water & forestry

Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

REPORT NO.: P 02/B810/00/0708/Volume 2/Annexure J-M

GROOT LETABA RIVER WATER DEVELOPMENT PROJECT (GLeWaP)

DRAFT

Environmental Impact Assessment

(DEAT Ref No: 12/12/20/978)

ANNEXURE J-M:

Heritage Resource Specialist Study
Health Impact Assessment
Traffic Impact Assessment
Sedimentation Impact Assessment

ILISO CONSULTING

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GROOT LETABA RIVER WATER DEVELOPMENT PROJECT (GLeWaP)

Environmental Impact Assessment

(DEAT Ref No 12/12/20/978)

ANNEXURE J: HERITAGE RESOURCES SPECIALIST STUDY

JUNE 2008

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DECLARATION OF CONSULTANTS' INDEPENDENCE

Dr J A van Schalkwyk, who is a cultural heritage management specialist from the National Cultural History Museum, Pretoria, is an independent consultant to ILISO Consulting (Pty) Ltd (for the Department of Water Affairs and Forestry), i.e. he has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of the specialist performing such work.

REPORT DETAILS PAGE

Project name:	***Groot Letaba River Water Development Project***
Report Title:	***Environmental Impact Assessment Appendix J: Heritage Resource Specialist Study***
Author:	***Dr J A van Schalkwyk***
DWAF report reference no.:	***P 02/B810/00/0708 Volume 2 Annexure J***
National Cultural History Museum project reference no.:	
Status of report:	***Draft***
First issue:	***April 2008***
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SPECIALIST
Approved for the Natural Cultural History Museum by:

Dr J A van Schalkwyk *Study Leader*	*Date*

ENVIRONMENTAL ASSESSMENT PRACTIONER
*Approved for ILISO Consulting (Pty) Ltd by**:***

Dr Martin van Veelen *Project Director*	*Date*

EXECUTIVE SUMMARY

The aim of the survey was to locate, identify, evaluate and document sites, objects and structures of cultural significance found within the area where the proposed Nwamitwa dam, the road re-alignments and bulk water distribution network are to be developed in a section of the Groot Letaba River.

The survey identified 26 sites of cultural significance located in the above mentioned development areas as well as the dam basin:

- Five Stone Age sites;
- Nine Iron Age sites;
- Four sites dating to historic times; and
- Eight sites containing graves.

All of the identified sites are judged, according to Section 7 of the National Heritage Resources Act, No. 25 of 1999, to have Grade III significance. The implication of this is that there are no sites of cultural heritage significance that would prevent the construction of the dam and the associated infrastructure from taking place. However, in accordance with Section 28 of the National Heritage Resources Act, No. 25 of 1999, mitigation measures should be implemented for the identified sites, after obtaining of the required permits from SAHRA and other Departments, e.g. the Department of Health. Based on what was found and its evaluation, the following is recommended:

- Examples of the Stone Age tools occurring in the area should be collected as they are identified, ideally when mitigation of the archaeological sites take place, i.e. when the archaeologists are active in the area. This collection can then be used in a local display on the prehistory of the area, or by local schools in their educational activities.
- Documentation (mapping and photographing) and limited excavations should be done on the identified Late Iron Age sites.
- Documentation (mapping and photographing) of some of the identified historic structures should be done.

- Workshops should be held with members of local communities in order to identify places to which oral traditions are attached or which are associated with living heritage, e.g. initiation sites, sacred sites, battlefields, etc.
- Graves should be relocated only after consultation with descendants.
- Workshops should be held by the archaeologists/heritage consultants with the various construction crews, at least on 'section head' level, in order to sensitise them about what to expect and how to act if something is uncovered.
- A direct link should be established by the developers with the archaeologist, who should be on call at all times, in the event that something is uncovered.

TABLE OF CONTENTS

Page

LISTS OF FIGURES

Page

LISTS OF TABLES

Page

ABBREVIATIONS

DWAF	Department of Water Affairs and Forestry
GLeWaP	Groot Letaba River Water Development Project
OA	Options Analysis
PCMT	Project Co-ordination and Management Team
PSP	Professional Service Provider
ADRC	Archaeological Recording Centre
ASAPA	Association of Southern African Professional Archaeologists
CSG	Chief Surveyor General
NASA	National Archives of South Africa
NHRA	National Heritage Resources Act
SAHRA	South African Heritage Resources Agency

1. STUDY INTRODUCTION

1.1 BACKGROUND TO PROJECT

The Department of Water Affairs and Forestry (DWAF) is currently undertaking an Environmental Impact Assessment (EIA) to investigate the environmental feasibility of raising the Tzaneen Dam, the construction of a storage dam in the Groot Letaba River and associated bulk water infrastructure (water treatment, pipelines, pump stations, off-takes and reservoirs) in the Limpopo province. The EIA is being undertaken by ILISO Consulting with Zitholele Consulting providing the public participation support. The EIA is being undertaken according to the EIA Regulations under Section 24 (5) of the National Environmental Management Act (NEMA), (Act No 107 of 1998) as amended in Government Notice R385, 386, 387 – Government Gazette No. 28753 of 21 April 2006.

ILISO Consulting has appointed J A van Schalkwyk to undertake the Heritage Impact Assessment as part of the EIA.

1.2 STRUCTURE OF THIS REPORT

This specialist study will be undertaken in compliance with regulation 33(2) of GN 385. **Table 1.1** indicates how Regulation 33 of GN385 has been fulfilled in this report.

Table 1.1: Indication of ompliance with Regulation 33 in this report

Regulatory Requirements	Section of Report
(a) The person who prepared the report; and the expertise of that person to carry out the specialist study or specialised process.	Chapter 2
(b) a declaration that the person is independent	Page i
(c) an indication of the scope of, and the purpose for which, the report was prepared	Chapter 3
(d) a description of the methodology adopted in preparing the report or carrying out the specialised process	Chapter 4
(e) a description of any assumptions made and any uncertainties or gaps in knowledge	Chapter 5

(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Chapter 7
(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	Chapter 8
(h) a description of any consultation process that was undertaken during the course of carrying out the study	Chapter 9
(i) a summary and copies of any comments that were received during any consultation process	Chapter 10
(j) any other information requested by the competent authority.	Chapter 11

2. PROJECT TEAM

Johan van Schalkwyk of the National Cultural History Museum, Pretoria, undertook the heritage impact assessment. He has a D Litt et Phil degree in Anthropology. He specialises in Heritage Impact Assessments and has completed Heritage Impact Assessments for developments such as dams, power stations, transmission power lines, urban developments, roads, pipe lines and mining activities. He is a member of ASAPA (Registration No. 164) and holds the accreditation of Principal Investigator for Iron Age, Colonial Period and Industrial Heritage.

3. PURPOSE OF REPORT AND SCOPE OF WORK

3.1 PURPOSE OF THE REPORT

The National Cultural History Museum, Pretoria, was appointed by ILISO Consulting (Pty) Ltd., to identify, evaluate and document sites, objects and structures of cultural significance found within the boundaries of the area in which it is planned by Department of Water Affairs and Forestry (DWAF) to develop a new dam and bulk water distribution network. The dam is provisionally named the Nwamitwa Dam, and is to be located in a section of the Groot Letaba River, Limpopo Province.

The aim of this report is to draw up a comprehensive mitigation and conservation management plan for heritage sites located in the area of the proposed dam, as well as for the bulk water distribution network. This plan is to be developed and implemented in different phases. It would start off by a Phase 1 survey, in accordance with the requirements of Section 38(3) of the National Heritage Resources Act (Act 25 of 1999). The second Phase would be the implementation of the various recommended mitigation measures.

3.2 SCOPE OF WORK

In order to achieve the stated aim, the following objectives were developed

- Identify possible archaeological, cultural and historic sites within the proposed development areas;
- Evaluate the potential impacts of construction, operation and maintenance of the proposed development on archaeological, cultural and historical resources;
- Recommend mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural or historical importance.

4. METHODOLOGY

4.1 PRELIMINARY INVESTIGATION

The study began with a survey of available published as well as unpublished information. These sources were reviewed with the aim to determine the potential of heritage sites occurring in the area. In this regard, various anthropological, archaeological and historical sources, as well as survey reports, were consulted - see the list of references below.

Various databases were also consulted. Available information, taken up in the *Data Recording Centre*, housed at the National Cultural History Museum, was accessed. This, in essence is also the information housed by SAHRA. Apart from this, the various farms were also accessed in the NASA and CSG databases.

Aerial photographs and topocadastral and other maps were also studied - see the list of references below.

4.1.1 Existing knowledge base

From a heritage point of view, the project area is by and large very under researched, resulting in a near absence of available information. Only a few areas in the larger region have been subjected to intensive surveys. The motivation for these were either self initiated research of for developmental purposes.

With regard to the former, there is, for example Evers (1975, 1982) who did some work on Iron Age settlement in the Hans Merensky Nature Reserve, east of the project area. Other self initiated research, covering large areas, is that of Pistorius (1989) on the Iron Age in the Phalaborwa region and Meyer (1986), who did an intensive survey of the Kruger National Park, documenting hundreds of Iron Age and historic sites.

Surveys done with the aim of some development in mind in the project area include the following: the original survey for the Namitwa Dam (then known as the Janetsi Dam - Van Schalkwyk 1996a), the Letsitele (Van Schalkwyk 1996b) and Thapane (Van Schalkwyk 2001) dams, township development in Letsitele (Van Schalkwyk 2000) and the Project Olympia mining area (Van Schalkwyk 1999).

However, based on the above information, it was possible not only to determined that the Letaba River valley falls in a region with a high potential for heritage sites, but also to indicate the range of sites to be expected in the project area. The distribution of these sites is indicated in **Figure 4.1**.

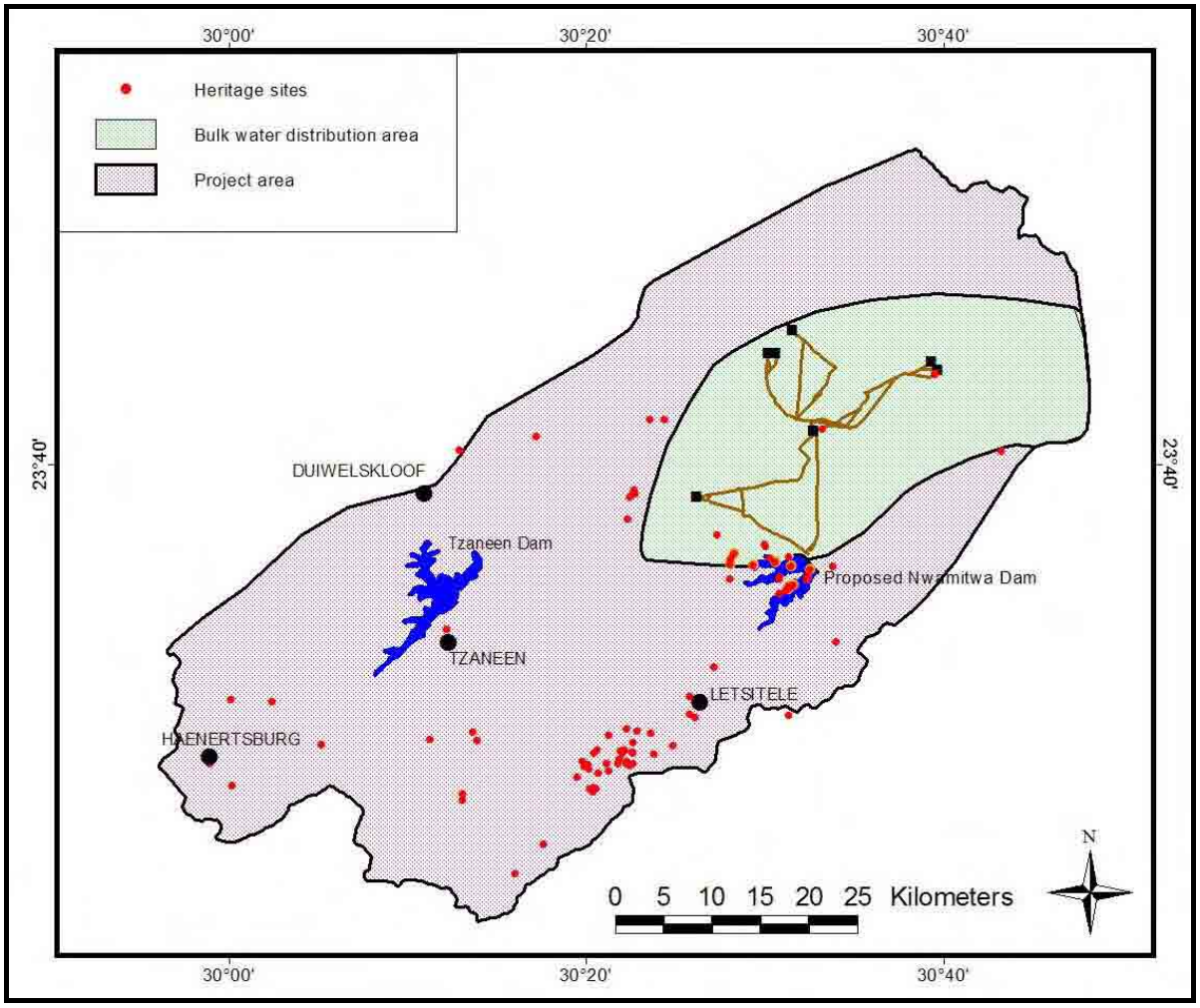

Figure 4.1: Map showing the distribution of known sites of heritage significance in the project area (n = 112).

4.2 FIELD SURVEY

The field survey was done according to generally accepted archaeological practices, and was aimed at locating all possible sites, objects and structures. The area that had to be investigated was identified by ILISO Consulting by means of maps.

The information that was obtained from the literature during the preliminary study was plotted on a map and was used to develop a strategy by which the area could be accessed systematically. The dam basin was surveyed on both sides of the river by walking across it in a number of parallel transects.

As the development for the bulk water distribution area is linear in nature, the proposed routes that were to be followed were travelled as closely as possible.

The various alternative road re-alignments were not as clearly identified as the water distribution routes, and therefore the affected areas were reviewed in a more general manner.

Engagement with Interested and Affected Parties (I&APs) forms an integral component of the EIA process. I&APs have an opportunity at various stages throughout the EIA process to gain more knowledge about the proposed project, to provide input into the process and to verify that their issues and concerns have been addressed. The EIA team consulted with Mr Ramalepe during the Heritage Resources Study fieldwork and it was agreed that detailed community consultation to identify next of kin etc. for the graves of concern would take place during the implementation of the project. This process is to be extended to also include other aspects such as the identification of places to which oral traditions are attached or which are associated with living heritage, e.g. initiation sites, sacred sites, battlefield

During the survey, a problem was encountered with the dense grass and shrub cover that resulted after good seasonal rains in the area (**Figure 4.2**). This made the detection of archaeological sites difficult, as surface features were in most cases obscured.

Figure 4.2: Photograph showing the dense vegetation encountered in most places during the field survey.

4.3 DOCUMENTATION

All sites, objects and structures that are identified in the preliminary investigation and field survey, were documented according to the general minimum standards accepted by the archaeological profession. Coordinates of individual localities are determined by means of the *Global Positioning System* (GPS)[1] and plotted on a map. This information is added to the description in order to facilitate the identification of each locality.

[1] According to the manufacturer a certain deviation may be expected for each reading. Care was, however, taken to obtain as accurate a reading as possible, and then to correlate it with reference to the physical environment before plotting it on the map.

4.4 IMPACT ASSESSMENT

The key issues identified during the Scoping Phase informed the terms of references of the specialist studies. Each issue consists of components that on their own or in combination with each other give rise to potential impacts, either positive or negative and from the project onto the environment or from the environment onto the project. In the EIA the significance of the potential impacts will be considered before and after identified mitigation is implemented.

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

The following criteria will be used to evaluate significance:

Nature

The nature of the impact will be classified as positive or negative, and direct or indirect.

Extent and location

Magnitude of the impact and is classified as:

- **Local**: the impacted area is only at the site – the actual extent of the activity
- **Regional**: the impacted area extends to the surrounding, the immediate and the neighbouring properties.
- **National**: the impact can be considered to be of national importance.

Duration

This measures the lifetime of the impact, and is classified as:

- **Short term**: the impact will be for 0 – 3 years, or only last for the period of construction.
- **Medium term**: three to ten years.
- **Long term**: longer than 10 years or the impact will continue for the entire operational lifetime of the project.

- **Permanent**: this applies to the impact that will remain after the operational lifetime of the project.

Intensity

This is the degree to which the project affects or changes the environment, and is classified as:

- **Low**: the change is slight and often not noticeable, and the natural functioning of the environment is not affected.
- **Medium**: The environment is remarkably altered, but still functions in a modified way.
- **High**: Functioning of the affected environment is disturbed and can cease.

Probability

This is the likelihood or the chances that the impact will occur, and is classified as:

- **Low**: during the normal operation of the project, no impacts are expected.
- **Medium**: the impact is likely to occur if extra care is not taken to mitigate them.
- **High**: the environment will be affected irrespectively; in some cases such impact can be reduced.

Confidence

This is the level knowledge/information, the environmental impact practitioner or a specialist had in his/her judgement, and is rated as:

- **Low**: the judgement is based on intuition and not on knowledge or information.
- **Medium**: common sense and general knowledge informs the decision.
- **High**: Scientific and or proven information has been used to give such a judgement.

Significance

Based on the above criteria the significance of issues will be determined. This is the importance of the impact in terms of physical extent and time scale, and is rated as:

- **Low**: the impacts are less important, but may require some mitigation action.
- **Medium**: the impacts are important and require attention; mitigation is required to reduce the negative impacts
- **High**: the impacts are of great importance. Mitigation is therefore crucial.

Cumulative Impacts

The possible cumulative impacts will also be considered.

Mitigation

Mitigation for significant issues will be incorporated into the EMP for construction.

Table 4.1: Example of Impact Assessment Table

Description of potential impact		
Nature of impact		
Legal requirements		
Stage	Construction and decommissioning	Operation
Nature of Impact		
Extent of impact		
Duration of impact		
Intensity		
Probability of occurrence		
Confidence of assessment		
Level of significance before mitigation		
Mitigation measures (EMP requirements)		N/A
Level of significance after mitigation		N/A
Cumulative Impacts		

Comments or Discussion	

5. DEFINITIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

5.1 DEFINITIONS

The National Heritage Resources Act (Act No. 25 of 1999) defines the 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 to include:

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, including-
  - ancestral graves;
  - royal graves and graves of traditional leaders;
  - graves of victims of conflict;
  - graves of individuals designated by the Minister by notice in the Gazette;
  - historical graves and cemeteries; and
  - other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- sites of significance relating to the history of slavery in South Africa;
- movable objects, including-
  - objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;objects to which oral traditions are attached or which are associated with living heritage;
  - ethnographic art and objects;
  - military objects;
  - objects of decorative or fine art;
  - objects of scientific or technological interest; and

- 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).

According to the National Heritage Resources Act, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of-

- its importance in the community, or pattern of South Africa's history;
- its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- 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
- sites of significance relating to the history of slavery in South Africa.

- Sites regarded as having low significance have already been recorded in full and require no further mitigation. Sites with medium to high significance require further mitigation.
- Archaeological sites: any area of land containing artefacts, ecofacts, features and structures in any combination of the above.
- Isolated occurrences: findings of artefacts or other remains located apart from archaeological sites. Although these are noted and samples are collected, it is not used in impact assessment and therefore do not feature in the report.
- Traditional cultural use: resources which are culturally important to people.

- The latitude and longitude of archaeological sites are to be treated as sensitive information by the developer and should not unduly be disclosed to members of the public

5.2 GAPS IN KNOWLEDGE

The possibility that other sites might occur in the study area is very good, especially in the category usually referred to as living heritage, meaning the intangible aspects of inherited culture (NHRA No. 25, 1999, Section 2 (xxi). Sites such as these can usually only be identified with the assistance of the local communities. As time did not allow for an investigation into this aspect, detailed information is still lacking and it is recommended that it is covered during the full EIA survey.

6. EXISTING ENVIRONMENT

At present, 26 sites of cultural significance were identified. Of these, 16 occur within the dam basin study area, and 10 in proximity of the road alignments or bulk water supply system. These sites are representative of all time periods of the past and, in order to understand their significance, they need to be contextualised.

What is presented below is simply a short overview of past human occupation in the region. It is done in order for the reader to gain insight into the complexity of the cultural resources that might be found in the area.

6.1 ARCHAEOLOGICAL SEQUENCE

6.1.1 Stone Age

That Stone Age people occupied the Letaba River valley and the area of the proposed dam is confirmed by the occurrence of stone tools dating to the Early, Middle and Late Stone Age. However, all the finds are classified as isolated surface occurrences. Consequently, such finds are judged to have a low significance and they require no mitigation measures. A case in point is the large number of bored stones, dating to the Later Stone Age, that were ploughed out near the Letaba River on the farm Riverside of Mr J Barnard.

Unfortunately, no primary (stratified/sealed) sites are known to exist in the survey area. The closest stratified site, known as Bushman Rock Shelter, is located at Echo Caves north of Ohrigstad. Here, early humans lived, discontinuously, for thousands of years, from the Early Stone Age, through what is known as the Middle Stone Age, and well into the Later Stone Age.

6.1.2 Iron Age

The term Iron Age is used by African archaeologists to refer to the advent of subsistence patterns based on farming and follow directly on the Stone Age. The Iron Age is characterised by the production and use of metals as well as characteristic types of pottery.

Iron Age people moved into southern Africa by c. AD 200, entering the area either by moving down the coastal plains, or by using a more central route. It seems more likely that the first option was what brought people into the study area. From the coast they followed the various rivers inland. Being cultivators, they preferred the rich alluvial soils to settle on.

Early Iron Age occupation of the region seems to have taken place on a significant scale and at least three different phases of occupation have been identified. One of the earliest known dated sites are located near Tzaneen. Called Silver Leaves, these people, belonging to the Kwale Branch of the Early Iron Age (Huffman 2007) seems to be the oldest Iron Age site discovered so far in southern Africa. As yet, no sites that can be related to this tradition have identified in the study area.

However, other sites dating somewhat later were also identified. Preliminary identification of the pottery indicates that it belong to the Doornkop phase of the Early Iron Age, and should have a date of between AD 600 – 900. These are the same group of people that produced the remarkable clay masks found near Lydenburg in the 1960s.

These settlements seems to have been followed at a slightly later date by settlements linked to the Eiland Facies of the Middle Iron Age (c. AD 1000-1200).

Early Iron Age sites are our only source of evidence for the occupation of the area by early farming communities. As such these sites are important and they are viewed to have medium significance, which implies that they would require mitigation measures.

Over time these communities were replaced by people belonging to groups recognisable in modern times, e.g. Sotho-speakers, for example the Lobedu, Phalaborwa, Letswalo and Kgaga, and TsiTsonga-speakers, such as the Nkuna.

Although located much further to the north, the Venda-speakers also had some influence in the study area, especially amongst the Lobedu.

As this was a period of population movement, conflict and change, it in large part set the scene for the current population situation in the country, a situation that was exploited by the policy of separate development in the sense of the creation of various homelands. Considering the time period that they were occupied, they also feature in the early historic period. These sites are therefore viewed to have medium significance and would require mitigation.

Based on the occurrence of specific resources, some interesting though not unique industries developed that was aimed at the exploitation of local resources. Two examples are the copper and iron smelting at Phalaborwa and the extraction of salt at the Eiland mineral springs.

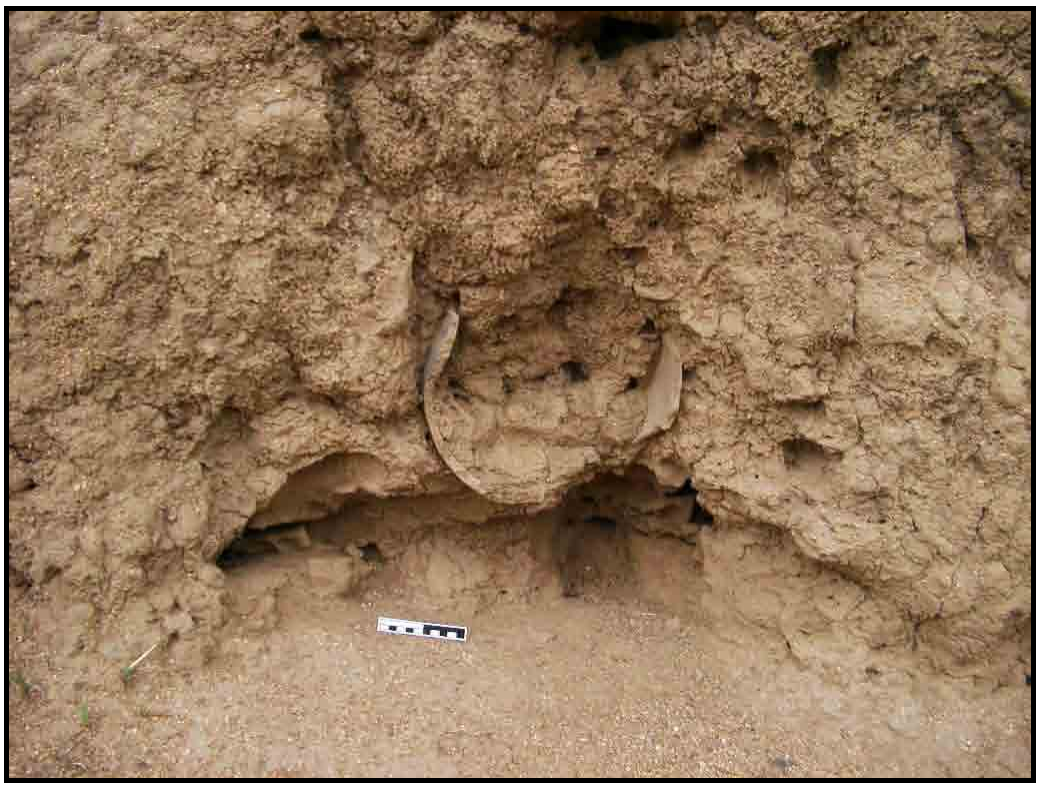

Figure 6.1: Clay pot found buried in a termite mound. It is used to catch the termites that are eaten as a source of protein. Decoration on this specific pot shows that it belongs to the Letaba tradition, implying that it can be as much as 300 years old.

6.1.3 Historic period

The historic period started c. 1840s, with the arrival of the first white hunters, missionaries and prospectors in the area.

The discovery of gold at what was to become Leydsdorp, set the scene for outsiders to enter the area in large numbers. However, the gold did not last long and, after a heyday lasting approximately 10 years, the little town was largely forgotten.

As time went by, the area was divided into farms. This, of course, gave rise to conflict between the whites entering the area and the local Sotho and Tsonga communities. Soon conflict broke out, e.g. against the *Kgoši* Makgoba, occupying Magoebas Kloof, and the ZAR government.

Still, development was very slow, with a few farms occupied by the early 20th century. It was only in the 1950s, after the success Dr Siegfried Anneke had with the fight against malaria that population numbers increased significantly.

6.2 ETHNO-HISTORICAL OVERVIEW

Two different language groups are found in the study and surrounding area: Sotho-speakers and Tsonga-speakers.

The Tsonga form the main group in the study area. Their origin is in Mozambique. Due to the wars in the coastal areas of Natal and Mozambique during the 1820-30s, they entered the (former) Transvaal, first in small groups and later, by the 1890's, due to Portuguese aggression, in larger groups with recognized chiefs. They were later given formal 'locations' to settle in, which, during the days of separate development under the previous government, became the homeland of Gazankulu.

To the north and east of the study area is found the Sotho-speakers, of which the Lobedu people is the best known because of their famous 'rain-queen'. They have a strong link to the Venda located more to the north. Other smaller Sotho groups such as the Thlabine and Sekororo are found to the west of the study area.

The map by Van Warmelo (1935) below, illustrated the diversity of people found in the region. It is also significant that it shows largely a lack of people staying in the study area (Fig. 6.2.1). This situation has changed drastically over the last few decades (Fig. 6.2.2), largely as a result of the process of homeland development

instituted by the previous government. As part of the process of homeland consolidation, people of Tsonga/Shangaan descent were forcibly removed from other areas and relocated in this area, which was to be part of what was planned to become an independent republic called Gazankulu..

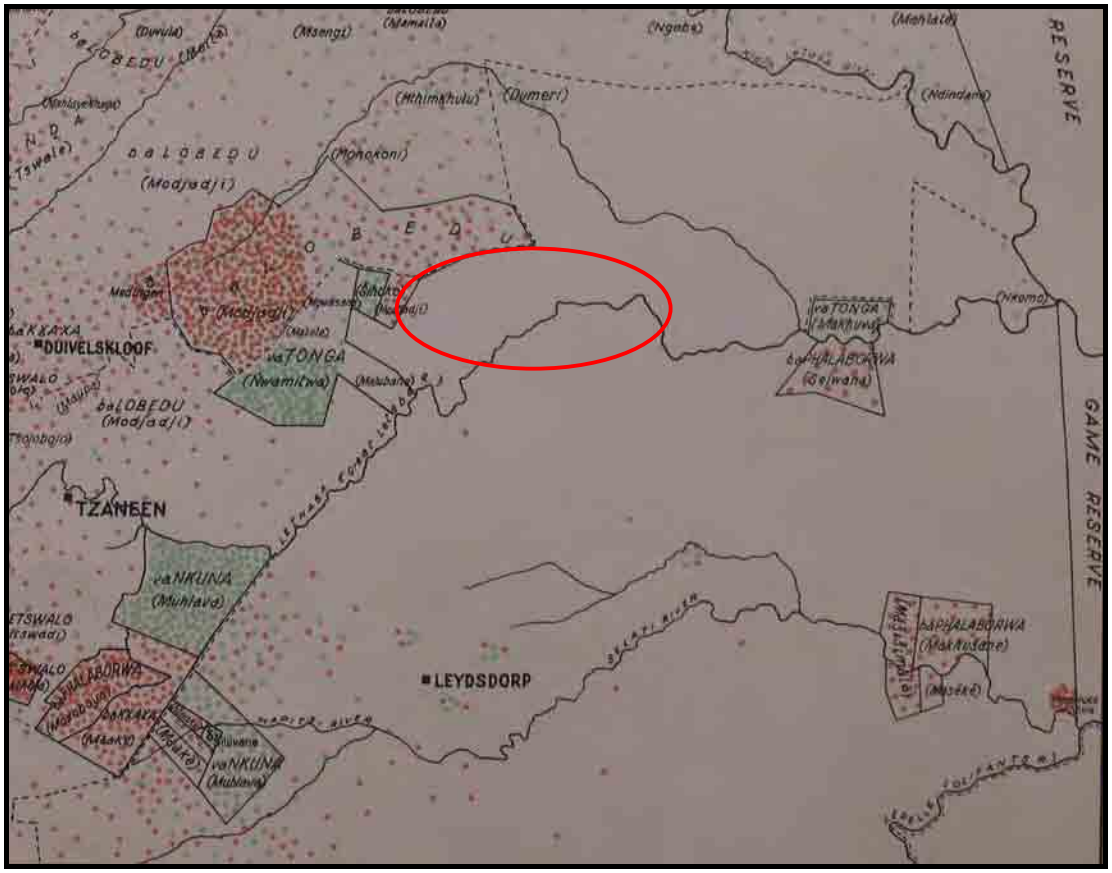

Figure 6.2: **Map showing the lack of population (black people) in the survey area (red ellipse) during the 1930s. One dot represents 10 taxpayers (Map: Van Warmelo 1935).**

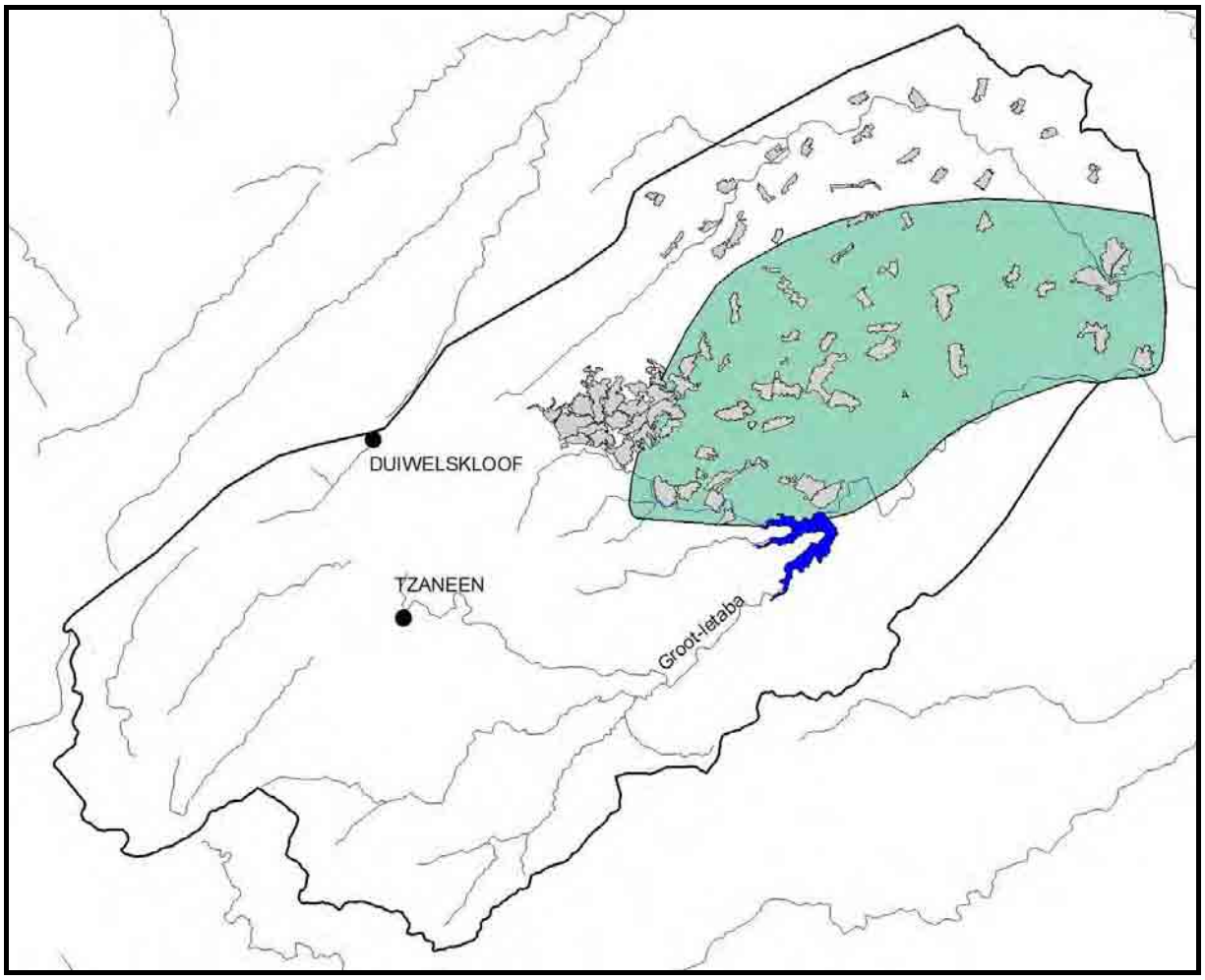

Figure 6.3: Map showing the current population, as expressed by the number of villages in the region.

