AUGMENTATION OF THE LUSIKISIKI REGIONAL WATER SUPPLY SCHEME, EASTERN CAPE PROVINCE, SOUTH AFRICA:

SPECIALIST SUMMARY 1

P WMA 12/T60/00/5414/2

Prepared for:

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Department of Water and Sanitation
Private Bag X313
Pretoria
0001

Prepared by:

EOH
Coastal & Environmental Services

EOH Coastal and Environmental Services
EAST LONDON
16 Tyrell Road, Berea
East London, 5241
043 726 7809
Also in Cape Town, Johannesburg, Grahamstown, Port Elizabeth and Maputo(Mozambique)
www.cesnet.co.za or www.eoh.co.za

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EOH Coastal and Environmental Services

Report Title: Augmentation of the Lusikisiki Regional Water Supply Scheme: Specialist Summary 1
Report Version: Draft

Project Number: 237

Name	Responsibility	Signature	Date
Caitlin Smith	Report Writer		January 2015
Roy de Kock	Project Leader		January 2015
Alan Carter	Report Reviewer		January 2015

THE PROJECT TEAM

Dr Alan Carter (Reviewer)
Dr Alan Carter, director of the East London Office, has extensive training and experience in both financial accounting and environmental science disciplines with international accounting firms in South Africa and the USA. He is a member of the American Institute of Certified Public Accountants and holds a PhD in Plant Sciences. He is also a certified ISO14001 EMS auditor with the American National Standards Institute and the British Standards Institute.

Mr Roy De Kock (Project Leader)
Roy is a Senior Consultant holding a BSc Honours in Geology and an MSc in Botany from the Nelson Mandela Metropolitan University in Port Elizabeth. His MSc thesis focused on Rehabilitation Ecology using an open-cast mine as a case study. He has been working for CES since 2010, and is based at the East London branch where he focuses on Ecological and Agricultural Assessments, Geological and Geotechnical analysis, Environmental Management Plans, mining applications and various environmental impact studies. Roy has worked on numerous projects in South Africa, Mozambique and Malawi.

Ms Caitlin Smith (Report Writer)
Caitlin holds a BSc degree in Geology and Geography and a BSc Honours Degree in Geology both obtained from Nelson Mandela Metropolitan University. Caitlin has 4 years’ experience as a mining geologist in the heavy mineral sand mining industry.

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1. INTRODUCTION

The Lusikisiki Regional Water Supply Scheme (LRWSS) has been under consideration since the 1970's (van Niekerk *et al.*, 2013) when it was recommended that a regional water supply scheme based on a dam on the Xura River and a main bulk supply reservoir close to Lusikisiki would provide potable water supply for the entire region between Lusikisiki and the coast, extending from the Mzimvubu River in the south west to the Msikaba River in the north east. Some areas up to 15 km inland of Lusikisiki would also be supplied. In 2007, SRK Consulting undertook the Lusikisiki Groundwater Feasibility Study to investigate groundwater potential and compare the new data with data produced by earlier studies. This study reported that there is a relatively strong possibility of finding high yielding boreholes, and that a combination of surface water (Zalu Dam) and groundwater would be the most feasible solution for the LRWSS (van Niekerk *et al*., 2013).

The study area comprises the region between Lusikisiki (up to 15 km inland) and the coast, extending from the Mzimvubu River in the south-west to the Msikaba River in the north-east (Figure 1.1).

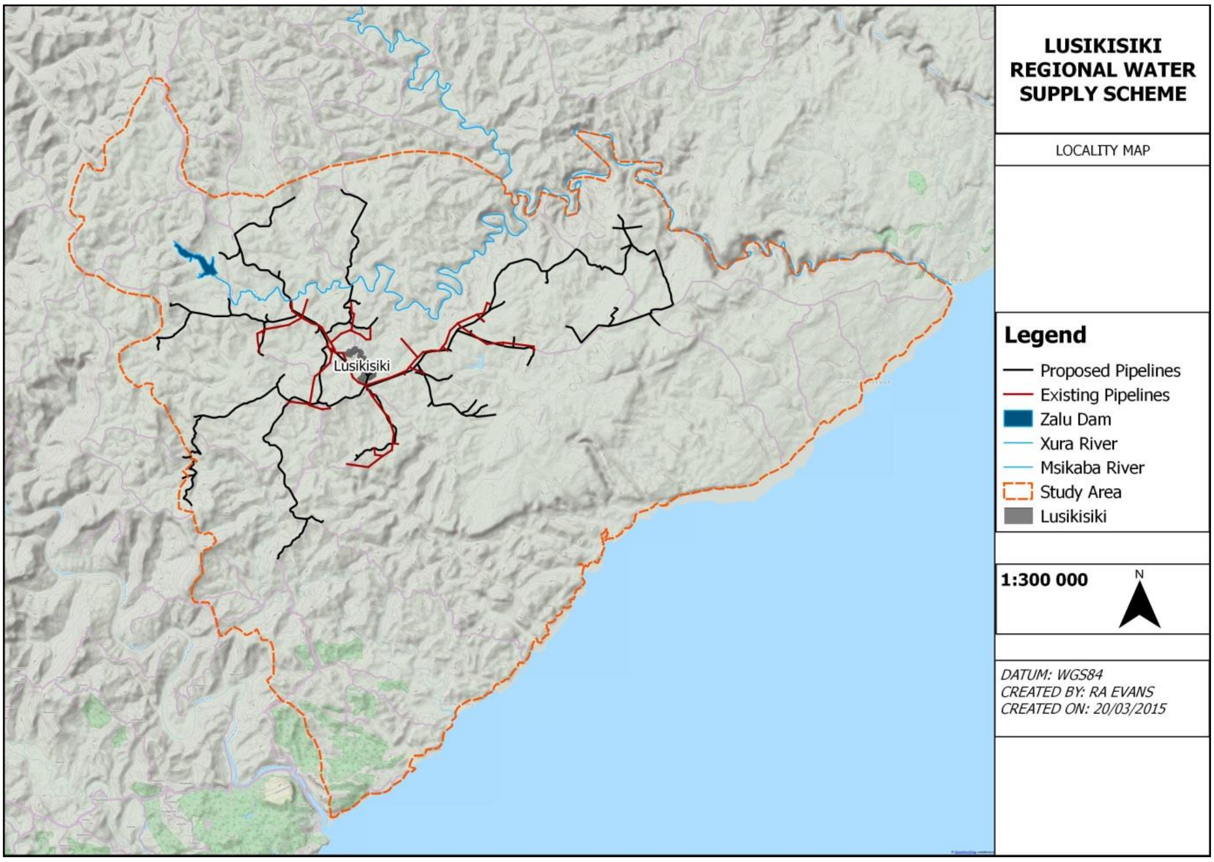

Figure 1.1. Locality Map showing the LRWSS study area.

The proposed activity consists of the following components:

- **Zalu Dam and Inundation area** - The dam will consist of an earth core rockfill dam with a full supply level of 622.6 masl, dam wall height of approximately 44 m and will be located approximately 0.5 km northeast of the Ndimbaneni village.

- **Borrow pits for dam construction** – Weathered dolerite clay is available in borrow areas downstream of the dam centreline. This material is sufficient for a central earthfill core for a rockfill dam. Two rockfill quarries with unweathered dolerite, one on the right bank and one on the left bank, 1km upstream of the centreline of the proposed dam, were identified.

- **Abstraction weir** – An abstraction weir approximately 5 km downstream from the proposed Zalu Dam, on the Xura River, will be upgraded.

- **Reticulation** – A new extended pipeline system will be constructed. The existing reservoirs will be upgraded and additional reservoirs will be constructed.

- **Water Water Treatment Plant (WTP)** – The Lusikisiki WTP will be refurbished and a new WTP constructed adjacent to the existing one.

- **Raw water pump station** – The raw water pumping will be upgraded.

- **Groundwater** – Groundwater sources are to be used in areas of considerable distance from the planned Zalu Dam and where topography is unfavourable for pipeline infrastructure. Where high yielding groundwater sources exist, they will be linked into the planned bulk water reticulation network. Numerous communities fall outside of the Regional Well-field Area and will need to be served by stand-alone schemes

2. HERITAGE IMPACT ASSESSMENT

Mr Gavin Anderson, from Umlando, was contracted by EOH Coastal and Environmental Services to undertake the Heritage Impact Assessment for the LRWSS.

2.1 Approach

The first step in the Heritage Impact Assessment (HIA) is a desktop assessment. This involves consultation of the Umlando database which contains archaeological site locations and basic information from several provinces. The database is in Google Earth format and is thus used as a quick reference when undertaking desktop studies. Local data recording centres, a historical architect, palaeontologist and a historian are also consulted where necessary. The survey results then define the significance of each recorded site as well as a management plan. All sites are grouped according to low, medium and high significance.

2.2 Results

Eighty-seven heritage sites were noted during the survey. Most of the sites consist of human graves in a fenced off and/or demarcated area, however, these tend to be close to the road and/or pipeline. Only graves within 50 m of the new pipelines were recorded.

2.3 Recommendations

- Each cemetery or grave is protected if it falls within 50 – 100 m of a development. All grave(s) and/or cemeteries should be clearly demarcated prior to the commencement of construction.

- There should be a 5 m buffer between the edge of the grave/cemetery and the fence. The fence should be clearly demarcated.

- A 20 m buffer is usually required between the edge of the grave and the edge of the footprint. The pipeline is, however, often restricted by space in the villages in which case the pipeline can be moved to the opposite side of the road.

- Graves that are already in demarcated and fenced off yards will not require further mitigation. In the case of human graves outside of the villages, the 20 m buffer rule should apply.

- If human graves are uncovered during the course of earthmoving activities then both the police and the Eastern Cape Provincial Heritage Resources Agency (ECPHRA) need to be contacted immediately. All construction activity in the area should stop.

- All graves that are not in a municipal graveyard are protected. Only a registered undertaker or an institution declared under the Human Tissues Act should handle human remains younger than 60 years.

- Anyone who wishes to develop an area where there are graves older than 60 years is required to follow the process described in the legislation.

- The archaeological artefacts affected by the development do not require permits. They are isolated instances of artefacts and do not constitute a site per se.

2.3 Conclusions

The heritage survey undertaken for the LRWSS recorded 87 heritage sites that may be affected by the project. Most of the heritage sites are human graves dating to the last 50 years. Many of these graves occur within existing fenced yards and should not be affected by any servitudes. The archaeological sites that were noted are of low significance and do not require further mitigation.

3. PALAEONTOLOGICAL IMPACT ASSESSMENT

Gideon Groenewald was appointed to undertake a Phase 1 Paleontological Impact Assessment in accordance with the potential paleontological impacts identified during the scoping phase.

3.1 Approach

Prior to the field investigation a preliminary assessment (desktop study) of the topography and geology of the study area was completed using appropriate 1:250 000 geological maps (3128 Umtata) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations, etc.) were identified within the study area and the known fossil heritage within each rock unit was inventoried from the published scientific literature, previous paleontological impact studies in the same region and the author's field experience.

Priority paleontological areas were identified within the development footprint to focus the field investigator's time and resources.

The likely impact of the proposed development on local fossil heritage was determined on the basis of the paleontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged.

3.2 Results

The field investigation confirms that the area is underlain by the Silurian aged Natal Group, Carboniferous to Permian aged Dwyka Formation, Permian aged Ecca Group, Jurassic aged Dolerite and Quaternary aged Alluvium.

Due to the deep weathering of the Dwyka Formation and Ecca Group sediments, a Low Paleontological Sensitivity is allocated to the development. No severe impacts are envisaged and paleontological mitigation is limited to the ECO noting the possibility of trace fossils on the bedding planes of Ecca Group shales at the wall and spillway of the Zalu Dam.

3.3 Recommendations

It is recommended that:

- The ECO of the project be informed of the possibility that trace fossils might be exposed on the bedding planes of the Ecca Group shales during deep excavations for the construction of the Zalu Dam wall and spillway. If fossils are recorded the palaeontologist, ECPHRA and SAHRA must be notified and the fossils recorded according to SAHRA specification.

AUGMENTATION OF THE LUSIKISIKI REGIONAL WATER SUPPLY SCHEME, EASTERN CAPE PROVINCE, SOUTH AFRICA:

SPECIALIST SUMMARY 2

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Report Title: Augmentation of the Lusikisiki Regional Water Supply Scheme: Specialist Summary 2

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Name	Responsibility	Signature	Date
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Roy de Kock	Project Leader		March 2015
Alan Carter	Report Reviewer		March 2015

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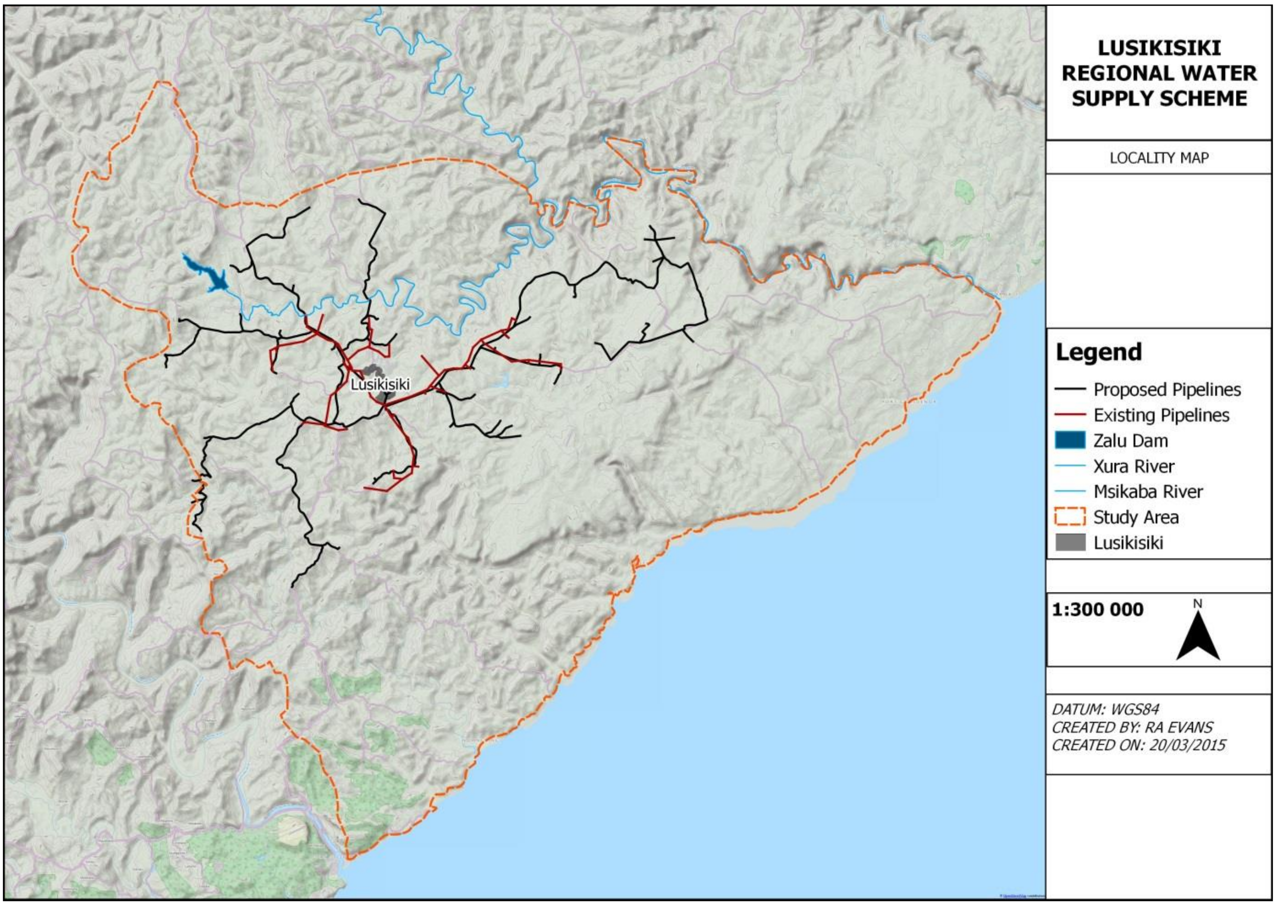

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2. ECOLOGICAL IMPACT ASSESSMENT

Ms Tarryn Martin, from EOH CES, was appointed to conduct an ecological specialist report in accordance with the potential ecological impacts identified during the scoping phase.

2.1 Approach

The study site and surrounding areas were described using a two-phased approach. Firstly, a desktop assessment of the site was conducted in terms of current vegetation classifications and biodiversity programmes and plans. This included the consideration of:

- The South African Vegetation Map (Mucina and Rutherford, 2006)
- NFEPA Wetlands and Rivers
- The ECBCP
- The list of National Threatened Ecosystems
- Protected Areas and National Protected Area Expansion Strategy (NPAES) Areas

Further to the above, one site visit was conducted (1-5 December 2014) in order to assess the actual ecological state, current land-use, identify potential sensitive ecosystems and identify plant species associated with the proposed project activities. The site visit also served to inform potential impacts of the proposed project and how significantly it would impact on the surrounding ecological environment.

Information on the general area and plant species was also generated using historical records for the Quarter Degree Square that the area falls within (SIBIS, 2015). This information has been used to supplement the findings of this report.

2.2 Results

- The site survey indicates that the study area is degraded and that areas classified as CBA 1 and 2, where project infrastructure will have an impact, are in poor condition and generally overgrazed. A significant loss of biodiversity in these areas has already occurred and these areas should therefore be classified as areas of low to moderate sensitivity rather than high sensitivity as the ECBCP spatial planning tool recommends.

- The majority of the Zalu Dam inundation area was degraded and impacted by human settlement. Consequently, these areas were defined as areas of low sensitivity.

- Although degraded and infested with alien vegetation, the riparian zone, forest patches, wetlands and drainage lines still play an important role for ecological processes. These areas were therefore classified as having a high sensitivity.

- Ngonigoni veld has been classified as low sensitivity due to its high level of degradation.

- Pipelines and access roads follow existing roads through areas that are already degraded and as a result many of the impacts will be avoided with effective management of the site as well as effective and monitored rehabilitation after construction.

2.3 Recommendations

- In the case of the pipeline route, it is essential that areas of high sensitivity (e.g. forests, water courses and wetlands) are avoided where feasible. Any disturbed land used during the construction phase of the development, which will not be used during the operation phase of the development, must be rehabilitated after construction is completed.

- Prior to construction and dam inundation it is recommended that a botanist/ecologist ground-truths the final pipeline route plans and inundation area to determine the presence of any of the species of special concern or protected species. Before the clearing of the site is authorised, the appropriate permit must be obtained from the relevant department should any protected species need to be removed or replanted.

- Impacts associated with the Operation Phase are associated with the infestation of alien plant species. Alien invasive species should be managed effectively to prevent further impacts on the study area.

- The operation phase will consist of the commissioning of the dam wall and actual inundation of the Zalu Dam. A search and rescue programme for slow moving and burrowing animals must be implemented during this time.

- A detailed Plant Removal and Rehabilitation Plan must be developed as a condition of authorisation. The plan must be incorporated into the final Environmental Management Programme (EMPr) and must consist of the location of protected plant species that may be affected, removal, relocation and storage methods, rehabilitation species, re-vegetation methodology and re-vegetation monitoring (in terms of frequency and success).

- The plants can also be removed and placed in a nursery for use for rehabilitation purposes. If a species is identified for relocation, individuals of the species will need to be located within the proposed site, before vegetation clearing commences, and carefully uprooted and removed by a skilled horticulturist. Prior to removal, however, suitable relocation areas need to be identified, either within the site or in other disturbed areas on the property. Individual plants that cannot be relocated at the time of removal should be moved to the nursery.

- It should be noted that many critical SSC are plants that will not be able to be successfully uprooted and replanted at all (Phillipson, 2002), or at best may have a low survival rate. In all cases the species will require very careful treatment to give them the best chances of survival, and specialist horticultural knowledge will be needed.

2.4 Conclusions

Overall, the impacts of the development will be **low negative** after mitigation measures and residual impacts will be mainly associated with a loss of vegetation. This loss of vegetation is also important for fauna as it constitutes habitat loss. Positive impacts include the active management of the alien vegetation on the site.

3. AQUATIC IMPACT ASSESSMENT

The Aquatic Impact Assessment was conducted by Dr Cherie-Lynn Mack of EOH CES, who is familiar with the assessment of linear infrastructure impacts on aquatic environments. EOH CES is familiar with the requirements of the Department of Water and Sanitation in terms of authorisation of activities that may impact on a water resource, i.e. water use licenses.

3.1 Approach

Before going on site, a thorough desktop assessment of the aquatic environment was conducted. This included mapping all wetlands, dams, watercourses, etc. in relation to the proposed infrastructure plan. Documents and programmes such as the National Freshwater Ecosystem Priority Area (NFEPA) programme, the National Spatial Biodiversity Assessment and the Eastern Cape Biodiversity Conservation Plan were consulted in order to determine the "state of aquatic environment". Areas where the aquatic environment intersected with proposed infrastructure were highlighted for further assessment in the field.

The aquatic environment was surveyed on two occasions; in August 2014 and in February 2014. Photographic analysis of each interaction was undertaken, and a high level aquatic habitat assessment was conducted.

3.2 Results

In total, over 70 interactions were confirmed. This includes the inundation of three listed wetlands by the proposed dam, the upgrading of a bridge, and a large number of occasions where pipelines will cross either major or minor water courses.

A sensitivity analysis was performed, with HIGH and MODERATE sensitivity areas indicated in relation to the proposed infrastructure.

Areas of high sensitivity include:

- Un-degraded process areas such as rivers, wetlands and streams that are important for ecosystem functioning, including surface and ground water as well as animal and plant dispersal;
- Areas that are not significantly impacted, transformed or degraded by current land use; and
- River reaches of major systems that are important for overall ecosystem functioning

Areas of moderate sensitivity include:

- Areas that still provide a valuable contribution to biodiversity and ecosystem functioning despite being degraded;
- Smaller tributaries of larger river systems

The study area was divided into three sections so that the resolution of the sensitivity maps would provide sufficient visual information. Figure 3.1, 3.2 and 3.3, below, show the sensitivity of the area. A corridor of 600m (300m on either side of the pipeline route centre line) was assessed.

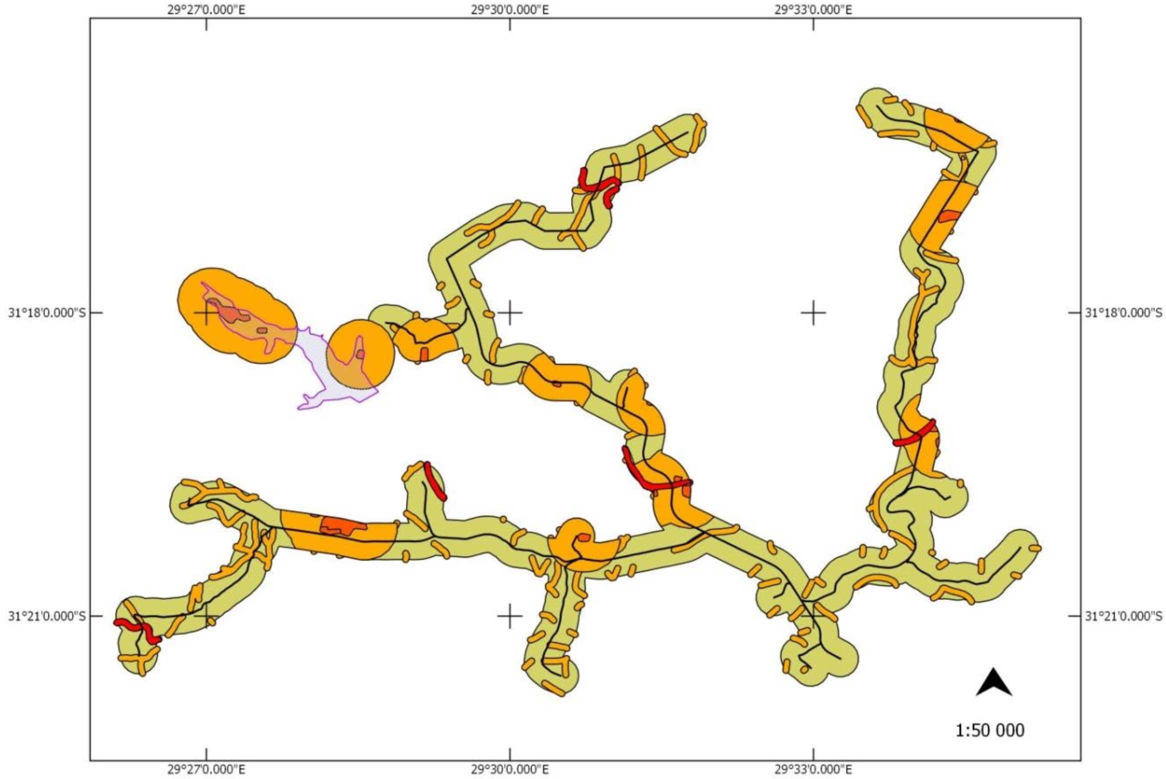

Figure 3.1: Sensitivity analysis of Section A (including the dam site). Orange areas are MODERATE and red areas are HIGH sensitivity.

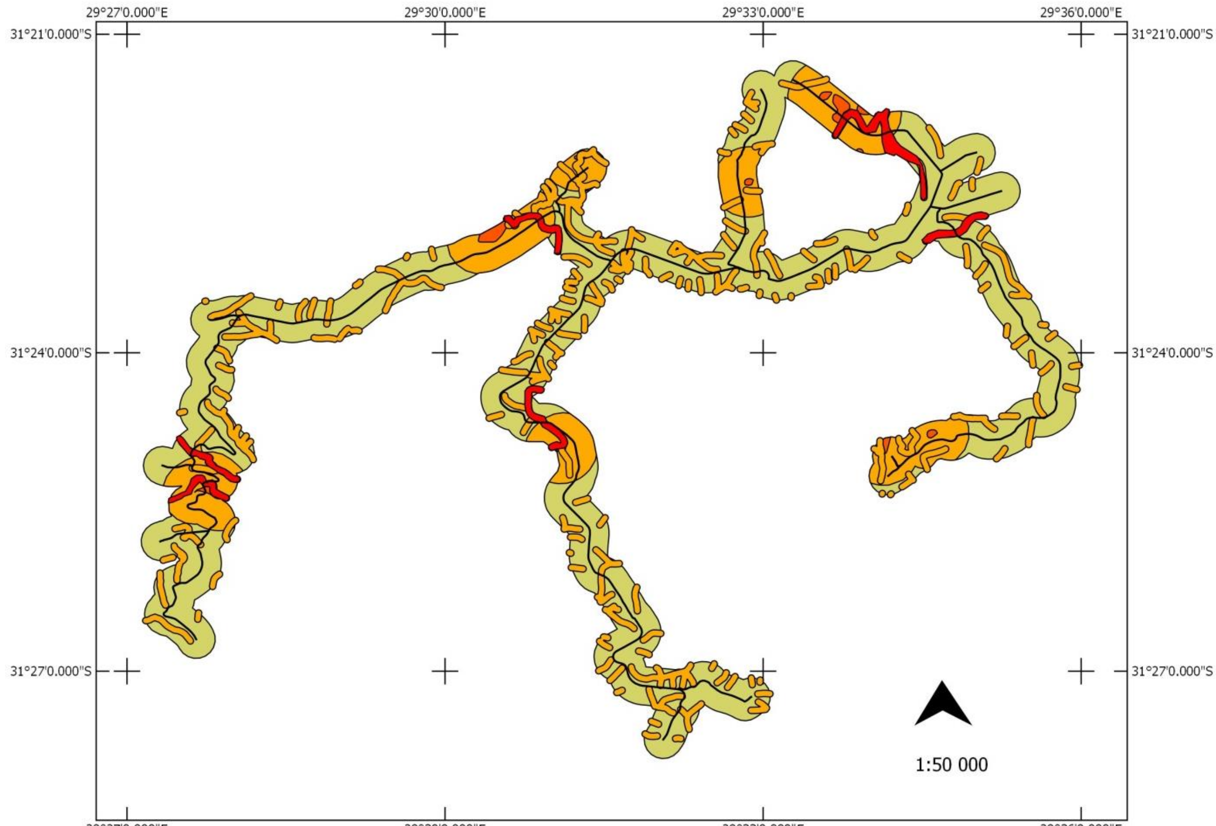

Figure 3.2: Sensitivity analysis of Section B. Orange areas are MODERATE and red areas are HIGH sensitivity.

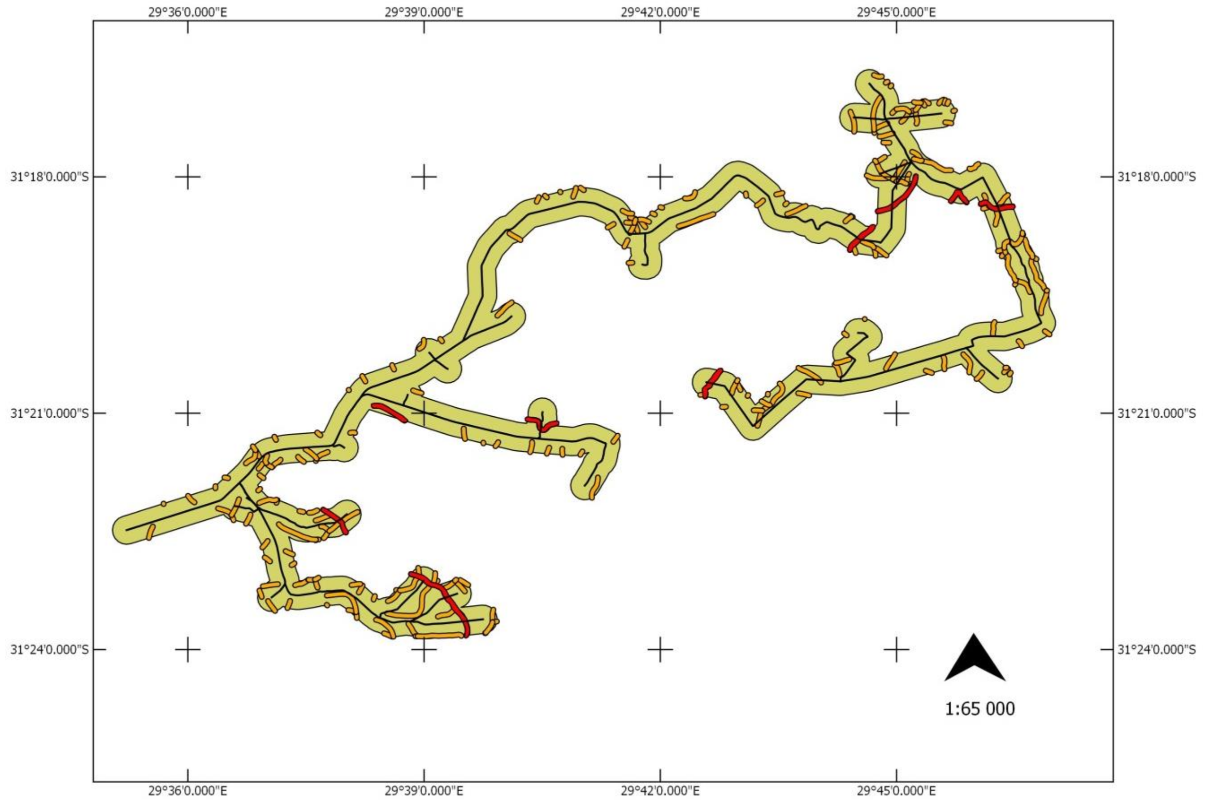

Figure 3.3: Sensitivity analysis of Section C. Orange areas are MODERATE and red areas are HIGH sensitivity.

3.3 Recommendations

- All watercourse crossings must be authorised by the Department of Water and Sanitation, in terms of Section c and i of the National Water Act (Act 36 of 1998).
- The impoundment of the Zalu Dam must be authorised by the Department of Water and Sanitation, in terms of Section b, c and i of the National Water Act (Act 36 of 1998).
- Abstraction of water from the Xura River must be authorised by the Department of Water and Sanitation, in terms of Section a, c and i of the National Water Act (Act 36 of 1998).
- Wherever possible, directional drilling should be used to direct pipelines under major water courses, i.e. Xura, Xurana, Mzintlava, Mateku, Mtafufu.
- Small tributaries can be crossed using conventional trenching methods.
- Coffer dams should not remain in place for longer than 6 weeks.
- No concrete mixing should take place within 50 m of a watercourse.
- Where pipelines are routed near NFEPA-listed wetlands, ensure that the pipeline is laid on the opposite side of the road from the wetland
- Construction in watercourses MUST take place in the drier winter months of the year, i.e. May to September.
- Where the pipeline crosses the Mateku River below the waterfall, the pipeline route should be amended to either cross at the road crossing, or amend the entire pipeline route as indicated in Figure 3.4.

- By amending the pipeline route as shown (adding green line and removing line scratched out in red), all communities are still serviced, but the difficult terrain and sensitive riparian and aquatic habitat around the Mateku River is avoided.

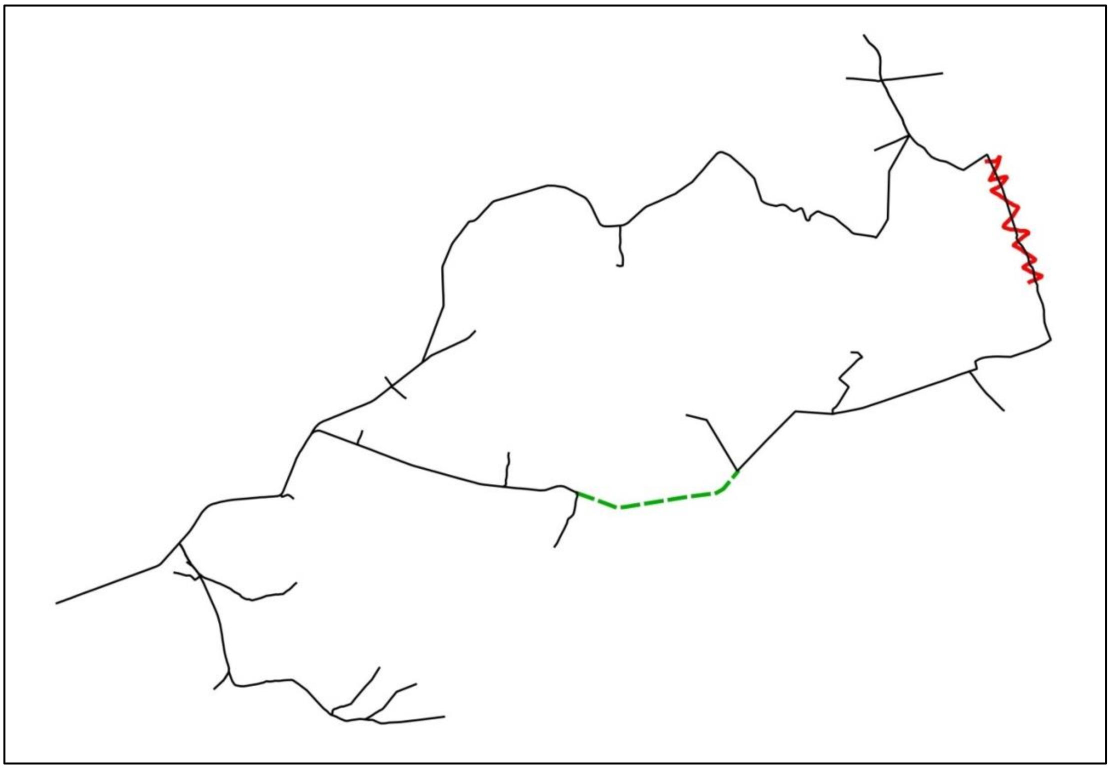

Figure 3.4: By amending the pipeline route as shown (adding green line and removing line scratched out in red), all communities are still serviced, but the difficult terrain and sensitive riparian and aquatic habitat around the Mateku River (in the eastern portion of the study area) is avoided.

3.4 Conclusions

The aquatic impact assessment recorded more than 70 water resource/infrastructure interactions. Each of these will need to be authorised by the Department of Water and Sanitation. Most of these are where pipelines cross streams, drainage lines, etc., but in a few cases the crossings are larger and will require more significant construction (e.g. the impoundment structure on the Xura River itself).

None of the impacts assessed remained HIGH after mitigation, and assuming that the mitigation measures are correctly implemented, the aquatic environment downstream of the dam should not suffer any permanent negative impact. In particular, the Dam Operating Rules must be designed to maintain the ecological reserve within the river across the seasons.

4. SOCIAL IMPACT ASSESSMENT

The Social Impact Assessment was conducted by Dr Greer Hawley and Mr Lungisa Bosman of EOH CES.

4.1 Approach

The SIA has been drafted in accordance with the South African Environmental Impact Assessment (EIA) regulatory requirements, as guided by Chapter 5 of the National Environmental Management Act (NEMA) (107 of 1998, as amended in 2010). By assessing the Project-Affected Communities (PACs), the report sketches the area's socio-economic environment and analyses the potential socio-economic impacts of the project on these PACs. This report is based largely on primary data gathered by means of qualitative focus group discussions, meetings and key individual interviews held during March and August 2014. Data has also been supplemented with an analysis of the South African Household Census Data of 2011, as well as secondary literature sources.

4.2 Results

The socio-economic environment in and around the project area is characterised by poor levels of education, low income generation and potential, service delivery backlogs and economic depression. The main economic drivers include civil service and agriculture (crop, livestock and forestry) are severely under-developed. At a local level, the Ingquza Hill Local Municipality (IHLM) Local Economic Development (LED) Plan identifies a number of high potential industries for economic development, such as tourism, including what is termed catalytic projects such as the Wild Coast N2 Toll Highway. Catalytic projects are expected to unlock the economic potential of the area. The current proposed LRWSS would also be considered a catalytic project.

The following mains issues and impacts relating to the proposed project have been identified and assessed:

1. Influx of Job-Seekers
    a. Increased community conflicts between local labour and outside workers
    b. Change in social behaviour – increased crime, increased prostitution, etc.
    c. Increased risk of spread of HIV/AIDS and other communicable diseases
    d. Economic stimulation of and investment into business and enterprise due to an increase in demand for local services

2. Impact on health and general quality of life
    a. Provision of water
    b. Upgrading of roads
    c. Increased demand on existing infrastructure facilities and social services
    d. Noise and dust generated by construction activity
    e. Reduced safety during the construction of the dam due to high vehicle activity and potential run-away fires
    f. Risk of drowning in the Zalu dam

3. Loss of land as result of the Zalu dam construction
    a. Land Acquisition for the Dam
    b. Loss of access to natural resources

4. Stimulation of Economic Growth
    a. Employing local labour: Job opportunities
    b. Supporting local businesses and Small Medium Micro Enterprises (SMMEs)
    c. Skills training opportunities
    d. Potential spin-off economic opportunities: aquaculture, irrigation, recreation and tourism.

5. Disturbance of graves sites
    a. Impact on grave sites along the route of the pipeline

4.3 Recommendations

The following recommendations have been supplied in the SIA:

Influx of Job Seekers	
Community conflicts between local labour and outside workers	• A project steering committee consisting of the DWS, contractor (community liaison person), recruitment agency, community leaders, elders, youth, ward councillors and the IHLM LED (Local Economic Development) must be established in order to: o Conduct an audit of the affected communities in terms of employment capacity o Identify potential workers from the affected communities o Identify possible conflicts in and between communities o Recommend support programmes that would assist with conflict minimisation and resolution
Change in social behaviour	• The following are mitigation measures for crime: o Support the Traditional Authorities role of exerting control over land allocation in order to prevent densification of people around the construction areas. o The DWS and contractor must encourage settlement in Lusikisiki by providing daily transport for “outside” workers who settle in the town of Lusikisiki, to and from the construction site to minimise the potential crime factor in the rural areas. o All construction workers must be clearly identifiable and wear easily recognisable uniforms. They need to carry identification cards issued by the contractor. o Ensure that the SAPS has access to construction sites o Encourage the local communities to report suspicious activity to the community liaison or nearest environmental site officer. o The contractor must prevent loitering around the construction camp by providing transport to and from the camp sites. o All construction and camp sites must be fenced and secure. • Mitigation measures for increased prostitution and sexual behaviour: o Support national and local awareness programmes that discourage promiscuity, especially at schools in the project area. o Ensure that condoms are easily accessible to all construction workers.
Risk of spread of HIV/AIDS and other communicable diseases	• HIV/AIDS (non-discrimination, awareness, prevention and health care support) policy must be implemented. • Condoms must be easily accessible to all construction workers. • Develop and implement an HIV/AIDs education and behaviour change programme for all contracted construction workers. This must extend to the communities located near the construction site. • Existing public health care centres and programmes such as TAC must be involved in the HIV/AIDS campaigns. The HIV/AIDS prevalence must be monitored through these agencies. • Voluntary counselling and testing must be encouraged for all workers.
Economic stimulation and investment into business and enterprise	• The proponent must link the Provincial Department of Economic Development and Local Municipal LED (Local Economic Development) programmes with small to medium enterprises (including communities) in the area so that a state of “readiness” to optimise economic benefits is achieved. This may involve training in the following sectors: business, tourism, catering, etc.

Loss of land due to Zalu Dam construction	
Land acquisition for the dam	• The process for land acquisition by DWS must be conducted through the traditional authorities operating in the areas as they have jurisdiction over land allocations. • Individual land users must be identified and engaged.
Loss of access to natural resources	• Current landowners and land users should be sufficiently compensated. Compensation must be equitable across gender and age. • Assist with the relocation of livestock, if necessary.
Disturbance to grave sites	
Inappropriate routing of pipelines	• Pipeline routes need to be planned around grave sites as specified in the Heritage Specialist report (20 m buffer around grave sites). • The community should be consulted before pipeline routes are established to ensure any grave sites that were not identified in the Heritage Specialist report are identified, mapped and taken into account in the pipeline layout.
Stimulation of economic growth	
Employing local labour	• Equal job opportunities for women and men must be promoted. • Employment must be managed by a recruitment agency/office that uses a selection system that ensures recruitment of semi and unskilled workers from all local, impacted communities in accordance with recent government policies related to local procurement. • Where appropriate, employees involved in the construction phase should be incorporated in the permanent maintenance staff for the operational phase; and • Particular attention must be paid to employment opportunities for women and disabled persons.
Supporting local businesses and SMMEs	• The proponent must ensure that the principal of utilising local business resources (suppliers and SMMEs) in accordance with recent government policies related to local procurement forms part of the procurement specifications. Examples of local business resources that must be considered: o Catering services o Transport services o Quarries/borrow pits (where necessary) o Small civils o Accommodation o Security o Hygiene services o Fencing
Skills training opportunities	• Implement a skills development programme which includes training in business, project management, monitoring and evaluation.
Potential spin-off economic opportunities	• DWS should, in their consideration of water use applications, consider the benefit to local communities. • DWS should readily facilitate water use activities that will benefit the community. • Construction camps and settlements can be converted into tourism or recreation facilities.
Impact on health and general quality of life	
Increased demand on existing infrastructure facilities and social services	• DWS should promote awareness of the project (with LMs, Department of Health, SAPS, etc.) and the potential pressure to provide services for new households. • Regularly monitor the schools and clinics in order to determine whether there are sufficient resources. When resources are deemed insufficient, DWS must communicate with the relevant departments for assistance.
Noise and dust	• Noise and dust prevention measures must be implemented.

generated by construction activity	• Dust along access roads must be monitored. • Ensure that communities have an easy grievance reporting mechanism, e.g. through a project steering or liaison committee
Reduced safety during construction of the dam	• Mitigation measures for traffic safety: o Develop and inform all affected communities of the formal construction routes. o All vehicle operators and drivers must undergo regular training, clearly outlining the high safety risk to local rural communities o Erect signage making communities aware of the high safety risk due to heavy construction vehicles on the road. o Traffic calming devices such as speed bumps must be considered on rural access roads. • Mitigation measures for fire safety: o No fires must be lit outside construction camps. o Fires that are lit must be in a contained area. The fire must be monitored for cinders and extinguished when no longer needed. o Fire fighting equipment must be stored onsite o The construction campsite must be surrounded by a firebreak. o Fire risks must form part of the construction worker training.
Risk of drowning	• Identify and develop safe and controlled recreational swimming sites. • A water safety awareness campaign should be implemented by DWS. • Ensure signage of drowning risks is visible in high activity areas such as the river/dam crossing. • The implementation of a swimming programme for local scholars should be considered.

4.4 Conclusions

The public engagement process shows that the project is highly desired due to the associated skills development and employment benefits. Key issues pertain to an influx of job-seekers and outsider workers, with particular emphasis on social pathologies in the communities. Several mitigation measures to manage the impacts have been proposed.

In conclusion, the consultant is of the opinion that the project will ultimately uplift communities, which are in dire need of basic water supply and employment opportunities. Since socio-economic impacts are often subtle and unintended, and exist within a dynamic shifting paradigm, consistent monitoring of key socio-economic aspects during project implementation must be employed. Since mitigation of socio-economic impacts are at times not possible, management of impacts will be required. It is the opinion of the author that the impacts identified in this report can be sustainably mitigated and managed through on going stakeholder engagement and the involvement of affected communities.

Lusikisiki Regional Water Supply Scheme, Eastern Cape, South Africa

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ECOLOGICAL IMPACT ASSESSMENT

Prepared for:

Department:
Water and Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Department of Water Affairs
Private Bag X313
Pretoria
0001

Prepared by:

EOH Coastal & Environmental Services
EAST LONDON
16 Tyrell Road, Berea
East London, 5201
043 726 7809

Also in Grahamstown, Port Elizabeth, Cape Town, Johannesburg and Maputo (Mozambique)
www.cesnet.co.za

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Name	Responsibility	Signature	Date
Tarryn Martin	Lead Author		16-01-2014
Ayanda Zide	Author		16-01-2014
Greer Hawley	Reviewer		10-02-2014

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THE PROJECT TEAM

Ms Tarryn Martin, **Ecological Specialist *(Pri. Sci. Nat)***
Tarryn holds a BSc (Botany and Zoology), a BSc (Hons) in African Vertebrate Biodiversity and an MSc with distinction in Botany from Rhodes University. Tarryn's Master's thesis examined the impact of fire on the recovery of C3 and C4 Panicoid and non-Panicoid grasses within the context of climate change for which she won the Junior Captain Scott-Medal (Plant Science) for producing the top MSc of 2010 from the South African Academy of Science and Art as well as an Award for Outstanding Academic Achievement in Range and Forage Science from the Grassland Society of Southern Africa. She conducts vegetation assessments including vegetation and sensitivity mapping to guide developments and thereby minimise their impacts on sensitive vegetation. Tarryn has conducted a number of vegetation and impact assessments in Mozambique (to IFC standards) which include the Lurio Forestry Project in Nampula, the Syrah Graphite Mine in Cabo del Gado and the Baobab Iron Ore Mine in Tete, Mozambique. Tarryn has also co-designed and implemented the Terrestrial Monitoring Program for Kenmare, MOMA, a heavy minerals mine in Mozambique. This monitoring program includes an assessment of forest health. She has also worked on the Lesotho Highlands Development Authority botanical baseline survey for phase 2 of the Lesotho Highlands Water Project.

Ms Ayanda Zide, **Ecological Specialist**
Environmental Consultant, holds a BSc in Botany, Microbiology and Chemistry and a Bsc (Hons) in Botany where her thesis focused on identifying and characterising galls and gall forming insects and associated pathogens (Fungi) on the mangrove species *Avicennia marina*. Courses in her honours year included Diversity Rarity and Endemism (DRE), Pollination Biology, Estuarine Ecology, Rehabilitation Ecology, a Stats course and a short GIS course. Her research interests lie in biological invasion, conservation, rehabilitation ecology, plant biotechnology and water research. Ayanda conducts vegetation and impact assessments that guide proposed developments to reduce their impacts on sensitive vegetation. As part of these surveys she identifies and maps the vegetation communities and areas of high sensitivity. She has worked as a botanical assistant on the Lesotho Highlands Development Authority botanical baseline survey and has conducted groundtruthing surveys for developments in the Eastern Cape.

Dr Greer Hawley, Principal Consultant *(Pri. Sci. Nat)*
Greer has a BSc degree in Botany and Zoology and a BSc Honours in Botany from the University of Cape Town. She completed her PhD thesis (Microbiology) at Rhodes University. The core academic focus has been directed in the field of taxonomy both in the plant and fungal kingdom. Greer's research ranges from studying fresh and marine algae, estuarine diatoms, Restio species classification in the fynbos and forest vegetation and fungal species identification and ecology. Greer's study of fungi have also contributed towards an understanding of soil ecology and "below ground" ecology. Greer has been involved in a number of diverse activities at CES with particular emphasis on renewable energy (biofuel) projects, carbon stock and biodiversity assessments. She is currently working on numerous impact assessments at the East London branch.

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1 INTRODUCTION

1.1 *Project description and locality*

The Study Area comprises the region between Lusikisiki (up to about 15km inland) and the coast, extending from the Mzimvubu River in the south-west to the Msikaba River in the north-east, as shown in Figure 1-1.

The proposed activity consists of the following components:

The Zalu Dam and inundation area – The dam will consist of an earth core rockfill dam with a full supply level of 612 masl (approximately 35 m high). It is anticipated that the dam will yield 6.95 million m^3/annum at 1:100 year assurance of supply. The domestic requirement will be 5.4 million m^3/annum in 2040, the irrigation requirements 1.45 million m /a (including 10% losses) and the 1:1 year ecological freshet requirement is 8 m^3/s for a period of three days per year. It is anticipated that the release for domestic use will be sufficient for the maintenance of ecological requirements (Department of Water Affairs, 2011). The area that will be inundated as a result of the proposed Zalu Dam, is approximately 143.47 hectares in size. No resettlement will be required.

Borrow pits for dam construction - The results from the pre-feasibility study (Department of Water Affairs, 2011) show that sufficient construction materials are available for a rockfill dam in close proximity to the proposed construction site. Residual dolerite clay is available in a borrow area downstream of the dam centreline on the right bank of the river. This material is sufficient for a central earth fill core for a rockfill dam.

Two rockfill quarries with unweathered dolerite, one on the right bank and one on the left bank, 10 km upstream of the centreline of the proposed dam, were identified. These sources are located below the full supply level of the dam. Both sources are covered with moderately to completely weathered shales. The moderately weathered shales can be used in the shells of a rockfill dam.
At the centreline of the dam on the right bank a horizontal layer of unweathered dolerite was encountered at a level of approximately 611 masl. This can be used for an approach channel floor for a side channel spillway. Some of the excavated materials can be used for the shells of the rockfill dam.

Abstraction weir – An abstraction weir will be constructed approximately 5 km downstream from the proposed Zalu Dam.

Reticulation of raw water to the existing treatment works – A pipeline will be constructed from the abstraction weir to the existing water treatment works on the outskirts of Lusikisiki. In addition to this it is anticipated that the water treatment works will be upgraded to cater for the increase in capacity required.

Reticulation of treated water to various reservoirs – Potable water will be transferred from the water treatment works to a number of reservoirs via a combination of existing and new pipelines. Existing pipelines may require upgrading.

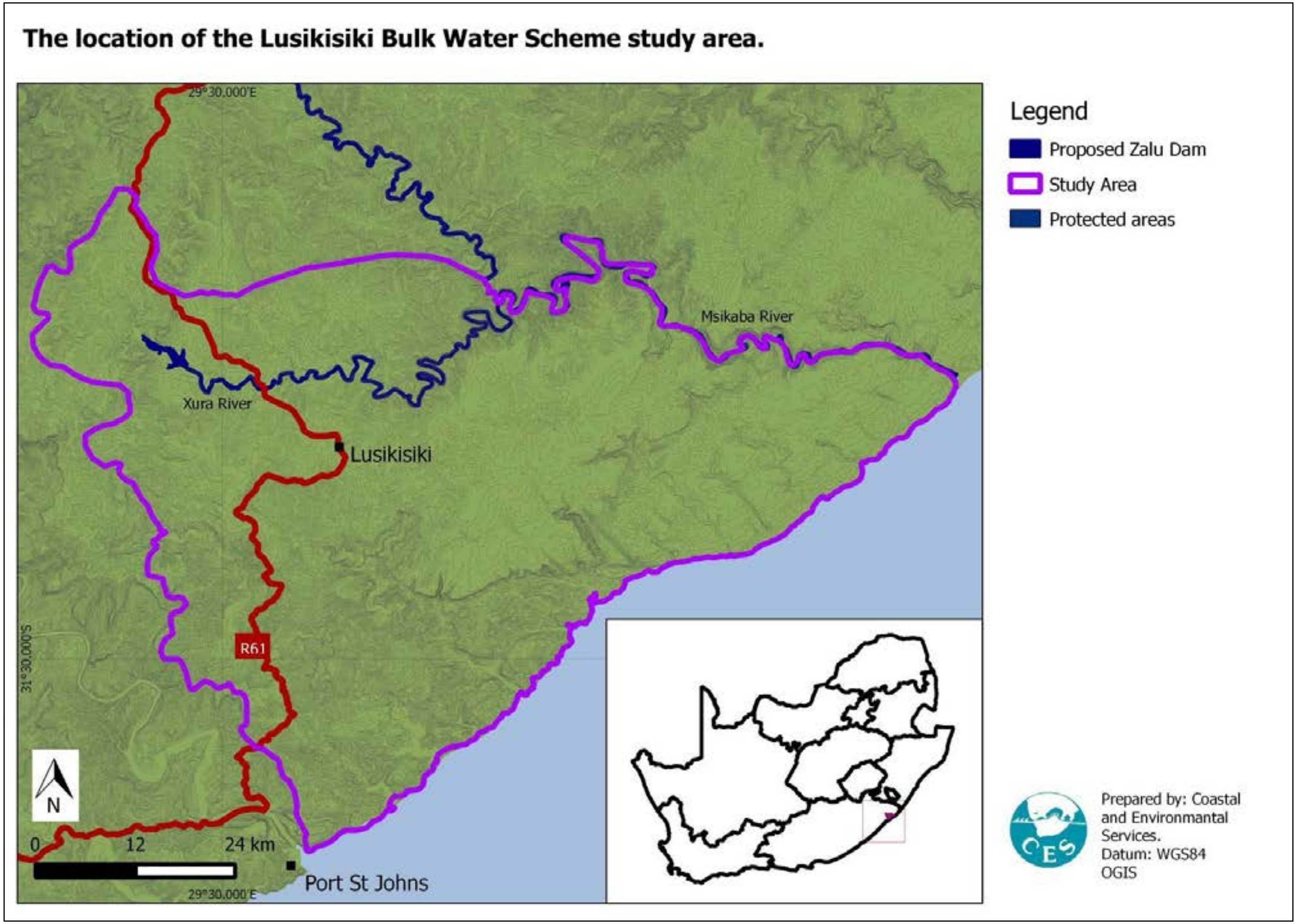

Figure 1-1: Locality Map indicating the locality of the Study Area

1.2 *Objectives and Terms of Reference*

The following terms of reference was used for the objectives of this study:

- Describe the study area in terms of land cover, vegetation, likely fauna and habitat. Faunal considerations will include mammals, birds, reptiles and amphibians. This aspect of the report will specifically include the identification of -
  - Areas of high biodiversity;
  - The presence of species of special concern, including sensitive, endemic and protected species;
  - Habitat associations of the identified fauna and flora;
  - The presence of areas sensitive to invasion by alien species; and
  - The presence of conservation areas and sensitive habitats where disturbance should be avoided or minimised.
- Review relevant legislation, policies, guidelines and standards.
- An assessment of the potential direct and indirect impacts resulting from the proposed development (including the dam, pipelines and associated infrastructure e.g. access roads), both on the footprint and the immediate surrounding area during construction and operation;
- Identification of potential impacts and a detailed description of appropriate mitigation measures that can be adopted to reduce negative impacts for each phase of the project, where required; and
- Checklists of floral and faunal groups identified in the region to date, highlighting sensitive species and their possible areas of distribution.

1.3 *Approach*

The study site and surrounding areas were described using a two-phased approach. Firstly, a desktop assessment of the site was conducted in terms of current vegetation classifications and biodiversity programmes and plans. This included the consideration of:

- The South African Vegetation Map (Mucina and Rutherford, 2006)
- NFEPA Wetlands and Rivers
- The ECBCP
- The list of National Threatened Ecosystems
- Protected Areas and National Protected Area Expansion Strategy (NPAES) Areas

Further to the above, one site visit was conducted (1-5 December 2014) in order to assess the actual ecological state, current land-use, identify potential sensitive ecosystems and identify plant species associated with the proposed project activities. The site visit also served to inform potential impacts of the proposed project and how significantly it would impact on the surrounding ecological environment.

Information on the general area and plant species was also generated using historical records for the Quarter Degree Square that the area falls within (SIBIS, 2015). This information has been used to supplement the findings of this report.

1.4 *Limitations and assumptions*

This report is based on currently available information and, as a result, the following limitations and assumptions are implicit:–

1. The report is based on a project description taken from design specifications for the proposed water scheme that has not yet been finalised, and which are likely to undergo a number of iterations and refinements before it can be regarded as definitive;
2. Descriptions of the natural and social environments are based on limited fieldwork and available literature.

2 RELEVANT LEGISLATION

Environmental legislation relevant to the proposed Lusikisiki Regional Water Supply Scheme (RWSS) is summarised below. Biodiversity Plans and Programmes are discussed in Chapter 5 and 8 where they are used to describe the desktop ecological conditions.

2.1 *National Environmental Management Act (No. 107 of 1998)*

<u>Relevant Sections of the Act: Section 2, 23, 24, 24-1, 28 -33</u>

Applications for the Lusikisiki RWSS:

- Application of the NEMA principles (e.g. need to avoid or minimise impacts, use of the precautionary principle, polluter pays principle, etc.)
- Application of fair decision-making and conflict management procedures are provided for in NEMA.
- Application of the principles of Integrated Environmental Management and the consideration, investigation and assessment of the potential impact of existing and planned activities on the environment; socio-economic conditions; and the cultural heritage.

Implications for the proposed Lusikisiki RWSS: In terms of Section 28, every person who causes; has caused, or may cause significant pollution or degradation of the environment must take reasonable measures to prevent pollution or rectify the damage caused.

2.2 *National Environmental Management: Biodiversity (No. 10 of 2004)*

<u>Relevant Sections of the Act: Section 50-62, 63-77, 75</u>

Objectives of the Act
The objectives of the Act include *inter alia*:
To provide for:

- The management and conservation of biological diversity within the Republic and of the components of such biological diversity;
    - The use of indigenous biological resources in a suitable manner;
    - The fair and equitable sharing of benefits arising from bio-prospecting of genetic material derived from indigenous biological resources; and
    - To give effect to ratified international agreements relating to biodiversity which are binding on the Republic;
- To provide for co-operative governance in biodiversity management and conservation; and
- To provide for a South African National Biodiversity Institute to assist in achieving the objectives of the Act.

Threatened or protected ecosystems and species
Sections 50-62 provide details relating to the protection of threatened or protected ecosystems and species.

A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit (Section 56-1). (Refer to EC Environmental Conservation Bill for lists of endangered and protected faunal and floral species).

Alien and invasive species
Sections 63-77 provide details relating to the alien and invasive species with the purpose of preventing the introduction and spread, managing and controlling, and eradication of alien and invasive species.

Implications for the Lusikisiki RWSS: an invasive species monitoring, control and eradication plan for land/activities under their control should be developed, as part of their environmental plans in accordance with section 11 of NEMA.

2.3 *National Water Act (No.36 of 1998)*

Purpose of the Act (Section 2)
The purpose of the Act is to ensure that the Nation‘s water resources are protected, used, developed, conserved and controlled in ways which take into account, including:

- Promoting sustainable use of water.
- Protect aquatic and associated ecosystems and their biological diversity.
- Reducing and preventing pollution and degradation of water resources.

Protection of water resources (Section 12-20)
Provides details of measures intended to ensure the comprehensive protection of all water resources, including the water reserve and water quality.

With respect to the establishment of water quality objectives, objectives may relate to (Section 13):

- the presence and concentration of particular substances in the water
- the characteristics and quality of the water resource and the in-stream and riparian habitat
- the characteristics and distribution of aquatic biota
- the regulation and prohibition of in-stream and land-based activities which may affect the quantity and quality of the water resource

Section 19 deals with Pollution Prevention (Part 4)
The person (including a municipality) who owns, controls occupies or uses the land in question, is responsible for taking reasonable measures to prevent pollution of water resources. If the measures are not taken, the catchment management agency concerned, may itself do whatever is necessary to prevent the pollution or remedy its effects and recover all reasonable costs from the persons responsible for the pollution.

The reasonable measures‘ which have to be taken may include measures to:

- Cease, modify or control any act or process causing the pollution;
- Comply with any prescribed waste standard or management practice;
- Contain or prevent the movement of pollutants;
- Eliminate any source of the pollution;
- Remedy the effects of the pollution; and
- Remedy the effect of any disturbance to the bed and banks of a watercourse.

With respect to pollution of rivers, the following definition is relevant when considering the potential impacts of development on water resources. Pollution may be deemed to occur when the following are affected:

- the quality, pattern, timing, water level and assurance of instream flow;
- the water quality, including the physical, chemical and biological characteristics of the water;
- the character and condition of the in-stream and riparian habitat;
- the characteristics, condition and distribution of the aquatic biota.

The Act defines instream habitat‘ as including the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse.

Riparian ecosystems
Riparian habitat' includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species and physical structure distinct from those of adjacent land areas.

Section 21 deals with the Use of Water
Section 21 (a-k) describes activities defined as a water use under the act. These activities may only be undertaken subject to the application for, and issue of, a water use licence.

Implications for the Lusikisiki RWSS:
- **Appropriate measures must be taken to prevent the pollution of water courses**
- **Riparian zones must be protected**
- **Construction within a water course or within 500 metres of a wetland will require a Water Use licence under section 21 (c) & (i) issued by the Department of Water Affairs and Sanitation**

2.4 *National Forest Act (No.84 of 1998)*

Any area that has vegetation which is characterised by a closed and contiguous canopy and under storey plant establishment is defined as a forest' and as a result falls under the authority of the Department of Agriculture, Forestry and Fisheries (DAFF): Forestry sector. A clause in Chapter 3, Part 1 covers:

Prohibition on destruction of trees in natural forests.
Section 7 (1) No person may cut, disturb, damage or destroy any ***indigenous living tree*** in, or remove or receive any such tree from, a natural forest except in terms of (a) A licence issued under subsection (4) or section 23.

Effect of setting aside protected areas
Section 10 (1) No person may cut, disturb, damage or destroy ***any forest*** produce in, or remove or receive any forest produce from, a protected area, except—
- in terms of the rules made for the proper management of the area in terms of section 11(2)(b);
- in the course of the management of the protected area by the responsible organ of State or person;
- in terms of a right of servitude:
- in terms of the authority of a licence granted under section 7(4) or 23;
- in terms of an exemption under section 7(1)(b) or 24(6); or
- in the case of a protected area on land outside a State forest, with the consent of the registered owner or by reason of another right which allows the person concerned to do so, subject to the prohibition in section 7(1).

Implications for the Lusikisiki RWSS:

Dam
- **The dam will inundate and destroy small patches of scarp forest therefore permits will need to be applied for before construction begins**

Pipeline
- **No forest or trees that form part of a forest or forest association may be damaged or destroyed**
- **The layout must be designed around forest**
- **Development that comes within 50 metres of forest must be closely monitored during the construction phase**

2.5 *Provincial Nature Conservation Ordinance Act (No. 19 of 1974)*

Chapter Vi, Section 62 (1) no person shall without a permit, be in possession of, sell, buy, donate, receive as a donation, pick, or import into, export from or transport in or through the Province, any endangered flora.

Implications for the Lusikisiki RWSS:

- **Construction may not begin until a permit for the removal and destruction of protected plant species has been issued.**

3 METHODS

The Project Area comprises the region between Lusikisiki (up to about 15km inland) and the coast, extending from the Mzimvubu River in the south-west to the Msikaba River in the north-east, as shown in Figure 1-1. The study area includes the Zalu Dam inundation area and the pipeline/access routes.

3.1 *Survey Strategy and Sample Site Selection*

One vegetation survey was undertaken during the early summer wet/growing season in order to coincide with the flowering times of grassland plant species. The intention was to ensure that the highest potential species richness and diversity was captured, during the peak growth period.

A stratified random sampling approach was adopted for the vegetation survey. Habitats were mapped prior to sampling using aerial imagery and each vegetation type ground-truthed and sampled. Sample siting ensured that variations in landscape features were taken into account. To a degree, site access was also a determining factor.

In total, 13 transects were completed during the field survey and the majority of the pipeline routes driven to establish the vegetation types. The number of sample sites was largely limited by access to the study area and time available in the field to observe and record data. A map of all the sampled sites is provided below (Figure 3-1).

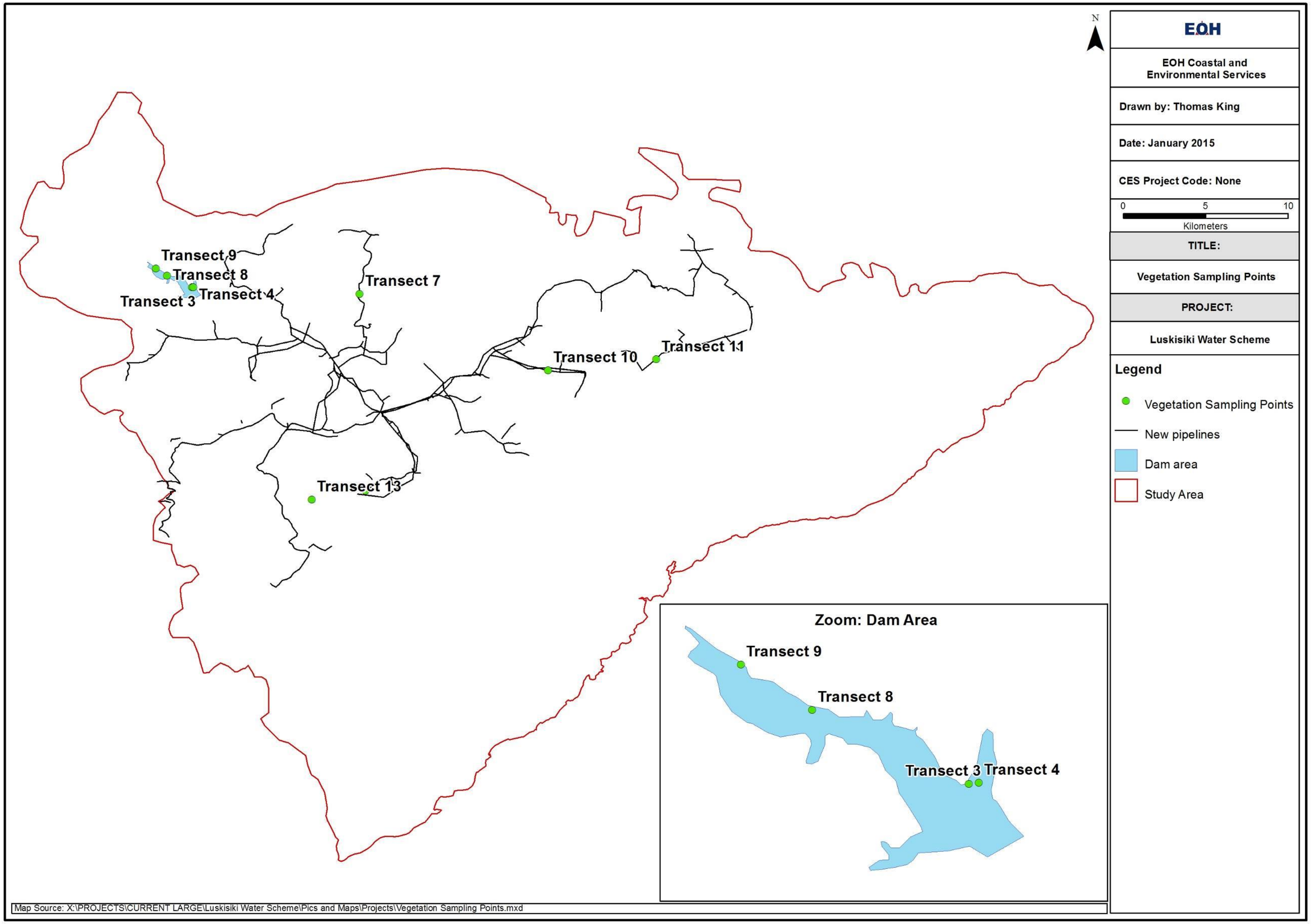

Figure 3-1: Transect points within the study area. Most of the transects were done within the inundated area. The majority of the pipeline routes were driven and assessed to establish the vegetation type.

3.2 *Floristic study*

3.2.1 Site observations

An inventory of plant species identified on site was recorded and the vegetation types assessed and ground-truthed.

3.2.2 Species of concern

Plant Species of Conservation Concern (SCC) are noted in this report as one or more of the following:

- Endemic Species with restricted distributions;
- Species with a "VULNERABLE, ENDANGERED or CRITICALLY ENDANGERED" conservation status (redlist' status) according to the recent classification appearing in the International Union for Conservation of Nature (IUCN) database (see http://www.iucnredlist.org/);
- Species that are CRITICAL or VULNERABLE on the South African Red Data List; and
- Species listed as protected by the Provincial Nature Conservation Ordinance (PNCO) Act.
- Species that are listed as Critically Endangered, Endangered, Vulnerable and Protected by the National Environmental Management: Biodiversity Act (NEMBA), 2004 (Act 10 of 2004).

3.3 *Methods of Sampling*

At each sample site, a line transect sampling strategy was utilised. This entailed a 100m line transect along the contour, with the presence of species at 1m intervals recorded (i.e. 100 observation points taken per line transect). Environmental data of each line transect, such as aspect, altitude and GPS coordinates, was recorded. The line transect method provided information on species composition and their relative abundance, allowing for an analysis of species diversity and vegetation structure within and between different landscapes and pre-mapped habitats.

3.4 *Vegetation mapping*

Vegetation was initially mapped using high resolution satellite images. These maps have been further refined based on observation and survey data gathered (See Chapter 5, Figures 5-4 and 5-5).

3.5 *Sensitive Areas*

The study area was assessed according to selected criteria in order to assign a sensitivity rating of areas or habitats to define areas of high conservation value. These areas included wetlands and riparian zones, even in their degraded state, in addition to areas that demonstrated high species richness, contained SCC or supported a unique species composition.

It must be noted that the sensitivity zonings in this study were based solely on ecological (primarily vegetation) characteristics. Social and economic factors were not taken into consideration. However, since land use (over grazing and cultivation) was the strongest driver of vegetation degradation observed, ecological sensitivity is directly affected by anthropogenic factors.

The approach used for the sensitivity assessment identifies zones of very high, high, moderate and low sensitivity according to a system developed by CES. The sensitivity analysis was based on 10 criteria which are considered to be of importance in determining ecosystem and landscape sensitivity. Examples of criteria that were utilised for the sensitivity assessment include: sensitive vegetation and habitat types (such as wetlands, riparian zones and other important process areas), topography and land transformation (Table 3-1).

The sensitivity criteria described in Table 3-1 was applied to habitat and vegetation types and scored as HIGH (10), MODERATE (5) or LOW (1). A total score for areas was calculated and the overall ecological sensitivity determined using the following scale:

- 0 - 34 : LOW ecological sensitivity
- 35 - 65 : MODERATE ecological sensitivity
- 66 - 85 : HIGH ecological sensitivity
- 86 – 100%: VERY HIGH ecological sensitivity.

A Global Information System (GIS) map has been generated to reflect the sensitivity rating.

Table 3-1: Criteria used for the analysis of the sensitivity of the area

CRITERIA		LOW SENSITIVITY 1	MODERATE SENSITIVITY 5	HIGH SENSITIVITY 10
1	**Topography**	Level, or even	Undulating; fairly steep slopes	Complex and uneven with steep slopes
2	**Vegetation** - Extent or habitat type in the region	Extensive	Restricted to a particular region/zone	Restricted to a specific locality / site
3	**Conservation status** of fauna/ flora or habitats	Well conserved independent of conservation value	Not well conserved, moderate conservation value	Not conserved - has a high conservation value
4	**Species of special concern** - Presence and number	None, although occasional regional endemics	No endangered or vulnerable species, some indeterminate or rare endemics	One or more endangered and vulnerable species, or more than 2 endemics or rare species
5	**Habitat fragmentation** leading to loss of viable populations	Extensive areas of preferred habitat present elsewhere in region not susceptible to fragmentation	Reasonably extensive areas of preferred habitat elsewhere and habitat susceptible to fragmentation	Limited areas of this habitat, susceptible to fragmentation
6	**Biodiversity** contribution	Low diversity, or species richness	Moderate diversity, and moderately high species richness	High species diversity, complex plant and animal communities
7	**Visibility** of the site or landscape from other vantage points	Site is hidden or barely visible from any vantage points with the exception in some cases from the sea.	Site is visible from some or a few vantage points but is not obtrusive or very conspicuous.	Site is visible from many or all angles or vantage points.
8	**Erosion potential** or instability of the region	Very stable and an area not subjected to erosion.	Some possibility of erosion or change due to episodic events.	Large possibility of erosion, change to the site or destruction due to climatic or other factors.
9	**Rehabilitation** potential of the area or region	Site is easily rehabilitated.	There is some degree of difficulty in rehabilitation of the site.	Site is difficult to rehabilitate due to the terrain, type of habitat or species required to reintroduce.
10	**Disturbance** due to human habitation or other influences (Alien invasive)	Site is very disturbed or degraded.	There is some degree of disturbance of the site.	The site is hardly or very slightly impacted upon by human disturbance.

3.6 *Data Analysis*

3.6.1 Two-way indicator species analysis (TWINSPAN)

TWINSPAN was used to provide a hierarchical clustering of sample site data (Hill, 1979a). The method typically provides an estimation of the similarity between sample sites by comparing the characteristics of each in terms of species composition and the importance of each species as a component at each site.

In addition to providing a quantitative analysis of the composition of the vegetation for each sample site within the study area, TWINSPAN was used to group together floristically similar sites which may represent specific plant communities.

TWINSPAN was used to generate a "two-way" (site-by-species) table and dendrogram representing the hierarchical relationship between the data for each sample site. TWINSPAN was also used to identify diagnostic or indicator plant species of plant communities or clusters.

3.6.2 Detrended Correspondence Analysis (DECORANA)

DECORANA (Hill,1979b) provides a means of ordinating sample sites and species on a scatter diagram against axes obtained from an iterative process derived from reciprocal averaging (Gauch, 1982). DECORANA was used to assess the extent of clustering of sites in term of species composition and importance.

The relative position of site clusters along the principle axis (x) corresponds to trends between the different sites. These trends may relate to environmental gradients, succession relationships or other factors. Plotting the corresponding ordination for the individual species on equivalent axes provided a means of detecting species with corresponding ordination values. Correlation between clusters of species and clusters of sample sites on the plotted graphs was used to determine characteristic species for each vegetation type. DECORANA was used in conjunction with TWINSPAN to further assist in recognising and distinguishing and characterising distinct plant communities.

4 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

4.1 *Geology and Landform*

4.1.1 Geology and soils

The underlying geology of the area is comprised of a combination of hard quartzite rock of the Natal Group Sandstones and tillite, shale, mudstone and sandstone of the Karoo Sequence. The Natal Group Sandstone gives rise to sandy, highly leached and relatively shallow soils which are not suitable for intensive agriculture (Nicolson, 1993). Soils associated with the Karoo Supergroup are characterised as being acidic, leached, heavy soils (Mucina and Rutherford, 2006).

4.1.2 Topography

The study area is characterised by coastal plateaus that are deeply incised by numerous rivers, creating deep gorges. These areas are associated with the underlying Natal Group Sandstones and hard quartzitic rock. Further inland, the study area is characterised by gentle, undulating hills associated with the underlying Dwyka and Ecca groups (Plate 4-1).

Plate 4-1: The general topography characteristic of the study area.

4.2 *Climate*

The study area occurs within a summer rainfall area and is characterised by a warm, temperate and humid climate. Data taken from Lusikisiki town and Port St Johns indicate that the area receives an average between 950 and 1250 mm of rainfall per annum (Buhmann *et al.,* 2006) with the highest rainfall occurring in November and March and the lowest rainfall occurring in June (www.saexplorer.co.za). The daily average temperatures range from 27^{0} C in February to 15^{0} C in July.

4.3 *Current Land use*

The majority of the study area has been transformed by anthropogenic activities such as overgrazing and active clearing/burning for improved pastures. The area is used for communal grazing and the site visit indicates that this area is generally overgrazed by livestock such as cattle, goats and sheep (Plate 4-2).

There are limited crops planted in the area and what does exist occurs mostly near homesteads.

Plate 4-2: The current land use characteristic of the study area.

5 DESCRIPTION OF ECOLOGICAL ENVIRONMENT

5.1 *Introduction and Regional Context*

The study area falls within two biomes; the Grassland Biome and the Nama-Karoo Biome. Grasslands are the second largest biome in South Africa and are widespread, ranging from sea level up to over 2000 meters above sea level. The Nama-Karoo biome is the third largest biome in South Africa and is situated in the western half of the country, stretching over the central plateau.

5.1.1 SANBI Vegetation Map

Mucina and Rutherford (2006) developed the National Vegetation map as part of a South African National Biodiversity Institute (SANBI) funded project: "It was compiled in order to provide floristically based vegetation units of South Africa, Lesotho and Swaziland at a greater level of detail than had been available before." The map was developed using a wealth of data from several contributors and has allowed for the best national vegetation map to date, the last being that of Acocks developed over 50 years ago. This map forms the base of finer scale bioregional plans such as STEP. This SANBI Vegmap project has two main aims:

* "to determine the variation within and between units of southern African vegetation based on the analysis and synthesis of data from vegetation studies throughout the region, and
* to compile a vegetation map. The map was to accurately reflect the distribution and variation on the vegetation and indicate the relationship of the vegetation with the environment. For this reason the collective expertise of vegetation scientists from universities and state departments were harnessed to make this project as comprehensive as possible."

The map and accompanying book describe each vegetation type in detail, along with the most important species including endemic species and those that are biogeographically important. This is the most comprehensive data for vegetation types in South Africa.

Mucina and Rutherford (2006) define the following vegetation types that occur within the study area (Figure 5-1) and from which source these descriptions are derived:

Midlands Mistbelt Grassland
This vegetation type occurs in KwaZulu-Natal and the Eastern Cape Provinces (Mucina *et. al.* 2006). It is characterised by a hilly and rolling landscape mainly associated with discontinuous east-facing scarp formed from dolerite intrusions. This vegetation type is dominated by forb-rich, tall sour *Themeda triandra* grasslands that have been transformed by the invasion of *Aristida junciformis subsp. junciformis.* Only a few patches of the original species-rich grassland remain. This vegetation type is classified as **Endangered** with a conservation target of 23%. Only 0.5% is statutorily conserved.

No inundation or infrastructure occurs within this vegetation type. The project therefore is unlikely to have any impacts on it.

Ngonigoni Veld
Ngonigoni veld occurs in the KwaZulu-Natal and Eastern Cape Provinces from Melmoth in the north to Libode in the former Transkei (Rutherford *et. al.,* 2006). It is characterised as being dense, tall grassland dominated by *Aristida junciformis* and an associated low species diversity. This vegetation type is classified as **Vulnerable** with a conservation target of 25%. Less than 1% is statutorily conserved in the Opathe and Vernon Crookes Nature Reserves. Approximately 39% has been transformed for cultivation, plantations and urban development.

The dam and the majority of the pipelines will be located within this vegetation type and will therefore be impacted by loss through inundation and vegetation clearing.It is estimated that 171 Ha of Ngonigoni Veld could be impacted by the project.

Pondoland-Ugu Sandstone Coastal Sourveld
This vegetation type occurs in both KwaZulu-Natal and the Eastern Cape from Port St. Johns to Port Shepstone (Mucina *et.al.* 2006). It is characterised by coastal peneplains and gentle undulating hills with flat table-lands and very steep river gorges. This vegetation type is usually rich in grassland species diversity and is punctuated with scattered low shrubs and small trees. The conservation status of this vegetation type is **Vulnerable** with a conservation target of 25%. Only 7% is statutorily conserved in the Mkambati Wildlife Reserve and Marine Sanctuary, Umtamvuna, Mbumbazi and Oribi Gorge Nature Reserves.

This vegetation type may be impacted by a small section of the pipeline.

Transkei Coastal Belt
This vegetation type occurs as a narrow strip along the Wild Coast of the former Transkei in the Eastern Cape (Mucina *et.al.* 2006). It is characterised as being highly dissected and hilly with alternating steep slopes of low-reach river valleys and coastal ridges. It is comprised of a mosaic of grassland on the higher lying areas such as the hill tops and upper slopes and alternates with bush clumps and small forests in the valleys. This vegetation type is classified as **Vulnerable** with a conservation target of 25%. Only 1 % is statutorily conserved and 20% has been transformed for cultivation.

This vegetation type may be impacted by a small section of the pipeline.

Scarp Forest
Scarp Forest is found from the Eastern Cape to KwaZulu Natal, Mpumulanga and Swaziland (Mucina and Geldenhuys, 2006). This vegetation type occurs as scattered patches of forest often associated with krantzes, scarps and coastal platforms. This vegetation type is usually found at low altitudes of between 50 and 600 m. Scarp Forests generally have a high biodiversity and are structurally diverse, multi-layered forests with well developed canopy and understory tree layers but a poorly developed herb layer. This vegetation type is classified as **Least Threatened** in protected areas but vulnerable to overexploitation elsewhere. The conservation target is 40% and 20% is statutorily conserved in various reserves. Although not indicated in the SANBI vegetation map, patches of scarp forest were observed within the proposed dam inundation area (Figure 5.4)

Although the map shows that a very small section of this vegetation type will be impacted on by the pipeline, the groundtruthing study indicated that this patch of forest has been disturbed by the creation of a road and is dominated by a number of alien species, some of which are invasive.

Eastern Valley Bushveld
This vegetation type occurs in KwaZulu-Natal and the Eastern Cape Provinces and occurs in deeply incised valleys of rivers (Rutherford *et.al.* 2006). It is characterised as being a mosaic of semi deciduous savannah woodlands and thickets dominated by succulent species such as *Euphorbia* and *Aloe* species. Eastern Valley Bushveld is classified as **Least Threatened** with a conservation target of 25%. Only 0.8% is statutorily conserved in the Luchaba Wildlife reserve and the Oribi Gorge Nature reserve. 15% has been transformed by cultivation.

This vegetation type is unlikely to be impacted on by the project activities.

Southern Mistbelt Forest
This vegetation type occurs in Kwa-Zulu Natal and Eastern Cape Provinces as forest patches that occur in fire-shadow habitats on south and southeast facing slopes Mucina and Geldenhuys, 2006). This occurs as forest patches of varying size and are characterised as tall (15-20m tall) and multi-layered (having two layers of trees, a dense shrubby understory and well-developed herb layer). This vegetation type is classified as **Least Threatened** with a conservation target of 30%. Eight percent has been statutorily conserved however uncontrolled harvesting and the mismanagement of fire and burning regimes are considered as current major threats.

This vegetation type is unlikely to be impacted on by the project activities.

Subtropical Dune Thicket

Subtropical Dune Thicket occurs in the Eastern Cape and Kwa-Zulu Natal Provinces and is comprised of very dense shrubby thickets of spiny shrubs, large-leaved mega-herbs (such as *Strelitzia nicolai),* dwarfed trees, abundant vines and poorly developed undergrowth. This vegetation type is classified as **Least Threatened** with a conservation target of 20%. Twenty-seven percent is statutorily conserved.

This vegetation type is unlikely to be impacted on by the project activities.

