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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE MZIMVUBU WATER PROJECT

DEA REF. No 14/12/16/3/3/2/677 (Dam Construction)
14/12/16/3/3/2/678 (Electricity Generation)
14/12/16/3/3/1/1169 (Roads)

AQUATIC ECOLOGY ASSESSMENT

FINAL
January 2015

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE MZIMVUBU WATER PROJECT

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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE MZIMVUBU WATER PROJECT

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REPORT TITLE	DWS REPORT NUMBER
Inception Report	P WMA 12/T30/00/5314/1
Scoping Report	P WMA 12/T30/00/5314/2
Environmental Impact Assessment Report	P WMA 12/T30/00/5314/3
Environmental Management Programme	P WMA 12/T30/00/5314/14
Integrated Water Use License Application for the Mzimvubu Water Project: Technical Report	P WMA 12/T30/00/5314/4
Ntabelanga Dam borrow pits and quarry Environmental Management Plan	P WMA 12/T30/00/5314/5
Lalini Dam borrow pits and quarry Environmental Management Plan	P WMA 12/T30/00/5314/6
SUPPORTING REPORTS	
Social Impact Assessment	P WMA 12/T30/00/5314/7
Economic Impact Assessment	P WMA 12/T30/00/5314/8
Visual Impact Assessment	P WMA 12/T30/00/5314/9
Floral Impact Assessment	P WMA 12/T30/00/5314/10
Faunal Impact Assessment	P WMA 12/T30/00/5314/11
Heritage Impact Assessment	P WMA 12/T30/00/5314/12
Water Quality Study	P WMA 12/T30/00/5314/13
Aquatic Ecology Assessment	P WMA 12/T30/00/5314/15
Wetland Assessment	P WMA 12/T30/00/5314/16
Rapid Reserve Determination: Tsitsa River at Lalini	P WMA 12/T30/00/5314/17

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DECLARATION OF INDEPENDENCE

I, Stephen van Staden as authorised representative of Scientific Aquatic Services, hereby confirm my independence as a specialist and declare that neither I nor Scientific Aquatic Services have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Scientific Aquatic Services was appointed as environmental impact assessment specialists in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed, specifically in connection with the Aquatic Ecological Impact Assessment for the Mzimvubu Water Project Environmental Impact Assessment. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it – as is described in my attached report.

Signed:  Date: January 2015

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE MZIMVUBU WATER PROJECT

AQUATIC ECOLOGY ASSESSMENT

Executive summary

BACKGROUND AND OBJECTIVES

Scientific Aquatic Services (SAS) was appointed to undertake a Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) analysis of the wetland, aquatic and riparian resources and assess the impact of the proposed project on aquatic ecology, and propose mitigation, if required, as part of the environmental assessment and authorisation process for the proposed Mzimvubu water project in the Eastern Cape. The project consists of the construction of two large reservoirs and associated infrastructure. The Ntabelanga dam is to be used for water supply. The Lalini Dam is to be used to provide hydro-electric power to feed back into the South African electrical supply grid, as well as to provide energy to pump water from the Ntabelanga Dam to the areas earmarked for irrigation.

ASSESSMENT OF AQUATIC ECOLOGY

Specific outcomes required from this report in terms of the aquatic assessment include the following:

- *Define the ecostatus of the river systems;*
- *Define the ecological importance and sensitivity of the systems based on stressor and receptor assessments, including habitat assessments;*
- *Biota specific water quality assessment;*
- *Aquatic and riparian zone habitat assessments;*
- *Aquatic community integrity assessments;*
- *Define impacts on the systems;*
- *Provide an opinion based on the study from an aquatic ecological point of view; and*
- *Present required mitigation measures.*

Based on the assessment the EIS, PES and DEMC of the systems in the area can be summarised as follows:

Development	Relevant sites	EIS	PES	DEMC
Ntabelanga Dam development	TS1 and TS4	High	C	B
Roads associated with Ntabelanga Dam construction	TS2, TS3 and TS5	Moderate to high	C	C/B
Area between Ntabelanga Dam and Lalini Dam	TS6	Moderate to high	C	C/B
Lalini Dam development	TS7 and TS8	Moderate	C	C
Pipeline development	TS9	Moderate to high	C	C/B
EIS = Ecological importance and sensitivity; PES = Present ecological state; DEMC = Desired ecological management class.				

A Summary of the results (ecological categories) obtained from the application of the various indices to the Tsitsa River and tributaries as assessed during April 2014 and June 2014 is presented in the table below:

Assessment	Month	Sites								
		Tsitsa River				Inxu River (TS6) and other unnamed tributaries of the Tsitsa River				
		TS1	TS4	TS7	TS8	TS2	TS3	TS5	TS6	TS9
IHIA	April 2014*	B	B	C	C	C	B	C	C	C
IHAS	April 2014	Highly suited	Ade-quite.	Ade-quite.	Ade-quite.	Ade-quite.	Inade-quate.	Inade-quate.	Ade-quate.	Ade-quate.
	June 2014	Ade-quite.	Ade-quite.	Ade-quite.	Highly suited	Ade-quite.	Inade-quate.	Inade-quate.	Ade-quate.	Ade-quate.
Dickens and Graham (SASS5)	April 2014	C	C	C	C	D	C	D	C	D
	June 2014	C	C	D/E	C	D	C	E	D	E
Dallas (SASS5)	April 2014	A	C	A	A	D/E/F	E/F	D	E/F	D/E/F
	June 2014	B	C	D	B	B	D/E/F	E/F	D/E/F	E/F
MIRAI	April 2014	B	C	B	C	D	C	D	C	D
	June 2014	C	C	C	C	C	C	D	C	D
FRAI	April 2014*	D	D	D	D	**	**	**	E	E

Abbreviations and footnotes:
IHIA = Invertebrate habitat integrity assessment;
IHAS = Invertebrate habitat assessment;
SASS5 = South African scoring system;
MIRAI = Macro-invertebrate response assessment index;
FRAI = Fish response assessment index.
NA = Not assessed;
*April 2014 conditions also representative of June 2014 conditions with reference to IHIA and FRAI;
** Conditions not suitable for habitation by fishes.

Conclusions

The following general conclusions were drawn upon completion of the aquatic impact assessment evaluation:

The ecological importance of the greater study area is reflected in the aquatic assessment results obtained, particularly with reference to the four sites on the larger Tsitsa River (Ecostatus values ranging between A (Natural) to C (moderately modified) for assessments pertaining to invertebrates and invertebrate habitat). Fish fauna diversity was, however, depauperate as was also indicated in literature sources consulted.

Smaller streams are thought to be less resilient to environmental change and more sensitive to disturbances, simply because of the smaller spatial scale in terms of potential areas of refugia and associated faunal and floral diversity to act as "buffer" to change. This is also reflected in the assessment results, with the tributary assessments generally yielding lower classifications.

Seasonal changes in terms of the macro-invertebrate assessments are evident, with lower classifications being recorded during the lower flow period in June 2014. However, the contributions of lower flow and hence also potentially poorer water quality, as well as potential diffuse and point sources (agriculture activities and existing rural settlements) cannot be quantified at present.

