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FAUNA AND FLORA ASSESSMENT REPORT FOR THE PROPOSED ADAMAYVIEW OUTFALL SEWER PIPELINE UPGRADE FOR THE CITY OF MATLOSANA MUNICIPALITY, NORTH WEST PROVINCE

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Indemnity

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as information available at the time of study. Therefore the author reserves the right to modify aspects of the report, including the recommendations, if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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EXECUTIVE SUMMARY

i. INTRODUCTION

SAZI Environmental Consulting cc was appointed by City of Matlosana Municipality to undertake an assessment of fauna and flora species for the proposed upgrade of a sewer outfall pipeline in the North West Province. The study was undertaken in May 2017.

ii. METHODOLOGY

Data sources from the literature consulted and used where necessary in the study included: IUCN, NFEPA, NPAES, CBA and ESA for North West, SIBIS. Line transect and random sampling methodology was used for field assessment.

Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and various spatial databases (SANBI's SIBIS and BGIS databases).

An ecological sensitivity map of the site was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases.

iii. RESULTS

- Vegetation

The project site is located within the highly threatened Grassland Biome of South Africa with approximately two percent currently conserved. The study area falls within the Vaal-Vet Sandy Grassland, which in turn comprises part of the Grassland Biome. This type is situated in the North-West and Free State Provinces, south of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein. The site mainly consisted of a herbaceous layer dominated by grasses as well as sporadic tree species and a discontinuous layer of shrubs. The site for the proposed sewer outfall pipeline development housed some alien invasive species and weeds. There were however, a number of indigenous species observed at the site.

- Vertebrates

The proposed development site comprised of highly transformed areas such as residences, dumping areas, mine residue sites and transformed vegetation patches which make for

unsuitable habitat for many animals, especially habitat specific threatened faunal species. No mammal, amphibian or reptile species were observed at the time of assessment.

- Avifauna

A total of 6 bird species were observed at the proposed development site during the time of assessment and these included: *Bostrychia hagedash* (Hadada ibis), *Vanellus armatus* (Blacksmith lapwing), *Vanellus coronatus* (Crowned lapwing) and *Acridotheres tristis* (Common myna).

- Invertebrates

During the site visits, invertebrates were observed on site including species from the orders, *Lepidoptera (Junonia hierta)*. No Arachnids or Molluscs were observed. No Red or Orange Listed or priority invertebrates were observed on site.

- Red data species and critical biodiversity

None of the plant species recorded in the study area are found in the "Red Data List of Southern African Plants" or on the updated PRECIS database of the National Botanical Institute (NBI), Pretoria. None of the animal species recorded on site are red listed and due to the developed nature of the area, human disturbance in the area, no red data fauna and flora species are likely to occur on the site.

According to the North West Province Biodiversity Conservation Assessment, a section of the site falls within a Critical Biodiversity Area. The entire proposed site is located within an Endangered Ecosystem.

Due diligence and care must be undertaken by the Environmental Control Officer (ECO) of the project during the construction phase, to identify species of importance that may have been missed.

- Sensitivity

The majority of the development site is regarded as of **High** sensitivity. The sensitivity rating scale used to determine the sensitivity of the proposed site is that explained in section 3.5

above. The high sensitivity status is given due to the fact that the proposed sewer outfall upgrade pipeline runs along the Palmietspruit River and associated wetland system.

iv. RISK FACTOR AND RECOMMENDATION

The planned construction activities involve a change of land use and thus often loss of natural habitat, which is the greatest threat to plant species in South Africa. In terms of the principles of NEMA (Section 2), sustainable development requires the consideration of all relevant factors including disturbance of ecosystems and loss of biodiversity, both of which should be avoided or, if that is not possible, should be minimized and remedied.

v. CONCLUSION

The proposed Adamayview sewer outfall pipeline development area is regarded as of **High** sensitivity on account that it runs along a river associated with a wetland system. Although no sensitive or red data species were observed during the time of assessment, minimum destruction of the environment must be adhered to. From an ecological perspective, due care must be undertaken when developing on this area and all relevant mitigation measures implemented.

TABLE OF CONTENTS

EXECUTIVE SUMMARY iii
DEFINITION OF TERMS ix
1 INTRODUCTION 11
1.1 TERMS OF REFERENCE 11
1.2 LIMITATIONS AND ASSUMPTIONS 11
1.3 LEGISLATIVE CONTEXT 13
1.4 BACKGROUND 14
2 DESCRIPTION OF THE RECEIVING ENVIRONMENT 15
2.1 GENERAL LOCATION 15
2.2 LAND USE 17
3 METHODOLOGY 19
3.1 SITE VISIT 19
3.2 DATA SOURCING AND REVIEW 19
3.2.1 Vegetation 19
3.2.2 Fauna 20
3.3 DATA COLLECTION, SAMPLING AND ANALYSIS 20
3.4 COMMON SAMPLING APPROACHES 21
3.4.1 SAMPLING SCALE ISSUES 21
3.4.2 RANDOM AND REPRESENTATIVE SAMPLING 22
3.4.3 LINE TRANSECT SAMPLING AND RANDOM QUADRAT SAMPLING 22
3.5 SENSITIVITY MAPPING & ASSESSMENT 23
4 RESULTS 25
4.1 VEGETATION 25
4.2 VEGETATION IDENTIFIED ON SITE 26
4.2.1 Trees and shrubs 27
4.2.2 Grasses 30
4.2.3 Flowers and Herbs 31
4.2.4 Reeds and Aquatic Plants 32
4.2.5 Declared weeds and invaders 33
4.2.6 Medicinal plants 34
4.3 FAUNA (Vertebrates) 36
4.3.1 Mammals 36

4.3.2 Avifauna 37
4.3.3 Reptiles 37
4.3.4 Amphibians 38
4.3.5 Invertebrates 39
4.4 RED DATA SPECIES 39
4.4.1 RED DATA SPECIES OBSERVED ON SITE 40
5 SENSITIVITY OF THE OVERALL AREA 40
5.1 CRITICAL BIODIVERSITY 40
5.2 THREATENED ECOSYSTEM 42
5.3 SENSITIVITY OF THE PROPOSED DEVELOPMENT AREA 43
6 IMPACT RISK FACTORS 43
6.1 POTENTIAL IMPACTS OF PIPELINE CONSTRUCTIN ON VEGETATION 44
7 IMPACT ASSESSMENT CRITERIA 44
8 IMPACT ASSESSMENT 45
8.1 NATURAL VEGETATION DESTRUCTION 45
8.2 SOIL EROSION AND RUN-OFF 46
8.3 ALIEN VEGETATION ENCROACHMENT 46
8.4 IMPACTS DURING OPERATIONAL PHASE 47
9 INDIGENOUS VEGETATION MANAGEMENT PLAN 50
9.1 ALIEN INVASIVE SPECIES CONTROL 50
9.2 MANAGEMENT OF RED DATA SPECIES ON SITE 52
9.3 FAUNA MANAGEMENT PRINCIPLES 52
10 CONCLUSION 53
11 REFERENCES 54

LIST OF FIGURES

Figure 1: Proposed outfall pipeline locality 16
Figure 2: Land use around the proposed Adamayview sewer outfall development 17
Figure 3: Proposed development area along Palmietspruit before N12 18
Figure 4: Transformed vegetation south of the proposed development area 18
Figure 5: Vegetation type within the study area 26
Figure 6: General view of the proposed development site 27
Figure 7: *Arundo donax* 33
Figure 8: IUCN Red data categories (SANBI, 2012) 40
Figure 9: Proposed development site is located in a Critical Biodiversity Area 41
Figure 10: Proposed sewer outfall pipeline site located within an endangered ecosystem 42
Figure 11: Proposed site sensitivity 43

LIST OF TABLES

Table 1: Trees and shrubs observed on site....29
Table 2: Grasses observed on site....30
Table 3: Flowers and herbs observed on site....32
Table 4: Alien invasive plants observed on site....34
Table 5: Medicinal plants observed on site....35
Table 6: Mammal species occurring in the study area QDS....36
Table 7: Reptile species occurring in the study area QDS....37
Table 8: Frogs (amphibians) occurring in the study area QDS....38
Table 9: Impact assessment criteria....45
Table 10: Impacts of vegetation during construction phase....48
Table 11: Impacts on vegetation during operational phase....49

APPENDICES

Appendix 1: Vegetation observed on site……...57
Appendix 2: List of threatened vegetation……..….58
Appendix 3: Gauteng threatened birds……60

DEFINITION OF TERMS

Alien species: Alien species are species which originate from a foreign country.

Assessment Criteria: The environmental impacts are assessed with mitigation measures (MM) and without mitigation measures (WMM).

Biodiversity: Biodiversity is the variety of plant and animal life in the world or in a habitat.

Biome: A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.

Confidence: The confidence level can be classified as medium during the construction phase. However, the confidence level becomes low during the operational phase.

Conservation: Conservation is the management of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.

Duration: the period of time during which something continues.

Ecosystem: Organisms together with their biotic environment, forming an interacting system, inhabiting an identifiable space.

Ecosystem services: Activities that help to maintain an ecosystem but are not directly part of energy flows and nutrient cycles. Examples include pollination, dispersal, population regulation, and provision of clean water and the maintenance of liveable climates (carbon sequestration).

Endangered: A taxon is endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Endemic: An ‘Endemic Species’ is one that is only found in that region and nowhere else in the world. As such they are of conservation concern because they are not widespread and may be confined to only one or two protected areas.

Exotic: a species introduced either accidentally or deliberately by human actions into places beyond its natural geographical range.

Edaphic: Refers to the influence by factors inherent in soil rather than climatic conditions.

Intensity: The intensity of the development can be categorized as medium since the impacts of the activity will alter the environment due to increased disturbance of the site by heavy machinery.

Probability: Is a way of expressing knowledge or belief that an event will occur or has occurred.

Red Data: A list of fauna and flora species that require environmental protection.

Significance with and without mitigation: The significance without mitigation is medium; meaning that the impact of the development is of moderate importance and is considered to have a medium negative impact. The significance with mitigation is low, meaning that the negative impact of the operation is of importance but is reduced by the mitigation measures.

Species diversity: A measure of the number and relative abundance of species (see biodiversity).