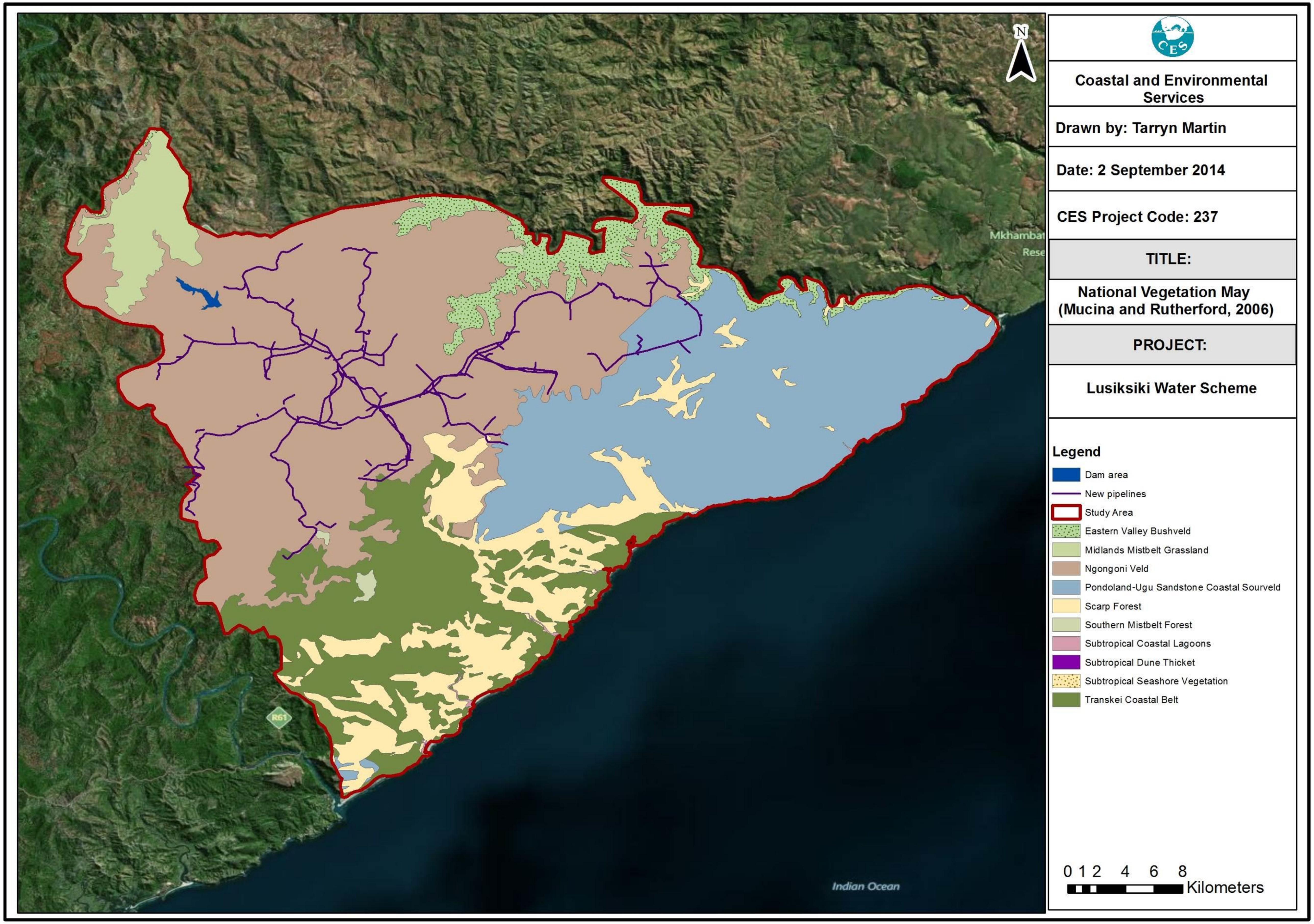

Figure 5-1: National Vegetation Map of the study area (Mucina and Rutherford, 2006).

5.2 *Vegetation Characterisation*

5.2.1 TWINSPAN

TWINSPAN is a subdivisive classification technique that is used to classify species and samples using a hierarchical classification process. Firstly, samples are successively divided into categories and then the species are divided into categories based on the sample classification.

The TWINSPAN analysis resulted in a dendrogram (or tree diagram) that defined different plant communities (Figure 5-2). The separation of the groups of communities is based on the presence or absence of the dominant species in the various community groups. Transects that share many species in common will appear closer to one another than to those that have very different species. The analysis thus identifies indicator species, whose presence or absence is used to separate the different categories.

The plant names shown at every node or division on the dendrogram are the species that TWINSPAN selected for division, termed “indicator species” for every pair of groups. These species are consistently present [+] or absent [-]. For example, the highest order division on the tree, which splits Group A from B, gives the presence of the weedy species *Caesalpinia decapetala,* as the best indicator species of Group A (Figure 5-1).

The results show a clear split into two groups – see the green highlights in Figure 5-2. The split defines two major vegetation groups: Group A *Scarp Forest* and Group B *Ngonigoni Veld.* Within Group B the dendogram further splits based on presence and absence of common species.

A DECORANA plot is also presented, which shows the distribution of the grouping of the transects spatially against axes 1 and 4 (Figure 5-3).

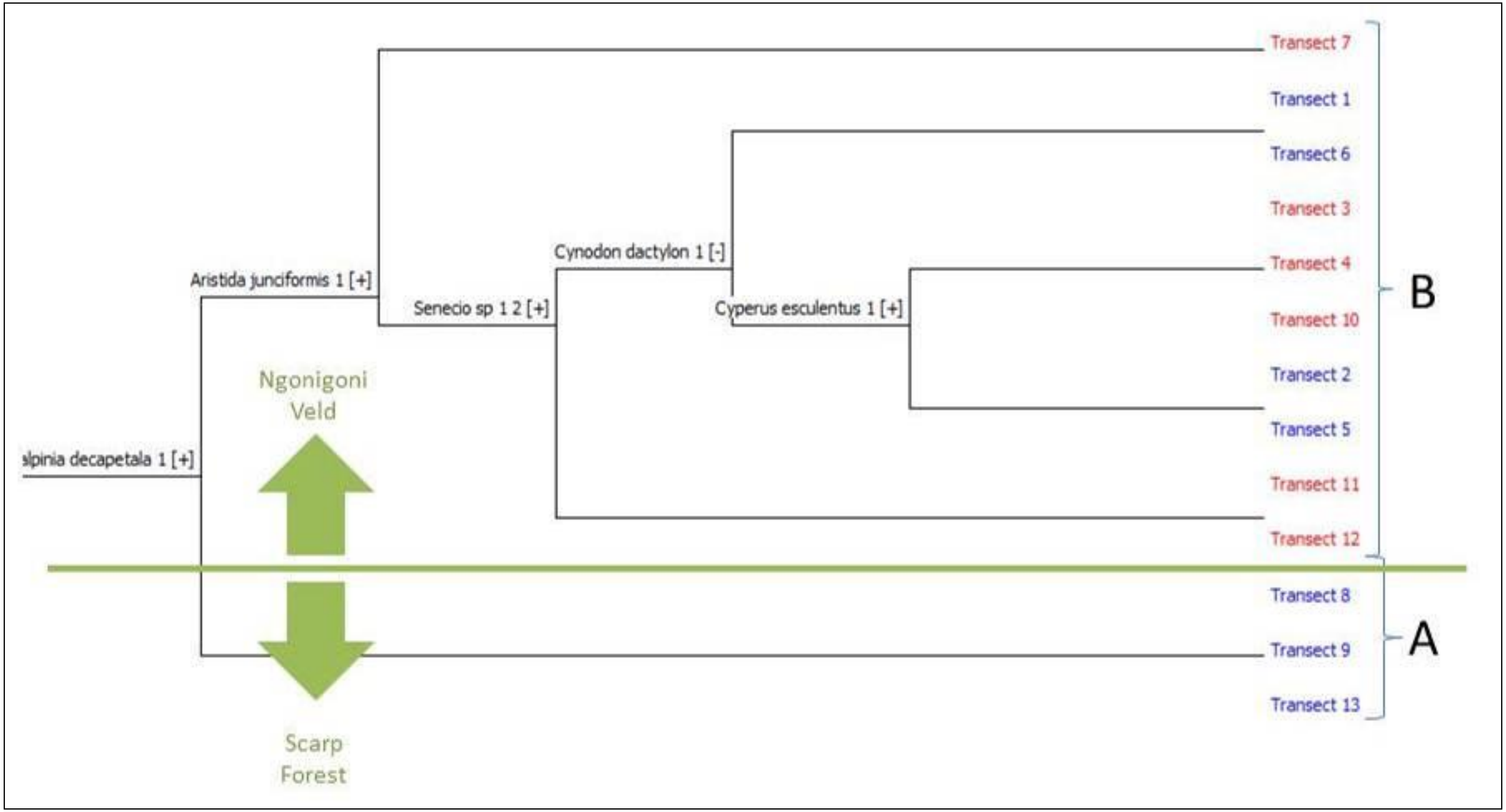

Figure 5-2: Dendrogram produced by TWINSPAN showing groupings defined for the 13 transects sampled in December 2014.

5.2.2 DECORANA

The DECORANA analysis resulted in a scatter plot representing the 13 transects. This analysis provides a clearer representation of the different communities in two dimensional space. The major groups of the TWINSPAN analysis are shown on Figure 5-3 which illustrates the combination of all of the data for the entire study area and shows a clustering of Community A (*Scarp Forest)* and B *(Ngonigoni Veld)* as distinctly separate.

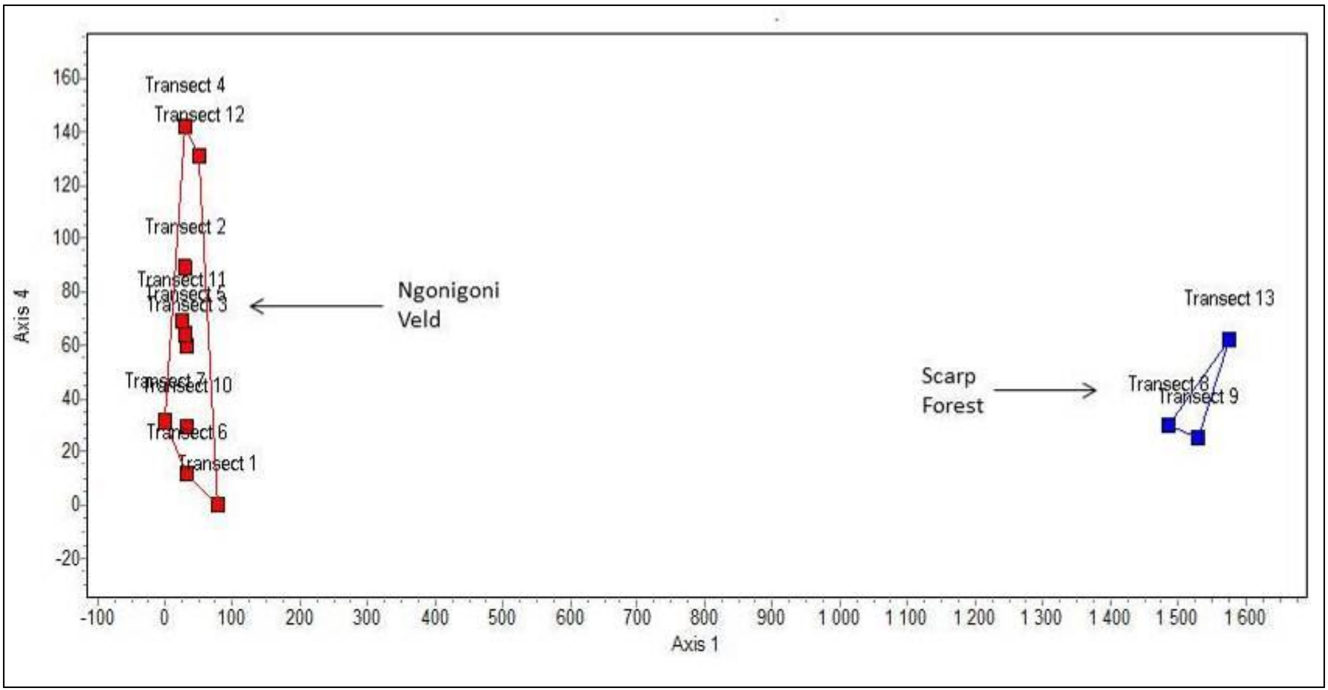

Figure 5-3: Detrended Correspondence Analysis scatter plot of 13 samples taken in December 2014 showing the clear division of the 2 major community types, A and B. The clusters in this figure may be compared with the groups shown on the TWINSPAN dendrogram (Figure 5-2).

5.3 *General description of vegetation types found within the project site*

Based on the TWINSPAN and DECORANA, two main vegetation types occur within the project area; *Scarp Forest* and *Ngonigoni Veld* each of which is described below. Their spatial distribution within the inundated area and along the pipeline routes is illustrated in Figures 5-4 and 5-5 respectively.

5.3.1 Ngonigoni Veld

Ngonigoni Veld is dominant throughout the inundated area and is dominated by *Aristida junciformis.* This vegetation type was degraded as a result of grazing and cultivation. Although there was very little evidence of active cultivation in the area at the time of sampling, a large portion of the area has been historically terraced, indicating that crops had previously been planted. This vegetation type was dominant throughout the site i.e. within the inundated area and along all the pipeline routes.

Other common species found within this vegetation type include *Paspalum notatum, Cynodon dactyolon, Helichrysum anomalum* and *Helichrysum cymosum*.

In low lying, moist areas along the river, species such as *Zantedeschia albomaculata subsp. albomaculata* and *Galtonia princeps* were common. *Acacia natalitia* was common along drainage lines and rivers.

There were small patches of *Acacia mearnsii,* an alien invasive species, within the site.

This vegetation type was degraded and of very little conservation value and although classified as Vulnerable by the South African Vegetation Map (Mucina and Rutherford, 2009) it is not considered as such for the project area.

Plate 5-1: Ngonigoni Veld found within the inundated area dominated by *Aristida junciformis*

5.3.2 Scarp Forest

Small patches of Scarp Forest occur along the river on the south facing slopes within the inundated area were observed (Figure 5.4). A larger patch was observed higher up the slope (Plate 5-2), but it will not be directly impacted by the dam. These remnant forests were dominated by the weed species *Caesalpinia decapetala (*Mauritian thorn). Other dominant species include *Maesa alcifolia, Syzigium cordatum, Ficus sur, Euphorbia tetragona, Cussonia spicata* and *Rhus* species.

Small patches of forest were also present near a few of the pipeline routes. Only one location along the proposed pipeline route will impact on a degraded forest patch, with an existing road through it (Figure 5.5). In two instances the pipeline is situated alongside forest patches and the impact is not considered significant.

Apart from the small patches of forest (described above), the riparian areas were generally degraded and dominated by alien invasive species indicative of disturbance such as *Caesalpinia decapetala, Solanum mauritianum* and *Senna didymobotrya,*

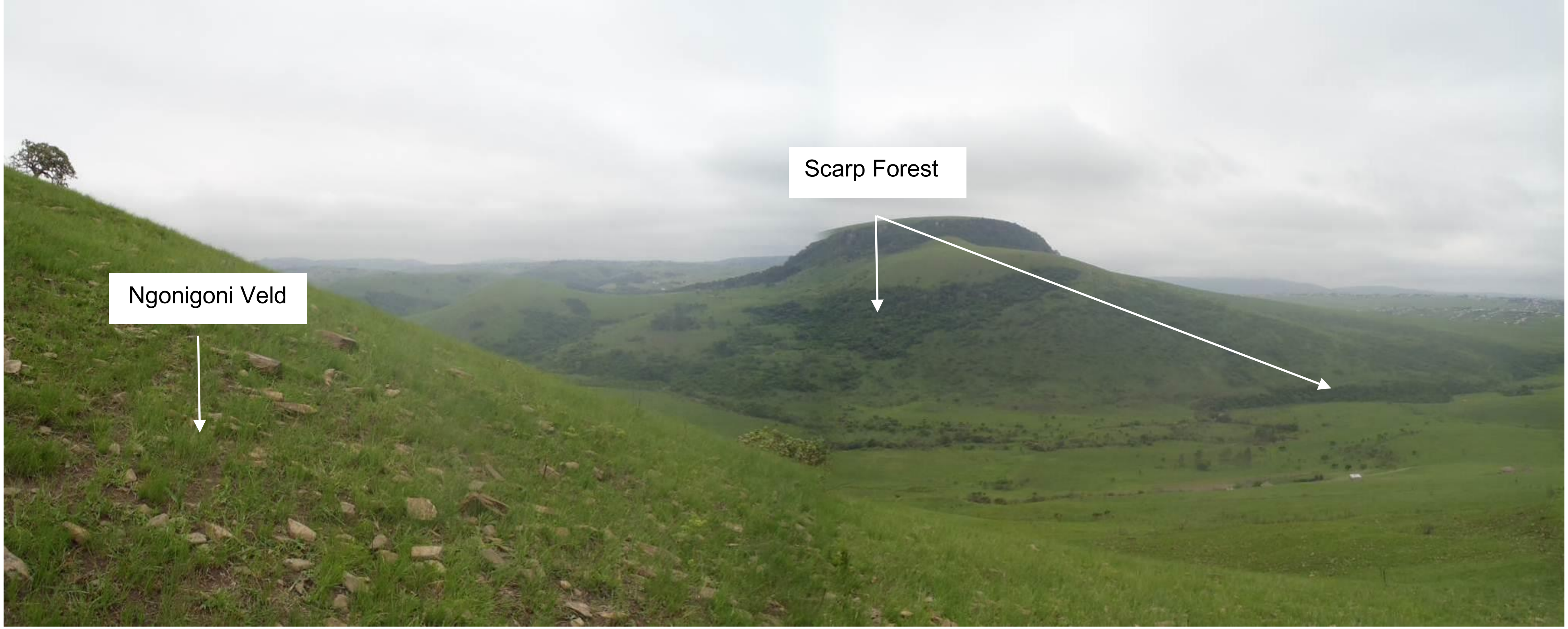

Plate 5-2: Photograph illustrating the Scarp Forest on the south facing slopes. The majority of the study area is dominated by Ngonigoni Veld.

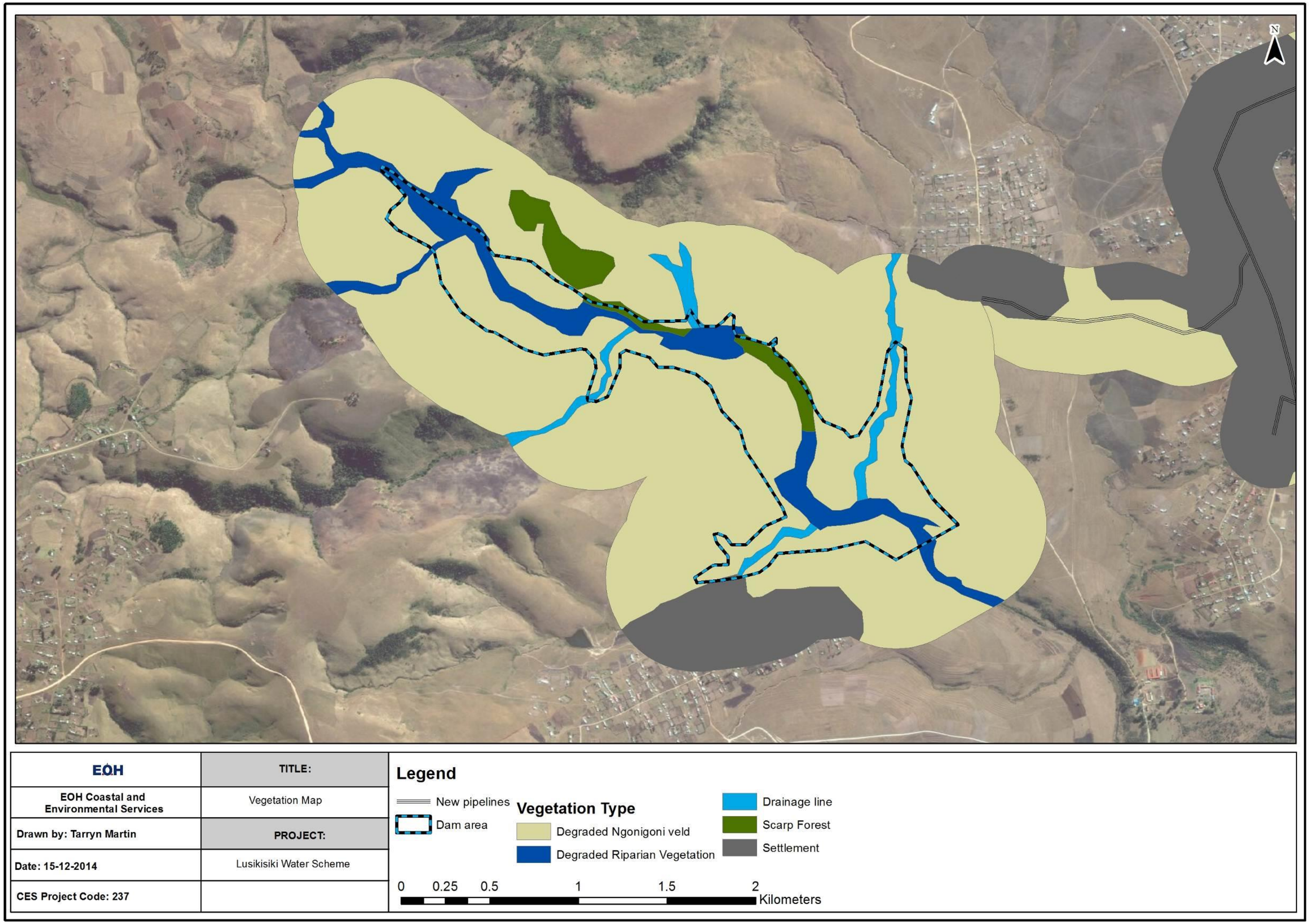

Figure 5-4: Vegetation map for the inundated area.

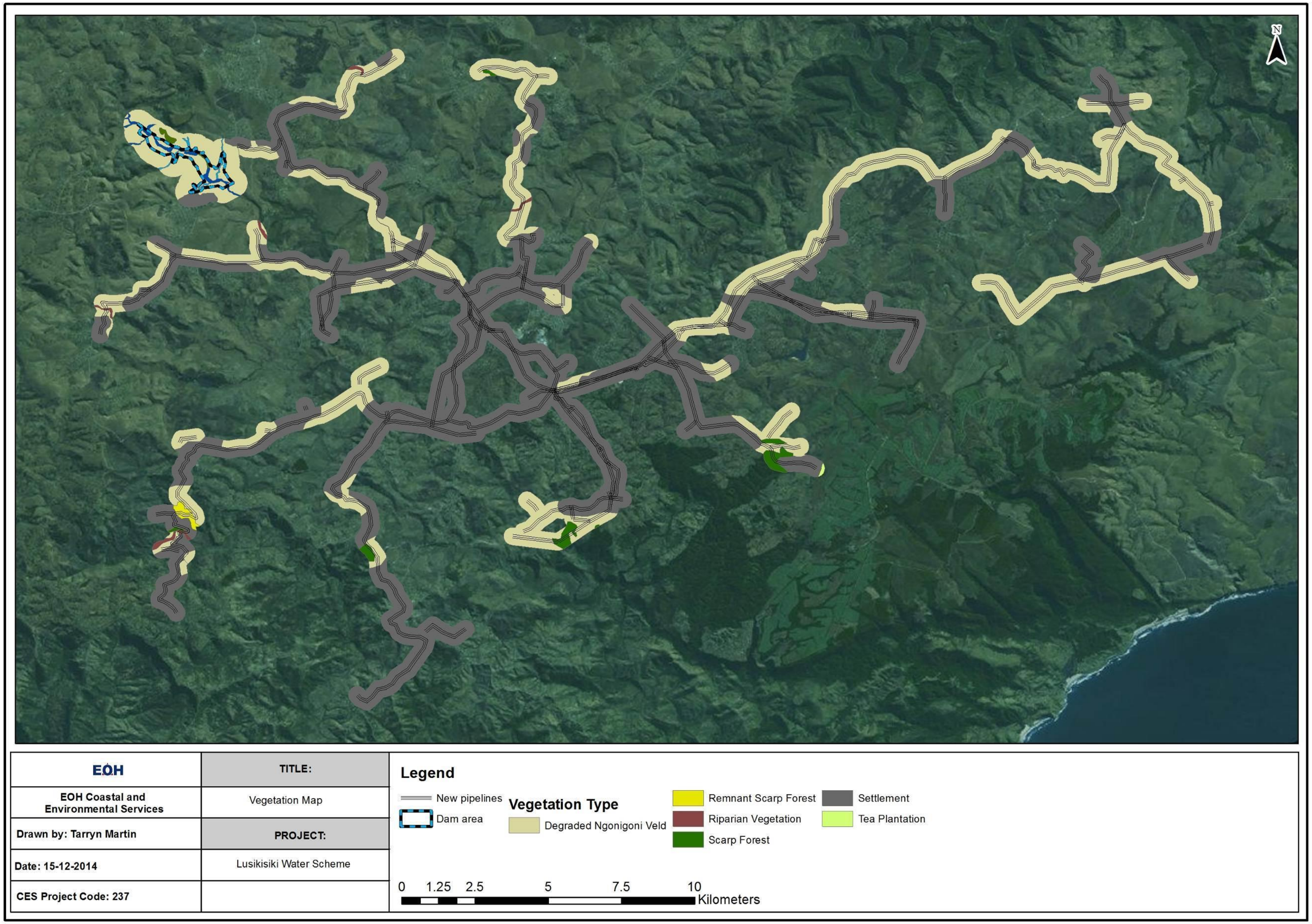

Figure 5-5: Vegetation map for the pipeline routes.

6 FLORISTICS

6.1 *Floristics*

Flora refers to the particular plants that occur in an area, with reference to not only the species which it contains, but also the genera or families. Plants are not evenly distributed, as they are confined to defined geographical ranges, and botanists classify the different ranges of species into regions, referred to as phytogeographic regions. These are very often associated with biophysical features such as geology, aspect, soils, climate and topography. Plants endemic[1] to the Cape region are thus those that form the natural characteristics of the Cape flora and are confined to this region.

White (1983) defined regional centres of endemism as geographical regions with a particular combination of endemic plant species. White's regions (1983) of particular concern in this study area are the Maputuland-Pondoland region, stretching down the coast of south-east Africa and the Afromontane region, which extends down the mountainous areas of Africa into southern Africa.

Species endemic to the area are described by Mucina and Rutherford (2006). In addition to the endemic taxa, a number of protected species are expected to be found in the study area. The list of species requiring protection is not complete as many species and taxa require additional study. The taxa with deficient data include specifically members of the Amaryllidaceae (Amaryllids), Iridaceae (Irises), Orchidaceae (Orchids) and Apocynaceae (Lianas), as well as members of the genus Aloe.

Potential Species of Conservation Concern (SCC) identified on site include all those plants listed in terms of the IUCN, CITES and both national and provincial legislation that may occur in the area of study.

6.2 *Plant Biodiversity and Protected species*

A total of 97 species were positively identified to occur within the project site (Appendix 1). Ngonigoni veld, the dominant vegetation type, typically has a low species diversity. It is therefore not surprising that the number of recorded species was low. Of these 97 species, only three are listed as species of conservation concern. These three species are all schedule 4 species on the Provincial Nature Conservation Ordinance Act 19 of 1974. The implication is that these species will require a permit for their removal or transplant prior to construction. No protected tree species were observed.

Table 6-1: Plant species identified in the study area

Family	Species	IUCN	SA RED LIST	PNCO	Protected Tree list	NEMBA
APOCYNACEAE	*Asclepias cf gibba*	-	Least Concern	Schedule 4	-	-
IRIDACEAE	*Dietes grandiflora*	-	Least Concern	Schedule 4	-	-
IRIDACEAE	*Moraea huttonii*	Least Concern	Least Concern	Schedule 4	-	-

[1] Endemic means restricted to a particular geographic region.

6.3 *Alien Species*

There are a number of alien species present within the study area, particularly along drainage lines. Alien species present on site and their category according to the Alien and Invasive Species Regulations (published 1 August 2014) are presented below (Table 6-2). It is advised that an alien invasive management plan is created and implemented during the construction phase and that active clearing of alien species listed as category 1b and 2 in impacted areas is carried out.

Table 4-2: Alien invasive species present on site

Species	Comment
Category 1b	
Agave sp. *Cirsium vulgare* *Tecoma capensis* *Cereus jamacaru* *Opuntia stricta* *Cuscuta campestris* *Acacia cyclops** *Acacia longifolia* *Caesalpinia decapetala* *Senna didymobotrya* *Plectranthus comosus* *Solanum mauritianum* *Solanum eloeagnifolium* *Lantana camara*	1) According to NEM:BA category 1b Listed species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be contained. 2) A landowner upon whose land a Category 1 b Listed Invasive Species occurs and which species is under the landowner's control must: (a) comply with the provisions of section 73(2) of the Act; and (b) contain the listed invasive species in compliance with section 75 (1), (2) and (3) of the Act; 3) If an Invasive Species Management Programme has been developed in terms of regulation 7, a landowner must control the listed invasive species in accordance with such programme. 4) A landowner contemplated in sub-regulation (2) must allow an authorised official from the Department to enter onto the land to monitor, assist with or implement the containment of the listed invasive species, or compliance with the Invasive Species Management Programme contemplated in regulation 7.
Category 2	
Acacia dealbata *Acacia mearnsii*	1) Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be. 2) Unless otherwise indicated in the Notice, no person may carry out a restricted activity in respect of a Category 2 Listed Invasive Species without a permit. 3) A landowner on whose land a Category 2 Listed Invasive Species occurs or person in possession of a permit, must ensure that the specimens of the species do not spread outside of the land or the area specified in the Notice or permit. 4) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in

Psidium guajava	accordance with such programme. 5) Unless otherwise specified in the Notice, any species listed as a Category 2 Listed Invasive Species that occurs outside the specified area contemplated in sub-regulation (1), must, for purposes of these regulations, be considered to be a Category 1 b Listed Invasive Species and must be managed according to Regulation 3.
Uncategorised	
Bidens pilosa	Although classified as weed species, these species don‘t occur on the Alien and Invasive Species Regulations List.
Taraxacum officinale	
Hypochaeris radicata	
Verbena aristigera	
Verbena bonariensis	

7 FAUNA

7.1 *Amphibians and Reptiles*

Amphibians and reptiles are well represented in sub-Saharan Africa. However, distribution patterns in southern Africa are uneven both in terms of species distribution and in population numbers (du Preez and Carruthers, 2009). Climate, centres of origin and range restrictions are the three main factors that determine species distribution. The eastern coast of South Africa has the highest amphibian diversity and endemicity while reptile diversity is generally highest in the north eastern extremes of South Africa and declines to the south and west (Alexander and Marais, 2010).

7.1.1 Reptiles

South Africa has 350 species of reptiles, comprising 213 lizards, 9 worm lizards, 105 snakes, 13 terrestrial tortoises, 5 freshwater terrapins, 2 breeding species of sea turtle and 1 crocodile (Branch, 1998). Of those 350 reptile species, the Eastern Cape is home to 133 which include 21 snakes, 27 lizards and eight chelonians (tortoises and turtles). The majority of these are found in Mesic Succulent Thicket and riverine habitats. Consultation of the Animal Demography Unit historical records indicates that 37 species of reptiles are likely to occur in the project site. One of these (*Bradypodion caffer* – Pondo Dwarf Chameleon) is classified as **Endangered** and one is listed as **Vulnerable** (*Bradypodion melanocephalum* – KwaZulu Dwarf Chameleon) (SARCA 2014). Dwarf chameleons usually occur in isolated populations within small patches of suitable habitat.

Pondo Dwarf Chameleons are only known to occur in the vicinity of Port St. Johns within low coastal forest (Tolley, 2010). It is estimated that their area of occupancy is 45km^2. It is unlikely that this species occurs

The distribution range of the **KwaZulu Dwarf Chameleon** is not currently known (Armstrong, 2010). It is believed to be centred around the Durban area and strongly associated with the coast. It is unlikely that this species occurs within the study area given that it is severely degraded in most parts.

7.1.2 Amphibians

Amphibians are important in wetland systems, particularly where fish are excluded or of minor importance. In these habitats, frogs are dominant predators of invertebrates. Reports of declining amphibian populations continue to increase globally, even in pristine protected areas (Phillips 1994). These declines are not simple cyclic events; for example, frogs have been identified as bio-indicator species that reflect the wellbeing of aquatic ecosystems (Poynton and Broadley 1991). Frog abundance and diversity is a poignant reflection of the general health and well-being of aquatic ecosystems. According to historical records, 23 species of frog have been documented in the Quarter Degree Squares that the study area falls in. One of these species is listed as **Endangered** (*Natalobatrachus bonebergi – Boneberg's Frog/ Natal Diving Frog)*) and one is listed as **Vulnerable** (*Afrixalus spinifrons* – Natal Banana Frog).

Boneberg's Frog/Natal Diving Frog/ Kloof Frog has a distribution that ranges from Dwesa Nature Reserve in the Eastern Cape Province east to southern and central Kwa-Zulu Natal (SA-FRoG, 2012). Its Area of Occupancy is estimated to be 150km^2 (and declining).It occurs in nine locations, all between 50 and 900m asl. Its habitat preference is in coastal forests and gallery forests along streams. It is unlikely that this species will occur within the project area as it is too far inland and the level of degradation due to the current landuse is likely to preclude this species from the area (Conradie, pers. comm).

The **Natal Banana Frog** is associated with low growing vegetation in shrubland and dry forest and breeds in vleis (including dams) and temporary pools and dams (SA-FRoG, 2012). It creates egg nests on emergent vegetation within these areas. This species is endemic to South Africa and occurs as two subspecies. *A.s. spinifrons* occurs in the Kwa-Zulu Natal lowlands and the eastern Cape coast of South Africa at low to intermediate altitudes. Based on habitat preference and distribution it is likely that this species will occur within the project area.

7.2 *Birds*

Nine bird species are endemic to South Africa, but there are no Eastern Cape endemics. However, there are 62 threatened species within the Eastern Cape Province (Barnes, 2000). Most of these species occur in grasslands or are associated with wetlands, indicating a need to conserve what is left of these ecosystems (Barnes, 2000). Historical records indicate that there are three **Endangered** species, eight **Vulnerable** species and eight **Near Threatened** species likely to occur in the area (Table 7-1).

While on site, three Southern Ground Hornbills (*Bucorvus leadbeateri)* were noted at an abandoned house located directly above the inundated area and eleven Cape Vultures (*Gyps coprotheres)* were counted soaring over the inundated area. It is likely that the Hornbills have a roost in the immediate area however Cape Vultures have colony roosts and can fly long distances in search of carrion. Their presence is therefore not indicative of a nearby roost. Migratory birds may not have been observed at the time of the site visit, therefore species absence as reported in this study is not definitive.

Table 7-1: Threatened bird species that are likely to occur in the study area (BirdlifeSA, 2012).

Scientific Name	Common name	Red List status	NEM:BA	Noted on Site
Balearica regulorum	Grey Crowned Crane	Endangered	Endangered	
Zoothera guttata	Natal Thrush	Endangered	-	
Campethera notata	Knysna Woodpecker	Near Threatened	-	
Neotis denhami	Denham's Bustard	Near Threatened	Protected	
Polemaetus bellicosus	Martial Eagle	Near Threatened	-	
Coracias garrulus	European Roller	Near Threatened	-	
Phalacrocorax capensis	Cape Cormorant	Near Threatened	-	
Puffinus griseus	Sooty Shearwater	Near Threatened	-	
Stephanoaetus coronatus	Crowned Eagle	Near Threatened	-	
Bradypterus sylvaticus	Knysna Scrub-Warbler	Near Threatened	-	
Bucorvus leadbeateri	Southern Ground-hornbill	Near Threatened	-	X
Geronticus calvus	Southern Bald Ibis	Near Threatened	Vulnerable	
Gyps coprotheres	Cape Vulture	Near Threatened	Endangered	X
Morus capensis	Cape Gannet	Near Threatened	-	
Procellaria aequinoctialis	White-chinned Petrel	Near Threatened	-	
Circus maurus	Black Harrier	Vulnerable	-	
Sagittarius serpentarius	Secretary Bird	Vulnerable	-	

7.3 *Mammals*

Large game makes up less than 15% of the mammal species in South Africa and a much smaller percentage in numbers and biomass. In developed and farming areas, this percentage is greatly reduced, with the vast majority of mammals present being small or medium-sized.

No large mammals were noted during the site visit. It is unlikely that any remain in the area due to the high density of human settlement. Mammals that still occur in the area are likely to be limited to small- (e.g. rodents) and the occasional medium-sized animals such as duiker in forest patches.

8 SENSITIVITY ASSESSMENT

8.1 *Conservation and Spatial Planning Tools*

Several conservation planning tools are available for the study area. These tools allow for the potential identification of any sensitive and important areas from a vegetation and faunal perspective at the early stage of a development and allow for the fine-tuning of plans and infrastructure layouts.

These available tools together with the field survey have been used to assess the sensitivity of the study area.

8.1.1 Protected Areas

The study area lies adjacent to the Mkambati Nature Reserve and the Pondoland Marine Protected Area (Figure 8-1). According to the National Environmental Management: Protected Areas Act (No 57 of 2003) the purpose of the declaration of protected areas is:

- *"to protect ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes in a system of protected area;*
- *to preserve the ecological integrity of these areas;*
- *to conserve biodiversity in these areas;*
- *to protect areas representative of all ecosystems, habitats and species naturally occurring in South Africa;*
- *to protect South Africa's threatened or rare species;*
- *to protect an area which is vulnerable or ecologically sensitive;*
- *to assist in ensuring the sustained supply of environmental goods and services*
- *to provide for the sustainable use of natural or biological resources;*
- *to create or augment destinations for nature based tourism;*
- *to manage the inter-relationship between natural environment biodiversity, human settlement and economic development;*
- *generally to contribute to human, social, cultural, spiritual and economic development;*
- *to rehabilitate and restore degraded ecosystems and promote the recovery of endangered and vulnerable species"*

The project infrastructure and activities will not impact on either protected area.

8.1.2 Protected Areas Expansion strategy

A National Spatial Biodiversity Assessment was conducted in 2004, revealing a lack of protection for a representative sample of the country's biodiversity, and poor conservation of adequate process areas. The Protected Areas Expansion Strategy allows for increased conservation of these aspects of the country in order to meet national biodiversity targets. The strategy outlines two methods of expanding the current National Protected Areas:

- For public land, the declaration of available, under-utilised and strategic parcels of public land in concordance with the relevant legal requirements for disposal of such land;
- For private land, contractual agreements with the affected landowners.

An area is considered important for expansion if it contributes to meeting biodiversity thresholds, maintaining ecological processes or climate change resilience. Forty-two focus areas for land-based protected area expansion have been identified and are composed of large, intact and fragmented areas suitable for the creation or expansion of large protected areas. The study area falls within a section of the Pondoland focus area (Figure 8-1). Although a few of the southern sections of the pipelines will impact on a small section of the Pondoland NPAES, this infrastructure is unlikely to contribute to further degradation since it follows existing roads and is therefore located in areas that are already severely degraded from an ecological perspective.

8.1.3 National List of Ecosystems that are threatened and in need of Protection (NEMBA, Act 10 of 2004).

The National Environmental Management: Biodiversity Act provides a list of threatened terrestrial ecosystems. This was established as little attention has historically been paid to the protection of ecosystems outside of protected areas. The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems.

There are a number of patches of vegetation classified as threatened that fall within the study area (Figure 8-2). However, as with the impact on NPAES areas, the pipelines are in areas that are already severely degraded. The inundated area is located within a threatened ecosystem and although the vegetation that occurs here is widespread and very few species of conservation concern were identified, this area will still be lost when the area is flooded.

8.1.4 Drainage lines and Wetlands

In this report, wetlands and drainage lines have been classified as having a HIGH sensitivity. Only three wetlands and one watercourse will be affected by the inundated area (Figure 8-3). The drainage lines and wetlands are important as they may act as refugia and/or corridors for faunal movement. Disturbance to these areas may affect animal habitats, particularly for amphibian species that are dependent on these areas.

The pipelines intersect with drainage lines at 15 points within the study area. Figure 8-4 illustrates where these points occur. A water use license application (WULA) will need to be submitted for the inundated area as well as for the areas where the pipelines intersect.

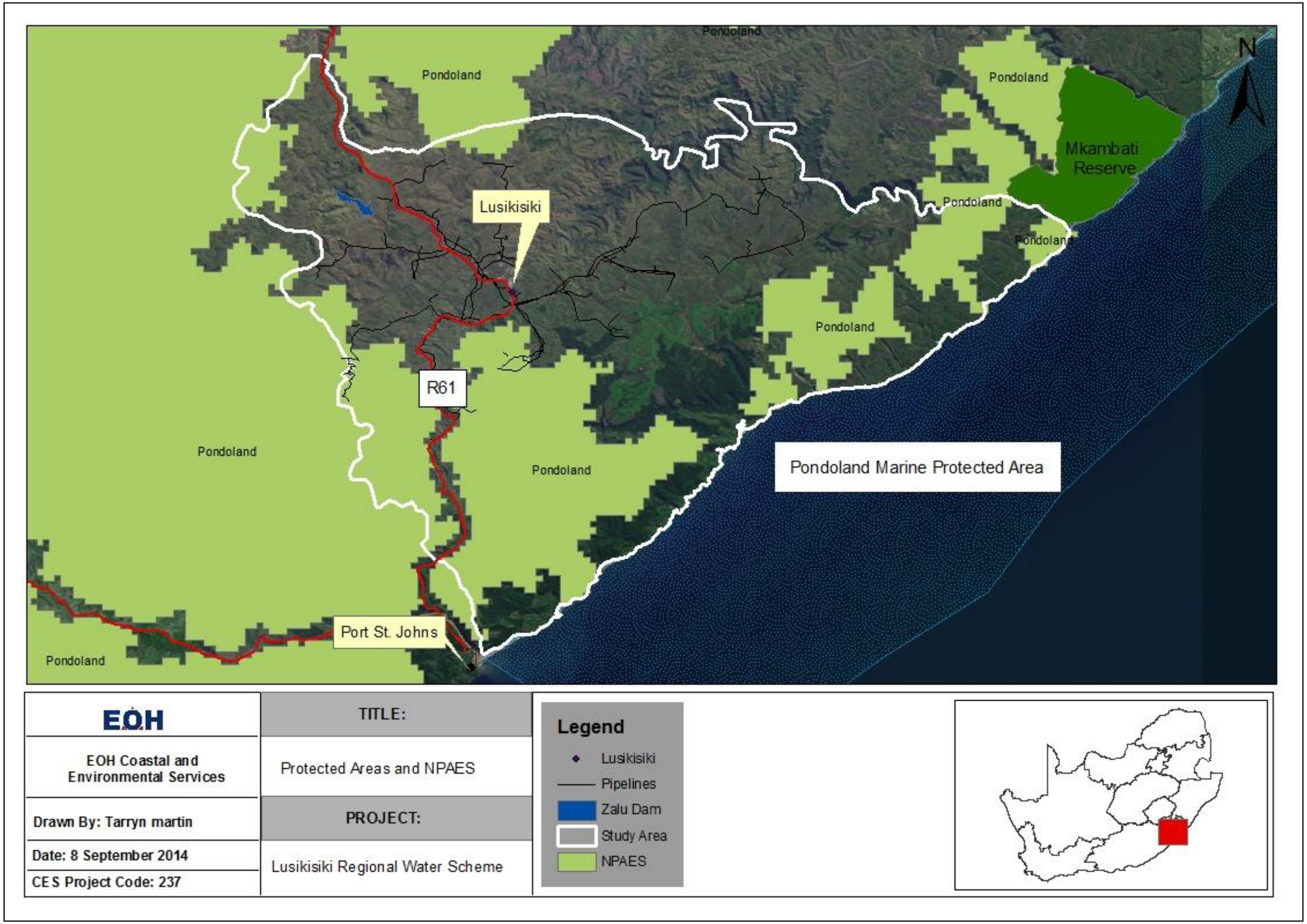

Figure 8-1: Terrestrial Protected Areas, Marine Protected Areas (MPA) and Expansion Strategy Areas that occur within and near the project study area.

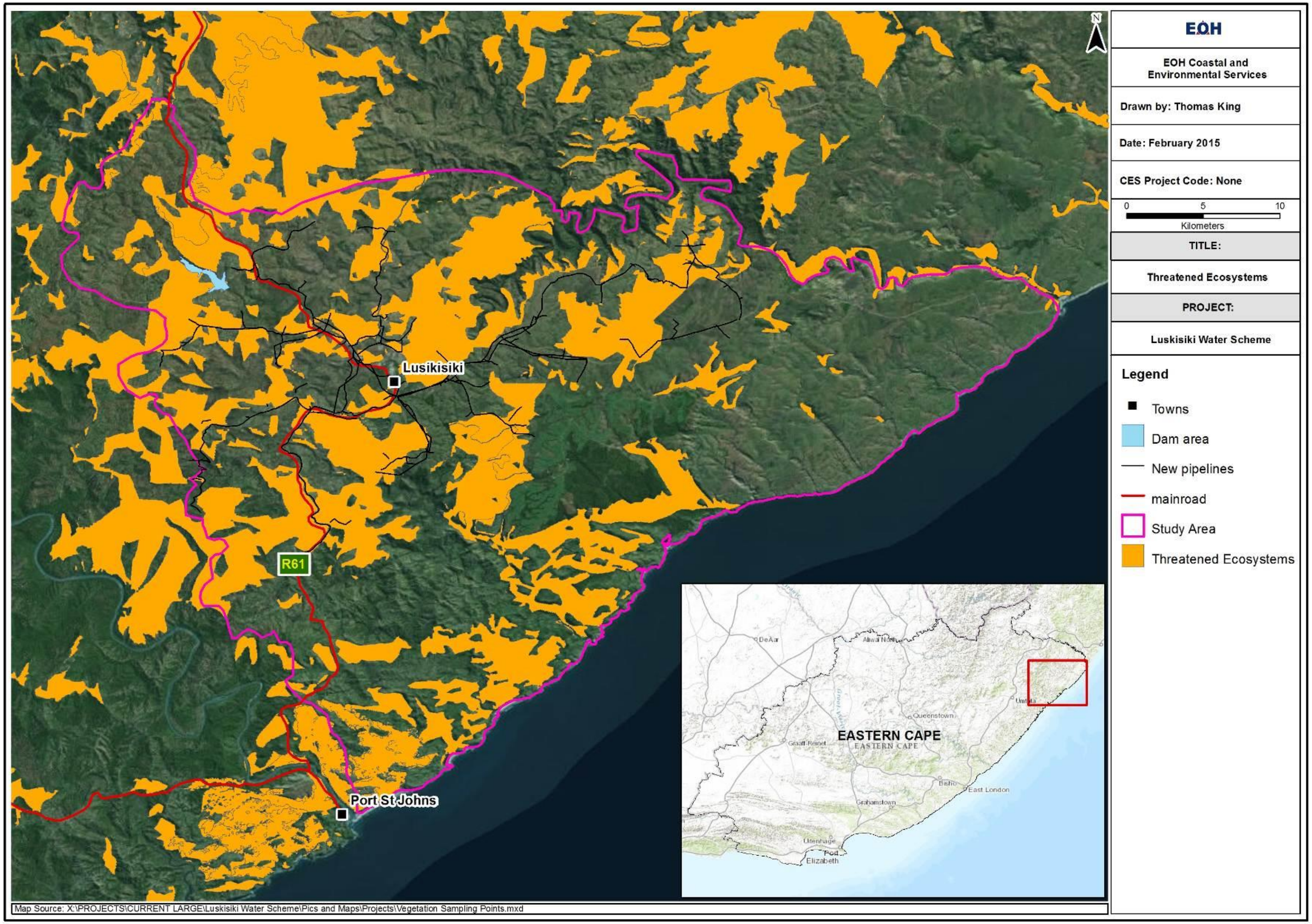

Figure 8-2: Threatened ecosystems found within the study area.

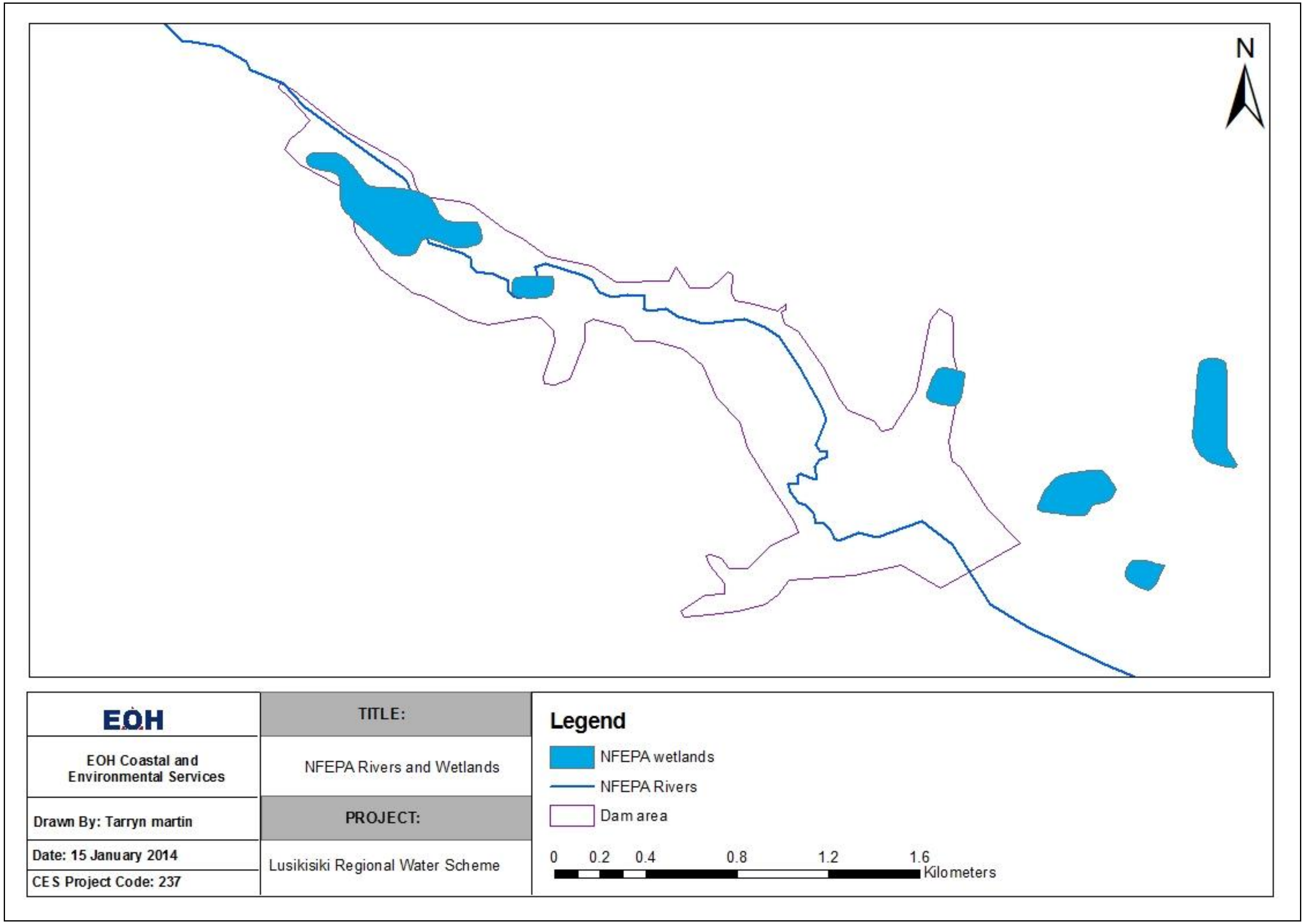

Figure 8-3: NFEPA rivers and wetlands found within the proposed Zalu dam.

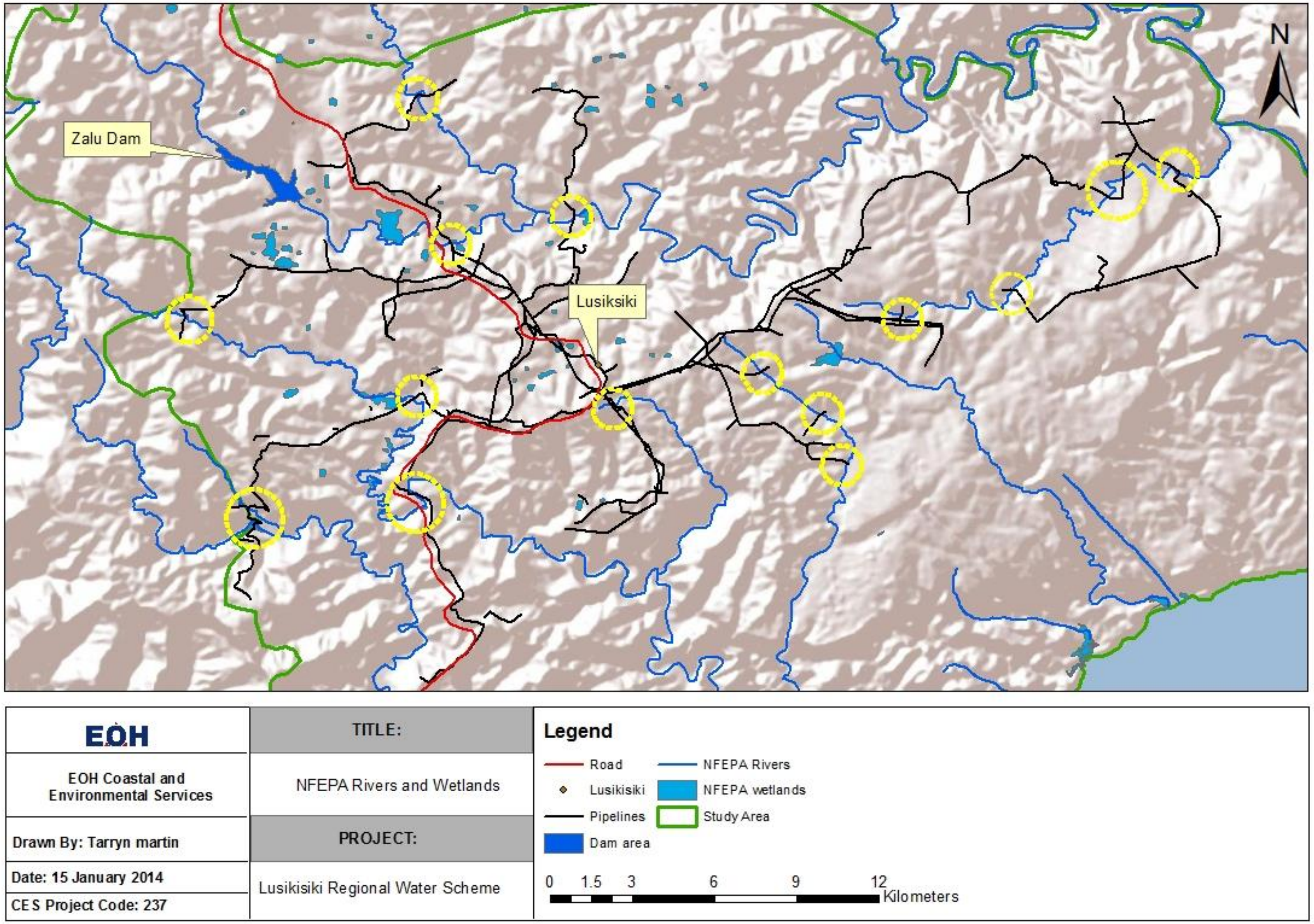

Figure 8-4: NFEPA rivers and wetlands found within the proposed Zalu dam. The dashed circles indicate areas where the pipeline crosses drainage lines.

8.1.5 The Eastern Cape Biodiversity Conservation Plan

The Eastern Cape Biodiversity Conservation Plan (ECBCP) is responsible for mapping areas that are priorities for conservation in the province, as well as assigning land use categories to the existing land depending on the state that it is in (Berliner et al. 2007).

Critical Biodiversity Areas (CBAs) are defined by Berliner et al. (2007) as: *"CBAs are terrestrial and aquatic features in the landscape that are critical for conserving biodiversity and maintaining ecosystem functioning".* These areas are classified as natural to near-natural landscapes. In addition to the CBA's the ECBCP also defines Other Natural Areas (ONA) as well as Transformed Areas.

Biodiversity Land Management Classes (BLMCs) are used in the plan: "Each BLMC sets out the desired ecological state that an area should be kept in order to ensure biodiversity persistence. For example, BLMC 1 refers to areas which are critical for biodiversity persistence and ecosystem functioning, and which should be kept in as natural a condition as possible". Table 8-1 shows how the BLMCs relate to the CBAs.

Table 8-1: Terrestrial Critical biodiversity Areas and Biodiversity Land Management Classes as described by the Eastern Cape Biodiversity Conservation Plan.

CBA map category	Code	BLMC		Recommended land use objective
Protected areas	PA1	BLMC 1	Natural landscapes	Maintain biodiversity in as natural state as possible. Manage for no biodiversity loss.
	PA2			
Terrestrial CBA 1 (not degraded)	T1			
Terrestrial CBA 1 (degraded)	T1	BLMC 2	Near-natural landscapes	Maintain biodiversity in near natural state with minimal loss of ecosystem integrity. No transformation of natural habitat should be permitted.
Terrestrial CBA 2	T2			
	C1			
	C2			
Other natural areas	ONA T3	BLMC 3	Functional landscapes	Manage for sustainable development, keeping natural habitat intact in wetlands (including wetland buffers) and riparian zones. Environmental authorisations should support ecosystem integrity.
	ONA			
Transformed areas	TF	BLMC 4	Transformed landscapes	Manage for sustainable development.

The study site falls within terrestrial areas classified as CBA 1 and CBA 2 as well as an aquatic CBA 1 area (Figure 8-5). ECBCP, although mapped at a finer scale than the National Spatial Biodiversity Assessment (Driver *et al*., 2005) is still, for the large part, inaccurate and "course". Therefore it is imperative that the status of the environment, for any proposed development MUST first be verified before the management recommendations associated with the ECBCP are considered (Berliner and Desmet, 2007).

The site survey indicates that the study area is degraded and that areas classified as CBA 1 and 2, where project infrastructure will have an impact, are in poor condition and generally overgrazed. A significant loss of biodiversity in these areas has already occurred and these areas should therefore be classified as areas of low to moderate sensitivity rather than high sensitivity as the ECBCP spatial planning tool recommends. A sensitivity map for the study area is presented below.

Since the project will have no impacts on the aquatic CBA, this area was not surveyed.

8.2 *Site sensitivity*

The study area of the proposed project has been mapped in terms of ecological sensitivity. The following areas are deemed as sensitive:

1. Water courses with a 50 metre buffer;
2. Wetlands within the inundation area;
3. Wetlands along the pipeline route (HIGH NO-GO areas);
4. Forest Patches within the inundation area; and
5. Forest Patches along the pipeline route with a 50 metre buffer.

The sensitivity map was developed by identifying areas of high, medium and low sensitivity (Figure 8-6 and 8-7).

Areas of **high sensitivity** include:

- Process areas such as rivers, wetlands and streams that are important for ecosystem functioning, including surface and ground water as well as animal and plant dispersal;
- Areas that have a high species richness;
- Areas that are not significantly impacted, transformed or degraded by current land use; and
- Areas that contain the majority of species of special concern found in the area and may contain high numbers of globally important species, or comprise part of a globally important vegetation type.

Areas of **medium sensitivity** include:

- Areas that still provide a valuable contribution to biodiversity and ecosystem functioning despite being degraded;
- Degraded areas that still have a relatively high species richness; and
- Degraded areas that still contain species of special concern.

Areas of **low sensitivity** include:

- Areas that are highly impacted by current land use and provide little value to the ecosystem; and
- Highly degraded areas that are unlikely to harbour any species of special concern.

8.2.1 Inundated Area: Zalu Dam

The majority of the area was degraded and impacted by human settlement. Consequently, these areas were defined as areas of low sensitivity (Figure 8-6).

Although degraded and infested with alien vegetation, the riparian zone, forest patches, wetlands and drainage lines still play an important role for ecological processes. These areas were therefore classified as having a high sensitivity.

Ngonigoni veld has been classified as low sensitivity due to its high level of degradation.

8.2.2 Pipeline Routes

The pipeline routes all follow existing roads and are located within areas that have a high density of settlements. With the exception of a few areas where small patches of forest are located, the majority of these areas, including the degraded Ngonigoni Veld, are considered to be of a low sensitivity (Figure 8-7).

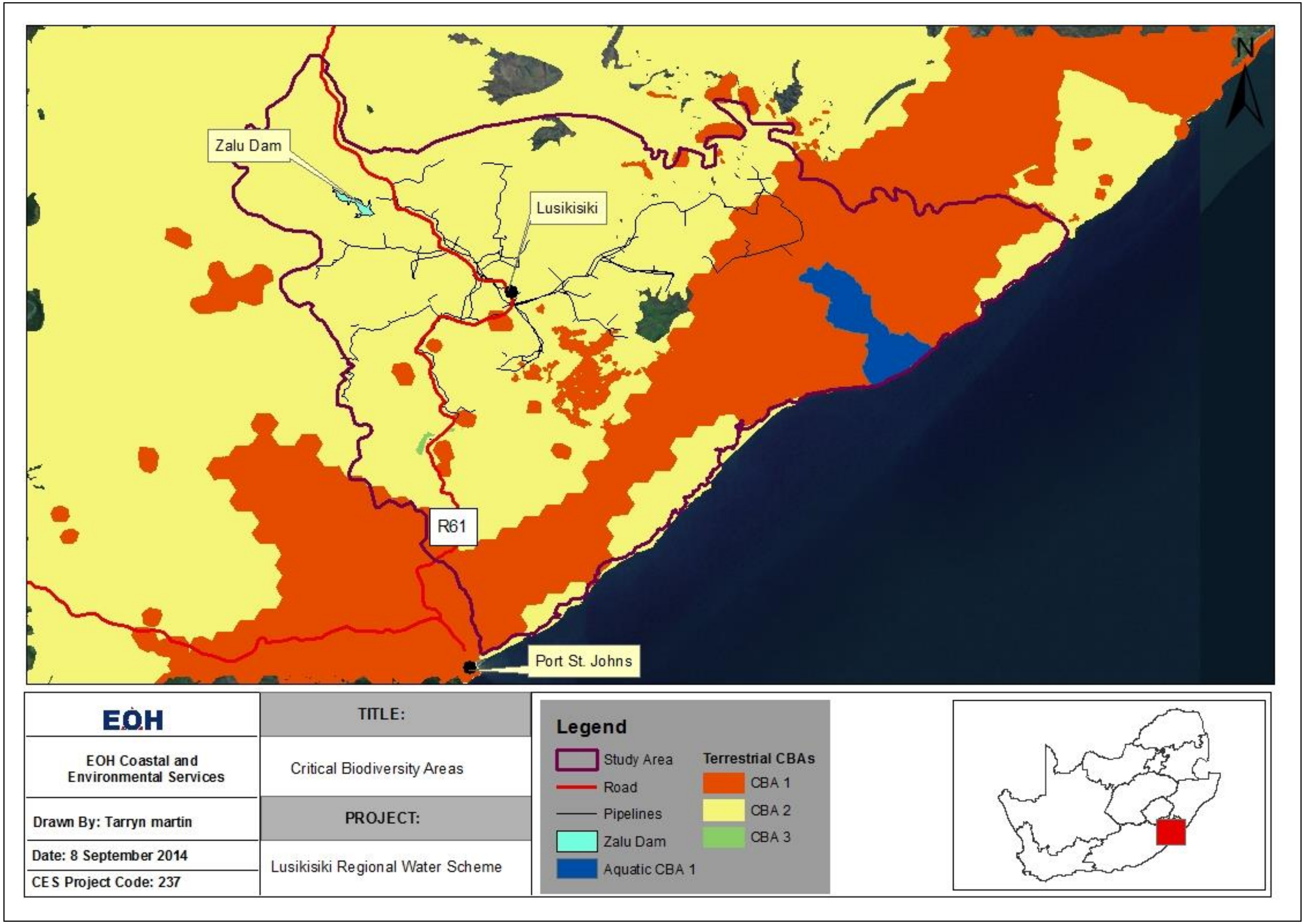

Figure 8-5: Terrestrial Critical Biodiversity Areas (CBA) found within the study area.

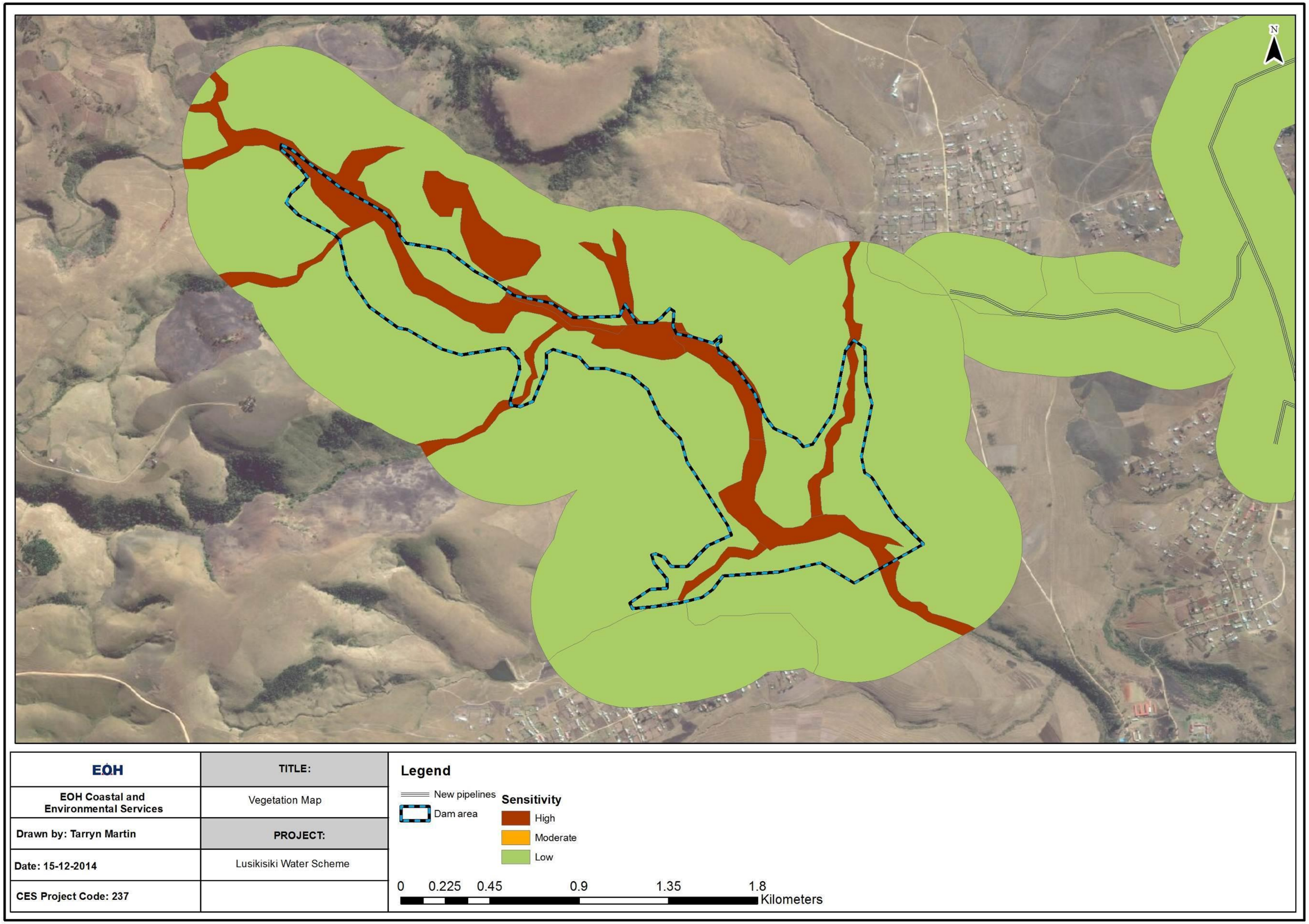

Figure 8-6: Sensitivity map showing areas of high, moderate and low sensitivity for the proposed Zalu dam (inundated area).

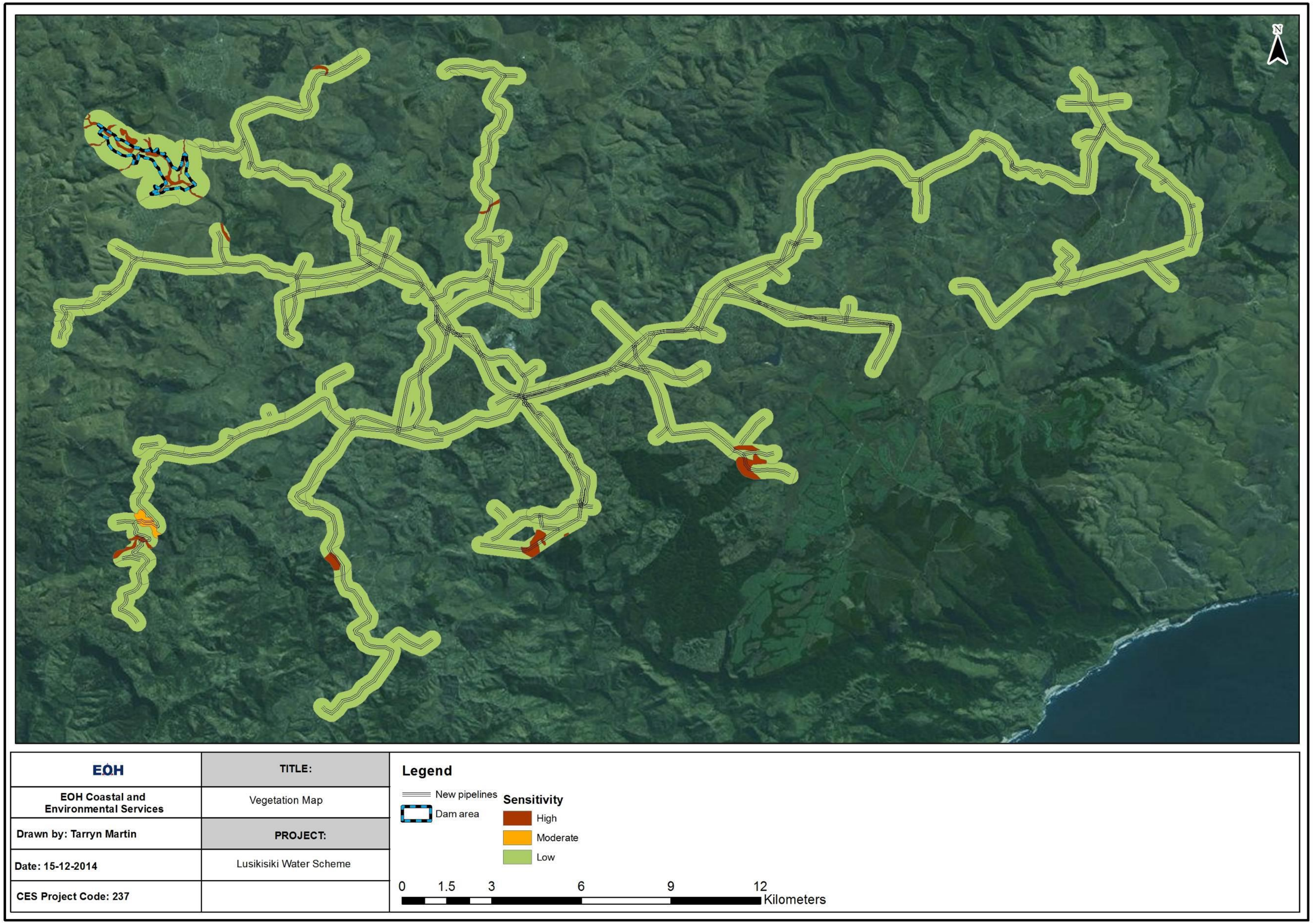

Figure 8-6: Sensitivity map showing areas of high, moderate and low sensitivity for the various pipeline routes.

9 IMPACT IDENTIFICATION AND ASSESSMENT

9.1 *Identified Impacts*

Ecological impacts that were identified during the Planning and Design, Construction and Operation Phase of the proposed Lusikisiki Regional Water Scheme are described below. These included the consideration of direct, indirect and cumulative impacts that may occur.

The construction phase has been assessed as being completed once the pipelines have been installed and the dam wall commissioned. The operational phase has been assessed as the period after the commissioning of the dam wall. The period during which the Zalu dam will be inundated has been classified as the operational phase in this report.

Table 9.1 Impact identified during the phases of the Lusikisiki Regional Water Scheme

Phase	Issue	Nature of Impact	Description of Impact	Further comment
Planning & Design	Loss of indigenous vegetation	Direct	Loss of 100 Ha of degraded Ngonigoni Veld due to the inundation of the Zalu dam site and installation of pipelines and access roads.	The area that will be impacted by project infrastructure is considered degraded and occurs in areas that have been previously impacted. This impact has not been assessed as severe.
	Loss of sensitive areas	Direct	Location of the inundated area within sensitive areas (scarp forest (6 ha), riparian areas and wetlands (7 ha)) and their sensitivity buffers.	Sensitive areas within the inundation area will be lost. This impact cannot be avoided or mitigated. Chapters 5 & 6 have described the site in terms of ecological sensitivity. This has in turn informed the assessment of the infrastructure layout. Since the area is generally classified as having a low sensitivity, this impact has not been assessed as severe.
		Direct	Inappropriate routing and design of pipelines and access roads through sensitive areas (Dense vegetation, riparian areas and wetlands) and their sensitivity buffers.	
Construction	Loss of vegetation during construction	Direct	Loss of natural vegetation due to vegetation clearing during construction of the pipeline, access roads and development of borrow pits and quarries.	The conservation status (Vulnerable and Least Threatened) of the vegetation types being affected, results in a moderate severity assessment of this impact.
		Indirect	Inadvertent or excessive damage and loss of vegetation beyond the development/construction footprint.	Although the impact above is not rated as severe, irresponsible and unnecessary vegetation clearing, especially in close proximity to sensitive areas, is considered unacceptable and contrary to NEMA principals.
		Direct	Loss of plant species of conservation concern.	A number of plant species of special concern are likely to occur in the study area.
	Disturbance of sensitive areas	Indirect	Erosion and degradation of water-courses and associated habitats due to irresponsible construction of the dam wall and reticulation	The access road / pipeline infrastructure throughout the study area will result in a number of water crossings (Chapter 8).

			pipelines and access roads.	Irresponsible construction may result in erosion and riparian habitat destruction, resulting in high impact severity.
	Disturbance to surrounding wildlife and fauna	Direct	During construction vehicular movement, noise and habitat destruction will disturb animals in the area.	Construction impacts on faunal groups is typically localised and short-term. As animals are mobile, they are able to move away from disturbance. Habitat destruction, however, may impact on the survival of the population.
		Direct	Poaching of wild animals during construction.	
		Indirect	Potential loss of specialised faunal habitat due to clearing beyond the development footprint (forests, wetlands, dense woody vegetation and riparian zones) may reduce faunal populations.	Pipeline construction in or close to key habitats will have a long-term effect on faunal groups.
	Soil erosion and degradation due to poor rehabilitation	Indirect	Clearing and excavation of soil for construction purposes will result in exposed soil. If not rehabilitated, it may result in severe topsoil erosion, bank destabilisation and downstream sedimentation.	Construction, especially within water courses and slopes, must be immediately followed by rehabilitation by re-landscaping and re-vegetation.
Operation	Infestation of alien plant species	Direct	Spread and establishment of alien plant species due to disturbance.	This impact can be mitigated by implementing an alien invasive monitoring plan.
	Loss of sensitive areas and habitats during inundation of the dam	Direct	Loss of 7ha wetlands and riparian areas and 6ha forest habitats due to inundation of the propose dam.	Although degraded, these habitats have intrinsic value as they provide unique niches/refugia for plant and animal species. Loss due to inundation cannot be mitigated.
		Direct	Loss of plant species of special concern	Loss due to inundation cannot be mitigated. A search and rescue programme to relocate trees and plant will be required.

		Direct	Loss of animals during inundation of the proposed dam.	Loss due to inundation cannot be mitigated, but a search and rescue programme for slow-moving animals will need to be implemented.

9.2 *Assessment methodology*

Identified impacts will be assessed against the following criteria:

- Temporal scale
- Spatial scale
- Risk or likelihood
- Degree of confidence or certainty
- Severity or benefits
- Significance

The relationship of the issue to the temporal scale, spatial scale and the severity are combined to describe the overall importance rating, namely the significance.

Description of criteria

Table 9.2 Significance Rating Table

Significance Rating Table	
Temporal Scale (The duration of the impact)	
Short term	Less than 5 years (Many construction phase impacts are of a short duration).
Medium term	Between 5 and 20 years.
Long term	Between 20 and 40 years (From a human perspective almost permanent).
Permanent	Over 40 years or resulting in a permanent and lasting change that will always be there.
Spatial Scale (The area in which any impact will have an affect)	
Individual	Impacts affect an individual.
Localised	Impacts affect a small area of a few hectares in extent. Often only a portion of the study area.
Project Level	Impacts affect the entire study area.
Surrounding Areas	Impacts that affect the area surrounding the development
Municipal	Impacts affect either BCM, or any towns within them.
Regional	Impacts affect the wider district municipality or the province as a whole.
National	Impacts affect the entire country.
International/Global	Impacts affect other countries or have a global influence.
Will definitely occur	Impacts will definitely occur.
Degree of Confidence or Certainty (The confidence with which one has predicted the significance of an impact)	

Definite	More than 90% sure of a particular fact. Should have substantial supportive data.
Probable	Over 70% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Only over 40% sure of a particular fact, or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact, or of the likelihood of an impact occurring.

Table 9.3 Impact Severity Rating

Impact severity (The severity of negative impacts, or how beneficial positive impacts would be on a particular affected system or affected party)	
Very severe	Very beneficial
An irreversible and permanent change to the affected system(s) or party (ies) which cannot be mitigated. For example the permanent loss of land.	A permanent and very substantial benefit to the affected system(s) or party (ies), with no real alternative to achieving this benefit. For example the vast improvement of sewage effluent quality.
Severe	Beneficial
Long term impacts on the affected system(s) or party (ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming, or some combination of these. For example, the clearing of forest vegetation.	A long term impact and substantial benefit to the affected system(s) or party (ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these. For example an increase in the local economy.
Moderately severe	Moderately beneficial
Medium to long term impacts on the affected system(s) or party (ies), which could be mitigated. For example constructing the sewage treatment facility where there was vegetation with a low conservation value.	A medium to long term impact of real benefit to the affected system(s) or party (ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way. For example a slight' improvement in sewage effluent quality.
Slight	Slightly beneficial
Medium or short term impacts on the affected system(s) or party (ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example a temporary fluctuation in the water table due to water abstraction.	A short to medium term impact and negligible benefit to the affected system(s) or party (ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.
No effect	Don't know/Can't know
The system(s) or party (ies) is not affected by the proposed development.	In certain cases it may not be possible to determine the severity of an impact.

Table 9.4 Overall Significance Rating

Overall Significance (The combination of all the above criteria as an overall significance)	
VERY HIGH NEGATIVE	VERY BENEFICIAL
These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or social) environment, and usually result in **severe** or **very severe** effects, or **beneficial** or **very beneficial** effects. **Example:** The loss of a species would be viewed by informed society as being of VERY HIGH significance. **Example:** The establishment of a large amount of infrastructure in a rural area, which previously	

had very few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH significance.	
HIGH NEGATIVE	BENEFICIAL
These impacts will usually result in long term effects on the social and/or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light. **Example:** The loss of a diverse vegetation type, which is fairly common elsewhere, would have a significance rating of HIGH over the long term, as the area could be rehabilitated. **Example:** The change to soil conditions will impact the natural system, and the impact on affected parties (such as people growing crops in the soil) would be HIGH.	
MODERATE NEGATIVE	SOME BENEFITS
These impacts will usually result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by society as constituting a fairly important and usually medium term change to the (natural and/or social) environment. These impacts are real but not substantial. **Example:** The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant.	
LOW NEGATIVE	FEW BENEFITS
These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by the public and/or the specialist as constituting a fairly unimportant and usually short term change to the (natural and/or social) environment. These impacts are not substantial and are likely to have little real effect. **Example:** The temporary changes in the water table of a wetland habitat, as these systems are adapted to fluctuating water levels. **Example:** The increased earning potential of people employed as a result of a development would only result in benefits of LOW significance to people who live some distance away.	
NO SIGNIFICANCE	
There are no primary or secondary effects at all that are important to scientists or the public. **Example:** A change to the geology of a particular formation may be regarded as severe from a geological perspective, but is of NO significance in the overall context.	
DON'T KNOW	
In certain cases it may not be possible to determine the significance of an impact. For example, the primary or secondary impacts on the social or natural environment given the available information. **Example:** The effect of a particular development on people's psychological perspective of the environment.	

9.3 *Impact Assessment*

The impacts identified in Section 9.2 are assessed in terms of the criteria described in Section 9.3 and are summarised in the tables below (Table 9.5 – 9.8).

Table 9.5 Assessment and mitigation of impacts identified in the Planning and Design Phase

PLANNING AND DESIGN PHASE							
GENERAL AND SPECIALIST STUDY IMPACTS	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Direct impacts							
Issue: Loss of indigenous vegetation							
Loss of 100 Ha of degraded Ngonigoni Veld due to the inundation of the Zalu dam site and installation of pipelines and access roads.	**Localised**	**Long-term**	**Definite**	**Slightly severe**	**MODERATE**	• All species of special concern, protected or vulnerable must be avoided or transplanted. • The existing roads must be utilised for access. • New access roads must only be constructed if there is no alternative, and the width of existing roads and tracks must be kept to a minimum width • In the unlikely event that a protected tree species needs to be removed, a permit to do so must be attained from DAFF. • Laydown areas and turning areas must be located in areas that have already been impacted or show evidence of degradation. The ECO must identify such areas. • The servitude of the pipeline must be kept to a minimum. • Where feasible the pipeline must be located in areas that are already impacted on and degraded. • Rehabilitation of the disturbed areas and the remaining stockpiles (if any) must take place immediately after construction. • Topsoil must be stockpiled separately to sub soil.	**LOW**
Issue: Loss of sensitive area							
Location of the inundated area within sensitive areas (6 ha scarp forest, riparian areas and 7ha wetlands) and their sensitivity buffers.	**Localised**	**Medium-term**	**Possible**	**Severe**	**HIGH**	• Use existing access roads where feasible; • Align roads and pipelines within a single corridor and keep this as narrow as feasible; and • Where practical and feasible, avoid locating linear infrastructure (such as roads and pipelines) through areas of high and moderate sensitivity.	**LOW**
Inappropriate routing and design of pipelines and access roads through sensitive areas (Dense vegetation, riparian areas and wetlands) and their sensitivity buffers.	**Localised**	**Medium-term**	**Possible**	**Severe**	**HIGH**		**LOW**

						• Where feasible, avoid locating the pipeline and access road alongside streams and wetlands;	

Table 9.6 Assessment and mitigation of impacts identified in the Construction Phase

CONSTRUCTION PHASE							
GENERAL AND SPECIALIST STUDY IMPACTS	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Direct impacts							
Issue: Loss of vegetation during construction							
Loss of natural vegetation due to vegetation clearing during construction of the pipeline, access roads and the development of borrow pits and quarries.	**Localised**	**Short-term**	**Probable**	**Moderately severe**	**MODERATE**	• All species of special concern, protected or vulnerable must be avoided or transplanted. • The existing roads must be utilised for access. • New access roads must only be constructed if there is no alternative, and the width of existing roads and tracks must be kept to a minimum width • In the unlikely event that a protected tree species needs to be removed, a permit to do so must be attained from DAFF. • Laydown areas and turning areas must be located in areas that have already been impacted or show evidence of degradation. The ECO must identify such areas. • The servitude of the pipeline must be kept to a minimum. • Where feasible the pipeline must be located in areas that are already impacted on and degraded. • To minimise visual impacts the pipeline will be buried. Rehabilitation of the disturbed areas and the remaining stockpiles (if any) must take place immediately after construction. • Topsoil must be stockpiled separately to sub soil.	**LOW**
Loss of plant species of conservation concern.	**Localised**	**Permanent**	**Possible**	**Moderately severe**	**HIGH**	• The area must be surveyed prior to construction during spring and mid-summer in order to locate protected geophytic plant species and transplant them in the neighbouring environment. • During excavations for the	**LOW**

						foundation, a search and transplant of species of special concern found in the topsoil layer must be undertaken • In the unlikely event that a protected tree species needs to be removed, a permit to do so must be attained from DAFF.	
Issue: Disturbance to surrounding wildlife and fauna							
During construction vehicular movement, noise and habitat destruction will disturb animals in the area.	**Localised**	**Short-term**	**Probable**	**Moderately severe**	**MODERATE**	• Restrict construction activities to post-dawn and pre-dusk. • Construction must be undertaken in the shortest time practical.	**LOW**
Poaching of wild animals during construction.	**Localised**	**Short-term**	**Possible**	**Severe**	**HIGH**	• All staff employed during construction must sign a daily register. • Construction workers must be transported to and from the site daily. • No construction residence may be set up on site. • An independent Environmental Control Officer must inspect the immediate vegetation for evidence of snares.	**LOW**
Indirect impacts							
Issue: Loss of vegetation during construction							
Inadvertent or excessive damage and loss of vegetation beyond the development/construction footprint.	**Study area**	**Long-term**	**Possible**	**Severe**	**HIGH**	• Construction activities must be demarcated and vegetation clearing and top soil removal limited to these areas. • Absolutely no dense vegetation that resembles Thicket or Forest may be removed. In such cases the ECO must consulted and an assessment of the vegetation must be undertaken.	**LOW**
Issue: Disturbance to surrounding wildlife and fauna							
Potential loss of specialised faunal habitat due to clearing beyond the development footprint (forests, wetlands, dense woody vegetation and riparian zones) may reduce faunal populations.	**Localised**	**Long-term**	**Possible**	**Severe**	**HIGH**	• No construction, unless authorised by an independent ECO, may be undertaken in an area demarcated in this report as a sensitive area, or its associated buffer. • Construction activities must be limited to delineated development areas.	**LOW**
Issue: Disturbance of sensitive areas							
Erosion and degradation of water-courses and associated riparian habitats due to irresponsible	**Localised and downstream**	**Short to medium term**	**Possible**	**Severe**	**HIGH**	• Construction through water courses, only where necessary,	**MODERATE**

construction of the dam wall, reticulation pipelines and access roads .						must occur within the smallest possible construction footprint, preferably during the dry season, and must be immediately followed by erosion stabilisation and re-vegetation.	
Issue: Soil erosion and environmental degradation due to poor rehabiliation							
Clearing and excavation of soil for construction purposes will result in exposed soil. If not rehabilitated, this may result in severe topsoil erosion, bank destabilisation and downstream sedimentation.	**Localised and downstream**	**Short to medium term**	**Possible**	**Severe**	**HIGH**	• Implement rehabilitation programme • Monitor success of re-vegetation. Success is considered achieved when there is 80% or more vegetation cover.	**Moderate**

Table 9.7 Assessment and mitigation of impacts identified in the Operation Phase

OPERATION PHASE							
GENERAL AND SPECIALIST STUDY IMPACTS	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Indirect impacts							
Issue: Alien Vegetation							
Introduction of alien plant species due to disturbance.	**Study area**	**Long-Term**	**Definite**	**Severe**	**HIGH**	• Design and Implement an Alien Management and Monitoring Plan; • Eradicate alien plants as they appear; and • Monitor the study area for any new invasive plants.	**LOW**
Issue: Loss of sensitive areas, habitats and plants & animals during inundation of the Zalu Dam							
Loss of 7ha wetlands and riparian zones and 6ha forest habitats due to inundation of the propose dam. Although degraded, these habitats have intrinsic value as they provide unique niches/refugia for plant and animal species.	**Localised**	**Permanent**	**Definite**	**Moderately Severe**	**HIGH**	• The loss of habitats due to inundation cannot be mitigated.	**HIGH**
Loss of plant species of special concern	**Localised**	**Permanent**	**Definite**	**Moderate**	**HIGH**	• The loss of plant species of special concern due to inundation cannot be mitigated. • A plant search and rescue programme to relocate trees and plants will be required. This may take place during the construction and operation phases.	**MODERATE**
Loss of animals during inundation of the proposed dam.	**Localised**	**Permanent**	**Definite**	**Slight**	**MODERATE**	• A search and rescue programme for slow-moving and burrowing animals will need to be implemented.	**LOW**

10 IMPACT STATEMENT, CONCLUSION & RECOMMENDATIONS

10.1 *Conclusions*

The project Area comprises the region between Lusikisiki (up to about 15km inland) and the coast, extending from the Mzimvubu River in the south-west to the Msikaba River in the north-east, as shown in Figure 1-1. The study area includes the Zalu Dam inundation area, abstraction weir, pipeline/access routes and borrow pits for dam construction.

