRAGE (C9)	Dam / Barrage	-29.041944	23.838889	C92
ZDWR02B DOUGLAS WEIR AT MILFORD (2,5KM UP/STR OF WALL)	DOUGLAS BARRAGE (C9)	Dam / Barrage	-29.036944	23.861944	C92
ZDWR03B DOUGLAS WEIR AT PONT (BROADWATERS)	DOUGLAS BARRAGE (C9)	Dam / Barrage	-29.026944	23.885	C92
ZDWR04B DOUGLAS WEIR - 50M D/STR VAAL/RIET RIVER CONFLUEN	DOUGLAS BARRAGE (C9)	Dam / Barrage	-29.001944	23.885	C92
ZDWR05B RIET RIVER - 50M UP/STR VAAL CONFLUENCE	RIETRIVIER - DRAINAGE REGION C51	Rivers	-28.998889	23.889444	C92
ZDWR06B RIET RIVER AT APIESDRAAI (BLUE WATER TANKS & PUMP	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.006944	23.903056	C51
ZDWR07B RIET RIVER AT PICTON	RIETRIVIER - DRAINAGE REGION C51	Rivers	-28.998889	23.915	C51
ZDWR08B RIET RIVER AT DE KALK (UP/STR OF CLIFFS)	RIETRIVIER - DRAINAGE REGION C51	Rivers	-28.99	23.941111	C51
ZDWR09B RIET RIVER AT BLAAUWKRANTZ BRIDGE	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.003056	23.943889	C51
ZDWR10B VAAL RIVER - 2KM UP/STR RIET CONFLUENCE	VAAL	Rivers	-28.979167	23.883056	C92
ZDWR11B VAAL RIVER - 4KM UP/STR RIET CONFLUENCE (POWER LI	VAAL	Rivers	-28.965	23.881944	C92
ZDWR12B VAAL RIVER - 300M UP/STR OF ISLAND	VAAL	Rivers	-28.969167	23.909722	C92

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
ZDWR13B VAAL RIVER AT KOPPIE ALLEEN (PUMPS)	VAAL	Rivers	-28.975	23.935	C92
ZDWR14B VAAL RIVER AT BRUINKOPPIES (VAALLUS IRR. SCHEME)	VAAL	Rivers	-28.966944	23.955278	C92
ZDWR15B VAAL RIVER AT OLIE RIVIER 170 (VAALLUS IRR. S.)	VAAL	Rivers	-28.951944	23.99	C92
ZDWR16B VAAL RIVER AT VAALLUS - 100M D/STR OF ISLAND	VAAL	Rivers	-28.915	23.965	C92
ZDWR17B VAAL RIVER AT VAALLUS - 100M UP/STR OF ISLAND	VAAL	Rivers	-28.906944	23.96	C92
ZJAC002 AT JACOBSDAL BRIDGE ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.1411389	24.76891667	C51
ZJAC003 CANAL S3050/15 AT INFLOW TO SCHOLTZBURG WEIR	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.026944	24.641944	C52
ZJAC010C RIET RIVER UPSTREAM OF CONFLUENCE WITH MODDER RIV	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.044722	24.6325	C51
ZJAC014 BLAAUWBOSCHFONTEIN WEIR ON RIET RIVER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.013056	24.14	C51
ZJANS-ANZ ERWATJAN SMUTS SEWAGE WORKS FINAL EFFLUENT	MADIBOHLOKO	Rivers	-26.221944	28.375278	C21
ZRM3DUM SEEPAGE FROM RM3 DUMP DRAINING INTO NATAL SPRUIT,	SUID KAAP RIVER (X2)	Rivers	-26.216667	28.129167	C22
ZVAAL-KNO VAAL RIVER AT KNOPFONTEIN DRIFT	VAAL	Rivers	-26.888333	26.927778	C23
ZVAAL-KRA VAAL RIVER AT KRANS DRIFT (LEEUD/BOTHAV BRIDGE)	VAAL	Rivers	-27.33	26.455556	C24

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
ZVAAL-REG VAAL RIVER AT VAAL REGINA BRIDGE (VAAL VIEW)	VAAL	Rivers	-27.104167	26.520833	C24
ZVAAL-SKA VAAL RIVER AT SKANDINAWIE DRIFT	VAAL	Rivers	-26.936667	27.0575	C23
ZVAAL-VER VAAL RIVER AT VERMAAS DRIFT	VAAL	Rivers	-26.936111	26.850833	C24
ZVAAL-VR8 VAAL RIVER AT VAAL REEFS N/S BRIDGE (SHAFT 8)	VAAL	Rivers	-26.945833	26.781944	C24
ZVAAL-VR9 VAAL RIVER AT VAAL REEFS BRIDGE (SHAFT 9)	VAAL	Rivers	-26.966111	26.736111	C24
ZVAAL-WCO VAAL RIVER AT WEST. TVL. WATER CO. ABSTRACTION PT	VAAL	Rivers	-26.934722	26.800833	C24
VET RIVER D/S SAND CONFLUENCE (LELIEFONTEIN)	VETRIVIER - DRAINAGE REGION C4	Rivers	-28.063889	26.395833	C43
C1H001Q01 AT LANGVERWYL STANDERTON ON VAAL	VAAL	Rivers	-26.941944	29.264167	C11
C1H002Q01 STERKFONTEIN DELANGESDRIFT ON KLIPRIVIER	KLIPRIVIER - DRAINAGE REGION C13	Rivers	-27.169444	29.233889	C13
C1H004Q01 BRANDDRIFT ROODEBANK ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.626944	29.0225	C12
C1H005Q01 LEEU SPRUIT AT WELBEDACHT	LEEU SPRUIT (C1)	Rivers	-26.853611	29.326111	C11
C1H006Q01 AT RIETVLEY ON BLESBOKSPRUIT	BLESBOKSPRUIT - DRAINAGE REGION C11	Rivers	-26.775556	29.539444	C11
C1H007Q01 VAAL RIVER AT GOEDGELUK/BLOUKOP	VAAL	Rivers	-26.84	29.723611	C11
C1H007Q02 VAAL RIVER AT GOEDGELUK/BLOUKOP	VAAL	Rivers	-26.84	29.723611	C11

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C1H008Q01 ELANDSLAAGTE ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.861111	28.884722	C12
C1H009Q01 MOLSPRUIT AT LEEUFONTEIN	MOLSPRUIT	Rivers	-26.916111	28.436944	C12
C1H010Q01 AT SWEET HOME ON BANKPLAASSPRUIT	BANKPLAASSPRUIT - DRAINAGE REGION C12	Rivers	-27.073889	28.565556	C12
C1H011Q01 VAAL RIVER AT GROOTDRAAI/VILLIERS	VAAL	Rivers	-27.018889	28.645833	C12
C1H012Q01 VAAL RIVER AT NOOITGEDACHT/GLADDEDRIFT	VAAL	Rivers	-27.001667	28.766111	C12
C1H015Q01 STERKFONTEIN DELANGESDRIFT AT STEEL BRIDGE ON KLIPRIVIER	KLIPRIVIER - DRAINAGE REGION C13	Rivers	-27.171944	29.236389	C13
C1H017Q01 VAAL RIVER AT VILLIERS FLOOD SECTION	VAAL	Rivers	-27.0225	28.594444	C12
C1H018Q01 ELANDSLAAGTE ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.858889	28.886944	C12
C1H019Q01 GROOTDRAAI DAM ON VAAL RIVER: DOWN STREAM WEIR	VAAL	Rivers	-26.921944	29.284722	C11
C1H027Q01 TWEEFONTEIN SPRUIT AT TWEEFONTEIN	TWEEFONTEIN SPRUIT (C1)	Rivers	-26.780278	29.806944	C11
C1R001Q01 VAAL DAM ON VAAL RIVER: NEAR DAM WALL	VAAL DAM	Dam / Barrage	-26.879444	28.123056	C12
C1R001Q02 VAAL DAM ON VAAL RIVER: POINT IN DAM	VAAL DAM	Dam / Barrage	-26.883333	28.001944	C22
C1R001Q03 VAAL DAM ON VAAL RIVER: POINT IN DAM	VAAL DAM	Dam / Barrage	-26.883333	28.001944	C22

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C1R001Q04 VAAL DAM ON VAAL RIVER: POINT IN DAM	VAAL DAM	Dam / Barrage	-26.883333	28.001944	C22
C1R001Q05 VAAL DAM ON VAAL RIVER: POINT IN DAM	VAAL DAM	Dam / Barrage	-26.883333	28.001944	C22
C1R001Q06 VAAL DAM ON VAAL RIVER: POINT IN DAM	VAAL DAM	Dam / Barrage	-26.883333	28.001944	C22
C1R001Q07 VAAL DAM ON VAAL RIVER: POINT IN DAM	VAAL DAM	Dam / Barrage	-26.883333	28.001944	C22
C1R001Q08 VAAL DAM ON VAAL RIVER: AT VAAL/WILGE CONFLUENCE	VAAL DAM	Dam / Barrage	-26.883333	28.116667	C83
C1R002Q01 GROOTDRAAI DAM ON VAAL RIVER: NEAR DAM WALL	GROOTDRAAI DAM	Dam / Barrage	-26.86717	29.21781	C11
C2H001Q01 MOOI RIVER AT WITRAND	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.648056	27.089444	C23
C2H003Q01 VAAL RIVER AT ELANDSFONTEIN/ENGELBRECHTSDRIFT (RW	VAAL	Rivers	-26.819722	28.063611	C22
C2H004Q01 SUIKERBOSRANT RIVER AT VEREENIGING WEIR (RW S2)	SUIKERBOSRANTRIVIER	Rivers	-26.67075	28.03044444	C21
C2H005Q01 RIETSPRUIT AT KAALPLAATS (RW RV2)	RIET SPRUIT (C2)	Rivers	-26.729722	27.717778	C22
C2H006Q01 MOOI RIVER AT KLERKSKRAAL (KLERKSKRAAL DAM)	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.252222	27.160556	C23
C2H007Q01 AT PILGRIMS ESTATE ORKNEY ON VAAL RIVER	VAAL	Rivers	-27.011111	26.698333	C24
C2H008Q01 VAAL RIVER AT DE PONT/LINDEQUESDRIFT	VAAL	Rivers	-26.735278	27.608611	C23

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C2H010Q01 VAAL RIVER AT RIETFONTEIN/VEREENIGING INTAKE 1 (R	VAAL	Rivers	-26.689167	27.936389	C22
C2H014Q01 AT VERDUN (RW T1) ON TAAIBOSSPRUIT	TAAIBOSSPRUIT - DRAINAGE REGION C22	Rivers	-26.823889	27.925833	C22
C2H015Q01 KLIP RIVER AT WALDRIFT/VEREENIGING	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.643333	27.964722	C22
C2H017Q01 VAAL RIVER AT KILLARNEY/COMMANDODRIFT	VAAL	Rivers	-27.480278	26.221667	C25
C2H018Q01 VAAL RIVER AT DE VAAL/SCHOEMANSDRIFT	VAAL	Rivers	-26.970278	27.211111	C23
C2H021Q01 KLIP RIVER AT WITKOP (RW K25)	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.453611	28.085833	C22
C2H022Q01 VAAL RIVER AT BALKFONTEIN	VAAL	Rivers	-27.397778	26.505556	C25
C2H023Q01 WONDERFONTEIN SPRUIT AT LUIPAARDSVLEI	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.223889	27.74	C23
C2H024Q01 WONDERFONTEIN SPRUIT AT GEMSBOKFONT. D/ST DONALDS	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.284167	27.680278	C23
C2H025Q01 WONDERFONTEIN SPRUIT NO 7 AT GEMSBOKFONTEIN	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.288333	27.669167	C23
C2H026Q01 MIDDELVLEI SPRUIT AT MIDDELVLEI	MIDDELVLEI SPRUIT (C2)	Rivers	-26.2325	27.669167	C23
C2H027Q01 KOCKSOORD SPRUIT AT MIDDELVLEI	KOCKSOORD SPRUIT (C2)	Rivers	-26.233333	27.6525	C23
C2H028Q01 RIETFONTEIN SPRUIT AT RIETFONTEIN	RIETFONTEIN SPRUIT (C2)	Rivers	-26.247778	27.59	C23
C2H032Q01 MOOIRIVIERLOOP (RIVER) AT WONDERFONTEIN	MOOIRIVIERLOOP	Rivers	-26.316667	27.3925	C23

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C2H033Q01 BUFFELSDOORN SPRUIT AT DOORNFONTEIN	BUFFELSDOORNSPRUIT (DUPL NAME 2)	Rivers	-26.436667	27.327222	C23
C2H039Q01 KLIP RIVER AT R84 PROTEA (D/S DURBAN DEEP MINE)	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.294167	27.836389	C22
C2H061Q01 VAAL RIVER AT KLIPPLAATDRIFT	VAAL	Rivers	-27.3875	26.4625	C25
C2H062Q01 LITTLE RIETSPRUIT AT RIETFONTEIN	KLEIN RIETSPRUIT (C2)	Rivers	-26.405278	27.601111	C22
C2H064Q01 AT EYE OF SCHOONSPRUIT ON SKOONSPRUIT	SKOONSPRUIT - DRAINAGE REGION C24	Rivers	-26.283889	26.860833	C24
C2H065Q01 LEEUDORING SPRUIT AT KLIPSPRUIT	LEEUDORING SPRUIT (C2)	Rivers	-27.369444	26.351111	C25
C2H066Q01 MAKWASSIE SPRUIT AT VLIEGEKRAAL	MAKWASSIE SPRUIT (C2)	Rivers	-27.495556	26.074722	C25
C2H067Q01 AT LEEGTE ON SANDSPRUIT	SANDSPRUIT - DRAINAGE REGION C25	Rivers	-27.560278	26.233333	C25
C2H069Q01 MOOIRIVIERLOOP (RIVER) AT BLAAUWBANK	MOOIRIVIERLOOP	Rivers	-26.375556	27.230833	C23
C2H070Q01 SCHICKFONTEIN ON SUIKERBOSRANT RIVER	SUIKERBOSRANTRIVIER	Rivers	-26.64	28.230278	C21
C2H071Q01 KLIP RIVER AT KOOKFONTEIN/VEREEN. RAIL BRIDGE (RW	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.619444	27.980833	C22
C2H072Q01 MOOI RIVER AT TAAIBOSCHBULT	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.866667	27.025	C23
C2H075Q01 MOOIRIVIERLOOP AT BLAAUWBANK WELVERDIEND (RAIL BR	MOOIRIVIERLOOP	Rivers	-26.368889	27.252778	C23
C2H084Q01 AT KLERKSDORP WEIR ON SKOONSPRUIT	SKOONSPRUIT - DRAINAGE REGION C24	Rivers	-26.873889	26.658611	C24

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C2H085Q01 MOOI RIVER AT HOOGEKRAAL/KROMDRAAI	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.880278	26.965	C23
C2H102Q01 AT DAVEYTON KLIPFONTEIN U/S N12 ON BLESBOKSPRUIT	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.163889	28.462222	C21
C2H122Q01 VAAL DAM ON VAAL RIVER: DOWN STREAM WEIR	VAAL	Rivers	-26.854167	28.121111	C22
C2H131Q01 RW C-S1 COLLIERY POINT ON SUIKERBOSRANT RIVER	SUIKERBOSRANTRIVIER	Rivers	-26.628889	28.297222	C21
C2H132Q01 RIET SPRUIT AT TAMBOEKIESFONTEIN (HERMAN) (RW R5)	RIET SPRUIT (C2)	Rivers	-26.428889	28.181389	C22
C2H133Q01 RW C-B10 AT HEIDELBERG ON BLESBOKSPRUIT	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.510278	28.351389	C21
C2H134Q01 COWLES DAM OUTFLOW AT SPRINGS (RW B9)	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.206944	28.4675	C21
C2H135Q01 NATAL SPRUIT AT RIETFONTEIN (RW N8)	NATAL SPRUIT (C2)	Rivers	-26.425278	28.166111	C22
C2H136Q01 RIETSPRUIT AT WATERVAL (LUTTIG) (RW R6)	RIET SPRUIT (C2)	Rivers	-26.45	28.088889	C22
C2H137Q01 KLIP RIVER AT ZWARTKOPJES (RW K21)	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.379722	28.071111	C22
C2H138Q01 VAAL RIVER AT GROOT VADERSBOSCH/BUFFELSFONTEIN	VAAL	Rivers	-26.934722	26.800833	C24
C2H139Q01 KOEKEMOER SPRUIT AT BUFFELSFONTEIN	KOEKEMOER SPRUIT (C2)	Rivers	-26.917222	26.817222	C24
C2H140Q01 VAAL RIVER AT WOODLANDS/GOOSE BAY CANYON	VAAL	Rivers	-26.736389	27.5925	C23

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C2H141Q01 KLIP RIVER AT WITKOP (NEW BRIDGE)	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.45	28.085833	C22
C2H142Q01 AT GROOTVLEI MINE BRIDGE EAST	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.2554722	28.49825	C21
C2H145Q01 @ VLAKFONTEIN MARIEVALE BIRD SANTUARY ON BLESBOKSP	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.358611	28.509167	C21
C2H146Q01 @ DAGGAFONTEIN 2KM DOWNSTREAM N17 ON BLESBOKSPRUIT	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.271944	28.505	C21
C2H147Q01 @ GROOTVLEI BETW MINE BRIDGE & N17 ON BLESBOKSPRUI	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.259444	28.5025	C21
C2H148Q01 @ NIGEL BRICK WORKS R42 BRIDGE ON BLESBOKSPRUIT	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.389722	28.497778	C21
C2H149Q01 (B8) NIGEL R51 ROAD BRIDGE TO BALF OUR	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.4275	28.504444	C21
C2H150Q01 R555 ROAD BRIDGE ON BLESBOKSPRUIT	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.213056	28.480833	C21
C2H152Q01 WONDERFONT SPRUIT RAIL BRIDGE (BETW TURK SHAFT AN	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.139722	27.766667	C23
C2H153Q01 WONDERFONTEIN SPRUIT AT RANDFONTEIN AZAADVILLE BRI	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.164444	27.767222	C23
C2H154Q01 WONDERFONTEIN SPRUIT AT BRIDGE ON THE DOORNKOP RA	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.265833	27.699444	C23
C2H156Q01 WEST DRIEFONTEIN GOLD MINE PROCESS H2O ROAD BRIDG	WES DRIEFONTEIN GM-PROCESS WATER	Reservoir	-26.358611	27.433333	C23
C2H157Q01 WONDERFONTEIN SPRUIT AT LOW WATER BRIDGE TO ABE B	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.323611	27.354167	C23

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C2H161Q01 @ GRAVEL RD BRIDGE TO MUISKRAAL ON MOOIRIVIERLOOP	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.434722	27.151944	C23
C2H162Q01 AT RYSMIERBULT ROAD BRIDGE U/S BOSKOP DAM ON MOOIRIVIER	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.514444	27.124722	C23
C2H163Q01 VARKENSLAAGTE SPRUIT ON FARM BRIDGE D/S WESTERN D	VARKENSLAAGTE SPRUIT (C2)	Rivers	-26.435	27.339444	C23
C2H164Q01 WESTERN NURSERY DAM OVERFLOW AT ELANDSRAND GOLD M	ELANDSRAND DAM	Dam / Barrage	-26.445556	27.344444	C23
C2H165Q01 DEELKRAAL GOLD MINE RECREATIONAL DAM DEELKRAAL GM	DEELKRAAL DAM	Dam / Barrage	-26.455	27.318056	C23
C2H166Q01 BUFFELSDOORN SPRUIT AT JOHANNESBURG/POTCHEFSTROOM	BUFFELSDOORNSPRUIT (DUPL NAME 1)	Rivers	-26.4925	27.373333	C23
C2H167Q01 ELANDSFONTEIN SPRUIT AT JOHANNESBURG/POTCHEFSTROO	ELANDSFONTEINSPRUIT - DRAINAGE REGION D32H	Rivers	-26.456667	27.420833	C23
C2H168Q01 KRAALKOP SPRUIT AT OLD JOHANNESBURG/POTCHEFSTROOM	KRAALKOPSPRUIT - DRAINAGE REGION C23J	Rivers	-26.439167	27.498889	C23
C2H169Q01 WELTEVREDEN 357IQ AT LOSBERG/BANK ROAD BRIDGE ON LOOPSPRUIT	LOOPSPRUIT (DUPL NAME 1)	Rivers	-26.478889	27.539444	C23
C2H170Q01 LOOPSPRUIT AT OUTFLOW FROM KLIPDRIFT DAM INTO CON	LOOPSPRUIT (DUPL NAME 1)	Rivers	-26.616944	27.296111	C23
C2H174Q01 POTCHEFSTROOM DAM-CANAL/PIPELINE (POTCHEFSTROOM	POTCHEFSTROOM DAM	Dam / Barrage	-26.661667	27.086389	C23
C2H175Q01 WONDERFONTEINSPRUIT AT DAM OVERFLOW HARRY'S DAM (	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.336111	27.3375	C23

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C2H176Q01 VARKENSLAAGTESPRUIT AT DORINGDRAAI DAM WELVERDIEN	VARKENSLAAGTE SPRUIT (C2)	Rivers	-26.388333	27.274167	C23
C2H218Q01 KLIP RIVER @ R41,WITPOORTJIE (U/S DURBAN DEEP MINE	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.176667	27.818611	C22
C2H219Q01 KLIP RIVER AT DURBAN DEEP MINE (D/S SHAFT NO.5)	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.1775	27.836944	C22
C2H220Q01 KLIP RIVER AT GOLDEN HIGHWAY,OLIFANTSVLEI/VAN WYK	KLIPRIVIER - DRAINAGE REGION C13	Rivers	-26.336111	27.903056	C22
C2H221Q01 RUSSEL STREAM @ NEW CANADA RD D/S CROWN MINE	KLIPSPRUIT - DRAINAGE REGION C25A	Rivers	-26.220278	27.981944	C22
C2H223Q01 RUSSEL STREAM (KLIPSPRUIT TRIB.) AT BOOYSENS RES/	KLIPSPRUIT - DRAINAGE REGION C25A	Rivers	-26.226944	28.003056	C22
C2H224Q01 KLIPSPRUIT AT SOWETO HIGHWAY, MZIMHLOPE HOSTEL-M82	KLIPSPRUIT - DRAINAGE REGION C25A	Rivers	-26.2225	27.928889	C22
C2H225Q01 ROSHERVILLE LOWER GERMISTON ON STREAM AT CITY DEEP	STREAM AT CITY DEEP GOLD MINE - DRAINAGE REGION C22B	Rivers	-26.226944	28.106667	C22
C2H226Q01 @ R46 DS CITY DEEP GM ON STREAM @ SIMMER & JACK GM	STREAM AT SIMMER & JACK GOLD MINE - DRAINAGE REGION C22B	Rivers	-26.237778	28.124167	C22
C2H227Q01 HILLVIEW SMITH AVENUE U/S SIMMER & JACK GM ON STRE	STREAM AT SIMMER & JACK GOLD MINE - DRAINAGE REGION C22B	Rivers	-26.2175	28.134722	C22
C2H228Q01 NATAL SPRUIT AT ALBERTON/HEIDELBERG ROAD-R554	NATALSPRUIT - DRAINAGE REGION C22	Rivers	-26.296111	28.141944	C22
C2H229Q01 AT DELMORE U/S ELSBURG DAM R46 ON ELSBURGSPRUIT	ELSBURGSPRUIT - DRAINAGE REGION C22B	Rivers	-26.212778	28.195	C22
C2H230Q01 AT WADEVILLE D/S ELSBURG DAM R39 ON ELSBURGSPRUIT	ELSBURGSPRUIT - DRAINAGE REGION C22B	Rivers	-26.248611	28.205	C22