6.3 IDENTIFIED SITES

The survey produced 26 sites. These are categorised according to time period, as well as to significance

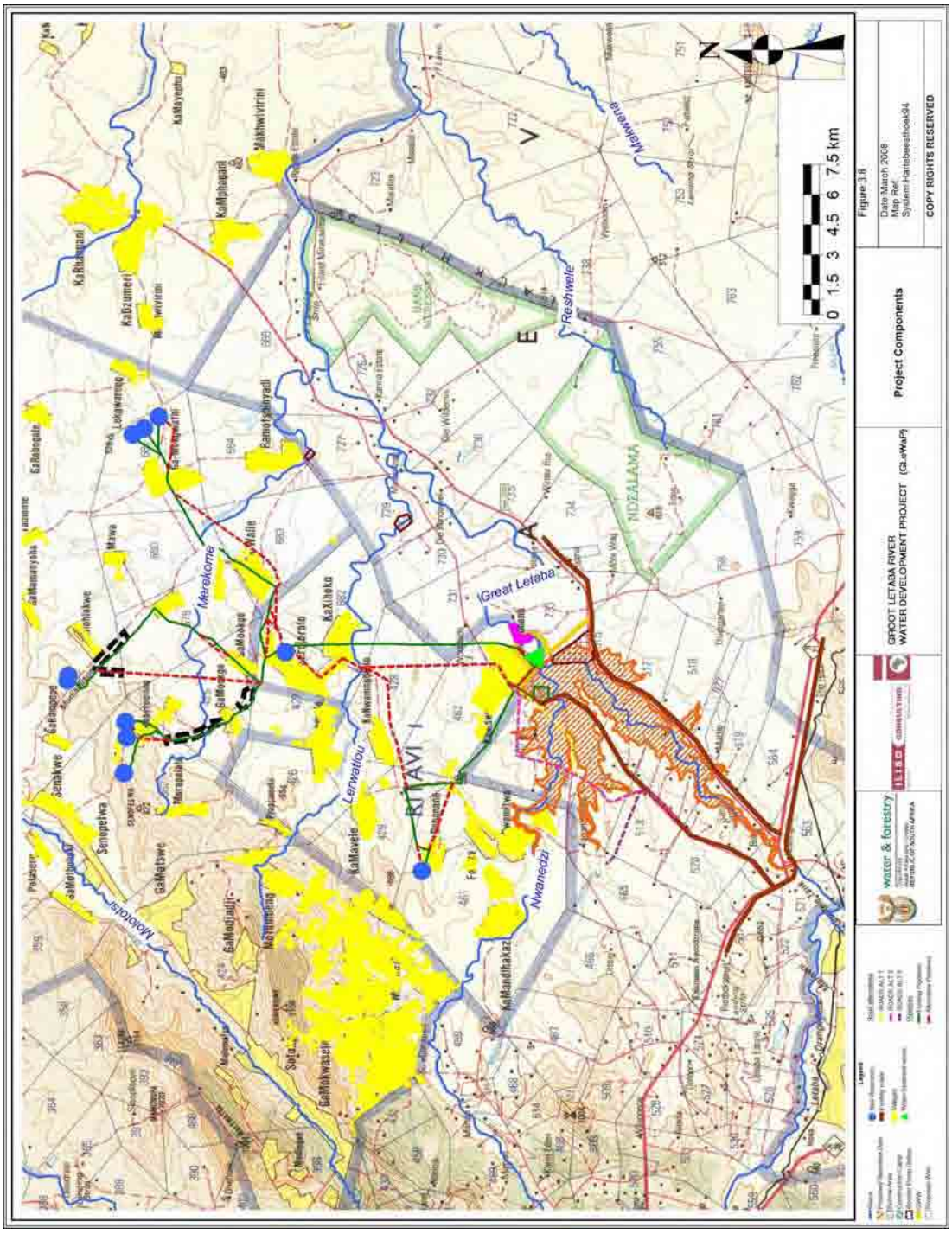

Figure 6.4: Map showing the location of the different project components.

6.3.1 Tzaneen Dam

No sites, features or objects of cultural significance are known to exist in the immediate vicinity of the Tzaneen dam and, therefore, the raising of the dam wall will have no impact on any such sites.

6.3.2 Namitwa Dam

(a) Stone Age

Three sites dating to the Stone Age were identified in the area of the full supply level of this dam. As all the finds are classified as isolated surface occurrences, they are judged to have a low significance and therefore require no mitigation measures.

(b) Iron Age

Seven sites dating to the Iron Age were identified in the area of the full supply level of this dam. Of these, 5 shows potential to contribute, on a scientific level, to our understanding of the prehistory of the region and therefore would require mitigation measures to be implemented before development can take place. Such measures would be the archaeological excavation of the sites.

(c) Historic period

No sites dating to the historic period was identified in the dam basin. However, 4 sites containing graves were identified within the dam basin and the graves would have to be relocated.

(d) Current period

At present, no sites referred to as living heritage, e.g. initiation sites, sacred sites, etc. are known to exist in the dam basin. Such sites can usually only be identified with the assistance of the local communities, and this should be done during the EIA process.

6.3.3 Bulk water supply network

(a) Stone Age

No sites dating to the Stone Age were identified in the bulk water supply network area

(b) Iron Age

No sites dating to the Iron Age were identified in the bulk water supply network area.

(c) Historic period

A number of sites dating to this period have been identified. However, at present it is not possible to determine if they would directly be impacted on, as the proposed alignments are difficult to determine down to this scale.

(d) Current period

At present, no sites referred to as living heritage, e.g. initiation sites, sacred sites, etc. are known to exist in the bulk water supply network. Such sites can usually only be identified with the assistance of the local communities, and this should be done during the EIA process

6.3.4 Alternative road re-alignments

(a) Stone Age

No sites dating to the Stone Age were identified in the road re-alignments.

(b) Iron Age

No sites dating to the Iron Age were identified in the road re-alignments.

(c) Historic period

No sites dating to this period were identified in the road re-alignments.

(d) Current period

At present, no sites referred to as living heritage, e.g. initiation sites, sacred sites, etc. are known to exist in the alternative road re-alignments. Such sites can usually

only be identified with the assistance of the local communities, and this should be done during the EIA process.

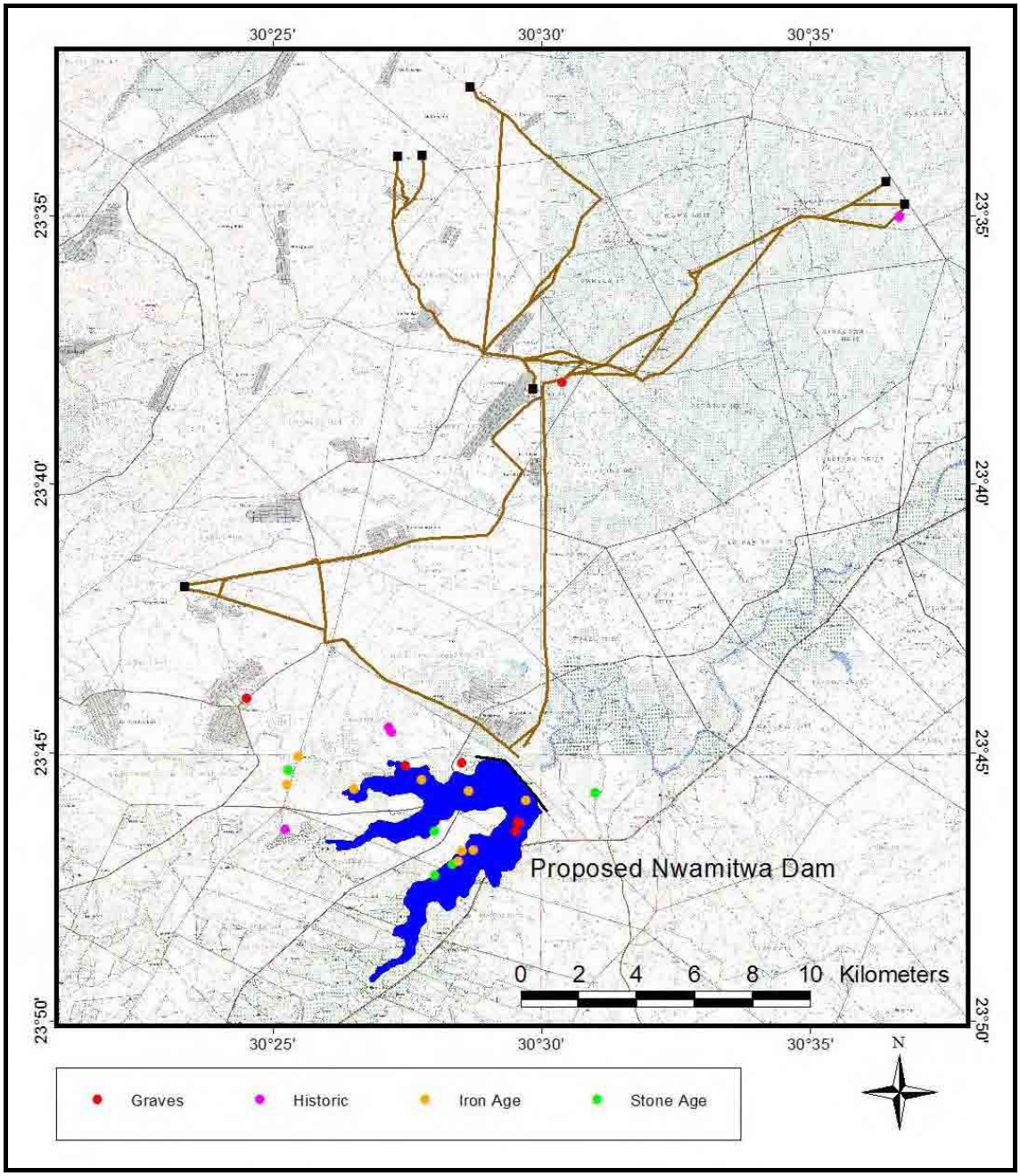

Figure 6.5: Map showing the location of the identified sites (Map 2330CB, 2330CD, 2330DA, 2330DC: Chief Surveyor General.

7. SITE SIGNIFICANCE AND ASSESSMENT

Impact analysis of cultural resources under threat of the proposed development, are based on the present understanding of the development.

According to the NHRA, Section 2(vi) the **significance** of a heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Sites regarded as having low significance are viewed as been recorded in full after identification and would require no further mitigation. Impact from the development would therefore be judged to be low. Sites with a medium to high significance would therefore require mitigation. Mitigation, in most cases the excavation of a site, is in essence destructive and therefore the impact can be viewed as high and as permanent.

The National Heritage Resources Act (Act no 25 of 1999) stipulates the assessment criteria and grading of heritage resources. The following categories are distinguished in Section 7 of the Act:

- Grade I: Heritage resources with qualities so exceptional that they are of special national significance;
- Grade II: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
- Grade III: Other heritage resources worthy of conservation, and which prescribes heritage resources assessment criteria, consistent with the criteria set out in section 3(3), which must be used by a heritage resources authority or a local authority to assess the intrinsic, comparative and contextual significance of a heritage resource and the relative benefits and costs of its protection, so that the appropriate level of grading of the resource and the consequent responsibility for its management may be allocated in terms of section 8.

Based on current knowledge and understanding of the area, one can evaluate the heritage sites in the area as follows:

- Stone tools dating from all periods of the Stone Age are known to occur all over the study area. As these objects are open finds and not in their original position anymore, they are viewed as having a low significance. A few 'sealed' sites, i.e. in a cave or rock shelter are known in the region, some of them containing rock art.

All the known Stone Age sites in the study area are currently viewed as being of Grade III significance.

- On the basis of current knowledge, a number of sites dating to the Early Iron Age are known to exist in the area. Almost all the early sites occur on the alluvial soils close to the river. It is possible that sites dating to the Late Iron Age would be located in the various hills and at the foot of the mountains, where stone was freely available to build structures.

All of the Early and Late Iron Age sites currently known in the area are viewed to be of Grade III significance

- Sites dating to the historic period can be related to early farming, mining and missionary activities. Included in these would be old farmsteads, graves and infra-structural elements such as roads and bridges.

All the sites dating to historic times currently known in the area are viewed to be of Grade III significance.

- At present, no sites referred to as living heritage, e.g. initiation sites, sacred sites, battlefields, etc. are known to exist in the dam basin or in areas where the road re-alignments and bulk water supply network is to be developed. However, there is a strong possibility that such sites will be identified after consultation with the local communities has been done.

All the sites dating to the current period that might exist in the area would be viewed to be of Grade III significance.

Table 7.1: Assessment of sites in the Namitwa dam

Description of potential impact	Inundation of sites by rising dam water / destruction of sites in the construction area	
Nature of impact	Destruction of sites	
Legal requirements	SAHRA permit	
Stage	Construction and decommissioning	Operation
Nature of Impact	Destruction of sites	
Extent of impact	Local	
Duration of impact	Permanent	Permanent
Intensity	High	
Probability of occurrence	Definite	
Confidence of assessment	High	
Level of significance before mitigation	High	
Mitigation measures (EMP requirements)	Document and test excavate / Relocate graves	N/A
Level of significance after mitigation	Medium	N/A
Cumulative Impacts		
Comments or Discussion		

Table 7.2: Assessment of sites in the bulk water supply network

Description of potential impact	Destruction of sites due to trenching / construction activities	
Nature of impact	Destruction of sites	
Legal requirements	SAHRA permit	
Stage	Construction and decommissioning	Operation
Nature of Impact	Destruction of sites	

Extent of impact	Local	
Duration of impact	Permanent	
Intensity	High	
Probability of occurrence	Definite	
Confidence of assessment	High	
Level of significance before mitigation	High	
Mitigation measures (EMP requirements)	Document and test excavate / Relocate graves	N/A
Level of significance after mitigation	Medium	N/A
Cumulative Impacts		
Comments or Discussion		

Table 7.3: Assessment of sites in the alternative road re-alignments

Description of potential impact	Destruction of sites due to road construction	
Nature of impact	Destruction of sites	
Legal requirements	SAHRA permit	
Stage	Construction and decommissioning	Operation
Nature of Impact	Destruction of sites	
Extent of impact	Local	
Duration of impact	Permanent	
Intensity	High	
Probability of occurrence	Definite	
Confidence of assessment	High	
Level of significance before mitigation	High	
Mitigation measures (EMP	Document and test excavate / Relocate	N/A

requirements)	graves	
Level of significance after mitigation	Medium	N/A
Cumulative Impacts		
Comments or Discussion		

8. RECOMMENDED MITIGATION MEASURES

Heritage resources are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted by the development can be excavated/recorded and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided and cared for in the future.

8.1 OBJECTIVES

Management of archaeological, historical and any other site or land considered being of cultural value within the project boundary against vandalism, destruction and theft.

The preservation and appropriate management of new discoveries in accordance with the National Heritage Resources Act (Act No. 25 of 1999), should these be discovered during construction.

8.1.1 Construction phase

General management objectives and commitments:

- To avoid disturbing sites of heritage importance; and
- To avoid disturbing burial sites.

The following shall apply:

- The contractors and workers should be notified that archaeological sites might be exposed during the construction work.
- Should any heritage artefacts be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer (ECO) shall be notified as soon as possible;
- All discoveries shall be reported immediately by the Environmental Control Officer to a museum, preferably one at which an archaeologist is available, so

that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the Environmental Control Officer will advise the necessary actions to be taken;

- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act (Act No. 25 of 1999), Section 51. (1).

8.1.2 Operation phase

General management objectives and commitments:

To avoid disturbing sites of heritage importance.

The following shall apply:

- Continued care should be taken to observe discovery of any sites and objects of heritage significance during operation. Should any archaeological artifacts and palaeontological remains be exposed during operations, work on the area where the artefacts were found, shall cease immediately and the appropriate person at the South African Heritage Resources Agency, local museum or the nearest local authority office shall be notified by the ECO as soon as possible;
- Upon receipt of such notification, an Archaeologist or Palaeontologist shall investigate the site as soon as practicable. Acting upon advice from these specialists, the necessary actions shall be taken;
- Under no circumstances shall archaeological or palaeontological artefacts be removed, destroyed or interfered with by anyone on the site during operations; and
- The dam operator shall advise its workers of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act (Act No. 25 of 1999), Section 51(1).

8.1.3 Impact minimization

Impact analysis and resultant management of cultural resources under threat of the proposed development, are based on the present understanding of the construction and operation of dams and bulk water supply systems. The following objectives and design standards, if adhered to, can eliminate, minimize or enhance potential impacts.

- The developer must ensure that an archaeologist inspects each site selected for the development, whether the inundation of the dam basin and the installation of a bulk water supply system or the road re-alignment. If a particular development impacts on a heritage site but cannot be shifted, mitigation measures, i.e. the controlled excavation of the site prior to development, can be implemented. This can only be done by a qualified archaeologist after obtaining a valid permit from SAHRA.
- The same action holds true for any support activities such as access routes, construction campsites, borrow pits, etc.
- In the past, people used to settle near water sources. Therefore riverbanks, rims of pans and smaller watercourses should be avoided as far as possible.
- In this particular part of the country, Iron Age people also preferred to settle on the saddle (or neck) between mountains (hills/outcrops). These areas should also be avoided.
- Avoid all patches bare of vegetation unless previously inspected by an archaeologist. These might be old settlement sites.
- Rock outcrops might contain rock shelters, engravings or stone walled settlements, and must be avoided unless previously inspected by an archaeologist.
- Communities living close to the proposed corridor should be consulted as to the existence of sites of cultural significance, e.g. graves, as well as sites that do not show any structures but have emotional significance, such as battlefields, initiation sites, sacred sites, etc.
- All graves or cemeteries should be avoided, unless when totally impossible. The correct procedure, i.e. notification of intent to relocate them, consultation with descendants and the various permit applications should then be followed in

relocating the graves. If any of the graves are older than 60 years, they can only be exhumed by an archaeologist. Graves of victims of conflict requires additional permits from SAHRA before they can be relocated.

- Archaeological material, by its very nature, occurs below ground. The developer should therefore keep in mind that archaeological sites might be exposed during the construction work. If anything is noticed, work in that area should be stopped and the occurrence should immediately be reported to a museum, preferably one at which an archaeologist is available. The archaeologist should then investigate and evaluate the find.
- Any mitigation measures applied by an archaeologist, in the sense of excavation and documentation, should be published in order to bring this information into the public domain.

9. CONSULTATION PROCESS

Engagement with Interested and Affected Parties (I&APs) forms an integral component of the EIA process. I&APs have an opportunity at various stages throughout the EIA process to gain more knowledge about the proposed project, to provide input into the process and to verify that their issues and concerns have been addressed.

The proposed project was announced in July 2007 to elicit comment from and register I&APs from as broad a spectrum of public as possible. The announcement was done by the following means:

- the distribution of Background Information Documents (BIDs) in four languages,
- placement of site notices in the project area,
- Placement of advertisements in regional and local newspapers,
- Placement of information on the DWAF web site,
- announcement on local and regional radio stations; and
- the hosting of five focus group meetings in the project area.

Comments received from stakeholders were captured in the Issues and Response Report (IRR) which formed part of the Draft Scoping Report (DSR). The DRS was made available for public comment in October 2007. A summary of the DSR (translated into four languages) was distributed to all stakeholders and copies of the full report at public places. Two stakeholder meetings were held in October to present and discuss the DSR. The Final Scoping Report was made available to stakeholders in December 2007.

The availability of the Draft Environmental Impact Assessment Report, its summary (translated in four languages), the various specialist studies, the Environmental Management Plans and Programmes will be announced by way of personalized letters to stakeholders and the placement of advertisements in regional and local newspapers. The draft documents will be made available to I&APs for the inputs and

comments. Two stakeholder meetings are planned to present the contents of the documents and to discuss the findings of the study.

A public review period of thirty (30 days) will be available for stakeholders to comment on the Draft Environmental Impact Assessment Report, its summary (translated in four languages), the various specialist studies, the Environmental Management Plans and Programmes. Stakeholder comments will be taken into consideration with the preparation of the final documents. The availability of the final documents will be announced prior to submission to the decision-making authority.

10. COMMENTS RECEIVED

Mr Lekgolo Ramalepe, BaKgaga BaMaupa Communal Property Association raised concerns in terms of what will happen to ancestral graves in the project area should the graves have to be removed.

Part of the area for the proposed dam construction could submerge traditional and ancestral land of great value to the people and also that people reside in that area. Ruins, gravesites, and other places of importance, such as places of worship, could be affected by the construction of the dam and other proposed developments associated with the bulk water supply. Mr Ramalepe requested an opportunity to show the EIA team the location of the mentioned sites. Mr Ramalepe added that the communities of the area did not have the opportunity to identify graves when the Tzaneen Dam was built and that there were still graves submerged in the dam.

The EIA team consulted with Mr Ramalepe during the Heritage Resources Study fieldwork and it was agreed that detailed community consultation to identify next of kin etc. for the graves of concern would take place during the implementation of the project. This process is to be extended to also include other aspects such as the identification of places to which oral traditions are attached or which are associated with living heritage, e.g. initiation sites, sacred sites, battlefields, etc.

11. OTHER INFORMATION REQUESTED BY THE AUTHORITY

No additional information has been requested by the authorities.

12. CONCLUSION

The aim of the survey was to locate, identify, evaluate and document sites, objects and structures of cultural significance found within the area where the proposed Nwamitwa dam, the road re-alignments and bulk water distribution network are to be developed in a section of the Groot Letaba River.

The survey identified 26 sites of cultural significance located in the above mentioned development areas as well as the dam basin:

- Five Stone Age sites;
- Nine Iron Age sites;
- Four sites dating to historic times; and
- Eight sites containing graves.

All of the identified sites are judged, according to Section 7 of the National Heritage Resources Act, No. 25 of 1999, to have Grade III significance. The implication of this is that there are no sites of cultural heritage significance that would prevent the construction of the dam and the associated infrastructure from taking place. However, in accordance with Section 28 of the National Heritage Resources Act, No. 25 of 1999, mitigation measures should be implemented for the identified sites, after obtaining of the required permits from SAHRA and other Departments, e.g. the Department of Health. Based on what was found and its evaluation, the following is recommended:

- Examples of the Stone Age tools occurring in the area should be collected as they are identified, ideally when mitigation of the archaeological sites take place, i.e. when the archaeologists are active in the area. This collection can then be used in a local display on the prehistory of the area, or by local schools in their educational activities.
- Documentation (mapping and photographing) and limited excavations should be done on the identified Late Iron Age sites.
- Documentation (mapping and photographing) of some of the identified historic structures should be done.

- Workshops should be held with members of local communities in order to identify places to which oral traditions are attached or which are associated with living heritage, e.g. initiation sites, sacred sites, battlefields, etc.
- Graves should be relocated only after consultation with descendants.
- Workshops should be held by the archaeologists/heritage consultants with the various construction crews, at least on 'section head' level, in order to sensitise them about what to expect and how to act if something is uncovered.
- A direct link should be established by the developers with the archaeologist, who should be on call at all times, in the event that something is uncovered.

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water & forestry

Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

REPORT NO.: P 02/B810/00/0708/Volume 2 Annexure K

GROOT LETABA RIVER DEVELOPMENT PROJECT (GLeWaP)

ENVIRONMENTAL IMPACT ASSESSMENT

(DEAT Ref 12/12/20/978)

ANNEXURE K: HEALTH IMPACT ASSESSMENT

JULY 2008

Margot Saner & Associates (Pty) Ltd

Compiled by:
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DECLARATION OF INDEPENDENCE

EIA Regulation 385 states, inter alia, that an independent consultant must be appointed to act on behalf of the client and to ensure that the public participation process is managed properly. In this regard, Margot Saner & Associates (Pty) Ltd, as part of the Environmental Impact Assessment team, submits that it has:

- *The necessary required expertise to conduct health impact assessments, including the required knowledge and understanding of any guidelines or policies that are relevant to the proposed activity;*
- *Undertaken all the work and associated studies in an objective manner, even if the findings of these studies are not favourable to the project proponent;*
- *No vested financial interest in the proposed project or the outcome thereof, apart from remuneration for the work undertaken under the auspices of the above-mentioned regulations;*
- *No vested interest, including any conflicts of interest, in either the proposed project or the studies conducted in respect of the proposed project, other than complying with the required regulations.*

REPORT DETAILS PAGE

Project name:	***Groot Letaba River Water Development Project***
Report Title:	***Health Impact Assessment***
Author:	***Andrew Dickson / Margot Saner / Dr Lorraine Hodge***
MS&A report reference no.:	***MS&A01322***
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Margot Saner & Associates (Pty) Ltd
Approved for MS&A by:

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Study Leader

ENVIRONMENTAL ASSESSMENT PRACTIONER
*Approved for ILISO Consulting (Pty) Ltd by**:***

....
Dr Martin van Veelen *Date*
Project Director

EXECUTIVE SUMMARY

As part of the Groot Letaba River Water Development Project, the Department of Water Affairs and Forestry (DWAF) is planning to construct a dam at the Nwamitwa site in the Limpopo Province, North-east of Tzaneen, in the Groot Letaba catchment area which falls within the Luvubu-Letaba Water Management Area. This dam is scheduled to be in operation by 2012, with full yield by 2013. Consideration is also being given to raising the dam wall of the Tzaneen Dam to increase water for irrigation to the area upstream from the proposed dam.

The above components, as well as the necessary road re-alignments, water treatment works and bulk water supply infrastructure will be considered within the Environmental Impact Assessment (EIA) studies as components of the Groot Letaba Water Development Project (GLeWaP).

Margot Saner & Associates (Pty) Ltd was appointed by ILISO Consulting (Pty) Ltd to conduct a specialist Health Impact Assessment (HIA) for the GLeWaP EIA. The broad aims of the investigation were to assess the potential health impacts (positive and negative) of the project and to improve public policy decision making through recommendations to enhance predicted positive health impacts whilst minimising negative ones.

The HIA was conducted in accordance with the prescribed methodology for specialist studies as per Regulation 33(2) of GN 385. Reference was made to international methodologies for HIA and to other specialist study reports:

- *European Policy Health Impact Assessment – a Guide*
- *The Merseyside Guidelines for Health Impact Assessment*
- *Social Impact Assessment – MasterQ Research*
- *Noise Impact Assessment – Jongens Keet Associates*
- *Air Quality Impact Assessment – Airshed Planning Professionals*

The HIA comprised a baseline description and an impact assessment.

Baseline description

This required the consideration of the number of construction workers involved in the project and their general state of health, as well as the number of persons in surrounding communities and their state of health.. The potential health risks to which construction workers engaged on the various sites may be exposed were identified along with the potential health risks which construction activities would pose to surrounding communities. Consideration was also given to determining the possible health impacts on construction workers and the surrounding communities as a consequence of water related diseases following construction of the proposed dam.

***Health impact assessment** – this included consideration of the following issues:*

**** Construction Phase** - Health risks associated with transmittable diseases, impacts of construction activities on construction workers and impacts of construction activities on surrounding communities.*

**** Operational Phase** - Potential health risks to surrounding communities associated with changing water levels and the change from a free-flowing river to a large body of water, potential impacts on community health following the provision of an improved water supply system.*

Assumptions and Limitations

- *The identified potential health impacts and health effects were qualitatively assessed only – i.e. no quantitative verification of impacts/effects was undertaken.*
- *Any inaccuracies and/or uncertainties contained in the referenced specialist reports may have inadvertently been incorporated into the HIA.*
- *The time-frame allocated to this specialist study precluded extensive on-site investigations and the HIA must therefore be viewed as a desk-based study which will require on-site verification once construction activities have been initiated.*

CONCLUSIONS

Baseline description

Number of construction workers and their state of health

Approximately 50 workers will be engaged in the raising of the Tzaneen dam, whilst approximately 300 workers will be engaged at the proposed dam site at Nwamitwa. Fifty of these will be professional workers and will be accommodated with their families in Letsitele. Another fifty of the workers will be skilled specifically in dam construction and will be sourced from outside of the region. These workers will be housed in the Letsitele single quarters. The remainder of the workforce (~200 workers) will be accommodated in purpose-built construction camps. Approximately 50 of the 300 workers will be female.

Within the South African context, some concern is expressed about the potential state of health of construction workers, particularly with respect to the incidence of HIV and TB infection.

**** Human Immunodeficiency Virus (HIV)***

As migratory workers, it can be expected that unskilled and semi-skilled construction workers sourced from outside of the region will exhibit an elevated incidence of STI, including HIV. Latest DoH data reveals that ~24.7% of antenatal women in the Mopani District Municipality (MDM) tested HIV positive in 2006. Local labour is therefore also likely to have a high prevalence of HIV.

**** Tuberculosis (TB)***

The incidence of TB amongst construction workers is also likely to be elevated, irrespective of whether they are sourced locally or from outside of the region. South Africa has the seventh highest incidence of TB in the world (720 cases per 100,000 population in 2006) and the incidence of the disease has increased significantly in the last ten years. The incidence of TB in South Africa is further complicated by the high rate of HIV infection.

Number of persons in the surrounding communities and their state of health

The proposed construction site at the Tzaneen Dam and the proposed site at Nwamitwa fall within the Greater Tzaneen Local Municipality (GTLM) and the Greater Letaba Local Municipality (GLLM) respectively. These municipalities form part of the Mopani District Municipality (MDP) of the Limpopo Province.

The GTLM covers an area of ~3242km^2 and has a population of ~375,000 people. The population density is ~116 persons/km^2. There are ~97,400 households in the area and the average number of persons per household is ~43.94. Approximately 98% of the population is designated Black African, whilst Females comprise ~54% of the population. Almost half of the populace (48.7%) is under the age of 19 years.

The GLLM covers an area of ~1891km^2 and has a population of ~220,000 people. The population density is ~116 persons/km^2. There are ~53,700 households in the area and the average number of persons per household is ~4.1. Approximately 99% of the population is designated Black African, whilst Females comprise ~55% of the population. More than half of the populace (53.9%) is under the age of 19 years.

Education levels throughout both the GTLM and the GLLM are generally low, with between 35-45% of the adult population having no formal education at all (Social Impact Study, MDM IDP).

With regard to the state of health of the populations within close proximity to the proposed construction sites, the following is relevant:

**** Human Immunodeficiency Virus (HIV)***

The incidence of HIV infection is high throughout the Limpopo Province, with a recorded 20.6% HIV incidence in antenatal women in 2006 whilst the Mopani District Municipality (MDM) recorded a prevalence of HIV in antenatal women of 24.7% (2006).

**** Tuberculosis (TB)***

The incidence of Tuberculosis (TB) amongst the local populace is likely to be fairly elevated as South Africa has the seventh highest incidence of TB in the world (720 cases per 100,000 population in 2006). Limpopo Province has a lower infection rate than the rest of SA (apart

from the Northern Cape) but the local incidence of TB is further complicated by the high rate of HIV infection within the local populace.

**** Malaria***

The Mopani District Municipality (MDM) is not considered to be an endemic malaria region. There remains some risk however as ~20% of the annual recorded cases of malaria for the Limpopo Province are recorded in the MDM. Local climate in the MDM can accommodate the insect vectors (Anopheles sp. mosquitoes) necessary for the spread of the malaria parasite (P.falciparum).

**** Schistosomiasis (bilharzia)***

The incidence of Schistosomiasis is difficult to estimate as it is not a notifiable disease. It is however recognised that schistosomiasis is second only to malaria in contributing to the disease burden in the developing world. The climate and rainfall characteristics of the MDM make it likely that both S.haemotobium and S.mansoni are endemic to the area, provided that suitable intermediate hosts (pulmonate snails sp.) are present. Residents of the villages in the area of the proposed GLeWaP bulk water distribution area are at risk of infection as they currently rely heavily on communal taps, borehole and/or river water.

**** Diarrhoeal diseases***

The lack of water-borne sewage systems in the proposed GLeWaP bulk water distribution area increases the risk of spread of diarrhoeal diseases as untreated sewage may enter rivers, streams and underground water resources.

**** Healthcare infrastructure/resources***

Latest available information shows that the status of healthcare services within the GTLM and GLLM is inadequate to effectively respond to the community health needs.

**** Poverty***

The majority of communities within the GTLM and TLLM are impoverished with generally poor levels of nutrition, especially amongst children. Poor nutritional standards impact adversely on the health status of populations and significantly increase the risk of disease.

Potential health risks to which construction workers will be exposed

Construction workers engaged on all of the sites can be expected to be exposed to the following health risks as a result of construction activities:

- ***chemical stressors***
    - *inhalation exposure to airborne hazardous chemical substances (total inhalable particulates, respirable particulates, cement dusts, bitumen fume, volatile organic compounds, welding fumes, gas-cutting fumes, diesel exhaust emissions)*
    - *dermal exposure to volatile organic compounds, cement dusts, bitumen products*

- ***physical stressors***
    - *excessive noise rating levels (plant machinery, pneumatic tools, impact tools, hammering, grinding, compressors, blasting)*
    - *excessive heat stress conditions (work requiring moderate to high metabolic work rates under hot/humid environmental conditions)*
    - *excessive cold stress conditions (work performed at night and early winter mornings – planned 24 hour work schedules)*
    - *vibration (whole body vibration during operation of plant machinery and vehicles; hand-arm vibration when operating power tools, compactors)*
    - *ultraviolet radiation (prolonged and/or repeated exposures to sunlight)*

- ***ergonomic stressors***
    - *work requiring manual lifting and carrying of heavy materials*
    - *work requiring heavy manual labour (digging, drilling etc)*
    - *repetitive work*
    - *prolonged standing*
    - *prolonged sitting (machine operators)*
    - *pushing / pulling activities*

- ***hazardous biological agents***
    - *sexually transmitted diseases (HIV, syphilis)*
    - *infectious diseases (TB, diarrhoeal diseases)*
    - *vector borne diseases (malaria, schistosomiasis)*

Potential health risks to communities during construction

Communities in close proximity to the construction sites can be expected to be exposed to the following health risks as a result of construction activities:

- ***chemical stressors***
    - *inhalation exposure to airborne pollutants (total inhalable particulates, respirable particulates, cement dusts, bitumen fumes)*
    - *ingestion exposure to pollutants released into existing water courses (oils, volatile organic compounds, pesticides, herbicides, sewage, garbage)*

- ***physical stressors***

  Excessive noise rating levels (plant machinery, pneumatic tools, impact tools, hammering, grinding, compressors, blasting, operation of pump stations) – planned 24 hour work schedules

- ***hazardous biological agents***
    - *sexually transmitted diseases (HIV, syphilis)*
    - *infectious diseases (TB, diarrhoeal diseases)*
    - *vector borne diseases (malaria, schistosomiasis)*

Health Impact Assessment

The outcome of the Health Impact Assessment revealed the following:

Construction workers will be potentially exposed to the following health risks with subsequent negative health impacts:

- *HIV, STI, TB – medium significance following mitigation*
- *Excessive noise rating levels – medium significance following mitigation*
- *Inhalation exposure to airborne Hazardous Chemical Substances (HCS) – low significance following mitigation*
- *Dermal exposure to HCS – low significance following mitigation*
- *Excessive heat stress conditions – low significance following mitigation*
- *Excessive cold stress conditions – low significance following mitigation*
- *Excessive vibration stress – low significance following mitigation*

- *Excessive heat stress conditions – low significance following mitigation*
- *Excessive ultraviolet radiation – low significance following mitigation*
- *Excessive ergonomic stress – medium significance following mitigation*
- *Malaria – low significance following mitigation*
- *Schistosomiasis – low significance following mitigation*
- *Diarrhoeal diseases – low significance following mitigation*

Priority potential health risks for construction workers therefore include:

- *HIV, STI and TB transmission*
- *Exposure to excessive noise rating levels*
- *Exposure to excessive ergonomic stress*

Even following the implementation of the recommended mitigation measures, it is likely that these risks would still present a medium significance in terms of their impact on the health of construction workers. Effective management of these priority health risks would be required if the impacts on the health of construction workers are to be effectively controlled.

Construction activities could potentially expose the surrounding communities to the following health risks with consequent negative heath impacts:

- *HIV, STI, TB – medium significance following mitigation*
- *Inhalation exposure to airborne Hazardous Chemical Substances (HCS) – low significance following mitigation*
- *Ingestion exposure to HCS – low significance following mitigation*
- *Excessive ambient noise rating levels – low significance following mitigation*

Priority potential negative health impacts for surrounding communities therefore include:

- *HIV, STI and TB transmission*

Even following the implementation of the recommended mitigation measures, it is likely that these risks would still present a medium significance in terms of their health impact on surrounding communities. Effective management of these priority health risks would be required if the impacts on the health of community members are to be effectively controlled.

The completion of the project could however impact <u>positively</u> on the following health risks to surrounding communities:

- *Malaria – low significance following mitigation*
- *Schistosomiasis – medium significance following mitigation*

- *Diarrhoeal diseases – medium significance following mitigation*

Whilst the incidence of these diseases is unlikely to change during the construction phase, it is very likely that it will decrease following completion of the installation of bulk water infrastructure. The incidence of schistosomiasis and diarrhoeal diseases within the local populace is likely to decrease significantly following provision of clean water to households.

In conclusion, the raising of the Tzaneen dam is unlikely to have any significant impact on the health of either the construction workers or the surrounding community provided the recommended mitigation measures are effectively implemented. The construction of a dam at the Nwamitwa site and the installation of bulk water infrastructure throughout the surrounding areas, is however, likely to have several potential health impacts on both construction workers and the affected communities.

- *The nett health impact of construction activities on construction workers is likely to be negative. The majority of impacts could however be effectively mitigated.*
- *The nett health impact on surrounding communities is likely to be positive, with the benefits of improved access to clean water supplies outweighing the temporary negative impacts associated with construction activities – all of which could be readily and effectively mitigated.*

Recommended Mitigation Measures for Priority Health Impacts

Transmittable diseases:

All construction workers should be subject to baseline medical examinations which should include appropriate testing for:

- *Tuberculosis*
- *HIV (voluntary consent but strongly encouraged)*
- *Syphilis / other STI*

Infected workers must be afforded appropriate treatment and/or counselling whilst all workers should be subject to education and training in the health risks associated with high risk sexual activities. Workers must be made familiar with the routes of exposure to STI and TB as well as ways to reduce the risks and/or prevent infection. Workers should be made to be familiar with the signs and symptoms of STI and should be encouraged to seek prompt treatment in the event of them developing these signs and symptoms. Consideration should

be given to distributing free condoms to workers and encouraging their use through education.