Species richness: The number of species in an area or habitat.

LIST OF ACRONYMS

IUCN: International Union for Conservation of Nature.

NFEPA: National Freshwater Ecosystem Priority Areas.

NPAES: National Protected Area Expansion Strategy.

CBA: Critical Biodiversity Area.

ESA: Ecological Support Area.

SIBIS: SANBI's Integrated Biodiversity Information System.

SARCA: Southern African Reptile Conservation Assessment

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

BGIS: Biodiversity- GIS (Geographic Information System).

SABIF: South African Biodiversity Information Facility.

POSA: Plants of Southern Africa.

SANBI: South African National Biodiversity Institute

QDS: Quarter Degree Square

1 INTRODUCTION

The City of Matlosana has since experienced blockages/overflow of sewage, where the outfall sewer line reduces the size from 600Ø to 375Ø then 1000Ø for approximately 3.7km.

The proposed project (sewer outfall pipeline upgrade) is aimed at providing intergraded social development in the City of Matlosana. The current outfall sewer line is discharging 225 litres per second. The existing outfall sewer line runs parallel with the existing stream. The proposed sewer outfall upgrade will run along the existing pipeline but further away from the river. The existing pipe sizes are detailed below:

- The pipe size at highest point of the site starts at 600mm and reduces to 375mm, then 1050mm at the lowest side; and
- For approximately 3.7km, the pipe size remains at 375mm then enlarges to 1000mm.

SAZI Environmental Consulting cc was appointed to undertake an assessment of fauna and flora species for the proposed upgrade of a sewer outfall pipeline by the City of Matlosana in Adamayview, North West Province. The study was undertaken in May 2017.

1.1 TERMS OF REFERENCE

The terms of reference for the current study were as follows:

- To undertake a vegetation survey on site and provide species lists;
- To identify possible Red Data floral species and important habitat that may occur within the proposed site;
- To provide a desktop faunal survey of the area;
- To provide an indication of the relative conservation importance and ecological function of the study area in terms of flora and fauna;
- Identify measures to reduce the impacts, and/or measures to optimise or enhance possible benefits to biodiversity; and
- Provide a vegetation and fauna management Plan.

1.2 LIMITATIONS AND ASSUMPTIONS

The major potential limitation associated with the project is the narrow temporal window allocated for sampling. Ideally, a site should be visited several times during different

seasons to ensure that the full complement of plant and animal species present are captured. However, this is rarely possible due to time and cost constraints and therefore, the representation of the species sampled at the time of the site visit should be evaluated.

The site visits took place on the last day of autumn (31 May 2017) when the conditions for sampling were not highly favourable. The autumn season is marked by slow rainfall and warm sunshine which are both favourable for plant and animal life. Animals have not gone into hibernation during this season and the warm temperatures during the day warm the ground making it softer and more yielding to plants. Although the assessment was undertaken in autumn, the temperatures had already transcended into the winter season. According to Pooley (2005), many herbaceous plants in winter die back and reptiles hibernate (Jacobsen, 2005) while many amphibians are still out to mate in the autumn rainfall (Du Preez & Carruthers, 2009). According to the Gauteng Department of Agriculture and Rural Development Requirements for Biodiversity Assessments Version 3 (2014), vegetation surveys must be undertaken during the summer season (beginning November to the end of April) while surveys for Red and Orange List plant species are to be undertaken during the flowering season of plants historically recorded on site. The limitations of undertaking fauna and flora assessments during winter are that this season is marked by decreased rainfall and colder temperatures which are both unfavourable for plant and animal life. Most animals are in hibernation in winter and colder temperatures cool the ground which may freeze over the winter months making it harder and unyielding to plants.
Therefore, the fauna and flora assessment undertaken by SAZI in winter may not offer a representative sample of the species diversity on site as the time of assessment does not offer optimal conditions for fauna and flora observation.

General observations upon walking through the study site and a survey of aerial imagery also assisted in the compilation of the sensitivity map. Information about this study relied on data from representative sections of natural grassland, wetlands and riparian areas.
The lists of avifauna, amphibians, reptiles and mammals for the site were based on those observed at the site as well as those likely to occur in the area based on their distribution and habitat preferences. This represents a sufficiently conservative and cautious approach which takes the study limitations into account. The following limitations also apply to this study:

- The majority of threatened plant and animal species are seasonal, only emerging after sufficient early heavy summer rainfalls between October and December; and
- The majority of threatened faunal species are extremely secretive and difficult to observe even during intensive field surveys conducted over several years.

1.3 LEGISLATIVE CONTEXT

South African environmental law chronicles the legal rules in South Africa concerning the philosophical, economic, and social and statute issues raised by the pursuit to protect and conserve the environment in the country. The environmental law in South Africa incorporates natural resource conservation and utilisation as well as development and land use planning. Enforcement issues are also considered. The primary acts that relate to the Adamayview fauna and flora assessment are described below:

Section 24 of the Constitution enshrines the right to – the Environment

Everyone has the right —

1. to an environment that is not harmful to their health or well-being; and

2. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that —

3. prevent pollution and ecological degradation;

4. promote conservation; and

5. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

NATIONAL ENVIRONMENTAL MANAGENENT ACT, 1998 (Act no. 107 of 1998). This act provides the underlying framework for environmental law in South Africa. The legislation in the act provides for environmental management in the country.

THE NATIONAL ENVIRONMENTAL MANAGEMENT BIOIDVERSITY ACT, 2004 (Act no. 10 of 2004)

The purpose of the National Environmental Management Biodiversity Act (NEMBA) is to provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act (107 of 1998). This includes: the protection of species and ecosystems; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving

indigenous biological resources; and the establishment of a South African National Biodiversity Institute.

THE NATIONAL WATER ACT, 1998 (Act no. 36 of 1998)

The act contains comprehensive provisions for the protection, use, development, management, conservation and control of South Africa's water resources. It is the principal legal requirement relating to water resources management in South Africa.

THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 (Act no. 59 of 2008)

The purpose of the act is, "To reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development; to provide for institutional arrangements and planning matters; to provide for national norms and standards for regulating the management of waste by all spheres of government; to provide for specific waste management measures; to provide for the licensing and control of waste management activities; to provide for the remediation of contaminated land; to provide for the national waste information system; to provide for compliance and enforcement; and to provide for matters connected therewith."

1.4 BACKGROUND

Environmental Impact Assessments (EIAs) are required in South Africa in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) and its' associated EIA Regulations. Construction of the sewer outfall pipeline triggers listed activities for which an environmental authorisation is required before construction can commence.

Natural vegetation will be affected by the proposed development, as such a specialist botanical survey was commissioned as part of the environmental assessment process. If a sub-population of a species of conservation concern is found to occur on the proposed development site, it would be one indicator that the proposed activity is likely to result in loss of biodiversity, bearing in mind that loss of sub-populations of these species will either increase their extinction risk or may in fact result in their extinction. This also applies to fauna whereby a specialist zoological survey needs to be undertaken if fauna will be affected by a

proposed development. The detection of a threatened species on a site during an environmental assessment should result in an Environmental Authorisation from the competent authority that avoids, mitigates, remedies or offsets loss of habitat for the species in question. The competent authority may also refuse authorisation for the proposed activity. In practice, the mitigation requirements that allow the proposed development to proceed, including the amount of habitat set aside differ widely depending on the environmental assessment practitioner's recommendations and the policies of the competent authority. In order to strengthen the environmental assessment process and improve consistency, the following section provides:

2 DESCRIPTION OF THE RECEIVING ENVIRONMENT

2.1 GENERAL LOCATION

The proposed development area is located west of Adamayview. The proposed pipeline begins downstream of the Palmietspruit River, crosses the N12, runs southward along the Palmietspruit River and finally ends on Kleynhans Street near the City on a Hill Church International in Klerksdorp, North West Province.

The general layout of the site is illustrated on Figure 1 below.