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C2H231Q01 DIXIE SPRUIT D/S CINDERELLA DAM	STREAM AT CINDERELLA DAM - DRAINAGE REGION C22B	Rivers	-26.261389	28.222222	C22
C2H232Q01 RIET SPRUIT AT R103/MAPLETON AGRICULTURAL HOLDING	RIETSPRUIT - DRAINAGE REGION C22C	Rivers	-26.370833	28.244444	C22
C2H233Q01 KLIP RIVER AT RIVIERA GOLF COURSE (U/S CONFLUENCE	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.663889	27.955556	C22
C2H234Q01 SUIKERBOSRANTRIVER AT BADFONTEIN	SUIKERBOSRANTRIVIER	Rivers	-26.693333	28.11	C21
C2H246Q01 LOOPSPRUIT AT GRAVEL ROAD BRIDGE LEEUDOORN (D/S K	LOOPSPRUIT (DUPL NAME 1)	Rivers	-26.433056	27.554167	C23
C2H247Q01 LOOPSPRUIT AT GRAVEL PIET VILJOEN PARK FOCHVILLE	LOOPSPRUIT (DUPL NAME 1)	Rivers	-26.499722	27.501944	C23
C2H249Q01 LOOPSPRUIT AT KLIPDRIFT DAM O/FLOW KLIPDRIFT	LOOPSPRUIT (DUPL NAME 1)	Rivers	-26.617778	27.210556	C23
C2H250Q01 VAALRIVER (BRIDGE) AT SCANDINAWIEDRIF	VAAL	Rivers	-26.936667	27.058611	C23
C2H251Q01 VAALRIVER AT PARYS	VAAL	Rivers	-26.894167	27.461111	C23
C2H252Q01 MOOI RIVER D/S DAM OVERFLOW AT POTCHEFSTROOM (DAM	MOOIRIVIER - DRAINAGE REGION V20	Rivers	-26.685	27.101944	C23
C2H253Q01 MOOI RIVER AT ROAD BRIDGE POTCHEFSTROOM	MOOIRIVIER - DRAINAGE REGION V20	Rivers	-26.715833	27.107222	C23
C2H254Q01 MOOI RIVER AT POTCHEFSTROOM (WILGEBOOM)	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.751389	27.099722	C23
C2H256Q01 LOOPSPRUIT (POTCHEFSTROOM/PARYS ROAD) AT POTCHEFS	LOOPSPRUIT (DUPL NAME 1)	Rivers	-26.728889	27.126111	C23

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C2H258Q01 LOOPSPRUIT 100M DS KOKOSI WCW AT KOKOSI	LOOPSPRUIT (DUPL NAME 1)	Rivers	-26.499167	27.46	C23
C2H260Q01 VAAL RIVER LOW WATER BRIDGE AT KROMDRAAI	VAAL	Rivers	-26.887222	26.926944	C23
C2H269Q01 VARKENSLAAGTESPRUIT AT DOORNFONTEIN (DOORNDRAAI D	VARKENSLAAGTE SPRUIT (C2)	Rivers	-26.439167	27.327778	C23
C2H270Q01 WONDERFONTEIN SPRUIT AT LUIPAARDSVLEI	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.216111	27.742222	C23
C2H271Q01 WONDERFONTEIN SPRUIT(R559) AT LUIPAARDSVLEI	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.244722	27.731111	C23
C2R001Q01 BOSKOP DAM ON MOOI RIVER: NEAR DAM WALL	BOSKOP DAM	Dam / Barrage	-26.561111	27.111667	C23
C2R002Q01 JOHAN NESSER DAM ON SKOON SPRUIT: NEAR DAM WALL	JOHAN NESER DAM (C2)	Dam / Barrage	-26.816944	26.614444	C24
C2R003Q01 KLERKSKRAAL DAM ON MOOI RIVER: NEAR DAM WALL	KLERKSKRAAL DAM	Dam / Barrage	-26.2525	27.160556	C23
C2R004Q01 POTCHEFSTROOM DAM ON MOOI RIVER: NEAR DAM WALL	POTCHEFSTROOM DAM (C2)	Dam / Barrage	-26.671944	27.1	C23
C2R005Q01 KLIPDRIF DAM ON LOOP SPRUIT: NEAR DAM WALL	KLIPDRIF DAM (DUPL NAME 3)	Dam / Barrage	-26.616667	27.301111	C23
C2R006Q01 ELANDSKUIL DAM ON SWARTLEEGTE RIVER: NEAR DAM WAL	ELANDSKUIL DAM	Dam / Barrage	-26.349167	26.777778	C24
C2R007Q01 RIETSPRUIT DAM ON RIET SPRUIT: NEAR DAM WALL	RIETSPRUIT DAM (DUPL NAME 1)	Dam / Barrage	-26.413611	26.7975	C24
C2R008Q01 LTS24 VAAL BARRAGE ON VAAL RIVER NEAR BARR WAL	VAAL BARRAGE (C2)	Dam / Barrage	-26.765556	27.684722	C23

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C3H003Q01 AT TAUNG ON HARTSRIVIER	HARTSRIVIER - DRAINAGE REGION C31	Rivers	-27.573056	24.746389	C31
C3H007Q01 AT ESPAGSDRIF ON HARTSRIVIER	HARTSRIVIER - DRAINAGE REGION C33	Rivers	-27.902778	24.615556	C33
C3H013Q01 AT SPITSKOP MOUNT RUPERT ON HARTSRIVIER	HARTSRIVIER - DRAINAGE REGION C33	Rivers	-28.1625	24.471111	C33
C3H016Q01 AT DELPORTSHOOP LLOYDS WEIR ON HARTSRIVIER	HARTSRIVIER - DRAINAGE REGION C33	Rivers	-28.376944	24.303056	C33
C3R001Q01 SCHWEIZER RENEKE DAM ON HARTS RIVER: NEAR DAM WAL	SCHWEIZER RENEKE DAM (C3)	Dam / Barrage	-27.174444	25.336667	C31
C3R002Q01 SPITSKOP DAM ON HARTS RIVER: NEAR DAM WALL	SPITSKOP DAM	Dam / Barrage	-28.123889	24.501389	C33
C3R002Q02 SPITSKOP DAM ON HARTS RIVER: POINT IN DAM	SPITSKOP DAM	Dam / Barrage	-28.123889	24.501389	C33
C3R003Q01 BARBERS PAN AT ZANDVLEI (AT GAUGE PLATE)	BARBERS PAN (C3)	Pan	-26.5675	25.598889	C31
C3R003Q02 BARBERS PAN AT ZANDVLEI (NEAR RAIL BRIDGE)	BARBERS PAN (C3)	Pan	-26.555	25.591944	C31
C3R006Q01 TAUNG DAM ON HARTS RIVER: NEAR DAM WALL	C3R006 TAUNG DAM AT TAUNG	Dam / Barrage	-27.536944	24.85	C31
C4H004Q01 AT FAZANTKRAAL NOOITGEDACHT ON VETRIVIER	VETRIVIER - DRAINAGE REGION C4	Rivers	-27.935	26.126667	C43
C4H005Q01 VET RIVER AT FLOORSDRIFT/HOOPSTAD	VETRIVIER - DRAINAGE REGION C4	Rivers	-27.841667	25.9	C43
C4H010Q01 ERFENIS DAM ON GREAT VET RIVER: DOWN STREAM WEIR	VETRIVIER - DRAINAGE REGION C4	Rivers	-28.5075	26.778333	C41

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C4H016 @ MOND VAN DOORNRIVIER BLOUDRIF ON SAND	SAND (C42)	Rivers	-28.1175	26.719444	C42
C4H017Q01 SAND RIVER AT DORINGRIVIER/BLOUDRIF	SAND (D54D &D62B)	Rivers	-28.116667	26.725278	C42
C4H020Q01 SAND RIVER AT ROAD BRIDGE U/S WATERFALL	A71A-A71K-SAND (A71)	Rivers	-28.233333	27.085833	C42
C4H021Q01 KLEIN-VET RIVER AT ROADBRIDGE RAPHIDAM 2150	VETRIVIER - DRAINAGE REGION C4	Rivers	-28.618889	27.017778	C41
C4H022Q01 AT VLAKPLAAS U/S ALLEMANSKRAAL ON SANDRIVIER	SAND (C42)	Rivers	-28.318889	27.490833	C42
C4H023Q01 GROOT-VET RIVER U/S ERFNIS DAM STRYDOMFONTEIN 23	VETRIVIER - DRAINAGE REGION C4	Rivers	-28.712222	26.961389	C41
C4H024Q01 @ JAKHALSKOP RD BRIDGE D/S BLOUDRIF ON SAND RIVER	SAND (C42)	Rivers	-28.120278	26.585833	C42
C4H025Q01 AT VIRGINIA 100 M D/S OF WEIR ON SAND RIVER	SAND (C42)	Rivers	-28.113056	26.908611	C42
C4R001Q01 ALLEMANSKRAAL DAM ON SAND RIVER: NEAR DAM WALL	ALLEMANSKRAAL DAM	Dam / Barrage	-28.287778	27.145833	C42
C4R002Q01 ERFENIS DAM ON GREAT VET RIVER: NEAR DAM WALL	ERFENIS DAM	Dam / Barrage	-28.5075	26.778333	C41
C5H003Q01 AT LIKATLONG / SANNASPOS ON MODDERRIVIER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.160278	26.573333	C52
C5H006Q01 AT BISHOP'S GLEN ON RENOSTERSPRUIT	RENOSTERSPRUIT - DRAINAGE REGION C52F	Rivers	-28.984722	26.341944	C52
C5H007Q01 AT SHANNON VALLEY ON RENOSTERSPRUIT	RENOSTERSPRUIT - DRAINAGE REGION C52F	Rivers	-29.144444	26.318056	C52

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C5H008Q01 RIET RIVER AT RIVIERA	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.812222	26.212222	C51
C5H009Q01 OSPOORT SPRUIT AT OS POORT	OSPOORT SPRUIT (C5)	Rivers	-29.902222	26.215	C51
C5H012Q01 RIET RIVER AT KROMDRAAI/RIETWATER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.658056	25.973333	C51
C5H014Q01 AT KLIPDRIFT RITCHIE ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.042222	24.6	C51
C5H015Q01 AT STOOMHOEK ON MODDER RIVIER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.8075	26.112222	C52
C5H016Q01 AT ESTATE BIESIESBULT AUCAMPSHOOP ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-28.96	24.2425	C51
C5H018Q01 MODDER RIVER AT TWEERIVIER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.043333	24.640833	C52
C5H022Q01 KGABANYANE RIVER AT BEDFORD UP STREAM GROOTHOEK D	KGABANYANE RIVER (C5)	Rivers	-29.285556	26.921944	C52
C5H023Q01 KGABANYANE RIVER AT DANKBAAR D/STREAM GROOTHOEK D	KGABANYANE RIVER (C5)	Rivers	-29.286111	26.764167	C52
C5H026Q01 KORANNA SPRUIT AT BRIGHTSIDE	KORANNA SPRUIT (C5)	Rivers	-29.080278	26.593333	C52
C5H027Q01 SEPANE SPRUIT AT LIKATLONG/SANNASPOS	SEPANE - DRAINAGE REGION C52B	Rivers	-29.161389	26.5975	C52
C5H028Q01 KGABANYANE RIVER AT BLIJDSCHAP	KGABANYANE RIVER (C5)	Rivers	-29.284167	26.813056	C52
C5H029Q01 AT KROMDRAAI ON KLEIN MODDER RIVIER	KLEIN MODDER RIVIER - DRAINAGE REGION C52B	Rivers	-29.242778	26.671944	C52
C5H035Q01 @ TWEE RIVIER D/S TWEE RIVIER ON MODDER RIVER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.028333	24.639167	C52

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C5H039Q01 KRUGERSDRIFT DAM ON MODDER RIVER: DOWN STREAM WEI	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.883333	25.950278	C52
C5H048Q01 AT ZOUTPANSDRIFT ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.033333	23.983333	C51
C5H053Q01 MODDER RIVER AT GLEN	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.948889	26.321667	C52
C5H054Q01 AT BISHOPS GLEN ON RENOSTERSPRUIT	RENOSTERSPRUIT - DRAINAGE REGION C52F	Rivers	-28.966667	26.333056	C52
C5R001Q01 TIERPOORT DAM ON KAFFER RIVER: NEAR DAM WALL	TIERPOORT DAM	Dam / Barrage	-29.421667	26.136389	C51
C5R002Q01 KALKFONTEIN DAM ON RIET RIVER: NEAR DAM WALL	KALKFONTEIN DAM (DUPL NAME 1)	Dam / Barrage	-29.496944	25.221389	C51
C5R003Q01 RUSTFONTEIN DAM ON MODDER RIVER: NEAR DAM WALL	RUSTFONTEIN DAM (DUPL NAME 2)	Dam / Barrage	-29.270833	26.616667	C52
C5R004Q01 KRUGERSDRIF DAM ON MODDER RIVER: NEAR DAM WALL	KRUGERSDRIF DAM - DRAINAGE REGION C52G	Dam / Barrage	-28.883333	25.956111	C52
C5R005Q01 GROOTHOEK DAM ON KGABANYANE RIVER: NEAR DAM WALL	GROOTHOEK DAM	Dam / Barrage	-29.302778	26.848889	C52
C5R006Q01 MASELSPOORT DAM ON MODDER RIVER: NEAR DAM WALL	MASELSPOORT DAM (C5)	Dam / Barrage	-29.029167	26.408333	C52
C5R007Q01 MOCKES DAM ON MODDER RIVER: NEAR DAM WALL	MOCKES DAM	Dam / Barrage	-29.050556	26.461667	C52
C6H001Q01 VALS RIVER AT ROODEWAL	VALS	Rivers	-27.441389	26.986389	C60
C6H002Q01 VALS RIVER AT GROOTDRAAI/BOTHAVILLE	VALS	Rivers	-27.398611	26.614722	C60

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C6H003Q01 VALS RIVER AT MOOIFONTEIN/BOTHAVILLE	VALS	Rivers	-27.4	26.624722	C60
C6H004Q01 VALS RIVER AT KLIPFONTEIN/LINDLEY	VALS	Rivers	-27.936111	27.996389	C60
C6H007Q01 VALS RIVER AT KROONSTAD BRIDGE (OLD BAREND WESSEL	VALS	Rivers	-27.671111	27.236944	C60
C6R002Q01 SERFONTEIN DAM ON VALS RIVER: NEAR DAM WALL	SERFONTEIN DAM	Dam / Barrage	-27.701667	27.3025	C60
C7H003Q01 AT DANKBAAR MISPAH ON HEUNINGSPRUIT	HEUNINGSPRUIT - DRAINAGE REGION C70	Rivers	-27.356667	27.286389	C70
C7H005Q01 RENOSTER RIVER AT SPES BONA	RENOSTER - DRAINAGE REGION C70 A B C	Rivers	-27.123333	27.109167	C70
C7H006Q01 RENOSTER RIVER AT ARRIESRUST	RENOSTER - DRAINAGE REGION C70 A B C	Rivers	-27.044444	27.005	C70
C7H013Q01 KOPPIES DAM ON RENOSTER RIVER: DOWN STREAM WEIR	RENOSTER - DRAINAGE REGION C70 A B C	Rivers	-27.258611	27.672778	C70
C7R001Q01 KOPPIES DAM ON RENOSTER RIVER: NEAR DAM WALL	KOPPIES DAM	Dam / Barrage	-27.258056	27.674167	C70
C7R002Q01 ROODEPOORT DAM ON LEEU SPRUIT: NEAR DAM WALL	ROODEPOORT DAM	Dam / Barrage	-27.223889	27.516667	C70
C7R003Q01 WELTEVREDE DAM ON LEEU SPRUIT: NEAR DAM WALL	WELTEVREDE DAM (DUPL NAME 2)	Dam / Barrage	-27.221667	27.570278	C70
C8H001Q01 WILGE RIVER AT FRANKFORT	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-27.273889	28.49	C83
C8H002Q01 WILGE RIVER AT HARRISMITH	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.270278	29.111667	C81

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C8H003Q01 AT WARDEN ON CORNELISRIVIER	CORNELISRIVIER - DRAINAGE REGION C82	Rivers	-27.845	28.96222222	
C8H004Q01 LIEBENBERGSVLEI RIVER AT DE MOLEN/DE WELKOM	LIEBENBERGSVLEI	Rivers	-27.7	28.321667	C83
C8H005Q01 ELANDS RIVER BELOW QWA QWA	ELANDSRIVIER - DRAINAGE REGION C81	Rivers	-28.375556	28.861667	C81
C8H006Q01 KLERK SPRUIT AT GEDULD	KLERK SPRUIT (C8)	Rivers	-28.295833	28.805556	C81
C8H007Q01 LIEBENBERGSVLEI RIVER AT VOGELFONTEIN	LIEBENBERGSVLEI	Rivers	-28.190556	28.344167	C83
C8H009Q01 AT TIJGER HOEK ON TIERKLOOF RIVER	TIERKLOOF	Rivers	-28.053611	28.4925	C83
C8H010Q01 OUBERG SPRUIT AT FRASERSPRUIT/HARRISMITH	OUBERG SPRUIT (C8)	Rivers	-28.352222	29.09	C81
C8H011Q01 ELANDS RIVER AT KILLARNEY	ELANDSRIVIER - DRAINAGE REGION C81	Rivers	-28.160833	28.874722	C81
C8H012Q01 AT VOORSPOED ON VAALBANK SPRUIT	VAALBANKSPRUIT (DUPL NAME 2)	Rivers	-28.083611	28.838333	C81
C8H013Q01 AT VAALBANK 327 ON VAALBANK SPRUIT	VAALBANKSPRUIT (DUPL NAME 2)	Rivers	-28.107222	28.783889	C81
C8H014Q01 WILGE RIVER AT BAVARIA	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-27.814444	28.783333	C82
C8H015Q01 AT HARRISMITH TOWN LANDS ON WILGERIVIER	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.307222	29.131389	C81
C8H016Q01 KROM SPRUIT AT COSMOS	KROM SPRUIT (C8)	Rivers	-27.257778	28.406667	C83
C8H017Q01 KLIP SPRUIT AT KLIPOOG	KLIP SPRUIT (C8)	Rivers	-27.128889	28.283889	C83
C8H018Q01 HOL SPRUIT AT DAVIDSDALE	HOL SPRUIT (C8)	Rivers	-27.651389	28.868611	C82

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C8H020Q01 LIEBENBERGSVLEI RIVER AT ROODEKRAAL	LIEBENBERGSVLEI	Rivers	-27.689167	28.378333	C83
C8H021Q01 SKULP SPRUIT AT KALKOEN	SKULP SPRUIT (C8)	Rivers	-27.305833	28.485833	C83
C8H022Q01 WILGE RIVER AT SLABBERTS/KIMBERLEY	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-27.298889	28.496111	C83
C8H023Q01 AT THE WILLOWS ON MEUL RIVER	MEUL	Rivers	-28.025556	28.9975	C81
C8H024Q01 MIDDEL SPRUIT AT MIDDELSPRUIT	MIDDEL SPRUIT (C8)	Rivers	-28.075278	28.7	C81
C8H025Q01 VAALBANK SPRUIT AT RUSTKOP	VAALBANK SPRUIT (C8)	Rivers	-28.131944	28.762222	C81
C8H026Q01 AT FREDERIKSDAL ON LIEBENBERGSVLEI RIVER	LIEBENBERGSVLEI	Rivers	-27.4275	28.525833	C83
C8H027Q01 AT BALLINGTOMP ON WILGE RIVER	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-27.3	28.586944	C82
C8H028Q01 WILGE RIVER AT BAVARIA (FLOOD SECTION)	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-27.802778	28.768333	C82
C8H032Q01 AT STERKFONTEINDAM ON NUWEJAAR SPRUIT	STERKFONTEIN DAM-DOWNSTREAM WEIR (C8)	Rivers	-28.387222	29.016667	C81
C8R003Q01 STERKFONTEIN DAM ON NUWEJAAR SPRUIT: NEAR DAM WAL	STERKFONTEIN DAM (DUPL NAME 4)	Dam / Barrage	-28.387222	29.016667	C81
C8R003Q02 STERKFONTEIN DAM ON NUWEJAAR SPRUIT: POINT IN DAM	STERKFONTEIN DAM (DUPL NAME 4)	Dam / Barrage	-28.387222	29.016667	C81
C8R003Q03 STERKFONTEIN DAM ON NUWEJAAR SPRUIT: POINT IN DAM	STERKFONTEIN DAM (DUPL NAME 4)	Dam / Barrage	-28.387222	29.016667	C81
C8R003Q04 STERKFONTEIN DAM ON NUWEJAAR SPRUIT: POINT IN DAM	STERKFONTEIN DAM (DUPL NAME 4)	Dam / Barrage	-28.387222	29.016667	C81
C8R003Q05 STERKFONTEIN DAM ON NUWEJAAR SPRUIT: POINT IN DAM	STERKFONTEIN DAM (DUPL NAME 4)	Dam / Barrage	-28.387222	29.016667	C81