Members of the surrounding communities should be encouraged to undergo voluntary examination/testing for:

- *Tuberculosis*
- *HIV*
- *Syphilis / other STI*

Infected individuals should be encouraged to undergo appropriate treatment and/or counselling and communities should be made familiar with the routes of exposure to HIV/STI and TB as well as ways to reduce the risks and/or prevent infection. Communities should also be made to be familiar with the signs and symptoms of infection and should be encouraged to seek prompt treatment in the event of them developing these signs and symptoms. Local healthcare resources are already struggling to cope with current HIV/AIDS and TB related infections and disease. Prior to initiation of construction activities it is recommended that community leaders be informed of the possible health risks associated with transmission of disease from/to workers and the communities. Community leaders should then be encouraged to distribute this knowledge and information to their community members.

Noise rating levels

In terms of the Construction Regulations promulgated under the Occupational Health and Safety Act (Act 85 of 1993), it is required of all contractors to conduct a baseline risk assessment prior to performing any construction activities. This risk assessment must identify and evaluate all of the risks to the health and safety of persons engaging in construction activities. Given that construction activities will expose workers to excessive noise rating levels it is recommended that a baseline noise survey also be conducted as soon as possible following commencement of site activities – in accordance with the requirements of the Noise Induced Hearing Loss Regulations (OHSAct 85 of 1993) and SANS 10083:2004. This noise survey will quantify worker exposures to noise during typical activities and allow for informed comment on the relative risks to hearing presented by various activities – i.e. identify sources of excessive noise and allow for demarcation of noise zones. Recommendations with regard to appropriate control measures (engineering controls and/or personal protective equipment) can then follow. A formal noise survey will also permit structuring of an appropriate audiometric examination protocol for construction workers – as required by the Noise Induced Hearing Loss Regulations – OHSAct 85 of 1993.

Ergonomic stress

Within the context of construction activities, ergonomic stresses present one of the highest risks to worker health. The Construction Regulations (OHSAct 85 of 1993) require that all contractors conduct an initial health risk assessment of their workers activities prior to initiating any work on site. Ergonomic stress must be included as a priority issue in any baseline risk assessment. Whilst the formal risk assessment would allow for identification of specific ergonomic issues, appropriate mitigation measures are likely to include:

- *Ensuring that all workers are certified medically fit to perform their duties by a qualified OMP*
- *Ensuring that mechanical assistance for lifting and transporting of heavy material is readily available and appropriate to the task*
- *Ensuring that workers are adequately trained in lifting techniques and actively practice these techniques*
- *Ensuring that workers know when to ask for assistance and do so*

With regard to expected health impacts of lower priority, recommended mitigation measures included:

Hazardous Chemical Substances

It is strongly recommended that an initial HCS Risk Assessment be performed for each of the construction sites. The outcomes of these assessments will permit specific and relevant comment on the suitability of existing engineering control measures, Personal Protective Equipment, policies and work procedures in preventing/controlling worker exposure to HCS. Comment on the need for personal air monitoring programmes and/or medical surveillance programmes will also be assessed by these baseline studies. Pending these assessments:

- *generation of dust should be minimised by implementing formal wetting down procedures for sites*
- *diesel powered equipment/ vehicles must be suitably serviced, maintained and repaired in order to minimise the emission of diesel particulate matter*
- *particulate emissions from construction activities should be minimised by:*
    - *ensuring that all roads, access ways and other unpaved areas are subject to appropriate dust control measures.*
    - *setting appropriate speed limits for all surfaces and roads*
    - *ensuring that the carry over of mud or dirt onto paved roads is prevented as far as possible*

- o *traffic movement is minimised as far as possible*
- o *all spillages onto road surfaces are promptly cleaned up*
- o *all exposed areas are promptly re-vegetated/stabilised*
- o *the extent of the excavations is minimised*
- o *the heights of stockpiles are minimised and stockpiles are located as far away from sensitive receptors as possible*
- o *windbreaks are erected around stockpiles where possible*

Thermal Stress

- *Heat Stress*
  - o *Ensuring that all workers are medically fit to conduct their activities*
  - o *Ensuring that all workers are suitably informed and trained in the signs and symptoms of heat stress*
  - o *Ensuring that all workers are trained in appropriate measures to prevent heat stress related injuries or illnesses. Informing workers of the need to drink regular quantities of water should be prioritised. Ready access to drinking water must be provided at all work locations.*
  - o *Drafting of formal work procedures for working in hot environments*

- *Cold Stress*
  - o *Issuing of appropriate protective wear (jackets, hats and gloves)*
  - o *Use of hand-held powered machinery and/or tools should be subject to special precautions under cold climatic conditions (low risk in this instance).*

Vibration Stress

Appropriate mitigation measures would include:

- *Ensuring that all equipment, tools and vehicles are properly maintained according to design specifications so as to minimise the risk of worker exposure to excessive vibration stress*
- *Ensuring that all defective and broken equipment, tools and vehicles are promptly removed from duty and properly repaired*
- *Ensuring that workers are trained to understand the hazards associated with vibration - i.e. sources of vibration, health effects.*
- *Ensuring that workers are adequately trained to recognise problematic vibration which could cause vibration related injuries*

- *Issuing of appropriate personal protective equipment*

Ultraviolet Radiation

Appropriate mitigation measures to address worker exposure to direct sunlight would include:

- *Issuing appropriate personal protective equipment (brimmed hats, caps)*
- *Educating the workforce about the damaging effects of prolonged and/or repeated exposure to solar radiation*
- *Encouraging the diligent use of sunscreens by especially vulnerable persons*

Malaria

- *Drafting of a formal malaria control plan for the construction sites is recommended. Although compulsory issue of prophylactic drugs to workers is not deemed necessary, some consideration could be given to initiating an appropriate chemical control programme at worker accommodation sites. Spraying of effective insecticides to control mosquito populations is an effective way of reducing the risk of malaria. Advice on residual spray methods should be obtained from a relevant authority prior to initiation.*
- *Educating workers in ways and means of preventing malaria is also recommended. Priority should be given to ensuring that workers are aware of the benefits of:*
  - *Limiting time out of doors after dark*
  - *Wearing long sleeved shirts and long trousers after dark*
  - *Making use of insect repellents*
  - *Closing windows and doors of sleeping quarters at night*
- *Consideration should be given to providing all worker sleeping quarters with mosquito repellents (chemical impregnated mats or coils) and/or mosquito nets above beds*
- *Ensuring that workers are able to readily identify the common signs and symptoms of malaria so that diagnosis is promptly confirmed and appropriate treatment initiated.*
- *Continuation of existing malaria control measures as implemented by the Provincial and Local health authorities*
- *Improve public awareness of risk*
- *Improve public knowledge about ways of reducing risks*

Schistosomiasis

** The incidence of Schistosomiasis should be confirmed in the study area by appropriate specialists, preferably before construction begins. A formal assessment should then be made of the risks of contamination following completion of the dam construction at the proposed Nwamitwa site. In the interim, mitigation measures should include:*

- *Education and training of workers in ways and means of reducing their risks of infection – i.e:*
  - *Avoid swimming or bathing in uncontrolled water sources*
  - *Avoiding drinking water from uncontrolled or unknown sources*
  - *Avoid urinating in water sources / courses*
- *Education of workers in signs and symptoms of infection so that medical assistance can be sought and appropriate treatment initiated*
- *Ready access to healthcare services for workers in the event of treatment being required.*

Diarrhoeal Diseases

** Mitigation measures should include:*

- *Education and training of workers in ways and means of reducing their risks of infection – i.e:*
  - *Avoid swimming or bathing in uncontrolled water sources*
  - *Avoiding drinking water from uncontrolled or unknown sources*
  - *Avoid urinating in water sources / courses*
  - *Follow good personal hygiene practices (washing hands etc)*
  - *Avoid eating food from unknown or suspect sources*
  - *Avoid unwashed, raw or undercooked foods*
- *Education of workers in signs and symptoms of infection so that medical assistance can be sought and appropriate treatment initiated*
- *Ready access to healthcare services for workers in the event of treatment being required.*
- *Education of the local population in ways and means of reducing their risks of infection – i.e:*
  - *Avoid swimming or bathing in uncontrolled water sources*
  - *Avoiding drinking water from uncontrolled or unknown sources*
  - *Avoid urinating in water sources / courses*

- *Thoroughly wash hands following ablutions and prior to eating, drinking or smoking*
- *Thoroughly wash vegetables and fruit prior to eating*
- *Thoroughly cook foods*

TABLE OF CONTENTS

Page

LISTS OF TABLES

Page

ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
DoH	Department of Health
DWAF	Department of Water Affairs and Forestry
GLeWaP	Groot Letaba River Water Development Project
GLLM	Greater Letaba Local Municipality
GTLM	Greater Tzaneen Local Municipality
HCS	Hazardous Chemical Substances
HIA	Health Impact Assessment
HIV	Human Immunodeficiency Virus
IDP	Integrated Development Plan
ILISO	ILISO Consulting
LP	Limpopo Province
MDM	Mopani District Municipality
OMP	Occupational Medical Practitioner
RDP	Reconstruction and Development Programme
SA	Republic of South Africa
STI	Sexually Transmitted Infections
TB	Tuberculosis

1. STUDY INTRODUCTION

1.1 BACKGROUND TO PROJECT

The Department of Water Affairs and Forestry (DWAF) is currently undertaking an Environmental Impact Assessment (EIA) to investigate the environmental feasibility of raising the Tzaneen Dam, the construction of a storage dam in the Groot Letaba River and associated bulk water infrastructure (water treatment, pipelines, pump stations, off-takes and reservoirs) in the Limpopo province. The EIA is being undertaken by ILISO Consulting with Zitholele Consulting providing the public participation support. The EIA is being undertaken according to the EIA Regulations under Section 24 (5) of the National Environmental Management Act (NEMA), (Act No 107 of 1998) as amended in Government Notice R385, 386, 387 – Government Gazette No. 28753 of 21 April 2006.

ILISO Consulting has appointed Margot Saner & Associates (Pty) Ltd to undertake the Health Impact Assessment (HIA) as part of the EIA.

1.2 STRUCTURE OF THIS REPORT

This specialist study will be undertaken in compliance with regulation 33(2) of GN 385. **Table 1.1** indicates how Regulation 33 of GN385 has been fulfilled in this report.

Figure 1.1: **Indication of compliance with Regulation 33 in this report**

Regulatory Requirements	Section of Report
(a) The persons who prepared the report; and the expertise of these persons to carry out the specialist study or specialised process.	Chapter 2
(b) a declaration that the person/s is/are independent	Page i
(c) an indication of the scope of, and the purpose for which, the report was prepared	Chapter 3
(d) a description of the methodology adopted in preparing the report or carrying out the specialised process	Chapter 4
(e) a description of any assumptions made and any uncertainties or gaps in knowledge	Chapter 5
(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Chapter 6
(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	Chapter 7
(h) a description of any consultation process that was undertaken during the course of carrying out the study	Chapter 8
(i) a summary and copies of any comments that were received during any consultation process	Chapter 9
(j) any other information requested by the competent authority.	Chapter 10

2. PROJECT TEAM

This report was jointly compiled by Andrew Dickson and Margot Saner of Margot Saner & Associates (Pty) Ltd. Additional input was provided by Dr Lorraine Hodge of OAITC (Occupational and Industrial Training College) cc.

Margot Saner & Associates (Pty) Ltd is a Department of Labour Approved Inspection Authority (CI036OH) and has offered professional services in the fields of Occupational and Environmental Hygiene since 1993.

Margot Saner has been a Certified Occupational Hygienist (COH) with the Southern African Institute for Occupational Hygiene (SAIOH) for 24 years. Margot also holds the following qualifications: National Higher Diploma in Medical Technology and Animal Science, a BSc degree in Geology and Chemistry and a National Diploma in Safety Management. Margot has developed the Air Pathway Analysis System (APAS) for Landfill sites in South Africa which incorporates an exhaustive methodology for the assessment of health risks to both workers and communities. The APAS has been successfully implemented on 17 sites in South Africa. Margot is currently engaged in post graduate research in Waste Resource Management.

Andrew Dickson attained a BSc degree in Natural Science (Zoology, Physiology) from the University of the Witwatersrand in 1991. After joining Margot Saner & Associates in 1995, Andrew obtained a Diploma of Professional Competence in Occupational Hygiene from the British Institute of Occupational Hygiene (1995-1999). In 1999 he was registered as a Certified Occupational Hygienist (COH) by the Southern African Institute for Occupational Hygiene (SAIOH). Andrew has acquired some 12 years of experience in the field of Occupational Hygiene, specialising in Health Risk Assessments.

Dr Lorraine Hodge attained her National Higher Diploma in Medical Technology in 1976. She went on to attain a BTech, MTech and PhD in Applied Community Science, focusing on Environmental Health and Safety issues.

3. PURPOSE OF REPORT AND SCOPE OF WORK

The aim of this investigation is to conduct a presumptive Health Impact Assessment for the proposed Groot Letaba River Water Development Project. Health Impact Assessments (HIA) may be defined as "the estimation of the effects of a specified action on the health of a defined population" (Scott-Samuel 1999). The broad aims of a HIA are:

- to assess the potential health impacts (positive and negative) of projects.
- to improve public policy decision making through recommendations to enhance predicted positive health impacts whilst minimising negative ones.

The scope of work covered in this Health Impact Assessment is described in detail below:

3.1 BASELINE DESCRIPTION

This will include:

- The determination of the approximate number and general state of health of the construction workers involved in the project.
- The determination of the approximate number and state of health of the surrounding community.
- The identification of potential health risks to which construction workers engaged on the various sites will be exposed.
- The identification of potential health risks to which the surrounding communities will be exposed as a consequence of construction activities.
- The determination of the possible health impacts on construction workers and the surrounding communities as a consequence of water related diseases following construction of the proposed dam.

3.2 HEALTH IMPACT ASSESSMENT

This will include consideration of the following issues:

3.1.1 Construction Phase

- Health risks associated with transmittable diseases – i.e. from construction workers to the surrounding communities.
- Health risks associated with transmittable diseases – i.e. from surrounding communities to construction workers.
- Impacts of construction activities on construction workers.
- Impacts of construction activities on surrounding communities.

3.1.2 Operational Phase

- Potential health risks to surrounding communities associated with changing water levels.
- Potential health risks to surrounding communities associated with the change from a free-flowing river to a large body of water.
- Potential impacts on community health following the provision of an improved water supply system

4. METHODOLOGY

The key issues identified during the Scoping Phase informed the terms of reference of this Health Impact Assessment specialist study. Each of the identified issues consists of components that, on their own, or in combination with each other, give rise to potential impacts, either positive or negative and from the project onto the environment or from the environment onto the project. In the EIA, the significance of the potential impacts will be considered before and after identified mitigation has been implemented.

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

The following criteria are used to evaluate significance:

Nature

The nature of the impact will be classified as positive or negative, and direct or indirect.

Extent and location

Magnitude of the impact and is classified as:

- **Local**: the impacted area is only at the site – the actual extent of the activity
- **Regional**: the impacted area extends to the surrounding, the immediate and the neighbouring properties.
- **National**: the impact can be considered to be of national importance.

Duration

This measures the lifetime of the impact, and is classified as:

- **Short term**: the impact will be for 0 – 3 years, or only last for the period of construction.
- **Medium term**: three to ten years.

- **Long term**: longer than 10 years or the impact will continue for the entire operational lifetime of the project.
- **Permanent**: this applies to the impact that will remain after the operational lifetime of the project.

Intensity

This is the degree to which the project affects or changes the environment, and is classified as:

- **Low**: the change is slight and often not noticeable, and the natural functioning of the environment is not affected.
- **Medium**: The environment is remarkably altered, but still functions in a modified way.
- **High**: Functioning of the affected environment is disturbed and can cease.

Probability

This is the likelihood or the chances that the impact will occur, and is classified as:

- **Low**: during the normal operation of the project, no impacts are expected.
- **Medium**: the impact is likely to occur if extra care is not taken to mitigate them.
- **High**: the environment will be affected irrespectively; in some cases such impact can be reduced.

Confidence

This is the level knowledge/information, the environmental impact practitioner or a specialist had in his/her judgement, and is rated as:

- **Low**: the judgement is based on intuition and not on knowledge or information.
- **Medium**: common sense and general knowledge informs the decision.
- **High**: Scientific and or proven information has been used to give such a judgement.

Significance

Based on the above criteria the significance of the identified issues are determined. This is the importance of the impact in terms of physical extent and time scale, and is rated as:

- **Low**: the impacts are less important, but may require some mitigation action.
- **Medium**: the impacts are important and require attention; mitigation is required to reduce the negative impacts
- **High**: the impacts are of great importance. Mitigation is therefore crucial.

Cumulative Impacts

The possible cumulative impacts are also considered.

Mitigation

Mitigation for significant issues will be incorporated into the EMP for construction.

The methodology followed by this Health Impact Assessment was broadly based on that detailed in the following guidelines:

- European Policy Health Impact Assessment – a Guide.
- The Merseyside Guidelines for Health Impact Assessment.

Reference was also made to the following specialist reports:

- Social Impact Assessment – MasterQ Research (Vol 2, Annexure 3).
- Noise Impact Assessment – Jongens Keet Associates (Vol 2, Annexure 9).
    - Air Quality Impact Assessment – Airshed Planning Professionals (Vol 2, Annexure 6).

These reports are fully referenced in Chapter 12.

5. ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

- The identified potential health impacts and health effects have been qualitatively assessed only – i.e. no quantitative verification of impacts/effects has yet been undertaken. Recommendations in this regard are detailed in **Chapter 7** of this report.

- For the purposes of this Health Impact Assessment, reference has been made to the following Specialist Studies:
  - Social Impact Assessment.
  - Noise Impact Assessment.
  - Air Quality Impact Assessment.

  Any inaccuracies and/or uncertainties contained in these reports may have inadvertently been incorporated into the Health Impact Assessment. Each of these specialist reports details the relevant limitations and assumptions and gaps in knowledge.

- This Health Impact Assessment must be viewed as a prospective / predictive study as there has as yet been no initiation of any construction activities on any of the proposed sites. Additional commentary in this regard is provided in Chapter 7: Recommendations.
-
- The time-frame allocated to this specialist study negated extensive on-site investigations. As such this Health Impact Assessment should be viewed as a desk-based study which will require on-site verification once construction activities have been initiated. Recommendations for future risk assessments and quantitative studies are detailed in **Chapter 7**.

6. FINDINGS

6.1 BASELINE DESCRIPTION

6.1.1 Number of construction workers and their state of health

The raising of the Tzaneen Dam wall will lead to the creation of approximately 50 jobs during the construction phase. The per annum direct temporary employment opportunity during the construction phase will be ¬250 jobs.

Most of the indirect and induced jobs will be created in the manufacturing, finance and business sector, mining, trade and accommodation sectors and transport sectors. During the construction phase, temporary employment will be created. The increased employment in the area during the construction phase will also result in increased expenditure, which will mean that more than just the proposed direct jobs required for the construction will be created due to economic spin-offs that will result. During the construction phase, local contractors and service providers will be utilised as far as practically possible.

There will be approximately 300 workers engaged at the proposed dam site at Nwamitwa. Fifty of these will be professional workers and will be accommodated with their families in Letsitele. Another fifty of the workers will be professional specifically in dam construction and will be sourced from outside of the region. These workers will be housed in the Letsitele single quarters. The remainder of the workforce (~200 workers) will be recruited locally and will be accommodated in their own homes. Approximately 50 of the 300 workers will be female.

Within the South African context, some concern is expressed about the potential state of health of construction workers, particularly with respect to the incidence of HIV and TB infection.

*** Human Immunodeficiency Virus (HIV)**

It can be expected that semi-skilled and unskilled construction workers sourced from outside of the region will, as migratory workers, exhibit an elevated incidence of Sexually Transmitted Infections (STI), including HIV. Based on the latest available (2006) Department of Health data (DoH Report on National HIV and Syphylis

Prevalence, 2006), locally sourced unskilled workers are also likely to have an elevated incidence of HIV infection (~24.7% of antenatal women in the Mopani District Municipality (MDM) were recorded as being HIV positive in 2006).

*** Tuberculosis (TB)**The incidence of Tuberculosis (TB) amongst construction workers is also likely to be elevated, irrespective of whether they are sourced locally or from outside of the region. South Africa has the seventh highest incidence of TB in the world (720 cases per 100,000 population in 2006) and the incidence of the disease has increased significantly in the last ten years. A total of 341,165 cases of TB were reported in 2006 (DoH Strategic Plan for TB: 2007-2011). The incidence of TB in South Africa is further complicated by the high rate of HIV infection, the proportion of co-infection with HIV/TB is ~55%. Treatment of TB has improved and cure rates have steadily increased, however an increasing number of patients receiving treatment fail to complete the course, resulting in ever-increasing cases of drug-resistant TB strains.

6.1.2 Number and state of health of surrounding communities

With respect to the number of persons living in the study area and the general state of their health, the following was established (data from the Integrated Development Plan for the Mopani District Municipality):

The proposed construction site at the Tzaneen Dam and the proposed site at Nwamitwa fall within the Greater Tzaneen Local Municipality (GTLM) and the Greater Letaba Local Municipality (GLLM) respectively. These municipalities form part of the **Mopani District Municipality** (MDP) of the Limpopo Province.

The **Greater Tzaneen Local Municipality** (GTLM) covers an area of ~3242km^2 and has a population of ~375,000 people. The population density is ~116 persons/km^2. There are ~97,400 households in the area and the average number of persons per household is ~3.9. Approximately 98% of the population is designated Black African, whilst Females comprise ~54% of the population. Almost half of the populace (48.7%) is under the age of 19 years.

The **Greater Letaba Local Municipality** (GLLM) covers an area of ~1891km^2 and has a population of ~220,000 people. The population density is ~116 persons/km^2. There are ~53,700 households in the area and the average number of persons per

household is ~4.1. Approximately 99% of the population is designated Black African, whilst females comprise ~55% of the population. More than half of the populace (53.9%) is under the age of 19 years.

The town of Tzaneen lies in close proximity to the planned construction site for the raising of the Tzaneen Dam wall. The raising of the wall will not require acquisition of additional land as the flood level will remain within the area purchased for the original dam.

Villages located within the area of the proposed GLeWaP bulk water distribution area include: ka-Matubana, Nwanedzi, ka-Mandehakazi, ka-Mavele, Runnymede, Serolorolo, ga-Mookgo, Morapalala, Kadzumeri, Makhwivirini, Ooghoek, Hlohlokwe, Kampakeni, Merekome, Babanana and Kharangwani. The settlements closest to the proposed areas of primary construction activity include: Nkamboko (dam site at Nwamitwa), Serololololo (water reservoir), Miragoma (borrow pit) and Gamokgwathi (borrow pit).

Education levels throughout both the GTLM and the GLLM are generally low, with between 35-45% of the adult population having no formal education at all (Social Impact Study, MDM IDP).

With regard to the state of health of the populations within close proximity to the proposed construction sites, the following is relevant:

*** Human Immunodeficiency Virus (HIV)**

The incidence of Human Immunodeficiency Virus (HIV) infection is high throughout the Limpopo province, with a recorded 20.6% HIV incidence in antenatal women in 2006 (DoH Report on National HIV and Syphylis Prevalence, 2006). The Mopani District Municipality (MDM) had a recorded prevalence of HIV in antenatal women of 24.7% in 2006 (DoH Report on National HIV and Syphylis Prevalence, 2006). It is therefore not unreasonable to expect that the populations of the villages listed above will exhibit similar infection rates.

*** Tuberculosis (TB)**

The incidence of Tuberculosis (TB) amongst the local populace is likely to be fairly elevated. As noted, South Africa has the seventh highest incidence of TB in the world

(720 cases per 100,000 population in 2006). Limpopo Province has a lower infection rate than the rest of SA (apart from the Northern Cape) but the local incidence of TB is further complicated by the high rate of HIV infection within the local populace.

*** Malaria**

The Mopani District Municipality (MDM) is not considered to be an endemic malaria region. The Hans Merensky Nature Reserve located ~15km Northeast of the proposed site of the Nwamitwa dam is malaria free and visitors are not obliged to take malaria prophylactics. There remains some risk however as illustrated by the fact that ~20% of the annual recorded cases of malaria for the Limpopo Province (6369 cases in 2006) are recorded in the Mopani District Municipality (DoH Annual Malaria Statistics, 2006).

Local climate in the MDM can accommodate the insect vectors (Anopheles sp. mosquitoes) necessary for the spread of the malaria parasite (*P.falciparum*).

*** Schistosomiasis (bilharzia)**

The incidence of Schistosomiasis is difficult to estimate as it is not a notifiable disease. It is however recognised that schistosomiasis is second only to malaria in contributing to the disease burden in the developing world. The climate and rainfall characteristics of the Mopani District Municipality (MDM) make it likely that both *S.haemotobium* and *S.mansoni* are endemic to the area, provided that suitable intermediate hosts (pulmonate snails sp.) are present. The occupants of villages in close proximity to the Tzaneen township have better access to piped drinking/bathing/washing water and are therefore at lower risk of exposure to the disease. The population of the villages in the area of the proposed GLeWaP bulk water distribution area are more at risk of infection as they currently rely heavily on communal taps, borehole and/or river water.

*** Diarrhoeal diseases**

The lack of water-borne sewage systems in the proposed GLeWaP bulk water distribution area increases the risk of spread of diarrhoeal diseases as untreated sewage may enter rivers, streams and underground water resources. The risk of exposure to diarrhoeal disease is significantly lower in the Tzaneen townships which are supplied with water-borne sewage systems and/or Ventilation Improved Pit (VIP) latrines in accordance with RDP standards.

*** Healthcare infrastructure/resources**

Latest available information (Limpopo Department of Health and Welfare, 2003) shows that the status of healthcare services within the GTLM and GLLM is inadequate to effectively respond to the community health needs:

Figure 6.1: **Health infrastructure and resources: Limpopo Province 2003**

ISSUE	GLLM	GTLM
Fixed clinics	20	33
Prof nurse	77	187
Prof nurse:population ratio	1:2612	1:2588
Ave no of patients/nurse/month	1:974	1:572
Mobile clinics	4	10
Visiting points	141	457
Frequency	Monthly	Monthly
Prof nurses	4	10
District hospitals	2	2
Number of beds	262	250
Regional hospital	-	1
Private hospital	-	1
Special care hospital	-	-
Prof houses	58	55
Medical doctors	14	24
NGOs/CBOs dealing with HIV/AIDS	4	39

*** Poverty**

The majority of communities within the GTLM and TLLM are impoverished with generally poor standards of nutrition, especially amongst children. Poor nutritional standards impact adversely on the health status of populations and significantly increase the risk of disease.

In summary therefore, the health of the populations currently living in the settlements located within the proposed GLeWaP bulk water distribution area is compromised by several factors at present, including low income levels, poor nutritional standards, lack of access to health care facilities, high incidence of HIV and TB infections, largely unknown incidence of schistosomiasis and diarrhoeal disease. Malaria may

also present a threat and additional health concerns such as diabetes, hypertension and pneumonia may further complicate matters.

6.1.3 Potential health risks to which construction workers will be exposed

Construction workers engaged on all of the sites (Tzaneen Dam, dam site at Nwamitwa, borrow pits and sites of the bulk water distribution infrastructure) can be expected to be exposed to the following health risks:

- **chemical stressors**
  - inhalation exposure to airborne hazardous chemical substances (total inhalable particulates, respirable particulates, cement dusts, bitumen fume, volatile organic compounds, welding fumes, gas-cutting fumes, diesel exhaust emissions).
  - dermal exposure to volatile organic compounds, cement dusts, bitumen products.

- **physical stressors**
  - excessive noise rating levels (plant machinery, pneumatic tools, impact tools, hammering, grinding, compressors, blasting).
  - excessive heat stress conditions (work requiring moderate to high metabolic work rates under hot/humid environmental conditions).
  - excessive cold stress conditions (night-time and early winter mornings).
  - vibration (whole body vibration during operation of plant machinery and vehicles; hand-arm vibration when operating power tools, compactors).
  - ultraviolet radiation (prolonged and/or repeated exposures to sunlight).

- **ergonomic stressors**
  - work requiring manual lifting and carrying of heavy materials.
  - work requiring heavy manual labour (digging, drilling etc).
  - repetitive work.
  - prolonged standing.
  - prolonged sitting (machine operators).
  - pushing / pulling activities.

- **hazardous biological agents**
  - sexually transmitted diseases (HIV, syphilis).
  - infectious diseases (TB, diarrhoeal diseases).

- vector borne diseases (malaria, schistosomiasis).

6.1.4 Potential health risks to communities during construction

Communities in close proximity to the construction sites (Tzaneen dam, dam site at Nwamitwa, borrow pits and sites of the bulk water distribution infrastructure) can be expected to be exposed to the following health risks as a result of construction activities:

- **chemical stressors**
  - inhalation exposure to airborne pollutants (total inhalable particulates, respirable particulates, cement dusts, bitumen fumes)
  - ingestion exposure to pollutants released into existing water courses (oils, volatile organic compounds, pesticides, herbicides, sewage, garbage)

- **physical stressors**

  Excessive noise rating levels (plant machinery, pneumatic tools, impact tools, hammering, grinding, compressors, blasting, operation of pump stations) – planned 24 hour work schedules

- **hazardous biological agents**
  - sexually transmitted diseases (HIV, syphilis)
  - infectious diseases (TB, diarrhoeal diseases)
  - vector borne diseases (malaria, schistosomiasis)

6.2 HEALTH IMPACT ASSESSMENT

Figure 6.2: **Health impacts associated with transmittable disease – from construction/maintenance workers to the surrounding communities**

Description of potential impact	Transmission of HIV, syphilis, TB	
Legal requirements	TB is notifiable disease	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Regional	Regional
Duration of impact	Short term	Long term
Intensity	Medium	Low

Probability of occurrence	Medium	Medium
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Low
Mitigation measures (EMP requirements)	Testing, Treatment, Education	Testing, Treatment, Education
Level of significance after mitigation	Medium	Low
Cumulative Impacts	Simultaneous infections with HIV and other diseases may exacerbate condition	Simultaneous infections with HIV and other diseases may exacerbate condition
Comments or Discussion: As noted, the incidence of HIV and STI in migrant workers such as construction workers is likely to be elevated and may even exceed the already high prevalence rate amongst the local population (24.7% in antenatal women – 2006). Construction workers are more likely to engage in risky sexual practices and the risk of transmission of HIV / STI from these workers to members of the local communities is deemed moderate-high.		

Figure 6.3: **Health impacts associated with transmittable disease – from surrounding communities to construction/maintenance workers**

Description of potential impact	Transmission of HIV, syphilis, TB	
Legal requirements	TB is notifiable disease	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Regional	Regional
Duration of impact	Short term	Long term
Intensity	Medium	Low
Probability of occurrence	Medium	Medium
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Low
Mitigation measures (EMP requirements)	Testing, Treatment, Education	Testing, Treatment, Education

Level of significance after mitigation	Medium	Low
Cumulative Impacts	Simultaneous infections with HIV and other diseases may exacerbate condition	Simultaneous infections with HIV and other diseases may exacerbate condition
Comments or Discussion: ~24.7% of antenatal women in the Mopani District Municipality tested HIV positive in 2006. It can be assumed therefore that the incidence of HIV infection in the local community is high and that there is a strong possibility that there will be some transmission of HIV infection from locals to construction workers following high risk sexual interactions.		

Figure 6.4: Health impacts on construction workers associated with construction activities – noise rating levels

Description of potential impact	Exposure to excessive noise rating levels (LAr,8h > 85dBA)	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Noise Induced Hearing Loss Regulations, SANS 10083:2004	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Medium-High	Medium
Probability of occurrence	High	Medium
Confidence of assessment	Medium	Medium
Level of significance before mitigation	High	Medium
Mitigation measures (EMP requirements)	Noise survey, Noise zoning, issue of PPE (hearing protective devices), Audiometry, Training	Noise survey, Noise zoning, issue of PPE (hearing protective devices), Audiometry, Training
Level of significance after mitigation	Medium	Low
Cumulative Impacts		
Comments or Discussion: Construction activities are known to generate excessive noise rating levels to which workers are very likely to be directly exposed. There is a high probability that some workers (machine/tool operators, blasting teams) will be exposed to 8 hour average noise rating levels in excess of the Statutory limit (85dBA). As a consequence there is a real		

risk of construction workers suffering from some form of noise induced hearing loss.

Figure 6.5: Health impacts on construction workers associated with construction activities – inhalation exposure to Hazardous Chemical Substances

Description of potential impact	Inhalation Exposure to Hazardous Chemical Substances (total inhalable, respirable particulates, cement dusts, bitumen fume, welding fume, VOC, diesel exhaust emissions)	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Regulations for Hazardous Chemical Substances, Construction Regulations; National Environment Management Air Quality Act (Act 39 of 2004)	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	Medium	Low
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Low
Mitigation measures (EMP requirements)	Baseline HCS Risk Assessment, Personal and ambient air sampling surveys, PPE (respiratory protective equipment), Medical surveillance, Training	Baseline HCS Risk Assessment, Personal and ambient air sampling surveys, PPE (respiratory protective equipment), Medical surveillance, Training
Level of significance after mitigation	Low	Low
Cumulative Impacts	Exposure to elevated airborne concentrations of HCS could complicate any existing medical conditions	Exposure to elevated airborne concentrations of HCS could complicate any existing medical conditions
Comments or Discussion: Construction activities will result in the emission of several airborne pollutant compounds, primarily airborne particulate matter (total inhalable and PM10 / respirable dusts). Road tarring activities are likely to expose workers to airborne concentrations of bitumen fumes and coal tar pitch volatiles (carcinogenic). Concrete fabrication will expose workers to airborne concentrations of cement dusts (irritant and corrosive). Operation of diesel powered vehicles will		

expose workers to airborne diesel exhaust fume (including carcinogenic diesel particulate matter).

Figure 6.6: Health impacts on construction workers associated with construction activities – dermal exposure to Hazardous Chemical Substances

Description of potential impact	Dermal Exposure to Hazardous Chemical Substances (cement dusts, bitumen, VOC, misc oils and greases)	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Regulations for Hazardous Chemical Substances, Construction Regulations	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Short term
Intensity	Low	Low
Probability of occurrence	Medium	Medium
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Medium
Mitigation measures (EMP requirements)	Baseline HCS Risk Assessment, Personal and ambient air sampling surveys, PPE (respiratory protective equipment), Medical surveillance, Training	Baseline HCS Risk Assessment, Personal and ambient air sampling surveys, PPE (respiratory protective equipment), Medical surveillance, Training
Level of significance after mitigation	Low	Low
Cumulative Impacts	Dermal exposure to solvents and oils could increase the risk of secondary skin infections	Dermal exposure to solvents and oils could increase the risk of secondary skin infections
Comments or Discussion: Construction workers are likely to experience direct skin contact with a variety of chemical compounds including VOC, oils, greases, cement, tar etc. Such dermal contact may result in a variety of health effects ranging from localised irritation of exposed skin to absorption of the chemicals through intact skin and into the body where they may cause systemic health effects.		

Figure 6.7: Health impacts on construction workers associated with construction activities – Heat Stress

Description of potential impact	Exposure to Heat Stress Conditions	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Environmental Regulations, Construction Regulations	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	Medium	Low
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Low
Mitigation measures (EMP requirements)	Baseline Heat Stress Risk Assessment, PPE, Acclimatisation, Medical surveillance, Training	Baseline Heat Stress Risk Assessment, PPE, Acclimatisation, Medical surveillance, Training
Level of significance after mitigation	Low	Low
Cumulative Impacts	Exposure to excessive heat stress could exacerbate other, existing medical conditions	Exposure to excessive heat stress could exacerbate other, existing medical conditions
Comments or Discussion: Local climate may periodically cause workers to be exposed to high air temperatures as well as elevated humidity levels (>50%), especially in Summer. Whilst the risk of outdoor worker exposure to Wet Bulb Globe Temperatures (WBGT) in excess of the Statutory limit (30 for 1 hour) is likely to be low, workers performing tasks which require moderate to high metabolic work rates (digging, carrying, lifting), or which are performed indoors, may be at some risk of developing heat stress related symptoms (heat syncope, heat exhaustion, heatstroke).		

Figure 6.8: Health impacts on construction workers associated with construction activities – Cold Stress

Description of potential impact	Exposure to Cold Stress Conditions	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Environmental Regulations, Construction Regulations	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	Medium	Low
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Low
Mitigation measures (EMP requirements)	Baseline Cold Stress Risk Assessment, PPE, Medical surveillance, Training	Baseline Cold Stress Risk Assessment, PPE, Medical surveillance, Training
Level of significance after mitigation	Low	Low
Cumulative Impacts	Exposure to excessive cold stress could increase the risk of exacerbating other medical conditions	Exposure to excessive cold stress could increase the risk of exacerbating other medical conditions
Comments or Discussion: Local climate ensures that worker exposure to air temperatures <6^{0}C is unlikely to occur except on occasional winter nights or mornings. The risk of workers being exposed to <6^{0}C for more than the Statutory limit of 4 hours is low as air temperatures rise rapidly following sunrise. Construction activities are however planned for 24 hours and there may be some risk of worker exposure to uncomfortably cold conditions during winter nights and early mornings.		

