SERJAHGE CONSULTANTS
'Sustainability is Tomorrow's Usage Assurance'
CC/2020/0010007

+264 81 407 5536
serja.consultants@gmail.com
P. O. Box 27318, Windhoek
Namibia

ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR THE:

PROPOSED CONSTRUCTION AND OPERATION OF OXIDATION (SEWER) PONDS IN THE TSES VILLAGE, //KARAS REGION: AN APPLICATION FOR THE ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC)

MEFT Application No.: **APP-001998**

Document Version: **Final**

Date: **05 March 2021**

Proponent: **Dunamis Consulting Engineers & Project Managers (Pty) Ltd**

P O Box 3757 Windhoek, Namibia

DUNAMIS
CONSULTING ENGINEERS
& PROJECT MANAGERS (PTY) LTD

March 2021

DOCUMENT INFORMATION

Title: Environmental Impact Assessment (EIA) for the proposed Construction and Operation of Four Oxidation (Sewer) Ponds in Tses Village of the //Karas Region

Prepared by:

Author:	**Fredrika N. Shagama (Hydrogeologist & Environmental Consultant / Environmental Assessment Practitioner (EAP))**
Qualifications:	**PhD. Student: Civil Engineering (Geotechnics & Hydrogeology)**, VSB - Technical University of Ostrava, Czech Republic **MSc. Geological Engineering** (*cum laude*) with primary focus in Hydrogeology, VSB - Technical University of Ostrava, Czech Republic **BSc. Geological Engineering**, VSB - Technical University of Ostrava, Czech Republic
Professional Affiliations:	International Association of Hydrogeologists (IAH) - Full Member, Membership No.139790 Namibian Hydrogeological Association (NHA) – Member Environmental Assessment Professionals of Namibia (EAPAN) - Ordinary Member Practitioner (Membership No. 183)
Contact Details:	Mobile: +264 81 407 5536 Email: serja.consultants@gmail.com Postal Address: P. O. Box 27318 Windhoek, Namibia
Signature:	
Date:	05 March 2021

SERJA' STATEMENT OF INDEPENDENCE

As the Appointed Environmental Consultant to undertake the Environmental Impact Assessment (EIA) for the proposed construction and operation of four oxidation (sewer) ponds in Tses of the //Karas Region, Serja Hydrogeo-Environmental Consultants cc declare that, we:

- do not have, to our knowledge, any information or relationship with any staff member from Dunamis Consulting Engineers & Project Manager (Pty) Ltd, the Ministry of Environment, Forestry and Tourism (MEFT)'s Department of Environmental Affairs and Forestry (DEAF) or the Competent Authority (Ministry of Agriculture, Water and Land Reform (MAWLR) that may reasonably have potential of influencing the outcome of this Environmental Assessment and the subsequent Environmental Clearance Certificate applied for.
- have knowledge of and experience in conducting environmental assessments, the Environmental Management Act (EMA) No. 7 of 2007 and its 2012 Environmental Impact Assessment (EIA) Regulation as well as other relevant national and international legislation, guidelines, policies, and standards that govern the proposed project as presented herein.
- have performed work related to the ECC application in an objective manner, even if the results in views and findings or some of these may not be favorable to the Proponent.
- have complied with the EMA and other relevant regulations, guidelines and other applicable laws as listed in this document.
- declare that we do not have and will not have any involvement or financial interest in the undertaking/implementation of the proposed project, other than remuneration for work performed to conduct the EIA and apply for the ECC in terms of the EIA Regulations' requirement as an Environmental Assessment Practitioner (EAP).

Disclaimer: Serja Hydrogeo-Environmental Consultants will not be held responsible for any omissions and inconsistencies that may result from information that was not available at the time this document was prepared and submitted for evaluation.

……

Signature:

Fredrika N. Shagama, Environmental Assessment Practitioner

Date: 05 March 2021

EXECUTIVE SUMMARY

Dunamis Consulting Engineers & Project Managers (Pty) Ltd (hereinafter referred to as Dunamis or the Proponent) are planning to construct four oxidation (sewer) stabilization ponds in Tses Village of the //Karas Region in southern Namibia. The site planned for the ponds' construction and operation is located on the southwestern side of the Village where the current dilapidated oxidation ponds are. The proposed site covers an area of 50 000 square metres (m^2) or 5 hectares (ha).

The proposed sewer ponds' site is located within the southwestern side (edge) of the Tses Village. Therefore, the project site falls under the Tses Village Council. The Village is located between the towns of Mariental (155 km north) and Keetmanshoop (about 80 km south) along the B1 main road that connects the central and southern parts of Namibia.

The establishment of development of waste treatment or management facilities is one of the listed activities that that may not be undertaken without an Environmental Clearance Certificate (ECC). Subsequently, to ensure that the proposed activity is compliant with the national environmental legislation the project Proponent, in this case Dunamis Consulting Engineers had to appoint an independent environmental consultant to undertake the required Environmental Assessment (EA) process and apply for the ECC on their behalf.

It is for this reason that Serja Hydrogeo-Environmental Consultants cc has been appointed by the Proponent to undertake the EA and apply for the ECC. The application for the ECC was compiled and submitted to the Competent Authority (Ministry of Agriculture, Water and Land Reform (MAWLR)) on 14 October 2020. The date stamped copy of the ECC by MAWLR was also uploaded on the online portal for the Ministry of Environment, Forestry and Tourism (MEFT) as the environmental custodian for project registration purposes. Upon submission of an Environmental Assessment Report (EAR) and Environmental Management Plan (EMP), an ECC for the proposed project will be considered by the Environmental Commissioner at the MEFT's Department of Environmental Affairs and Forestry (DEAF).

Project Need and Desirability

The Tses Village Council has been managing its wastewater by using five existing ponds bordering each other at the site, i.e., where the new ponds will be constructed. Out of the five ponds only two that are active, i.e., filled with wastewater and in operation but not properly managed and equipped. The other three existing ponds have all dried up (there is no wastewater in them). These existing ponds, especially the two active ponds are now in a very bad (dilapidated) and unsafe state, such that local children and animals swim in and drink from the ponds, respectively.

The existing ponds' site was fenced off, but the fence has fallen apart over the years, and as a result it cannot keep children and animals out. For these reasons, the current wastewater treatment system (existing ponds) needs to be upgraded and the site secured so that the Village Council can manage its wastewater (effluent) better.

Public Consultation

Public Consultation Activities

Regulation 21 of the EIA Regulations details steps to be taken during a public consultation process and these have been used in guiding this process. The public consultation process assisted the Environmental Consultant in identifying all potential impacts and aided in the process of identifying possible mitigation measures and alternatives to certain project activities. The communication with I&APs about the proposed ponds was done through the following means and in this order to ensure that the public is notified and afforded an opportunity to comment on the proposed project:

- Registration of pre-identified stakeholders and interested & affected parties (I&APs) and updating the list throughout the environmental assessment process.
- Placement of newspaper adverts in the widely read newspapers in the project area/region (*Die Republikein* and *Namiban Sun* of the Namibia Media Holdings on 12 and 19 October 2020).
- Circulation of the background information document (BID) to pre-identified stakeholders and I&APs and to new I&APs (upon registration request).
- Placement of A2 notices for the public consultation meeting in Tses (at the Tses Village Council office and Tses PHC Centre/Clinic).
- Holding and facilitation of the public consultation meeting in Tses and recording of meeting minutes.
- The issues/questions and responses raised and provided, respectively via emails during the consultation period and in the public meeting as presented under the Public Consultation Chapter (Chapter 6).

Public Feedback: First Round of Consultation

The public was afforded nineteen (19) days from the date of the first newspaper advert to register as I&APs and submit comments and or concerns. During this period, but prior to the public meeting, a concern was raised by one of the I&APs. The rest of the concerns were only raised during the public meeting and were addressed and recorded in the meeting minutes and incorporated into this document (Report).

A written comment in the form o f a suggestion or alternative to the proposed wastewater treatment method was also received from one of the I&APs (Aqua Services). This comment has been summarized and added to other concerns and issues raised as well as responses provided to these are presented in **Table 6.** The concerns and issues have been translated into an **Issue & Response Trail Document -Appendix I** where they were addressed upon compilation of the draft EA Report and formed basis for the EA Report and EMP compilation.

Public Feedback: Second Round of Consultation (Draft Report Review)

The draft EIA Report was circulated to the registered I&APs for review and comments from 18 to 26 February 2021 (a 9-day review period). A letter containing four comments/points was received by Serja Consultants from one I&AP organization. The comments were addressed by Serja Consultants in consultation with the Proponent and amendments made under the final EIA Report to address the comments. The draft report email to I&APs (on 18 February 2021) and original letter containing the I&AP comments are attached as **Appendix J** with the Comments & Response Trail Document. The comments received are summarized as follows and copied in full under the Comments & Response Table in **Appendix J**:

- Section 3.1.4: Cost Implications of constructing new oxidation ponds compared to other alternatives without no further detail regarding actual cost comparisons done in the local context. Recommendation for a more extensive cost comparisons are carried out to validate this conclusion
- The efficiency of the evaporation pond to produce a treated effluent that is compliant with the applicable General Standard parameters: It is well known that effluent produced by oxidation ponds cannot typically achieve the applicable General Standard parameters due to process limitations. The DWAF Guidelines (Code of Practice: Vol 2, 2008 - Page 4 of 24) state that “Generally, open ponds cannot produce a final effluent complying with the currently applicable Namibian standards for effluent discharge. Therefore, final effluent produced by a pond system will not be allowed for discharge into the environment.” This would mean that the planned ponds must be sufficiently sized to achieve evaporation of the entire inflow load to comply with the Guidelines. It is not clear from the report whether this is the case, and we strongly disagree with this approach, as properly treated wastewater can be re-used successfully for numerous applications that have the potential to provide value to the local community.
- Section 2.1.1 of the report states that “…ponds’ facility is designed to be at least 150 m from residential houses…” whereas Section 4.1 of the CoP: Vol 2 states “…ponds may not be built closer than 500 m from the nearest residential area and where anaerobic ponds are included, this distance should ideally be increased to 1.0 km”. The location of the ponds may have to be adjusted to meet this requirement.

- While it can be expected that the normal operating costs of a treatment plant such as trickling filters will generally be higher that evaporation ponds, it should be kept in mind that the cleaning and reconditioning of such ponds (which must be done once the solids build-up has decreased their effective volume to such an extent that they are no longer able to achieve their design retention time) carries extensive associated costs as well as potentially expensive repairs to the liner that is easily damaged during such operations. These costs must also be considered in a life-cycle cost analysis to determine the actual cost comparison between such systems Furthermore, the ability to re-use properly treated effluent for economically beneficial purposes, and the associated employment creation effects, can successfully offset the operating costs of an alternative treatment system, while at the same time greatly reducing the environmental footprint of the community.

Potential Impacts identified

The following impacts were identified both by the Environmental Consultant and with the public (I&APs) input, especially on the negative impacts:

Potential positive impacts:

- Socio-economic development through temporary job (employment) creation in the Village during the construction phase – **during the construction phase and few people may be required for the operational and maintenance.**
- Improved wastewater management in the Tses Village **during the operational phase**, thus preventing the amount of wastewater that would otherwise be uncontrollably released into the environment due to the dilapidated state of the existing ponds. This would improve the local public and environment health.

The following potential negative impacts are anticipated:

- **Soil disturbance:** physical land (soil) disturbance during site preparation and potential soil compaction by heavy vehicles and machinery as well as erosion due to topsoil displacement.
- **Soil and water pollution**: improper handling of wastewater (sewage) may lead to pollution of surrounding soils and eventually water resources systems (through wastewater runoff and infiltration).
- **General environmental pollution (littering)** through mishandling of project related waste during construction and operational phases.
- **Loss of biodiversity through the removal of vegetation** that may be found within the planned expansion of the site footprints during the construction phase.
- **Air pollution by potential dust on untarred roads and gas emissions** from construction activities (excavations, heavy vehicles, and machinery).

- **Odour:** Some by-products of anaerobic digestion used in wastewater treatment facilities, may give off a strong, nauseating smell. This may affect the locals in proximity of the ponds.
- **Noise:** potential increase in noise level from construction activities such as heavy trucks and excavators.
- **Vehicular traffic**: potential increase in local traffic due to construction activities on site.
- **Health and safety**: improper handling of site materials and equipment may cause health and safety risks.
- **Archaeological or cultural heritage** impact through uncovering of unknown objects on site (when carrying out earthworks).

The potential negative impacts were assessed, and mitigation measures provided accordingly.

RECOMMENDATIONS AND CONCLUSIONS

The potential impacts (both positive, negative, and cumulative) that are anticipated from the proposed project activities were identified, described, and assessed. For the significant adverse (negative) impacts with high and medium rating, appropriate mitigation measures were recommended for implementation by the Proponent, their contractors and project related employees.

The public was consulted as required by the EMA and its 2012 EIA Regulations (Section 21 to 24). This was done via the two newspapers used for this environmental assessment; site/public notices placed in Tses Village (at the Tses Village Council offices and Tses Clinic notice boards). A notice for public consultation was also erected at the Village Council offices entrance to further notify the locals of the EA process and the planned public meeting in Tses. The public (I&APs) raised comments and concerns on the proposed project via the consultation platforms provided (emails and face-to-face session in the form of public consultation meeting).

The issues and concern raised by the registered I&APs formed the basis for this Report and the EMP. The issues were addressed and incorporated into this Report whereby mitigation measures have been provided thereof to avoid and/or minimize their significance on the environment. Most of the potential impacts were found to be of medium and to slightly high rating significance. With the effective implementation the recommended management actions (mitigation measures), this will particularly see the reduction in the significance of adverse impacts that cannot be avoided completely (from slightly high to medium and for medium rating to low). Furthermore, to improve the high rating to medium to low and maintain the low rating, monitoring of the implementation of management measures by the Proponent (an Environmental Control Officer (ECO) or SHE Officer) and applicable Competent Authority (MAWLR) is highly recommended. The monitoring of this implementation will not only be done to maintain the reduce impacts' rating or maintain

low rating but to also ensure that all potential impacts identified in this study and other impacts that might arise during implementation are properly identified in time and addressed right away too.

The findings of this assessment were deemed sufficient and conclude that no further detailed assessments are required to the ECC application.

Recommendations

Therefore, the Environmental Consultant is confident that the potential negative impacts associated with the proposed project activities can be mitigated by effectively implementing the recommended management action measures and with more effort and commitment put on monitoring the implementation of these measures. It is therefore, recommended that the proposed oxidation ponds and associated activities be granted an Environmental Clearance Certificate, provided that:

- All respective management measures (mitigations) provided in the EMP be effectively and progressively implemented and backed up by consistent site monitoring of environmental components listed in the EMP to achieve full EMP implementation compliance.
- All required permits, licenses and approvals for the project activities are obtained as required (please refer to the Permitting and Licensing in the EMP).
- The Proponent and all their project workers or contractors comply with the legal requirements governing their project and its associated activities and ensure that project permits and or approvals required to undertake specific site activities are obtained and renewed as stipulated by the issuing authorities.
- All the necessary environmental and social (occupational health and safety) precautions provided are adhered to.
- Environmental (EMP) Compliance Monitoring should be conducted on a weekly basis during the construction phase by the project Safety, Health and Environmental Officer or an independent Environmental Consultant and bi-annually during the operational phase. Environmental Compliance monitoring reports should be compiled and submitted to the DEAF Portal as per provision made on the MEFT/DEAF's portal**.**

These recommendations are primarily aimed at improving environmental management, ensuring sustainability and promote harmonious co-existence of the project activities and the host biophysical and social environment.

Conclusions

In conclusion, with that being done, the positive impacts of the improved (upgraded) oxidation ponds will be able to overweigh the negative impacts in the long run. This will be a potential win-win for both the Tses community and the surrounding biophysical and social environment, mainly regarding public and environmental health protection. Not only for public and environmental health but also the provision of the

end-product of the wastewater treatment process that will be utilized for other purposes in the community (such as treated effluent to be used for irrigation).

Therefore, it is crucial for the Proponent and their contractors to effectively implementation of the recommended management measures to protect both the biophysical and social environment throughout the project phases (from planning, decommissioning of the existing ponds, construction of new ponds and their operational & maintenance phase). All these would be done with the aim of promoting environmental sustainability while ensuring a smooth and harmonious existence and purpose of the project activities in the community and environment at large.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

APPENDIX A: Copy of the Environmental Clearance Certificate (ECC) Application

APPENDIX B: Environmental Management Plan (EMP) – **attached separately as required**

APPENDIX C: Environmental Assessment Practitioner (EAP)' CV - **attached separately as required**

Appendix D: Drawings (Layout) of the Proposed Oxidation Ponds

Appendix E: List of registered Stakeholders and Interested & Affected Parties (I&APs)

Appendix F: Proof of Background Information Document (BID) circulation to pre-identified Stakeholders and I&APs

Appendix G: Newspaper adverts (notification) for the Environmental Assessment Process

Appendix H: Public Consultation Meeting Minutes and Attendance Register

Appendix I: Issues and Response Trail Document (Issues/Suggestion by I&APs and Response)

Appendix J: Proof of Draft EIA Report circulation, Comments & Response Trail Document

NOTE: Appendix E to J are attached to the merged file titled ''*Proof of Public Consultation*''

LIST OF ABBREVIATIONS

Abbreviation	Meaning
°C	Degree Celsius
AQI	Air quality index
ASP	Acid-soluble polyphosphate
BID	Background Information Document
BOD	Biological Oxygen Demand
CFP	Chance Find Procedure
COD	Chemical Oxygen Demand
COP Vol.6	Code of Practice Volume 6
DEAF	Department of Environmental Affairs and Forestry
DWA	Department of Water Affairs
EA	Environmental Assessment
EAP	Environmental Assessment Practitioner

Abbreviation	Meaning
ECC	Environmental Clearance Certificate
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EMP	Environmental Management Plan
GG / GN	Government Gazette / Government Notice
HDPE	High-density polyethylene
HIV/AIDS	Human Immunodeficiency Viruses and Acquired Immune Deficiency Syndrome
HPP	Harambee Prosperity Plan
I&APs	Interested and Affected Parties
MAWLR	Ministry of Agriculture, Water and Land Reform
MEFT	Ministry of Environment, Forestry and Tourism
m^3/d and m^3/h	Cubic meter per day and cubic meter per hour
mg/l	Milligram per liter
NamWater	Namibia Water Corporation Limited
NDP	National Development Plan
OP	Oxidation pond
PHC	Primary Health Care
PM	(Atmospheric) Particulate Matter
PPE	Personal Protective Equipment
Reg	Regulation
S	Section
SHE	Safety, Health and Environment
SPCC	Spill Prevention, Control, and Countermeasure
SS	Suspended Solid
TDS	Total Dissolved Solids
TSS	Total Suspended Solis

1 INTRODUCTION

Wastewater is a term given to the water that is polluted (containing enough impurities to make it unfit for a particular use, such as drinking, swimming, or fishing). Although water quality is affected by natural conditions, the word pollution usually implies human activity as the source of contamination. Water pollution, therefore, is caused primarily by the drainage of contaminated wastewater into surface water or groundwater, and wastewater treatment is a major element of water pollution control (Encyclopædia Britannica Inc., 2020). The typical contaminants or impurities in wastewater are biochemical oxygen demands (BOD), nitrates and phosphates, pathogens, metals, total suspended solids (TSS), total dissolved solids (TDS), etc. Wastewater can be classified into three groups, namely, sewage water, industrial wastewater and municipal wastewater." Wastewater can be divided into two major groups, sewage and industrial.

The polluted water or wastewater is then treated to remove impurities (pollutants) so that the improved water quality can either be re-used for a certain intended purpose such as irrigation for instance or be discharged back into the environment upon meeting the set environmental standards. The treatment is therefore done to ensure that the polluted water (wastewater) is not a threat to both the biophysical and social environment either in a short or long-term. Not only to prevent to reduce the environmental threat, but also to reduce the loss of usable water in this wastewater.

According to Pescod (2020), the principal objective of wastewater treatment is generally to allow human and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment. Irrigation with wastewater is both disposal and utilization and indeed is an effective form of wastewater disposal (as in slow-rate land treatment). However, some degree of treatment must normally be provided to raw municipal wastewater before it can be used for agricultural or landscape irrigation or for aquaculture.

The objective of most wastewater treatment is to maintain or improve the quality of the receiving body of water. There has been a trend over time to tighten the requirements from the initial simple removal of gross debris, through biological treatment for BOD and Suspended Solids (SS) removal, more recently to removal of dissolved nutrients. As well as this qualitative change of new processes being introduced, the existing processes are increasingly required to give better performance, with acceptable levels for BOD, SS, and ammonia having been reduced continuously over time (Moran, 2018).

In general, from about 1900 to early 1970s, treatment objectives were concerned with: (i) the removal of suspended and floatable material from wastewater, (ii) the treatment of biodegradable organics (BOD removal) and (iii) the elimination of disease-causing pathogenic micro-organisms. From the early 1970s to about 1990s, wastewater treatment focused on aesthetic and environmental concerns (Rajassulochana and Preethy, 2016).

1.1 Background and Project Location

As appointed by the Tses Village Council, Dunamis Consulting Engineers & Project Managers (Pty) Ltd (hereinafter referred to as Dunamis or the Proponent) are planning to construct four oxidation (sewer) stabilization ponds in Tses Village of the //Karas Region in southern Namibia. The site planned for the ponds' construction and operation is located on the southwestern side of the Village where the current five dilapidated oxidation ponds are. The proposed site covers an area of 50 000 square metres (m^2) or 5 hectares (ha).

The proposed sewer ponds' site is located on the southwestern side (edge) of the Tses Village. Tses Village is located between the towns of Mariental (155 km north) and Keetmanshoop (about 80 km south) along the B1 main road that connects the central and southern parts of Namibia. The site map is shown in **Figure 1**. The GPS coordinates of the existing ponds at the proposed site are presented in **Table 1** below.

Table 1: GPS coordinates of the existing oxidation ponds' site and the site for the new ponds in Tses

Pond Name or Reference	GPS Coordinates
Existing Active Pond 1 (P1)	-25.888468° 18.118139°
Existing Active Pond 2 (P2)	-25.887560° 18.117028°
Dry Pond 3 (P3)	-25.887314° 18.116566°
Dry Pond 4 (P4)	-25.887271° 18.116282°
Dry Pond 5 (P5)	-25.887132° 18.116394°

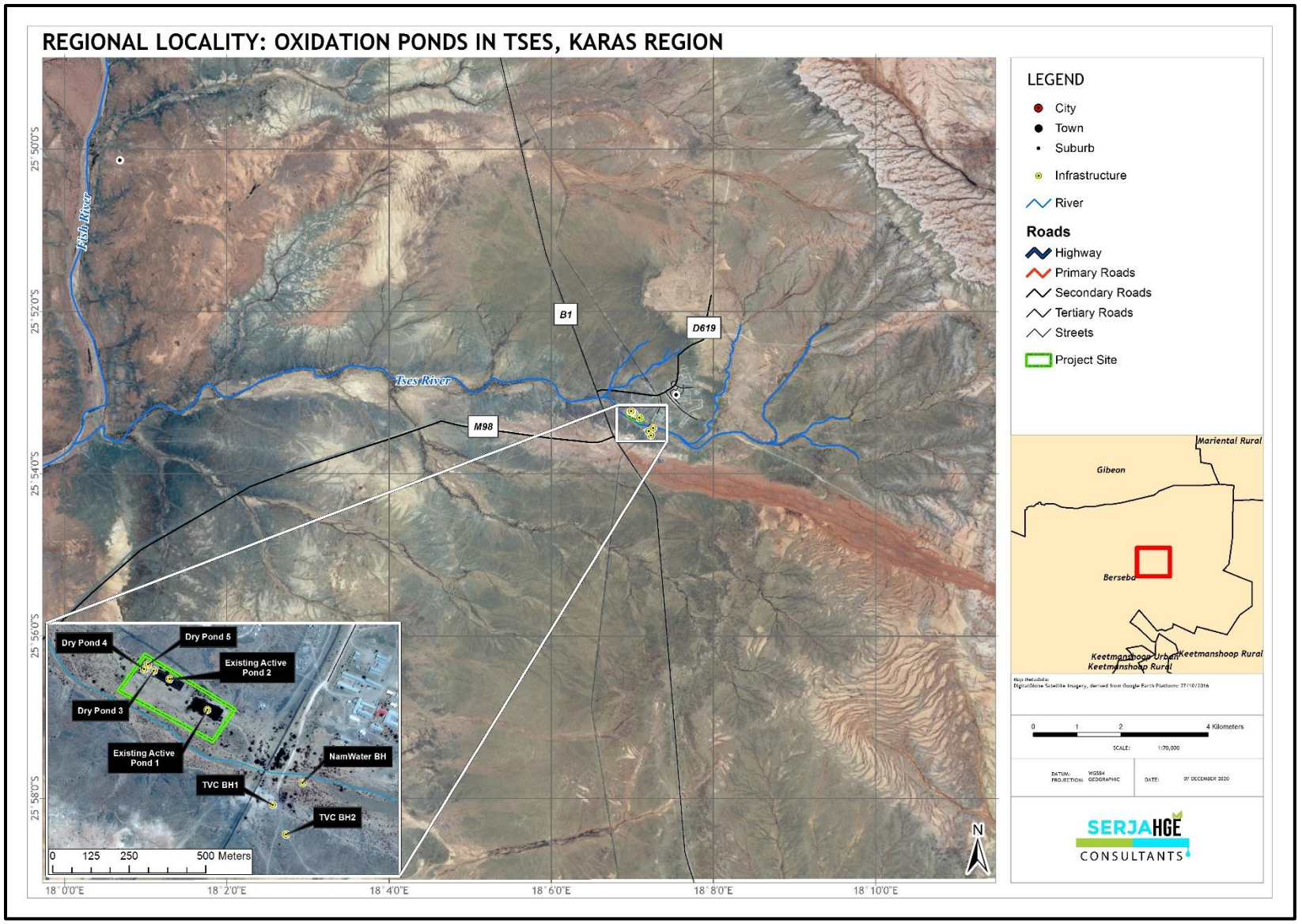


Figure 1: **Locality map of the proposed sewer ponds site in Tses Village, //Karas Region**

1.2 Scope of Work and Report Contents

This EIA Study has been conducted according to the Environmental Management Act (EMA) No. 7 of 2007, and its 2012 Environmental Impact Assessment (EIA) Regulations, whereby the construction and operation of waste treatment sites and associated works such as the proposed oxidation ponds is one of the listed activities in the Environmental Impact Assessment (EIA) Regulations (2012) of the Environmental Management Act (EMA) No. 7 of 2007 that may not be undertaken without an Environmental Clearance Certificate (ECC). The listed activities that are relevant to proposed project are as follows:

- ***Regulation 2.1*** *The construction of facilities for waste sites,* ***treatment of waste*** *and disposal of waste.*
- ***Regulation 8.6*** *The construction of industrial and domestic wastewater treatment plants and related pipeline systems.*
- ***Regulation 9.2*** *Any process or activity which requires a permit, license or other form of authorization, or the modification of or changes to existing facilities for any process or activity which requires an amendment of an existing permit, license, or authorization or which requires a new permit license or authorization in terms of a law governing the generation or release of emissions, pollution, effluent, or waste.*

Subsequently, an application for Environmental Clearance Certificate (ECC) accompanied by the Background Information Document (BID) and was hand delivered on 14 October 220 to the Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR), the *Competent Authority* in Windhoek - **Appendix A**.

Furthermore, an EA process will need to be undertaken, completed, and an EA Report and draft EMP compiled and submitted to the Department of Environmental Affairs and Forestry (DEAF) of the Ministry of Environment, Forestry and Tourism (MEFT) for evaluation and consideration of ECC issuance.

The purpose of the EIA and subsequent issuance of the ECC is to ensure that the proposed project activities are undertaken in an environmentally friendly and sustainably manner, through the effective implementations of recommended environmental management measures to minimize the adverse identified impacts while maximizing the positive impacts.

This Report has been compiled as a required output of an environmental assessment process after the ECC application has been submitted to the Competent Authority. The EA Report, together with the EMP and all its appendices will be submitted to the DEAF.

Apart from the introductory chapter, this Report covers the following chapters:

- The need and desirability of the proposed oxidation ponds (**section 1.3**).
- The responsible Environmental Consultant (Environmental Assessment Practitioner) – section 1.4.