A summary of site relevance to proposed projects and general potential impacts associated with such development is provided below:

Development	Relevant sites	General potential impacts
Ntabelanga Dam and associated infrastructure development	TS1 and TS4	Both sites are located on the Tsitsa River. During the construction phase destruction of bank cover and release of silt/sediment particles possibly resulting in discoloration and inundation is considered to be the most important potential impacts. After construction disruption of flow, also in terms of seasonal flow patterns, is considered the most significant impact along with the extensive loss of natural riverine habitat due to the inundation of the valley and the associated loss of aquatic community structure sensitivity and function. This impact is particularly pertinent as the system is reliant on clear fast flowing water to support the aquatic macro-invertebrate community of the area (as deduced from the MIRAI habitat preference tables discussed previously). Impacts on the Tsitsa River may thus impact the system on a much larger scale. Given the depauperate fish species diversity, potential impact on macro-invertebrates communities are expected to be far more significant throughout the system than on the fish community. However the still deep impoundments created are likely to lead to a very significant increase in the population of the alien fish species *Cyprinus carpio* and *Micropterus Salmoides* and increased impacts on the migratory connectivity of eels. The area is known to harbour endemic mayflies (Kleynhans 1999). With the location of the two dams situated between two waterfalls and hence geographically isolated, the area is likely to contain several macro-invertebrate species of conservation concern. Both prior to and after mitigation this impact is considered to be high to moderately high. Through minimising the time in which stream flow, water quality and habitat is affected during the construction phase of the project, this impact can, however, be mitigated to a limited degree.
Roads associated with Ntabelanga Dam construction	TS2, TS3 and TS5	Anticipated impacts resulting from construction and use of roads include vegetation removal, increased risk of erosion, sediment loading into the system and inhibition of water flow. If not designed correctly, roads can severely impact on in-stream habitat as well as bankside stability and riparian habitat
Area between Ntabelanga Dam and Lalini Dam	TS6	The Inxu River is the largest tributary and may also potentially act as "refugia" from where smaller tributaries can be populated. However, with limited diversity of flow and habitat types (very little rocky habitat) the potential to do so is also limited.
Lalini Dam development	TS7 and TS8	As for sites TS1 and TS4 and the Ntabelanga dam site.
Pipeline development	TS9	Impact resulting from construction of pipelines and use of roads as well as extensive digging are considered the greatest risk. Impacts as for TS2, TS3 and TS5.

Impact assessment:

Impact assessment results are summarised in the table below:

Impact	Construction and first filling		Operational phase	
Mitigation status	Unmitigated	Mitigated	Unmitigated	Mitigated
Roads and Infrastructure	Very low	Very low	Very low	Very low
Electricity Generation and Distribution impact on habitat	Medium low	Low	Medium low	Very low
Electricity Generation and Distribution impact on flow dependant species	Medium low	Low	Medium low	Very low
Electricity Generation and Distribution impact on species diversity	Medium low	Low	Low	Medium low
Electricity Generation and Distribution impact on SCC	Low	Very low	Low	Very Low
Dam impact on habitat	High	High	High	Medium high
Dam impact on flow dependant species	High	High	High	Medium high
Dam impact on species diversity	High	High	Medium high	Medium high
Dam impact on SCC	High	Medium high	Medium high	Medium low

Dam construction and operation

In terms of both dam and associated infrastructure construction and first filling phase, greatest impact pertains to habitat alteration/destruction as well as natural flow rate. These impacts result in secondary impacts on flow sensitive species, species of conservation concern and aquatic biodiversity in general. The effects (inundation of habitat upstream of the dam walls and disruption of natural flow downstream) are considered high impact and permanent and hence also applicable to the operation phase. In terms of dam size alternatives, the impact on the aquatic system will be largely the same with only slight impact in terms of scale, moving more towards a local impact compared to a site impact. In terms of flow rate, base flows need to be maintained during both the construction/initial filling and operation phases. Without periodic, seasonal floods with associated "purging" of the river system, impacts such as silting/sedimentation and decrease in general water quality is a possibility.

Key mitigation measures to limit the impact include:

- *The construction of the dams will lead to reduced stream flow and hence loss of fast shallow riffle habitat and glide habitat. This impact is considered to be of high significance in the construction phase and even with mitigation the impact remains relatively unchanged. It is however deemed important that during construction the maintenance of base flows in the system is maintained at all times and that the duration of impacts on flows is limited to as short a period as possible;*
- *Ensure that all stockpiles are well managed and have measures such as berms and hessian sheets implemented to prevent erosion and sedimentation;*

- *Through ensuring that good construction practice is followed in terms of the clearing of areas, such as the use of water control berms and clearing footprint areas that are as small as possible, the severity of the impact can be reduced;*
- *Ongoing aquatic biomonitoring on a minimum of a quarterly basis must take place from six (6) months prior to construction till one (1) year after construction to determine trends in ecology and define any impacts requiring mitigation;*
- *It must be ensured that downstream of both the Ntabelanga dam as well as Lalini Dam that the flows as defined in the EWR are maintained at all times to support the flow sensitive aquatic macro-invertebrate community in this system;*
- *Impact on flow-dependent species is considered to be of high to very high importance in the construction phase and even with mitigation the impact remains relatively unchanged;*
- *During construction, the maintenance of base flows in the system must be maintained at all times and the duration of impacts on flows should be limited to as short a period as possible;*
- *During construction the maintenance of base flows in the system must be maintained at all times and the duration of impacts on flows should be limited to as short a period as possible;*
- *Eelways should be included in the design of the dam walls*
- *Loss of habitat will impact on a regional scale with the duration permanent however impacts downstream of the impoundments can be mitigated through management of the flow regime. The intensity of impact is considered high, with loss of resources and a definite probability of occurrence in all instances. Maintenance of base flow is to be maintained with seasonal peak flow management (winter) limiting daily variations in habitat availability to a single season;*
- *The impact on the aquatic community structures within the full supply level will be very significant with drastic changes to the aquatic community structure in these areas with more sensitive taxa no longer occurring and less desirable species of fish becoming dominant in the system;*

Electricity generation and distribution

Construction of such infrastructure will be of low impact if mitigated. Mitigation includes minimising the spatial footprint of the development to the greatest degree possible, with special reference to avoiding erosion, silting and sedimentation within the aquatic system. During the operation phase discharge through the Lalini Dam tunnel into the river will also be applicable. The section of river below the dam wall up to the tunnel discharge point will be largely subjected to base flow as defined by the EWR, which may impact on the most flow sensitive biota.

Peak electricity generation is not deemed appropriate to the system as it will significantly impact on the ecology of the system. Base energy generation would impact on the system unless variable base generation can be employed. Non variable base generation is therefore not deemed appropriate for this project. Base generation which is regulated in line with releases to meet EWR's and mimic natural discharge patterns through the year is deemed the most appropriate regime for the project;

As mentioned previously this may result in silting, sedimentation, decrease in water quality and excessive vegetation growth. The shorter the length of this section between the dam wall and discharge point, the smaller the area of impact. The tunnel must also be positioned and designed in such a manner as to preclude erosion effects at times of peak discharge.

Road and pipeline infrastructure

Construction of such infrastructure will be of low impact if mitigated. Mitigation again includes minimising the spatial footprint of the development to the greatest degree possible, with special reference to avoiding erosion, silting and sedimentation within the aquatic system during both construction and operation. Good housekeeping and management principles must be instilled throughout the life of the project. During the operation phase increased run-off from hard surfaces may also result in erosion.

Throughout the life of the project ongoing aquatic biomonitoring must take place, and if any trends are observed where impacts on the aquatic ecology is becoming unacceptable, measures to reduce the impacts must be immediately implemented. All aquatic biomonitoring should be undertaken by a suitably qualified and South African River Health Program (SA RHP) accredited assessor.

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE MZIMVUBU WATER PROJECT – AQUATIC ECOLOGY IMPACT ASSESSMENT

DEA REF No. 14/12/16/3/3/2/677 (Dam construction application)
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ACRONYMS AND ABBREVIATIONS

AsgiSA-EC	Accelerated and Shared Growth Initiative for South Africa – Eastern Cape
BGIS	Biodiversity Geographic Information System
BID	Background Information Document
BLMC	Biodiversity Land Management Class
BMWP	Biological Monitoring Working Party
CBA	Critical Biodiversity Areas
CFRD	Concrete-faced rockfill dam
DEMC	Desired Ecological Management Class
DM	District Municipality
DWA	replace with DWS
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Eastern Cape
ECBCP	Eastern Cape Biodiversity Conservation Plan
ECRD	Earth core rockfill dam
EF	Earthfill (dam)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMPr	Environmental Management Programme
ESA	Ecological Supporting Areas
ESIA	Environmental and Social Impact Assessment
EWR	Environmental Water Requirements
FHA	Fish Habitat Assessment
FRAI	Fish Response Assessment Index
FSL	Full Supply Level
GERCC	Grout enriched RCC
GIS	Geographic Information System
GN	General Notice
GPS	Global Positioning System
HCR	Habitat Cover Ratings
HG	Hydrogeomorphic
HGM	Hydrogeomorphic Units
IHAS	Invertebrate Habitat assessment System
IHIA	Intermediate Habitat Integrity Assessment
IH	Index of Habitat Integrity
ISO	International Standards Organisation
IVRCC	Internally vibrated RCC
LM	Local Municipality
MAP	Mean Annual Precipitation
MAPE	Mean Annual Potential for Evaporation
MASMS	Mean Annual Soil Moisture Stress