Figure 6.9: Health impacts on construction workers associated with construction activities – Vibration Stress

Description of potential impact	Exposure to Vibration Stress	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993), Construction Regulations	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	Medium	Low
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Low
Mitigation measures (EMP requirements)	Baseline Ergonomics Risk Assessment, Vehicle, Tool, Plant Maintenance, PPE, Medical surveillance, Training	Baseline Ergonomics Risk Assessment, Vehicle, Tool, Plant Maintenance, PPE, Medical surveillance, Training
Level of significance after mitigation	Low	Low
Cumulative Impacts	Exposure to vibration stress could exacerbate other medical conditions	Exposure to vibration stress could exacerbate other medical conditions
Comments or Discussion: Vehicle operators may be at some risk of exposure to Whole Body Vibration (WBV) whilst operators of compactors, drilling machines and similar tool/machinery may be at risk of exposure to Hand-Arm Vibration (HAV). Plant equipment, pumps, compressors may also be sources of vibration. Actual assessment of these risks would only be possible once it is known what equipment is to be used at the sites and what state of repair it is in. The impact of the operation of pump stations would require similar assessment following completion and commissioning.		

Figure 6.10: Health impacts on construction workers associated with construction activities – UV Radiation

Description of potential impact	Exposure to Ultraviolet Radiation (sunlight)	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993), Construction Regulations	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Short term
Intensity	Medium	Medium
Probability of occurrence	High	Medium
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Medium
Mitigation measures (EMP requirements)	PPE, Medical surveillance, Education, Training	PPE, Medical surveillance, Education, Training
Level of significance after mitigation	Low	Low
Cumulative Impacts	n/a	n/a
Comments or Discussion: Construction workers will spend the majority of their time outdoors and directly exposed to sunlight. South Africa has a very high incidence of solar UVA and UVB and there is a high risk of suffering skin damage following prolonged or repeated exposures to sunlight. Although fair skinned people are most at risk in this regard, darker skinned persons can also develop serious and life threatening conditions (cancers) if exposed to excessive amounts of sunlight.		

Figure 6.11: Health impacts on construction workers associated with construction activities – Ergonomic Stress

Description of potential impact	Exposure to Ergonomic Stress	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993), Construction Regulations	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Short term
Intensity	Medium	Low
Probability of occurrence	Medium	Low
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Low
Mitigation measures (EMP requirements)	Mechanical assistance, Medical surveillance, Education, Training	Mechanical assistance, Medical surveillance, Education, Training
Level of significance after mitigation	Medium	Low
Cumulative Impacts	n/a	n/a
Comments or Discussion: Many of the construction workers will engage in manual labour activities which require physical strength to perform and may consequently expose them to musculo-skeletal stresses and strains. Although mechanical assistance may be available for digging and transport purposes there remains significant risk of injury to workers. Correct training is vital if injuries are to be prevented.		

Figure 6.12: Health impacts on construction workers associated with construction activities - Malaria

Description of potential impact	Exposure to Hazardous Biological Agents - Malaria	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993), Regulations for Hazardous Biological Agents	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Medium	Medium
Probability of occurrence	Low	Low
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Medium
Mitigation measures (EMP requirements)	Prophylaxis, Chemical control (Spraying of Accommodations with DDT), Medical surveillance, Education, Training	Prophylaxis, Chemical control (Spraying of Accommodations with DDT), Medical surveillance, Education, Training
Level of significance after mitigation	Low	Low
Cumulative Impacts	Malaria infection is very likely to impact adversely on any pre-existing medical condition	Malaria infection is very likely to impact adversely on any pre-existing medical condition
Comments or Discussion: Although the Mopani District Municipality (MDM) is not an endemic malaria region, incidences of malaria are regularly recorded. During 2006, ~20% of the 6369 cases of malaria recorded in Limpopo Province where from the MDM. Whilst no hard evidence exists to confirm the presence of either the malarial parasite (*P.falciparum*) or the insect vector (Anopheles mosquitoes) in the area, construction workers may be at some risk of contracting malaria from already infected persons (via a mosquito vector). Development of a comprehensive malaria control programme for the construction sites would however adequately address these risks. The incidence of malaria is very seasonal, with the vast majority of cases being recorded in the summer wet season. Precautionary measures and controls should be prioritised during the peak infection season.		

Figure 6.13: Health impacts on construction workers associated with construction activities - Schistosomiasis

Description of potential impact	Exposure to Hazardous Biological Agents - Schistosomiasis	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993), Regulations for Hazardous Biological Agents	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	Low	Low
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Low	Low
Mitigation measures (EMP requirements)	Clean water supply, Medical surveillance, Education, Training	Clean water supply, Medical surveillance, Education, Training
Level of significance after mitigation	Low	Low
Cumulative Impacts	Schistosomiasis is very likely to impact adversely on any pre-existing medical condition	Schistosomiasis is very likely to impact adversely on any pre-existing medical condition
Comments or Discussion: Because schistosomiasis is not a notifiable disease its incidence in the Mopani District Municipality (MDM) is largely unknown. There is some evidence to suggest that between 10-50% of children under 14 years of age may be (or have been) infected. Construction workers are likely to be at minimal risk of contracting the disease provided they observe basic precautions such as not drinking from unknown water sources, not bathing, washing in untreated water. As the construction sites will have ready access to clean potable water the risks of exposure should be lower than for the local populace. Construction workers are also likely to have better access to health services which will ensure better diagnosis and treatment.		

Figure 6.14: Health impacts on construction workers associated with construction activities – Diarrhoeal Diseases

Description of potential impact	Exposure to Hazardous Biological Agents - Infectious Diarrhoeal Diseases	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993), Regulations for Hazardous Biological Agents	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	Low	Low
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Low	Low
Mitigation measures (EMP requirements)	Clean water supply, Formal ablution facilities, Good food hygiene and personal hygiene practices, Medical surveillance, Education, Training	Clean water supply, Formal ablution facilities, Good food hygiene and personal hygiene practices, Medical surveillance, Education, Training
Level of significance after mitigation	Low	Low
Cumulative Impacts	Diarrhoeal diseases are very likely to impact adversely on any pre-existing medical condition	Diarrhoeal diseases are very likely to impact adversely on any pre-existing medical condition
Comments or Discussion: Construction workers are likely to be at minimal risk of contracting diarrhoeal disease provided they observe basic precautions such as not drinking from unknown water sources, not bathing or washing in untreated water and making use of controlled ablution facilities. Provided that the construction sites have ready access to clean potable water, formal controlled ablution facilities and well run kitchen and canteen facilities, the risks of worker exposure to pathogenic micro-organisms will be significantly lower than for the local populace. Construction workers are also likely to have better access to health services which will ensure better diagnosis and treatment should any disease be contracted.		

Figure 6.15: Health impacts on communities associated with construction activities – Hazardous Chemical Substances (Tzaneen site)

Description of potential impact	Inhalation Exposure to ambient concentrations of Hazardous Chemical Substances (total inhalable, respirable particulates, cement dusts, diesel exhaust emissions) – Tzaneen site	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Regulations for Hazardous Chemical Substances, National Environment Management Air Quality Act (Act 39 of 2004)	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	High	Low
Confidence of assessment	High	High
Level of significance before mitigation	Low	Low
Mitigation measures (EMP requirements)	Baseline Air Quality Impact Assessment, effective dust control programmes	Management of effective dust control programmes
Level of significance after mitigation	Low	Low
Cumulative Impacts	Exposure to elevated airborne concentrations of HCS could complicate any existing medical conditions	Exposure to elevated airborne concentrations of HCS could complicate any existing medical conditions
Comments or Discussion: Construction activities at the Tzaneen site will result in the emission of airborne pollutant compounds, particularly airborne particulate matter (total inhalable and PM10 / respirable dusts). Concrete fabrication will generate airborne concentrations of cement dusts (irritant and corrosive) whilst the operation of diesel powered machinery will generate airborne concentrations of diesel exhaust emissions including carcinogenic diesel particulate matter. Based on the outcome of the Air Quality Impact Assessment, particulate emissions generated at the construction site are unlikely to impact significantly on nearby sensitive receptors. The associated health risk to residents is therefore minimal and can be effectively reduced even further by implementation of appropriate mitigation measures.		

Figure 6.16: Health impacts on communities associated with construction activities - Hazardous Chemical Substances (Nwamitwa site)

Description of potential impact	Inhalation Exposure to ambient concentrations of Hazardous Chemical Substances (total inhalable, respirable particulates, cement dusts, bitumen fume, diesel exhaust emissions) – Nwamitwa site	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Regulations for Hazardous Chemical Substances, National Environment Management Air Quality Act (Act 39 of 2004)	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Medium	Low
Probability of occurrence	High	Low
Confidence of assessment	High	High
Level of significance before mitigation	Medium (Nkamboko)	Low
Mitigation measures (EMP requirements)	Baseline Air Quality Impact Assessment, effective dust control programmes	Management of effective dust control programmes
Level of significance after mitigation	Low	Low
Cumulative Impacts	Exposure to elevated airborne concentrations of HCS could complicate any existing medical conditions	Exposure to elevated airborne concentrations of HCS could complicate any existing medical conditions
Comments or Discussion: Construction activities at the Nwamitwa site will result in the emission of airborne pollutant compounds, including airborne particulate matter (total inhalable and PM10 / respirable dusts), bitumen fumes and coal tar pitch volatiles (carcinogenic), cement dusts (irritant and corrosive) and diesel exhaust emissions including carcinogenic diesel particulate matter. Based on the completed Air Quality Impact Assessment, emissions of particulate matter from dam wall construction activities are only likely to impact significantly on the nearby Nkamboko settlement. In the absence of any effective mitigation measures, the residents of Nkamboko may be at risk of exposure elevated airborne concentrations of PM10 respirable dusts which may in turn impact adversely on their health. Following completion of construction activities, routine operation of the infrastructure is unlikely to impact significantly on ambient air quality / public health.		

Figure 6.17: Health impacts on communities associated with construction activities - Hazardous Chemical Substances (Bulk infrastructure sites)

Description of potential impact	Inhalation Exposure to ambient concentrations of Hazardous Chemical Substances (total inhalable, respirable particulates, cement dusts, bitumen fume, diesel exhaust emissions) – Bulk infrastructure sites (reservoirs, pumpstations, water treatment plant)	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Regulations for Hazardous Chemical Substances, National Environment Management Air Quality Act (Act 39 of 2004)	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Medium	Low
Probability of occurrence	High	Low
Confidence of assessment	High	High
Level of significance before mitigation	Medium (Serololololo)	Low
Mitigation measures (EMP requirements)	Baseline Air Quality Impact Assessment, effective dust control programmes	Management of effective dust control programmes
Level of significance after mitigation	Low	Low
Cumulative Impacts	Exposure to elevated airborne concentrations of HCS could complicate any existing medical conditions	Exposure to elevated airborne concentrations of HCS could complicate any existing medical conditions
Comments or Discussion: Construction activities at the reservoir and pump station sites will result in the emission of airborne pollutant compounds, including airborne particulate matter (total inhalable and PM10 / respirable dusts), cement dusts (irritant and corrosive) and diesel exhaust emissions (carcinogenic). Based on the completed Air Quality Impact Assessment, emissions of particulate matter from these sites are only likely to impact significantly on the Serololololo settlement. In the absence of effective mitigation measures, residents of Serololololo may be at risk of exposure elevated airborne concentrations of PM10 dusts – may impact adversely on their health. Following completion of the construction activities, routine operation of the bulk infrastructure is unlikely to impact significantly on ambient air quality / public health.		

Figure 6.18: Health impacts on communities associated with construction activities - Hazardous Chemical Substances (Borrow Pits)

Description of potential impact	Inhalation Exposure to ambient concentrations of Hazardous Chemical Substances (total inhalable, respirable particulates, cement dusts, bitumen fume, diesel exhaust emissions) – Borrow Pits	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Regulations for Hazardous Chemical Substances, National Environment Management Air Quality Act (Act 39 of 2004)	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	n/a
Extent of impact	Local	n/a
Duration of impact	Short term	n/a
Intensity	Low	n/a
Probability of occurrence	High	n/a
Confidence of assessment	High	n/a
Level of significance before mitigation	Low	n/a
Mitigation measures (EMP requirements)	Baseline Air Quality Impact Assessment, effective dust control programmes	n/a
Level of significance after mitigation	Low	n/a
Cumulative Impacts	Exposure to elevated airborne concentrations of HCS could complicate any existing medical conditions	n/a
Comments or Discussion: Borrow pit activities will result in the emission of airborne pollutant compounds, including airborne particulate matter (total inhalable and PM10 / respirable dusts) and diesel exhaust emissions (including carcinogenic diesel particulate matter). Based on the completed Air Quality Impact Assessment, emissions of particulate matter from borrow pit activities are unlikely to impact significantly on any of the residential settlements – i.e. minimal public health risk.		

Figure 6.19: Health impacts on communities associated with construction activities - Hazardous Chemical Substances (Transport of Material)

Description of potential impact	Inhalation Exposure to ambient concentrations of Hazardous Chemical Substances (total inhalable, respirable particulates, cement dusts, bitumen fume, diesel exhaust emissions) – Transportation of material	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Regulations for Hazardous Chemical Substances, National Environment Management Air Quality Act (Act 39 of 2004)	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	n/a
Extent of impact	Local	n/a
Duration of impact	Short term	n/a
Intensity	Low	n/a
Probability of occurrence	High	n/a
Confidence of assessment	High	n/a
Level of significance before mitigation	Low	n/a
Mitigation measures (EMP requirements)	Baseline Air Quality Impact Assessment, effective dust control programmes	n/a
Level of significance after mitigation	Low	n/a
Cumulative Impacts	Exposure to elevated airborne concentrations of HCS could complicate any existing medical conditions	n/a
Comments or Discussion: Transport of materials along roadways will result in the entrainment of airborne particulate matter (total inhalable and PM10 / respirable dusts) and diesel exhaust emissions (including carcinogenic diesel particulate matter). Based on the completed Air Quality Impact Assessment, emissions of particulate matter from transport activities are unlikely to impact significantly on any of the residential settlements – i.e. minimal public health risk.		

Figure 6.20: Health impacts on communities associated with construction activities – Ingestion of pollutants

Description of potential impact	Ingestion exposure to pollutants released into existing water courses	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Regulations for Hazardous Chemical Substances, National Environment Management Air Quality Act (Act 39 of 2004)	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	Medium	Low
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Low
Mitigation measures (EMP requirements)	Effective pollution control programmes	Effective pollution control programmes
Level of significance after mitigation	Low	Low
Cumulative Impacts	Exposure to elevated levels of pollutant compounds in drinking water will complicate any existing medical conditions	Exposure to elevated levels of pollutant compounds in drinking water will complicate any existing medical conditions
Comments or Discussion: Construction activities may generate chemical pollutants which could enter the existing water courses if control measures are not effectively implemented. The majority of the local populace within the proposed GLeWaP bulk water distribution area obtains at least some of their water from uncontrolled sources (rivers, boreholes) which may be readily polluted following spillage (deliberate or accidental) of chemicals as a result of construction activities. Following completion of construction activities, routine operation of the infrastructure is unlikely to pose any significant risk of additional water pollution.		

Figure 6.21: Health impacts on communities associated with construction activities – Noise Rating Levels

Description of potential impact	Exposure to excessive ambient noise rating levels	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993) – Noise Induced Hearing Loss Regulations, SANS 10083:2004, SANS 10103:2003, SANS 10328:2003	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative	Negative
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Medium	Low
Probability of occurrence	Medium	Low
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Low
Mitigation measures (EMP requirements)	Baseline ambient noise survey, Engineering control measures, Noise control program	Baseline ambient noise survey, Engineering control measures, Noise control program
Level of significance after mitigation	Low	Low
Cumulative Impacts		
Comments or Discussion: Construction activities will generate elevated noise rating levels which are likely to have some impact on ambient noise rating levels in the surrounding communities. These impacts are however expected it be restricted to annoyance and irritation rather than having significant health impacts. The planned 24 hour operation of some construction sites is likely to cause some annoyance to affected parties during night-time.		

Figure 6.22: Health impacts on communities associated with construction activities - Malaria

Description of potential impact	Exposure to Hazardous Biological Agents - Malaria	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993), Regulations for Hazardous Biological Agents	
Stage	Construction and decommissioning	Operation
Nature of Impact	Positive	Positive
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	Medium	Medium
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Low	Low
Mitigation measures (EMP requirements)	Prophylaxis, Chemical control (Spraying of dwellings with DDT), Medical surveillance, Education, Training	Prophylaxis, Chemical control (Spraying of dwellings with DDT), Medical surveillance, Education, Training
Level of significance after mitigation	Low	Low
Cumulative Impacts	Malaria infection is very likely to impact adversely on any pre-existing medical condition	Malaria infection is very likely to impact adversely on any pre-existing medical condition
Comments or Discussion: As noted, despite the Mopani District Municipality (MDM) not being an endemic malaria region, incidences of malaria are regularly recorded. During 2006, ~20% of the 6369 cases of malaria recorded in Limpopo Province where from the MDM region. Whilst no hard evidence exists to confirm the presence of either the malarial parasite (*P.falciparum*) or the insect vector (Anopheles mosquitoes) in the area, construction activities may in fact lower the risk of community members contracting malaria due to improved vector control through effective spraying campaigns. The development of a comprehensive malaria control programme for the construction sites could also effectively address malaria risks in surrounding communities. It is unlikely that, following construction activities, the new dam at Nwamitwa will increase the risk of malaria in the MDM region – the dam may in fact reduce the risks due to infiltration/inundation of previous potential mosquito habitats.		

Figure 6.23: Health impacts on communities associated with construction activities - Schistosomiasis

Description of potential impact	Exposure to Hazardous Biological Agents - Schistosomiasis	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993), Regulations for Hazardous Biological Agents	
Stage	Construction and decommissioning	Operation
Nature of Impact	Positive	Positive
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	Medium	Medium
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Medium
Mitigation measures (EMP requirements)	Clean water supply, Medical surveillance, Education, Training	Clean water supply, Medical surveillance, Education, Training
Level of significance after mitigation	Medium	Medium
Cumulative Impacts	Schistosomiasis is very likely to impact adversely on any pre-existing medical condition	Schistosomiasis is very likely to impact adversely on any pre-existing medical condition
Comments or Discussion: Although the incidence of schistosomiasis in the Mopani District Municipality (MDM) is largely unknown, there is some evidence to suggest that between 10-50% of children under 14 years of age may be (or have been) infected. The construction of the dam at the Nwamitwa site and the provision of bulk water supply infrastructure to the broader community will undoubtedly reduce the risk of locals contracting schistosomiasis. Provision of clean potable water to households will prevent occupants from having to collect water from uncontrolled sources and thereby reduce their risk of exposure to schistosoma pathogens and vectors. Education will further improve matters.		

Figure 6.24: Health impacts on communities associated with construction activities – Diarrhoeal Diseases

Description of potential impact	Exposure to Hazardous Biological Agents - Infectious Diarrhoeal Diseases	
Legal requirements	Occupational Health & Safety Act (Act 85 0f 1993), Regulations for Hazardous Biological Agents	
Stage	Construction and decommissioning	Operation
Nature of Impact	Positive	Positive
Extent of impact	Local	Local
Duration of impact	Short term	Short term
Intensity	Low	Low
Probability of occurrence	Medium	High
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Medium	Medium-High
Mitigation measures (EMP requirements)	Clean water supply, improved ablution facilities, improved food hygiene and personal hygiene, Education	Clean water supply, improved ablution facilities, improved food hygiene and personal hygiene, Education
Level of significance after mitigation	Medium	Medium-High
Cumulative Impacts	Diarrhoeal diseases are very likely to impact adversely on any pre-existing medical condition	Diarrhoeal diseases are very likely to impact adversely on any pre-existing medical condition
Comments or Discussion: The construction of the dam at the Nwamitwa site and the provision of bulk water supply infrastructure to the broader community will reduce the risk of locals contracting diarrhoeal diseases. Provision of clean potable water to households will prevent occupants from having to collect water from uncontrolled sources and thereby reduce their risk of exposure to pathogenic micro-organisms associated with causing diarrhoeal disease. Education will further improve matters. Similarly, the provision of water borne sewage systems or RDP approved latrine facilities will significantly lower the risk of infection. Education will further improve matters		

7. RECOMMENDED MITIGATION MEASURES

7.1 MITIGATION MEASURES: TRANSMITTABLE DISEASES

Construction workers

- All construction workers should be subject to baseline (pre-employment) medical examinations. The structure of these examinations should be at the discretion of a registered Occupational Medical Practitioner but should include appropriate testing for:
  - Tuberculosis.
  - HIV (voluntary consent but strongly encouraged).
  - Syphilis.
  - Other STI.
- Infected workers must be afforded appropriate treatment and/or counselling whilst all workers should be subject to education and training in the health risks associated with high risk sexual activities.
- Workers must be made familiar with the routes of exposure to STI and TB as well as ways to reduce the risks and/or prevent infection.
- Workers should be made to be familiar with the signs and symptoms of STI and should be encouraged to seek prompt treatment in the event of them developing these signs and symptoms.
- Consideration should be given to distributing free condoms to workers and encouraging their use through education.

Surrounding community

- Members of the communities should be encouraged to undergo voluntary examination/testing for:
  - Tuberculosis.
  - HIV.
  - Syphilis.
  - Other STI.
- Infected individuals should be encouraged to undergo appropriate treatment and/or counselling.
- Communities should be made familiar with the routes of exposure to HIV/STI and TB as well as ways to reduce the risks and/or prevent infection.

- Communities should also be made to be familiar with the signs and symptoms of infection and should be encouraged to seek prompt treatment in the event of them developing these signs and symptoms.
- Local healthcare resources are already struggling to cope with current HIV/AIDS and TB related infections and disease. Prior to initiation of construction activities it is recommended that community leaders be informed of the possible health risks associated with transmission of disease from/to workers and the communities. Community leaders should then be encouraged to distribute this knowledge and information to their community members.

7.2 MITIGATION MEASURES: NOISE RATING LEVELS

Construction workers

- In terms of the Construction Regulations promulgated under the Occupational Health and Safety Act (Act 85 of 1993), it is required of all contractors to conduct a baseline risk assessment prior to performing any construction activities. This risk assessment must identify and evaluate all of the risks to the health and safety of persons engaging in construction activities.
- Given that construction activities will expose workers to excessive noise rating levels it is recommended that a baseline noise survey also be conducted as soon as possible following commencement of site activities – in accordance with the requirements of the Noise Induced Hearing Loss Regulations (OHSAct 85 of 1993) and SANS 10083:2004. This noise survey will quantify worker exposures to noise during typical activities and allow for informed comment on the relative risks to hearing presented by various activities – i.e. identify sources of excessive noise and allow for demarcation of noise zones. Recommendations with regard to appropriate control measures (engineering controls and/or personal protective equipment) can then follow. A formal noise survey will also permit structuring of an appropriate audiometric examination protocol for construction workers – as required by the Noise Induced Hearing Loss Regulations – OHSAct 85 of 1993.

Surrounding communities

The health risks to surrounding communities presented by ambient noise rating levels generated by activities conducted on the various construction sites are likely to be low based on the findings of the Noise Impact Assessment. Noise generated by construction activities are however likely to present some annoyance to affected

residents, with night-time and after-hours activities being of particular concern. Mitigation measures to limit such annoyance noise are detailed in the Noise Impact Assessment.

7.3 MITIGATION MEASURES: HAZARDOUS CHEMICAL SUBSTANCES

Construction workers

- Workers engaged on the various construction sites are likely to be at some risk of inhalation and/or dermal exposure to a large variety of HCS. In order to formally assess the health risks associated with such exposures it is a requirement of law (Construction Regulations and the Regulations for Hazardous Chemical Substances – OHSAct 85 of 1993) that an initial HCS Risk Assessment be performed. It is strongly recommended that an initial HCS Risk Assessment be performed for each of the construction sites. The outcomes of these assessments will permit specific and relevant comment on the suitability of existing engineering control measures, Personal Protective Equipment, policies and work procedures in preventing/controlling worker exposure to HCS. Comment on the need for personal air monitoring programmes and/or medical surveillance programmes will also be assessed by these baseline studies.
- In order to minimise the generation of dust by construction activities it is recommended that a formal wetting down procedures for sites be drafted and implemented. Additional dust control measures are detailed under the discussion for surrounding communities (overleaf).
- All diesel powered equipment and vehicles used in construction activities must be suitably serviced, maintained and repaired in order to minimise the emission of diesel particulate matter and reduce subsequent worker exposure to this carcinogenic substance.

Surrounding communities

- Construction activities will also cause surrounding communities to be potentially exposed to a range of airborne pollutants. The outcome of the Air Quality Impact Assessment revealed that the only community likely to be significantly affected by ambient particulate emissions from construction activities is the Nkamboko settlement (proposed dam wall site at Nwamitwa).
- In order to minimise the generation of particulate emissions from construction activities it is recommended that:

- All roads, accessways and other unpaved areas on which vehicular traffic will be required to operate should be subject to appropriate dust control measures. Application of chemical suppressant materials to road surfaces is an effective means of reducing dust generation. Simple wetting down with water may also prove effective, especially on surfaces which are in temporary or intermittent use.
- Speed limits be set and enforced on all surfaces and roads. Paved surfaces/roads should be subject to a speed limit of 35km/h whilst on unpaved surfaces/roads the speed limit should be 15-20km/h.
- The carry over of mud or dirt onto paved roads should be prevented as far as possible in order to limit subsequent dust generation following drying out of these materials.
- Traffic movement should be minimised as far as possible.
- Spillages onto road surfaces must be promptly cleaned up.
- All areas exposed during excavation activities should be re-vegetated and stabilised as soon as possible.
- Minimise the extent of the excavations as far as reasonably practicable.
- All excavated areas and related accessways must be subject to an appropriate wetting down procedure – especially under dry and windy weather conditions.
- The heights of stockpiles should be minimised as far as possible to reduce wind entrainment and stockpiles should be located as far away from sensitive receptors as possible.
- Windbreaks should be erected around stockpiles where possible in order to reduce wind entrainment of dust emissions.

7.4 MITIGATION MEASURES: THERMAL STRESS

Construction workers

As previously noted it is required in terms of the Construction Regulations (OHSAct 85 of 1993) that all contractors conduct an initial health risk assessment of their workers activities prior to initiating any work on site. One of the stressors to which construction workers may be exposed in the course of their work on the GLeWaP project may be thermal stress (heat stress and cold stress). Whilst the initial health risk assessment would allow for more specific comment on the health risks

associated with worker exposure to thermal stress, appropriate mitigation measures would include:

- **Heat Stress**
  - Ensuring that all workers are medically fit to conduct their activities, with priority being given to those workers required to engage in manual physical labour activities – pre-employment medical examinations are recommended
  - Ensuring that all workers are suitably informed and trained in the signs and symptoms of heat stress
  - Ensuring that all workers are trained in appropriate measures to prevent heat stress related injuries or illnesses. Informing workers of the need to drink regular quantities of water should be prioritised. Ready access to drinking water must be provided at all work locations.
  - Drafting of formal work procedures for working in hot environments

- **Cold Stress**
  - Issuing of appropriate protective wear (jackets, hats and gloves) should suffice in preventing workers from developing any adverse health effects following exposure to cold working conditions.
  - Use of hand-held powered machinery and/or tools should be subject to special precautions under cold climatic conditions (low risk in this instance).

7.5 MITIGATION MEASURES: VIBRATION STRESS

Construction workers

In terms of the Construction Regulations (OHSAct 85 of 1993), all contractors must conduct an initial health risk assessment of their workers activities prior to initiating any work on site. Another of the potential stressors to which construction workers may be exposed in the course of their work is vibration stress. Whilst the initial health risk assessment would allow for more specific comment on the health risks associated with worker exposure to vibration stress, appropriate mitigation measures would include:

- Ensuring that all equipment, tools and vehicles are properly maintained according to design specifications so as to minimise the risk of worker exposure to excessive vibration stress
- Ensuring that all defective and broken equipment, tools and vehicles are promptly removed from duty and properly repaired.

- Ensuring that workers are trained to understand the hazards associated with vibration - i.e. sources of vibration, health effects.
- Ensuring that workers are adequately trained to recognise problematic vibration which could cause vibration related injuries.
- Issuing of appropriate personal protective equipment to limit/prevent worker exposure to excessive vibration stress (kidney belts for machine operators etc).

7.6 MITIGATION MEASURES: ULTRAVIOLET RADIATION

Construction workers

Appropriate mitigation measures to address worker exposure to direct sunlight would include:

- Issuing appropriate personal protective equipment (brimmed hats or peaked caps) and enforcing the use of such PPE.
- Educating the workforce about the damaging effects of prolonged and/or repeated exposure to solar radiation.
- Encouraging the diligent use of sunscreens by especially vulnerable persons (fair-haired and light-skinned).

7.7 MITIGATION MEASURES: ERGONOMIC STRESS

Construction workers

Within the context of construction activities, ergonomic stresses present one of the highest risks to worker health. The Construction Regulations (OHSAct 85 of 1993) require that all contractors conduct an initial health risk assessment of their workers activities prior to initiating any work on site. Ergonomic stress must be included as a priority issue in any baseline risk assessment. Whilst the formal risk assessment would allow for identification of specific ergonomic issues, appropriate mitigation measures are likely to include:

- Ensuring that all workers are certified medically fit to perform their duties by a qualified Occupational Medical Practitioner. Priority should be given to high risk work categories such as those engaging in manual physical labour.
- Ensuring that mechanical assistance for lifting and transporting of heavy material is readily available and appropriate to the task.
- Ensuring that workers are adequately trained in lifting techniques and actively practice these techniques.
- Ensuring that workers know when to ask for assistance and do so.

7.8 MITIGATION MEASURES: MALARIA

Construction workers

- Drafting of a formal malaria control plan for the construction sites is recommended. Although compulsory issue of prophylactic drugs to workers is not deemed necessary, consideration could be given to initiating an appropriate chemical control programme at worker accommodation sites. Spraying of effective insecticides to control mosquito populations is an effective way of reducing the risk of malaria and advice on residual spray methods should be obtained from the relevant authority.
- Educating workers in ways and means of preventing malaria is also recommended. Priority should be given to ensuring that workers are aware of the benefits of:
  - Limiting time out of doors after dark.
  - Wearing long sleeved shirts and long trousers after dark.
  - Making use of insect repellents.
  - Closing windows and doors of sleeping quarters at night.
- Consideration should be given to providing all worker sleeping quarters with mosquito repellents (chemical impregnated mats or coils) and/or mosquito nets above beds.
- Ensuring that workers are able to readily identify the common signs and symptoms of malaria so that diagnosis is promptly confirmed and appropriate treatment initiated.

Surrounding communities

- Continuation of existing malaria control measures as implemented by the Provincial and Local health authorities.
- Improve public awareness of risk.
- Improve public knowledge about ways of reducing risks.

7.9 MITIGATION MEASURES: SCHISTOSOMIASIS

Construction workers

* The incidence of Schistosomiasis should be confirmed in the study area by appropriate specialists, preferably before construction begins. A formal assessment should then be made of the risks of contamination following completion of the dam

construction at the proposed Nwamitwa site. In the interim, mitigation measures should include:

- Education and training of workers in ways and means of reducing their risks of infection – i.e:
  - Avoid swimming or bathing in uncontrolled water sources.
  - Avoiding drinking water from uncontrolled or unknown sources.
  - Avoid urinating in water sources / courses.
- Education of workers in signs and symptoms of infection so that medical assistance can be sought and appropriate treatment initiated.
- Ready access to healthcare services for workers in the event of treatment being required.

Surrounding communities

* During the construction phase it is unlikely that communities surrounding the construction sites will be at any increased risk of infection with Schistosomiasis. Following completion of the project the risks of infection will, on balance, be reduced as a consequence of the provision of clean drinking water to communities which were previously reliant on uncontrolled water sources. The following mitigation measures remain relevant:

- Education of the local population in ways and means of reducing their risks of infection – i.e:
  - Avoid swimming or bathing in uncontrolled water sources.
  - Avoiding drinking water from uncontrolled or unknown sources.
  - Avoid urinating in water sources / courses.

7.10 MITIGATION MEASURES: DIARRHOEAL DISEASES

Construction workers

* Mitigation measures should include:

- Education and training of workers in ways and means of reducing their risks of infection – i.e:
  - Avoid swimming or bathing in uncontrolled water sources.
  - Avoiding drinking water from uncontrolled or unknown sources.
  - Avoid urinating in water sources / courses.
  - Follow good personal hygiene practices (washing hands etc).
  - Avoid eating food from unknown or suspect sources.

- Avoid raw or undercooked foods.

- Education of workers in signs and symptoms of infection so that medical assistance can be sought and appropriate treatment initiated.
  - Ready access to healthcare services for workers in the event of treatment being required.
  - Surrounding communities.
  - * During the construction phase it is unlikely that communities surrounding the construction sites will be at any significant increased risk of infection with diarrhoeal diseases. Following completion of the project, the risks of infection will, on balance, be reduced as a consequence of the provision of clean drinking water and improved toilet facilities to communities which were previously reliant on uncontrolled water sources and pit latrines. The following mitigation measures remain relevant.
- Education of the local population in ways and means of reducing their risks of infection – i.e:
  - Avoid swimming or bathing in uncontrolled water sources.
  - Avoiding drinking water from uncontrolled or unknown sources.
  - Avoid urinating in water sources / courses.
  - Thoroughly wash hands following ablutions and prior to eating, drinking or smoking.
  - Thoroughly wash vegetables and fruit prior to eating.
  - Thoroughly cook foods.

8. CONSULTATION PROCESS

THE PUBLIC PARTICIPATION PROCESS

Engagement with Interested and Affected Parties (I&APs) forms an integral component of the EIA process. I&APs have an opportunity at various stages throughout the EIA process to gain more knowledge about the proposed project, to provide input into the process and to verify that their issues and concerns have been addressed.

The proposed project was announced in July 2007 to elicit comment from and register I&APs from as broad a spectrum of the public as possible. The announcement was done by the following means:

- the distribution of Background Information Documents (BIDs) in four languages,
- placement of site notices in the project area,
- publishing of advertisements in regional and local newspapers,
- publishing of information on the DWAF web site,
- announcement on local and regional radio stations; and
- the hosting of five focus group meetings in the project area.

Comments received from stakeholders were captured in the Issues and Response Report (IRR) which formed part of the Draft Scoping Report (DSR). The DRS was made available for public comment in October 2007. A summary of the DSR (translated into four languages) was distributed to all stakeholders and copies of the full report at public places. Two stakeholder meetings were held in October to present and discuss the DSR. The Final Scoping Report was made available to stakeholders in December 2007.

The availability of the Draft Environmental Impact Assessment Report, its summary (translated in four languages), the various specialist studies, the Environmental Management Plans and Programmes will be announced by way of personalized letters to stakeholders and the placement of advertisements in regional and local newspapers. The draft documents will be made available to I&APs for the inputs and comments. Two stakeholder meetings are planned to present the contents of the documents and to discuss the findings of the study.

A public review period of thirty (30 days) will be available for stakeholders to comment on the Draft Environmental Impact Assessment Report, its summary (translated in four languages), the various specialist studies, the Environmental Management Plans and Programmes. Stakeholder comments will be taken into consideration with the preparation of the final documents. The availability of the final documents will be announced prior to submission to the decision-making authority.

9. COMMENTS RECEIVED

The sole comment received with respect to the terms of reference for the Health Impact Assessment was:

- That the EIA specialist studies should consider the possibility of increased water borne diseases such as malaria.

This has been addressed as part of the Health Impact Assessment – refer **Table 6.11**

10. OTHER INFORMATION REQUESTED BY THE AUTHORITY

No other information was requested by the authority.

11. CONCLUSION

The outcome of this Health Impact Assessment revealed the following:

Construction workers will be potentially exposed to the following health risks with subsequent negative health impacts:

- HIV, STI, TB – medium significance following mitigation
- Excessive noise rating levels – medium significance following mitigation.
- Inhalation exposure to airborne Hazardous Chemical Substances (HCS) – low significance following mitigation.
- Dermal exposure to HCS – low significance following mitigation.
- Excessive heat stress conditions – low significance following mitigation.
- Excessive cold stress conditions – low significance following mitigation.
- Excessive vibration stress – low significance following mitigation.
- Excessive heat stress conditions – low significance following mitigation.
- Excessive ultraviolet radiation – low significance following mitigation.
- Excessive ergonomic stress – medium significance following mitigation.
- Malaria – low significance following mitigation.
- Schistosomiasis – low significance following mitigation.
- Diarrhoeal diseases – low significance following mitigation.

Priority potential health risks for construction workers therefore include:

- HIV, STI and TB transmission.
- Exposure to excessive noise rating levels.
- Exposure to excessive ergonomic stress.

Even following the implementation of the recommended mitigation measures, these risks would still present a medium significance in terms of their impact on the health of construction workers. Effective management of these priority health risks would be required if the impacts on the health of construction workers are to be effectively controlled.