- Project description and associated activities - (**Chapter 2**).
- Project alternatives considered (that were found to be environmentally friendly and technically feasible) - **Chapter 3**).
- The legal requirements governing the proposed project and its related activities, i.e., the legislations that the proposed development will need to comply with (**Chapter 4**).
- The relevant pre-project environmental conditions (environmental and social baseline) of the project area as presented under **Chapter 5**.
- The Public Consultation Process undertaken to inform, invite and engage the public (stakeholders and interested & affected parties) on the proposed project- **Chapter 6**.
- The presentation and assessment of potential identified impacts associated with the proposed development (**Chapter 7**) - This chapter presents both the positive and negative (adverse) as well as cumulative impacts, assessment methodology and the assessment of the negative impacts. The mitigation measures in the form of management action plans, with timeframe and implementation responsibilities are given in Draft Environmental Management Plan (EMP) under **Appendix B**.
- The recommendations and conclusions to the environmental assessment are presented under **Chapter 8**. The data sources (literature) consulted for the assessment are listed under **Chapter 9**.

1.3 Project Need and Desirability

The Tses Village Council has been managing its wastewater by using five existing ponds bordering each other at the site, i.e., where the new ponds will be constructed. Out of the five ponds only two that are active i.e., filled with wastewater and in operation but not properly managed and equipped – **Figure 2** (referred to as Pond 1 (P1) and Pond 2 (P2)). The other three existing ponds have all dried up (there is no wastewater in them). These existing ponds, especially the two active ponds are now in a very bad (dilapidated) and unsafe state, such that local children and animals swim in and drink from the ponds, respectively.

The existing ponds' site was fenced off, but the fence has fallen apart over the years, and as a result it cannot keep children and animals out. For these reasons, the current wastewater treatment system (existing ponds) needs to be upgraded and the site secured so that the Village Council can manage its wastewater (effluent) better.

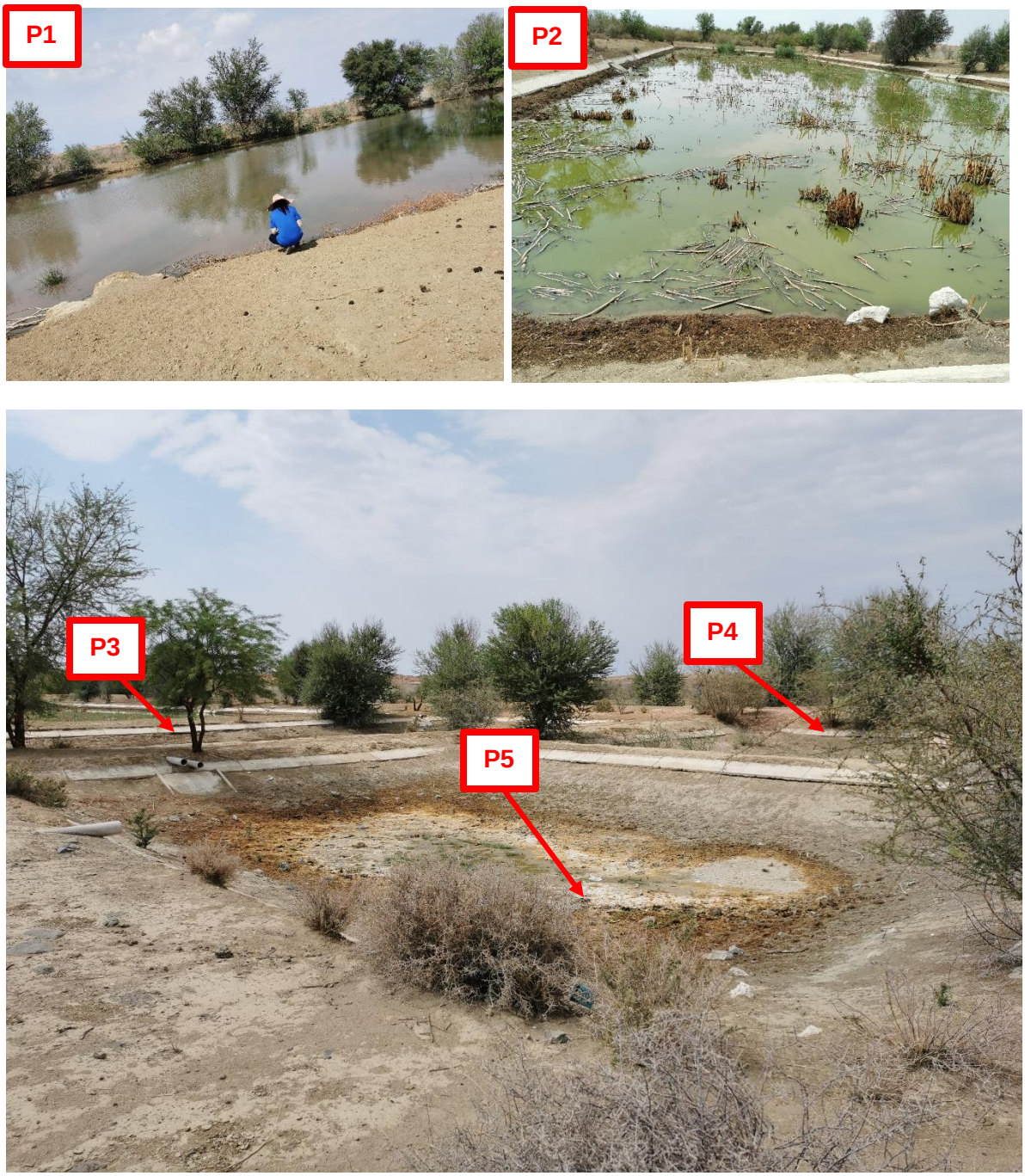


Figure 2: Existing sewer ponds at the proposed site in Tses – Active Pond 1 (P1) and P2 are on the east of P3, P4 and P5 (to the west of P1 and P2) (Photo: Author, 2020)

The wastewater will be treated as per acceptable national standards (with a discharge permit from the relevant water regulatory body) so that it can be safely used in the environment, for irrigational purposes. The Namibian Division responsible for this permit issuance is the Water and Environment of the Department of Water Affairs (DWA) at the Ministry of Agriculture, Water and Land Reform (MAWLR).

The wastewater management facility will be a much-needed contribution to the local community's public and environmental health improvement. This would be achieved through efficient treatment of waste in a more environmentally friendly manner and ensure the good health of the surrounding biophysical and social environment. It is for these reason that the four new ponds need to be constructed.

1.4 The Environmental Assessment Practitioner (Consultant)

To fulfil the requirements of the EMA, the Proponent appointed Serja Hydrogeo-Environmental cc (hereinafter referred to as the Environmental Consultant or Serja) to undertake the required EIA process and submit the ECC application to the Competent Authority (MAWLR).

Further tasks of the Environmental Consultant include public participation, compilation of all the required documents (including EA Report and draft Environmental Management Plan (EMP)). These documents are to be submitted to the Environmental Commissioner at the Department of Environmental Affairs and Forestry (DEAF) of the Ministry of Environment, Forestry and Tourism (MEFT) for evaluation and consideration of an ECC issuance.

The entire EIA Study (ECC application, public consultation process and reporting) was done by Ms. Fredrika Shagama of Serja. Ms. Shagama is a qualified and experienced hydrogeologist with 5 years of experience in water and environmental consulting and a member of the International Association of Hydrogeologists. She is also an experienced and registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Professionals of Namibia (EAPAN). The Curriculum Vitae (CV) of Ms. Shagama is presented under **Appendix C**.

The description of the proposed project activities is presented under the next chapter.

2 DESCRIPTION OF THE PROPOSED PROJECT ACTIVITIES

This chapter presents the activities to be undertaken and services infrastructure required for the realization of the proposed oxidation ponds' construction and operation. Oxidation ponds, also called lagoons or stabilization ponds, are large, shallow ponds designed to treat wastewater through the interaction of sunlight, bacteria, and algae (Encyclopaedia Britannica, 2020). These processes are presented in terms of activities to be undertaken in the main project phases, namely, the planning & design, construction and operational and maintenance upon issuance of the proposed project's environmental clearance certificate.

Given the dilapidated state of the two existing ponds, these will be demolished to make way for the construction and operation of new wastewater management ponds.

2.1 Oxidation (Stabilization) Ponds Mechanism

Oxidation pond is one of the biological systems which are used for the treatment of wastewater. According to Khan *et al* (2018), an oxidation pond is a shallow body of water contained in an earthen basin, open to sun and air. Longer time of retention from few days to weeks is provided in the pond. The purification of wastewater occurs due to symbiotic relationship of bacteria and algae. These ponds are classified according to the nature of the biological activity which takes place within the pond as **aerobic**, and **anaerobic**.

Aerobic pond: *In an aerobic pond the microbial population like acid-soluble polyphosphate (ASP) exists along with algae. The aerobic population release carbon dioxide (CO_2), which is taken up by the algae for their growth. Algae in turn release oxygen (O_2), which helps in maintaining the aerobic condition in the pond. Very shallow depth of aerobic pond (0.15 to 0.45 m) is used for the treatment of wastewater for removal of nitrogen by algae growth. For general wastewater treatment depth of 0.5 to 1.2 m may be used. The solar radiation should penetrate to the entire depth of the pond to support photosynthesis to keep entire pond content aerobic.*

Anaerobic pond: *in this pond, the entire depth is under anaerobic condition except an extremely shallow top layer. The depth of these ponds is in the range of 2.5 to 6 m as they are generally used for the treatment of high strength industrial wastewaters and sometimes for municipal wastewater and sludges. Depending upon the strength of the wastewater, longer retention time up to 50 days is maintained in the anaerobic ponds. Anaerobic lagoons are covered these days by polyethylene sheet for biogas*

Oxidation pond system is considered as the secondary treatment method by which natural purification and stabilization of wastewaters like domestic sewage, trade waste and industrial effluents is accelerated. The biological treatment process in oxidation pond mainly involves an interaction between bacteria, algae, and other organisms. This wastewater treatment method is a simple scientifically designed pond with 2-6 feet (0.6 to 2 m) depth, where BOD reduction of a wastewater takes place by supporting algal-bacterial growth (Tharavathy *et al*., 2013).

Within an oxidation pond, heterotrophic bacteria degrade organic matter in the sewage which results in production of cellular material and minerals. The production of these supports the growth of algae in the oxidation pond. Growth of algal populations allows further decomposition of the organic matter by producing oxygen. The production of this oxygen replenishes the oxygen used by the heterotrophic bacteria.

Typically, oxidation ponds need to be less than 10 feet (3 m) deep to support the algal growth. Oxidation ponds typically operate in an extended aeration mode with long detention and solids retention time and is a widely adopted technique for the treatment of domestic and trade wastes. The ponds are cheaper to construct and operate in warm climate as compared to conventional treatment system and hence they are considered as low-cost wastewater treatment systems. In other words, oxidation pond system is one of the methods used extensively in the tropical areas of the world for treating the wastewater. Given the climate of the proposed project area, this wastewater treatment system would be viable for the Tses Village in the arid Namibia.

2.1.1 Typical Oxidation Ponds Design (General)

There are four significant mechanisms that form the oxidation pond system. These are interception, gravity, advection, and diffusion.

The ponds' facility is designed to be at least 150 m from residential houses and the treated effluent would be constantly diluted of discharge. Soils and parent materials at site must be impermeable to pond waters as the waste solution can contaminate ground water if seepage occurs. Consideration that are made entails the suitable location or siting of the aerobic pond in an open area for interception of solar radiation and wind (Oyati *et al.,* 2020). One of the components to consider that the storm water catchment needs to be kept to a minimum to increase the retention time of ponds such that rainwater run-off would be channelled away from the effluent system and technical pipeline laying system and creation of accessibility for earth moving equipment. Oyati *et al.* (2020) further stated that this process ensures that the effluent remains within the system for a required period. The oxidation stabilization width is designed for effective workability of excavators and desludging machinery, the design of 0.5 m for the freeboard is allowed for slurry and sedimentation.

The following project phases will be followed to implement the proposed project.

2.2 Planning and Design Phase

As part of the planning and design phase which also cover the EIA/EA study, a preliminary layout of the site drawn by the Engineers and the construction cost determined in the feasibility study by the project planners, Dunamis Consulting Engineers & Project Managers.

The planning (feasibility) study is aimed at presenting key concepts of the project alongside a general overview of the study area. It also presents the legal framework to be considered, and a preliminary assessment of the main aspects affecting the feasibility of the proposed oxidation (sewer) ponds. Thereafter, the feasibility study assesses the technical and financial feasibility of such a project by identifying risks and proposing mitigation measures where possible. It is also vital for the study to highlight 'fatal flaws' wherever mitigation measures are unavailable or impractical with regards to the available finances and time.

The EIA Study is crucial to the planning phase as it makes provision for the outcomes of the EIA Study such as concerns and suggestions to be considered and incorporated into the preliminary layouts of the project designs before they are finalized for implementation. The inputs and suggestions from the EIA Study, specifically the public consultation and assessment by the Environmental Consultant will aid in ensuring that the project designs and layouts meet the site conditions in terms of biophysical and social requirements, thus protecting the environment and promote long-term sustainability.

2.2.1 Design for the Tses Oxidation Ponds

Oxidation ponds are designed to fit the needs and conditions of the sites they would be constructed and operated in. The four ponds planned for Tses will be constructed at the same site where the five old ponds (planned for demolition) are currently. To ensure that the new ponds' construction and operation comply with the DWA Regulations, particularly the Code of Practice Volume 2: 2008 regarding the distance of the ponds from the residents, the new ponds will be constructed on the ponds' site areas that comply with this requirement, i.e., with increased distance from houses. Currently, the existing Pond 1 (eastern pond) for instance is about 200 m from the nearest eastern residence. This could be explained by the fact that these old ponds were constructed have been in operation way before the 2008 Regulations on ponds' location, hence the current distance. The ponds' site area is sufficient (5 ha) to accommodate the four new ponds and ensure compliance with the DWA' Codes of Practice for ponds' locations and specifications.

The proposed (new) ponds will be equipped with the following:

- Inlet structure to pump sewage into the pond system,
- Two anaerobic ponds of 14.1x14.1 size and 2.5 m deep,
- Two primary ponds of 52.3 x 52.8 size and 1.3 m deep,
- Two secondary ponds (size: 29.1 x 52.8 x 1.3 m deep), and
- A 102 x 116 and 1.3 m deep evaporation pond where the effluent will be dried prior to its intended use and if necessary, other uses in the environment.

These above-listed structures that will form up the pond system onsite are shown in the proposed layout (drawings) of the Tses oxidation ponds in **Figure 3** and **Appendix D**.

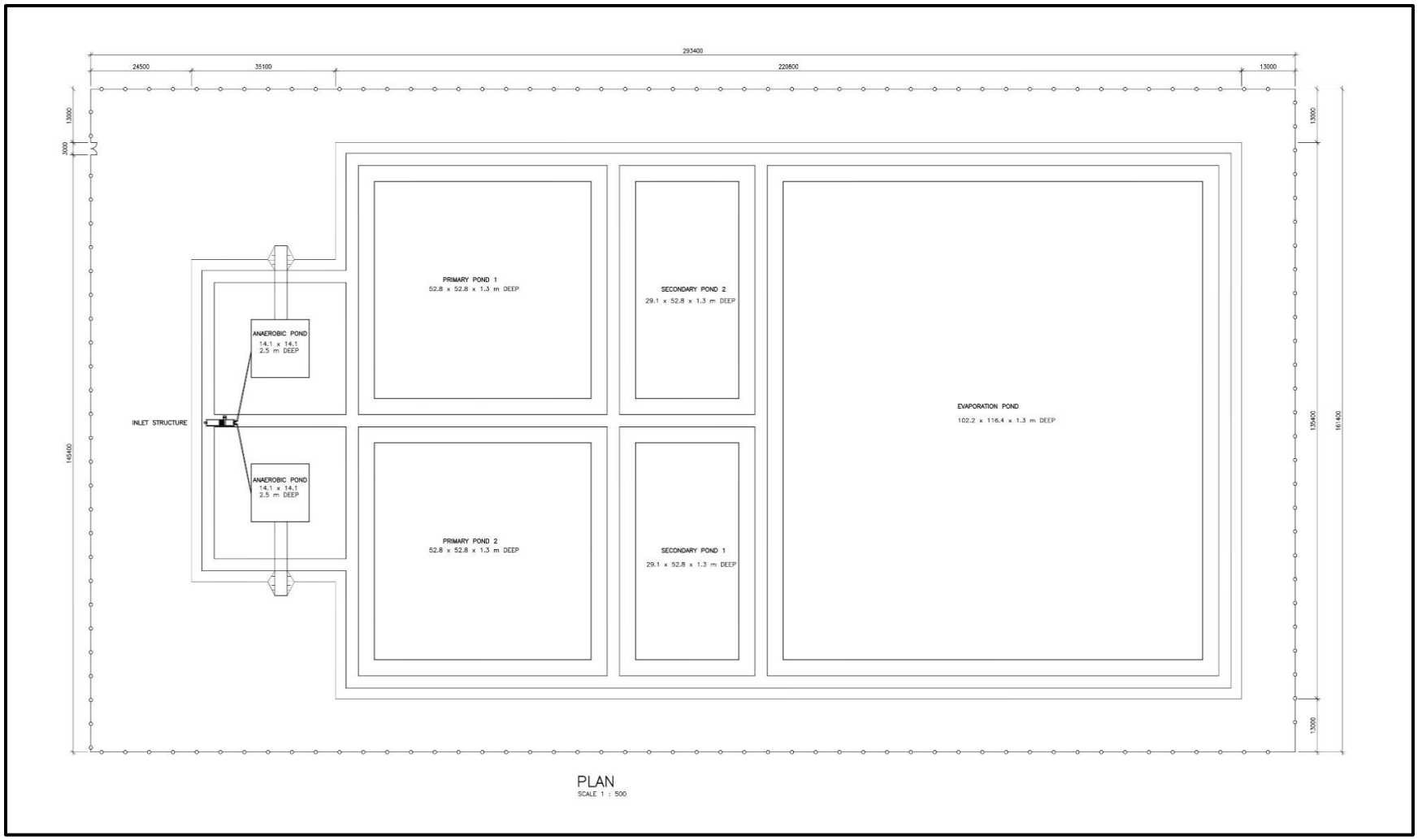


Figure 3: The proposed drawings (site layout) of the oxidation ponds (Source: Dunamis Consulting Engineers & Project Managers, 2020)

After the technical and administrative documentations of the planning and design phase are approved (including the ECC) and the preparations for the next phase are finalized, demolishing (decommissioning) activities of the existing oxidation ponds will follow as planned by the project Proponent and their construction engineers/contractors.

2.3 Demolishing of Existing (old) Oxidation Ponds

Prior to site preparation for the construction of new oxidation ponds, the five old ponds will need to be decommissioned (demolished) as they cannot be used as they are (in their current state). This is done to ensure that no further safety, environmental and human health hazards and to provide land/space for the new ponds.

2.3.1 Handling of Existing and Incoming Sewage during Ponds' Demolition Stage

Given the fact that it is not expected for the Tses Village Council to cease the inflow of wastewater (sewage) from the sewer source to the ponds during the demolishing of old ponds and construction of the new ponds, the Proponent, Village Council, and the Demolishing and or Construction Contractor may need to decide on **carrying out progressive demolition** by determining the feasibility of either of the two options or both:

1. This will need to be done by demolishing one or two ponds at a time to ensure that there is still one or two ponds to still contain incoming wastewater from the Village sources and avoid environmental catastrophe of uncontrolled sewage overflowing into the general surrounding surface area and into the ground (groundwater)
2. Alternatively, provision to be made for industry standard temporary storage facilities such as sewage tanks to contain sewage while demolition and construction is ongoing.

The decommissioning of these ponds will entail the following:

- The treatment of liquids as well as removal and disposal of biosolids accumulated at the bottom of the ponds, especially the two active ponds (P1 and P2 in **Figure 1 and 2**). These solids need to be handled properly before re-using the ponds, i.e., for the construction of new ones and cleaned up.
- Cleaning up and closure of the other three inactive ponds (P3, P3, and P5 also shown in **Figure 1** and **2**).
- Proper demolition, capping and elimination of existing treatment components as well as disposal of waste to relevant approved waste management facilities.
- The demolition of old ponds should also be planned and done in **consultation and collaboration with the Water Environment Division at the Department of Water Affairs of the Ministry of Agriculture, Water and Land Reform** to ensure compliance to Regulations pertaining to handling Wastewater. If required, a Permit should be applied for and obtained from the Division.

The most important end component of pond demolition will be to determine the quantity and quality of the biosolids that will have to be removed from the ponds and the option that will be appropriate for land use or disposal (Minnesota Pollution Agency, 2010). An example of but (Domestic) Wastewater Pond Decommissioning or Relining Plan is attached as **Appendix 2** to the EMP for further reading and consideration.

Demolition team (workforce): A few people will be temporarily hired for both technical and casual work to carry out the demolition work, however, the number of such workers is not yet known. It is possible that this staff will be selected from the 15 people that will be required for the construction phase or a different team will be hired for this work.

Once decommissioning of the old ponds is completed, the site will be prepared for construction works of the new ponds.

2.4 Construction Phase

The proposed project involves the construction of four new oxidation ponds. The anticipated associated activities will include site clearance, earthworks, concrete works, lining and fencing of the site by the appointed reputable and experienced construction contractor.

During this phase, the site will be cleared in preparation of the subsequent project activities. Earthworks will be carried out on the site areas planned for the establishment of the four ponds. The concrete works will be done followed by surface lining of the ponds' base to prevent leaching/seepage of effluent into the ground during the operational phase.

To ensure that the ponds are secured and protected from possible public unauthorized access, and most importantly protecting the public, especially local children, a razor mesh fence will be erected around the ponds' area.

Construction period: The construction activities are anticipated to last for about five months.

2.4.1 Human Resources

The project will require the following in terms of human resources and accommodation:

- **Human resources**: the construction work will require about fifteen (15) people; therefore 15 people will be temporary employed (both skilled, semi-skilled and unskilled). Priority for employment will be given to the locals for any project related job that they are qualified for or capable of carrying out.
- **Contractors' Accommodation**: the construction workforce (workers) will be accommodated in tented facilities that will be set up near the site so that they are well on time and available for site works during the working hours and days of the week.

2.4.2 Required Services Resources

The following services will be required and utilized for this phase:

- **Vehicles and machinery:** there will be light, medium, and heavy vehicles to be used for different project activities. The heavy vehicles such as trucks would be needed to transport construction materials and equipment to and from site (as needed). The light vehicles such as bakkies and small buses will be used to transport workers around, to and from site (as and when required). These light vehicles may also be used to transport or move certain project materials and substances on site. Medium vehicles such as excavators will be used to carry out earthworks and other related activities.

- **Water:** A certain amount of water will be required for concrete works and other related project activities as well as for human consumption (drinking water) on site. However, the exact volume of water required is not known at this stage. The required water will either be sourced from the Tses Village Council supply line (upon reaching an agreement with the contractor) or will be brought to site from elsewhere by the Construction Contractor.

- **Fuel:** the power required for construction works will be supplied by diesel powered generators.

- **Site access:** the oxidation ponds' site is accessible via the access road currently used to get to the existing dilapidated oxidation ponds at the site. The same access road will be used during the construction works and subsequent operational and maintenance activities.

2.4.3 Health, Waste Management, Safety and Security

- **Personal health and safety**: all construction workers will be supplied with appropriate and adequate personal protective equipment (PPE) while carrying project activities onsite.

- **First aid kits**: At least two first aid kits will be made available on site; one at the working sites and the second one at the site campsite. The workers will be equipped with basic first aid kit administrating skills.

- **Waste management (general and hazardous):** all waste generated from the construction activities will be sorted, stored on site in designated waste containers and carted to the approved local landfill site (upon authorization from the facility owner/operator).

- **Human waste/sanitation:** the appointed contractor will ensure that the site is equipped with portable chemical toilets for the workers and possibly project related visitors. The toilets will need to be emptied according to the manufacturer's instruction.

- **Fire management:** At least two extinguishers will be on site and project vehicles will also be equipped with fire extinguishers.

Site fencing: The site area will be demarcated with temporary boundary during the construction activities and then a razor mesh will be erected. The razor mesh will serve both as protection of the site from potential vandalism and theft of project equipment and infrastructure. The fence will prevent unauthorized public access and protect the vulnerable community members such as unsuspecting children from drowning, playing with the wastewater and dangerous project equipment as well as preventing local animals from entering the site.

2.5 Operational Phase Activities

This is the phase during which the newly constructed and equipped oxidation ponds will be operational, i.e., treating the wastewater (effluent) from the Tses Village Council wastewater system and maintenance done by the Village Council or an independent contractor. The ponds are expected to be operated 24 hours, 7 days (everyday).

2.5.1 Input and Treatment Process

General operating procedure of oxidation: When treating waste at the oxidation ponds, the algae that is required for the process, is grown using energy from the sun and carbon dioxide and inorganic compounds released by bacteria in the water. During the process of photosynthesis, the algae release oxygen needed by aerobic bacteria.

According to the Encyclopaedia Britannica (2020), mechanical aerators are sometimes installed to supply yet more oxygen, thereby reducing the required size of the pond. Sludge deposits in the pond must eventually be removed by dredging. Algae remaining in the pond effluent can be removed by filtration or by a combination of chemical treatment and settling.

2.5.2 Wastewater Treatment Output: Irrigation and Other Applications in the COP Vol. 6

The slurry (effluent) will be stored in the ponds. The final effluent will be treated so that it is compliant with and have a quality equal or better than the specified quality for the General Standards as laid out in the Government Gazette Regulation R553 of 5 April 1962, in Section 21(1) and 21(2) of the Water Act (Act No 54 of 1956). In other words, the remaining (dry) slurry will be treated in accordance with acceptable environmental standards so that it can be used in the environment for irrigation purposes in Tses or nearest areas where it may be required. The National Department of Water Affairs' Code of Practice (COP) Volume 6 (Vol.6) on Wastewater Re-use of July 2012 will be also used as guide to ensure that the treated effluent meets the standards and requirements for wastewater re-use.

Other post-treatment applications as listed in the COP would also be explored and considered to ensure that the volumes of treated effluent that is not taken up for irrigation does not all end piled in nature (environment) as mere waste.

2.5.3 Services Infrastructure

A. **Water:** The operational phase of the ponds will not require a significant amount of water apart from time-to-time drinking water for workers and possibly maintenance works, when and as required. This water will be provided by the Tses Village Council from their water supply line. The volume of water is insignificant therefore cannot be determined at this stage

B. **Site accessibility (Road):** The site will be accessed from the existing Village road currently used to access the existing ponds area**.**

2.6 Decommissioning Phase and Activities

Decommissioning referred to herein is for the decommissioning of the construction works and sites at the end of the construction phase.

The decommissioning phase will particularly entail the following:

- Dismantling and removal of all infrastructures and structures that will no longer be required for the operational and maintenance phase. These structures include camping sites, storage tanks, onsite temporary offices, ablution facilities and other supporting structures erected for construction. These will be transported to designated storage facilities offsite.
- Removal of all project related vehicles, machinery, and equipment from site to designated parking and storage sites off site, respectively.
- Carrying away the waste storage containers and disposal of waste to designated and approved waste management sites.
- Closure of all access roads that may have been created for the construction phase and no longer required for operational phase.
- Levelling of stockpiled topsoil and where possible, backfilling of all construction excavated pits and trenches.

3 PROJECT ALTERNATIVES AND ANALYSIS

According to the Environmental Management Act No. 7 of (2007) and its 2012 EIA Regulations, alternatives are defined as: “different means of meeting the general purpose and requirements of the activity”. This chapter will highlight the different ways in which the project can be undertaken and to identify the alternative that will be the most practical but least damaging to the environment.

Once the alternatives have been established, these are examined by asking the following three questions:

- What alternatives are technically and economically feasible?
- What are the environmental effects associated with the feasible alternatives?

- What is the rationale for selecting the preferred alternative?

The alternatives considered for the proposed development are discussed in the following subchapters.

3.1 Project Alternatives

3.1.1 The No-Go (No Proposed Project) Alternative

The “No-Go” alternative is the option of not proceeding with the activity, which typically implies a continuation of the current site state. Should the proposed oxidation ponds idea be discontinued, the site will continue to only house the existing sewage ponds. In addition, none of the potential impacts identified would occur. Without the construction and eventual operations of the proposed ponds, the Tses Village would be faced with a challenge of not being able to efficiently manage its wastewater which may already be polluting the Village’s local groundwater resources. Should the status quo continue, this would also mean that the local animals will continue to roam around the ponds area for grazing and drink the polluted water. The state of the current ponds especially the two active ponds would continue to be a threat to the local children and the current odour emanating from the ponds would continue to be a nuisance to the residents in the house within proximity of the ponds.