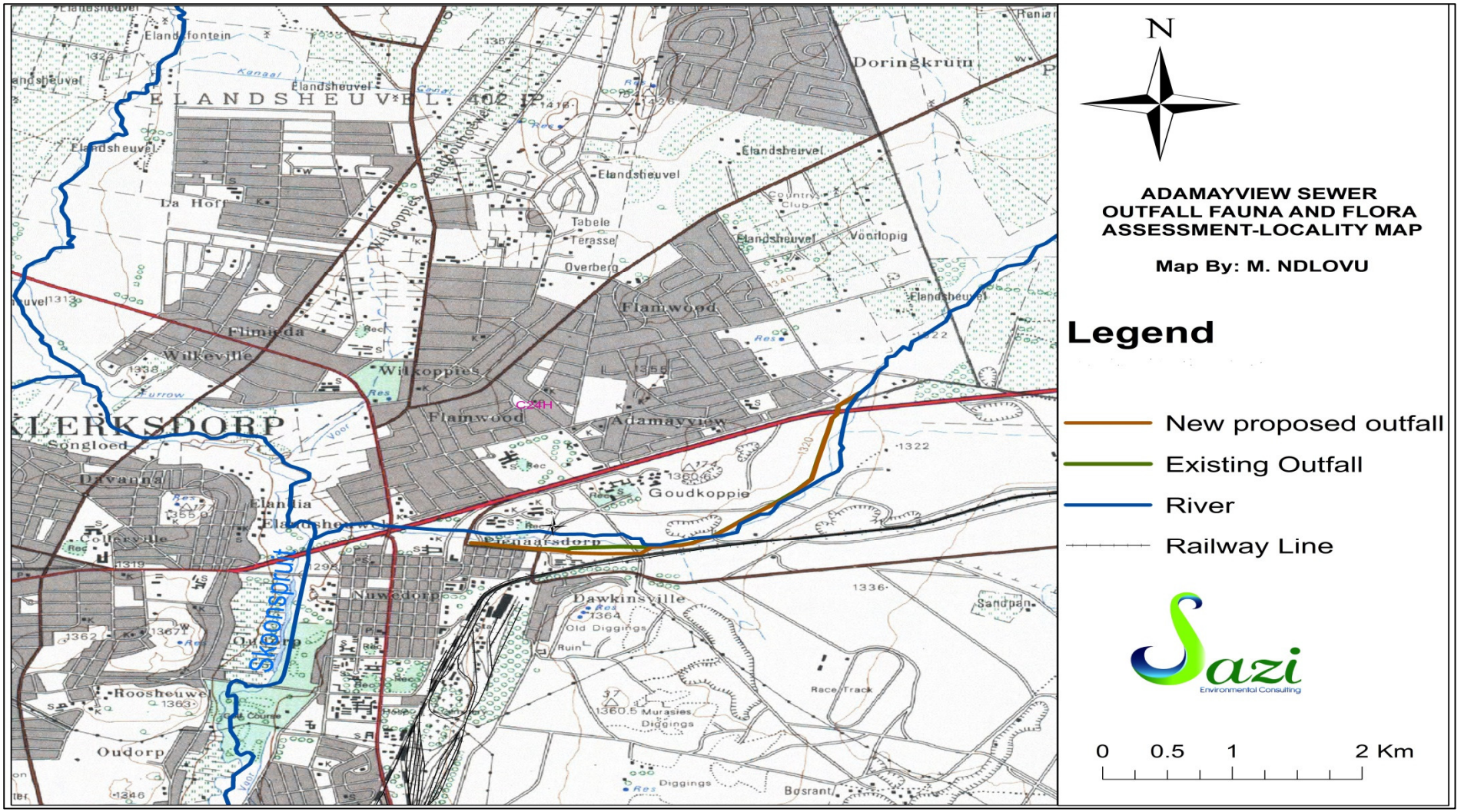


Figure 1: Proposed outfall pipeline locality

2.2 LAND USE

To the north, west and south of the proposed development area are urban areas. The residential areas surrounding the proposed development site can be classified as urban built up areas. The nearest residential complex is the Adamayview and Flamwood residential areas to the north of the proposed site. To the north east and east of the proposed development area is grassland. To the south of the proposed development site are areas of industry and transport and mine pits and tailings (Figure 2).

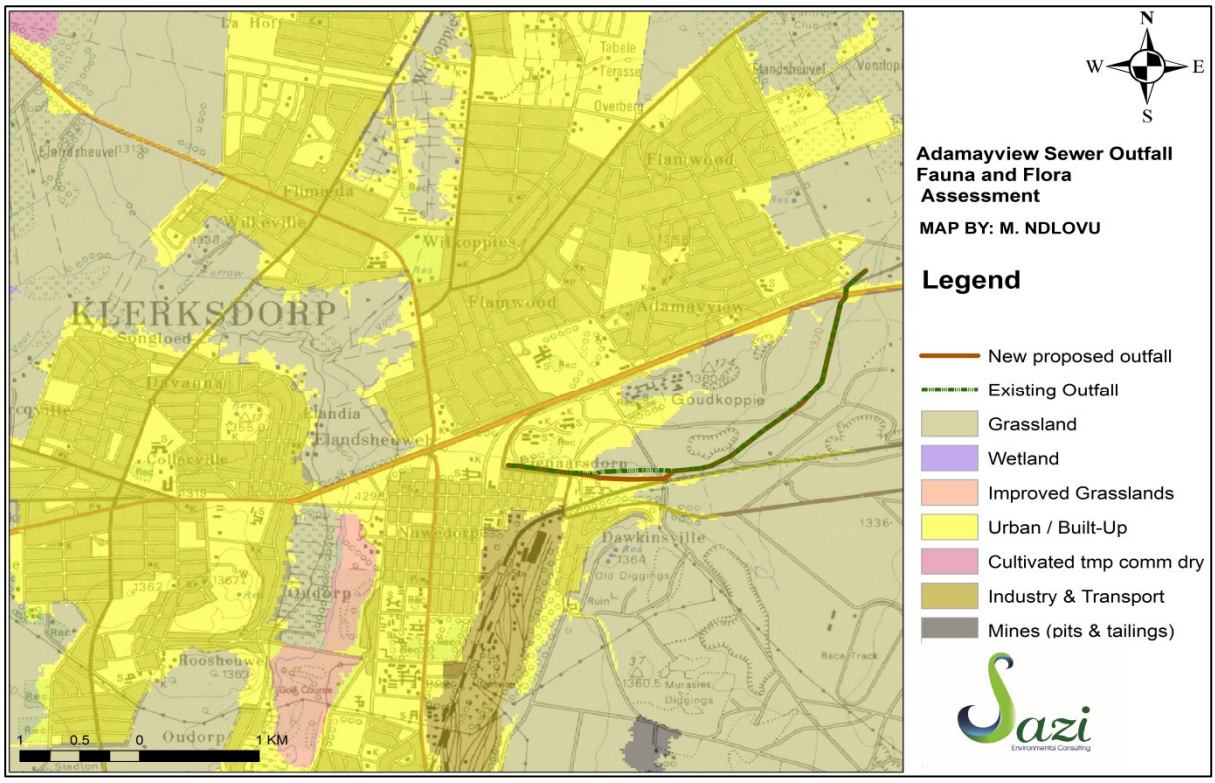


Figure 2: Land use around the proposed Adamayview sewer outfall development



Figure 3: Proposed development area along Palmietspruit before N12



Figure 4: Transformed vegetation south of the proposed development area

3 METHODOLOGY

3.1 SITE VISIT

The site visit took place in May 2017. During the site visit, all sensitive features present within and around the study area were noted and recorded. A plant species list for the site was developed and all fauna observed were recorded. Photographs were taken to illustrate information collected from the site.

The presence of sensitive habitats within the site such as drainage features were noted in the field if present and recorded on a GPS. All drainage features were identified and demarcated in the field where necessary.

3.2 DATA SOURCING AND REVIEW

Data sources from the literature consulted and used where necessary in the study include the following:

3.2.1 Vegetation

Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina & Rutherford, 2006) as well as the National List of Threatened Ecosystems (2011), where relevant. Critical Biodiversity Areas for the site and surroundings were extracted from the Fine Scale Conservation Plan of Gauteng. Information on plant and animal species recorded for the project site was extracted from the SABIF/SIBIS database hosted by the South African National Biodiversity Institute (SANBI).

The International Union for Conservation of Nature (IUCN) conservation status of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2014). Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel *et al.,* 2011). Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

The following books (but not limited to) were used to identify flora species observed on site: Field guide to trees of Southern Africa (van Wyk & van Wyk, 2013), Guide to grasses of Southern Africa (van Oudtshoorn, 2012), Photo guide of wildflowers of South Africa (Manning, 2012), Guide to plant families of southern Africa (Koekemoer, Steyn & Bester, 2014), and A field guide to wildflowers of KwaZulu-Natal and the Eastern region (Pooley, 2005).

3.2.2 Fauna

Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and various spatial databases (SANBI's SIBIS and BGIS databases).

Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez & Carruthers (2009) for amphibians, Friedmann & Daly (2004) and Skinner & Chimimba (2005) for mammals.

Apart from the literature sources, additional information on reptiles were extracted from the SARCA web portal, hosted by the Animal Demographic Unit (ADU), http://vmus.adu.org.za for the quarter degree square in which the site occurs.

The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.

The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria version 2014.2 and where species have not been assessed under these criteria, the CITES status is reported where possible.

3.3 DATA COLLECTION, SAMPLING AND ANALYSIS

Vegetation refers to the great diversity of plant species which occur in repeating assemblages over the face of the earth. Before attempting to inventory and map vegetation, it is necessary to understand certain features of the nature of vegetation (Kuchler & Zonneveld, 1988). Three areas of ecological theory should be given consideration in the sampling design for vegetation classification and mapping: (1) the nature of vegetation as a biotic component of ecosystems, (2) the nature of the abiotic component, and (3) the vegetation/abiotic relationships.

The overall appearance of the vegetation is called its physiognomy (Kuchler & Zonneveld 1988). The physiognomy is used to describe the broad features of the vegetation, such as the growth forms and/or the life form of dominant species within a plant community. Life form is a very important characteristic of vegetation and is used in many vegetation classification systems (Kuchler & Zonneveld 1988).

The floristic composition of vegetation includes all species occurring within a plant community. However, most plant communities consist of so many species that it is not practical to discover all species within a community. Vegetation profile is defined as the vertical aspect of the vegetation. Stratification is the most obvious application of the study of

vegetation profile. The strata are not always horizontal, such as epiphytic bryophyte and/or lichen layers in forests. The vertical structures of vegetation are very important for the physiognomic aspect of the standard ecological assessment as well as for photo interpretation. A combination of physiognomy, floristic composition, and profile is essential information to identify and describe plant communities.

Ecologists are often interested in obtaining information pertaining to a large number of variables in a community. The following brief descriptions of most common vegetation parameters used in ecological assessments are as follows:

Species Occurrence: The species component is the fundamental structure of a plant community. A species list is an essential part of all vegetation survey activities (Causton, 1988).

Frequency: The frequency of a species is defined as the probability of finding it within a plot when the plot is placed on the ground. The prime requirement in estimating frequency is to use as large a sample size as possible (Causton, 1988).

Cover: The cover of a species is defined as the proportion of ground occupied by vertical projection. Cover is normally expressed as a percentage and the maximum cover of any one species is 100 percent. For classification purposes, the most common practice is estimation of cover in field. There are a number of "scales" or ratings based on cover (Mueller-Dombois & Ellenberg, 1974; Causton, 1988). Sampling of percentage cover is very similar in principle to the sampling of frequency. Thus, the recommendation of having a large sample size is also applicable to cover.

3.4 COMMON SAMPLING APPROACHES

The complex spatiotemporal nature of the vegetation presents a number of problems when designing optimal sampling schemes for a landscape. First, there is a lack of useful information on the spatial characteristics of the vegetation. Second, little attention has been given to extensions of traditional sampling theory for two-dimensional sampling of vegetation (Mueller-Dombois & Ellenberg, 1974).

3.4.1 SAMPLING SCALE ISSUES

Vegetation is a multilevel phenomenon, that is to say the scale of pattern ranges from the region of influence of an individual plant to the ecoregion. The choice of scale for observation is of great importance in vegetation inventory. Hierarchies of observation scale present different issues because scale can be changed in a continuous manner, while the hierarchies of vegetation classification systems emphasize the importance of distinguishing types. It is important to understand this to ensure that different types are not mixed by using various observation scales. The relation of vegetation and environment and ecological

processes are also scale dependent phenomena. Several studies (Allen & Starr 1982; Weir & Wilson 1988; Reed *et al.,* 1993) indicated that multiple scales of observation in ecological investigations can be critical for understanding vegetation patterns and processes.