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C8R004Q01 SAULSPOORT DAM ON LIEBENBERGSVLEI RIV: NEAR DAM W	SAULSPOORT DAM	Dam / Barrage	-28.216667	28.363333	C83
C8R005Q01 LOCH ATHLONE DAM ON JORDAAN RIVER: NEAR DAM WALL	LOCH ATHLONE DAM	Dam / Barrage	-28.25	28.309167	C83
C8R006Q01 GERRANDS DAM ON GERRANDS SPRUIT: NEAR DAM WALL	GERRANDS DAM	Dam / Barrage	-28.280278	28.2925	C83
C9H003Q01 VAAL RIVER AT DROOGFONTEIN/RIVERTON	VAAL	Rivers	-28.513056	24.6975	C91
C9H007Q01 VAAL RIVER AT ST CLAIRE/DOUGLAS	VAAL	Rivers	-29.043333	23.837222	C92
C9H008Q01 VAALHARTS BARRAGE ON VAAL RIVER: DOWN STREAM WEIR	VAAL	Rivers	-28.114167	24.915278	C91
C9H009Q01 VAAL RIVER AT DE HOOP	VAAL	Rivers	-28.515833	24.601111	C91
C9H010Q01 VAAL RIVER AT MOZIB/GAMAGARA	VAAL	Rivers	-28.405833	24.271667	C92
C9H011Q01 VAAL RIVER AT DOUGLAS BRIDGE	VAAL	Rivers	-29.049167	23.769722	C92
C9H021Q01 BLOEMHOF DAM ON VAAL RIVER: DOWN STREAM WEIR	VAAL	Rivers	-27.669167	25.618056	C91
DRIEHOEK U/S RESM 7 ON KLIPSPRUIT	KLIPSPRUIT - DRAINAGE REGION C12D	Rivers	-26.540278	29.1625	C12
GROOT BOSSIESPRUIT	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.55	29.130556	C12
DONALDSON DAM	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.2825	27.682222	C23
SKOONSPRUIT DUPLICATE	SKOONSPRUIT - DRAINAGE REGION C24	Rivers	-26.984167	26.631944	C24
C9H023Q01 VAAL RIVER AT SCHMIDTSDRIFT (FLOOD SECTION)	VAAL	Rivers	-28.704167	24.075	C92

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C9H024Q01 AT SCHMIDTSDRIFT (WEIR) ON VAAL RIVER	VAAL	Rivers	-28.711111	24.073333	C92
C9R001Q01 VAALHARTS BARRAGE ON VAAL RIVER: NEAR BARRAGE WAL	VAALHARTS BARRAGE (C9)	Dam / Barrage	-28.115278	24.925833	C91
C9R001Q03 VAALHARTS BARRAGE ON VAAL RIVER: POINT IN BARRAGE	VAALHARTS BARRAGE (C9)	Dam / Barrage	-28.115278	24.925833	C91
C9R002Q01 BLOEMHOF DAM ON VAAL RIVER: NEAR DAM WALL	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.669167	25.618056	C91
C9R002Q02 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.705	25.653	C91
C9R002Q03 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.716	25.715	C43
C9R002Q04 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.767	25.768	C43
C9R002Q05 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.669167	25.618056	C91
C9R002Q06 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.669167	25.618056	C91
C9R002Q07 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.669167	25.618056	C91
C9R002Q08 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.621	25.706	C25
C9R002Q09 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.566	25.828	C25
C9R002Q11 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.669167	25.618056	C91

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C9R002Q13 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.62	25.89	C25
C9R002Q14 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.669167	25.618056	C91
C9R002Q15 BLOEMHOF DAM ON VAAL RIVER: POINT IN DAM	BLOEMHOF DAM (DUPL NAME 2)	Dam / Barrage	-27.669167	25.618056	C91
C9R003Q01 DOUGLAS BARRAGE ON VAAL RIVER: NEAR BARRAGE WALL	DOUGLAS BARRAGE (C9)	Dam / Barrage	-29.043333	23.836944	C92
VAAL DAMWALL	VAAL	Rivers	-26.99	28.18	C83
GROOTDRAAI DAMWALL	VAAL	Rivers	-26.93	29.4	C11
BOSKOP DAMWALL	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.66	27.21	C23
KLERKSKRAAL DAMWALL	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.27	27.25	C23
POTCHEFSTROOM DAMWALL (LAKESIDE DAM)	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.71	27.1	C23
VAALRIVIER BARRAGE	VAAL	Rivers	-26.9	27.69	C23
ALLEMANSKRAAL DAMWALL	SAND (C42)	Rivers	-28.32	27.25	C42
KALKFONTEIN DAMWALL	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.61	25.26	C51
RUSTFONTEIN DAMWALL	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.3	26.61	C52
KRUGERSDRIFT DAMWALL	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.88	26.01	C52
MASELSPOORT DAMWALL	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.14	26.48	C52
MOCKES DAMWALL	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.05	26.56	C52
SERFONTEIN DAMWALL (SAMPLING POINT)	VALS	Rivers	-27.71	27.32	C60

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
KOPPIES DAMWALL	RENOSTER - DRAINAGE REGION C70 A B C	Rivers	-27.33	27.74	C70
VAALHARTS STORAGE WEIR	VAAL	Rivers	-28.25	25	C91
BLOEMHOF DAMWALL (OPPERMANSDRIFT)	VAAL	Rivers	-27.69	25.63	C91
DOUGLAS STORAGE WEIR	VAAL	Rivers	-29.13	23.86	C51
KLIP RIVER AT HENLY ON KLIP WIER	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.549722	28.053333	C22
C4H015Q01 AT VAALKOPPIES ON VET	VETRIVIER - DRAINAGE REGION C4	Rivers	-28.141944	26.417778	C41
C8H001Q02 FRANKFORT-EC LOGGER	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-27.265833	28.488333	C83
C8H026Q02 (FREDERIKSDAL-EC LOGGER) POINT NOT REGISTERED	LIEBENBERGSVLEI	Rivers	-27.4275	28.525833	C83
C4H002Q01 FLOORSDRIFT HOOPSTAD	VETRIVIER - DRAINAGE REGION C4	Rivers	-27.845833	25.908889	C43
C6R001Q01 BAREND WESSELSDAM (SEE C6H007)	VALS	Rivers	-27.670833	27.233333	C60
C4H008Q01 DOWNSTREAM WEIR OF ALLEMANSKRAAL DAM ON SAND RIVER	SAND (C42)	Rivers	-28.287778	27.145833	C42
C8R007Q01 DRIEKLOOF: DRIEKLOOF DAM	DRIEKLOOF DAM	Dam / Barrage	-28.387222	29.016667	C81
C2H189Q01 BLESBOKSPRUIT CANAL AT SNAKE ROAD	R23 ROAD BRIDGE STREAM (C2)	Rivers	-26.181944	28.334722	C21
C2H191Q01 RYNFIELD DAM OVERFLOW	RYNFIELD NO.1-LAKE	Dam / Barrage	-26.160278	28.365278	C21
C2H194Q01 HOSPITAL ROAD STREAM	RAILWAY STREAM DRAINAGE REGION C2	Wetland	-26.199444	28.388889	C21

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C2H196Q01 BLESBOKSPRUIT ON R29 MAIN REEF ROAD	C21D-C21D-TRIBUTARY OF BLESBOKSPRUIT - DRAINAGE REGION C21D	Rivers	-26.183889	28.391944	C21
C2H198Q01 MURRAY PARK BLESBOKSPRUIT AT BIRD DAM OUTFLOW	BIRD DAM NEXT TO ALEXANDER DAM	Dam / Barrage	-26.2125	28.418056	C21
C2H210Q01 KLEIN BLESBOKSPRUIT ON R29 ERMELO ROAD	KLEIN BLESBOKSPRUIT - DRAINAGE REGION C21E	Rivers	-26.2625	28.484722	C21
C2H216Q01 STREAM FROM DUDUZA AT KAYDALE	DUDUZA STREAM - DRAINAGE REGION C21F	Rivers	-26.470278	28.4025	C21
C2H177Q01 DAVEYTONSPRUIT AT WELGEDACHT	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.198611	28.479722	C21
C2H178Q01 GROOTVLEI MINE BRIDGE 50M WEST	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.255278	28.496944	C21
C2H179Q01 BLESBOKSPRUIT ON R29 ERMELO ROAD BRIDGE	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.266111	28.504167	C21
C2H180Q01 N17 ROAD BRIDGE OVER BLESBOKSPRUIT	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.273333	28.505	C21
C2H181Q01BLESBOKSPRUIT AT DAGGAFONTEIN	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.29	28.503056	C21
C2H182Q01 MARIEVALE BIRD SANCTUARY BRIDGE	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.355278	28.516111	C21
C2H183Q01 R42 DELMAS- NIGEL ROAD BRIDGE	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.386944	28.505556	C21
C2H184Q01 NOYCEDALE NIGEL ON BLESBOKSPRUIT	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.438333	28.456667	C21

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C2H185Q01 POORTJIE ROAD ON BLESBOKSPRUIT	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.478056	28.425833	C21
C2H186Q01 AT KLIPSTAPEL ON BLESBOKSPRUIT	BLESBOKSPRUIT - DRAINAGE REGION C21	Rivers	-26.584167	28.298611	C21
C1H028Q01 POORTJIESFONTEIN AT ROAD BRIDGE ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.828333	28.986389	C12
C1H029Q01 WATERVAL BALFOUR/STANDERTON ROAD	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.858333	28.889167	C12
C1H030Q01 AT WOLWEFONTEIN U/S VAAL CONFLUENCE ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.9702778	28.73222222	C12
C1H031Q01 VAAL AT GLADDEDRIFT U/S WATERVAL CONFLUENCE	VAAL	Rivers	-26.991389	28.729722	C12
C1H032Q01 RESM 1 TRICHARDSPRUIT D/S BOSJESSPRUIT CONFLUENCE	TRICHARDSPRUIT - DRAINAGE REGION C12D	Rivers	-26.545	29.114167	C12
C1H033Q01 RESM 8 U/S SASOL SECUNDA ON KLIPSPRUIT	KLIPSPRUIT - DRAINAGE REGION C12D	Rivers	-26.543333	29.205	C12
C1H034Q01 RESM 17 D/S GROOTVLEI WEIR ON KLIPSPRUIT	KLIPSPRUIT - DRAINAGE REGION C12D	Rivers	-26.539722	29.241389	C12
C1H036Q01 LM3 AT ROODEBANK ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.627778	29.021111	C12
C1H037Q01 LM7 WILDEBEESTSPRUIT @ R50 BEFORE CONFLUENCE WITH WATERVAL	TWEEFONTEIN SPRUIT (C1)	Rivers	-26.583611	29.030278	C12
C1H038Q01 RESM 5 TRICHARDSPRUIT D/S SECUNDA U/S KLIPSPRUIT	TRICHARDSPRUIT - DRAINAGE REGION C12D	Rivers	-26.529722	29.150556	C12
C1H039Q01 RESM 6 U/S TRICHARDSPRUIT CONFLUENCE ON KLIPSPRUIT	KLIPSPRUIT - DRAINAGE REGION C12D	Rivers	-26.536111	29.15	C12

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
C4H019Q01 DE HOOP-AT WEIR	VETRIVIER - DRAINAGE REGION C4	Rivers	-28.481111	26.701389	C41
VRB2 VAAL RIVER AT LETHABO POWER STATION WEIR	VAAL	Rivers	-26.730556	26.9925	C23
VRB3 VAAL RIVER AT PANFONTEIN CANAL INFLOW	VAAL	Rivers	-26.706667	28	C22
VRB4 VAAL U/S SUIKERBOSRANT AT ZUIKER-BOSCH PURIFIC WORKS	VAAL	Rivers	-26.688056	27.993056	C22
VRB5 SUIKERBOSRANT U/S CONFLUENCE WITH VAAL RIVER	SUIKERBOSRANTRIVIER	Rivers	-26.664722	27.985	C21
VRB6 VAAL U/S SUIKERBOSRANT AND D/S KLIP RIVER	VAAL	Rivers	-26.669444	27.9675	C22
VRB7 KLIP RIVER AT VAAL RIVER CONFLUENCE AT VOSLOO PARK	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.670556	27.955278	C22
VRB8 VAAL U/S KLIP RIVER AND D/S HOUTKOP SPRUIT CONFLUENCE	VAAL	Rivers	-26.672222	27.948889	C22
VRB9 VAAL D/S OF HOUTKOPSPRUIT CONFLUENCE	VAAL	Rivers	-26.674444	27.941944	C22
VRB10 VAAL RIVER D/S ISCOR VEREENIGING DISCHARGE	VAAL	Rivers	-26.680556	27.938333	C22
VRB12 VAAL D/S OF LEEUKUIL CANAL INFLOW, D/S R59 BRIDGE	VAAL	Rivers	-26.708611	27.898611	C22
VRB13 VAAL U/S OF TAAIBOSCHSPRUIT CONFLUENCE	VAAL	Rivers	-26.746111	27.8775	C22
VRB14 JUST PAST R59 BRIDGE U/S VAAL CONFLUENCE ON TAAIBOSSPRUIT	TAAIBOSSPRUIT - DRAINAGE REGION C22	Rivers	-26.753333	27.874722	C22

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
VRB15 VAAL D/S OF TAAIBOSCHSPRUIT CONFLUENCE	VAAL	Rivers	-26.748611	27.871667	C22
VRB16 VAAL AT ISCOR VAN BIJL ABSTRACTION POINT, U/S OF R57	VAAL	Rivers	-26.75	27.826667	C22
VRB17 INFLOW TO VAAL @ EMERALD ISLE ON SPRUIT FROM BOPHELONG	SPRUIT FROM BOPHELONG - DRAINAGE REGION C22K	Rivers	-26.747222	27.796667	C22
VRB18 VAAL U/S OF LEEUSPRUIT CONFLUENCE 13 KM FR BARRAGE	VAAL	Rivers	-26.786944	27.768611	C22
VRB19 LEEUSPRUIT U/S CONFLUENCE WITH VAAL RIVER	LEEU SPRUIT (C2)	Rivers	-26.789444	27.779167	C22
VRB20 VAAL D/S OF LEEUSPRUIT CONFLUENCE 12KM FR BARRAGE WALL	VAAL	Rivers	-26.806944	27.788056	C22
VRB21 VAAL RIVERT AT BOSCHENVAAL JETTY (MARLBANK)	VAAL	Rivers	-26.798611	27.766667	C22
VRB22 VAAL D/S OF RIETSPRUIT (FREESTATE) CONFLUENCE	VAAL	Rivers	-26.766667	27.7375	C22
VRB23 VAAL RIVER 100 M UPSTREAM OF BARRAGE	VAAL BARRAGE (C2)	Dam / Barrage	-26.763889	27.685	C22
VRB24 VAAL RIVER AT LOCH VAAL BAY (RUSHING WATERS)	VAAL BARRAGE (C2)	Dam / Barrage	-26.75	27.695556	C22
VRB25 VAAL AT LOCH VAAL BAY BETWEEN TOM'S CABIN AND THE OVAL	VAAL BARRAGE (C2)	Dam / Barrage	-26.745556	27.715556	C22
VRB26 RIETSPRUIT AND LOCH VAAL CONFLUENCE UNDER R42 BRIDGE	RIET SPRUIT (C2)	Rivers	-26.738611	27.7125	C22
VS1 VAAL RIVER ORIGIN AT N17 BRIDGE (GDDC01)	VAAL	Rivers	-26.3625	30.108056	C11

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
WILLEM BRUMMER DAM (C1)	KLEIN TRIBUTARY OF WATERVALRIVIER - DRAINAGE REGION C11F	Rivers	-26.433333	29.931389	C11
WILLEM BRUMER DAMWALL/OUTFLOW (GDDC03)	WILLEM BRUMMER DAM (C1)	Dam / Barrage	-26.473056	29.923056	C11
GDDC04 DOUGLAS DAM INFLOW AT N11 BRIDGE (GDDC04)	DOUGLAS DAM STREAM - DRAINAGE REGION C11F	Rivers	-26.464444	29.955556	C11
DOUGLAS DAM AT OUTFLOW (GDDC05)	DOUGLAS DAM STREAM - DRAINAGE REGION C11F	Rivers	-26.467778	29.94	C11
GDDC06 SPRUIT AT OLD SPITZKOP	DOUGLAS DAM STREAM - DRAINAGE REGION C11F	Rivers	-26.461667	29.973333	C11
HUMANSPRUIT DOWNSTEAM OF DELTA MINE AT R29/N2 BRIDGE(GDDC08)	HUMANSPRUIT - DRAINAGE REGION C11B	Rivers	-26.578889	30.073333	C11
WITPUNTSPRUIT AT R29/N2 CAMDEN BRIDGE (GDDC09)	WITPUNT SPRUIT (C1)	Rivers	-26.592778	30.096944	C11
VS2 VAAL RIVER AT R29/N2 BRIDGE AT CAMDEN (GDDC10)	VAAL	Rivers	-26.647222	30.151667	C11
VS4 GDDC11 VAAL RIVER AT R35 BLOUKOP BRIDGE	VAAL	Rivers	-26.854722	29.698056	C11
VS2-3 BLESBOK SPRUIT AT R39 BRIDGE RIETVLEY (GDDC12)	BLESBOKSPRUIT - DRAINAGE REGION C11	Rivers	-26.755556	29.543333	C11
GDDC13 BETHAL AT DAM WALL	BETHAL DAM (C1)	Dam / Barrage	-26.45	29.475833	C11
GDDC14 UPSTREAM OF BETHAL SEWAGE WORKS	BLESBOKSPRUIT - DRAINAGE REGION C11	Rivers	-26.488611	29.440556	C11

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
GDDC15 @ R38 BRIDGE TOPFONTEIN ON TRIBUTARY OF BLESBOKSPRUIT	TRIBUTARY OF BLESBOKSPRUIT @ TOPFONTEIN - DRAINAGE REG C11H	Rivers	-26.500806	29.454917	C11
BLESBOKSPRUIT D/S OF BETHAL SEWAGE WORKS AT PIEKSDAL(GDDC16)	BLESBOKSPRUIT - DRAINAGE REGION C11	Rivers	-26.526667	29.423056	C11
BLESBOKSPRUIT AT R38 BRIDGE GOEDEHOOP (GDDC17)	BLESBOKSPRUIT - DRAINAGE REGION C11	Rivers	-26.566389	29.445556	C11
LEEUSPRUIT DOWNSTREAM OF NEW DENMARK COLLIERY (GDDC18)	LEEU SPRUIT (C1)	Rivers	-26.728056	29.295556	C11
VS2-4 LEEUSPRUIT AT R39 WELBEDACHT BRIDGE (GDDC19)	LEEU SPRUIT (C1)	Rivers	-26.854167	29.325278	C11
MIDVAAL1 HOOGEKRAAL UPSTREAM OF MOOI RIVER	VAAL	Rivers	-26.87	26.95	C23
MIDVAAL2 REGINA WEIR	VAAL	Rivers	-27.103333	26.522778	C24
RAUHAIA GROOT EILAND	VAAL DAM	Dam / Barrage	-26.869722	28.170278	C83
RAUHAIB HARTBEESFONTEIN - VAAL DAM	VAAL DAM	Dam / Barrage	-26.804722	28.146667	C12
RAUHAIC 500 M UPSTREAM OF BARRAGE	VAAL BARRAGE (C2)	Dam / Barrage	-26.761111	27.688333	C22
ZVET01 DOWNSTREAM SAND RIVER CONFLUENCE (LELIEFONTEIN)	VETRIVIER - DRAINAGE REGION C4	Rivers	-28.063889	26.395833	C43
C2R008H01 VAAL RIVER: AT GATES 1-36 (RW V17)	VAAL BARRAGE (C2)	Dam / Barrage	-26.781667	27.684722	C23
C3H017Q01 AT TLAPENG UPSTREAM OF TAUNGDAM ON HARTSRIVIER	HARTSRIVIER - DRAINAGE REGION C31	Rivers	-27.471667	24.930833	C31

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
05 DISCH RESM 21	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.563056	29.148611	C12
REGM 8 COURSE ASH DUMP	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.556389	29.138611	C12
BOSJESSPRUIT BOSSIESPRUIT DAM RESM 20	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.578056	29.195833	C12
BM2 GROOTSPRUIT D/S WINKEL HAAKSPRUIT CONFLUENCE	GROOTSPRUIT - DRAINAGE REGION C12D	Rivers	-26.5325	29.058889	C12
LM2 DOWNSTREAM LESLIE GOLD MINE ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.210556	28.478333	C21
UPSTREAM TRICHARDSPRUIT	TRICHARDSPRUIT - DRAINAGE REGION C12D	Rivers	-26.53	29.149444	C12
LM8 WATERVAL RIVER BELOW CONFLUENCE OF THE WILDEBEES SPRUIT	TRIBUTARY OF WATERVALRIVIER - DRAINAGE REGION C11	Rivers	-26.583889	29.031389	C12
WH5 DOWNSTREAM OF WINKELHAAK GOLD MINE ON WINKELHAAKSPRUIT	WINKELHAAKSPRUIT - DRAINAGE REGION C12D	Rivers	-26.499444	29.105833	C12
BM11 WINKELHAAKSPRUIT U/S GROOTSPRUIT CONFLUENCE	WINKELHAAKSPRUIT - DRAINAGE REGION C12D	Rivers	-26.520278	29.071667	C12
BM13 GROOTSPRUIT D/S BRACKEN KARIBA DAM	SUIKERBOSRANTRIVIER	Rivers	-26.629722	28.296667	C21
KM4 GROOTSPRUIT D/S KINROSS KARIBA DAMS	GROOTSPRUIT - DRAINAGE REGION C12D	Rivers	-26.48	29.068611	C12
AT WOLWEFONTEIN ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.959167	28.743611	C12
RESM 12 GROOT BOSJESSPRUIT U/S BOSJESSPRUIT CONFLUENCE	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.5644444	29.155	C12

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
NATALSPRUIT OFF RING RD EAST IN ALBERTON	NATALSPRUIT - DRAINAGE REGION C22	Rivers	-26.263333	28.123333	C22
EYE OF THE KLEINWIESRITSPRUIT DOWNSTREAM OF PETER WRIGHT DAM	RIET SPRUIT (C2)	Rivers	-26.366667	27.7375	C22
WAGM RECHARGEESC TO BOREHOLE	RIET SPRUIT (C2)	Rivers	-26.341667	27.777778	C22
(SEE 90682)COWLES DAM OVERFLOW	COWLES DAM ON BLESBOKSPRUIT - DRAINAGE REGION C21D	Dam / Barrage	-26.400833	28.473611	C21
ENNERDALE S/W F/E INTO RIETSPRT	RIET SPRUIT (C2)	Rivers	-26.416667	27.766667	C22
VDBPR RIETSPR S/W TO RIETSPRUIT	RIET SPRUIT (C2)	Rivers	-26.693611	27.760556	C22
ISCOR (VDB) FLOWING TO RIETSPRUIT VIA CANAL	RIET SPRUIT (C2)	Rivers	-26.666667	27.8	C22
SEBOKENG S/W TO RIETSPR(BIOFILT)	RIET SPRUIT (C2)	Rivers	-26.575	27.808333	C22
HOUTKOP SPRUIT DOWN STR ISCOR VEREENIGING WORKS	HOUTKOP SPRUIT (C2)	Rivers	-26.666667	27.933333	C22
KLOOF MINE MIXTURE OF SEWAGE AND PROCESS EFFUENT TO THE LOOP	RIET SPRUIT (C2)	Rivers	-26.425	27.591667	C22
BOTSHABELO 3 AT BRIDGE DOWNSTREAM OF PSE OUTFLOW	KLEIN MODDER RIVIER - DRAINAGE REGION C52B	Rivers	-29.242833	26.673667	C52
BOTSHABELO 2 FINAL CITY EXIT POINT UPSTREAM OF PSE OUTFLOW	KLEIN MODDER RIVIER - DRAINAGE REGION C52B	Rivers	-29.238	26.682	C52
BOTSHABELO 1 RUNS THROUGH SUBURB COLLECTING RESIDENTIA WASTE	KLEIN MODDER RIVIER - DRAINAGE REGION C52B	Rivers	-29.295333	26.715	C52
KOEKEMOERSPRUIT-DURBAN ROODEPOORT DEEP ORANGE SHAFT	KOEKEMOER SPRUIT (C2)	Rivers	-26.916	26.8171	C24
MOOI-RYSMIERBULT RDBRIDGE BELOW CONFLUENCE WONDERFONTEINSPR	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.5146	27.1245	C23