For these reasons and by considering the proposed project, the ‘no-go’ option is not considered the preferred alternative.

3.1.2 Project Location and Services Infrastructure

There has not been another site/location considered for the proposed ponds. The site was selected based on the following factors:

- **Land suitability (current land use) -** there is already an existing similar land use, i.e., waste management facilities (sewer ponds).
- **Relocation of ponds:** The relocation of ponds to a different area in the Village would be a good idea, but there are lot of factors to consider. These factors include the new biophysical and social environment impacts when a completely new site areas for such type of facilities are established. The current site proposed for the new ponds would be ideal to restrict the cumulative (old and new) impacts to the same area with existing similar land use (existence of the dilapidated ponds). Therefore, improving this site and utilize it for the same land use would avoid the occurrence of new impact biophysical and social impacts on a new and probably pristine land (site).
- **Distance to the source of raw material** - the new ponds would be located within the same area with the existing sewage ponds and where the raw material (wastewater) pipelines are already existing. This would also reduce the distance that would otherwise be travelled by trucks transporting wastewater tanks or prevent the construction of new pipelines to bring the wastewater to the ponds for treatment.

- **Land ownership:** - the proposed site is still within the Tses Village Council, therefore there will be no need to apply for new land rights, should the site be relocated outside the Village boundaries.
- **Topography** - the site is relatively flat which will make the construction of the new ponds and related structures much easier, compared to uneven locations that may require levelling.
- **Services infrastructure** - there is an existing access road to site from the Village centre and this would mean easy access by the project's related vehicles.
- **Climatic conditions**: the stabilization (oxidation) ponds are commonly used in regions with warm to mild climate throughout the year (Oyati *et al*., 2020). Given the climate of the proposed project area (Tses being in the arid Namibia), the oxidation pond system would be the suitable wastewater treatment method for the proposed project.

For this reason, the proposed location is considered more feasible for the proposed project.

3.1.3 Wastewater Treatment Method Alternative and Cost

According to Rajasulochana and Preethy (2016), methods of wastewater treatment were first developed in response to the adverse conditions caused by the discharge of wastewater to the environment and the concern for public health. Further, as cities became larger, limited land was available for wastewater treatment and disposal, principally by irrigation and intermittent filtration. Also, as populations grew, the quantity of wastewater generated rose rapidly and the deteriorating quality of this huge amount of wastewater exceeded the self-purification capacity of the streams and river bodies. Therefore, other methods of treatment were developed to accelerate the forces of nature under controlled conditions in treatment facilities of comparatively smaller size.

Depending on the wastewater treatment objective, size, site conditions and capacity, some of the commonly used treatment methods include:

- ion exchange
- aerobic and anaerobic biological process
- flocculation and sedimentation water treatment
- filtration, and membrane separation
- oxidation and disinfection
- clarification water treatment
- water disinfection
- evaporation and crystallization
- membrane bioreactors and sludge treatment and handling.

3.1.3.1 Advantages and Disadvantage of Oxidation Pond System

A recent World Bank Report in the 80s came out strongly in favour of stabilization ponds as the most suitable wastewater treatment system for effluent use in agriculture. Stabilization ponds are the preferred wastewater treatment process in developing countries, where land is often available at reasonable opportunity cost and skilled labour is in short supply (Pescod, 1992). Further advantages of the oxidation ponds according to Tharavathy *et al* (2013) are as presented in **Table 2.**

Table 2: Advantages and disadvantages of oxidation pond system

Advantages (preference/justification)	**Disadvantages (preference/justification)**
Effective, low-cost, and simple technology for the treatment of wastewater before it is discharged to an aquatic ecosystem – suitable and sufficient for a small community such as Tses where financing for other wastewater treatment methods could be a problem.	They require extensive land area: project – the land is sufficient (using the existing ponds' site and the space within the boundary of the old-fenced area of the ponds will be sufficient to cater for the proposed ponds and associated infrastructure). Potential odour problem - The ponds' machinery and equipment will be designed to contain a technology that makes provision for the installation odour controlling caps at the ponds to control or minimize odour. Mosquito menace Little control over the effectiveness of the treatment process – suitable for the small community and low operating cost. The main disadvantage is seepage of effluents into soil which may also lead to groundwater pollution - The new ponds will be lined to avoid and not to add to the situation that is possibly may have been occurring with the old (current) ponds already (sewer infiltrating into the ground over the years).
Suitable in warm climates to purify wastewater. The performance of pond depends on climatological conditions like light, temperature, rain, wind, and the wastewater quality – Tses is in a dry part of the country where temperature as high as 35°C for about 2 weeks in a month for 6 to 7 months in a year are expected, low rainfall, wind at speed of 19 to 28 km/hr and sufficient sunlight. These are one of the perfect conditions for the ponds' functionality.	
Other advantages of an oxidation pond wastewater treatment system also include the adequate treatment compartments, accurate balancing of temperature and other parameters as dissolved oxygen (DO), nutrient and organic matters (Oyati et al., 2020).	

Regardless of the disadvantages, oxidation ponds have proved to be one of the most significant devices of economical waste treatment for small communities and isolated industrial units (Tharavathy *et al*., 2013). Therefore, making the ponds technology an ideal option for Tses.

With other wastewater treatment pond systems, Table 3 displays the comparison of their advantages and disadvantages with those of high-rate biological wastewater treatment processes based on certain factors (criteria).

Table 3: The advantages and disadvantages of various sewage treatment pond systems (Pescod, 1992)

	Criteria	Package plant	Activated sludge plant	Extended aeration activated sludge	Biological filter	Oxidation ditch	Aerated lagoon	Waste stabilization pond system
Plant performance	BOD removal	F	F	F	F	G	G	G
	FC removal	P	P	F	P	F	G	G
	SS removal	F	G	G	G	G	F	F
	Helminth removal	P	F	P	P	F	F	G
	Virus removal	P	F	P	P	F	G	G
Economic factors	Simple and cheap construction	P	P	P	P	F	F	G
	Simple operation	P	P	P	F	F	P	G
	Land requirement	G	G	G	G	G	F	P
	Maintenance costs	P	P	P	F	P	P	G
	Energy demand	P	P	P	F	P	P	G
	Sludge removal costs	P	F	F	F	P	F	G

Key:

FC = Faecal coliforms;
SS = Suspended slids;
G = Good;
F = Fair;
P = Poor.

From the above-listed methods in **Table 3** above, the proposed wastewater treatment method/system preferred for Tses is oxidation ponds (oxidation stabilization pond system) because of its performance rating.

3.1.4 Cost Implications

The ponds are cheaper to construct and operate in warm climate as compared to conventional treatment system and hence they are considered as low-cost wastewater treatment systems (Khan *et al*., 2018).

4 LEGAL FRAMEWORK: OPERATIONAL PERMITTING AND LICENSES

The project's activities are undertaken in a biophysical and social environment. These activities or some of them may even at minimum impact some of these environmental components. It is therefore necessary to consider the legislations and legal requirements governing the project and its associated activities.

The main legal framework presented herein is that of Namibia for the relevant project component under the scope of this document – detailed legislation that are applicable to the project are given below**.**

4.1 Environmental Management Act No. 7 of 2007

The Environmental Management Act No.7 of 2007 and its 2012 EIA Regulations aims to ensure that the potential impacts of the development on the environment are considered carefully and in good time; that all interested and affected parties have an opportunity to participate in the environmental assessment processes and that the findings of the environmental assessments are fully considered before any decisions are made about activities which might affect the environment.

The Act aims at promoting sustainable management of the environment and use of natural resources. The Environmental Management Act (EMA) is broad; it regulates land use development through environmental clearance certification and/or Environmental Impact Assessments. The Act provides for the clearance certification for '' *2.1 The construction of facilities for waste sites, treatment of waste and disposal of waste and 8.6 The construction of industrial and domestic wastewater treatment plants and related pipeline systems*''.

4.2 Water Act No. 54 of 1956

The Water Resources Management Act 11 of 2013 is presently without regulations; therefore, the Water Act No 54 of 1956 is still in force:

- Prohibits the pollution of water and implements the principle that a person disposing of effluent or waste has a duly of care to prevent pollution (S3 (k)).
- Provides for control and protection of groundwater (S66 (1), (d (ii)).
- Liability of clean-up costs after closure/abandonment of an activity (S3 (l)).

Implication for the proposed project: The project will involve the treatment of wastewater that pose a risk to water resources (pollution), therefore the Proponent will need to ensure that they are in possession of the required licenses and permits from the DWA.

4.3 Water Resources Management Act No. 11 of 2013

Act provides for the management, protection, development, use and conservation of water resources; and provides for the regulation and monitoring of water services and to provide for incidental matters. The objects of this Act are to:

Ensure that the water resources of Namibia are managed, developed, used, conserved, and protected in a manner consistent with, or conducive to, the fundamental principles set out in Section 66 - protection of aquifers, Subsection 1 (d) (iii) provide for preventing the contamination of the aquifer and water pollution control (Section 68).

Implication or responsibility to Water Acts: The protection (both quality and quantity/abstraction) of water resources should be a priority. Therefore:

- The Proponent should ensure that the permit/license for effluent (wastewater) discharge into the environment (including its use for irrigation) is applied for from the Department of Water Affairs' Water Environment Division of the Ministry of Agriculture, Water and Land Reform.

For this EA Report, the information on the legal obligations (legislations, policies, and guidelines) that governs the proposed project is presented in **Table 4** below. **The requirements in terms of project activities' permitting and/or licensing that may be required from different applicable regulatory authorities are presented in the Environmental Management Plan.**

4.4 Codes of Practice including Vol. 6 – Wastewater Re-Use of July 2012

The project is subject to the Regulations listed in the DWA' Codes of Practice. The recent Code of Practice: Volume 6 of July 2012 contains the following guidelines on the:

- Treatment of wastewater (grey water, domestic wastewater, and industrial effluents)
- Precautions for wastewater re-use systems
- Specific applications for re-use of wastewater (mining, industrial & food processing, agricultural re-use, gardening & landscape re-use, aquacultural re-use and other uses)
- Disposal and discharge of treated effluent into nature.

Table 4: The list of applicable national and international legislations governing the proposed project and related activities

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
The Constitution of the Republic of Namibia, 1990 as amended	The Constitution of the Republic of Namibia (1990 as amended) addresses matters relating to environmental protection and sustainable development. Article 91(c) defines the functions of the Ombudsman to include: *"…the duty to investigate complaints concerning the over-utilisation of living natural resources, the irrational exploitation of non-renewable resources, the degradation and destruction of ecosystems and failure to protect the beauty and character of Namibia…"* *Article 95(l) commits the state to actively promoting and maintaining the welfare of the people by adopting policies aimed at the:* *"…Natural resources situated in the soil and on the subsoil, the internal waters, in the sea, in the continental shelf, and in the exclusive economic zone are property of the State."*	By implementing the environmental management plan, the establishment will be in conformant to the constitution in terms of environmental management and sustainability. Ecological sustainability will be main priority for the proposed development.
The Regional Councils Act (No. 22 of 1992)	This Act sets out the conditions under which Regional Councils must be elected and administer each delineated region. From a land use and project planning point of view, their duties include, as described in section 28 "to undertake the planning of the development of the region for which it has been established with a view to physical, social, and economic characteristics, urbanisation patterns, natural resources, economic development potential, infrastructure, land utilisation pattern and sensitivity of the natural environment. The main objective of this Act is to initiate, supervise, manage, and evaluate development.	The relevant Regional Councils are Interested &Affected Parties and must be consulted during the Environmental Assessment (EA) process. The project site area falls under the //Karas Regional Council; therefore, they should be consulted.
Forestry Act No. 12 of 2001	The Act provides for the management and use of forests and related products / resources. It offers protection to any living tree, bush or shrub growing within 100 metres of a river, stream or watercourse on land that is not a surveyed erven of a local authority area. In such instances, a licence would be required to cut and remove any such vegetation.	Should there be trees within the actual footprint of the site that need to be removed; the Proponent should notify the Tses Village Council. The number and/or type of trees to be removed to allow construction works should also be submitted to the Village Council. Should these trees be of

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
	These provisions are only guidelines.	a protected species, the permit to remove them should be applied from the nearest Forestry office.
National Heritage Act No. 27 of 2004	The Act makes provision for the protection and conservation of places and objects of heritage significance and the registration of such places and objects. Part V Section 46 of the Act prohibits removal, damage, alteration, or excavation of heritage sites or remains, while Section 48 sets out the procedure for application and granting of permits such as might be required in the event of damage to a protected site occurring as an inevitable result of development. Part VI Section 55 Paragraphs 3 and 4 require that any person who discovers an archaeological site should notify the National Heritage Council. Section 51 (3) sets out the requirements for impact assessment.	The Proponent should ensure compliance with this Acts' requirements. The necessary management measures and related permitting requirements must be taken. This done by consulting with the National Heritage Council of Namibia.
The National Monuments Act (No. 28 of 1969)	The Act enables the proclamation of national monuments and protects archaeological sites.	
Soil Conservation Act (No 76 of 1969)	The Act makes provision for the prevention and control of soil erosion and the protection, improvement and conservation of soil, vegetation and water supply sources and resources, through directives declared by the Minister.	Duty of care must be applied to soil conservation and management measures must be included in the EMP.
Public Health Act (No. 36 of 1919)	Section 119 states that “no person shall cause a nuisance or shall suffer to exist on any land or premises owned or occupied by him or of which he is in charge any nuisance or other condition liable to be injurious or dangerous to health.”	The Proponent and all its employees or contractors should ensure compliance with the provisions of these legal instruments.
Health and Safety Regulations GN 156/1997 (GG 1617)	Details various requirements regarding health and safety of labourers.	

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
Public and Environmental Health Act No. 1 of 2015	The Act serves to protect the public from nuisance and states that no person shall cause a nuisance or shall suffer to exist on any land or premises owned or occupied by him or of which he is in charge any nuisance or other condition liable to be injurious or dangerous to health.	The Proponent should ensure that the project infrastructure, vehicles, equipment, and machinery are designed and operated in a way that is safe, or not injurious or dangerous to public health and that the noise and dust emissions which could be considered a nuisance remain at acceptable levels. The Proponent should ensure that the public as well as the environmental health is preserved and remain uncompromised.
Petroleum Products and Energy Act (No. 13 of 1990) Regulations (2001)	Regulation 3(2)(b) states that "No person shall possess or store any fuel except under authority of a licence or a certificate, excluding a person who possesses or stores such fuel in a quantity of 600 litres or less in any container kept at a place outside a local authority area.	The Proponent should obtain the necessary authorization from the MME for the storage of fuel on-site.
Atmospheric Pollution Prevention Ordinance (No.11 of 1976)	This ordinance provides for the prevention of air pollution.	Measures should be instituted to ensure that dust emanating from construction activities and operations is kept at acceptable levels. In addition, odour from the operational phase of the ponds should be contained by implementing odour controlling measures.
Road Traffic and Transport Act, No. 22 of 1999	The Act provides for the establishment of the Transportation Commission of Namibia; for the control of traffic on public roads, the licensing of drivers, the registration and licensing of vehicles, the control and regulation of road transport across Namibia's borders; and for matters incidental thereto. Should the Proponent wish to undertake activities involving road transportation or access onto existing roads, the relevant permits will be required.	Mitigation measures should be provided for, if the roads and traffic impact cannot be avoided. If required, the relevant permits must therefore be applied for.
Labour Act (No. 6 of 1992)	Ministry of Labour (MOL) is aimed at ensuring harmonious labour relations through promoting social justice, occupational health and safety and enhanced labour market services for the benefit of all Namibians. This ministry insures effective implementation of the Labour Act no. 6 of 1992.	The Proponent should ensure that the project construction and operations and maintenance, do not compromise the safety and welfare of workers.

The legal requirements above have been listed and explained as per their relevance to the project. The project is being carried in a specific environment that may be affected in terms of its biophysical and social features.

The environmental baseline (receiving environment) of the project area is presented under Chapter 4 as per the information and observations obtained and made on site and project area, respectively. The site information has also been complemented by review of existing different and relevant data sources

5 THE RECEIVING BIOPHYSICAL AND SOCIAL ENVIRONMENT

The baseline (pre-project site conditions) information of a project area is crucial to understand the state of the environment before the implementation of the proposed project. This aids in undertaking a concise assessment and make informed conclusions on the proposed impact of the project activities on sensitive environmental and social components and recommend practical and realistic management measures.

The data source used to compile this chapter ranges from the review of existing and relevant published academic papers, old project reports and books containing the information on the area. The information sourced from online (soft copies) and physical source research has been complemented by raw data collected on site during the site visits, assessments and public engagement meetings undertaken between 12 and 30 October 2020.

5.1 Climate

The climate of the project area is classified as subtropical desert / low-latitude arid hot (as per the Köppen – Geiger Climate Classification – BWh) (GCS Water & Environmental Consultants, 2017). According to Groot Environmental Engineers (2016), Tses climate is a desert one with an average yearly rainfall of 183 mm. The rainfalls are sporadic and unpredictable, high intensity, highly localised storm events between December and March. Evaporation rates are averaged between 3 000 and 3 200 mm per year and variates depending on the rainfall and temperature (Groot Environmental Engineers, 2016).

5.1.1 Temperatures

The temperatures (minimum, maximum and average) for Tses over an eleven (11) year period are shown in **Figure 4** below. The average annual temperature is 20°C.

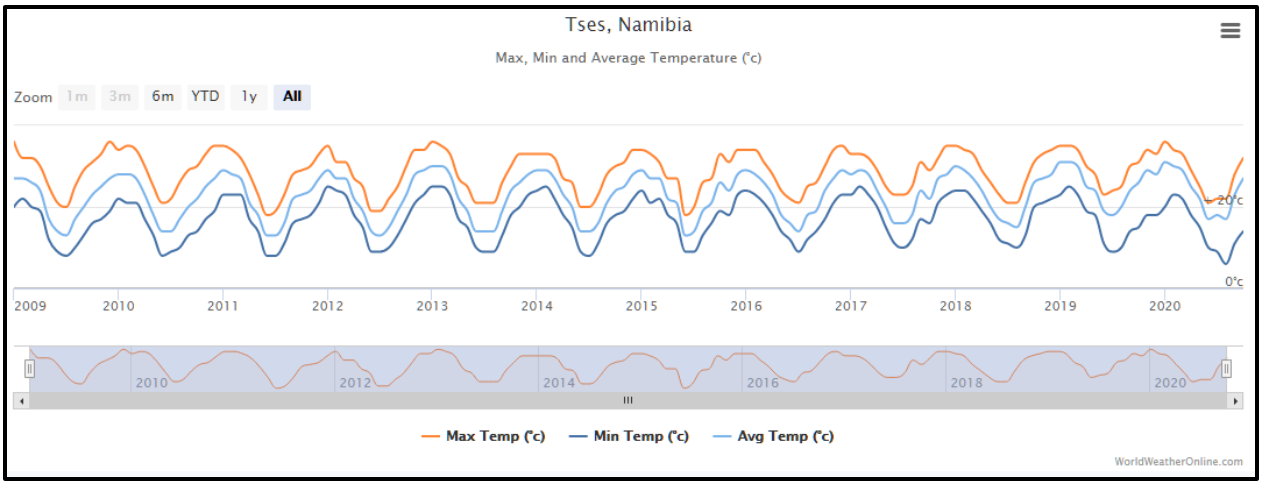


Figure 4: Maximum, minimum, and average temperatures for Tses (World Weather Online, 2020)

The maximum temperature diagram for Tses (**Figure 5**) displays how many days per month reach certain temperatures. The lowest temperatures (less than 10°C) are common from June to August for a period of 2 to 3 days, while the highest temperatures of greater than 35°C are common in the months January, February, November, and December lasting between 10 and 15 days.

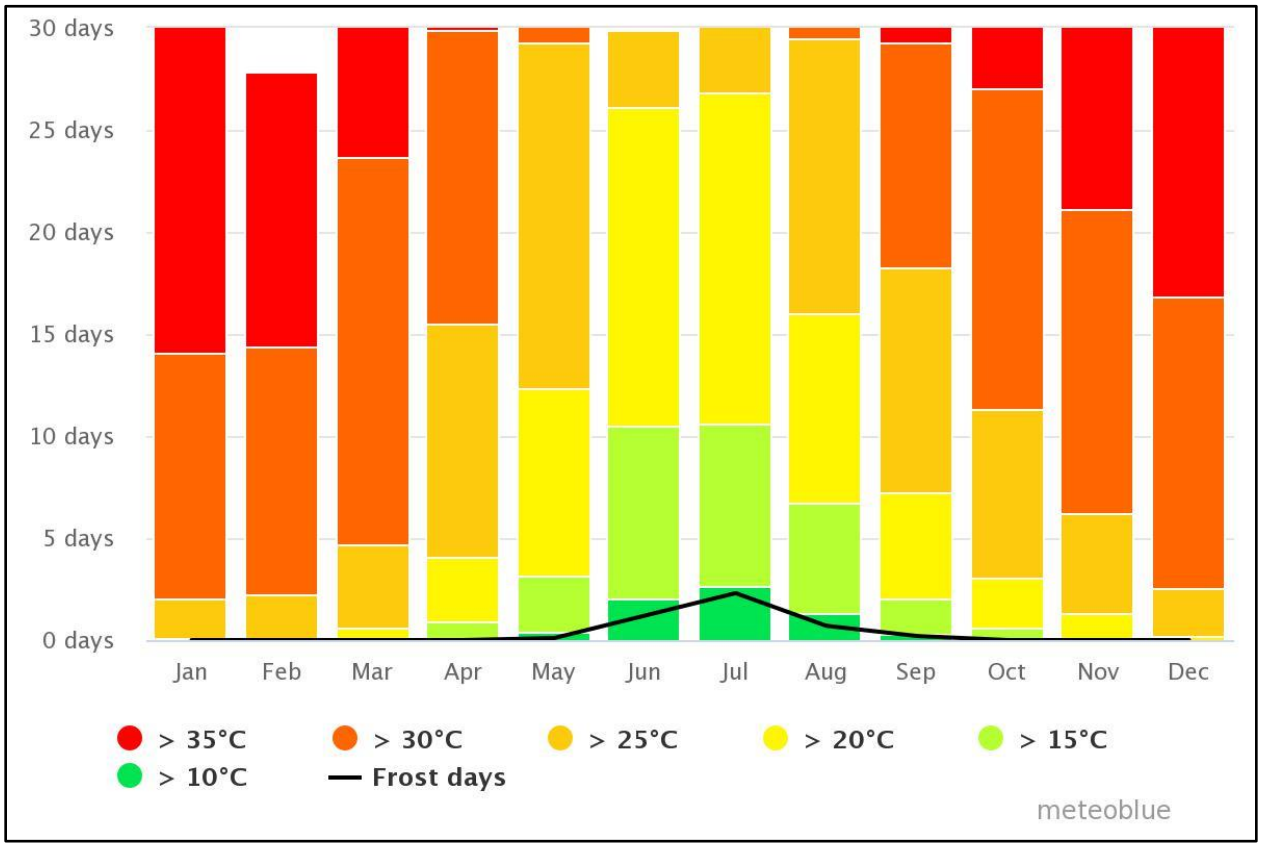


Figure 5: The maximum temperature diagram for Tses displaying how many days per month reach certain temperatures (Meteoblue, 2021)

5.1.2 Rainfall and Humidity

The average rainfall, and humidity for Tses over a period of eleven (11) years, i.e., from 2009 to 2020 are shown in **Figure 6** and **Figure 7** below. The lowest rainfall recorded over this period was less than 10 mm in 2010 with the highest recorded in 2012 at over 100 mm (about 110 mm).

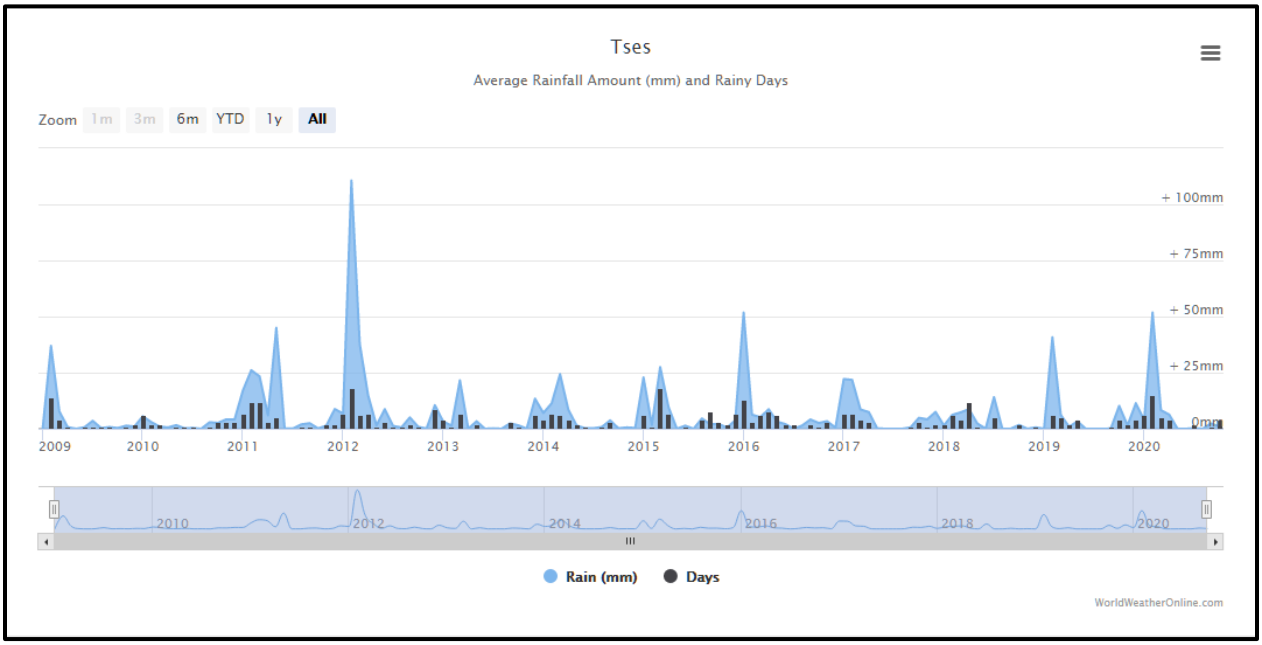


Figure 6: Average rainfall and rainy days of the Tses area (World Weather Online, 2020)

The relative humid conditions occur during rainy season, from January to March with 48% and from October to December. Rainfall and temperature determine the variation in humidity (Groot Environmental Engineers, 2016). The average humidity and cloud recorded from 2009 to 2020 are shown in **Figure 6** below.

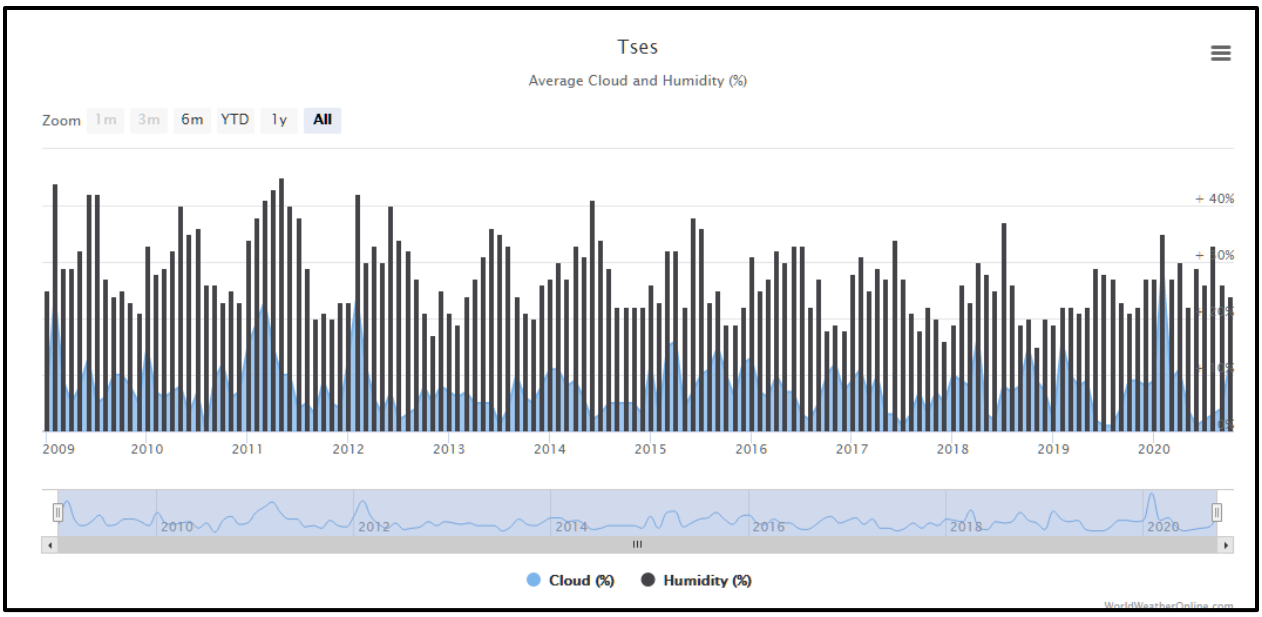


Figure 7: Average cloud and Humidity (World Weather Online, 2020)

Figure 8 shows the precipitation diagram (chart) for Tses showing on how many days per month, certain precipitation amounts are reached. In tropical and monsoon climates, the amounts may be underestimated.