MAT	Mean Annual Temperature
MIRAI	Macro-invertebrate Response Assessment Index
MPRDA	Mineral and Petroleum Resources Development
MW	Megawatt
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NOCL	Non-overspill crest level
NOMR	New Order Mining Rights
NPAES	National Protected Area Expansion Strategy
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
PES	Present Ecological State
PPP	Public Participation Process
PRECIS	Pretoria Computer Information Systems
PSC	Project Steering Committee
PSP	Professional Services Provider
RAU	Rand Afrikaans University
RCC	Roller-compacted concrete
RDL	Red Data Listed
RDSIS	Red Data Sensitivity Index Score
REC	Recommended Ecological Category
RHP	River Health Program
SACNASP	South African Council for Natural Scientific Professions
SASSA	South African Soil Surveyors Association
SASS5	South African Scoring System 5
SASSO	South African Soil Surveyors Association
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SMC	Study Management Committee
SPV	Special Purpose Vehicle
SQR NAME	Sub Quat River Name
TCTA	Trans Caledon Tunnel Authority
TSP	Threatened Species Programme
VEGRAI	Vegetation Response Assessment Index
WRYM	Water Resources Yield Model
WMA	Water Management Areas
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups

LIST OF UNITS

GW	Gigawatt
GWh/a	Gigawatt hour per annum
MW	Mega Watt
m	Metre
km^2	Square Kilometres
kW	Kilowatt
ha	Hectare
°C	Degrees Celsius
%	Percentage
mS	Millisiemens
ℓ	Litre
ℓ/s	Litres per second
mL	Millilitre
million m^3	Million cubic metres

1. INTRODUCTION

1.1 BACKGROUND

The Department of Water and Sanitation (DWS) commissioned the Mzimvubu Water Project, an integrated multi-purpose (domestic water supply, agriculture, power generation, transport, tourism, conservation and industry) project, with the intention of providing a socio-economic development opportunity for the Eastern Cape region.

Environmental authorisation is required for the infrastructure components of the project. The purpose of the Environmental Impact Assessment (EIA) is to assess the components of the project that are listed activities by the National Environmental Management Act (NEMA) for which the Department of Water and Sanitation (DWS) has the mandate and intention to implement. The EIA process will provide the information that the environmental authorities require to decide whether the project should be authorised or not, and if so then under what conditions.

As part of this EIA process Scientific Aquatic Services have been contracted to undertake an Aquatic Ecological Impact Assessment.

1.2 PURPOSE OF THIS REPORT

Scientific Aquatic Services (SAS) was appointed to undertake a Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) analysis of the terrestrial wetland, aquatic and riparian resources and to assess the impact associated with the proposed development and to provide mitigatory measures as necessary as part of the environmental assessment and authorisation process for the proposed Mzimvubu water project in the Eastern Cape. Specific outcomes required from this report in terms of the aquatic assessment include the following:

- Define the ecostatus of the river systems;
- Define the ecological importance and sensitivity of the systems based on stressor and receptor assessments, including habitat assessments;
- Biota specific water quality assessment;
- Aquatic community integrity assessments;
- Define impacts on the systems;
- Provide an opinion based on the study from an aquatic ecological point of view; and
- Present required mitigation measures to minimise the impact on the receiving aquatic environment.

1.3 DETAILS AND EXPERTISE OF THE SPECIALIST

Stephen van Staden
SACNASP REG.NO: 400134/05

Stephen van Staden completed an undergraduate degree in Zoology, Geography and Environmental Management at RAU. On completion of this degree, he undertook an honours course in Aquatic health through the Zoology department at RAU. In 2002 he began a Masters degree in environmental management, where he did his mini dissertation in the field of aquatic resource management, also undertaken at RAU. At the same time, Stephen began building a career by first working at an environmental consultancy specialising in town planning developments, after which he moved to a larger firm in late 2002. From 2002 to the end of 2003, he managed the monitoring division and acted as a specialist consultant on water resource management issues and other environmental processes and applications. In late 2003, Stephen started consulting as an independent environmental scientist, specialising in water resource management under the banner of Scientific Aquatic Services. In addition to aquatic ecological assessments, clients started enquiring about terrestrial ecological assessments and biodiversity assessments. Stephen, in conjunction with other qualified ecologists, began facilitating these studies as well as highly specialised studies on specific endangered species, including grass owls, arachnids, invertebrates and various vegetation species. Scientific Aquatic Services soon became recognised as a company capable of producing high quality terrestrial ecological assessments. Stephen soon began diversifying into other fields, including the development of EIA process, EMPR activities and mine closure studies.

Stephen has experience on well over 1000 environmental assessment projects with specific mention of aquatic and wetland ecological studies, as well as terrestrial ecological assessments and project management of environmental studies. Stephen has a professional career spanning more than 10 years, of which almost the entire period has been as the owner and Managing member of Scientific Aquatic Services and the project manager on most projects undertaken by the company. Stephen has also obtained extensive experience in wetland and aquatic assessments in the Limpopo Plains aquatic ecoregion.

Stephen is registered by the SA RHP as an accredited aquatic biomonitoring specialist and is also registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP) in the field of ecology. Stephen is also a member of the Gauteng Wetland Forum and South African Soil Surveyors Association (SASSO).

Dionne Crafford
SACNASP REG.NO: 400146/14
Dionne Crafford matriculated in 1993 and obtained a BSc Ecology degree from the University of Pretoria in 1996. He obtained his BSc (Hons) Zoology degree with distinction at the same university in 1997, where he was awarded the Zoological Society of Southern Africa (ZSSA) award for the best honours student in Zoology. His honours project focused on behavioural ecology (grass owl acoustics).

He spent 1998 in the United States of America exploring various warm water fly fishing opportunities, before returning to enrol for an MSc in Zoology at the Rand Afrikaans University in 1999. He obtained the degree with distinction in 2000 and was awarded the Neitz Medallion for the best MSc in Zoology by the Parasitological Society of Southern Africa (PARSA). His MSc project was on aquatic environmental management/biological monitoring using catfish and their parasites as indicators of water quality.

From 2001 to 2006 he was first employed as "Veterinary Researcher" and later "Specialist Veterinary Researcher" by former Intervet at their Malelane research facility. From 2003 to 2006 he also performed part-time fly fishing guiding services for the former Fly Fishing Outfitters (Nelspruit). He moved to Bloemfontein in 2007 where he was employed as "Assistant Manager: Endoparasitology" at ClinVet International (Pty) Ltd from 2007 to 2012. In 2009 he enrolled for a part-time PhD in Zoology (monogenean parasites of freshwater fish) at the University of Johannesburg and received his degree in 2013. As from 2013 he is employed as Associate Scientific Writing Manager at ClinVet and also performs scientific writing services for Scientific Aquatic Services. In the latter capacity he has participated in a number of studies relating to aquatic biomonitoring and toxicity testing.

1.4 STRUCTURE OF THIS REPORT

This specialist study is undertaken in compliance with Regulation 32 of GN 543. **Table 1** indicates how the requirements of Regulation 32 of GN 543 have been fulfilled in this report.

Table 1: Report content requirements in terms of Regulation 32 of GN 543

Regulatory Requirements in terms of Regulation 32 of GN 543	Section of Report
(a) The person who prepared the report; and the expertise of that person to carry out the specialist study or specialised process.	Chapter 1
(b) a declaration that the person is independent	Page iv
(c) an indication of the scope of, and the purpose for which, the report was prepared	Chapters 1 and 3
(d) a description of the methodology adopted in preparing the report or carrying out the specialised process	Chapter 3
(e) a description of any assumptions made and any uncertainties or gaps in knowledge	Chapter 4
(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Chapters 6 to 8
(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	Chapter 11
(h) a description of any consultation process that was undertaken during the course of carrying out the study	Chapter 9
(i) a summary and copies of any comments that were received during any consultation process	Chapter 9
(j) any other information requested by the competent authority.	Chapter 10

2. PROJECT BACKGROUND SUMMARY

2.1 LOCALITY

The project footprint spreads over three District Municipalities (DMs) namely the Joe Gqabi DM in the north west, the OR Tambo DM in the south west and the Alfred Nzo DM in the east and north east.

