

Wetland Assessment Report for the Volspruit Mine Project, Limpopo Province



For:

EcoPartners (Pty.) Ltd.



By:

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Reference: 1430b/2021



DOCUMENT SUMMARY DATA

PROJECT: **Wetland Assessment Report for the Volspruit Mine Project, Limpopo Project**

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INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

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 available information. The 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 and Wetland Consulting Services (Pty.) Ltd. and its staff reserve 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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1. INTRODUCTION AND TERMS OF REFERENCE

Volspruit Mining Company (Pty) Ltd proposes the mining of two (2) separate ore bodies through open cast mining on the farm Volspruit 326 KP, Mokopane, Limpopo Province. In addition, areas of the remaining extent of the Farm Zoetveld 294 KR are proposed for the establishment of supporting above ground infrastructure (e.g. residue stockpiles and residue deposits). The mining of these two ore bodies will require the establishment of two separate opencast pits, the 'north pit' and the 'south pit'. It is estimated that the targeted ore reserves underlying the site equal approximately 56 million tonnes, which suggests that the mine will be in operation for approximately 18-20 years; where the mining of the respective pits will occur in a phased manner. The north pit will be mined between years 1-13, and the south pit between years 13-19. It is proposed that Platinum Group Metals (PGMs) will be mined to a depth of approximately 180 m at the north pit and south pit.

The Volspruit Project also includes provision for the establishment of an ore processing plant (frother flotation) and smelter complex including a fluidised bed ore roasting plant, a 5MW DC Arc furnace (and an additional 5MW furnace toward ramp up a couple of years into operations) and a Chemical Vapour Metal Recovery Plant (CVMR) for the beneficiation of metal produced. These plants aim to further process the mined mineral bearing ore into saleable PGM mineral fractions and beneficiate the ore to high value pure metals. This process will produce significant volumes of waste rock and minerals residues which will require residue stockpiles (waste rock and tailings disposal facilities). The 'plant site' is proposed to be established on the farm Volspruit 326 KP, at a site centrally located to the opencast pits and away from the Nyl River and associated wetland.

The proposed project site is currently a 'Green-fields' site which is partially under intense agriculture, as well as having large tracts of undisturbed natural vegetation. All relevant surface infrastructure and other infrastructural requirements for the project will need to be developed on the site. Further to the infrastructures already mentioned, the mine's development will include provision for, inter alia, access roads, administration buildings, workshops, storage/lay-down yards, sewage treatment plants, return water- and storm water dams, explosives store, electricity sub-stations, as well as supporting electrical, sewage and water reticulations.

EcoPartners (Pty.) Ltd., the designated project Environmental Assessment Practitioner (EAP), appointed Wetland Consulting Services (Pty.) Ltd. (WCS) to undertake the specialist wetland assessment for the proposed Volspruit Project. WCS had already completed a prior wetland assessment report for the Volspruit Project in 2012. Although the prior wetland assessment (WCS, 2012) was used as a starting point for this study, additional field surveys were undertaken as part of the current study, and all ecological assessments of the wetland (PES, IS, functional assessment) were re-done as part of the current study, applying the latest updated assessment methodologies.

The aim of the study was to identify and delineate the wetlands within the site earmarked for the proposed mining and associated activities, to undertake ecological assessments of the wetlands identified, to then identify and assess likely impacts to wetlands resulting from the construction and operation of the mine, and to provide detailed recommendations on the mitigation and management measures within the framework of the of the mitigation hierarchy to ensure expected impacts to wetlands are appropriately considered and addressed.

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

- Review available wetland data for the mining rights area (previous specialist studies, Provincial Conservation plans, NFEPA, relevant other studies);
- Undertake a desktop delineation of all wetlands and watercourses within the proposed opencast mining area and 500m buffer;
- Detailed field verification of all wetland areas within the project study area as per the DWAF Wetland Delineation Guidelines (DWAF, 2005);
- Typing of the wetlands within the study area according to the hydro-geomorphic wetland types detailed by Ollis, Snaddon, Job & Mbona (2013);
- Undertake a functional assessment of all wetland HGM types present using the level 2 assessment as described in “Wet-EcoServices (Version 2)” (Kotze, Macfarlane and Edwards, 2021);
- Determine the Present Ecological State (PES) and Importance and Sensitivity (IS) of the wetlands. PES and IS of wetlands to be determined using the WET-Health Version 2 Level 1b tool (Macfarlane, Ollis & Kotze, 2020) and the IS methodology described by Rountree, Malan & Weston (2013) respectively; and
- Review of the available mining and associated infrastructure plans and proposed management plans, including alternatives;
- Assessment of potential impacts to the wetland habitats as a result of the proposed mine plans;
- Provision of mitigation and management measures regarding project related impacts; and
- Compilation of the findings into a comprehensive wetland impact assessment report.