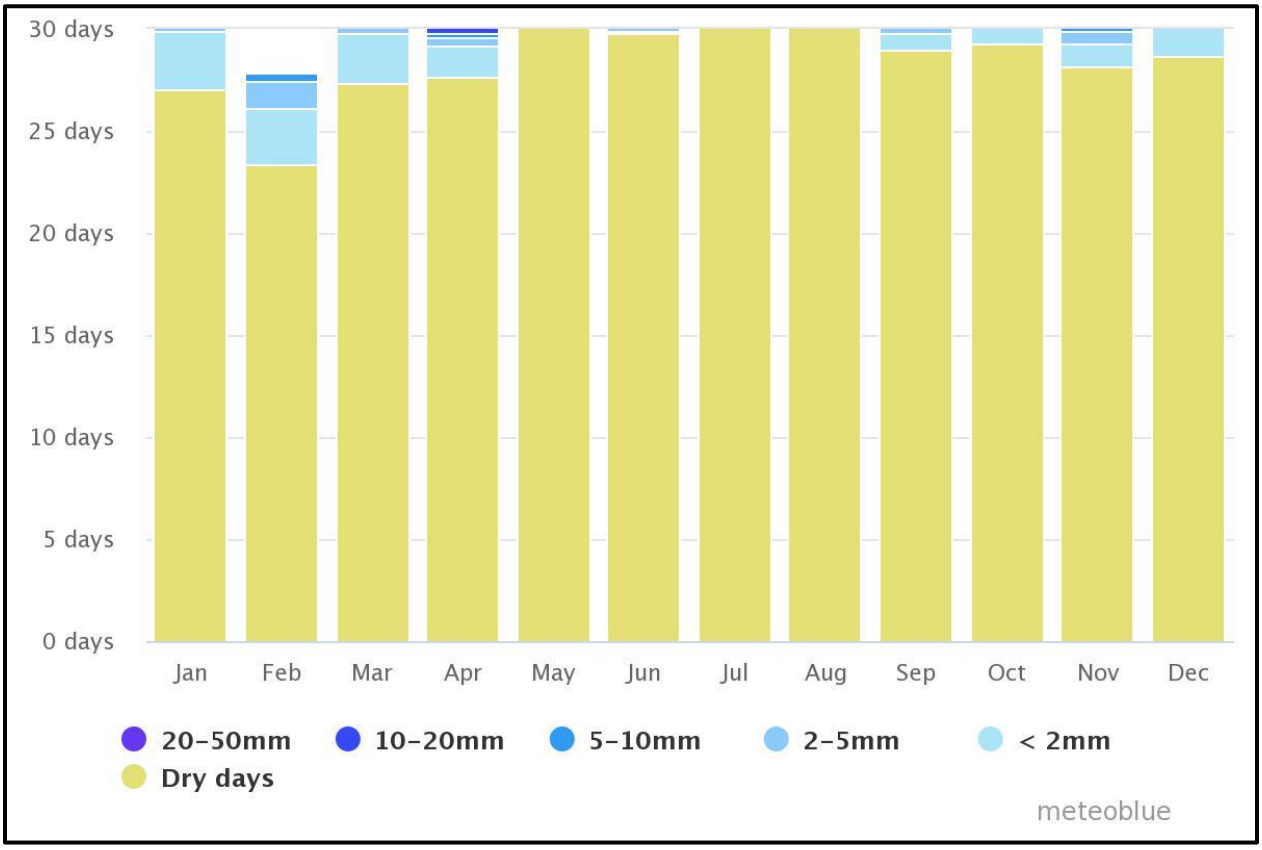


Figure 8: Precipitation chart for days per month when certain precipitation amounts are reached (Meteoblue, 2021)

5.1.3 Air and Wind

Air: The current known sources of air pollution in the area are dust emissions from unpaved access roads within the town, and minimally emissions from heavy vehicles on the B1. The local source of air pollution in terms of odour, especially to residents living within proximity of the site are the old sewage ponds.

According to IQ Air (2021), the current air pollution level of the Tses area, the project area's air pollution level is good. The air quality index (AQI) is 42 US AQI, and the main pollutant is the atmospheric particulate matter (PM) 2.5 (measured at a concentration level of 10.1 µg/m^3). PM are defined by IQ Air as microscopic solid or liquid matter suspended in the air with a diameter of 2.5 micrometres (µm) or less. Sources of particulate matter can be natural or anthropogenic. Of greatest concern to public health are the particles small enough to be inhaled into the deepest parts of the lungs. The biggest impact of particulate air pollution on public health is therefore understood to be from long-term exposure to PM2.5 (Meteoblue, 2021).

Wind: The wind rose for Tses in **Figure 9** shows how many hours per year the wind blows from the indicated direction. For instance, Southwest (SW): Wind is blowing from Southwest (SW) to Northeast (NE) with the predominant wind direction from South to North and North to South. The seasonal variations are indicated to be from South-Southwest (SSW) to North-Northeast (NNE). The speed at which the wind blows from the indicated directions is also shown on the wind speed chart in **Figure 10**. For instance, the predominant wind speed from SW to NE blows with the speed range of about 19 and 28 kilometres per hour (km/h).

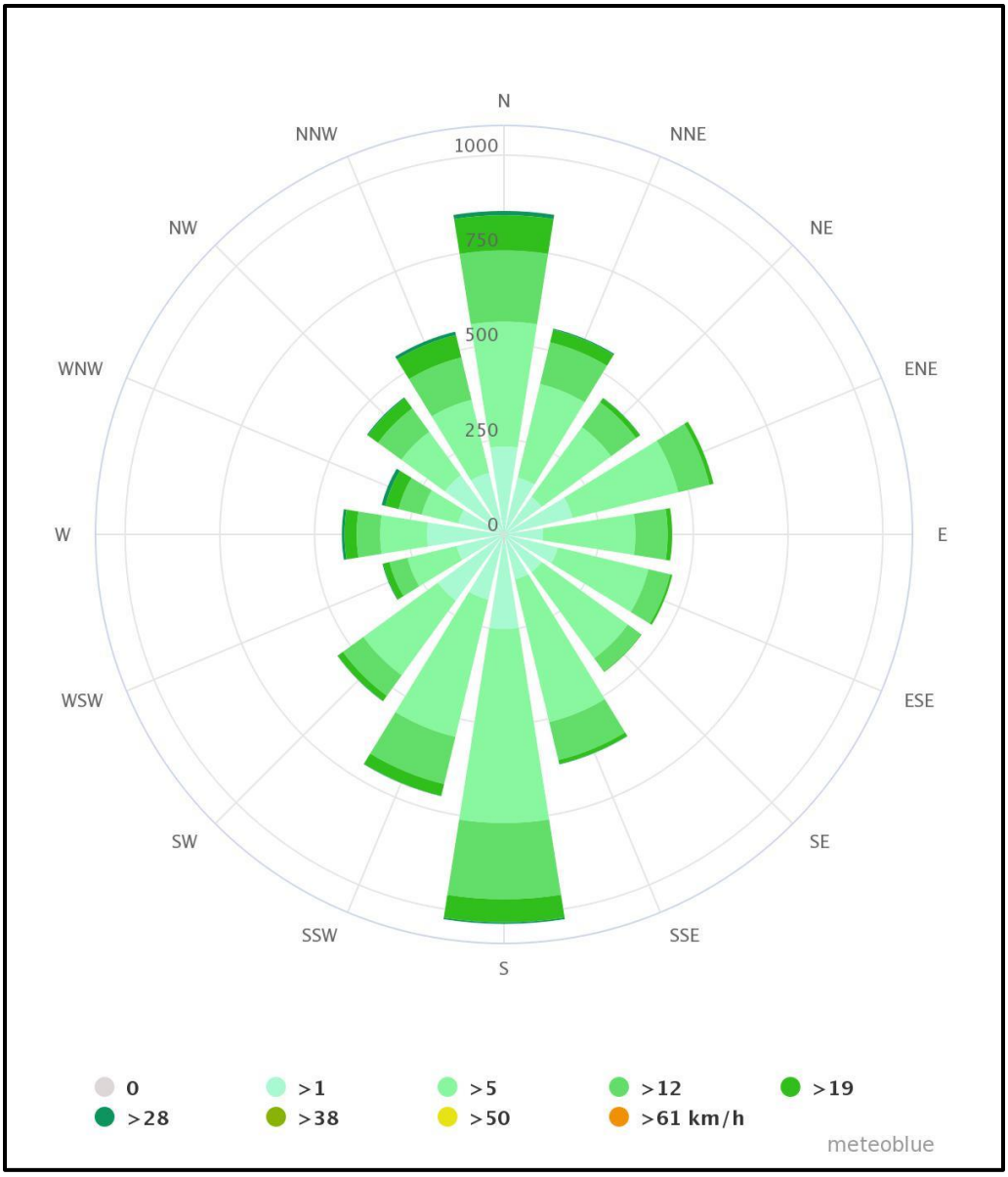


Figure 9: **The wind rose for Tses (Meteoblue, 2021)**

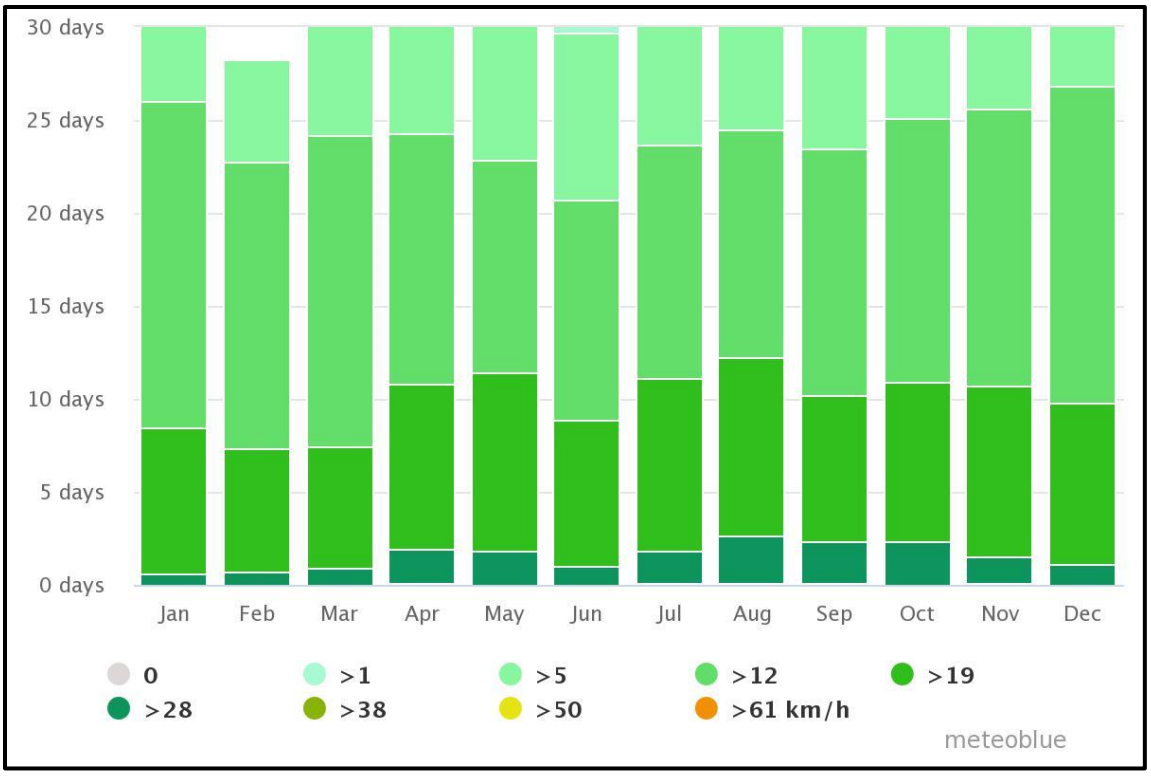


Figure 10: Wind speed for the Tses with days per month (Meteoblue, 2021)

According to Groot Environmental Engineers (2016), the Tses area experiences strong wind during dry season between July – September. The maximum and average wind speeds recorded from 2009 to 2020 are shown in **Figure 11**.

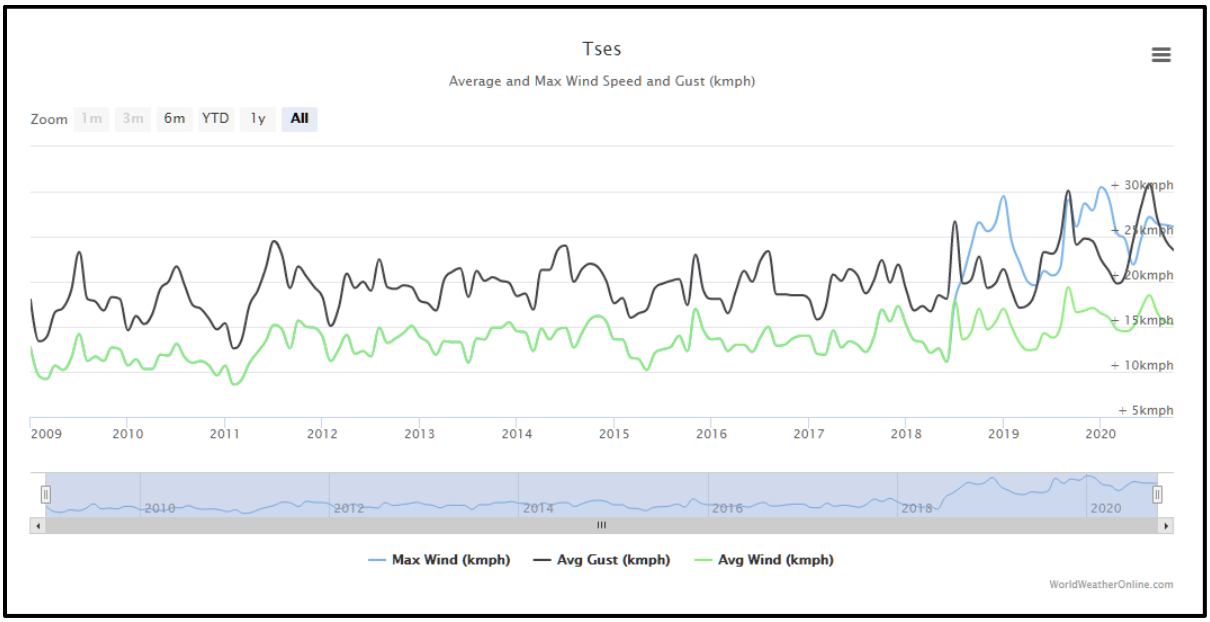


Figure 11: Average and maximum wind speeds in Tses (source: World Weather Online, 2020)

5.2 Topography

The //Karas Region is flat, especially along the escarpment. The Tses area is low lying and relatively flat with the general topography dips to the west. The elevation differences from the highest to the lowest grounds is 50 metres. There are several riverines traversing from higher ground on the east to lower ground on the western areas. Therefore, in events of floods, the flow would follow the topography, i.e., mainly along the rivers (Groot Environmental Engineers, 2016).

5.3 Soils

The soils in and surrounding the project site have poor structure and little to no distinct layering, and soil texture is fine and sandy, with very low moisture content. The soils of the project site are light brown loamy sandy soils and in some site areas loamy sand soil with gravel pebbles that may be site activities influenced (**Figure 12**).

Figure 12: Typical sandy loamy soils and rock outcrops at the ponds' site

5.4 Geology

The regional geology comprises of the Kalahari Group sediments (sands and calcrete) to the northeast of Tses and the western part of Tses is characterized by the sandstones and shales of the Nama Group and

The geology of Tses Village and surrounding is characterised or underlain by the sandstones and shales of the Karoo Supergroup (Sequence) of the Fish River Subgroup (Nama Group). The formations that underlie the Tses Village include gross Aub and Nababis comprising red shale and red sandstone, locally greenish and red shale and red to purple sandstone, locally greenish, respectively – **Table 5.**

The regional geology map of the project area is shown in **Figure 13.** The common rock units and outcrops shown in **Figure 14** and **Figure 15**.

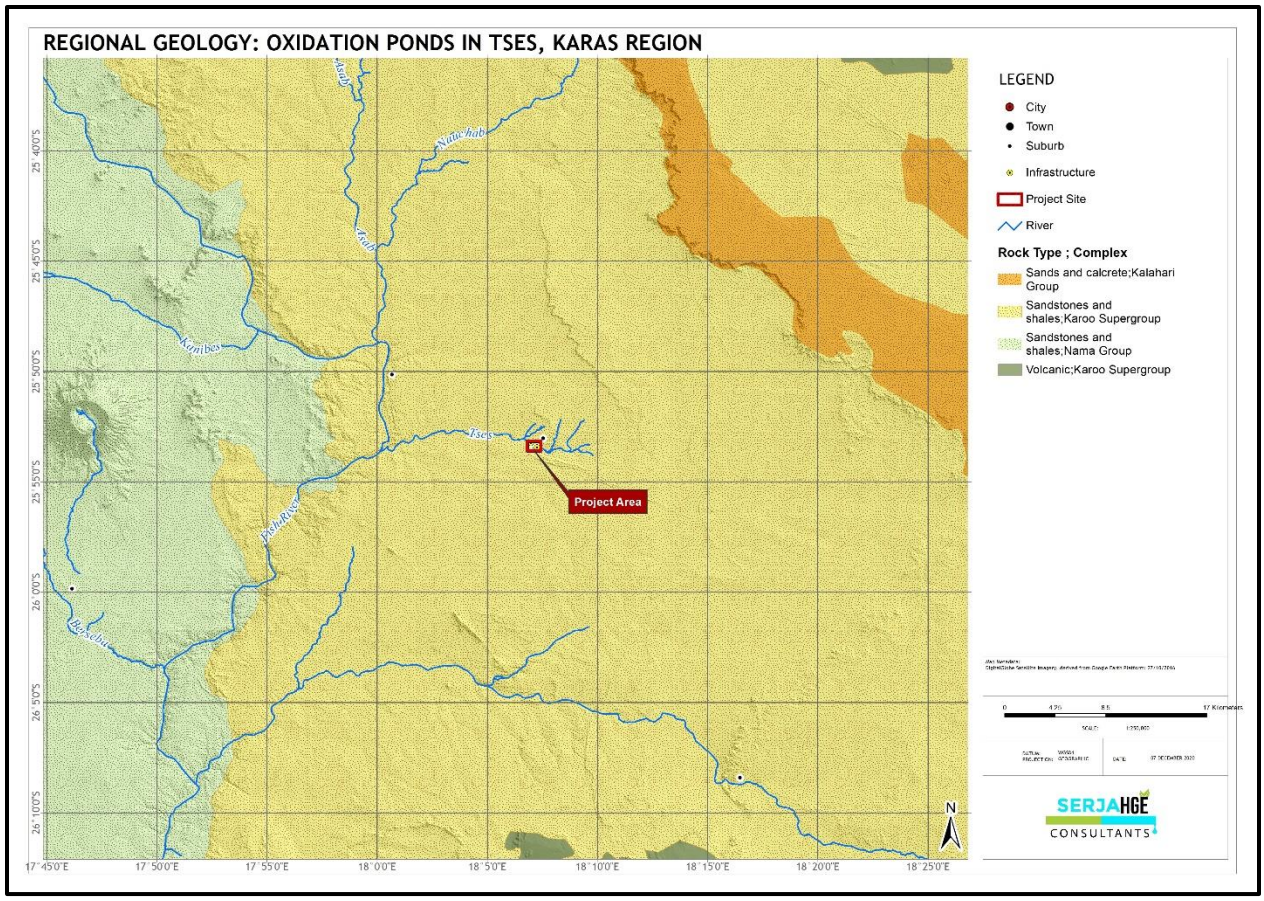


Figure 13: Regional Geological Map of the Tses area

Table 5: The Geology of the Tses area (Christelis and Struckmeier, 2011)

The Nama Group is subdivided as follows:

Group	Sub-group	Formation	Lithology
Nama	Fish River	Gross Aub	Red shale and red sandstone, locally greenish.
		Nababis	Red shale and red to purple sandstone, locally greenish.
		Breckhorn	Red to purple quartzitic sandstone and some subordinate red shale.
		Stockdale	Basal red to purple coarse grained quartzitic sandstone with thin conglomerate layer. Red friable sandstone, shale.
	Schwarz-rand	Vergesig	Green shale with green and red sandstone.
		Nomtsas	Reddish shale and reddish sandstone, becoming green south of Maltahöhe, with basal coarse conglomerate in many places, limestone towards the south-west.
		Urusis	Greenish shale and greenish sandstone (in the north), with dark blue limestone and black limestone inter-layered and intercalated (in the south).
		Nudaus	Green shale and greenish sandstone, grey to greenish quartzite.
	Kuibis	Zaris	Bluish-green shale, sandstone, pink and grey to black limestone.
		Dabis	Grey to white quartzite, some grey dolomitic limestone, grey to greenish quartzite.

Figure 14: Shale rock units at the project site

Figure 15: Shale outcrops at the ponds' site area and the manhole within proximity of the ponds

Due to their predominantly horizontal bedding, rocks of the Nama Group tend to weather and erode in layers, resulting in flat plains, with major drainages forming canyons and gorges. Erosion produces rock fragments or clay-size particles, and rivers accumulate very little sandy alluvium (Christelis and Struckmeier, 2011).

5.5 Hydrology and Catchment

On a regional scale, the wider area falls within the Orange River Catchment. The main surface water features near the project site are the ephemeral Fish River, Tses River, and several dry streams (**Figure 16**) in and around the Tses Village. According to GCS Water and Environmental Consultants (2017), the Fish River flows in a southerly direction towards the Orange River.

Figure 16: One of the dry streams on the southern side of the Tses Village and east of the oxidation ponds' site

The project site was delineated by using ArcGIS. The digital elevation model (DEM) was used as an input to enable the delineation of a drainage system and then quantify the characteristics of that system. The tools in the extension allows the user to determine, for any location in a grid, the upslope area contributing to that point and the down slope path that would be followed by the water. This data is usually important during impact assessments. The catchment delineation for the project site is shown in **Figure 17** below.

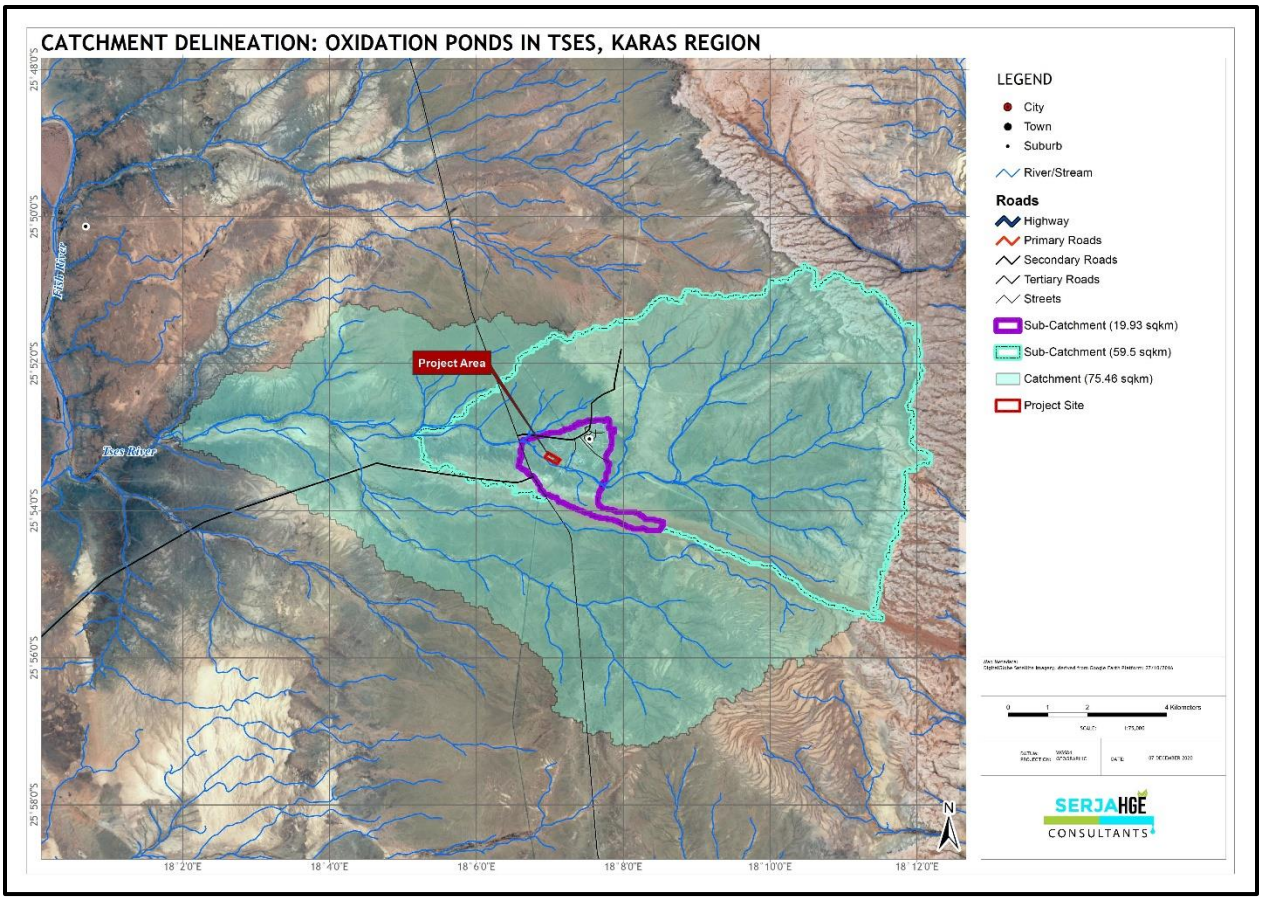


Figure 17: Sub-catchment of the project site in Tses

5.6 Hydrogeology

In terms of hydrogeology, the Tses Village falls under the Fish River-Aroab groundwater basin. Most of the small towns such as Aroab, Maltahohe, Kalkrand, Gibeon, Berseba and Bethanie rely on groundwater abstracted from aquifers in the Nama sediments. The landscape in the basin is extremely barren and rock with little soil cover. The vegetation is mainly found in riverbeds (Christelis and Struckmeier, 2011).

5.6.1 Groundwater Quantity (yields)

The rock types of the Nama Group, in which the site area is found, are inherently impermeable with little or no primary porosity. Groundwater in the area is hosted in secondary features like faults and joints in sedimentary rocks of clastic origin (sandstone, quartzite, and shale). The Nama Group is a generally weak aquifer. Boreholes of moderate yield were drilled on fractures crossing river courses (Christelis and Struckmeier, 2011).

In the Hardap and Karas regions water levels are generally shallow in the east, close to the course of the Fish River, but become progressively deeper towards the escarpment in the west, where water levels deeper than 200 m are recorded. Furthermore, the various formations of the Fish River Subgroup have different hydrogeological properties. In the younger Gross Aub Formation water tables are shallow and drilling targets can be selected geologically with good success. A high success rate can be achieved in the Nababis Formation with careful selection of drilling sites. Water levels are generally deeper than in the Gross Aub Formation. In the older Breckhorn and Stockdale formations, up to 30 % of the recorded boreholes were dry, due to the deeper water table and resultant difficulty in accurately determining a drilling site (Christelis and Struckmeier, 2011).