The proposed Ntabelanga Dam site is located approximately 25 km east of the town of Maclear and north of the R396 Road. The proposed Lalini Dam site is situated approximately 17 km north east of the small town Tsolo. Both are situated on the Tsitsa River.

2.2 MAIN PROJECT COMPONENTS

The project forms a large integrated project with several components. The proposed water resource infrastructure includes:

- A dam at the Ntabelanga site with a storage capacity of 490 million m^3;
- A dam at the Lalini site with a storage capacity of approximately 150 million m^3;
- A pipeline and tunnel and a power house at the Lalini Dam site for generating hydropower;
- Five new flow measuring weirs will be required in order to measure the flow that is entering and released from the dams. These flow gauging points will be important for monitoring the implementation of the Reserve and for operation of the dams.
- Wastewater treatment works at the dam sites;
- Accommodation for operations staff at the dam sites; and
- An information centre at each of the dam sites.

The Ntabelanga Dam will supply potable water to 539 000 people, which is estimated to rise to 730 000 people by the year 2050. The domestic water supply infrastructure will include:

- A river intake structure and associated works;
- A regional water treatment works at Ntabelanga Dam;
- Potable bulk water distribution infrastructure for domestic and industrial water requirements (primary and secondary distribution lines);
- Bulk treated water storage reservoirs strategically located; and
- Pumping stations.

The Ntabelanga Dam will also provide water to irrigate approximately 2 900 ha of arable land. This project includes bulk water conveyance infrastructure for raw water supply to edge of field.

About 2 450 ha of the high potential land suitable for irrigated agriculture are in the Tsolo area and the rest near the proposed Ntabelanga Dam and along the river, close to the villages of Machibini, Nxotwe, Culunca, Ntshongweni, Caba, Kwatsha and Luxeni.

There will be a small hydropower plant at the Ntabelanga Dam to generate between 0.75 MW and 5 MW (average 2.1 MW). This will comprise a raw water pipeline from the dam to a building containing the hydropower turbines and associated equipment, and a discharge pipeline back to the river just below the dam wall. The impact is expected to be similar to that of a pumping station.

Another small hydropower plant will be constructed at the proposed Lalini Dam.

The larger hydropower plant at the Lalini Dam and tunnel (used conjunctively with the Ntabelanga Dam) will generate an average output of 30 MW if operated as a base load power station and up to 150 MW if operated as a peaking power station. The power plant will require a pipeline (approximately 4.6 km) and tunnel (approximately 3.2 km) linking the dam to the power plant downstream of the dam and below the gorge.

The power line to link the Lalini power station to the existing Eskom grid will be approximately 13 km. Power lines will be constructed to supply power for construction at the two dam sites and for operating five pumping and booster stations along the bulk distribution infrastructure.

The area to be inundated by the dams will submerge some roads. Approximately 80 km of local roads will therefore be re-aligned. Additional local roads will also be upgraded to support social and economic development in the area. The road design will be very similar to the existing roads as well as be constructed using similar materials.

The project is expected to cost R 12.45 billion and an annual income of R 5.9 billion is expected to be generated by or as a result of the project during construction and R 1.6 billion per annum during operation. It will create 3 880 new skilled employment opportunities and 2 930 un-skilled employment opportunities during construction.

2.3 ALTERNATIVES

The following project level alternatives will be assessed:

- Three hydro power tunnel positions and associated power lines;
- Peak versus Base load power generation;
- Three different dam sizes for the Lalini Dam; and
- The no project option.

For the construction camps, pipeline routes and new roads, the specialist will identify any sensitive areas and deviations to avoid these will be proposed in consultation with the technical team.

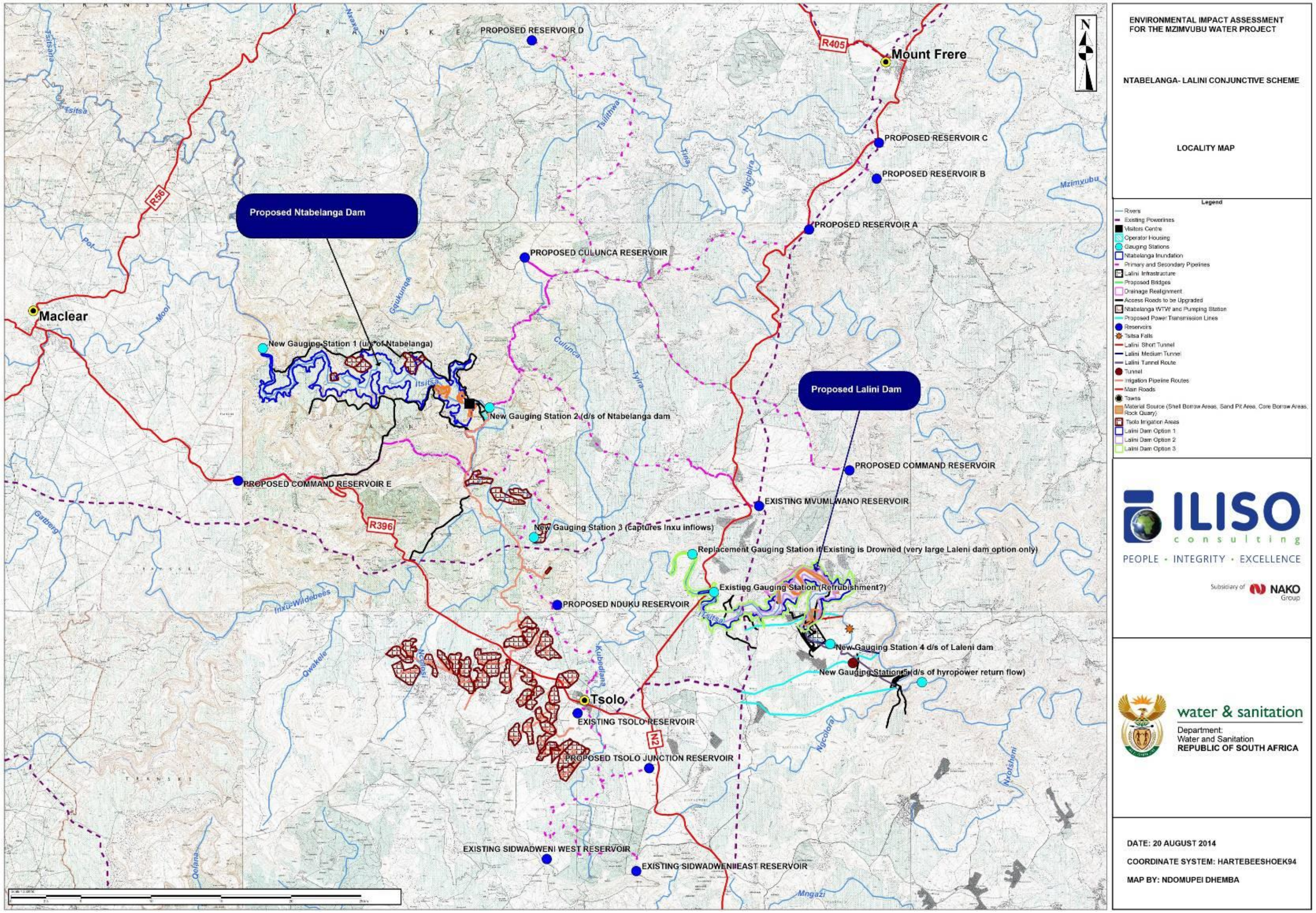

Figure 1: Locality map of the study area.

3. TERMS OF REFERENCE

3.1 SCOPE OF THE STUDY

3.1.1 Aquatic ecological assessment sites and site selection

Aquatic ecological assessments were undertaken at four points on the Tsitsa River. One point (TS1) was above the full supply level of the proposed Ntabelanga Dam with another point (TS4) located immediately upstream of the proposed wall position. Further downstream two points (TS7 and TS8 respectively) were located upstream of the full supply level and downstream of the wall of the proposed Lalini Dam development respectively. In addition five other assessment points were identified on tributaries of the Tsitsa River in the greater study area.

Table 2 presents geographic information with regards to the monitoring points on the Tsitsa River and associated tributaries assessed. **Figure 2** visually presents the locations of the various points along the various river systems, assessed either in the current assessment or by accessing information available from the literature review and historical data collected.