A revised mine layout was received from EcoPartners on the 30th August 2023 and the impact assessment section of the report (Section 7) was updated to reflect the latest layout.

2. DETAILS OF SPECIALIST

2.1 Details of the Specialist Who Prepared the Report

Table 1. Details of the Specialist

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Company Registration	1998/017216/07
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2.2 Expertise of the Specialist

2.2.1 Qualifications of the Specialist

Dieter Kassier holds the following degrees:

- B.Sc. from UNISA (2007) Environmental Management (Zoology Stream).
- B.Sc. (Hons) from the NWU Potchefstroom Campus (2012) in Environmental Science: Aquatic Ecosystem Health.

Dieter Kassier holds a Professional Registration with SACNASP since 2014 – 400254/14. He is registered in two fields:

- Environmental Science
- Ecological Science

2.2.2 Past Experience of the Specialist

Dieter Kassier, Wetland Ecologist, Holds a B.Sc. degree in Environmental Management (with specialisation in Zoology) from the University of South Africa (UNISA) as well as a Honours BSc degree in Environmental Science (Aquatic Ecosystem Health) from the University of the North West (Potchefstroom Campus). After 5 years working within the field of nature conservation and tourism in the Limpopo Lowveld and a short stint as an environmental consultant, Dieter joined Wetland Consulting Services in 2007 and is based in Pretoria. Since 2017 he has also been a Director of WCS Scientific. Over the past few years, he has gained extensive experience in the delineation and assessment of wetlands and riparian zones and the development of mitigation and management measures for the purposes of Environmental Impact Assessments in a wide range of projects, with special emphasis on coal mining in the Mpumalanga Coalfields and infrastructure developments within the greater Gauteng and Mpumalanga region. International work experience includes wetland prioritisation and rehabilitation planning in the Highlands of Lesotho as well as mining-related wetland impact assessment studies in Mozambique and the Democratic Republic of Congo. In addition, he has contributed to the wetland component of various Ecological Reserve studies, including for the Olifants/Letaba River System and the Thukela Catchment.

2.2.3 CV of the Specialist

A summarised CV of the Specialist is attached as APPENDIX A to this report.

3. DECLARATION OF INDEPENDENCE

I, **Dieter Kassier**, as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).



Signature of the specialist

Wetland Consulting Services (Pty.) Ltd

Name of company

30 August 2023

Date

4. SCOPE, PURPOSE, APPROACH AND METHODOLOGY

4.1 Scope and Purpose

This purpose of this report is to provide a detailed summary of the current conditions of the wetlands within the project area from an ecological perspective, focussing on the following key considerations:

- Presence and extent of wetlands;
- Wetland type (hydro-geomorphic classification);
- Functional importance of wetlands;
- Present ecological state of the wetlands on site; and
- Ecological importance and sensitivity of the wetlands on site.

Using the baseline information collected as part of this study, the next step was to identify and assess likely impacts of the proposed activities on the wetlands, and to provide detailed recommendations on the mitigation and management measures required, within the framework of the of the mitigation hierarchy, to ensure the avoidance and minimisation of the impact to wetlands.

4.2 Approach, Methodology and Actions Performed

4.2.1 Collation of existing information

Two previous wetland reports compiled by WCS for the Volspruit Project formed the starting point of this study:

- Wetland Consulting Services. 2012. *Biodiversity Assessment for the Proposed Sylvania Resources Volspruit Mine near Mokopane in the Limpopo Province. Report Reference 590/2012.*
- Wetland Consulting Services. 2021. *Wetland Scoping Report for the Volspruit Mine Project, Limpopo. Project Reference 1430.*

4.2.2 Wetland Identification, Delineation & Typing

The National Water Act, Act 36 of 1998, defines wetlands as follows:

“Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

The presence of wetlands in the landscape can be linked to the presence of both surface water and perched groundwater. Wetland types are differentiated based on their hydro-geomorphic (HGM) characteristics; i.e. on the position of the wetland in the landscape, as well as the way in which water moves into, through and out of the wetland systems. A schematic diagram of how these wetland systems are positioned in the landscape is given in the figure below.