5.6.2 Groundwater Quality

According to Earthwise Contributors (2020), there is little anthropogenic contamination of groundwater in general, but untreated wastewater in some communities causes degradation of quality. There are some cases of increased nitrate concentration linked to cattle farming, and some natural occurrence of elevated nitrate. The main groundwater quality problem is naturally high TDS and fluoride.

Groundwater that is currently considered safe for drinking will in many cases now be classed as sub-standard, particularly in smaller communities and rural areas. Water treatment will become increasingly necessary (Earthwise Contributors, 2020).

The water quality of the regional aquifers is said to have deteriorated due to over-abstraction and lack of recharge, which could be linked to low rainfall received in the area (Christelis and Struckmeier, 2011) and continuing abstraction to supply the communities, resulting to little or no recharge and aquifer recovery, respectively.

5.6.2.1 Groundwater Vulnerability to Pollution

The aspects of water pollution and water protection have increasingly become an issue in most parts of the world, especially in areas where there is an extensive development such as in agriculture, mining and industrial activities but with poor planning of waste management or none. Poor water quality however does not only come from direct pollution from the ground surface, but also from over-abstraction of water from aquifers that are poorly recharged. This would be the case with the aquifers in the southern parts of Namibia, where if abstraction exceeds effective recharge, the salt concentrations increase leading to poor quality water. The lowering of water levels from intensive abstraction may lead to the salinization of groundwater.

The groundwater quality issue in the larger southern parts of Namibia (including the project area) is more of a "natural" problem (geologically controlled) because the main parameter of concern in the water is excess salts such as flouride contained in the water-bearing rock units (aquifers) and nitrate from anthropogenic activities. The presence of excess salts which worsens the water quality is due to low rainfalls and eventual poor recharge, and in most cases, groundwater cannot be used for human consumption without some sort of treatment.

Based on the Groundwater Resources Vulnerability Map of Namibia, the vulnerability of groundwater to pollution in the project area is **moderate for the Tses and surrounding areas.** Geologically, the southern part of Namibia (including Tses Village) is mainly underlain by intact/non-fractured sedimentary rocks (limestone, dolomite, diamictite, conglomerates and sandstones), metamorphic rocks (granite, quartzite, etc.) as well as granitic intrusives. However, groundwater is only hosted in secondary aquifers (fractured and faulted rocks units) and alluvial aquifers along the Orange River. These rocks without any fractures/faults or joints are considered aquitards (rock units that restrict water flow or hardly transmit water from one rock unit to the other). The main concern regarding groundwater pollution in these parts of the //Karas Region would be on areas that are underlain by faults (fractured/faulted rock units) or partly overlain by the limited sediments and alluvial (sediments) aquifers at or near the Orange River. These structures would provide ready passage for pollutants into groundwater. The geology of the project areas is mainly comprising these intact (non-fractured or faulted) rocks and without faults or fractures these rock units would behave as aquitards.

The vulnerability of groundwater to pollution at Tses would be bound to fractured/faulted rock units therefore moderate.

Typically, the vulnerability risk to pollution is assessed based on the vulnerability of groundwater resources to pollution as per parameters on the vulnerability map is shown in **Figure 18**, with the approximate project area enclosed in the green ellipse.

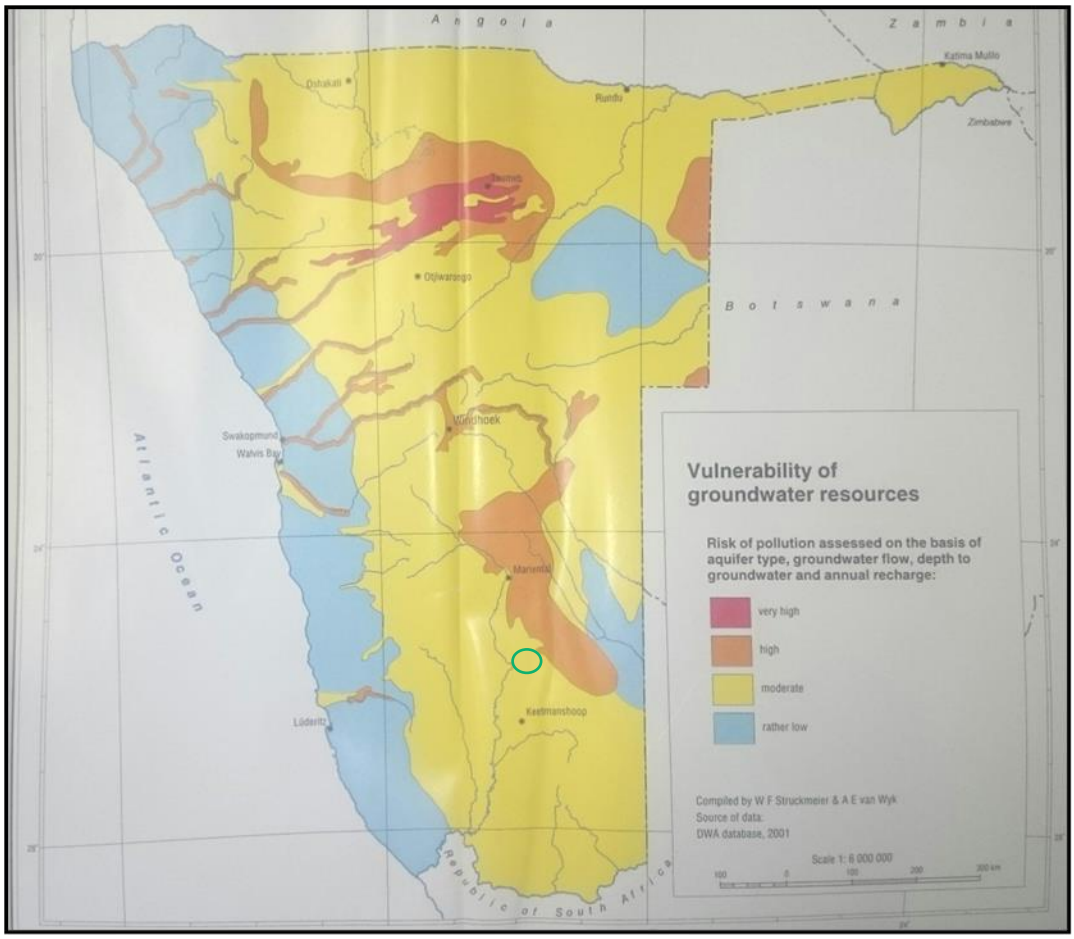


Figure 18: Vulnerability of groundwater resources to Pollution (Van Wyk et.al, 2001)

The Tses community is supplied with water from the NamWater groundwater scheme which has recently been complemented by the recently drilled Tses Village Council boreholes. According to the information obtained from the Village Council Representative onsite, it was observed that one of the Village Council's boreholes was supplying poor water quality. However, it was not established as to whether this could be linked to a possible groundwater pollution from the existing ponds and or other potential unverified sources within or around the Village.

An independent Groundwater Impact Assessment Study is therefore recommended to be undertaken for the whole Tses Village to determine the extent and potential major sources of groundwater pollution that may have already been ongoing at the Village unnoticed and undocumented.

5.7 Fauna and Flora

The faunal community of the south and central Namibia is generally characterised by low species diversity. The fauna of the //Karas Region in general is as presented below:

Mammals: Common mammalian species expected to occur at and around the project site include Springbok (*Antidorcas marsupialis*), Kudu (*Tragelaphus strepsiceros*), Steenbok (*Raphicerus campestris*), Jackal (*Canis mesomelas*), Caracal (*Caracal caracal*) and Cape ground squirrel (*Xerus inauris*).

The only mammals that could be seen on site were some local donkeys (**Figure 19**) that were grazing at the ponds' site area. There were also faeces of cattle observed at the ponds because these animals drink from the ponds since they are not fenced off.

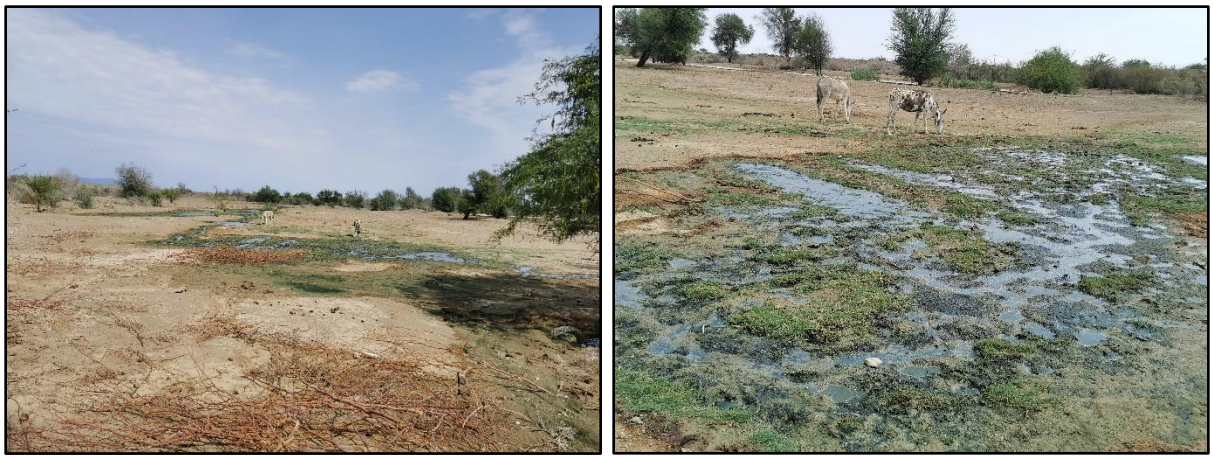


Figure 19: Two donkeys grazing at the project site

Reptiles and amphibians: The overall reptile diversity in the general //Karas Region are estimated at between 41 to 50 species (Mendelsohn *et al*. 2002). The most important reptiles in the general Keetmanshoop area are viewed as those classified as vulnerable and protected game under Namibian legislation, these being the Leopard tortoise (*Stigmochelys pardalis*), Kalahari tent tortoise (*Psammobates oculiferus*), Bushmanland tent tortoise (*Psammobates tentorius verroxii*), Southern African python (*Python natalensis*) and rock monitor (*Varanus albigularis*).

Birds: The wider area has approximately 93 avifauna species, of which 87 species are not associated with aquatic environments. Of these terrestrial species, 7 species are uncommon, 19 species common and the remaining 61 are common species. Much of the species identified are residents, this being 79 species. There are 10 Endemic and 26 Near Endemic resident species occupying the Quarter Degree Square within which the site is located. The residents have 4 listed species, these being two (2) Near Threatened, and two (2) Vulnerable. The Vulnerable species identified within the area are the Kori Bustard (*Ardeotis kori*) and Martial Eagle (*Polemaetus bellicosus*) (GCS Water and Environmental Consultants, 2017).

A couple of birds could be seen flying over the area, but they could not be identified as to what they were and what category they belonged.

In terms of flora, the wider area falls within the Nama Karoo biome, which covers most of the south-eastern part of Namibia and extends along the escarpment, making a transition zone between Savanna to the east and desert to the west. Overall, there is a varied assemblage of plant communities within the biome, including shrubby vegetation and grasslands. The vegetation type in the area is that of Karas Dwarf Shrubland. On the plains, an open tall shrubland, with a relatively high grass cover, is found. The total number of species is estimated to be around 259 (GCS Water and Environmental Consultants, 2017).

The project site vegetation is medium vegetated to the north and eastern and slightly high vegetated further to the south. The dominating vegetation are as follows:

- Camelthorn (*Acacia mellifera*) trees and shrubs common in the Tses area.
- Bitterbush (*Pechuel-Loeschea leubnitziae*) shrubs
- Honey mesquite (*Prosopis glandulosa*), the ever-green invasive species.

The common vegetation observed on the project site and the invasive honey mesquite are shown in **Figure 20** and **Figure 21.**

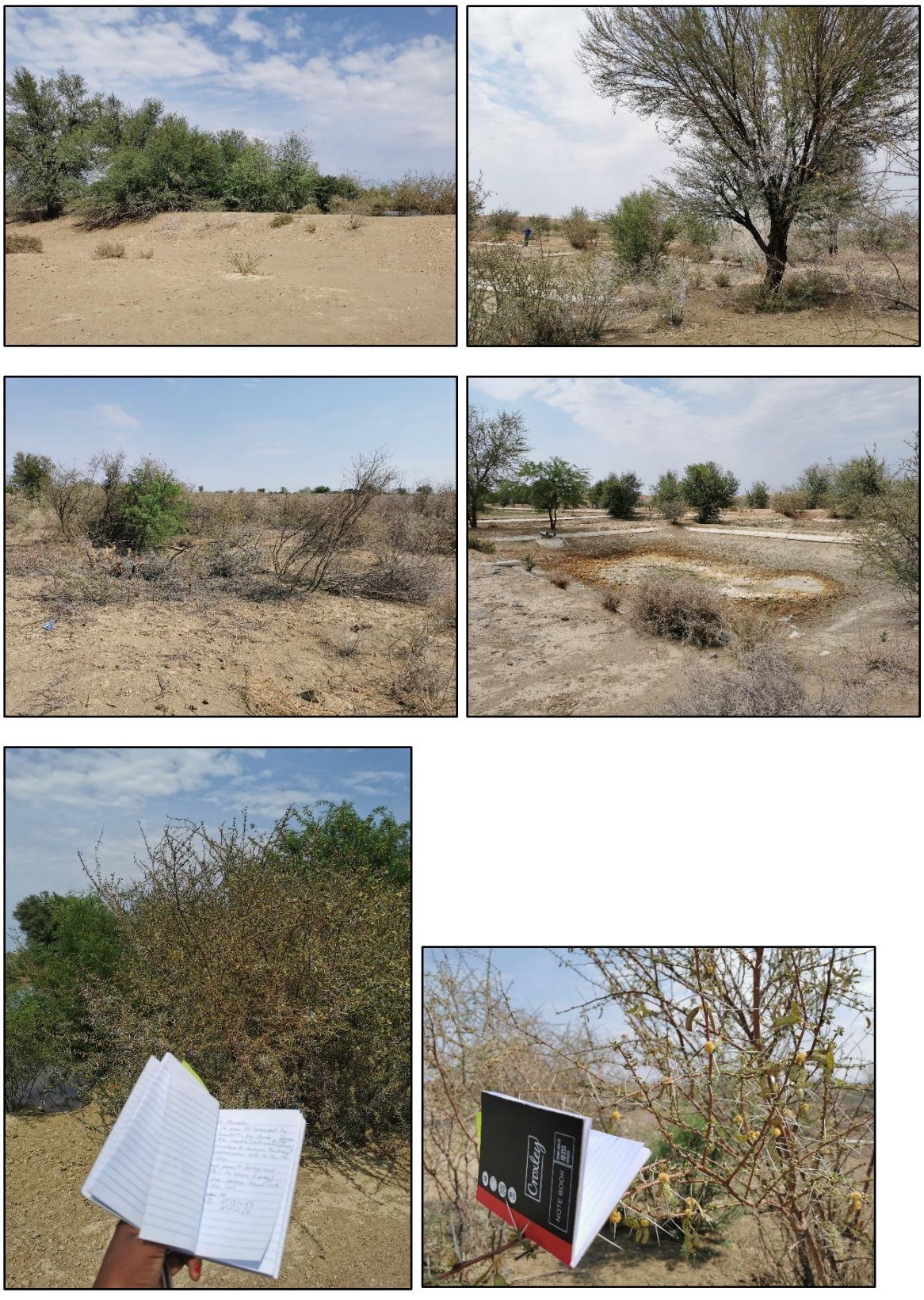


Figure 20: Common vegetation around the project site

Figure 21: The dense honey mesquite shrubs (invasive species) found around the active ponds

Although much of the vegetation was observed around the ponds' site and immediate surroundings, much of the vegetation has also been severely impacted by local grazing activities and most of the project area of bare soils were present. The evidence of livestock grazing around the site can also be proven by the presence of cattle and donkeys seen at and around the project site.

5.8 Surrounding Land Uses

The project site is bordered to the west by the B1 road running from the northwest of the site to the south, Tses Village to the north and north-eastwards, houses from the north to the eastern side of the ponds' site area. To the east of the site is a school (St Therese Junior Secondary School) and the railway that runs from Mariental side to Keetmanshoop – **Figure 22**. To the southern side of the site is the ephemeral Fish River that runs in an easterly-westerly direction (trend).

Figure 22: Houses to the east (top left), houses to the north (top right) and St Therese Junior Secondary School & railway (bottom) east of the oxidation ponds' site

The ponds' area is surrounded by medium to dense vegetation. There are also footprints of the old ponds' fence markings around the site – **Figure 23**.

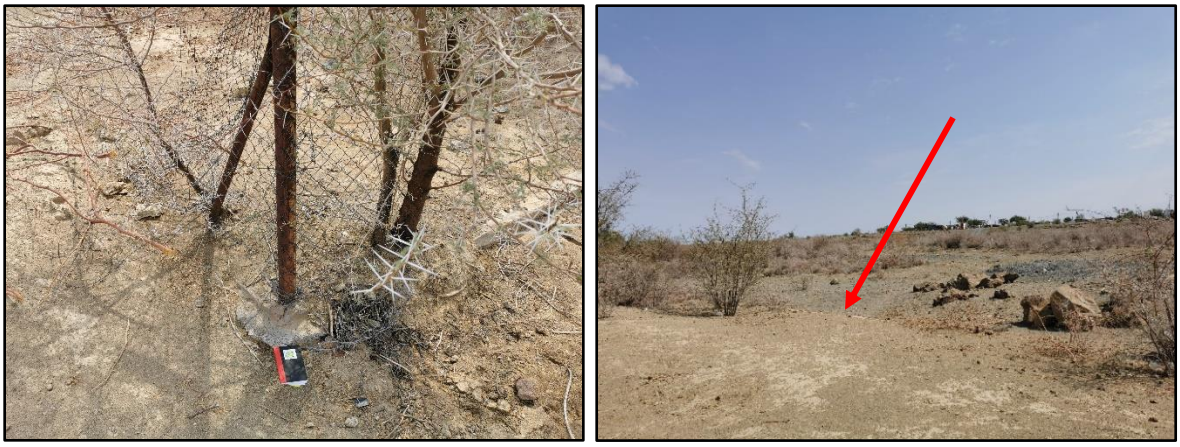


Figure 23: Remains and concrete markings of the sewer ponds' old fence boundary

5.9 Services Infrastructure

The project site is in a Village set up, but it has the basic services for the people. Tses Village is found in the //Karas Region that is connected to the rest of the country by the B1 tarred road as well as good-graded gravel road links, health centres, educational institutions, shops (in towns and settlements) and hospitality facilities, etc. Some of these services are well-placed around the project site area and nearby areas.

The following services infrastructure have been observed near the site and for the general project area and Region:

- **Water Supply**: The general project area is supplied with freshwater by NamWater from the local water boreholes. According to the information provided by the Tses Village Council, there are currently six boreholes, four belonging to NamWater and two belonging to the Tses Village Council - **Figure 24**. Only three of the Village boreholes were visited during the site visit.

Figure 24: One of the NamWater boreholes (left) and Tses Village Council borehole observed to the east of the existing sewer ponds

- **Electricity:** There is a NamPower substation that supply power to the Tses Village and surrounding areas. The substation is on the southern side of the Tses Village between the School and the immediate NamWater and Village Council water boreholes.
- **Roads:** The project area is accessed by D619 from the B1 road, and local gravel and access roads. The site accessed from the B1 and D619 into Tses Village by single track roads – **Figure 25**.

Figure 25: Single track access road from the eastern side houses to the sewer ponds site

- **Railway**: A railway passes on the eastern side of the ponds' site in Tses. According to the //Karas Regional Council (2020), the Region's capital town, Keetmanshoop is an important national railway junction with a TransNamib Train Station, linking the town via Tses with the north of the country, to the west it links via Aus the coastal town Ludertz, and to the south-east it links via Grünau, Karasburg and Ariamsvlei to the neighbouring country, South Africa.
- **Air transport**: The Keetmanshoop airport facilities which can accommodate long distance aircraft has also a training venue for Namibia's only flying School (//Karas Regional Council, 2020).
- **Telecommunication Services**: The //Karas Region and the project site area are well connected to the rest of the country and world via local network service providers such as the Mobile Telecommunications Company (MTC Namibia).and in some instance, Telecom Namibia as well landlines in urban areas and in some rural residences, including villages such as Tses.
- **Waste management:** The proposed project site is in a rural set up but with waste manged at an urban level. There is waste management facility (landfill site) in Tses that is operated by the Village Council.

5.10 Social Demographics

5.10.1 Regional Population Density

The //Karas Region has a population of 77 421 people with an average population density of 0.5 persons/km². Out of the total population, 38 014 were women and 39 407 were men, and this population was growing at an annual rate of 1.1%. Over half of the population lived in urban areas (54%) compared to only 46 percent in rural areas. This was due to a large proportion of migration from rural to urban areas, particularly among young adults, in search of job opportunities in towns (Namibia Statistics Agency, 2011).

The largest concentrations of people are found in major urban and mining centres such as Lüderitz, Oranjemund and Keetmanshoop, with the remaining population spread across the Region in smaller settlements such as Berseba, Aroab, Bethanie and Tses.

The predominant languages in the region are Nama and Damara, Afrikaans, although Otjherero and Oshiwambo are also commonly spoken (//Karas Regional Council, 2020).

5.10.2 Constituency Population Density

The //Karas Region has six constituencies: Berseba, Karasburg, Keetmanshoop Rural, Keetmanshoop Urban, Lüderitz and Oranjemund. The Tses Village falls under the Berseba Constituency. According to the 2011 National Housing and Population Census, the population of Berseba was recorded at 10 589 out of which 4 932 were females and 5 657 were males (Namibia Statistics Agency, 2014).

According to the City Population map (2020), the Tses Village population was recorded at 1 365 in 2011, with an area of 34.4 km^2 and density of 39.74/km^2.

5.11 Economic Development

The //Karas Region's economy is attributed to its diamonds; it is home to the country's largest mining activities.

The main sources of incomes in the Berseba Constituency under which the project area (Tses Village) falls are farming (18%), wages & salaries (40%), cash remittance (7%), business, non-farming (4%) and pension at 25% (Namibia Statistics Agency, 2014).

5.11.1 Agriculture, Mining and Tourism

The //Karas Region is a predominantly small stock (sheep and goats) farming area. However, game and irrigation farming (at the Naute Dam and along the Orange River) have become increasingly important (GCS Water and Environmental Consultant, 2017). The Naute Irrigation project is about 132 hectares in extent with dates and grapes being the main product grown at the scheme. The upcoming irrigation scheme at the Neckartal Dam promises to add to the economic livelihood in the Region.

Important mining operations in the Region include onshore diamond mining (Namdeb Diamond Corporation), offshore diamond mining (De Beers Marine Namibia and Sakawe Mining Corporation), zinc and lead concentrate (Rosh Pinah Zinc Corporation) and high-grade zinc (Skorpion Mining) (GCS Water and Environmental Consultant, 2017).

With regards to tourism in the Region, some of the places of attraction include: Hot Water Springs (Ai-Ais and Warmbad), the Kokerboom Forest (near Keetmanshoop), the Fish River Canyon (the second largest canyon in the world), Brukaros Mountain (near Berseba), the coastal town of Lűderitz (with fishing and boat building industries) and several guest and game farms. The Quiver Tree Resort, associated with the Mesosaurus fossils, Giants Playground dolomitic features, the Quiver Trees of the area and various hospitality service providers within and surrounding Keetmanshoop (GCS Water and Environmental Consultant, 2017).

5.12 Housing Conditions, Water Supply and Waste Management

The population of households with safe water in Berseba Constituency was at 85%, while 48% of the population did not have toilet facility.

According to the Namibia Statistics Agency (2014), 23.3% of the 20 988 households in the //Karas Region had no toilet facility. Out of the 2 597 households in the Berseba Constituency, 20.3% had piped water inside, 33.5% had piped water outside, 8.8 rely on the public water pipeline. Overall, 84.8% of the households had safe water for drinking and cooking.

In terms of sanitation on a regional level, in urban areas 86.7% of the households used flush toilets while the rural percentage was only 37.9%. 41.1% of the 20 988 households in //Karas Region had private flush toilet system connected to sewer, 18.0% were on a shared flushed toilet facility connected to sewer, 2.7% households had private flush toilets connected to septic system. About 2.4% of the households' sanitation system was shared flush toilets connected to the septic system, 3.7% was using pit latrine with ventilation pipe, 2.95 was using covered pit latrine system without ventilation pipe. The 1.5% of the households in the Region relied on uncovered pit latrine without ventilation pipe, 3.5% relied on bucket toilet system, 23.3% on no toilet facility and 0.7% relied on other means of toilet facilities (Namibia Statistic Agency, 2014).

On a constituency level, out of the Berseba households, 28% had private flush toilet system connected to sewer, 4.5% were relying on a shared flushed toilet facility connected to sewer, 2.1% households had private flush toilets connected to septic system. 1% of the households' sanitation system was shared flush toilets connected to the septic system, 4.7% of the household was using pit latrine with ventilation pipe, 4.3% was using covered pit latrine system without ventilation pipe. The 1.1% of the households in the Region relied on uncovered pit latrine without ventilation pipe, 6.5% relied on bucket toilet system, 47.5% on no toilet facility and 0.2% relied on other means of toilet facilities (Namibia Statistic Agency, 2014).

5.13 Archaeology and Cultural Resources

There were no archaeological or heritage resources such as sites or objects observed on and around the project site. This was confirmed during the site visit (assessment) and based on information provided by the locals.

The absence of such resources however is not evidence that there are no archaeological resources in the project area or site because such resources may be absent on the ground (not visible) but sites such as graves or buried archaeological objects may be present below the ground (subsurface). The presence of such resources, if any, can only be confirmed upon commencement of earthwork for the establishment of new ponds on the project site. Regardless, mitigation measures to protect and preserve the archaeological resources will be provided herein and, in the EMP.,

To ensure that the public also add their input to the proposed project, a consultation process was carried out for the EIA Study. The public consultation process was conducted as presented under the next chapter.

6 PUBLIC CONSULTATION ACTIVITIES

Public consultation is an important aspect of an Environmental Assessment (EA) process. This process entails the sharing of information through the recommended means by the EMA as well as other means that are considered efficient to get the notifications to the public. The consultation provides potential Interested and Affected Parties (I&APs) with an opportunity to comment on and raise any issues relevant to the project for consideration as part of the assessment process.

The consultation process has been undertaken in accordance with the Environmental Management Act No. 7 of 2007 and its 2012 Environmental Impact Assessment (EIA) Regulations: Section 21-24 (Public Consultation).

The public consultation process assisted the Environmental Consultant in identifying all potential impacts and aided in the process of identifying possible mitigation measures. Potential impacts that may stem from the proposed development were pre-identified prior to the consultation process and additional impacts were identified upon public feedback (through comments and concerns). Public Consultation with Interested and Affected Parties (I&APs) allows for a transparent decision-making with regards to the environmental clearance certificate (ECC).

6.1 First Round of Public Consultation Activities

The following listed activities (and as described under the subsequent sections) were undertaken to ensure that the public is notified and afforded an opportunity to comment on the proposed project:

- Registration of pre-identified stakeholders and interested & affected parties (I&APs)

- Placement of newspaper adverts in the widely read newspapers in the project area/region.
- Circulation of the background information document (BID) to pre-identified stakeholders and I&APs and to new I&APs (upon registration request).
- Placement of notices for the public consultation meeting in Tses
- Holding and facilitation of the public consultation meeting in Tses and recording of meeting minutes.

6.1.1 Registration of Stakeholders and Interested & Affected Parties (I&APs)

The relevant and applicable stakeholders from the national, regional, and local authorities were pre-identified and registered. The representatives from these authorities made up the initial list of stakeholders at the beginning of the environmental assessment process. Upon seeing the newspaper adverts, some members of the public requested to be registered as Interested & Affected Parties (I&APs) and were added to the Stakeholders and I&APs list, which was continuously updated. The summary of registered groups of I&APs or their representative bodies is as follows:

- Central or national government: Ministry of Environment, Forestry & Tourism, Ministry of Agriculture & Land Reform, Ministry of Works & Transport, Ministry of Urban &Rural Development, etc.
- Regional government: //Karas Regional Council and Berseba Constituency Office
- Local authority: Tses Village Council
- Parastatals: NamWater and Roads Authority
- Non-governmental organisations (NGOs): Namibian Chambers of Mine, Botanical Society.
- Members of the public in Tses and other registered I&APs.