The proposed activity consists of the following components:

- The Zalu Dam and inundation area
- Borrow pits for dam construction
- Abstraction weir
- Reticulation of raw water to the existing treatment works
- Reticulation of treated water to various reservoirs

Associated impacts identified with the proposed development were not deemed insurmountable. All HIGH rated impacts (pre-mitigation) are easily mitigated. Ecologically sensitive areas have been mapped for the study area and recommendations in chapter 9 in this report provide mitigation measures to reduce the severity of the impacts. Overall, it was determined that the identified ecological impacts associated with the facility can be affectively mitigated.

10.2 *Current status*

The vegetation on the study site is mostly degraded and transformed as a result of previous land use such as agriculture and grazing. There was evidence of alien species within the study site which could become a problem left unchecked.

10.3 *Comparison of impacts*

The impacts associated with the development have been assessed with and without mitigation measures (Table 10-1). Since the pipelines and access roads follow existing roads through areas that are already degraded, many of the impacts will be avoided with effective management of the site as well as effective and monitored rehabilitation after construction. In the case of the pipeline route, it is essential that areas of high sensitivity (e.g. forests, water courses and wetlands) are avoided where feasible. Any disturbed land used during the construction phase of the development, which will not be used during the operation phase of the development, must be rehabilitated after construction is completed.

Impacts associated with the Operation Phase are associated with the infestation of alien plant species. Alien invasive species should be managed effectively to prevent further impacts on the study area. In addition, the operation phase will consist of the commissioning of the dam wall and actual inundation of the Zalu Dam. A search and rescue programme for slow moving and burrowing animals must be implemented during this time.

Overall, the impacts of the development will be low negative after mitigation measures and residual impacts will be mainly associated with a loss of vegetation. This loss of vegetation is also important for fauna as it constitutes habitat loss. Positive impacts include the active management of the alien vegetation on the site.

Table 10-1: Summary of impacts associated with the water supply scheme pre and post mitigation. The no-go alternative has also been included for comparative purposes.

Impact	Pre-Mitigation	Post-Mitigation
Design and Planning		
Loss of 100 Ha of degraded Ngonigoni Grassland (classified as Vulnerable) due to the inundation of the Zalu dam site and installation of pipelines and access roads.	Moderate	Low
Location of the inundated area within sensitive areas (6 ha scarp forest, riparian areas and 7ha wetlands) and their sensitivity buffers.	High	Low
Inappropriate routing and design of pipelines and access roads through sensitive areas (Dense vegetation, riparian areas and wetlands) and their sensitivity buffers.	High	Low
Construction		
Loss of natural vegetation due to vegetation clearing during construction of the pipeline, access roads and the development of borrow pits and quarries.	Moderate	Low
Loss of plant species of conservation concern.	High	Low
During construction vehicular movement, noise and habitat destruction will disturb animals in the area.	Moderate	Low
Poaching of wild animals during construction.	High	Low
Inadvertent or excessive damage and loss of vegetation beyond the development footprint.	High	Low
Potential loss of specialised faunal habitat due to clearing beyond the development footprint (wetlands, dense woody vegetation and riparian zones) may reduce faunal populations.	High	Low
Erosion and degradation of water-courses and associated riparian habitats due to irresponsible construction of the dam wall, reticulation pipelines and access roads.	High	Moderate
Clearing and excavation of soil for construction purposes will result in exposed soil. If not rehabilitated, this may result in severe topsoil erosion, bank destabilisation and downstream sedimentation.	High	Moderate
Operation		
Introduction of alien plant species due to disturbance.	High	Low
Loss of 7ha wetlands and riparian zones and 6ha forest habitats due to inundation of the propose dam. Although degraded, these habitats have intrinsic value as they provide unique niches/refugia for plant and animal species.	High	High
Loss of plant species of special concern.	High	Moderate
Loss of animals during inundation of the proposed dam.	Moderate	Low

10.4 *Plant removal\rehabilitation*

A detail Plant removal and Rehabilitation Plan must be developed as a condition of authorisation. The plan must be incorporated into the final Environmental Management Programme (EMPr) and must consist of the location of protected plant species that may be affected, removal, relocation and storage methods, rehabilitation species, re-vegetation methodology and rev-vegetation monitoring (in terms of frequency and success).

Prior to construction and dam inundation it is recommended that a botanist/ecologist ground-truths the final pipeline route plans and inundation area to determine the presence of any of the species of special concern or protected species . Before the clearing of the site is authorised, the appropriate permit must be obtained from the relevant department should any protected species need to be removed or replanted. These permits may be subject to certain conditions, for example allowing various nurseries to collect plants before vegetation clearance commences.

The plants can also be removed and placed in a nursery for use for rehabilitation purposes. If a species is identified for relocation, individuals of the species will need to be located within the proposed site, before vegetation clearing commences, and carefully uprooted and removed by a skilled horticulturist. Prior to removal, however, suitable relocation areas need to be identified, either within the site or in other disturbed areas on the property. Individual plants that cannot be relocated at the time of removal should be moved to the nursery.

It should be noted that many critical SCC are plants that will not be able to be successfully uprooted and replanted at all (Phillipson, 2002), or at best may have a low survival rate. In all cases the species will require very careful treatment to give them the best chances of survival, and specialist horticultural knowledge will be needed.

10.5 *Invasion of alien species*

Any form of disturbance to the natural vegetation provides a gateway for alien species to invade the site of disturbance. An Alien Invasive Plant Species Eradication Plan must be developed as a condition of authorisation and incorporated into the Final EMPr. The plan must identify alien plant species, assess their invasive potential (and therefore its eradiation priority), outline standard best practice removal techniques, develop a post-construction and operation monitoring programme. The plan should also provide the dam operator with a visual manual describing these species in detail.

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APPENDIX 1: SPECIES LIST

Table A1: Full list of species recorded within the study area

Family	Species	IUCN	SA RED LIST	PNCO	Protected Tree list	NEMBA
FABACEAE	*Acacia cyclops**	-	Not Evaluated	-	-	-
FABACEAE	*Acacia dealbata*	-	Not Evaluated	-	-	-
FABACEAE	*Acacia longifolia*	-	Not Evaluated	-	-	-
FABACEAE	*Acacia mearnsii*	-	Not Evaluated	-	-	-
FABACEAE	*Acacia natalitia*	-	Least Concern	-	-	-
FABACEAE	*Acacia nilotica*	-	Least Concern	-	-	-
AGAVACEAE	*Agave sp.*	-	-	-	-	-
POACEAE	*Aristida diffusa*	-	Least Concern	-	-	-
POACEAE	*Aristida junciformis*	-	Least Concern	-	-	-
APOCYNACEAE	*Asclepias cf gibba*	-	Least Concern	Schedule 4	-	-
ASTERACEAE	*Bidens pilosa*	-	Not Evaluated	-	-	-
FABACEAE	*Caesalpinia decapetala*	-	Not Evaluated	-	-	-
CACTACEAE	*Cereus jamacaru*	-	-			
SINOPTERIDACEAE	*Cheilanthes sp.*	-	-	-	-	-
ASTERACEAE	*Cirsium vulgare*	-	Not Evaluated	-	-	-
COMMELINACEAE	*Commelina africana*	Least Concern	Least Concern	-	-	-
COMMELINACEAE	*Commelina sp*	-	-	-	-	-
EUPHORBIACEAE	*Croton sp.*	-	-	-	-	-
CONVOLVULACEAE	*Cuscuta campestris*	-	Not Evaluated	-	-	-
ARALIACEAE	*Cussonia spicata*	-	Least Concern	-	-	-
SOLANACEAE	*Lycium tubulosum*	-	Not Evaluated	-	-	-
POACEAE	*Cynodon dactylon*	-	Least Concern	-	-	-
CYPERACEAE	*Cyperus esculentus*		Least Concern	-	-	-
THYMELAEACEAE	*Dais cotinifolia*		Least Concern	-	-	-
IRIDACEAE	*Dietes grandiflora*	-	Least Concern	Schedule 4	-	-
EBENACEAE	*Diospyros cf lycioides*	-	Least Concern	-	-	-

MELIACEAE	*Ekebergia capensis*	-	Least Concern	-	-	-
POACEAE	*Eragrostis capensis*	-	Least Concern	-	-	-
POACEAE	*Eragrostis chloromelas*	-	Least Concern	-	-	-
POACEAE	*Eragrostis curvula*	-	Least Concern	-	-	-
POACEAE	*Eragrostis porosa*	-	Least Concern	-	-	-
FABACEAE	*Erythrina caffra*	-	Least Concern	-	-	-
EUPHORBIACEAE	*Euphorbia tetragona*	-	Least Concern	-	-	-
ASTERACEAE	*Felicia sp*	-	-	-	-	-
MORACEAE	*Ficus sp.*	-	-	-	-	-
MORACEAE	*Ficus sur*	-	Least Concern	-	-	-
HYACINTHACEAE	*Galtonia cf princeps*	-	Least Concern	-	-	-
HYACINTHACEAE	*Galtonia sp.*	-	-	-	-	-
HYACINTHACEAE	*Gamochaeta pensylvanica*	-	-	-	-	-
SCROPHULARIACEAE	*Hebenstetia sp*	-	-	-	-	-
ASTERACEAE	*Helichrysum anomalum*	-	-	-	-	-
ASTERACEAE	*Helichrysum cymosum*	-	Least Concern	-	-	-
ASTERACEAE	*Helichrysum sp.*	-	-	-	-	-
BRASSICACEAE	*Heliophila sp*	-	-	-	-	-
POACEAE	*Heteropogon contortus*	-	Least Concern	-	-	-
MALVACEAE	*Hibiscus pedunculatus*	-	Least Concern	-	-	-
POACEAE	*Hyparrhenia hirta*	-	Least Concern	-	-	-
ARECACEAE	*Hyphaene coriacea*	-	Least Concern	-	-	-
ASTERACEAE	*Hypochaeris radicata*	-	Not Evaluated	-	-	-
HYPOXIDACEAE	*Hypoxis cf argentea*	-	Least Concern	-	-	-
POACEAE	*Imperata cylindrica*	-	Least Concern	-	-	-
VERBENACEAE	*Lantana camara*	-	Not Evaluated	-	-	-
LOBELIACEAE	*Lobelia anceps*	-	Least Concern	-	-	-
LOBELIACEAE	*Lobelia sp 1*	-	-	-	-	-
LOBELIACEAE	*Lobelia sp 2*	-	-	-	-	-
LOBELIACEAE	*lobelia tomentosa*	-	Least Concern	-	-	-

FABACEAE	*Lotononis sp*	-	-	-	-	-
MAESACEAE	*Maesa alnifolia*	-	Least Concern	-	-	-
POACEAE	*Melinis repens*	-	Least Concern	-	-	-
SCROPHULARIACEAE	*Mimulus gracilis*	Least Concern	Least Concern	-	-	-
LOBELIACEAE	*Monopsis stellarioides*	-	Least Concern	-	-	-
IRIDACEAE	*Moraea huttonii*	Least Concern	Least Concern	Schedule 4	-	-
CACTACEAE	*Opuntia stricta*	Least Concern	Not Evaluated	-	-	-
OXALIDACEAE	*Oxalis corniculata*	-	Not Evaluated	-	-	-
OXALIDACEAE	*Oxalis Latifolia*	-	Not Evaluated	-	-	-
POACEAE	*Paspalum scrobiculatum*	Least Concern	Least Concern	-	-	-
GERANIACEAE	*Pelargonium alchemilloides*	-	Least Concern	-	-	-
LAMIACEAE	*Plectranthus comosus*	-	Not Evaluated	-	-	-
POLYGALACEAE	*Polygala sp*	-	-	-	-	-
MYRTACEAE	*Psidium guajava*	-	Not Evaluated	-	-	-
CELASTRACEAE	*Pterocelostrus tricuspidatus (small white flower)*	-	Least Concern	-	-	-
RANUNCULACEAE	*Ranunculus multifidus*	Least Concern	-	-	-	-
ANACARDIACEAE	*Rhus sp*	-	-	-	-	-
CYPERACEAE	*Schoenoxiphium madagascariense (sedge)*	-	Least Concern	-	-	-
ASTERACEAE	*Senecio madagascariensis*	-	Least Concern	-	-	-
ASTERACEAE	*Senecio sp*	-	-	-	-	-
FABACEAE	*Senna didymobotrya*	-	Not Evaluated	-	-	-
SOLANACEAE	*Solanum elaeagnifolium*	-	Not Evaluated	-	-	-
SOLANACEAE	*Solanum mauritianum (Bugweed?)*	-	Not Evaluated	-	-	-
SOLANACEAE	*Solanum sp (9)*	-	-	-	-	-
FABACEAE	*Spenostylis sp.*	-	-	-	-	-
POACEAE	*Sporobolus africanus*	-	Least Concern	-	-	-
POACEAE	*Sporobolus nitens*	-	Least Concern	-	-	-
LAMIACEAE	*Stachys cf aethiopica*	-	Least Concern	-	-	-

FABACEAE	*Sutherlandia cf frutescens*	-	Least Concern	-	-	-
MYRTACEAE	*Syzygium cordatum*	Least Concern	Least Concern	-	-	-
ASTERACEAE	*Taraxacum officinale*	-	Not Evaluated	-	-	-
BIGNONIACEAE	*Tecoma capensis*	-	Least Concern	-	-	-
FABACEAE	*Tephrosia sp.*	-	-	-	-	-
POACEAE	*Themeda triandra*	-	Least Concern	-	-	-
FABACEAE	*Trifolium/ indogofera*	-	-	-	-	-
POACEAE	*Urochloa sp (grass)*	-	-	-	-	-
VERBENACEAE	*Verbena aristigera*	-	Not Evaluated	-	-	-
VERBENACEAE	*Verbena bonariensis*	-	Not Evaluated	-	-	-
ARACEAE	*Zantedechia albomaculata subsp albomaculata*	-	Least Concern	-	-	-
FABACEAE	*Zornia capensis*	-	Least Concern	-	-	-

HERITAGE SURVEY OF THE LUSIKISIKI REGIONAL WATER SUPPLY SCHEME, EASTERN CAPE.

FOR EOH COASTAL & ENVIRONMENTAL SERVICES

DATE: 1 OCTOBER 2014

By Gavin Anderson

Umlando: Archaeological Surveys and Heritage Management

PO Box 102532, Meerensee, 3901

Phone: 035-7531785 Fax: 0865445631

Cell: 0836585362

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INTRODUCTION

“The Department of Water Affairs (DWA) appointed AECOM (Pty) Ltd. in 2010, to undertake a Feasibility Study for Augmentation of the Lusikisiki Regional Water Supply Scheme. This study reported that a combination of surface water (Zalu Dam) and groundwater would be the most feasible solution for the long-term water supply for the LRWSS. The Zalu Dam was found to be the most feasible surface storage option for the areas around Lusikisiki, with the south-western part of the study area requiring supplies from groundwater [Figures 1 – 3].

The DWA proposes to begin the second phase of the scheme to augment the existing water supply in the area from Lusikisiki to Port St Johns (Ingquza Hill and Port St John’s Local Municipalities). This will involve two water resources:

- The construction of the Zalu Dam on the Xura River to the west of Lusikisiki, which will also involve the upgrading of the Lusikisiki water treatment works and the expansion of the potable water reticulation in the Lusikisiki area; and
- A groundwater abstraction scheme in the south, which will augment water supplies to Port St Johns and the surrounding areas.

The study area for the EIA comprises the entire region between Lusikisiki (up to about 15 km inland) and the coast, extending from the Mzimvubu River in the south-west to the Msikaba River in the northeast. This area includes the Zalu Dam site and its catchment along the Xura River, conveyance routes between the dam and control reservoirs, as well as borehole sites that could be developed for augmentation of water supplies from groundwater and the routes of the main pipelines from the boreholes to the control reservoirs" (CES BID 2014).

LIMITATIONS IN THE STUDY

There are two limitations to the study area. They are as follows:

1. The precise location of the pipeline is to be decided and it is currently a conceptual layout. However, the pipeline might be moved closer to the existing roads, as opposed to creating new access roads.
2. There are several conceptual boreholes and extraction points. However, the locations of the pipelines from these points to the main system have not been finalised. Given the large area, these points were omitted from the study, as the pipelines has not been finalised.

The limitations can be covered by a desktop study at a later stage.

FIG. 1 GENERAL LOCATION OF THE LUSIKISIKI SSW

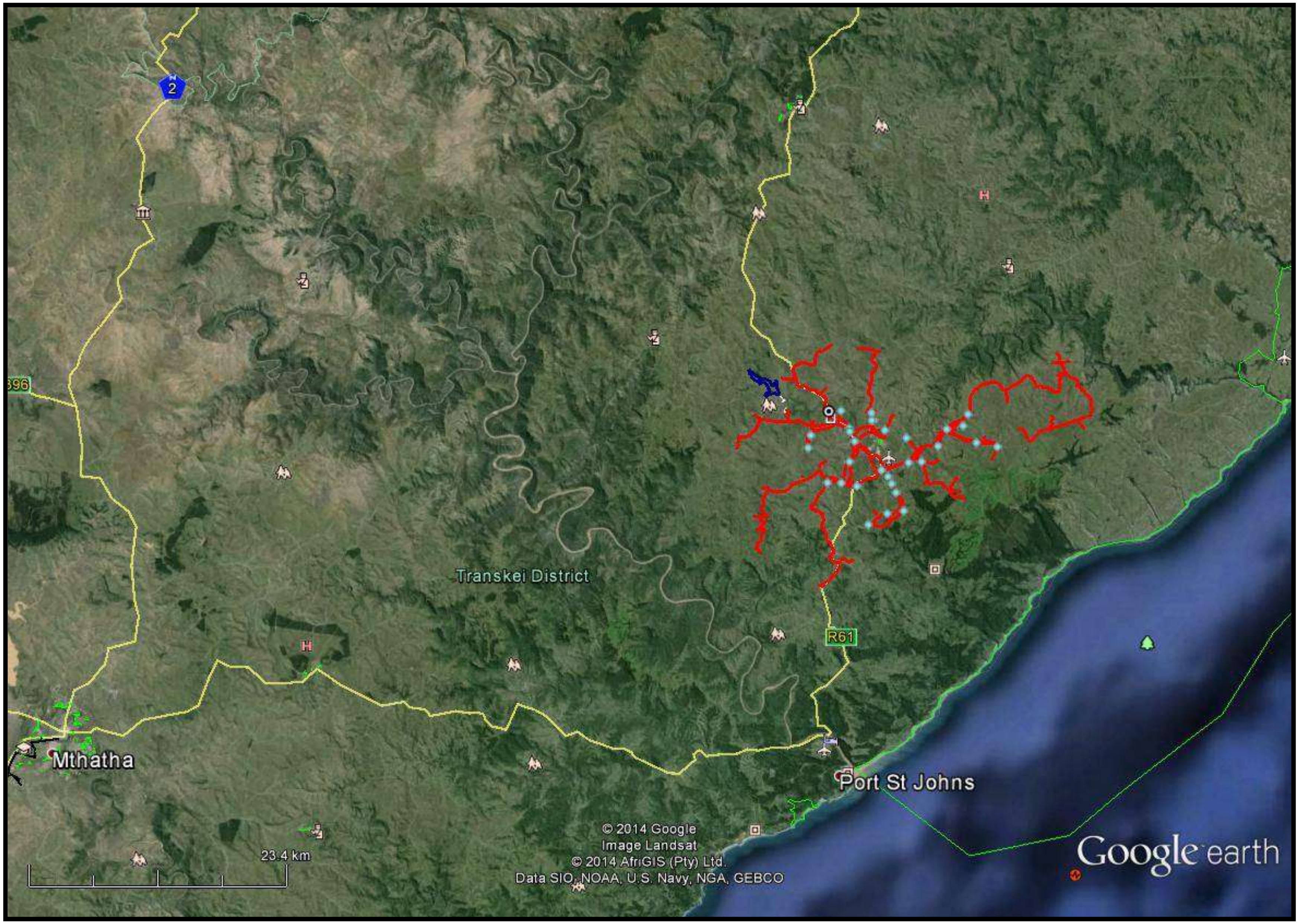


FIG. 2: AERIAL OVERVIEW OF THE LUSIKISIKI SSW

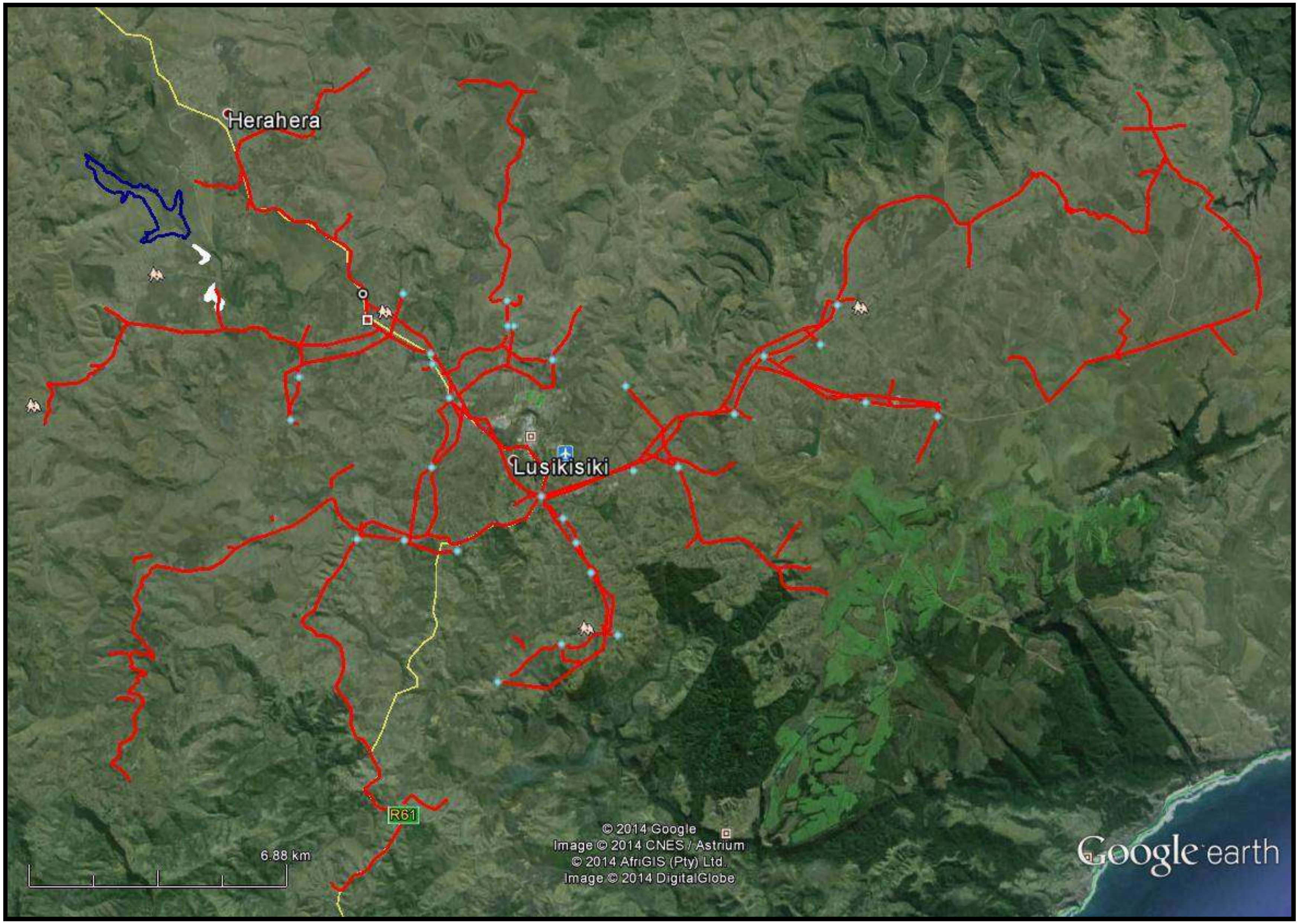


FIG. 3A: NORTHERN TOPOGRAPHICAL MAP OF THE LUSIKISIKI SSW

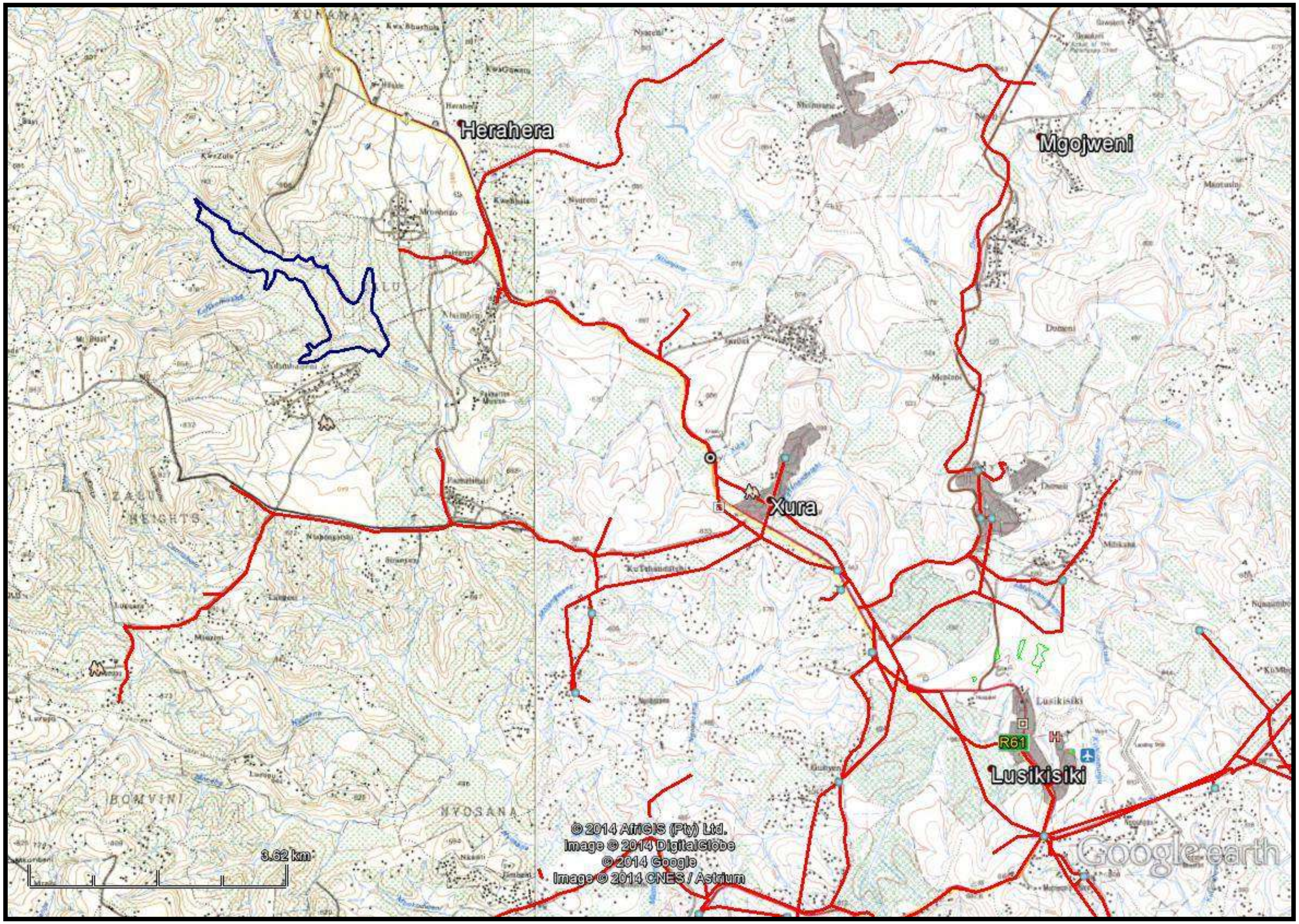


FIG. 3B: SOUTHERN TOPOGRAPHICAL MAP OF THE LUSIKISIKI SSW

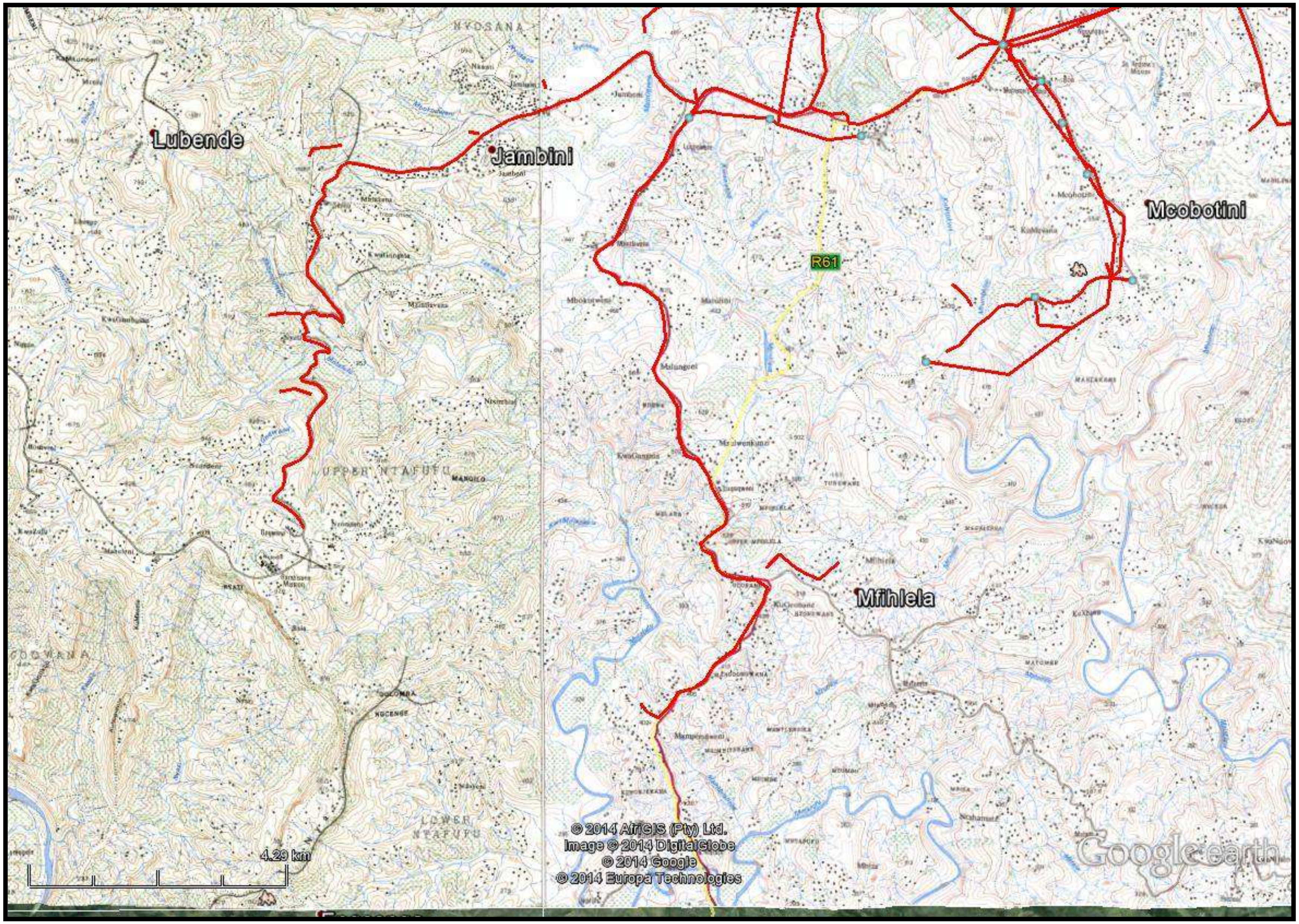
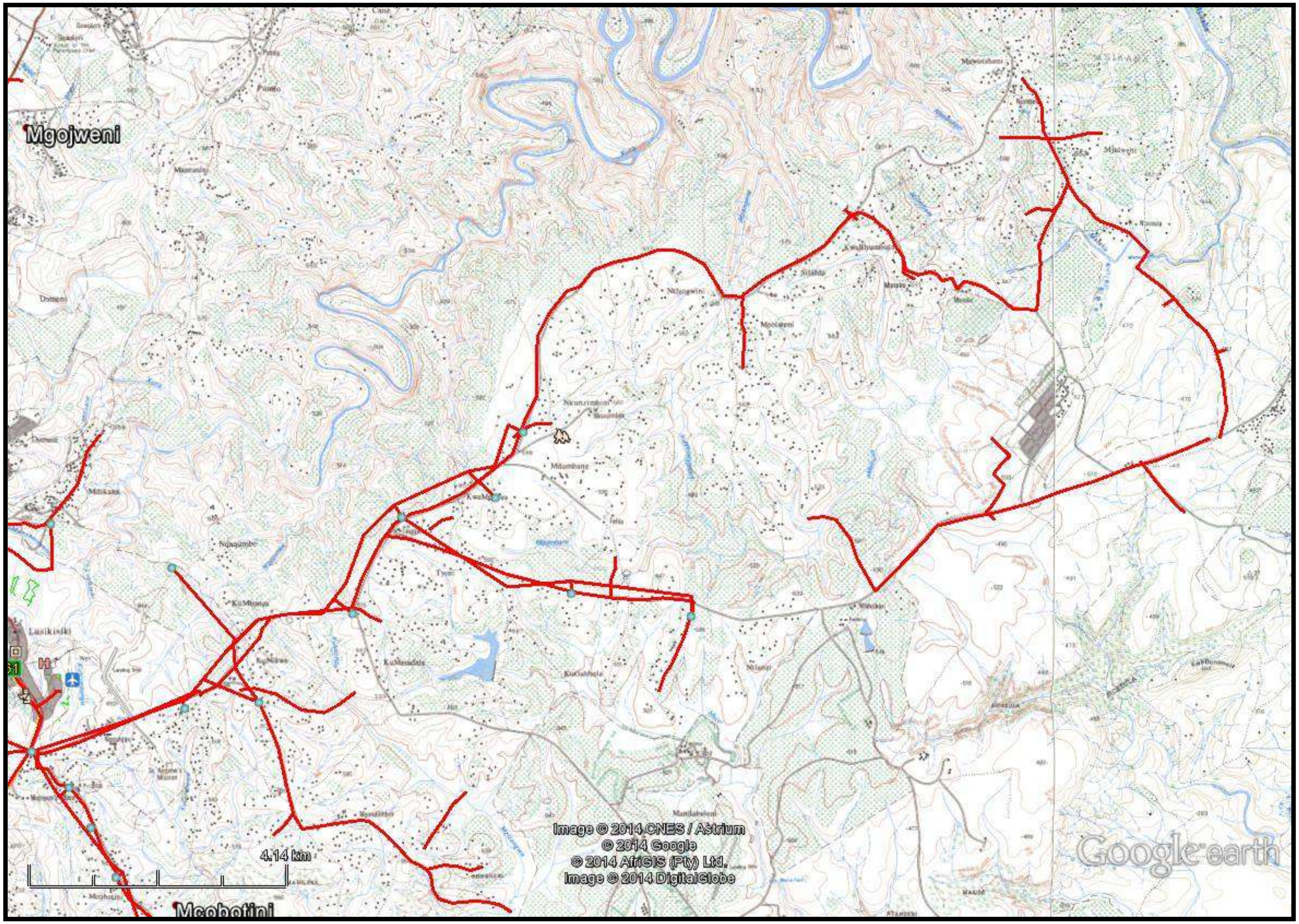


FIG. 3C: TOPOGRAPHICAL MAP OF THE LUSIKISIKI SSW



NATIONAL HERITAGE RESOURCES ACT OF 1999

The National Heritage Resources Act of 1999 (pp 12-14) protects a variety of heritage resources. This are resources are defined as follows:

1. **“**For the purposes of this Act, those heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations must be considered part of the national estate and fall within the sphere of operations of heritage resources authorities.
2. Without limiting the generality of subsection (1), the national estate may include—
   - 2.1. Places, buildings, structures and equipment of cultural significance;
   - 2.2. Places to which oral traditions are attached or which are associated with living heritage;
   - 2.3. Historical settlements and townscapes;
   - 2.4. Landscapes and natural features of cultural significance;
   - 2.5. Geological sites of scientific or cultural importance;
   - 2.6. Archaeological and palaeontological sites;
   - 2.7. Graves and burial grounds, including—
     - 2.7.1. Ancestral graves;
     - 2.7.2. Royal graves and graves of traditional leaders;
     - 2.7.3. Graves of victims of conflict;
     - 2.7.4. Graves of individuals designated by the Minister by notice in the Gazette;
     - 2.7.5. Historical graves and cemeteries; and
     - 2.7.6. Other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
3. Sites of significance relating to the history of slavery in South Africa;
   - 3.1. Movable objects, including—

4. Objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
   4.1. Objects to which oral traditions are attached or which are associated with living heritage;
   4.2. Ethnographic art and objects;
   4.3. Military objects;
   4.4. objects of decorative or fine art;
   4.5. Objects of scientific or technological interest; and
   4.6. books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).
5. Without limiting the generality of subsections (1) and (2), a place or object is to be considered part of the national estate if it has cultural significance or other special value because of—
   5.1. Its importance in the community, or pattern of South Africa's history;
   5.2. Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
   5.3. Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
   5.4. Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
   5.5. Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
   5.6. Its importance in demonstrating a high degree of creative or technical achievement at a particular period;
   5.7. Its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
   5.8. Its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and

5.9. sites of significance relating to the history of slavery in South Africa”

METHOD

The method for Heritage assessment consists of several steps.

The first step forms part of the desktop assessment. Here we would consult the database that has been collated by Umlando. This database contains archaeological site locations and basic information from several provinces (information from Umlando surveys and some colleagues), most of the national and provincial monuments and battlefields in Southern Africa (http://www.vuvuzela.com/googleearth/monuments.html) and cemeteries in southern Africa (information supplied by the Genealogical Society of Southern Africa). We use 1st and 2nd edition 1:50 000 topographical and 1937 aerial photographs where available, to assist in general location and dating of buildings and/or graves. The database is in Google Earth format and thus used as a quick reference when undertaking desktop studies. Where required we would consult with a local data recording centre, however these tend to be fragmented between different institutions and areas and thus difficult to access at times. We also consult with an historical architect, palaeontologist, and an historian where necessary.

The survey results will define the significance of each recorded site, as well as a management plan.

All sites are grouped according to low, medium, and high significance for the purpose of this report. Sites of low significance have no diagnostic artefacts or features. Sites of medium significance have diagnostic artefacts or features and these sites tend to be sampled. Sampling includes the collection of artefacts for future analysis. All diagnostic pottery, such as rims, lips, and decorated sherds are sampled, while bone, stone, and shell are mostly noted. Sampling usually occurs on most sites. Sites of high significance are excavated and/or extensively sampled. Those sites that are extensively sampled have high research potential, yet poor preservation of features.

Defining significance

Heritage sites vary according to significance and several different criteria relate to each type of site. However, there are several criteria that allow for a general significance rating of archaeological sites.

These criteria are:

1. State of preservation of:

1.1. Organic remains:

1.1.1. Faunal

1.1.2. Botanical

1.2. Rock art

1.3. Walling

1.4. Presence of a cultural deposit

1.5. Features:

1.5.1. Ash Features

1.5.2. Graves

1.5.3. Middens

1.5.4. Cattle byres

1.5.5. Bedding and ash complexes

2. Spatial arrangements:

2.1. Internal housing arrangements

2.2. Intra-site settlement patterns

2.3. Inter-site settlement patterns

3. Features of the site:

3.1. Are there any unusual, unique or rare artefacts or images at the site?

3.2. Is it a type site?

3.3. Does the site have a very good example of a specific time period, feature, or artefact?

4. Research:

4.1. Providing information on current research projects

4.2. Salvaging information for potential future research projects

5. Inter- and intra-site variability

5.1. Can this particular site yield information regarding intra-site variability, i.e. spatial relationships between various features and artefacts?

5.2. Can this particular site yield information about a community's social relationships within itself, or between other communities?

6. Archaeological Experience:

6.1. The personal experience and expertise of the CRM practitioner should not be ignored. Experience can indicate sites that have potentially significant aspects, but need to be tested prior to any conclusions.

7. Educational:

7.1. Does the site have the potential to be used as an educational instrument?

7.2. Does the site have the potential to become a tourist attraction?

7.3. The educational value of a site can only be fully determined after initial test-pit excavations and/or full excavations.

8. Other Heritage Significance:

8.1. Palaeontological sites

8.2. Historical buildings

8.3. Battlefields and general Anglo-Zulu and Anglo-Boer sites

8.4. Graves and/or community cemeteries

8.5. Living Heritage Sites

8.6. Cultural Landscapes, that includes old trees, hills, mountains, rivers, etc related to cultural or historical experiences.

The more a site can fulfill the above criteria, the more significant it becomes. Test-pit excavations are used to test the full potential of an archaeological deposit. This occurs in Phase 2. These test-pit excavations may require further excavations if the site is of significance (Phase 3). Sites may also be mapped and/or have artefacts sampled as a form of mitigation. Sampling normally occurs when the artefacts may be good examples of their type, but are not in a primary archaeological context. Mapping records the spatial relationship between features and artefacts.

TABLE 1: SAHRA GRADINGS FOR HERITAGE SITES

SITE SIGNIFICANCE	FIELD RATING	GRADE	RECOMMENDED MITIGATION
High Significance	National Significance	Grade 1	Site conservation / Site development
High Significance	Provincial Significance	Grade 2	Site conservation / Site development
High Significance	Local Significance	Grade 3A / 3B	
High / Medium Significance	Generally Protected A		Site conservation or mitigation prior to development / destruction
Medium Significance	Generally Protected B		Site conservation or mitigation / test excavation / systematic sampling / monitoring prior to or during development / destruction
Low Significance	Generally Protected C		On-site sampling monitoring or no archaeological mitigation required prior to or during development / destruction

FIG. 4: KNOWN HERITAGE SITES IN THE GENERAL AREA

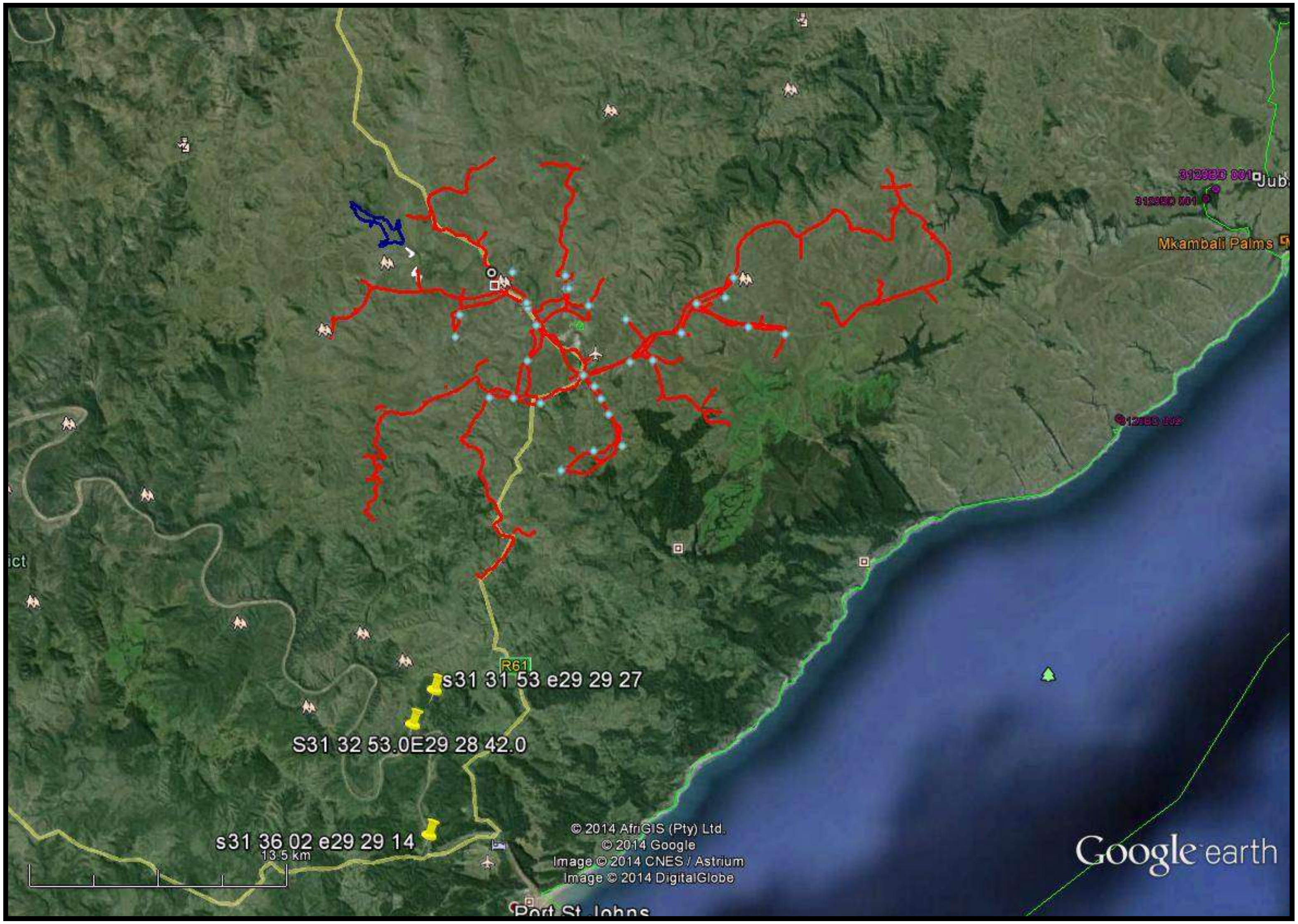


FIG. 5: SETTLEMENT LOCATIONS IN THE STUDY AREA IN 1954

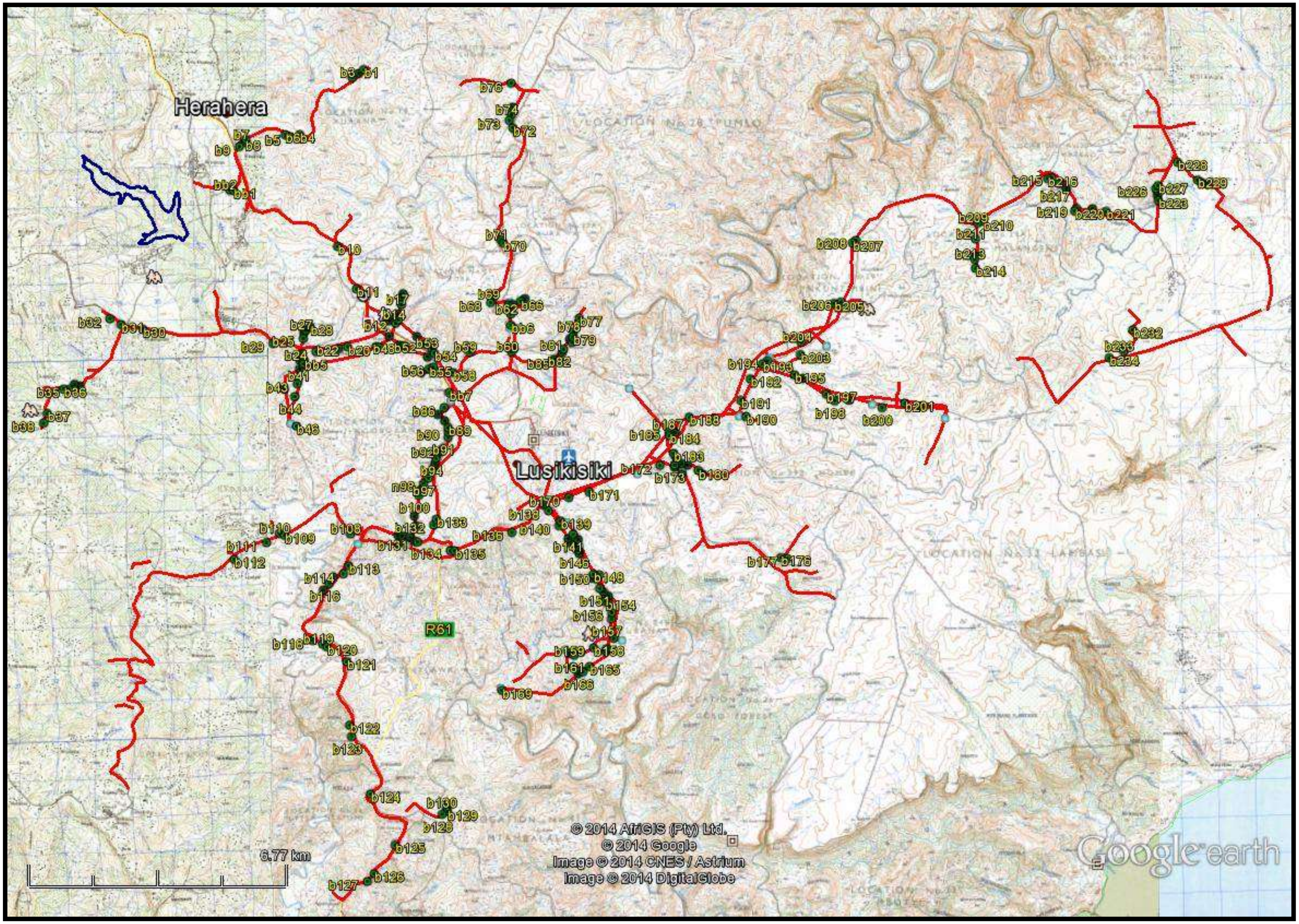


TABLE 2: LOCATION OF SETTLEMENTS IN 1954

Name	Latitude	Longitude
b1	31.274723501	29.526968686
b2	31.275599705	29.525546673
b3	31.276541457	29.523723861
b4	31.290240954	29.509361304
b5	31.290662992	29.506567494
b6	31.290236177	29.505384387
b7	31.291456572	29.494572245
b8	31.292072792	29.494346379
b9	31.293074727	29.492757496
bb1	31.303355841	29.491005943
bb2	31.303231472	29.489956793
b10	31.316537611	29.519466704
b11	31.326560220	29.524599644
b12	31.334745116	29.535558998
b13	31.334232427	29.533582427
b14	31.333962458	29.536336411
b15	31.333751474	29.535136947
b16	31.332638894	29.536161230
b17	31.330368434	29.537185898
b18	31.328636085	29.537363234
b19	31.327801511	29.537609230
bb3	31.337896214	29.533781041
b20	31.340465294	29.531093711
b21	31.340344901	29.530148963
b22	31.340353657	29.522305853
b23	31.340774919	29.519880900
b24	31.341466876	29.513555286
b25	31.338359268	29.510081167
b26	31.337025010	29.510214819
b27	31.336399274	29.510764727
b28	31.335711484	29.511974073
b29	31.339472629	29.501590645
b30	31.336047398	29.465618449
b31	31.334937378	29.459703442
b32	31.333553732	29.456757283
bb4	31.348975627	29.446601583
b33	31.349390510	29.448153618
b34	31.349683676	29.447567595
b35	31.350209182	29.445042863
b36	31.350148022	29.443661939
b37	31.355870120	29.439113423
b38	31.358118344	29.438143733
b39	31.341958057	29.509735344
b40	31.343457717	29.509025400
b41	31.344265415	29.509998418
bb5	31.343579799	29.510221265
b42	31.345525466	29.508895587
b43	31.349041360	29.508201980
b44	31.352050043	29.507450003
b45	31.350306138	29.504608474
b46	31.359059755	29.507802223
b47	31.340066777	29.536631610
b48	31.340146002	29.538013412
b49	31.342838551	29.544411532
b50	31.337968874	29.541444580
b52	31.339786046	29.543812543
b53	31.340790093	29.545569694
b54	31.341930373	29.546293419
b55	31.345634110	29.544834053
b56	31.345295249	29.546002010
b57	31.346521335	29.542657430
b58	31.346540763	29.551491721
b59	31.341750283	29.556123332
b60	31.341667589	29.567700155
b61	31.340850215	29.568420464
bb6	31.335340723	29.567561773
b62	31.332719104	29.567516743
b63	31.331658506	29.566677557
b64	31.330435295	29.566725444
b65	31.330401621	29.568110681
b66	31.329599582	29.570234666
b67	31.329042746	29.571450485
b68	31.329901362	29.561856984
b69	31.329089035	29.562515335
b70	31.315670917	29.565379531
b71	31.314949059	29.564777055
b72	31.288683942	29.568289964
b73	31.286914596	29.567297750
b74	31.285578320	29.567901972
b75	31.283784671	29.568303821
b76	31.278171979	29.567886553
b77	31.333666109	29.586449453
b78	31.336882468	29.584889657
b79	31.338153378	29.584706524
b80	31.338619619	29.583796711
b81	31.339396786	29.584432696
b82	31.341022413	29.582102527
b83	31.341872566	29.581680688
b84	31.343385870	29.579543347
b85	31.343825423	29.580749159
bb7	31.351271016	29.550377376
b86	31.354822451	29.548972693
b87	31.356441239	29.547198887
b88	31.357952313	29.549095246
b89	31.359578303	29.550056456
b90	31.360553808	29.550113466
b91	31.361829103	29.550067787

Name	Latitude	Longitude
b92	31.364541345	29.548596421
b93	31.365268945	29.548034515
b94	31.366795911	29.546696479
b95	31.367980061	29.546404423
b96	31.369253491	29.545764607
b97	31.371541192	29.544548529
n98	31.372718876	29.543183851
b99	31.374233501	29.542409182
b100	31.375538710	29.541846716
b102	31.380486864	29.540528906
b103	31.382798129	29.540919878
b104	31.385486299	29.539367804
b105	31.385188103	29.537081163
b106	31.385003468	29.535913996
b107	31.386970672	29.535926683
b108	31.384677862	29.522649515
b109	31.384977856	29.504245351
b110	31.384542258	29.502779836
b111	31.386680758	29.499196508
b112	31.390639864	29.490191343
b113	31.392258647	29.522140035
b114	31.394154227	29.520649083
b115	31.394876106	29.517821650
b116	31.396481154	29.516581256
b117	31.398054439	29.514928320
b118	31.410038909	29.511711326
b119	31.410906882	29.514605418
b120	31.411601392	29.515790105
b121	31.415098551	29.521331627
b122	31.430218836	29.522085198
b123	31.432928051	29.522610713
b124	31.446645873	29.527822691
b125	31.458992039	29.534489128
b126	31.466012443	29.528444644
b127	31.467901236	29.526491332
b128	31.451738904	29.547613926
b129	31.451027663	29.549090239
b130	31.450224435	29.548799064
b130	31.386449937	29.540590117
b131	31.386634229	29.541410482
b132	31.382623300	29.545932155
b133	31.381234259	29.546745309
b134	31.388693285	29.550586748
b135	31.388728138	29.551769739
b136	31.384382157	29.567740715
b137	31.377910285	29.576425191
b138	31.379307565	29.577858999
b139	31.381738663	29.581133315
b140	31.382846916	29.580772952
b141	31.384900865	29.584629810
b142	31.386159934	29.586040216

Name	Latitude	Longitude
b143	31.385947249	29.583275757
b144	31.387261251	29.584330088
b145	31.387902330	29.585309722
b146	31.388713205	29.586174124
b147	31.389480070	29.586340220
b148	31.394445934	29.590251157
b149	31.395328217	29.590081659
b150	31.394542227	29.591842229
b151	31.397736201	29.591952043
b152	31.398556532	29.593010816
b153	31.399576883	29.594382645
b154	31.400766249	29.593529862
b155	31.401243101	29.594462408
b156	31.403508878	29.595294986
b157	31.404972354	29.595183790
b158	31.409648051	29.595776167
b159	31.411942145	29.590208381
b160	31.412968401	29.586638075
b161	31.413687263	29.584775380
b162	31.413249738	29.583387125
b163	31.412065035	29.593917366
b164	31.412781346	29.593565007
b165	31.416365493	29.589067289
b166	31.417648943	29.587204897
b167	31.418150889	29.585817534
b168	31.416473402	29.584423629
b169	31.422150339	29.564556888
b170	31.376208090	29.583488507
b171	31.374866245	29.589135287
b172	31.368638513	29.608801465
b173	31.368587071	29.612861379
b174	31.369159124	29.612895113
b175	31.370704755	29.614904178
b176	31.390635205	29.642305907
b177	31.390842017	29.644092565
b178	31.368250051	29.614772980
b179	31.368629990	29.616452979
b180	31.369853196	29.619411769
b181	31.370753379	29.620637384
b182	31.366832652	29.613324619
b183	31.365823045	29.612555644
b184	31.361604110	29.611401205
b185	31.360763403	29.611365330
b186	31.360815464	29.613021893
b187	31.360234823	29.612240052
b188	31.357224837	29.616946758
b189	31.357530661	29.623911334
b190	31.357127722	29.632746004
b191	31.353299034	29.631269448
b192	31.348165050	29.633955584
b193	31.344611957	29.637369279

Name	Latitude	Longitude
b194	31.343916279	29.638731509
b195	31.347304254	29.646225848
b196	31.348077197	29.648518101
b197	31.351882096	29.655013875
b198	31.353452787	29.657294741
b199	31.353312555	29.661237231
b200	31.355077831	29.670532388
b201	31.354044105	29.676864464
b202	31.354684126	29.681776114
b203	31.342519045	29.647850051
b204	31.339542388	29.648078116
b205	31.330373764	29.657203275
b206	31.330056628	29.659081583
b207	31.316028032	29.662399970
b208	31.315444007	29.663281487
b209	31.311340131	29.697253302
b210	31.310865380	29.698699719
b211	31.315068791	29.696687405
b212	31.319080194	29.696586670
b213	31.319869507	29.696461295
b214	31.322000696	29.696691791
b215	31.300583746	29.717708050
b216	31.300816017	29.716633076
b217	31.302016064	29.719920138
b218	31.303130864	29.721857016
b219	31.307855680	29.724673480
b220	31.308491354	29.724204911
b222	31.307951204	29.729186678
b221	31.308573647	29.733008237
b223	31.305853131	29.747842439
b224	31.304698014	29.747615727
b225	31.303771168	29.747705621
b226	31.303057003	29.747130755
b227	31.302315035	29.747791574
b228	31.296847944	29.753059132
b229	31.300959650	29.758871105
b230	31.301493410	29.759887793
b231	31.301906770	29.761576859
b232	31.336653722	29.740490319
b233	31.341753587	29.737984389
b234	31.343297114	29.733983861

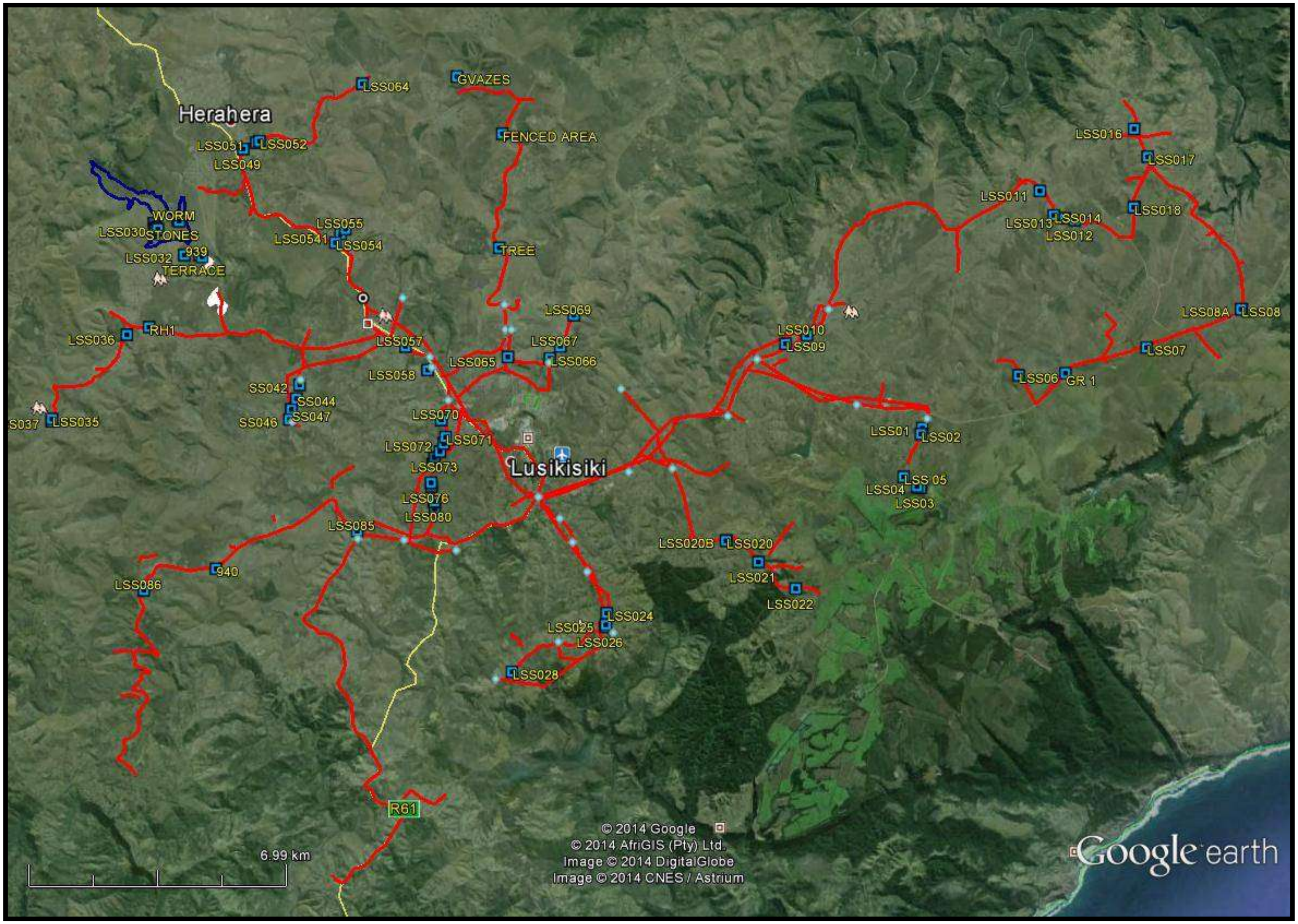
FIELD SURVEY

Eighty-seven heritage sites were noted during the survey. Their locations are shown in Figure 6 and Table 3. Most of the sites consist of human graves in a fenced of and/or demarcated area. However, these tend to be close to the road and/or pipeline. Only those graves within 50m of the new pipelines were recorded. Full mitigation for graves is explained in ‘Management Plan’.

TABLE 3: LOCATION OF RECORDED HERITAGE SITES

Name	Latitude	Longitude	Description
LSS 005	-31.371822964	29.681340031	
LSS001	-31.359942975	29.686807981	
LSS002	-31.361459568	29.686532674	
LSS003	-31.374574006	29.686366003	
LSS004	-31.374267982	29.685335029	
LSS006	-31.346953036	29.714606982	
LSS007	-31.339033626	29.750965885	
LSS008	-31.330701029	29.778458979	
LSS008A	-31.330715027	29.778637011	
LSS009	-31.339401025	29.647517977	
LSS010	-31.337295994	29.653602988	
LSS011	-31.302133240	29.720237342	
LSS012	-31.308725388	29.730775314	
LSS013	-31.308385003	29.727541964	
LSS014	-31.307990398	29.724135878	
LSS015	-31.305782812	29.724294873	
LSS016	-31.286696742	29.747681277	
LSS017	-31.293461274	29.751366012	
LSS018	-31.305726981	29.747654982	
LSS018A	-31.305764029	29.747912977	GR
LSS019	-31.302130960	29.761767006	
LSS020	-31.387511976	29.630495002	
LSS020B	-31.387420027	29.630531967	
LSS021	-31.392676081	29.639870389	
LSS022	-31.399118025	29.650515690	
LSS023	-31.387268826	29.586185269	
LSS024	-31.405188745	29.596255394	
LSS025	-31.408055793	29.595632865	
LSS026	-31.408452023	29.595541597	
LSS027	-31.413271404	29.584402146	
LSS028	-31.419517553	29.568873468	
LSS029	-31.309983982	29.467077982	
LSS030	-31.311446037	29.468199983	
LSS030B	-31.311303042	29.467769992	
LSS030C	-31.311248979	29.467600007	
LSS031	-31.311720042	29.467530018	
LSS032	-31.317775967	29.475692986	
LSS033	-31.326851194	29.484090309	
LSS034	-31.330071115	29.487021106	
LSS035	-31.337174959	29.459262025	
LSS036	-31.357692648	29.437919367	
LSS037	-31.358263231	29.437816085	
LSS038	-31.359614416	29.437434846	
LSS039	-31.341579552	29.457135493	
LSS040	-31.336304869	29.464402199	
LSS042	-31.349443680	29.508278854	
LSS044	-31.352760019	29.507515971	
LSS046	-31.357864011	29.505430972	
LSS047	-31.355356984	29.506004965	
LSS049	-31.292088032	29.492800031	
LSS051	-31.290573576	29.496522841	
LSS052	-31.290269983	29.497422238	
LSS053	-31.314650544	29.518614303	
LSS054	-31.312448550	29.520172739	
LSS055	-31.311341390	29.521507022	
LSS056	-31.310296477	29.523266204	
LSS057	-31.340693985	29.540962543	
LSS058	-31.345844995	29.545203072	
LSS059	-31.341634253	29.557918004	
LSS060	-31.341838816	29.561769751	
LSS061a	-31.317742020	29.479968008	
LSS061b	-31.318177041	29.480776023	
LSS062	-31.284863733	29.568231594	
LSS063	-31.287694444	29.566388889	
LSS064	-31.275951881	29.526530099	
LSS065	-31.342532163	29.568110176	
LSS066	-31.342972078	29.580105357	
LSS067	-31.339903854	29.582838959	
LSS068	-31.336535383	29.567863494	
LSS069	-31.332465187	29.587072860	
LSS070	-31.358128369	29.548908612	
LSS071	-31.362130489	29.550090836	
LSS072	-31.363831424	29.549838908	
LSS073	-31.365872424	29.548683650	
LSS074	-31.367165013	29.546919152	
LSS075	-31.368798958	29.546603970	
LSS076	-31.373313238	29.546355269	
LSS077	-31.374349450	29.546060745	
LSS078	-31.374756406	29.546252596	
LSS079	-31.376637823	29.546525019	
LSS080	-31.377927490	29.546883804	
LSS081	-31.379683797	29.547413993	
LSS082	-31.379676091	29.547063669	
LSS084	-31.384499540	29.545379725	
LSS085	-31.385136964	29.524794007	
LSS086	-31.399990547	29.463600177	
LSS087	-31.304295364	29.746854430	

FIG. 6: LOCATIONS OF RECORDED SITES



LSS01

The site consists of a recent cemetery in the fenced yard of a house (fig. 7). The cemetery is 21m from the pipeline and 60m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The graves occur 10m from the pipe centre point and require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 7: CEMETERY AT LSS01

LSS02

The site consists of a recent grave in the fenced yard of a house (fig. 8). The grave is 11m from the pipeline centre. The pipeline footprint will affect the graves.

Significance: The site is of high significance

Mitigation: The graves occur 10m from the pipe centre point and require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 8: GRAVE AT LSS02

LSS03

The site consists of a recent cemetery in an open space (fig. 9). The cemetery is near a proposed extraction point and/or bore hole. The pipeline footprint may affect the graves.

Significance: The site is of high significance

Mitigation: The location of the pipeline for the boreholes still needs to be determined. General mitigation applies to the site.

SAHRA Rating: 3A

FIG. 9: CEMETERY AT LSS03

LSS04

The site consists of a recent cemetery in an open space demarcated by large poles (fig. 10). The grave is near a proposed extraction point and/or bore hole. The pipeline footprint may affect the graves.

Significance: The site is of high significance

Mitigation: The graves occur 10m from the pipe centre point and require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 10: GRAVE AT LSS04

LSS05

The site consists of a recent cemetery of eight graves in the fenced yard of a house (fig. 11). The cemetery is near the end of the line (by 300m), but will be affected if the line is extended. The current pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The graves occur 10m from the pipe centre point and require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 11: CEMETERY AT LSS05

LSS06

The site consists of an area of religious activity, possibly linked to the ZCC that is still in use by the community. There is an outer circle of stones painted white and two central large boulders, of which one has writing on it (fig. 12). The circle is 49m from the pipeline and 12m from the road. The pipeline footprint will not affect the site.

Significance: The site is of high significance

Mitigation: The site occurs 10m from the access road and requires mitigation in the form of demarcation and moving the line further away from the area.

SAHRA Rating: 3A

FIG. 12: RELIGIOUS AREA AT LSS06

LSS07

The site consists of a cemetery with a demarcated boundary (fig. 13). The cemetery is 50m from the road, and the pipeline occurs between the two. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline should be moved closer to the road.

SAHRA Rating: 3A

FIG. 13: CEMETERY AT LSS07

LSS08

The site consists of a cemetery on the outskirts of a village (fig. 14). The pipeline currently occurs 5m to the east of the main cemetery and 5m west of an isolated grave. This suggests that more graves could occur in the pipeline footprint. The current pipeline footprint will affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline will need to be moved further north. There is an access road ~280m north that can be used.

SAHRA Rating: 3A

FIG. 14: CEMETERY AT LSS08

LSS09 (a.k.a. LUS01)

The site consists of a single grave that was recorded by Umlando (2011). The report states" *"LUS01 is located ~370m northeast of the proposed substation on the top of a hill (Fig. 8). The site is probably the same as H44, however since the area has been systematically ploughed, there are no foundations. The only feature is a grave with a headstone. The grave appears to have been made from mud, and then painted white. There is no date or name on the grave.*

The line will not go over the grave; however, the substation may occur within 50m of the grave.

Significance: The grave is of high significance.

Mitigation: the grave should be fenced off if the substation is built nearby. The norm is that any grave within 20m requires to be fenced off; however, since this is a construction area, I would suggest the grave is fenced of regardless of distance."

SAHRA Rating: 3A

Fig. 15 shows the grave without demarcation or fencing during the above construction phase. The pipeline will not affect the grave.

FIG. 15: GRAVE AT LSS09

LSS010

The site consists of the foundations of a settlement. Only one house floor is currently visible (fig. 16). More foundations should occur in the general area, and thus so should human remains. The current pipeline occurs 11m from the one foundation.

Significance: The site is of currently of low significance, unless human remains occur, then it will be of high significance.

Mitigation: The pipeline should be moved towards the road in case human remains are uncovered.

SAHRA Rating: 3C, if no graves.

FIG. 16: HOUSE FOUNDATION AT LSS010

LSS011

The site consists of two modern graves ~20m from the road (fig. 17). The current pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: No mitigation is currently required.

SAHRA Rating: 3A

FIG. 17: GRAVES AT LSS011

LSS012

The site consists of a settlement with two graves below the houses (fig. 18). The graves are ~40m from the pipeline and 70m from the road. The pipeline footprint will not affect the graves. The pipeline footprint may affect the house foundations.

Significance: The graves are of high significance

Mitigation: The graves occur 40m from the pipe centre point and require mitigation in the form of demarcation and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 18: AT LSS012

LSS013

The site consists of a recently abandoned settlement that may have human graves (fig. 19). If graves do occur at the site, and are subsurface and unmarked, then the current position of the pipeline will directly affect the graves.

Significance: The site is possibly of high significance

Mitigation: The pipeline should be moved closer to the road and uphill of the settlement.

SAHRA Rating: 3C, unless graves are found.

FIG. 19: RECENTLY ABANDONED SETTLEMENT AT LSS013

LSS014

The site consists of the foundations of a settlement that is probably related to site 'b220' from the desktop study. Three – four house floors are currently visible (fig. 20). More foundations should occur in the general area, and thus so should human remains. The current pipeline goes through the site.

Significance: The site is of currently of low significance

Mitigation: The pipeline should be moved towards the road in case human remains are uncovered.

SAHRA Rating: 3C, if no graves.

FIG. 20: HOUSE FLOOR REMAINS AT LSS014

LSS015

The site consists of a two grave cemetery (fig. 21). The graves are ~30m from pipeline and 50m from the road. The 20m buffer for the graves will fall into the pipeline buffer.

Significance: The site is of high significance

Mitigation: The graves occur 30m from the pipe centre point and require mitigation in the form of demarcation and moving the line further away from the graves.

SAHRA Rating: 3A

FIG. 21: AT LSS015

LSS016

The site consists of a four graves on the top of the hill (fig. 22). The current pipeline footprint will directly affect these graves.

Significance: The site is of high significance

Mitigation: The graves occur in the footprint and require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 22: GAVES AT LSS016

LSS017

The site consists of a single grave ~7m from the road (fig. 23). The grave is in a fenced of area of a yard

Significance: The site is of high significance

Mitigation: The grave occurs within 7m of the road edge. Given the limited available space, the pipeline should not need to be rerouted provided it remains on the opposite side of the road

SAHRA Rating: 3A

FIG. 23: GRAVE AT LSS017

LSS018

The site is located at the base of a hill just above the flood plains of a river. The site consists of a ~5 house foundations and two graves (fig. 24). This site is probably related to 'b223' from the desktop study. The pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The graves occur 30m from the pipe centre point and require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 24: SETTLEMENT AND GRAVES AT LSS018

LSS019

The site consists of two recent graves ~15m to the south of the road (fig. 25). The site probably relates to ‘b231’ from the desktop study. The cemetery is 21m from the pipeline and 60m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The graves occur on the opposite side of the pipeline footprint. Provided the pipeline remains on the northern side of the road, then no mitigation will be required.

SAHRA Rating: 3A

FIG. 25: GRAVES AT LSS019

LSS020

The site consists of a cemetery ~6m – 20m from the road (fig. 26). The current pipeline is 12m from the cemetery. The pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The graves occur 10m from the pipe centre point and require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave. The pipeline should move to the opposite side of the road.

SAHRA Rating: 3A

FIG. 26: CEMETERY AT LSS020

LSS021

The site consists of a single grave demarcated with a wooden fence (fig. 27). The grave is situated next to an existing pipeline and 10m from the road. The pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The grave occurs within the current pipeline footprint. The grave requires mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 27: GRAVE AT LSS021

LSS022

The site consists of two graves, near the house and in a demarcated yard (fig. 28). The grave is situated in the pipeline footprint and will be affected by the construction activity.

Significance: The site is of high significance

Mitigation: The grave occurs within the current pipeline footprint. The grave requires mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 28: GRAVES AT LSS022

LSS023

The site consists of a single grave in the fenced yard of a house (fig. 29). The grave is ~20m from the road. The current pipeline footprint that occurs on the opposite side of the road will not affect the graves.

Significance: The site is of high significance

Mitigation: No mitigation is currently required provided the pipeline remains on the opposite side of the road.

SAHRA Rating: 3A

FIG. 29: AT LSS023

LSS024

The site consists of a three graves cemetery in the fenced yard of a house (fig. 30). The graves occur in the pipeline footprint and are 7m from the road. The current pipeline footprint will affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline will need to be moved to the opposite, or eastern, side of the road.

SAHRA Rating: 3A

FIG. 30: GRAVES AT LSS024

LSS025

The site consists of a single grave demarcated with wooden poles (fig. 31). The grave is ~30m from the road and 20m from the pipeline. The pipeline footprint might affect the grave.

Significance: The site is of high significance

Mitigation: The graves occur within the current pipeline footprint. Mitigation will be in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 31: GRAVE AT LSS025

LSS026

The site consists of a three recent graves in the fenced yard of a house (fig. 32). The cemetery is 40m from the road and falls within the pipeline footprint... The pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline should move closer to the road. The graves require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 32: GRAVES AT LSS026

LSS027

The site consists of three graves in the fenced yard of a house (fig. 33). The graves occur within the current pipeline footprint and 8m from the road. The pipeline footprint will affect the graves.

Significance: The site is of high significance

Mitigation: The graves occur 8m from the pipe centre point and require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave. The pipeline should be placed on the opposite side of the road.

SAHRA Rating: 3A

FIG. 33: GRAVES AT LSS027

LSS028

The site consists of a recently abandoned settlement (fig. 34). No graves were observed at the settlement; however, the grass was dense resulting in poor visibility. If this site follows the pattern of sites similar in age, then graves would occur in front of the tree. The tree is 20m from road, with pipeline located between the two. The pipeline footprint will affect the site.

Significance: The site is of high significance

Mitigation: The pipeline must be moved as close to the road as uphill, and thus uphill form the settlement.

SAHRA Rating: 3C, if no graves occur.

FIG. 34: SETTLEMENT AT LSS028

LSS029

The site consists of a single recent grave (fig. 35). The grave is made out of a brick wall and a headstone. The high water mark for the Zalu Dam occurs ~65m below the grave. The dam wall occurs ~1km to the southeast. The Zalu Dam will not affect the graves if the high water mark does not come closer than 25m.

Significance: The site is of high significance
Mitigation: No mitigation is required
SAHRA Rating: 3A

FIG. 35: GRAVE 2AT LSS029

LSS030

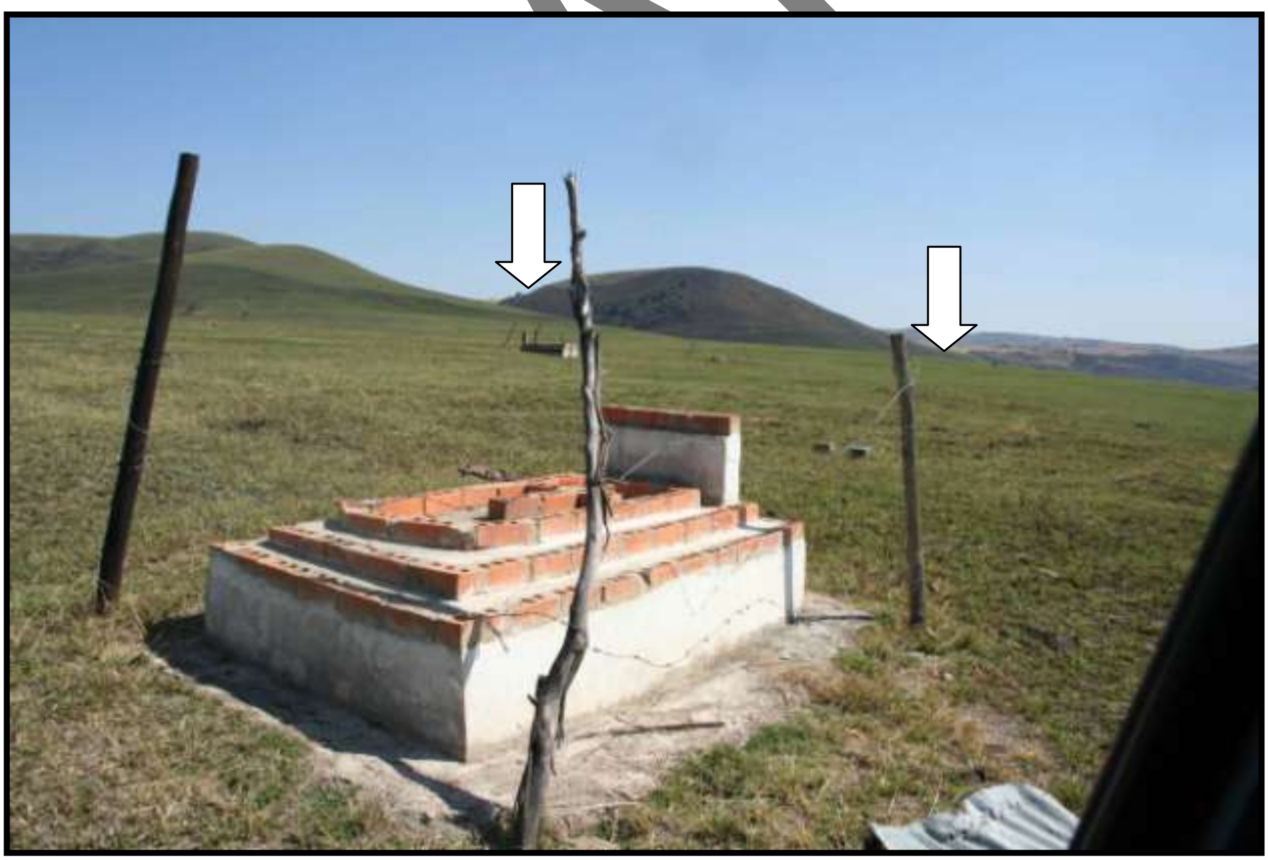
The site consists of a three recent graves each that has wooden poles around them (fig. 36). The high water mark for the Zalu Dam occurs ~35m below the grave. The dam wall occurs ~800m to the southeast. The Zalu Dam will not affect the graves if the high water mark does not come closer than 25m.

Significance: The site is of high significance

Mitigation: The graves occur 10m from the pipe centre point and require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 36: GRAVES AT LSS030

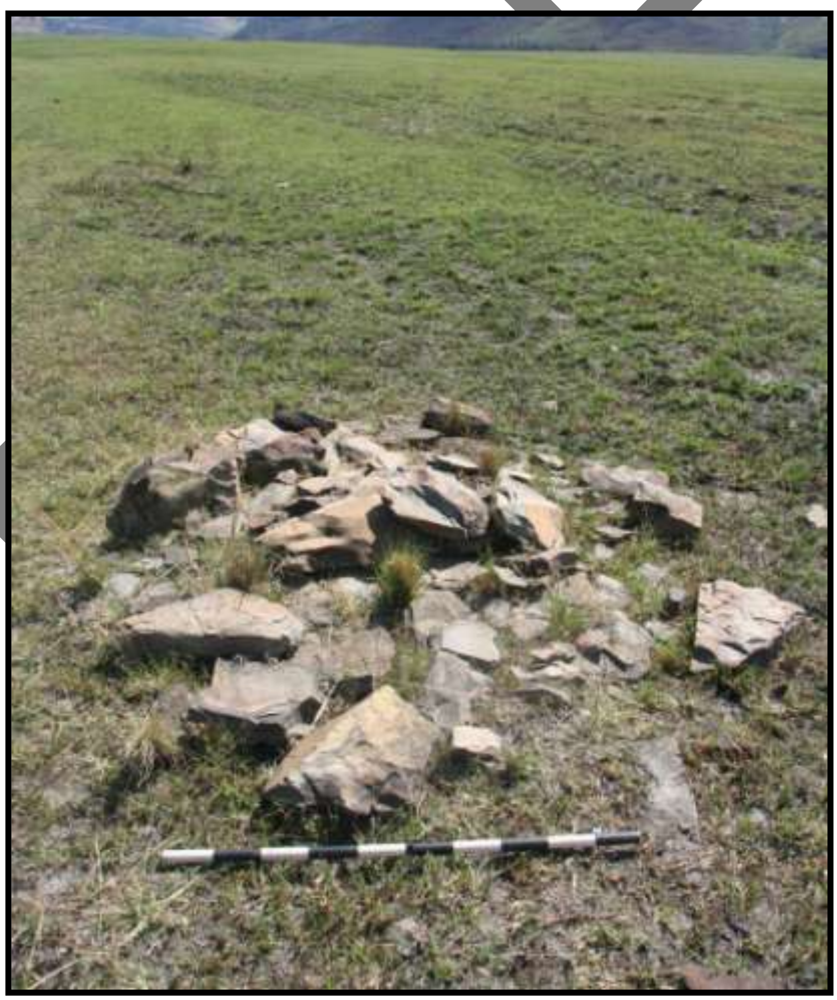


LSS031

The site consists of a sunken stone cairn that may be a grave (fig. 37). There are remnants of house foundations; however, the field has been ploughed. The cairn is 110m from the Zalu Dam high water mark. The pipeline footprint will not affect the graves.