Table 2: Location of the biomonitoring points with co-ordinates

Site	Detailed Site Description	GPS coordinates	
		South	East
Riverine assessment points			
TS1	Site on the **Tsitsa River** upstream of the proposed Ntabelanga Dam and road upgrades development	31°06'19.63"	28°30'50.16"
TS4	Site on the **Tsitsa River** downstream of the proposed Ntabelanga Dam and road upgrade development	31°07'07.29"	28°40'11.38"
TS7	Site on the **Tsitsa River** upstream of the proposed Lalini Dam development	31°14'43.06"	28°50'30.74"
TS8	Site on the **Tsitsa River** downstream of the proposed Lalini Dam development	31°14'19.00"	28°56'14.15"
TS2	Site on an **unnamed tributary of the Tsitsa River** upstream of the proposed Ntabelanga Dam and road upgrade development	31°06'13.72"	28°30'53.72"
TS3	Site on an **unnamed tributary of the Tsitsa River** upstream of the proposed Ntabelanga Dam and road upgrade development	31°06'59.53"	28°30'50.13"
TS5	Site on an **unnamed tributary of the Tsitsa River** at the starting point of the proposed road upgrade development	31°13'12.12"	28°37'51.91"
TS6	Site on the **Inxu River** (tributary of the Tsitsa river) at the starting point of the proposed road upgrade development	31°12'37.94"	28°37'36.51"
TS9	Site on an **unnamed tributary of the Tsitsa River** directly associated with the proposed pipeline development	31°20'08.51"	28°45'54.20"

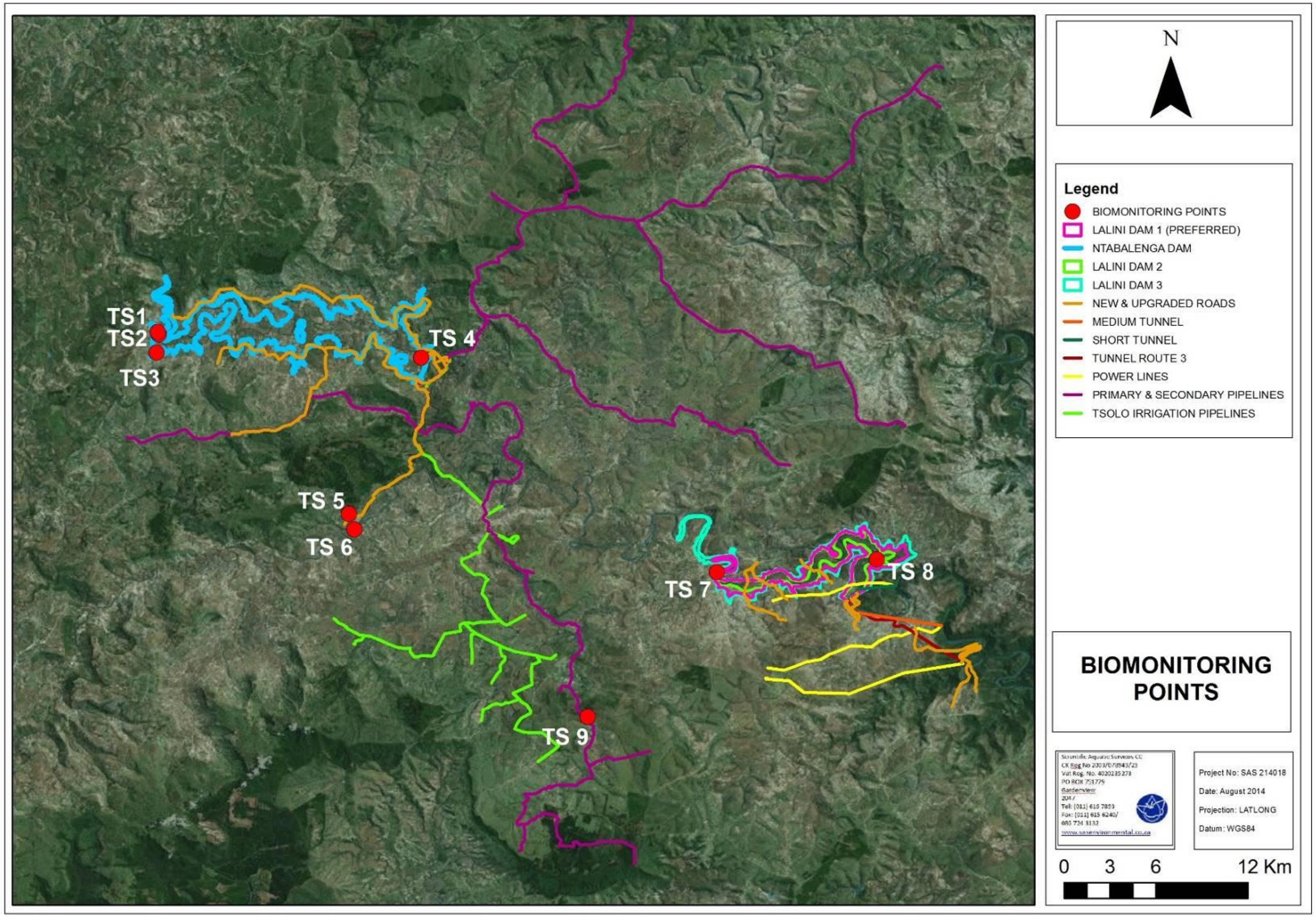

Figure 2: Digital satellite image of the study area showing assessment sites on the Tsitsa River (TS1, TS4, TS7 and TS8) as well as on tributaries of this river (TS2, TS3, TS5, TS6 and TS9) depicted on an aerial photograph in relation to surrounding areas.

The sites assessed were all visually assessed. In the field analyses of biota specific water quality variables took place at each point. In addition the Invertebrate Habitat Assessment System (IHAS), Intermediate Habitat Integrity Assessment (IHIA), the South African Scoring System version 5 (SASS5) and Macro-Invertebrate Risk Assessment Index (MIRAI) were applied along with an assessment of the fish community integrity to define the ecostatus of the aquatic resources in the vicinity of the proposed project area. The protocols of applying the indices were strictly adhered to and all work was carried out by a South African River Health Program (SA RHP) accredited assessor.

3.2 METHODOLOGY

3.2.1 Literature review

A desktop study was compiled with all relevant information as presented by the South African National Biodiversity Institutes (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org). Wetland specific information resources taken into consideration during the desktop assessment of the study area included:

- National Freshwater Ecosystem Priority Areas (NFEPAs, 2011)
  - NFEPA water management area (WMA)
  - NFEPA wetlands/National wetlands map
  - Wetland and estuary FEPA
  - FEPA (sub)WMA % area
  - Sub water catchment area FEPAs
  - Water management area FEPAs
  - Fish sanctuaries
  - Wetland ecosystem types
- Threatened Terrestrial Ecosystems for South Africa, 2009
- National Wetlands Inventory, 2006

Studies undertaken by the Institute for Water Quality Studies assessed all quaternary catchments as part of the Resource Directed Measures for Protection of Water Resources. In these assessments, the EIS, Present Ecological Management Class (PEMC) and Desired Ecological Management Class (DEMC) were defined, and serve as a useful guideline in determining the importance and sensitivity of aquatic ecosystems.

Water resources are generally classified according to the degree of modification or level of impairment. The classes used by the South African River Health Program (RHP) are presented in **Table 3** and will be used as the basis of classification of the systems in the study area.

Table 3: Classification of river health assessment classes in line with the RHP

Class	Description
A	Unmodified, natural.
B	Largely natural, with few modifications.
C	Moderately modified.
D	Largely modified.
E	Extensively modified.
F	Critically modified.

In addition the ecological category (EC) classification will be employed using the eco-status A to F continuum approach (Kleynhans and Louw, 2007). This approach allows for boundary categories denoted as B/C, C/D etc., as illustrated in **Figure 3**.