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
MOI3 KIEL 128IQ @ MUISKRAAL ROAD BRIDGE ON WONDERFONTEINSPRUIT	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.4366	27.1514	C23
WONDERFONTEINSPRUIT-DWAF PT# 69 NEAR WELVERDIEND	WONDERFONTEIN SPRUIT (C2)	Rivers	-26.3704	27.2482	C23
MOOI RIVER-DERBY ROAD BRIDGE	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.1425	27.1515	C23
MOOI RIVER-VENTERSDORP N14 BRIDGE D/S KLERKSKRAAL DAM	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.2531	27.1598	C23
SKOONSPRUIT AT VENTERSDORP ON KLERKSDORP RD BRIDGE	SKOONSPRUIT - DRAINAGE REGION C24	Rivers	-26.3199	26.833	C24
VENTERSDORP-KLERKSDORP RD BRIDGE BELOW RIETSPRUIT CONFLUENCE	SKOONSPRUIT - DRAINAGE REGION C24	Rivers	-26.4215	26.7286	C24
AT R507 VENTERSDORP - KLERKDORP ROAD BRIDGE ON SKOONSPRUIT	SKOONSPRUIT - DRAINAGE REGION C24	Rivers	-26.6794	26.5833	C24
C2SKOO-URANI NOOITGEDACHT 434 JP KLERKSDORP ORKNEY ROAD @ URANIA RD BRIDGE ON SKOONSPRUIT	SKOONSPRUIT - DRAINAGE REGION C24	Rivers	-26.9347	26.6646	C24
SKOONSPRUIT D/S FROM ORKNEY SEWAGE WORKS	SKOONSPRUIT - DRAINAGE REGION C24	Rivers	-26.986	26.6321	C24
KOEKEMOERSPRUIT/KLERKSDORP-POTCHEFSTROOM N12 RD BRIDGE	KOEKEMOER SPRUIT (C2)	Rivers	-26.8202	26.8317	C24
LONELY HILL - STELLA SOUTPAN	LONELY HILL - STELLA SOUTPAN	Pan	-26.558056	24.880556	C32
3DDD ON MODDERFONTEIN 345 IQ	LEEUSPRUIT (DUPL NAME 2)	Rivers	-26.4214	27.6817	C22
MNS-2 MODDERFONTEIN 345 IQ	LEEUSPRUIT (DUPL NAME 5)	Rivers	-26.4275	27.6744	C22
MNS-3 MODDERFONTEIN 345 IQ	LEEUSPRUIT (DUPL NAME 5)	Rivers	-26.4208	27.6681	C22
MNS-5 MODDERFONTEIN 345 IQ	LEEUSPRUIT (DUPL NAME 2)	Rivers	-26.4353	27.6861	C22

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
ENS-4 ELANDSFONTEIN 115 IQ	ELANDSFONTEINSPRUIT - DRAINAGE REGION D32H	Rivers	-26.4222	27.4525	C23
MNS-4 MODDERFONTEIN 345 IQ	LEEUSPRUIT (DUPL NAME 2)	Rivers	-26.4289	27.6897	C22
MNS-6 MODDERFONTEIN 345 IQ	LEEUSPRUIT (DUPL NAME 5)	Rivers	-26.4378	27.685	C22
HARTS RIVER AT CONFLUENCE WITH VAAL RIVER AT DELPORTSHOOP	HARTSRIVIER - DRAINAGE REGION C33	Rivers	-28.4014	24.2806	C33
DOWNSTREAM OF TAUNG DAM UPSTREAM OF TAUNG	HARTSRIVIER - DRAINAGE REGION C31	Rivers	-27.5392	24.8247	C31
C3R002Q03 SPITSKOP DAM ON HARTS RIVER: POINT IN DAM	SPITSKOP DAM	Dam / Barrage	-28.08	24.555	C33
DAM AT 42ND HILL INFORMAL SETTLEMENT	DAM AT 42ND HILL INFORMAL SETTLEMENT	Dam / Barrage	-28.241556	29.10689	C81
PLOT 33 STEEL VALEY VAN DER BIJLPARK	CONCRETE RESERVOIR ON PLOT 33 VDBPARK	Reservoir	-26.6372	27.8017	C22
RS1 AT ELANDSFONTEIN U/S ENNERDALE SW ON TRIB OF RIETSPRUIT	TRIBUTARY OF RIETSPRUIIT - DRAINAGE REGION C22H	Rivers	-26.404861	27.77775	C22
RS2 AT ELANDSFONTEIN D/S ENNERDALE SW ON TRIB OF RIETSPRUIT	TRIBUTARY OF RIETSPRUIIT - DRAINAGE REGION C22H	Rivers	-26.417056	27.776667	C22
H1 AT GOUDKOPPIE U/S GOUDKOPPIES SW ON HARRINGTON SPRUIT	HARRINGTON SPRUIT - DRAINAGE REGION C22A	Rivers	-26.276028	27.924807	C22
H2 AT GOUDKOPPIE D/S GOUDKOPPIES SW ON HARRINGTON SPRUIT	HARRINGTON SPRUIT - DRAINAGE REGION C22A	Rivers	-26.282556	27.912417	C22
H4 AT MISGUND U/S BUSHKOPPIES SW ON HARRINGTON SPRUIT	HARRINGTON SPRUIT - DRAINAGE REGION C22A	Rivers	-26.315	27.929167	C22
KR5 AT MISGUND D/S BUSHKOPPIES SW ON HARRINTON SPRUIT	HARRINGTON SPRUIT - DRAINAGE REGION C22A	Rivers	-26.318611	27.9425	C22

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
KR10 AT OLIFANTSVLEI U/S OLIFANTSVLEI SW ON KLIPRIVIER	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.325	27.894167	C22
KR11 AT OLIFANTSVLEI D/S OLIFANTSVLEI SW ON KLIPRIVIER	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.336472	27.902861	C22
LOCH LOGAN AT GAZEBO ON BLOEMSPRUIT	BLOEMSPRUIT - DRAINAGE REGION C52F	Rivers	-29.11425	26.210444	C52
SBR#01 @ DUIKER OVERNIGHT HUT IN SUIKERBOSRAND NATURE RESERV	BOSCH STREAM ON SUIKERBOSRAND - DRAINAGE REGION C21F	Rivers	-26.498778	28.302333	C21
SBR#02 @ ELANDSVLAKTE IN SUIKERBOSRAND NATURE RESERVE	ELANDSVLAKTE STREAM ON SUIKERBOSRAND - DRAINAGE REGION C21F	Rivers	-26.546528	28.271056	C21
SBR#3 DAM TREATMENT	BOSCH STREAM ON SUIKERBOSRAND - DRAINAGE REGION C21F	Rivers	-26.518833	28.188194	C22
SBR#04 AT TAMBOEKIESVLAKTE IN SUIKERBOSRAND NATURE RESERVE	TAMBOEKIESFONTEIN STREAM SUIKERBOSRAND - DRAINAGE REG C22C	Rivers	-26.468361	28.189972	C22
SBR#05 AT EVERGREEN DAM IN SUIKERBOSRAND NATURE RESERVE	KOEDOESKLOOF STREAM - DRAINAGE REGION C22C	Rivers	-26.472444	28.218028	C22
C2JAGS-GOEDG GOEDGENOEG 433 IP AT ORKNEY ROAD BRIDGE ON JAGSPRUIT	JAGSPRUIT - DRAINAGE REGION C24H	Rivers	-26.990278	26.619778	C24
KOEKEMOERSPRUIT AT BUFFELSFONTEIN BRIDGE	KOEKEMOER SPRUIT (C2)	Rivers	-26.911194	26.815389	C24
VAALRIVER AT R30 BOTHAVILLE ORKNEY BRIDGE	VAAL	Rivers	-27.014889	26.693833	C24

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
VAAL RIVER AT GROOTEILAND DOWNSTREAM OF PARYS	VAAL	Rivers	-26.918611	27.420278	C23
VAALHARTS BARRAGE SOUTH OF MAIN WATER BODY ON SCHOOLPLAATS	VAALHARTS BARRAGE (DAM)	Dam / Barrage	-28.123833	24.934444	C91
C1H044 AT WELBEDACHT ON LEEUSPRUIT	LEEUSPRUIT (C11K AND C11L)	Rivers	-26.8489	29.3153	C11
C1H045 AT WITBANK UPPER ON HUMANSPRUIT	HUMANSPRUIT - DRAINAGE REGION C11B	Rivers	-26.56917	30.02833	C11
C1H046 AT WITBANK LOWER ON HUMANSPRUIT	HUMANSPRUIT - DRAINAGE REGION C11B	Rivers	-26.5753	30.0344	C11
C2R009 ALEXANDER DAM SPRINGS ON BLESBOKSPRUIT	ALEXANDER DAM ON BLESBOKSPRUIT - DRAINAGE REGION C21D	Dam / Barrage	-26.215	28.43083	C21
C2R010 COWLES DAM SPRINGS ON BLESBOKSPRUIT	COWLES DAM ON BLESBOKSPRUIT - DRAINAGE REGION C21D	Dam / Barrage	-26.20611	28.46278	C21
C2R011 NIGEL DAM	NIGEL DAM - DRAINAGE REGION C21E	Dam / Barrage	-26.40583	28.46917	C21
SELOSESHA (SEROALA) DAM AT INLET ON SEPANE	SEPANE - DRAINAGE REGION C52B	Rivers	-29.205367	26.799767	C52
DITLHAKE TOWNSHIP KOFFIEFONTEIN ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.3945556	25.00502778	C51
DVASCOT ASCOT ON VAAL BRIDGE	VAAL	Rivers	-26.7205556	27.89527778	C22
DVFW F W DE KLERK BRIDGE ON VAAL RIVER	VAAL	Rivers	-26.6816667	27.93777778	C22
C2H274 VAN NIEKERKSRUST VIERFONTEIN ON VIERFONTEINSPRUIT	VIERFONTEINSPRUIT	Rivers	-27.07158	26.7584	C24
GONG GONG D/S BARKLEY WEST ON VAAL	VAAL	Rivers	-28.4964722	24.40672222	C91

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
RONDAVEL NOORD BRENT PARK WEIR D/S KROONSTAD ON VALS	VALS	Rivers	-27.6760556	27.18658333	C60
DOORNFONTEYN MIDDELPLAATS D/S WARRENTON ON VAAL	VAAL	Rivers	-28.1173889	24.82619444	C91
WITKOP @ HENLEY ON KLIP UPSTREAM OF HENLEY WEIR ON KLIPRIVIER	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.4994444	28.07027778	C22
MIDWAY @ N8 BRIDGE ON BLOEMSPRUIT	BLOEMSPRUIT - DRAINAGE REGION C52F	Rivers	-29.1114167	26.31352778	C52
WATERVAL @ N8 BRIDGE ON RENOSTERSPRUIT	RENOSTERSPRUIT - DRAINAGE REGION C52F	Rivers	-29.116	26.32861111	C52
GLEN AT ROAD BRIDGE ON MODDER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.9555	26.33533333	
KOFFIEFONTEIN AT R48 ROAD BRIDGE ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.4126944	25.01727778	
PALMIETFONTEIN @ BOTSHABELO DAM ON KLEIN MODDER RIVIER	KLEIN MODDER RIVIER - DRAINAGE REGION C52B	Rivers	-29.2498056	26.65775	
KRUGERSDRIFT DAM AT DAM WALL NEAR RIGHT BANK	KRUGERSDRIF DAM - DRAINAGE REGION C52G	Dam / Barrage	-28.88325	25.95405556	
STOOMHOEK SOETDORING AT ROAD BRIDGE ON MODDER RIVIER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-28.807	26.10925	
DOORNS AT MODDERRIVIER R29 ROAD BRIDGE ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.03775	24.62480556	
MASELSPOORT DOWNSTREAM OF MAZELSPOORT DAM ON MODDER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.0285556	26.40661111	
RIETKUIL AT 704 ROAD BRIDGE ON PROSESSPRUIT	PROSESSPRUIT	Rivers	-29.8060833	25.49594444	

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
SLAGKRAAL AT ROAD BRIDGE ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.5759444	25.71075	
RUSTFONTEIN DAM NEAR YACHT CLUB ON RUSTFONTEIN DAM	RUSTFONTEIN DAM (DUPL NAME 2)	Dam / Barrage	-29.2698889	26.60872222	
STERKFONTEIN AT ROAD BRIDGE ON KAALSPRUIT	KAALSPRUIT (DUPL NAME 4)	Rivers	-29.2479722	26.04488889	
LOCKSHOEK AT ROAD BRIDGE ON KROMELLENBOOGSPRUIT	KROMELLENBOOGSPRUIT	Rivers	-29.7043056	25.60008333	
LIKATLONG / SANNASPOS AT FARM ROAD BRIDGE ON SEPANE	SEPANE - DRAINAGE REGION C52B	Rivers	-29.1634722	26.59508333	
DAVIDSRUST EINDPUNT ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.1563056	24.77291667	
KALKFONTEIN DAM DISCHARGE TO RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.4963056	25.22105556	
BLAAUWBOSCH FONTEIN DOWNSTREAM OF WEIR ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.0122778	24.13855556	
ROOIDAM ON MODDERRIVIER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.0259444	24.74955556	
EMBALENHLE SECUNDA D/S OF 546 RD BRIDGE ON KLEINSPRUIT	KLEINSPRUIT - DRAINAGE REGION C12D	Rivers	-26.5461278	29.09361944	
TAAIBOSCH FONTEIN SCHOLTZBURG BARRAGE ON RIETRIVIER	RIETRIVIER - DRAINAGE REGION C51	Rivers	-29.0266944	24.04269444	
STANDERTON SAKHILE DOWNSTREAM OF STW AND BUCKET DUMPING SITE ON VAAL	VAAL	Rivers	-26.9769444	29.22663889	
WARDEN 150 M UPSTREAM OF DAM WALL ON CORNELISRIVIER	CORNELISRIVIER - DRAINAGE REGION C82	Rivers	-27.8436111	28.96480556	
WARRENTON @ JAN KEMPDORP R47 ROAD BRIDGE ON VAALRIVIER	VAAL	Rivers	-28.1078333	24.84372222	

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
BARKLEY WEST ABOUT 1KM U/S OF R31 ROAD BRIDGE ON VAALRIVIER	VAAL	Rivers	-28.5485556	24.54144444	
DELPORTSHOOP 2.5KM UPSTREAM OF HARTS CONFLUENCE ON VAALRIVIER	VAAL	Rivers	-28.4178333	24.29038889	
D DAM @ RHEEDERS DAM FRIEDESHEIM ON RHEEDERSDAM	RHEEDERSDAM ON MAHEMSPRUIT - DRAINAGE REGION C43B	Dam / Barrage	-27.9479444	26.68452778	
PRESIDENT STEYN MINE @ DOLLY ON NOORDVLEIDAM	NOORDVLEIDAM - DRAINAGE REGION C25B	Pan	-27.843	26.67327778	
KALKKUIL AT MIMOSA PARK CARAVAN PARK ODENDAALSRUS ON KALKKUIL PAN	KALKKUIL PAN MIMOSA PARK ODELDAALSRUS - DRINAGE REGION C25B	Pan	-27.8811111	26.69375	
MOI1 VARKENSKRAAL 931Q ABOUT 680M D/S OF KLERKSKRAAL DAM ON MOOI RIVER	MOOIRIVIER - DRAINAGE REGION C23	Rivers	-26.2586389	27.15966667	
EC CASINO SASOL SECUNDA ON TRICHARDSPRUIT	TRICHARDSPRUIT - DRAINAGE REGION C12D	Rivers	-26.515	29.163333	C12
ECH20FNT SASOL SECUNDA	TRIBUTARY OF TRICHARDSPRUIT IN SECUNDA - DRAINAGE REGION C12D	Rivers	-26.515833	29.176944	C12
ECHAMH SASOL SECUNDA	KLEIN TRIBUTARY OF WATERVALRIVIER - DRAINAGE REGION C11F	Rivers	-26.517222	29.901944	C11
RESM 2 SASOL SECUNDA	TRICHARDSPRUIT - DRAINAGE REGION C12D	Rivers	-26.538889	29.125278	C12
RESM 3 SASOL SECUNDA	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.545	29.129722	C12
RESM 9 BRANDSPRUIT U/S BOSJESSPRUIT CONFLUENCE	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.561944	29.142778	C12

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
RESM 10 GROOT BOSJESSPRUIT D/S BOSJESSPRUIT CONFLUENCE	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.5644444	29.15305556	C12
RESM 23 SASOL SECUNDA	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.563889	29.1575	C12
RESM16 SASOL SECUNDA	TRIBUTARY OF KLIPSPRUIT ON GOEDEHOOP - DRAINAGE REGION C12D	Rivers	-26.545833	29.214722	C12
RESM 18 SASOL SECUNDA	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.628333	29.025278	C12
RESM 7 SASOL SECUNDA	KLIPSPRUIT - DRAINAGE REGION C12D	Rivers	-26.539722	29.161667	C12
RESM 24 SASOL SECUNDA	GROOT-BOSSIESPRUIT - DRAINAGE REGION C12D	Rivers	-26.578611	29.196111	C12
EC VINKEDAM ON TRIBUTARY OF TRICHARDSPRUIT IN SECUNDA	TRIBUTARY OF TRICHARDSPRUIT IN SECUNDA - DRAINAGE REGION C12D	Rivers	-26.516944	29.183611	C12
EC DUCK DAM ON TRIBUTARY OF TRICHARDSPRUIT IN SECUNDA	TRIBUTARY OF TRICHARDSPRUIT IN SECUNDA - DRAINAGE REGION C12D	Rivers	-26.516111	29.209167	C12
LM4 UPSTREAM OF THE LESLIE MINE COMPLEX ON WATERVALRIVIER	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.471111	28.998889	C12
LM5 WATERVAL RIVER BELOW LESLIE MINE EMERGENCY DAM	WATERVALRIVIER - DRAINAGE REGION C12	Rivers	-26.501667	29.015556	C12
KM6 UPSTREAM OF THE KINROSS MINE COMPLEX ON GROOTSPRUIT	GROOTSPRUIT - DRAINAGE REGION C12D	Rivers	-26.458056	29.0875	C12
KM2 GROOTSPRUIT AT THE BRIDGE ON THE NO7 TO NO8 SHAFT ROAD	GROOTSPRUIT - DRAINAGE REGION C12D	Rivers	-26.468333	29.078333	C12

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
WH7 BELOW NO2 SHAFT AT THE B/G SECUNDA ON TRICHARDSPRUIT	TRICHARDSPRUIT - DRAINAGE REGION C12D	Rivers	-26.515833	29.156944	C12
WH8 BELOW SHAFT BRIDGE EVANDER S/R ON TRICHARDTSPRUIT	TRICHARDSPRUIT - DRAINAGE REGION C12D	Rivers	-26.491111	29.175556	C12
TS EVANDER GOLD MINE	TRICHARDSPRUIT - DRAINAGE REGION C12D	Rivers	-26.551944	29.078333	C12
WH2 EVANDER DAM	EVANDER DAM - DRAINAGE REGION C12D	Dam / Barrage	-26.490833	29.130278	C12
BM3 GROOTSPRUIT AT BRIDGE ON LESLIE BRACKEN MINE ROAD	GROOTSPRUIT - DRAINAGE REGION C12D	Rivers	-26.506667	29.058889	C12
ELSBURG SPRUIT ON BRUG ROAD	VAAL	Rivers	-26.291944	28.2025	C22
HUMANSPRUIT AT DELTA FARM HOUSE	VAAL	Rivers	-26.503333	29.443056	C11
HUMANSPRUIT NEXT TO RAIL LINE	VAAL	Rivers	-26.503333	29.443056	C11
HUMAN SPRUIT UPSTREAM VAN HEERDEN	VAAL	Rivers	-26.503333	29.443056	C11
WITPUNTSPRUIT AT USUTU MINE	WITPUNTSPRUIT	Rivers	-26.58	30.092778	C11
LBB LIEBENBERGVLIE RIVER AT BEFORE BETHLEHEM	LIEBENBERGSVLEI	Rivers	-27.424444	28.5325	C83
BETHLEHEM SEWAGE WORKS FINAL EFFUENENT	LIEBENBERGSVLEI	Rivers	-28.213611	28.311389	C83
REITZ SEWAGE WORKS FINAL EFFUENENT	LIEBENBERGSVLEI	Rivers	-27.783056	28.439167	C83
ARO LESOTHO HIGHLANDS ASH RIVER OUTFALL	LIEBENBERGSVLEI	Rivers	-28.272222	28.372778	C83
JLL JORDAANSPRUIT AT LOCK LOMOND	LIEBENBERGSVLEI	Rivers	-28.166944	28.311389	C83
LIEBENBURG RIVER AT BOHLOKONG BRIDGE	LIEBENBERGSVLEI	Rivers	-28.191389	28.343611	C83
KLIPSPRUIT DOWN STR OF PROTEA ON N12	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.301667	27.900833	C22