Significance: The site is of high significance
Mitigation: No mitigation is required.
SAHRA Rating: 3A if a grave

FIG. 37: STONE CAIRN AT LSS031



LSS032

The site consists of a sunken stone cairn that may be a grave (fig. 38). There are remnants of house foundations; however, the field has been ploughed. The cairn is 110m from the Zalu Dam high water mark. The pipeline footprint will not affect the graves.

Significance: The site is of high significance
Mitigation: No mitigation is required.
SAHRA Rating: 3A if a grave

FIG. 38: POSSIBLE GRAVE AT LSS032

LSS033

The site consists of a church that post-dates 1980 (fig. 39, and see fig. 4). The church is located in the area designated for Borrow Pit 1.

Significance: The building is of low significance; however, it is attached to a place of spiritual activity and thus may be of high local significance.

Mitigation: The buildings are not directly protected by the NHRA, as they are not older than 60 years. Community consultation would be required if the building was to be damaged. I suggest that Borrow Pit 1 excludes this area.

SAHRA Rating: 3C

FIG. 39: CHURCH AT LSS039

LSS034

The site consists of a large cemetery near the church at LS033 and the village of Pamalitoli. Borrow Pit 1 has included the cemetery in the study area.

Significance: The site is of high significance

Mitigation: The borrow pit will need to move its location or pay for the exhumation of the human remains if community consent was given. I suggest the former option is more viable.

SAHRA Rating: 3A

FIG. 40: CEMETERY AT LSS034

LSS035

The site consists of four graves 2m to the east of the road (fig. 41). The pipeline and footprint occurs on the graves. The pipeline footprint will affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to be moved to the opposite side of the road. The graves need to be demarcated before construction begins.

SAHRA Rating: 3A

FIG. 41: GRAVES AT LSS035

LSS036

The site consists of two recent graves in the fenced yard of a house (fig. 42). The graves are 5m from the road in the pipeline footprint. The pipeline footprint will affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to move to the opposite side of the road.

SAHRA Rating: 3A

FIG. 42: GRAVES AT LSS036

LSS037

The site consists of two recent graves in the fenced yard of a house (fig. 43). The graves are 5m from the road in the pipeline footprint. The pipeline footprint will affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to move to the opposite side of the road.

SAHRA Rating: 3A

FIG. 43: GRAVES AT LSS037

LSS038

The site consists of a single grave in the fenced yard of a house (fig. 44). The grave is 5m from the road and in the pipeline footprint; however the pipeline is on the opposite side of the road. The pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 44: GRAVE AT LSS038

LSS039

The site consists of a single grave in the fenced yard of a house (fig. 45). The grave is 15m from the road and in the pipeline footprint. The pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 45: GRAVE AT LSS039

LSS040

The site consists of a recent cemetery on the outer fencing of a school (fig. 46). The cemetery is unfenced and ~45m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The graves should be demarcated before construction occurs.

SAHRA Rating: 3A

FIG. 46: CEMETERY AT LSS040

LSS041

The site consists of a single grave in the fenced yard of a house (fig. 47). The cemetery is 15m from the road and 10m from an existing pipeline... The pipeline footprint will not directly affect the graves. It appears as if the pipeline will extend to the west from this point.

Significance: The site is of high significance

Mitigation: The pipeline should keep the 20m buffer, however this is unlikely as it links into the existing system. The pipeline should remain in the area between the two dirt roads, and thus would not affect the grave.

SAHRA Rating: 3A

FIG. 47: GRAVE AT LSS041

LSS042

The site consists of a two graves in the fenced yard of a house (fig. 48). The graves are ~13m from the road. The graves will occur in the pipeline footprint.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 48: GRAVES AT LSS042

LSS043

The site consists of a single recent grave in the fenced yard of a house (fig. 49). The grave is ~21m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 49 GRAVE AT LSS043

LSS044

The site consists of three graves next to the road (fig. 50). The graves are not demarcated and ~1m - 5m from the road. The pipeline will not affect the graves if it remains on the opposite side of the road...

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road. The graves need to be demarcated before construction beings.

SAHRA Rating: 3A

FIG. 50: GRAVES AT LSS044

LSS045

The site consists of two recent graves in the fenced yard of a house (fig. 51). The graves are ~3m – 5m from the road. The pipeline footprint will not affect the graves as it occurs on the opposite side of the road...

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road. SAHRA Rating: 3A

FIG.51: GRAVES AT LSS045

LSS046

The site consists of four recent graves in the fenced yard of a house (fig. 52). The graves are ~20m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: No mitigation is required provided that the pipeline does not occur within the yard.

SAHRA Rating: 3A

FIG. 52: GRAVES AT LSS046

LSS047

The site consists of a single recent grave in the fenced yard of a house (fig. 53). The grave is 22m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 53: GRAVE AT LSS047

LSS048

The site consists of a single recent grave in the fenced yard of a house (fig. 54). The grave is ~10m from the road. The current pipeline footprint will not affect the graves.

Significance: The site is of high significance
Mitigation: The pipeline needs to remain on the opposite side of the road.
SAHRA Rating: 3A

FIG. 54: GRAVE AT LSS048

LSS049

The site consists of a single recent grave in the fenced yard of a house (fig. 55). The grave is ~10m from the road. The current pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 55: GRAVES AT LSS049

LSS050

The site consists of a recent grave in the fenced yard of a house (fig. 56). The grave is ~7m from the road. The current pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 56: GRAVE AT LSS050

LSS051

The site consists of two recent graves in the fenced yard of a house (fig. 57). The cemetery is 2m from the road. The pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 57: GRAVES AT LSS051

LSS052

The site consists of two recent graves in the fenced yard of a house (fig. 58). The cemetery is ~8m from the road. The pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.
SAHRA Rating: 3A

FIG. 58: GRAVES AT LSS052

LSS053

The site consists of a single recent grave in the fenced yard of a house (fig. 59). The grave is 8m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 59: GRAVE AT LSS053

LSS054

The site consists of a single recent grave in the fenced yard of a house (fig. 60). The cemetery is 9m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 60: GRAVE AT LSS054

LSS055

The site consists of a single recent grave in the fenced yard of a house (fig. 61). The cemetery is 7m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 61: GRAVE AT LSS055

LSS056

The site consists of a single grave that has been fenced off (fig. 62). The cemetery is 21m from the pipeline and 60m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: No mitigation is required

SAHRA Rating: 3A

FIG. 62: GRAVE AT LSS056

LSS057

The site consists of a recent cemetery in the fenced yard of a house (fig. 63). The cemetery is 20m from the R68. The pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The graves require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave.

SAHRA Rating: 3A

FIG. 63: CEMETERY AT LSS057

LSS058

The site consists of two recent graves in the fenced yard of a house (fig. 64). The cemetery is ~3m from the road. The pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The graves occur 10m from the pipe centre point and require mitigation in the form of demarcation, moving the line further away from the grave, and restricting the footprint width for 20m around the grave. The pipeline should move to the opposite side of the road.

SAHRA Rating: 3A

FIG. 64: GRAVES AT LSS058

LSS059

The site consists of a single recent grave in the fenced yard of a house (fig. 65). The cemetery is 21m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: No mitigation is required provided that the pipeline footprint remains 20m from the grave. The pipeline should remain on the opposite side of the road. SAHRA Rating: 3A

FIG. 65: GRAVE AT LSS059

LSS060

The site consists of two recent graves in the fenced yard of a house (fig. 66). The cemetery is 21m from the pipeline and 60m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline should be placed on the opposite side of the road.

SAHRA Rating: 3A

FIG. 66: GRAVES AT LSS060

LSS061

The site is located in the proposed Borrow Pit 2. .The site consists of an area of terracing with scattered artefacts. These artefacts include Middle Stone Age flakes, a lower grinding stone and pottery sherds (fig. 67). The artefacts are all in a secondary context. The terracing is for houses, and thus human graves may occur in the borrow pit

Significance: The site is of high significance

Mitigation: No mitigation is required but the Borrow Pit 2 should be noted as being sensitive for human remains.

SAHRA Rating: 3A

FIG. 67: ARTEFACTS AT LSS061[1]

[1] GPS is 12cm in length

LSS062

The site consists of a single recent grave in the fenced yard of a house (fig. 68). The grave is in the pipeline footprint and 130m from the road. The pipeline footprint will affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to move closer to the road.

SAHRA Rating: 3A

FIG. 68: GRAVE AT LSS062

LSS063

The site consists of three recent graves in the fenced yard of a house (fig. 69). The graves are in the pipeline footprint and 140m from the road. The pipeline footprint might affect the graves. 60m to the southeast is a fenced off area that may be older graves.

Significance: The site is of high significance

Mitigation: The pipeline needs to move closer to the road.

SAHRA Rating: 3A

FIG. 69: GRAVES AT LSS063

LSS064

The site consists of a recent cemetery on the side of the road (fig. 70). The cemetery is 6m from the road while the pipeline is ~20m from the cemetery, on the opposite side of the road. The pipeline footprint should not affect the graves.

Significance: The site is of high significance

Mitigation: The cemetery should be demarcated before construction begins and the pipeline must be placed on the opposite side of the road.

SAHRA Rating: 3A

FIG. 70: CEMETERY AT LSS064

LSS065

The site consists of several buildings and an entry wall (fig. 75). The walls for the gate are 16m from the road. The buildings occur on the 1982, but not 1954, topographical maps: they are thus not older than 60 years. The buildings are part of a general store.

Significance: The site is of low significance

Mitigation: While the buildings are not protected, the pipeline should not affect the walls.

SAHRA Rating: 3C

FIG.71: BUILDING AT LSS065

LSS066

The site consists of three recent graves in the fenced yard of a house (fig. 72). The graves are ~10m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline should remain on the opposite side of the road. SAHRA Rating: 3A

FIG. 72: GRAVES AT LSS066

LSS067

The site consists of a single recent grave in the fenced yard of a house (fig. 73). The grave is ~17m from the road. The current pipeline footprint will affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline should be moved to the opposite side of the road. SAHRA Rating: 3A

FIG. 73: AT LSS067

LSS068

The site consists of three recent graves in the fenced yard of a house (fig. 74). The graves are 10m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 74: GRAVES AT LSS068

LSS069

The site consists of a single recent grave in the fenced yard of a house (fig. 75). The grave is ~20m from the road. The pipeline footprint will not affect the grave.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 75: GRAVE AT LSS069

LSS070

The site consists of a single recent grave in the fenced yard of a house (fig. 76). The grave is ~20m from the road. The pipeline footprint will not affect the grave.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road.

SAHRA Rating: 3A

FIG. 76: GRAVE AT LSS070

LSS071

The site consists of a single recent grave in the fenced yard of a house (fig. 76). The grave is ~20m from the road. The current pipeline footprint will affect the grave.

Significance: The site is of high significance

Mitigation: The pipeline will need to be moved to the opposite side of the road.

SAHRA Rating: 3A

FIG. 77: GRAVE AT LSS071

LSS072

The site consists of two recent graves in the fenced yard of a house (fig. 78). The graves are 10m from the road. The pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 78: GRAVES AT LSS072

LSS073

The site consists of a single recent grave in the fenced yard of a house (fig. 76). The grave is ~20m from the road. The current pipeline footprint will affect the grave.

Significance: The site is of high significance

Mitigation: The pipeline will need to be moved to the opposite side of the road.

SAHRA Rating: 3A

FIG. 79: GRAVE AT LSS073

LSS074

The site consists of two recent graves in the fenced yard of a house (fig. 78). The graves are 10m from the road. The current pipeline footprint will affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 80: GRAVES AT LSS074

LSS075

The site consists of a recent grave in the fenced yard of a house (fig. 81). The graves are 10m from the road. The pipeline footprint will not affect the grave.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 81: GRAVE AT LSS075

LSS076

The site consists of a recent grave in the fenced yard of a house (fig. 82). The graves are 10m from the road. The pipeline footprint will not affect the grave.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG.82: GRAVE AT LSS076

LSS077

The site consists of two recent graves in the fenced yard of a house (fig. 83). The graves are 10m from the road. The current pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 83: GRAVES AT LSS077

LSS078

The site consists of two recent graves in the fenced yard of a house (fig. 84). The graves are ~3m from the road. The current pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 84: GRAVES AT LSS078

LSS079

The site consists of two recent graves in the fenced yard of a house (fig. 85). The graves are ~20 from the road. The current pipeline footprint will not affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 85: GRAVES AT LSS079

LSS080

The site consists of two recent graves in the fenced yard of a house (fig. 86). The graves are ~6 from the road. The current pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 86: GRAVES AT LSS080

LSS081

The site consists of a recent grave in the fenced yard of a house (fig. 87). The graves are 10m from the road. The pipeline footprint will not affect the grave.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 87: GRAVE AT LSS081

LSS082

The site consists of a recent grave in the fenced yard of a house (fig. 88). The graves are ~5m from the road. The pipeline footprint might affect the grave.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 88: GRAVE AT LSS082

LSS083

The site consists of a recent grave in the fenced yard of a house (fig. 89). The graves are ~10m from the road. The pipeline footprint might affect the grave.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 89: GRAVE AT LSS083

LSS084

The site consists of a recent grave in the fenced yard of a house (fig. 90). The graves are ~3m from the road. The pipeline footprint might affect the grave.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 90: GRAVE AT LSS084

LSS085

The site consists of two recent graves in the fenced yard of a house (fig. 91). The graves are ~5 from the road. The current pipeline footprint might affect the graves.

Significance: The site is of high significance

Mitigation: The pipeline will need to remain on the opposite side of the road, or between the existing fence and road.

SAHRA Rating: 3A

FIG. 91: GRAVES AT LSS085

LSS086

The site consists of a General Dealer building dating to 1924 (fig. 92). The pipeline footprint will not affect the building.

Significance: To be assessed if affected.

Mitigation: The pipeline should remain on the opposite side of the road to avoid potential historical middens related to the original building.

SAHRA Rating: N/A

FIG. 92: GENERAL DEALER AT LSS086

LSS087

The site consists of Early Stone Age and Historical Period artefacts (fig. 93). The artefacts were observed on the top of a hill in an agricultural field. They include a hand-axe, cleaver, general core, and a mortar.

Significance: The site is of low significance as the artefacts are in a secondary context.

Mitigation: No mitigation is required.

SAHRA Rating: 3A

FIG. 93: ARTEFACTS AT LSS087

MANAGEMENT PLAN

The normal practice for all human burials is that each cemetery, or grave, is protected if it falls within 50m – 100m of a development. All grave(s) and/or cemeteries are required to be clearly demarcated prior to the commencement of construction. There should be a 5m buffer between the edge of the grave/cemetery and the fence. The fence needs to be clearly demarcated as well. In most circumstances, a 20m buffer is required between the edge of the grave, and the edge of the footprint. However, in many instances the pipeline is restricted by space in the villages. In these instances, the pipeline can be moved to the opposite side of the road. Those graves that are already in demarcated, and fenced off, yards would not require further mitigation. In the case of human graves outside of the villages, the 20m buffer rule should apply.

The historical sites noted from the desktop study may yield human remains. The nature of the older human graves in this area is that they are subsurface, and unmarked. That is, it will not be possible to note their exact locations, and only those areas where they might occur. Each settlement noted in Table 2 should have a 50m sensitivity radius placed around it, for potential human remains.

Several steps need to be followed if graves are uncovered during the course of the project. If human graves are uncovered during the course of earthmoving activity, then both the police and ECPHRA need to be contacted immediately. All construction activity in the area needs to stop.

In terms of the National Heritage Resources Act (No. 25 of 1999), all graves not in a municipal graveyard are protected. Only a registered undertaker should handle human remains younger than 60 years or an institution declared under the Human Tissues Act. Anyone who wishes to develop an area where there are graves older than 60 years is required to follow the process described in the legislation (section 36 and associated regulations). The specialist will require a permit from the heritage resources authority:

- Determine/ confirm the presence of the graves on the property. Normally the quickest way to proceed is to obtain the service of a professional archaeologist accredited to undertake burial relocations. The archaeologist will provide an estimate of the age of the graves. There may be a need for archival research and possibly test excavations (permit required).
- The preferred decision is to move the development so that the graves may remain undisturbed. If this is done, the developer must satisfy SAHRA/KZN Heritage that adequate arrangements have been made to protect the graves on site from the impact of the development. This usually involves fencing the grave (yard) and setting up a small site management plan indicating who will be responsible for maintaining the graves and how this is legally tied into the development. It is recommended that a distance of 10-20 m is left undisturbed between the grave and the fence around the graves.
- If the developer wishes to relocate or disturb the graves:
  - A 60-day public participation (social consultation) process as required by section 36 (and regulations - see attachment), must be undertaken to identify any direct descendants of those buried on the property. This allows for a period of consultation with any family members or community to ascertain what their wishes are for the burials. It involves notices to the public on site and through representative media. The archaeologist, who can explain the process, may do this but for large or sensitive sites, a social consultant should be employed. Archaeologists often work with undertakers, who rebury the human remains.
  - If as a result of the public participation, the family (where descendants are identified) or the community agree to the relocation process then the graves may be relocated.

- The archaeologist must submit a permit application to SAHRA/KZN Heritage for the disinterment of the burials. This must include written approval of the descendants or, if there has not been success in identifying direct descendants, written documentation of the social consultation process, which must indicate to SAHRA's satisfaction, the efforts that have been made to locate them. It must also include details of the exhumation process and the place to which the burials are to be relocated. (There are regulations regarding creating new cemeteries and so this usually means that relocation must be to an established communal rural or formal municipal cemetery.)
- Permission must be obtained before exhumation takes place from the landowner where the graves are located, and from the owners/managers of the graveyard to which the remains will be relocated.
- Other relevant legislation must be complied with, including the Human Tissues Act (National Department of Health) and any ordinances of the Provincial Department of Health). The archaeologist can usually advise about this.

The archaeological artefacts affected by the development do not require permits. They are isolated instances of artefacts, and do not constitute a site *per se*.

CONCLUSION

A heritage survey was undertaken for the Lusikisiki Regional Water Supply Scheme. The LRWSS covers a large area and includes a new dam, new pipelines; two borrow pits, and possible upgrades to existing pipelines. New boreholes and extraction points may be added at a later stage.

The heritage survey recorded 87 heritage sites that may be affected by the project. Most of the sites are human graves dating to the last 50 years. Many of these graves occur within existing fenced yards and thus should not be affected by any servitudes and footprints. In most occurrences the pipeline can be moved to the opposite side of the road.

The archaeological sites that were noted are of low significance and do not require further mitigation. They tend to be scatters of artefacts, as opposed to proper sites, and thus should not require a permit.

PALAEONTOLOGICAL IMPACT ASSESSMENT REPORT

Lusikisiki Regional Water Supply Scheme, OR Thambo District Municipality, Eastern Cape Province.

FOR

Coastal and Environmental Services

by

Gideon Groenewald

04 September 2014

EXECUTIVE SUMMARY

Gideon Groenewald was appointed to undertake a Phase 1 Palaeontological Impact Assessment, assessing the potential palaeontological impact of the proposed Lusikisiki Regional Water Supply Scheme (LRWSS), located within the OR Thambo District Municipality in the Eastern Cape. The purpose of this Palaeontological Impact Assessment is to identify exposed and potential palaeontological heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated

This report forms part of the Basic Environmental Impact Assessment for the proposed project and complies with the requirements for the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Palaeontological Impact Assessment is required to assess any potential impacts to palaeontological heritage within the development footprint of the project.

A study done in 2010 reported that a combination of surface water (Zalu Dam) and groundwater would be the most feasible solution for the long-term water supply for the LRWSS. The Zalu Dam was found to be the most feasible surface storage option for the areas around Lusikisiki, with the south-western part of the study area requiring supplies from groundwater. The Department of Water Affairs (DWA) proposes to begin the second phase of the scheme to augment the existing water supply in the area from Lusikisiki to Port St Johns (Ingquza Hill and Port St John's Local Municipalities). This will involve two water resources:

- The construction of the Zalu Dam on the Xura River to the west of Lusikisiki, which will also involve the upgrading of the Lusikisiki water treatment works and the expansion of the potable water reticulation in the Lusikisiki area; and
- A groundwater abstraction scheme in the south, which will augment water supplies to Port St Johns and the surrounding areas.

The Study area is underlain from East to West by Cambrian to Ordovician aged quartzites of the Natal Group, Carboniferous to Permian aged tillite of the Dwyka Formation and Permian aged shale, sandstone and mudstone of the Ecca Group, Karoo Supergroup. Parts of the study area are underlain by Jurassic aged Dolerite that intruded into the surrounding country rock and Quaternary aged Alluvial deposits underlie the valley floors near present day rivers in the study area.

The Natal Group quartzites, Dolerite and Alluvium are not known to contain significant fossils whereas numerous fossils have been described from the Dwyka Formation and Ecca Group in South Africa. In the study area the Dwyka Formation tillites and Ecca Group shales are, however, very deeply weathered and no fossils were observed in these rocks during this investigation. A Low Palaeontological sensitivity is therefore allocated to all the routes of the pipelines, the reservoir sites and the proposed construction site of the Zalu Dam. Due to the fact that deep excavation of Ecca Group shales is expected at the construction site of the Zalu Dam wall and spillway, it is recommended that the ECO of the project be informed of the possibility that fossils (notably trace fossils) might be present in freshly exposed shales at the construction site of the Zalu Dam wall and spillway.

It is recommended that:

1. The ECO of the project be informed of the slight possibility that trace fossils might be exposed on the bedding planes of Ecca Group shales during deep excavations for the construction of the Zalu Dam wall and spillway. If fossils are recorded the palaeontologist, Eastern Cape Heritage Authority and SAHRA must be notified and the fossils recorded according to SAHRA specification.
2. No further mitigation for Palaeontological Heritage needs to be planned for this project.

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1. INTRODUCTION

Gideon Groenewald was appointed to undertake a Phase 1 Palaeontological Impact Assessment, assessing the potential palaeontological impact of the proposed Lusikisiki Regional Water Supply Scheme, located within the OR Thambo District Municipality in the Eastern Cape. The purpose of this Palaeontological Impact Assessment is to identify exposed and potential palaeontological heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

1.1. Legal Requirements

This report forms part of the Basic Environmental Impact Assessment for the proposed project and complies with the requirements for the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Palaeontological Impact Assessment is required to assess any potential impacts to palaeontological heritage within the development footprint of the project.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens; and
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

2. AIMS AND METHODOLOGY

A Phase 1 investigation is often the last opportunity to record the fossil heritage within the development footprint. These records are very important to understand the past and form an important part of South Africa's National Estate.

Following the "SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports" the aims of the palaeontological impact assessment were:

- to identifying exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assessing the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

Prior to the field investigation a preliminary assessment (desktop study) of the topography and geology of the study area was made using appropriate 1:250 000 geological maps (3128 Umtata) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) were identified within the study area and the known fossil heritage within each rock unit was inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas were identified within the development footprint to focus the field investigator's time and resources. The aim of the fieldwork was to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The likely impact of the proposed development on local fossil heritage was determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 2.1 below.

Table 2.1 Palaeontological sensitivity analysis outcome classification

Sensitivity	Description
Low Sensitivity	Areas where there is likely to be a negligible impact on the fossil heritage. This category is reserved largely for areas underlain by igneous rocks. However, development in fossil bearing strata with shallow excavations or with deep soils or weathered bedrock can also form part of this category.
Moderate Sensitivity	Areas where fossil bearing rock units are present but fossil finds are localised or within thin or scattered sub-units. Pending the nature and scale of the proposed development the chances of finding fossils are moderate. The developer should be made aware of the potential for finding fossils. If fossil material is later discovered it must be appropriately protected and the discovery reported to the appropriate Heritage Authority so that any appropriate mitigation by a palaeontological specialist can be considered and implemented, at the developer's expense.
High Sensitivity	Areas where fossil bearing rock units are present with a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in outcrops and exposed bedrock. The chances of finding fossils during excavations by a professional palaeontologist are high. Palaeontological mitigation measures need to be incorporated into the Environmental Management Plan. The mitigation should involve the comprehensive recording and collection of surface and embedded fossils along and close to the development footprint by a professional palaeontologist.

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures should be incorporated into the Environmental Management Plan.

2.1. Scope and Limitations of the Phase 1 Investigation

The scope of a phase 1 Investigation includes:

- an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units;
- a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports;
- data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and
- where feasible, location and examination of any fossil collections from the study area (e.g. museums).
- do an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/study area rather than formal palaeontological collection. The investigation should focus on the sites where bedrock excavations would definitely require palaeontological monitoring.

The results of the field investigation are then used to predict the potential of buried fossil heritage within the development footprint. In some investigations this involves the examination of similar accessible bedrock exposures, such as road cuttings and quarries, along roads that run parallel to or across the development footprint.

3. PROPOSED DEVELOPMENT DESCRIPTION

Project History:
The LRWSS was originally planned in 1978 as a regional scheme to utilize a dam on the Xura River. Only phase 1 of the originally planned larger scheme has been implemented to date, and the dam has never been built. This phase was commissioned in July 1989 and currently supplies the town of Lusikisiki (11 000 people) and 23 surrounding villages (41 000 people). The town of Lusikisiki is provided with full water services, including house connections and water borne sanitation, but the level of services for the villages is limited to bulk water supply to village reservoirs (CES 2014)

Current Status:
The current capacity of the bulk water supply infrastructure is 2 760 m3/day. Water is pumped from a weir on the Xura River and conveyed by gravity to the pump station which is located near the weir. The water is then pumped to the existing Water Treatment Works (WTW). After treatment the potable water is conveyed to bulk storage reservoirs at various points in the area, which in turn feed 24 service reservoirs that supply rural villages.
The current scheme is not able to meet the water requirements in the area and water shortages are experienced frequently. This low assurance of water supply can be attributed to the following reasons:

- Inadequate capacity of existing infrastructure;
- The poor condition of existing infrastructure;
- Significant housing development in the area, which has significantly increased water use requirements in the area.

A study done in 2010 reported that a combination of surface water (Zalu Dam) and groundwater would be the most feasible solution for the long-term water supply for the LRWSS. The Zalu Dam was found to be the most feasible surface storage option for the areas around Lusikisiki, with the south-western part of the study area requiring supplies from groundwater. The Department of Water Affairs (DWA) proposes to begin the second phase of the scheme (Figure 3.1) to augment the existing water supply in the area from Lusikisiki to Port St Johns (Ingquza Hill and Port St John's Local Municipalities). This will involve two water resources:

- The construction of the Zalu Dam on the Xura River to the west of Lusikisiki, which will also involve the upgrading of the Lusikisiki water treatment works and the expansion of the potable water reticulation in the Lusikisiki area; and
- A groundwater abstraction scheme in the south, which will augment water supplies to Port St Johns and the surrounding areas.

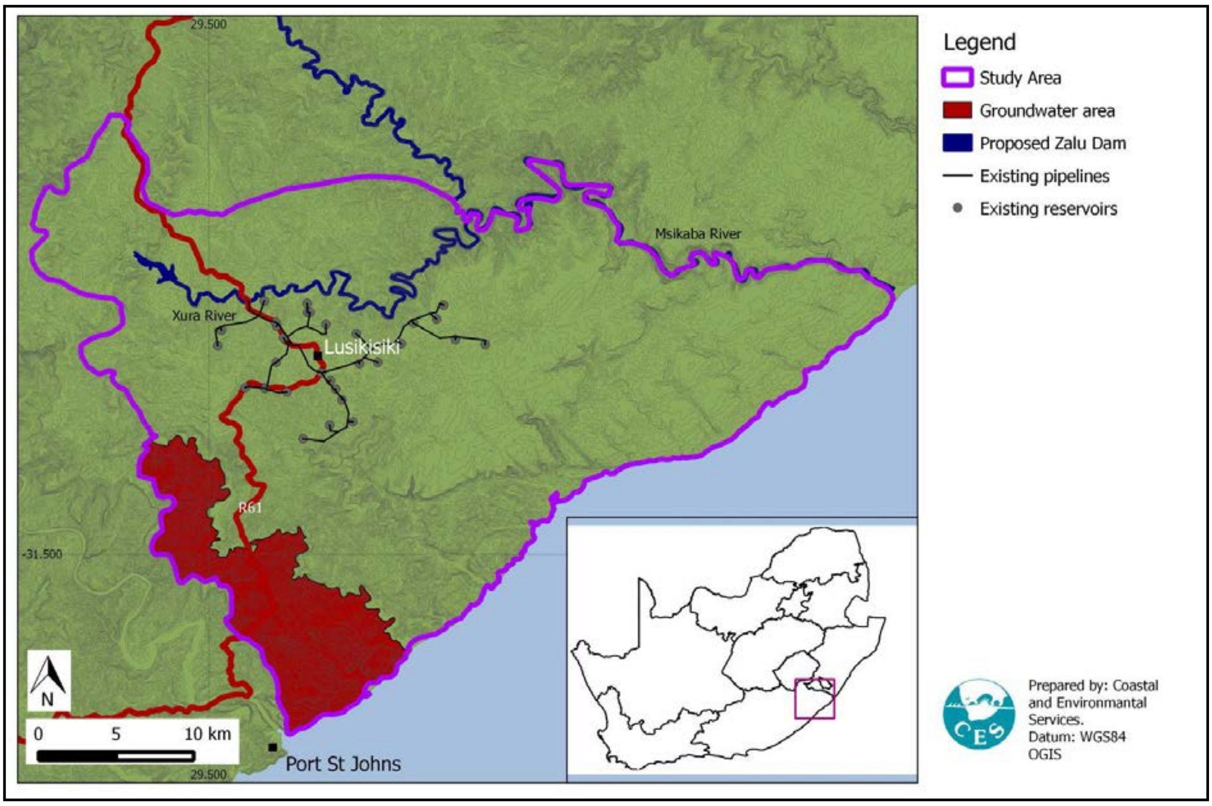

Figure 3.1 Location of the Lusikisiki Regional Water Supply Scheme.

4. GEOLOGY OF THE AREA

The Study area is underlain from East to West by Cambrian to Ordovician aged quartzites of the Natal Group, Carboniferous to Permian aged tillite of the Dwyka Formation and Permian aged shale, sandstone and mudstone of the Ecca Group, Karoo Supergroup. Parts of the study area are underlain by Jurassic aged Dolerite that intruded into the surrounding country rock and Quaternary aged Alluvial deposits underlie the valley floors near present day rivers in the study area.

4.1. Natal Group (S?)

The Cambrian to Ordovician (possibly Silurian) aged rocks of the Natal Group are predominantly light grey quartzitic sandstone and minor interbedded shales. Structures preserved in these sandstones indicate that the sediments were transported and deposited by rivers that drained highlands to the northeast. Close to their source, in northern KZN, deep valleys were in-filled with thick accumulations of boulders and pebbles.

4.2. Dwyka Formation (Pd)

The Carboniferous to Permian aged Dwyka Formation consists of dark-grey tillite that was deposited by retreating Glaciers. The tillite is generally deeply weathered and where exposed in quarries, the rock unit is characterised by a rich assemblage of dropstones that vary in size from millimetre scale to nearly a meter in diameter.

4.3. Ecca Group (Pe)

The Permian aged Ecca Group is undifferentiated and comprises of dark grey shale, mudstone and fine-grained sandstone. The sedimentary rocks are deeply weathered and mostly only exposed in deep excavations for road cuttings and quarries. The Ecca Group rocks are interpreted as a deep water deposit of silts and clays in the Ecca Sea.

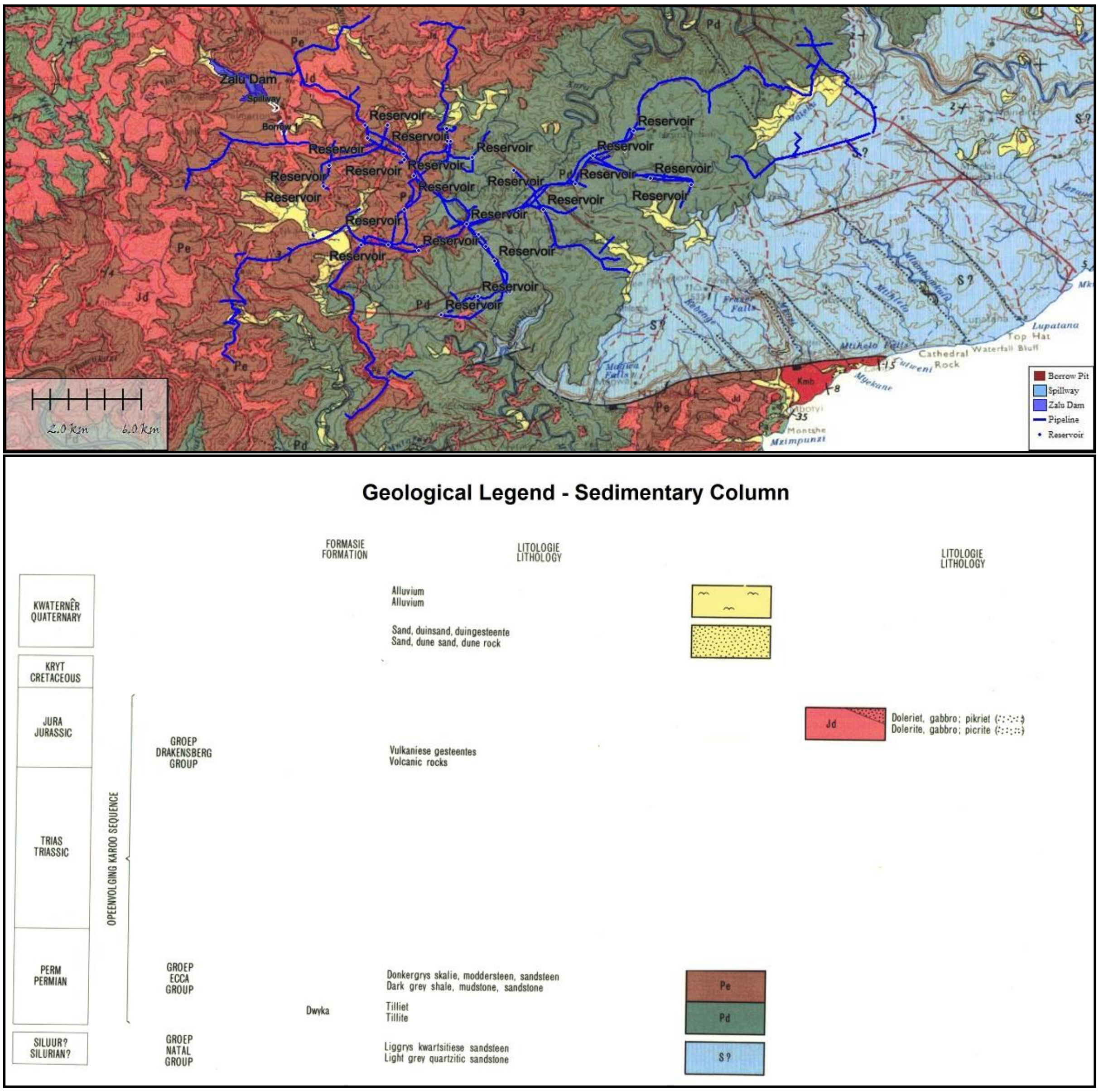

Figure 4.2 Geology of the study area

Dolerite (Jd)

Permian aged Dolerite sills and dykes are present throughout the study area, but particularly in the Western parts. These deposits represent magma intrusions into the Karoo Supergroup and older Natal Group sediments during the Jurassic volcanic episode that occurred during the breakup of Gondwanaland.

4.4. Alluvium

Quaternary aged Alluvium is present in the river valleys, consisting mostly of fine-grained sand and clay deposits with boulder beds at the base of river channels.

5. PALAEONTOLOGY OF THE AREA

The potential palaeontology of a rock unit relates directly to the geology of the area. Desktop surveys include the comparison of relevant referenced geological maps and locality maps and/or waypoints provided for the development project.

5.1. Natal Group (S?)

Up to date, no fossils have been described from the Natal Group quartzites which are most probably of Silurian age. Trace fossils have however been recorded from similar aged rocks in the Cape Supergroup, and recording of fossils from this rock unit will be significant.

5.2. Dwyka Formation (Pd)

Trace fossils have been recorded from the fine-grained shales of the Dwyka Formation in KwaZulu-Natal (Linstrom, 1987; MacRae, 1999). All of the following could therefore potentially be found in this formation. Trackways, produced mostly by fish and arthropods (invertebrates), have been recovered in shales from the uppermost Dwyka Formation. Other trace fossils include coprolites (fossilized faeces) of chondrichthyians (sharks, skates and rays).

Body fossils include aranaceous foraminifera and radiolarians (single-celled organisms), bryozoans, sponge spicules (internal support elements of sponges), primitive starfish, orthoceroid nautiloids (marine invertebrates similar to the living *Nautilus*), goniatite cephalopods (*Eoasinites* sp.), gastropods (marine snails such as *Peruvispira viperdorfensis*), bivalves (*Nuculopsis* sp., *Phestia* sp., *Aphanaia haibensis*, *Eurydesma mytiloides*), brachiopods (*Attenuatella* sp.) and palaeoniscoid fish such as *Namaichthys schroederi* and *Watsonichthys lotzi*.

Fossil plants have also been found, including lycopods (*Leptophloem australe*), moss, leaves and stems (possibly belonging to a proto-glossopterid flora). Fossil spores and pollens (such as moss, fern and horsetail spores and primitive gymnosperm pollens) as well as fossilized wood probably belonging to primitive gymnosperms have also been recorded from Dwyka deposits (MacRae, 1999; McCarthy and Rubidge, 2005).

5.3. Ecca Group (Pe)

Trace fossils have been described from the deep water deposits of this Group in various places in the Karoo Basin, whereas plant fossils are abundantly present in the sandstone rich units in the northern parts of the Basin.

The bivalve *Megadesmus* is described from the Late Permian upper Volksrust Shale Formation in the north-eastern Karoo Basin, South Africa. This is the first reported discovery of this genus in Africa. The fossil is large, 9 cm dorsally and 8.4 cm laterally, and both valves are articulated indicating minimum transport after death. The bivalve was encased in interbedded siltstone-shale that constitutes the distal sediments of a prograding delta at the Beaufort –Ecca Group boundary. *Megadesmus* is known from other continents (Australia, India, Siberia, South America and Tasmania) where its presence indicates exclusively marine conditions. The implication for the northeastern Karoo Basin during the Late Permian is that a marine enclave still existed in this geographic area and that terrestrial conditions did not yet prevail as in the southern basin region (Cairncross *et al*, 2005).

5.4. Karoo Dolerite (Jd)

Due to the igneous character of these rocks they do not contain fossils.

5.5. Alluvium

No significant fossils have been described from the alluvium deposits in this part of South Africa. Significant fossils have however been described from similar deposits in the Free State Province and recording of fossil finds from the alluvium deposits in the study area will be highly significant.

6. PRELIMINARY ASSESSMENT RESULTS

The palaeontological sensitivity was predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and evaluating the nature and scale of the development itself. Due to the known presence of trace fossils in rocks of the Dwyka Formation and Ecca Group, a Moderate Palaeontological sensitivity was allocated to these rock units, requiring a Phase 1 Palaeontological Impact Assessment (PIA). Although the potential for fossils in rocks of the Natal Group and the Alluvial deposits are low, site visits were planned to do preliminary investigations and record any possible fossils from these units. The dolerite units will not have associated fossils.

7. FIELD INVESTIGATION

Dr Gideon Groenewald and David Groenewald, experienced fieldworkers, visited the study area of the Lusikisiki Regional Water Supply Scheme between Wednesday 26 August 2014 and Thursday 28 August 2014. The topography of the area is dominated by rolling hills with isolated cliffs in regions where outcrops of Natal Group quartzite and dolerite occur. The methodology followed for fossil hunting mainly entailed driving along all the routes of the proposed pipelines where exposure of bedrock was expected in erosion dongas, road cuttings or quarries and excavations as envisaged from Google Earth images. All exposures of bedrock were inspected for fossils.

7.1. Routes underlain by Natal Group Quartzites

Quartzites of the Natal Group underlies the north-eastern part of the study area (Figure 7.1). The quartzite outcrops form some of the most spectacular cliffs in this region (Figures 7.2 and 7.3). The outcrops were inspected for the presence of possible trace fossils, but none were recorded during this investigation.

7.2. Routes underlain by Dwyka Formation tillites

The tillites of the Dwyka Formation is present in the central, east and north-east of the study area and are mostly weathered to a depth of several meters, giving rise to a landscape of rolling hills (Figure 7.4 and 7.5). The weathering of the tillite leads to the accumulation resistant boulders of dropstones in the soil profiles on site. Fresh exposure of Dwyka Formation tillite was observed in a working quarry where good examples of the tillite with dropstones of varying sizes were observed (Figure 7.6). No fossils were recorded from the tillite deposits.

7.3. Routes underlain by Ecca Group shale

The shale and fine-grained sandstone of the Ecca Group is also deeply weathered, with an associated topography of rolling hills with relatively deeply incised valleys in the central and western part of the study area (Figure 7.7). The sedimentary rocks are deeply weathered and outcrops of bedrock are restricted to road cuttings where weathering causes exposure of thinly bedded, but highly weathered shale with well-defined bedding planes (Figure 7.8). In some cases, weathered shale samples were exposed in smaller excavations that were made for the installation of infrastructure, possibly pipelines or electrical cables (Figure 7.9). No trace fossils were however recorded from these weathered rocks. Outcrops of fresh bedrock were restricted to a few quarries in the study area (Figure 7.10) and these outcrops were investigated for possible presence of trace fossils. No fossils were recorded from the shale deposits of the Ecca Group during this investigation.

7.4. Routes and Quarries underlain by Dolerite

Due to the igneous character of dolerite it will not contain fossils and all the routes underlain by this rock type will not contain fossils. Dolerite quarries (Figure 7.11) for provision of material for road fill and hard rock (Burrow 1 and Burrow 2 (Figure 7.12)) will not contain fossils.

7.5. Spillway of the proposed Zalu Dam

The spillway of the proposed Zalu Dam is underlain by shale of the Ecca Group. Outcrops of the shale formation are restricted to small (20cm) ledges of highly weathered shale on a grass-covered slope (Figure 7.13). A small test pit was excavated into the shale formation and although bedding planes are well defined in the highly weathered shale, no fossils were observed.

7.6. Alluvium in the basin of the proposed Zalu Dam

The valley floor in the basin of the proposed Zalu Dam is underlain by Quaternary aged alluvium, with gravel and pebble layers associated with the channel base deposits (Figure 7.14). During this investigation, no fossils were observed in the alluvium deposits.

Figure 7.1 Outcrop of Natal Group Quartzites in the north-eastern part of the study area

(GPS: 31° 19’ 42.4”S 29° 45’ 16.6”E)

Figure 7.2 Prominent cliff faces formed by the Natal Group Quartzites

(GPS: 31° 19’ 55.99”S 29° 46’ 40.7”E)

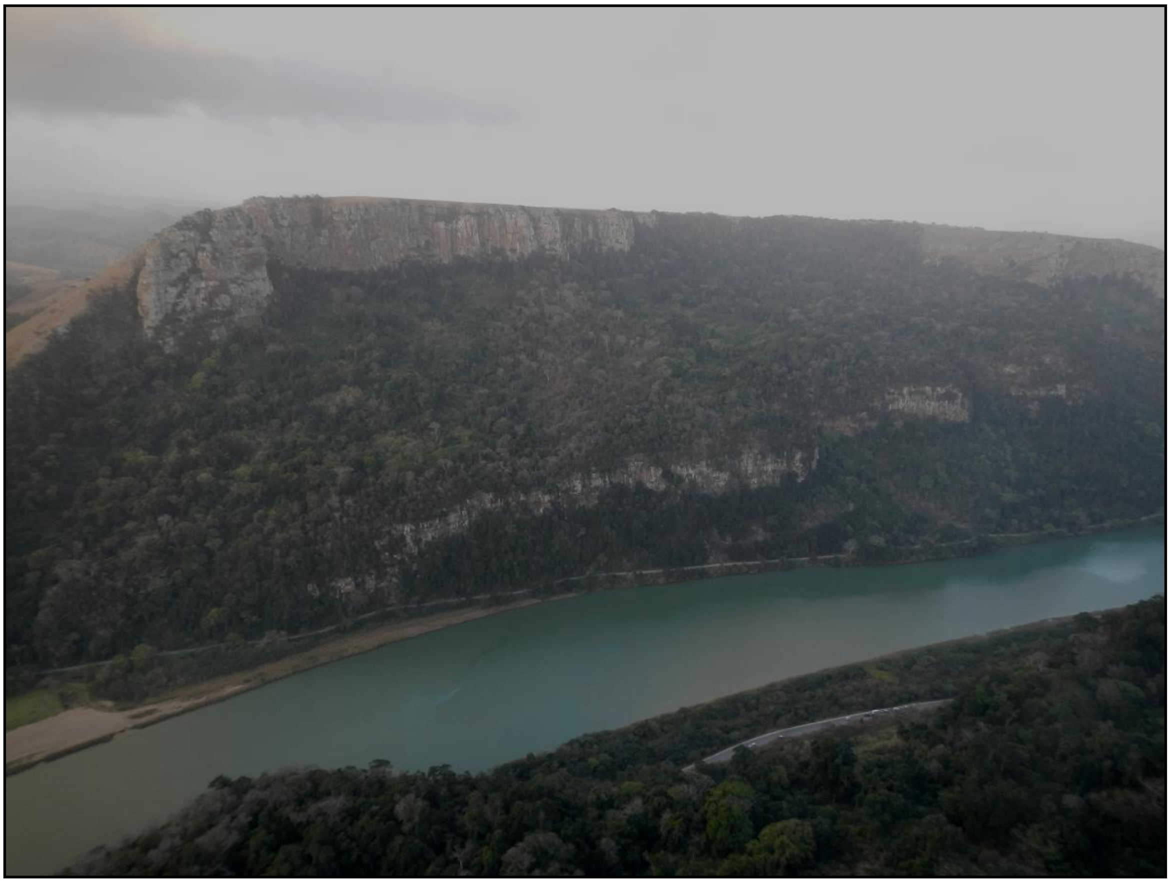

Figure 7.3 Spectacular cliffs of Natal Group Quartzites near Port St Johns

(GPS: 31° 36' 14.27"S 29° 31' 39.38"E)

Figure 7.4 Rolling hill topography characteristic of the Dwyka Formation

(GPS: 31° 21' 30.08"S 29° 41' 58.47"E)

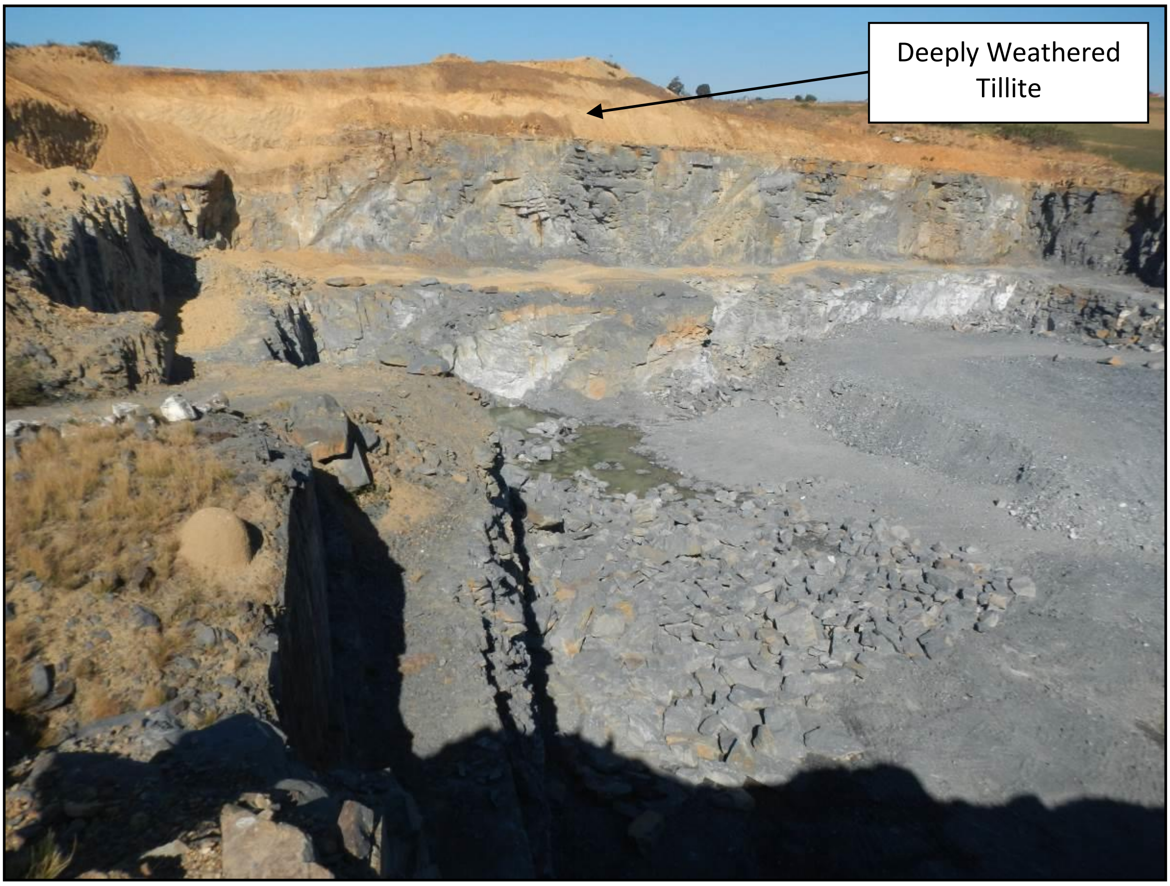

Figure 7.5 Freshly exposed Dwyka Tillite in a quarry. Note the deeply weathered nature of this formation. (GPS: 31° 21'13.38"S 29° 30' 36.3"E)

Figure 7.6 Tillite with dropstones (GPS:31° 21’ 13.71”S 29° 40’ 38”E)

Figure 7.7 Ecca Group is also deeply weathered, with an associated topography of rolling hills with relatively deeply incised valleys in the central and western part of the study area (GPS: 31° 19’ 51.5”S 29° 27’ 9.05”E)

Figure 7.6 Typical road cutting outcrop of Ecca Group Shales showing well defined bedding planes. No fossils observed. (GPS: 31° 24' 2.85"S 29° 30' 52.09"E)

Figure 7.7 Trench into weathered Ecca Group Shales, no fossils were observed. (GPS: 31° 19' 55.07"S 29° 33' 53.32"E)

Figure 7.8 Quarry exposing fresh shales of the Ecca Group (GPS: 31° 20' 22.87"S 29° 30' 18.99"E)

Figure 7.9 Typical quarrying into weathered dolerite near proposed Borrow Pit 1

(GPS: 31° 19’ 28.44”S 29° 29’ 11.79”E)

Figure 7.11 Dolerite outcrop at site of hardrock quarry, Borrow Pit 2 (GPS: 31° 18’ 59.66”S 29° 29’ 3.28”E)

Figure 7.10 Spill way of Zalu Dam underlain by Ecca Group Shales (GPS: 31° 18’ 43.5”S 29° 28’ 30.00”E)

Figure 7.12 Typical Alluvial fill in the Zalu Dam Basin. No fossils were observed. (GPS: 31° 18' 43.58"S 29° 28' 30"E)

8. PALAEONTOLOGICAL SIGNIFICANCE AND RATING

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered during the field investigation.

No fossils have up to date been recorded from the Natal Group Quartzites or the Alluvium deposits in this area and the dolerite will not contain fossils. A Low Palaeontological sensitivity is allocated to areas underlain by these rocks. Numerous fossils have been described from the Dwyka Formation and Ecca Group in South Africa and there is a possibility of finding fossils in excavation of fresh bedrock in these units. During the field survey it has however been confirmed that both the Dwyka Formation tillite and Ecca Group shales are deeply weathered in the study area and no fossils were recorded during this study. Due to the deeply weathered nature of these units and the fact that no fossils were recorded, a Low Palaeontological sensitivity is allocated to these units. This allocation is mainly based on the assumption that it is unlikely that significant fossil remains will be exposed during excavation of the trenches for the pipelines. The only exception is at the deep excavations that are envisaged for the building of the Zalu Dam wall and the spillway where the ECO must note the possibility of the presence of trace fossils in the Ecca Group sediments.

The palaeontological significance and rating is summarised in Table 8.1 and 8.2 and the Palaeontological sensitivity is shown in Figure 8.1. The methodology for assessing the significance of impacts can be found in Appendix A.

Table 8.1 Palaeontological Significance of Geological Units on Site

Geological Unit	Rock Type and Age	Fossil Heritage	Vertebrate Biozone	Palaeontological Sensitivity
Natal Group	Fluvial sandstone and quartzite. *SILURIAN?*	Possible trace fossils	*None*	Low sensitivity
Dwyka Formation	Glacial tillite and shale *CARBONIFEROUS/ PERMIAN*	Trace fossils, gastropods, brachiopods and palaeoniscoid fish and plant fossils	*None*	Low sensitivity due to deep weathering
Ecca Group	Deep water shale and fine-grained sandstone PERMIAN	Trace fossils and bivalves – possibly *Megadesmus*	*None*	Low sensitivity due to deep weathering
Dolerite	Dolerite *JURASSIC*	None	None	Low sensitivity
Alluvium	Sandy and clayey alluvium *QUATERNARY*	No fossils recorded	None	Low sensitivity

Table 8.2 Significance Rating Table as Per CES Template

Rock Unit	Temporal Scale (duration of impact)	Spatial Scale (area in which impact will have an effect)	Degree of confidence (confidence with which one has predicted the significance of an impact)	Impact severity (severity of negative impacts, or how beneficial positive impacts would be)		Overall Significance (The combination of all the other criteria as an overall significance)	
				With mitigation	Without mitigation	With mitigation	Without mitigation
Natal Group	Permanent	International	Unsure	No Effect	No Effect	Slightly beneficial	No Effect
Dwyka Formation	Permanent	International	Possible	Beneficial	Slight	Beneficial	Slight
Ecca Group	Permanent	International	Possible	Beneficial	Slight	Beneficial	Slight
Dolerite	No Impact	No Impact	Definite	No Effect	No Effect	No Effect	No Effect
Alluvium	Permanent	International	Unsure	No Effect	No Effect	Slightly beneficial	No effect

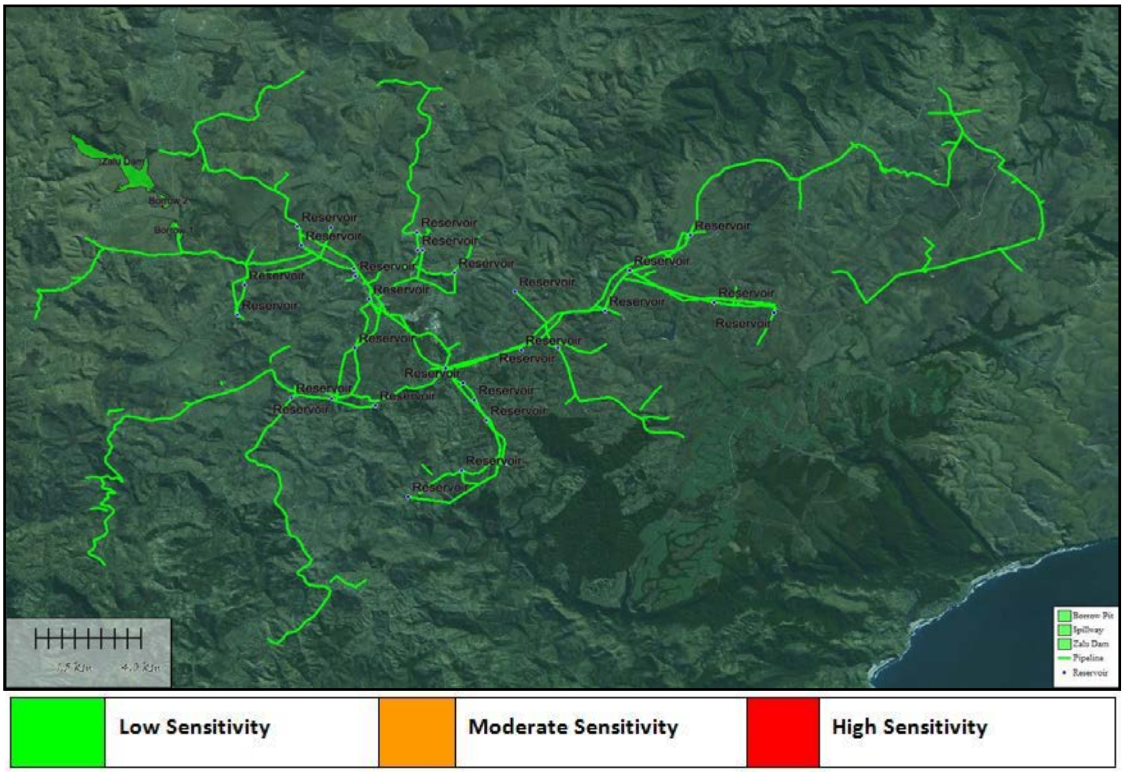

Figure 8.1 Palaeosensitivity of the areas affected by the development

9. PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered during the field investigation. The field investigation confirms that the area is underlain by the Silurian aged Natal Group, Carboniferous to Permian aged Dwyka Formation, Permian aged Ecca Group, Jurassic aged Dolerite and Quaternary aged Alluvium.

Due to the deep weathering of the Dwyka Formation and Ecca Group sediments, a Low Palaeontological sensitivity is allocated to the development. No severe impacts are envisaged and palaeontological mitigation is limited to the ECO noting the possibility of trace fossils on the bedding planes of Ecca Group shales at the wall and spillway of the Zalu Dam.

10. CONCLUSION

The development site for the proposed Lusikisiki Regional Water Supply Scheme, located within the OR Thambo District Municipality in the Eastern Cape is underlain by rocks of the Silurian aged Natal Group, Carboniferous to Permian aged Dwyka Formation, Permian aged Ecca Group, Jurassic aged Dolerite and Quaternary aged Alluvium.

The Natal Group quartzites, Dolerite and Alluvium are not known to contain significant fossils whereas numerous fossils have been described from the Dwyka Formation and Ecca Group in South Africa. In the study area the Dwyka Formation tillites and Ecca Group shales are however very deeply weathered and no fossils were observed in these rocks during this investigation. A Low Palaeontological sensitivity is therefore allocated to all the routes of the pipelines, the reservoir sites and the proposed construction site of the Zalu Dam. Due to the fact that deep excavation of Ecca Group shales is expected at the construction site of the Zalu Dam wall and spillway, it is recommended that the ECO of the project be informed of the possibility that fossils (notably trace fossils) might be present in freshly exposed shales at the construction site of the Zalu Dam wall and spillway. If fossils are reported from these rocks the palaeontologist , Eastern Cape Heritage Authority and SAHRA must be informed and the fossils recorded according to SAHRA specification.

It is recommended that:

3. The ECO of the project be informed of the slight possibility that trace fossils might be exposed on the bedding planes of Ecca Group shales during deep excavations for the construction of the Zalu Dam wall and spillway. If fossils are recorded the palaeontologist, Eastern Cape Heritage Authority and SAHRA must be notified and the fossils recorded according to SAHRA specification.
4. No further mitigation for Palaeontological Heritage needs to be planned for this project.

11. REFERENCES

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12. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

13. DECLARATION OF INDEPENDENCE

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Dr Gideon Groenewald
Geologist

APPENDIX A - METHODOLOGY FOR ASSESSING THE SIGNIFICANCE OF IMPACTS

Although specialists will be given relatively free rein on how they conduct their research and obtain information, they will be required to provide their reports to the EAP in a specific layout and structure, so that a uniform specialist report volume can be produced.

To ensure a direct comparison between various specialist studies, a standard rating scale has been defined and will be used to assess and quantify the identified impacts. This is necessary since impacts have a number of parameters that need to be assessed. Four factors need to be considered when assessing the significance of impacts, namely:

1. Relationship of the impact to **temporal** scales - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.

2. Relationship of the impact to **spatial** scales - the spatial scale defines the physical extent of the impact.

3. The severity of the impact - the **severity/beneficial** scale is used in order to scientifically evaluate how severe negative impacts would be, or how beneficial positive impacts would be on a particular affected system (for ecological impacts) or a particular affected party.

   The severity of impacts can be evaluated with and without mitigation in order to demonstrate how serious the impact is when nothing is done about it. The word 'mitigation' means not just 'compensation', but also the ideas of containment and remedy. For beneficial impacts, optimization means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable.

4. The **likelihood** of the impact occurs - the likelihood of impacts taking place as a result of project actions differs between potential impacts. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

The ***environmental significance*** scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts of especially a social nature need to reflect the values of the affected society.

Negative impacts that are ranked as being of "**VERY HIGH**" and "**HIGH**" significance will be investigated further to determine how the impact can be minimised or what alternative activities or mitigation measures can be implemented. These impacts may also assist decision makers i.e. lots of **HIGH** negative impacts may bring about a negative decision.

For impacts identified as having a negative impact of "**MODERATE**" significance, it is standard practice to investigate alternate activities and/or mitigation measures. The most effective and practical mitigations measures will then be proposed.

For impacts ranked as "**LOW**" significance, no investigations or alternatives will be considered. Possible management measures will be investigated to ensure that the impacts remain of low significance.

Table 9-1: Criterion used to rate the significance of an impact

Significance Rating Table	
Temporal Scale (The duration of the impact)	
Short term	Less than 5 years (Many construction phase impacts are of a short duration)
Medium term	Between 5 and 20 years
Long term	Between 20 and 40 years (From a human perspective almost permanent).
Permanent	Over 40 years or resulting in a permanent and lasting change that will always be there
Spatial Scale (The area in which any impact will have an affect)	
Individual	Impacts affect an individual.
Localised	Impacts affect a small area, often only a portion of the project area.
Project Level	Impacts affect the entire project area.
Surrounding Areas	Impacts that affect the area surrounding the development
Municipal	Impacts affect either the Local Municipality, or any towns within them.
Regional	Impacts affect the wider district municipality or the province as a whole.
National	Impacts affect the entire country.
International/Global	Impacts affect other countries or have a global influence.
Will definitely occur	Impacts will definitely occur.
Degree of Confidence or Certainty (The confidence to predicted the significance of an impact)	
Definite	More than 90% sure of a particular fact. Should have substantial supportive data.
Probable	Over 70% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Only over 40% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or of the likelihood of an impact occurring.

Table 9-2: The severity rating scale

Impact severity (The severity of negative impacts, or how beneficial positive impacts would be on a particular affected system or party)	
Very severe	**Very beneficial**
An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example the permanent loss of land.	A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit. For example the vast improvement of sewage effluent quality.
Severe	**Beneficial**
Long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming, or some combination of these. For example, the clearing of forest vegetation.	A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these. For example an increase in the local economy.
Moderately severe	**Moderately beneficial**
Medium to long term impacts on the affected system(s) or party (ies), which could be mitigated. For example constructing the sewage treatment facility where there was vegetation with a low conservation value.	A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way. For example a ‘slight’ improvement in sewage effluent quality.
Slight	**Slightly beneficial**
Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example a temporary fluctuation in the water table due to water abstraction.	A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.
No effect	**Don’t know/Can’t know**
The system(s) or party(ies) is not affected by the proposed development.	In certain cases it may not be possible to determine the severity of an impact

Table 3: Overall significance appraisal

<table>
<tr><td colspan="2">Overall Significance (The combination of all the above criteria as an overall significance)</td></tr>
<tr><td>VERY HIGH NEGATIVE</td><td>VERY BENEFICIAL</td></tr>
<tr><td colspan="2">These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or social) environment, and usually result in severe or very severe effects, or beneficial or very beneficial effects.
Example: The loss of a species would be viewed by informed society as being of VERY HIGH significance.
Example: The establishment of a large amount of infrastructure in a rural area, which previously had very few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH significance.</td></tr>
<tr><td>HIGH NEGATIVE</td><td>BENEFICIAL</td></tr>
<tr><td colspan="2">These impacts will usually result in long term effects on the social and/or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light.
Example: The loss of a diverse vegetation type, which is fairly common elsewhere, would have a significance rating of HIGH over the long term, as the area could be rehabilitated.
Example: The change to soil conditions will impact the natural system, and the impact on affected parties (such as people growing crops in the soil) would be HIGH.</td></tr>
<tr><td>MODERATE NEGATIVE</td><td>SOME BENEFITS</td></tr>
<tr><td colspan="2">These impacts will usually result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by society as constituting a fairly important and usually medium term change to the (natural and/or social) environment. These impacts are real but not substantial.
Example: The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant.</td></tr>
<tr><td>LOW NEGATIVE</td><td>FEW BENEFITS</td></tr>
<tr><td colspan="2">These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by the public and/or the specialist as constituting a fairly unimportant and usually short term change to the (natural and/or social) environment. These impacts are not substantial and are likely to have little real effect.
Example: The temporary change in the water table of a wetland habitat, as these systems is adapted to fluctuating water levels.
Example: The increased earning potential of people employed as a result of a development would only result in benefits of LOW significance to people who live some distance away.</td></tr>
<tr><td colspan="2">NO SIGNIFICANCE</td></tr>
<tr><td colspan="2">There are no primary or secondary effects at all that are important to scientists or the public.
Example: A change to the geology of a particular formation may be regarded as severe from a geological perspective, but is of NO significance in the overall context.</td></tr>
<tr><td colspan="2">DON'T KNOW</td></tr>
<tr><td colspan="2">In certain cases it may not be possible to determine the significance of an impact. For example, the significance of the primary or secondary impacts on the social or natural environment given the available information.
Example: The effect of a particular development on people's psychological perspective of the environment.</td></tr>
</table>

AUGMENTATION OF THE LUSIKISIKI REGIONAL WATER SUPPLY SCHEME, EASTERN CAPE PROVINCE, SOUTH AFRICA

AQUATIC IMPACT ASSESSMENT

P WMA 12/T60/00/5414/2

Prepared for:

Department of Water and Sanitation

Prepared by:

EOH Coastal& Environmental Services
16 Tyrell Road
Berea
East London, 5201
043 726 7809
Also in Grahamstown, Port Elizabeth, Cape Town, Johannesburg and Maputo
www.cesnet.co.za

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REVISIONS TRACKING TABLE

EOH Coastal and Environmental Services

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Report Version: Final

Project Number: 237

Name	Responsibility	Signature	Date
Caitlin Smith	Report Writer		February 2015
Dr Cherie-Lynn Mack	Report Writer		February 2015
Dr Alan Carter	Reviewer		February 2015

THE PROJECT TEAM

Dr Alan Carter, Director of the East London Office, has extensive training and experience in both financial accounting and environmental science disciplines with international accounting firms in South Africa and the USA. He is a member of the American Institute of Certified Public Accountants and holds a PhD in Plant Sciences. He is also a certified ISO14001 EMS auditor with the American National Standards Institute and the British Standards Institute.

Dr Cherie-Lynn Mack, Principal Environmental Consultant, holds a PhD and MSc (with distinction) degrees in Environmental Biotechnology, with a BSc degree in Microbiology and Biochemistry. She has postgraduate research experience in industrial and domestic wastewater treatment technologies, with particular emphasis on the coal and platinum mining industries. Her interests lie in the water sector, with experience in ecological reserve determination and water quality monitoring and analysis. She has experience in water quality analysis and industrial wastewater treatment research.

Ms Caitlin Smith, Environmental Consultant. Caitlin holds a BSc degree in Geology and Geography and a BSc Honours Degree in Geology both obtained from Nelson Mandela Metropolitan University. Caitlin has 4 yearsôexperience as a mining geologist in the heavy mineral sand mining industry. Caitlin has a keen interest in the water sector.

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1 INTRODUCTION

The Lusikisiki Regional Water Supply Scheme (LRWSS) has been under consideration since the 1970's (van Niekerk *et al*., 2013) when it was recommended that a regional water supply scheme based on a dam on the Xura River and a main bulk supply reservoir close to Lusikisiki would provide potable water supply for the entire region between Lusikisiki and the coast, extending from the Mzimvubu River in the south west to the Msikaba River in the north east. Some areas up to 15 km inland of Lusikisiki would also be supplied. In 2007, SRK Consulting undertook the Lusikisiki Groundwater Feasibility Study to investigate groundwater potential and compare the new data with data produced by earlier studies. This study reported that there is a relatively strong possibility of finding high yielding boreholes, and that a combination of surface water (Zalu Dam) and groundwater would be the most feasible solution for the LRWSS (van Niekerk *et al*., 2013).

The Ingquza Hill Local Municipality that forms part of the O.R. Tambo District Municipality faces a number of infrastructure challenges. These include a lack of waste management, lack of proper sanitation, limited access to electricity and poor road access. One of the main challenges identified is the provision of water not only to this specific municipal area but also to the broader O.R. Tambo District Municipality (Statistics South Africa, 2008).

An overview of household access to infrastructure in the Municipality, specifically the Ingquza Hill Local Municipality, has shown that in 2007, approximately 84% of the population had no basic access to water (Business Trust and DPLG, 2007).

In 2011, the census undertaken revealed that the population of Port St Johns Local Municipality was 156 136 (Stats SA, 2011). Of the economically active population, 50% was unemployed. 75% of households in the municipality do not have access to municipal water supply (Stats SA, 2011).

An aquatic impact assessment was commissioned in order to assess the ecological importance of the aquatic environments surrounding the proposed dam site, infrastructure located within 32 metres of any watercourse and any reticulation crossings of rivers.

The study area comprises the region between Lusikisiki (up to 15 km inland) and the coast, extending from the Mzimvubu River in the south-west to the Msikaba River in the north-east in the O.R. Tambo District Municipality (as shown in Figure 1.1).

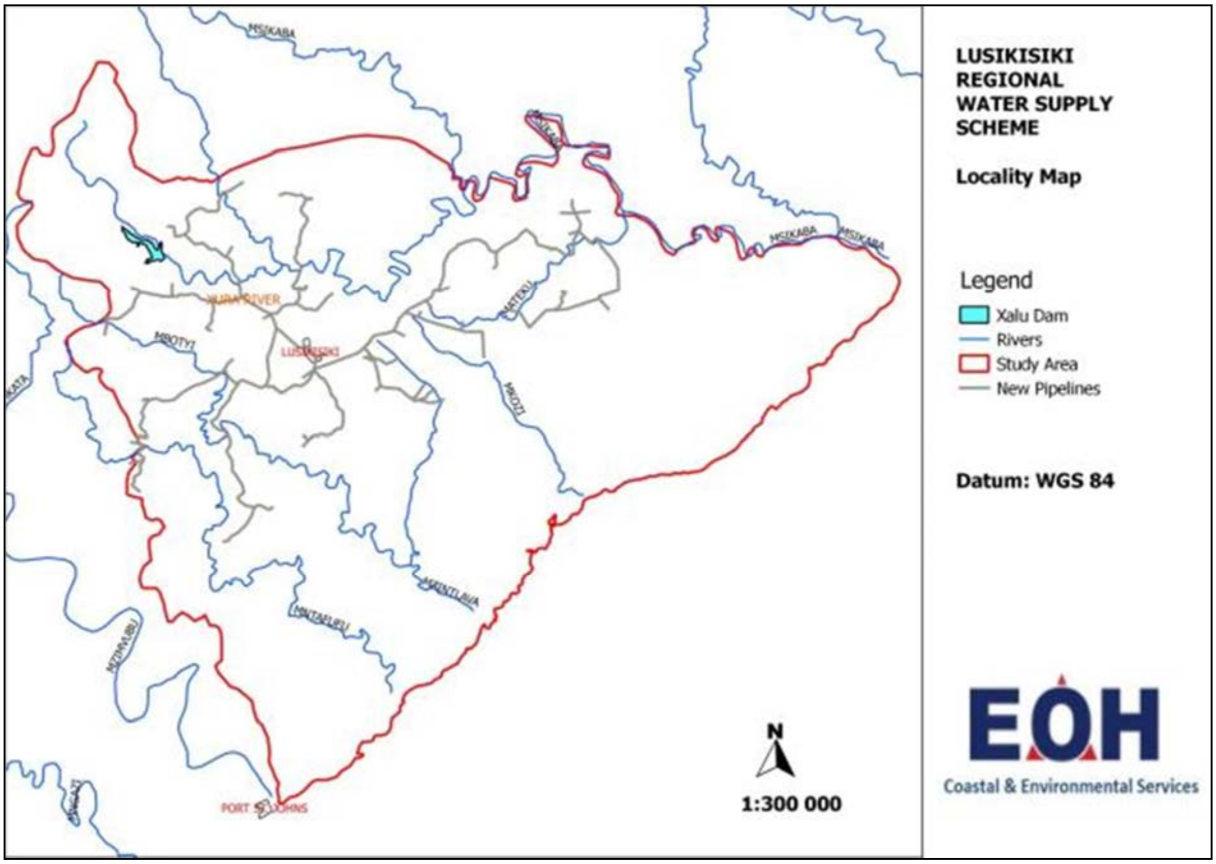

Figure 1.1: Locality map indicating the study area with the proposed Zalu Dam along the Xura River.

1.1 Objectives and Terms of Reference

The objectives of the aquatic assessment are to complete:

- A background review (desktop) of the affected quaternary catchment and the affected water resources.
- Assessment of the various activities involved in the construction of the pipeline crossings of the rivers and their potential impacts on the aquatic environment.
- Development of a set of mitigation measures to address the potential impacts of the proposed water supply scheme on the aquatic environment.

1.2 Assumptions and Limitations

This report is based on currently available information and, as a result, the following limitations and assumptions are implicit:ï

- The report is based on information provided by the client and is therefore assumed to be correct.
- Descriptions of the natural environments are based on fieldwork and reports generated as part of the Ecological Reserve Study for the Xura River (Department of Water Affairs, 2014).

1.3 Project description

The proposed activity consists of the following components:

1.3.1 Zalu Dam and Inundation Area

The dam will consist of an earth core rockfill dam on the Xura River with a full supply level of 622.6 masl. The dam will yield 6.85 million m^3/a. This can support the 5.4 million m^3/a 2040 domestic demand for the planning area plus the 1.45 million m^3/a irrigation demand, augmented with groundwater development of seventeen production boreholes with a yield of 0.93 million m^3/a. The area that will be inundated as a result of the proposed Zalu Dam is approximately 143.47 hectares. No resettlement will be necessary.

1.3.2 Borrow pits for dam construction

Sufficient construction materials are available for a rockfill dam in close proximity to the proposed construction site. Clay is available in a borrow area downstream of the dam centreline on the right bank of the river. The material is sufficient for the central earthfill core for a rockfill dam.

Two rockfill quarries with unweathered dolerite, one on the right bank and one on the left bank, 10 km upstream of the centreline of the proposed dam, were identified. These sources are located below the full supply level of the dam. Both sources are covered with moderately to completely weathered shales. The moderately weathered shales can be used in the shells of a rockfill dam. At the centreline of the dam on the right bank a horizontal layer of unweathered dolerite was encountered at a level of approximately 611 masl. This can be used for an approach channel floor for a side channel spillway. Some of the excavated materials can be used for the shells of the rockfill dam.

1.3.3 Abstraction weir

There is an existing abstraction weir approximately 7 km downstream of the proposed Zalu Dam wall. This may be upgraded as part of the LRWSS.

1.3.4 Bulk distribution infrastructure

A new extended pipeline system will be built for transferring water from the dam to the water treatment works and from the water treatment works to various reservoirs. Existing reservoirs will be upgraded and new additional reservoirs will be built.

1.3.5 Groundwater

Groundwater sources are to be used in areas of considerable distance from the planned Zalu Dam and where topography is unfavourable for pipeline infrastructure. Where high yielding groundwater sources exist, they will be linked into the planned bulk water reticulation network.

1.4 Approach

The study site and surrounding areas were assessed using a two-phased approach. Firstly, a desktop assessment of the site was conducted in terms of current biodiversity programmes and plans. This included the consideration of:

- Eastern Cape Biodiversity Conservation Plan (ECBCP)
- National Spatial Biodiversity Assessment (NSBA)
- National Freshwater Ecosystem Priority Areas (NFEPA)
- National Wetlands Inventory (NFEPA)

Further to the above, a site visit was conducted on 27, 28 and 29 August 2014, and again on 25 and 26 February 2015. The site visit served to inform potential impacts of the proposed project and how significantly it would impact on the surrounding aquatic environment.

2 RELEVANT LEGISLATION

The following legislation is relevant when considering aquatic impacts identified during the Planning and Design, Construction and Operation Phase of the LRWSS.

Table 2.1: Environmental legislation considered in the preparation of the Aquatic Report for the construction of the proposed Zalu Dam and pipeline for the LRWSS.

<table>
<tr><th>Title of Environmental legislation, policy or guideline</th><th colspan="2">Implications for the Lusikisiki Regional Water Supply Scheme</th></tr>
<tr><td>Constitution Act (108 of 1996)</td><td colspan="2">Obligation to ensure that the proposed development will not result in pollution and ecological degradation; and
Obligation to ensure that the proposed development is ecologically sustainable, while demonstrating economic and social development.</td></tr>
<tr><td>National Environmental Management Act (NEMA) (107 of 1998)</td><td colspan="2">The developer must apply NEMA principles, the fair decision-making and conflict management procedures that are provided for in NEMA.
The developer must apply the principles of Integrated Environmental Management and consider, investigate and assess the potential impact of existing and planned activities on the environment, socio-economic conditions and the cultural heritage.</td></tr>
<tr><td>National Environment Management: Biodiversity Act (10 of 2004)</td><td colspan="2">The proposed development must conserve endangered ecosystems and protect and promote biodiversity;
Must assess the impacts of the proposed development on endangered ecosystems;
No protected species may be removed or damaged without a permit;
The proposed site must be cleared of alien vegetation using appropriate means.</td></tr>
<tr><td>National Water Act (36 of 1998)</td><td colspan="2">The Act regulates the protection, use, development, conservation, management and control of water resources in South Africa. The principal concerns in terms of the Act are the potential for the proposed development to pollute surface and groundwater resources, and to ensure that water is used as efficiently as possible.

The following project-related activities will require an application for a water use licence as stipulated in Section 21 of the Act:
(a) Taking water from a water resource;
(b) Storing water;
(c) Impeding or diverting the flow of water in a watercourse;
(i) Altering the bed, banks, course or characteristics of a watercourse;</td></tr>
<tr><td>Water Services Act (108 of 1997)</td><td colspan="2">The Water Services Act provide for the rights of access to basic water supply and basic sanitation. Sufficient water and an environment not harmful to health or well-being is necessary. Government has to ensure that water supply services and sanitation services are provided in a manner that is efficient, equitable and sustainable. The provision of water supply services and sanitation services, although an activity distinct from the overall management of water resources, must be undertaken in a manner consistent with the broader goals of water resource management.</td></tr>
<tr><td rowspan="3">EIA regulations</td><td colspan="2">Water related triggering activities:</td></tr>
<tr><td>GNR544 (9)</td><td>Bulk water reticulation infrastructure will be constructed for the purposes of supplying water to water users. These pipelines will potentially exceed 0.36 m in diameter.</td></tr>
<tr><td>GNR544 (11)</td><td>Pipelines for reticulation of bulk water may cross watercourses.</td></tr>
</table>

Title of Environmental legislation, policy or guideline	Implications for the Lusikisiki Regional Water Supply Scheme	
	GNR544 (18)	The construction of the Zalu Dam will require both excavation and infilling of material into the Xura River.
	GNR 545 (19)	Construction of the Zalu Dam on the Xura River. It is estimated that the highest part of the dam will exceed 5 m.
	GNR 546 (2)	Reservoirs will be required for water storage.
	GNR 546 (13)	The area to be inundated by the proposed dam is identified as a critical biodiversity area in terms of the Eastern Cape Biodiversity Conservation Plan (ECBCP).
	GNR 546 (16)	Construction will take place within the Xura River (dam construction). The site is within a critical biodiversity area in terms of the Eastern Cape Biodiversity Conservation Plan (ECBCP).

3 ASSESSMENT METHODOLOGY

3.1 Assessment methodology

The impact assessment methodology will be discussed in full in the EIR document.

4 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

The study site and surrounding areas were described using a two-phased approach. Firstly, a desktop assessment of the site was conducted in terms of current biodiversity programmes and plans, followed by a site visit in order to obtain photographic evidence of the current state of the aquatic environment.

4.1 Desktop Investigation

Published literature on the ecology of the area was referenced in order to describe the study site in the context of the region and the Eastern Cape Province. The following documents/plans are referenced:

- The National Spatial Biodiversity Assessment (2004)
- The Eastern Cape Biodiversity Conservation Plan (2007)
- The National Freshwater Ecosystems Protected Areas Programme (2011)

The project is located within quaternary catchments T60F, T60G, T60J, T60K and T60H (Figure 4.1). These quaternary catchments fall within primary catchment T which forms part of the Water Management Area 12 (Mzimvubu to Keiskamma Region).

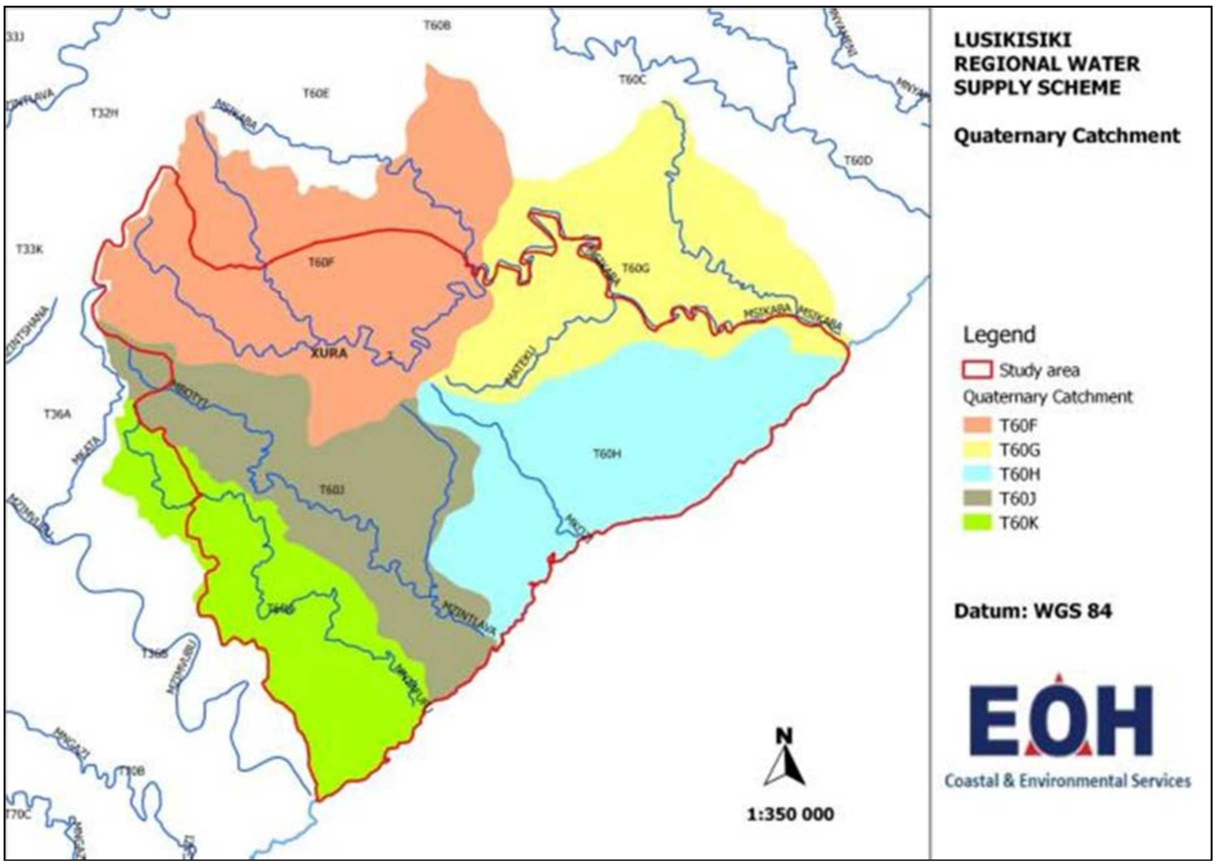

Figure 4.1: Quaternary catchment locality map.