Construction activities could potentially expose the surrounding communities to the following health risks with consequent negative heath impacts:

- HIV, STI, TB – medium significance following mitigation

- Inhalation exposure to airborne Hazardous Chemical Substances (HCS) – low significance following mitigation
- Ingestion exposure to HCS – low significance following mitigation
- Excessive ambient noise rating levels – low significance following mitigation

Priority potential negative health impacts for surrounding communities therefore include:

- HIV, STI and TB transmission

  Even following the implementation of the recommended mitigation measures, these risks would still present a medium significance in terms of their health impact on surrounding communities. Effective management of these priority health risks would be required if the impacts on the health of community members are to be effectively controlled.

Construction activities could however impact *positively* on the following health risks to surrounding communities:

- Malaria – low significance following mitigation.
- Schistosomiasis – medium significance following mitigation.
- Diarrhoeal diseases – medium significance following mitigation.

Whilst the incidence of these diseases is unlikely to change during the construction phase, it is very likely that it will decrease following completion of the bulk water infrastructure. The incidence of schistosomiasis and diarrhoeal diseases within the local populace is likely to decrease significantly following provision of clean water to households.

In summary:

The raising of the Tzaneen Dam is unlikely to have any significant impact on the health of either the construction workers or the surrounding community provided that the recommended mitigation measures are effectively implemented.

The construction of a dam at the Nwamitwa site and the installation of bulk water infrastructure throughout the surrounding areas, is however, likely to have several potential health impacts on both construction workers and the affected communities.

- The nett health impact of construction activities on construction workers is likely to be negative. The majority of impacts could be effectively mitigated.

- The nett health impact on surrounding communities is likely to be positive, with the benefits of improved access to clean water supplies outweighing the temporary negative impacts associated with construction activities – all of which could be readily and effectively mitigated.

NOTE: The project description details alternatives for the following:

- The supply level of the dam at the Nwamitwa site.
- Re-alignment of the roadways.
- Pipeline routes.
- Reservoir positions.
- Weir position.

Modification of the Health Risk Assessment for each of these alternatives was not deemed necessary as the *health risks* associated with each alternative are not expected to differ significantly from those identified and assessed as part of the initial study. Comments on the effects of these alternatives on Ambient Air Quality and/or Ambient Noise Rating Levels are detailed under the relevant specialist reports.

12. REFERENCES

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Department of Health www.doh.gov.za

Department of Water Affairs and Forestry www.dwaf.gov.za

Department of Labour www.dol.gov.za

Health Systems Trust www.hst.org.za

World Health Organisation www.who.int

Mopani District Municipality www.mopani.gov.za

Limpopo Province www.limpopo.gov.za

Malaria in Southern Africa www.malaria.org.za

Integrated Development Plans

June 2002	Greater Letaba IDP
June 2002	Mopani District Municipality IDP
May 2002	Greater Tzaneen Municipality IDP

water & forestry

Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

REPORT NO.:P 02/B810/00/0708/ Volume 2 Annexure L

GROOT LETABA RIVER WATER DEVELOPMENT PROJECT (GLeWaP)

Environmental Impact Assessment

(DEAT Ref No 12/12/20/978)

APPENDIX L: TRAFFIC IMPACT ASSESMENT

JULY 2008

Compiled by: ILISO Consulting

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DECLARATION OF CONSULTANTS' INDEPENDENCE

Bert de Vries and Cobus de Kock, who are Traffic Engineers from ILISO Consulting are independent consultants to the Department of Water Affairs and Forestry, i.e. they have no business, financial, personal or other interest in the activity, application or appeal in respect of which they were appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of these specialists performing such work.

REPORT DETAILS PAGE

Project name:	***Groot Letaba River Water Development Project***
Report Title:	***Environmental Impact Assessment Annexure L: Traffic Impact Assessment***
Author:	***Cobus de Kock and Bert de Vries***
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ENVIRONMENTAL ASSESSMENT PRACTIONER
Approved for ILISO Consulting (Pty) Ltd by:

…… ……..

Dr Martin van Veelen *Date*
Project Director

EXECUTIVE SUMMARY

The aim of the investigation is to quantify the possible traffic impacts resulting from the proposed raising of the Tzaneen Dam, the construction of a storage dam in the Groot Letaba River and associated bulk water supply infrastructure, on traffic in the area, and to recommend mitigation if required.

The outcome of the investigations is that although there is ample spare capacity on the road network and the relative low volumes of construction vehicles that will utilise the public roads there are some mitigation measure to consider as a result of the project. These are related to public safety, comfort and maintenance issues and comprise construction signage, pavement management and provision of turning lanes at borrow pits and construction sites access intersections.

The construction of the proposed dam in the Groot Letaba River necessitates the re-alignment of affected roads. Three alternative re-alignments have been proposed of which the shortest route (Alternative 1) is the preferred option form a transportation point of view.

- *Farmers and Communities affected will be those along the R529 and the R81.*
- *Vehicles to be used from borrow pits is estimated to be 10 ton per vehicles which make an average number of 10 trips per hour.*
- *Leratlou River borrow pit site produce 60% and the Merekome River borrow pit site produce 30% of these trips and both sites effect the R529 towards the storage dam in the Groot Letaba River. Additionally the R81 is affected with the raising of the Tzaneen Dam wall. However approximately 76% of all material will be within the construction site of the storage dam in the Groot Letaba River and this would therefore not have a noticeable effect on the public roads. The traffic generated by construction ads between 3% and 5% to the daily traffic on the R529.*

TABLE OF CONTENTS

Page

ABBREVIATIONS

DWAF	Department of Water Affairs and Forestry
GLeWaP	Groot Letaba River Water Development Project
OA	Options Analysis
PCMT	Project Co-ordination and Management Team
PSP	Professional Service Provider
TIA	Traffic Impact Assessment
LOS	Level of Service
v/c	Volume to Capacity Ratio
ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
SANRAL	South African National Roads Agency
RAL	Roads Agency Limpopo

1. STUDY INTRODUCTION

1.1 BACKGROUND TO PROJECT

The Department of Water Affairs and Forestry (DWAF) is currently undertaking an Environmental Impact Assessment (EIA) to investigate the environmental feasibility of raising the Tzaneen Dam, the construction of a storage dam in the Groot Letaba River and associated bulk water infrastructure (water treatment, pipelines, pump stations, off-takes and reservoirs) in the Limpopo province. The EIA is being undertaken by ILISO Consulting with Zitholele Consulting providing the public participation support. The EIA is being undertaken according to the EIA Regulations under Section 24 (5) of the National Environmental Management Act (NEMA), (Act No 107 of 1998) as amended in Government Notice R385, 386, 387 – Government Gazette No. 28753 of 21 April 2006.

ILISO Consulting is also undertaking the Traffic Impact Assessment as part of the EIA.

1.2 STRUCTURE OF THIS REPORT

This specialist study has been undertaken in compliance with regulation 33(2) of GN 385. **Table 1.1** indicates how Regulation 33 of GN385 has been fulfilled in this report

Table 1.1.Indication of compliance with Regulation 33 in this report

Regulatory Requirements	Section of Report
(a) The person who prepared the report; and the expertise of that person to carry out the specialist study or specialised process.	Chapter 2
(b) a declaration that the person is independent	Page i
(c) an indication of the scope of, and the purpose for which, the report was prepared	Chapter 3
(d) a description of the methodology adopted in preparing the report or carrying out the specialised process	Chapter 4
(e) a description of any assumptions made and any uncertainties or gaps in knowledge	Chapter 5

(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Chapter 7
(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	Chapter 8
(h) a description of any consultation process that was undertaken during the course of carrying out the study	Chapter 9
(i) a summary and copies of any comments that were received during any consultation process	Chapter 10
(j) any other information requested by the competent authority.	Chapter 11

2. PROJECT TEAM

Cobus de Kock of ILISO Consulting has undertaken the Traffic Impact Assessment. He has a Masters degree in Civil Engineering focussing on Structures and Information Systems. He specialises in Traffic Impact Assessments, Traffic Engineering and Civil Engineering. He has completed Traffic Impact Assessments for developments such as Cape Town International Airport, Cape Town Regional Waste Site and private housing and industrial developments.

Bert de Vries of ILISO Consulting has reviewed the Traffic Impact Assessment. He has a degree in Traffic and Transportation Engineering and a Masters degree in Business Administration. He has 30 years experience in traffic ad transportation projects and has undertaken numerous traffic impact assessments.

3. PURPOSE OF REPORT AND SCOPE OF WORK

The aim of the investigation is to quantify the possible impacts resulting form the proposed raising of the Tzaneen Dam, the construction of a storage dam in the Groot Letaba River and associated bulk water infrastructure, on traffic in the area and to recommend mitigation if required. To achieve this, a good understanding of the current roads and traffic volumes of the sites is necessary and subsequently an understanding of human movement patterns.

Typical specialist investigations were undertaken; seven day classified vehicle count surveys were conducted on possible affected roads.

3.1 SCOPE OF WORK

The following tasks were undertaken:

3.1.1 Baseline Characterisation

This is an investigation in the status quo of the operational traffic along the roads possible affected by the construction of a storage dam in the Groot Letaba River and the raising of the Tzaneen Dam wall.

3.1.2 Impact Assessment

An investigation of the effect the additional construction vehicles will have on the road network from a capacity and the pavement design point of view, as well as an assessment of the effect that the road re-alignments will have on additional travel time to regular users.

4. METHODOLOGY

The impact of the Groot Letaba River Water Development Project will be investigated for the construction and the operational stages. The nature and extent of impact will be described as well as any legal requirements.

4.1 TRAFFIC IMPACT ASSESSMENT

4.1.1 Status Quo

The present traffic in the assessed area is established with traffic count surveys. With this information the status quo situation can be quantified.

4.1.2 Trip Generation

Trip generation estimation is conducted separately for site and non-site traffic. Non-site traffic includes through traffic that has neither origin nor destination at the site as well as traffic generated by developments within the study area, but outside the specific site under analysis. With calculated assumptions construction trip generation can be estimated for the various phases of this project.

4.1.3 Trip Distribution

The generated trips are distributed over the existing and amended road network according to observed distribution patterns as well as the locations of borrow pits and construction sites. Some of these trips are entering the site while others are leaving the site. Knowledge of the destination of the generated trips is critical to assess to what extent certain roads will be affected.

4.1.4 Impact Assessment

The traffic assessment step determines the amount of traffic that will use certain routes of the roadway network between the site and the surrounding zones (within the influence area). Links of the network will be loaded differentially, depending on the origin and destinations, as well as the traffic conditions on each link. As a result, some links or the network segments may receive the bulk of the site-generated traffic, while others may receive no additional traffic.

A measure of cost is necessary to perform the assessment: usually, travel time or distance. The use of travel time instead of distance is preferred because it represents actual flow conditions on the network.

4.2 SIGNIFICANCE RATING

The key issues identified during the Scoping Phase informed the terms of references of the specialist studies. Each issue consists of components that on their own or in combination with each other give rise to potential impacts, either positive or negative and form the project onto the environment or from the environment onto the project. In the EIA the significance of the potential impacts will be considered before and after identified mitigation is implemented.

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

The following criteria will be used to evaluate significance:

Nature
The nature of the impact will be classified as positive or negative, and direct or indirect.

Extent and location
Magnitude of the impact and is classified as:

- **Local**: the impacted area is only at the site – the actual extent of the activity
- **Regional**: the impacted area extends to the surrounding, the immediate and the neighbouring properties, local towns and communities.
- **National**: the impact can be considered to be of national importance.

Duration
This measures the lifetime of the impact, and is classified as:

- **Short term**: the impact will be for 0 – 3 years, or only last for the period of construction.
- **Medium term**: three to ten years.
- **Long term**: longer than 10 years or the impact will continue for the entire operational lifetime of the project.
- **Permanent**: this applies to the impact that will remain after the operational lifetime of the project.

Intensity

This is the degree to which the project affects or changes the environment, and is classified as:

- **Low**: the change is slight and often not noticeable, and the natural functioning of the environment is not affected.
- **Medium**: The environment is remarkably altered, but still functions in a modified way.
- **High**: Functioning of the affected environment is disturbed and can cease.

Probability

This is the likelihood or the chances that the impact will occur, and is classified as:

- **Low**: during the normal operation of the project, no impacts are expected.
- **Medium**: the impact is likely to occur if extra care is not taken to mitigate them.
- **High**: the environment will be affected irrespectively; in some cases such impact can not be reduced.

Confidence

This is the level knowledge/information, the environmental impact practitioner or a specialist had in his/her judgement, and is rated as:

- **Low**: the judgement is based on intuition and not on knowledge or information.

- **Medium**: common sense and general knowledge informs the decision.
- **High**: Scientific and or proven information has been used to give such a judgement.

Significance

Based on the above criteria the significance of issues will be determined. This is the importance of the impact in terms of physical extent and time scale, and is rated as:

- **Low**: the impacts are less important, but may require some mitigation action.
- **Medium**: the impacts are important and require attention; mitigation is required to reduce the negative impacts
- **High**: the impacts are of great importance. Mitigation is therefore crucial.

Cumulative Impacts

The possible cumulative impacts will also be considered.

Mitigation

Mitigation for significant issues will be incorporated into the EMP for construction.

5. ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

In interpreting the study findings it is important to note the limitations and assumptions on which the assessment was based. The most important assumptions of the traffic impact assessment are as follows:

- The trip generation as a result of the construction activities is based on the travel between the borrow pits and the construction site for a 8 hour working day, 5 days a week for 24 months construction time.

- The same borrow pits will be used for the construction of the proposed new dam wall and the raising of the Tzaneen Dam wall.

- The three borrow pits are at the Nwamitwa Dam, Lerwatlou River and the Merekome River. The percentage contribution form the borrow pits is estimated as Namitwa Dam (75.76%), Lerwatlou River (18.18%) and Merekome River (6.06%).

- That a delivery vehicle will transport 6 m^3 of material (10 ton payload) from the borrow pits per load.

- Some workers will be skilled migrant workers and accommodation will be provided in Letsitele.

- No traffic surveys were undertaken on the R70, R36, and the R528. Traffic volumes provided by VelaVKE on the roads surrounding the Tzaneen Dam indicated the Annual Average Daily Traffic (AADT) and the Volume-Capacity (v/c) ratio as reported in the Limpopo National Transport Master Plan. The AADT for these roads as counted in 2006 is reported to be in the order of 2500 – 8000 per day.

6. EXISTING TRAFFIC AND BASELINE CONDITIONS

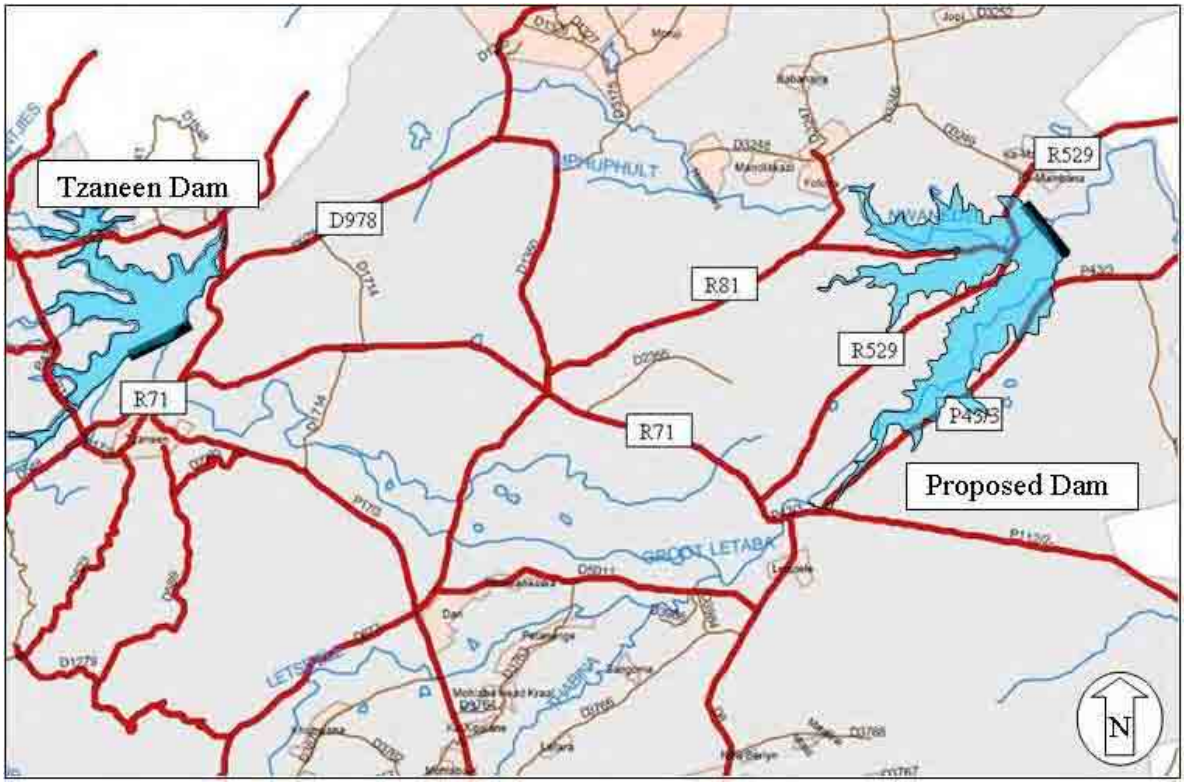
6.1 THE NEW STORAGE DAM IN THE GROOT LETABA RIVER

6.1.1 Affected Roads

The R71, R81, R529 and P43/3 might be affected by construction vehicles for the new storage dam in the Groot Letaba River see **Figure 6.1**. The R81, R529 and the P43/3 will also be effected by the extent of the dam basin and therefore have to be realigned (this will be investigated in Chapter 7.3).

7 day 24 hour counting stations were placed on roads described below. The data from these counts provided Average Daily Traffic (ADT) volumes on these roads.

Figure 6.1: Locality Map



R71

The R71 is the main road between Tzaneen and Phalaborwa; this is a surfaced two-lane narrow single carriageway with gravel shoulders. According to SANRAL the condition of the road is fair and no upgrading is planned for the near future. Two counting stations were installed in the vicinity of the proposed dam site between 13 November 2007 and 21 November 2007. The outcome of these two stations can be seen in Table 6.1 and 6.2 and Figure 6.1 and 6.2 below. The R71 is a single carriage way road, the capacity of the road is 2 400 vehicle/hr. While the observed peak hour flow is about 350 vehicles per hour. The road has ample capacity to absorb the traffic generated by the dam construction or the traffic generated by the constructed dam. With ADT volumes of between 3121 and 3751 vehicles and heavy vehicles between 10 % and 12.6 % there is ample spare capacity on the R71.

Table 6.1: ADT on the R71 North of the R529

	Daily Volume R71 - (Station P410)			
	Light	Short Heavy	Med Heavy	Long Heavy
11/13/2007 *	1038	62	49	36
11/14/2007	3593	271	139	136
11/15/2007	3952	312	170	131
11/16/2007	2968	209	68	43
11/17/2007	2408	125	49	57
11/18/2007	3287	250	114	119
11/19/2007	3314	257	157	125
11/20/2007	3428	306	132	139
11/21/2007 *	2020	173	87	78

* Not Full Day Volumes

	R71 - (Station P410) ADT			
	Light	Short Heavy	Med Heavy	Long Heavy
ADT	3279	247	118	107

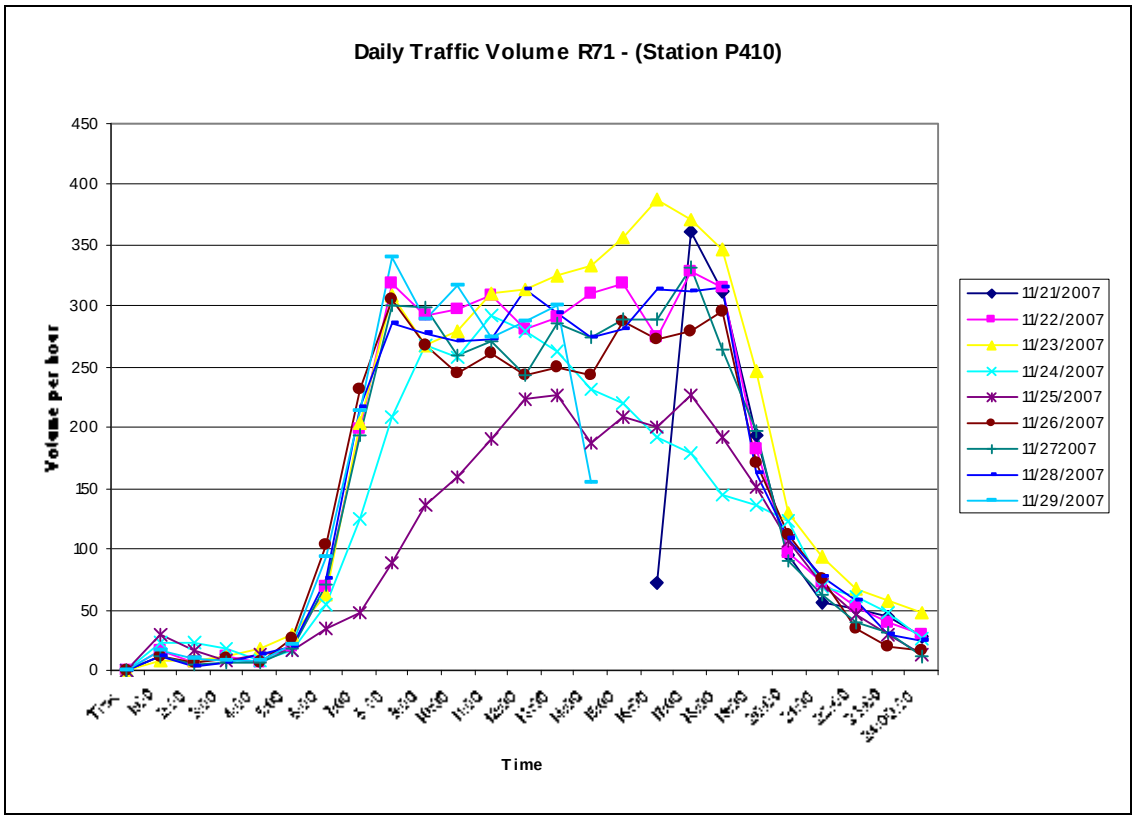


Figure 6.2: R71 Traffic Volumes North of the R529

Table 6.2: ADT for the R71 South of the R529

	Daily Volume R71 - (Station P413)			
	Light	**Short Heavy**	**Med Heavy**	**Long Heavy**
11/13/2007				
11/14/2007 *	1437	30	50	123
11/15/2007	2373	49	109	158
11/16/2007	3244	62	82	162
11/17/2007 *	1743	16	21	41
11/18/2007				
11/19/2007				
11/20/2007				
11/21/2007				

* Not Full Day Volumes

	R71 - (Station P413) ADT			
	Light	**Short Heavy**	**Med Heavy**	**Long Heavy**
ADT	2809	56	96	160

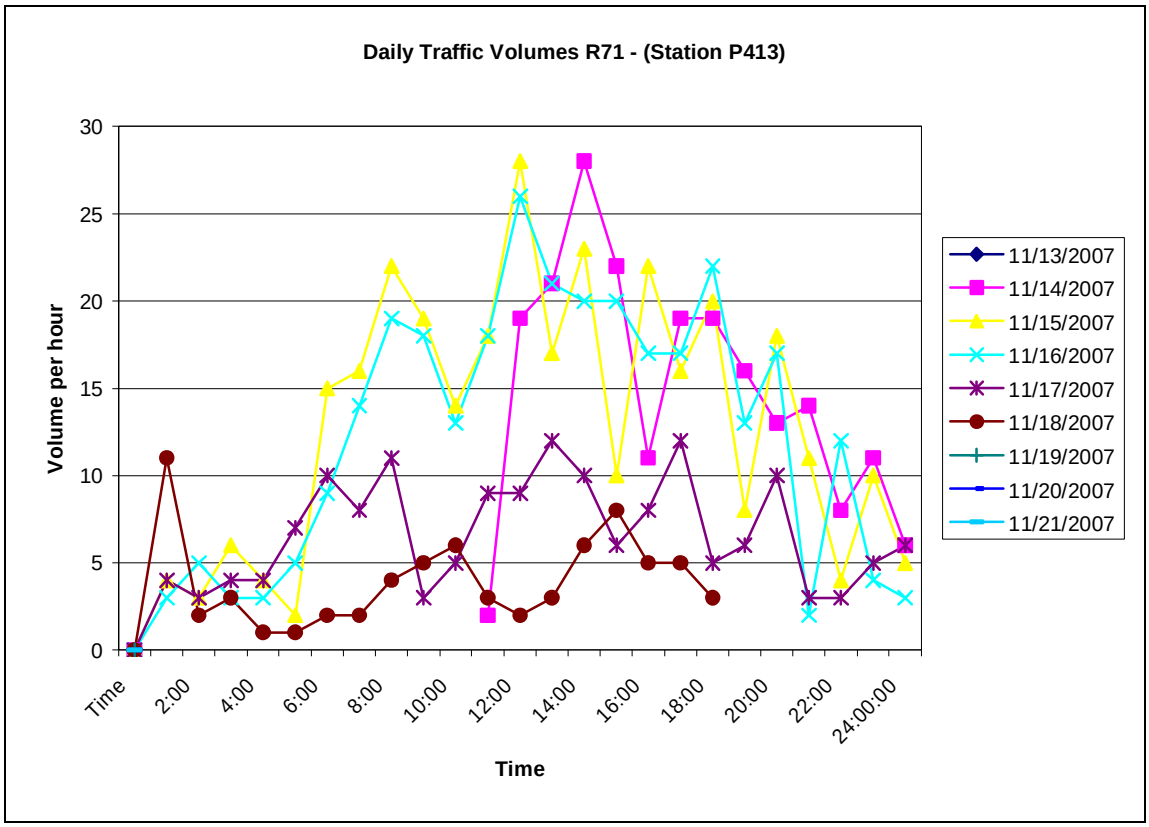


Figure 6.3: R71 Traffic Volumes South of the R529

R81

The R81 is the link between the proposed dam site and Tzaneen, this is a surfaced two-lane narrow single carriageway with gravel shoulders. According to SANRAL the condition of the road is fair and no upgrading is planned for the near future. This also links Tzaneen with the Nkamboko and Nwamitwa communities. A counting station was installed in the vicinity of the proposed dam site between 13 November 2007 and 21 November 2007. The R81 is a single carriage way road, the capacity of the road is 2 400 vehicle/hr. While the observed peak hour flow is about 250 vehicles per hour. The road has ample capacity to absorb the traffic generated by the dam construction or the traffic generated by the constructed dam. The ADT for this road is 3153 vehicles of which 12.2 % is heavy vehicles (see **Table 6.3** and **Figure 6.3**.) There is spare capacity on the R81.

Table 6.3: ADT for the R81

	Daily Volume R81 - (Station P408)			
	Light	Short Heavy	Med Heavy	Long Heavy
11/13/2007 *	1556	107	76	80
11/14/2007	2607	162	124	140
11/15/2007	2686	184	118	120
11/16/2007	3308	226	135	123
11/17/2007	3162	200	53	78
11/18/2007	2400	128	41	23
11/19/2007	2697	176	118	119
11/20/2007	2521	171	133	121
11/21/2007 *	841	43	36	47

* Not Full Day Volumes

	R81 (Station P408) ADT			
	Light	Short Heavy	Med Heavy	Long Heavy
ADT	2769	178	103	103

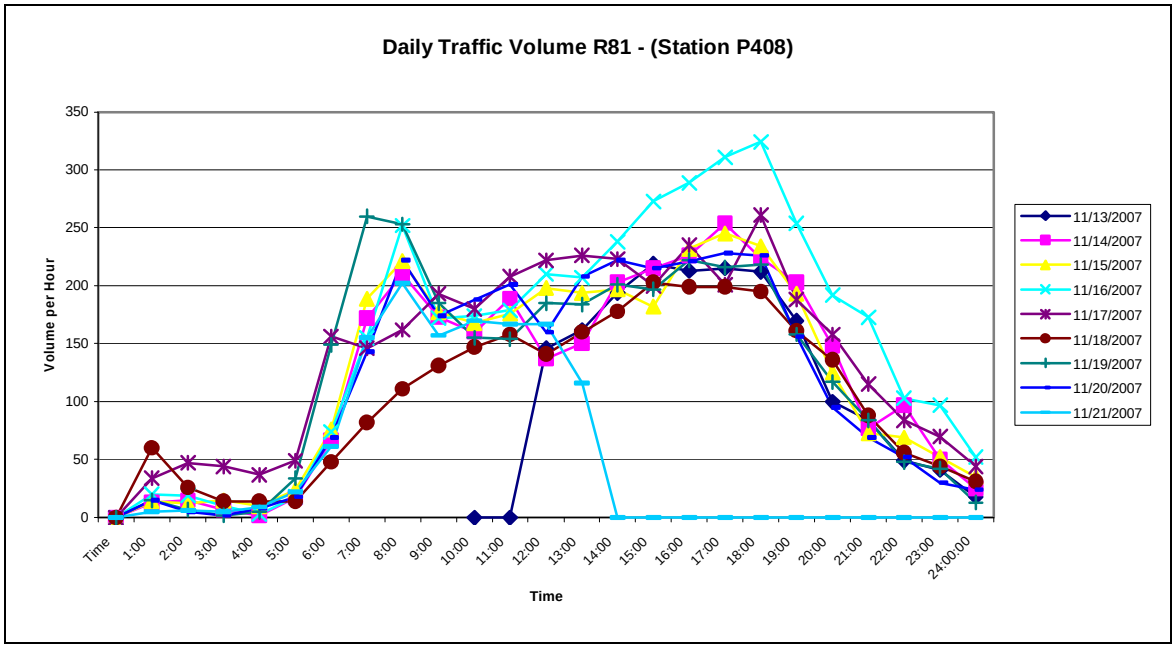


Figure 6.4: R81 Traffic Volumes

R529

The R529 is the link from the R71 in a northern direction through the proposed Nwamitwa dam basin, this is a surfaced two-lane narrow single carriageway with gravel shoulders. Two counting stations were installed in the vicinity of the proposed dam site between 13 November 2007 and 21 November 2007. The R529 is a single carriage way road, the capacity of the road is 2 400 vehicle/hr. While the observed peak hour flow is about 250 vehicles per hour. The road has ample capacity to absorb the traffic generated by the dam construction or the traffic

generated by the constructed dam. With ADT volumes of 2 747 and 2 894 vehicles and heavy vehicles percentage of 11.7% and 10.9%, there is ample spare capacity on the R529.

Table 6.4: ADT for the R529 North of the R81

	Daily Volume R81 - (Station P407)			
	Light	Short Heavy	Med Heavy	Long Heavy
11/13/2007 *	1644	68	52	69
11/14/2007	2317	169	134	97
11/15/2007	2458	156	97	73
11/16/2007	2992	223	115	98
11/17/2007	2548	133	50	61
11/18/2007	1900	95	34	29
11/19/2007	2457	150	102	83
11/20/2007	2308	167	101	85
11/21/2007 *	569	31	18	28

* Not Full Day Volumes

	R81 (Station P407) ADT			
	Light	Short Heavy	Med Heavy	Long Heavy
ADT	2426	156	90	75

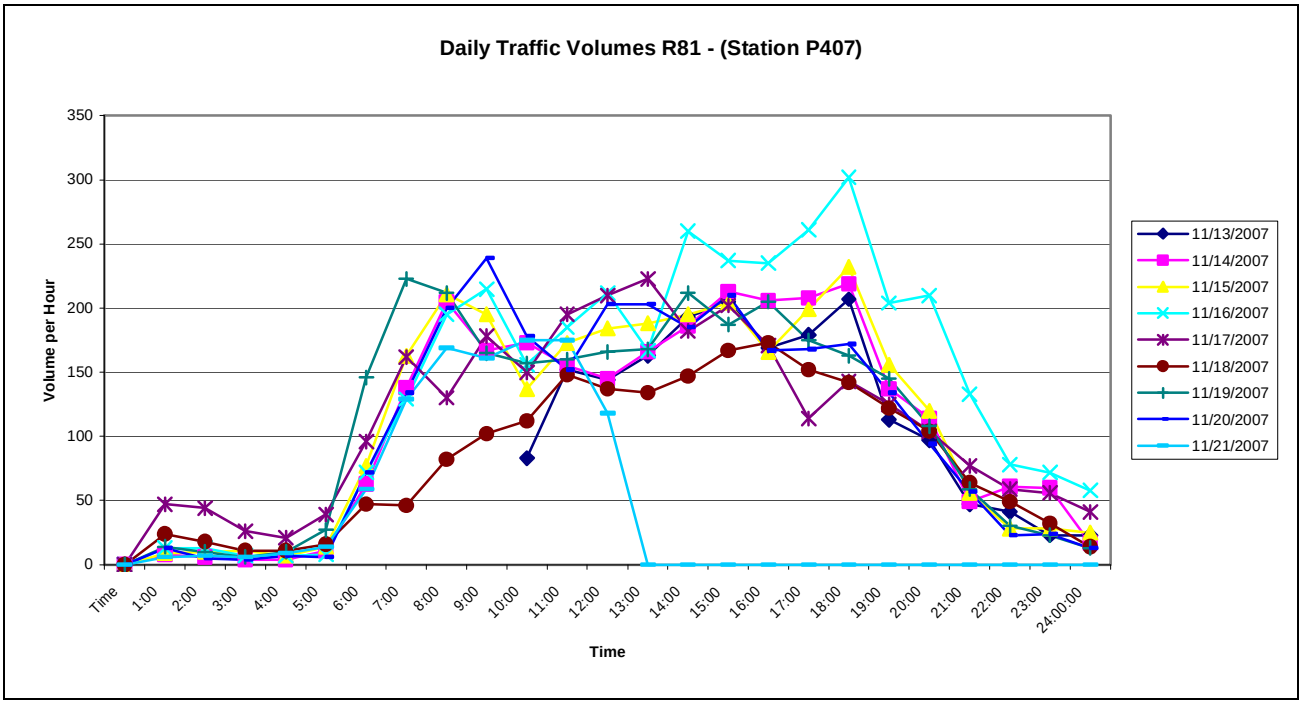


Figure 6.5: R529 Traffic Volumes North of the R81

Table 6.5: ADT for the R529 South of the R81

	Daily Volume R529 - (Station 409)			
	Light	Short Heavy	Med Heavy	Long Heavy
11/13/2007 *	1288	69	30	45
11/14/2007	2578	124	101	117
11/15/2007	2614	165	95	108
11/16/2007	3136	201	95	102
11/17/2007	2684	174	36	64
11/18/2007	1901	93	32	32
11/19/2007	2638	129	111	99
11/20/2007	2503	130	98	103
11/21/2007 *	1053	55	51	58

* Not Full Day Volumes

	R529 - (Station 409) ADT			
	Light	Short Heavy	Med Heavy	Long Heavy
ADT	2579	145	81	89

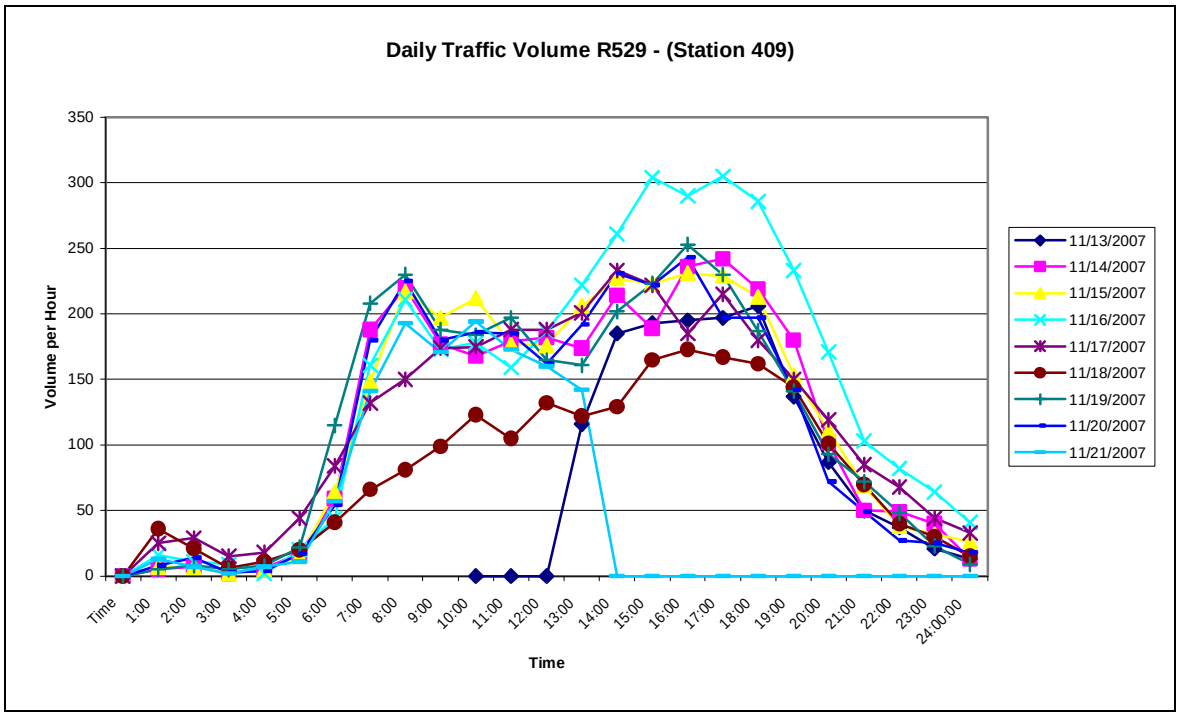


Figure 6.6: R529 Traffic Volumes South of the R81

P43/3

The P43/3 is the road to the South of the proposed dam basin, this is a surfaced two-lane narrow single carriageway with gravel shoulders. A counting station was installed in the vicinity of the proposed dam site between 13 November 2007 and 21 November 2007. The P43/3 is a single carriage way road, the capacity of the road

is 2 400 vehicle/hr. While the observed peak hour flow is about 120 vehicles per hour. The road has ample capacity to absorb the traffic generated by the dam construction or the traffic generated by the constructed dam. An ADT volume of 1264 vehicles and heavy vehicle percentage of 10%, there is ample spare capacity on the P43/3.