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
TRIBUTARY TO KLIPRIVIER DOWN STR OF ELDORADOPARK ON N12	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.318333	27.857222	C22
KLIP RIVER ON R59	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.2647222	28.12388889	C22
KLIP RIVER ON KAREEKLOOF RD D/S WATERVAL STW	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.351944	28.086944	C22
KLIP RIVER AT VOSLOOPARK CONFLUENCE WITH VAAL BARRAGE LAKE	TRIBUTARY OF WATERVALRIVIER - DRAINAGE REGION C12F	Rivers	-26.705	28.937222	C12
NATALSPRUIT ON R550 D/S ZONKIZIZWE & CONFLUENCE WITH RIET	NATALSPRUIT - DRAINAGE REGION C22	Rivers	-26.4261111	28.165	C22
WITHOKSPRUIT SOUTH ON R23 U/S TAILINGSDAM	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.301667	28.334722	C22
WITHOKSPRUITNORTH ON R23 D/S OF SALLIES AND ERGOPLANT	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.320278	28.336111	C22
RIETSPRUIT DOWN STR OF KNIGTHS AND ERGO	RIETSPRUIT - DRAINAGE REGION C22C	Rivers	-26.373056	28.238611	C22
RIETSPRUIT ON R550 U/ S CONFLUENCE WITH NATALSPRUIT	RIETSPRUIT - DRAINAGE REGION C22C	Rivers	-26.4294444	28.18111111	C22
ELSBURGSPRUIT ON R554 U/S OF CONFLUENCE WITH NATALSPRUIT	NATALSPRUIT - DRAINAGE REGION C22	Rivers	-26.288333	28.168333	C22
KLIP RIVER CONFLEUNCE WITH RIETSPRUIT D/S WATERVAL EFFL	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.4425	28.085833	C22
KLIP RIVER ON R550 U/S WATERVAL STW DISCHARGE	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.4016667	28.09333333	C22
RIETSPRUIT ON WATERVAL STW U/S CONFLUENCE WITH KLIP RIVER	RIETSPRUIT - DRAINAGE REGION C22C	Rivers	-26.291944	28.2025	C22

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
PARYS WCW FINAL DISCHARGE POINT INTO VAAL RIVER	VAAL	Rivers	-27.438778	26.902322	C60
WASGOEDSPRUIT BEFORE CONFLUENCE WITH MOOI RIVER IN POTCHEFST	MOOIRIVIER - DRAINAGE REGION V20	Rivers	-27.443583	26.902308	C60
ENNERDALE BRIDGE JUST BEFORE SEWAGE WORKS	RIET SPRUIT (C2)	Rivers	-26.409722	27.778833	C22
STREAM BELOW TRIPLE DAMS	RIET SPRUIT (C2)	Rivers	-26.423056	27.6815	C22
LEEUSPRUIT AT KALBASFONTEIN BEFORE ENTERING RIETSPRUIT	RIET SPRUIT (C2)	Rivers	-26.548611	27.691111	C22
LEEUKUIL SEWAGE FINAL EFFLUENT	RIET SPRUIT (C2)	Rivers	-26.670278	27.899167	C22
THIRTEEN AND EIGHTH SPRUIT WHICH FLOWS INTO THE LEEUSPRUIT	RIET SPRUIT (C2)	Rivers	-26.494722	27.6925	C22
RIETSPRUIT AT RIETSPRUIT DOWNSTREAM OF SEBOKENG	RIET SPRUIT (C2)	Rivers	-26.579444	27.793167	C22
WILGE RIVER ABOVE FRANKFORT	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.483611	27.291667	C42
NUWEJAAR DOWNSTREAM OF STERKFONTIEN DAM	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.292222	29.095	C81
ELANDS RIVER DOWNSTREAM OF QWAQWA	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.3825	28.866389	C81
HARRISMITH SEWAGE WORK FINAL EFFLUENT TO BE DELETED	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.268889	29.099722	C81
MEUL RIVER DOWNSTREAM OF RIBBOKSPRUIT	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.018333	29.246944	C81
QWAQWA SEWAGE WORK FINAL EFFLUENT TO BE DELETED	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.508889	28.830278	C81

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
CORNELIS RIVER AT WARDEN TO BE DELETED	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-27.849722	28.961111	C82
ELANDS RIVER AT ABERFELDY TO BE DELETED	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.223889	28.852222	C81
TWEELING SPRUIT C8	LIEBENBERGSVLEI	Rivers	-27.534722	28.524167	C83
SULLAGE STREAM UPSTREAM OF KLIPRIVER KLIPTOWN	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.273889	27.884444	C22
SULLAGE STREAM MIDDLESTREAM OF KLIPRIVER KLIPTOWN	KLIPRIVIER - DRAINAGE REGION C83	Rivers	-26.7383	28.0519	C22
SULLAGE STREAM DOWNSTREAM OF KLIPRIVER AT KLIPTOWN	KLIPRIVIER - DRAINAGE REGION C22	Rivers	-26.7547	28.0689	C22
WE WILGE RIVER AT CORNELIS RIVER	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.9611	27.2928	C41
QSW QWAQWA SEWAGE WORKS FINAL EFFLUENT	KGOTJWANE	Rivers	-28.5089	28.8303	C81
WILGE AT ABERFELDY	ELANDSRIVIER - DRAINAGE REGION C81	Rivers	-28.2297	28.8522	C81
WH WILGE RIVER BELOW HARRISMITH	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.2286	28.965	C81
TSW TSHIAME SEWAGE WORK FINAL EFFLUENT	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.2797	28.99	C81
HSW HARRISMITH SEWAGE WORK FINAL EFFLUENT	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-28.2689	29.0943	C81
MEUL CONFLUENCE RIBBOK	MEUL	Rivers	-28.0183	28.2477	C83
WAL WILGE RIVER CONFLUENCE LIENBENDERG RIVER	DUPLOOYSPRUIT	Rivers	-28.4836	27.2917	C42

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
KLIP RIVER ON THE GRAVEL ROAD ON THE R543 BETWEEN STD & VOLK	KLIPRIVIER - DRAINAGE REGION C13	Rivers	-27.356944	29.483056	C13
SPRUITSONDERDRIF D/S VREDE ON R546 R/D FROM VREDE STANDERTON	SPRUITSONDERDRIF - DRAINAGE REGION C13	Rivers	-27.415278	29.183611	C13
PAMPOENSPRUIT DOWN STREAM OF MEMEL	KLIPRIVIER - DRAINAGE REGION C13	Rivers	-27.669444	29.563333	C13
KLIP RIVER UP STREAM OF MEMEL ON R34 RD TO NEWCASTLE	KLIPRIVIER - DRAINAGE REGION C13	Rivers	-27.683611	29.577778	C13
SCHUILHOEKSPRUIT TRIBUTARY OF THESANDSPRUIT	SANDSPRUIT (C13A &B)	Rivers	-27.306944	29.817778	C13
SANDSPRUIT AT VOLKSRUST	SANDSPRUIT (C13A &B)	Rivers	-27.264444	29.781111	C13
VAAL RIVER AT STANDERTON UPSTREAM OF THE SEWAGE WORK	VAAL	Rivers	-26.960278	29.243333	C11
SKOONSPRUIT D/S CORNELIA ON R34 RD FROM VREDE TO CORNELIA	SKOONSPRUIT - DRAINAGE REGION C12C	Rivers	-27.220833	28.844167	C12
ORANJEVILLE SEWAGE WORK FINAL EFFLUENT	C81A-C83M-WILGERIVIER - DRAINAGE REGION C8	Rivers	-26.972222	28.183333	C83
LTS13 LEEUSPRUIT AT R59 BRIDGE	LEEU (DUPL NAME 2)	Rivers	-26.409722	28.098611	C22
LTS20 TAAIBOSCHSPRUIT AT WEIR ON JERSEY FARM	TAAIBOSSPRUIT - DRAINAGE REGION C22	Rivers	-26.823056	27.933611	C22
LTS30 KROMELMBOOGSPRUIT ON R59 BRIDGE	KROMELMBOOGSPRUIT	Rivers	-26.848889	27.657222	C23
VAAL RIVER DOWNSTREAM OF STANDERTON	VAAL	Rivers	-27.016667	29.030278	C12
LTS15 INDUSTRIAL EFFLUENT TO TAAIBOSCH FROM DRIEFONTEIN DAM	DRIEFONTEIN DAM (DUPL NAME 4)	Dam / Barrage	-26.809444	27.879722	C22
LTS28 CANAL TO HENRY DAM OMNIA EFFLUENT	WEBBS DAM SASOLBURG	Dam / Barrage	-26.799167	28.9075	C12

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
LTS21 TAAIBOSCH SPRUIT DOWNSTREAM OF WEBBS DAM AT RAIL LINE	TAAIBOSSPRUIT - DRAINAGE REGION C22	Rivers	-26.38	27.508611	C23
SANDSPRUIT ON N11 R/D FROM AMERSFORT TO VOLKSRUST	SANDSPRUIT (C13A &B)	Rivers	-27.241667	29.889444	C13
KLIP RIVER D/S MEMEL ON GRAVEL R/D FROM VOLKSRUST TO MEMEL	KLIPRIVIER - DRAINAGE REGION C13	Rivers	-27.47	29.600278	C13
BRUMMERSPRUIT AT N17 D/S ERMELO S/W	BRUMMERSPRUIT (C1)	Rivers	-26.512778	29.908056	C11
RIETSPRUIT AT N11 TAPFONTEIN BRIDGE BETWEEN ERMELO AMERSFORT	RIETSPRUIT (C11E)	Rivers	-26.913056	29.872222	C11
VS3 VAAL RIVER ON N11 BRIDGE TO AMERSFORT	VAAL	Rivers	-26.778611	29.920833	C11
TWEEFONTEIN SPRUIT AT BRIDGE ON N17	TWEEFONTEIN SPRUIT (C1)	Rivers	-26.516111	29.298056	C12
KLEIN RIETSPRUIT 1KM DOWNSTREAM OF ENNERDALE SEWAGE WORKS	KLEINWESRIETSPRUIT - SWKR11	Rivers	-26.4308	27.7791	C22
FOCHVILLE ROAD BEFORE BRIDGE OVER THE N1	RIET SPRUIT (C2)	Rivers	-26.5793	27.7928	C22
KLEIN RIETSPRUIT D/S EVATON OFF R553 TO SEBOKENG	KLEIN RIETSPRUIT (C2)	Rivers	-26.5552	27.8155	C22
KLEIN WES RIETSPRUIT SOUTH OF R28 BRIDGE OVER N1 TO BLOEM	KLEINWESRIETSPRUIT - SWKR11	Rivers	-26.5424	27.8062	C22
RIETSPRUIT ON BRIDGE N1 SOUTH WEST OF ISCOR VADERBIJLPARK	RIET SPRUIT (C2)	Rivers	-26.6472	27.746	C22
NATALSPRUIT ON HELSTON STREET BRIDGE	NATAL SPRUIT (C2)	Rivers	-26.2925	28.169444	C22
KLEIN VAAL	KLEIN VAAL	Rivers	-26.788611	30.128333	C11
DELANGESDRIFT BRIDGE ON R546 ROAD TO VREDE ON KLIPRIVIER	KLIPRIVIER - DRAINAGE REGION C13	Rivers	-27.1827778	29.235	C13

Monitoring Point Name	Located on Feature Name	Located on Type	Latitude	Longitude	Drainage Region Name
STERKFONTEIN DAM	STERKFONTEIN DAM (DUPL NAME 4)	Dam / Barrage	-28.4158	29.0358	C81
SANNASPOS ON MODDER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.158333	26.544444	C52
WELKOM WITPAN SEWAGE WORKS, FINAL EFFLUENT	WITPAN	Pan	-28.006944	26.769444	C42
KORANASPRUIT ON MODDER RIVER	MODDERRIVIER - DRAINAGE REGION C52	Rivers	-29.158333	26.855556	C52
PETER WRIGHT DAM	PETER WRIGHT DAM	Dam / Barrage	-26.35	27.716667	C23
KLEINWESRIETSPRUIT - SWKR11	KLEINWESRIETSPRUIT - SWKR11	Rivers	-26.35	27.733334	C23
DEEL KRAAL MINE PTN. TAAIBOSHSPRUIT - 013	LOOPSPRUIT TRIBUTARY - DRAINAGE REGION C23J	Rivers	-26.525217	27.3235	C23
TAAIBOSCHSPRUIT 401IQ @ ROAD BRIDGE U/S KLIPDRIFDAM - 014 ON LOOPSPRUIT	LOOPSPRUIT (DUPL NAME 1)	Rivers	-26.5224	27.376667	C23
C2H034Q01 BLYVOORUITZICHT - 012	C2H034Q01 BLYVOORUITZICHT - 012	Rivers	-26.397567	27.401817	C23

APPENDIX B

INVENTORY OF DWAF FREE STATE REGIONAL OFFICE MONITORING POINTS IN THE MIDDLE VAAL RIVER

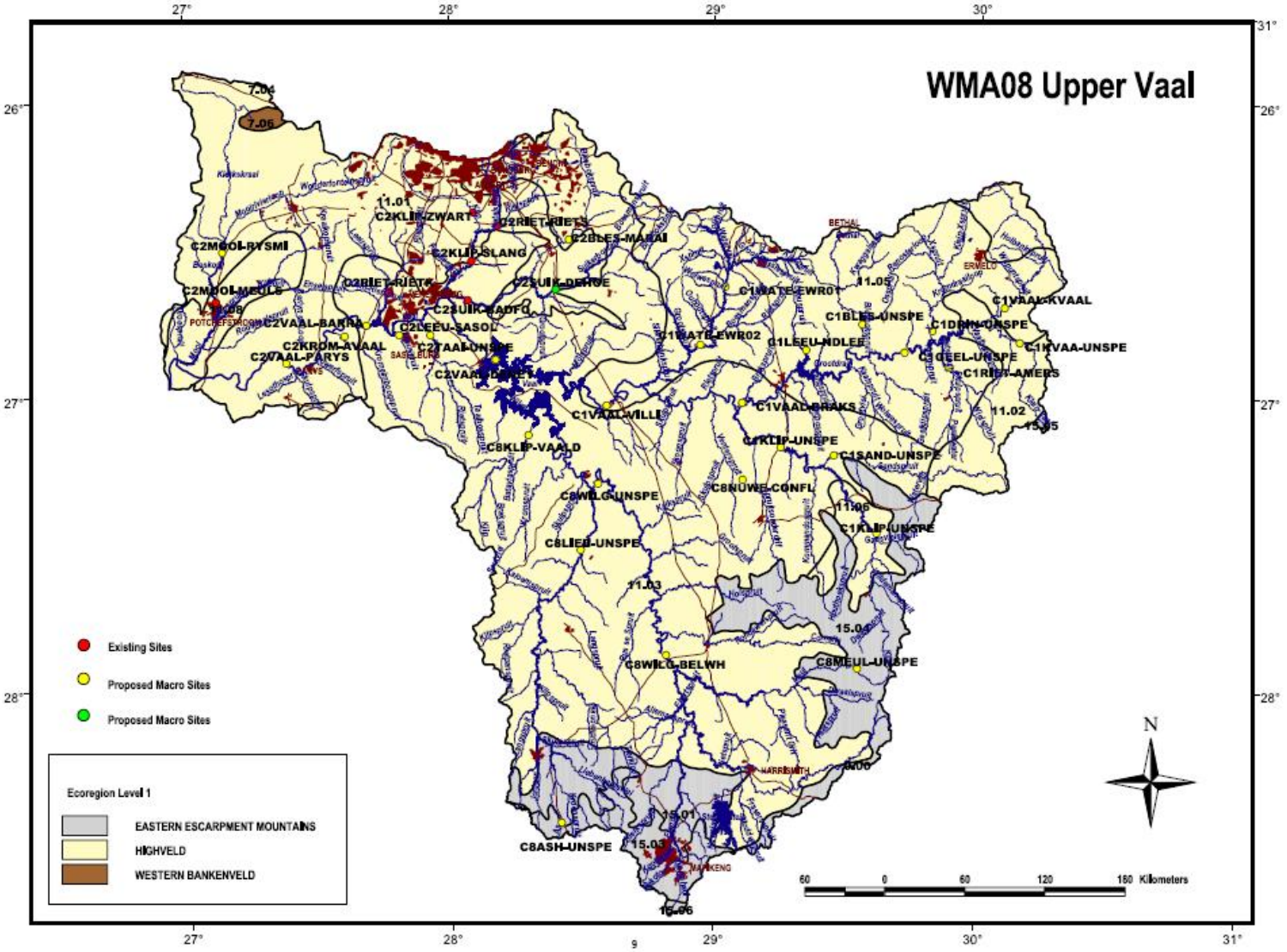
Table B.1: List of the WQ monitoring points as part of the DWAF Free State Regional Monitoring Programme

DWAF Free Regional Monitoring Points						
WMA	**Monitoring Point ID**	**VS number**	**Monitoring Point Name**	**Tertiary Drainage Region**	**Latitude**	**Longitude**
Middle Vaal	RO WQ point	**VS10**	**VS10 VERMAASDRIFT**	C24	-26.933	26.852
	RO WQ point	**VS11**	**VS11 MIDVAAL WATER COMPANY**	C24	-27.935	26.808
	RO WQ point	**VS13**	**VS13 REGINA BRIDGE**	C24	-27.1028	26.528
	RO WQ point	**VS15**	**VS15 UPSTREAM BLOEMHOF DAM (MAKWASSIE AT GREYLINGSDRIFT BRIDGE)**	C25	-27.6	26.094

*RO WQ point (Regional Office Water Quality point): This monitoring point does not form part of the Department's national chemical monitoring network, but is rather a monitoring point that is managed by the Regional Office only. However these points should eventually be registered on the Department's national chemical monitoring network (on the Water Management System).

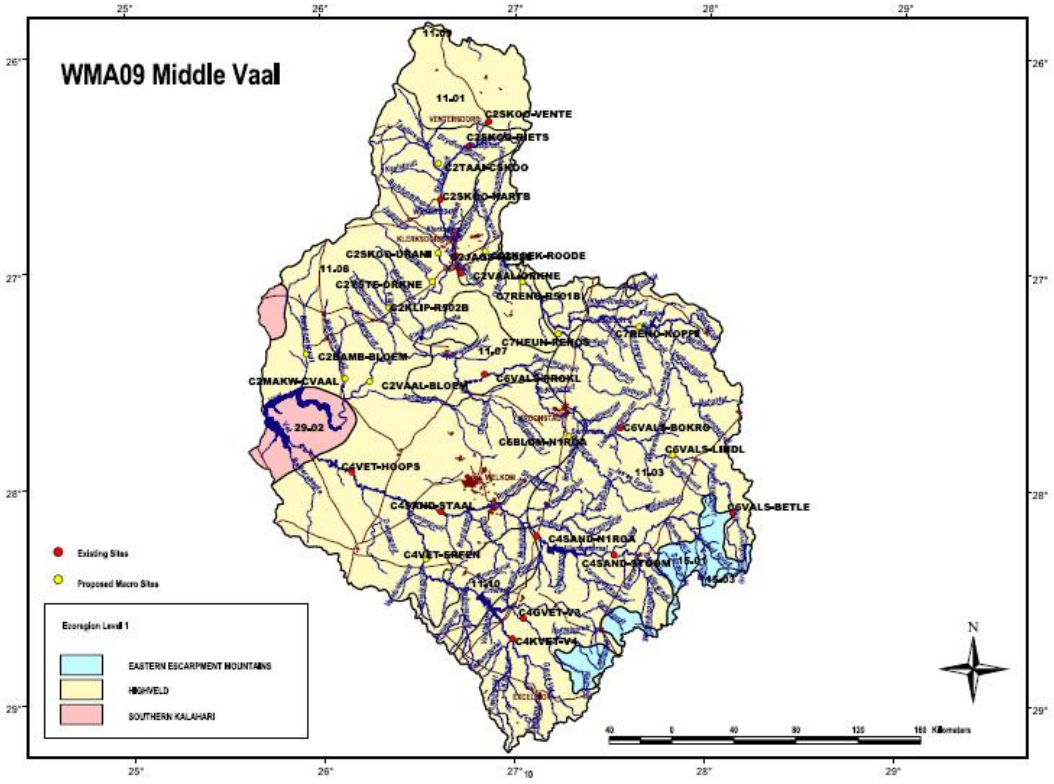
APPENDIX C

RIVER HEALTH PROGRAMME SITES


WMA08 Upper Vaal
27°
28°
29°
30°
31°
26°
27°
28°
7.04
7.06
11.01
C2KLIP-ZWART
C2RIET-RIET3
C2BLES-MAKAI
C2MOOL-RYSMI
C2KLIP-SLANG
C2MOOL-MEULS
C2RIET-RIET5
C2SUIK-DEHOE
C2SUIK-BADFO
C2VAAL-BANK3
C2LEEU-SASOL
C2KROM-AVAAL
C2VAAL-PARYS
C2VAAL-UNSPE
C1VAAL-VILLI
C8KLIP-VAALD
C1BATE-EWR01
C1BATE-EWR02
11.05
C1VAAL-KVAAL
C1BLES-UNSPE
C1DRIE-UNSPE
C1LEEU-NDLEE
C1KVAA-UNSPE
C1LEEU-UNSPE
C1RIET-AMERS
C1VAAL-BRAKS
11.02
15.05
C1KLIP-UNSPE
C1SAND-UNSPE
C8NUWE-CONFL
C8WLG-UNSPE
11.06
C1KLIP-UNSPE
C8LIEB-UNSPE
11.03
15.04
C8WLG-BELWH
C8MEUL-UNSPE
15.01
15.03
C8ASH-UNSPE
15.06
Existing Sites
Proposed Macro Sites
Proposed Macro Sites
Ecoregion Level 1
EASTERN ESCARPMENT MOUNTAINS
HIGHVELD
WESTERN BANKENVELD
N
60 0 60 120 180 Kilometers