WMA 12 falls almost entirely within the Eastern Cape Province, with a small portion in Kwazulu-Natal. It is bordered by the Fish to Tsitsikamma, Upper Orange and Mvoti to Umzimkulu water management areas, as well as by Lesotho in the north. The Mzimvubu River with its main tributaries the Tsitsa, Tina and Mzintlava Rivers, is the largest river in the water management area and also the largest undeveloped river in South Africa. The Kei River drains a relatively large catchment and other significant rivers in the water management area are the Keiskamma, Buffalo, Mbashe and Mtata Rivers, all of which flow in a general south-easterly direction towards the Indian Ocean. Several small coastal rivers and streams drain directly to the ocean.

4.1.1 The National Spatial Biodiversity Assessment (2004)

The National Spatial Biodiversity Assessment of 2004 is a framework document within which fine-scale conservation planning in identified priority areas should occur. The NSBA integrates terrestrial, river, marine, estuarine and wetland ecosystems using available spatial data, relevant conservation planning software and a series of expert and stakeholder workshops. It is important to note that the NSBA was conducted at a national scale (1:250 000), and thus can only provide a general context for biodiversity assessments at a local level.

When establishing a conservation plan, river integrity is recommended by the NSBA as a suitable method for determining the most suitable rivers for conservation. Rivers that are largely natural should be the first choice for meeting biodiversity targets. If the targets cannot be met in rivers with a high ecological integrity, then rivers with a moderate integrity (i.e. those with relatively inexpensive rehabilitation costs) would be the next best option. The NSBA mapped river integrity based on the present ecological status category (PESC) desktop estimates from the national Water Situation Assessment Model.

All of the rivers in the study area are Class B rivers, meaning that they are LARGELY NATURAL (Figure 4.2). A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.

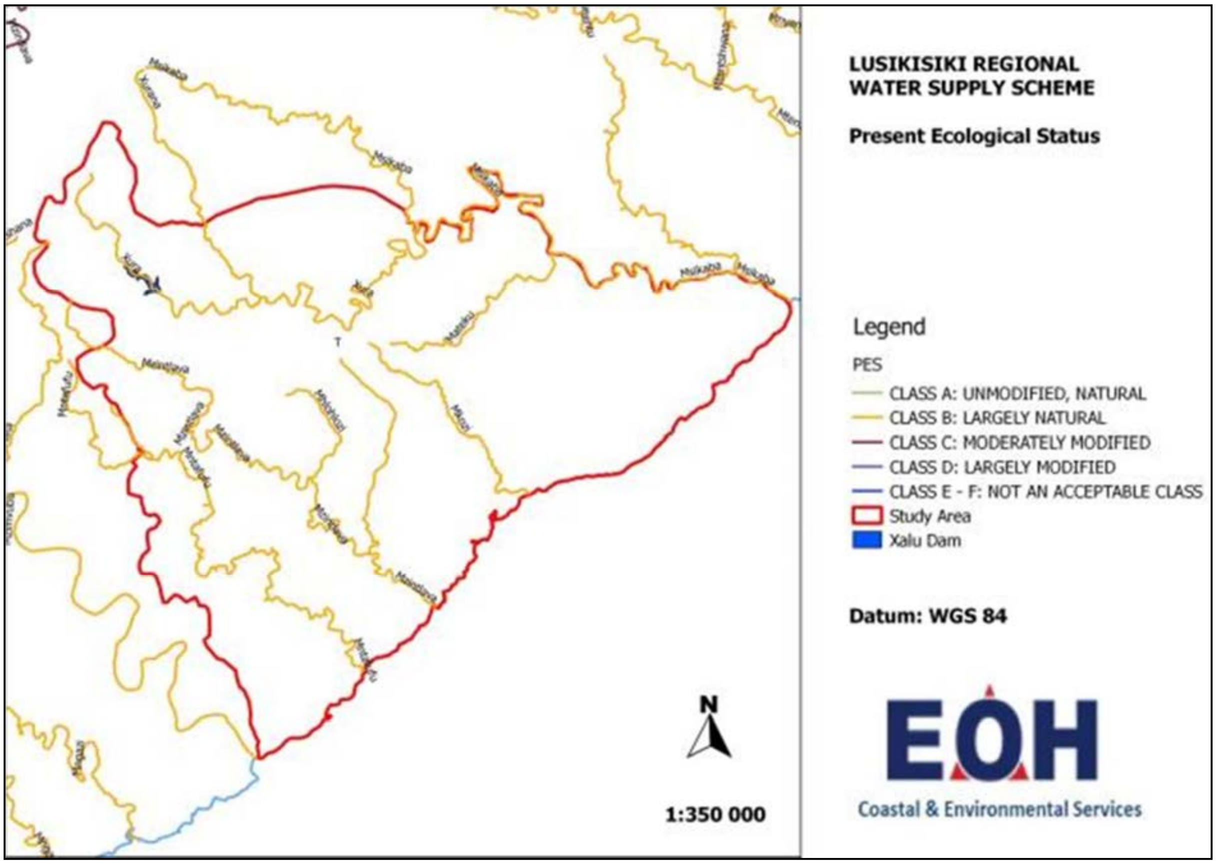

Figure 4.2: Present Ecological Status of rivers in Primary Catchment T (NSBA, 2004).

A second important mapping tool used in the NSBA is conservation status. Conservation status aims at identifying threatened ecosystems, and is based on the classification scheme developed by the IUCN to categorise species. Of the 120 rivers in South Africa that have been classified using this categorisation, 44 are critically endangered, 27 % are endangered, 11 % are vulnerable and 18 % are least threatened. All of the rivers in the study area are categorised as VULNERABLE (Figure 4.3).

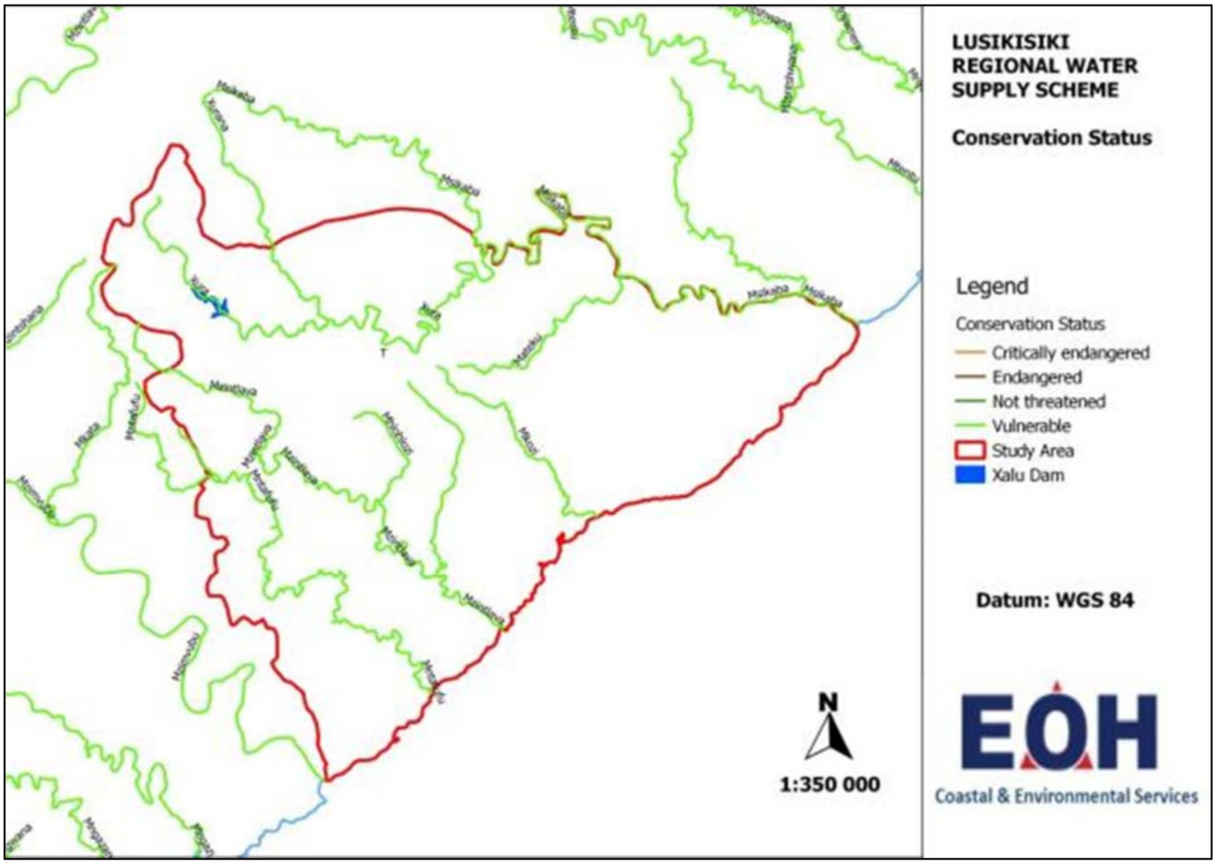

Figure 4.3: Conservation status of rivers in Primary Catchment T (NSBA, 2004).

4.1.2 National Freshwater Ecosystem Priority Areas (NFEPA), 2011

The National Freshwater Ecosystem Priority Areas (NFEPA) project provides strategic spatial priorities for conserving South Africaôs freshwater ecosystems and supports sustainable use of water resources. These priority areas are called Freshwater Ecosystem Priority Areas, or ôFEPAsô

FEPAs were identified based on:

- Representation of ecosystem types and flagship free-flowing rivers
- Maintenance of water supply areas in areas with high water yield
- Identification of connected ecosystems
- Representation of threatened and near-threatened fish species and associated migration corridors
- Preferential identification of FEPAs that overlapped with:
  - Any free-flowing river
  - Priority estuaries identified in the National Biodiversity Assessment 2011
  - Existing protected areas and focus areas for protected area expansion identified in the National Protected Area Expansion Strategy.

A portion of the Xura river (Figure 4.4) as well as the Xurana River are classified as an Upstream Management Area (areas in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas) and a portion of the Xura River is classified as a Fish Support Area (includes sub-quaternary catchments that are important for migration of threatened or near-threatened fish species). The Mntafufu, Msikaba and Mateku rivers are classified as FEPAs.

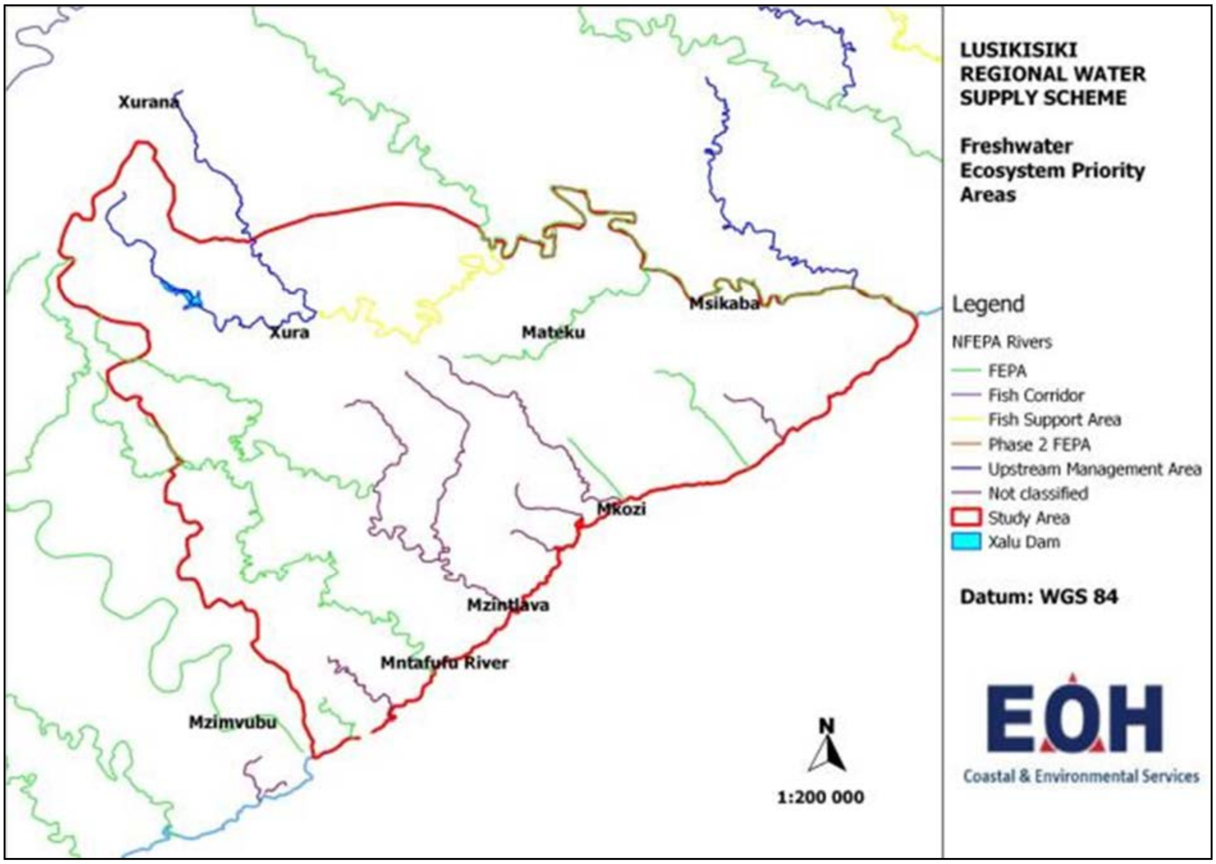

Figure 4.4: Freshwater Ecosystem Priority Area status of the main rivers in the project area (NFEPA, 2011).

4.1.3 Eastern Cape Biodiversity Conservation Plan (ECBCP)

The ECBCP is a first attempt at detailed, low-level conservation mapping for land-use planning purposes. Specifically, the aims of ECBCP were to map critical biodiversity areas through a systematic conservation planning process. The current biodiversity plan includes the mapping of priority aquatic features, land-use pressures, critical biodiversity areas and develops guidelines for land and resource-use planning and decision-making.

The main outputs of the ECBCP are “critical biodiversity areas” or CBAs, which are allocated the following management categories:

1. CBA 1 = Maintain in a natural state
2. CBA 2 = Maintain in a near-natural state

The ECBCP maps CBAs based on extensive biological data and input from key stakeholders. Although ECBCP is mapped at a finer scale than the National Spatial Biodiversity Assessment (Driver *et al.,* 2005) it is still, for the large part, inaccurate and “coarse”. Therefore it is imperative that the status of the environment, for any proposed development MUST first be verified before the management recommendations associated with the ECBCP are considered (Berliner and Desmet, 2007). It is also important to note that in absence of any other biodiversity plan, the ECBCP has been adopted by the Provincial Department of Economic Development, Environmental Affairs and Tourism (DEDEAT) as a strategic biodiversity plan for the Eastern Cape.

As with terrestrial CBAs, aquatic CBAs are grouped into BLMCs. The ECBCP recommends limits (thresholds) to the total amount of land transformation that should be allowed in an ABLMC 1 and 2, if biodiversity is to be conserved. The goal is to maintain sufficiently large intact and well-connected habitat patches in each sub-quaternary catchment.

ABLMC	CBA Code	Description of CBAs	ABLMC Transformation Threshold
ABLMC 1	CBA1	Critically important river sub-catchments; Priority primary catchments for E1 estuaries	Less than 10 % of total area of sub-quaternary catchment
ABLMC 2a	CBA2	Important sub-catchments, Primary catchment management areas for E2 estuaries.	Less than 15 % of total area of sub-quaternary catchment
ABLMC 2b	CBA3	Catchments of free flowing rivers important for fish migration	Less than 20 % of total area of sub-quaternary catchment

A portion of the T60H quaternary catchment is classified as CBA1 (Figure 4.5).

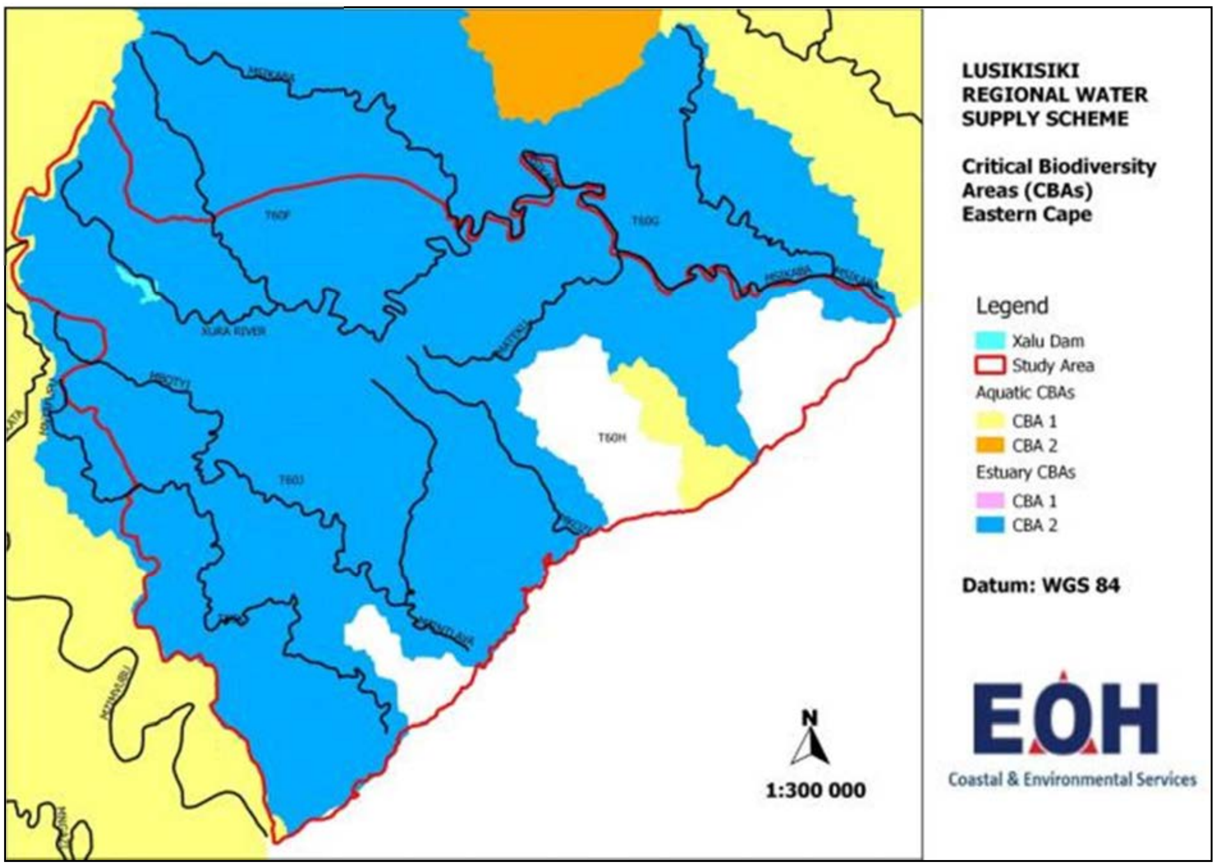

Figure 4.5: Critical Biodiversity Areas of the Eastern Cape, indicating the classification of quaternary catchments T60F, T60G, T60H, T60J and T60K (ECBCP, 2007).

4.1.4 Summary of biodiversity status of the affected rivers

Table 4.1 summarises the status of the rivers and the surrounding quaternary catchment area.

Table 4.1: Status of the rivers in the affected areas.

Status	Source	Comment
PES: Class B ï Largely Natural	NSBA, 2004	Largely Natural. A small change in natural habitats and biota may have taken place

		but the ecosystem functions are essentially unchanged.
Conservation Status: Vulnerable	NSBA, 2004	
Upstream Management Area	NFEPA, 2011	Human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas
Fish Support Area	NFEPA, 2011	Important for migration of threatened or near-threatened fish species
FEPA	NFEPA, 2011	
Aquatic CBA Class 1	ECBCP, 2007	
Estuary CBA Class 2	ECBCP, 2007	

4.1.5 Wetlands

Wetlands in South Africa have been mapped on a broad-scale by various stakeholders and have been included in the National Freshwater Ecosystem Priority Assessment (NFEPA, 2011). Due to the broad-scale nature of the NFEPA map it is not spatially accurate and therefore some error is expected. The location of NFEPA wetlands was derived from the National Land Cover 2000 (Van Den Berg et al., 2008) and inland water features from the Department of Land Affairsô Chief Directorate: Surveys and Mapping (DLA-CDSM). All wetlands are classified as either ónaturalô or ártificialô water bodies.

The NFEPA wetland map identifies important or sensitive wetlands and wetland clusters. A wetland cluster is a group of wetlands all within 1 km of each other and which are surrounded by relatively natural vegetation. Figure 4.6 indicates the ñnaturalò wetlands listed in the inventory that occur within the study area. None of them have been classified as priority ñFEPAò wetlands.

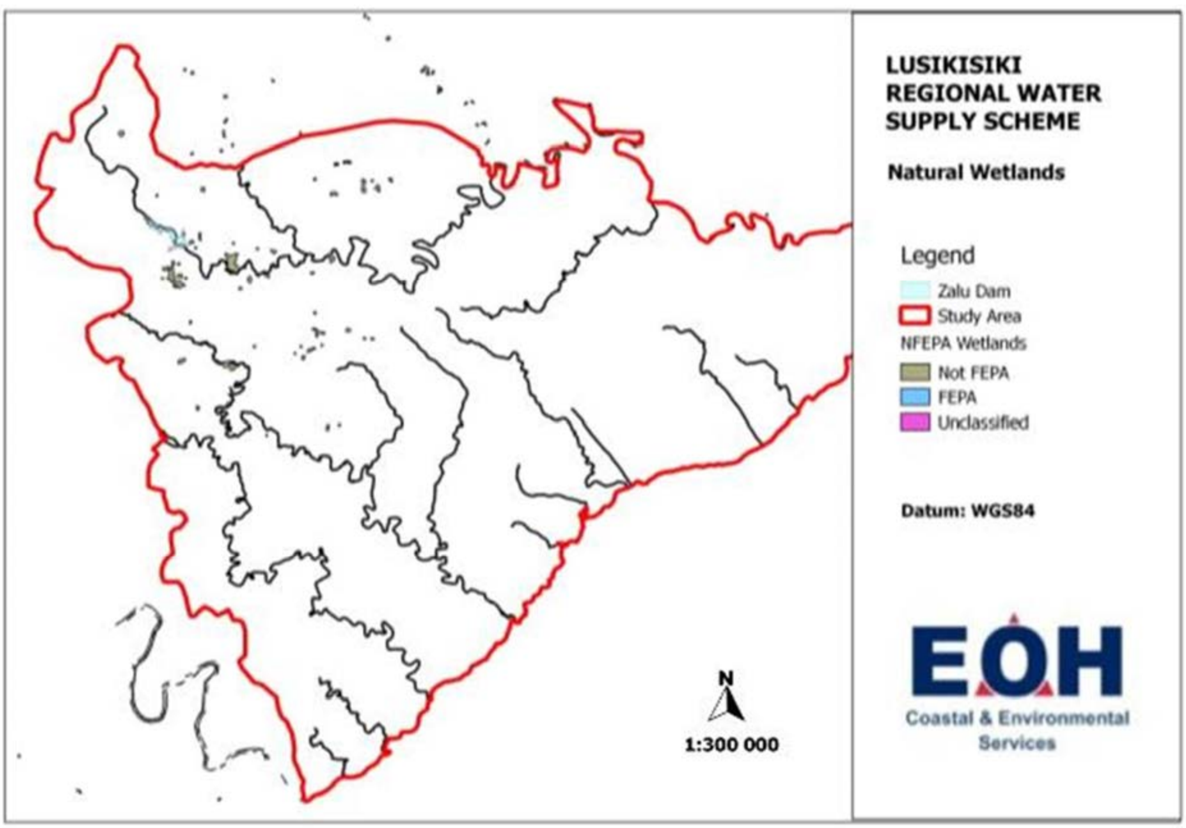

Figure 4.6: Natural wetlands in the study area. All have been classified as Non-FEPA wetlands (NFEPA, 2011).

5 SPECIALISTS REPORTS FOR ECOLOGICAL RESERVE:

5.1 Introduction

Module 4 of the Feasibility Study for Augmentation of the Lusikisiki Regional Water Supply Scheme conducted by AECOM, was coordinated by Scherman Colloty & Associates, and involved the determination of Ecological Water Requirements (EWR, or the Intermediate Ecological Reserve) for the Xura and Msikaba River systems. This study followed the methodology currently in place for Reserve determination (REF). The objective of the study was to determine the EWR for different ecological states at each selected study site.

For the purposes of the current Impact Assessment report, the information provided in the final report, Intermediate Preliminary Reserve Determination Report (Department of Water Affairs, 2014) by the relevant specialists was used to identify and rate the potential impacts of the construction of the Zalu Dam and associated infrastructure on the aquatic environment.

The specialists involved in the study are listed in Table 5.1.

Table 5.1. Specialists involved in the Reserve Determination study.

Team Member: Specialization	Company Name
Scherman, P-A: Team leader and water quality	Scherman Colloty & Associates
Louw, MD: Habitat integrity and EWR integrator/coordinator	Rivers for Africa
Birkhead, A: Hydraulics	Streamflow Solutions
Van Niekerk, E: Hydrology and yield modelling	AECOM
Rountree, M: Geomorphology	Fluvius Consulting
Colloty, BM: Riparian vegetation	Scherman Colloty & Associates
Hughes, D: SPATSIM	Institute for Water Research, Rhodes University
Uys, AC: Macroinvertebrates	Laughing Waters
Bok, AH: Fish	Anton Bok Aquatic Consultants
Koekemoer, S: Diatoms	Koekemoer Aquatic Services

5.2 Location and description of survey site

For the reserve study, two sites were selected; one on the Xura River (Site 1) and one on the Msikaba River (Site 2). The Msikaba River was included as the Xura River is a tributary of that system, and it was suggested that the impounding of the Xura River (at the Zalu Dam) may have an impact on the ecological functioning of the Msikaba River. For the purposes of this assessment, only the Site 1 and associated information for the Xura River will be assessed in detail.

Table 5.2 lists further information regarding the site location.

Table 5.2: Location information for EWR site 1 (from Department of Water Affairs, 2014)

	Site information
River	Xura River
Co-ordinates of site	31° 19ô37.20òS; 29° 29ô12.70òE
EcoRegion (Level II)	16.03
Geozone	Lower Foothills
Altitude (mamsl)	586
Quaternary	T60F

	Site information

5.3 Present Ecological State

A vital step in determining the Ecological Reserve, is accurately describing the reference condition (RC), which typically represents the un-impacted, natural state of the water resource. This is done based on available historical information. The Present Ecological State (PES) reflects the changes to a stream in terms of the Ecological Category (EC) from reference conditions (usually A). Table 5.3 describes the RC and the present state of site 1 as described in Department of Water Affairs, 2014. The site, and by extension, the river reach, was classified as an A/B PES, so is Largely Natural.

Table 5.3: Description of Reference condition and Present state of Site 1.

	Reference Condition	**Present State**	**PES**
Hydrology	14.16 million m³. Updated simulated natural flow data (1920 ï 2007).	The EWR site was upstream of the abstraction point of the Lusikisiki Water Treatment Works (WTW) at gauge T6H004. Negligible changes in flow occurred at the site with some forestry and probably local abstractions and cattle watering present.	A/B
Water Quality	No Reference Condition (RC) data. RC based on A river benchmark conditions as outlined in DWAF (2008b).	PES data from gauging weir T6H004; 1995-2011; n = over 100 for all sampled parameters was available. The main water quality issue was some nutrient enrichment due to catchment-based activities.	A/B
Geo-morphology	The river channel would have been a small, single channel characterised by bedrock and fixed boulder bed with fines in the lee areas and well vegetated marginal and riparian zone. An alluvial small river with weakly developed paired terraces would have been present. The banks would be alluvial (silt) and the bed composed of cobbles and boulders and gravels.	The river channel was a small, single channel with a bedrock and fixed boulder bed, with fines in the lee areas. The riparian zone was generally well-vegetated although trampling and grazing has reduced vegetation cover and increased erosion in some places. The low cut banks evident during the site visit were natural, being caused by the recent large floods.	A/B

Riparian vegetation	It was well understood that broad riparian zones would not be a feature of the study area due to the steep incised valleys, and when found these would be associated with scarp forest or thickets that extend down into these river valleys, while the remainder of the catchments would be dominated by grassland and emergent vegetation within the riparian zones. The inferred reference state was thus based on the present structure and function of the observed present day species (cover), while it was understood that species abundance had been altered drastically and a high number of species observed in the 1940ôs were no longer observed in the greater catchments, and are only found in small populations in isolated areas downstream of the proposed development.	The present marginal zone was close to the reference state, possibly with a small loss of species cover and abundance due to trampling, grazing and alien plant cover. As a result only ten dominant marginal species were observed. These were however typical of the region, with no rare or endemic species being observed. The species that were found have adaptive life histories, able to tolerate low to no flow conditions for short periods as well as high flow conditions. Most species require moist soils in order to survive. Lower and Upper zone species were largely flow independent and only require inundation for very short periods at least once a year. The present cover and abundance was however limited by a small percentage of alien plant cover and a high degree of trampling and grazing.	B/C
Fish	Three fish species expected to be present (Barbus amatolicus, Anguilla mossambica and A. marmorata). Clean, unbedded rocks in pools as well as in riffles, deep refuge pools with little silt on substrate.	All three expected species were found in abundance at the site and good quality habitat was present with all expected hydraulic habitats suitable for fish. Limited siltation in deep pools was evident as well as algal growth on rocks indicating nutrient input, but this had a limited impact on fish	A/B
Macro-Invertebrates	Of the nearby Eastern Cape river sites reviewed, only one site, with a single sample, was considered appropriate as a reference site, in terms of similar channel size, position in catchment, habitat availability, invertebrate community and overall SASS5 (South African Scoring System version 5) score: **Ntafufu River**, locality: S 31^{0} 29ô50.6ö E 29 ^{0}31 43.2ö The SASS5 score was slightly better than at EWR 1. The data was sourced from DWA: EC. The sample date for the data was 4 Nov 2004. In the natural (reference) state, one would have expected better water quality (clearer water with low nutrient levels and lower turbidity). Surfaces of cobbles and boulders would be clear of substrates and algae. There may have been more indigenous leaf-fall (low impact).	The invertebrate community reflected the impacts to this section of the river, in that it included a number of sensitive, flow-dependent taxa scoring >10 (Perlidae, Baetidae >2spp, Heptageniidae, Psephenidae, and Athericidae). The change from the natural state, in which one would anticipate additional taxa of this sensitivity level (e.g. Philopotamidae, Platycnemidae, and Pisuliidae) probably related largely to the increase in nutrient levels (algae on upper and front surfaces of rocks decrease habitat availability) and increased turbidity at the site.	A/B
Overall site classification			**B**

5.4 Environmental Importance and Sensitivity

The Environmental Importance and Sensitivity (EIS) model (DWAF, 1999) estimates and classifies the streams in a catchment by taking into consideration number of ecological components, such as the presence of:

- rare and endangered species,
- unique species (i.e. endemic or isolated populations) and communities,
- intolerant species and
- species diversity for both the instream and riparian components of the river

Habitat diversity is also considered in terms of type, e.g. pools, riffles, runs, rapids, waterfalls, riparian forests, etc.

The EIS model categorises streams as per Table 5.4.

Table 5.4: Environmental Importance and Sensitivity categories (DWAF, 1999)

EIS Categories	General Description
Very high	Quaternaries/delineations that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.
High	Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases, may have a substantial capacity for use.
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use.
Low/Marginal	Quaternaries/delineations which are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.

The EIS evaluation resulted in a **MODERATE** importance rating. The following aspects of the aquatic environment were of most significance in the evaluation:

- Unique (instream) species: *Barbus sp*. is still being described and possibly only occurs in four rivers;
- Diversity of habitat types and features (instream habitat): Riffles, shoots, rapids, marginal vegetation, pools, back waters and undercut banks;
- Refugia and critical habitat (instream habitat): Important due to lack of strongly perennial tributaries;
- Diversity of habitat types and features (riparian habitat): Wetlands and off-channel pools upstream of site; and
- Migration corridor (riparian): Very distinct and different type of habitat in valley within grassland areas. Important for birds, and other riparian fauna.

Table 5.5 summarises the EcoClassification of Site 1. Without mitigation, the construction and operation of the dam would deteriorate the situation to a C. It was recommended that the PES be maintained at a B, which, from the results of the Water Resource Yield Model (WRYM) is possible under all scenarios.

The latest version of the Water Resource Yield Model (WRYM) incorporated in the Water Resource Information Management System (WRIMS), version 3.8.2 was used to simulate the behaviour of the Xura River and the water users under various development scenarios. The scenarios selected for the ecological consequences analyses investigated domestic releases via the river. This was based on yield analyses demonstrating the benefit of releases from the dam and abstraction from the weir.

Table 5.5: Summary of the EcoClassification

EWR 1

EIS: MODERATE
Highest scoring of the metrics used to assess EIS, were unique instream species, diversity of instream and riparian habitat types, presence of critical instream refuges and important riparian migration corridors.

PES: B
Trampling and limited erosion (cattle).
Increased nutrient levels (cattle, human waste and clothes washing).
Alien vegetation.

REC: B
EIS was MODERATE and the REC was therefore to maintain the PES.

AEC: C
A hypothetical deteriorated situation was characterised by decreased flows and the resulting abiotic and biotic responses to this situation.

Driver Components	PES & REC	Trend	AEC ↓
IHI HYDROLOGY	A/B		
WATER QUALITY	A/B		B/C
GEOMORPHOLOGY	A/B		C
Response Components	PES	Trend	AEC↑
FISH	A/B	0	B/C
MACRO INVERTEBRATES	A/B	0	B/C
INSTREAM	A/B	0	B/C
RIPARIAN VEGETATION	B/C	0	C
ECOSTATUS	B		C
INSTREAM IHI	A/B		
RIPARIAN IHI	B		
EIS	MODERATE		

6 FIELD SURVEY

6.1 Site survey

For the purposes of the site survey the proposed infrastructure layout has been separated into three sections; A, B and C (See Figure 6.1). Each section will be discussed individually, with certain aspects of greater importance highlighted.

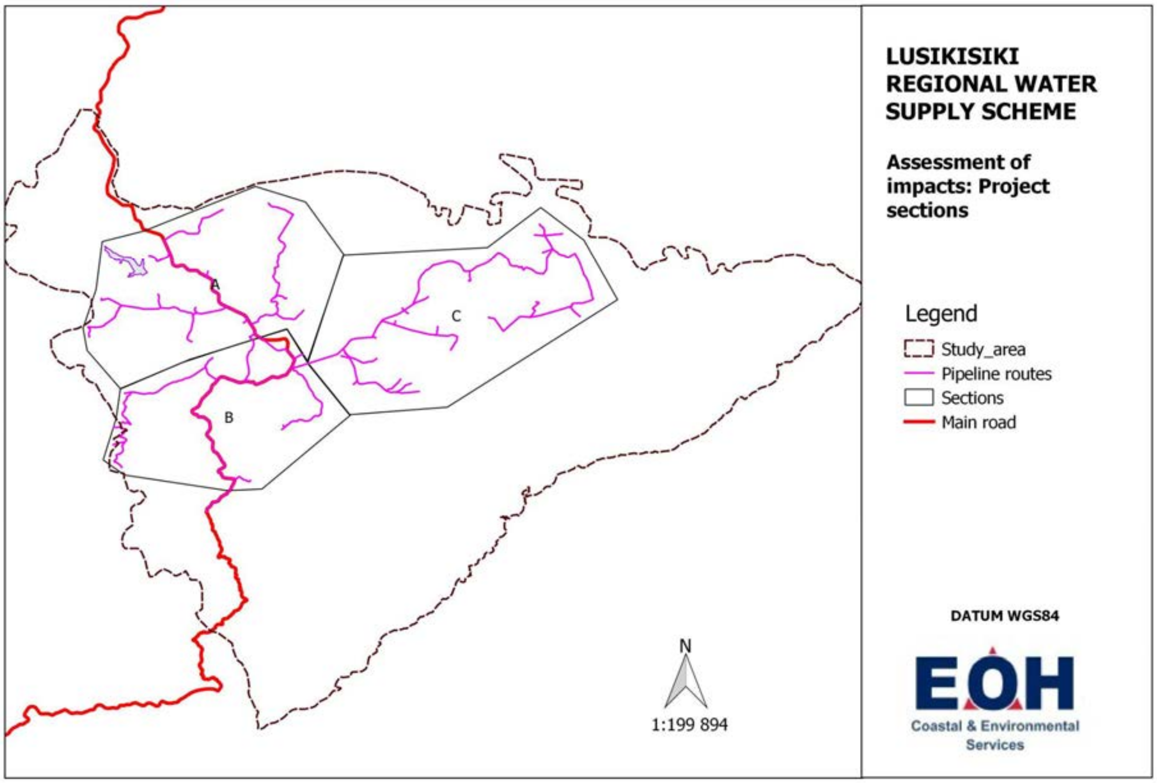

Figure 6.1: Section A, B and C of the project infrastructure

6.1.1 Section A

Section A includes the dam site, abstraction weir and water treatment works (Figure 6.2). Other notable impacts on the aquatic environment include the possible upgrading of a bridge downstream of the dam site, below the Palmarton Mission School.

The major rivers in this section are the Xura and Xurana Rivers. The Xura River will be impounded at the Zalu Dam site, water will be abstracted at the abstraction weir approximately 7 km downstream of the dam, and will be crossed once by pipeline infrastructure. The Xurana River will be crossed by pipeline infrastructure once.

The NFEPA wetland database indicates 3 small channelled valley bottom wetlands within the inundation area of the dam. Channelled valley-bottom wetlands are characterised by their location on valley floors, the absence of characteristic floodplain features and the presence of a river channel flowing through the wetland, i.e. the Xura River.

In total, 24 direct impacts on water resources by proposed infrastructure have been identified in this section. These will all require authorisation from the Department of Water and Sanitation in the form of Water Use Licenses.

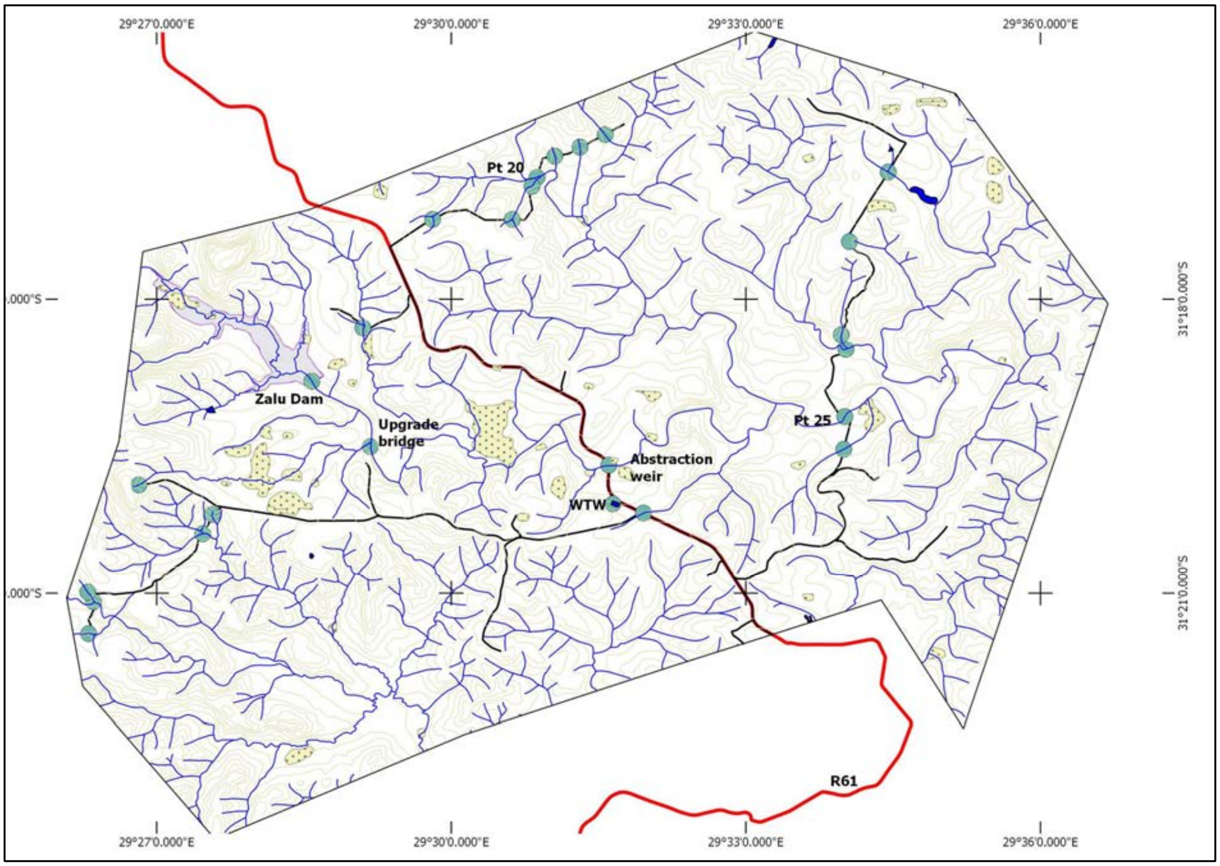

Figure 6.2: Section A. Points of aquatic impact are indicated with circles.

Proposed Zalu Dam
GPS Coordinates of Dam Wall: 31°54.78"S, 29°28'36.24"E
Site description: The lower-lying areas of the riverbank are dominated by remnants of riparian forest species (Common Guarii (*Euclea undulata*) and Buffalo-thorn (*Ziziphus mucronata*)) and Small-leaved Trimeria (*Trimeria trinervis*). The woody species have been removed for firewood and the area has been heavily grazed. The instream channel is occupied by plants that are associated with water (i.e. Ruigtegras (*Miscanthus capensis*), Cape Bulrush (*Typha capensis*), Sedge (*Schoenoplectus littoralis*) and the Common Reed (*Phragmites australis*)). The rest of the riverbank was covered by the Wild Date Palm (*Phoenix reclinata*), which has been stunted due to grazing.Small reaches of the riverbank were composed of rock and cliffs. Plants found on these formations include the Cape Aloe (*Aloe ferox*, *Aloe puridens*), Spekboom (*Portulacaria afra*), Tree Euphorbia, (*Euphorbia triangularis*), Sisal spesies and Giant Turpentine Grass (*Cymbopogon validus*). The Present Ecological Status is Class B, which indicates that the site is largely natural with few modifications, but some loss of natural habitat, particularly riparian habitat, is evident. The riparian zones have been degraded by riverbank erosion, which was caused by the removal of stabilising vegetation that binds the soil and erosion gullies that are formed by vehicle tracks and animal paths. The cultivation of maize crops, wood-cutting and intensive grazing have severely impacted the riparian zone. Currently, impacts on the instream component are relatively small as indicated by the Class B status.

Figure 6.3. Aerial view of proposed Zalu Dam inundation area

Figure 6.4. The Xura River within the dam inundation area

Figure 6.5. The Xura River within the dam inundation area.

Figure 6.6 and 6.7: Channeled valley-bottom wetlands indicated in the NFEPA database. The aerial images clearly show that the areas have been heavily cultivated.

Figure 6.8: Evidence of extensive ploughing and cattle grazing in the inundation area, stretching right to the river banks in some areas.

Bridge upgrade
GPS Coordinates: 31°19'31.20"S, 29°29'10.28"E
Site description: Located 390 m south of the Palmarton Mission. The bridge may need to be upgraded in order to be used by heavy vehicles during construction of the dam wall. It is also heavily utilised by the communities, and this will need to be taken into account in the design, either by attaching a pedestrian bridge alongside the vehicle bridge, or by constructing a separate pedestrian bridge nearby. In the event that the bridge is not used during the construction phase, it would still be important to confirm that the proposed changes to the flow of the Xura River will not render the bridge unsafe for further use by the communities.

Figure 6.9. Aerial view of bridge site

Figure 6.10. Upstream view from the bridge

Figure 6.11. Downstream view from the bridge

Abstraction Weir

GPS Coordinates: 31°19'41.56"S, 29°31'36.29"E

Site description: The existing abstraction works may need to be upgraded to account for an increased abstraction volume.

Figure 6.12. Aerial view of the abstraction weir site.

Figure 6.13. Upstream view of the Xura River from the road bridge above the current abstraction infrastructure.

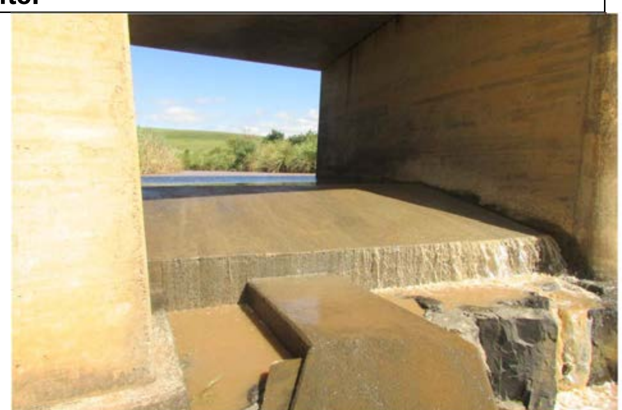

Figure 6.14 Existing abstraction weir.

Figure 6.15: Abstraction pipeline infrastructure on the downstream side of the road bridge.

Figure 6.16: Gauging weir on the upstream side of the road bridge.

Pipeline crossing the Xurana River

GPS Coordinates: 31°16'45.17"S, 29°30'52.36"E

Site description: Access to this site was not possible within the time constraints. Photographs were taken from approximately 800 m away from the crossing on the western side of the river. It appears that there may be some intact riparian vegetation along the western bank of the river at the crossing site, but the eastern bank (floodplain) appears to be/have been cultivated.

Figure 6.17. Aerial veiw of the pipeline crossing site.

Figure 6.18. Approximate direction of the pipeline crossing the Xurana River.

Pipeline crossing the Xura River
GPS Coordinates: 31°19'11.44"S, 29°34'00.10"E
Site description: The pipeline will cross the Xura River at an existing bridge crossing site. There is little/no riparian vegetation at the site, and evidence of significant erosion. The site is hevily impacted by various types of traffic (foot, vehicle, livestock).

Figure 6.19. Aerial veiw of the pipeline crossing site.

Figure 6.20. Upstream view of the Xura River from the existing road bridge.

Figure 6.21 Downstream view of the Xura River from the existing road bridge.

6.1.2 Section B

Section B comprises only pipeline reticulation (Figure 6.22). In total, 23 impacts on the aquatic environment will occur due to proposed infrastructure construction.

The major rivers in this section are the Mntafufu and the Mzintlava. The pipeline route may also impact on wetlands in this section. The NFEPA wetland database lists a channelled valley-bottom wetland on the western edge of the section, associated with the Mntafufu River, and a system of sub-escarpment savannah seep wetlands in the north-eastern section, within Lusikisiki town.

A seep wetland is generally located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend onto a valley floor.

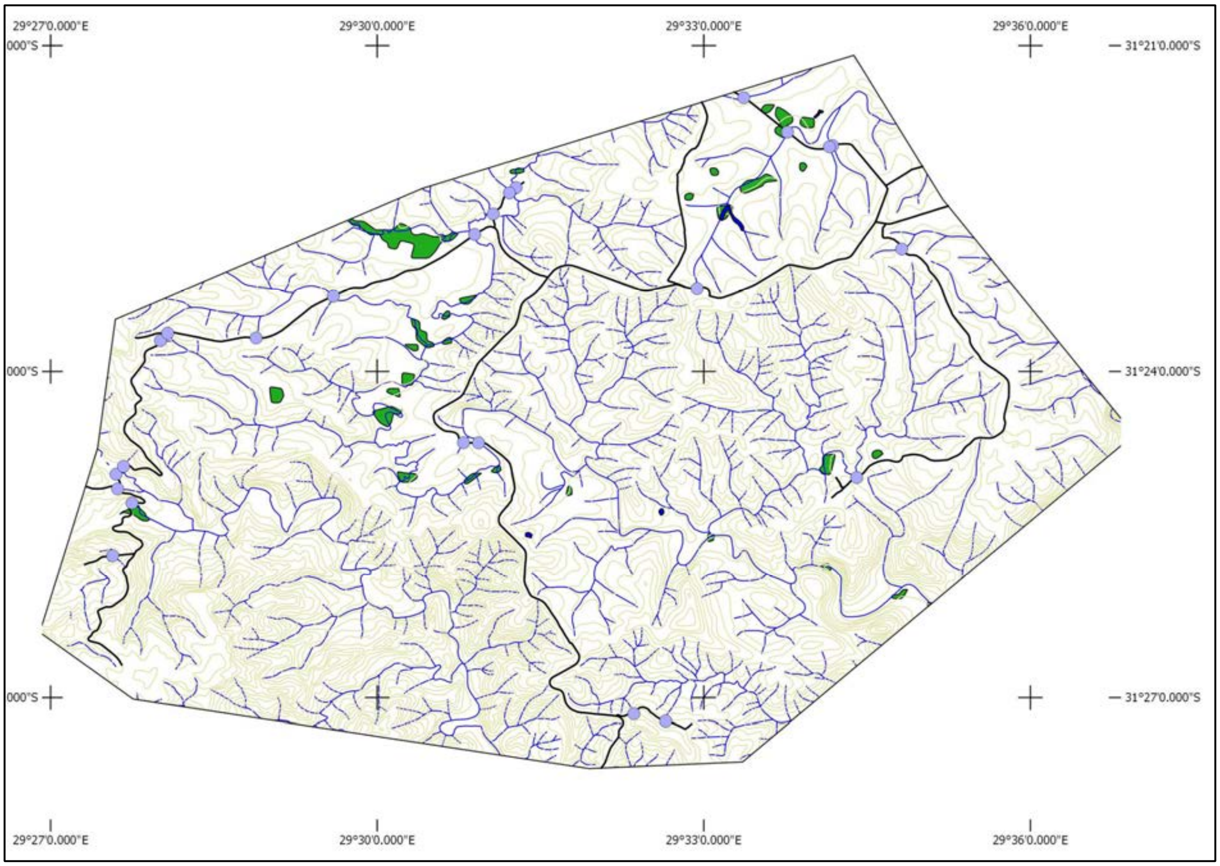

Figure 6.22: Section B. Points of aquatic impact are indicated with circles.

Pipeline crossing the Mntafufu River and associated wetland.

GPS coordinates: 31°25'13.24"S, 29°27'44.31"E

Site Description: A road bridge exists at the proposed crossing site. Immediately upstream and downstream of the bridge, the riparian zone is heavily impacted by alien vegetation. There is also a well-sued vehicle track down to the river bank approximately 30m downstream of the bridge. It is highly likely that vehicles are washed at this point. Both sides of the river bank show evidence of recent cultivation, and no surface visual evidence exists of the presence of the wetland listed in the NFEPA database.

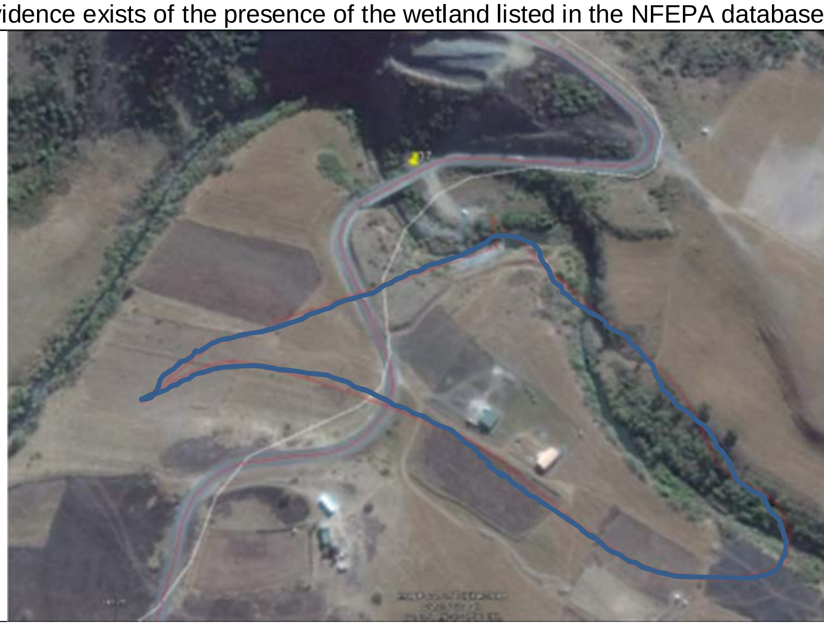

Figure 6.23: Aerial view of the pipeline crossing. The outline of the listed wetland is also indicated.

	
Figure 6.24: A view of the Mntafufu River downstream of the bridge. In the foreground of the photo a bush of invasive *Senna sp*. can be seen.	**Figure 6.25: A view of the Mntafufu River upstream of the bridge. The banks are relatively shallow, with evidence of bank erosion present.**

Pipeline crossing the Mzintlava River (1)
GPS coordinates: 31°22'44.60"S, 29°30'53.55"E
Site Description: There is an existing bridge crossing at the proposed crossing site. There is evidence of erosion on both sides of the bridge. At the time of the site visit, the water level was quite low. There is little/no riparian zone evident.

Figure 6.26. Aerial image of the pipeline crossing site

	
Figure 6.27 Upstream view of the Mzintlava River at the bridge.	**Figure 6.28. Downstream view of the Mzintlava River at the bridge.**

Pipeline crossing the Mzintlava River (2)
GPS coordinates: 31°24'39.43"S, 29°30'56.06"E
Site description: There is an existing road bridge at the crossing site. The river banks are relatively steeply incised and there is little/no riparian vegetation or riparian zone.

Figure 6.29. Aerial image of the pipeline crossing site

	
Figure 6.30. View of the river bank downstream of the road bridge.	**Figure 6.31. Upstream view of the Mzintlava River from the bridge.**

Wetland system in Lusikisiki
GPS Coordinates:31°24'56.74"S, 29°27'36.05"E
Site description: The area has been heavily grazed and potentially historically cultivated. No pristine wetalnd habitat was noted.

Figure 6.32: Aerial view of seep wetlands and watercourse within Lusikisiki town.

Figure 6.33 View of the wetland seep area on the slope above the watercourse on the eastern side of the road (R61).

Figure 6.34: According to the NFEPA database, a seep wetland should be located as indicated by the blue polygon. The river has an associated wetland in the background of the picture.

Figure 6.35: The course of the river can be followed by following the wetland vegetation.

Figure 6.36: The river course on the western side of the road (R61).

Figure 6.37: The “floodplain” area associated with the watercourse on the western side of the road (R61).

Figure 6.38: Watercourse and associated wetland on the eastern side of the R61.

Figure 6.39: Watercourse and associated wetland on the eastern side of the R61.

Figure 6.40: Wetland area in vicinity of the watercourse crossing at 31° 21’ 55.84”S, 29° 34’ 09.82”E.

Figure 6.41: Watercourse downstream of the watercourse crossing at 31° 21’ 55.84”S, 29° 34’ 09.82”E.

6.1.3 Section C

Section C comprises only pipeline reticulation (Figure 6.42). In total, 18 impacts on the aquatic environment will occur due to proposed infrastructure construction.

The major river in this section is the Mateku River, which is traversed at five locations.

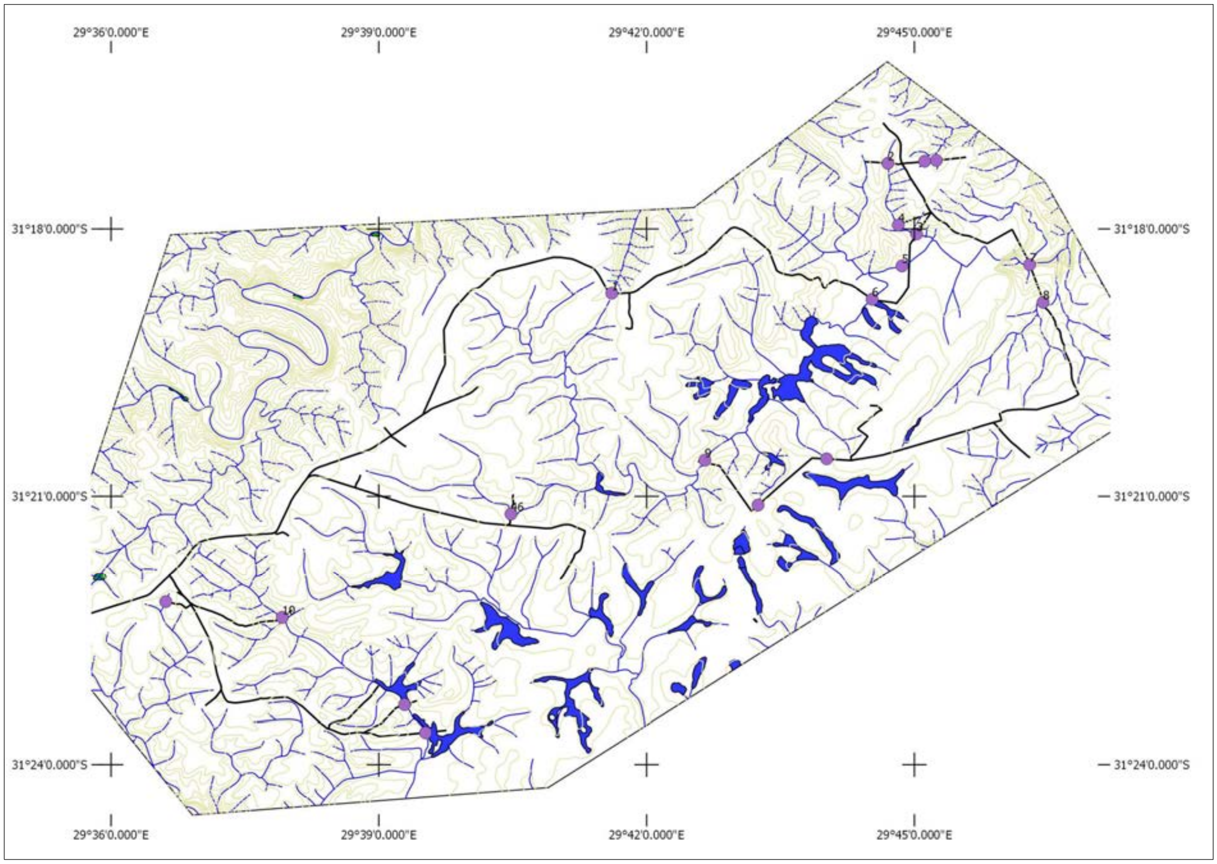

Figure 6.42: Section C. Points of aquatic impact are indicated with circles.

First crossing of the Mateku River
GPS Coordinates: 31°21'12.58"S, 29°40'28.69"E
Site description: The river channel is fairly narrow at this point, the banks are steep with very little erosion. No riparian vegetation is present. A large quarry is located immediately downstream of the site, on the western bank.

Figure 6.43. Aerial view of the proposed crossing site.

	
Figure 6.44 Downstream view of pipeline crossing	**Figure 6.45 Upstream view of pipeline crossing**

Second crossing of the Mateku RIver
GPS Coordinates: 31°20'37.27"S, 29°42'38.06"E
Site description: The crossing site occurs between two relatively steep slopes. There is a large amount of erosion along the channel, particularly upstream of the crossing site. No riparian vegetation is present.

Figure 6.46. Aerial view of the proposed crossing site.

<table>
<tr><td></td><td></td></tr>
<tr><td>Figure 6.47 Upstream view of pipeline crossing</td><td>Figure 6.48 Downstream view of pipeline crossing</td></tr>
</table>

Third crossing of the Mateku River
GPS Coordinates: 31°18'47.23"S, 29°44'30.91"E
Site description: The river flows through a relatively flat area. The surrounding area has been utilized for various agricultural activies.

Figure 6.49. Aerial view of the proposed crossing site.

Figure 6.50 Upstream view of pipeline crossing

Figure 6.51 Downstream view of pipeline crossing

Fourth crossing of the Mateku River
GPS Coordinates: 31°25'12.68"S, 29°27'44.85"E
Site description: The river bank directly north of the proposed pipeline crossing is very steep. Riparian vegetation is visible along the river at the crossing point.

Figure 6.52. Aerial view

Figure 6.53 Upstream view of pipeline crossing

Figure 6.54 Downstream view of pipeline crossing

Fifth crossing of the Mateku River
GPS Coordinates: 31°18'24.3"S, 29°46'18.22"E
Site description: The pipeline crosses at a point where the river has descended into a very steep and deeply incised valley which joins the Msikaba River approximately 2.5 km downstream. The crossing point is quite narrow. A pipe bridge will be the only way to cross at this point. The valley itself contains signficant riparian vegetation. <u>It is recommended that this crossing be avoided if possible.</u>

Figure 6.55. Aerial view of the proposed crossing site.

Figure 6.56. View of pipeline crossing

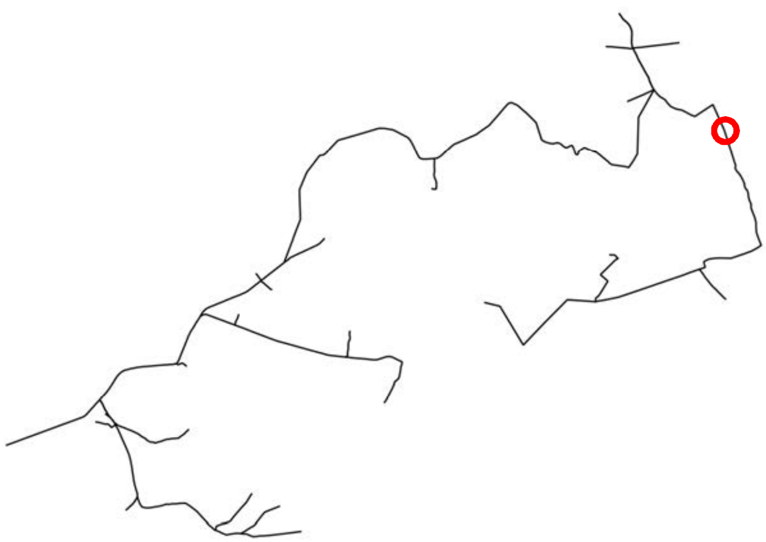

Figure 6.58. The current pipeline routing for Section C. Mateku crossing 5 is circled.

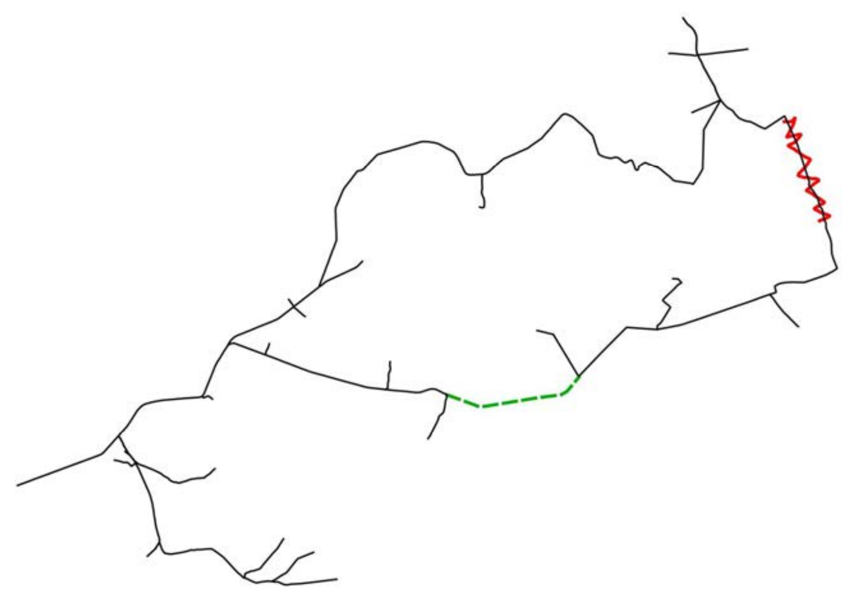

Figure 6.59. A suggested alternative routing, where all communities served in the current routing are still served, but the 5th crossing of the Mateku River is avoided. Remove the section scratched out in red, and add the dotted line in green.

6.2 Site sensitivity

The study area of the proposed project has been mapped in terms of aquatic ecological sensitivity. A corridor of approximately 300m on either side of the proposed pipeline route was included in the analysis.

The following areas were deemed sensitive:
1. Water courses, including a 50 metre buffer;
2. Wetlands within the inundation area, and along the pipeline route, including a 500m buffer;

The sensitivity maps were developed by identifying areas of high and moderate sensitivity (Figure 6.60, 6.61 and 6.62).

Areas of high sensitivity (RED) include:
- Un-degraded process areas such as rivers, wetlands and streams that are important for ecosystem functioning, including surface and ground water as well as animal and plant dispersal;
- River reaches of major systems that are important for overall ecosystem functioning

Areas of moderate sensitivity (ORANGE) include:
- Areas that still provide a valuable contribution to biodiversity and ecosystem functioning despite being degraded;
- Smaller tributaries of larger river systems

In ALL cases, Water Use Authorisations MUST be obtained from the Department of Water and Sanitation prior to the start of any construction within the respective buffer areas of the rivers, streams and wetlands.

Although in some cases there was no visual evidence on site of a functioning wetland, because these areas have been mapped in the NFEPA wetland database, they have been included in the sensitivity analysis and treated as fully functional wetlands.

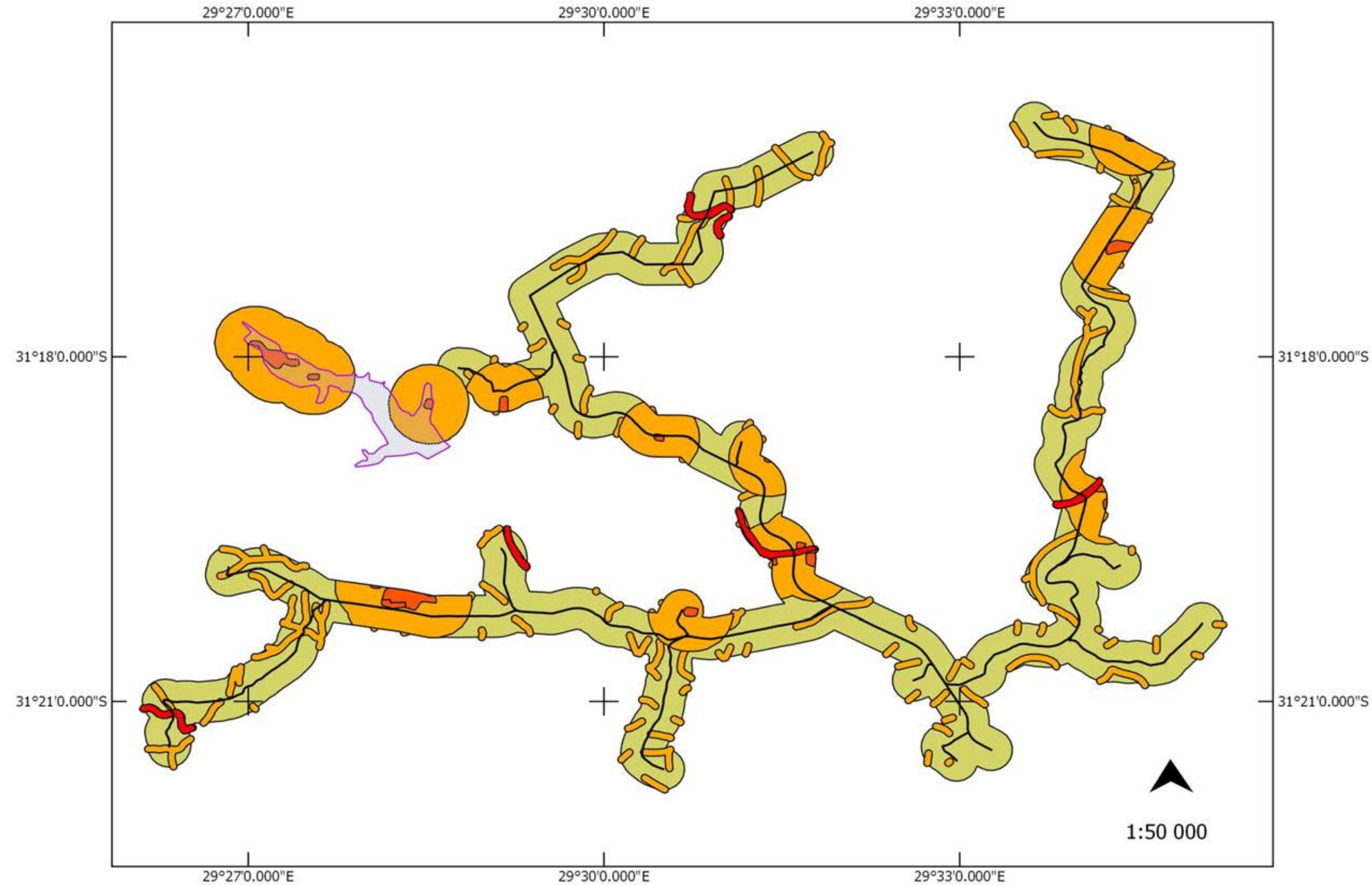

Figure 6.60. Sensitivity analysis of Section A.

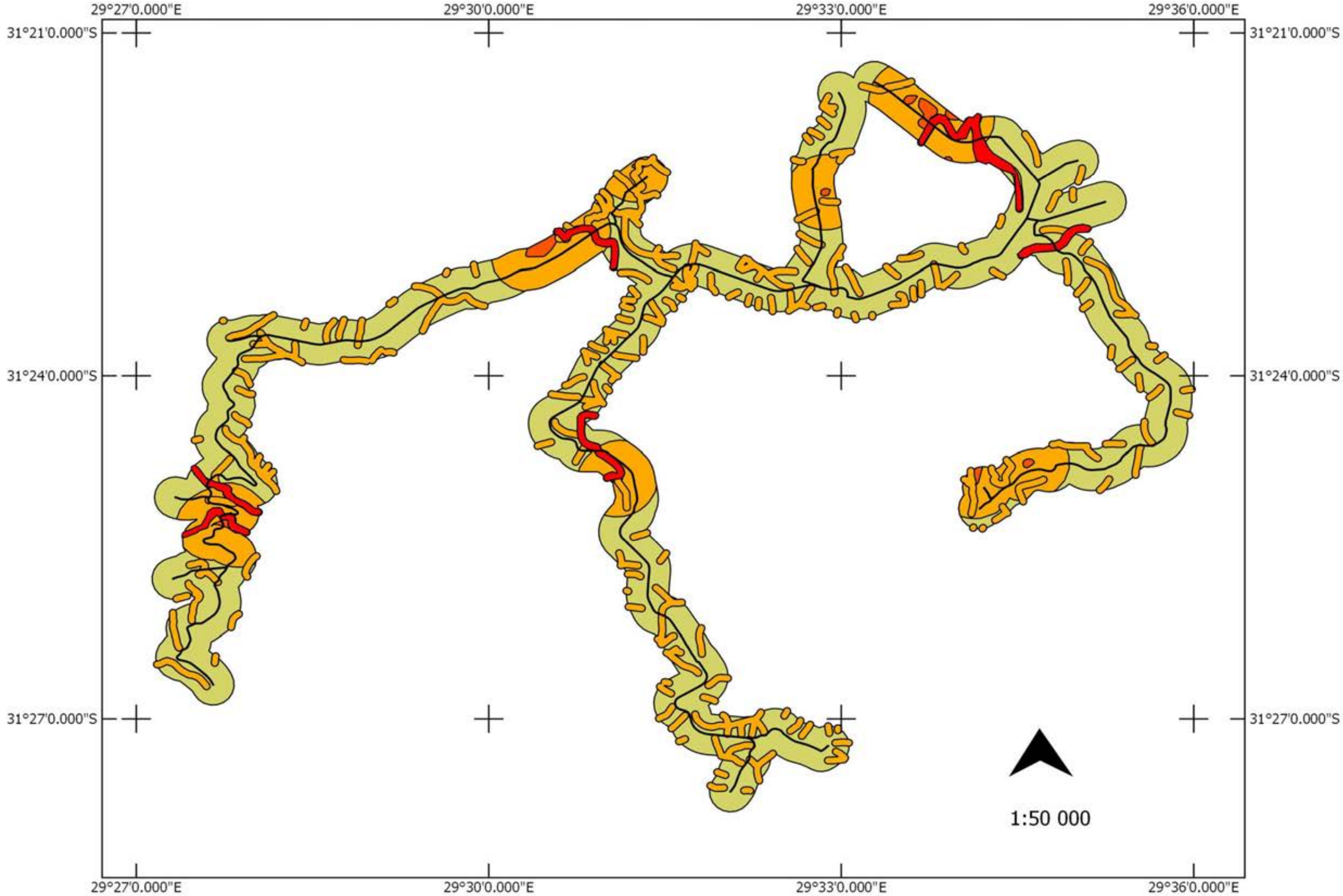

Figure 6.61. Sensitivity analysis of Section B.

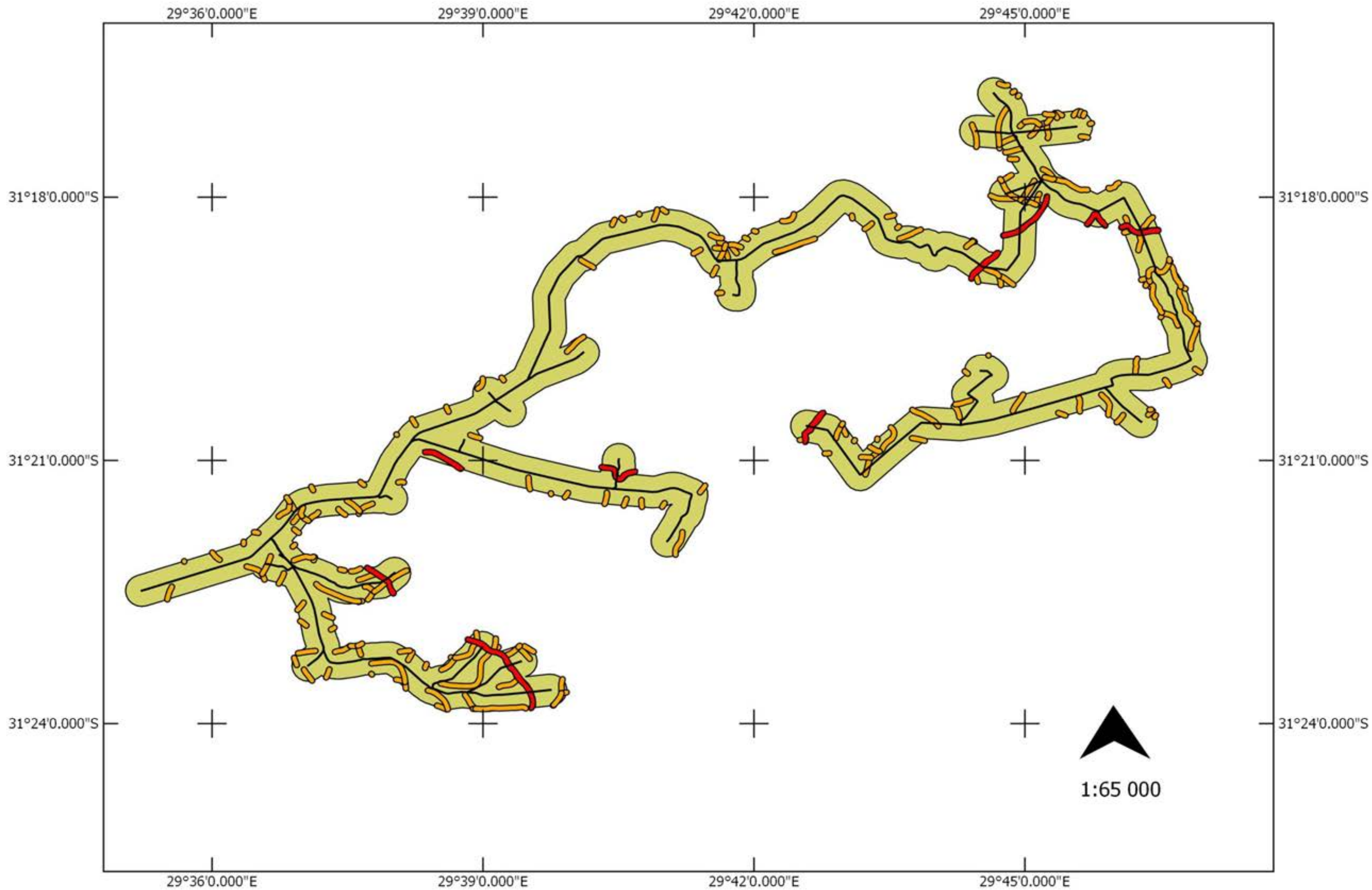

Figure 6.62. Sensitivity analysis of Section C.

7 IMPACT IDENTIFICATION AND ASSESSMENT

7.1 Impacts identified in the Scoping Report

The Scoping Report identified impacts specific to the aquatic environment in both the Construction and Operational phases of the project.

Construction Phase
Issue 1: Surface- and groundwater pollution Various substances may result in the pollution of surface- and groundwater sources. Construction activities may lead to sediment being deposited into wetlands and/or drainage areas. Pollution may occur from poor vehicle maintenance and improper storage of hazardous materials such as fuel and other hydrocarbons.
Issue 2: Wetlands During the construction phase there may be impacts on wetlands in terms of vegetation clearing (intact communities, species of special concern, etc.) and pollution (such as sediment, solid waste and hydrocarbons). All wetlands are protected in terms of the National Water Act and should be avoided where possible.
Issue 3: Impacts on the Xura River downstream of the dam The river may have to be temporarily diverted during the construction phase, resulting in various environmental issues like sedimentation.
Operational Phase
Issue 1: Impacts on the Xura River downstream of the dam The reduction in mean annual run-off due to the construction of the Zalu Dam may have impacts on the river and estuary downstream of the dam. This includes changes in water quality.

These issues will be assessed as part of the current report

7.2 Alternatives

The impacts of pipeline reticulation on the aquatic environment will be limited to areas where pipelines cross rivers/streams only. Three alternatives are assessed:

- Alternative A: Buried pipelines, i.e. trenching
  - Trenching within a stream bed consists of digging an open trench in the stream bottom, laying the pipe and then backfilling the trench. Depending on the prevailing conditions (weather, stream flow, etc.) this can be achieved with or without the use of temporary coffer dams and stream diversion techniques.
- Alternative B: Above ground pipeline, i.e. a pipe bridge across the watercourse OR attachment to an existing bridge
  - A **pipe bridge** is a bridge for running a pipeline over a river. Pipe bridges are, as a rule, only built when it is not possible to run the pipeline on a conventional bridge or under the river.
- Alternative C: Trenchless buried pipelines, i.e. horizontal directional drilling
  - **Horizontal directional drilling** is a type of subsurface construction work that requires few trenches or no continuous trenches. The method requires considering soil characteristics and the loads applied to the surface, e.g. in cases where the soil is sandy, the water table is at shallow depth, or heavy loads like that of urban traffic are expected, the depth of excavation has to be such that the pressure of the load on the surface does not affect the bore, otherwise there is danger of surface caving in.
  - Installation of a pipeline by HDD is generally accomplished in three stages:
    1. The first stage consists of drilling a small diameter pilot hole along a planned directional path. The path of the drilling string is tracked and directed using surface monitoring systems. The surface monitoring system determines the

location of the drill bit in the hole by taking measurements from a grid or point on the surface. This allows the operator to follow the designed directional path.

2. The second stage involves enlarging the pilot hole to a diameter that will accommodate the pipeline. The enlargement process involves the use of hydraulic cutting with drill bits and jet nozzles and hydraulic motors (also called ñmud motorsò) used to cut harder soils. It can take several passes to enlarge the hole to the required diameter, which is typically 12 inches larger than the pipeline being installed.

3. The third stage begins once the pilot hole is enlarged to the correct size. The section of pipe, prepared in advance, is pulled back through the hole using the horizontal-directional drilling unit.

- HDD uses bentonite clay slurry as a drilling fluid to maintain lubrication and cooling at the drilling tip. The slurry is able to escape via subterranean fractures, and while this does not always cause a problem, releases to aquatic environments are more difficult to contain due to the dispersive nature of the bentonite slurry. Bentonite is non-toxic, but there are two specific indirect effects of bentonite on aquatic life. Initially, the suspended bentonite may inhibit respiration of fishes, although this is typically short-lived. Once the bentonite settles, secondary long-term effects can result. For example, egg masses of fish could be covered by a layer of bentonite inhibiting the flow of dissolved oxygen to the egg masses. Secondly, benthonic invertebrates and/or the larval stages of pelagic organisms may be covered and suffocate due to fouled gills and/or lack of oxygen.

7.3 Assessment of Impacts

The impact assessment has been broken down into the following activity assessments:

- General impacts, *Planning and Design, Construction, and Operation*
- Zalu Dam and abstraction infrastructure, *Construction and Operation*

In order to accurately assess the effects of the operation of the dam on the Xura River, the river should be broken into three ñreachesò as was done in the Ecological Reserve report (DWS, 2014). Figure 7.1 indicates the three reaches; Reach 1 is the scour zone, heavily impacted by very high baseflows (releases meant for abstraction), and reduced flooding; Reach 2 is the dewatered zone, immediately downstream of the abstraction weir. Baseflows will be very low, and the reach will experience very little in the way of flooding. Reach 3 is the recovery zone, inputs from large tributaries will help to ameliorate the impact of the dam, and the reach will experience more varied baseflow volumes and some flooding. Each of the reaches will be impacted differently by the dam.

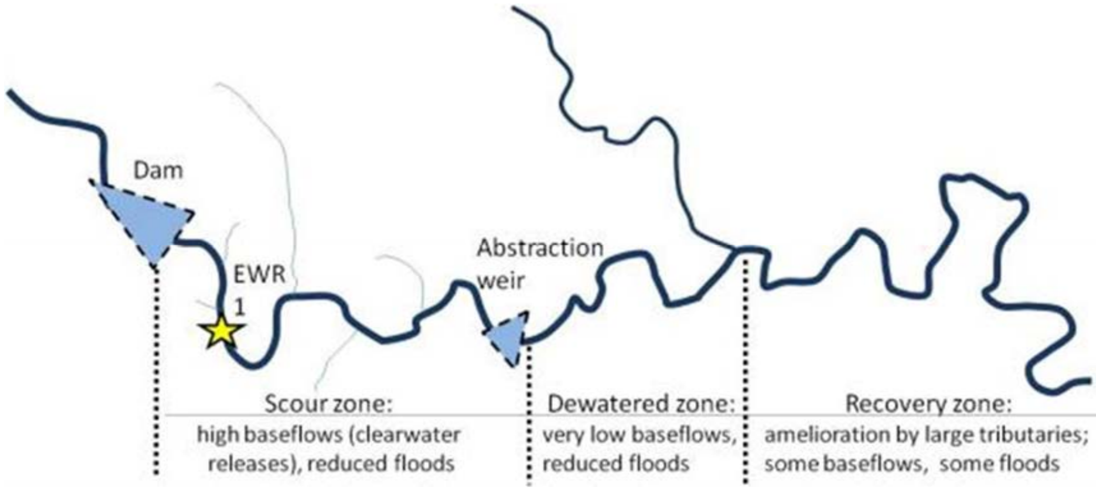

Figure 7.1 Line diagram (not to scale) illustrating the various impact zones below the proposed dam, taken from the Ecological Reserve Report (DWS, 2014).

- Pipeline reticulation, *Construction and Operation*

The impacts of pipeline reticulation on the aquatic environment will be limited to areas where pipelines cross rivers/streams only. Three alternatives are assessed:

- Alternative A: Buried pipelines, i.e. trenching
- Alternative B: Above ground pipeline, i.e. a pipe bridge
- Alternative C: Trenchless buried pipelines, i.e. directional drilling

- Bridge upgrade near Palmerton Mission, *Planning and Design and Construction*

7.3.1 General Impacts

Table 7.1: General impacts associated with the proposed infrastructure.

General							
PLANNING AND DESIGN PHASE							
IMPACT	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Issue: Legal and policy compliance							
Non-compliance with the laws and policies of South Africa as the pertain to the aquatic environment could lead to unnecessary delays in construction activities, and potentially criminal cases, based on the severity of the non-compliance, being brought against the proponent and his/her contractors.	**Localised, Study Area**	**Short term**	**Probable**	**Moderately negative**	**MODERATE NEGATIVE**	• All legal matters pertaining to permitting must be completed prior to construction. In particular, all necessary Water Use Licences must be in order.	**LOW NEGATIVE**
Issue: Loss of sensitive aquatic habitat							
Inadequate assessment of the planned route of pipelines and positioning of the dam, and compilation of the dam operating rules during the planning of the project could lead to widespread degradation and loss of potentially sensitive aquatic habitats in both the	**Regional**	**Long term**	**Definite**	**Highly negative**	**VERY HIGH NEGATIVE**	• The planning of all infrastructures, including locations and operating rules, must take place with suitable regard for the environment. Suitably qualified specialists MUST be consulted during the planning phase.	**MODERATE/ LOW NEGATIVE**

inundation area, and downstream of the dam.							
Issue: Scheduling of construction							
Construction scheduling that does not take into account the seasonal requirements of the aquatic environment, e.g. allowing for unimpeded flood events, could lead to short-term (and potentially long-term) impacts such as excessive sediment mobilization, etc.	**Regional**	**Short term**	**Possible**	**Moderately negative**	**MODERATE NEGATIVE**	• Wherever possible, construction activities must be undertaken during the driest part of the year to minimize downstream sedimentation due to excavation, etc.. • When not possible, suitable stream diversions structures must be used to ensure that rivers/streams are not negatively impacted by construction activity.	**LOW NEGATIVE**

7.3.2 Zalu Dam and abstraction infrastructure

Table 7.2: Construction Phase impacts associated with the proposed Zalu Dam and abstraction infrastructure.