Table 6.6: ADT for the P43/3

	Daily Volume P43/3 - (Station P412)			
	Light	**Short Heavy**	**Med Heavy**	**Long Heavy**
11/13/2007 *	114	0	9	2
11/14/2007	1061	42	46	39
11/15/2007	1182	63	54	32
11/16/2007	1388	81	78	22
11/17/2007	1085	45	27	15
11/18/2007	899	32	5	4
11/19/2007	1188	57	46	34
11/20/2007	1147	69	74	32
11/21/2007 *	648	28	34	16

* Not Full Day Volumes

	P43/3 - (Station P412) ADT			
	Light	**Short Heavy**	**Med Heavy**	**Long Heavy**
ADT	1136	56	47	25

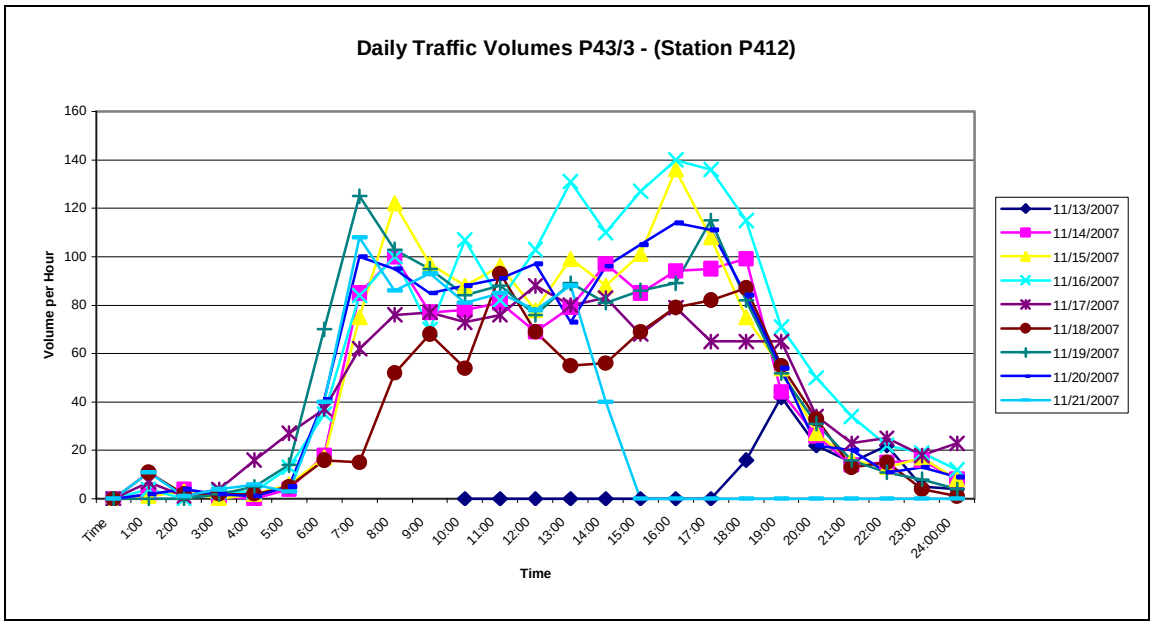


Figure 6.7: P43/3 Traffic Volumes

6.2 THE RAISING OF THE TZANEEN DAM WALL

6.2.1 Affected Roads

The R70, R36, and the R528 are the major road network surrounding the Tzaneen Dam (see **Figure** 6.1). Traffic volumes provided by VelaVKE on the roads surrounding the Tzaneen Dam indicated the Annual Average Daily Traffic (AADT) and the Volume-Capacity (v/c) ratio as reported in the Limpopo National Transport Master Plan.

The AADT for these roads as counted in 2006 is reported to be in the order of 2500 – 8000 per day. The peak hour traffic can be estimated to be in the order of 10% of the AADT. This is equivalent to a peak hour in the order of 250 to 800 vehicles on a link road. The v/c for these roads is reported to be in the order of 0.16 – 0.33. This results in only 25% of the road being utilised.

It can therefore safely be assumed that there is ample spare capacity on the road network surrounding the Tzaneen Dam.

6.3 THE ASSOCIATED BULK INFRASTRUCTURE

6.3.1 Affected Roads

Due to the nature and proximity of this related bulk infrastructure, such as reservoirs and pipelines (see **Figure** 6.8), it is estimated that the same roads as for the storage dam in the Groot Letaba River will be affected. In addition local access roads to villages will also be affected. However due to the unknown locations of all the reservoirs and precise alignment of the bulk water pipelines as well as the fact that these construction sites will generate very limited additional traffic, it was not investigated in detail for the purpose of this report. The impact on the road network due to this component of the project will be more of a localised construction nature, the effect on the local roads has to be minimised by normal construction traffic accommodation measures.

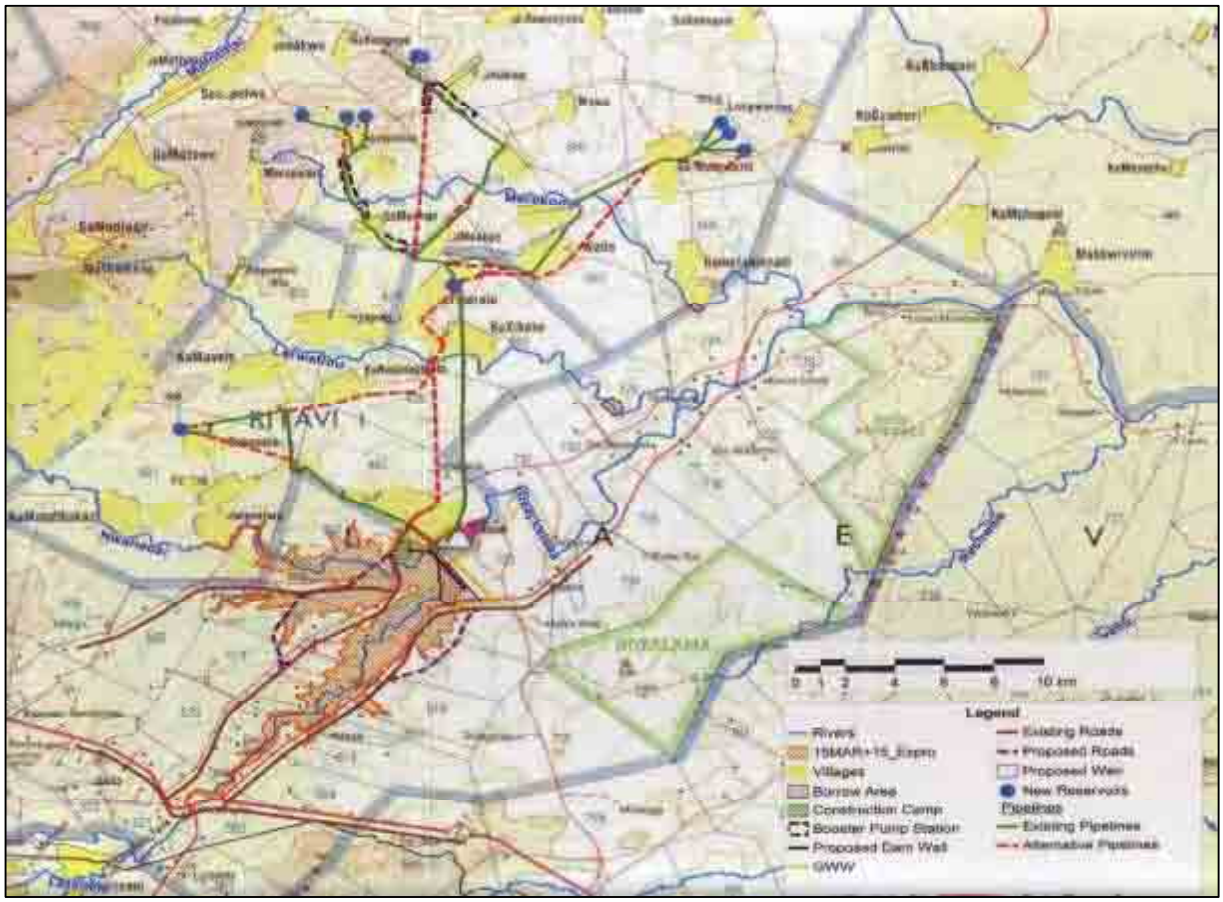


Figure 6.8: Project Components

7. FINDINGS

7.1 TRIP GENERATION

Assumptions needed to be made to establish the effect that the construction process will have on the local road networks. Due to all the uncertainties related to the construction process of the proposed new storage dam and the raising of the Tzaneen Dam wall the assumptions are:

- The trip generation as a result of the construction activities is based on the travel between the borrow pits and the construction site for a 8 hour working day, 5 days a week for 24 months construction time.
- The same borrow pits will be used for the construction of the proposed new dam wall and the raising of the Tzaneen Dam wall.
- The three borrow pits are at the Nwamitwa Dam, Lerwatlou River and the Merekome River. The percentage contribution form the borrow pits is estimated as Namitwa Dam (75.76%), Lerwatlou River (18.18%) and Merekome River (6.06%).
- That a delivery vehicle will transport 6 m^3 of material (10 ton payload) from the borrow pits per load.
- Some workers will be skilled migrant workers and accommodation will be provided in Letsitele which is 20km from the proposed new storage dam wall.

Table 7.1 shows trip generation from the borrow pits and the worker related trip generation. It is assumed that the required number of construction vehicles required will stay onsite till decommissioning and that the only construction related vehicles will be the 10 ton tipper trucks that will transport fill from the borrow pits at Lerwatlou River and Merekome River. These two borrow pits are located between the R529 and the P43/3. Therefore either of these two roads can be utilised to haul fill to the sites.

Table 7.1: Trip Generation

Assumptions	Borrow Pit	Percentage	
	Nwamitwa Dam	75.76%	
	Leratlou River	18.18%	
	Merekome River	6.06%	
	Loaded Vehicle	6	m^3

Construction Trips	Total Constuction Volume Req m^3	Borrow Pit Volume Req m^3	Total Trips	Construction Time (Months)	Trips per Month	Trips per Day	Trips per Hour
Tzaneen Dam	18375	18375	3063	12	255	12	2
Nwamitwa Dam	990000	239976	39996	24	1666.5	79	10

Workers Trips	Construction Time (Months)	Trips
Tzaneen Dam	12	50
Nwamitwa Dam	24	50

7.2 EFFECT ON THE ROAD NETWORK

The roads affected by construction vehicles are the R529 and R81 and possibly the P43/3 which links the borrow pits at Leratlou River and Merekome River to both proposed construction sites. With the assumptions as described in section 7.1 these will be on average 12 vehicles per from the borrow pits on the public roads. Due to this low estimated volume of construction traffic and the ample spare capacity of the road network it is deemed that the effect of the construction will be of Low impact on the roads network.

7.3 EFFECT ON THE ROAD PAVEMENT

The current road surfaces has been indicated to be fair by SANRAL but due to the heavy loads associated with construction traffic the effect this will have on the pavement it is proposed that a Pavement Assessment is done prior to the construction commences. It is also proposed that the pavement structure is constantly assessed throughout the construction period via a Pavement Management System and that remedial work is done if required.

7.4 ADDITIONAL TRAVEL TIME

Due to the extent of the proposed dam basin the following roads, R81, R529 and the P43/3 will have to be realigned and this will have travel time implications. The least effected road alignment is that of the P43/3, this road will have a few minor changes which are insignificant. The re-alignment of the R529 and R81 are not finalised at this stage. There are four proposed alternatives (see **Figure 7.1**) of which Alternative 4 has the least amount of impact. The initial indications show that there is no additional distance for the R529 after the dam has been constructed. Alternative 1 has an additional 780m, Alternative 2 has an additional 1.6 km and Alternative 3 has an additional 7.07 km in comparison to the existing alignments. The effect on the local farmers might be additional travel distance and time over and above the above distances to shuttle farm or factory workers to the surrounding villages. The social impacts the road re-alignment has can be seen in the Social Impact Assessment. The effect for traffic on the R529 travelling at 100 km/h, the additional time should not be more than five minutes of travel time for Alternative 3 which is the worst case scenario.

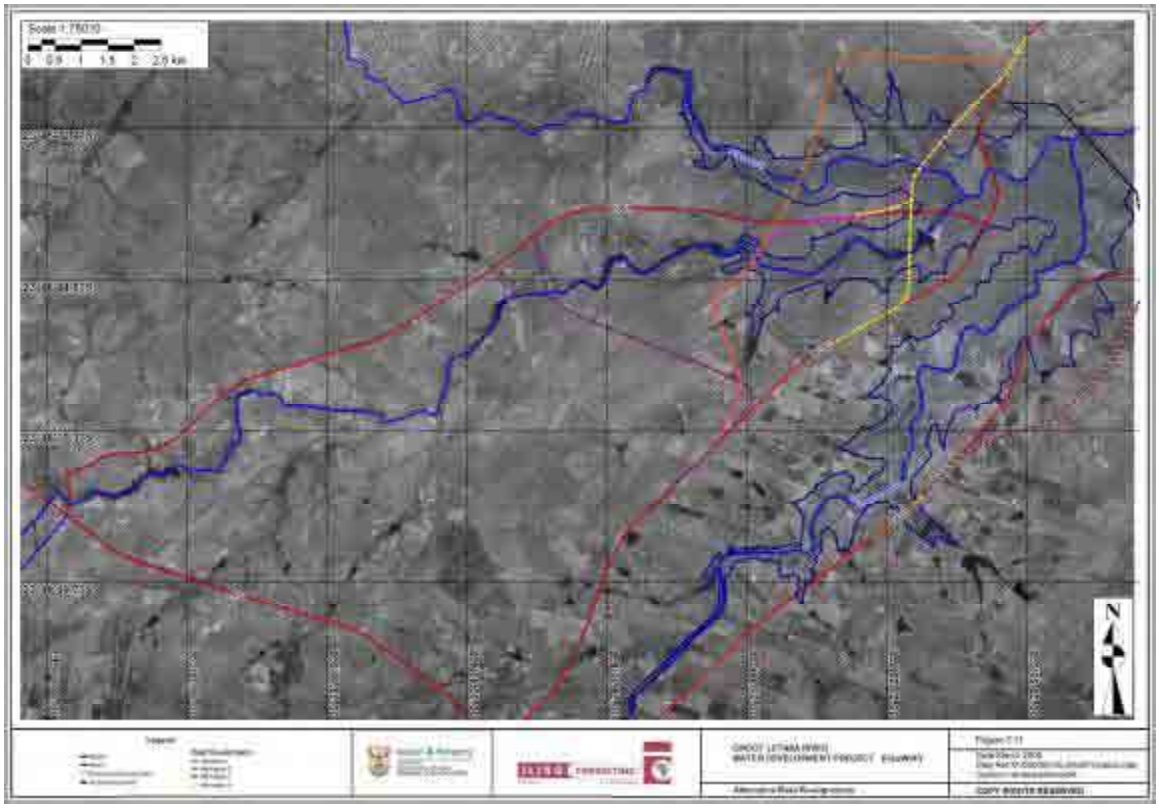


Figure 7.1: Alternative Road Re-Alignments

7.5 IMPACT TABLES

7.5.1 The New Storage Dam in the Groot Letaba River

	New Storage Dam in the Groot Letaba River	
Description of potential impact	Additional Traffic on the Roads Network	
Nature of impact	Additional slow moving construction vehicles can cause delays to regular road users.	
Legal requirements	None	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative – Indirect	None
Extent of impact	Regional – Construction Traffic on the R529 and the P43/3	None
Duration of impact	Short Term – Construction Period	None
Intensity	Low	None
Probability of occurrence	High	None
Confidence of assessment	High	None
Level of significance before mitigation	Low	None
Mitigation measures (EMP requirements)	Construction Signage as part of the project by the Contractor	N/A
Level of significance after mitigation	Low	N/A
Cumulative Impacts	None	None
Comments or Discussion The additional construction traffic is estimated to be minimal in relation to the existing traffic volumes on the affected roads. An average of 12 vehicles per hour in addition to the existing peak hour of 250 vehicles per hour, the roads have sufficient capacity to deal with the additional traffic. Although the additional traffic might have a negative effect on the average speed on these this is not considered to be a major issue due to the low volumes on the roads. The affected parties with be the general public travelling on the roads network.		

7.5.2 The Raising of the Tzaneen Dam Wall

	Raising of the Tzaneen Dam Wall	
Description of potential impact	Additional Traffic on the Roads Network	
Nature of impact	Additional slow moving construction vehicles can cause delays to regular road users.	
Legal requirements	None	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative – Indirect	None
Extent of impact	Regional – Construction Traffic on the R71 and the D978	None
Duration of impact	Short Term – Construction Period	None
Intensity	Low	None
Probability of occurrence	High	None
Confidence of assessment	High	None
Level of significance before mitigation	Low	None
Mitigation measures (EMP requirements)	Construction Signage as part of the project by the Contractor	N/A
Level of significance after mitigation	Low	N/A
Cumulative Impacts	None	None
Comments or Discussion The additional traffic is estimated to be minimal in relation to the existing traffic volumes on the affected roads. The roads have sufficient capacity to deal with the additional traffic. Although the additional traffic might have a negative effect on the average speed on these this is not considered to be a major issue due to the low volumes on the roads.		

7.5.3 Effect of Construction Vehicles in the Pavement

	Effect of Construction Vehicles on the Pavement	
Description of potential impact	Additional Heavy Construction Vehicles on the Local Roads	
Nature of impact	Additional heavy construction vehicles can cause failure to the road structure and therefore have negative effects for all road users	
Legal requirements	None	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative – Indirect	None
Extent of impact	Regional – Construction Traffic on the R529, R81, D978 and the P43/3	None
Duration of impact	Short Term – Construction Period	None
Intensity	Low	None
Probability of occurrence	Medium	None
Confidence of assessment	Medium	None
Level of significance before mitigation	Low	None
Mitigation measures (EMP requirements)	Monitoring and Remedial Road Works if Required by DWAF and the Responsible Road Authority	N/A
Level of significance after mitigation	Low	N/A
Cumulative Impacts	None	None
Comments or Discussion The current road condition is reported to be in a fair condition according to the South African National Roads Association (SANRAL). The additional heavy vehicle movements on the roads will accelerate the deterioration of roads used by construction traffic. The road condition should be monitored with a pavement management system and remedial action taken when required. This responsibility resides with DWAF and the responsible road authority (SANRAL or RAL)		

7.5.4 Road Realignment due to New Storage Dam Basin

	Road Realignment due to Storage Dam Basin	
Description of potential impact	Realignment of the R529 and the R81 due to the extent of the dam basin	
Nature of impact	Additional travel time and distance will be added to residents and travellers after the construction of the dam has finished.	
Legal requirements	None	
Stage	Construction and decommissioning	Operation
Nature of Impact	Negative – Indirect	Negative – Indirect
Extent of impact	Regional – Additional travel time and distance on the R529 and the R81	Regional – Additional travel time and distance on the R529 and the R81
Duration of impact	Short Term – Construction Period	Permanent
Intensity	Medium	Medium
Probability of occurrence	Definite	Definite
Confidence of assessment	Medium	Medium
Level of significance before mitigation	Low	Low
Mitigation measures (EMP requirements)	None	None
Level of significance after mitigation	Low	Low
Cumulative Impacts	None	None
Comments or Discussion Alternative 4 results in the least amount of additional travel time and distance for general traffic along the R529 and is therefore the preferred alignment from a traffic operational point of view. However other considerations might be identified through the other specialist assessment reports (SIA, VIA, HIA, NIA, BIA ect).		

8. RECOMMENDED MITIGATION MEASURES

8.1 PAVEMENT MONITORING SYSTEM

Objective

The objective is to minimise the damage to the affected roads.

Target

The target is to maintain the roads at the current operational conditions.

Method

Due to the increased activity of heavy construction vehicles on the roads network it is proposed that a pavement monitoring system is used to assess road condition on an ongoing bases and that remedial work to the roads will be done to minimise the effect of the construction traffic. This responsibility resides with DWAF and the responsible road authority (SANRAL or RAL).

8.2 ADDITIONAL TURNING LANES

Objective

The objective is to maintain good Level of Service at the access intersection to the constructing sites and the borrow pits.

Target

The target is to ensure safety and to minimise delays for the general traffic on the affected roads.

Method

Due to the increased activity of heavy construction vehicles on the roads network it is proposed that turning lanes are provided to minimise the conflict points with the general road users. These turning lanes should to be at the intersections with the access roads to borrow pits and construction sites. These will be permanent on access roads maintained after construction. These lanes should be built as part of the contract.

8.3 CONSTRUCTION SIGNAGE

Objective

The objective is to warn the general public of construction traffic.

Target

The target is to ensure road safety along the public roads and to increase awareness of slow moving vehicles.

Method

Due to the public nature of the roads it is recommended that adequate construction signage is in place to inform the public of increased construction activities in the affected areas by placing adequate legal and required signage. Construction signage should be installed by the contractor as part of the contract.

9. CONSULTATION PROCESS

Engagement with Interested and Affected Parties (I&APs) forms an integral component of the EIA process. I&APs have an opportunity at various stages throughout the EIA process to gain more knowledge about the proposed project, to provide input into the process and to verify that their issues and concerns have been addressed.

The proposed project was announced in July 2007 to elicit comment from and register I&APs from as broad a spectrum of public as possible. The announcement was done by the following means:

- the distribution of Background Information Documents (BIDs) in four languages,
- placement of site notices in the project area,
- publishment of advertisements in regional and local newspapers,
- publishment of information on the DWAF web site,
- announcement on local and regional radio stations; and
- the hosting of five focus group meetings in the project area.

Comments received from stakeholders were captured in the Issues and Response Report (IRR) which formed part of the Draft Scoping Report (DSR). The DRS was made available for public comment in October 2007. A summary of the DSR (translated into four languages) was distributed to all stakeholders and copies of the full report at public places. Two stakeholder meetings were held in October to present and discuss the DSR. The Final Scoping Report was made available to stakeholders in December 2007.

The availability of the Draft Environmental Impact Assessment Report, its summary (translated in four languages), the various specialist studies, the Environmental Management Plans and Programmes will be announced by way of personalized letters to stakeholders and the placement of advertisements in regional and local newspapers. The draft documents will be made available to I&APs for the inputs and comments. Two stakeholder meetings are planned to present the contents of the documents and to discuss the findings of the study.

A public review period of thirty (30 days) will be available for stakeholders to comment on the Draft Environmental Impact Assessment Report, its summary (translated in four languages), the various specialist studies, the Environmental Management Plans and Programmes. Stakeholder comments will be taken into consideration with the preparation of the final documents. The availability of the final documents will be announced prior to submission to the decision-making authority.

10. COMMENTS RECEIVED

ISSUES RELATED TO ACCESS AND ROAD RE-ALIGNMENT		
Issue	**Raised By**	**Source**
a. That the alignment of the roads will make access for labourers and workers very difficult – how will they travel to their work places which might be on the other side of the proposed dam?	Lady Chief Nwamitwa, Member of Parliament.	Attendance at meeting at Nwamitwa Tribal office, 1 August 2007.
b. That the distance from homes and work places will increase and that it will result in additional costs for transport. Subsidisation for transport need to be considered.	Lady Chief Nwamitwa, Member of Parliament.	Attendance at meeting at Nwamitwa Tribal office, 1 August 2007.
c. That early / timeous communication with villagers take place so that proper planning can be done to ensure that should relocation have to take place, access to work places and Tzaneen be considered and addressed. Presently the distance from Nwamitwa to Tzaneen is approximately 39km and if relocation will take place, the distance will increase.	Lady Chief Nwamitwa, Member of Parliament.	Attendance at meeting at Nwamitwa Tribal office, 1 August 2007.
d. That issues of transportation and access should be thoroughly investigated as it might affect farm workers in terms of production and transport arrangements. Most farm workers travel from their homes to farms where they work on a daily basis. Access is also important to schoolchildren – when existing rivers are full, children miss a school day, with the proposed dam the problem might increase.	BC (Burgert) van Rooyen, Group 91 Export. Mr Ngobeni, Ms Mashele and Mr Nkuna, Nkambako village and Rwanda village.	Written submission (BID comment sheet) and attendance at meeting at Groot Letaba Water User Association offices, 31 July 2007 and Nwamitwa Tribal office, 1 August 2007. Site visit by the Social Impact Assessment Team.

e. That farmers down stream should be involved with the design and planning of road realignment.	Piet Vorster, Chairperson - Constantia Farmers' Union, Letsitele and several other members of the union.	Written submission (BID comment sheet) and attendance at meeting at Letaba Junction on 1 August 2007. Attendance at a public meeting 12 October 2007, Tzaneen.
f. That information must be supplied about how the D1267 Road will be realigned.	P (Peter) Faul, Landowner, Riverside.	Written submission (BID comment sheet) and attendance at meeting at Letaba Junction on 1 August 2007.
g. That if the project involves the movement of a community it will impact on the services that the Department of Health and related organisations are delivering (clinics). Therefore Health needs to be informed should this happen. Also with regards to roads as it impacts on emergency services.	Dr Matome Masipa, Department of Health and Social Development, Limpopo.	Attended meeting at Fairview Country Lodge, 31 July 2007, Tzaneen.
h. Where the Eiland road might be affected by the dam, the road should not be re-aligned but a soil dam wall should be considered to accommodate the current alignment. This will decrease travelling distance. It is not easy to steer tractors round sharp bends, which will be a reality should soil dams not be possible.	Some of the landowners in the project area.	Site visit by the Social Impact Assessment Team.
i. That the proposed road re-alignment will result in an increase in traffic to Nwamitwa. Already there are too many accidents. A traffic light and speed bumps will have to be considered.	Some of the landowners in the project area.	Site visit by the Social Impact Assessment Team.
j. That it should be considered that the gravel road from Mandakhazi to Deerpark be tarred.	Some of the landowners in the project area.	Site visit by the Social Impact Assessment Team.
k. That the re-alignment could include tarring the road from Msipane Health Centre to the road that is being tarred between Nwamitwa and ka Mvale.	Some of the landowners in the project area.	Site visit by the Social Impact Assessment Team.
l. That no new roads should be built near existing houses, as this will negatively impact on peace and quiet.	Some of the landowners in the project area.	Site visit by the Social Impact Assessment Team.

m. That all encroachment on provincial road reserved must be approved by the Limpopo Roads Agency before work is carried out within the road reserves.	Mbhazima Thomas Shivambu, Roads Agency Limpopo, Polokwane.	Written submission (BID comment sheet).
n. That the R529 should be re-aligned on an existing servitude road on La Gratitude North towards the D1292 and join between Karibu and De Nysschen – only one bridge has to be built over Taganashoek River. This option will have the least effect on the orchards on La Gratitude , Riverside, Taganashoek and Janetsi. As a second alternative: No change to the road, only use the existing Letsitele Road.	Mr Peter Faul, Landowner, Riverside 514 LT and La Gratitude 28. Mr Koos de Nysschen, landowner.	Written submission (DSR comment sheet) and attendance of the public meeting on 12 October 2007 in Tzaneen.
o. That Constantia farmers will be severely effected by the re-alignment of roads – please include us in the planning process.	Mr Pieter Voster, Chairman, Constantia Farmers Association (Agri-Letaba), Letsitele.	Written submission (DSR comment sheet) and attendance of the public meeting on 12 October 2007 in Tzaneen.
p. That all encroachment on provincial road reserved must be approved by the Limpopo Roads Agency before work is carried out within the road reserves.	Mbhazima Thomas Shivambu, Roads Agency Limpopo, Polokwane.	Written submission (BID comment sheet).

11. OTHER INFORMATION REQUESTED BY THE AUTHORITY

No specific requests have been raised by the authority.

12. CONCLUSION

The impact that the construction of the proposed storage dam in the Groot Letaba River, the raising of the Tzaneen Dam Wall and the associated bulk water supply Infrastructure, has on the roads network is generally deemed to be a short term, low intensity but a high probability effect. Due to the ample spare capacity of the roads network and the relative low (12 vehicles per hour) volumes of construction vehicles that will utilise the public roads it is considered to be of low significance as a whole.

There are four proposed alternative alignments however Alignment 4 is the preferred re-alignment. This re-alignment has the lease amount of impact on traffic form a time and distance point of view.

water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

REPORT NO.: P02/B810/00/0708 Vol 2 Annexure M

GROOT LETABA RIVER WATER DEVELOPMENT PROJECT (GLeWaP)

Environmental Impact Assessment Report (DEAT Ref No: 12/12/20/978)

Annexure M: Sedimentation Impact Assessment

JULY 2008

Compiled by:

Prof GR Basson
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DECLARATION OF INDEPENDEANCE

Mr Gerrit Basson of ASP Technology (Pty) Ltd., is an independent consultant to ILISO Consulting (Pty) Ltd (for the Department of Water Affairs and Forestry), i.e. he has no business, financial, personal or other interest in the activity, application or appeal in respect of which they were appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of these specialists performing such work

REPORT DETAILS PAGE

Project name:	***Groot Letaba River Development Project***
Report Title:	**Environmental Impact Assessment Annexure M: Sedimentation Specialist Study**
Author:	***ASP Technology (Pty) Ltd.***
DWAF report reference no.:	***P 02/B810/00/0708/Volume 2 Annexure M***
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Dr Martin van Veelen *Date*
Project Director

EXECUTIVE SUMMARY

Prof GR Basson of ASP Technology (Pty) Ltd was appointed during 2008 to assess the possible impacts of the proposed water resources developments in the Groot Letaba basin on the sediment transport balance in the river system. This report forms part of the EIA to investigate the environmental feasibility of raising Tzaneen Dam, the construction of the proposed Nwamitwa Dam on the Groot Letaba River and associated water infrastructure (water treatment, pipelines, pumpstation, off-takes and reservoirs) in the Limpopo Province.

Field work was carried out to obtain river bed sediment samples and a hydrodynamic model was used to investigate the sediment balance in the Groot Letaba River.

The key findings are:

a) Downstream of Nwamitwa Dam:

- *The dam will cause flood peak attenuation (reduced flood peaks) by about 7 % for large floods (3000 m^3/s), but more for smaller floods: 30 % attenuation for a 1600 m^3/s flood peak and 70 % attenuation for a 270 m^3/s flood peak.*
- *The post-dam river will become narrower due to flood attenuation caused by the dam. Near the dam the main channel width could decrease by 19 % (22 m reduction on 116 m). In the KNP upstream of the Olifants River confluence the reduction of channel width could be about 17 % (70 m on 411 m channel width).*
- *The river bed between the dam and the Klein Letaba River tributary will become coarser due to sediment trapping at the dam: from 0.56 mm median diameter to 0.72 mm median sediment diameter.*
- *Slightly more sediment will be transported down the river in the post-dam scenario due to the narrower river and local bed degradation on the Klein Letaba River near the confluence with the Groot Letaba River.*
- *Local bed degradation (lower bed level) near the dam of at least 2 m is expected.*

b) Upstream of Nwamitwa Dam

The estimated sediment deposition volume in Nwamitwa Reservoir over a 50 year period is 17.5 million m^3 which is relatively small compared to the reservoir storage (1.2 MAR = 187 million m^3) . Deposition of sediment above full supply level has to be

considered in the detailed design and floodline analysis of the reservoir as it would affect flood levels.

c) Flow gauging station downstream of Nwamitwa Dam

The weir downstream of the dam will have a negligible impact on the flow and sediment balance of the river.

d) Tzaneen Dam raising

Small floods will be attenuated more and it is expected that the main channel width downstream of the dam to the first main tributary could decrease by less than 5 % of the current width. The river morphology downstream of Tzaneen Dam is not expected to change significantly.

Elevated flood levels upstream of the reservoir could be expected due to future sedimentation above the raised full supply level. This has to be considered in the floodline assessment.

e) Relocation of roads and proposed dam access roads

As long as the relocated roads and access roads are designed based on the guidelines of the NRA Road Drainage Manual (2007), no significant problems are foreseen in term of sedimentation.

f) Construction aspects related to Nwamitwa Dam

The coffer dam should be designed not to cause river bank erosion or local scour at the dam site. The sediment concentrations 300 m downstream of the dam site should be monitored during construction to ensure present (90 percentile) high sediment concentrations are not exceeded as proposed in Table 12-1.

g) Treatment plant and water reticulation pipelines

The upgrading of the treatment plant and construction of water reticulation pipelines should have limited effect on sedimentation as long as proper stormwater drainage is designed at river crossings and during construction the present stream sediment concentrations based on 90 percentile values should not be exceeded. If required sedimentation basins should be constructed on site.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

DWAF	Department of Water Affairs and Forestry
EIA	Environmental Impact Assessment
GLeWaP	Groot Letaba River Water Development Project
MAR	Mean annual runoff
PSP	Professional Service Provider

1. INTRODUCTION

The Department of Water Affairs and Forestry (DWAF) is currently undertaking an Environmental Impact Assessment (EIA) to investigate the environmental feasibility of raising Tzaneen Dam, the construction of a storage dam on the Groot Letaba River and associated bulk water infrastructure (water treatment, pipelines, pump stations, off-takes and reservoirs) in the Limpopo Province.

The project will comprise of the following components:

- The raising of the Tzaneen Dam;
- A new dam at the site known as Nwamitwa;
- A flow gauging weir just downstream of the Nwamitwa Dam;
- Associated relocation of roads at Nwamitwa Dam;
- Access roads to the Nwamitwa Dam;
- Upgrading of the existing Water Treatment Works just north of the Nwamitwa Dam;
- Water reticulation pipelines inclusive of appurtenant infrastructure, namely pump stations and reservoirs.

Prof GR Basson of ASP Technology (Pty) Ltd was appointed during 2008 to assess the possible impacts of the proposed water resources developments in the Groot Letaba River basin on the sediment transport balance in the river.

The proposed Nwamitwa Dam on the Groot Letaba River could have a storage capacity of 1 to 1.5 times the mean annual runoff (MAR). The dam would trap most of the incoming sediment load. Sedimentation would also occur above full supply level in the upper reaches of the reservoir which would raise flood levels.

While the dam wall would only be about 30 m high, the over-year storage capacity could lead to reduced flood peaks (flood attenuation) downstream of the dam. Due to the size of the reservoir, almost all of the sediment load entering the reservoir would be trapped in the reservoir. Flow released from the dam would therefore be relatively free of sediment which could lead to local bed degradation near the dam. Further

downstream more sediment deposition in the river is expected downstream of tributaries since flood peaks will be attenuated by the dam.

Both upstream and downstream impacts of the proposed dam on sediment transport, deposition and erosion are discussed in more detail in this report. Other project components listed above and their possible impacts on sedimentation are also discussed.

2. METHODOLOGY TO ASSESS DOWNSTREAM RIVER MORPHOLOGICAL IMPACTS OF THE NWAMITWA DAM ON THE GROOT LETABA RIVER

A one-dimensional hydrodynamic mathematical model was used to assess possible fluvial morphological changes downstream of the proposed dam. For the pre-dam scenario the river was setup from the dam site to inside the Kruger National Park (KNP), upstream of the Olifants River confluence. Tributaries downstream of the dam were combined into one tributary entering the Groot Letaba at the location of the Klein Letaba River. Cross-sectional data of the river was obtained from 1:50000 maps and satellite images.

Sediment input in the model of sand fractions were calculated based on the sediment transport capacity at the boundaries (main channel and tributary).