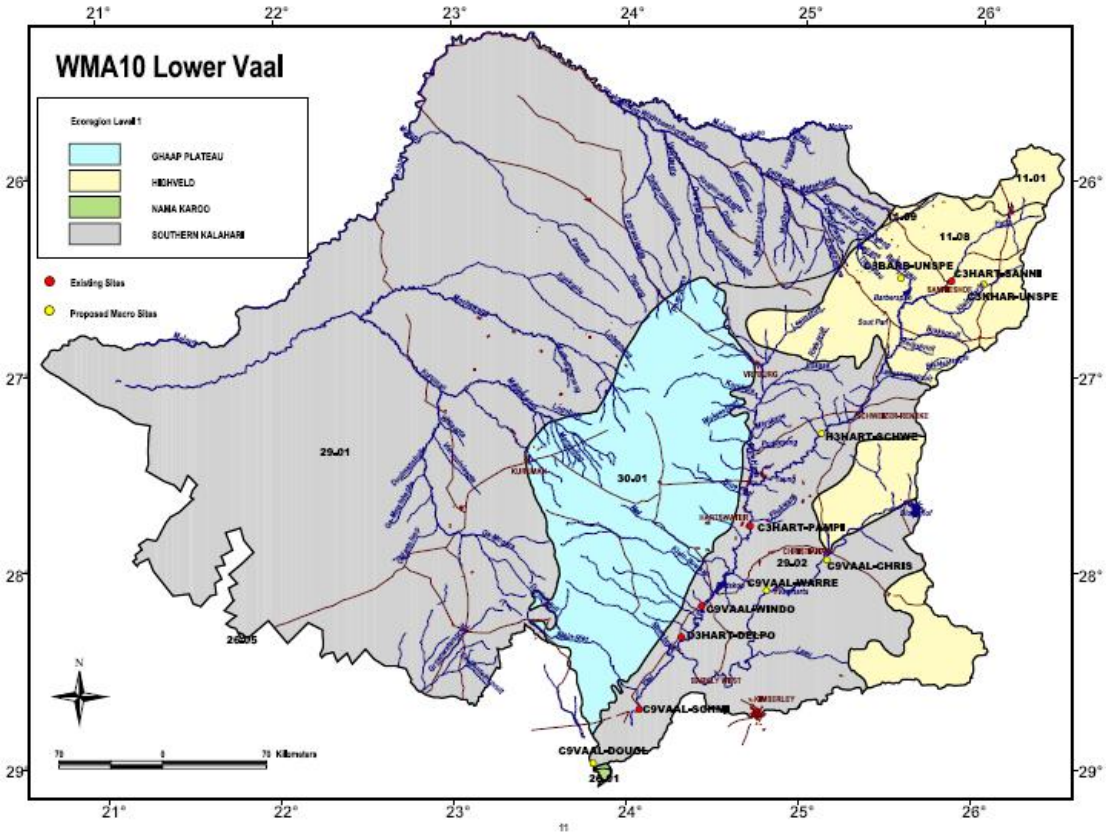
Upper Vaal WMA: RHP sites

RHP Site Code	Province	Site Type	Ecoregion	Major Rivers	Tributary	Original Site Name / Site Code	Site description	Latitude	Longitude
C1VAAL-KVAAL	Mpumalanga	P	11.05	Vaal		Proposed macro site	Above confluence with Klein-Vaal River	-26.703100	30.078670
C1Vaal-BRAKS	Mpumalanga	P	11.03	Vaal		Proposed macro site	Between Brakspruit and Klip confluence	-27.030400	29.087330
C1VAAL-VILLE	Free-State	P	11.03 or 11.05	Vaal		Proposed macro site	Nera Villiers	-27.038200	28.573930
C2VAAL-DENEY	Free-State	P	11.03	Vaal		Proposed macro site	Near Deneyville	-26.884240	28.154460
C2VAAL-PARYS	Free-State	P	11.01	Vaal		Proposed macro site	Downstream of Parys	-26.893440	27.361990
C2VAAL-BARRA	Free-State	P	11.03	Vaal		Proposed macro site	Downstream of Vaal Barrage	-26.763430	27.666040
C8ASH-UNSPE	Free-State	P	15.03	Vaal	Ash	Proposed macro site	Possibly site AA of Rand Water?	-28.457533	28.402017
C1BLES-UNSPE	Mpumalanga	P	11.05	Vaal	Blesbokspruit	Proposed macro site	Possibly site VB	-26.761233	29.540517
C2BLES-MARAI	Gauteng	P	11.03	Vaal	Blesbokspruit	Proposed macro site	IFR Site, At Poortjie upstream of the bidge	-26.475000	28.431944
C1DRNIN-UNSPE	Mpumalanga	P	11.05	Vaal	Drinkwaterspruit	Proposed macro site	Possibly site VK	-26.781017	29.806283
C1KVAA-UNSPE	Mpumalanga	P	11.02	Vaal	Klein Vaal	Proposed macro site	Possibly Site VKV	-26.819700	30.136550
C1KLIP-UNSPE	Free-State	P	11.03	Vaal	Klip (Grootdraai)	Proposed macro site	Possibly site KD	-27.18252	29.234417
C1KLIP-UNSPE	Free-State	P	11.06	Vaal	Klip (Grootdraai)	Proposed macro site	Possibly site KB	-27.47008	29.600483
C1LEEU-NDLEE	Mpumalanga	P	11.05	Vaal	Leeuspruit	Proposed macro site	Possibly site Ndleeu	-26.85022	29.329367
C1RIWT-AMERS	Mpumalanga	P	11.05	Vaal	Rietspruit	Proposed macro site	Below Amersfoort Dam, above confluence with Vaal River	-26.90710	29.87155
C1SAND-UNSPE	Mpumalanga	P	11.03	Vaal	Sandspruit	Proposed macro site	Possibly site VSS	-27.20843	29.43695
C1GEEL-UNSPE	Mpumalanga	P	11.05	Vaal	Geelklipspruit	Proposed macro site	Possibly site VAS	-26.85415	29.701167
C1WATE-EWR01	Mpumalanga	P	11.05	Vaal	Waterval	Proposed macro site		-26.63518	29.02262
C1WATE-EWR02	Mpumalanga	P	11.05	Vaal	Waterval	Proposed macro site		-26.83428	28.92836
C2KLIP-ZWART	Gauteng	E	11.03	Vaal	Klip (Vaal Barrage)		On Rand Water Property west of R59	-26.38118	28.07168
C2KLIP-SLANG	Gauteng	E	11.03	Vaal	Klip (Vaal Barrage)		Below Henley-on-Klip weir	-26.54934	28.06435
C2RIET-RIETK	Gauteng	E	11.03	Vaal	Rietspruit	C2RIET-REITK	East of N1, at Iscor	-26.6546	27.7484
C2KROM-AVAAL	Free-State	P	11.01	Vaal	Kromeelenboogspruit	Proposed macro site	Above confluence with Klein-Vaal River	-26.8003	27.58428
C2LEEU-SASOL	Free-State	P	11.03	Vaal	Leeuspruit	Proposed macro site	Near Sasolburg	-26.79903	27.78994
C2MOOI-KLERK	North-West	E	11.03	Vaal	Mooi		Downstream from Klerkskraal dam	-25.2586388	27.159666
C2MOOI_MEULS	North-West	E		Vaal	Mooi		Below Potch Dam at Meul street in Potchefstroom	-26.682833	27.098555
C2MOOI-RYSMI	North-West	P	11.01	Vaal	Mooirivierloop	Proposed macro site	Rysmierbult Rd bridge, below confluence with Wonderfoteinspruit	-26.514617	27.12455
C2RIET-RIETS	Gauteng	E	11.03	Vaal	Rietspruit (Klip River)		North-West of Suikerbosrand Nature Reserve	-26.42917	28.16061
C2SUIK-BADFO	Gauteng	E	11.03	Vaal	Suikerbosrant	C2SUIK-BADFO	Downstream of the Balfour-Vereenging road	-26.681222	28.050111
C2SUIK-DEHOE	Gauteng	R	11.03	Vaal	Suikerbosrand		West of N3 crossing	-26.646722	28.381972
C2TAAI-UNSPE	Free-State	P	11.03	Vaal	Taaibosspruit	Proposed macro site	Possibly site TW2	-26.800133	27.907633
C8LIEB-UNSPE	Free-State	P	11.03	Vaal	Liebenbergsvlei	Proposed macro site	Possibly site WLT	-27.5317	28.475783
C8KLIP-VAALD	Free-State	P	11.03	Vaal	Klip (flows into Vaal Dam from FS)	Proposed macro site	Upstream of confluence with Vaal Dam	-27.14232	28.27802
C8WILG-UNSPE	Free-State	P	11.03	Vaal	Wilge	Proposed macro site	Possibly site WAF	-27.307000	28.54195
C8WILG-BELWH	Free-State	P	11.03	Vaal	Wilge	Proposed macro site	Downstream of WH Site	-27.88788	28.80106
C8NUWE-CONFL	Free-State	P	15.01	Wilge	Nuwejaarspruit	Proposed macro site	Downstream of confluence with Fraiser, IFR Site, downstream of roadbridge to Bethlehem	-27.289666	29.090683
C8MEUL-UNSPE	Free-State	P	15.04	Wige	Meul	Proposed macro site	In upper reaches of river	-27.93242	29.53044


WMA09 Middle Vaal
25°
26°
27°
28°
29°
11.01
C2SKOO-VENTE
C2SKOO-RIETS
C2TAAI-SKOO
C2SKOO-HARTB
C2SKOO-USANI
11.08
C2RSTE-ORKNE
C2KLIP-R502B
C2BAMB-BLOEM
C2MAKW-CVAAL
C2VAAL-BLOEM
C7HEUN-RENOS
11.07
C6VALS-BOKRO
C6VALS-LINDL
C6BLOM-N1RDS
C6VET-HOOPS
11.03
C6VALS-BETLE
C4SAND-N1RDS
C4VET-GREEN
11.10
C4GVET-V3
C4KVET-V4
29.02
Existing Sites
Proposed Macro Sites
Ecoregion Level 1
EASTERN ESCARPMENT MOUNTAINS
HIGHVELD
SOUTHERN KALAHARI
N
40 0 40 80 120 160 Kilometers

Middle Vaal WMA: RHP sites

RHP Site Code	Province	Site Type	Ecoregion	Major Rivers	Tributary	Original Site Name/ Site Code	RHP Site Code	Site Description	Latitude	Longitude
C2VAAL-BLOEM	Free State	P	29/02 or 11.08	Vaal		Proposed macro site	C2VAAL-Bloem	MV1 between Bloemhof and concluence with Vals River	-27.51729	26.21604
C2VAAL-ORKNE	North-West	E	11.08	Vaal		MV2	C2VAAL-ORKNE	Orkney Brug	-27.01366	26.69313
C2KLIP-R502B	North-West	P	11.08	Vaal	Klipspruit	Proposed macro site	C2KLIP-R502B	MV3 - Above R502 road bridge	-27.17468	26.31863
C2STE-ORKNE	North-West	P	11.08	Vaal	Ysterspruit	Proposed macro site	C2STE-ORKNE	MV4 - Orkney-Leeudoringstad Rd bridge	-27.05595	26.54283
C2KOEK-ROODE	North-West	P	11.01	Vaal	Koekemoerspruit	Proposed macro site	C2KOEK-ROODE	MV5 - Durban Roodepoort Deep Oranje Shaft	-26.91605	26.81713
C2JAGS-R502B	North-West	P	11.08	Vaal	Jagspruit	Proposed macro site	C2JAGS-R502B	Mv6 - Above R502 road bridge	-26.92229	26.57512
C2MAKW-CVAAL	North-West	P	11.08	Vaal	Makwassiespruit	Proposed macro site	C2MAKW-CVAAL	Mv7 - upstream of confluence with Vaal Rivier	-27.50026	26.08791
C2BAMB-BLOEM	North-West	P	11.08	Vaal	Bamboesspruit	Proposed macro site	C2BAMB-BLOEM	Mv8 - upstream of Bloemhof Dam	-27.38458	25.88745
C2SKOO-URANI	North-West	E	11.08	Vaal	Skoonspruit	SK1	C2SKOO-URANI	IFR Site - Uraniumville	-26.93333	26.66527
C2SKOO-HATRB	North-West	E	11.08	Vaal	Skoonspruit	SK2	C2SKOO-HATRB	IFR SITE - Hartbeesfontein	-26.67500	26.58611
C2SKOO-RIETS	North-West	E	11.08	Vaal	Skoonspruit	SK3	C2SKOO-RIETS	IFR Site - Rietspruit Dam	-26.42688	26.73594
C2SKOO-Vente	North-West	E	11.01	Vaal	Skoonspruit	SK4	C2SKOO-Vente	IFR Site - Ventersdorp	-26.31178	26.83761
C2TAAI-CSKOO	North-West	P	11.08	Vaal	Taaibosspruit	Proposed macro site	C2TAAI-CSKOO	SK5 - upstream of confluence with Skoonspruit	-26.50565	26.57665
C4VET-HOOPS	Free State	E	29.02	Vaal	Vet	V1	C4VET-HOOPS	Hydro @ Hoopstad	-27.93412	26.12094
C4VET-ERFEN	Free State	P	11.10 or 11.08	Vaal	Vet	Proposed macro site	C4VET-ERFEN	V2 - between Hoopstad and downstream of Erfenis Dam	-28.34339	26.50617
C4GVET-V3	Free State	E	11.03	Vaal	Groot Vet	V3	C4GVET-V3	V3 - Groot Vet, Often Dry	-28.61872	27.01661
C4GVET-V4	Free State	E	11.03	Vaal	Klein Vet	V4	C4GVET-V4	V4 - Klein Vet, Often Dry	-28.71239	26.95911
C4SAND-STAAL	Free State	E	11.08	Vaal	Sand	V5	C4SAND-STAAL	Staalbrug	-28.12289	26.58597
C4SAND-N1ROA	Free State	E	11.03	Vaal	Sand	V6	C4SAND-N1ROA	At N1	-28.23286	27.08525
C4SAND-STOOM	Free State	E	11.03	Vaal	Sand	V7	C4SAND-STOOM	Stoompomp	-28.32175	27.49094
C6VALS-PROKL	Free State	E	11.07	Vaal	Vals	VA1	C6VALS-PROKL	Proklameerdrift	-27.48683	26.81305
C6VALS-BOKRO	Free State	E	11.08	Vaal	Vals	VA2	C6VALS-BOKRO	Bo-Kroonstad	-27.73061	27.52161
C6VALS-LINDL	Free State	P	11.03	Vaal	Vals	Proposed macro site	C6VALS-LINDL	VA3 - Proposed macro site, between Lindley and Liebenbergstroom	-27.85923	27.79463
C6VALS-BETLE	Free State	E	11.03	Vaal	Vals	VA4	C6VALS-BETLE	Bethlehem	-28.12472	28.11108
C6BLOM-N1ROA	Free State	P	11.08	Vaal	Blomspruit	Proposed macro site	C6BLOM-N1ROA	VA5 Upstream of N1	-27.77180	27.25213
C7RENO-R501B	Free State	P	11.08	Vaal	Renoster	Proposed macro site	C7RENO-R501B	R1 - Old DWAF Site, at R501 road bridge	-27.05286	27.00991
C7HEUN-RENOS	Free State	P	11.01	Vaal	Heuningspruit	Proposed macro site	C7HEUN-RENOS	R2 - Before confluence with Renoster River	-27.29372	27.19626
C7RENO-KOPPI	Free State	P	11.03	Vaal	Renoster	Proposed macro site	C7RENO-KOPPI	R3 - Upstream of Koppies Dam	-27.25897	27.61482


WMA10 Lower Vaal
Ecoregion Level 1
GHAAP PLATEAU
HIGHVELD
NAMA KAROO
SOUTHERN KALAHARI
Existing Sites
Proposed Macro Sites
21°
22°
23°
24°
25°
26°
26°
27°
28°
29°
11.01
11.05
11.08
C3BARB-UNSPE
C3HART-SAHNI
C3KHAR-UNSPE
H3HART-SCHWE
C3HART-PAMPI
29.02
C9VAAL-CHRIS
C9VAAL-WARRE
C9VAAL-WINDO
H3HART-DELPO
C9VAAL-SCHMI
C9VAAL-DOUGL
29.01
30.01
29.05
N
70
0
70 Kilometers

Lower Vaal WMA: RHP sites

RHP Site Code	Province	Site Type	Ecoregion	Major Rivers	Tributary	Original Site Name/ Site Code	Site Description	Latitude	Longitude
C3HART-DELPO	Northern Cape	E	29.02	Vaal	Harts		H1 - Delpoortshoop, Old Site of Christa Thirion, downstream of Spitskop Dam	-28.35124	24.31354
C3HART-PAMPI	North-West	E	29.02	Vaal	Harts	HR6 (Pampierstad)	H2 - NB Below irrigation scheme canal, vicinity of Hartswater	-27.78670	24.70485
H3HART-SCHWE	North-West	P	29.02	Vaal	Harts	Proposed macro site	H3 - between Schweizer-reneke and Taung	-27.30770	25.10719
C3HART-SANNI	North-West	E	11.08	Vaal	Harts		H4-Sannieshof, existing Site but details unknown	-26.52592	25.83545
C3KHAR-UNSPE	North-West	P	11.08	Vaal	Klein Harts	Proposed macro site	H5 - anywhere on Klein Harts River	-26.53677	26.01752
C3BARB-UNSPEC	North-West	P	11.08	Vaal	Barberspan	Proposed macro site	Existing site - to check location	-26.51601	25.54899
C9VAAL-SCHMI	Northern Cape	E	29.02	Vaal	Schmidstrift	Schmidstrift	Schmidstrift	-28.72533	24.07293
C9VAAL-WINDO	Northern Cape	E	29.02	Vaal		Windsorton	Windsorton	-28.19325	24.43001
C9VAAL-WARRE	Northern Cape	P	29.02	Vaal		Proposed macro site	Warrenton, at bridge	-28.11097	24.80193
C9VAAL-CHRIS	Northern Cape	P	29.02	Vaal		Proposed macro site	Christiana, Inkolo spar, fly-fishing area	-27.95299	25.14791
C9VAAL-DOUGL	Northern Cape	P	26.02	Vaal		Proposed macro site	Douglas, IFR Site at bridge, above confluence with Orange	-29.00083	23.80646