3.4.2 RANDOM AND REPRESENTATIVE SAMPLING

The primary goal of vegetation surveys is to characterize as many vegetation patterns as possible within the study area. The recovery of vegetation pattern is not necessarily accomplished by the usual statistical sampling procedures. Sampling theory emphasizes randomization in order to provide a probability structure for statistical analysis or to give credibility to the statistical model used.

Data sets need to be representative of the full range of variability in biological patterns in response to variability in the environment. In vegetation surveys, two aspects of pattern recognition should be considered: (1) the recognition of the pattern itself (e.g. a specific forest type) and (2) the frequency and distribution of patches of the pattern (i.e. spatial distribution, number and size of forest stands) (Godron & Forman 1983; Gillison & Brewer 1985). In landscapes, vegetation patch frequency and distribution vary as a scale-sensitive function of environmental complexity and the level of resolution of the vegetation classifications used to characterize the pattern (Gillison & Brewer, 1985).

In this study a GIS desktop exercise and literature review preceded the site visits. Areas of natural vegetation were identified from imagery and groundtruthed upon arrival on site. Vegetation sampling within the project area was then focused in the identified areas, data being collected during the sampling visit. The adopted methodology comprised of scientific vegetation sampling (Mueller-Dombois & Ellenberg, 1974) method, where presence absence data was collected using the following sampling techniques:

3.4.3 LINE TRANSECT SAMPLING AND RANDOM QUADRAT SAMPLING

Line transect sampling was undertaken during the site visits at the same time, species were recorded at 40m intervals whilst walking along the altitudinal gradient of the site. Random quadrat sampling was undertaken by first visually identifying vegetation communities at a landscape level. Within these communities, random 40x40m quadrats were set out and a Braun Blanquet cover abundance measurement was applied as means of data collection. Repetitive sampling was undertaken where three plots were set out in each section of the site.

Braun Blanquet cover abundance measurement assigns values to specific species based on their presence in the quadrat. This allowed dominant species to be identified and gave an indication of community dynamics. Photographs and physical attributes supplemented the sampling. From this data, the species composition of specific communities could be

generated and further areas could be classified based on their species compositions. Only two distinct communities were categorised and were comprised of the wetlands and the grasslands. These were largely based on vegetation composition; however physical characteristics also played a role in the classification.

When individuals were thought to be of importance, whole specimens were collected, bagged, labelled and location was recorded with a Global Positioning System (GPS) for identification at a later stage. The data was analysed by undertaking the following:

- Comparison with Mucina & Rutherford (2006) species listed for the Vaal-Vet Sandy Grassland vegetation unit;
- Comparison of data between sample plots; and
- Comparison of sample plots to derive dominant species composition and hence classify vegetation communities.

3.5 SENSITIVITY MAPPING & ASSESSMENT

An ecological sensitivity map of the site was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases. This includes delineating the different habitat units identified in the field and assigning sensitivity values to the units based on their ecological properties, conservation value and the observed presence of species of conservation concern. The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

Low – Areas of natural or transformed habitat with a low sensitivity where there is likely to be a negligible impact on ecological processes and terrestrial biodiversity. Most types of development can proceed within these areas with little ecological impact.

Medium- Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. These areas usually comprise the bulk of habitats within an area. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.

High – Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. These areas may contain or be important habitat for faunal species or provide important ecological services such as water flow regulation or forage provision. Development within these areas is undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.

Very High – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided as much as possible.

In some situations, areas were also classified between the above categories, such as Medium-High, where it was deemed that an area did not fit well into a certain category but rather fell most appropriately between two sensitivity categories.

4 RESULTS

4.1 VEGETATION

The project site is located within the highly threatened Grassland Biome of South Africa with approximately two percent currently conserved (Le Roux, 2002). The study area falls within the Vaal-Vet Sandy Grassland (Low & Rebelo 1998) (Figure 5), which in turn comprises part of the Grassland Biome (Mucina & Rutherford, 2006). This type is situated in the North-West and Free State Provinces, south of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein. The topography is a plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Vegetation is mainly low-tussock grasslands with an abundant karroid element. The dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* is associated with an increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta*, frequently attributed to heavy grazing and/or erratic rainfall. Nationally, the conservation status is regarded as Endangered, implying an ecosystem that has undergone significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems. Only 0.3 % of this ecological type is statutorily conserved in the Bloemhof Dam, Palmietspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63 % is currently transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep. The endemic species *Lessertia phillipsiana* is known to persist in this vegetation type.

Important taxa include the following:

• **Graminoids** - *Anthephora pubescens, Aristida congesta, Chloris virgata, Cymbopogon caesius, C. pospischilii, Cynodon dactylon, Digitaria argyrograpta, D. eriantha, Elionurus muticus, Eragrostis chloromelas, E. lehmanniana, E. plana, E. trichophora, E. curvula, E. obtusa, E. superba, Heteropogon contortus, Panicum coloratum, P. gilvum, Setaria sphacelata, Themeda triandra, Tragus berteronianus, Brachiaria serrata, Pogonarthria squarrosa, Trichoneura grandiglumis and Triraphis andropogonoides.*

• **Herbs** - *Stachys spathulata, Barleria macrostegia, Berkheya onopordifolia var. onopordifolia, Chamaesyce inaequilatera, Geigeria aspera var. aspera, Helichrysum caespititium, Hermannia depressa, Hibiscus pusillus, Monsonia burkeana, Rhynchosia adenodes, Selago densiflora and, Hilliardiella oligocephala.*

• **Geophytic Herbs** - *Bulbine narcissifolia and Ledebouria marginata.*

• **Succulent Herb** - *Tripteris aghillana var. integrifolia.*

• **Low Shrubs** - *Felicia muricata, Pentzia globosa, Anthospermum rigidum subsp. pumilum, Helichrysum dregeanum, H. paronychioides and Ziziphus zeyheriana.*

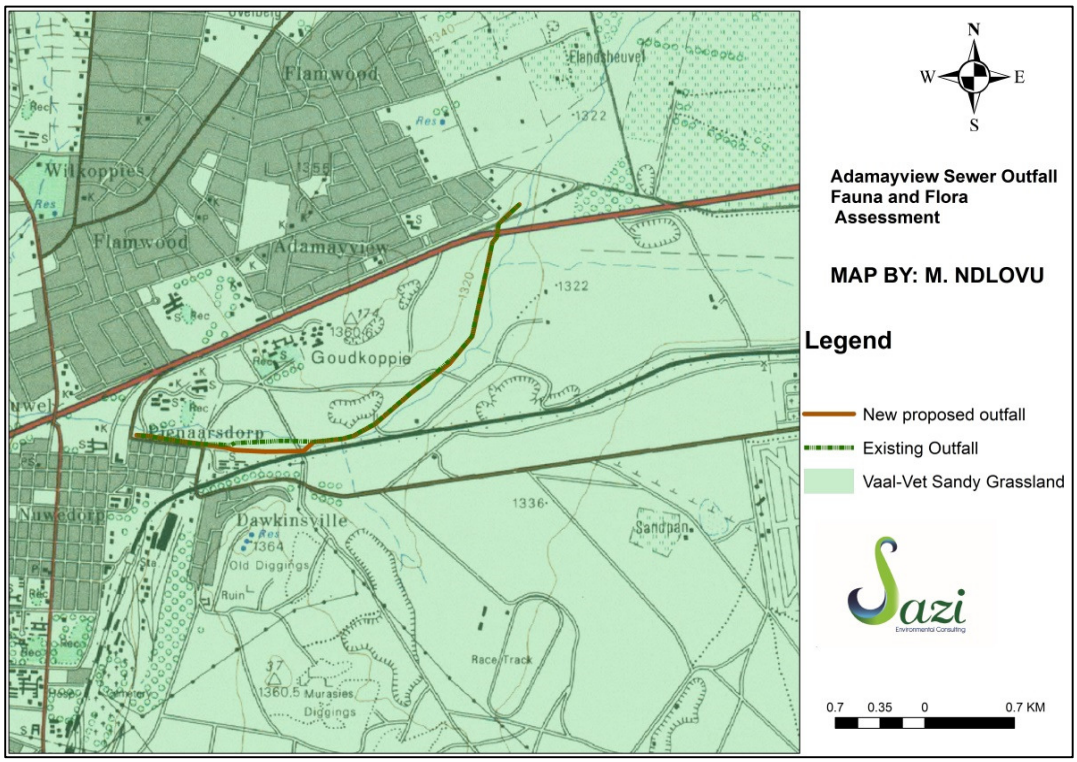


Figure 5: Vegetation type within the study area

4.2 VEGETATION IDENTIFIED ON SITE

The majority of the site consisted of grassland and disturbed areas surrounded by built-up area. Roads also cross the site. The site mainly consisted of a herbaceous layer dominated by grasses as well as sporadic tree species and a discontinuous layer of shrubs. The vegetation species identified on the site included alien species. Alien invaders are plants that are of exotic origin and invade areas that were previously pristine or invade ecological niches (Bromilow, 2001). However, not all weeds are exotic in origin but more often than not, they grow aggressively and are the most opportunistic in an ecosystem. Consequently, most often they are the most noticeable and dominant within an area. Ground disturbances such as mining, urbanisation, roads, trampling and excavations often lead to the dominance of exotic species as might be the case in this study area as it is surrounded by numerous urban

developments. The majority of the site is used as a residential area as well as farm areas. The figure below provides a general view of the proposed development site.

A plant species list recorded during the assessment is provided as Appendix 1. A total of 30 species were recorded (dominant vegetation types) during the assessment of which 10 are declared weeds or invader plants (Table 4). The proportion of exotic and declared weeds or invader species is noticeable (33 %), a reflection of high levels of disturbance and transformation in the study area.



Figure 6: General view of the proposed development site

4.2.1 Trees and shrubs

The proposed site for the sewer outfall pipeline consisted of sporadic trees and shrubs, which were characterised by small to medium sized woody plants, which were under 6m in height. Alien tree species and weeds were observed on site and included; *Eucalyptus camaldulensis, Salix babylonica, Agave sisalana, Populus x canescens* and *Seriphium plumosum* (previously known as *Stoebe vulgaris*).