The inflow record at the dam site was scaled from data at gauging station B8H017. The tributary flow record was generated by subtracting flow records of gauging station B8H018 in the KNP and the flow at the dam site, considering the lag. The inflow records into the model at the dam site and at the tributary are shown in **Figures 2.1** and **2.2.**

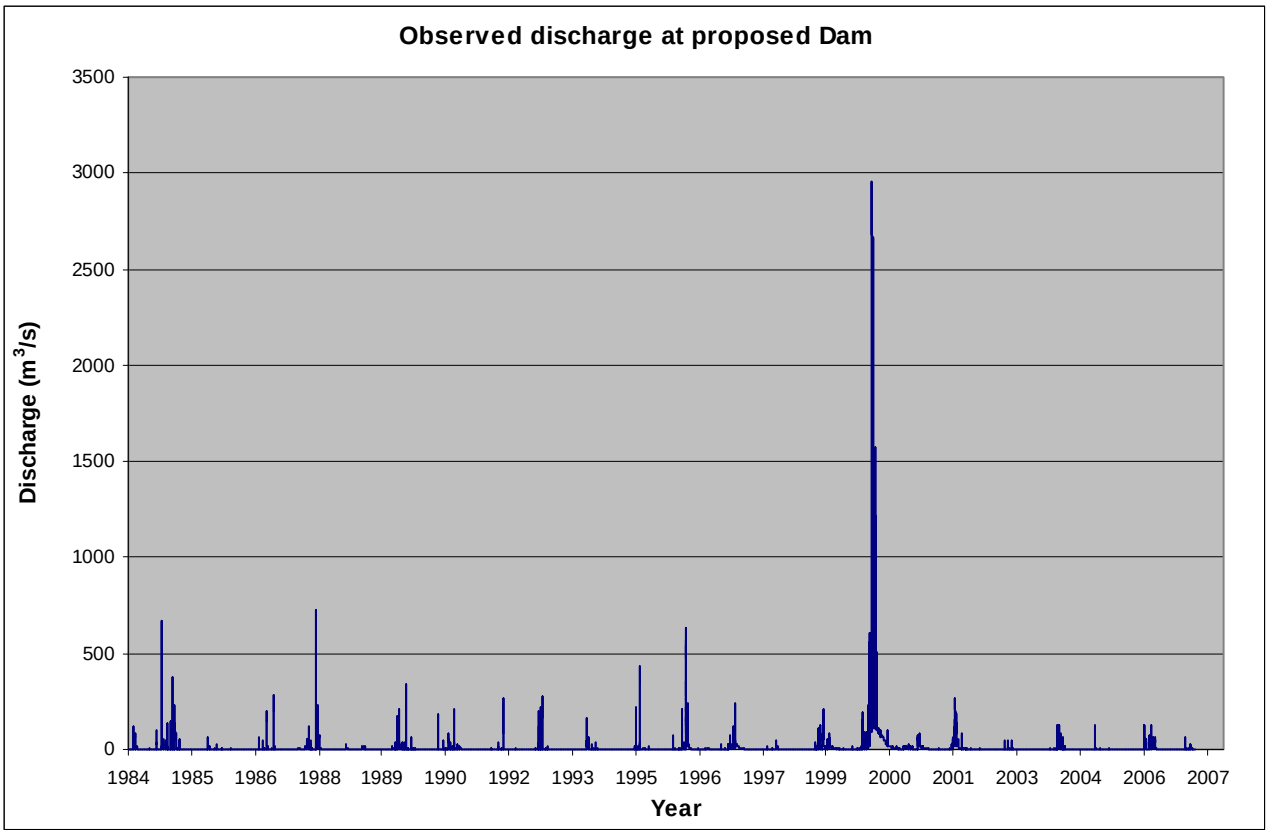

Figure 2.1: Generated inflow record at dam site

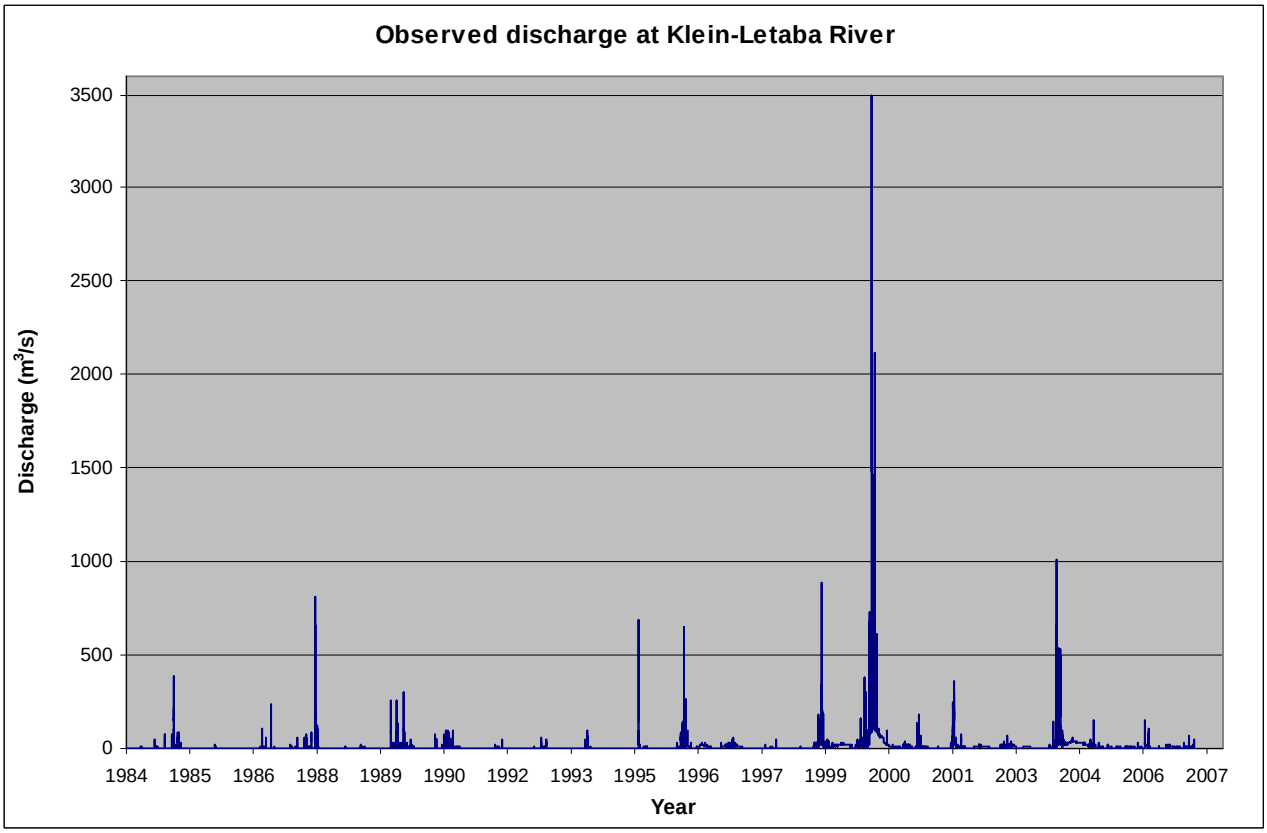

Figure 2.2: Generated inflow record at combined tributaries (Klein Letaba)

The large flood of 2000 was included in the flow record. During this flood the flow gauging stations were washed away in many cases. At the dam site the year 2000 flood peak was reconstructed by extrapolation of the discharge table based on observed water levels. The Probable Maximum Flood (PMF) and Regional Maximum Flood (RMF) at the dam site are in the order of 13000 m^3/s (routed through the dam) and 6500 m^3/s (not routed) respectively (Ninham Shand, 2008).

In the post-dam scenario in this study the effect of the proposed dam was analysed by routing the flow record (**Figure 2.1**) through the dam, with a spillway length of 190 m and assuming a 1.5 MAR storage capacity with a spillway crest level at 486 masl (Ninham Shand, 2008). For this scenario it was assumed all the sediment would be trapped in the reservoir.

3. FIELD WORK

Sediment samples were taken from the Groot Letaba River and grading analyses were carried out on four samples. The samples were taken at the Letaba-Mopani (Road H1-6) and Phalaborwa-Mopani (Road H14) bridges in the KNP, and near the R71 Road Bridge near the proposed dam site. The grading analysis results are shown in **Table 3.1** and graphically in **Figure 3.1**.

Table 3.1: Grading analysis of Groot Letaba River bed samples (cumulative % passing sieve)

Sample No.	<0.075mm (%)	<0.15mm (%)	<0.3mm (%)	<0.6mm (%)	<1.18mm (%)	<2.36mm (%)	<4.75mm (%)	<9.5mm (%)
1	0.2	0.5	2.3	37.0	91.6	99.3	100.0	100.0
2	3.4	10.1	59.2	98.7	100.0	100.0	100.0	100.0
3	0.4	0.8	8.2	68.5	93.9	98.6	99.8	100.0
4	0.3	1.0	9.4	58.9	94.3	98.5	100.0	100.0

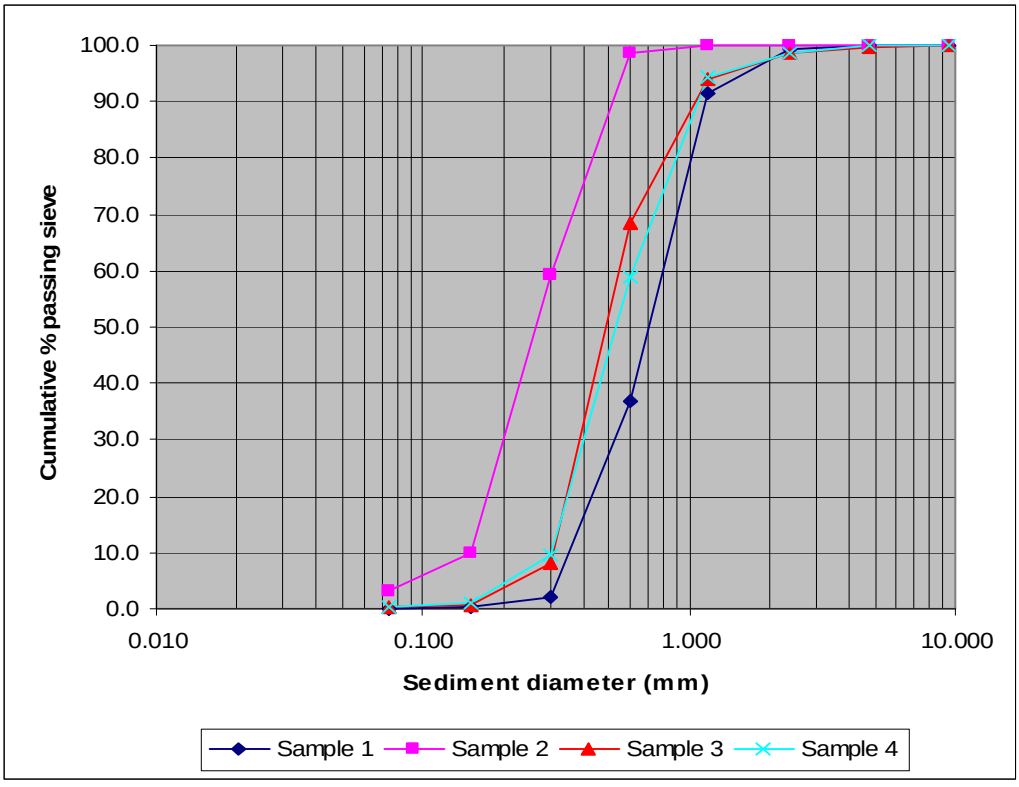

Figure 3.1: Sediment grading analysis of the Groot Letaba River bed sediment

The median sediment sizes of the 3 samples taken range from 0.25 mm to 0.7 mm, which is typical of South African sand bedded rivers. The range of sediment sizes sampled in the bed was generally smaller than 2 mm, with very little silt and clay (< 0.065 mm). Sample 1 was taken at the Road H14 bridge which could have caused flow constriction and local scour during floods leading to a larger median sediment size compared to further downstream near Letaba Camp on the same river. Samples 2 and 3 were taken from the bridge north of the Letaba Camp in the KNP (Road H1-6). Sample 2 was finer than sample 3 due to the river bend effect with higher velocities and sediment transport capacity near the outside of the bend (sample 3) compared to the middle of the river (sample 2). Sample 4 was obtained near the R71 bridge near the dam site and is similar in grading to sample 3.

4. DESCRIPTION OF RIVER

The river has a sandy bed and varies in width from about 100 m at the dam site to about 300 m in the KNP. **Figures 4.1** to **4.7** show more details of the river in and outside the KNP. In most cases the river banks are densely vegetated. There are several existing weirs on the river but their impact on the flow and sediment balance is expected to be small.

Figure 4.1: Downstream view of Groot Letaba River on R71 road near the proposed dam site

Figure 4.2: Upstream view of Groot Letaba River on near Malotsi River tributary

Figure 4.3: Downstream view of Groot Letaba River at Road H14 bridge in KNP

Figure 4.4: Upstream view of Groot Letaba River from Road H1-6 bridge in KNP

Figure 4.5: Groot Letaba River at Letaba Camp in KNP viewed from right bank

Figure 4.6: Groot Letaba River between Letaba and Olifants Camp in KNP with bedrock reach viewed from right bank

Figure 4.7: Groot Letaba River near Olifants River with wide sand bedded main channel viewed from right bank

5. SIMULATION RESULTS: IMPACTS OF THE PROPOSED DAM ON THE DOWNSTREAM FLOODS

The pre- and post-dam scenarios immediately downstream of the dam are shown in **Figure 5.1** and **5.2**. The flood peak is attenuated (reduced peak discharge) by only about 7 % due to the dam during a large flood such as in year 2000, but for smaller floods the attenuation (decrease in peak discharge) is 30 % (**Figure 5.1**) to 70 % (**Figure 5.2**).

Figure 5.3 shows the simulated long flow record immediately downstream of the dam. This graph should be compared to the pre-dam condition at the dam site (**Figure 2.1**).

Figure 5.4 shows the flow series simulated in the KNP. The tributary inflow upstream of this point (**Figure 2.2**) has cancelled out to a large extent the effect of the proposed dam (**Figure 5.5**).

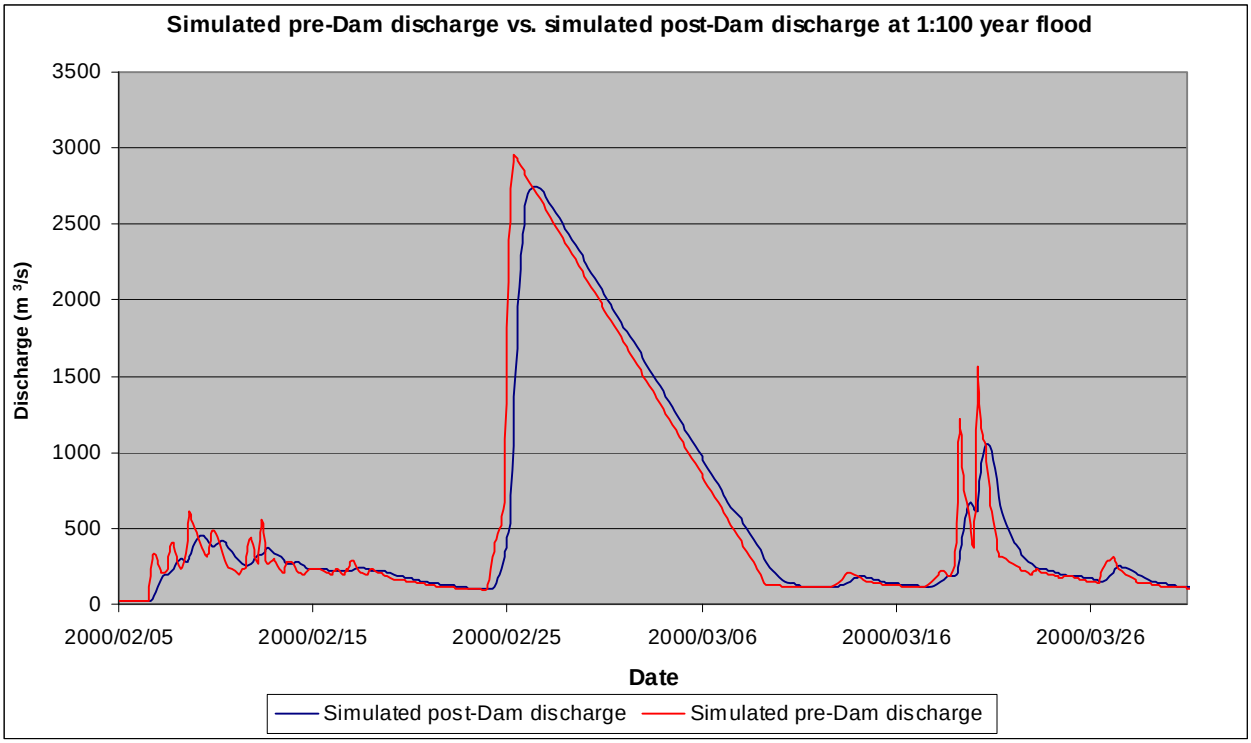

Figure 5.1: Simulated pre- and post dam large flood attenuation caused by the dam immediately downstream of the dam

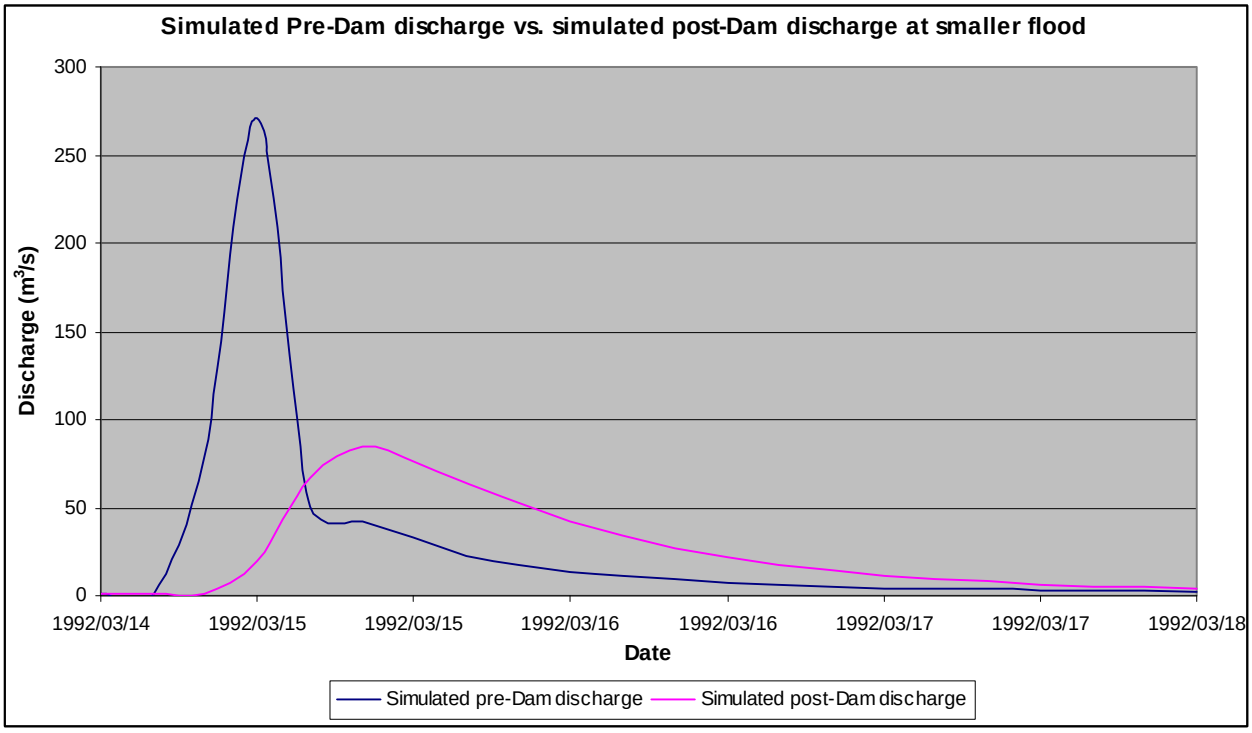

Figure 5.2: Simulated pre- and post dam small flood attenuation caused by the dam immediately downstream of the dam

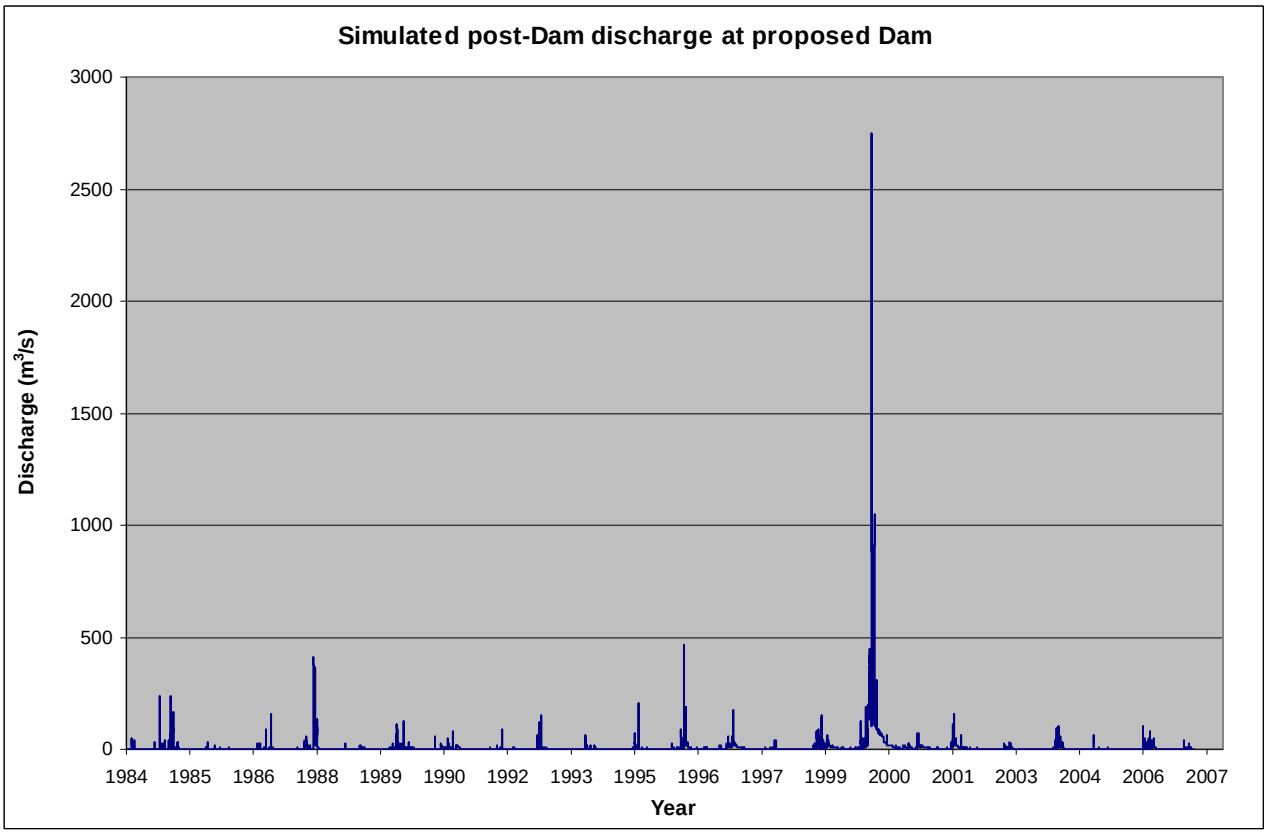

Figure 5.3: Simulated post-dam discharge at proposed dam

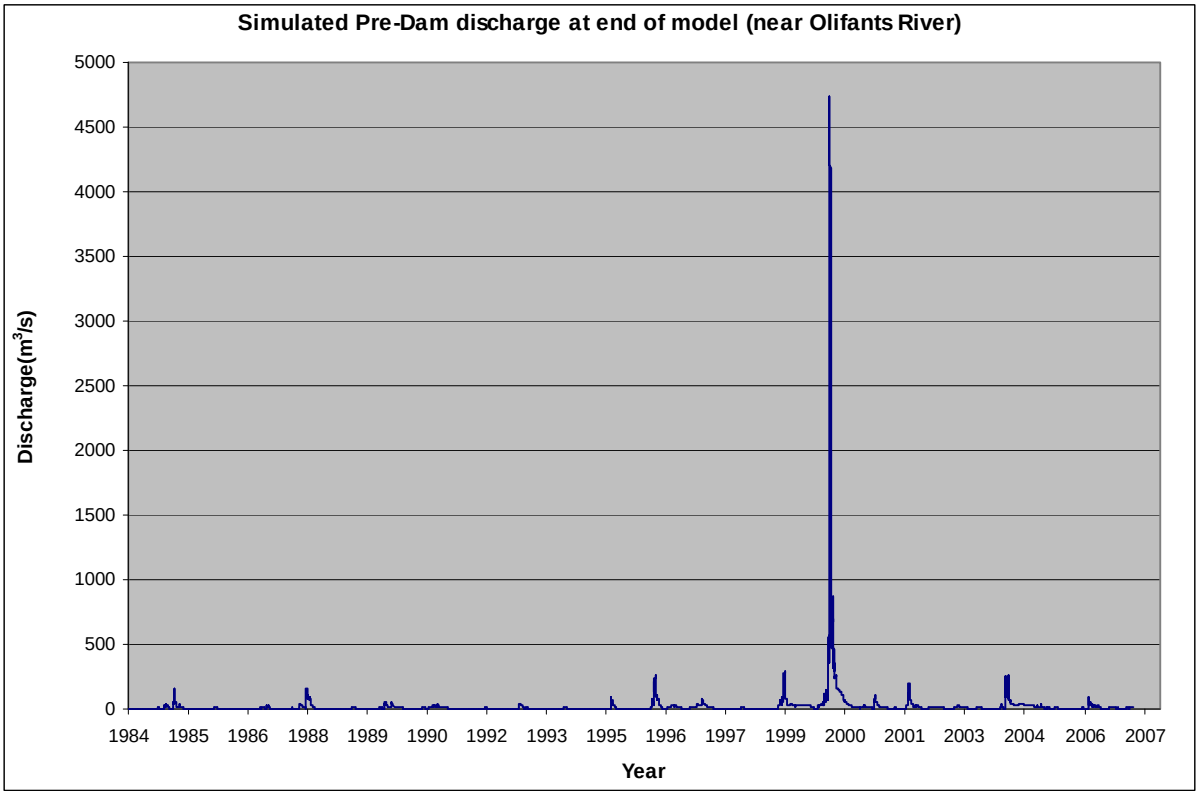

Figure 5.4: Simulated Pre-Dam discharge at downstream end of model (near Olifants River)

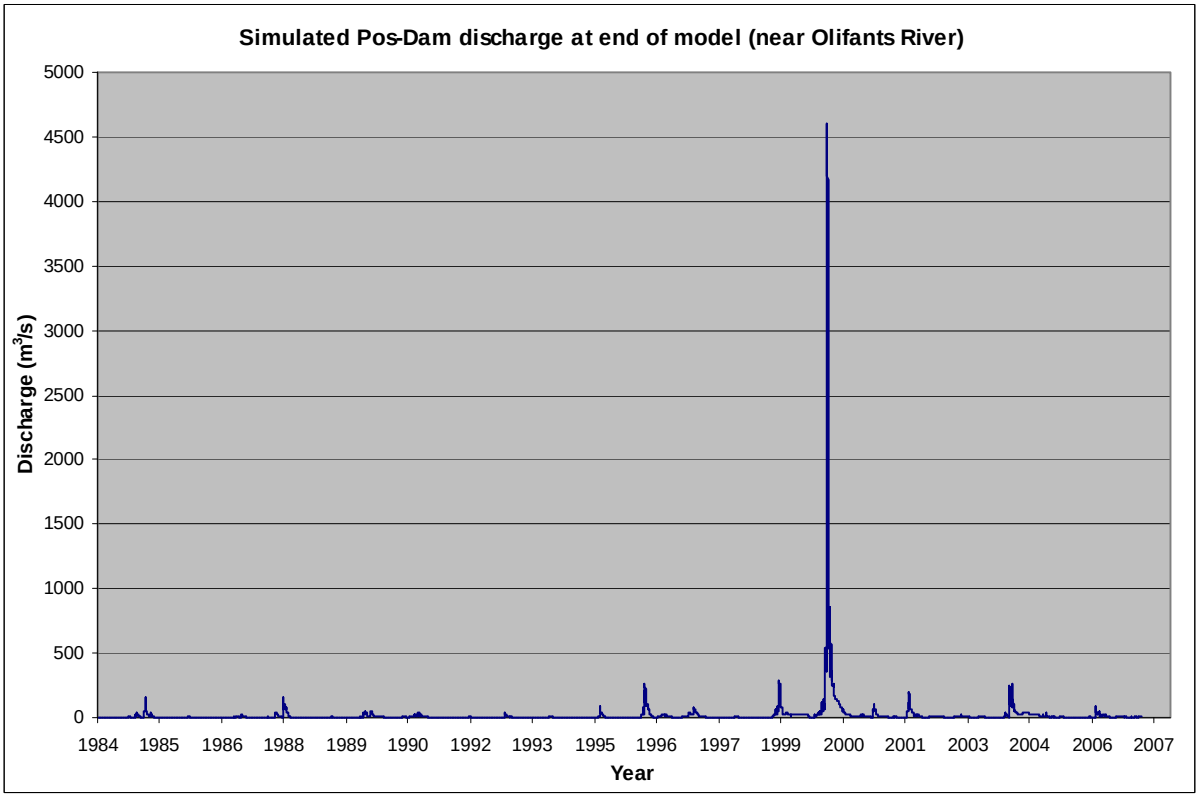

Figure 5.5: Simulated Post-Dam discharge at downstream end of model (near Olifants River)

6. SIMULATION RESULTS: IMPACTS OF THE DAM ON THE DOWNSTREAM RIVER MORPHOLOGY

The reduced flood peaks caused by the dam will cause a reduction in the river width downstream of the dam. From empirical data for South Africa this reduction can be calculated with the following equations (Beck and Basson, 2003):

$$B_2 = -3.40 + 0.856 \cdot B_1 + 0.142 \cdot MAR_2 - 0.0013 \cdot Q_{p_1} \quad \text{.....(1)}$$

$$B_2 = -1.02 + 0.805 \cdot B_1 + 0.183 \cdot MAR_2 - 0.00036 \cdot Q_{a1} \quad \text{.....(2)}$$

With:

- Pre- and post-dam widths (B_1/B_2) in m
- Post-dam mean annual runoff (MAR_2) in m^3/s
- Pre-dam mean annual maximum flood peaks (Q_{a1}) in m^3/s
- Highest flood peak for the pre-dam period (Q_{p1}) in m^3/s

Table 6-1 shows the observed and calculated river widths for the pre- and post dam scenarios at various locations downstream of the dam.

With the inflow data the calculated reduction in river channel width will be 19 % near the dam, which is a 23 m reduction on a 116 m channel width. Downstream of the Klein Letaba River confluence the width reduction caused by the dam will be about 17 %, or 70 m on 411 m channel width. These reduced channel widths were taken into account in the post-dam scenario. Figures 6-1 and 6-2 show two the observed and predicted post-dam river widths downstream of the proposed dam.

Table 6.1: Calculated river widths for post-dam scenario

Description	Chainage downstream of dam (km)			
	1	96	102	189
B_1 (m) (observed)	116	180	250	411
MAR_2 (m^3/s)	9	9	20	20
Q_{pl} (m^3/s)	2926	2431	4936	4743
Q_{al} (m^3/s)	356	168	401	504
B_2 from eq.1 (m)	93	149	207	345
B_2 from eq.2 (m)	94	146	204	333
Average B_2 (m)	93	147	206	339
B_2/B_1 ratio	0.81	0.82	0.82	0.83

Note:
Chainage 1 located at dam site immediately downstream of dam
Chainage 96 located upstream of Klein Letaba tributary
Chainage 102 located immediately downstream of Klein Letaba tributary
Chainage 189 located near downstream end in KNP, upstream of Olifants tributary

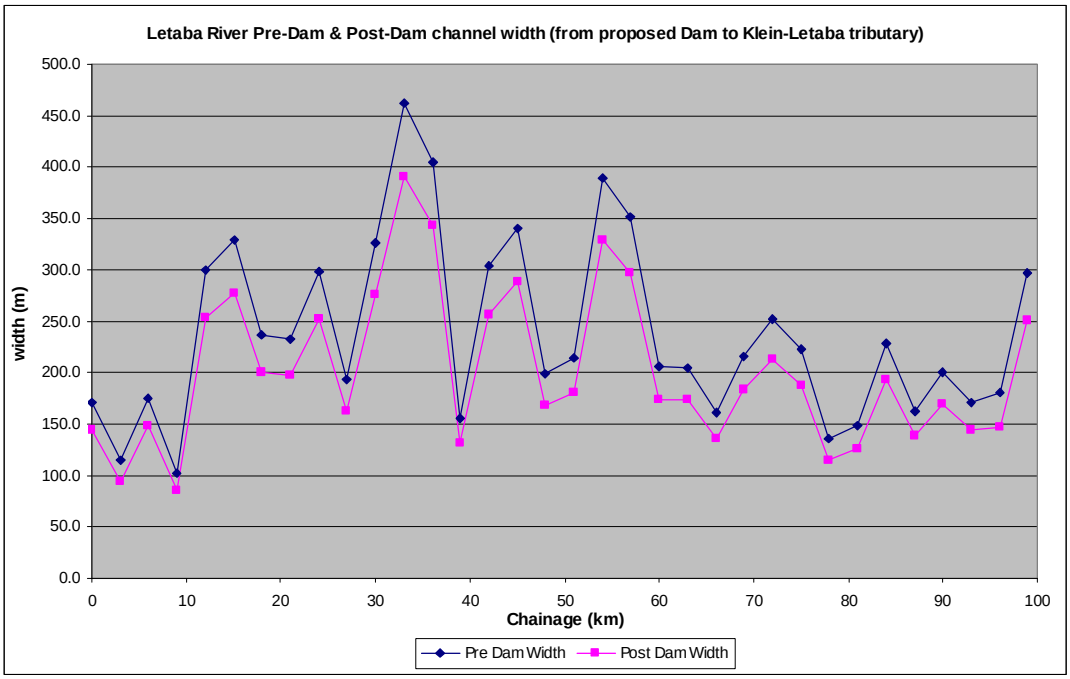

Figure 6.1: Letaba River predicted main channel river widths downstream of the proposed dam to the Klein Letaba River

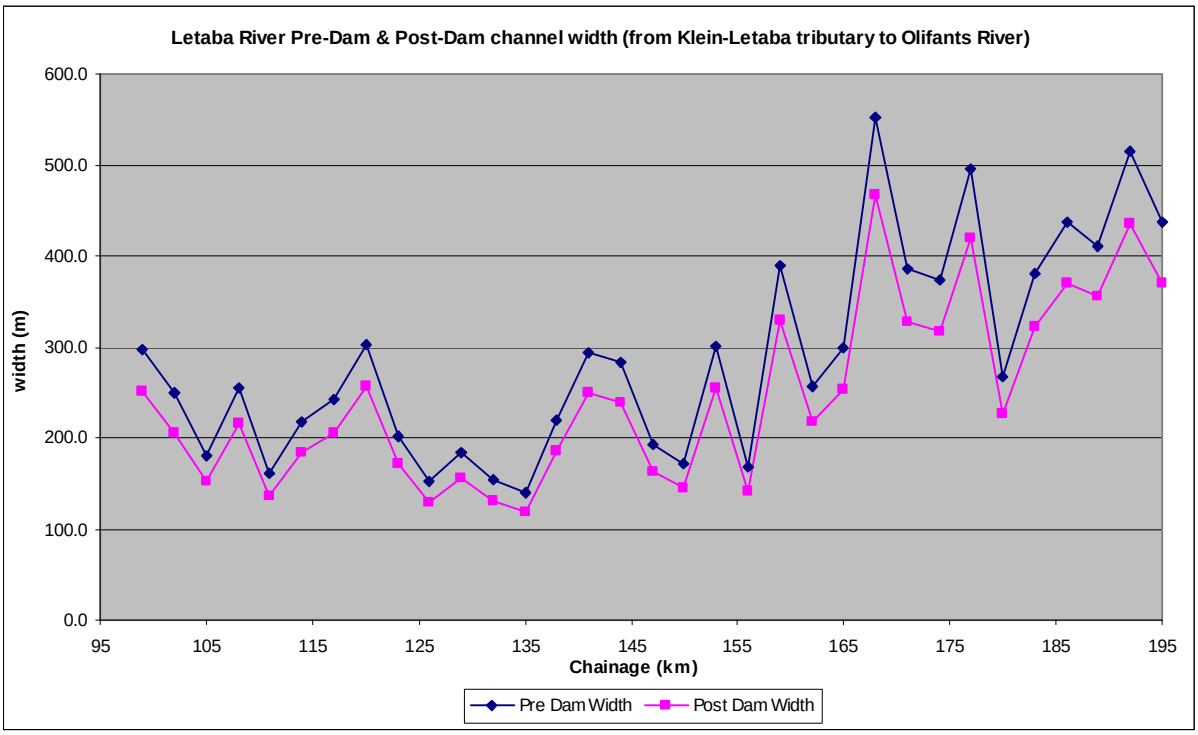

Figure 6.2: Letaba River predicted main channel river widths downstream of the Klein Letaba River to the Olifants River in the KNP

Near the dam the sediment in the bed would tend to coarsen as the fine sediment is removed during floods in a post-dam scenario. In the model the initial bed fractions were taken as 0.3 mm (50 %) and 0.82 mm (50 %). The post-dam simulation upstream of the Klein Letaba tributary indicated that over time the 0.3 mm fraction will decrease to about 20 %, with 0.82 mm sediment forming about 80 % of the bed material.