CONSTRUCTION PHASE							
IMPACT	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Issue: Water Quality							
Wet concrete (for dam wall construction) is highly alkaline. Could result in flash kills of macroinvertebrates and fish species in the vicinity (See appendix A)	**Localised**	**Short term**	**Probable**	**Moderately severe**	**MODERATE NEGATIVE**	• No concrete mixing to take place within 32m of the river bank. • A serviced CO_2 fire extinguisher should be available on site in the event that wet concrete is accidentally spilled into the river. • The mitigation measures in Appendix A must be read in conjunction with this report.	**LOW NEGATIVE**
Issue: Channel banks and soils							
Dam wall construction activities could result in localised erosion and affect bank stability. Associated vegetation removal could also destabilise the banks.	**Localised**	**Medium-term**	**Probable**	**Severe**	**HIGH NEGATIVE**	• Construction activities should take place during the driest season	**MODERATE NEGATIVE**
Issue: Riparian vegetation							
Indiscriminate removal of riparian vegetation at the dam site may lead to disturbance of the aquatic ecosystem	**Localised**	**Medium-term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	• Removal of riparian vegetation must take place under the supervision of the ECO. • Removal of the alien	**LOW NEGATIVE**

CONSTRUCTION PHASE							
IMPACT	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
						invasive vegetation should be prioritised	
Issue: Sedimentation							
Excavations within the inundation area for material for dam construction, if undertaken without proper precautions, could mobilize large volumes of sediment into the Xura River, reducing aquatic habitat and decreasing water quality.	**Study area, downstream of the dam**	**Short term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	• The river must be diverted away from areas where excavation within the inundation area is to take place. • Excavation should take place in the drier months of the year in order to limit the influence of stormwater on the mobilization of sediment. • If necessary, stabilize berms should be used to prevent stormwater from carrying sediment into the existing river channel.	**LOW NEGATIVE**
Issue: Water quantity							
Impeding the existing flow of the river during construction will result in the degradation of the aquatic environment downstream of the dam, essentially halting all of the ecosystem functions that the river plays.	**Study area, downstream of the dam**	**Medium term**	**Possible**	**Severe**	**HIGH NEGATIVE**	• During construction, all care should be taken to ensure that the ecological reserve volume of water is always released into the river downstream of the dam site.	**LOW NEGATIVE**

Table 7.3: Operation Phase impacts associated with the proposed Zalu Dam and abstraction infrastructure.

OPERATION PHASE							
GENERAL AND SPECIALIST STUDY IMPACTS	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Issue: Water quality							
Dams typically act as nutrient "sinks", trapping excess nutrients along with the sediments that would originally have moved freely down the length of the river. This may improve the quality of the water downstream of the dam. In particular, the water clarity will improve, with "clear" water becoming the predominant release from the dam.	**Localised, study area and down-stream**	**Long-term**	**Definite**	**Moderately positive**	**MODERATE POSITIVE**	• No mitigation provided	**MODERATE POSITIVE**
Issue: Geomorphology							
The condition of the river geomorphology in the scour zone will degrade since sediment will be trapped in the dam, causing clear water (sediment free) releases to the downstream reach. These clear water releases will scour the bed of this reach, causing deepening of the channel in alluvial	**Localised, immediately downstream of the dam to the abstraction works: Reach 1**	**Long-term**	**Definite**	**Moderately severe**	**MODERATE NEGATIVE**	• The dam operating rules must stipulate that there be infrequent but regular releases of water from the lower section of the dam, allowing sediment to move through the system.	**LOW NEGATIVE**

OPERATION PHASE							
GENERAL AND SPECIALIST STUDY IMPACTS	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
sections and widening in sections where shallow bedrock prevents incision.							
At the abstraction weir the baseflows released from the dam will be abstracted from the river. This will result in the reach immediately downstream of the weir experiencing very low baseflows.	**Localised, from the abstraction works to the next major tributary: Reach 2**	**Long term**	**Definite**	**Low severity**	**LOW NEGATIVE**	• The effects of the reduced sediment load should be alleviated naturally by upstream erosion and tributaries at this point, so existing flows from tributaries can be used to maintain sediment flow.	**LOW NEGATIVE**
Reduced floods are likely to cause a degradation of the riparian and in-channel habitat conditions through reduced scour abilities of the river.	**Localised, reach from the next major tributary to the confluence with the Msikaba River: Reach 3**	**Long term**	**Definite**	**Low severity**	**LOW NEGATIVE**	• Downstream of large tributary junctions, the impacts of the dam will be progressively reduced through the amelioration provided by sediment and inflows entering from the tributaries	**LOW NEGATIVE**
Issue: Riparian vegetation							
The sediment-free or clearwater releases and the resultant scour will decrease the availability of any riparian habitat (Instream and	**Localised, immediately downstream of the dam to the abstraction**	**Long-term**	**Definite**	**Severe**	**MODERATE NEGATIVE**	• The dam operating rules must stipulate that there be regular releases of sediment from the dam. This	**MODERATE NEGATIVE**

OPERATION PHASE							
GENERAL AND SPECIALIST STUDY IMPACTS	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Marginal), particularly where incision takes place within the alluvial sections coupled to the loss of fine sediment needed for plants to root in, i.e. the riparian zone will narrow, losing its eco-tonal or transitional nature between the aquatic and terrestrial environments.	**works: Reach 1**					may lessen the overall affect.	
The potential reduction in baseflows, due to abstraction at the weir, would impact on the potential availability of water to supply the adjacent riparian zones and could thus reduce the overall extent of these habitats.	**Localised, from the abstraction works to the next major tributary: Reach 2**	**Long-term**	**Definite**	**Moderately severe**	**MODERATE NEGATIVE**	• The ecological reserve volume must be released at all times and seasonality maintained in the river downstream of the dam.	**LOW NEGATIVE**
Issue: Fish							
Reduced breeding success of *Barbus* ñTranskeiò n. sp. (Transkei barb), a new species. Breeding is triggered by high flows (i.e. floods), and the dam wall could reduce the severity of these	**Localised, study area and down-stream**	**Long-term**	**Possible**	**Severe**	**HIGH NEGATIVE**	• The ecological reserve volume must be released at all times and seasonality maintained in the river downstream of the dam.	**MODERATE NEGATIVE**

OPERATION PHASE							
GENERAL AND SPECIALIST STUDY IMPACTS	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
high waters, thereby muting the breeding signals for the fish. The number of spawning events could also be reduced by the capture of the high flow events by the dam.							
Disruption of the normal migratory behaviour of eels	**Localised, study area and down-stream**	**Long-term**	**Possible**	**Severe**	**HIGH NEGATIVE**	• The ecological reserve volume must be released at all times and seasonality maintained in the river downstream of the dam.	**MODERATE NEGATIVE**
Issue: Macroinvertebrates							
Reduction in the sediment content of water downstream of the dam could reduce both the availability of food and habitat for macroinvertebrates	**Localised, study area and down-stream**	**Long-term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	• The ecological reserve volume must be released at all times and seasonality maintained in the river downstream of the dam. • Regular releases of sediment from the dam may lessen the overall effect.	**LOW NEGATIVE**

7.3.3 Pipeline reticulation

Alt A: Trenched pipeline, Alt B: Above ground pipeline, Alt C: Horizontal Directional Drilling

Table 7.4: Construction Phase impacts associated with the proposed pipeline infrastructure.

CONSTRUCTION PHASE							
	SPATIAL SCALE	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY/ BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
Issue: Water Quality							
Impact: Wet concrete is highly alkaline. Accidental contamination of water resources could result in flash kills of macroinvertebrates and fish species in the vicinity (See appendix A)							
A	**Localised**	**Short-term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	• The mitigation measures in Appendix A must be read in conjunction with this report. • A serviced CO_2 fire extinguisher should be available on site in the event that wet concrete is accidentally spilled into the river • No concrete mixing will take place within 32m of the river bank.	**LOW NEGATIVE**
B	**Localised**	**Short-term**	**Possible**	**Slight**	**LOW NEGATIVE**	• The mitigation measures in Appendix A must be read in conjunction with this report. • A serviced CO_2 fire extinguisher should be available on site in the event that wet concrete is accidentally spilled into the river • No concrete mixing will take place within 32m of the river bank.	**LOW NEGATIVE**

CONSTRUCTION PHASE							
	SPATIAL SCALE	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY/ BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
C					**No impact**		**No impact**
Impact: Pollution from accidental spills of chemicals in the vicinity of water courses.							
A	**Localised**	**Short-term**	**Possible**	**Slight**	**LOW NEGATIVE**	• No machinery should be parked overnight within 50 m of a watercourse. • All stationery should be equipped with a drip tray to retain any oil leaks. • No concrete mixing will take place within 32m of the river bank.	**LOW NEGATIVE**
B	**Localised**	**Short-term**	**Possible**	**Slight**	**LOW NEGATIVE**	• No machinery should be parked overnight within 50 m of a watercourse. • All stationery should be equipped with a drip tray to retain any oil leaks. • No concrete mixing will take place within 32m of the river bank.	**LOW NEGATIVE**
C	**Downstream**	**Short-term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	• Monitors should be stationed 50m upstream and downstream of the crossing site on a flowing stream. They should be trained to observe and identify bentonite releases, and have the equipment capacity to rapidly relay information to the drilling team. • Appropriate containment measures must be	**LOW NEGATIVE**

CONSTRUCTION PHASE							
	SPATIAL SCALE	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY/ BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
						implemented to minimise the further release of slurry into the water course. • The pressure levels of the lubricating slurry should be closely monitored while drilling is in progress, as a rapid or sudden loss of pressure could indicate a potential release of slurry into a fracture.	
Impact: Mobilisation of soil into the stream via erosion will cause sedimentation of ecological habitats downstream of construction. This could decrease the diversity of macroinvertebrate communities.							
A	**Downstream**	**Short-term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	• Excavation/trenching should take place during the driest season • Where possible, silt fences should be installed to collect sediments mobilized during construction. • Banks must be monitored for signs of erosion, and measures must be taken to minimize the erosion as soon as possible.	**LOW NEGATIVE**
B	**Downstream**	**Short-term**	**Possible**	**Slight**	**LOW NEGATIVE**	• Pipe bridge pilings should not be placed on stream banks wherever possible. • Where this is not possible, ensure that appropriate sediment collection measures are put in place.	**LOW NEGATIVE**

CONSTRUCTION PHASE							
	SPATIAL SCALE	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY/ BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
C					**NO IMPACT**	•	**NO IMPACT**
Issue: Riparian vegetation							
Impact: Indiscriminate removal of riparian vegetation at the site of the pipeline may lead to disturbance of the aquatic ecosystem							
A	**Localised**	**Medium-term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	• Removal of riparian vegetation must take place under the supervision of the ECO. • Removal of the alien invasive vegetation should be prioritised. • Banks should be artificially stabilized as soon as possible if significant riparian vegetation is removed.	**LOW NEGATIVE**
B	**Localised**	**Medium-term**	**Possible**	**Slight**	**LOW NEGATIVE**	• Removal of riparian vegetation must take place under the supervision of the ECO. • Removal of the alien invasive vegetation should be prioritised. • Banks should be artificially stabilized as soon as possible if significant riparian vegetation is removed.	**LOW NEGATIVE**
C					**NO IMPACT**	•	**NO IMPACT**
Issue: Hydrology							
Impact: Coffer dams have the potential to permanently change the flow dynamics in a river, exacerbating scour and enhancing sedimentation. Both of these changes can impact negatively on the aquatic ecosystem.							
A	**Localised and down-stream**	**Medium-term**	**Possible**	**Severe**	**HIGH Negative**	• Coffer dams must not be left in place for longer than 30	**MODERATE NEGATIVE**

CONSTRUCTION PHASE							
	SPATIAL SCALE	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY/ BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
						days. • All work within a water resource should be completed during the dry season, when flows are at their lowest. • Water in the river must be allowed to pass downstream of the construction. If necessary this should be achieved via a temporary diversion ï this should not be in place for more than 30 days.	
B					**NO IMPACT**	•	**NO IMPACT**
C					**NO IMPACT**	•	**NO IMPACT**

Table 7.5: Operational Phase impacts associated with the proposed pipeline infrastructure.

OPERATION PHASE							
	SPATIAL SCALE	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Issue: Hydrology and sediment dynamics							
Impact: Once the pipeline is in position, the new infrastructure will make a permanent change to the flow dynamics of the water course. This could result in loss of habitat and an associated loss in aquatic biodiversity.							
A					**NO IMPACT**	•	**NO IMPACT**
B	**Localised**	**Short-term**	**Possible**	**Moderately severe**	**LOW NEGATIVE**	• Pipe bridge pilings on the banks or bed of the water course must be designed to limit the effects of scour on the sediment flows in the stream.	**LOW NEGATIVE**
C					**NO IMPACT**	•	**NO IMPACT**

7.3.4 Bridge upgrade near Palmerton Mission

Table 7.6: Planning and Design Phase impacts associated with the proposed bridge upgrade.

Bridge Upgrade							
PLANNING AND DESIGN PHASE							
IMPACT	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Issue: Changes to fluvial geomorphology							
Incorrect placement and/or design of bridge pilings or culverts may result in scouring of the river bed in the areas immediately surrounding the pilings or culverts	**Localised**	**Long term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	• Ensure that scour countermeasures are incorporated into the design of the bridge.	**LOW NEGATIVE**
Insufficient planning for erosion prevention along the banks of the river	**Localised and down-**	**Long term**	**Possible**	**Severe**	**HIGH NEGATIVE**	• Adequate bank stabilization measures must be incorporated	**MODERATE NEGATIVE**

alongside the bridge structure will result in erosion that may eventually impair the safety of the structure.	**stream**					into the design of the bridge.	
Issue: Stormwater management							
Failure to account for the 1:100 year flood event may endanger the bridge infrastructure and eventually lead to the bridge being washed away.	**Municipal**	**Long-term**	**Possible**	**Very Severe**	**VERY HIGH NEGATIVE**	• The bridge must be designed to ensure that all infrastructure will be placed outside of the 1:100 year floodline wherever possible. • Flood attenuation and storm water management plans must be drawn up by a qualified engineer and approved by DEA and DWS.	**MODERATE NEGATIVE**

Table 7.7: Construction Phase impacts associated with the proposed bridge upgrade.

CONSTRUCTION PHASE							
IMPACT	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Issue: Water Quality							
Wet concrete is highly alkaline. This could result in flash kills of macroinvertebrates and fish species in the vicinity (See appendix A).	**Localised**	**Short-term**	**Probable**	**Moderately severe**	**MODERATE NEGATIVE**	• No concrete mixing to take place within 32m of the river bank. • A serviced CO_2 fire extinguisher should be available on site in the event that wet concrete is accidentally spilled into the river. • The mitigation measures	**LOW NEGATIVE**

						in Appendix A must be read in conjunction with this report.	
Soil erosion	**Study area**	**Short-term**	**Possible**	**Severe**	**MODERATE NEGATIVE**	• Construction activities must be demarcated and vegetation clearing and top soil removal (if required) limited to these areas.	**LOW NEGATIVE**
Issue: Hydrology							
Coffer dams have the potential to permanently change the flow dynamics in a river, exacerbating scour and enhancing sedimentation. Both of these changes can impact negatively on the aquatic ecosystem.	**Localised and down-stream**	**Medium-term**	**Possible**	**Severe**	**HIGH NEGATIVE**	• Coffer dams must not be left in place for longer than 30 days. • All work within the river should be completed during the dry season, when flows are at their lowest. • Water in the river must be allowed to pass downstream of the construction. If necessary this should be achieved via a temporary diversion ï this should not be in place for more than 30 days.	**MODERATE NEGATIVE**
Issue: Riparian vegetation							
Indiscriminate removal of riparian vegetation at the site of the bridge may lead to disturbance of the aquatic ecosystem	**Localised**	**Medium-term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	• Removal of riparian vegetation should take place under the supervision of the ECO. • Removal of the alien invasive vegetation should be prioritised	**LOW NEGATIVE**
Issue: Channel banks and soils							

Construction activities may decrease bank stability at the site of the bridge resulting in localised erosion. Associated vegetation removal could also destabilise the banks.	**Localised**	**Medium-term**	**Probable**	**Moderately Severe**	**MODERATE NEGATIVE**	• Removal of riparian vegetation should take place under the supervision of the ECO.	**LOW NEGATIVE**

Table 7.8: Operation Phase impacts associated with the proposed bridge upgrade.

OPERATION PHASE							
GENERAL AND SPECIALIST STUDY IMPACTS	**SPATIAL SCALE**	**TEMPORAL SCALE (DURATION)**	**CERTAINTY SCALE (LIKELIHOOD)**	**SEVERITY/ BENEFICIAL SCALE**	**SIGNIFICANCE PRE-MITIGATION**	**MITIGATION MEASURES**	**SIGNIFICANCE POST-MITIGATION**
Issue: Soil erosion and sedimentation							
Inappropriate routing of stormwater will lead to stream sedimentation.	**Localised, study area and down-stream**	**Long-term**	**Probable**	**Severe**	**HIGH NEGATIVE**	• Flood attenuation and storm water management plans must be drawn up by a qualified engineer and approved by DEA and DWS. • An Erosion Action Programme must be developed and implemented to minimize the ingress of sediment-laden stormwater into the river.	**MODERATE NEGATIVE**

8 IMPACT STATEMENT, CONCLUSION & RECOMMENDATIONS

8.1 Impact Statement

The tables below summarise the impacts identified and their significance pre- and post-mitigation. In total, 39 potential impacts on the aquatic environment were identified. One of these was a positive impact on water quality downstream of the dam, where excess nutrients in the water as a result of upstream activities will be trapped in the dam, reducing the potential for algal blooms and other associated water quality issues downstream. This is particularly important with regard to the quality of the water to be abstracted downstream of the dam. All of the negative impacts could be mitigated to either MODERATE or LOW significance. In most cases, the MODERATE impacts relate to geomorphology, and the associated issues of scour, erosion and sedimentation.

General Impacts		
PLANNING AND DESIGN PHASE		
IMPACT	**SIGNIFICANCE PRE-MITIGATION**	**SIGNIFICANCE POST-MITIGATION**
Issue: Legal and policy compliance		
Non-compliance with the laws and policies of South Africa as the pertain to the aquatic environment could lead to unnecessary delays in construction activities, and potentially criminal cases, based on the severity of the non-compliance, being brought against the proponent and his/her contractors.	**MODERATE NEGATIVE**	**LOW NEGATIVE**
Issue: Loss of sensitive aquatic habitat		
Inadequate assessment of the planned route of pipelines and positioning of the dam, and compilation of the dam operating rules during the planning of the project could lead to widespread degradation and loss of potentially sensitive aquatic habitats in both the inundation area, and downstream of the dam.	**VERY HIGH NEGATIVE**	**MODERATE /LOW NEGATIVE**
Issue: Scheduling of construction		
Construction scheduling that does not take into account the seasonal requirements of the aquatic environment, e.g. allowing for unimpeded flood events, could lead to short-term (and potentially long-term) impacts such as excessive sediment mobilization, etc.	**MODERATE NEGATIVE**	**LOW NEGATIVE**

8.1.1 Zalu Dam and abstraction infrastructure

OPERATION PHASE		
IMPACT	**SIGNIFICANCE PRE-MITIGATION**	**SIGNIFICANCE POST-MITIGATION**
Issue: Water quality		
Dams typically act as nutrient ñsinksò, trapping excess nutrients along with the sediments that would originally have moved freely down the length of the river. This may improve the quality of the water downstream of the dam. In particular, the water clarity will improve, with ñclearò water becoming the predominant release from the dam.	**MODERATE POSITIVE**	**MODERATE POSITIVE**
Issue: Geomorphology		
The condition of the river geomorphology in the scour zone will degrade since sediment will be trapped in the dam, causing clear water (sediment free) releases to the downstream reach. These clear water releases will scour the bed of this reach, causing deepening of the channel in alluvial sections and widening in sections where shallow bedrock prevents incision.	**MODERATE NEGATIVE**	**LOW NEGATIVE**

At the abstraction weir the baseflows released from the dam will be abstracted from the river. This will result in the reach immediately downstream of the weir experiencing very low baseflows.	**LOW NEGATIVE**	**LOW NEGATIVE**
Reduced floods are likely to cause a degradation of the riparian and in-channel habitat conditions through reduced scour abilities of the river.	**LOW NEGATIVE**	**LOW NEGATIVE**
Issue: Riparian vegetation		
The sediment-free or clearwater releases and the resultant scour will decrease the availability of any riparian habitat (Instream and Marginal), particularly where incision takes place within the alluvial sections coupled to the loss of fine sediment needed for plants to root in, i.e. the riparian zone will narrow, losing its eco-tonal or transitional nature between the aquatic and terrestrial environments.	**MODERATE NEGATIVE**	**MODERATE NEGATIVE**
The potential reduction in baseflows, due to abstraction at the weir, would impact on the potential availability of water to supply the adjacent riparian zones and could thus reduce the overall extent of these habitats.	**MODERATE NEGATIVE**	**LOW NEGATIVE**
Issue: Fish		
Reduced breeding success of *Barbus* ñTranskeiò n. sp. (Transkei barb), a new species. Breeding is triggered by high flows (i.e. floods), and the dam wall could reduce the severity of these high waters, thereby muting the breeding signals for the fish. The number of spawning events could also be reduced by the capture of the high flow events by the dam.	**HIGH NEGATIVE**	**MODERATE NEGATIVE**
Disruption of the normal migratory behaviour of eels	**HIGH NEGATIVE**	**MODERATE NEGATIVE**
Issue: Macroinvertebrates		
Reduction in the sediment content of water downstream of the dam could reduce both the availability of food and habitat for macroinvertebrates	**MODERATE NEGATIVE**	**LOW NEGATIVE**

8.1.2	**Pipeline reticulation**		
	CONSTRUCTION PHASE		
	IMPACT	**SIGNIFICANCE PRE-MITIGATION**	**SIGNIFICANCE POST-MITIGATION**
Issue: Water Quality			
Wet concrete is highly alkaline. Accidental contamination of water resources could result in flash kills of macroinvertebrates and fish species in the vicinity (See appendix A)			
A	Trenched pipeline	**MODERATE NEGATIVE**	**LOW NEGATIVE**
B	Above ground pipeline	**LOW NEGATIVE**	**LOW NEGATIVE**
C	Horizontal Directional Drilling	**No impact**	**No impact**
Pollution from accidental spills of chemicals in the vicinity of water courses.			
A	Trenched pipeline	**LOW NEGATIVE**	**LOW NEGATIVE**
B	Above ground pipeline	**LOW NEGATIVE**	**LOW NEGATIVE**
C	Horizontal Directional Drilling	**MODERATE NEGATIVE**	**LOW NEGATIVE**
Mobilisation of soil into the stream via erosion will cause sedimentation of ecological habitats downstream of construction. This could decrease the diversity of macroinvertebrate communities.			
A	Trenched pipeline	**MODERATE NEGATIVE**	**LOW NEGATIVE**
B	Above ground pipeline	**LOW NEGATIVE**	**LOW NEGATIVE**
C	Horizontal Directional Drilling	**NO IMPACT**	**NO IMPACT**

Issue: Riparian vegetation			
Indiscriminate removal of riparian vegetation at the site of the bridge may lead to disturbance of the aquatic ecosystem			
A	Trenched pipeline	**MODERATE NEGATIVE**	**LOW NEGATIVE**
B	Above ground pipeline	**LOW NEGATIVE**	**LOW NEGATIVE**
C	Horizontal Directional Drilling	**NO IMPACT**	**NO IMPACT**
Issue: Hydrology			
Coffer dams have the potential to permanently change the flow dynamics in a river, exacerbating scour and enhancing sedimentation. Both of these changes can impact negatively on the aquatic ecosystem.			
A	Trenched pipeline	**HIGH Negative**	**LOW NEGATIVE**
B	Above ground pipeline	**NO IMPACT**	**NO IMPACT**
C	Horizontal Directional Drilling	**NO IMPACT**	**NO IMPACT**

OPERATION PHASE			
IMPACT		**SIGNIFICANCE PRE-MITIGATION**	**SIGNIFICANCE POST-MITIGATION**
Issue: Hydrology and sediment dynamics			
Once the pipeline is in position, the new infrastructure will make a permanent change to the flow dynamics of the water course. This could result in loss of habitat and an associated loss in aquatic biodiversity.			
A	Trenched pipeline	**NO IMPACT**	**NO IMPACT**
B	Above ground pipeline	**LOW NEGATIVE**	**LOW NEGATIVE**
C	Horizontal Directional Drilling	**NO IMPACT**	**NO IMPACT**

8.1.3 **Bridge upgrade near Palmerton Mission**		
PLANNING AND DESIGN PHASE		
IMPACT	**SIGNIFICANCE PRE-MITIGATION**	**SIGNIFICANCE POST-MITIGATION**
Issue: Changes to fluvial geomorphology		
Incorrect placement and/or design of bridge pilings or culverts may result in scouring of the river bed in the areas immediately surrounding the pilings or culverts	**MODERATE NEGATIVE**	**LOW NEGATIVE**
Insufficient planning for erosion prevention along the banks of the river alongside the bridge structure will result in erosion that may eventually impair the safety of the structure.	**HIGH NEGATIVE**	**MODERATE NEGATIVE**
Issue: Stormwater management		
Failure to account for the 1:100 year flood event may endanger the bridge infrastructure and eventually lead to the bridge being washed away.	**VERY HIGH NEGATIVE**	**MODERATE NEGATIVE**

CONSTRUCTION PHASE		
IMPACT	**SIGNIFICANCE PRE-MITIGATION**	**SIGNIFICANCE POST-MITIGATION**
Issue: Water Quality		
Wet concrete is highly alkaline. This could result in flash kills of macroinvertebrates and fish species in the vicinity (See appendix A).	**MODERATE NEGATIVE**	**LOW NEGATIVE**
Soil erosion	**MODERATE NEGATIVE**	**LOW NEGATIVE**
Issue: Hydrology		
Coffer dams have the potential to permanently change the flow dynamics in a river, exacerbating scour and enhancing sedimentation. Both of these changes can impact negatively on the aquatic ecosystem.	**HIGH NEGATIVE**	**MODERATE NEGATIVE**

Issue: Riparian vegetation		
Indiscriminate removal of riparian vegetation at the site of the bridge may lead to disturbance of the aquatic ecosystem	**MODERATE NEGATIVE**	**LOW NEGATIVE**
Issue: Channel banks and soils		
Construction activities may decrease bank stability at the site of the bridge resulting in localised erosion. Associated vegetation removal could also destabilise the banks.	**MODERATE NEGATIVE**	**LOW NEGATIVE**

OPERATION PHASE		
IMPACT	**SIGNIFICANCE PRE-MITIGATION**	**SIGNIFICANCE POST-MITIGATION**
Issue: Soil erosion and sedimentation		
Inappropriate routing of stormwater will lead to stream sedimentation.	**HIGH NEGATIVE**	**MODERATE NEGATIVE**

In order to realise the POST-mitigation significance, the following mitigation measures must be implemented during the relevant phases of the development of the water supply scheme:

General impacts associated with the proposed infrastructure.

PLANNING AND DESIGN PHASE

- All legal matters pertaining to permitting must be completed prior to construction. In particular, all necessary Water Use Licences must be in order.
- The planning of all infrastructures, including locations and operating rules, must be undertaken with suitable regard for the environment. Suitably qualified specialists MUST be consulted during the planning phase.
- Wherever possible, construction activities must be undertaken during the driest part of the year to minimize downstream sedimentation due to excavation, etc.
- When not possible, suitable stream diversions structures must be used to ensure that rivers/streams are not negatively impacted by construction activity.

Zalu Dam and abstraction infrastructure

CONSTRUCTION PHASE

- No concrete mixing to take place within 32m of the river bank.
- A serviced CO_2 fire extinguisher should be available on site in the event that wet concrete is accidentally spilled into the river.
- The mitigation measures in Appendix A must be read in conjunction with this report.
- Construction activities should take place during the driest season.
- Removal of riparian vegetation must take place under the supervision of the ECO.
- Removal of the alien invasive vegetation should be prioritised.
- The river must be diverted away from areas where excavation within the inundation area is to take place.
- Excavation should take place in the drier months of the year in order to limit the influence of stormwater on the mobilization of sediment.
- If necessary, stabilizing berms should be used to prevent stormwater from carrying sediment into the existing river channel.
- During construction, all care should be taken to ensure that the ecological reserve volume of water is always released into the river downstream of the dam site.

OPERATION PHASE

- The dam operating rules must stipulate that there be infrequent but regular releases of water from the lower section of the dam, allowing sediment to move through the system.
- The effects of the reduced sediment load should be alleviated naturally by upstream

erosion and tributaries at this point, so existing flows from tributaries can be used to maintain sediment flow.
- The ecological reserve volume must be released at all times and seasonality maintained in the river downstream of the dam.

Pipeline reticulation

CONSTRUCTION PHASE

- The mitigation measures in Appendix A must be read in conjunction with this report.
- A serviced CO_2 fire extinguisher should be available on site in the event that wet concrete is accidentally spilled into the river
- No concrete mixing will take place within 32m of the river bank.
- No machinery should be parked overnight within 50 m of a watercourse.
- All stationary vehicles should be equipped with a drip tray to retain any oil leaks.
- Monitors (in the case of directional drilling) should be stationed 50m upstream and downstream of the crossing site on a flowing stream when conducting HDD. They should be trained to observe and identify bentonite releases, and have the equipment capacity to rapidly relay information to the drilling team.
- Appropriate containment measures must be implemented to minimise the further release of slurry into the water course.
- The pressure levels of the lubricating slurry should be closely monitored while drilling is in progress, as a rapid or sudden loss of pressure could indicate a potential release of slurry into a fracture.
- Excavation/trenching should take place during the driest season.
- Where possible, silt fences should be installed to collect sediments mobilized during construction.
- Banks must be monitored for signs of erosion, and measures must be taken to minimize the erosion as soon as possible.
- Pipe bridge pilings should not be placed on stream banks wherever possible.
- Where this is not possible, ensure that appropriate sediment collection measures are put in place.
- Removal of riparian vegetation must take place under the supervision of the ECO.
- Removal of the alien invasive vegetation should be prioritised.
- Banks should be artificially stabilized as soon as possible if significant riparian vegetation is removed.
- Coffer dams must not be left in place for longer than 30 days.
- All work within a water resource should be completed during the dry season, when flows are at their lowest.
- Water in the river must be allowed to pass downstream of the construction. If necessary this should be achieved via a temporary diversion ï this should not be in place for more than 30 days.

OPERATION PHASE

- Pipe bridge pilings on the banks or bed of the water course must be designed to limit the effects of scour on the sediment flows in the stream.

Bridge upgrade near Palmerton Mission

PLANNING AND DESIGN PHASE

- Ensure that scour countermeasures are incorporated into the design of the bridge.
- Adequate bank stabilization measures must be incorporated into the design of the bridge.
- The bridge must be designed to ensure that all infrastructure will be placed outside of the 1:100 year floodline wherever possible.
- Flood attenuation and storm water management plans must be drawn up by a qualified

engineer and approved by DEA and DWS.

CONSTRUCTION PHASE

- No concrete mixing will take place within 32m of the river bank.
- A serviced CO_2 fire extinguisher should be available on site in the event that wet concrete is accidentally spilled into the river.
- The mitigation measures in Appendix A must be read in conjunction with this report.
- Construction activities must be demarcated and vegetation clearing and top soil removal (if required) limited to these areas.
- Coffer dams must not be left in place for longer than 30 days.
- All work within the river should be completed during the dry season, when flows are at their lowest.
- Water in the river must be allowed to pass downstream of the construction. If necessary this should be achieved via a temporary diversion ï this should not be in place for more than 30 days.
- Removal of riparian vegetation must take place under the supervision of the ECO.
- Removal of the alien invasive vegetation should be prioritised

OPERATION PHASE

- Flood attenuation and storm water management plans must be drawn up by a qualified engineer and approved by DEA and DWS.
- An Erosion Action Programme must be developed and implemented to minimize the ingress of sediment-laden stormwater into the river.

8.2 Conclusions

The aquatic impact assessment recorded more than 70 water resource/infrastructure interactions. Each of these will need to be authorised by the Department of Water and Sanitation. Most of these are where pipelines cross streams, drainage lines, etc., but in a few cases the crossings are larger and will require more significant construction (e.g. the impoundment structure on the Xura River itself).

None of the impacts assessed remained HIGH after mitigation, and assuming that the mitigation measures are correctly implemented, the aquatic environment downstream of the dam should not suffer any permanent negative impact. In particular, the Dam Operating Rules must be designed to maintain the ecological reserve within the river across the seasons.

It is the opinion of the specialist, that NO FATAL FLAWS preclude the development of the water supply scheme. In fact, the positive social benefits to the surrounding communities far outweigh the negative impacts.

8.3 Recommendations

The following recommendations are made in addition to the mitigation measures with regard to the LRWSS scheme where it would impact on the aquatic environment:

- All watercourse crossings must be authorised by the Department of Water and Sanitation, in terms of Section *c* and *i* of the National Water Act (Act 36 of 1998).
- The impoundment of the Zalu Dam must be authorised by the Department of Water and Sanitation, in terms of Section *b*, *c* and *i* of the National Water Act (Act 36 of 1998).
- Abstraction of water from the Xura River must be authorised by the Department of Water and Sanitation, in terms of Section *a*, *c* and *i* of the National Water Act (Act 36 of 1998).
- Wherever possible, directional drilling should be used to direct pipelines under major water courses, i.e. Xura, Xurana, Mzintlava, Mateku, Mtafufu.
- Small tributaries can be crossed using conventional trenching methods.

- Where pipelines are routed near NFEPA-listed wetlands, ensure that the pipeline is laid on the opposite side of the road from the wetland.
- Where the pipeline crosses the Mateku River below the waterfall, the pipeline route should be amended to either cross at the road crossing, or amend the entire pipeline route as indicated in Figure 6.59.

9 REFERENCES

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National Environmental Management: Biodiversity Act (No 10 of 2004).

National Spatial Biodiversity Assessment (2004).

National Water Act (No 36 of 1998).

The Constitution Act (108 of 1996).

The Department of Water and Sanitation, 2014. Feasibility Study for the Augmentation of the Lusikisiki Regional Water Supply Scheme: Intermediate Preliminary Reserve Determination Report, P WMA 12/T60/00/3911.

APPENDIX A
Concrete Works – Information and Mitigation

Background
Concrete, cement, mortars, grouts and other Portland cement or lime-containing construction materials are basic or alkaline materials. They are highly toxic to fish and must only be used near water with extreme care.

What are acceptable pH ranges?
A pH level around 7 is typical for most watercourses, and this neutral pH is required for the survival of aquatic organisms. Should the pH rise or drop out of this range, fish and other aquatic organisms will become stressed and may die. Complete isolation of the work area is needed to ensure that pH value in the surrounding waterbody does not rise (become more alkaline) during works. The Ministry of Water, Land, and Air Protection's ***British Columbia Approved Water Quality Criteria for pH setsthe range for acceptable pH*** change with respect to fresh water aquatic life between 6.5 and 9.0. However, any increase in pH noted in conjunction with concrete works should be monitored and emergency protection measures implemented in accordance with the best practices below.

Objectives
The objective of this set of best practices is to ensure no concrete materials or leachates enter any watercourses.

Operational or Construction-related Best Practices

To ensure your works meet the requirements of applicable legislation:

Concrete Works

- Use pre-cast concrete structures whenever possible.
- As concrete leachate is alkaline and highly toxic to fish and other aquatic life, ensure that all works involving the use of concrete, cement, mortars, and other Portland cement or lime containing construction materials (concrete) will **not** deposit, directly or indirectly, sediments, debris, concrete, concrete fines, wash or contact water into or about any watercourse.
- Concrete materials cast in place must remain inside formed structures.
- Keep a carbon dioxide (CO_2) tank with regulator, hose and gas diffuser readily available during concrete work. Use it to release carbon dioxide gas into the affected area to neutralize pH levels should a spill occur. Train workers to use the tank.
- Provide containment facilities for the wash-down water from concrete delivery trucks, concrete pumping equipment, and other tools and equipment.
- Report immediately any spills of sediments, debris, concrete fines, wash or contact water. Implement emergency mitigation and clean-up measures immediately.
- Completely isolate all concrete work from **any** water within or entering into **any** watercourse or stormwater system.
- Monitor the pH frequently in the watercourse immediately downstream of the isolated worksite until completion of the works. Emergency measures will be implemented if downstream pH has changed **more than 1.0 pH unit**, measured to an accuracy of +/- 0.2 pH units from the background level, or is recorded to be **below 6.0 or above 9.0 pH units**.
- Prevent any water that contacts uncured or partly cured concrete during activities like exposed aggregate wash-off, wet curing, or equipment washing from directly or indirectly entering any watercourse or stormwater system.
- Maintain complete isolation of all cast-in-place concrete and grouting from fish-bearing waters for a minimum of 48 hours if ambient air temperature is above 0°C and for a minimum of 72 hours if ambient air temperature is below 0°C.
- Isolate and hold any water that contacts uncured or partly cured concrete until the pH is **between 6.5 and 8.0 pH units**, and the turbidity is **less than 25 nephelometric turbidityunits (NTU)**, measured to an accuracy of +/- 2 NTU.

For further information regarding the safe use of concrete materials, refer to the following websites:

Cement and Concrete: Environmental Considerations
http://www.buildinggreen.com/features/cem/cementconc.html
Carbon Dioxide for Concrete Wash Water Treatment
http://www.praxair.com/Praxair.nsf/d63afe71c771b0d785256519006c5ea1/78b5b272ccfbcd8885256555006 9e32d?OpenDocument

LUSIKISIKI REGIONAL WATER SUPPLY SCHEME

SOCIAL IMPACT ASSESSMENT

P WMA 12/T60/00/5414/2

Prepared for:

water affairs

Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Department of Water Affairs
Private Bag X313
Pretoria
0001

Prepared by:

EOH

EOH Coastal & Environmental Services
EAST LONDON
16 Tyrell Road
Berea
East London 5241
P.O Box 8145
Nahoon, 5210
Also in Cape Town, Grahamstown, Port Elizabeth, Johannesburg and Maputo
www.cesnet.co.za

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Project Name: Lusikisiki Regional Water Supply Scheme

File names	Compiled by	Reviewed/edited	Date
Draft Social Impact Assessment	L Bosman		December 2014
Final Social Impact Assessment	G Hawley		April 2015

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1 INTRODUCTION

1.1 Introduction and Project overview

This report presents the Social Impact Assessment (SIA) study that is part of the Environmental, Impact Assessment (EIA) process for the proposed Lusikisiki Regional Water Supply Scheme (LRWSS) proposed by the Department of Water Affairs (DWA).

The Study Area comprises the region between Lusikisiki (up to about 15 km inland) and the coast, extending from the Mzimvubu River in the south-west to the Msikaba River in the north-east, as shown on Figure 1.1. The proposed LRWSS dam site is situated north-west of the town of Lusikisiki (Figure 1.1) in two Local Municipalities within the O.R. Tambo District Municipality (ORTDM) in the Eastern Cape Province of South Africa, namely the Ingquza Hill Local Municipality (IHLM) and to a lesser degree, Port St Johns Local Municipality (PSJLM).

The proposed project, which includes the associated pipeline reticulation, will directly affect fourteen wards in the IHLM which include ward no: 4; 12; 13; 14; 15; 16; 17; 18; 19; 20; 21; 22; 23 and 24 and five wards in the PSJLM: 13, 14, 15, 19 and 20 (Figure 1.2). For the purposes of this study engagement and impact assessment was restricted to these areas and has been named the project area.

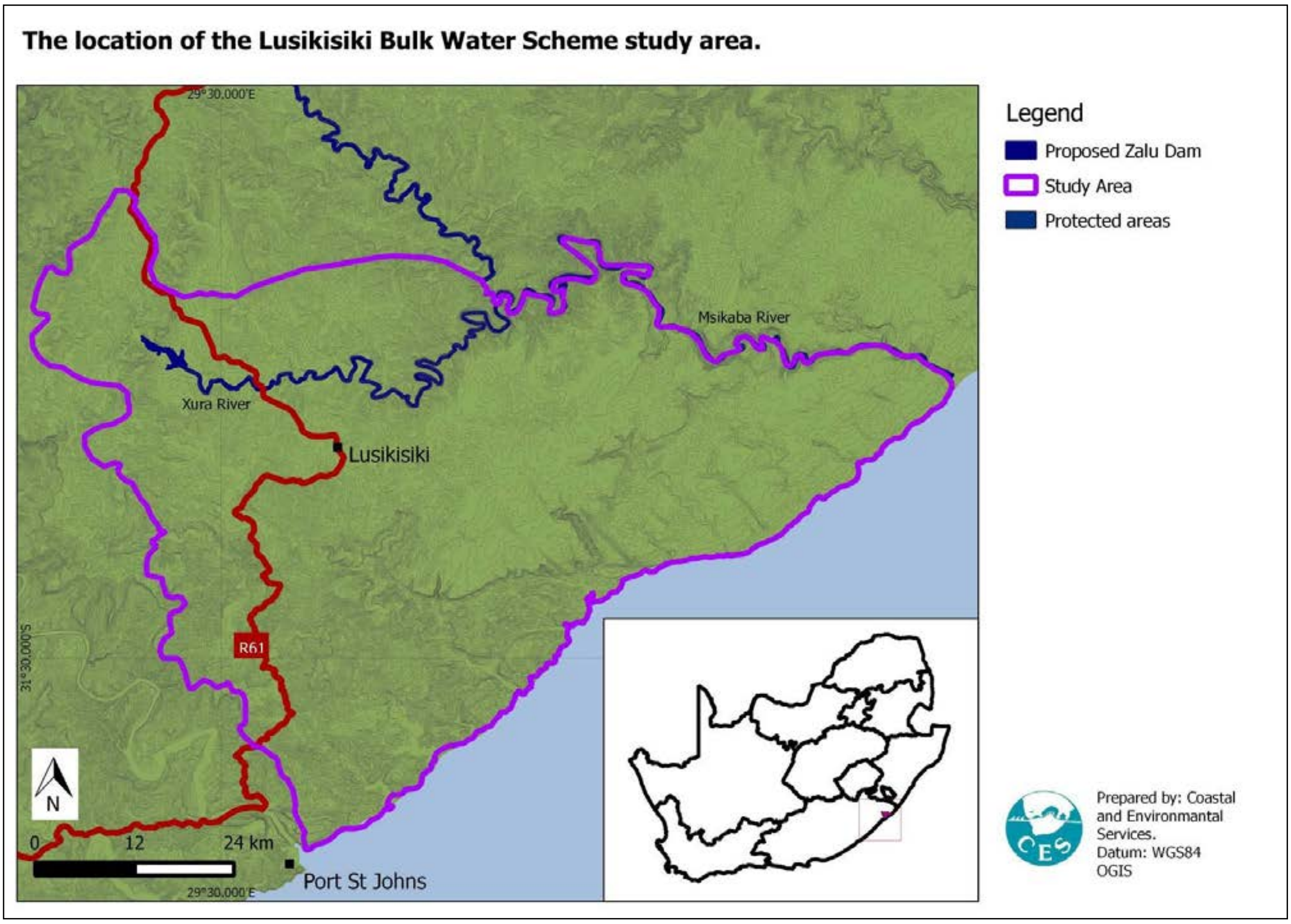


Figure 1.1: Location of the proposed Lusikisiki Regional Water Supply Scheme

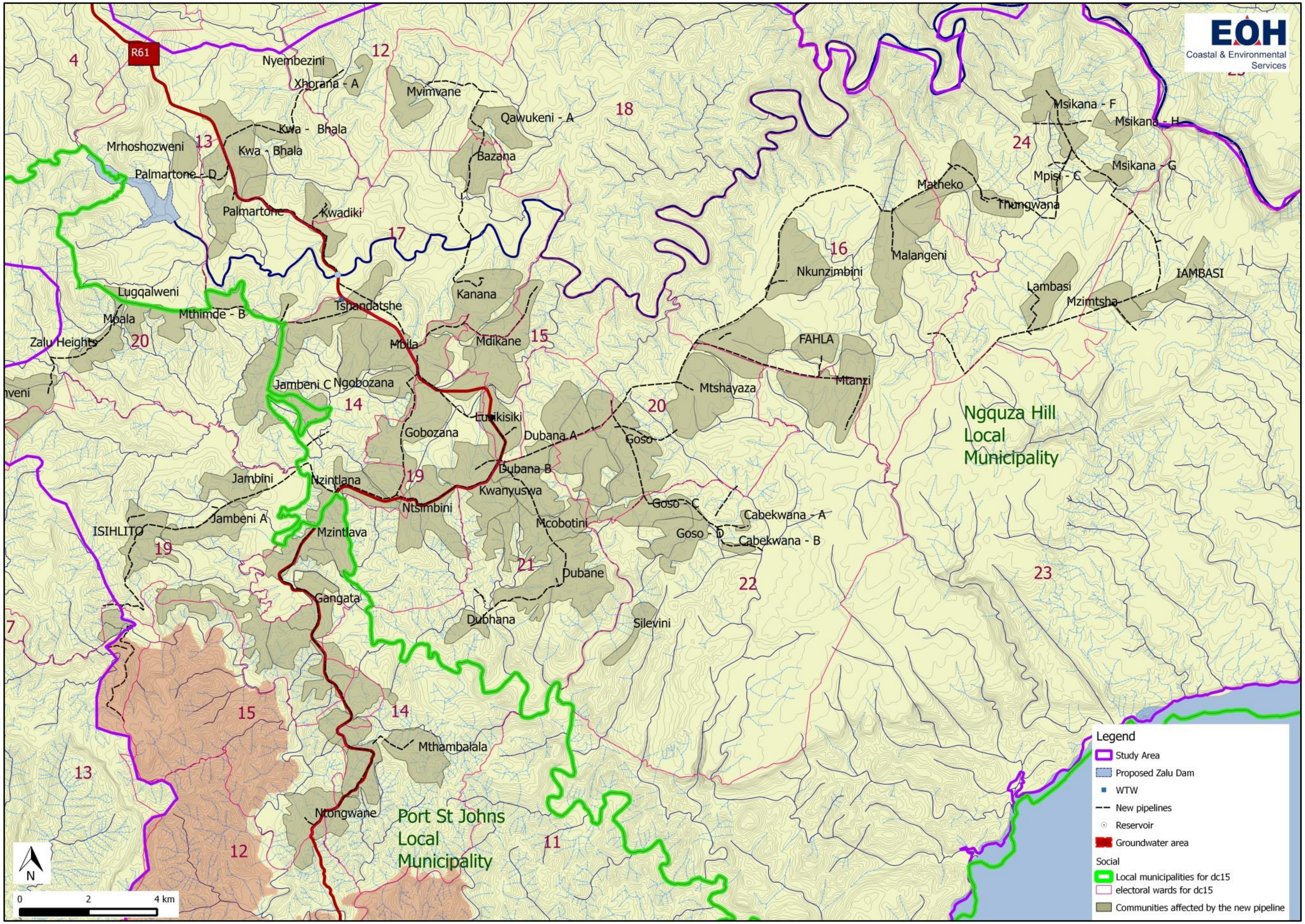


Figure 1.2 Affected villages (in darker shading) and the associated ward number in the Ingquza Hill and Port St John Local Municipalities.

The proposed project consists of the following activities:

The Zalu Dam and inundation area – The dam will consist of an earth core rockfill dam with a full supply level of 612 masl (the dam wall will be approximately 35 m high). It is anticipated that the dam will yield 6.95million m3/annum, at 1:100 year assurance of supply. The domestic requirement is 5.4 million m3/annum in 2040, the irrigation requirements 1.45 million m /annum (including 10% losses) and the 1:1 year ecological flow requirement is 8 m3/s for a period of three days per year. It is anticipated that the release for domestic use will be sufficient for the maintenance of ecological requirements (MJ Trümpelmann, 2014). The area that will be inundated as a result of the proposed Zalu Dam is approximately 143.47 hectares in size. No resettlement will be required.

Borrow pits for dam construction - The results from the pre-feasibility study (MJ Trümpelmann, 2014) show that sufficient construction materials are available for a rockfill dam in close proximity to the proposed construction site. Residual dolerite clay is available in a borrow area downstream of the dam wall. This material is sufficient for a central earthfill core for a rockfill dam.

Two rockfill quarries with unweathered dolerite 10 km upstream of the proposed dam wall, were identified. These sources are located below the full supply level of the dam. Both sources are covered with moderately to completely weathered shales. The moderately weathered shales can be used in the shells of a rockfill dam.

At the centreline of the dam on the right bank a horizontal layer of unweathered dolerite was encountered at a level of approximately 611 masl. This can be used for an approach channel floor for a side channel spillway. Some of the excavated materials can be used for the shells of the rockfill dam.

Abstraction weir – An abstraction weir will be constructed approximately 5 km downstream from the proposed Zalu Dam in close proximity to the R61 road north of Lusikisiki.

Reticulation of raw water to the existing treatment works – A pipeline will be constructed from the abstraction weir to the existing water treatment works on the outskirts of Lusikisiki. The location of this route will be provided in the EIR Phase as it is not finalised at this stage. In addition to this it is anticipated that the water treatment works will be upgraded to cater for the increase in capacity required.

Reticulation of treated water to various reservoirs and communities – Potable water will be transferred from the water treatment works to a number of reservoirs via a combination of existing and new pipelines. Existing pipelines may require upgrading. The location of new pipelines is shown in dotted lines on Figure 1.1 above.

1.2 Study Terms of Reference and Approach to the Study

The SIA has been drafted in accordance with the South African Environmental Impact Assessment (EIA) regulatory requirements, as guided by Chapter 5 of the National Environmental Management Act (NEMA) (107 of 1998, as amended in 2010). By assessing the Project-Affected Communities (PACs), the report sketches the area's socio-economic environment and analysis the potential socio-economic impacts of the project on these PACs. In so-doing, it provides guidelines for limiting or mitigating negative impacts and optimising expected benefits. This report is based largely on primary data gathered by means of qualitative focus group discussions, meetings and key individual interviews held during March and August 2014. Data has also been supplemented with an analysis of the South African Household Census Data of 2011, as well as secondary literature sources.

According to the International Association of Impact Assessments (IAIA), an SIA can be defined as:

"[…] the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions." (IAIA, 2012:1).

Foremost, it is important to draw a distinction between the scope of work for the SIA and that of the general Public Participation Process (PPP), the latter being an integral part of the EIA process. Whereas the PPP aims to notify and involve all stakeholders and Interested and Affected Parties (I&APs) who might be affected by the project, the SIA is a specialist study aimed largely at providing a broad overview of the most relevant social impacts and issues in the area. It is unfeasible to consult every affected landowner, stakeholder or I&AP during the SIA process, for which purposes the PPP has been initiated. Issues and concerns raised during the PPP are included for incorporated into the SIA.

The Terms of Reference (ToR) for this SIA, as defined by the scoping report of the EIA process, are as follows:

1. Describe the local socio-economic environment that will be directly affected as a result of the project;
2. Ensure that the study deals with the issues raised during scoping;
3. Assess the significance of potential economic and social impacts and benefits on the local populace and the Local Municipality and O R Tambo District Municipality;
4. Assess the local social infrastructure (health, education, markets, community);
5. Describe the formal and informal governing structures;
6. Identify income and expenditure trends;
7. Describe landownership
8. Identify project-related impacts and provide recommendations for mitigating negative impacts and optimising positive impacts.

Through the SIA process, communities and stakeholders are also assisted to identify their own development needs, ensuring that positive outcomes are maximised and possible negative impacts on such communities are minimised. What is also important to note is that an SIA should also analyse impacts that occur as a result of past activities, in other words, taking a holistic and cumulative view.

1.3 The Social Impact Assessment Specialist

Mr Lungisa Bosman and Ms Nande Suka were consultants involved in the data collection of this SIA.

Mr Bosman is a social scientist involved in socio-economic baseline studies, SIAs, Social Management Plans and Resettlement Action Plans (RAPs). His academic qualifications and accomplishments include a B. Soc. Sc. (Public Administration) obtained from the University of Cape Town in South Africa, as well as a Post Graduate Diploma in Organisation and Management also obtained from UCT. At EOH CES, some of the projects which he has been involved in include various RAPs in Malawi and Mozambique, as well as SIAs in South Arica, Mozambique and Malawi. Most of these projects have been conducted in accordance with the IFC Performance Standards.

Ms Nande Suka, Environmental Consultant, holds a B.Sc. degree with majors in Botany and Zoology (2010) and B.Sc. Honours in Terrestrial Botany (2011), both obtained at the Nelson Mandela Metropolitan University in Port Elizabeth. Her academic focus was in the broad field of Environmental Management and with great interest in impact assessments, environmental planning and conservation.

Dr Greer Hawley, Principal Consultant, has a BSc degree in Botany and Zoology and a BSc Honours in Botany from the University of Cape Town. She completed her PhD thesis (Microbiology) at Rhodes University. Greer was involved by reviewing, researching and writing the Social Impact Assessment report.

1.4 Background information

1.4.1 Feasibility Study for Augmentation of the Lusikisiki Regional Water Supply Scheme (2014)

A feasibility study of the proposed LRWSS and its likely impacts on the regional economics was prepared by Urban-Econ Development Economist in February 2014 (Department of Water Affairs, Report no. P WMA 12/T60/00/4611, 2014). The study included economic modelling in order to predict the direct, indirect and induced economic effects that are likely to be realised over a three year construction phase of different elements of the project and a 46 year operation phase in terms of maintenance and refurbishments. For the purposes of this report, the sum of the activities in each phase (dam construction, pipeline reticulation, upgrade of the water treatment works and refurbishment of the pump station) is presented. The most important outcomes of the economic modelling show that a significant amount of jobs will be created directly and indirectly during construction and operation (Table 2.1). It is estimated that 80% of the direct employment opportunities (approximately 900 jobs) created during construction will be sourced locally.

Table 2.1 Direct, indirect and induced economic effect of the construction and operation of the proposed Zalu Dam and supporting infrastructure (at 7.2 million m3/annum)

	Over a 3 year construction phase:	**Total over a 46 year operation phase**
The job creation potential	5220	6088
Spend on worker income	R444,78 million	R500 million

1.4.2 Wild Coast N2 Toll Highway

An important factor that may significantly alter the economic and social dynamics of the local communities is the future construction of the new National 2 (N2) Wild Coast Toll road. The new N2 is routed through Lusikisiki and will result in significant social and economic impacts of its own, during construction and operation. The sections of road that will be affected include the R61 coming into Lusikisiki from the south and a new road out of Lusikisiki travelling east (Figure 1.3). Depending on the timing of the construction of this stretch of the Wild Coast Toll Road and the proposed Zalu Dam, the social impacts exerted by both projects may be difficult to discern.

The SIA conducted by Huggins et al. on behalf of Dr Neville Bews & Associates in 2008 outlined potential impacts associated with the N2. These included the concerns raised by communities in the affected areas in addition to predicted impacts:

- A perceived direct increase in job opportunities and indirect opportunities due to increased traffic.
- Expressed that jobs need to go to local people: increase skill levels and increase employment potential: recommendation that a skills audit of local communities is undertaken in order recruit and select most suitable people.
- Increased regional economic development
- Increased employment opportunities
- Increase SMME opportunities
- Increases in HIV/STDs with the increased number of construction workers
- Increases in crime levels with the increased in the number of construction workers
- Opportunities to destabilise community structures with the increased in the number of construction workers.

The N2 Wild Coast toll impacts that are likely to be relevant to the current proposal due to overlapping issues and impacts are:

- Increase HIV/STD risk associated with construction “gangs” and increased traffic
- Secondary impacts such as an increase in crime
- Improvement in transport within the area

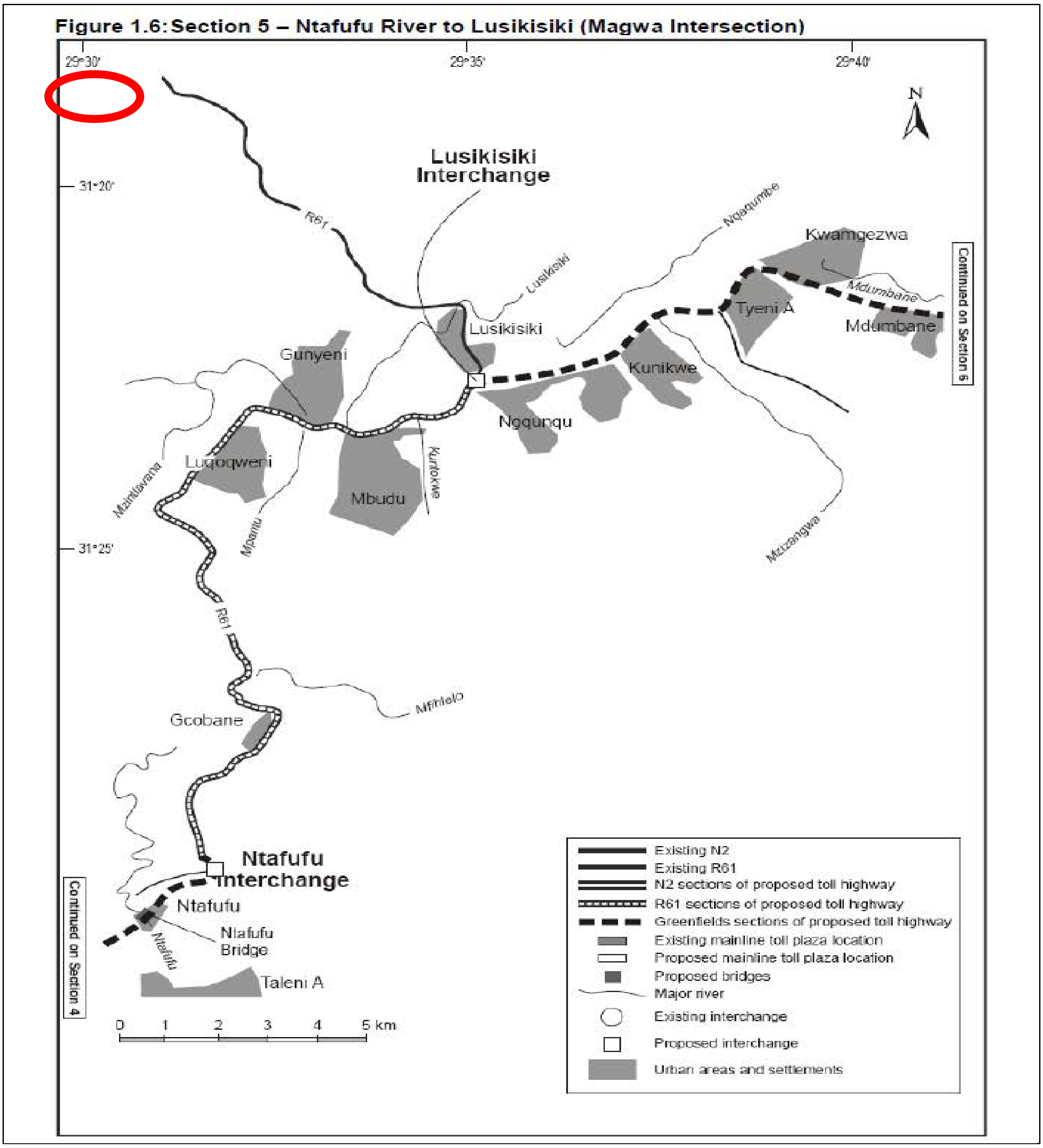


Figure 1.3 Proposed N2 Wild Coast Toll Road. Taken from: Dr Neville Bews and Associates (2008) - Social Impact Assessment of the Proposed N2 Wild Coast Toll Highway. Proposed dam site in area of red oval.

1.4.3 Ingquza Hill Local Municipality LED strategy (2008)

A Local Economic Development (LED) Strategy is a legislative and policy imperative of local government. It supplies the framework for resource allocation for sustainable economic development by providing direction, vision, goals and objectives in addition to strategies through which to achieve the these objectives.

The IHLM LED Strategy, which was developed for long term vision of 15 years, characterises the social and economic infrastructure of the LM as severely inadequate, with electricity and access road services poorly developed. The following economic constraints were identified:

- The economy is entirely dependent on government and communities sector.

- Retail and trade have increased, but agriculture, forestry and fisheries have declined. Retail and wholesale, however, is marginal; the sector experiences economic leakages and suffers from poor infrastructure such as commercial land/property and poor basic services (water, electricity and sanitation)
- Tourism, which has the potential to be major contributor, remains poorly developed due to poor basic economic infrastructure (roads, electrification, communications, etc.)

The IHLM LED strategy anticipates economic benefits from high impact investments such as the N2 Toll highway, Umzimvubu River Basin, Lusipark residential and retail development and the proposed biofuels plant. These projects have a major impact on creating an enabling environment necessary to unlock the economic potential of the relevant areas. The LED strategy identifies the need to implement programmes and projects that can increase the multiplier effect of these investments.

The LED strategy identifies opportunities and proposed projects by sector, as summarised below:

1. Tourism: developing accommodation, infrastructure and recreation facilities around agro-tourism (Magwa tea estate), eco-tourism (Mkambathi and Msikaba) and socio-tourism (cultural and political history), including marketing projects to create awareness.

2. Agriculture Sector: Beef, Sheep, Poultry and eggs and Crop (maize and potato) farming. The only realistic opportunities recommended include (all the rest of the suggested projects fall within the mandate of the Department of Agriculture):
   - Provision of centralised marketing facilities and services for all agriculture production
   - Establishment of cooperatives and auction facilities
   - Establishment of hatchery, abattoirs and rehabilitation of broiler and layer houses (Poultry)
   - Support and institutional restructuring of the maize milling plant
   - Establish potato packaging plant at Lambasi

3. Forestry Sector: Many of the proposed projects fall within the ambit of the Department of Forestry and can therefore not be directly implemented, but rather facilitated by IHLM:
   - Rehabilitation of Flagstaff municipal plantation
   - Development of supporting infrastructure: roads, communications, development of forest product value-chain.
   - Upgrade and expand pole treatment plant in Flagstaff
   - Establishment of seedling nursery
   - Establishment of a charcoal plant, craft development, saw-mill or fibre-board plant
   - Create linkages with tourism

The LED strategy also provides details of projects that may have bearing on the current project that are associated with:

- Bioprospecting and processing
- Business Development Services and SMME support programme (e.g. development of database of local businesses and emerging entrepreneurs
- Through chamber and consultation events, provide platform for dialogue and capacity building
- Urban Renewal projects
- Retail infrastructure
- Property Development (i.e. development of office and accommodation/residential sites in Flagstaff and Lusikisiki)

No LED strategy could be sourced for the Port St Johns Local Municipality.

2 LEGISLATION

2.1 Overview

Legislation and policy both play an integral role in the EIA process required to identify and assess the potential social impacts that might be associated with projects. Legislation and policy assist an SIA to assess a given development's fit with key planning and policy documents of the government, the district and local municipalities. Therefore, by assessing relevant legislation and policy, one of the SIA's purposes should be to indicate whether a proposed development in its current format conforms to spatial development plans and economic policies by creating opportunities for development.

The following chapter describes the institutional and legislative framework of South Africa and the affected municipalities. This framework will, in turn, inform the impact rating and identification of mitigation measures. In addition, a number of planning documents from the affected municipalities were consulted to guide this SIA.

2.2 Applicable South African Legislation

The project is subject to the prescriptions of numerous local statutes, which are predominantly dealt with (as environmental and social considerations) as part of the EIA process. The most applicable South African EIA-related legislation that bears relevance to the project at hand are listed in Table 2.1 below (in no particular order).

Table 2.1: Relevant South African legislation

Legislation	Date of Enactment
The Constitution of South Africa	Act Nr 108 of 1996 (last amended with Act Nr 3 of 2003)
The National Environmental Management Act (NEMA)	Act Nr 107 of 1998 (last amended with Act Nr 62 of 2008)
The National Heritage Resources Act	Act Nr 25 of 1999
The National Water Act	Act Nr 36 of 1998 (amendment bill in 2013)
The Conservation of Agricultural Resources	Act Nr 43 of 1983(draft amendment bill in 2013)
Development Facilitation Act (DFA)	Act Nr 67 of 1995

2.2.1 The Constitution of South Africa

The Constitution of the Republic of South Africa is the supreme law of the land. It is a comprehensive document that promotes and protects the rights of all South Africans. Today, under the Bill of Rights (Chapter 2 of the Constitution), every citizen has the right to equality of life, freedom of expression and human dignity. Above all, of relevance to the project, people have the right to an environment that is not harmful to their health or well-being. Access to information about project developments is also enforced by the Constitution. The SIA process has been designed to promote these Constitutional rights of interested and affected people (I&AP).
Furthermore, the Constitution requires any developer to:

- Ensure that the proposed development will not result in pollution and ecological degradation;
- Ensure that the proposed development is ecologically sustainable, while demonstrating economic and social development.

2.2.2 The National Environmental Management Act (NEMA)

NEMA specifically provides for and promotes co-operative governance - especially by decision-making powers - on matters related to the environment. In this way, it promotes co-operative governance by establishing procedures and principles for ordinary citizens to become involved in the management of the environment. A key aspect of NEMA is that it provides a set of environmental management principles that apply throughout the Republic to the actions of all organs of state that may significantly affect the environment. The proposed development has been assessed in terms of possible conflicts or compliance with these principles.

Section 2 of NEMA contains principles relevant to the proposed project. Some of the most important principles applicable to this SIA include the fact that:

- The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in light of such consideration and assessment;
- Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably;
- Development must be socially, environmentally and economically sustainable;
- Any decisions must take into account the interests, needs and values of all I&APs, and this includes recognising all forms of knowledge, including traditional and ordinary knowledge.

2.2.3 The National Heritage Resources Act

The proposed LRWSS is to be developed in an area where many land has been held in families for generations. As the project has the potential to affect a number of heritage sites, especially graves, along the pipeline this Act is applicable.

The Act largely provides for the protection of historical, cultural, archaeological and paleontological resources, placing the responsibility on the developer to report any objects or material to the responsible heritage resources authority. In addition, of relevance to this project, the Act legislates that no person may alter or demolish any structure or part of a structure (older than 60 years) or disturb any archaeological or paleontological site or grave (older than 60 years) without a permit issued by the relevant provincial heritage resources authority. A permit is required to destroy damage, excavate, alter or deface archaeological or historically significant sites.

2.2.4 The Conservation of Agricultural Resources Act (CARA)

The land that will be inundated by the Zalu dam and the neighbouring area is considered as agricultural land by the affected communities. Adequate measures need to be in place to regulate the control and utilisation of agricultural resources around the dam in order to promote the conservation of soil, water and vegetation and combating weeds and Alien Invasive Plants (AIPs) in order to minimise sedimentation of the dam. CARA provides the regulatory framework for (amongst others):

- The production potential of land to be maintained;
- Preventing and combating erosion;
- Preventing and combating weakening or destruction of the water sources, and
- Protecting vegetation and combating of weeds and invader plants.

2.2.5 The Development Facilitation Act

The Development Facilitation Act of 1995 has an important bearing on the SIA process in terms of national planning and requirements. Specific planning principles that are applicable include, but are not limited to (quoted from Barbour, 2007: p.18):

- "Promoting the integration of the social, economic, institutional and physical aspects of land development;
- Optimising the use of existing resources including such resources relating to agriculture, land, minerals, bulk infrastructure, roads, transportation and social facilities;
- Contributing to the correction of the historically distorted spatial patterns of settlement in the Republic and to the optimum use of existing infrastructure in excess of current needs;
- Encouraging environmentally sustainable land development practices and processes;
- Promoting the establishment of viable communities; and
- Promoting sustained protection of the environment."

3 METHOD/APPROACH

The study area as defined in Section 1.1 was further refined for community engagement and data collection for this assessment. An area, called the project area, was selected based on direct impacts of inundation and pipeline construction (called Project Affected Communities). Surrounding villages and communities around the inundation area were directly engaged, while communities associated with pipeline reticulation were engaged through ward councillors only.

3.1 Project-Affected Communities

In terms of the Project Affected Communities (PACs), a distinction is made between those that will be directly affected by the proposed Zalu Dam and those that will be affected by the supporting infrastructure such as pipelines. The former will face land acquisition or land losses, and will be affected by inundation of their land as a result of the dam. The latter group includes all villages that will benefit from the project where pipelines for water supply will be either constructed and/or upgraded.

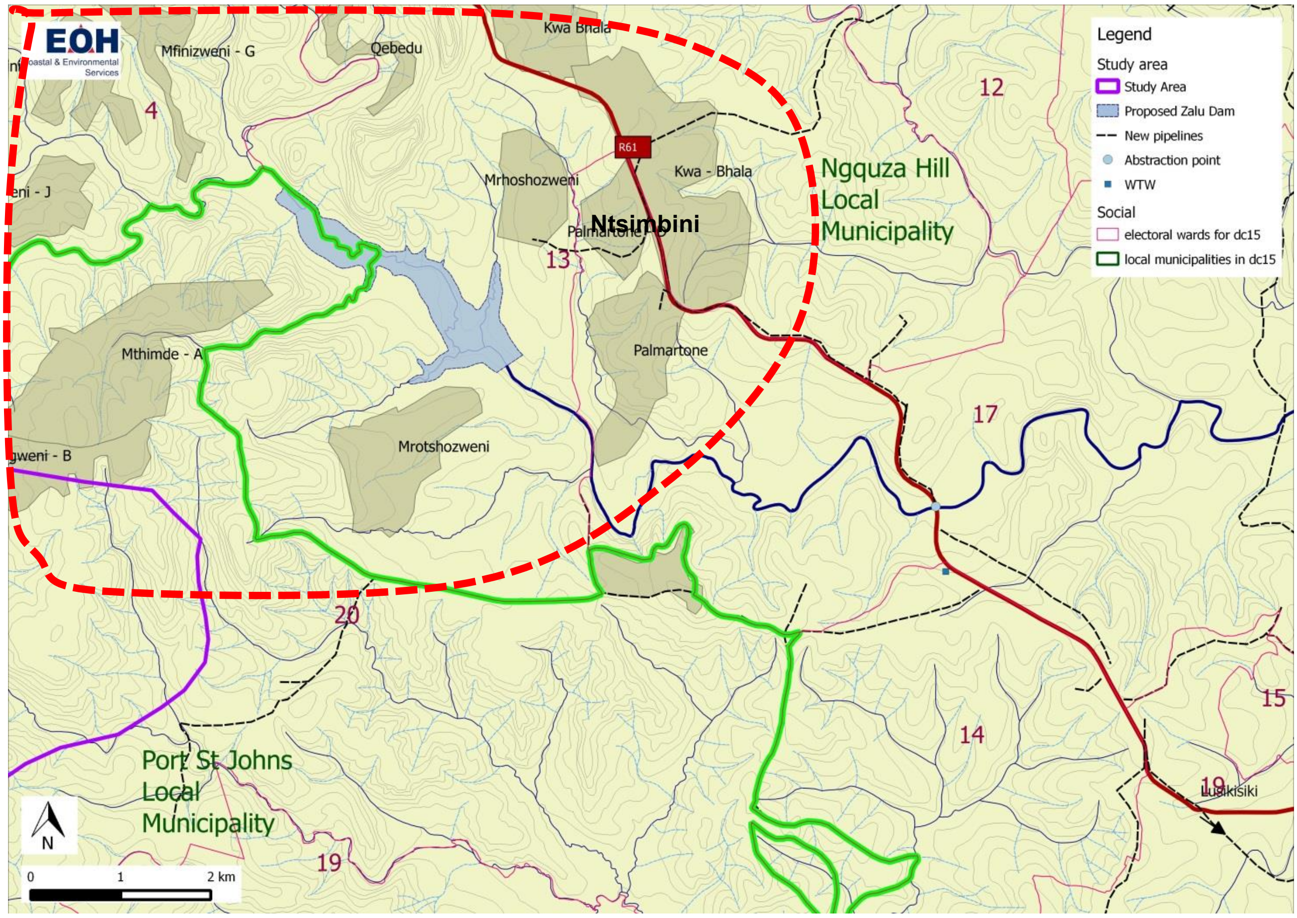


Figure 3.1 Project affected communities that will be directly affected by the proposed Zalu Dam (settlements within red dashed outline)

The Zalu Dam PACs, - the proposed Zalu Dam will affect a number of old arable lands within Zalu Heights Administrative Area (AA). Most of the land at the dam site has not been cultivated for some time, but is primarily used for stock grazing.

The infrastructure PACs – the proposed development includes associated infrastructure such pipelines and the upgrading of the existing Water Treatment Works (WTW). The pipelines will traverse villages and in some instances will be crossing community grazing areas. According to the HIA a number of pipelines will affect gravesites (see HIA specialist report). The communities where pipelines will affect grave sites and/or even properties, proper consultation must be conducted prior any construction. In some cases it will be necessary to divert the route of the pipeline to avoid affecting these areas.

3.2 Meetings, site visit and data collection

Throughout the EIA, public participation has been ongoing and the SIA has incorporated all communication from IAPs. This study has also undertaken specific activities to collect socio-economic data. Information was gathered from initial community meetings, EIA public meetings and Focus Group & Key Informant Interviews. These are discussed in detail below.

3.2.1 Initial Community Meetings

Due to the large number of affected villages and the limited time on site, initial introductory meetings were held on the 18th and 19th March 2014, with only the communities that will be directly affected by the Zalu Dam. With the help of ward committees the consultant arranged focus group meetings with representatives from the Qhawukeni and Mthimde Traditional Authorities in order to discuss each community, its residents' socio-economic status and living conditions, as well as possible socio-economic impacts of the LWRSS development. All the meetings were well-attended.

All the meetings were chaired by Mr Bosman in the residents' first language (IsiXhosa) to inform them of the EIA for the proposed project. In addition, a Background Information Document (BID) was provided to community leaders in the affected villages. During each meeting, Mr Bosman and Ms Suka were introduced, after which some background was provided on the proposed LRWSS. This included the location of the Zalu Dam and associated infrastructure such as pipelines and upgrade of the existing Water Treatment Works (WTW). The need to engage with the affected communities and to obtain socio-economic data was explained on the basis that this information would be fed into the EIA process. Mr Bosman further explained that a SIA report would be drafted and presented to the Government and client. He further clarified that this report would include particular recommendations on how to mitigate possible negative socio-economic impacts, as well as how to optimise benefits from the project.

Table 3.2: Project-Affected Communities*

Project-Affected Community	Venue	Nr of Attendees		Date
		Males	*Females*	
Mthimde Village	Community Hall	28	22	05/03/2014
Ntsimbini Village	Community Hall	13	31	05/03/2014

*A local ward councillor agreed to organise a meeting with the community of Mfinizweni without success, due to service delivery protests.

3.2.2 Environmental Impact Assessment public participation

During pre-EIA process, DWS had started to engage with local key stakeholders. Additional stakeholders were identified during the scoping phase of the EIA process, especially at local and district level (refer to Appendix A for the Stakeholder Database). These stakeholders were notified of the EIA via email and phone.

During the Scoping Report Phase community meetings were held from 7-11 July 2014. The meetings were publicised via ward councillors, ward committees and community leaders. During the EIR phase, extensive meetings were held from the 23-26 February 2014. Details, such as attendance and meeting minutes, can be found in the Public Participation Report of the EIA.

The comments received during these meetings have been considered in the compilation of this SIA and the impacts chapter (Chapter 9).

3.2.3 SIA Focus Group and key Informant Interviews

From 25 to 29 August 2014, Mr Bosman and Ms Suka visited the proposed project site and PACs in order to gather data regarding the socio-economic conditions and potential issues and impacts of the proposed Zalu Dam and pipeline reticulation.

An understanding of the socio-economic conditions of the PACs was established by conducting meetings, focus group discussions and key informant interviews (to obtain community information). Details of all interviews are presented in Table 3.1 below.

Questionnaires with open-ended questions were used to guide the meetings. These questionnaires are attached as Appendix B-E. The questions were primarily drafted to obtain basic socio-economic information on each village (essential data which could not be obtained from StatsSA), its social amenities, living conditions and residents' livelihoods. The questions were also aimed at eliciting and identifying possible positive or negative project impacts.

Several issues were discussed, such as cumulative development in the area, cultural issues that may be affected by the project, health issues, water supply and most importantly, employment opportunities. Table 3.2 below provides a list of all the meetings held (Attendance registers presented in Appendix F).

Table 3.1: Key Informant/Focus Group Interviews

Key Informant	Position	Date	Meeting
Mr Nomandindi	Manager Water & Sanitation (IHLM) representing OR Tambo DM	28/08/2014	Not successful
(Mr. Mcondobi & Mr Samfu)	Mthimde Primary: Acting Principal & HOD	26/08/2014	Successful
Ms Mbembe	Laphumilanga Primary School (Ntsimbini Village): Principal	27/08/2014	Successful
Mr E Cezula	St Elizabeth Hospital: Hospital Administrator	28/08/2014	Successful
No name was provided	Palmerton Clinic: Head Nurse	27/08/2014	Successful
Mr Sigwebo	IHLM Environment Department	28/08/2014	Successful
Ncedo Dlomo	Siyazama Power Project: Ntsimibini Village	26/08/2014	Successful
Mthimde Village (PSJ Ward 20)	See attached register in Appendix F	28/08/2014	Successful
Ntsimbini (IHLM Ward 13/17)	See attached register in Appendix F	26/08/2014	Successful
Mfinizweni (IHLM Ward 4)	NA	26/08/2014	Not successful

Meetings were held with the principals of two schools located in the area in order to supplement the information received from Stats Data. Issues regarding the number of people enrolled at the schools and availability of teaching staff, school furniture *etc* were discussed.

Two health centres were also visited in the area and interviews were held with representatives. Information regarding the number of people visiting the health centres and the areas they service were discussed. At St Elizabeth we met with Mr Cezula (Hospital Administrator) who provided insight on the challenges facing the hospital, especially with regards to water supply. The clinic at Palmerton was also visited and an interview with the head nurse at the clinic was conducted. Issues that were raised include the high rate of alcohol- and substance-abuse, as well as other communicable diseases such as HIV/AIDS.

Lastly, a meeting was held with representative of Siyazama Power Project which is a local business venture formed by people at Ntsimbini village. The meeting discussed the challenges facing small businesses in the area and their development.

From the data gathered in the field, together with the South African Census data of 2011, sufficient information was available for a detailed socio-economic description of the project area.

3.3 Data Analysis

The StatsSA Census data of 2011 was used to generate baseline information across a range of socio-economic indicators. A more qualitative approach was adopted to analyse the data obtained through the community and one-on-one interviews, municipal discussion and community meetings. This approach is fundamentally more unstructured, and is often used in the social sciences to construct social trends, and identify socio-economic patterns; relying on participant observation and field notes.

3.4 Limitations

The following limitations are associated with this assessment:

- Not all the direct and indirect PACs could be interviewed, therefore inferences had to be drawn and generalisations made. However, the consultant is confident that the communities that were interviewed were generally similar to all other affected villages.

4 BASELINE FINDINGS: DESKTOP AND SITE OBSERVATIONS

4.1 Overview

As the proposed project affects a number of wards across the IHLM and PSJLM, this chapter focuses largely on the socio-economic context of only the directly affected wards in both these municipalities. Detailed socio-economic indicators for these specific wards would reflect a more accurate setting of the current conditions surrounding the proposed LRWSS. The “project area” referred to in this study consists of wards 4,12,13,14,15,16, 17,18,19,20,21,22,23 and 24 in the IHLM and wards 13,14,15,19 and 20 in the PSJLM.

Data at ward level was obtained from StatsSA (2011), and information supplemented by the IDP of the IHLM (2013-2014) and ORTDM (2012-2016). The section has also been informed by primary data obtained through discussions with the local municipalities, one-on-one interviews, as well as focus groups held with representatives from the PACs.

4.2 Socio-economic description of wards in the LRWSS project area

4.2.1 Demographic Overview

As illustrated in Figure 4.1 below, the vast majority of the population in the project area are classified as Black African (99%) while all other races combined are less than 1%. This may be largely attributed to the fact that this area is a former homeland (Transkei) and therefore still remains largely populated by blacks. The majority of the population is female at 54%, while males constitute 46%.

According to StatsSA (2011) 44.5% of the population in the project area are 15 years or younger, while 50.3% are in the 15-64 year age bracket. Senior citizens above the age of 64 years constitute 5.2% of this population.

There seems to be an out-migration of economically active people in the age group of 20-34 years. This highlights the need for economic investment in order to retain an active workforce and a healthy male-to-female ratio in the area. According to the IHLM IDP, the “high number of young people… leaving the area… suggests that service provision and social upliftment should be targeted at the youth and should be an important consideration for development.” (IHLM IDP Review, 2014-2015). The reasons for such migration can be attributed to a number of factors such as:

- The absence of tertiary educational institutions;
- Promises of better living and working conditions elsewhere;
- Poorly developed rural areas; and
- The poverty context and high unemployment levels.

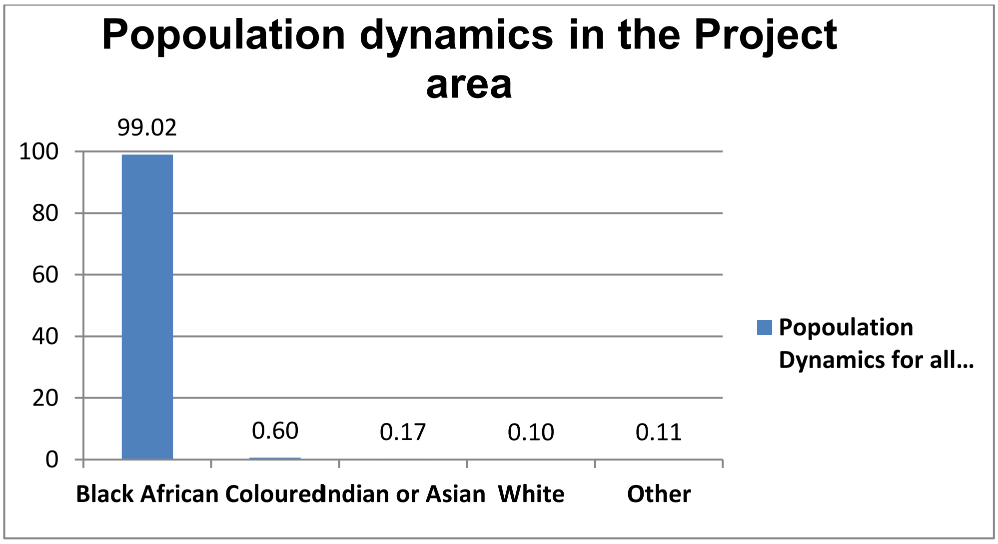


Figure 4.1 Population dynamics for the affected wards

In addition to migration patterns, the largest issue with regards to population dynamics is the prevalence of HIV/AIDs. This disease, apart from creating large strain on health and community support services, can also cripple the local economy. A survey of antenatal HIV prevalence conducted in ORTDM (Table 4.1) indicates that as of 2012, approximately 30% of the survey participants were HIV positive. The incidence of the disease recorded in the economically active age groups (estimated in this study to range from 20-39 years old) was 73.1%, although an alarming 24.1% of the surveyed women younger than 19 are also HIV positive (Figure 4.2). This means that the majority of HIV victims, and 22% of the antenatal group surveyed, may not be economically active.

Table 4.1 HIV/AIDS prevalence in the ORTDM*

Year	2009	2010	2011	2012
% HIV/AIDs prevalence	29.7%	31.5%	28.4%	30.1%

*National Antenatal Sentinel HIV and Herpes Prevalence Survey, South Africa, National Department of Health, 2012

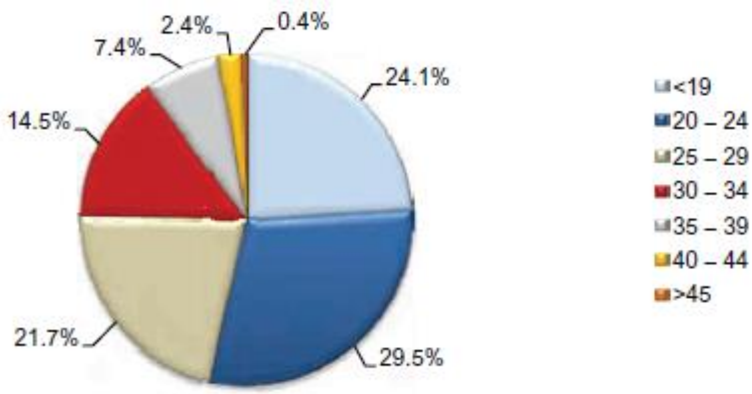


Figure 4.2 HIV prevalence among age groups in the Eastern Cape
(Taken from: National Antenatal Sentinel HIV and Herpes Prevalence Survey, South Africa, National Department of Health, 2012)

According to the IHLM Annual Report (2008), however, the HIV/AIDS prevalence in the local municipality was 20.2%. The source of this information is not provided, but these values indicate that HIV/AIDs prevalence is significantly lower that the surrounding municipalities in the ORTDM. A local HIV/AIDS support programme, TAC, was contacted for more accurate and localised information, but none had been received at the time of report submission.