APPENDIX D

PROPOSED MONITORING ROGRAMME

Table D.1: Proposed salinity monitoring programme for the Vaal River System

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
UPPER VAAL WMA										
VAAL DAM CATCHMENT										
VS1	177935	Vaal	VS1-GDDC01 VAAL RIVER ORIGIN AT N17 BRIDGE	C11	-26.36250	30.10806	w	w	m,s,c	2
			Water supply to Camden power station	C11			m	m	m,s	2
		Vaal	Camden power station / associated coal mine effluent	C11			w	w	m,s,c	1
VS2	177949	Vaal	VS2-GDDC10 VAAL RIVER AT R29/N2 BRIDGE AT CAMDEN	C11	-26.64722	30.15167	w	w	m,s,c	2
1	177947	Witpuntspruit	GDC09 WITPUNTSPRUIT AT R29/N2 CAMDEN BRIDGE	C11	-26.59278	30.09694	w	w	m,s,c	2
VS3	10001098	Vaal	VS3-VAAL RIVER ON N11 BRIDGE TO AMERSFORT	C11	-26.77861	29.92083	w	w	m,s,c	2
2	100001153	Klein Vaal	KLEIN VAAL	C11	-26.78861	30.12883	w	w	m,s,c	2
		Klein Vaal	Usutu-Vaal Water transfer (ex. Heyshope Dam)	C11			w	w	m,s,c	1
3	100001044	Rietspruit	RIETSPRUIT AT N11 TAPFONTEIN BRIDGE	C11	-26.91306	29.87222	w	w	m,s,c	2
			Water supply to Amersfoort	C11			m	m	m,s	2
	177963	Rietspruit	FINAL EFFLUENT AT AMERSFOORT STW (GDDC21)	C11	-26.98861	29.87333	w	w	m,s,c	2
C1H007	90589	Vaal	VAAL RIVER AT GOEDGELUK/BLOUKOP	C11	-26.84000	29.72361	w	w	m,s,c	1
			Water supply to Ermelo	C11			w	w	m,s	1
		Kafferspruit[6]	Ermelo effluent	C11			m	m	m,s,c	1
*[7]	*[7]	Kafferspruit[6]	Crump weir	C11			w	c	m	1
		Buffalo	Water transfer from Zaaihoek Dam	C11			w	w	m,s	1
		Buffalo	Water use by Majuba Power station	C11			m	m	m,s	1
			Net transfer from Zaaihoek Dam to Vaal (ex balancing dam)	C11			m	m	m,s	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
		Palmiet	Majuba Power station / associated coal mine effluent	C11			w	w	m,s,c	1
			Water supply to Bethal from RW	C11			m	m	m,s	1
	178899	Blesbokspruit	FINAL EFFLUENT AT BETHAL STW	C11	-26.48333	29.45000	w	w	m,s,c	1
		Blesbokspruit	Coal mining effluent	C11			w	w	m,s,c	1
C1H006	90588	Blesbokspruit	RIETVLEY ON BLESBOKSPRUIT	C11	-26.77556	29.53944	w	w	m,s,c	1
		Vaal	Water supply to Tutuka power station	C11			m	m	m,s	1
		Leeuspruit	Tutuka power station / associated coal mine effluent	C11			w	w	m,s,c	1
C1H005	90687	Leeuspruit	LEEUSPRUIT AT WELBEDACHT	C11	-26.85361	29.32611	w	w	m,s,c	1
C1R002[8] VS5	90612	Vaal	VS5 - GROOTDRAAI DAM ON VAAL RIVER: NEAR DAM WALL[14]	C11	-26.86717	29.21781	w	w	m,s,c	1
C1H019[8]	90599	Vaal	GROOTDRAAI DAM ON VAAL RIVER: DOWN STREAM WEIR[14]	C12	-26.92194	29.28472	w	w	m,s,c	1
C1H001[8]	90584	Vaal	STANDERTON WEIR AT LANGVERWYL	C12	-26.94194	29.26417	w	w	m,s,c	1
		Vaal	Grootdraai Dam abstraction	C12			w	w	m,s	1
		Vaal	Emergency scheme transfer from Vaal Dam to Grootdraai Dam	C12			w	w	m,s,c	1
		Vaal	Water supply to Standerton	C12			m	m	m,s	1
		Vaal	Standerton effluent	C12			w	w	m,s,c	1
C1H002	90585	Klip	STERKFONTEIN DELANGESDRIFT WEIR	C13	-27.16944	29.23389	w	c	m,s,c	1
			Water supply to Vrede	C11			m	m	m,s	2
		Vaal	Vrede effluent	C11			m	m	m,s,c	1
C1H012	90595	Vaal	NOOITGEDACHT/GLADDEDRIFT	C12	-27.00167	28.76611	w	w	m	1
C1H004	90586	Waterval River	BRANDDRIFT ROODEBANK WEIR	C12	-26.62694	29.02250	w	c	m,s,c	1
C1H008	90591	Waterval River	ELANDSLAAGTE ON WATERVALRIVIER	C12	-26.86111	28.88472	w	w	m,s,c	1
C1H032[9]	*[9]	Trichardspruit	RESM1-SASOL weir downstream of Klipspruit at SASOL security fence	C12			w	c	m	1
BM2	178989	Grootspruit	GROOTSPRUIT D/S WINKELHAAKSPRUIT CONFLUENCE	C12	-26.53250	29.05889	w	c	m	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
LM2	178990	Waterval River	DOWNSTREAM LESLIE GOLD MINE ON WATERVALRIVIER	C12	-26.21056	28.47833	w	c	m	1
LM7	177885	Wildebeesspruit	C1H037Q01 AT R50 BEFORE CONFLUENCE WITH WATERVAL	C12	-26.58361	29.03028	w	w	m	1
			Water supply to Sasol	C12			m	m	m,s	1
			Water supply to Secunda	C12			m	m	m,s	1
	188716		Water supply to eMbalenhle ex RW	C12	-26.55194	29.06861	m	m	m,s	1
			Water supply to Evander	C12			m	m	m,s	1
C1H040	177889	Trichardspruit	Sasol unit 53 and 253 / Secunda STW	C12			w	w	m,s,c	1
		Trichardspruit	Sasol Unit 205 blowdown water	C12			w	w	m,s,c	1
C1H035	177882	Trichardspruit	RESM 21 SECUNDA UNIT 05 DISCH TO TRIB TRICHARD	C12	-26.56083	29.14556	w	w	m,s,c	1
		Groot Bossiespruit	Sasol fertilizer	C12			w	w	m,s,c	1
		Groot Bossiespruit	Polifin	C12			w	w	m,s,c	1
			Water supply to Greylingstad	C12			m	m	m,s	2
		Tributary of grootspruit	Nthorwane STW (near Greyliongstad)	C12			w	w	m,s,c	2
C1H043	177894	Waterval River	Leslie Gold Mine STW	C12			w	w	m,s,c	2
C1H041	177890	Winkelhaakspruit	Evander STW	C12			w	w	m,s,c	1
C1H042	177892	Trichardspruit	eMbalenhle effluent	C12	-26.55139	29.07722	w	w	m,s,c	1
			Water supply to Braken Gold Mine	C12			m	m	m,s	3
		Waterval	Braken Gold Mine sewage effluent	C12			m	m	m,s,c	3
C1H017 VS6	90597	Vaal	VS6 - VAAL RIVER AT VILLIERS FLOOD SECTION	C12	-27.02250	28.59444	w	w	m,s,c	1
C1H009	90592	Molspruit	MOLSPRUIT AT LEEUFONTEIN (d/s Grootvlei Power station)	C12	-26.91611	28.43694	w	w	m	2
		Molspruit	Effluent from Grootvlei power station and associated coal mine	C12			w	w	m,s,c	1
C1R001	90604	Vaal	VAAL DAM ON VAAL RIVER: NEAR DAM WALL	C12	-26.87944	28.12306	w	w	m,s,c	1
C2H122 VS7	90678	Vaal	VS7 - VAAL DAM ON VAAL RIVER: DOWN STREAM WEIR	C12	-26.85417	28.12111	w	d[10]	m,s,c	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
		Vaal	Vaal Dam abstraction via RW pipeline	C12			w	d[10]	m,s,c	1
		Vaal	Vaal Dam abstraction via RW canal	C12			w	d[10]	m,s	1
		Vaal	Vaal Dam abstraction for small local towns (e.g. Denysville)	C12			m	m	m,s	2
		Vaal	Vaal Dam abstraction for Groootvlei power station	C12			w	w	m,s	1
		Vaal	Vaal Dam abstraction for Grootdraai via old emergency scheme	C12			w	w	m,s	1
C8H002	90860	Wilge	WILGE RIVER AT HARRISMITH	C81	-28.27028	29.11167	w	w	m	2
		Wilge	Water supply to Harrismith	C81			m	m	m,s	2
	100000821	Wilge	HARRISMITH SEWAGE WORK FINAL EFFLUENT	C81			m	m	m,s,c	1
C8H032	90886	Nuwejaarspruit	STERKFONTEIN DAM: DOWNSTREAM WEIR	C81	-28.38722	29.01667	w	w	m	1
C28R003	90888	Nuwejaarspruit	STERKFONTEIN DAM: NEAR DAM WALL	C81	-28.38722	29.01667	w	w	m	1
C8R007	177724	Nuwejaarspruit	DRIEKLOOF DAM (transfer from Tugela)	C81	-28.38722	29.01667	w	w	m,s,c	1
C8H005	90863	Elands	ELANDS RIVER BELOW QWA QWA	C81	-28.37556	28.86167	w	w	m	1
	189582	Elands	Water supply to Phutha-ditjhaba	C81	-28.52861	28.82806	m	m	m,s	1
		Elands	Witsieshoek effluent	C81			w	w	m,s,c	1
C8H011	90869	Elands	ELANDS RIVER AT KILLARNEY	C81	-28.16083	28.87472	w	w	m	1
			Water supply to Kestell				m	m	m,s	2
	100001010	Klerkspruit	KESTELL SEWAGE WORK FINAL EFFLUENT	C81	-28.32111	28.70389	m	m	m,s,c	2
C8H012	90870	Vaalbankspruit	VOORSPOED ON VAALBANK SPRUIT	C81	-28.08361	28.83833	w	w	m	1
C8H023	90880	Meul	THE WILLOWS ON MEUL RIVER	C82	-28.02556	28.99750	w	w	m	1
C8H003	90861	Cornelius	WARDEN ON CORNELISRIVIER	C82	-27.84500	28.96222	w	w	m	1
			Water supply to Warden	C82			m	m	m,s	2
			Warden effluent	C82			w	w	m,s,c	2
C8H028	90885	Wilge	BAVARIA (FLOOD SECTION)	C82	-27.80278	28.76833	w	w	m	2
C8H018	90876	Holspruit	DAVIDSDALE	C82	-27.65139	28.86861	m	m	m,s,c	3
C8H027	90884	Wilge	BALLINGTOMP ON WILGE RIVER	C82	-27.30000	28.58694	w	c	m	1
	100000512	Liebenbergsvlei	LESOTHO HIGHLANDS ASH RIVER OUTFALL	C83	-28.27222	28.37278	w	w	m,s,c	1
C8R004	90893	Liebenbergsvlei	SAULSPOORT DAM	C83	-28.21667	28.36333	w	w	m	1
			Water supply to Bethlehem	C83			m	m	m,s	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
	100000510	Liebenbergsvlei	BETHLEHEM SEWAGE WORKS FINAL EFFLUENT	C83			w	w	m,s,c	1
C8H004	90862	Liebenbergsvlei	DE MOLEN/DE WELKOM	C83	-27.70000	28.32167	w	w	m	2
			Water supply to Reitz	C83			m	m	m,s	2
	100000511		REITZ SEWAGE WORKS FINAL EFFLUENT	C83			m	m	m,s,c	2
			Water supply to Tweeling	C83			m	m	m,s	3
			Tweeling effluent	C83			m	m	m,s,c	3
C8H026	90883	Liebenbergsvlei	FREDERIKSDAL WEIR	C83	-27.42750	28.52583	w	c	m,s,c	1
C8H001	90859	Wilge	FRANKFORT WEIR	C83	-27.27389	28.49000	w	c	m	1
		Wilge	Water supply to Frankfort	C83			m	m	m,s	2
		Wilge	Frankfort effluent	C83			w	w	m,s,c	2
VAAL BARRAGE CATCHMENT										
C2H122 VS7	90678	Vaal	VS7 - VAAL DAM ON VAAL RIVER: DOWN STREAM WEIR	C22	-26.85417	28.12111	w	d[10]	m,s,c	1
C2H003	90614	Vaal	ELANDSFONTEIN/ENGELBRECHTSDRIFT (RW weir)	C22	-26.81972	28.06361	w	w	m,s,c	1
		Vaal	Eskom intakes above Lethabo Barrier	C22			w	w	m,s	1
		Vaal	Sasol intakes above Lethabo Barrier	C22			w	w	m,s	1
		Vaal	Mittal steel (Iscor) abstraction above Lethabo Barrier	C22			w	w	m,s	1
		Vaal	RW abstraction above Lethabo Barrier	C22			w	d[10]	m,s	1
		Vaal	RW Zuikerbosch intakes	C22			w	d[10]	m,s	1
C2H134	90682	Blesbokspruit	COWLES DAM OUTFLOW AT SPRINGS (RW B9)	C21	-26.20694	28.46750	w	w	m	1
C2H150	90698	Blesbokspruit	R555 ROAD BRIDGE	C21	-26.21306	28.48083	w	w	m	2
C2H145	90693	Blesbokspruit	VLAKFONTEIN MARIEVALE BIRD SANCTUARY	C21	-26.35861	28.50917	w	w	m	2
C2H149	90697	Blesbokspruit	NIGEL R51 ROAD BRIDGE TO BALFOUR	C21	-26.42750	28.50444	w	w	m	2
C2H133	90681	Blesbokspruit	RW C-B10 AT HEIDELBERG	C21	-26.51028	28.35139	w	c	m	1
C2H131	90679	Suikerbosrand	RW C-S1 COLLIERY POINT	C21	-26.62889	28.29722	w	w	m	1
C2H070	90653	Suikerbosrand	SCHICKFONTEIN FLOOD SECTION	C21	-26.64000	28.23028	w	w	m	2
C2H004	90615	Suikerbosrand	VEREENIGING WEIR (RW S2)	C21	-26.67075	28.03044	w	c	m,s,c	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
		ER canal	ERGO Brakpan abstraction	C21			m	m	m,s	1
		Blesbokspruit	ERGO Daggafontein abstraction	C21			m	m	m,s	1
	179049	Blesbokspruit	ERWAT DAVEYTON STW FINAL EFFLUENT	C21	-26.23333	28.33333	w	w	m	1
	100001097	Blesbokspruit	ERWAT WELDEDACHT STW FINAL EFFLUENT	C21	-26.19306	28.47750	w	w	m,s,c	1
C2H207	177815	Blesbokspruit	GROOTVLEI MINE HDS PLANT EFFLUENT	C21	-26.24944	28.49583	w	w	m,s,c	1
	179050	ER canal	ERWAT RYNFIELD STW FINAL EFFLUENT	C21	-26.16528	28.35833	w	w	m,s,c	1
	179054		ERWAT JP MARAIS STW FINAL EFFLUENT	C21	-26.16944	28.39861	w	w	m,s,c	1
	88793		ERWAT JAN SMUTS STW FINAL EFFLUENT	C21	-26.22194	28.37528	w	w	m,s,c	1
	179287	ER canal	Sappi HDS effluent	C21			w	w	m,s,c	1
	88724	ER canal	Sappi AL effluent (Closed)[11]	C21			w	w	m,s,c	1
		ER Canal	Sappi effluent to irrigation (closed)	C21			w	w	m,s,c	1
	88569	ER canal	ERWAT McComb STW	C21			w	w	m,s,c	1
	177815	Blesbokspruit	Grootvlei GM effluent	C21			w	w	m,s,c	1
	179051	Klein Blesbok	ERWAT ANCOR STW FINAL EFFLUENT	C21	-26.26444	28.47889	w	w	m,s,c	1
			ERWAT Grundling STW	C21			w	w	m,s,c	1
	179052	Blesbokspruit	ERWAT HERBERT BICKLEY STW FINAL EFFLUENT	C21	-26.44583	28.46667	w	w	m,s,c	1
	179048	Kaydalespruit	ERWAT TSAKANE STW FINAL EFFLUENT	C21	-26.37500	28.36944	w	w	m,s,c	1
	88777	Blesbokspruit	ERWAT HEIDELBERG STW FINAL EFFLUENT	C21	-26.53861	28.33083	w	w	m,s,c	1
	100000759	Blesbokspruit	ERWAT RATANDA STW FINAL EFFLUENT	C21	-26.62831	28.63033	w	w	m,s,c	1
	100001011	Suikerbosrand	BALFOUR STW FINAL EFFLUENT	C21	-26.63639	28.57833	w	w	m,s,c	1
C2H137	90685	Klip	ZWARTKOPJES (RW Crump weir K21)	C22	-26.37972	28.07111	w	c	m	1
C2H135	90683	Natalspruit	RIETFONTEIN (RW old Parshall flume N8)	C22	-26.42528	28.16611	w	w	m	2
		Rietspruit	Upstream of Natalspruit (RW R5)	C22			w	w	m	2
C2H126	90684	Rietspruit	WATERVAL (LUTTIG) (RW crump weir R6)	C22	-26.45000	28.08889	w	c	m	1
C2H141	90689	Klip	WITKOP (NEW BRIDGE)	C22	-26.45000	28.08583	w	w	m	1
C2H021	90627	Klip	WITKOP (RW K25)	C22	-26.45361	28.08583	w	c	m	1
C2H071	90654	Klip	KOOKFONTEIN/VEREEN. RAIL BRIDGE (RW K19)	C22	-26.61944	27.98083	w	c	m	1
	179311	Harringtonspruit	BUSHKOPPIES STW FINAL EFFLUENT	C22	-26.25111	27.91667	w	w	m,s,c	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
	179313	Klip	GOUDKOPPIES FINAL EFFLUENT	C22	-26.31111	27.88611	w	w	m,s,c	1
	179315	Klip	OLIFANTS S/W TO KLIP RIVER	C22	-26.30278	27.90833	w	w	m,s,c	1
		Klipspruit	Klipspruit STW (closed)	C22			w	w	m,s,c	1
		Klip	Orlando PS supply from Klipspruit STW (closed)[11]	C22			w	w	m,s	2
		Klip	Orlando PS effluent (closed)	C22			w	w	m,s,c	2
		Klip	Everite effluent	C22			m	m	m,s,c	3
		Klip	Effluent water supply to Polifin (AE&CI)	C22			w	w	m,s	2
		Klip	Olifantsvlei STW effluent to irrigation	C22			m	m	m,s,c	1
		Klip	Klipspruit/Goudkopjies STW effluent to irrigation	C22			m	m	m,s,c	1
		Klip	Sewer leakage to Klip	C22			*[12]	*[12]	m,s,c	1
		Klip	ERWAT Waterval STW	C22			w	w	m,s,c	1
		Klip	Meyerton STW	C22			w	w	m,s,c	2
		Klip	Klip Power station effluent (closed)	C22			w	w	m,s,c	1
		Klip	Samancor effluent	C22			w	w	m,s,c	2
		Natalspruit	Palmietfontein STW (closed)	C22	-26.32833	28.16833	w	w	m,s,c	1
	179330	Natalspruit	DEKEMA S/W EFF INTO NATALSPRUIT	C22	-26.32833	28.16833	w	w	m,s,c	1
		Natalspruit	Rondebult STW	C22			w	w	m,s,c	1
		Natalspruit	Vlakplaats STW	C22			w	w	m,s,c	1
		Natalspruit	Sewer leakage to Natalspruit	C22			*[12]	*[12]	m,s,c	1
C2H010	90620	Vaal	RIETFONTEIN/VEREENIGING INTAKE 1 (RW V1)	C22	-26.68917	27.93639	w	d[10]	m,s,c	1
		Vaal	RW no. 1 intake (RW V2)	C22			w	d[10]	m,s	1
		Vaal	Leeuwkuil STW	C22			w	w	m,s,c	1
		Vaal	Stewart and Lloyds effluent	C22			w	w	m,s,c	1
		Vaal	Water supply to (USCO Klip)	C22			w	w	m,s	2
		Vaal	Iscor (USCO Klip) effluent	C22			w	w	m,s,c	2
		Vaal	Water supply to (USCO Vaal)	C22			w	w	m,s	2
		Vaal	Iscor (USCO Vaal) effluent	C22			w	w	m,s,c	2
		Vaal	Vereeniging refractories	C22			w	w	m,s,c	2
	100000955	Vaal	LTS25 GROENPUNT S/W DISCHARGE	C22	-26.83056	27.82056	w	w	m,s,c	3
C2H014	90623	Taaibosspruit	VERDUN (RW T1)	Rivers	-26.82389	27.925833	w	d[10]	m,s,c	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
		Taaibosspruit	Polifin (AECI) effluent	C22			w	w	m,s,c	1
C2H005	90616	Riet	KAALPLAATS (RW RV2)	Rivers	-26.72972	27.717778	w	d[10]	m,s,c	1
		Riet	Sebokeng nutrient removal STW	C22			w	w	m,s,c	1
		Riet	Sebokeng biofilter STW	C22			w	w	m,s,c	1
		Riet	Vanderbijlpark STW	C22			w	w	m,s,c	1
		Riet	Ennerdale STW	C22			w	w	m,s,c	1
		Riet	Mittal steel (Iscor) effluent	C22			w	w	m,s,c	1
C2R008 VS8	90780	Vaal	VS8-VAAL BARRAGE NEAR BARR WALL	C22	-26.76556	27.68472	w	d[10]	m,s,c	1
VAAL (BARRAGE TO BOTTOM OF UPPER VAAL WMA)										
C2H008	90619	Vaal	DE PONT/LINDEQUESDRIFT	C23	-26.73528	27.60861	w	w	m	1
14	100000958	Kromelmboog	LTS30 KROMELMBOOGSPRUIT ON R59 BRIDGE	C23	-26.84889	27.65572	w	w	m,s,c	2
		Vaal	Sasol 1 effluent	C23			w	w	m,s,c	1
		Vaal	Parys effIent	C23			w	w	m,s,c	1
C2H018	90626	Vaal	DE VAAL/SCHOEMANSDRIFT	C23	-26.97028	27.21111	w	w	m,s,c	1
C2H023	90629	Mooirivierloop	LUIPAARDSVLEI	C23	-26.22389	27.74000	w	w	m	2
C2H024	90630	Mooirivierloop	GEMSBOKFONT. D/ST DONALDS	C23	-26.28417	27.68028	w	w	m	2
C2H025	90631	Mooirivierloop	NO 7 AT GEMSBOKFONTEIN	C23	-26.28833	27.66917	w	w	m	2
C2H060	90644	Mooirivierloop	DOORNFONTEIN CANAL AT BLAAUWBANK	C23	-26.37083	27.25306	w	w	m,s,c	1
C2H069	90652	Mooirivierloop	BLAAUWBANK WEIR	C23	-26.37556	27.23083	w	w	m	1
C2H030		Dolomitic eye	Eye of Wonderfonteinspruit @ Gemsbokfontein	C23			m	w	m,s,c	2
C2H013		Dolomitic eye	Eye of Turfontein	C23			m	w	m,s,c	2
C2H011		Dolomitic eye	Eye of Gerhardusminnebron	C23			m	w	m,s,c	2
C2R003	90775	Mooi	KLERKSKRAAL DAM: NEAR DAM WALL	C23	-26.25250	27.16056	w	w	m	1
C2R001	90773	Mooi	BOSKOP DAM: NEAR DAM WALL	C23	-26.56111	27.11167	w	w	m	1
C2H001	90613	Mooi	WITRAND WEIR	C23	-26.64806	27.08944	w	w	m	1
C2R004	90776	Mooi	POTCHEFSTROOM DAM: NEAR DAM WALL	C23	-26.67194	27.10000	w	w	m	2
C2R005	90777	Loopspruit	KLIPDRIF DAM: NEAR DAM WALL	C23	-26.61667	27.30111	w	w	m	1
C2h085	90668	Mooi	HOOGEKRAAL/KROMDRAAI WEIR	C23	-26.88028	26.96500	w	c	m,s,c	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
C2H155	90703	Mooirivierloop	WEST DRIEFONTEIN GOLD MINE FISSURE H2O D/S OF NOR	C23	-26.36361	27.47278	w	w	m,s,c	1
C2H158	90706	Mooirivierloop	BLYVOORUITZICHT GOLD MINE FISSURE WATER PIPE LINE DISCHARGE	C23	-26.38750	27.37333	w	w	m,s,c	1
C2H160	90708	Mooirivierloop	DOORNFONTEIN GOLD MINE FISSURE H2O NO 3 SHAFT DIS	C23	-26.42472	27.35056	w	w	m,s,c	1
C2H171	90719	Mooirivierloop	VENTERSPOST GOLD MINE FISSURE WATER AT VENTERSPOST	C23	-26.40806	27.17833	w	w	m,s,c	1
C2H237	90743	Mooirivierloop	FLIP HUMAN WCW FINAL EFFLUENT	C23	-26.18111	27.77111	w	w	m,s,c	1
C2H239	90744	Mooirivierloop	FINAL EFFLUENT FROM HANNES VAN NIEKERK WCW	C23	-26.31000	27.61111	w	w	m,s,c	1
C2H241	90746	Mooirivierloop	FINAL EFFLUENT FROM DOORNFONTEIN G/M#3	C23	-26.42500	27.34556	w	w	m,s,c	1
C2H244	90747	Mooirivierloop	EASTDENE FINAL EFFLUENT FROM BLYVOORUITZICHT GOLD MINE	C23	-26.38861	27.39278	w	w	m,s,c	1
C2H245	90748	Mooirivierloop	FINAL EFFLUENT FROM WESTERN DEEP LEVELS GOLD MINE	C23	-26.41889	27.40694	w	w	m,s,c	1
C2H261	90764	Mooirivierloop	WONDERFONTEIN ON FINAL EFFLUENT FROM OBERHOLZER STW	C23	-26.33056	27.38111	w	w	m,s,c	1
C2H265	90766	Mooirivierloop	FINAL EFFLUENT FROM EAST DRIEFONTEIN AT PHOMOLONG	C23	-26.38472	27.49750	w	w	m,s,c	1
C2H066	90767	Mooirivierloop	FINAL EFFLUENT FROM WEST DRIEFONTEIN #4	C23	-26.38361	27.42528	w	w	m,s,c	1
C2H268	90769	Mooirivierloop	WELVERDIEND STW FINAL EFFLUENT	C23	-26.37139	27.25583	w	w	m,s,c	1
C2H257	90760	Loopspruit	FINAL EFFLUENT FROM KOKOSI WCW	C23	-26.49722	27.46028	w	w	m,s,c	1
C2H259	90762	Loopspruit	FINAL EFFLUENT FROM WESTERN DEEP LEVELS SOUTH STW	C23	-26.44831	27.42139	w	w	m,s,c	1
C2H262	90765	Loopspruit	FINAL EFFLUENT FROM WEDELA SW AT BUFFELSDOORN	C23	-26.48694	27.37500	w	w	m,s,c	1
C2H255	90758	Mooi	FINAL EFFLUENT FROM POTCHEFSTROOM WCW	C23	-26.75056	27.09444	w	w	m,s,c	1
C2H260 VS9	90763	Vaal	VS9-C2H260Q01 VAAL RIVER AT LOW WATER BRIDGE	C23	-26.88722	26.92694	w	w	m,s,c	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
MIDDLE VAAL WMA										
C7R001	90856	Renoster	KOPPIES DAM: NEAR DAM WALL	C7	-27.25806	27.67417	w	w	m	1
C7H013	90855	Renoster	KOPPIES DAM: DOWN STREAM WEIR	C7	-27.25861	27.67278	w	w	m	2
C7H003	90851	Heuningspruit	DANKBAAR MISPAH WEIR	C7	-27.35667	27.28639	w	w	m	2
C7H006	90853	Renoster	ARRIESRUST WEIR	C7	-27.04444	27.00500	w	w	m,s,c	1
VS10		Vaal	VS10-VERMAASDRIFT	C24	-26.93300	26.85200	w	w	m,s,c	2
C2H139	90687	Koekemoerspruit	BUFFELSFONTEIN	C24	-26.91722	26.81722	w	w	m,s,c	1
VS11		Vaal	VS11 MIDVAAL WATER COMPANY	C24	-27.93500	26.80800	w	w	m,s,c	2
C2H274	188476	Vierfonteinspruit	VAN NIEKERKSRUST VIERFONTEIN	C24	-27.07158	26.75840	w	w	m,s,c	2
C2H007 VS12	90618	Vaal	PILGRIMS ESTATE ORKNEY	C24	-27.01111	26.69833	w	w	m,s,c	1
C2H064	90648	Schoonspruit	EYE OF SCHOONSPRUIT	C24	-26.28389	26.86083	w	w	m,s,c	1
C2R006	90778	Swartleegte	ELANDSKUIL DAM: NEAR DAM WALL	C24	-26.34917	26.77778	w	w	m	1
C2R007	90779	Rietspruit	RIETSPRUIT DAM: NEAR DAM WALL	C24	-26.41361	26.79750	w	w	m	1
C2R002	90774	Skoonspruit	JOHAN NESSER DAM: NEAR DAM WALL	C24	-26.81694	26.61444	w	w	m	2
C2H073	90656	Skoonspruit	GOEDGENOEG WEIR	C24	-26.95667	26.65111	w	c	m,s,c	1
C6H004	90848	Vals	KLIPFONTEIN/LINDLEY	C60	-27.93611	27.99639	w	w	m	2
C6R002	90850	Vals	SERFONTEIN DAM: NEAR DAM WALL	C60	-27.70167	27.30250	w	w	m	1
C6H001	90845	Vals	ROODEWAL WEIR	C60	-27.44139	26.98639	w	w	m	1
C6H002	90846	Vals	GROOTDRAAI/BOTHAVILLE WEIR	C60	-27.39861	26.61472	w	w	m,s,c	1
C2H022	90628	Vaal	BALKFONTEIN WEIR	C25	-27.39778	26.50556	w	w	m	2
C2H061 VS14	90645	Vaal	KLIPPLAATDRIFT WEIR	C25	-27.38750	26.46250	w	w	m,s,c	1
C2H067	90651	Sandspruit	VS14-LEEGTE ON SANDSPRUIT	C25	-27.56028	26.23333	w	w	m,s,c	2
C2H066	90650	Makwassiespruit	VLIEGEKRAAL	C25	-27.49556	26.07472	w	w	m,s,c	2
VS15		Vaal	VS15-UPSTREAM BLOEMHOF DAM (MAKWASSIE AT GREYLINGSDRIFT BRIDGE)	C25	-27.60000	26.09400	w	w	m,s,c	2
C4R001	90809	Sand	ALLEMANSKRAAL: NEAR DAM WALL	C42	-28.28778	27.14583	w	w	m	1
C4H018	90802	Mosterd Canal	VERMEULENSKRAAL NOORD/VIRGINIA WEIR	C42	-28.09194	26.80556	w	w	m	1
		Doringspruit	Doringspruit	C42			w	w	m	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
		Sand	Blaaudrift bridge weir	C42			w	w	m	1
C4R002	90810	Vet	ERFENIS DAM: NEAR DAM WALL	C41	-28.50750	26.77833	w	w	m	1
C4H004	90795	Vet	FAZANTKRAAL NOOITGEDACHT WEIR	C43	-27.93500	26.12667	w	w	m,s,c	1
C4H005	90796	Vet	FLOORSDRIFT/HOOPSTAD	C43	-27.84167	25.90000	w	w	m	2
C9R002	101774	Vaal	BLOEMHOF DAM: NEAR DAM WALL	C91	-27.66917	25.61806	w	w	m,s,c	1
		Vaal	Midvaal Water abstraction	C24			w	w	m,s	1
		Skoonspruit	Klerksdorp STW	C24			w	w	m,s,c	1
		Vaal	Orkney STW	C24			w	w	m,s,c	1
			Water abstraction by Viljoenskroon	C24			m	m	m,s	2
		Renoster	Viljoenskroon STW	C70			m	m	m,s,c	2
		Vaal	Water abstraction by Vaal Reefs GM (closed)	C24			w	w	m,s	2
		Vaal	Vaal Reefs GM effluent	C24			w	w	m,s,c	1
		Vaal	Midvaal Water abstraction	C24			w	w	m,s	1
		Vals	Water abstraction by Lindley	C60			w	w	m,s	1
		Vals	Lindley STW	C60			w	w	m,s,c	1
		Vals	Water abstraction by Kroonstad	C60			w	w	m,s	1
		Vals	Kroonstad STW	C60			w	w	m,s,c	1
		Vals	Bothaville STW	C60			w	w	m,s,c	1
		Vaal	Water abstraction by Sedibeng	C25			w	w	m,s	1
		Sand	Water abstraction by Senekal	C42			m	m	m,s	2
		Sand	Senekal STW	C42			m	m	m,s,c	2
		Sand	Water abstraction by Ventersburg	C42			m	m	m,s	2
		Sand	Ventersburg STW	C42			m	m	m,s,c	2
		Sand	Water abstraction at Sedibeng Virginia works	C42			w	w	m,s	1
		Sand	Virginia STW	C42			w	w	m,s,c	1
		Sand	Welkom STW	C42			w	w	m,s,c	1
			Odendaalsrus STW	C42			m	m	m,s,c	2
			Allanridge STW	C42			m	m	m,s,c	2
		Vet	Water abstraction by Winburg	C41			m	m	m,s	2
		Vet	Winburg STW	C41			m	m	m,s,c	2