Normally a dam reduces the sediment transport in a river downstream of it, but this depends on many local hydraulic factors. In the case of the Groot Letaba River upstream of the Klein Letaba tributary, **Figure 6.3** shows that there could be a small increase in sediment transport in the post-dam scenario, probably because the narrowing of the river dominates over the flood attenuation caused by the dam. The difference in sediment transport is however very small: 100000 m^3 (bed load and suspended load) over a 23 year period, which is a 23 % change from the current condition. The higher sediment transport in the post-dam scenario indicates scour downstream of the dam. Near the dam the model indicates bed degradation (lower bed level) of at least 2 m. This degradation depends on large floods but the new equilibrium is typically established 7 to 10 years after completion of a dam.

Figure 6.4 shows the cumulative sediment transport downstream of the Klein Letaba tributary, near the downstream end of the model (upstream of the Olifants tributary).

In this case the post-dam scenario indicates even higher sediment transport than in **Figure 6.3**. This is due to the narrower main channel, but also changed hydraulic conditions at the Klein Letaba – Groot Letaba confluence which leads to more scour of the bed of the Klein Letaba River near the confluence.

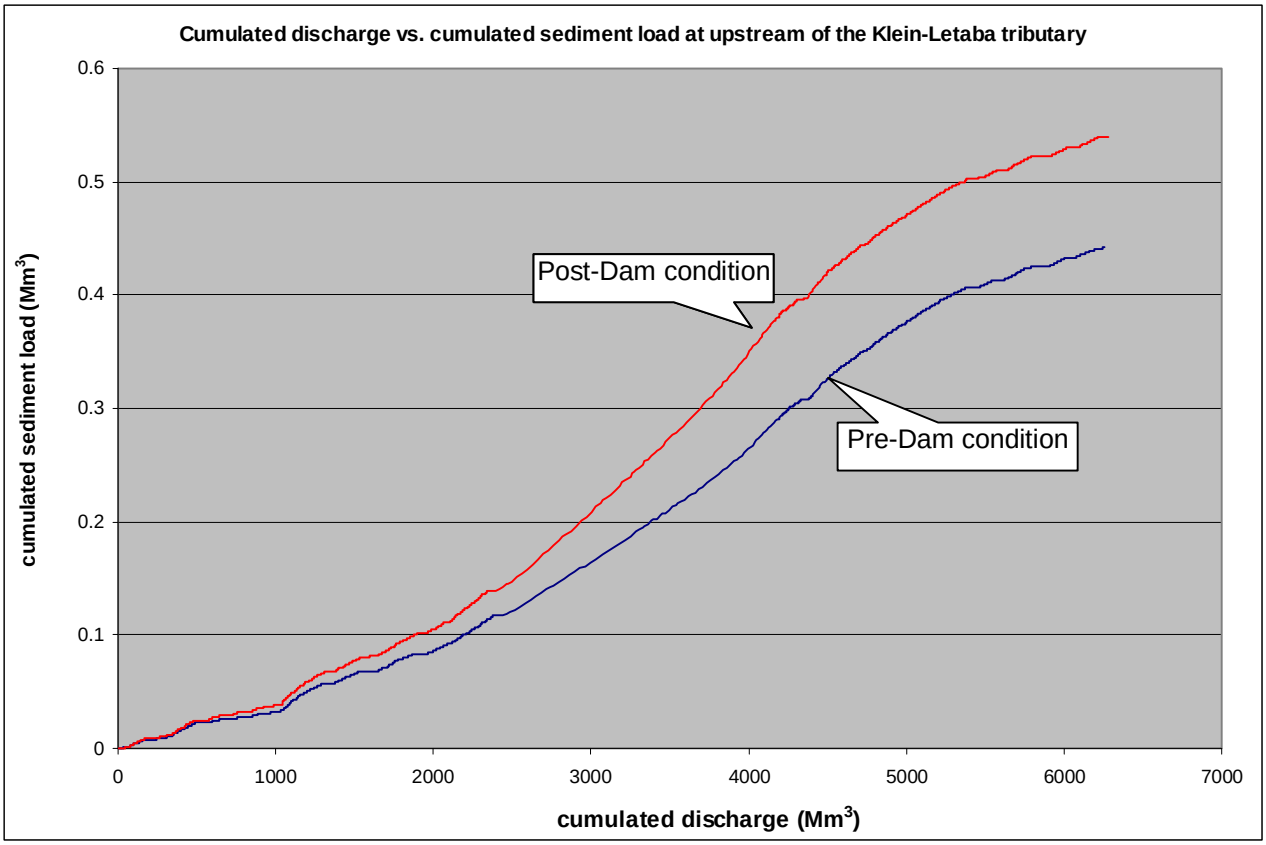

Figure 6.3: Cumulative discharge vs. cumulative sediment load upstream of the Klein-Letaba tributary

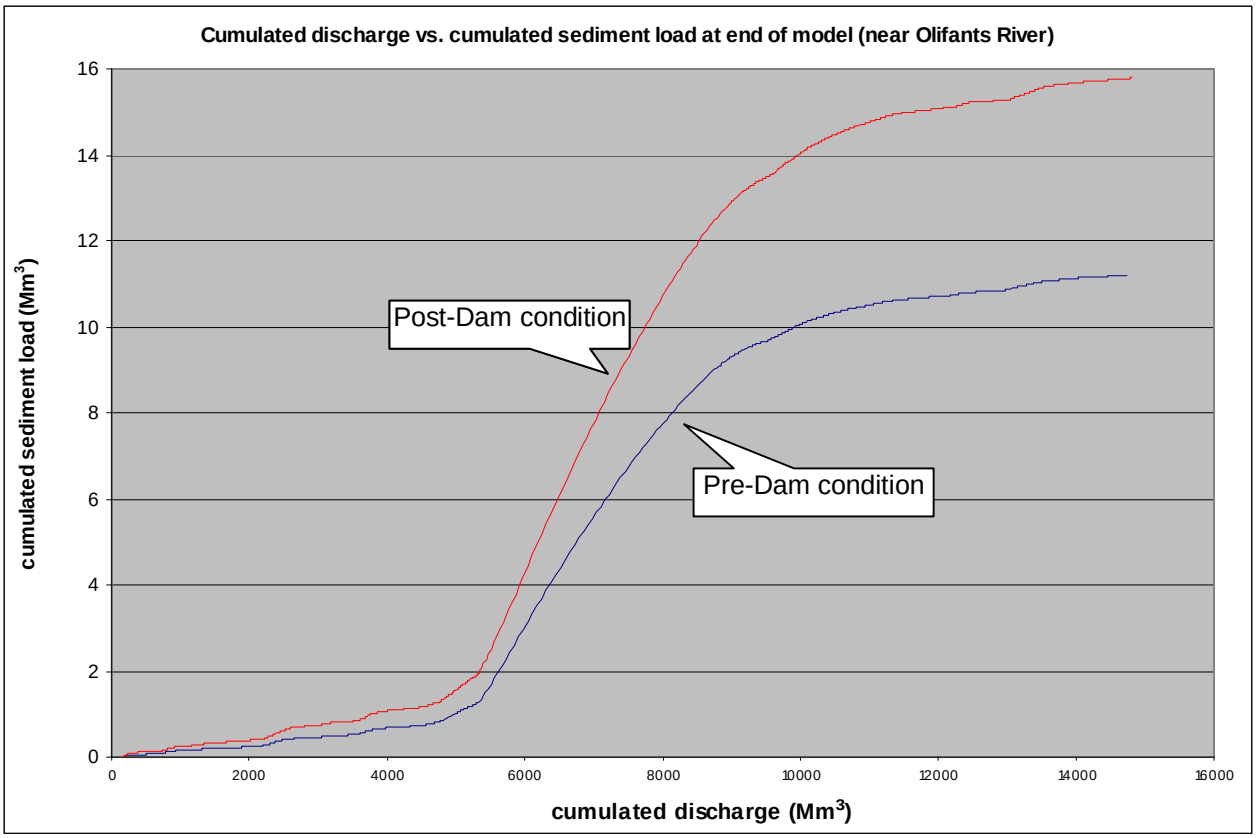

Figure 6.4: Cumulative discharge vs. cumulated sediment load at downstream end of model (near Olifants River)

Figures 6.5 and **6.6** show the simulated sediment transport in the Groot Letaba River downstream of the proposed dam, for pre- and post-dam scenarios. In both scenarios the sediment loads on the Groot Letaba River upstream of the Klein Letaba tributary are similar. In the post-dam scenario more sediment will be scoured from the Klein Letaba River near the confluence resulting in a 41 % higher sediment load (bed load and suspended sediment only) in the post-dam scenario on the Groot Letaba River in the KNP. The additional sediment transport in the KNP in the post-dam scenario is mainly due to scour (bed degradation near the confluence) of the Klein Letaba River.

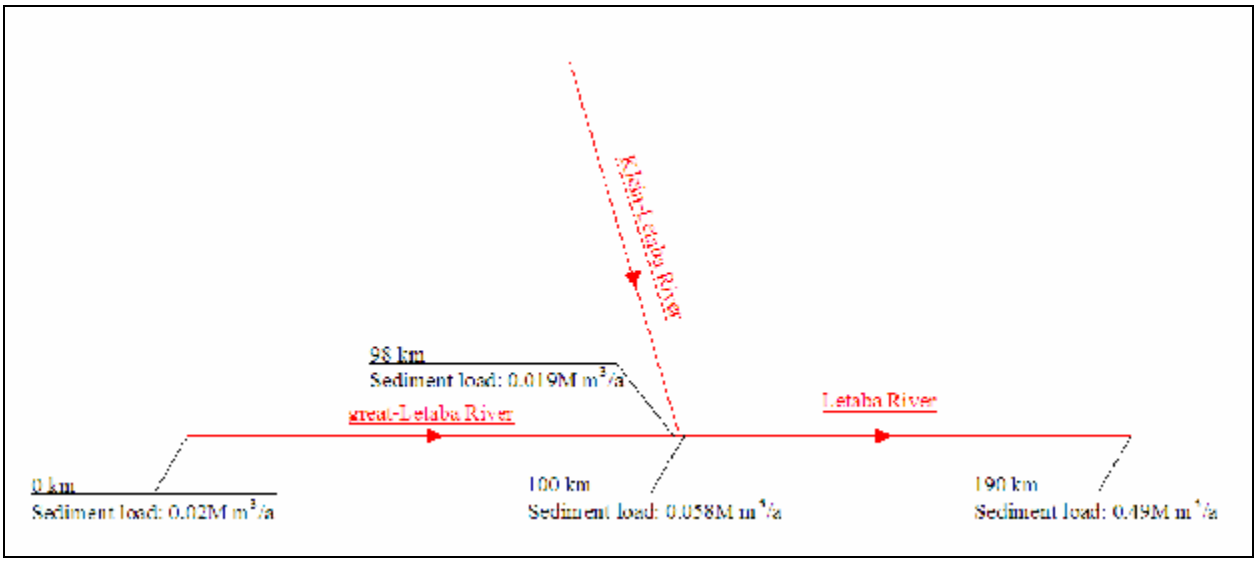

Figure 6.5: Pre-dam sediment balance on the Groot Letaba River

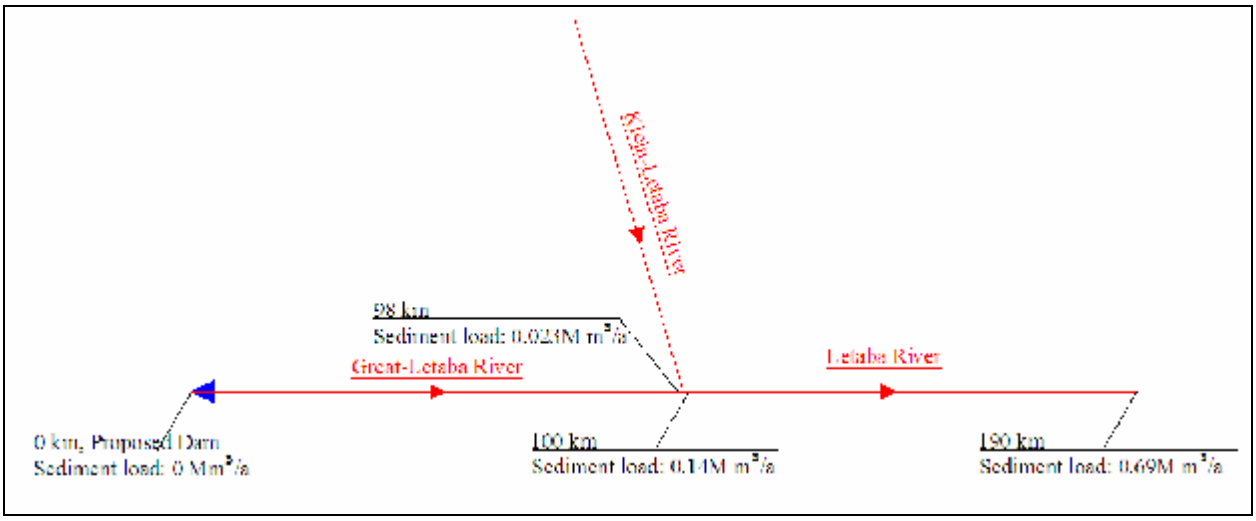

Figure 6.6: Post-dam sediment balance on the Groot Letaba River

Figures 6.7 and **6.8** show the simulated river bed levels downstream of the Nwamitwa Dam in the post-dam scenario. Letaba Camp in KNP is at about 155 km and the Klein Letaba River tributary at 99 km.

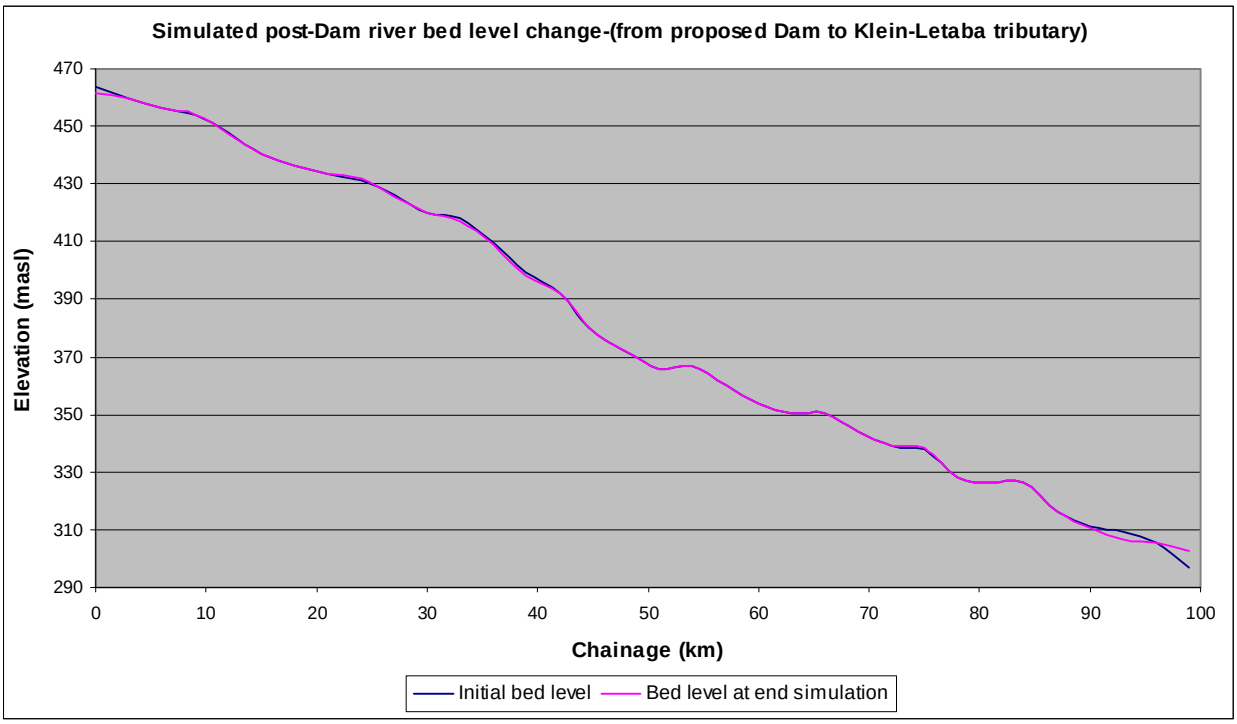

Figure 6.7: Groot Letaba River bed levels from the dam to Klein Letaba River simulated based on 23 year historical flow record

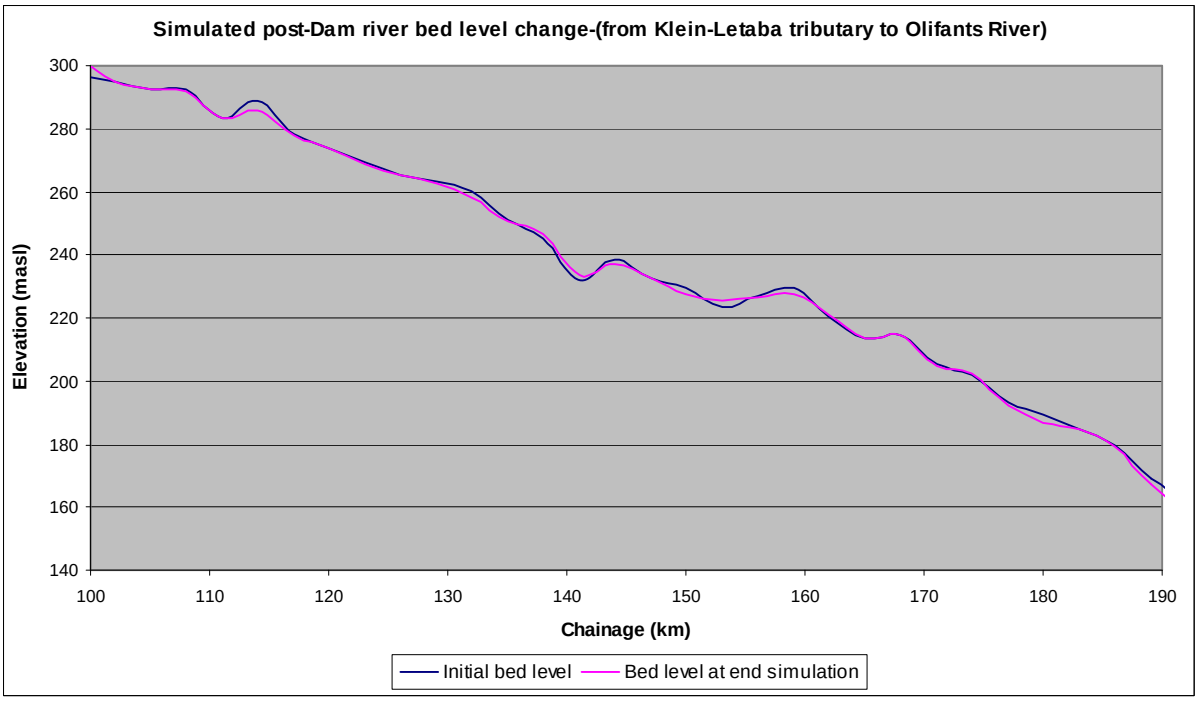

Figure 6.8: Groot Letaba River bed levels from Klein Letaba River to near the Olifants River in the KNP simulated based on 23 year historical flow record

7. RESERVOIR SEDIMENTATION UPSTREAM OF THE PROPOSED NWAMITWA DAM

7.1 SEDIMENT YIELD DETERMINATION

7.1.1 Previous studies

Rooseboom (1990) in the Letaba Basin Study proposed the following maximum sediment yields:

Nwanedzi River : 320 t/km^2.year (220 km^2)

Thabina River : 350 t/km^2.year (150 km^2)

Letsitele River : 360 t/km^2.year (170 km^2)

The proposed sediment yields were based on observed sedimentation rates of existing reservoirs in the region.

In the Letaba Water Resource Development: Pre-feasibility Study of 1994, Rooseboom reviewed his 1990 sediment yields, based on a regional method development for the SA Water Research Commission (Rooseboom, 1992). Based on this method the predicted average sediment yield for the Nwamitwa Dam site was 280 t/km^2.a, for a 1352 km^2 effective catchment area and reservoir storage capacities that ranged from 58.7 to 192 million m^3. This sediment yield estimation was based on observed sedimentation rates of existing reservoirs in the region. Basson (2007) carried out a Reservoir Sedimentation study for DWAF as part of the Groot Letaba River Water Resources Development Project. The key findings of that study are discussed here in sections 7.1.2 to 7.2.

7.1.2 Sediment yields of existing dams

The latest reservoir basin survey data were obtained from DWAF and observed sediment yield data of dams (**Figure 7.1**) near the proposed dam site are shown in **Table 7.1.**

Figure 7.1: Dams and gauging stations located in the region of Nwamitwa dam site

Table 7.1: Observed sediment yields based on reservoir surveys

Dam	River	Effective catchment area (km^2)	First survey	Last survey	Sediment yield ($t/km^2.a$)*
Ebenezer	Groot Letaba	156	1959	1986	155
Magoebaskloof	Politsi	64	1970	2000	93**
Dap Naude	Broederstroom	14	1961	1987	357***
Tzaneen	Groot Letaba	419	1976	1990	285
Massingir	Olifants	41480	-	-	245****
Middel Letaba	Middel Letaba	1799	1986	2001	293

Notes: * A 100 % sediment trapping efficiency was assumed in the reservoirs.

** The sediment yield of Magoebaskloof Dam is not reliable due to the small storage capacity – mean annual runoff ratio at the dam of only 0.13, which makes it difficult to estimate the sediment trapping efficiency of the reservoir.

*** The Dap Naude Dam sediment yield was found to be the highest, but the dam has a very small effective catchment area of only 14 km^2. In larger catchments the sediment delivery ratio is usually reduced due to more sediment deposition occurring.

**** Massingir Dam in Mozambique was included since it is located downstream the proposed Nwamitwa Dam site. Basson (2002) determined the sediment yield of Massingir Dam based on suspended sediment data and reservoir basin surveys. The catchment area of Massingir Dam is very large compared to the 1352 km^2 of Nwamitwa Dam, and covers a large catchment area to the south of the Nwamitwa Dam site.

From Table 7-1 the data of Tzaneen Dam, Middel Letaba Dam and Massingir Dam are probably most applicable to the proposed Nwamitwa Dam. Ebenezer Dam has a relatively small catchment area and is located upstream of Tzaneen Dam. The latter dam has a much higher sediment yield than Ebenezer Dam.

7.1.3 Sediment yield based on suspended sediment data

Suspended sediment grab samples are taken at some DWAF flow gauging stations in South Africa. Data were obtained at the gauging stations listed in **Table 7.2**.

Table 7.2: Suspended sediment data at flow gauging stations

Station	Location	Total catchment Area (km^2)	Sampling period	Max Q (m^3/s)	Max concentration (mg/l)
B8H008	Letaba Ranch on Groot Letaba	4710	1981-1982; 1998-1999	149	2072
B8H009	Junction on Groot Letaba	851	1981; 1999	55	123
B8H010	Letsitele River	477	1981-1982; 1998	9	2172

Figure 7.2 shows the data of these three stations. From Table 7-2 it is clear that data were only obtained for relatively short periods in the past, and that the data sets are very small. Only the data of B8H008 could be used since it had a relatively large recorded discharge in the sediment load-discharge relationship. The sediment load-discharge relationship was integrated with the observed flow record of B8H008 to obtain a sediment yield for the period 1966 to 2002. The sediment load-discharge relationship represents a “high probable” curve in order to obtain a conservatively high sediment yield. The sediment yield calculated at B8H008 is 278 t/km^2.a, and

takes into account bedload and non-uniformity in suspended sediment transport which was added by adjusting the suspended sediment concentration data by a factor of 1.25. The sediment yield obtained by this method is in agreement with the data obtained with reservoir basin surveys, but it is based on very limited suspended sediment data, obtained at relatively small flows and floods.

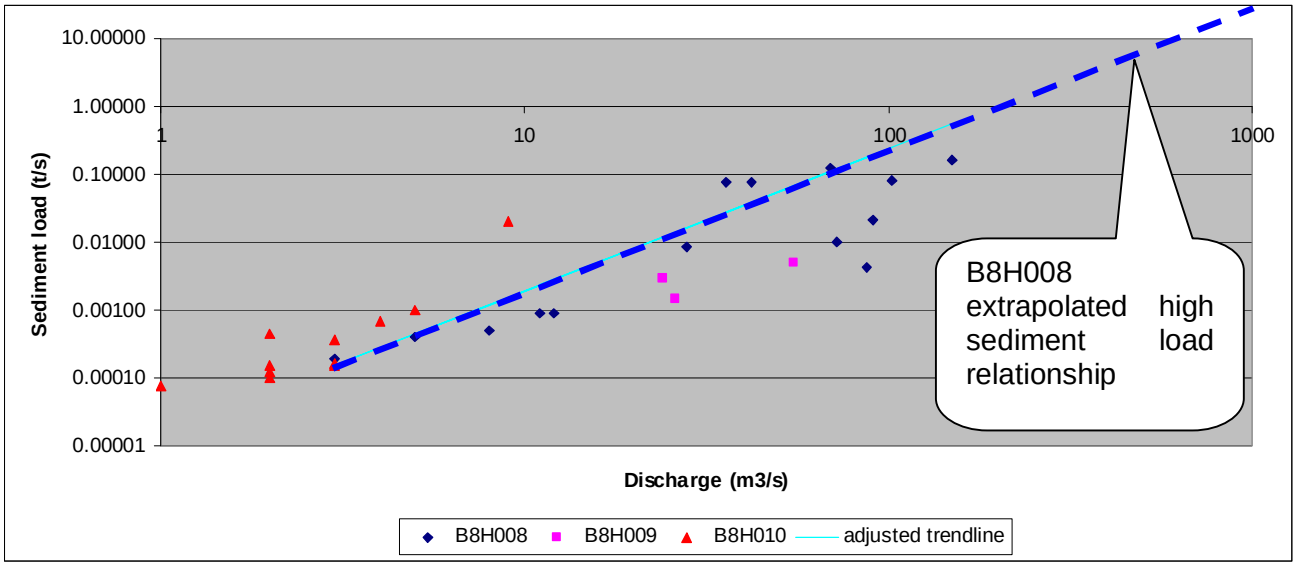

Figure 7.2: Sediment load-discharge relationships

7.1.4 Proposed sediment yield

The methods described above yielded the following sediment yields:

a) Rooseboom (1992) regional empirical method: 280 t/km^2.a at proposed dam site

b) Reservoir basin surveys: 245 to 293 t/km^2.a

c) River suspended sediment samples: 278 t/km^2.a at Letaba Ranch

It seems that the above methods resulted in very similar sediment yields. (The method in (a) is of course based on data of (b); method (c) had very limited suspended sediment data and the sediment load-discharge relationship had to be extrapolated for larger floods).

The future land use could affect the sediment yield. The current land use consists mainly of forestry, irrigated commercial farming, urban areas and subsistence farming. The catchment area of the Nwamitwa Dam falls in the high and medium soil

erosivity regions of the Rooseboom (1992) method. If due to future land degradation the medium region changes to high erosivity, the maximum possible sediment yield would be 350 t/km^2.a based on a 95 percentile assurance. Possible maximum sediment yield values in the order of 350 t/km^2.a were also proposed in the 1990 study by Rooseboom.

Due to possible future land degradation and the effect of climate change, it was recommended that a sediment yield of 350 t/km^2.a is used for the design of Nwamitwa Dam (Basson, 2007).

7.2 ESTIMATED RESERVOIR SEDIMENT DEPOSITION IN NWAMITWA RESERVOIR

Based on the Brune (1953) sediment trapping efficiency relationship, it was assumed the proposed reservoir would trap 100 % of the incoming sediment load. The sediment density of deposited sediment was assumed to be 1.35 t/m^3 after a 50 year period. An effective catchment area of 1352 km^2 was used for Nwamitwa Dam. **Table 7.3** shows the sediment volumes expected as deposited sediment in Nwamitwa Reservoir in future.

Table 7.3: Estimated Nwamitwa Reservoir sedimentation

Sediment yield (t/km^2.a)	Effective catchment area (km^2)	Estimated sediment volumes (million m^3)		
		After 10 years	After 20 years	After 50 years
350	1352*	6.9	11.5	17.5

Note: * From the Rooseboom (1994) study.

If the storage capacity of the proposed dam is 1.2 MAR which is equal to 187 million m^3 (Ninham Shand, 2008), the 50 year sediment volume will only fill 9 % of the reservoir, which is relatively low for South Africa. The average rate of sedimentation of the reservoir will be 0.19 %/year compared to the average rate for South African dams of 0.4 %/year.

Although the sediment deposition volume in Nwamitwa Reservoir is expected to be small over a 50 year period, deposition above full supply level will result in elevated flood levels in the river upstream of the reservoir which should be considered when floodlines are determined during the design of the dam. In many reservoirs in South Africa the observed sediment deposition above the full supply level in the river

upstream of the reservoir is as much as 10% to 30% of the total sediment volume deposited in the reservoir (Basson and Rosseboom, 1996).

8. FLOW GAUGING WEIR JUST DOWNSTREAM OF NWAMITWA DAM

The proposed flow gauging station downstream of the dam will have a negligible impact on the flow and sediment balance of the river.

9. RAISING OF TZANEEN DAM

Raising of Tzaneen Dam will not significantly alter the sediment trapping efficiency of the dam and most of the incoming sediment load will be trapped in the reservoir. Sediment deposition in the live storage will however occur further upstream than before.

Raising of Tzaneen Dam will increase the storage capacity which could attenuate small and medium floods more. Large floods will not be attenuated significantly more than in the current condition. Therefore the river morphology downstream of the dam is not expected to change significantly. It is estimated that the river width downstream of the dam will decrease by less than 5% after the raising of the dam.

10. RELOCATION OF ROADS AND PROPOSED DAM ACCESS ROADS

As long as the relocated roads and access roads are designed based on the guidelines of the NRA Road Drainage Manual (2007), no significant problems are foreseen in term of sedimentation.

11. TREATMENT PLANT AND WATER RETICULATION PIPELINES

The upgrading of the treatment plant and construction of new pipelines should have limited impact on the river sediment balance, if:

- Stormwater drainage is properly designed
- Low sediment concentrations are discharged offsite into the local streams/rivers. Sedimentation basins should be constructed on site if required.
-

12. CONSTRUCTION ASPECTS RELATED TO NWAMITWA DAM

During construction of the dam a coffer dam will probably be constructed to divert flood flow around the construction site. The river should not be constricted too much since this could lead to local scour.

When work is carried out in the river the suspended sediment concentrations downstream of the dam site should not exceed the sediment load-rating values shown in Table 12-1. Regular water grab samples (or calibrated turbidity meter readings to convert to mg/l) have to be taken say 300 m downstream of the dam site during construction. This table is based on limited data and none at the dam site. If more pre-dam samples could be obtained at the dam site before construction starts the limiting values could be recalibrated.

Table 12.1: Proposed 90 percentile suspended sediment concentrations 300 m downstream of the dam site

River discharge (m^3/s)	Suspended sediment concentration (mg/l)
5	130
10	240
50	1000
100	1900
250	4300
500	8100
1000	15000

13. PUBLIC PARTICIPATION

Engagement with Interested and Affected Parties (I&APs) forms an integral component of the EIA process. I&APs have an opportunity at various stages throughout the EIA process to gain more knowledge about the proposed project, to provide input into the process and to verify that their issues and concerns have been addressed.

The proposed project was announced in July 2007 to elicit comment from and register I&APs from as broad a spectrum of public as possible. The announcement was done by the following means:

- the distribution of Background Information Documents (BIDs) in four languages,
- placement of site notices in the project area,
- publishment of advertisements in regional and local newspapers,
- publishment of information on the DWAF web site,
- announcement on local and regional radio stations; and
- the hosting of five focus group meetings in the project area.

Comments received from stakeholders were captured in the Issues and Response Report (IRR) which formed part of the Draft Scoping Report (DSR) (Appendix A). The DRS was made available for public comment in October 2007. A summary of the DSR (translated into four languages) was distributed to all stakeholders and copies of the full report at public places. Two stakeholder meetings were held in October to present and discuss the DSR. The Final Scoping Report was made available to stakeholders in December 2007.

The availability of the Draft Environmental Impact Assessment Report, its summary (translated in four languages), the various specialist studies, the Environmental Management Plans and Programmes will be announced by way of personalized letters to stakeholders and the placement of advertisements in regional and local newspapers. The draft documents will be made available to I&APs for the inputs and

comments. Two stakeholder meetings are planned to present the contents of the documents and to discuss the findings of the study.

A public review period of thirty (30 days) will be available for stakeholders to comment on the Draft Environmental Impact Assessment Report, its summary (translated in four languages), the various specialist studies, the Environmental Management Plans and Programmes. Stakeholder comments will be taken into consideration with the preparation of the final documents. The availability of the final documents will be announced prior to submission to the decision-making authority.

14. CONCLUSIONS AND RECOMMENDATIONS

This study investigated the impacts of the proposed Nwamitwa Dam on the sediment transport balance in the Groot Letaba River. The upstream impacts were analysed by analytical and empirical methods while the downstream impacts were assessed by mathematical hydrodynamic modelling. Other aspects of the development such as access roads and raising of Tzaneen Dam were also addressed.

The key findings are:

a) Downstream of Nwamitwa Dam:

- The dam will cause flood peak attenuation (reduced flood peaks) by about 7 % for large floods (3000 m^3/s), but more for smaller floods: 30 % attenuation for a 1600 m^3/s flood peak and 70 % attenuation for a 270 m^3/s flood peak.
- The post-dam river will become narrower due to flood attenuation caused by the dam. Near the dam the main channel width could decrease by 19 % (22 m reduction on 116 m). In the KNP upstream of the Olifants River confluence the reduction of channel width could be about 17 % (70 m on 411 m channel width).
- The river bed between the dam and the Klein Letaba River tributary will become coarser due to sediment trapping at the dam: from 0.56 mm median diameter to 0.72 mm median sediment diameter.
- Slightly more sediment will be transported down the river in the post-dam scenario due to the narrower river and local bed degradation on the Klein Letaba River near the confluence with the Groot Letaba River.
- Local bed degradation (lower bed level) near the dam of at least 2 m is expected.

b) Upstream of Nwamitwa Dam

The estimated sediment deposition volume in Nwamitwa Reservoir over a 50 year period is 17.5 million m^3 which is relatively small compared to the reservoir storage (1.2 MAR = 187 million m^3) . Deposition of sediment above

full supply level has to be considered in the detailed design and floodline analysis of the reservoir as it would affect flood levels.

c) Flow gauging station downstream of Nwamitwa Dam

The weir downstream of the dam will have a negligible impact on the flow and sediment balance of the river.

d) Tzaneen Dam raising

Small floods will be attenuated more and it is expected that the main channel width downstream of the dam to the first main tributary could decrease by less than 5 % of the current width. The river morphology downstream of Tzaneen Dam is not expected to change significantly.

Elevated flood levels upstream of the reservoir could be expected due to future sedimentation above the raised full supply level. This has to be considered in the floodline assessment.

e) Relocation of roads and proposed dam access roads

As long as the relocated roads and access roads are designed based on the guidelines of the NRA Road Drainage Manual (2007), no significant problems are foreseen in term of sedimentation.

f) Construction aspects related to Nwamitwa Dam

The coffer dam should be designed not to cause river bank erosion or local scour at the dam site. The sediment concentrations 300 m downstream of the dam site should be monitored during construction to ensure present (90 percentile) high sediment concentrations are not exceeded as proposed in **Table 12.1**.

g) Treatment plant and water reticulation pipelines

The upgrading of the treatment plant and construction of water reticulation pipelines should have limited effect on sedimentation as long as proper stormwater drainage is designed at river crossings and during construction the present stream sediment concentrations based on 90 percentile values should not be exceeded. If required sedimentation basins should be constructed on site.

15. REFERENCES

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APPENDIX A: Issues and Responses

The issues below have been extracted from the Issues and Responses (Version 2) that was submitted to DEAT with the Scoping Report.

ISSUES related to the environmental impact assessment

9.1 Issues related to the EIA process and specialist studies

ISSUE	RAISED BY	SOURCE	RESPONSE
a. That sedimentation (likelihood of that in the dam and downstream) be investigated.	Mr Sean O'Beirne, EIA peer reviewer. Dr TK (Thomas) Gyedu-Ababio, Kruger National Park.	Comments as part of a peer review of the Draft Scoping Report. Written submission (DSR comment sheet) and attendance of the public meeting on 12 October 2007 in Tzaneen.	Will be considered by the Technical Study Module in the Impact Assessment Phase of the project.