4.3 Employment

Only 7% of the people within the project area are economically active/employed, most of which are employed within the government sector (Figure 4.3). This status is indicative of a collapsed economy which will require large-scale investment intervention to stimulate economic sectors.

According to the IHLM IDP the IHLM is the second highest contributor to the ORTDM GGP, after King Sabata Dalindyebo Local Municipality, and accounts for 9.4% GGP contribution to the District Municipality (IHLM, 2006). The government sector makes a significant contribution to the IHLM GGP of the municipality with a total contribution of 56%, followed by wholesale (8.7%), retail (7.8%) and agriculture & hunting at 7.4%. The remaining sectors have a contribution of less than 5% each which hampers the economic growth of the area.

Ironically it is the sectors that are making the smallest contribution that have the highest potential to improve the local economy. For example the agricultural sector which should be the dominant sector in the project area, is declining. The decline in agricultural output has several implications for the economy. It indicates that the IHLM depends almost entirely on imports of basic food stuffs. This also results in loss of employment opportunities that could be created by this sector.

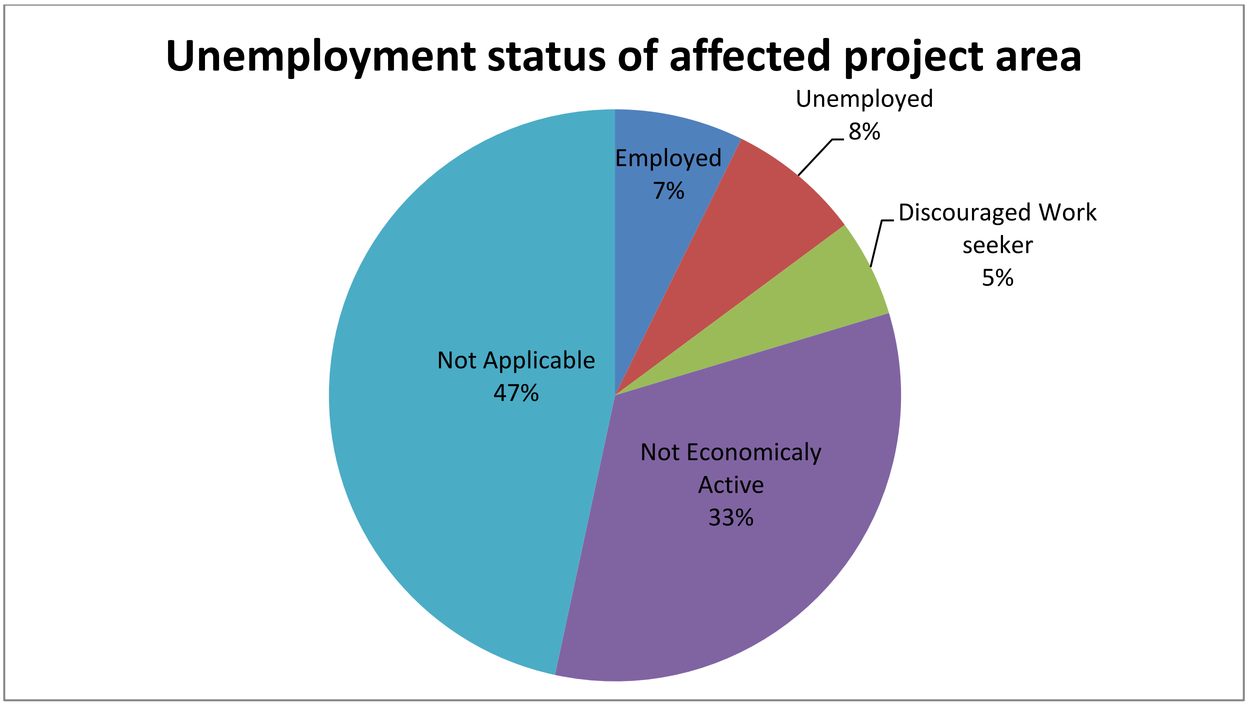


Figure 4.3: Unemployment status of project area

Figure 4.3 represents the unemployment status of the population in the project area. The majority of this population is 15 years or younger (47%) and thus may attribute to the large percentage of the population falling under the „not applicable' category. Only 7% of the population is employed, implying that this area may have a low standard of living. Many (33%) are not economically active which suggest a high dependency on social grants.

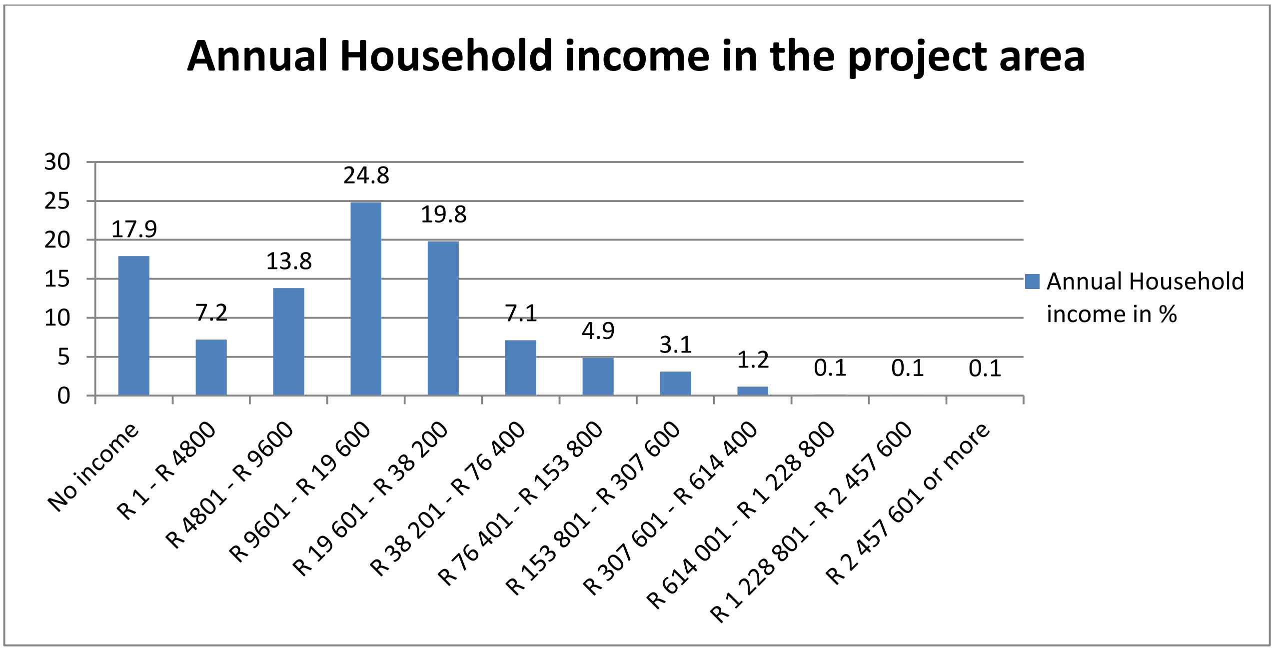


Figure 4.4: Annual Household Income in project area (StatsSa, 2011)

Figure 4.4 above illustrates that the bulk of the households in the project area (58.4%) receive between R4,801- R38,200 per year. While almost 18% of the household receive no income at all.

Very few households (only 1.45%) receive more than R307,601 per year (or R25,633 per month). Baseline data generated from interviews indicates that items such as food, electricity, healthcare and school-related expenses (uniforms and books, for example) were the households' largest monthly expenses.

According to members of Siyazama Power Project, and local business enterprise, the lack of employment opportunities in the area is what made them start the project. The aim of the project is create job opportunities for youth in the area.

4.4 Socio-Economic Living Conditions

4.4.1 Land-Use and Households

All the affected wards are based in the former Transkei. As a result the vast majority of the land is zoned as traditional land at 93.6%. Approximately 0.1% of the land is classified as farms and 3.8% zoned as "urban", (Figure 4.5). According to Stats SA (2011) 1.2% of the population in the project area occupy informal dwellings. Due to the rural nature of the project area, the majority of the population live in traditional dwellings (56%).

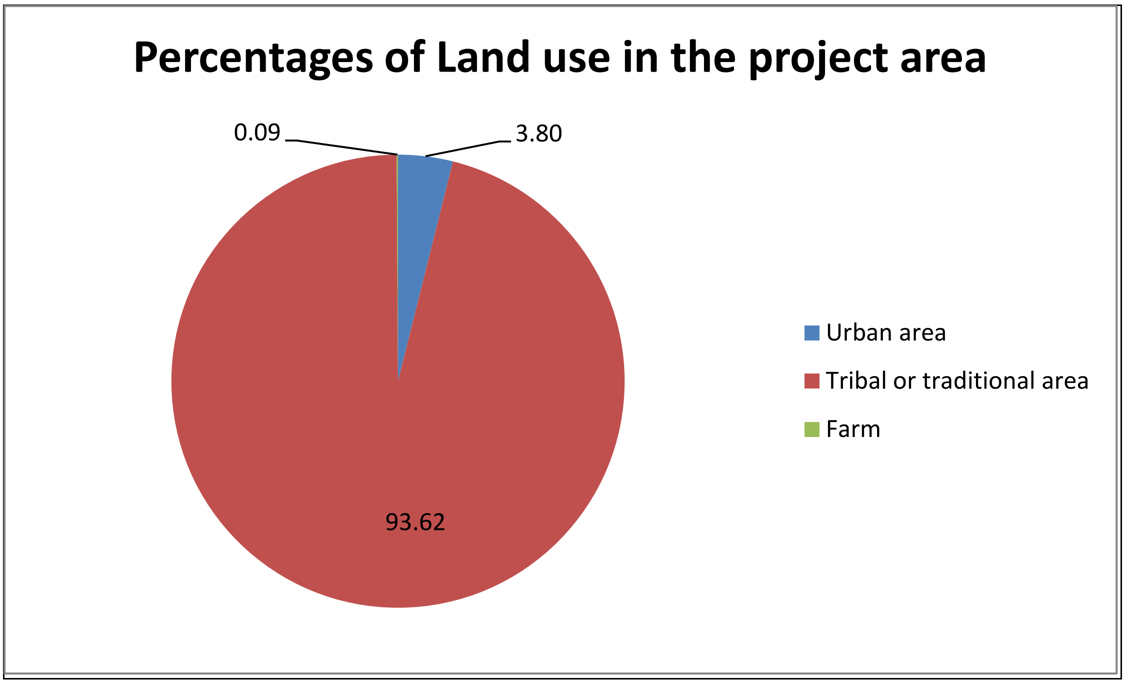


Figure 4.5: Land-use and households (StatsSA, 2011).

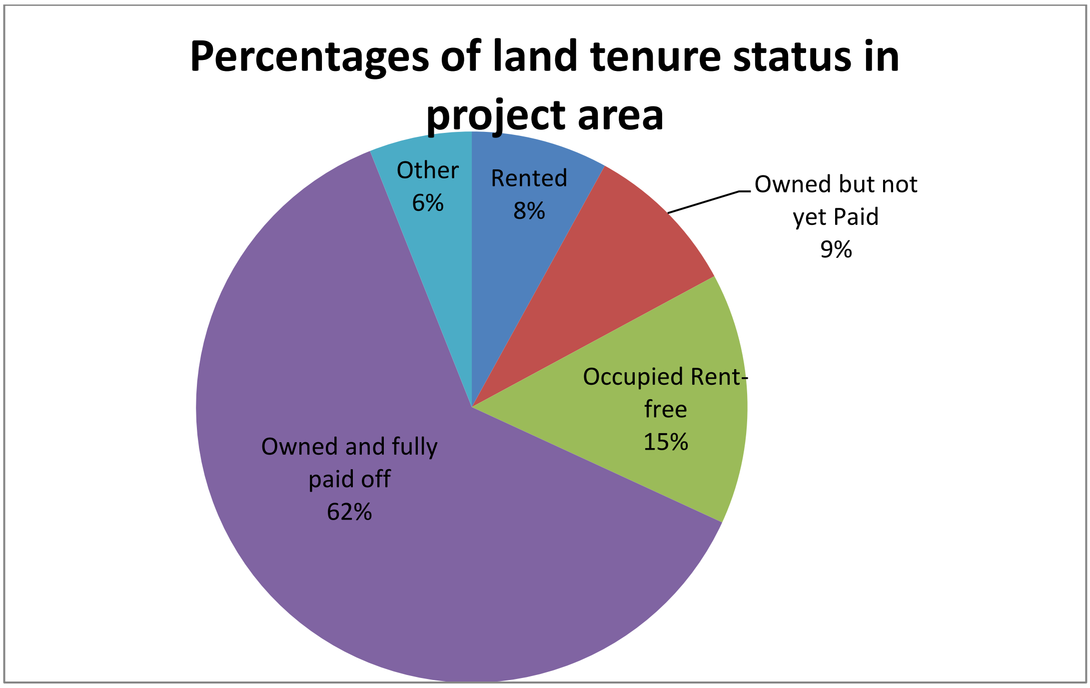


Figure 4.6: Tenure status in the project area (StatsSA, 2011)

Figure 4.6 above illustrates that the majority of the population (62%) in the project area own fully paid houses and 9% are still paying for their homes. About 8% of the population live in rent houses and approximately 15% occupy houses rent free.

The average household in the project area is occupied by 4.7 people and approximately 60% of households are female-headed. In light of the area's limited economic opportunities, many of these female-headed households are reliant on social grants to make ends-meet. Women in particular might therefore benefit significantly from employment and skills opportunities that arise from the proposed LRWSS.

4.4.2 Education

The level of education in the project area is very low. The majority (35.7%) of the population have some primary school education. Only 6.8% of the population have completed secondary school and a mere 2.6% of the population have education higher than matric (Figure 4.7). This can be attributed to lack of higher educational institutions within the project area. According to the IHLM IDP when comparing the levels of education across the municipalities, a strong correlation with household incomes, high unemployment and a low human development index can be demonstrated.

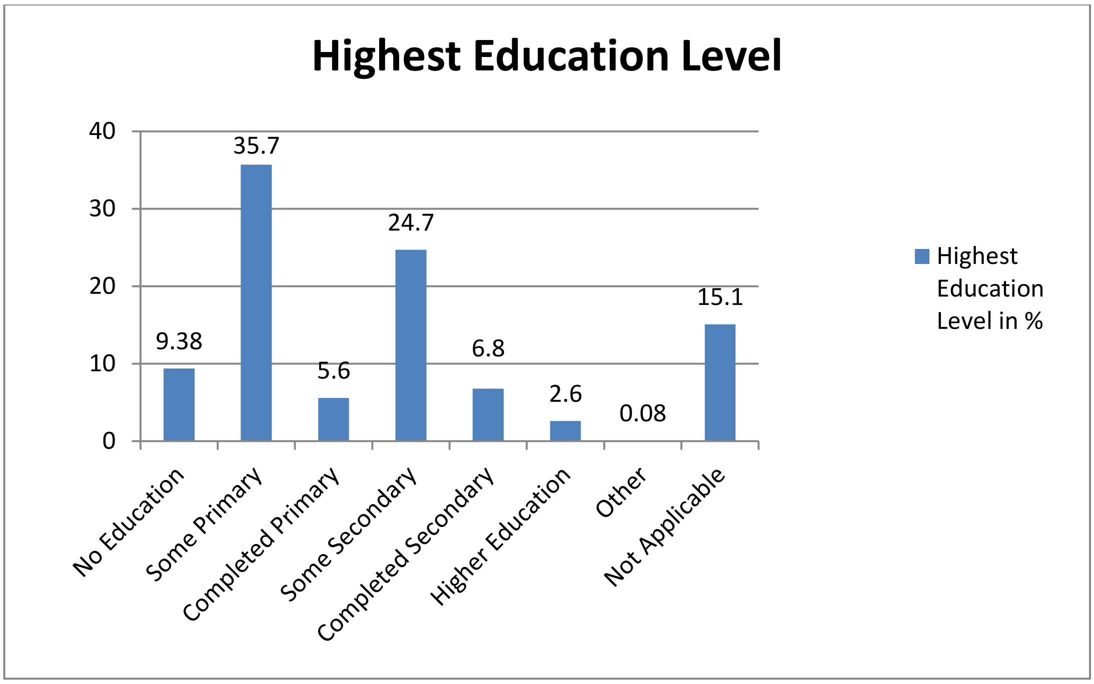


Figure 4.7: Highest education level completed

It was also noted from the site visit and from interviews with educators in the project area that the learning conditions of schools in the area is poor. The schools are faced with challenges such as shortage of teachers, classrooms, furniture and other basic services such as water and sanitation facilities. The three schools visited relied on rain water tanks for water supply or in some cases the municipality delivers water to the school. Due to lack of classrooms, learners in some schools sit outside (Figure 4.8).

There are a few institutions of higher learning in the IHLM. These are based in the two main towns (Lusikisiki and Flagstaff) within the municipality, such as the Ingwe TVET College (Lusikisiki campus). Pupils from far rural areas experience difficulty accessing these institutions. In most instances they rent flats in close proximity.

Figure 4.8: Schools within the project area

4.4.3 Water

According to StatsSA (2011), an alarming percentage of the population in the project area have no access to piped water (61.28%). While this figure has dropped in the past decade, this remains a serious challenge in the area. Figure 4.9 shows access to different sources of water within the project area.

There are number of rivers running through the project area, which extends from the Mzimvubu River in the south-west to the Msikaba River in the north-east. There are other rivers within the project area such as Xura where the Zalu dam will be located. Most of the communities within the project area receive water from natural sources especially rivers, springs and boreholes.

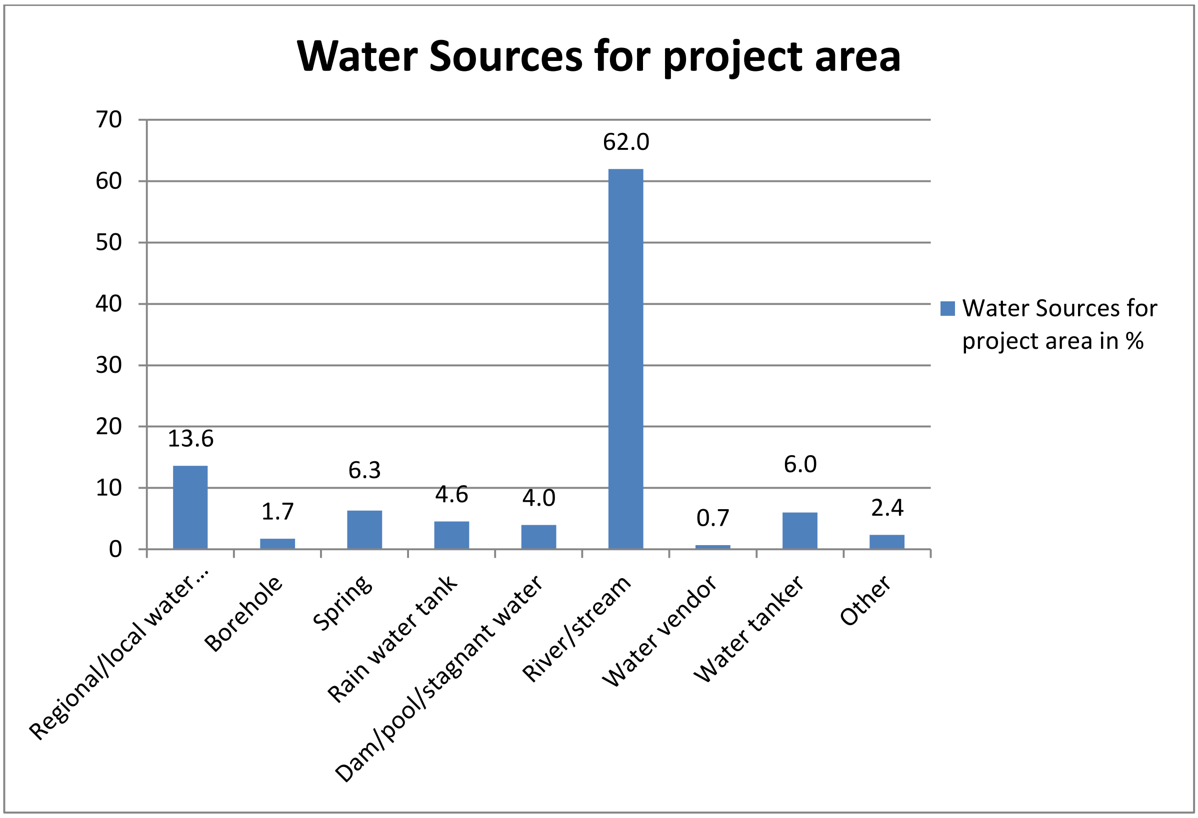


Figure 4.9: Sources of water for the project area. **(Regional/local water: formal supply provided by municipal services)**

Clearly, there is a need to provide not only potable water services to more households within the area, but also to assist the municipalities with sustainable and clean water provision. At present, the ORTDM has a number of water schemes under its area of jurisdiction. In order to deal with the need for water supply, boreholes are used in some areas. ORTDM upgrades them to ensure better access to communities and monitors their use in order to prohibit the use of the same water by livestock and people. Water is pumped from the borehole into a rainwater tank and is then collected in buckets (Figure 4.10). In most instances these systems are poorly maintained and non-functional.

Figure 4.10: Borehole used for water supply (tank supplied by ORTDM)

4.4.4 Roads

IHLM is traversed by the R61 which links Port St Johns to Durban. This road runs through the commercial centres of IHLM which are Lusikisiki and Flagstaff, and is also a link with Mthatha, the main city in the ORTDM. In most cases this road is not fenced (Figure 4.11a). The road is not adequately maintained resulting in a gradual decline in the quality and safety. The majority of the smaller, rural access roads in the project area are poorly-maintained gravel roads (Figure 4.11b) that have no road markings or signs. There is a serious problem of vehicle-livestock collisions on most of the roads in the project area, especially along the R61 (Figure 4.11a). The majority of the population are pedestrians. A small proportion of the population makes use of buses, minibus axis and private cars for transport.

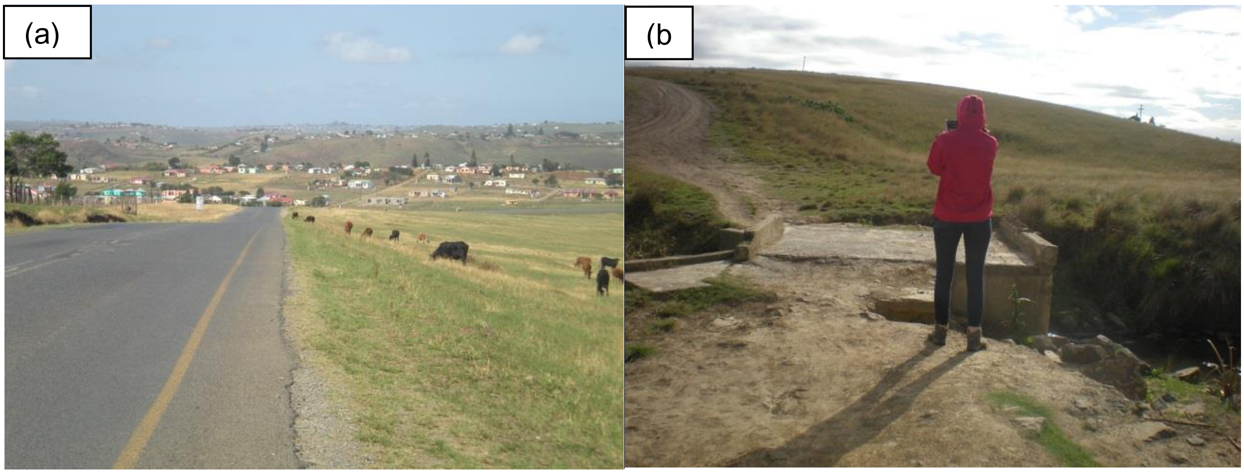


Figure 4.11 (a) R61 within the project area showing no fences and livestock close to the road; (b) Smaller rural gravel roads are poorly maintained.

An important factor that may significantly alter the economic and social dynamics of the local communities is the future construction of the new National 2 (N2) Wild Coast Toll road. The new N2 is routed through Lusikisiki and will result in significant social and economic impacts of its own, during construction and operation. The sections of road that will be affected include the R61 coming into Lusikisiki from the south and a new road out of Lusikisiki travelling east.

4.4.5 Electricity

Numerous electrification projects are currently underway in the general project area. The ESKOM Hombe power line is currently under construction, electrifying villages north of Ntsimbini. The project material was kept at Ntsimbini and can be seen in Figure 4.12 below.

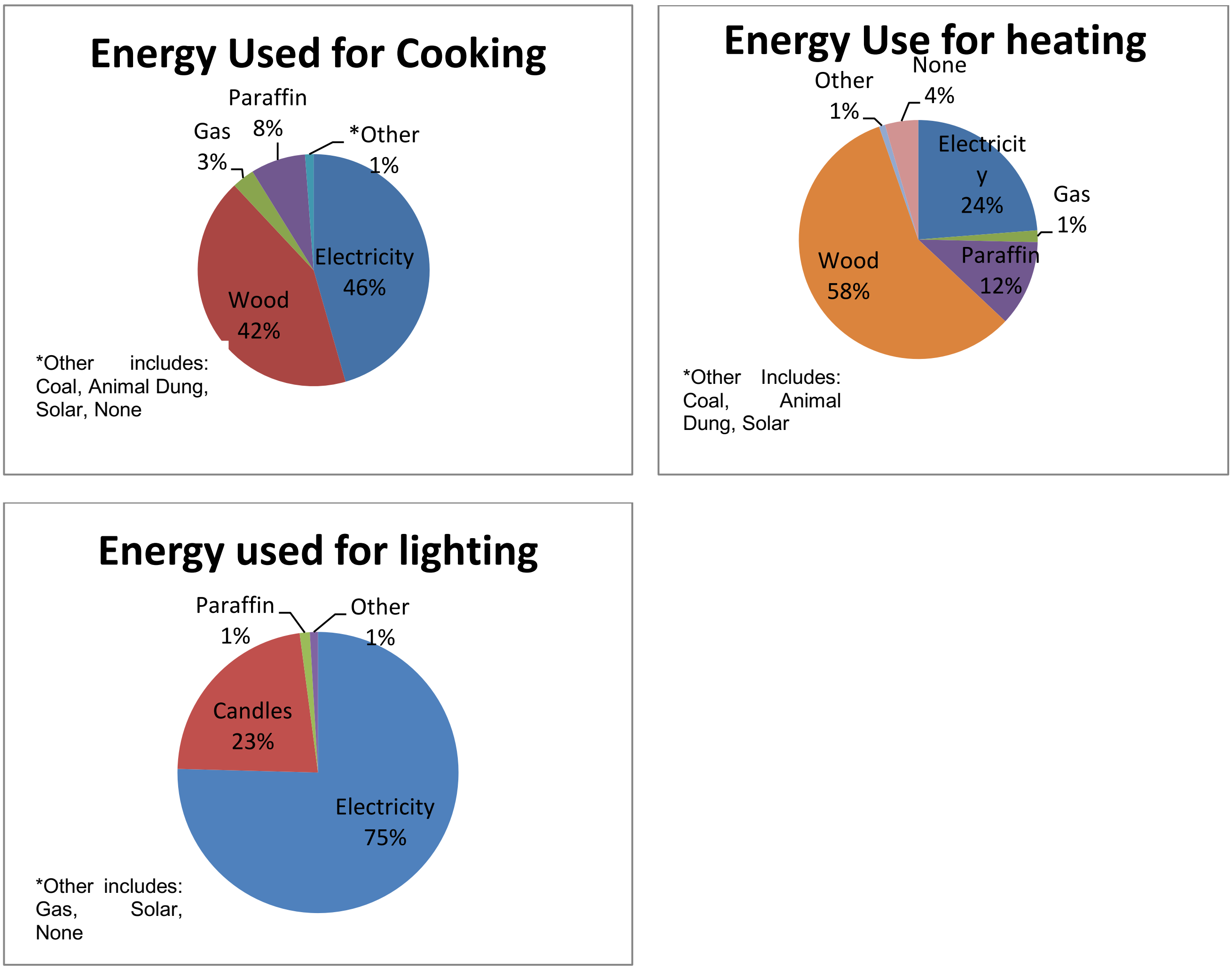


Figure 4.12 Energy sources and usage in the LRWSS project area

Figure 4.13: (a) Electrification; (b & c) Materials for further electrification in the project area.

4.4.6 Sanitation and Refuse Removal

No sanitation (water borne) and refuse removal services ae provided in the project area. These services are limited to the major towns in both the IHLM and PSJLM. According to StatsSa only 2% of the population in the project area have flush toilets and a further 12% use chemical toilets. As shown in Figure 4.14, 12% of the population have no access to sanitation services. The majority of the population use pit toilets without ventilation (38%) (Figure 5.14).

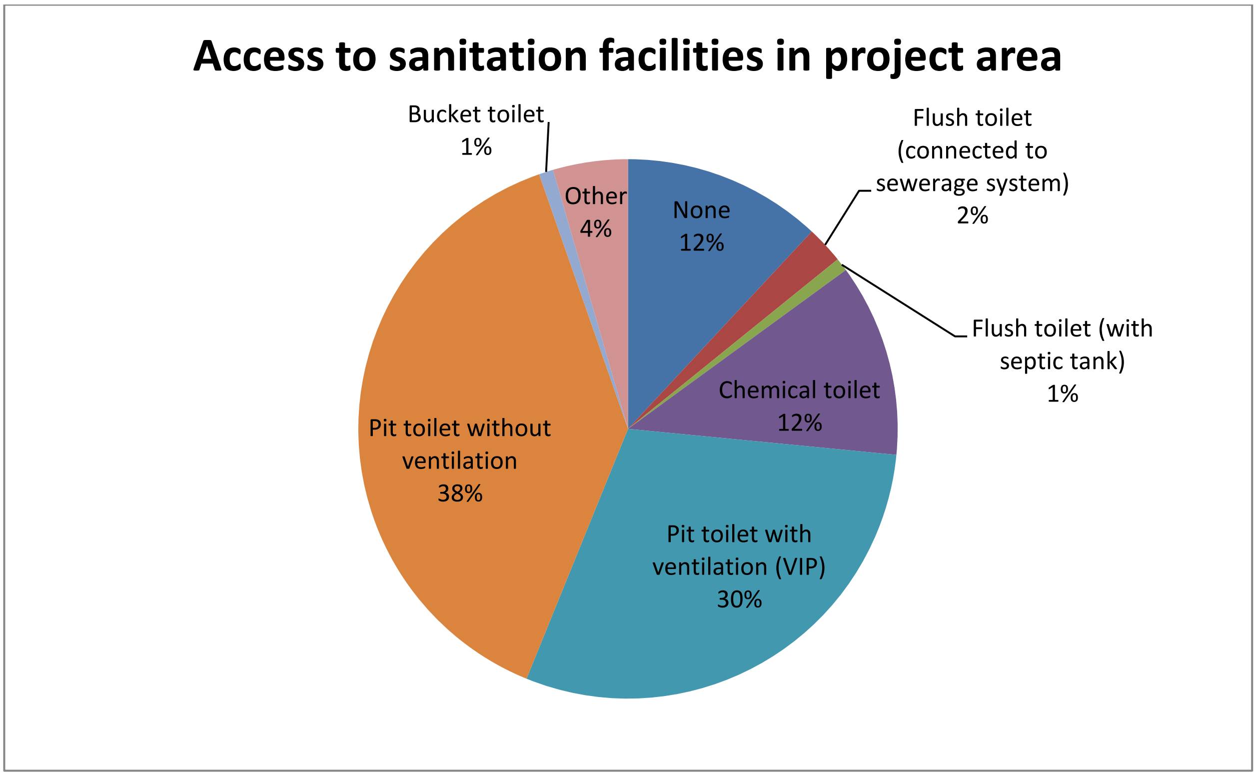


Figure 4.14: Access to sanitation services within the project area

Figure 4.15: Ventilated pit toilet in the project area

Refuse removal is limited to major towns and surrounding townships in the municipalities. According to StatsSA only 2.4% of the population in the project area have refuse collected weekly and a further 0.5% have their refuse collected less often (Figure 4.16). The majority of the population (77.6%) dispose of refuse in their own dumps. In all the villages interviewed, it was noted that they either burn their waste or bury their waste.

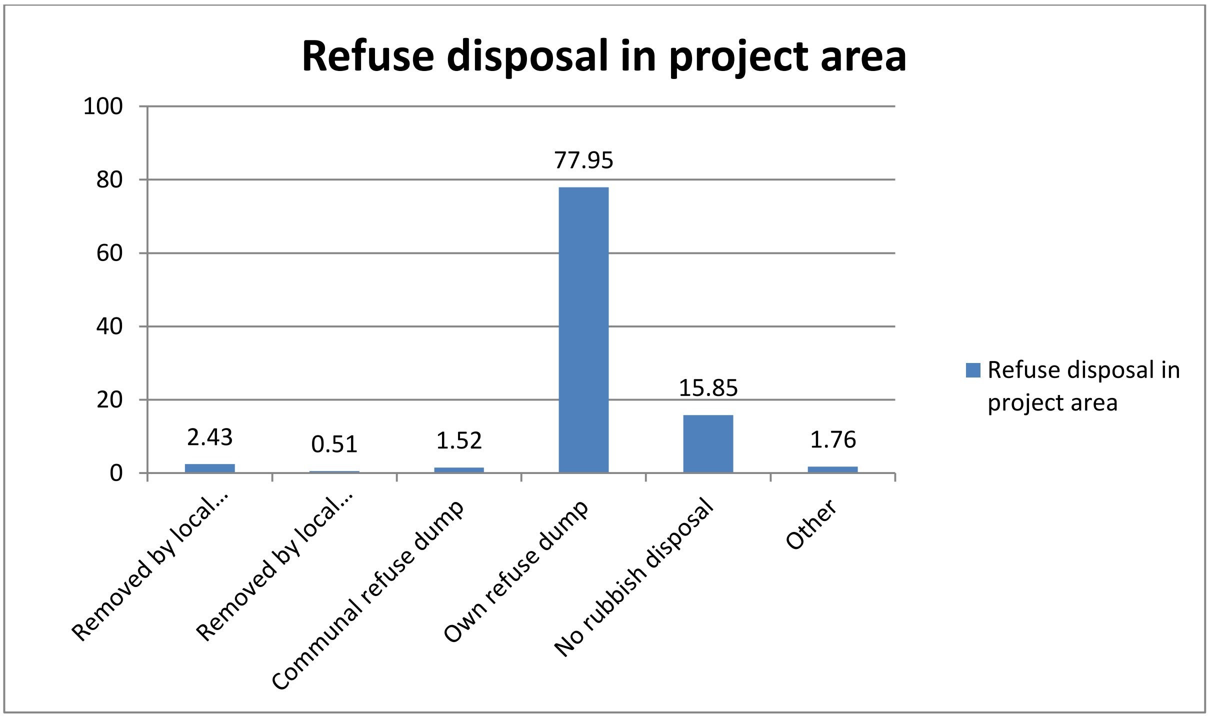


Figure 4.16: Refuse disposal in project area

4.4.7 Culture and Recreation

The predominant religion in the area is the Christian faith. Often, a patriarchal system exists amongst the households in this area. This is a system which has undoubtedly been shaped and reinforced by traditional rural family practices, especially in the Eastern Cape.

However, the patriarchal system has evolved with the Government's commitment to gender equality, as well as the introduction of the South African Social Grant System. There also seems to be a tendency for men to leave their partners after a pregnancy, which might force women to become single-headed households. Still, community members confirmed that men are generally regarded as the household heads in their culture.

During the community meetings and key informant interviews, most residents verified that their communities have few cultural or recreational activities, especially for the youth. A reason put forward is that there are no opportunities in the area for youth to engage in recreational activities. Even sporting activities (i.e. soccer) in the area are poorly supported and the youth rather participate in activities that involve substance abuse. Although many communities have soccer fields many assert that such facilities need an upgrade. Safer recreational activities in the areas are clearly needed, such as playgrounds for children, whilst there seems to be a particular need for after-school care and activities for school children.

The communities in the project area also practise the initiation custom (ulwaluko). In most instances this practise is done in areas outside villages close to forests and woodlands. During the site visit an initiate hut was located east of the dam site. The project will not affect the areas meant for initiation, as they are typically close to villages.

4.4.8 Organisations and Important Groups

During the community meetings and key informant interviews, residents were asked whether there are any important organisations or groups in their communities which the proponent should consult and work with. It was expressed that only soccer teams and a few small business groups such as Siyazama Power Project exist within these communities.

4.4.9 Crime

The local communities raised the current levels of crime as an issue that may be exacerbated by the proposed LRWSS. Although representatives from the Lusikisiki precinct were not available for comment, statistics on the crimes reported in 2012, 2013 and 2014 (Figure 4.17) show a general increase in criminal activities. The total number of reports in the categories given below from 2012-2014 is 2459, 2683, 2930, respectively.

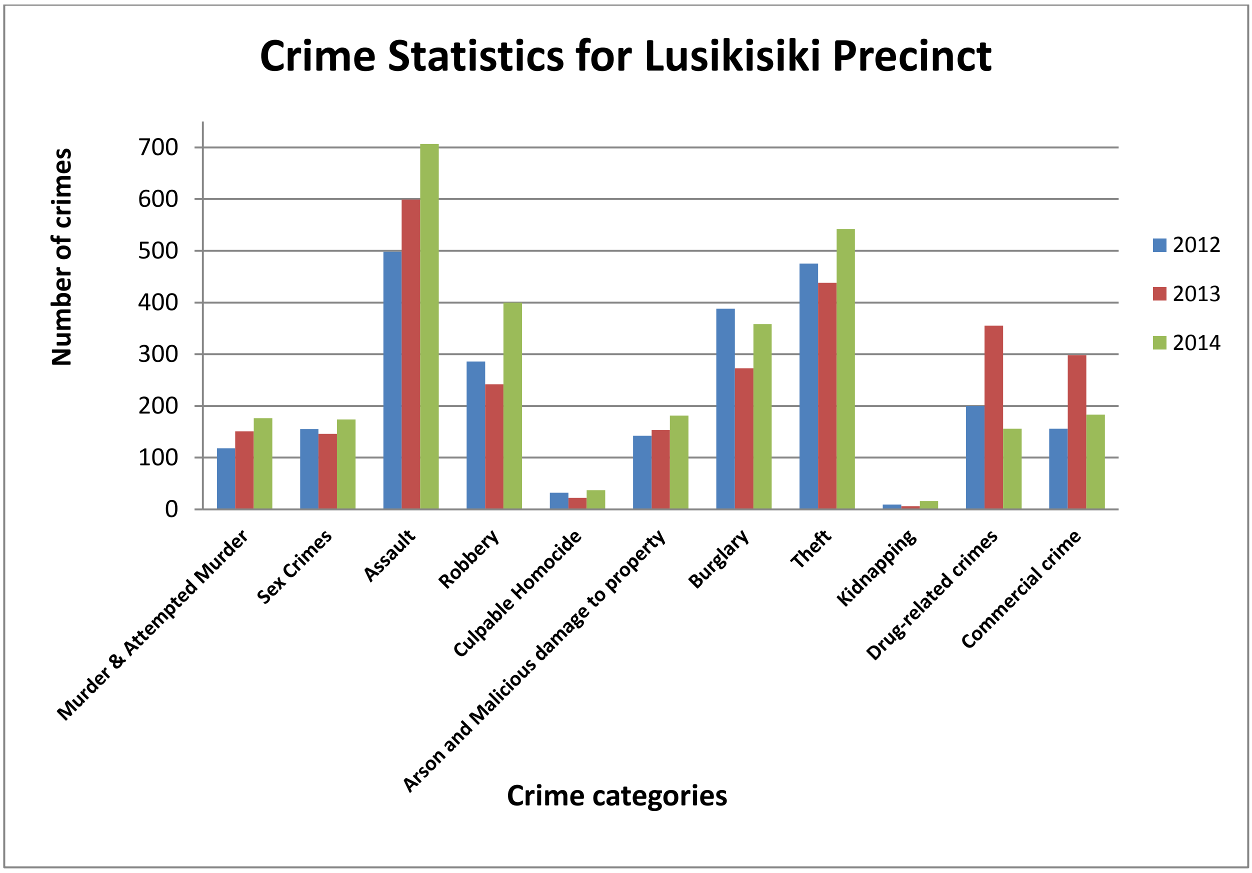


Figure 4.17 Reported crimes at the SAPS Lusikisiki precinct (CrimeStats SA, 2014)

4.5 Key outcomes of site observations and interviews

4.5.1 Project Perceptions

Taking into account many perspectives from a variety of interest groups and stakeholders, the PAC members and the IHLM appear to be receptive of the development. Some of the most important reasons in favour of the project include:

- The need for water supply in most villages;
- The possibility for the project to provide employment opportunities for locals; and
- The need to upgrade existing infrastructure – there will be an upgrade of the current Water Treatment Works (WTW) and supporting infrastructure.

4.5.2 Current socio-economic issues

In summary, the following baseline socio-economic issues, pertaining to the proposed LRWSS, have been identified:

- According to members of Siyazama Power Project, and local business enterprise, there is a serious lack of employment opportunity for youth in the area.

- Items such as food, electricity, healthcare and school-related expenses (uniforms and books, for example) are the largest monthly expenses.
- Learning conditions of schools in the area are poor. The schools are faced with challenges such as shortage of teachers, classrooms, furniture and other basic services such as water and sanitation facilities.
- Safer recreational activities in the areas are needed, such as playgrounds for children, whilst there seems to be a particular need for after-school care and activities for school children.
- ORTDM, as the Water Service Providers, have installed boreholes for community use as an interim measure to supply water. In most instances boreholes are poorly maintained and non-functional.

4.5.3 Socio-economic issues of the proposed LRWSS PPP and SIA meetings:

The following issues have been raised through the public/community meetings held as part of the PPP of the EIA. Only the issues relevant to socio-economic assessment are considered in this study. These issues have been integrated into the impact assessment in Chapter 6.

Table 4.2 Socio-economic issue raised in meetings

Raised by:	Issue	Concern/Comment	Reply/Action
Mr. Nongwani	Traffic Safety	What will be the solution to speeding trucks and construction vehicles?	It was confirmed that an Environmental Management Plan (EMP) will be submitted with the EIA. The aim of the EMP is to provide guidelines which will be followed during the construction and operational phase of the project. These include safety guidelines that will be followed by construction vehicles such as minimum and maximum speed limits. These guidelines will also be made available to the communities as part of the Environmental Authorisation. It was indicated that at this stage we cannot promise what will be or not be done as we are still speculating. If these disasters occur even if it's as a result of the dam the government normally has a disaster management plan to deal with such issues.
Mr Mthemba	Disturbance of grave sites	How would the community know if those are real graves as it is clear from your presentation that you are not sure about some of them? You said some graves look to be more than fifty years old?	It was confirmed that DWS will initiate a separate public consultation process once the EIA has been approved to engage with all those affected either with regard to graves or loss of land.
Mr. Ngwane	Additional benefits	What are the benefits we will get as the communities surrounding the dam except for the water from the dam?	It was indicated that at this stage there is nothing tangible that will benefit the adjacent communities except water supply but a number of initiatives such as fly fishing can be looked at once the EIA has been approved.

Mr. Mafana	Water Safety	Will the dam not be safety hazard to livestock and people? For example will it not bring water animals that will suck and drown animals and people into the dam?	It was indicated that dam safety would be considered and if necessary, the dam will be fenced off. At this stage there is no proposal to close or fence the dam.
Mr. Ngcoza	Landuse in and around the inundation area	What will happen to people who still plant close to the dam?	It was indicated that the only land that will be affected will be the land in the inundation area of the dam. The area adjacent to the dam can be used as normal.
Mr. Witbooi	Disturbance of grave sites	What if you cannot find the owners of the graves? Is the project going to stop?	It was indicated that there is a legal process that will be followed prior to the relocation of the graves if the owners cannot be found. This process will be completed in collaboration with community leaders of the affected area. All in all the project will not stop but it might be delayed if the relatives are not found.
Mr. Mtwasa	Job creation for local communities.	How is the employment going to happen? Are people from all these villages going to be employed in the project?	It was confirmed that people from local communities will be employed in the project. The department (DWS) has policy with regards to how contractors must deal with employment issues.

5 CURRENT AND FUTURE LAND-USE POTENTIAL

5.1 Current land-use of the inundation area

Due to the rural nature of the area most the land in the inundation area is used for grazing and small scale agriculture (Figure 5.1). Most of the arable lands owned by community members outside homesteads are not cultivated, but used as grazing areas. During the focus group interviews the locals informed us that the reason for this is lack of fences and a closure of cooperatives that were operational in the previous Transkei government. The communities close to the proposed dam will have the opportunity to access water for irrigation in the future, but the major concern raised was fencing around the arable fields to protect them from livestock.

Livestock grazing is the dominant land use in the area. The grazing areas are not fenced and in some instances livestock graze along the main roads. This often results in accidents and loss of lives and livestock.

Figure 5.1: Home gardens close to houses

5.2 Tourism and recreation

As identified in the IHLM LED Strategy, Tourism is an economically important and established industry in the study area. Most of the tourism facilities are geographically limited to the Wild Coast.

The following are established tourism facilities in the broader area of the propose project:

- Mkambati Nature Reserve (Eco-tourism)
- Mbotyi Campsite
- Mbotyi River Lodge
- Magwa Estate and Backpackers (Agri-tourism)
- Khululeka Retreat
- Port St Johns as a coastal resort
- Silaka Nature Reserve (Eco-tourism)

The proposed Zalu Dam may contribute towards the tourism economy by providing facilities for water-based recreation and sport. The new proposed N2 Wild Coast Toll Road will provide infrastructure linkages with coastal tourism to potential recreational and tourism activities at Zalu Dam.

It is proposed in this study that the applicant consider the conversion of construction camps, which may include formal ablution, water, semi-permanent structures/buildings and offices, to recreation and tourism facilities after construction has been completed.

5.3 Irrigation/agriculture Potential Assessment (2013)

From Google Earth images dating back to 2004 (Figure 5.2), it is evident that a large portion of the site that will be inundated was still cultivated. In recent years, however, this land has been left fallow and no crops have been planted for some years.

Downstream from the proposed Zalu Dam, pockets of land adjacent to the river are still being cultivated. The construction of a dam may result in excess water allocated to irrigation schemes. For this reason an Irrigation Potential Assessment, prepared by Aecom (DWA, 2013. Report no. P WMA12/T60/00/4211), was conducted for land downstream of the dam, as part of the feasibility study for this project. The irrigation potential assessment was undertaken from 2010/2011 – 2013, and assessed the soil potential for irrigation projects. The majority of the lands (5247.6 out of a total 5253 ha) were considered moderate to marginal, which would not be suitable for irrigation (Figure 5.3).

The area of inundation was not assessed since the land would hold no irrigation potential, however, detailed soil surveys were undertaken for the adjacent and downstream pockets of land previously cultivated. Most of the pockets surveyed are geographically similar to the inundation area (i.e. adjacent to the river) and consist of the same underlying geology. Therefore, this report has extrapolated the results of the Irrigation Potential Assessment (2013) in order to assess the cultivation potential of the inundation area, and therefore the impact that the loss of agricultural land may have on the livelihoods of surrounding communities.

In summary, only 5.4 ha of land downstream of the proposed dam was identified as suitable for irrigation cropping, which means that a large-scale irrigation scheme would not be viable. The remaining cultivation areas were deemed moderate to marginal and therefore not desirable for irrigation. The Irrigation Potential Assessment does state that there is opportunity, with technical and managerial input, for small agricultural gardens where soil conditions are more favourable.

In addition, the Irrigation Potential Assessment (2013) investigated the status of other agricultural activities, such as livestock and milk production, broiler and egg production, in the surrounding project area. It was determined that:

- Maize, vegetable, milk, eggs and hens are imported into the project area, which means there is opportunity to increase local production.
- There is high potential for commercial forestry plantation, tourism and dry-land agriculture due to favourable climatic and natural conditions.

Figure 5.2 Land within the inundation area of the Zalu Dam, adjacent to the river which was actively cultivated in 2004 (shaded in red).

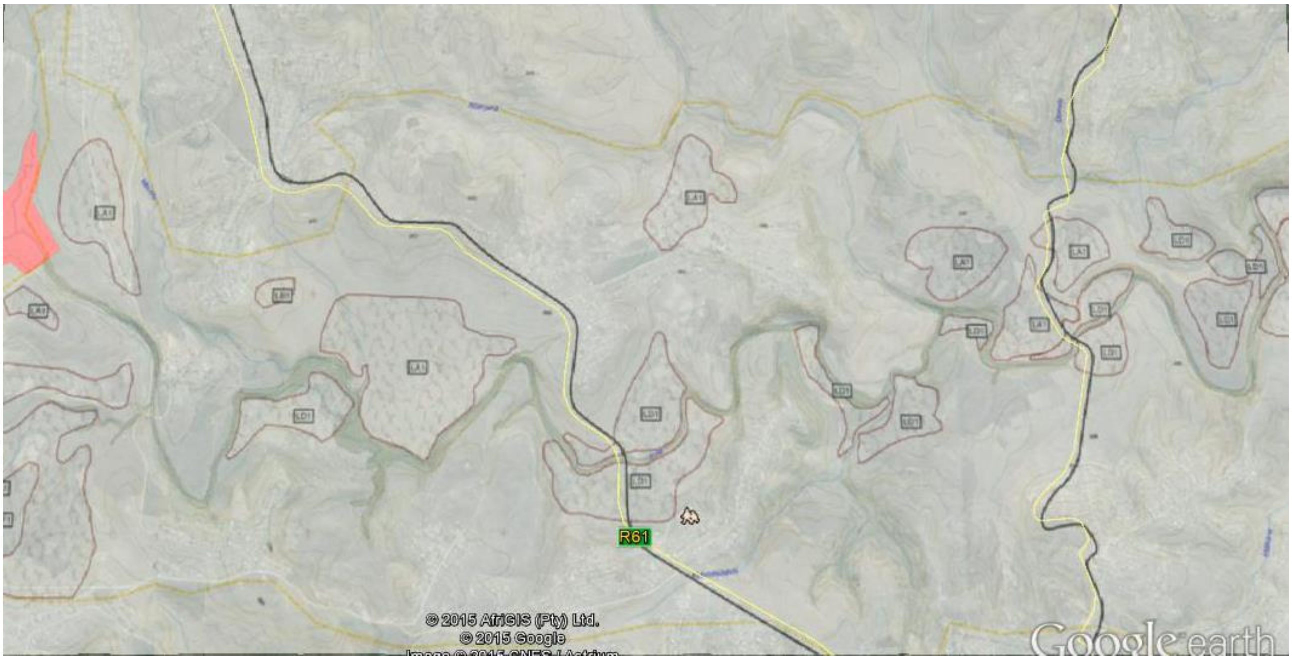


Figure 5.3 Soil irrigation potential downstream of the proposed Zalu Dam. 99.8% of the lands is considered moderate to marginal.

5.4 Aquaculture

There is a significant increase in interest in aquaculture both in South Africa and globally, where global fish consumption has doubled in the last 40 years, outpacing population growth. In addition, nutritionists promote the health benefits of eating fish.

The IHLM LED Strategy reported a decline in the Fisheries economy. The Zalu Dam could present very real economic opportunities for the culture of freshwater fish/plant species. However, setting up an aquaculture business can be a risky exercise and requires a serious commitment of time and financial resources. As with any other business venture, it requires a detailed feasibility study before investment decisions are made.

Potential fish species and products that could be considered
It is suggested that an aquaculture facility at the Zalu Dam could focus on the following main fish species:

- Tilapia
- Trout (uncertain if appropriate climatic conditions)

Tilapia fish	
Tilapia products processing	

The total global aquaculture production of tilapia was reported to be 1,265,800 tons in 2000. The largest exporter, Taiwan, supplies Japan with high-quality tilapia fillets for the sashimi market, and ships frozen tilapia to the United States market (40,000 tons in 2001). Taiwan exports about 70% of its domestic tilapia production. In Africa, Zimbabwe, now also produces fresh and frozen fillets for the EU market.

Criteria for an optimal aquaculture project
The following criteria may be relevant for the establishment of an aquaculture project:

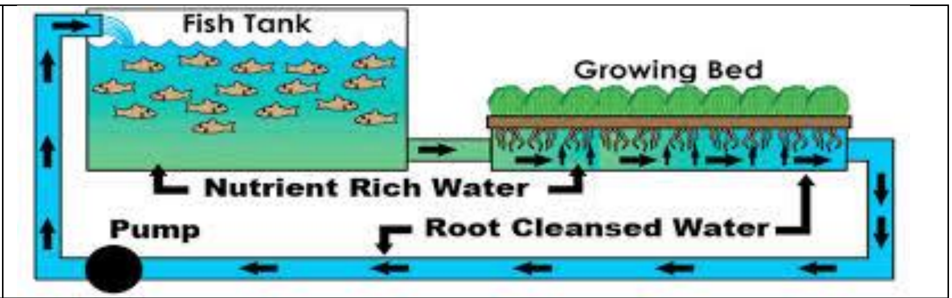
- Located on a suitable site, reliable water source and suitable land
- Acceptable water supply and water quality conditions

- Knowledge of the relevant climatic and land conditions
- Climatic conditions that are suitable for the intended species
- Access to the relevant target markets
- Adequate space for intended use plus future expansion
- Access to services, technical assistance and public infrastructure such as roads
- Environmentally friendly enterprise

Integrated multi-trophic aquaculture
Aquaculture has been combined with a number of other production processes to form a recycle beneficiation system. Land-based aquaculture in combination with integrated beneficiation such as biomass production and food gardens, presents a key opportunity in terms of job creation, food production and food security potential renewable energy projects.

Integrated multi-trophic aquaculture (IMTA), also called aquaponics uses the by-products, including waste, from one aquatic species as inputs (fertilizers, food) for another (Figure 5.4). Farmers combine fed aquaculture (e.g., fish) with inorganic extractive (e.g., algae, food gardens or hydroponic cropping) hydroponics to create balanced systems for environment remediation (biomitigation), economic stability (improved output, lower cost, product diversification and risk reduction), food production and social acceptability (better management practices). These systems, however, can be highly technical and require skilled management in order to maintain the optimal balance.

Aquaponics where waste water from fish tanks can be used to grow crops such as spinach, lettuce, tomotoes, beans, cauliflower, cabbage, broccoli, etc.



Solid waste from fish prduction can also be composted using organisms, which can then be used to ameliorate soils for crop cultivation.

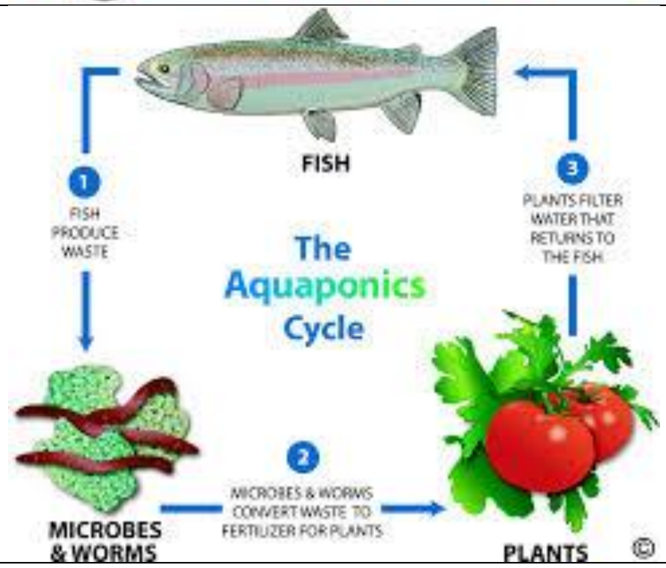


Figure 5.4 Examples of Integrated multitrophic aquaculture/ aquaponics.

6 ASSESSMENT OF THE POTENTIAL SOCIO-ECONOMIC IMPACTS

6.1 Overview

The following section of the report identifies the potential positive and negative impacts of the proposed LRWSS project on the PACs, as well as on the broader district and region. These impacts have been identified after consultation with the PACs as well as discussions with municipal officials. In addition, some of the impacts have also been guided by secondary literature and data.

The impacts in this chapter are listed in no particular order. Each impact has been aggregated into several issues. Each issue (as a heading) has a common theme and management strategy at its core. It should be noted that the assessment of socio-economic impacts differs from identifying environmental impacts in the following key ways:

- The social impact of a project is not always measurable, and their assessment often involves a subjective dimension. Considering whether such an impact is positive or negative is also a value judgement in itself. Consequently, such impacts need to be informed by a clear understanding of the social processes and knowledge of the communities under study;
- Social impacts are often cumulative and synergistic, i.e. often clustered and interdependent;
- Social impacts can change as community dynamics and social processes change. Consequently, the project at hand is one of a number of possible contributing factors to such on-going change, and hence cannot be viewed in isolation from the broader social and economic dynamics of the area. The specialist believes that an SIA should account for such cumulative factors, which in itself alludes to the fact that the project cannot be viewed in isolation. It is therefore often very difficult to attribute a particular impact entirely to the project itself. For example, potential health risks already exist, but it is possible for a project to compound (or indeed even reduce) these impacts; and
- It should be noted that social impacts are often unintended and unavoidable, making them extremely difficult to mitigate. Therefore, in this study, mitigation strategies need to be conceptualised as strategies aimed at managing change, as opposed to a means to avoid such impacts entirely. It can also be the case that successful management of potentially negative impacts may even change the impacts from negative to positive.

6.2 Identified Potential Project Issues and Impacts

The potential project related impacts are described below. Most of the impacts are short-term. i.e. during the construction phase of the project. Long term beneficial impacts are anticipated during operational phase which relate to service provision and economic opportunities. Table 6.1 below summarises the issues and impacts discussed in this chapter.

Table 6.1: A Summary of Potential Project Issues and Impacts Identified

Issue Nr	Issues	Impacts
1	Influx of Job-Seekers	Increased community conflicts between local labour and outside workers
		Increased social pathologies
		Increase and spread of communicable diseases (HIV)
		Economic stimulation of and invest into business and enterprise due to an increase in demand for local services
2	Impact on health and general quality of life	Provision of water
		Upgrading of roads
		Increased demand on existing infrastructure facilities and social services
		Noise and dust generated by construction vehicles,

Issue Nr	Issues	Impacts
		blasting, borrow pit and hard rock quarry sites.
		Reduced safety during the construction of the dam due to high vehicle activity and potential run-away fires
		Increased risk of drowning in the Zalu Dam
3	Loss of land as result of the Zalu Dam construction	Land Acquisition for the Dam
		Loss of access to natural resources
4	Stimulation of Economic Growth	Employing local labour: Job opportunities
		Supporting local businesses and stimulation of economic opportunities in Lusikisiki
		Skills training opportunities
		Potential spin-off economic opportunities: aquaculture, irrigation, recreation and tourism.
5	Disturbance of graves sites	Impact on grave sites along the route of the pipeline

To ensure comparability and consistency of impact assessment criteria between various specialist studies, CES uses a standard rating scale. Details of the impact rating scales are provided in Appendix G.

The issues and impacts identified above are described in detail, assessed in terms of selected criteria and mitigation measures recommended to reduce negative impacts and enhance positive impacts.

6.3 Issue 1: Influx of Job Seekers

Although many of the construction workers will be recruited from surrounding communittees, a portion of the job opportunities, especially the skilled and highly skilled positions will need to be sourced externally. As the study area's residents are poorly educated, more educated and skilled labour will certainly be needed from other areas. The construction of the dam in the area will therefore cause an influx of job-seekers and contractual workers into the area. It may also result in the return of men who have left the area in search of work.

In addition, the study area is characterised by high levels of unemployment and the possibility of the project creating job opportunities will attract people from neighbouring villages and towns.

The impacts associated with the influx of people can be significant. A major concern raised by communities is the potential conflict between outsiders and locals. In addition, an influx of people to the area may also increase and worsen existing social pathologies such as substance-abuse, sex work, risky sexual behaviours, spread of HIV and other communicable diseases and teenage pregnancies. Although an influx of job seekers is outside the control of project developers, it is suggested that the situation is monitored and managed, as an influx of job seekers can threaten the project.

Depending on the timing, the influx of job seekers into the area may be compounded by the construction of the N2 Wild Coast Toll Road. The impacts resulting from the influx of people will therefore be difficult to attribute to either project.

It should be noted that, as with most social impacts, in-migration may also have a positive impact in terms of providing locals with small business opportunities due to an increased demand for local produce and other goods.

The following issues are discussed under this section:

- Increased community conflicts due to differential benefits or between local labour and outside workers; and
- Increased social pathologies (substance-abuse, crime and an increase in high risk sexual behaviours and related teenage pregnancies)

- Spread of HIV and other communicable diseases
- Economic stimulation due to increase in demand for local services

Impact 1.1: Increased community conflicts within communities and between locals and outsiders

Cause and Comment

Community members and key informant interviewees revealed a general concern that conflict might be stirred between the local residents and potential migrant workers, especially in the areas around the dam. Such conflicts could result from tension over perceived preferential treatment. For example, local residents may perceive that migration workers receive unfair benefits from the construction company.

Conflict within communities could result due to the disruption of the host communities' social dynamics. Conflict can be generated by a number of factors. Some of these include (but are not limited to):

- An increase in economic disparities between those with jobs and those without;
- Changes in values and changes in „way of life' of those with jobs;
- Changes in power relations between employed youth and elders;
- Perceived unfair recruitment strategies; and/or
- Perceived preferential procurement strategies;

Mitigation Measures

The following mitigation and/or enhancement measures should be adopted:

It is suggested that a project steering committee consisting of the DWS, contractor (community liaison person), recruitment agency, community leaders, elders, youth, ward councillors and the IHLM LED must be established in order to:

- Conduct an audit of the affected communities in term of employment capacity.
- Identify potential workers from the affected communities.
- Identify possible conflicts in and between communities.
- Recommend support programmes that would assist with conflict minimisation and resolution.

With Mitigation

Should appropriate mitigation measures be adopted, the overall significance of this impact should be **low negative** during the construction and **low** in operational phase as there will be fewer direct job opportunities. With any development, a degree of community tension would be expected.

Without Mitigation

Without any mitigation measures, the consultant believes that the overall significance of this impact would be **moderate negative** during the construction phase. However, its severity might decrease to an overall significance of **low negative** during the operational phase as there will be fewer job opportunities during operational phase.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
	Construction Phase				
Without Mitigation	Short-term	Study area	Moderately severe	May occur	MOD -
With Mitigation	Short-term	Study area	Slightly severe	May occur	LOW -
	Operation Phase				
Without Mitigation	Long-term	Study area	Slightly severe	May occur	LOW -
With Mitigation	Long-term	Study area	Slightly severe	Unlikely	LOW -
	No-Go				
General Impact	No Change – existing status will not be affected				

Impact 1.2: Increased social pathologies

Cause and Comment

Throughout the report, issues of substance-abuse have been raised. Substance abuse (alcohol- and drug-use) reinforces and accounts for a range of social pathologies, such as intra-household violence, women abuse, rape, teenage pregnancies and crime. Several South Africa studies have confirmed that these pathologies are directly linked with substance-abuse (*cf.* Meade *et al.,* 2012; King *et al.,* 2004 and Bhatt, 1998).

Apart from substance-abuse, many people fear that newcomers could elevate levels of crime. At present, residents complained about high crime rates, with almost 3000 crimes reported annually at the Lusikisiki precinct (Crime Stats SA, 2014). Many believe that this behaviour might increase with new people coming to the area. A concern regarding potential increases in crime was mostly expressed by community members at a focus group meeting at Nstimbini Village. An increase in crime rate will place more pressure on policing resources. Residents have voiced concern about the current local police station's limited capacity to deal with such issues, as most stations are far from the rural towns.

Moreover, it is expected that there might be an increase in risky sexual behaviour and prostitution. Increased numbers of construction workers with an increase in disposable income combined with the low income levels in the surrounding communities may result stimulate prostitution. A concern has also been expressed by the Principal Laphumilanga Primary School at Ntsimbini, regarding an increase in teenage pregnancies. There is reason to believe that this might worsen with an influx of job-seekers if no mitigation measure is implemented.

Mitigation Measures

The following mitigation and/or enhancement measures should be adopted:

Crime:

- The role of Traditional Authorities in exerting control over land allocation in order to prevent densification of people around the construction areas should be supported.
- The DWS and contractor must encourage settlement in Lusikisiki by providing daily transport for "outside" workers who settle in the town of Lusikisiki, to and from the construction sites to minimise the potential crime factor in the rural areas.
- All construction workers must be clearly identifiable and wear easily recognisable uniforms. They need to carry identification cards issued by the contractor.
- The SAPS must have access to construction sites.
- Local communities should be encouraged to report suspicious activity to the community liaison or nearest environmental site officer.
- The contractor must prevent loitering around the construction camp by providing transport to and from the camp sites.
- All construction and camp sites must be fenced and secure.

Increased prostitution and sexual behaviour:

- National and local awareness programmes that discourage promiscuity, especially at schools in the project area should be supported.
- Condoms must be made easily accessible to all construction workers.

With Mitigation

Should appropriate mitigation measures be adopted, the overall significance of this impact should be **low negative** both during the construction and operational phase. Changing social pathological behaviours is extremely difficult, as it involves changing attitudes and community values. At most, associated impacts can be managed, but never eliminated.

Without Mitigation

Without any mitigation measures, the consultant believes that the overall significance of this impact would be **moderate negative** during the construction and **low negative** during the operational phase.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Short-term	Study area	Moderately severe	May occur	MOD -
With Mitigation	Short-term	Study area	Slightly severe	Probable	LOW -
Operation Phase					
Without Mitigation	Long-term	Study area	Moderately severe	May occur	MOD -
With Mitigation	Long-term	Study area	Slightly severe	May occur	LOW -
No-Go					
General Impact	No Change – existing status will not be affected				

Impact 1.3: Increase and spread of HIV/AIDs and other communicable diseases

Cause and Comment

The main driver in the increase of communicable diseases, especially on large capital development projects such as the LRWSS, is labour migration. This results social pathologies such as substance abuse, prostitution and short-term relationships with the local residents. As a result, the spreading of communicable diseases such as HIV is facilitated. This has long-term effects on family well-being, community integrity and the local economy. The increase in and spread of communicable diseases also places pressure on local health facilities and social welfare. It is also important to consider that a number of large infrastructure projects in the area (e.g. Mzimvubu Basin, N2 Wild Coast Toll Road) may also contribute towards this impact and therefore this project should not be considered in isolation.

Mitigation Measures

The following mitigation and/or enhancement measures should be adopted:

- An HIV/AIDS, non-discrimination, awareness, prevention and health care support, policy must be implemented.
- Condoms must be made easily accessible to all construction workers.
- An HIV/AIDs education and behaviour change programme for all contracted construction workers, should be developed.
- The above program must extend to the communities located near the construction site.
- Existing public health care centres and programmes such as TAC must be involved in HIV/AIDS campaigns and monitoring of HIV/AIDs prevalence should be undertaken in collaboration with these agencies.
- Voluntary counselling and testing should be encouraged for all workers.

With Mitigation

Should appropriate mitigation measures be adopted, the overall significance of this impact should be **moderate negative** during the construction and **low negative** during operational phase as the number of migrant labourers would have decreased. The spread of HIV cannot be halted, but with proper awareness and education programmes, impacts may be managed.

Without Mitigation

Without any monitoring and management interventions, the spread of communicable diseases is likely to be more severe and therefore the overall significance of this impact would be **high negative** during the construction phase. However, the severity may decrease to an overall significance of **low negative** during the operational phase, as there will be few workers during operational phase.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Long-term	Study area	Severe	Probable	HIGH -
With Mitigation	Long-term	Study area	Moderately severe	May occur	MOD -
Operation Phase					
Without Mitigation	Long-term	Study area	Slightly severe	May occur	LOW -
With Mitigation	Long-term	Study area	Slightly severe	May occur	LOW -
No-Go					
General Impact	No Change – existing status will not be affected				

Impact 1.4: Economic stimulation of and investment into business and enterprise due to an increase in demand for local services

Cause and Comment
The skilled and unskilled construction workers for the proposed LRWSS will require local services such as food, fuel and accommodation. The demand for more services will stimulate investment into local towns and will create a market place in Lusikisiki for local resources during the construction phase. Further comment on the economic benefits is discussed in Impact 4.4.

Mitigation Measures
The following enhancement measures should be adopted:

- DWS is limited in its capacity to enhance the benefits of this impact, as the development of the communities and town will occur in response to the needs and demands of construction workers. The proponent can play role in facilitating the skills required to recognise the need and respond appropriately. The proponent must link the Provincial Department of Economic Development and Local Municipal LED programmes with small to medium enterprises (including communities) in the area so that a state of "readiness" to optimise economic benefits is achieved. This may involve training in the following sectors: business, tourism, catering etc.

With Mitigation
The success of mitigation cannot be predicted with certainty as it relies on:

- The willingness of enterprises to respond to the available demand opportunities,
- The skills available and acquired
- The involvement of organisations that are able to provide support, training and skills transfer

The proponent can play a key facilitation role. Ultimately, with successful mitigation, the significance of the potential **benefits** is **high** during the construction phase, especially since mitigation can prolong benefits into the operation phase. Economic benefits during the operation phase are discussed in Impact 4.4 below.

Without Mitigation
Without a key facilitator or driver, it is unlikely that stakeholders will engage and integrate in a cohesive manner with the primary objective to ensure maximum benefits to all affected communities. The potential economic benefits of an influx of people will not be optimised and the significance will therefore be **moderate**. Economic benefits during the operation phase are discussed in Impact 4.4 below.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Medium-term	Study area	Moderately severe	Probable	MOD +
With Mitigation	Long-term	Study area	Severe	Probable	HIGH +
No-Go					
General Impact	No Change – existing status will not be affected				

6.4 Issue 2: Impact on Health and general quality of life

The main aim of the project is to improve water supply to communities within the project area, covering wards in the IHLM and PSJLM. In all meetings, community members expressed support of the project, especially as it will bring the much needed water supply to their areas. It is acknowledged that the proposed LRWSS will improve the welfare of the study area, through increased access to infrastructure and services such as:

- Direct access to clean water may reduce disease and mortality.
- Improved access roads will improve access to markets, education and health care services
- Improved communication networks will improve education

The project may also have negative short-term (construction) effects on the provision of particular social services by increasing their demand and placing limited resources under pressure. Such services include: health care, education, municipal and policing.

The LRWSS will have additional short-term impacts on the health and quality of life of surrounding communities through noise and dust generation during the construction phases of all aspects of the project.

Impact 2.1: Provision of Water

Cause and Comment
In South Africa, the provision of basic services is a key challenge, especially in rural communities. The proposed LRWSS is aimed at providing the ORTDM with the resources and infrastructure to provide basic water services to its residents. The proposed LRWSS has been based on several engagements with the ORTDM as the Water Service Provider for IHLM and PSJLM. The proposed project will improve water supply to schools and clinics, where it is needed. In most instances public facilities rely on rain water tanks, which run dry during the winter season, or water delivered by the municipality.

Mitigation Measures
As the project is for provision of water supply in the municipality no mitigation measures are suggested.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Not applicable				
With Mitigation					
Operation Phase					
Without Mitigation	Long-term	Municipality	Very beneficial	Probable	HIGH +
With Mitigation	Long-term	Municipality	Very beneficial	Definite	HIGH +
No-Go					
General Impact	No Change – existing status will not be affected				

Impact 2.2: Upgrading of roads

Cause and Comment
Generally, the conditions of the roads are construed as poor and inadequate by many community leaders and people that were engaged during the site visit. A number of roads will be upgraded as a result of the proposed LRWSS and this includes the bridge over the Xura River just below Palmerton Primary School. This bridge was described by locals as dangerous and a number of vehicles have been washed over this bridge. In 2013 a vehicle carrying school children was washed over this bridge. Learners and teachers do not attend school when the river is full as they cannot cross over safely.

Mitigation Measures
The upgrading of existing roads within the project area will be very beneficial to the region and the affected communities and will have long term benefits. The upgrades will also create better business opportunities for local businesses as it will be easier to travel around the project area. No mitigation or enhancement measures have been identified.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Long-term	Study area	Beneficial	Definite	MOD +
With Mitigation	Long-term	Study area	Beneficial	Definite	MOD +
Operation Phase					
Without Mitigation	Long-term	Study area	Beneficial	Definite	MOD +
With Mitigation	Long-term	Study area	Beneficial	Definite	MOD +
No-Go					
General Impact	No Change – existing status will not be affected				

Impact 2.3: Increased demand on existing infrastructure facilities and social services

Cause and Comment
The influx of people into the Lusikisiki area making use of the direct and indirect economic opportunities of the proposed Lusikisiki RWSS project will require access to the basic infrastructure and services. The increase in demand may especially place pressure on social service provision, such as hospitals and clinics and schools. The IHLM will be required to improve its service delivery (e.g. sanitation and solid waste management) in order to cope with the anticipated development of the area.

An increase in criminal elements will place pressure on current resources and may affect effective policing of the surrounding communities.

Mitigation Measures

The following mitigation measures should be adopted:

- Service providers associated with the IHLM and PSJLM, clinics, schools and the SAPS must be made aware of an increase in demand, both in the town of Lusikisiki and in the surrounding rural areas, and therefore the increased pressure to provide services for new households.
- This will require direct communication with the local municipalities, ORTDM, the Department of Health, South African Police Service and the Department of Education. The channels of communication must be established as permanent points of contact throughout the construction phase of the project.

- Regular monitoring of the schools and clinics in order to determine whether there are sufficient resources must be undertaken. When resources are deemed insufficient, DWS must communicate, through established channels, with the relevant departments for assistance.

With Mitigation

The DWS is limited in its capacity to increase the resources allocated to social services, but can be instrumental in communicating with the relevant Provincial departments. With mitigation, resource allocation to social services may meet the demand, resulting in **moderate**-**low** **negative** impact. This impact is likely to be much less severe during the operation phase as the Lusikisiki RWSS will retain fewer workers.

Without Mitigation

The current resource allocation to social services in the project area is already spread thin. The Lusikisiki RWSS project will result in an increase in the demand for these services and therefore increase the pressure, resulting in poor service delivery during the construction period. This is considered a **high** **significance** impact, without the necessary monitoring and intervention from DWS.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Short-term	Project area	Severe	Probable	HIGH-
With Mitigation	Short-term	Project area	Slightly severe	Probable	MOD -
Operation Phase					
Without Mitigation	Long-term	Project area	Slightly severe	May occur	LOW -
With Mitigation	Long-term	Project area	Slightly severe	May occur	LOW -
No-Go					
General Impact	No Change – existing status will not be affected				

Impact 2.4: Noise and dust generated by construction vehicle activity, blasting, borrow pit and hard rock quarry sites

Cause and Comment

Noise generation by construction vehicles and blasting in the quarry sites and dam wall site will result in noise impacts. The impact is exacerbated by the rural, and therefore generally quiet, nature of the project site.

Dust created by construction vehicles using gravel access roads and from burrow pits and hard rock quarries may become a nuisance. In high wind conditions, the dust generated may increase.

Mitigation Measures

The following mitigation and/or enhancement measures should be adopted:

- Noise and dust prevention measures and monitoring thereof must be included in an Environmental Management Programme.
- Communities must have access to a grievance reporting mechanism, e.g. through a project steering or liaison committee.

With Mitigation

With mitigation, the associated impacts of dust and noise may be reduced to **low** **significance**.

Without Mitigation

Without mitigation, noise and dust nuisance will affect the quality of life in the surrounding communities throughout the construction period. The significance of these impacts, with particular emphasis on dust, is **moderate**.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Short-term	Study area	Moderately severe	May occur	MOD -
With Mitigation	Short-term	Study area	Slightly severe	May occur	LOW -
Operation Phase					
Without Mitigation	Not applicable				
With Mitigation					
No-Go					
General Impact	No Change – existing status will not be affected				

Impact 2.5: Reduced safety during the construction of the dam due to high vehicle activity and potential run-away fires

Cause and Comment

The safety of surrounding community members may be reduced during the construction phase of the LRWSS, through increased vehicle activity (especially on rural access roads to a from construction and quarry sites) and increased risk of veld fires.

A significant number of heavy construction vehicles will be using rural access roads for transporting materials to and from construction sites. Village communities and homesteads in close proximity to construction access routes will be most at risk, with the most vulnerable being the young and elderly.

Mitigation Measures

The following mitigation and/or enhancement measures should be adopted:

Traffic safety:

- All affected communities must be informed of the formal construction routes.
- All vehicle operators and drivers must undergo regular training, clearly outlining the high safety risk to local rural communities
- Signage making communities aware of the high safety risk due to heavy construction vehicles on the road must be erected at appropriate locations.
- Traffic calming devices such as speed bumps should be considered on rural access roads.

Fire safety:

- Fires outside construction camps must be prohibited.
- Fires that are lit must be in a contained area and safety precautions must be followed. The fire must be monitored for cinders and extinguished when no longer needed.
- Firefighting equipment must be stored onsite.
- The construction campsite must be surrounded by a firebreak.
- Education of fire risks must form part of the construction-worker training.

With Mitigation

The strict implementation of the recommended mitigation measures, the significance of the risks may be reduced to **moderate**. Constant auditing of vehicle speed and driver training must be emphasised.

Without Mitigation

The risk to the safety of the surrounding communities during the construction phase of the proposed Lusikisiki RWSS in terms of both vehicle and fire risk is **high**. During the operation phase, these risks are considered **negligible**.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Short-term	Project area	Severe	May occur	HIGH -
With Mitigation	Short-term	Project area	Moderately severe	May occur	MOD -
Operation Phase					
Without Mitigation	Not applicable.				
With Mitigation					
No-Go					
General Impact	No Change – existing status will not be affected				

Impact 2.6: Increased risk of drowning in the Zalu Dam

Cause and Comment

The unusual presence of a large water body during the operation phase may pose a risk of drowning to community members. Although some people may be familiar with bathing in the rivers or streams, the dam will be far deeper. Also, people may start to use water transport, exposing water users to the risk of drowning. Fencing off the dam was considered during the public engagement, but this is not feasible and would restrict other benefits, such as stock watering and public access.

Although a concern about livestock safety has been raised, it is unlikely that livestock will be negatively affected.

Mitigation Measures

The following mitigation measures should be adopted:

- Safe and controlled recreational swimming sites should be identified.
- A water safety awareness campaign should be implemented by DWS.
- Signage providing warning of drowning risks should be placed at visible locations in high activity areas such as the river/dam crossing.
- A swimming programme for local learners should be implemented.

With Mitigation

During the construction phase, there is unlikely to be any significant water storage. During operation, the dam will fill up over time, giving the surrounding communities time to adjust. Public awareness about the danger of water, in conjunction with management and training programmes, will go a long way towards reducing the likelihood of this impact and its significance to **moderate**.

Without Mitigation

Ignorance about the danger of large and deep water bodies may result in irresponsible use of the water resource, which may consequently result in the loss of life. Due to the long-term severity of this impact, it has been rated as **high** without mitigation.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Not applicable.				
With Mitigation					
Operation Phase					
Without Mitigation	Long-term	Project area	Severe	Probable	HIGH -

With Mitigation	Long-term	Project area	Moderately severe	May occur	MOD -
No-Go					
General Impact	No Change – existing status will not be affected				

6.5 Issue 3: Loss of land due to Zalu Dam construction and inundation

Impact 3.1: Land Acquisition for the Zalu Dam

Cause and comment
Although no resettlement will be necessary, families in the surrounding communities and villages will claim the land. The dam inundation area is old fallow land currently used for grazing. The process of acquiring the land for the dam will include an economic valuation in order to determine appropriate compensation. The land could be important from a cultural perspective, but this has not been raised by any of the communities as an impact.

Mitigation Measures
The process for land acquisition by DWS must be conducted through the traditional authorities operating in the areas as they have jurisdiction over land allocations. Individual landowners must be identified and engaged. All the properties must be professionally assessed and valued by professional independent evaluators registered with South African Institute of Valuers and the South African Council for Property Valuers. Valuations, and the process of evaluation, must be shared with the landowners and will form the basis for on-going negotiations with them.

With Mitigation
The loss of land, if correctly compensated, will be **low** in significance during the construction and operation phase, although the loss of land will only take place once the land is inundated.

Without Mitigation
Without mitigation, the loss of land is considered a **moderate** significance impact. The acquisition of the land may not be successful if the correct engagement procedure is employed.

Impact Significant Rating

Impact	**Effect**			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	**Spatial Scale**	**Severity of Impact**		
Construction Phase					
Without Mitigation	Permanent	Project area	Slightly severe	Definite	MOD -
With Mitigation	Permanent	Project area	Slightly severe	Definite	LOW -
Operation Phase					
Without Mitigation	Permanent	Project area	Slightly severe	Definite	MOD -
With Mitigation	Permanent	Project area	Slightly severe	Definite	LOW -
No-Go					
General Impact	No Change – existing status will not be affected				

Impact 3.2: Loss of access to natural resources

Cause and Comment
The inundation of the dam will result in a loss of access to natural resources and ecological services that the river valley provides, that may be sustaining livelihoods. Resources such as: medicinal plant and food harvesting, hunting, fuel wood collection, thatch grass harvesting, livestock grazing, etc. will be permanently lost after inundation. These losses will be most felt by the marginal and vulnerable groups, who rely more heavily on these resources.

Mitigation Measures

The following mitigation measures should be adopted:

- It is anticipated that the increase in economic activity in the general area will result in an increase in alternative livelihood opportunities and activities. It is important that all members of the community are afforded equal opportunities to be involved with the proposed Lusikisiki RWSS by affording the surrounding communities opportunities to provide input into project planning.
- Current landowners and land users should be sufficiently compensated. Compensation must be equitable across gender and age.
- Assist with the relocation of livestock, if necessary.

With Mitigation

The loss of natural resources that will occur during dam inundation cannot be directly mitigated, but management interventions that ensure financial compensation and alternative livelihood strategies, will reduce the severity of the impact to a **low** significance.

Without Mitigation

It is possible that the economic stimulation associated with the proposed Lusikisiki RWSS will result in a shift in livelihood strategies of the surrounding communities, and that they will become less reliant on natural resources for sustenance. Without equitable allocation of opportunities the loss of natural resources may be of **moderate** significance.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Not applicable. Dam inundation will occur during operation phase.				
With Mitigation					
Operation Phase					
Without Mitigation	Long-term	Project area	Moderately severe	Probable	MOD -
With Mitigation	Long-term	Project area	Slightly severe	Probable	LOW -
No-Go					
General Impact	No Change – existing status will not be affected				

6.6 Issue 4: Stimulation of Economic Growth

One of the major positive impacts of the project is the fact that a significant number of direct and indirect employment opportunities will be generated during construction, together with skills development opportunities for the youth.

In addition, significant spin-off opportunities exist during the operation phase. Agriculture (through irrigation schemes), aquaculture, sports & recreation and tourism activities are some of the potential economic possibilities associated with the dam.

However, appropriate mitigation and project enhancement measures are needed to ensure that employment remains a positive impact and that all the benefits are equitable and can be optimised or enhanced. The following impacts are discussed below:

- Employment of local labour;
- Developing and supporting local businesses;
- Skills and training opportunities; and
- Economic spin-off opportunities associated with aquaculture, irrigation, sports & recreation and tourism

Impact 4.1: Employing local labour: Job opportunities

Cause and Comment

An estimated 900 direct job opportunities over a 3 year construction period, created by the proposed LRWSS, will need to be fulfilled locally. As the project area is characterised by high levels of unemployment, the proposed development will bring much needed employment opportunities to the area. The question of employment of local people in the project area was raised in almost every public meeting held during the EIA process and is therefore perceived to be one of the biggest impacts.

The importance of employing local residents cannot be overstated. Employment provides an income to households that have none, in addition to other benefits that could include:

- Reducing rates of crime – crime was stated as a serious problem in the project area;
- Reducing rates of alcohol and drug-abuse; and
- Reducing intra-household violence. Intra-household violence and especially women abuse are believed to be coupled with income-related arguments and worsened by substance-abuse.

The proposed LRWSS will need highly skilled workers especially when constructing the Zalu Dam and staff with experience in dam construction. However, a large number of the tasks can be performed by local labour, and the proponent is encouraged to maximise such opportunities as far as reasonably possible.