Appendix 2 includes a list of threatened plant species likely to be found on site, which have been used to prioritise conservation in Gauteng. Table 1 below indicates some of the trees and shrubs observed on site.

Table 1: Trees and shrubs observed on site

Trees and shrubs	Name
	*Salix babylonica*
	*Agave sisalana*
	*Populus x canescens*

	*Eucalyptus camaldulensis*

4.2.2 Grasses

The grass species observed included: *Hyparrhenia hirta, Hyparrhenia tamba, Themeda triandra, Elionurus muticus, Aristida congesta, Cymbopogon pospischilii, Eragrostis curvula, Eragrostis superba* and *Heteropogon contortus,* Table 2 below illustrates some of the grasses observed on site.

Table 2: Grasses observed on site

Grass	Name
	*Themeda triandra*

	*Hyparrhenia hirta*
	*Elionurus muticus*

4.2.3 Flowers and Herbs

Flowers and herbs observed on site included *Vernonia oligocephala, Tagetes minuta, Aloe greatheadii* var*. davyana, Amaranthus hybridus, Bidens pilosa, Verbena bonariensis, Hermannia depressa, Anthospermum rigidum subs. Pumilum* and *Datura ferox* as indicated in Table 3 below. The *Tagetes minuta* and *Bidens pilosa* plants were dominant on site. Both these plants are classified as weed invaders and thrive in disturbed land.

Table 3: Flowers and herbs observed on site

	*Tagetes minuta*
	*Amaranthus hybridus*
	*Bidens pilosa*

4.2.4 Reeds and Aquatic Plants

The Spanish reed (*Arundo donax*) was found in various sections of the assessed site. The reed formed clomps on sections of the site. The reed mostly grows in disturbed and

degraded land. The aquatic plant, *Typha capensis* together with the indigenous reed, *Phragmites australis* were also observed at various points near the Palmietspruit River.



Figure 7: *Arundo donax*

4.2.5 Declared weeds and invaders

Concern is growing over the way in which alien/exotic plants are invading large areas within South Africa. Invasive species are a major threat to the ecological functioning of natural systems as well as the productive use of the land, and should ideally be removed if they are serving no ecological function. In terms of the amendments to the regulations under the National Environmental Management: Biodiversity Act, 2004 (Act no. 10 of 2004) – Alien and Invasive Species (AIS) Regulations which became law on 1 October 2014, landowners are legally responsible for the control of invasive alien plants on their properties. There are currently 198 alien species listed as declared weeds and invaders, and have been divided into three categories (Henderson, 2001):

- Category 1 plants are prohibited and must be controlled;
- Category 2 plants (commercially used plants) may be grown in demarcated areas proving that there is a permit and that steps are taken to prevent their spread; and
- Category 3 plants (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading there of, except within the flood line of watercourses and wetlands.

The site for the proposed development housed a number of alien invasive species and weeds. The majority of the site was surrounded by indigenous grasses. The following alien invasive species (among others) were observed on site, *Arundo donax, Eucalyptus camaldulensis, Datura stramonium, Agave sisalana* and *Verbena bonariensis*. Table 4 below gives a list of alien invasive species and weeds observed on site.

Table 4: Alien invasive plants observed on site

SCIENTIFIC NAME	COMMON NAME	INVADER CATEGORY
Datura stramonium	Thorn Apple	Category 1b
Tagetes minuta	Tall Khakiweed	Declared Weed Category 1
Arundo donax	Spanish Reed	Category 1b
Datura ferox	Thorn Apple	Category 1b
Agave sisalana	Century Plant	Category 2
Eucalyptus camaldulensis	Red gum	Category 2
Verbena bonariensis	Tall Verbena	Category 1b
Solanum mauritianum	Bugweed	Category 1b
Salix babylonica	Weeping Willow	Category 2
Populus x canescens	Poplar	Category 2

4.2.6 Medicinal plants

Medicinal plants are plants which are used in herbalism and thought to have certain extractable/compound in their leaves, stems, flowers and fruit for medicinal purposes. These extracts are used as inputs in the pharmaceutical, nutraceutical, insecticide and other chemical industries. Some of the medicinal plants observed on site included: *Bidens pilosa, Tagetes minuta, Aloe greatheadii var. davyana, Amaranthus hybridus* and *Rumex obtusifolius.* The table below illustrates some of the medicinal plants observed on site.

Table 5: Medicinal plants observed on site

Trees and shrubs	Name
	*Tagetes minuta*
	*Amaranthus hybridus*

In addition to those listed above, during the site assessment, a variety of plant species with medicinal properties were identified. These included plants that are alien invasive as well as weeds. Although they are invasive or weeds, it is important that their medicinal properties (van Wyk, van Oudtshoorn & Gericke, 1997) are also mentioned:

- *Eucalyptus camaldulensis*: the oil found in the leaves of this tree can be used as an antiseptic and for relieving coughs and sore throats;
- *Datura stramonium*: although very poisonous, the juice from this herb can be used to treat hair loss and dandruff by applying it over the scalp; Jimson weed is used to treat spasm of bronchitis in asthma;

- Datura seeds and leaves are used as anti-asthmatic, antispasmodic, hypnotic and narcotic; and
- *Tagetes minuta*: this herb can be used to treat inflammation.

4.3 FAUNA (Vertebrates)

The presence of fauna was recorded and based primarily on evidence of their occurrence (droppings, burrows, skulls, spoor and visual confirmation). The proposed development route comprised of highly transformed areas such as the residences, dumping areas and transformed vegetation patches which make for unsuitable habitat for many animals, especially habitat specific threatened faunal species. This is largely due to the disturbed nature of the site to house threatened/species of conservation concern.

4.3.1 Mammals

No small mammal trapping was conducted. Fieldwork was augmented with previous surveys in similar habitats as well as published data. The area was initially traversed on foot to ascertain the presence of mammals. During the site assessment, no mammal species were observed. From a desktop study for mammals, 30 mammal species were found to occur within the quarter degree square in which the study area is located (SARCA, http://sarca.adu.org.za accessed on 21 June 2017) and therefore, these species could potentially occur on the site. However, due to the developed nature in which the site occurs, no suitable habitat is available for most of the species and so, presented in the table below is a list of only those mammals that are likely to occur on site due to suitable habitat. The table below provides a list of the species together with their conservation status.

Table 6: Mammal species occurring in the study area QDS

Species	**Common name**
Herpestes sanguineus	Slender Mongoose
Xerus (Geosciurus) inauris	South African Ground Squirrel
Lepus saxatilis	Scrub Hare
Cynictis penicillata	Yellow Mongoose
Lepus capensis	Cape Hare
Procavia capensis	Rock Hyrax
Ichneumia albicauda	White-tailed Mongoose
Thryonomys swinderianus	Greater Cane Rat
Sylvicapra grimmia	Bush Duiker
Pedetes capensis	South African Spring Hare

4.3.2 Avifauna

A total of 6 bird species were observed at the proposed development site during the time of assessment: *Bostrychia hagedash* (Hadada ibis), *Vanellus armatus* (Blacksmith lapwing), *Vanellus coronatus* (Crowned lapwing), *Burhinus capensis* (Spotted thick-knee), *Ardea cinerea* (Grey Heron) and *Acridotheres tristis* (Common myna). During a desktop assessment of the bird species that may potentially occur on site, the South African Bird Atlas Project 2 (SABAP2) (www.sabap2.adu.org.za, accessed 21 June 2017) did not have a list of birds occurring in the 2627BA QDS in which the proposed development site occurs. Appendix 3 provides a list of threated bird species in Gauteng.

4.3.3 Reptiles

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe during field surveys. The majority of reptile species are sensitive to severe habitat alteration and fragmentation. Due to human presence in the area coupled with transformation of the habitat within the site are all causal factors in the alteration of reptile species occurring on the site and surrounding areas. The indiscriminate killing of all snake species as well as the illegal collecting of certain species for private and the commercial pet industry reduces reptile populations especially snake populations drastically.

No reptiles were observed during the site assessment. Twenty two reptile species (geckos, lizards, skinks, snakes and agamas) occur in the 2626DC quarter degree square in which the proposed sewer outfall pipeline development site is located (SARCA, http://sarca.adu.org.za accessed on 21 June 2017). This means that some of the species could occur in the proposed development area.

Table 7: Reptile species occurring in the study area QDS

Species	Common name
Lygodactylus capensis capensis	Common Dwarf Gecko
Boaedon capensis	Brown House Snake
Crotaphopeltis hotamboeia	Red-lipped Snake
Chamaeleo dilepis dilepis	Common Flap-neck
Dasypeltis scabra	Rhombic Egg-eater
Chamaeleo dilepis dilepis	Common Flap-neck Chameleon
Bitis arietans arietans	Puff Adder
Pachydactylus capensis	Cape Gecko
Psammophylax tritaeniatus	Striped Grass Snake
Pelomedusa galeata	South African Marsh Terrapin

Stigmochelys pardalis	Leopard Tortoise
Pachydactylus affinis	Transvaal Gecko
Varanus niloticus	Water Monitor
Hemachatus haemachatus	Rinkhals
Trachylepis punctatissima	Speckled Rock Skink
Lamprophis aurora	Aurora House Snake
Naja nivea	Cape Cobra
Varanus albigularis albigularis	Rock Monitor
Trachylepis punctatissima	Speckled Rock Skink
Varanus niloticus	Water Monitor
Chamaeleo dilepis dilepis	Common Flap-neck Chameleon
Hemidactylus mabouia	Common Tropical House Gecko

4.3.4 Amphibians

During the current site assessment, no amphibians were recorded on site. The *Pyxicephalus adspersus* (Giant Bullfrog) is the only Threatened amphibian species that could potentially occur on the site. However, during the site assessment, this species was not observed. The Giant Bullfrog is a protected species under South African legislation and is classified as Near Threatened according to NEMBA (Act 10 of 2004).