A complete list of the registered stakeholders and I&APs identified and registered is attached under **Appendix E**.

The communication/consultation and interaction with the I&APs were done through the following means and in this order.

5.1.2 Background Information Document (BID)

A Background Information Document (BID) was drafted at the beginning of the EIA process. The BID provided details on the public consultation process with contact details for further information. This document was advertised for availability and shared through newspaper placements. The BID was sent to pre-identified I&APs and stakeholders via email on the 12th and 19th of October 2020 (proof of email communication/BID circulation is attached under **Appendix F**). Upon request by additional I&APs, the BID was shared with them as well. Some printed copies of the BID were distributed to the meeting attendees during the public consultation meeting on the 29th of October 2020 in Tses.

6.1.2 Step 1: Public Notification (Newspaper Adverts)

The newspaper adverts notifying the public about the commencement of the EIA processes were circulated in two newspapers, namely *Die Republikein* and *Namibian Sun* (of the Namibia Media Holdings). The adverts were placed for two weeks on Monday, 12 and 19 October 2020. The copies of the newspaper adverts are shown in **Appendix G**.

6.1.3 Step 2: Public Notification (Project Site Notices))

The notices of the ongoing EIA process in A2 size were placed at the Tses Village Council office notice boards - **Figure 26,** public meeting invitation notice at the Village Council office entrance **(Figure 27)** and Tses PHC (Clinic) entrance –**Figure 28**. The notice provided information about the project and related ESA contact details of the Consultant for public communication purposes with regards to the EIA.

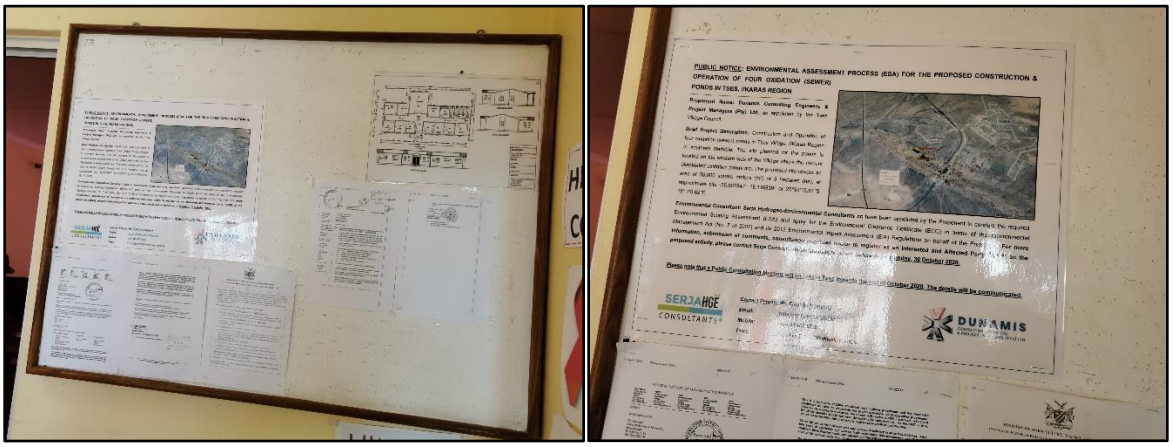


Figure 26: Project notice at the Tses Village Council in Tses

Figure 27: **Public consultation meeting invitation placed at the Tses Village Council office entrance**

Figure 28: **Project notice at the Tses Primary Health Care (PHC) Centre or Clinic**

6.1.4 Public Consultation Meeting Invitation and Facilitation

A public consultation meeting is one of the most important component of public consultation process as it brings together the consultant and affected members of the public (particularly from the affected site area). The meeting is usually done in an interactive session form so that the community members or members of the public can express their opinions, give their concerns, and make suggestions to the proposed project while it is still in the early stages (planning and design).

A face-to-face public meeting was arranged for 29 October 2020. The meeting invitation sent out to the Tses Village Council for local community dissemination and communication sent to all registered stakeholders and I&APs.

The meeting was held at the Tses Community Hall on 29 October 2020 and attended by twenty-one (21) community members from Tses (and two Serja Consultants) – **Figure 29**. Due to the COVID-19 Regulations on gatherings, the meeting seats were set up in such a way that social distance was adhered to and every attendee had a face mask on. Prior to commencement of the meeting and signing of the attendance register, a hand sanitizer provided by Serja Consultants was applied to all the attendees' hands by one of Serja Consultants.

Figure 29: Photos from the public meeting at the Community Hall in Tses

Serja Consultants presented the EIA process, how the community members can be involved and why their involvement is vital. Mr Abraham from the Tses Village Council helped with translating from Afrikaans to English and vice-versa for the elders who do not speak English. The presentations entailed an outline of the project, the environmental assessment process and the main potential issues or impacts identified to date. Issues that were raised in both Afrikaans, and Damara-Nama and were summarized and translated into English for recording and incorporation into this EA Report. Mr. Abraham also translated for Serja Consultants from Afrikaans/Damara-Nama to English so that comments and issues raised in the meeting could be noted for addressing and incorporation into the EA Report.

The audience were encouraged to give their comments, concerns, and additions to the proposed project regarding their community. The issues and concerns raised in the meeting were recorded and translated into meeting minutes attached to this document as **Appendix H**.

6.2 Public Feedback: First Round of Consultation

The public was afforded nineteen (19) days from the date of the first newspaper advert to register as I&APs and submit comments and or concerns. During this period, but prior to the public meeting, a concern was raised by one of the I&APs. The rest of the concerns were only raised during the public meeting and were addressed and recorded in the meeting minutes and incorporated into this document (Report).

A written comment in the form o f a suggestion or alternative to the proposed wastewater treatment method was also received from one of the I&APs (Aqua Services). This comment has been summarized and added to other concerns and issues raised as well as responses provided to these are presented in **Table 6.** The concerns and issues have been translated into an **Issue & Response Trail Document -Appendix I** where they were addressed upon compilation of the draft EA Report and formed basis for the EA Report and EMP compilation.

Table 6: Issues and concerns raised during the meeting and received via email and responses by Serja Consultants (and or Proponent)

No.	Name of Commentor, Date & Mode of communication	Comment/Issue/Concern/Suggestion	Response by Serja Consultant (and or Proponent)
1.	Mr Mattheus Hambabi, 21 October 2020, Telephonically	**Comment** - The manhole (north of the trees nearby the ponds) – the pipe leading to the manhole and goes to the ponds has a 45-degree bend. The 45 degree has been a problem in the past, that when the community members disposed things like toilet papers into the manhole, it used to overflow due to blockage caused by these papers. When the manhole overflows, it does so towards the river (which feeds the Fisch River too) and in the direction of existing groundwater supply boreholes which could potential pollute the borehole water. **Suggestion:** The pipeline bend needs manoeuvring (to straighten the bend so that the wastewater can flow with ease to the ponds)	Well noted. We will incorporate this into the EA Report and make it a recommendation in the EMP.
2.	Ms. A. M Witbooi (Community member / Tses resident), 29 October 202, in the public meeting	The odour that comes from there as well as mosquitoes associated with the existing ponds is a concern to us residents with houses that side of the Village.	We have taken note of your concern and we will incorporate it into the EA Report. We will also present the issue to the Planning Engineers, that if there is anything that can still be done while they are still in the planning & design phase or what could be improved (technique-wise) during the construction and operation of the proposed new sewer ponds to minimise the odour nuisance. **Response by Dunamis Engineers (Proponent) on 2 November 2020, upon reviewing of the meeting minutes:** We Will incorporate new technology at the new sewer ponds. These technologies include odour caps to control the odour in the area.

No.	Name of Commentor, Date & Mode of communication	Comment/Issue/Concern/Suggestion	Response by Serja Consultant (and or Proponent)
3.	Mr. Tobias Linus (Representative from the Ministry of Agriculture, Water and Land Reform for the //Karas Region), 29 October 2020 in the public meeting	**Comment:** The pipe leading to the hole and then to the ponds has a 45-degree bend. The 45 degree has been a problem in the past, that when the community members dispose of things like toilet papers and other solid insoluble waste into the manhole, it used to overflow due to blockage caused by these papers (solid waste blocking and or delaying the waste flow to the ponds). When the manhole overflows, it does so towards the river (which feeds the Fish River too) and in the direction of existing NamWater groundwater supply boreholes which could potential pollute the borehole water. **Suggestion**: The pipeline bend needs manoeuvring (to straighten the bend so that the wastewater can flow with ease to the ponds). The diameter of the hole also needs to be revised as well.	We will present your concern to the Planning Engineers who will then need to consult and agree with the Tses Village Council to incorporate the suggested change into the current planning and design of the new ponds, if possible or what can be done. **Response by Dunamis Engineers (Proponent) on 2 November 2020**: We Will incorporate the suggestion into our new design. **Further response by the Proponent (on 2 November 2020):** We will investigate the size of the bend and pipe. If need be, we will incorporate another manhole in our designs, for better flow of the effluent.
4.	Mr Abraham Goliath (Chairperson of the Tses Village Council), 29 October 2020 in the public meeting	There was a mentioned about the potential impact of sewer leaching into the ground to possibly pollute groundwater resources. How will this be mitigated?	The new ponds will be lined to avoid the situation that is possibly may have been occurring with the old (current) ponds already (sewer infiltrating into the ground over the years).
5.	Mr. Bradley Juhrs (Community member / Tses resident), 29 October 2020 in the public meeting	There is a very high unemployment rate here in Tses, and based on the information you provided, it says that the construction will only employ 15 people. That number is too low. Can it not be reconsidered to accommodate more people?	The number provided by the Engineers (Proponent) has probably been estimated based on the number of working opportunities and human resources required for that work. However, the number can be decreased or increased once the magnitude of site work is established and finalized later. The exact number of people required for the work will be finalized by the Appointed Construction Contractor later (after the clearance has been issued and when they are ready for construction works). The recruitment will probably be

No.	Name of Commentor, Date & Mode of communication	Comment/Issue/Concern/Suggestion	Response by Serja Consultant (and or Proponent)
			communicated to the community by the Contractor through the Village Council or other suitable existing channels. Furthermore, in accordance with the Labour Act, in the Environmental Management Plan (EMP) we emphasize on the preference of locals for any work type that they are qualified for and capable of doing over outsiders.
6.	Ms Katrina Garises (Community member / Tses resident), 29 October 2020 in the public meeting	The odour (smell) from the ponds is a concern. Why can it not be relocated far from people?	The relocation would be a good idea. However, there are lot of factors that need to be considered. These factors include the new biophysical and social environment impacts when a completely new site area for such type of facilities is established. The current site proposed for the new ponds would be ideal to restrict the cumulative (old and new) impacts to the same area with existing similar land use (existence of the dilapidated ponds) and try to better mitigate the impacts going forward.
7.	Mr. Tobias Linus (Representative from the Ministry of Agriculture, Water and Land Reform for the //Karas Region), 29 October 2020 in the public meeting	This is a suggestion and addition to the ponds' related odour and mosquito issues raised by Ms. Witbooi earlier and now Ms. Garises. Perhaps the Village Council should consider rezoning the area around the ponds to a certain extent so that there will be no future houses built further towards the ponds' area or within a demarcated radius. Alternatively, they (Village Council) should consider relocating the affected community (that is already in the area close to the ponds) to move them elsewhere.	Well noted. We will share this with the Tses Village Council to consider regarding future house establishment on that side of the Village (where the ponds are).
8.	Ruweide Schrywer Julius (Process Engineer at AQUA Services & Engineering), 28 October 2020 and 27 November 2020	-Request to be registered as I&AP to comment on the proposed project (ponds). -Proposal for an alternative to proposed oxidation ponds at Tses. Aqua Services needed the number of people to be	Well noted and AQUA Services has been registered as I&AP. The BID was shared with them on 28 October 2020

No.	Name of Commentor, Date & Mode of communication	Comment/Issue/Concern/Suggestion	Response by Serja Consultant (and or Proponent)
		serviced by the oxidations ponds prior to presenting an alternative wastewater treatment method and if there were any considerations for future expansion	The proposal email and attachment thereof comprising the technical proposal to the alternative method (trickling filter), Code of Practice: Volume 6 (Wastewater Use) and method design/drawings has been well received and forwarded to the Proponent for consideration. The Proponent informed Serja that they will be holding a technical meeting with AQUA Services to discuss the alternative wastewater treatment method and provide feedback. Based on the meeting with AQUA Services and the Proponent and with environmental, economic, and technical aspects, consideration of the oxidation ponds against Trickling Filter system, the oxidation ponds are preferred technology for Tses – **refer to Project Alternative Chapter (section 3.1.3 – Table 2).**

6.3 Public Feedback: Second Round of Consultation (Draft Report Review)

The draft EIA Report was circulated to the registered I&APs for review and comments from 18 to 26 February 2021 (a 9-day review period). A letter containing four comments/points was received by Serja Consultants from one I&AP organization. The comments were addressed by Serja Consultants in consultation with the Proponent and amendments made under the final EIA Report to address the comments. The draft report email to I&APs (on 18 February 2021) and original letter containing the I&AP comments are attached as **Appendix J** with the Comments & Response Trail Document. The comments received are summarized as follows and copied in full under the Comments & Response Table in **Appendix J**:

- Section 3.1.4: Cost Implications of constructing new oxidation ponds compared to other alternatives without no further detail regarding actual cost comparisons done in the local context. Recommendation for a more extensive cost comparisons are carried out to validate this conclusion
- The efficiency of the evaporation pond to produce a treated effluent that is compliant with the applicable General Standard parameters: It is well known that effluent produced by oxidation ponds cannot typically achieve the applicable General Standard parameters due to process limitations. The DWAF Guidelines (Code of Practice: Vol 2, 2008 - Page 4 of 24) state that “Generally, open ponds cannot produce a final effluent complying with the currently applicable Namibian standards for effluent discharge. Therefore, final effluent produced by a pond system will not be allowed for discharge into the environment.” This would mean that the planned ponds must be sufficiently sized to achieve evaporation of the entire inflow load to comply with the Guidelines. It is not clear from the report whether this is the case, and we strongly disagree with this approach, as properly treated wastewater can be re-used successfully for numerous applications that have the potential to provide value to the local community.
- Section 2.1.1 of the report states that “…ponds’ facility is designed to be at least 150 m from residential houses…” whereas Section 4.1 of the CoP: Vol 2 states “…ponds may not be built closer than 500 m from the nearest residential area and where anaerobic ponds are included, this distance should ideally be increased to 1.0 km”. The location of the ponds may have to be adjusted to meet this requirement.

- While it can be expected that the normal operating costs of a treatment plant such as trickling filters will generally be higher that evaporation ponds, it should be kept in mind that the cleaning and reconditioning of such ponds (which must be done once the solids build-up has decreased their effective volume to such an extent that they are no longer able to achieve their design retention time) carries extensive associated costs as well as potentially expensive repairs to the liner that is easily damaged during such operations. These costs must also be considered in a life-cycle cost analysis to determine the actual cost comparison between such systems Furthermore, the ability to re-use properly treated effluent for economically beneficial purposes, and the associated employment creation effects, can successfully offset the operating costs of an alternative treatment system, while at the same time greatly reducing the environmental footprint of the community.

7 POTENTIAL IMPACTS' IDENTIFICATION AND ASSESSMENT

This chapter presents the potential impacts that are anticipated associated with the project activities, their description and assessment. The mitigation measures to avoid and or reduce the significance of these impacts, particularly the adverse (negative) impacts are also presented under this chapter and in the form management action plans in the Draft EMP (Appendix B).

7.1 The Identified Potential Environmental Impacts

The development of waste management facilities is usually associated with some impacts, both positive and negative. The potential impacts that have been identified so far are as follows:

Positive:

- Socio-economic development through temporary job (employment) creation in the Village during the construction phase - **during the construction phase and few people may be required for the operational and maintenance.**
- Improved wastewater management in the Village during the operational phase, thus preventing the amount of wastewater that would otherwise be uncontrollably released into the environment due to the dilapidated state of the existing ponds. This would improve the local public and environment health.

The following potential negative impacts are anticipated:

- **Soil and water pollution**: improper handling of wastewater (sewage) may lead to pollution of surrounding soils and eventually water resources systems (through wastewater runoff and infiltration).
- **General environmental pollution (littering)** through mishandling of project related waste during construction and operational phases.

- **Loss of biodiversity through the removal of vegetation** that may be found within the planned expansion of the site footprints.
- **Air pollution by potential dust on untarred roads and gas emissions** from construction activities (excavations, heavy vehicles, and machinery).
- **Odour:** Some by-products of anaerobic digestion used in wastewater treatment facilities, may give off a strong, nauseating smell. This may affect the locals in proximity of the ponds.
- **Vehicular traffic**: potential increase in local traffic due to construction activities on and around the site.
- **Health and safety**: improper handling of site materials and equipment may cause health and safety risks.
- **Archaeological or cultural heritage** impact through uncovering of unknown objects on site (when carrying out earthworks).

7.2 Impact Assessment Methodology

7.2.1.1 Impact Assessment Criteria

The methodology employed for this assessment is presented below.

The proposed oxidation ponds and associated activities will likely to some scale/extent (spatial scale), magnitude (severity) and duration (temporal scale) have impacts on certain biophysical and social components. The potential impacts were assessed as per criteria presented in **Table 7**. To enable a scientific approach to the determination of the environmental significance, a numerical value is linked to each rating scale. This methodology ensures uniformity and that potential impacts can be addressed in a standard manner so that a wide range of impacts are comparable.

It is assumed that an assessment of the significance of a potential impact is a good indicator of the risk associated with such an impact. The following process will be applied to each potential impact:

- Provision of a brief explanation of the impact.
- Assessment of the pre-mitigation significance of the impact; and
- Description of recommended mitigation measures.

The recommended mitigation measures prescribed for each of the potential impacts contribute towards the attainment of environmentally sustainable operational conditions of the project for various features of the biophysical and social environment.

Table 7: Impact Assessment Criteria employed to assess the potential impacts

Nature	Description	Rating
Extent (Spatial scale)	An indication of the physical and spatial scale of the impact.	**Low (1):** Impact is localized within the site boundary: Site only. **Low/Medium (2):** Impact is beyond the site boundary: Local. **Medium (3):** Impacts felt within adjacent biophysical and social environments: Regional. **Medium/High (4):** Impact widespread far beyond site boundary: Regional **High (5):** Impact extend National or over international boundaries.
Duration	The timeframe, over which the impact is expected to occur, measured in relation to the lifetime of the project.	**Low (1):** Immediate mitigating measures, immediate progress **Low/Medium (2):** Impact is quickly reversible, short term impacts (0-5 years) **Medium (3):** Reversible over time; medium term (5-15 years). **Medium/High (4):** Impact is long-term. **High (5):** Long term; beyond closure; permanent; irreplaceable or irretrievable commitment of resources
Intensity, Magnitude / Severity (Qualitative criteria)	The degree or magnitude to which the impact alters the functioning of an element of the environment. The magnitude of alteration can either be positive or negative	**Medium/low (4):** Low deterioration, slight noticeable alteration in habitat and biodiversity. Little loss in species numbers. **Low (2):** Minor deterioration, nuisance or irritation, minor change in species / habitat / diversity or resource, no or very little quality deterioration.
Probability of occurrence	Probability describes the likelihood of the impacts occurring. This determination is based on previous experience with similar projects and/or based on professional judgment	**Low (1):** Improbable; low likelihood; seldom. No known risk or vulnerability to natural or induced hazards. **Medium/low (2):** Likely to occur from time to time. Low risk or vulnerability to natural or induced hazards. **Medium (3):** Possible, distinct possibility, frequent. Low to medium risk or vulnerability to natural or induced hazards.

Nature	Description	Rating
		Medium/High (4): Probable if mitigating measures are not implemented. Medium risk of vulnerability to natural or induced hazards. **High (5):** Definite (regardless of preventative measures), highly likely, continuous. High risk or vulnerability to natural or induced hazards.

7.2.1.2 Impact Significance

After the impact has been assessed, its significance is then determined. The impact significance is determined through a synthesis of the above impact characteristics (in **Table 7** above). The significance of the impact "without mitigation" is the main determinant of the nature and degree of mitigation required.

Once the above factors (**Table 7**) have been ranked for each potential impact, the impact significance of each is assessed using the following formula:

SP = (magnitude + duration + scale) x probability

The maximum value per potential impact is 100 significance points (SP). Potential impacts were rated as high, moderate, or low significance, based on the following significance rating scale (**Table 8**).

Table 8: Impact significance rating scale

Significance	*Environmental Significance Points*	*Colour Code*
High (positive)	>60	H
Medium (positive)	30 to 60	M
Low (positive)	<30	L
Neutral	0	N
Low (negative)	>-30	L
Medium (negative)	-30 to -60	M
High (negative)	>-60	H

For an impact with a significance rating of high, mitigation measures are recommended to reduce the impact to a low or medium significance rating, provided that the impact with a medium significance rating can be sufficiently controlled with the recommended mitigation measures. To maintain a low or medium significance rating, monitoring is recommended for a period to enable the confirmation of the significance of the impact as low or medium and under control.

The assessment of the project impacts is done for both pre-mitigation (before implementing any mitigation) and post-mitigation (after mitigations are effectively implemented).

The potential impacts listed under section 7.1 above are described and assessed under the subsequent sections.

7.3 Assessment of Potential Positive Impacts

7.3.1 Socio-Economic development

The construction and operational activities will create some temporary job opportunities for the locals (both skilled, semi and unskilled), resulting in socio-economic development through employment creation and skills transfer.

The skills transferred to these workers will ensure improved employability for those workers in the industry or at other similar project operations in future. The income earned by the employed locals (workers) will positively impact their lives, individually and that of their households (families). This impact is assessed as follows.

- **Impact type**: positive
- **Extent**: Local
- **Duration**: short-term
- **Probability**: Probable
- **Significance**: Low, **Significance (post-mitigation)**: medium

Mitigation measures:

- People from Tses Village should be prioritized for all project related works that they qualify for and capable of carrying out. This includes skilled, semi and unskilled labour where possible. Out-of-area employment should be justified, for example by the unavailability of local skills only.
- Equal opportunity should be provided for both men and women, when and where possible.

7.3.2 Improved Sewage Management

Through the construction of new and technologically enhanced ponds, the new sewage management system will improve the wastewater treatment for the Tses Village resulting in improved environmental and public health. This impact is assessed as follows.

- **Impact type**: positive
- **Extent**: Local to regional
- **Duration**: short-term
- **Probability**: Probable
- **Significance (no mitigation):** Low, **Significance (post-mitigation)**: medium to high

•**Mitigation measures:**

- The new ponds' design should be implemented in such a way that future failure of these facility that may lead to environmental and public health are avoid at all cost

- The ponds design and construction should include all the necessary infrastructure that will be used to monitor and detect early defects in the facility system before it compromises the environment (for instance ponds' leakage and overflowing detection systems and response plans).

7.4 Assessment of Potential Negative Impacts

The potential negative impacts associated with any kind of development can occur if the planning and design of such development is not properly done in its early stages. At times, the planning and designs are properly done, and environmental management measures provided to avoid and/or minimize these impacts. However, if these construction and operational management measures are not effectively implemented on site, these potential impacts would be inevitable.

The potential adverse impacts describe and assessed under the following sections of this chapter are these that are anticipated for both the construction and operational phases. A single-impact assessment has been whether the impact occurs in one phase or the other to avoid repetition of information. Where a specific impact only applies to one phase and not the other, it is indicated as such.

7.4.1 Physical Land Disturbance

The excavations and land clearing to enable siting of project structures and equipment will potentially result in soil disturbance which will leave the site soils exposed to erosion. This impact would be probable at site areas with no to little vegetation cover to the soils in place. The movement of heavy vehicles and equipment may lead to compaction of the soils during construction phase. This will be short-term and localized impact.

The potential impact can be rated as medium if no mitigation measures are implemented. However, with the effective implementation of mitigation measures and monitoring, the impact significance will be reduced to low. The impact is assessed in **Table 9**.

Table 9: Impact assessment of project activities on the site soils

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M – 44
Post mitigation	L/M - 2	L/M - 2	L - 2	L/M - 2	L - 12

Mitigation measures

- The topsoil that was stripped from certain site areas to enable construction works and can be returned to its initial position, should be returned. This is to avoid unnecessary stockpiling of site soils which would leave them prone to erosion.
- All construction pits excavated on site should be rehabilitated and returned to their pre-excavation state as possible.
- Soils that are not within the intended footprints of the site areas should be left undisturbed and soil conservation implemented as far as possible.
- Project vehicles/machinery should stick to access roads provide and or meant for the project operations but not to unnecessarily create further tracks on and around the site by driving everywhere resulting in soil compaction.

7.4.2 Soil Pollution

In areas where activities such as waste management and industrial activities are practiced, soil pollution becomes one of the main environmental and social concerns if no prior proper planning is conducted. The main sources of soil pollution at waste management projects (from construction to operational phases) are wastewater from onsite washing and sanitation as well as hazardous waste such hydrocarbons (fuels). These may lead to surrounding soil pollution and eventually water resources systems, especially groundwater, resulting into poor water quality.

The impact will be more significant during the construction phase where handling of hydrocarbons and wastewater will be produced onsite related to construction works during the five months. Therefore, the impact significance will be short-term (during the construction). Another potential concern of soil pollution is with the handling of wastewater onsite during the operational phase and decommissioning of the old ponds, i.e., the mishandling of untreated wastewater may result in spills on the ground and pollute soils. Without any mitigation measures this impact can be rated slightly high to medium. However, with the effective implementation of mitigation measures and monitoring, the impact significance will be reduced to low. The impact is assessed in **Table 10**.

Table 10: Impact assessment of project activities on site and surrounding soils

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L/M - 2	L/M - 2	L - 2	L/M - 2	L - 12

Mitigation measures

- During decommissioning of the existing ponds, care should be taken to ensure that the wastewater in the two active ponds do not run off into the surrounding environment.
- Through clean up should be implemented to remove the wastewater currently standing on the surface of the site between the active ponds and the area rehabilitated to an appealing state or before it can be utilized for the new pond construction.
- Spill control preventive measures should be in place on site to management soil contamination, thus preventing and or minimizing the contamination from reaching groundwater bodies. Some of the soil control preventive measures are:
  - ✓ Identification of oil storage and use locations on site and allocate drip trays and polluted soil removal tools suitable for that specific surface on the site.
  - ✓ Maintain equipment and fuel storage tanks to ensure that they are in good condition thus preventing leaks and spills.
  - ✓ The oil storage and use locations should be visually inspected for container or tank condition and spills.
  - ✓ Maintain a fully provisioned, easily accessed spill kit. Spill kits should be located throughout the active project sites contain the floor dry absorbent material and absorbent booms, pads, mats.
  - ✓ All project employees should be made aware of the impacts of soil pollution and advised to follow appropriate fuel delivery and handling procedures.
  - ✓ The Proponent should develop and prepare countermeasures to contain, clean up, and mitigate the effects of an oil spill. This includes keeping spill response procedures and a well-stocked cache of supplies easily accessible.

- ✓ Ensure employees receive basic Spill Prevention, Control, and Countermeasure (SPCC) Plan training and mentor new workers as they get hired in each phase of the project.

- The site areas where hydrocarbons will be utilized, the surface should be covered with an impermeable plastic liner (e.g., an HDPE liner), carefully placed to minimize risk of puncturing, to prevent any spillages from getting into direct contact with the soils and prevent eventual infiltration into the ground and pollute groundwater.
- Project machines and equipment should be equipped with drip trays to contain possible oil spills when operated.
- All wastewater and hydrocarbon substances and other potential pollutants associated with the project activities should be contained in designated containers on site and later disposed of at nearby approved waste sites in accordance with MAWLR's Water Environment Division standards on waste discharge into the environment. This is to ensure that these hazardous substances do not infiltrate into the ground and affect the groundwater quality.
- In cases of accidental fuel or oil spills on the soils from site vehicles, machinery and equipment, the polluted soil should be removed immediately and put in a designate waste type container for later disposal as per the preceding bullet point. The removed polluted soil should either be completely disposed of or cleaned and returned to where it was taken from on site or can be replaced with a cleaner soil. This is to ensure that the pollutants contained int the soil does not infiltrate into the site soils and eventually reach to groundwater.
- In the event of a fuel (diesel) storage tank onsite in a tank mounted on a mobile trailer, drip trays must be readily available on this trailer and monitored to ensure that accidental fuel spills around fuel usage sites are cleaned up on time (soon after the spill has happened).
- Polluted soil must be collected and transported away from the site to an approved and appropriately classified hazardous waste treatment facility.
- Washing of equipment contaminated hydrocarbons, as well as the washing and servicing of vehicles should take place at a dedicated area, where contaminants are prevented from contaminating soil or water resources.
- Toilet water should be treated using one of the following methods:
  - ✓ Discharged into chemical toilets and periodically emptied out before reaching capacity and transported to a wastewater treatment facility.
  - ✓ A type of pit latrine (where excreta in the pit is treated to prevent the waste from being a water pollution risk).