Mitigation Measures

The following mitigation and enhancement measures are proposed:

- Equal jobs opportunities for women and men must be promoted.
- Culture and tradition must be considered when planning the division of labour for construction.
- Employment must be managed by a recruitment agency/office that uses a selection system that ensures recruitment of semi and unskilled workers from all local impacted communities in accordance with recent government policies related to local procurement. This must ensure a fair and equitable recruitment process.
- Where appropriate, employees involved in the construction phase should be incorporated into the permanent maintenance staff for the operational phase; and
- Particular attention must be paid to employment opportunities for women and disabled persons.

With Mitigation

This is sensitive impact which could, if managed properly, have a **high positive** overall impact on the population during the construction phase, and a **low positive** impact during the operational phase. During the operational phase there will be fewer job opportunities and the spatial scale would become local.

Without Mitigation

Without proper labour recruitment practices and use of local resources the project may garner negative sentiment with local communities. Also, without specific enhancement measures, some economic benefits may not be realised. Such a missed opportunity would result in a **high negative** impact during the construction phase and a **low negative** during the operational phase.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Short-term	Study area	Very severe	Probable	HIGH -
With Mitigation	Short-term	Study area	Very beneficial	Definite	VERY HIGH +

Operation Phase					
Without Mitigation	Long-term	Local	Slightly beneficial	May occur	LOW -
With Mitigation	Long-term	Local	Slightly beneficial	Probable	LOW +
No-Go					
General Impact	No affect				

Impact 4.2: Supporting local businesses

Cause and Comment
The buying power of people living in the area will increase due to increases individual and household income. This will increase the demand for goods and services, which presents an opportunity for local businesses to diversify and expand.

With specific reference to the financial spend of the LRWSS associated with construction, the demand for building materials, accommodation, food, fuel, catering, conferencing facilities etc., will also present significant opportunities to local business enterprises and SMMEs. Building materials for the project will be sourced locally and regionally which will boost local and regional businesses.

The following sectors are anticipated to benefit:
- Construction Phase: building and construction, manufacturing, real estate and business services
- Operational Phase: Water, manufacturing, transport and storage

Mitigation measures
The following enhancement measures are proposed:

The proponent must ensure that the principal of utilising local business resources (suppliers and SMMEs) in accordance with recent government policies related to local procurement (State of the nation address, 2015) forms part of the procurement specifications. Examples of local business resources that must be considered:
- Catering services
- Transport services
- Quarries/borrow pits (where necessary)
- Small civils
- Accommodation
- Security
- Hygiene services
- Fencing

With Mitigation
Should appropriate mitigation measures be implemented, the overall significance of this impact would be **high positive** especially during the construction phase. SMMEs will develop skills during the construction phase that could then be applied to other sectors, such as tourism. In this way the LRWSS project will result in **moderate beneficial** impacts on local businesses during the operation phase.

Without Mitigation
Should local SMMEs not be supported and their development not stimulated, the economic benefit of the LRWSS would be considered a missed opportunity and therefore result in **high negative** impact during the construction phase and would be **low positive** (as some benefits would ultimately accrue due to skill development in the project area) during the operation phases.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Short-term	Regional	Very severe	May occur	HIGH -
With Mitigation	Medium-term	Regional	Very beneficial	Definite	HIGH +
Operation Phase					
Without Mitigation	Long-term	Regional	Slightly beneficial	May occur	LOW +
With Mitigation	Long-term	Regional	Beneficial	Probable	MODERATE+
No-Go					
General Impact	No affect				

Impact 4.3: Skills training opportunities

Cause and Comment

The construction of the Zalu Dam and supporting infrastructure will need skilled/unskilled workers and staff with experience in dam construction. Although some community members do have brick-laying or building experience, a concern was raised that much of this knowledge is not related to dam construction, but housing construction. Sufficient community skills and training opportunities should be provided prior and during the construction phase of the LRWSS, in order for the communities to satisfy the labour requirements. Training and skills development throughout construction will assist with the long-term employability of the local communities.

Mitigation Measures

The following enhancement measure is proposed:

- Implement a skills development programme which includes training in business, project management, monitoring and evaluation.

With Mitigation

By implementing a skills development programme, the LRWSS should have a positive overall significant impact on the communities. This is considered as a **benefit** of **high** significance during the construction phase and of **moderate** significance during the operation phase due to the long-term benefits of training and skill development.

Without Mitigation

Without mitigation measures, such as not having a skills development programme, the effect on the population would remain unchanged. Therefore, there would be **no affect (no benefits)** during the construction or operational phases. However, the missed opportunity to improve the livelihoods of the local community due a lack of skills transfer and training is considered a moderate negative during construction and operation phase.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Medium - term	Study area	Moderately severe	Possible	MOD -
With Mitigation	Long-term	Regional	Beneficial	Definite	HIGH +
Operation Phase					
Without Mitigation	Medium - term	Study area	Moderately severe	Possible	MOD -
With Mitigation	Long-term	Regional	Beneficial	Probable	MOD +
No-Go					
General Impact	No affect				

Impact 4.4: Potential spin-off economic opportunities associated with aquaculture, irrigation schemes, recreation and tourism.

Cause and Comment

There is a very real and significant economic opportunity that the proposed Zalu Dam may provide in terms of spin-off projects and investment opportunities. This includes the consideration of production activities such as crop irrigation in limited garden-type projects, integrated aquaculture and biomass production due the availability of water. In addition, the Zalu Dam can support water-sport and recreational facilities, which can link with the established tourism industry along the coastline.

Mitigation Measures

The following mitigation and/or enhancement measures should be adopted:

- The proponent is limited in terms of their input regarding the spin-off business opportunities as these depend on investor interest and market demand; however they play a key role in permitting water use activities. The DWS should therefore, in their consideration of water use applications, consider the benefit to local communities and ensure that equitable benefits are realised and readily facilitate water use activities that will benefit the community.
- DWS must consider in their planning and development of construction camps and settlements the possibility of converting these transformed areas into tourism or recreation facilities.

With Mitigation

The facilitation of issuing water use licences for spin-off business opportunities will assist the local communities to realise not just the social benefits, but also the long-term **highly** significant economic **benefits** of the propose Zalu Dam.

Without Mitigation

It is unlikely that the proponent would limit development opportunities associated with water uses on Zalu Dam. However, applications that do not result in local beneficiation will decrease the direct economic benefit of the dam resources for local communities, resulting in long-term **moderate** economic **benefits**.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Not applicable.				
With Mitigation					
Operation Phase					
Without Mitigation	Long-term	Project area	Beneficial	Possible	MOD +
With Mitigation	Long-term	Project area	Very beneficial	Possible	HIGH +
No-Go					
General Impact	No Change – existing status will not be affected				

6.7 Issue 5: Disturbance of grave sites

Impact 5.1: Impact on grave sites along the route of the pipeline

Cause and Comment
The inundation of dam area will not affect grave sites. However, a number of grave sites along the route of the pipeline as noted in the Heritage Impact Study, may be affected. Some of the pipeline routes are also in close proximity to graves which might result in disturbance thereof.

Mitigation measures
Where practical and feasible, pipeline routes need to be diverted around identified grave sites. Where this is not possible, the affected families need to be consulted to discuss reburial. Additional mitigation measures are provided in the Heritage Impact Assessment.

With Mitigation
This significance of this impact is considered **high**.

Without Mitigation
Without mitigation measures, the impact would be **very high** as graves are considered culturally important for the surrounding local communities.

Impact Significant Rating

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Construction Phase					
Without Mitigation	Short-term	Local	Very severe	May occur	VERY HIGH -
With Mitigation	Short-term	Local	Severe	May occur	HIGH -
Operation Phase					
Without Mitigation	Not applicable				
With Mitigation					
No-Go					
General Impact	No affect				

6.8 No-go option

The No-Go option is described as the “without project” scenario, i.e. no dam construction, water treatment or distribution reticulation. The impact of the “No-Go” alternative is assessed in terms of the Constitution and the National Infrastructure Plan (2012). The assessment of the No-Go scenario as non-compliances in terms of the state’s obligations and policies is considered as a HIGH negative impact, in that service delivery and hence economic development will continue to be underdeveloped.

6.8.1 The Constitution
The Constitution places the responsibility on government to ensure that such services are progressively expanded to all, within the limits of available resources. Government policy on most of these issues is to provide universal access to basic services which include:

- Housing,
- Education,
- Health care,
- Social welfare,
- Transport,
- Electricity and energy,
- **Water,**
- Sanitation and Refuse and waste removal.

Without the construction of the proposed LRWSS, it is unlikely that the state will be able to fulfil this responsibility.

6.8.2 National Infrastructure Plan

In 2012, the South African Government adopted a National Infrastructure Plan. The objectives of the plan are to identify and implement key infrastructure projects that will stimulate the economy by infrastructure development that will combine the goals of ensuring service delivery and at the same time creating jobs.

The investment into infrastructure projects is anticipated to improve access by South Africans to healthcare facilities, schools, **water**, sanitation, housing and electrification, whilst the construction of ports, roads, railway systems, electricity plants, hospitals, schools and **dams** will contribute to faster economic growth.

In order to implement the goals and objectives of the National Infrastructure Plan, a number of Strategic Infrastructure Projects (SIPs) have been developed. The construction of the proposed LRWSS forms part of SIP 18 which speaks directly to Water and Sanitation infrastructure. SIP 18 involves a 10 year plan to address the estimated backlog of **adequate water to supply 1.4 m households** and 2.1 m households to basic sanitation. The project will involve provision of sustainable supply of water to meet social needs and support economic growth. These projects include provision for new infrastructure, rehabilitation and upgrading of existing infrastructure, as well as improve management of water infrastructure.

Without the construction of the proposed LRWSS, it is unlikely that the state will be able to fulfil the objectives within the project area in question.

7 CONCLUSION

7.1 Proposed project and Terms of Reference

The DWS propose the construction of the LRWSS which includes the development of the Zalu Dam, abstraction weir, water treatment facility upgrade and pipeline reticulation to surrounding villages. A clay borrow area and rockfill quarries will be needed and are located within the project area.

The terms of reference provided to guide this study have been fulfilled and comment, where necessary, provided in Table 7.1 below.

Table 7.1 Comments on the terms of reference

Terms of reference	Comment
Describe the local socio-economic environment that will be directly affected as a result of the project;	Chapter 5 of this report provides a detailed account of the socio-economic conditions of the all the wards that will be directly affected by the proposed LRWSS.
Assess the local social infrastructure (health, education, markets, community);	
Identify income and expenditure trends;	
Ensure that the study deals with the issues raised during scoping public participation	Chapter 3 describes the public meetings held as part of the EIA public participation, as well as interviews held with specific key informants as part of this study. Chapter 5 describes key outcomes and communications with respect to issues raised.
Describe the formal and informal governing structures;	The District and Local Municipal structures have been described. The traditional leadership have been engaged throughout the public participation.
Describe landownership	Landownership is discussed in Chapter 4
Assess the significance of potential economic and social impacts and benefits on the local populace and the Local Municipality and O R Tambo District Municipality;	Chapter 7 identifies and assesses issues and impacts that may be associated with the porposed LRWSS.
Identify project-related impacts and provide recommendations for mitigating negative impacts and optimising positive impacts.	

7.2 Issues and impacts

Socio-economic issues and impacts identification and assessment can be highly subjective. Due to the interdependence of socio-economic structures and networks, the severity and likelihood are difficult to predict and are therefore even more difficult to mitigate. In most instances, impacts cannot be mitigated, but instead need to be monitored and managed through intervention strategies.

It is also important to note that in many cases, by addressing a negative impact, socio-economic benefits may accrue. In summary, 9 (nine) potentially HIGH pre-mitigation negative impacts were identified during construction (Table 7.2). These could all be reduce through the implementation of mitigation measures to MODERATE impacts, with the exception of "Disturbance of gravesite", which cannot be avoided, but can be managed. Some impacts, with mitigation, could provide benefits through the service delivery and provision of economic opportunities. Post-mitigation, the proposed LRWSS could result in significant socio-economic benefits during the construction phase.

The operation phase impacts are anticipated to be relatively muted. This is due to the lower job requirements of the project. No HIGH negative impacts have been identified, but numerous economic benefits may be realised through the increased access to water resources.

Table 7.2 Summary of assessment of Socio-economic Impacts

	Pre-mitigation			Post-mitigation		
	LOW	MOD	HIGH	LOW	MOD	HIGH
Construction	0	5 (2+)	7 (1+)	3	5 (1+)	1 (5+)
Operation	4 (1+)	4 (2+)	0	5 (1+)	1 (3+)	1+
Total	4 (1+)	9 (4+)	7 (1+)	8 (1+)	6 (4+)	1 (6+)

7.3 Concluding remarks

There is an obligation on the National and Local governments to provide basic services. These obligations are implicit in the Constitution and the National Infrastructure Plan and associated Strategic Infrastructure Projects, and largely speak to the provision/supply of water. The proposed LRWSS is aimed at fulfilling these objectives, as well as creating the necessary conditions required for economic growth.

In order to achieve the maximum economic benefit for local communities, implementation of the proposed LRWSS project must include ongoing community engagement and concerted efforts to link with other economic programmes (such as the LED and DEDEAT initiatives).

With regards to economic spinoff activities and land use and water resource use effort must be made to stimulate and encourage agriculture and tourism activities. As a downstream irrigation scheme will not be viable, aquaculture, dry crop production and livestock production should be looked at as alternative agricultural options. DWS must consider the benefit to the local communities when allocating water use licences.

The Lusikisiki Regional Water Supply Scheme (LRWSS) Project SIA has been based on fieldwork undertaken in March and August 2014. The fieldwork methodology entailed community and focus group meetings, as well as face-to-face interviews with the key stakeholders.

Apart from the construction of the Zalu Dam, pipeline reticulation will deliver water to a number of selected villages. The impacts that will be experienced by villages due to dam inundation are different to those that will experience impacts associated with pipeline reticulation (for e.g. disturbance of gravesites).

The PACs are directly affected by land acquisition and inundation by the Zalu Dam. Several issues and impacts have been identified in this report pertaining to the communities who will lose their land. The proponent must engage with landowners and follow appropriate land acquisition and compensation procedures.

The engagement process shows that the project is highly desired due to the associated skills development and employment benefits opportunities. Most community members and their leaders were concerned about the lengthy timeframes of the EIA process, but none objected to the project.

Key issues pertaining to an influx of job-seekers and outsider workers have been assessed. In particular, there is a concern amongst community members that social pathologies in the communities, such as substance-abuse, risky sexual behaviours and crime might increase in response to the influence of "outsiders". Several mitigation measures to manage the impact have been proposed.

7.4 Impact Statement:

7.4.1 Summary of impact assessment and recommended mitigation measures

Since many of the socio-economic impacts cannot be prevented, management responses, rather than preventative actions, are required in order to mitigate the severity of negative impacts. In order to implement management responses, monitoring of certain impacts will be necessary.

During construction, the Environmental Control Officer (ECO) must be responsible for the collection or sourcing of monitoring data. Alternatively, these functions may be delegated to DWS officials. Ultimately, the ECO must ensure that monitoring is conducted and must collate, review and comment on the outcomes/trends, and make management response recommendations.

A summary of the identified issues/impacts and the responding recommended mitigation measures is provided below (Table 7.3).

Table 7.3 Summary of the impact and associated recommended mitigation measures.

Issue Nr	Issues	Impacts	Mitigation
1	Influx of Job-Seekers	Increased community conflicts between local labour and outside workers	A project steering committee consisting of the DWS, contractor (community liaison person), recruitment agency, community leaders, elders, youth, ward councillors and the IHLM LED must be established in order to: • Conduct an audit of the affected communities in term of employment capacity • Identify potential workers from the affected communities • Identify possible conflicts in and between communities • Recommend support programmes that would assist with conflict minimisation and resolution
		Increased social pathologies	Crime: • The role of Traditional Authorities in exerting control over land allocation in order to prevent densification of people around the construction areas should be supported. • The DWS and contractor must encourage settlement in Lusikisiki by providing daily transport for “outside” workers who settle in the town of Lusikisiki, to and from the construction to minimise the potential crime factor in the rural areas. • All construction workers must be clearly identifiable and wear easily recognisable uniforms. They need to carry identification cards issued by the contractor. • The SAPS must have access to construction sites. • Local communities should be encouraged to report suspicious activity to the community liaison or nearest environmental site officer. • The contractor must prevent loitering around the construction camp by providing transport to and from the camp sites. • All construction and camp sites must be fenced and secure. Increased prostitution and sexual behaviour: • National and local awareness programmes that discourage promiscuity, especially at schools in the project area should be supported. • Condoms must be made easily accessible to all construction workers.

		Increase and spread of communicable diseases (HIV)	• An HIV/AIDS, non-discrimination, awareness, prevention and health care support, policy must be implemented. • Condoms must be made easily accessible to all construction workers. • An HIV/AIDs education and behaviour change programme for all contracted construction workers, should be developed. • The above program must extend to the communities located near the construction site. • Existing public health care centres and programmes such as TAC must be involved in HIV/AIDS campaigns and monitoring of HIV/AIDs prevalence should be undertaken in collaboration with these agencies. • Voluntary counselling and testing should be encouraged for all workers.
		Economic stimulation of and investment into business and enterprise due to an increase in demand for local services	• DWS is limited in its capacity to enhance the benefits of this impact, as the development of the communities and town will occur in response to the needs and demands of construction workers. The proponent can play role in facilitating the skills required to recognise the need and respond appropriately. The proponent must link the Provincial Department of Economic Development and Local Municipal LED programmes with small to medium enterprises (including communities) in the area so that a state of “readiness” to optimise economic benefits is achieved. This may involve training in the following sectors: business, tourism, catering etc.
2	Impact on health and general quality of life	Provision of water	No mitigation measure required.
		Upgrading of roads	No mitigation measure required.
		Increased demand on existing infrastructure facilities and social services	• Service providers associated with the IHLM and PSJLM, clinics, schools and the SAPS must be made aware of an increase in demand, both in the town of Lusikisiki and in the surrounding rural areas, and therefore the increased pressure to provide services for new households. • This will require direct communication with the local municipalities, ORTDM, the Department of Health, South African Police Service and the Department of Education. The channels of communication must be established as permanent

			points of contact throughout the construction phase of the project. • Regular monitoring of the schools and clinics in order to determine whether there are sufficient resources must be undertaken. When resources are deemed insufficient, DWS must communicate, through established channels, with the relevant departments for assistance.
		Noise and dust generated by construction vehicle activity, blasting, borrow pit and hard rock quarry sites.	• Noise and dust prevention measures and monitoring thereof must be included in an Environmental Management Programme. • Communities must have access to a grievance reporting mechanism, e.g. through a project steering or liaison committee.
		Reduced safety during the construction of the dam due to high vehicle activity and potential run-away fires	Traffic safety: • All affected communities must be informed of the formal construction routes. • All vehicle operators and drivers must undergo regular training, clearly outlining the high safety risk to local rural communities • Signage making communities aware of the high safety risk due to heavy construction vehicles on the road must be erected at appropriate locations. • Traffic calming devices such as speed bumps should be considered on rural access roads. Fire safety: • Fires outside construction camps must be prohibited. • Fires that are lit must be in a contained area and safety precautions must be followed. The fire must be monitored for cinders and extinguished when no longer needed. • Firefighting equipment must be stored onsite. • The construction campsite must be surrounded by a firebreak. • Education of fire risks must form part of the construction-worker training.
		Increased risk of drowning in the Zalu dam	• Safe and controlled recreational swimming sites should be identified. • A water safety awareness campaign should be implemented by DWS. • Signage providing warning of drowning risks should be placed at visible locations in high activity areas such as the river/dam crossing.

			• A swimming programme for local learners should be implemented.
3	Loss of land as result of the Zalu dam construction	Land acquisition for the Dam	• The process for land acquisition by DWS must be conducted through the traditional authorities operating in the areas as they have jurisdiction over land allocations. • Individual landowners must be identified and engaged. • All the properties must be professionally assessed and valued by professional independent evaluators registered with South African Institute of Valuers and the South African Council for Property Valuers. Valuations, and the process of evaluation, must be shared with the landowners and will form the basis for on-going negotiations with them.

		Loss of access to natural resources	• It is anticipated that the increase in economic activity in the general area will result in an increase in alternative livelihood opportunities and activities. It is important that all members of the community are afforded equal opportunities to be involved with the proposed Lusikisiki RWSS by affording the surrounding communities opportunities to provide input into project planning.
			  • Current landowners and land users should be sufficiently compensated. Compensation must be equitable across gender and age.
			  • Assist with the relocation of livestock, if necessary.

4	Stimulation of Economic Growth	Employing local labour: Job opportunities	• Equal jobs opportunities for women and men must be promoted. • Culture and tradition must be considered when planning the division of labour for construction. • Employment must be managed by a recruitment agency/office that uses a selection system that ensures recruitment of semi and unskilled workers from all local impacted communities in accordance with recent government policies related to local procurement. This must ensure a fair and equitable recruitment process. • Where appropriate, employees involved in the construction phase should be incorporated into the permanent maintenance staff for the operational phase; and • Particular attention must be paid to employment opportunities for women and disabled persons.
		Supporting local businesses and stimulating local economic opportunities	The proponent must ensure that the principal of utilising local business resources (suppliers and SMMEs) in accordance with recent

			government policies related to local procurement (State of the nation address, 2015) forms part of the procurement specifications. Examples of local business resources that must be considered: • Catering services • Transport services • Quarries/borrow pits (where necessary) • Small civils • Accommodation • Security • Hygiene services • Fencing
		Skills training opportunities	• Implement a skills development programme which includes training in business, project management, monitoring and evaluation.
		Potential spin-off economic opportunities: aquaculture, irrigation, recreation and tourism.	• The proponent is limited in terms of their input regarding the spin-off business opportunities as these depend on investor interest and market demand; however they play a key role in permitting water use activities. The DWS should therefore, in their consideration of water use applications, consider the benefit to local communities and ensure that equitable benefits are realised and readily facilitate water use activities that will benefit the community. • DWS must consider in their planning and development of construction camps and settlements the possibility of converting these transformed areas into tourism or recreation facilities.
5	Disturbance of graves sites	Impact on grave sites along the route of the pipeline	Where practical and feasible, pipeline routes need to be diverted around identified grave sites. Where this is not possible, the affected families need to be consulted to discuss reburial. Additional mitigation measures are provided in the Heritage Impact Assessment.

7.5 Opinion of the specialist

Although a number of high negative impacts have been identified in this study, it is expected for the positive impacts to far outweigh the negative. Negative impacts can be sustainably mitigated and managed through proper monitoring, stakeholder engagement and the involvement of affected communities from the inception of the project. With regard to the possible affected land-owners at the dam site, further discussion and engagements are needed to resolve land delineation and ownership issues.

In conclusion, the EOH Coastal & Environmental Services consultants are of the opinion that the project will ultimately uplift communities, which are in dire need of basic water supply and employment opportunities. No fatal flaws with respect to any of the proposed activities have been raised or identified.

It is also the opinion of EOH Coastal & Environmental Services that this SIA contains sufficient information to allow DEA to make an informed decision. EOH Coastal & Environmental Services therefore, recommends that the application for authorisation be approved on condition that the recommended mitigation measures stated herein are effectively implemented.

8 REFERENCES

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APPENDIX A: STAKEHOLDERS DATA BASE

Organisation	Name	E-mail	Tel	fax
Stakeholders				
SAHRA	M Galimberti	mgalimberti@sahra.org.za		
ECPHRA	Mr Mzikayise L. Zote	mlzote@ecphra.org.za	(043) 642 2811 or (076) 836 5467	(043) 642 2812
Department of Water Affairs				
Zimkhitha /Lungiswa	Mthatha Town Hall	lungiswab@ksd.gov.za	047 5014081	0866929701
I & AP register				
Ben van dr Merwe	Urban-econ	ben@urban-econ.com		
Mluleki Fihlani	Ingquza Hill LM	nmdiya@ihlm.gov.za	039 253 1568/ 039 253 1096	039 252 0131
Nomvuyo (Speaker's office)	PSJ LM		047 564 1208	
Mr N Pakde (Acting Municipal Manager)	PSJ LM	mshiywa.feziwe@gmail.com	047 564 1208	
Kabane Siyabonga	Eskom	kabanes@eskom.co.za		
Kumbula Charles	OR Tambo	charles@yahoo.com		
Mafumbata Ntosh	Eskom	mafumba@eskom.co.za		
Mase Sithembele	ECDC	smase@ecdc.co.za		
V Fihla	Eskom	fihlav@eskom.co.za		
Mjindi LM	Eskom	mjindilm@eskom.co.za		
Wana Xolani	Eskom	wanaxs@eskom.co.za		
Mdoda N	Eskom	mdoadan@eskom.co.za		
Sifiso Khoza	OR Tambo	sifisok@ortambodm.gov.za		
Mzayiya Eric	OR Tambo	mzayiyae@ortambodm.gov.za		
Mr Notho	OR Tambo DM	Singwa@gmail.com		
O Sopela	Ingquza Hill LM	osopela@psjmunicipality.co.za		
Nyawose Mthokozi	Amatola Water	cthompson@amatolawater.co.za		
Ndzungu C	DWA	ndzunguc@dwa.gov.za		
Van Jaarsveld S	DWA	vanjaarsvelds@dwa.gov.za		
Fourie F	DWA	fourief@dwa.gov.za		

Geldenehuys T	DWA	geldenhuyst@dwa.gov.za		
DM Mangqo (Mayor)	PSJ LM	dmangqo@psjmuni.co.za		
S Sotshongaye (Ward 17)	PSJ LM	silassotshongaye@gmail.com		
N Diki (Ward 11)	PSJ LM	ngdiki@gmail.com		
M Vena (Ward 10)	PSJ LM	mthuthuzelivena@gmail.com	073 477 7569	
Novangeli Town Hall	PSJ LM		073 415 4731	
Fono M (Ward 9)	PSJ LM	fonokm@gmail.com	082 634 6725	
Daniso B (Ward 11)	PSJ LM		072 564 1712	
Mtiki Z (Ward 12)	PSJ LM	zemtiki@gmail.com	073 394 6089	
Zweni M (Ward 13)	PSJ LM	rmzweni@gmail.com	082 564 0212	
Cuba Z (Ward 14)	PSJ LM		082 564 2979	
Tshoto G (Ward 15)	PSJ LM	tshoto@webmail.co.za	072 256 2463/ 079 896 1111	
Mzaza S (Ward 19)	PSJ LM	siyamthanda.mzaza@yahoo.com	082 564 5298	
Ms Mbotshwa N (Ward 20) (Mthimde)	PSJ LM	ntsebz@gmail.com	073 035 3219 or 079 691 1451	
Cllr X Moni (Ward 18)	PSJ LM	xolilemoni@gmail.com		
IHLM Reception			039 253 1563/ 039 253 1096	
Ms Nkayitshana (Ward 12)	Ingquza Hill LM		071 865 3068	
Mr Ntshobo (Ward 13)	Ingquza Hill LM		071 865 3029	
Mr Malulwana (Ward 14)	Ingquza Hill LM		082 843 3887	
Mr Thambodala (Ward 15)	Ingquza Hill LM		083 562 3717	
Ms Jotile (Ward 16)	Ingquza Hill LM		083 462 3892	
Mr Mpofana (Ward 17)	Ingquza Hill LM		071 865 3038	
Mr Zati (Ward 18)	Ingquza Hill LM		073 782 1459	
Mr Mtsosto (Ward 19)	Ingquza Hill LM	mndenyane@ihlm.gov.za	074 865 3591	
Mr Ngxamile (Ward 20)	Ingquza Hill LM	pngxamile@ihlm.gov.za	071 865 3089	
Ms Daniso (Ward 21)	Ingquza Hill LM		083 668 5540	
Mr Tshwatshuka (Ward 22)	Ingquza Hill LM		083 668 4480	
Ms Daliwe (Ward 23)	Ingquza Hill LM		083 623 6921	
Mr Nkungu (Ward 24)	Ingquza Hill LM	minkungu@yahoo.com	083 623 9025	
Nolwazi N	PSJ LM	nolwazin2000@yohaoo.com	082 774 4288	
Mr Mgwili (Ward 4) (Mfinizweni)	Ingquza Hill LM		083 455 3286	
Neliswa IHLM		n92vato@gmail.com		

IAP Scoping Phase				
B Ngotana			083 340 9583	
MD Mvinjwa			083 445 2496	
SE Malulwana			082 843 3887	
H Mabetla			083 441 6564	
A Vungaye			073 230 5592	
T Songunzu			073 665 5772	
M Mfolozi			083 444 1194	
F Mdutshane			083 440 3459	
L Dumani			082 209 3471	
N Ndondo			083 446 0225	
S Mnge			073 555 7913	
Z Bashe			083 419 8256	
M Tana			083 448 2567	
NF Diko			083 591 4708	
N Nyenyiso			083 447 1990	
B Mfitizo			083 444 0933	
NF Dwabayo			076 587 6282	
N Msikwa			083 445 0593	
W Mhanywa			083 444 4289	
N Bhala			083 419 8550	
N kwakhwa			060 380 5946	
M Sithilanga			082 448 0351	
N Zikizela			083 446 9036	
Z Tshemese			083 448 3823	
M Matwasa			078 670 1128	
NC Mkombe			083 444 5600	
N Mtenjwa			083 445 2229	
N Linganiso			083 441 5869	
XW Sopilase			083 448 3303	
M Mkwenkwe			078 514 4996	
M Mali			083 442 2457	
NC Cawe			083 419 9499	
L Mgwaza			083 444 3153	
P Mbaleni			073 188 4465	
N Mkumbuzi			073 347 6531	

Y Kholisile			083 441 4355	
Veliswa Peter			083 447 5064	
Nothemba Jijimba			073 559 0100	
Mampinge M Diko			083 41 6762	
Michael Gqweta			083 440 8277	
Mfundiso Jazi			083 485 0115	
Alicia Mbalo			083 443 2703	
P Tshicila			083 443 3214	
TA Muge			083 444 7774	
Nomalizo Manciya (Chieftainess)			083 532 8191	
Hamilton Mgwici			083 455 3286	
T Gwane		thembisile2@gmail.com	078 654 4972	
B Bantwana		bongeka2@gmail.com	078 026 2170	
A Mbena			073 806 5470	
N Mpambaniso			078 529 1242	
N Tenyane			078 136 7929	
S Dlomo			079 628 9203	
N Siko		n.siko@gmail.com	073 390 6243	
N Mngoma			071 943 8596	
M Mngwane			078 754 8704	
DL Mbola			073 660 5004	
M Dlomo			073 321 1638	
S Matwasa			078 741 4790	
M Mafanya			083 424 8945	
S Dlomo			083 622 4396	
S Mbendana			073 900 5574	
M Siko			083 770 6499	
M Mthemba			078 501 5948	
L H Ngotana			078 773 8858	
S Mbena			071 816 0502	
K A Duntsula			073 348 5430	
M Mbena			072 662 3883	
B Mbena				
M Mtsenge			078 078 6997	
Mgwili Dedani	Ingquza Hill		073 702 0716	

APPENDIX B: QUESTIONNAIRE USED AT FOCUS GROUP MEETINGS

lusikisiki regional water supply scheme traditional leaders questionnaire

Prepared for:	Prepared by:
Department of Water Affairs	EOH Coastal & Environmental Services
water affairs Department: Water Affairs REPUBLIC OF SOUTH AFRICA	Head office: Grahamstown (South Africa) Physical Address: 67 African Street, Grahamstown 6139 Postal Address: P.O Box 934, Grahamstown 6140 Telephone: +27 46 622 2364 Mobile: +27 82 783 6393 Fax: +27 46 622 6564 Website: www.cesnet.co.za

EOH Coastal & Environmental Services (CES) has been appointed by the Department of Water Affairs (DWA) to undertake the Environmental Impact Assessment (EIA) for the proposed Lusikisiki Regional Water Supply Scheme (LRWSS) and obtain environmental approval in terms of the National Environmental Management Act (1998). The LRWSS has been under consideration since the 1970‟s (van Niekerk et al., 2013) when it was recommended that a regional water supply scheme based on a dam on the Xura River and a main bulk supply reservoir close to Lusikisiki would provide potable water supply for the entire region between Lusikisiki and the coast, extending from the Mzimvubu River in the south west to the Msikaba River in the north east. Some areas up to 15 km inland of Lusikisiki would also be supplied.

As part of the EIA process CES is conducting specialist studies to identify the impacts pf the proposed project on environment. We would like to ask you a few questions to get more information on the socio-economic situation of the affected areas.

Questions for Traditional Leadership

1. Which villages fall under your jurisdiction?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

2. What is the name of this tribal authority?

…………………………………………………………………………………………………

3. What is the name of your administrative area?

…………………………………………………………………………………………………

4. Do you have knowledge about the proposed development (LRWSS)? Explain

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5. What do you think will be the major challenges to the success of this project

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6. How do you see the community benefiting from this development?

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7. Are there any existing community organisations that are operational in your area?

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8. If yes, how are they doing? (i.e. management, finances, etc)

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9. How is the relationship between the different affected areas? Is there a good working relationship?

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………………………………………………………………………………………………

10. Are there no people/families that have land use rights at the site allocated for the project?

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………………………………………………………………………………………………

11. According to your knowledge, are there are any graves in and around the project area?

………………………………………………………………………………………………

………………………………………………………………………………………………

12. Are there no cultural activities that are being practised in the area?

………………………………………………………………………………………………

………………………………………………………………………………………………

13. Are there any recreational activities (e.g. sports) taking place at the dam site?

………………………………………………………………………………………………

………………………………………………………………………………………………

14. What is the relationship between traditional and political leaders (i.e. councillors) in these areas?

………………………………………………………………………………………………

………………………………………………………………………………………………

15. Do you have any other comments to make about the proposed development?

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………………………………………………………………………………………………

Signature of leader: ………………………………………………………………..

Date: ………………………………………………………………………

APPENDIX C: QUESTIONNAIRE USED FOR HEALTHWORKERS

lusikisiki regional water supply scheme health workers questionnaire

Prepared for:	Prepared by:
Department of Water Affairs water affairs Department: Water Affairs REPUBLIC OF SOUTH AFRICA	EOH Coastal& Environmental Services EOH Head office: Grahamstown (South Africa) Physical Address: 67 African Street, Grahamstown 6139 Postal Address: P.O Box 934, Grahamstown 6140 Telephone: +27 46 622 2364 Mobile: +27 82 783 6393 Fax: +27 46 622 6564 Website: www.cesnet.co.za

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As part of the EIA process CES is conducting specialist studies to identify the impacts of the proposed project on environment. We would like to ask you a few questions to get more information on the socio-economic situation of the affected areas.

Questionnaire for Health Workers

1. Name of health centre (clinic/hospital)

………………………………………………………………………………………………

2. Which areas does this health centre service?

   ………………………………………………………………………………………………

3. What kind of sicknesses do you commonly deal with?

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

4. Are there any spatial variations in the nature of sicknesses in different villages in the areas?

………………………………………………………………………………………………

5. How many staff members are presently working at the health centre?

………………………………………………………………………………………………

6. To what extent is the staff at the health centre overloaded (under-staffed)?

………………………………………………………………………………………………

7. To what extent is this health centre adequately resourced? (equipment, buildings and vehicles)

………………………………………………………………………………………………

………………………………………………………………………………………………

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8. Which government services are currently available at the health centre (e.g. water, electricity, etc.)?

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………………………………………………………………………………………………

9. Is alcoholism and drug abuse a common social problem in this area (relative to other areas)? (% of cases?) [Severe, high, average, low, non-existent]

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………………………………………………………………………………………………

10. What are the challenges or constraints with respect to the provision of health services in the Lusikisiki area?

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………………………………………………………………………………………………….

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………………………………………………………………………………………………….

11. To what extent are health services available to communities in the region? (problems)

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………………………………………………………………………………………………….

12. How would you expect the development of the LRWSS to affect the health situation in the area?

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………………………………………………………………………………………………….

………………………………………………………………………………………………….

Signature: ………………………………………………………………

Date: ………………………………………………………………….

APPENDIX D: QUESTINNAIRE USED AT SCHOOLS

lusikisiki regional water supply scheme health workers questionnaire

Prepared for:	Prepared by:
Department of Water Affairs water affairs Department: Water Affairs REPUBLIC OF SOUTH AFRICA	EOH Coastal & Environmental Services EOH Head office: Grahamstown (South Africa) Physical Address: 67 African Street, Grahamstown 6139 Postal Address: P.O Box 934, Grahamstown 6140 Telephone: +27 46 622 2364 Mobile: +27 82 783 6393 Fax: +27 46 622 6564 Website: www.cesnet.co.za

EOH Coastal & Environmental Services (CES) has been appointed by the Department of Water Affairs (DWA) to undertake the Environmental Impact Assessment (EIA) for the proposed Lusikisiki Regional Water Supply Scheme (LRWSS) and obtain environmental approval in terms of the National Environmental Management Act (1998). The LRWSS has been under consideration since the 1970‟s (van Niekerk et al., 2013) when it was recommended that a regional water supply scheme based on a dam on the Xura River and a main bulk supply reservoir close to Lusikisiki would provide potable water supply for the entire region between Lusikisiki and the coast, extending from the Mzimvubu River in the south west to the Msikaba River in the north east. Some areas up to 15 km inland of Lusikisiki would also be supplied.

As part of the EIA process CES is conducting specialist studies to identify the impacts pf the proposed project on environment. We would like to ask you a few questions to get more information on the socio-economic situation of the affected areas.

Schooling questions

Questions for School Teacher/Principal

1. Name of school:

…………………………………………………………………………………………………

2. Location of school:

…………………………………………………………………………………………………

3. What grades are taught at this school?

…………………………………………………………………………………………………

4. What is the medium of instruction in this school? (language)

…………………………………………………………………………………………………

5. How many pupils are enrolled at this school?

…………………………………………………………………………………………………

6. From which surrounding villages do the learners come from?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

7. What proportion (or number) of the pupils are from the project affected villages?

…………………………………………………………………………………………………

8. Where do the pupils who graduate from this school go to next?

…………………………………………………………………………………………………

9. Is pupil attendance at school excellent, good, average or poor?

…………………………………………………………………………………………………

10. Is pupil performance at school excellent, good, average or poor? Explain ………………………………………………………………………………………………

…………………………………………………………………………………………………

11. Do you know what proportions of students who have come to this school have gone on to obtain higher levels of education at other schools? (estimate)

…………………………………………………………………………………………………

12. Where does the teacher live? (at the village or elsewhere)?

…………………………………………………………………………………………………

13. Is water and electricity provided to the school?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

14. How many classrooms, offices, libraries, toilets, sports fields etc. (fixed assets) does the school have?

…………………………………………………………………………………………………

School Facilities	Yes/No or Number
Accommodation for teacher	
Class Rooms	
Office	
Library	
School Hall	
Toilets	
Yard	
Sports fields	
Electricity	
Water	
Telephone	

15. To what extent can this school accommodate any additional children (if there is a lot of immigration as a result of the proposed project?

…………………………………………………………………………………………………

16. What proportion of pupils who leave school go on to find jobs? (estimate)

…………………………………………………………………………………………………

17. Do you have any concerns about the proposed development, and how it would affect your school and pupils?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

18. Are there any incidences of teenage pregnancies amongst pupils at this school?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

19. Are there any incidences of violence, or drug/alcohol consumption amongst pupils at this school?

…………………………………………………………………………………………………

20. What are the challenges currently facing the school?

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

Signature: ………………………………………….

Date:

APPENDIX E: QUESTIONNAIRE USED FOR MUNICIPAL OFFICIALS

lusikisiki regional water supply scheme MUNICIPAL OFFICIALS questionnaire

Prepared for: Department of Water Affairs water affairs Department: Water Affairs REPUBLIC OF SOUTH AFRICA	Prepared by: EOH Coastal & Environmental Services EOH Head office: Grahamstown (South Africa) Physical Address: 67 African Street, Grahamstown 6139 Postal Address: P.O Box 934, Grahamstown 6140 Telephone: +27 46 622 2364 Mobile: +27 82 783 6393 Fax: +27 46 622 6564 Website: www.cesnet.co.za

EOH Coastal & Environmental Services (CES) has been appointed by the Department of Water Affairs (DWA) to undertake the Environmental Impact Assessment (EIA) for the proposed Lusikisiki Regional Water Supply Scheme (LRWSS) and obtain environmental approval in terms of the National Environmental Management Act (1998). The LRWSS has been under consideration since the 1970‟s (van Niekerk et al., 2013) when it was recommended that a regional water supply scheme based on a dam on the Xura River and a main bulk supply reservoir close to Lusikisiki would provide potable water supply for the entire region between Lusikisiki and the coast, extending from the Mzimvubu River in the south west to the Msikaba River in the north east. Some areas up to 15 km inland of Lusikisiki would also be supplied.

As part of the EIA process CES is conducting specialist studies to identify the impacts pf the proposed project on environment. We would like to ask you a few questions to get more information on the socio-economic situation of the affected areas.

Questionnaire for Municipal Officials

Provision of Services

1. What are the main challenges facing the communities in the project area from the municipality perspective?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

2. What are the current projects that the municipality is involved in these areas?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

3. Does the municipality have any plans to bring service in the project area and if so please list the planned services and the projected time frames for completion? (esp. water supply related infrastructure)

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…………………………………………………………………………………………………

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Water

4. Describe the current water supply system for these communities?

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…………………………………………………………………………………………………

5. Have there been any problems with the water supply system in these areas, and if so, explain what these problems were?

…………………………………………………………………………………………………

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…………………………………………………………………………………………………

6. Does the municipality have any plans to expand the supply of water and in what areas?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

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Local Economic Development

7. What are the municipality’s plans for local economic development?

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…………………………………………………………………………………………………

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8. What initiatives have been implemented so far? (history)

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…………………………………………………………………………………………………

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9. How have they performed? What impact or success have they had?

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10. What are the constraints to LED in this area?

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…………………………………………………………………………………………………

11. What are the opportunities for LED in this area?

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…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

12. What assistance will be needed to overcome these constraints and make use of these opportunities?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

Signature: ……………………………………………………

Date ……………………………………………………………..

APPENDIX F: ATTENDANCE REGISTERS

Focus Group Meeting at Mthimde

DWA - LUSIKISIKI REGIONAL WATER SUPPLY SCHEME PUBLIC MEETING

VILLAGE	Mthimde (Traditional Authority)
FACILITATORS	Mr Bosman & Ms Nande Suka
DATE	28 / 08 /2014

ATTENDANCE REGISTER Focus group duration:

NAME	VILLAGE	Contact details	Signature
Cigwashu Nomnawa	Mthimde	—	X
Cileia Mjeje	Mthimde	—	X
John Norgwana	Mthimde	—	X
W. Bezana	Mthimde	—	X
Lenard Xotho	Mthimde	—	X

DWA - LUSIKISIKI REGIONAL WATER SUPPLY SCHEME PUBLIC MEETING

VILLAGE	Mthimde
FACILITATORS	Mr Bosman & Ms Nande Suka
DATE	26 / 08 /2014

ATTENDANCE REGISTER Focus group duration:

NAME	VILLAGE	Contact details	Signature
B. Mathandabuzo	Mtimde	0823693253	
John Nongwana	mtimde	X	
Z. Mbeli	Mtimde	X	
S. Seline Macotho	mtimde	X	
M.M Lobe	Mtimde	X	
Zakalia Lutsula	mtimde	X	
E. Gcotho	mtimde	0791016038	
N. Mayeza	mtimde	0835479380	
N Magiya	mtimde	0835328191	
Z. Nocha	Mtimde	0781214084	
L. Gcotho	Mtimde	None	
Zhabha Macuya	Mtimde	X	
Silayi Zimoshile	Mtimde	X	
T. Ngqanabeni	Mtimde	X	
W. Bezana	Mtimde	X	
Jilela Tshitshi	mtimde	X	
Z. Mgula	Mtimde	X	

Focus Group Meeting at Ntsimbini

DWA - LUSIKISIKI REGIONAL WATER SUPPLY SCHEME PUBLIC MEETING

VILLAGE	Qhawukazi Traditional Authority
FACILITATORS	Mr Bosman & Ms Nande Suka
DATE	26 / 08 / 2014

ATTENDANCE REGISTER Focus group duration:

NAME	VILLAGE	Contact details	Signature
MAFANYA Bongisile	Mrhotshozweni	0782202802	[signature]
MPAMBANISO Nobuhle	"	078 529 1242	N. [signature]
Mbuyiselo Tshova	Ntsimbaneni	0730403267	[signature]
[illegible]	NTSIMBINI	0835060436	[signature]
M.A. Mngoma	Mrotsho	0725533896	[signature]
V [illegible]	Ntsimbini	0787553529	[signature]
J.W. MBombo	MRotsho	0730956890	[signature]

APPENDIX G: IMPACT RATING SCALE

EOH CES' Ranking of Evaluation Criteria

	Temporal Scale			**Score**
EFFECT	Short-term	Less than 5 years		1
	Medium-term	Between 5-20 years		2
	Long-term	Between 20 and 40 years (a generation) and from a human perspective also permanent		3
	Permanent	Over 40 years and resulting in a permanent and lasting change that will always be there		4
	Spatial Scale			
	Localised	At localised scale and a few hectares in extent		1
	Study Area	The proposed site and its immediate environs		2
	Regional	District and Provincial level		3
	National	Country		3
	International	Internationally		4
	Severity	**Severity***	**Benefit**	
	Slight	Slight impacts on the affected system(s) or party(ies)	Slightly beneficial to the affected system(s) and party(ies)	1
	Moderate	Moderate impacts on the affected system(s) or party(ies)	Moderately beneficial to the affected system(s) and party(ies)	2
	Severe/ Beneficial	Severe impacts on the affected system(s) or party(ies)	A substantial benefit to the affected system(s) and party(ies)	4
	Very Severe/ Beneficial	Very severe change to the affected system(s) or party(ies)	A very substantial benefit to the affected system(s) and party(ies)	8
LIKELIHOOD	**Likelihood**			
	Unlikely	The likelihood of these impacts occurring is slight		1
	May Occur	The likelihood of these impacts occurring is possible		2
	Probable	The likelihood of these impacts occurring is probable		3
	Definite	The likelihood is that this impact will definitely occur		4

** This refers to the impact's intensity*

Matrix used to determine the overall significance of the impact based upon the likelihood and effect of the impact

		Effect													
		3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Likelihood	**1**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
	2	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
	3	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
	4	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**

Description of socio-environmental significance ratings and associated range of scores*

Significance rating	**Description**	**Score**
Low	An acceptable impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in either positive or negative medium to short term effects on the social and/or natural environment.	**4-8**
Moderate	An important impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in either a positive or negative medium to long-term effect on the social and/or natural environment.	**9-12**
High	A serious impact, which if not mitigated, may prevent the implementation of the project (if it is a negative impact). These impacts would be considered by society as constituting a major and usually a long-term change to the (natural &/or social) environment and result in severe effects or beneficial effects.	**13-16**
Very High	A very serious impact which, if negative, may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are unmitigatable and usually result in very severe effects, or very beneficial effects.	**17-20**

** These tables have been formulated by CES through years of experience with impact assessments*

PROPOSED LUSIKISIKI REGIONAL WATER SUPPLY SCHEME, EASTERN CAPE PROVINCE, SOUTH AFRICA

VISUAL STUDY OF THE PROPOSED ZALU DAM

P WMA 12/T60/00/5414/2

Prepared for:

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Department of Water & Sanitation
Private Bag X313
Pretoria
0001

Prepared by:

EOH
Coastal & Environmental Services

EOH Coastal & Environmental Services
EAST LONDON
16 Tyrell Road, Berea
East London, 5201
043 742 3302
Also in Grahamstown, Port Elizabeth, Cape Town, Johannesburg and Maputo
www.cesnet.co.za

06 February 2015

REVISIONS TRACKING TABLE

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Report Version: Draft
Project Number: 237

Name	Responsibility	Signature	Date
Rosalie Evans	Lead Author		06-02-15
Roy de Kock	Reviewer		17-02-15
Alan Carter	Reviewer		19-02-15

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THE PROJECT TEAM

Mr Roy de Kock, Cand. Nat. Sci. Roy is a Senior Consultant holding a BSc Honours in Geology and an MSc in Botany from the Nelson Mandela Metropolitan University in Port Elizabeth. His MSc thesis focused on Rehabilitation Ecology using an open-cast mine as a case study. He has been working for CES since 2010, and is based at the East London branch where he focuses on Ecological and Agricultural Assessments, Geological and Geotechnical analysis, Environmental Management Plans, mining applications and various environmental impact studies. Roy has worked on numerous projects in South Africa, Mozambique and Malawi.

Ms Rosalie Evans, Environmental Consultant. Rosalie holds a BA Social Dynamics degree with majors in Geography and Psychology, as well as BA (Hons) in Geography and Environmental Studies - both from Stellenbosch University. Rosalie's honours dissertation analysed the role of small grains in soil carbon sequestration in the agricultural sector of the Western Cape. Her academic focuses include renewable energy, sustainable development and the interactions between humans and their environment.

1 INTRODUCTION

One of the significant environmental issues identified during the scoping phase of the Lusikisiki Regional Water Supply Scheme Environmental Impact Assessment (EIA) process was the visual impact of the proposed Zalu Dam development on the landscape. A Visual Study is therefore included as part of the EIA process.

Visual, scenic and cultural components of the environment can be seen as a resource, much like any other resource, which has a value to individuals, to society and to the economy of the region. In addition, this resource may have a scarcity value, be easily degraded, and is usually not replaceable.

Impact (visual): A description of the effect of an aspect of the development on a specified component of the visual, aesthetic or scenic environment within a defined time and space.

The current report provides specialist visual input into the EIA process relating to the proposed Zalu Dam of the Lusikisiki Regional Water Supply Scheme.

The main issues relating to visual and aesthetic impacts can be summarised as follows:

- Impacts of design and built-form (e.g. use of building materials, height of structures, inconsistent with surrounding buildings) on aesthetic character of the area;
- Impacts of the overall development on sense of place and sense of privacy of the area; and
- Impacts of the development on sensitive landscapes.

1.1 Project description and locality

The Study Area comprises the region between Lusikisiki (up to about 15km inland) and the coast, extending from the Mzimvubu River in the south-west to the Msikaba River in the north-east, as shown in Figure 2.

The Zalu Dam and inundation area – The dam will consist of an earth core rockfill dam with a full supply level of 612 masl (approximately 35 m high). It is anticipated that the dam will yield 6.95 million m_3/a at 1:100 year assurance of supply. The domestic requirement is 5.4 million m^3/a in 2040, the irrigation requirements 1.45 million m^3/a (including 10% losses) and the 1:1 year ecological freshet requirement is 8 m^3/s for a period of three days per year. It is anticipated that the release for domestic use will be sufficient for the maintenance of ecological requirements (Department of Water Affairs, 2011). The area that will be inundated as a result of the proposed Zalu Dam is approximately 144 hectares in size; see images in Figure 1. No resettlement will be required. The sensitivity of the environment surrounding the proposed Zalu Dam is indicated in Figure 3. The sensitive ecological and heritage areas have been ranked according to their significance: from low to high.

Figure 1: Photographs of the location of the proposed Zalu Dam.

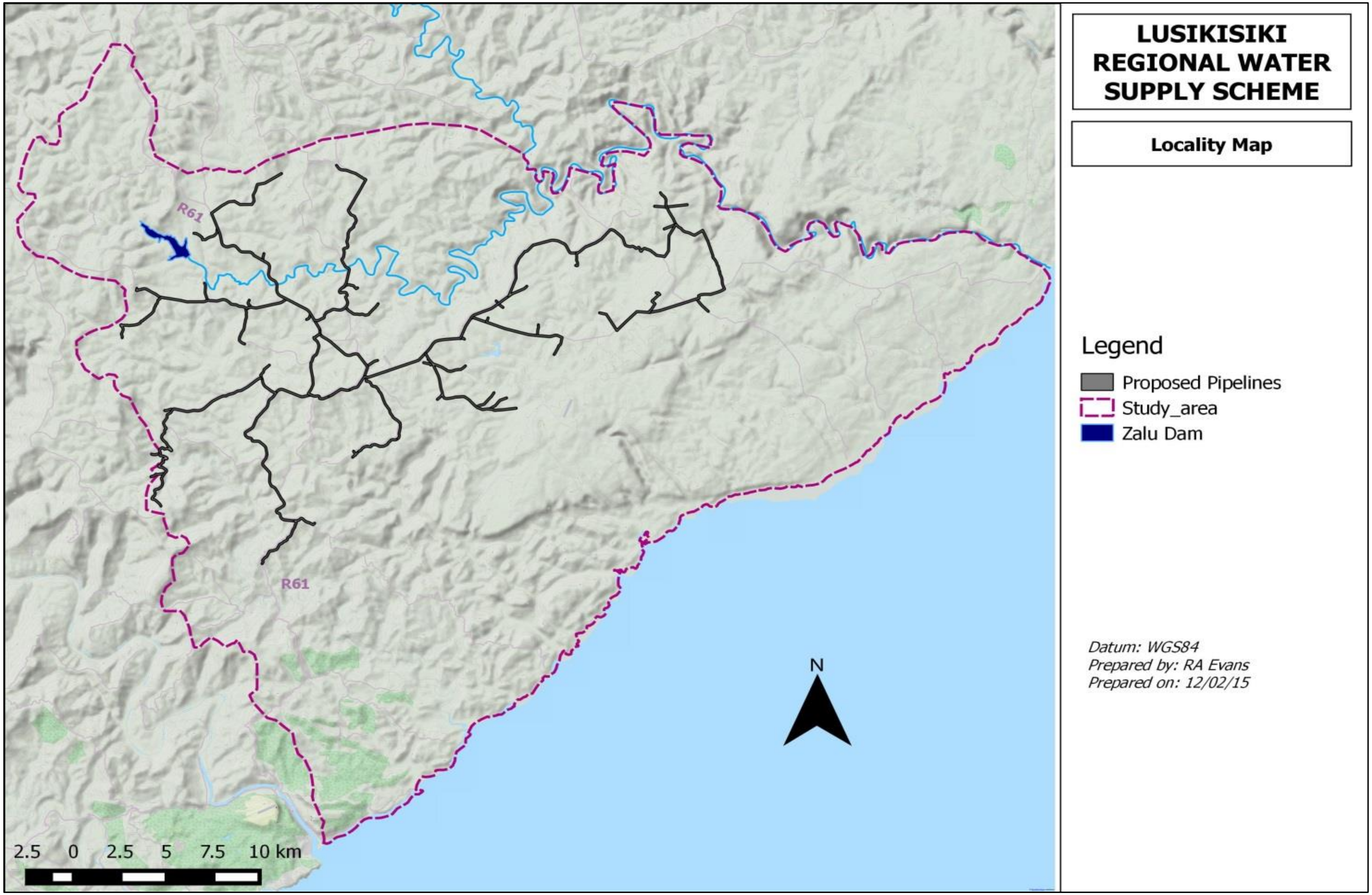

Figure 2: Locality Map of the proposed Zalu Dam development.

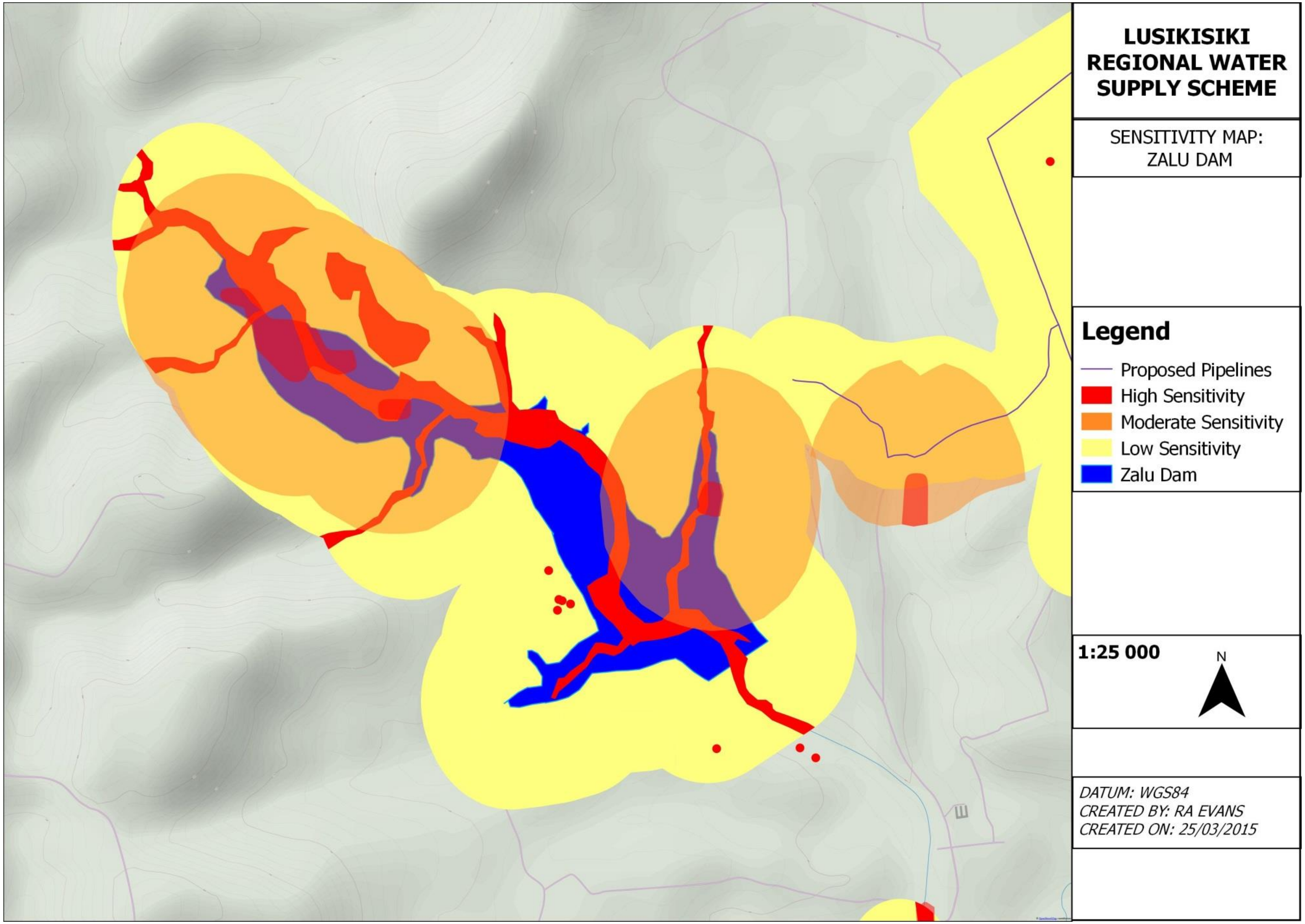

Figure 3: Sensitivity map of the area of the proposed Zalu Dam

2 LEGAL, POLICY AND PLANNING CONTEXT

The following legal and policy documents are relevant to assessing the visual impacts of a proposed activity.

2.1 Legislation

The following legislation is directly relevant when assessing the visual and aesthetic aspects relating to a development:

2.1.1 National Environmental Management Act (NEMA) (107 of 1998) and the EIA regulations

Current South African environmental legislation governing the EIA process, which may include consideration of visual impacts if this is identified as a key issue of concern, is the National Environmental Management Act (NEMA) (107 of 1998 and amended in 2010) and the EIA regulations promulgated in terms of the NEMA.

2.1.2 National Heritage Resources Act (25 of 1999)

The National Heritage Resources Act (25 of 1999) and the associated provincial regulations provides legislative protection for listed or proclaimed sites, such as urban conservation areas, nature reserves and proclaimed scenic routes.

3 VISUAL STUDY APPROACH & VIEWPOINTS

The proposed Zalu Dam is to be situated in the valley between the following significant viewpoints:

- Bayi Village
- Mrhoshozo Village
- Mthimde Village
- Ndimbaneni Village
- Ntsimbini Village
- Palmarton Mission
- R 61

These viewpoints are situated in the range between 125m and 1 791m from the proposed Zalu dam, spillway and the dam wall. The permanent and temporary receptors may vary based on the opinions of the individuals and due to the abstract nature of visual and aesthetic qualities. For these reasons, the overall impacts of the proposed Zalu dam have been discussed in Table 1.

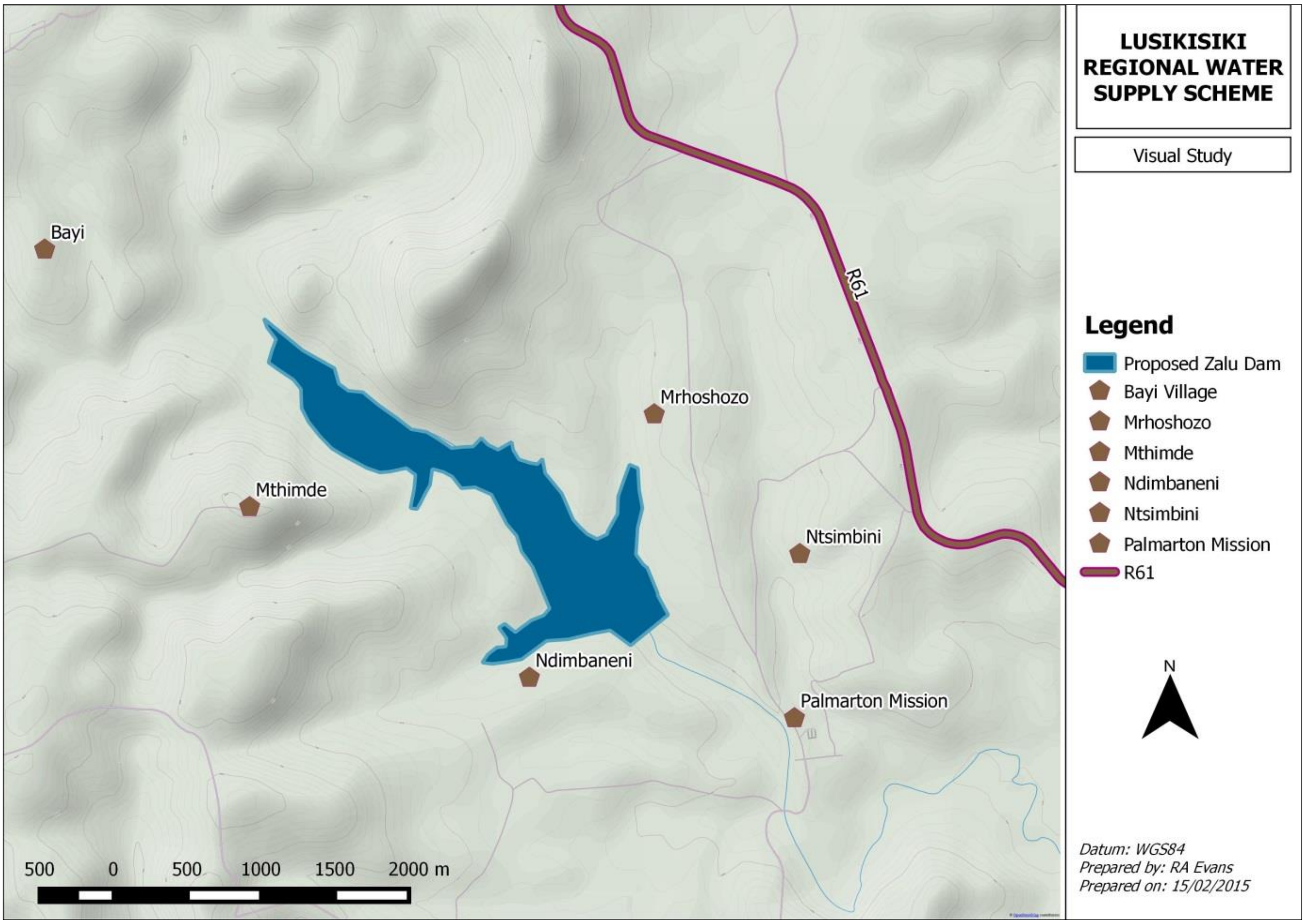

Figure 4: Map of the visual viewpoints in proximity to the proposed Zalu Dam

3.1 Bayi Village

Coordinates: 31°17'26.49" S *(latitude)*, 29°26'00.08" E *(longitude)*
Dwelling closest to Zalu development: 1 572 m
Elevation: 750 m

Bayi Village is a small informal village which is located in close proximity to the proposed Zalu Dam development. The primary receptors from this viewpoint would be permanent residents from the Bayi Village. This village is situated more than a kilometre from the proposed development and due to the surrounding topography and the vegetation, the view of the development from this point should be limited. The significance of the visual impact from this viewpoint would therefore be MODERATE.

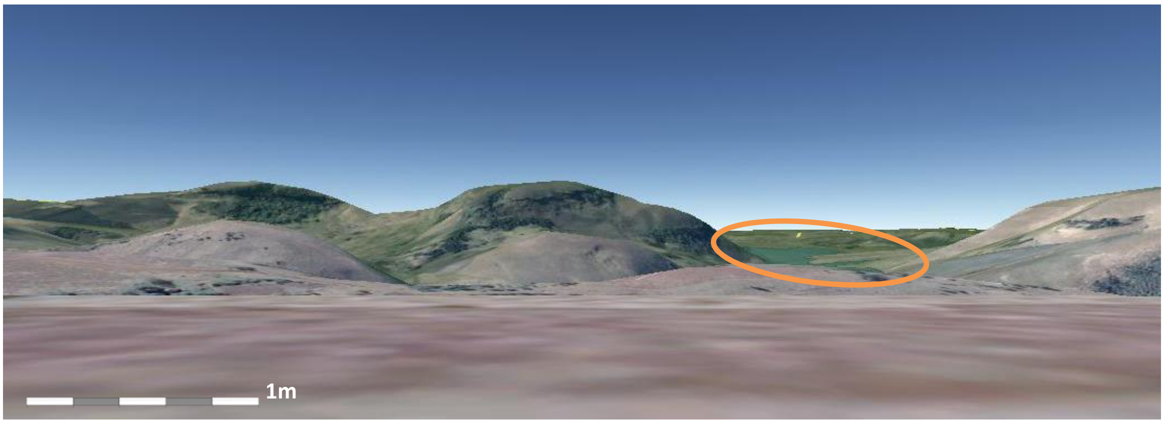

Figure 5: Google Earth image of the view from Bayi Village towards the proposed Zalu Dam

3.2 Mrhoshozo Village

Coordinates: 31°18'02.82" S *(latitude)*, 29°28'36.27" E *(longitude)*
Dwelling closest to Zalu development: 385 m
Elevation: 655 m

Mrhoshozo Village is a small informal village which is located in close proximity to the proposed Zalu Dam development. The primary receptors from this viewpoint would be permanent residents from the Mrhoshozo Village. As indicated in Figure 6, the view of the proposed development would be significant from the Mrhoshozo Village; even though parts of the development will be hidden by the topography. The significance of the visual impact from this viewpoint would therefore be MODERATE.

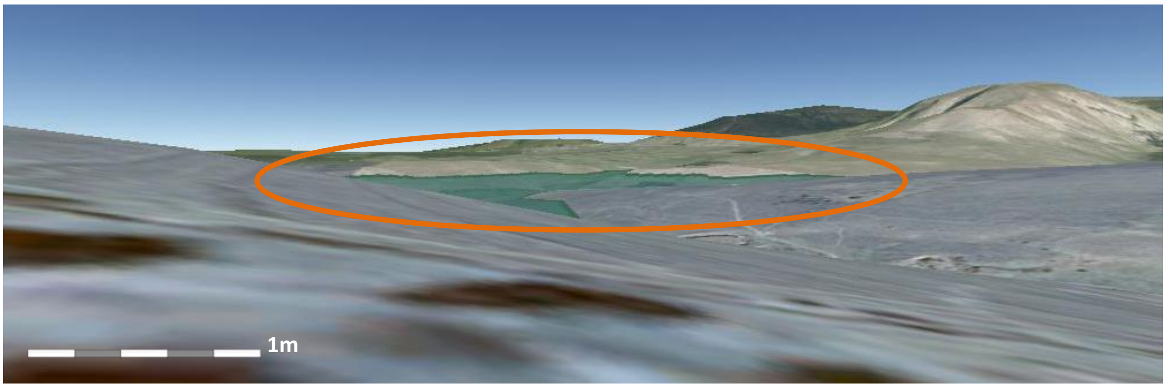

Figure 6: Google Earth image of the view from Mrhoshozo Village towards the proposed Zalu Dam

3.3 Mthimde Village

Coordinates: 31°18'22.91" S *(latitude)*, 29°26'52.59" E *(longitude)*
Dwelling closest to Zalu development: 728 m
Elevation: 812 m

Mthimde Village is a small informal village which is located in close proximity to the proposed Zalu Dam development. The primary receptors from this viewpoint would be permanent residents from the Mthimde Village. The proposed development would not be clearly visible from this viewpoint due to the topography of the Mthimde Village. The significance of the visual impact from this viewpoint would therefore be LOW.

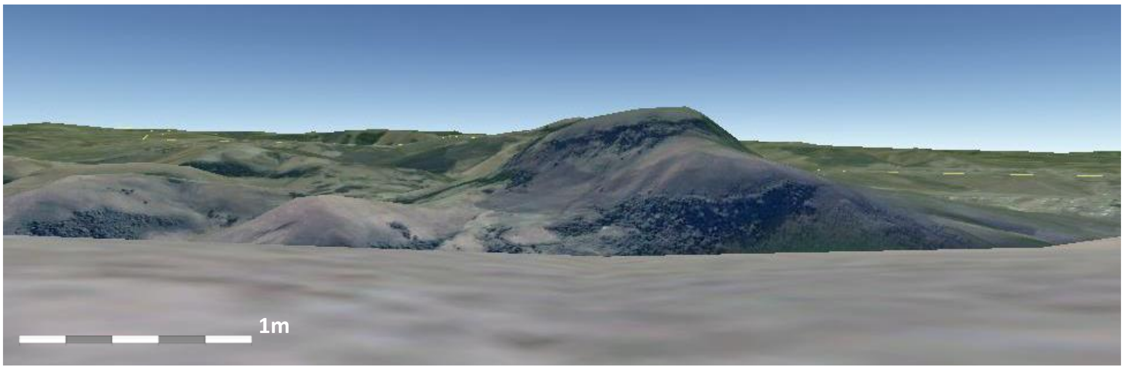

Figure 7: Google Earth image of the view from Mthimde Village towards the proposed Zalu Dam

3.4 Ndimbaneni Village

Coordinates: 31°19'00.50" S *(latitude)*, 29°28'04.27" E *(longitude)*
Dwelling closest to Zalu development: 125 m
Elevation: 637 m

Ndimbaneni Village is a small informal village which is located in close proximity to the proposed Zalu Dam development. The primary receptors from this viewpoint would be permanent residents from the Ndimbaneni Village. This village is situated closest to the proposed Zalu Dam development and, as indicated in Figure 8, the visual impact will be the most significant from this viewpoint. The significance of the visual impact from this viewpoint would therefore be HIGH.

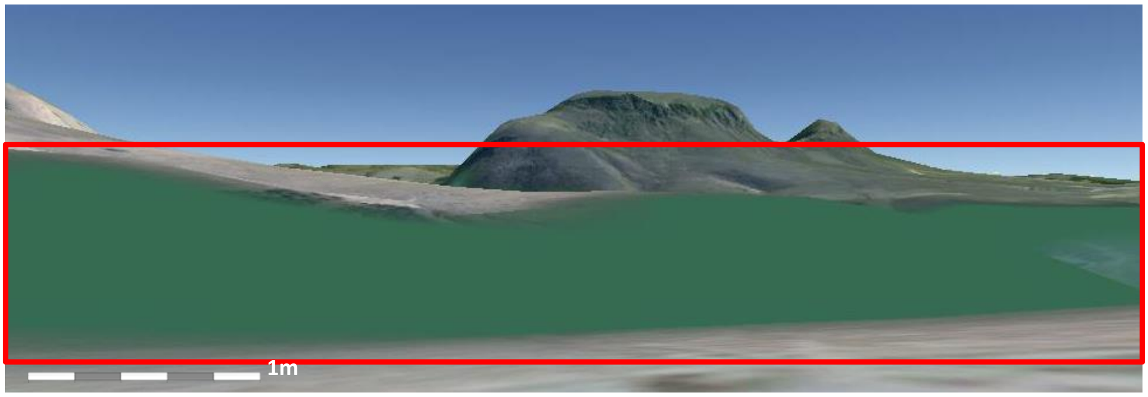

Figure 8: Google Earth image of the view from Ndimbaneni Village towards the proposed Zalu Dam

3.5 Ntsimbini Village

Coordinates: 31°18'33.45" S *(latitude)*, 29°29'13.57" E *(longitude)*
Dwelling closest to Zalu development: 994 m
Elevation: 628 m

Ntsimbini Village is a small informal village which is located in close proximity to the proposed Zalu Dam development. The primary receptors from this viewpoint would be permanent residents from the Ntsimbini Village. The significance of the visual impact from this viewpoint would therefore be LOW.

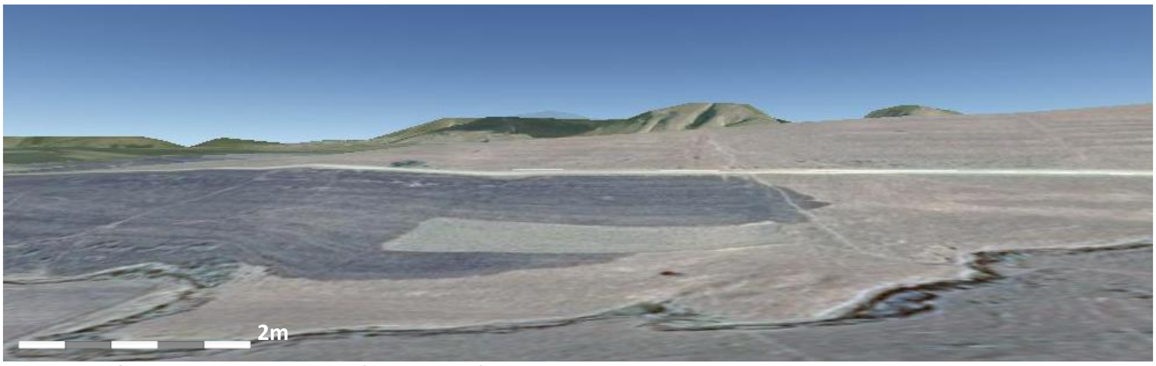

Figure 9: Google Earth image of the view from Ntsimbini Village towards the proposed Zalu Dam

3.6 Palmarton Mission

Coordinates: 31°19'09.31" S *(latitude)*, 29°29'12.27" E *(longitude)*
Dwelling closest to Zalu development: 1 138 m
Elevation: 608 m

Palmarton Mission is located more than one kilometre from the proposed Zalu Dam development. The primary receptors from this viewpoint would be permanent residents and temporary visitors to the Palmarton Mission. Figure 10 indicates that the Zalu Dam, the dam wall and the spillway will be visible from this viewpoint, although there are tall trees that are not visible on Google Earth that would screen parts of the development. The significance of the visual impact from this viewpoint would therefore be MODERATE.

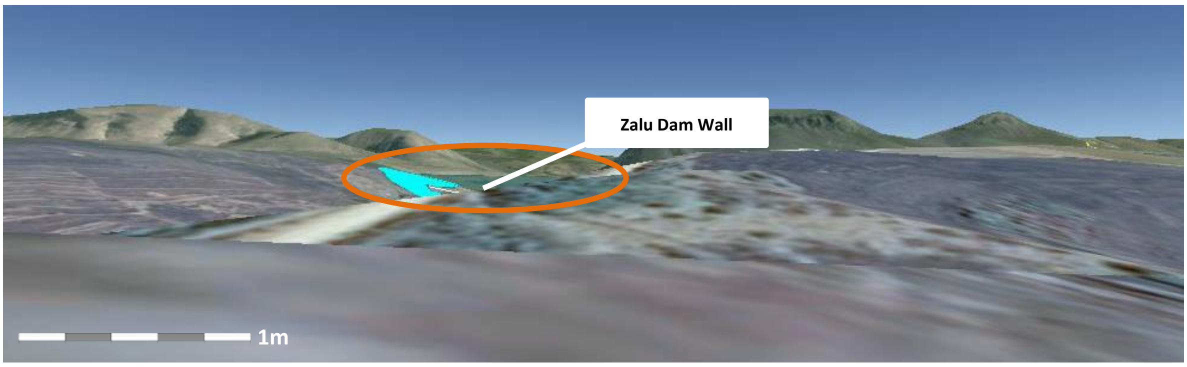

Figure 10: Google Earth image of the view from Palmaton Mission towards the proposed Zalu Dam

3.7 R61

The R61 is situated to the east of the proposed development and primarily consists of temporary receptors. The part of the road that is closest to the proposed Zalu Dam is approximately 1 800m away. As indicated in Figure 11, the vegetation largely screens the proposed development from this viewpoint. The significance of the visual impact from this viewpoint would therefore be LOW.

Figure 11: Google Earth images from the R61 towards the proposed Zalu Dam development; a) Street view image b) Image indicating the proposed spillway (light blue) and Zalu Dam (medium blue)

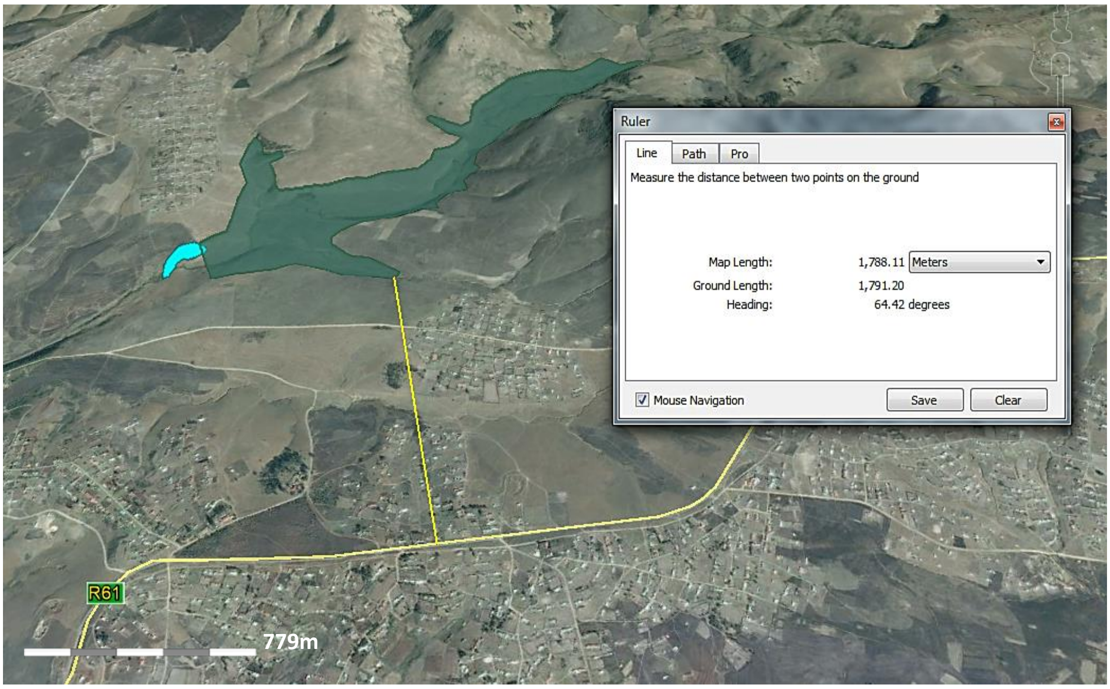

Figure 12: Google Earth image of the proximity of the R61 to the closest boundary of the proposed Zalu Dam development (Ground length: 1 791m)

4 ASSESSMENT OF IMPACTS

Table 1 : Visual impacts & mitigation measures

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
PLANNING & DESIGN PHASE									
VISUAL IMPACTS									
Zalu Dam Wall	Inappropriate planning and design of the Zalu Dam wall could result in a visually unappealing dam wall structure.	**DIRECT CUMULUATIVE**	**Localised, study area**	**Long-term**	**Probable**	**Moderately Severe**	**MODERATE NEGATIVE**	• The planning and design of the Zalu Dam Wall should include a plan for grassing large barren areas of the dam wall. • The planning and design phase should include the planting of trees to screen the dam wall from the dwellings of individuals who view the development as having a significant impact on the aesthetic quality of their surroundings.	**LOW**
Associated Infrastructure	Inadequate planning for the construction of infrastructure associated with	**DIRECT CUMULATIVE**	**Localised, study area**	**Long-term**	**Possible**	**Moderately Severe**	**MODERATE NEGATIVE**	• During the planning and design phase, any buildings or structures must	**LOW**

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
	the Zalu Dam, such as a carpark or buildings, could result in the loss of scenic quality.							be painted, tiled, etc. using neutral colours such as grey, beige or dark green (roof only). • The planning and design phase should, where possible, plan for buildings and structures to be constructed in low lying areas to reduce their visual intrusion on the surrounding landscape.	
Inundation Area	During the planning and design phase, the Zalu Dam development will result in the alteration of the inundation area and could detract from the scenic quality of the landscape.	**DIRECT CUMULATIVE**	**Localised, study area**	**Long-term**	**Definite**	**Moderately Severe**	**MODERATE NEGATIVE**	• No mitigation was identified during the planning and design phase.	**MODERATE**
	Inappropriate	**DIRECT**	**Localised,**	**Long-term**	**Probable**	**Slight**	**LOW NEGATIVE**	• Ensure that	**LOW**

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
Loss of Vegetation	planning for the removal of indigenous vegetation from the inundation area could result in the degradation of the aesthetic quality of the area surrounding the dam development.	**CUMULATIVE**	**study area**					during the planning and design phase, plans are made to replant indigenous vegetation, that was removed during the construction phase, in close proximity to the area of removal in order to reduce the alteration in the vegetation surrounding the dam development.	
CONSTRUCTION PHASE									
VISUAL IMPACTS									

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
Site Management	If the site management guidelines are not adequately laid out during the planning and design phase, the overall the construction site may have an extensive negative impact on the aesthetic quality of the study area and surrounding areas.	**DIRECT CUMULUATIVE**	**Localised, study area**	**Short-term**	**Possible**	**Slight**	**LOW NEGATIVE**	• The planning and design of the site management plan must include a demarcated construction area, demarcated construction vehicle parking, etc. and this plan must be adhered to.	**LOW**
OPERATIONAL PHASE									
VISUAL IMPACTS									
Dam Wall	If grassing and tree planting screens are deemed necessary but not implemented correctly and/or maintained during the operational phase, the Dam Wall could negatively impact the aesthetic	**DIRECT CUMULUATIVE**	**Localised, study area**	**Long-term**	**Possible**	**Moderately Severe**	**MODERATE NEGATIVE**	During the operational phase, the vegetation that has been planted (grassing and/or trees) must be maintained and rehabilitated if necessary.	**LOW**

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
	quality of the landscape.								
Associated Infrastructure	If the associated infrastructure is not maintained during the operational phase, it may become degraded and visibly unappealing or be redesigned using colours which are not recommended for reducing the visual impact.	**DIRECT CUMULUATIVE**	**Localised, study area**	**Long-term**	**Possible**	**Moderately Severe**	**MODERATE NEGATIVE**	During the operational phase, the associated infrastructure must be maintained and must adhere to the planning and design phase associated infrastructure guidelines.	**LOW**

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
Loss of vegetation	If the indigenous vegetation, that was planted within the offset area, is not maintained correctly during the operational phase it could result in sections of the site becoming visually unappealing.	**DIRECT CUMULUATIVE**	**Localised, study area**	**Long-term**	**Possible**	**Slight**	**LOW NEGATIVE**	During the operational phase, the replanted indigenous vegetation in the offset area should be maintained.	**LOW**

5 CONCLUSIONS & RECOMMENDATIONS

The proposed Zalu Dam has been positioned in such a way that the development is largely sheltered by both natural vegetation and the topography of the landscape. The overall visual sensitivity of the site (depending on the visual receptor and the location of the point) is MODERATE.

However, overall, it is concluded that for all viewpoints, the impact is:

- MODERATE, where the impact should have an influence on the decision unless it is mitigated. The overall visual impact, post-mitigation, is LOW.

The assessment of these impacts was undertaken in terms of the following visual assessment criteria:

- Visibility of the project;
- Visual exposure;
- Visual sensitivity of the area;
- Visual sensitivity of receptors;
- Visual absorption capacity; and
- Visual intrusion.

The following receptors were identified:

- Permanent:
    - Local landowners
    - Rural Villages
- Temporary:
    - R61 Road users

In assessing the direct impacts to visual resources, it has been recognised that the visual impact will be limited to only a few temporary (R61) and permanent (landowners and villages) individuals. According to the details in this report it can be concluded that the overall pre-mitigation visual impact will be MODERATE.

Concluding Statement

The development will dominate the visual landscape for those in its immediate proximity. However;

- Based on the assessment of significance in this report;
- Given certain mitigation recommendations in this report;
- Given an understanding that although there are local losses, there are also other local, regional and national environmental, social and economic gains; and
- Given authentic efforts to ensure certain benefits accrue to those in close proximity to the development;

<u>**It is concluded that potential losses of scenic resources are not sufficiently significant to present a fatal flaw to the proposed project.**</u>