High densities of the Giant Bullfrog are often associated with specific microhabitats or patches (hygrophytic or aquatic ephemerophytic grass and sedge dominated temporary pans) that can be identified and randomly sampled. Emphasis must be placed on remaining natural open grassland habitats (important migratory and foraging areas) as well as seasonal wetlands (drainage and marshland vegetation) in an area. As stated above, the Giant Bullfrog was not observed on site and is unlikely to occur. This is due to various explanations with the most pertinent being that the wetland at the site offers no suitable breeding habitat for Giant Bullfrogs due to its degradation and close proximity to residential areas. Due to extensive habitat transformation as well as high levels of human disturbances it is highly unlikely that any Giant Bullfrogs remain in the area.

The table below provides a list of frog species recorded for the Quarter Degree Square 2626DC in which the site occurs.

Table 8: Frogs (amphibians) occurring in the study area QDS

Species	**Common name**
Sclerophrys gutturalis	Guttural Toad
Cacosternum boettgeri	Common Caco
Hyperolius marmoratus	Painted Reed Frog
Amietia fuscigula	Cape River Frog

Pyxicephalus adspersus	Giant Bull Frog
Sclerophrys poweri	Power's Toad
Strongylopus fasciatus	Striped Stream Frog
Schismaderma carens	Red Toad

4.3.5 Invertebrates

During the site visits, invertebrates were observed on site including species from the orders, *Lepidoptera (Junonia hierta)*. No Arachnids or Molluscs were observed. No Red or Orange Listed or priority invertebrates were observed on site.

4.4 RED DATA SPECIES

According to the IUCN Red data database, Threatened species are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered, Endangered or Vulnerable is a threatened species (figure 8).

Species of conservation concern are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare (CR), Rare (R), Declining and Data Deficient - Insufficient Information (DDD) (SANBI, 2012).

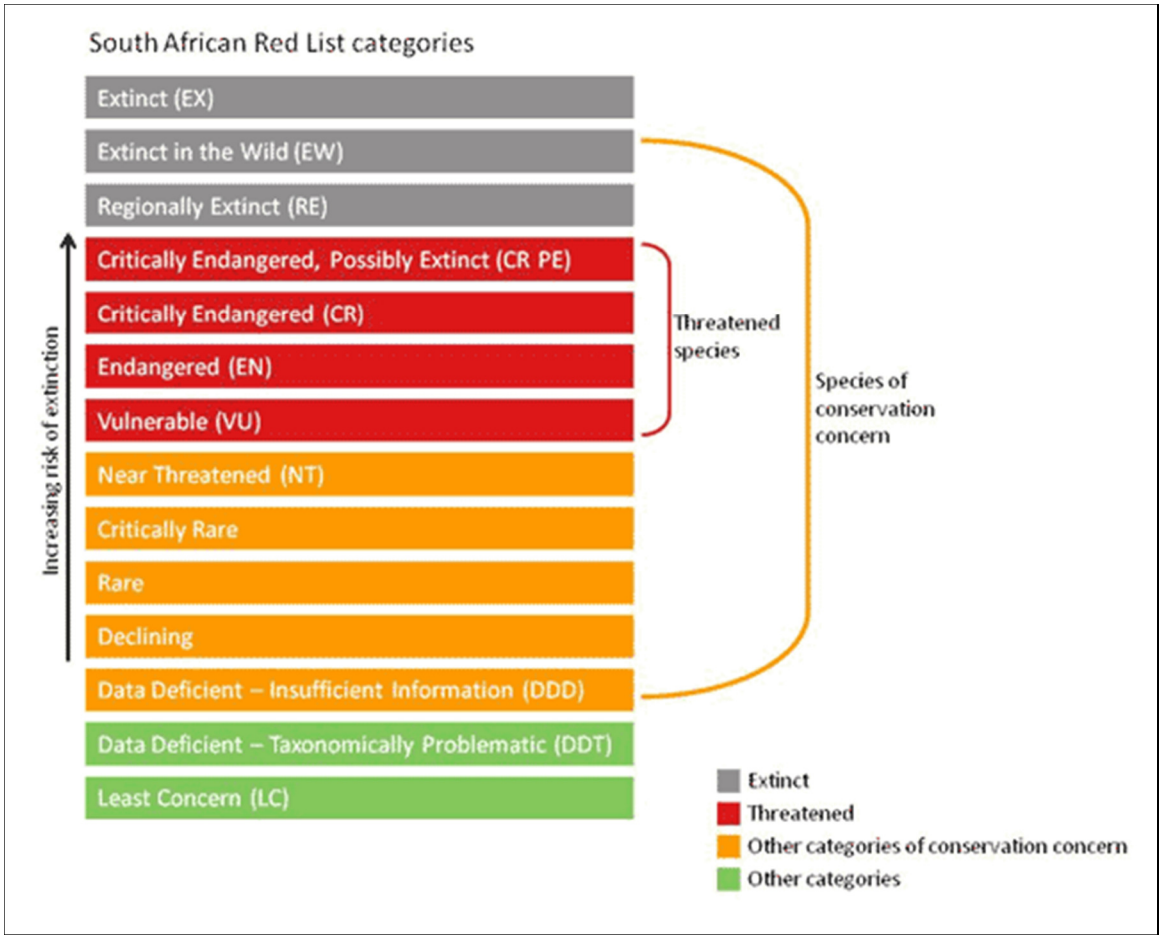


Figure 8: IUCN Red data categories (SANBI, 2012)

4.4.1 RED DATA SPECIES OBSERVED ON SITE

South Africa has been recognised globally as a country with remarkable plant and animal diversity and high levels of endemism. None of the plant species recorded in the study area are found in the "Red Data List of Southern African Plants" (Raimando *et al.*, 2009) or on the updated PRECIS database of the National Botanical Institute (NBI), Pretoria. None of the animal species recorded on site are red listed and due to the developed nature of the area, human disturbance in the area, no red data fauna and flora species are likely to occur on the site.

5 SENSITIVITY OF THE OVERALL AREA

5.1 CRITICAL BIODIVERSITY

According to the North West Province Conservation Assessment, a section of the proposed development site falls within a Critical Biodiversity Area (CBA) (Figure 9). This means that

due diligence and care must be undertaken by the Environmental Control Officer (ECO) of the project during construction phase, to identify species of importance should they occur.

Figure 9 below indicates the site in relation to the Critical Biodiversity Areas of the North West Region.

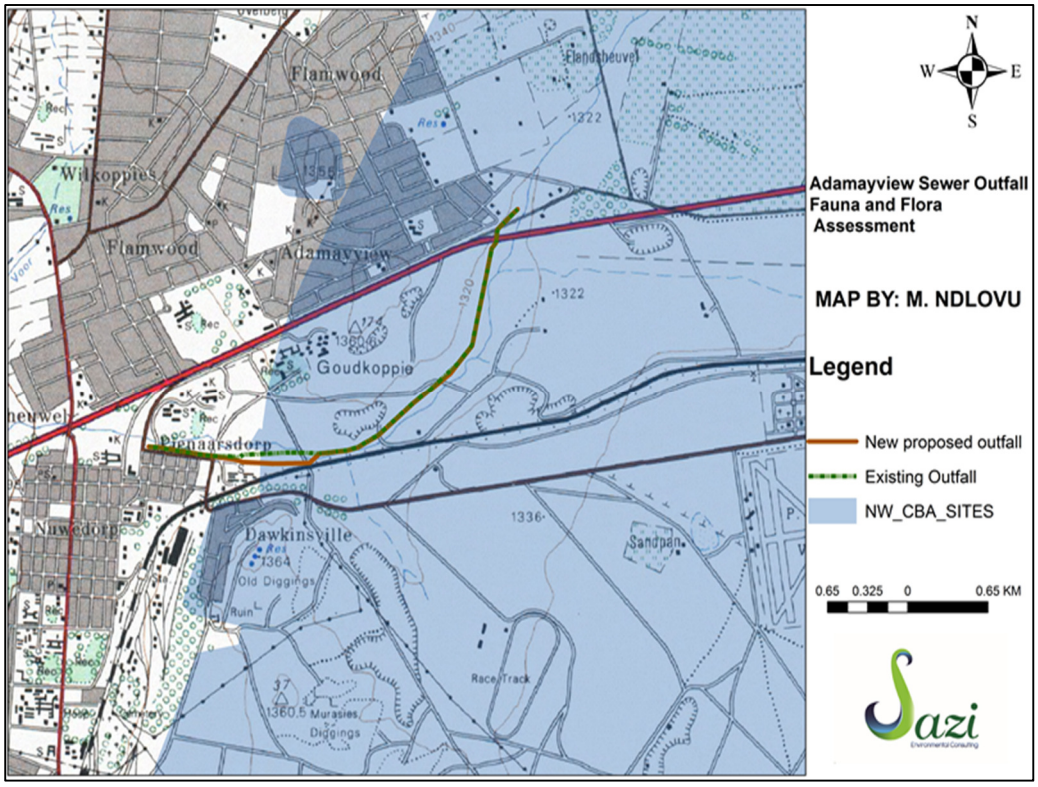


Figure 9: Proposed development site is located in a Critical Biodiversity Area

5.2 THREATENED ECOSYSTEM

The Biodiversity Act (Act 10 of 2004) provides for listing of threatened or protected ecosystems, in one of four categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Protected. The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction. According to this database, the entire proposed site is located within an Endangered ecosystem.