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
		Vet	Water abstraction by Theunissen	C41			m	m	m,s	2
		Vet	Theunissen STW	C41			m	m	m,s,c	2
		Vet	Water abstraction by Bultfontein	C43			m	m	m,s	2
			Bultfontein STW	C43			m	m	m,s,c	2
LOWER VAAL WMA										
C9H021 VS16	90908	Vaal	VS16-BLOEMHOF DAM: DOWN STREAM WEIR	C91	-27.66917	25.61806	w	w	m,s,c	1
C9R001	101772	Vaal	VAALHARTS BARRAGE: NEAR BARRAGE WALL	C91	-28.11528	24.92583	w	w	m	1
C9H008 VS17	90898	Vaal	VS17-VAALHARTS BARRAGE]: DOWN STREAM WEIR	C91	-28.11417	24.91528	w	w	m	2
C9H009 VS18	90899	Vaal	VS18-DE HOOP WEIR	C91	-28.51583	24.60111	w	w	m	1
C3R003	90792	Harts	BARBERS PAN AT ZANDVLEI (AT GAUGE PLATE)	C31	-26.56750	25.59889	m	m	m	2
C3R001	90789	Harts	SCHWEIZER RENEKE DAM: NEAR DAM WALL	C31	-27.17444	25.33667	w	w	m	2
C3R006	90794	Harts	TAUNG DAM: NEAR DAM WALL	C31	-27.53694	24.85000	w	w	m	1
C3H003	90781	Harts	TAUNG WEIR	C31	-27.57306	24.74639	w	w	m	1
C3H007	90782	Harts	ESPAGSDRIF WEIR	C33	-27.90278	24.61556	w	w	m	1
C3R002	90790	Harts	SPITSKOP DAM: NEAR DAM WALL	C33	-28.12389	24.50139	w	w	m	1
C3H013	90786	Harts	SPITSKOP MOUNT RUPERT WEIR	C33	-28.16250	24.47111	w	w	m	1
C3H016	90788	Harts	DELPORTSHOOP LLOYDS WEIR	C33	-28.37694	24.30306	w	w	m	1
C9H010	90900	Vaal	MOZIB/GAMAGARA RAW WATER INTAKES	C92	-28.40583	24.27167	w	w	m	1
C9H024 VS19	101770	Vaal	VS19-SCHMIDTSDRIFT WEIR	C92	-28.71111	24.07333	w	w	m	1
C9R003 VS20	101787	Vaal	VS20-DOUGLAS BARRAGE: NEAR WALL[13]	C92	-29.04333	23.83694	w	w	m	1
C9H011	90901	Vaal	DOUGLAS BRIDGE[13]	C92	-29.04917	23.76972	w	w	m	1
C9H007	90897	Vaal	ST CLAIRE/DOUGLAS[13]	C92	-29.04333	23.83722	w	w	m	1
		Vaal	Water supply to Bloemhof	C91			m	m	m,s	2
		Vaal	Bloemhof effluent	C91			m	m	m,s,c	2
		Vaal	Water supply to Christiana	C91			m	m	m,s	2

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
		Vaal	Christiana effluent	C91			m	m	m,s,c	2
		Vaal	Water supply to Vaalharts	C91			w	w	m,s	1
		Vaal	Water supply to Jan Kempdorp	C91			m	m	m,s	1
		Vaal	Water supply to Warrenton	C91			m	m	m,s	2
		Vaal	Warrenton effluent	C91			m	m	m,s,c	2
		Vaal	Water supply to Windsorton	C91			m	m	m,s	2
		Vaal	Windsorton effluent	C91			m	m	m,s,c	2
		Vaal	Water supply to Kimberley	C91			w	w	m,s	1
		Vaal	Water supply to Barclay West	C91			m	m	m,s	2
		Vaal	Barclay West effluent	C91			m	m	m,s,c	2
		Harts	Water supply to Lichtenberg	C31			w	w	m,s	1
		Harts	Lichtenberg effluent	C31			w	w	m,s,c	1
		Harts	Water supply to Schweizer Reyneke	C91			m	m	m,s	2
		Harts	Schweizer Reyneke effluent	C91			m	m	m,s,c	2
		Harts	Water supply to Taung	C31			w	w	m,s	1
		Harts	Taung effluent	C31			w	w	m,s,c	1
		Harts	Jan Kempdorp effluent	C33			m	m	m,s,c	2
		Vaal	Water supply to Gamagara	C92			w	w	m,s	1
		Vaal	Water supply to Douglas	C92			m	m	m,s	2
C9H025	101771	Canal	ORANGE-VAAL CANAL AT ST CLAIR/DOUGLAS BARRAGE	C92B	-29.04583	23.84139	w	w	m,s	1
		Vaal	Douglas effluent	C92			m	m	m,s,c	2
MODDER-RIET										
C5R003	90840	Modder	RUSTFONTEIN DAM : NEAR DAM WALL	C52	-29.27083	26.61667	w	w	m	1
C5R005	90842	Kgabanyane	GROOTHOEK DAM: NEAR DAM WALL	C52	-29.30278	26.84889	w	w	m	1
C5H023	90824	Kgabanyane	DANKBAAR WEIR D/STREAM GROOTHOEK DAM	C52	-29.28611	26.76417	w	w	m	1
C5H003	90811	Modder	LIKATLONG / SANNASPOS WEIR	C52	-29.16028	26.57333	w	w	m	1
C5H027	90827	Sepane	LIKATLONG/SANNASPOS	C52	-29.16139	26.59750	w	w	m	1
C5H026	90826	Korana	BRIGHTSIDE	C52	-29.08028	26.59333	w	w	m	2

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
C5R007	90844	Modder	MOCKES DAM: NEAR DAM WALL	C52	-29.05056	26.46167	w	w	m	2
C5R006	90843	Modder	MASELSPOORT DAM: NEAR DAM WALL	C52	-29.02917	26.40833	w	w	m	1
C5H007	90813	Renoster	SHANNON VALLEY	C52	-29.14444	26.31806	w	w	m	2
C5H006	90812	Renoster	BISHOP'S GLEN WEIR	C52	-28.98472	26.34194	w	w	m	1
C5H053	90836	Modder	GLEN WEIR	C52	-28.94889	26.32167	w	w	m	1
C5R004	90841	Modder	KRUGERSDRIF DAM: NEAR DAM WALL	C52	-28.88333	25.95611	w	w	m	1
C5H039	90833	Modder	KRUGERSDRIFT DAM: DOWN STREAM WEIR	C52	-28.88333	25.95028	w	w	m	1
C5H018	90820	Modder	TWEERIVIER WEIR+D349	C52	-29.04333	24.64083	w	w	m	2
C5H035	90831	Modder	TWEERIVIER WEIR D/S TWEERIVIER	C52	-29.02833	24.63917	w	w	m	1
C5R001	90838	Kaffer	TIERPOORT DAM: NEAR DAM WALL	C51	-29.42167	26.13639	w	w	m	1
C5H012	90816	Riet	KROMDRAAI/RIETWATER	C51	-29.65806	25.97333	w	w	m	1
C5T002	90839	Riet	KALKFONTEIN DAM: NEAR DAM WALL	C51	-29.49694	25.22139	w	w	m	1
C5H014	90817	Riet	KLIPDRIFT RITCHIE WEIR	C51	-29.04222	24.60000	w	w	m	1
C5H016	90819	Riet	ESTATE BIESIESBULT AUCAMPSHOOP WEIR	C51	-28.96000	24.24250	w	w	m	1
C5H048	90835	Riet	ZOUTPANSDRIFT WEIR	C51	-29.03333	23.98333	w	c	m,s,c	1
	88781	Canal	INFLOW TO S2 BALANCING DAM ON ORANGE-RIET CANAL	C51K	-29.16806	24.706944	w	w	m,s,c	1
	88786	Canal	INFLOW TO RITCHIE WEIR OF RITCHIE BRANCH CANAL	C51L	-29.04222	24.6	w	w	m,s,c	1
C5H030	90830	Canal	RIETRIVIER SETT. JACOBSDAL ON ORANGE-RIET CANAL	C51K	-29.14056	24.756667	w	w	m,s,c	1
			Water supply to Bloemfontein from Caledon River				w	w	m,s,c	1
			Transfer to Modder River from Knellpoort Dam				w	w	m,s,c	1
C5H052	103050	Modder	C5H052S01 MASELSPOORT TREATMENT WORKS - TREATED WATER	C52E	-29.02806	26.407778	w	w	m,s	1
C5H025	90825	Bloemspruit	C5H025Q01 BLOEMSPRUIT SEWAGE EFFLUENT AT SUNNYSIDE	C52F	-29.12333	26.280833	w	w	m,s,c	1
	188758	Bloemspruit	BLOEMFONTEIN BLOEMSPRUIT STW DISCHARGE TO BLOEMSPRUIT	C52F	-29.12444	26.245833	w	w	m,s,c	1

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		
	188741		BLOEMFONTEIN BAINSVLEI SEWAGE WORKS DISCHARGE VIA STORM WATER CANAL TO IRRIGATION DAM	C52H	-29.10222	26.143056	w	w	m,s,c	1
	188769	Renosterspruit	BLOEMFONTEIN STERKWATER SEWAGE WORKS DISCHARGE TO RENOSTERSPRUIT	C52F	-29.19	26.328889	w	w	m,s,c	1
	188762	Stinkhoutspruit	BLOEMFONTEIN NORTHERN SEWAGE WORKS STW DISCHARGE TO UNNAMED TRIBUTARY OF STINKHOUTSPRUIT	C52G	-29.04667	26.204167	w	w	m,s,c	1
	188760	Sepane	THABA NCHU SEWAGE WORKS DISCHARGE TO SEPANE	C52B	-29.18861	26.793056	w	w	m,s,c	1
	188771	Modder	BOTSHABELO SEWAGE WORKS DISCHARGE TO KLEIN MODDER RIVIER	C52B	-29.23917	26.686111	w	w	m,s,c	1
	188751	Keeromspruit	BRANDFORT STW FINAL EFFLUENT DISCHARGE TO KEEROMSPRUIT	C52G	-28.69389	26.491667	m	m	m,s,c	2
	188763	Riet	KOFFIEFONTEIN SEWAGE WORKS DISCHARGE TO RIETRIVIER	C51K	-29.41694	25.015278	m	m	m,s,c	2
C5H051	103048	Riet	C5H051R01 RIET RIVER TREATM WORKS - ORANGE/RIET CANAL RAW W	C51K	-29.14694	24.734722	m	m	m,s	2

NOTES:

(1) The monitoring frequencies have the following meaning: m = monthly, w = weekly, d = daily, c = continuous data logger.

(2) The reasons given for adopting the monitoring at each station have the following definitions:

m - to support hydro-salinity modelling

s - to support water and salt mass balance calculation.

c - to measure compliance with objectives at key points.

(3) A priority rating of 1 is the highest.

(4) DMS = Dissolved Major Salts calculated from the sum of the major salts (mg/l)

(5) EC = Electrical Conductivity (mS/m)

(6) This river name has probably been changed.

(7) A Crump weir was constructed on this stream. Could not locate the WMS code, probably due to the river name change

(8) In common with most dams the dam wall and downstream weir component have been used for the Grootdraai Dam outlet. Standerton Weir has also been included to cover the period prior to the construction of Grootdraai Dam.

(9) This station used to be called RESM6 by Sasol. There is thus the danger of mixing up the old and new records.

Hydro. Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]		Reason[2]	Priority[3]
					Lat.	Long.	DMS[4]	EC[5]		

(10) RW already carries out daily EC sampling in their Vaal Dam and Vaal Barrage raw water intakes.

(11) It is essential to retain data for closed point sources since these are needed to calculate historical time series.

(12) Raw sewage leakage cannot be monitored directly and has to be estimated from the sewage works salinity data.

(13) It should be noted that the C9R003 monitoring point is on the right bank of Douglas Weir. However the left bank concentration is often less than half the TDS concentration due to lateral stratification caused by the discharge of low TDS Orange River Water on the left bank. This renders the monitoring highly unrepresentative on all occasions when water is spilling over the long labyrinth crest of the barrage. For this reason a more representative monitoring point is required further downstream where the water is better mixed.

(14) All outflow volumes from dams should be monitored, including at the dam wall, the downstream weir, in right and left bank outlet canals and all pipe outlets. Generally water quality sampling at one key point at the dam wall suffice, with less frequent sampling at the other outlets. More frequent sampling is often warranted at dam weir components since during low flow the water is released from low-level sluices, while during floods top water that can exhibit significantly different water quality passes over the spillway. Canal outlets at different levels or on different banks of the river can also sometimes display different concentrations in the face of significant stratification. Experience of the behaviour of each dam can be used to rationalise the sampling at each dam outlet.

Table D.2: Proposed nutrient monitoring programme for the Vaal River System

Hydro Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]						Reason[2]	Priority[3]
					Lat.	Long.	DIN[4]	DIP[4]	TP[4]	Chl-a[4]	Turb[4]	O_2[5]		
UPPER VAAL WMA														
VAAL DAM CATCHMENT														
VS1	177935	Vaal	VS1-GDDC01 VAAL RIVER ORIGIN AT N17 BRIDGE	C11	-26.3625	30.10806	w	w	w	w	w		l, s,c	1
VS2	177949	Vaal	VS2-GDDC10 VAAL RIVER AT R29/N2 BRIDGE AT CAMDEN	C11	-26.6472	30.15167	w	w	w	w	w		l, s,c	1
VS3	10001098	Vaal	VS3-VAAL RIVER ON N11 BRIDGE TO AMERSFORT	C11	-26.7786	29.92083	w	w	w	w	w		l,s,c	1
VS4	177950	Vaal	VS4-GDDC11 VAAL RIVER AT R35 BLOUKOP BRIDGE	C11	-26.8547	29.698056	w	w	w	w	w		l,s,c	1
C1R002 VS5	90612	Vaal	VS5 - GROOTDRAAI DAM ON VAAL RIVER: NEAR DAM WALL[14]	C11	-26.8672	29.21781	w	w	w	w	w		l,s,c	1
C1H017 VS6	90597	Vaal	VS6 - VAAL RIVER AT VILLIERS FLOOD SECTION	C12	-27.0225	28.59444	w	w	w	w	w		l,s,c	1
C2H122 VS7	90678	Vaal	VS7 - VAAL DAM ON VAAL RIVER: DOWN STREAM WEIR	C12	-26.8542	28.12111	w	w	w	w	w		l,s,c	1
C2R008 VS8	90780	Vaal	VS8-VAAL BARRAGE NEAR BARRAGE WALL	C22	-26.7656	27.68472	w	w	w	w	w	c	l,s,c	1

Hydro Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]						Reason[2]	Priority[3]
					Lat.	Long.	DIN[4]	DIP[4]	TP[4]	Chl-a[4]	Turb[4]	O_2[5]		
VAAL (BARRAGE TO BOTTOM OF UPPER VAAL WMA)														
C2H260 VS9	90763	Vaal	VS9-C2H260Q01 VAAL RIVER AT LOW WATER BRIDGE	C23	-26.8872	26.92694	w	w	w	w	w		l,s,c	1
MIDDLE VAAL WMA														
VS10	RO POINT[6]	Vaal	VS10-VERMAASDRIFT	C24	-26.933	26.852	w	w	w	w	w		l,s,c	1
VS11	RO POINT	Vaal	VS11 MIDVAAL WATER COMPANY	C24	-27.935	26.808	w	w	w	w	w		l,s,c	1
C2H007 VS12	90618	Vaal	PILGRIMS ESTATE ORKNEY	C24	-27.0111	26.69833	w	w	w	w	w		l,s,c	1
VS13	RO POINT	Vaal	VS13 REGINA BRIDGE	C24	-27.1028	26.528	w	w	w	w	w		l,s,c	1
C2H061 VS14	90645	Vaal	KLIPPLAATDRIFT WEIR	C25	-27.3875	26.4625	w	w	w	w	w		l,s,c	1
VS15	RO POINT	Vaal	VS15-UPSTREAM BLOEMHOF DAM (MAKWASSIE AT GREYLINGSDRIFT BRIDGE)	C25	-27.6	26.094	w	w	w	w	w		l,s,c	1
LOWER VAAL WMA														
C9H021 VS16	90908	Vaal	VS16-BLOEMHOF DAM: DOWN STREAM WEIR	C91	-27.6692	25.61806	w	w	w	w	w		l,s,c	1
C9H008 VS17	90898	Vaal	VS17-VAALHARTS BARRAGE]: DOWN STREAM WEIR	C91	-28.1142	24.91528	w	w	w	w	w		l,s,c	1
C9H009 VS18	90899	Vaal	VS18-DE HOOP WEIR	C91	-28.5158	24.60111	w	w	w	w	w		l,s,c	1
C9H024 VS19	101770	Vaal	VS19-SCHMIDTSDRIFT	C92	-28.7111	24.07333	w	w	w	w	w		l,s,c	1

Hydro Code	WMS code	River	Description	Drainage Region	Coordinates		Frequency[1]						Reason[2]	Priority[3]
					Lat.	Long.	DIN[4]	DIP[4]	TP[4]	Chl-a[4]	Turb[4]	O_2[5]		
			WEIR											
C9R003 VS20	101787	Vaal	VS20-DOUGLAS BARRAGE: NEAR WALL	C92	-29.0433	23.83694	w	w	w	w	w		l,s,c	1

NOTES:

(1) The monitoring frequencies have the following meaning: w = weekly, c = continuous data logger.

(2) The reasons given for adopting the monitoring at each station have the following definitions:

- l - to support load balance calculation
- s - to determine status of eutrophication at strategic monitoring points
- c - to measure compliance with objectives at key points.

(3) A priority rating of 1 is the highest.

(4) Variables to be measured for the eutrophication: DIN, DIP, TP, Chl-*a* and turbidity.

(5) Continuous monitoring of oxygen (O_2) required in the Barrage

(6) RO point: Regional Office monitoring point (DWAF Free State Region)