Figure 3: Ecological categories (EC) eco-status A to F continuum approach employed (Kleynhans and Louw, 2007)

3.2.2 Visual assessment of aquatic assessment points

Each site was selected in order to identify current conditions, with specific reference to impacts from surrounding activities where applicable. Both natural constraints placed on ecosystem structure and function, as well as anthropogenic alterations to the systems identified, was identified by observing conditions and relating them to professional experience. Photographs of each site were taken to provide visual records of the conditions at the time of assessment. Factors which were noted in the site-specific visual assessments included the following:

- Upstream and downstream significance of each point, where applicable;
- Significance of the point in relation to the study area;
- stream morphology;
- instream and riparian habitat diversity;
- stream continuity;
- erosion potential;
- depth flow and substrate characteristics;
- signs of physical disturbance of the area;
- other life forms reliant on aquatic ecosystems.

3.2.3 Physico-chemical water quality data

On site testing of biota specific water quality variables took place on all sites where surface water was present. The results of on-site biota specific water quality analyses were used to aid in the interpretation of the data obtained from assessments of the aquatic community assemblages at each point. Results are discussed against the guideline water quality values for aquatic ecosystems (DWAF, 1996 vol. 7).

3.2.4 Intermediate habitat integrity assessment (IHIA)

It is important to assess the habitat of riverine systems in order to aid in the interpretation of the results of the community integrity assessments by taking habitat conditions and impacts into consideration. The general habitat integrity of the sites was assessed based on the application of the Intermediate Habitat Integrity Assessment for (Kemper 1999). The Intermediate Habitat Integrity Assessment (IHIA) protocol, as described by Kemper (1999), was used using the site specific application protocols. This is a simplified procedure, which is based on the Habitat Integrity approach developed by Kleynhans (1996). The IHIA is conducted as a first level exercise, where a comprehensive exercise is not practical. The Habitat Integrity of each site was scored according to 12 different criteria which represent the most important (and easily quantifiable) anthropogenically induced possible impacts on the system.

The in-stream and riparian zones were analysed separately, and the final assessment was then made separately for each, in accordance with Kleynhans' (1999) approach to Habitat Integrity Assessment. Data for the riparian zone is, primarily interpreted in terms of the potential impact on the in-stream component. The assessment of the severity of impact of modifications is based on six descriptive categories with ratings. Analysis of the data was carried out by weighting each of the criteria according to Kemper (1999). By calculating the mean of the instream and riparian Habitat Integrity scores, an overall Habitat Integrity score can be obtained for each site. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitats of the sites. The method classifies Habitat Integrity into one of six classes, ranging from unmodified/natural (Class A), to critically modified (Class F).

3.2.5 Invertebrate habitat suitability [invertebrate habitat assessment (IHAS)]

The Invertebrate Habitat Assessment System (IHAS) was applied to all the sites according to the protocol of McMillan (1998). This index was used to determine specific habitat suitability for aquatic macro-invertebrates, as well as to aid in the interpretation of the results of the South African Scoring System version 5 (SASS5) scores. Scores for the IHAS index were interpreted according to the guidelines of McMillan (1998) as follows:

- <65%: habitat diversity and structure is inadequate for supporting a diverse aquatic macro-invertebrate community.

- 65%-75%: habitat diversity and structure is adequate for supporting a diverse aquatic macro-invertebrate community.
- >75%: habitat diversity and structure is highly suited for supporting a diverse aquatic macro-invertebrate community.

3.2.6 Aquatic Macro-Invertebrates: South African Scoring System (SASS5)

Aquatic macro-invertebrate communities of all the sites were investigated according to the SASS5 method, which is specifically designed to comply with international accreditation protocols. This method is based on the British Biological Monitoring Working Party (BMWP) method and has been adapted for South African conditions by Chutter (1998).

The assessment was undertaken according to the South African Scoring System (SASS) protocol as defined by Dickens and Graham (2001). All work was undertaken by an accredited South African Scoring System, version 5 (SASS5) practitioner.

Interpretation of the results of biological monitoring depends, to a certain extent, on interpretation of site-specific conditions (Thirion *et al.* 1995). In the context of this investigation it would be best not to use SASS5 scores in isolation, but rather in comparison with relevant habitat scores.

The reason for this is that some sites have a less desirable habitat or fewer biotopes than others do. In other words, a low SASS5 score is not necessarily regarded as poor in conjunction with a low habitat score. Also, a high SASS5 score in conjunction with a low habitat score can be regarded as better than a high SASS5 score in conjunction with a high habitat score.

A low SASS5 score together with a high habitat score would be indicative of poor conditions. The IHAS Index is valuable in helping to interpret SASS5 scores and the effects of habitat variation on aquatic macro-invertebrate community integrity.

The perceived reference state for the local streams was determined in consideration of the ecoregion conditions as well as local habitat conditions. Local conditions are generally adequate to highly suited for supporting a diverse aquatic macro-invertebrate community, particularly sites on the Tsitsa River, as is evident from IHAS scores. Fair diversities and abundances of aquatic macro-invertebrates can thus be expected.

Reference scores for sites on the larger Tsitsa River were defined as a SASS5 score of 170 and an Average Score Per Taxon (ASPT) of 7.5 (South Eastern Uplands Aquatic Ecoregion – Lower). Reference scores for sites on the smaller Tsitsa River tributaries were defined as a SASS5 score of 200 and an Average Score Per Taxon (ASPT) of 7.2 (South Eastern Uplands Aquatic Ecoregion – Upper).

Interpretation of the results in relation to the reference scores was made according to the classification of SASS5 scores presented in the SASS5 methodology published by

Dickens and Graham (2001) (**Table 4**) as well as according to Dallas (2007) (**Figures 4 and 5**).

Table 4: Definition of Present State Classes in terms of SASS and ASPT scores as presented in Dickens and Graham (2001)

Class	Description	SASS Score%	ASPT%
A	Unimpaired. High diversity of taxa with numerous sensitive taxa.	90-100 80-89	Variable >90
B	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.	80-89 70-79 70-89	<75 >90 76-90
C	Moderately impaired. Moderate diversity of taxa.	60-79 50-59 50-79	<60 >75 60-75
D	Largely impaired. Mostly tolerant taxa present.	50–59 40-49	<60 Variable
E	Severely impaired. Only tolerant taxa present.	20-39	Variable
F	Critically impaired. Very few tolerant taxa present.	0-19	Variable

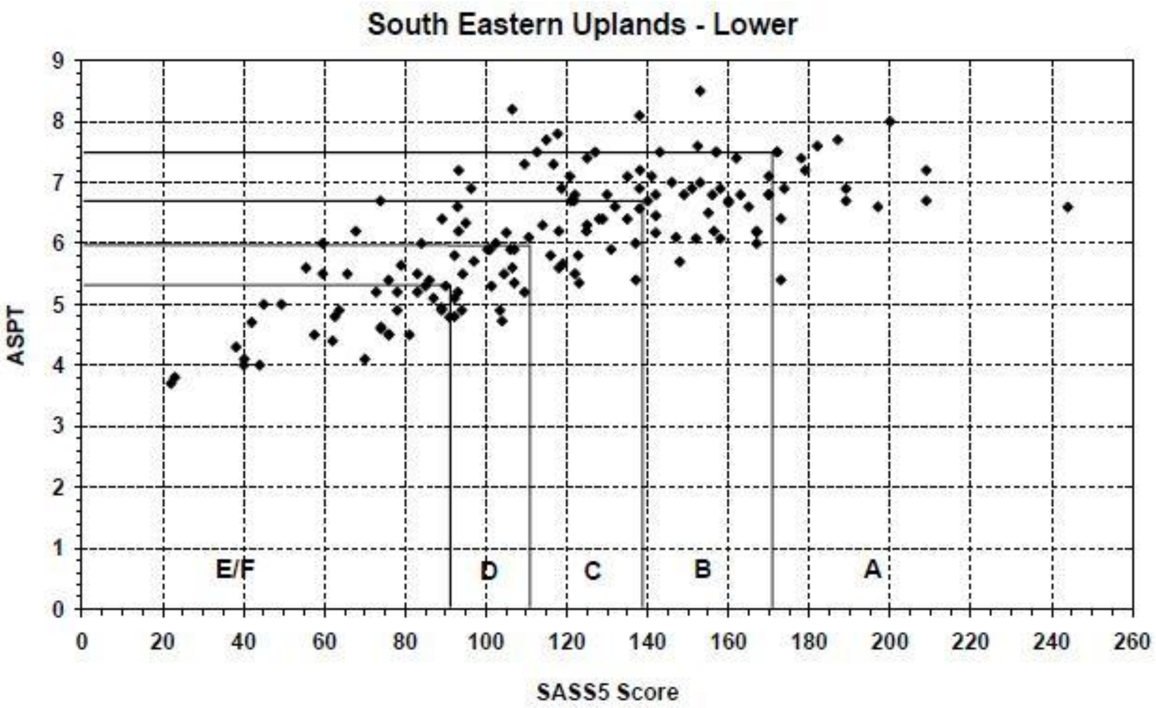

Figure 4: SASS5 Classification using biological bands calculated form percentiles for the South Eastern Uplands Aquatic Ecoregion - Lower, Dallas, 2007. This will be applied to the assessment sites on the larger Tsitsa River.