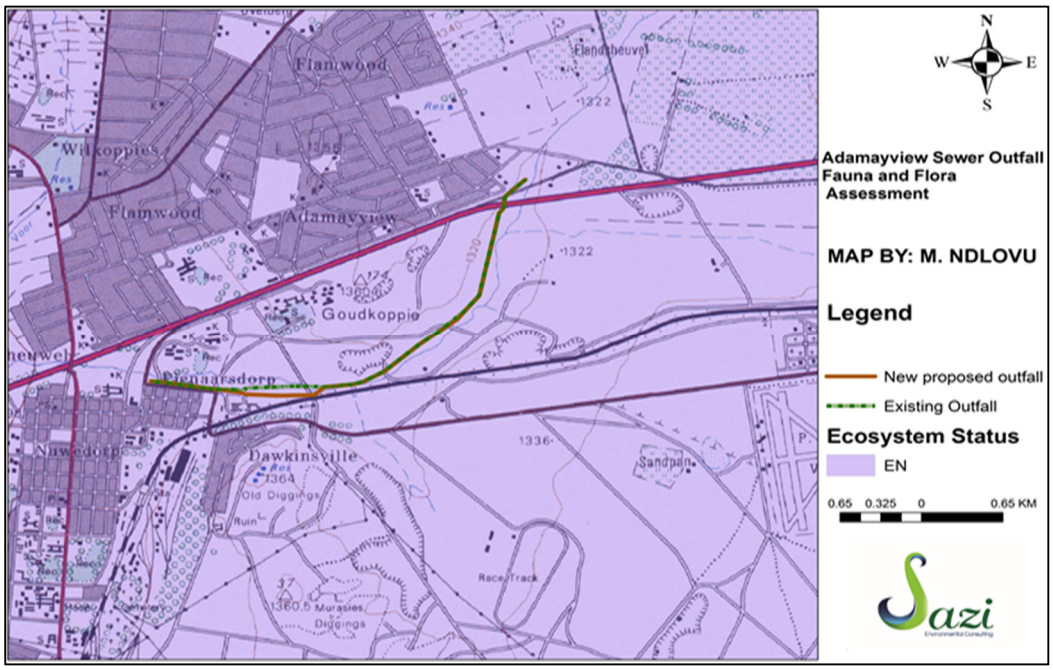


Figure 10: Proposed sewer outfall pipeline site located within an endangered ecosystem

5.3 SENSITIVITY OF THE PROPOSED DEVELOPMENT AREA

The majority of the development site is regarded as of **High** sensitivity. The sensitivity rating scale used to determine the sensitivity of the proposed site is that explained in section 3.5 above. The high sensitivity status is given due to the fact that the proposed sewer outfall upgrade pipeline runs along the Palmietspruit River and associated wetland system (Figure 11).

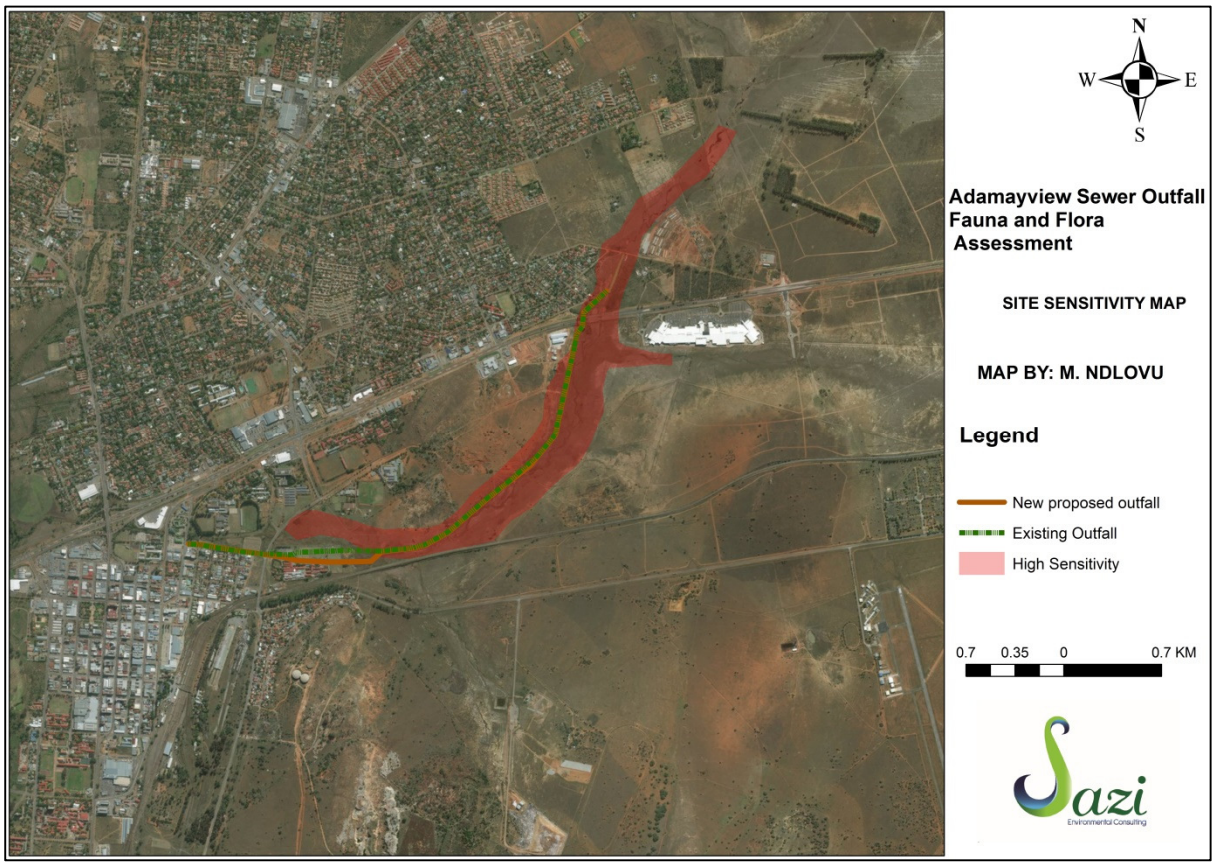


Figure 11: Proposed site sensitivity

6 IMPACT RISK FACTORS

The planned sewer outfall pipeline activities involve a change of land use and thus often loss of natural habitat, which is the greatest threat to plant species in South Africa. In terms of the principles of NEMA (Section 2), sustainable development requires the consideration of all relevant factors including disturbance of ecosystems and loss of biodiversity, both of which should be avoided or, if that is not possible, should be minimized and remedied.

Development is an inevitable part of human evolution, but even so, prior to any development the following factors (which determine the significance of impacts of development) should first be determined:

- Extent of the impact;
- Duration of the impact;
- Intensity of the impact;
- Probability of occurrence of the impact; and
- Significance of the impact with or without mitigation.

Once the significance of impacts due to a proposed development have been ascertained, proper and relevant mitigation measures that can decrease the level of impacts can be developed and implemented. However, if the impacts are found to be significant and will have a detrimental effect on threatened ecosystems and vegetation units, then development should not advance.

6.1 POTENTIAL IMPACTS OF PIPELINE CONSTRUCTIN ON VEGETATION

Potential ecological impacts resulting from the construction and operation of the sewer outfall pipeline would stem from a variety of different activities and risk factors associated with the construction and operational phases of the project.

7 IMPACT ASSESSMENT CRITERIA

The assessment of possible impacts during the various stages of the proposed pipeline construction was done through the establishment of the following criteria in the table below (Table 9).

Table 9: Impact assessment criteria

DURATION (D)	**MAGNITUDE (M)**
5 - Permanent	10 - Very high/do not know
4 - Long term (ceases with operational life)	8 - High
3 - Medium term (5-15 years)	6 - Moderate
2 - Short term (0-5 years)	4 - Low
1 – Immediate	2 - Minor
SCALE (S)	**PROBABILITY (P)**
5 - International	5 - Definite/do not know
4 - National	4 - Highly probable
3 - Regional	3 - Medium probability
2 - Local	2 - low probability
1 - Site	1- Improbable
0 – None	0 - None
SIGNIFICANCE POINTS (SP) = (D+M+S) X P	
HIGH (H) = >60 POINTS	
MODERATE (M) = 30-60 POINTS	
LOW (L) = <30 POINTS	
NO SIGNIFICANCE = 0	
POSITIVE IMPACT	

8 IMPACT ASSESSMENT

Potential ecological impacts resulting from the construction and operation of the sewer outfall pipeline would stem from a variety of different activities and risk factors associated with the construction phase of the project including the following:

8.1 NATURAL VEGETATION DESTRUCTION

The removal of vegetation will be a consequence of the construction phase of the proposed pipeline and associated infrastructure. During construction, storage facilities, disposal and storage of waste and operation of heavy machinery will inevitably flatten vegetation which could ultimately result in the destruction of natural vegetation. Vegetation will also be cleared during site preparation. Mitigation measures recommended include:

- Before the commencement of construction, an Environmental Control Officer (ECO) should be appointed to supervise the process;
- Sensitive areas should be marked off with a fence or any other form of demarcation in order to keep vegetation destruction to a minimum and no facilities should be placed within sensitive areas;
- Make use of existing roads (both vehicles and pedestrians);
- Construction in sensitive areas should be avoided and prohibited;
- No fires should be allowed;
- A rehabilitation plan for vegetation should be in place and implemented;

- All contractors must undergo environmental induction prior to construction activities;
- All hazardous spills must be cleared in an appropriate manner; and
- Construction vehicles must be confined to demarcated areas.

8.2 SOIL EROSION AND RUN-OFF

During the construction phase, vegetation will be removed leaving soil exposed and vulnerable to erosion especially during rainy days where run-off will be produced causing sedimentation. The consequence of eroded soil will be alien vegetation encroachment as aliens spread easily in disturbed soil. Mitigation measures recommended include;

- All areas susceptible to erosion must be protected;
- Vegetation removal should be done when construction is about to begin;
- Monitoring of disturbed areas is essential in order to combat and mitigate alien encroachment;
- Vegetation should only be removed in areas where construction will take place; and
- Make use of existing roads.

8.3 ALIEN VEGETATION ENCROACHMENT

Alien vegetation spreads easily on disturbed soil and is likely to occur on the disturbed soil that has been removed and stockpiled. To combat the potential increase of alien vegetation in the area, the following mitigation measures are recommended;

- Alien species (including their seedlings and saplings) identified within the study area should be removed (manually preferably) to prevent their spreading; and

- Removal of alien invasive species and monitoring of the environment to keep invasive species to a minimum should they occur.

8.4 IMPACTS DURING OPERATIONAL PHASE

Anticipated impacts on vegetation during the operational phase are related to the maintenance of the pipeline. One of the impacts that will stem from the maintenance is the spread of alien vegetation due to human presence.

Table 10 below gives a summary of the impacts on vegetation during the construction phase and Table 11 thereafter summarises impacts during the operational phase. The tables allocate significance scores to each impact identified to ascertain the significance of the impacts using the impact assessment criteria calculations depicted in Table 9.