7.4.3 Water Resources Pollution

Wastewater treatment facilities are known to be one of the contributing sources of water pollution mainly during their operations. The proposed ponds will have a potential impact on the water resources through pollution and this is explained under the following subsections (surface water and groundwater).

7.4.3.1 Impact on Surface water

The potential of local groundwater getting polluted by the ponds' operation would occur through the mishandling of; sewage in the existing ponds during their demolition, hazardous waste such as hydrocarbons and effluent during construction of new ponds. Surface water would also be impacted during the operational phase when the flow of wastewater in the ponds is not controlled to detect overflow (over-capacity) on time. These are likely to occur particularly if these activities are carried out during heavy rain season whereby combined overflow of onsite sewage would be intensified by rainfall. These wastes would be washed away and runoff into nearby surface water bodies such as the Fisch River and/or infiltrate into the ground and pollute groundwater.

The potential impact is likely if the ponds design is not properly implemented on the ground (site) to prevent overflowing of wastewater during operations. Without any mitigation measures to prevent or reduce this impact, the significance is medium to high. However, upon implementation of the correct and practical preventive measures and monitoring, the impact significance will be reduced to low. The potential impact is assessed in **Table 11** below.

Table 11: Impact assessment of the potential impact of the project activities on surface water

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L/M - 2	L/M - 2	L - 2	L/M - 2	L - 12

Mitigation measures

- All run off materials such as hydrocarbons, wastewater and other potential contaminants should be contained on site in designated containers and disposed of in accordance with municipal wastewater discharge standards, so that they do not reach to water systems.
- Stormwater management plans (discharge points) should be designed and implemented on site to prevent the on potential contaminated run-off from reaching surface water resources.
- The demolition of currently active ponds should be done in such a way that no wastewater spills or leaks on the ground.
- The ponds should be equipped with a robust wastewater flow monitoring system ensure that the first sign of overflow is detected and addressed in time (for flow and capacity monitoring in the ponds).
- The ponds should be maintained frequently to ensure that no overflow leaves the ponds undetected.
- Sediments removal from the ponds should be done at least once a year to prevent overflow due to the thick sediments settling at the bottom of the ponds.

7.4.3.2 Impact on Groundwater Quality

The pollution impact on groundwater is both a potential and cumulative impact, given the current operation of the existing ponds. The potential of local groundwater getting polluted by the ponds' operation would occur through the mishandling of; sewage in the existing ponds during their demolition, hazardous waste such as hydrocarbons and effluent during construction as well as sewage/wastewater during the operational phase of new ponds. The current (existing) ponds are unlikely to be lined and there is free wastewater flow on the ground at the ponds' area such that groundwater pollution may already be ongoing at site. If no adequate measures are done to improve this situation, i.e., no liners are incorporated into the new ponds' design, this impact will be an add-on to a potential existing pollution problem (cumulative impact).

On potential groundwater pollution from the proposed ponds' activities, groundwater within the site area is hosted in secondary features like faults and joints in sedimentary rocks of clastic origin (sandstone and shale). Without the faults and joints, these primary rocks units are considered inherently impermeable with little to no porosity and therefore low permeability (aquitards). The low permeability of these host rocks (rock units) and the absence of faults and joints would mean that wet pollutants or wastewater from the ground surface would not enter the groundwater system easily and rapidly. Therefore, the potential of groundwater pollution during the operational phase of the new ponds would only occur upon failure of the ponds' base and eventual penetration of wastewater (infiltration) into groundwater through the faulted rock units and or joints.

With that said, the impact of the proposed ponds on groundwater quality is of medium to slightly high significance if no mitigation measures are implemented. However, upon implementation of the mitigation measures, the rating will be reduced to low. The impact is assessed in **Table 12** below.

Table 12: Assessment of the impacts of the oxidation ponds activities on groundwater quality

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M - 3	M/H - 8	M/H - 4	M – 56
Post mitigation	L/M - 2	L/M - 2	M - 6	L/M - 2	L - 20

Mitigation measures

- All run off materials such as hydrocarbons, wastewater and other potential contaminants should be contained on site in designated containers and disposed of in accordance with municipal wastewater discharge standards, so that they do not reach to groundwater systems.
- The base of the ponds should be properly lined with an approved and appropriate liner material to ensure that there will be no direct contact between wastewater in the ponds and groundwater through leakages due to unlined base or liner failure and poor installation.
- The demolition of currently active ponds should be done in such a way that no wastewater spills or leaks on the ground. This is to reduce the infiltration of additional wastewater into the ground as it is seen on the western side of Pond 1 on site. The demolition should be done but not limited to the following:
    - Consider **carrying out progressive demolition by determining the feasibility of either of the two points or both:**

- ✓ This will need to be done by demolishing one or two ponds at a time to ensure that there is still a pond or two to still contain incoming wastewater from the Village sources and avoid environmental catastrophe of uncontrolled sewage overflowing into the general surrounding surface area and into the ground (groundwater).
- ✓ Alternatively, provision to be made for industry standard temporary storage facilities such as sewage tanks to contain sewage while demolition and construction is ongoing.

- The demolition of old ponds should be done during the dry season so that the risk of wastewater running off with rainwater and eventual infiltration into the ground is prevented.
- The pipeline bend at the manhole of concern in the Village should be manoeuvred by incorporating these changes into the proposed oxidation ponds' design to ensure that wastewater flows with ease to the ponds during operations.
- Stormwater management plans (discharge points) should be designed and implemented on site to prevent the potential contaminated run-off from reaching surface water resources, and or eventual infiltration into groundwater.
- The effluent / wastewater containers or ponds should be lined to prevent dissolving waste from leaching into the ground, and potentially into groundwater systems.
- A Groundwater impact assessment with a primary focus on pollution should be undertaken for the Tses Village (Tses Village Council responsibility or in collaboration with NamWater). This will be aimed at establishing the extent of pollution that may already been ongoing primarily because of the existing unlined and dilapidated ponds.

7.4.4 Environmental Pollution (Solid Waste Management and Sanitation)

General environmental pollution (littering) through mishandling of project related waste during construction and operational phases. Not only through littering of solid waste but also human waste (sewage).

The associated waste from construction activities includes domestic, hazardous, and general. Improper handling, storage and disposal of wastes may lead to environmental degradation/pollution. If not handled, store and disposed of properly, the waste may scatter around the project site and pollute the immediate project area.

Another form of waste of concern is sewage. If there is no proper sewage management system especially during the construction phase, the construction workforce will have nowhere to help themselves when nature calls. As a result, they would be forced to defecate anywhere in the environment within proximity of the site, which leads to unhygienic surroundings.

Without any measures for implementation, the impact significance is medium but upon the effective implementation of these, the significance will be reduced to low (**Table 13).**

Table 13: Assessment of environmental pollution from the project activities

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L - 1	L/M - 2	L - 2	L/M -2	L - 10

Mitigation measures

- Project workers should be sensitized to dispose of waste in a responsible manner and not to litter.

- After each daily works, there should not be waste left scattered on site, but rather be disposed of in allocated site waste containers.
- No waste may be buried or burned on site or anywhere else throughout the project lifecycle.
- All domestic and general waste produced daily should be contained until such that time it will be transported to designated waste sites on a weekly basis.
- The sites should be equipped with separate waste bins for hazardous and general waste/domestic.
- Hazardous waste, including emptied chemical containers should be safely stored on site where they cannot be accessed and used by uniformed locals for personal use. These containers can then be transported to the nearby approved hazardous waste sites for safe disposal. No waste should be improperly disposed of on site or in the surroundings, i.e., unapproved waste sites.
- As an emphasis on the preceding point, empty hazardous substance containers should not be disposed of anywhere on the project site or its surrounding, but instead they should be kept at a designated storing place on site until such time that they can be safely taken to the nearest approved hazardous waste sites.
- All equipment, infrastructure/structures and other items used for construction should be safely removed from site and disposed of accordingly or stored at designated areas offsite.
- All construction waste materials, including possible rubbles should be collected and transported to the approved waste site in Tses or to the appropriate waste site facilities for certain waste types.
- A penalty system for irresponsible disposal of waste on site and anywhere in the area should be implemented.
- With regards to sanitation, the site should be equipped with enough portable toilets that should be emptied in accordance with their manufacturers' instruction.

7.4.5 Loss of Biodiversity (Flora and Fauna)

7.4.5.1 Flora

The removal of site vegetation found within the planned site footprints may lead to the loss of biodiversity especially for the protected species.

The site and its surrounding are covered by trees and shrubs (medium to high vegetation cover). The ponds' construction and operational works will not require complete removal of site vegetation. The only vegetation to be removed are those that are within the planned site footprints, and only when and where it will be necessary. The common vegetation on site are the camelthorn shrubs and trees (protected species) and the ever-green invasive *Prosopis glandulosa*, commonly known as honey mesquite found mainly around the active eastern pond. The rest of the vegetation on and around the site will be left to preserve the floral community on site. Therefore, the impact significance is medium. The assessment of the project activities on the local vegetation is presented in **Table 14**.

Table 14: Impact assessment of project activities on local (site) flora

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L/M - 2	L/M - 2	L - 2	L/M - 2	L - 12

Mitigation measures

- Make use of the existing access roads as much as possible and avoid off-road driving.
- The Proponent and their workers should avoid unnecessary removal of vegetation, thus promoting a balance between biodiversity and project operations.
- A Permit must be obtained from the Directorate of Forestry before any protected species is removed (upon findings of the Botanist/Ecologist).
- Vegetation found on the site, but not in the actual project footprints should not be removed but left to preserve biodiversity on the site area.
- The movement of vehicles and machinery should be restricted to existing roads and if necessary, to newly established tracks only to prevent unnecessary damage to the site vegetation.
- No onsite vegetation should be cut or used for firewood related to the project's operations. The Proponent should provide firewood for his onsite camping workers from authorized firewood producer or seller.
- Care should be taken when carrying out vegetation clearing without destroying all the site vegetation.
- The Proponent should aim to use the already damaged area with little to no vegetation for the site expansion and construction and operation of new ponds.

7.4.5.2 Fauna

The primary impact of the project activities, particularly construction works on fauna is the direct destruction of habitats through land clearing and earthmoving activities. Mobile domestic species such as cattle and donkeys as well as wildlife species, like birds that may have been drinking from the existing ponds may leave the ponds' area. More sedentary animals, like invertebrates, many reptiles, burrowing rodents, and small mammals, may be more severely affected.

Secondary impacts relate to activities with varying degrees of disturbance beyond the immediate point where site preparation and construction activities are taking place, such as access roads and other infrastructure. Windblown dust from the site and related dust-generating activities may also affect surrounding animals' species and human settlements.

In addition, the project's construction impacts may also contribute to habitat fragmentation. This would occur through the removal of more vegetation, making dispersal by native species from one bush/tree to another difficult or impossible, and thus, cutting off migratory routes. Isolation may lead to local decline of species and this would result in the disappearance of species that require large patches of forest.

Based on site observations and locals, the site area is not rich in terms of large mammals. This could be explained by the fact that the area has been heavily disturbed by Village activities, including the site being in use for many years as a sewage management facility, thus making the whole area less likely to have the potential of hosting diverse fauna. According to Kanime and Kamwi (2021), the sensitive and shy fauna would move away from the area during the construction phase due to noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed. The presence shrubs and grasses provide a good habitat for several invertebrates. The site is expected to host diverse invertebrates which include insects.

The only fauna (mammal) that was found around the site are donkeys that were grazing at the site. They are assumed to belong to some of residents from the Tses Village or nearby farms. Local animals could be disturbed by the movement of vehicles in the area, especially heavy vehicles such as trucks. Another sign of other animals that have been coming to drink from the ponds are cattle (the faeces of both cattle and donkeys were seen at the ponds). There were no signs of wild animals such as mammals, probably due to the site being located close to human presence, activities, and movements.

There were also some birds seen flying over the trees, but these could not be identified as to what they were or what category or species they belong to and if they lived on site or just flying through.

The impact of the project on the fauna can therefore be considered low to slightly medium. With the implementation of appropriate mitigation measure, the low significance rating will be maintained throughout the project life cycle. The assessment of this impact is presented in **Table 15**.

Table 15: Impact assessment of project activities on local fauna

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	L/M - 2	L/M - 2	M - 6	M - 3	M – 30
Post mitigation	L - 1	L - 1	L - 2	L/M - 2	L - 8

Mitigation measures

- Workers should refrain from killing or snaring any animal species (big or small) that may be found on and around the site.
- Workers should refrain from disturbing, killing or stealing locals' animals and/or small soil animals species found on site.
- Environmental awareness on the importance of biodiversity preservation should be provided to the site contractors and workers.

7.4.6 Air Pollution (Dust and Emissions)

Dust emanating from vehicles travelling on unpaved roads when transporting construction equipment (time-to-time) may compromise the air quality in the site area through dust generation. The proposed site is in a rural area far from urban areas and according to Dunne (2011), the presence of healthy trees or the increase in tree numbers indicates that air quality is excellent and virtually free from pollutants in that specific area. The pond site is surrounded by 'healthy-looking'' and bright-green vegetation, but the very green vegetation is mostly the invasive honey mesquite that is said to be deep-rooted, and drought-tolerant. The bright green colour of the site vegetation could be a result of good air quality but also due to the presence of sufficient wastewater tapped by the vegetation roots from ground recharged by the ponds.

The dust generated and fumes emissions do not only impact people (health and visual) and fauna but also flora. Mainly for nearby flora, the fallout dust could affect the rates of photosynthesis and transpiration in a long-terms due to the duration of mining activities.

Construction works are usually associated with dust, especially in dry months and areas. The dust emanating from traffic travelling on the gravel and unpaved access sandy roads to site during construction, particularly will lead to the decrease in the air quality around the site.

Receptors: The potential odour would be a nuisance to the Tses residents on the northern and northeastern sides of the ponds' site due to wind blowing from southwest to the north and northeastern side of the pond site – as per section 5.1.3 of this document.

Since construction works will only be carried out for a short period of time, i.e., five days a week for the duration of the five months, the impact of dust generation by project related vehicles is therefore minimal. Pre-implementation of any mitigation measure, the impact significance is low to medium. The medium significance of this impact can be reduced to a low significance rating by properly implementing mitigation measures as provided in **Table 16** below.

Table 16: Impact on air quality

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L/M - 2	L/M - 2	L/M - 4	L/M - 2	L - 16

Mitigation measures

- The Proponent should ensure that the construction schedule is limited to the given number of days of the week, but not every day. This will keep the vehicle-related dust level minimal in the area, especially when it is windy.
- In extremely windy days, a reasonable amount of water should be used to suppress the dust that may be emanating from certain site areas (limited to the site only) or certain parts of the local utilized gravel roads that is generating a lot of dust.
- All access roads leading to the site should have speed limits of no more than 40km/h to minimise the amount of dust generated by the vehicles, which will in turn minimise air quality concerns to any potential receptors, particularly the residents south of the site.

- Dust masks, eye protective glasses and other respiratory personal protective equipment (PPE) such as face masks should be provided to the workers on site operating or working at the excavated areas, where they may be exposed to dust.
- The vehicles carrying dusty materials should be covered to prevent materials being blown from the vehicle.
- The transportation of project materials, equipment and machinery should be limited to certain days of the week only as so to reduce dust generated by heavy vehicles in the area.
- Project vehicles and heavy machines should not be left idling when not in use, such that they emit air polluting gases.
- Project vehicles and machinery should be maintained through regular servicing to ensure that they do not release harmful and air polluting fumes while on and off site.

7.4.7 Odour

Some by-products of anaerobic digestion used in wastewater treatment facilities during the operational phase may give off a strong nauseating smell. This may affect the locals in proximity of the ponds. Odours from wastewater treatment facilities can result in complaints from the neighbouring communities (residents). If these complaints escalate, they could negatively impact the facility's reputation. According to Cormier (2017) odours are typically worse at higher temperatures. Therefore, it would make sense when more odour complaints are received by the wastewater treatment operator or owner during the warmer months of the year. The potential odour would then be a nuisance to the Tses residents on the northern and northeastern sides of the ponds' site because the wind blows from southwest to the north on a record of 19 to 30 kilometers per hour – as per section 5.1.3 of this document.

Food and Agriculture Organisation (FAO) of the United Nations (2008) stated that odour problems are generally concentrated within 500 m of the source. Although generally not causing any public health concern, odour can represent a strong local problem to neighbours of the wastewater treatment facilities as the most disturbing environmental impact. This issue of odour was raised in the public consultation meeting by two of the Tses residents who live in the houses near the existing ponds.

Without any mitigation measures and/or proper ponds' designs, the impact can be of medium significance. Upon effectively implementing mitigation measures, the impact will be significantly reduced to low. The impact is assessed **Table 17**. Some of the mitigation measures to control odour are presented under the same Table below.

Table 17: Assessment of the impacts of odour from the oxidation ponds

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L/M - 2	L/M - 2	L/M - 4	L/M - 2	L - 16

Mitigation measures

- The first step in solving any odour problem is identifying the source at the facility. Since this could be caused by several different things, it is best to pinpoint the source of odours with the help of a professional/specialist in wastewater treatment.

- The Proponent should ensure that the ponds' machinery and equipment are designed in such a way or contain technologies that can help to control or minimize odour. **An example of such technology includes odour controlling caps at the ponds. These caps will be incorporated into the ponds' design and installed during construction.**
- **Covering the problem:** Many wastewater treatment facilities choose to seal the source of odour (a tank, basin, or lagoon) with an industrial-grade cover, thereby preventing the diffusion of odour vapours. Covering a tank or lagoon to control odours is a rare example of when covering up a problem makes perfect sense.
- With regards to persistent odour issue, should the residents still express grievances over odour after the demolition of current ponds and construction of new ponds, the Tses Village Council should consider consulting with the affected residents to weigh the option of relocating them further from the ponds, rezone the area to industrial (from residential) and set up a no-go zone (buffer line) for future house establishment.

7.4.8 Noise

The movement and operating of heavy vehicles and equipment may potentially increase noise levels in around the site area which can be a nuisance to the site nearest neighbors (residents), particularly the residents on the eastern and northern sides of the pond site. The excavation activities may also contribute to noise level. Overexposure to high noise levels would be a concern and pose health risk to site workers who are operating and working close to equipment and machinery that produce high noise level. However, this effect is dependent on the duration of overexposure to high noise level.

Project related excavations will be limited to a certain extent, construction activities mainly and within site boundaries only. The activities will be limited to working hours of the day only and five days in a week for a period of five months. With that said, noise level will be limited to the pond site area and only for the duration of the works on site, and therefore, the impact likelihood is minimal.

However, without any implementation of mitigation measures, the impact can be rated as slightly high to medium significant, but upon implementation, the impact will be of slightly medium of low significance - **Table 18**.

Table 18: Noise impact assessment

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L/M - 2	M - 3	L - 2	L/M - 3	L - 21

Mitigation measures

- The transportation of project materials, equipment and machinery should be limited to once or twice a week only, but not every day.
- Noise from project vehicles and equipment on site should be reduced to acceptable levels.
- Excavations and all activities that are likely to increase noise levels should be conducted between 8am and 5pm during weekday to avoid noise during the night residents are resting (in weekends) and sleeping (during the night).
- The construction times should be set such that, no such activities are carried out during the night or very early in the mornings (to be limited between 8am and 5pm on weekdays).

- Construction hours should be restricted to between 8am and 5pm to avoid noise generated by project equipment and the movement of vehicles before or after hours.
- When operating trucks such as hauling or any high noise level machinery, workers should be equipped with personal protective equipment (PPE) such as earplugs to reduce noise exposure. These PPE should be regularly checked/tested for effectiveness and on detected malfunction, should be replaced as soon as possible.

7.4.9 Health, Safety and Security

The project construction but also operational activities can be associated with some health and safety risks. This is possible when personnel (workers) involved in the project activities are exposed to health and safety risks. These are in terms of accidental injury, owing to either minor (i.e., superficial physical injury) or major (i.e., involving heavy machinery or vehicles) accidents.

The use of heavy equipment, especially during excavation, and the presence of hydrocarbons on sites may result in accidental fire outbreaks. This could pose a safety risk to the project personnel, equipment, and vehicles too.

If machinery and equipment are not properly stored and packed, the safety risk may not only be a concern for project workers but residents too, especially children, given the fact that the project site is within proximity of some houses to the north and east of the project site. This is true because, the local children already got used to playing around the ponds and may try to access the active site areas and play with dangerous materials and equipment.

Another potential health risk from the proposed project activities is the handling of project hazardous waste in relation to the local community. The impact is likely because some of the unsuspecting and uniformed local people may be wandering around and if they see improperly stored or kept empty hazardous containers on site, they may be tempted to take these containers without the site workers or Proponent's knowledge. The locals may then use the containers for domestic use like water and/or food storage without proper container treatment or cleaning. The storage of and eventual consumption of water and/or food from such containers may lead to serious health risks to the locals.

The impact can be rated as medium to slightly high to medium significant if no mitigation measures are implemented, but upon implementation, the impact will be of low significance - **Table 19**.

Table 19: Assessment of the impacts of odour from the oxidation ponds

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M - 3	M/H - 8	M/H - 4	M – 56
Post mitigation	L/M - 2	M - 3	L - 2	L/M - 3	L - 21

Mitigation measures

- The site safety of all personnel will be the Proponent's responsibility and should be adhered to as per the requirements of the Labour Act (No 11 of 2007) and the Public Health Act (No. 36 of 1919).
- The heavy vehicle, equipment and fuel storage area should be properly secured to prevent any harm or injury to the Proponent's personnel or local people or even their animals.

- As part of their induction, the project workers should be provided with an awareness training of the risks of mishandling equipment and materials on site as well as health and safety risk associated with their respective jobs.
- All onsite project employees and authorized site visitors (including inspectors) should be properly equipped with adequate personal protective equipment (PPE) such as coveralls, gloves, safety boots, earplugs, dust masks, safety glasses, etc.
- Heavy vehicle, equipment and fuel storage site should be properly secured, and appropriate warning signage placed where visible.
- An emergency preparedness plan should be compiled, and all personnel appropriately trained.
- Workers should not be allowed to drink alcohol prior to and during working hours as this may lead to mishandling of equipment which results into injuries and other health and safety risks.
- The site to be equipped with "danger" or "cautionary" signs for any potential danger or risk area on site.
- To ensure that the ponds are secured and protected from possible public unauthorized access, and most importantly protecting the public, especially local children as well as local animals, a razor mesh fence should be erected around the ponds' area.
- A security guard or guards should be deployed on site so that they can look after the project equipment and vehicles during construction that would be left on site in weekends or public holidays (when no work is done) to ensure that no unauthorized person enters the area.
- The Tses Village Council should ensure that a security personnel is deployed onsite during the operational and maintenance phase to ensure that the site infrastructure and its surroundings are protected, secured and all security matters pertaining to the site operations are reported and addressed on time.
- To discourage the unsuspecting and uniformed local community from eyeing the empty hazardous containers that may be used onsite, these containers should be securely kept on site, inside the boundary wall before transporting the containers to the waste site.
- All employees and contractors (personnel) should be trained on environmental awareness, the Proponent's internal Environmental Health and Safety Policy, Environmental Management Plan, and engagement with key stakeholders, specifically the key government ministries and farmers.
- With regards to accidental fire outbreaks, the following should be implemented:
    - Portable fire extinguishers should be provided on sites (per vehicle and working sites).
    - No open fires should be created by project personnel.
    - Potential flammable areas and structures such as fuel storage tanks should be marked as such with clearly visible signage.

7.4.10 Vehicular Traffic Safety

The project works may potentially put pressure on the existing roads when construction materials are delivered to site. The construction of the ponds will increase traffic in the area. An increase in traffic would potentially lead to road accidents, especially by slow moving heavy trucks that will be frequenting the area during the construction phase. However, only so many times a week or even in month during the period which construction works will be done, and materials and equipment will be transported to site.

Pre-mitigation, the impact can be rated medium and with the implementation of mitigation measures, the significance will be low. The impact is assessed in **Table 20** below and mitigation measures are provided below.

Table 20: Impact Assessment of the project activities on vehicular traffic

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L/M - 2	L/M - 2	L - 2	L/M - 2	L - 12

Mitigation measures

- The transportation of project materials, equipment and machinery should be limited to once or twice a week only, but not every day.
- The heavy truck loads should comply with the maximum allowed limit while transporting materials and equipment/machinery on the public and access roads.
- Drivers of all project phases' vehicles should be in possession of valid and appropriate driving licenses.
- Vehicle drivers should adhere to the road safety rules.
- Drivers should drive slowly (40km/hour or less), and on the lookout for livestock and wildlife.
- The Proponent should ensure that the site access roads are well equipped with temporary road signs condition to cater for vehicles travelling to and from site, especially during the construction phase when heavy vehicles are present.
- Project vehicles should be in a road worthy condition and serviced regularly to avoid accidents because of mechanical faults of vehicles.
- Vehicle drivers should only make use of designated site access roads provided.
- Vehicle drivers should not be allowed to operate vehicles while under the influence of alcohol.
- Sufficient parking area for all project vehicles should be provided for and clearly demarcated on site.
- The Proponent should make provision for safe materials and equipment offloading and loading areas on sites.
- No heavy trucks or project related vehicles should be parked outside the project site boundary or demarcated areas for such purpose.
- Truck movements, frequency, times, and routes should be carefully planned and scheduled – please refer to the next point.
- To control traffic movement on site, deliveries from and to site should be carefully scheduled. This should optimally be during weekdays and between the hours of 8am and 5pm..

7.4.11 Archaeological Resources

During site clearing and earthworks activities, historical resources may be impacted through inadvertent destruction or damage. This may include the excavation of subsurface graves or other archaeological objects and damaging of heritage sites.

Based on the site visit, there was no visible (above-ground) archaeological materials (object or site). The site is situated on an area that is partly degraded due to previous and current land use. It is assumed that the chances of recovering significant archaeological materials could have been compromised. Therefore, it is unlikely that the impact of the proposed project activities will not be of great significance on these and potentially other archaeological remains.

It should also be noted that the absence of archaeological materials on the surface is not evidence that there are no such materials below the surface. Therefore, if there are buried archaeological materials, this would need to be verified on the ground when work commences.

With that said, the potential impact significance is slightly medium if no mitigation measures, are implemented. However, after the implementation of the measures provided below, this impact significance will be low. The assessment of the impact is shown in **Table 21** below.

Table 21: Archaeological impact assessment

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M - 3	M - 6	M - 3	M – 36
Post mitigation	L - 1	L - 1	L - 2	L/M - 2	L - 8

General Mitigation measures

- Caution should be exercised when carrying out excavations associated with the old ponds' demolition and construction activities if archaeological/heritage remains are discovered.
- Identified of any archaeological significant objects on the site should not be disturbed but are to be reported to the project Environmental Control Officer (ECO) or Safety, Health & Environmental (SHE) officer or National Heritage Council offices for further instructions and actions.
- Workers should be educated to not destroy or throw away any unknown object found/discovered on site (above and below ground) but to report it to the Environmental Control Officer or SHE officer.
- The Proponent or the project ECO / SHE Officer should familiarise themselves with the National Heritage Council's Chance Find Procedure (CFP) and if uncertain about the procedure should receive training by a suitably qualified archaeologist with respect to the identification of archaeological/heritage remains and the procedures to follow if such remains are discovered throughout the project activities' duration. The CFP is attached to the EMP.
- Emphasis: sub-surface materials may still be lying hidden from surface surveys. Therefore, absence (during surface survey) is not evidence of absence all together. The recommended and necessary measures, monitoring and reporting procedures must be followed in the event of a chance find, to ensure compliance with heritage laws and policies for best practice.

7.4.12 Social Nuisance: Conflicts, Property Intrusion and Damage

7.4.12.1 Conflicts due to Site Area Influx and Job seeking

Like any new development for project in an area, the proposed project activities may attract the influx of people from outside the project area in search of job opportunities. Such influxes may lead to social annoyance and conflicts. This is generally considered a concern given the current unemployment rate of youth in Namibia and specifically in the Tses area, that people from other areas in different regions may hear about the project intentions (especially from the ESA newspaper adverts) and would go look for work opportunities in Tses. The different ways of living by outsiders could interfere with the local norms, culture, and values resulting in social crashes between the locals and outsiders.