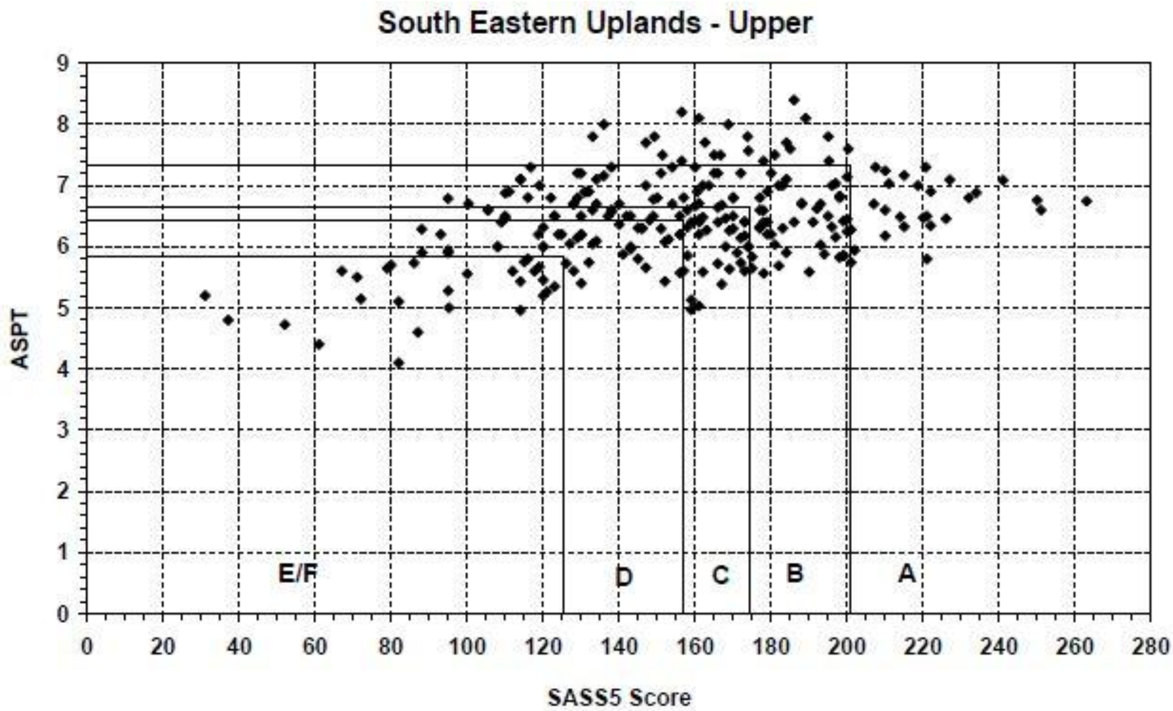

Figure 5: SASS5 Classification using biological bands calculated form percentiles for the South Eastern Uplands Aquatic Ecoregion - Upper, Dallas, 2007. This will be applied to the assessment sites on the smaller tributaries of the Tsitsa River.

3.2.7 Aquatic Macro-Invertebrates: Macro-invertebrate Response Assessment Index (MIRAI)

The four major components of a stream system that determine productivity, with particular reference to aquatic organisms, are flow regime, physical habitat structure, water quality and energy inputs. An interplay between these factors (particularly habitat and availability of food sources) result in the discontinuous, patchy distribution pattern of aquatic macro-invertebrate populations. As such aquatic invertebrates shall respond to habitat changes (i.e. changes in driver conditions).

To relate drivers to such changes in habitat and aquatic invertebrate condition, two key elements are required. Firstly habitat preferences and requirements for each taxa present should be obtained. As such reference conditions can be established against which any response to drivers can be measured. Secondly habitat features should be evaluated in terms of suitability and the requirements mentioned in the first point. As a result expected and actual patterns can be evaluated to achieve an Ecostatus Category (EC) rating.

Based on the three key requirements, the MIRAI provides an approach to deriving and interpreting aquatic invertebrate response to driver changes. The index has been applied to all sites following methodology described by Thirion (2007). Aquatic macro-invertebrates expected at each point were derived from data on macro-invertebrate families present within the entire study area at the time of assessment. Families collected from all sites were listed together. This list was then applied as macro-invertebrate families expected at each of the respective sites.
Given the homogeneity in terms of habitat types within the Tsitsa River system as well as the intact ecology of the system this approach is deemed acceptable.

3.2.8 Fish biota: Habitat Cover Rating (HCR) and Fish Habitat Assessment (FHA)

This approach was developed to assess habitats according to different attributes that are surmised to satisfy the habitat requirements of various fish species. At each site, the following depth-flow (df) classes are identified, namely:

- Slow (<0.3m/s), shallow (<0.5m) - Shallow pools and backwaters.
- Slow, deep (>0.5m) - Deep pools and backwaters.
- Fast (>0.3m/s), shallow - Riffles, rapids and runs.
- Fast, deep - Usually rapids and runs.

The relative contribution of each of the above mentioned classes at a site was estimated and indicated as:

0 = Absent
1 = Rare (<5%)
2 = Sparse (5-25%)
3 = Moderate (25-75%)
4 = Extensive (>75%)

For each depth-flow class, the following cover features (cf) -considered to provide fish with the necessary cover to utilise a particular flow and depth class- were investigated:

- Overhanging vegetation
- Undercut banks and root wads
- Stream substrate
- Aquatic macrophytes

The amount of cover present at each of these cover features (cf) was noted as:

0 = absent
1 = Rare/very poor (<5%)
2 = Sparse/poor (5-25%)
3 = Moderate/good (25-75%)
4 = Extensive/excellent (>75%)

The fish habitat cover rating (HCR) was calculated as follows:

The contribution of each depth-flow class at the site was calculated ($df/\Sigma df$).

For each depth-flow class, the fish cover features (cf) were summed (Σcf).

$HCR = df/\Sigma df \times \Sigma cf$.

The amount and diversity of cover available for the fish community at the selected sites was graphically expressed as habitat cover ratings (HCR) for different flow-depth classes as a stacked bar chart.

3.2.9 Fish biota: Fish Response Assessment Index (FRAI)

The FRAI (Kleynhans 2008) is based on the premise that "drivers" (environmental conditions) may cause fish stress which shall then manifest as changes in fish species assemblage.

The index employs preferences and intolerances of the reference fish assemblage, as well as the response of the actual (present) fish assemblage to particular drivers to indicate a change from reference conditions. Intolerances and preferences are divided into metric groups relating to preferences and requirements of individual species. This allows cause-effect relationships to be understood, i.e. between drivers and responses of the fish assemblage to changes in drivers. These metric groups are subsequently ranked, rated and finally integrated as a fish Ecological Category (EC) shown previously in **Figure 3**. Fish expected to occur in the system is summarised in **Table 5**.

Table 5: Intolerance ratings for naturally occurring fish species with natural ranges included in the Tsitsa River the study area (Skelton, 2001; Mlondolozi et al. 2010; Scherman et al, 2007; Kleynhans, 2003; Kleynhans, Louw and Moolman, 2007).

SPECIES NAME	COMMON NAME	INTOLE-RANCE RATING [2]	FROC [1] score	COMMENTS
Anguilla mossambica	Longfin eel	2.8	1	East coast from Kenya south to Cape Agulhas
Barbus anoplus	Chubbyhead barb	2.6	3	Widely distributed from Highveld Limpopo to upland Kwa-Zulu Natal, Transkei and the middle and upper Orange basin.
Cyprinus carpio	Carp	1.4	1	Widespread
Micropterus salmoides	Largemouth bass	2.2	1[3]	Widespread in Western and Eastern Cape coastal drainages, KwaZulu-Natal midlands and interior of the North-West and Northern Provinces, Gauteng, Mpumalanga and Free State. **Not expected to occur at the sites sampled.**

[1] FROC = Frequency of occurrence as obtained from Kleynhans *et al.* 2007

[2] Average overall intolerance rating as per Kleynhans (1999). Tolerant: 1-2; Moderately tolerant :> 2-3; Moderately Intolerant: >3-4; Intolerant: >4

[3] FROC scores not listed – allocated a score of 1.