Table 10: Impacts of vegetation during construction phase

Aspect	Impact	Positive/negative impact	Probability	Duration	Scale	Magnitude	Significance/ Risk	Impact Significance	Mitigation Required
Land clearing	Habitat destruction	Negative	4	2	1	5	32	Moderate	Yes
Land clearing	Soil loss/soil erosion	Negative	4	2	1	6	36	Moderate	Yes
Toxic chemicals from construction vehicles (oil, petrol, brake fluid etc.)	Pollution of vegetation and habitat which could ultimately lead to underground water contamination	Negative	2	3	2	4	18	Low	Yes
Domestic waste disposal (littering)	Land pollution leading to degradation and deterioration of vegetation	Negative	3	2	1	4	21	Low	Yes
Human dispersal of	Alien invasion of native species	Negative	3	4	2	6	36	Moderate	Yes

alien seeds/sapling by construction vehicles, shoes, clothes.	habitat								

Table 11: Impacts on vegetation during operational phase

Aspect	Impact	Positive/Negative	Probability	Duration	Scale	Magnitude	Significance/risk	Impact Significance	Mitigation Required
Servitude maintenance	Spread of alien invasive species by humans	Negative	2	3	2	6	22	Low	Yes

9 INDIGENOUS VEGETATION MANAGEMENT PLAN

Although no red data flora species were observed at the site, indigenous vegetation was present and should be managed accordingly. Indigenous plants are plants that are native to a particular area. South Africa has many indigenous species that are found only in Africa. It is important to protect indigenous species because they have often evolved to cope with particular conditions, circumstances or situations.

There are many indigenous species that have been found to contain unique medicinal properties, which have been used to develop specialised drugs and saved thousands of lives. Once indigenous plants become extinct, they are lost forever.

One of the best ways to manage and maintain indigenous vegetation is through the removal of alien invasive species and weeds in an area before they take over the environment and replace all indigenous vegetation. An alien invasive species management plan is vital in ensuring the survival of indigenous species.

9.1 ALIEN INVASIVE SPECIES CONTROL

Invasive alien plants, animals and microbes are organisms that are imported or introduced into countries where they outcompete indigenous species. In South Africa, invasive alien species are the biggest threat to biodiversity and cost the country billions of Rands in damage every year. They pose not only a threat to biological diversity but to water security as well as the ecological functioning of natural systems. In South Africa, 198 plants have been characterised as invasive. The removal of invasive alien species also increases water yield which is necessary in a water scarce province such as Gauteng. According to the Environmental Planning and Climate Change Protection Department, eThekwini Municipality (2013), a range of methods can be used to control invasive alien plants. These include:

1. Mechanical methods: burning or removing of alien invasives, felling;
2. Chemical Methods: using herbicides that are environmentally friendly;
3. Biological control: the use of species-specific diseases and insects from the country of origin of the alien plant;
4. Integrated control: the use of the combination of all three methods mentioned above. In most cases, this type of approach is necessary in preventing enormous impacts.

Mechanical and chemical methods are recommended in the removal of invasive alien plant species at the site because these methods have been found to be the most successful and safest for the environment. Although they may be time consuming in larger areas and labour intensive, they are the safest. Chemical methods are easier to apply but may have unwanted effects on water resources. Although biocontrol methods have been proven to be safe and host-specific, they do not completely exterminate populations of their host plants because few host plants always survive. Biocontrol also works slowly by comparison to other techniques and take at least 5 years on average to establish successfully before attacking its host and damaging it.

An integrated approach of mechanical and chemical methods may be the best option for quick and effective invasive alien species eradication.

For this control programme for alien vegetation, follow up control (control of root suckers, coppice growth etc.) and maintenance control (annual control to sustain low alien plant numbers) are compulsory.

Invasive alien control techniques that can be utilised at the site include the following:

- Some alien invasive trees and weeds across the site can be felled and removed using chainsaws, bowsaws and brushcutters, for example the invasive tree, *Solanum mauritianum, Tagetes minuta*;
- The hand pull methods can be used to removed small shrubs and herbs such as the *Datura ferox,* young *Datura stramonium;*
- The assessed points had a number of mature alien invasive tree species that cannot be eradicated mechanically only. An integrated method is necessary for such trees as *Eucalyptus* etc. Felling and treating stumps with herbicide and follow-up removal of seedlings is essential.

A certified professional on herbicide use must be consulted before any form of herbicide is utilised.

9.2 MANAGEMENT OF RED DATA SPECIES ON SITE

Although no red data species were observed at the site, nature is unpredictable and it is important to plan ahead. Should any red data species be observed on site in future for whatever reason, a plan to manage them properly should be in place.

Individuals of protected species if found within the site should be conserved *in situ*. They should be mapped and appropriate buffer zones provided according to the occurrence of the plants (i.e. whether they occur in rural areas or highly developed areas or whether they are endemic to the province or not and which other province they are found). This is in accordance with the GDARD Requirements for biodiversity assessments (Version 3, 2014).

Translocation of a plant from its natural environment may negatively harm or result in rapid changes in the plant or even harm the plants of the receiving environment by transmitting pathogens. As such, the translocation of red data listed plants is not recommended and should be the last option when all other options have been exhausted. A permit obtainable from the Department of Environmental Affairs is required before any protected species may be interfered with.

9.3 FAUNA MANAGEMENT PRINCIPLES

Extensive habitat transformation and degradation within and immediately adjacent to the site should be prevented.

The majority of reptile species are sensitive to severe habitat alteration and fragmentation. No termite mounds should be intentionally destroyed. Any lizards, geckos, agamids, monitors or snakes encountered should be allowed to escape to suitable habitat away from the disturbance. No reptile should be intentionally killed, caught or collected at any point in time. A team of trained reptile handlers must be called upon to handle and remove any reptiles found on site. This also applies to amphibians and mammals, none should be intentionally killed. Should there be any red data mammals, reptiles, amphibians or birds observed on site in future, the appropriate specialist should be consulted.

10 CONCLUSION

The proposed Adamayview sewer outfall pipeline development area is regarded as of **High** sensitivity on account that it runs along a river associated with a wetland system. Although no sensitive or red data species were observed during the time of assessment, minimum destruction of the environment must be adhered to. From an ecological perspective, due care must be undertaken when developing on this area and all relevant mitigation measures implemented.

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APPENDIX 1: Vegetation observed on site

SPECIES NAME
Eucalyptus camaldulensis
Elionurus muticus
Aristida congesta
Cymbopogon pospischilii
Eragrostis curvula
Eragrostis superba
Stoebe vulgaris
Hermannia depressa
Anthospermum rigidum subsp. *pumilum*
Agave sisalana
Aloe greatheadii var. davyana
Tagetes minuta
Bidens pilosa
Themeda triandra
Hyparrhenia hirta
Heteropogon contortus
Hyparrhenia tamba
Datura stramonium
Datura ferox
Amaranthus hybridus
Berkheya radula
Populus x Canescens
Verbena bonariensis
Vernonia oligocephala
Rumex obtusifolius
Arundo donax
Typha capensis
Phragmites australis
Salix babylonica
Solanum mauritianum

APPENDIX 2: List of threatened vegetation of the Gauteng Region

Vegetation	Status
1. Adromischus umbraticola subsp. umbraticola	Near Threatened
2. Alepidea attenuata	Near Threatened
3. Aloe peglerae	Endangered
4. Argyrolobium campicola	Near Threatened
5. Argyrolobium megarrhizum	Near Threatened
6. Blepharis uniflora	Rare
7. Bowiea volubilis subsp. volubilis	Vulnerable
8. Brachycorythis conica subsp. transvaalensis	Vulnerable
9. Brachystelma discoideum	Endangered
10. Ceropegia decidua subsp. pretoriensis	Vulnerable
11. Ceropegia turricula	Near Threatened
12. Cheilanthes deltoidea	Vulnerable
13. Cineraria austrotransvaalensis	Near Threatened
14. Cineraria longipes	Vulnerable
15. Cleome conrathii	Near Threatened
16. Cucumis humifructus	Vulnerable
17. Delosperma gautengense	Vulnerable
18. Delosperma leendertziae	Near Threatened
19. Delosperma macellum	Endangered
20. Delosperma purpureum	Endangered
21. Dioscorea sylvatica	Vulnerable
22. Encephalartos lanatus	Vulnerable
23. Encephalartos middelburgensis	Critically Endangered
24. Eulophia coddii	Vulnerable
25. Frithia humilis	Vulnerable
26. Frithia pulchra	Rare
27. Gladiolus pole-evansii	Rare
28. Gladiolus robertsoniae	Near Threatened

29. Gnaphalium nelsonii	Rare
30. Habenaria barbertoni	Near Threatened
31. Habenaria bicolor	Near Threatened
32. Habenaria kraenzliniana	Near Threatened
33. Habenaria mossii	Endangered
34. Holothrix micrantha	Endangered
35. Holothrix randii	Near Threatened
36. Khadia beswickii	Vulnerable
37. Kniphofia typhoides	Near Threatened
38. Lithops lesliei subsp. lesliei	Near Threatened
39. Lithops lesliei subsp. lesliei var. rubrobrunnea	Endangered
40. Melolobium subspicatum	Vulnerable
41. Nerine gracilis	Near Threatened
42. Prunus africana	Vulnerable
43. Searsia gracillima var. gracillima	Near Threatened
44. Stenostelma umbelluliferum	Near Threatened
45. Trachyandra erythrorrhiza	Near threatened

APPENDIX 3: GAUTENG THREATENED BIRDS

Bird species	Status
1. *Alcedo semitorquata* Half-Collared Kingfisher	Near Threatened
2. *Anthropoides paradiseus* breeding area Blue Crane	Vulnerable
Anthropoides paradiseus overwinter area	Vulnerable
3. *Circus ranivorus* African Marsh-Harrier	Vulnerable
4. *Eupodotis caerulescens* Blue Korhaan	Near Threatened
5. *Eupodotis senegalensis* White-bellied Korhaan	Vulnerable
6. *Gorsachius leuconotus*	Vulnerable
7. *Gyps coprotheres* breeding area	Vulnerable
8. *Mirafra cheniana* Melodious Lark	Near Threatened
9. *Podica senegalensis* African Finfoot	Vulnerable
10. *Sagittarius serpentarius* Secretary bird	Near Threatened
11. *Tyto capensis* African Grass-Owl	Vulnerable