The influx of people into the project area may also lead to sexual relations between these out-of-area workers and the locals. This would lead to the spreading of sexual transmitted diseases (i.e., HIV/AIDS) when engaging in unprotected sexual intercourse.

Pre-implementation of mitigation measures, the impact is rated as of slightly high to medium significance. However, upon mitigation (post-mitigation) – see mitigation measures below, the significance will change from medium to low rating. The impact is assessed in **Table 22** below.

Table 22: Impact assessment of social conflicts due to influx of jobseekers in the project area

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M - 3	M/H - 8	M/H - 4	M – 56
Post mitigation	L/M - 2	L/M - 2	M - 6	L/M - 2	L - 20

Mitigation measures

- The Proponent should prioritize the employment of local people, and only if necessary and due to lack of skills in the area, out-of-area people can be given some of the work. This is to avoid the influx of outsiders into the area.
- The locals to be employed during the project phases should be provided with the necessary training of skills required for the project to avoid bringing in many out-of-area employees.
- The workers should be engaged in health talks and training about the dangers of engaging in unprotected sexual relations which results in contracting HIV/AIDS and other sexual related infections.
- Out-of-area workers that may be employed (due to their unique work skills) on site should be sensitized on the importance of respecting the local values and norms, so that they can co-live-in harmony with the local communities during the duration of their employment on site.

7.4.12.2 Property Invasion and Damage

The presence of some out-of-area workers may lead to social annoyance to the local community, particularly when they or some of those workers enter or damage properties of the locals. The locals' private properties could be homes, yards/fences, vegetation, livestock, etc. The damage or disturbance to properties may not only be private but also community properties. The unpermitted and unauthorized entry to private properties may cause social crashes between the local community (affected property owners) and the Proponent or Contractor.

Pre-implementation of mitigation measures, the impact is rated as of medium significance. However, upon mitigation (post-mitigation), the significance will change from medium to low rating. The impact is assessed below (**Table 23**).

Table 23: Impact assessment of social conflicts due to private property invasion and damage

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M - 3	M - 6	M - 3	M – 36
Post mitigation	L/M - 2	L/M- 2	L/M - 4	L/M -2	L - 16

Mitigation measures

- The Proponent should inform their workers on the importance of respecting the locals' properties by not intruding or damage their homes, fences or disturbing their livestock.
- Any workers or site employees that will be found guilty of intruding peoples' properties should be called in for disciplinary hearing and/or dealt with as per their employer' (Proponent)'s code of employment conduct
- Site workers should be advised to respect the community and local's private properties, values, and norms.
- No worker should be allowed to wander in people's private yards or fences without permission.
- Site workers are not allowed to kill or in any way disturb local livestock or animals that may be seen on and around the site.
- No cutting down or damaging of trees within or around the project site without proper authorisation, i.e., Tses Village Council or the DEAF's Forestry Division for protected species such as camelthorn trees.

7.5 Cumulative Impacts

Should the proposed project be approved, there will be certain cumulative impacts that will be related to the construction and operational phases.

Cumulative impacts for the construction phase include:

- **Surface water and groundwater pollution** – should the demolishing of the existing active ponds be carried out during the rainy seasons; the improper handling of the wastewater may lead accidental runoff into the nearby surface water bodies such as the Fisch and Tses Rivers and surrounding streams. These impacts can be mitigated by using retention dams in lined/concrete channels. The mishandling of wastewater during the demolition of the existing ponds may lead to the infiltration of this water into the local aquifers and pollute the groundwater (water supply boreholes). The surface water flows will be altered during the construction phase by a storm water management plan.
- **Vehicular traffic safety** – the increased number of vehicles in the area may lead to high traffic flow around the ponds' area, as this road will be used by both locals, project related vehicles (small cars and heavy trucks). In terms of infrastructure and facilities, the project size is small, short-term and the equipment and vehicles required for construction will not be that many at the same time on site within these 5 months of actual construction works.

Cumulative impacts for the operational phase include:

- **Groundwater pollution** – the current ponds were not properly lined since their establishment years ago, and there is stagnant wastewater observed on the ground, south of the western active pond (referred to as Pond 2 under section 1.3) during the site visit. This could already indicate ongoing infiltration of wastewater into the ground (local aquifers) and developing or existing pollution of groundwater (water supply boreholes) in Tses. Therefore, failure to properly design the planned liners for the ponds would mean continuation of wastewater infiltration into the environment (groundwater) even during the operation of the new ponds. **A separate Groundwater Impact Assessment of the Tses Village will need to be taken to establish the extent of pollution that may have been primarily caused by infiltration of wastewater from the ponds over time already and identify other potential contributing sources of pollution in and around the Village**.
- Another cumulative impact on groundwater is also on the issue raised during the public consultation period about the manhole in the Village where the wastewater is channeled to the sewer ponds. The manhole is said to be at times blocked by solid waste that is dumped there by some Village residents and during rainy seasons, the manhole gets blocked and as a result the wastewater overflows out of the wastewater channel to the ponds. The overflowing wastewater would potentially end up in groundwater instead of flowing to the ponds. If this manhole is not upgraded as recommended, this impact would just persist even during the operation of the proposed sewer ponds. The recommended measures provided under the groundwater impact assessment section (7.4.3.2) should be implemented to minimize the impact of the wastewater treatment facilities in the long run.
- **Odour**s – There is a current odour nuisance experienced by the Tses residents who live close to the existing ponds, especially the southern and northeastern sides of the ponds' site. Therefore, if no improvement is made to reduce this nuisance, the impact (odour) will likely continue even with the new ponds. According to the Proponent on this issue, they have indicated that a new technology (odour caps) will be incorporated into the ponds' design to control the odour in the area.

Subsequently, the above-mentioned cumulative impacts can be mitigated if the proposed activities are correctly planned, and measures recommended to the respective potential impact are effectively implemented to manage the potential and cumulative impacts stemming from the activities.

7.6 Current Pollution of Site Soils by Existing Ponds

There is currently an existing soil pollution on the immediate western side and southern side of active Pond 1 (P1) and Pond 2 (P2), respectively, whereby a pool of stagnant uncontrolled wastewater from these ponds can be seen on site – **Figure 30**. It is however cannot be determined whether this wastewater on the soils is entirely from overflow from ponds when capacity was reached or also from possible seepage from the ''saturated'' onsite soils due to prolonged infiltration of the waste.

This uncontrolled and uncontained wastewater does not only pose a risk to the site soils and vegetation but also to groundwater whereby potentially dangerous chemicals in the wastewater could pollute water resources.

Figure 30: Pool of stagnant wastewater from the two active ponds on site soils

7.6.1 Soil Contamination & Impact Assessment and Remediation Recommendations

Although out of the scope of this EIA, it is crucial for the Proponent to include a Soil Contamination and Impact Assessment Study (Soil Study) in the planning phase to cater for the existing soil contamination on site. The Study will aid in determine the extent of pollution, plan for possible remediation of contaminated soils during the demolition of old ponds. The Soil Study will also aid in confirming whether the contamination presents a significant risk of harm, recommending the suitable, realistic, and practical measures that can be implemented to remediate the contaminated soils onsite.

The remediated soils can then be safely returned to site and placed back where it was removed.

For contaminated land (soils), there is a three-phased international practice that is used for assessment and remediation. The phased approach is shown in (**Figure 31**).

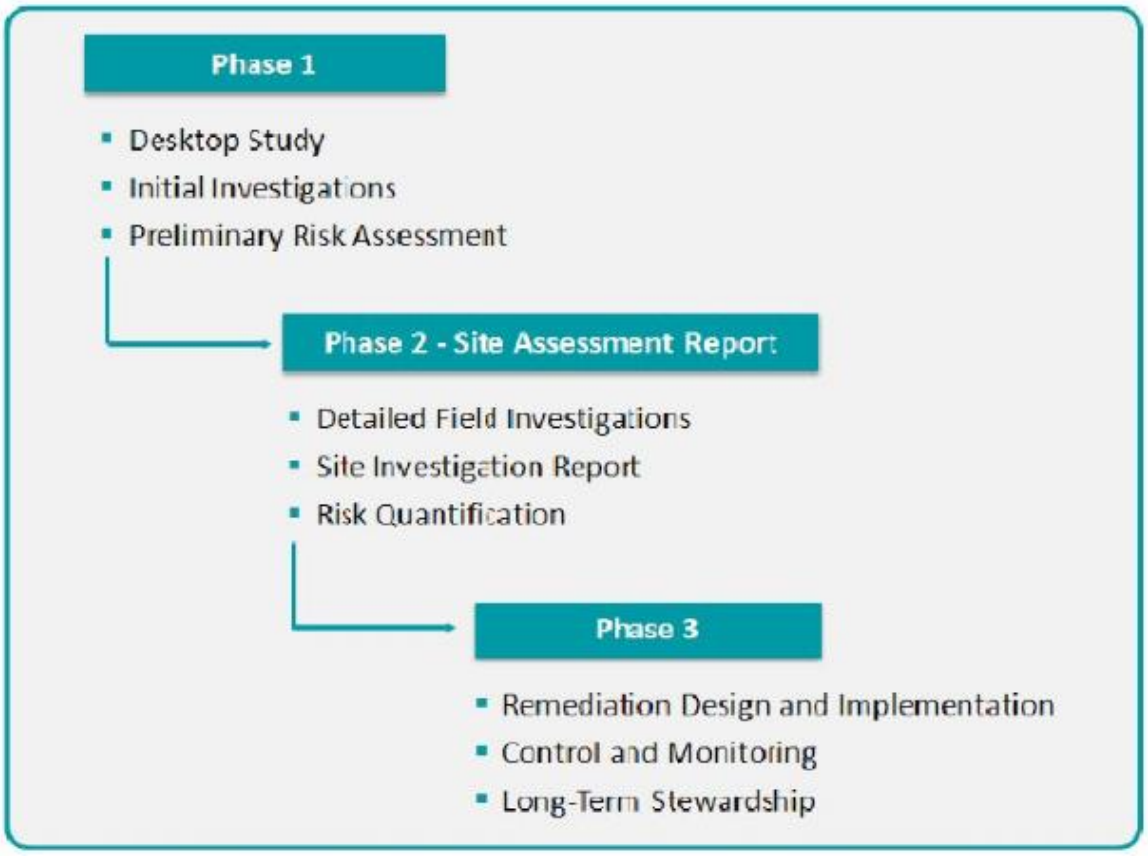


Figure 31: A phase approach for the assessment and remediation of contaminated land (Ashraf *et al.*, 2014)

There are several known international known soil remedial measures that can be applied on site. However, implementation cost, contaminant type, site suitability, technology required, and other factors may be main hinderances to achieving these or some of the remedial methods.

The appropriate and suitable measures and method(s) to remediate the contaminated site soils can only be ascertained by a specialist (soil scientist) between the planning phase and construction of the new ponds. It is therefore of high importance to include a soil scientist in the planning phase and pre-demolition of old ponds to carry out the required Study. The Soil Study will also ensure that the existing (pre-construction) contamination is addressed prior to establishment of the new ponds.

8 RECOMMENDATIONS AND CONCLUSIONS

The following recommendations and conclusions have been made with regards to the proposed establishment of the oxidation ponds in Tses.

8.1 Recommendations

The potential impacts (both positive, negative, and cumulative) that are anticipated from the proposed project activities were identified, described, and assessed. For the significant adverse (negative) impacts with high and medium rating, appropriate mitigation measures were recommended for implementation by the Proponent, their contractors and project related employees.

The public was consulted as required by the EMA and its 2012 EIA Regulations (Section 21 to 24). This was done via the two newspapers used for this environmental assessment; site/public notices placed in Tses Village (at the Tses Village Council offices and Tses Clinic notice boards). A notice for public consultation was also erected at the Village Council offices entrance to further notify the locals of the EA process and the planned public meeting in Tses. The public (I&APs) raised comments and concerns on the proposed project via the consultation platforms provided (emails and face-to-face session in the form of public consultation meeting).

The issues and concern raised by the registered I&APs formed the basis for this Report and the EMP. The issues were addressed and incorporated into this Report whereby mitigation measures have been provided thereof to avoid and/or minimize their significance on the environment. Most of the potential impacts were found to be of medium and to slightly high rating significance. With the effective implementation the recommended management actions (mitigation measures), this will particularly see the reduction in the significance of adverse impacts that cannot be avoided completely (from slightly high to medium and for medium rating to low). Furthermore, to improve the high rating to medium to low and maintain the low rating, monitoring of the implementation of management measures by the Proponent (an Environmental Control Officer (ECO) or SHE Officer) and applicable Competent Authority (MAWLR) is highly recommended. The monitoring of this implementation will not only be done to maintain the reduce impacts' rating or maintain low rating but to also ensure that all potential impacts identified in this study and other impacts that might arise during implementation are properly identified in time and addressed right away too.

The findings of this assessment were deemed sufficient and conclude that no further detailed assessments are required to the ECC application.

Therefore, the Environmental Consultant is confident that the potential negative impacts associated with the proposed project activities can be mitigated by effectively implementing the recommended management action measures and with more effort and commitment put on monitoring the implementation of these measures. It is therefore, recommended that the proposed oxidation ponds and associated activities be granted an Environmental Clearance Certificate, provided that:

- All respective management measures (mitigations) provided in the EMP be effectively and progressively implemented and backed up by consistent site monitoring of environmental components listed in the EMP to achieve full EMP implementation compliance.
- All required permits, licenses and approvals for the project activities are obtained as required (please refer to the Permitting and Licensing in the EMP).
- The Proponent and all their project workers or contractors comply with the legal requirements governing their project and its associated activities and ensure that project permits and or approvals required to undertake specific site activities are obtained and renewed as stipulated by the issuing authorities.
- All the necessary environmental and social (occupational health and safety) precautions provided are adhered to.
- Environmental (EMP) Compliance Monitoring should be conducted on a weekly basis during the construction phase by the project Safety, Health and Environmental Officer or an independent Environmental Consultant and bi-annually during the operational phase. Environmental Compliance monitoring reports should be compiled and submitted to the DEAF Portal as per provision made on the MEFT/DEAF's portal**.**

These recommendations are primarily aimed at improving environmental management, ensuring sustainability and promote harmonious co-existence of the project activities and the host biophysical and social environment.

8.2 Conclusions

In conclusion, with that being done, the positive impacts of the improved (upgraded) oxidation ponds will be able to overweigh the negative impacts in the long run. This will be a potential win-win for both the Tses community and the surrounding biophysical and social environment, mainly regarding public and environmental health protection. Not only for public and environmental health but also the provision of the end-product of the wastewater treatment process that will be utilized for other purposes in the community (such as treated effluent to be used for irrigation).

Therefore, it is crucial for the Proponent and their contractors to effectively implementation of the recommended management measures to protect both the biophysical and social environment throughout the project phases (from planning, decommissioning of the existing ponds, construction of new ponds and their operational & maintenance phase). All these would be done with the aim of promoting environmental sustainability while ensuring a smooth and harmonious existence and purpose of the project activities in the community and environment at large.

9 REFERENCES LIST

//Karas Regional Council. (2020). *//Karas Regional Council: Home - About Us*. Retrieved from https://karasrc.gov.na/about-us

Ashraf, M. M. (2014). *IntechOpen Limited: Environmental Risk Assessment of Soil Contamination*. Retrieved from Soil Contamination, Risk Assessment and Remediation: https://www.intechopen.com/books/environmental-risk-assessment-of-soil-contamination/soil-contamination-risk-assessment-and-remediation

City Population. (2020, September 16). *City Population*. Retrieved from Republic of Namibia: Towns, Villages & Settlements - Tses: https://www.citypopulation.de/en/namibia/cities/

Cormier, V. (2017). *Pollution Equipment News: How to Control Odors at Wastewater Treatment Plant*. Retrieved from https://www.pollutionequipmentnews.com/how-to-control-odors-at-wastewater-treatment-plants

Dunne, A. (2011). *Environmental Impact Statement for Piggery Extension at Jorristown Upper, Killucan, Co. Westmeath.* Port Laoise: Environmental Protection Agency.

Earthwise Contributors. (2020). *Earthwise*. Retrieved from Hydrogeology of Namibia: Groundwater Quality: http://earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Namibia#Groundwater_Quantity

Encyclopædia Britannica, Inc. (2020). *Encyclopædia Britannica, Inc*. Retrieved from Wastewater Treatment: Oxidation Ponds: https://www.britannica.com/technology/wastewater-treatment/Oxidation-pond

Food and Agriculture Organisation (FAO) . (2008). *Poultry in the 21st Century: avian influenza and beyond. Proceedings of the International Poultry Conference, held 5–7 November 2007, Bangkok, Thailand. Edited by O. Thieme and D. Pilling. FAO Animal Production and Health Proceedings, No. 9. Rome.* Rome: FAO.

GCS Water & Environmental Consultants. (2017). *Environmental Scoping AsseEnvironmental Assessment for the Proposed Construction of a 66 kV Power Transmission line near Keetmanshoop in the //Karas Region.* Windhoek: Unpublished.

Groot Environmental Engineers. (2016). *Final Scoping Report for the Environmental Impact Assessment and Environmental Management Plan for the Construction and Operation of the Proposed Tses Glass Manufacturing Factories in Tses Village, //Karas Region.* Windhoek: Groot Group.

Christelis, G and Struckmeier, W. (2011). *Explanation to the Hydrogeological Map: Groundwater in Namibia.* Windhoek: Ministry of Agriculture, Water and Land Reform.

IQ Air. (2021). *World Air Quality*. Retrieved from Air Quality in Tses, //Karas Region, Namibia: https://www.iqair.com/us/namibia/karas/tses

Khan, F. M., Saxena, A. K. and Kushwaha, A. (2018). *Sewage/Wastewater Treatment Technologies with Special Reference to Oxidation Pond : A Tool For Waste Water Treatment. Vol 4. Issue 1.* Madhya Pradesh: International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET).

Meteoblue. (2021). *Meteoblue*. Retrieved from Climate Tses, //Karas Region, Namibia: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/tses_namibia_3352609

Minnesota Pollution Control Agency. (2010, October). Retrieved from Decommissioning or Relining Domestic Wastewater Ponds: Requirements and Procedures: https://www.pca.state.mn.us/sites/default/files/wq-wwtp5-86.pdf

Moran, S. (2018). *An Applied Guide to Water and Effluent Treatment Plant Design.* Elsevier Science.

Namibia Statistic Agency (NSA). (2014). *2011 Population and Housing Census: //Karas Regional Profile - Basic Analysis with highlights.* Windhoek: Namibia Statistic Agency.

Oyati, E. N., Olotu, Y., Gimba, I. N. and Rasheed, I. (2020). *Design of a Wastewater Treatment Oxidation Pond. Asian Review of Environmental and Earth Sciences, 7 (1): 55-60.* Auchin: Auchi Polytechnic.

Pescod, M. B. (1992). *Wastewater Treatment and Use in Agriculture Food and Agriculture (FAO) irrigation and drainage paper 47.* Rome: Food and Agriculture (FAO) of the United Nations. Retrieved from Wastewater Treatment - The Problem: http://www.fao.org/3/t0551e/t0551e05.htm

Rajasulochana, P and Preethy, V. (2016). *RajasuloComparison on efficiency of various techniques in treatment of waste and sewage water. A comprehensive review. Science Direct , 175-184.*

Tharavathy, N.C., M Krishnamoorthy, M., and Hosetti, B. B. (2013). *Oxidation Pond: A Tool for Wastewater Treatment.* Karnataka: Research & Reviews: Journal of Ecology and Environmental Sciences.

Van Wyk, A.E., Strub, H. and Struckmeier, W. (2001). *Hydrogeological Map of Namibia, Scale 1:000 000 : Vulnerability of Groundwater Resources Map.* Windhoek: Ministry of Agriculture, Water and Forestry (Agriculture, Water and Land Reform).

World Weather Online. (2020). *World Weather Online*. Retrieved from World Weather Online: Tses: https://www.worldweatheronline.com/tses-weather-history/karas/na.aspx

APPENDIX A: COPY OF THE ENVIRONMENTAL CLEARANCE CERTIFICATE APPLICATION

Natalie

RECEIVED
061208 7649
2020 -10- 14
EXECUTIVE DIRECTOR'S OFFICE

ANNEXURE 1
FORMS

Form 1

NAMIBIA REVENUE N$200

NAMIBIA REVENUE N$100

REPUBLIC OF NAMIBIA

ENVIRONMENTAL MANAGEMENT ACT NO. 7 OF 2007

(Section 32)

APPLICATION FOR ENVIRONMENTAL CLEARANCE CERTIFICATE

PART A: DETAILS OF APPLICANT

1. Name: (person or business)
   Dunamis Consulting Engineers & Project Managers (Pty) Ltd
2. Business registration/Identity No.
   2018/2459
3. Correspondence Address:
   PO Box 3757 Windhoek, Namibia
4. Name of Contact Person:
   Mr. Solidarity Kaimu
5. Position of Contact Person:
   Engineering Manager / Civil Engineer
6. Telephone No.:
   +264 61 236 911
7. Fax No.:
   +264 61 256 777
8. E-mail Address: if any
   Solidarity@dynamicnam.com

Regional Authority:	//Karas Regional Council
Regional Constituency:	Berseba Constituency
Local Authority	Tses Village Council

Scale and Scope of Activity:

The proposed activity is localised, therefore considered a small to medium scale activity.

There are some potential positive and negatives impacts that are expected from the proposed project and associated activities.

Positive Impacts: (a) Socio-economic development through temporary job (employment) creation in the Village during the construction phase and **(b)** Improved wastewater management in the Village, thus preventing the amount of wastewater that would otherwise be uncontrollably released into the environment due to the dilapidated state of the existing ponds. This would improve the local public and environment health.

Potential negative Impacts identified: soil and water pollution, general environmental pollution, loss of vegetation due to site clearing, sir pollution, odour, vehicular traffic safety, health, & safety and archaeological or cultural heritage impact

PART C: DECLARATION BY APPLICANT

I hereby certify that the particulars given above are correct and true to the best of my knowledge and belief. I understand the environmental clearance certificate may be suspended, amended or cancelled if any information given above is false, misleading, wrong or incomplete.

Signature of Applicant	**FREDRIKA N. SHAGAMA** Full name in Block Letters	**Environmental Assessment Practitioner & Hydrogeologist** Position
Dunamis Consulting Engineers & Project Managers (Pty) Ltd On behalf of	**14 October 2020** Date	

SERJAHGE
CONSULTANTS
"Sustainability is Tomorrow's Usage Assurance"
CC/2020/0010007

Natalia
RECEIVED
0612087649
2020 -10- 14
EXECUTIVE DIRECTOR'S OFFICE
MAWLR

+264 81 407 5536
serja.consultants@gmail.com
P. O. Box 27318, Windhoek
Namibia

Date: 14 October 2020

The Executive Director

Ministry of Agriculture, Water and Land Reform

Private Bag 13184, Windhoek, Namibia

Attention: Mr. Percy Misika

Dear Sir

RE: ENVIRONMENTAL SCOPING ASSESSMENT (ESA) FOR THE PROPOSED CONSTRUCTION AND OPERATION OF OXIDATION (SEWER) PONDS IN TSES VILLAGE, //KARAS REGION: AN APPLICATION FOR THE ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC)

Serja Hydrogeo-Environmental Consultants cc (*Serja Consultants* or the *Environmental Assessment Practitioner* hereafter), Independent Environmental Consultants have been appointed by Dunamis Consulting Engineers & Project Managers (Pty) Ltd (*The Proponent*) to conduct an Environmental Scoping Assessment (ESA) for the proposed construction and operation of four oxidation (sewer) ponds in the Tses Village of the //Karas Region and submit an application for an Environmental Clearance Certificate (ECC) in accordance with the Environmental Management Act (EMA) No. 7 of 2007 and its 2012 EIA Regulations.

According to Section 32 of the Environmental Management Act, the relevant Competent Authority identified for this project is the Ministry of Agriculture, Water and Land Reform (MAWLR). The Environmental Assessment Practitioner is hereby submitting this letter accompanied by the **Application for Environmental Clearance Certificate** (Form 1) and the project **Background Information Document (BID)**.

Should you wish to send us any potential issues, suggestions and or recommendations that you would like us to considered as part of the environmental assessment process and addressed in the Environmental Scoping Assessment Report, please send us your inputs **before the end of business on Friday, 30 October 2020**.

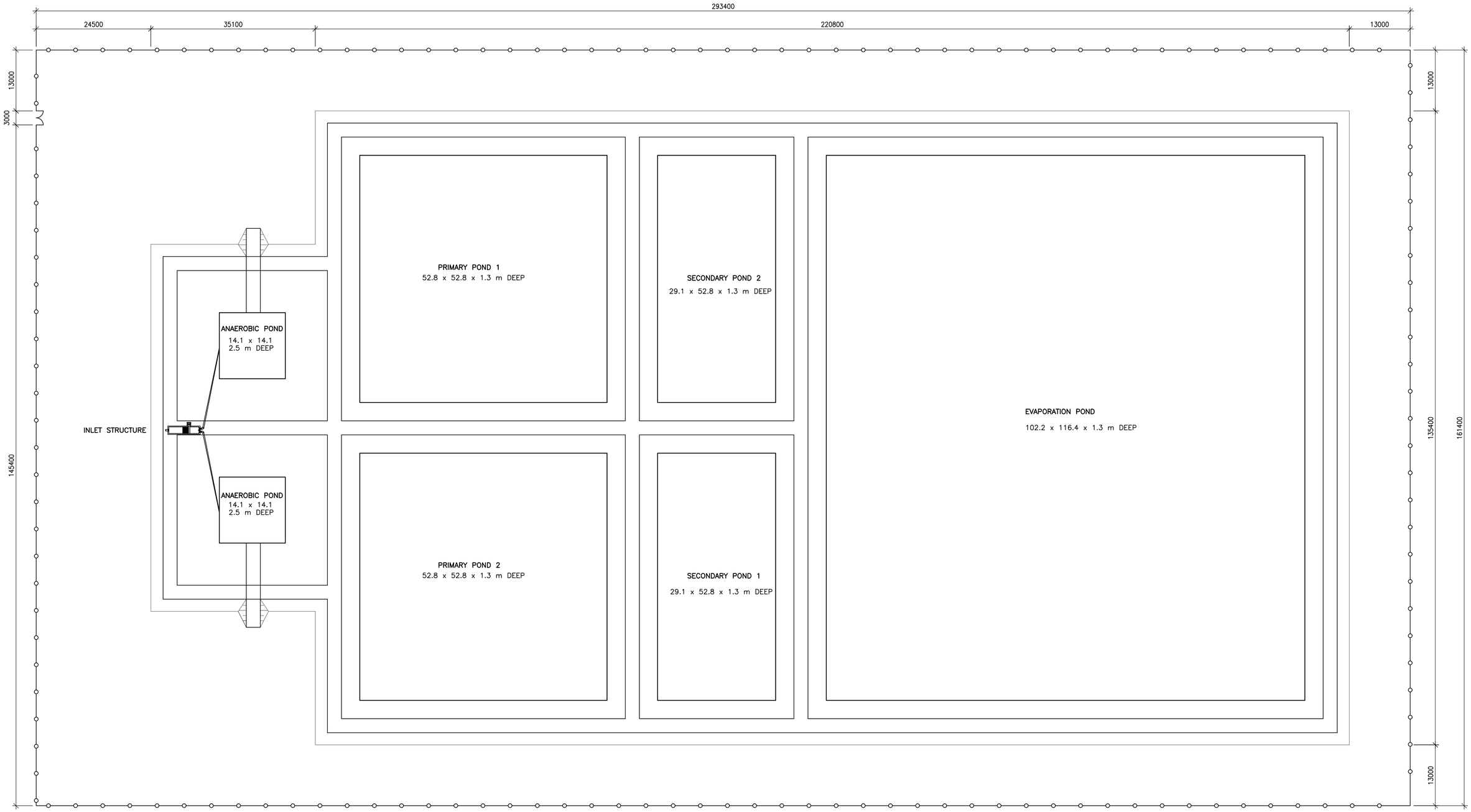
Yours Sincerely,

.....

Ms. Fredrika N. Shagama

Principal Hydrogeologist and Environmental Assessment Practitioner & Hydrogeologist

APPENDIX D: THE DRAWING/LAYOUT OF THE PROPOSED OXIDATION PONDS



PLAN

SCALE 1 : 500