3.3 IMPACT CRITERIA AND RATING SCALE

The impacts are rated in accordance with the Environmental Impact Assessment Regulations, 2010 and the criteria drawn from the IEM Guidelines Series, Guideline 5: Assessment of Alternatives and Impacts, published by the (DEAT, 2006) as well as the Guideline Document on Impact Significance (DEAT, 2002) as listed below.

The key issues identified during the Scoping Phase inform the terms of reference of this specialist study. Each issue consists of components that on their own or in combination with each other give rise to potential impacts, either positive or negative, from the project onto the environment or from the environment onto the project.

The significance of the potential impacts is considered before and after identified mitigation is implemented, for direct, indirect, and cumulative impacts, in the short and long term.

A description of the nature of the impact, any specific legal requirements and the stage (construction/decommissioning or operation) is given. Impacts are considered to be the same during construction and decommissioning.

The following criteria have been used to evaluate significance:

- **Nature:** This is an appraisal of the type of effect the activity is likely to have on the affected environment. The description includes what is being affected and how. The nature of the impact will be classified as positive or negative, and direct or indirect.

- **Extent and location:** This indicates the spatial area that may be affected (**Table 6**:).

Table 6: Geographical extent of impact

Rating	Extent	Description
1	Site	Impacted area is only at the site – the actual extent of the activity.
2	Local	Impacted area is limited to the site and its immediate surrounding area
3	Regional	Impacted area extends to the surrounding area, the immediate and the neighbouring properties.
4	Provincial	Impact considered of provincial importance
5	National	Impact considered of national importance – will affect entire country.

- **Duration:** This measures the lifetime of the impact (**Table 7**).

Table 7: Duration of Impact

Rating	Duration	Description
1	Short term	0 – 3 years, or length of construction period
2	Medium term	3 – 10 years
3	Long term	> 10 years, or entire operational life of project.
4	Permanent – mitigated	Mitigation measures of natural process will reduce impact – impact will remain after operational life of project.
5	Permanent – no	No mitigation measures of natural process will reduce impact after

	mitigation	implementation – impact will remain after operational life of project.

- **Intensity/severity:** This is the degree to which the project affects or changes the environment; it includes a measure of the reversibility of impacts (**Table 8**).

Table 8: Intensity of Impact

Rating	Intensity	Description
1	Negligible	Change is slight, often not noticeable, natural functioning of environment not affected.
2	Low	Natural functioning of environment is minimally affected. Natural, cultural and social functions and processes can be reversed to their original state.
3	Medium	Environment remarkably altered, still functions, if in modified way. Negative impacts cannot be fully reversed.
4	High	Cultural and social functions and processes disturbed – potentially ceasing to function temporarily.
5	Very high	Natural, cultural and social functions and processes permanently cease, and valued, important, sensitive or vulnerable systems or communities are substantially affected. Negative impacts cannot be reversed.

- **Potential for irreplaceable loss of resources:** This is the degree to which the project will cause loss of resources that are irreplaceable (**Table 9**).

Table 9: Potential for irreplaceable loss of resources

Rating	Potential for irreplaceable loss of resources	Description
1	Low	No irreplaceable resources will be impacted.
3	Medium	Resources can be replaced, with effort.
5	High	There is no potential for replacing a particular vulnerable resource that will be impacted.

- **Probability:** This is the likelihood or the chances that the impact will occur (**Table 10**).

Table 10: Probability of Impact

Rating	Probability	Description
1	Improbable	Under normal conditions, no impacts expected.
2	Low	The probability of the impact to occur is low due to its design or historic experience.
3	Medium	There is a distinct probability of the impact occurring.
4	High	It is most likely that the impact will occur
5	Definite	The impact will occur regardless of any prevention measures.

- **Confidence:** This is the level of knowledge or information available, the environmental impact practitioner or a specialist had in his/her judgement (**Table 11**).

Table 11: Confidence in level of knowledge or information

Rating	Confidence	Description
	Low	Judgement based on intuition, not knowledge / information.
	Medium	Common sense and general knowledge informs decision.

	High	Scientific / proven information informs decision.

- **Consequence:** This is calculated as extent + duration + intensity + potential impact on irreplaceable resources.

- **Significance:** The significance will be rated by combining the consequence of the impact and the probability of occurrence (i.e. consequence x probability = significance). The maximum value which can be obtained is 100 significance points (**Table 12**).

Table 12: Significance of issues (based on parameters)

Rating	Significance	Description
1-14	Very low	No action required.
15-29	Low	Impacts are within the acceptable range.
30-44	Medium-low	Impacts are within the acceptable range but should be mitigated to lower significance levels wherever possible.
45-59	Medium-high	Impacts are important and require attention; mitigation is required to reduce the negative impacts to acceptable levels.
60-80	High	Impacts are of great importance, mitigation is crucial.
81-100	Very high	Impacts are unacceptable.

- **Cumulative Impacts:** This refers to the combined, incremental effects of the impact. The possible cumulative impacts will also be considered.

- **Mitigation:** Mitigation for significant issues will be incorporated into the EMP.

3.4 LEGISLATION AND GUIDELINES CONSIDERED

National Environmental Management Act (Act 107 of 1998)

The National Environmental Management Act (Act 107 of 1998) and the associated Regulations (Listing No R. 544, No R. 545 and R. 546) as amended in June 2010, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed.

This could follow either the Basic Assessment process or the Environmental Impact Assessment (EIA) process depending on the nature of the activity and scale of the impact. In the case of this project the EIA process has been followed.

National Water Act (NWA; Act 36 of 1998)

The NWA; Act 36 of 1998 recognises that the entire ecosystem and not just the water itself in any given water resource, constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS).

Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from DWS in terms of Section 21 of the NWA.

GN 704 – Regulations on use of water for mining and related activities aimed at the protection of water resources, 1999

These Regulations, forming part of the NWA, were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining.

It is recommended that the proposed project complies with Regulation GN 704 of the NWA, 1998 (act no. 36 of 1998) which contains regulations on use of water for mining, including borrowing activities and related activities aimed at the protection of water resources. GN 704 states that:

No person in control of a mine or activity may:

- locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;
- According to the above, the activity footprint must fall outside of the 1:100 year floodline of the drainage feature or 100m from the edge of the feature, whichever distance is the greatest.

4. ASSUMPTIONS AND LIMITATIONS

For purposes of SASS5 result comparisons, the following assumption was made with reference to the Dallas (2007): Smaller streams are generally more sensitive to negative disruptive effects while larger systems are more resilient. For this reason all Tsitsa River sites were assessed according to the "South Eastern Uplands Aquatic Ecoregion – Lower" reference scores, whilst the higher "South Eastern Uplands Aquatic Ecoregion – Upper" reference scores were used for all the smaller tributaries.

The following points serve to indicate the assumptions and limitations of this study.

- ***Reference conditions are unknown:*** The composition of aquatic biota in the study area, prior to major disturbance, is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available.
- ***Temporal variability:*** The data presented in this report are based on two site visits, undertaken in late autumn (April 2014) and mid-winter (June 2014). The effects of natural seasonal and long term variation in the ecological conditions and aquatic biota found in the streams are, therefore, unknown.
- ***Ecological assessment timing:*** *A*quatic and terrestrial ecosystems are dynamic and complex. It is likely that aspects, some of which may be important, could have been overlooked. A more reliable assessment of the biota would require seasonal sampling, with sampling being undertaken under both low flow and high flow conditions.
- ***Size of the Tsitsa River:*** The Tsitsa River is a large river with some areas comprising of deep pools. Deep pools are difficult to comprehensively sample for fish and benthic aquatic taxa. This, combined with the season when fish are known to hold in deeper pools where water temperatures are more stable, means that some aspects of the ecology of the Tsitsa River will not have been comprehensively assessed.