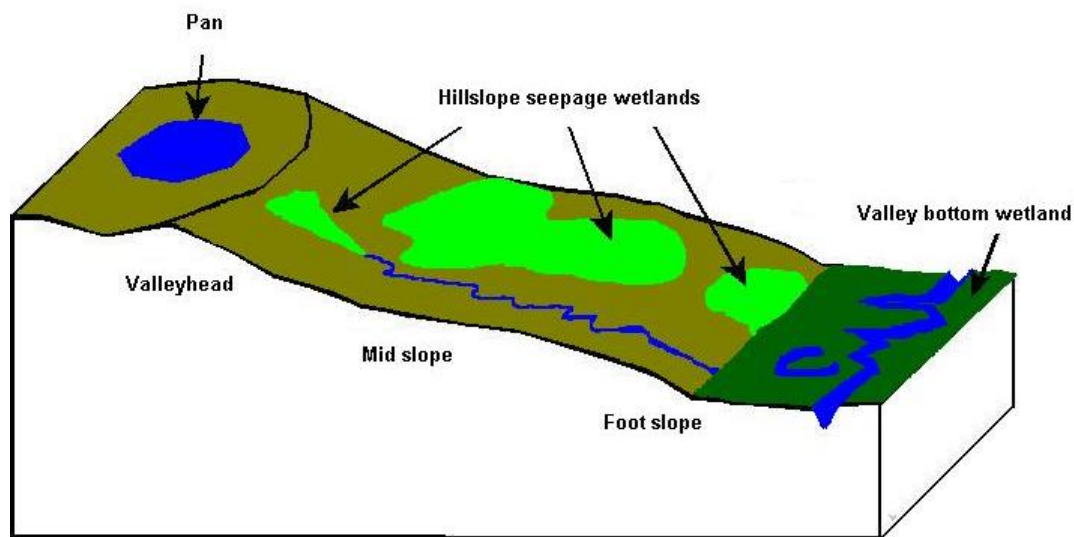


Figure 1. Diagram illustrating the position of the various wetland types within the landscape.

Use was made of 1:50 000 topographical maps, 1:10 000 orthophotos and Google Earth Imagery to create digital base maps of the study area onto which the wetland boundaries could be delineated using ArcMap 9.0. A desktop delineation of suspected wetland areas was undertaken by identifying rivers and wetness signatures on the digital base maps. All identified areas suspected to be wetlands were then further investigated in the field.

Wetlands were identified and delineated according to the delineation procedure as set out by the “*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*” document, as described by DWAF (2005) and Kotze and Marneweck (1999). Using this procedure, wetlands were identified and delineated using the Terrain Unit Indicator, the Soil Form Indicator, the Soil Wetness Indicator and the Vegetation Indicator.

For the purposes of delineating the actual wetland boundaries use is made of indirect indicators of prolonged saturation, namely wetland plants (hydrophytes) and wetland soils (hydromorphic soils), with particular emphasis on hydromorphic soils. It is important to note that under normal conditions hydromorphic soils must display signs of wetness (mottling and gleying) within 50cm of the soil surface for an area to be classified as a wetland (*A practical field procedure for identification and delineation of wetlands and riparian areas*, DWAF).

Practical application of the delineation methodology involves the collection of vegetation and soil profile observations (through the use of a handheld soil auger) along a series of transects or points intersecting the wetland boundary. Co-ordinates of observations points are collected in the field using a handheld GPS unit and imported to GIS and overlain on suitable, recent aerial imagery. The wetland boundary is then delineated using collected observation points and interpolation between the points or transects.

The delineated wetlands were then classified using a hydro-geomorphic classification system based on the system detailed by Ollis *et al.* (2013).

4.2.3 Functional Assessment

A functional assessment of the wetland types represented on site was undertaken using the Wet-EcoServices (Version 2) assessment (Kotze et al., 2021). This method provides a scoring system for establishing wetland ecosystem services. It enables one to make relative comparisons of systems based on a logical framework that measures the likelihood that a wetland is able to perform certain functions, as well as the demand for such functions based on within wetland and adjacent land uses and impacts..

4.2.4 Present Ecological State Assessment

A tool for assessing the PES of wetlands was first developed in 1999 (DWAF, 1999a). Thereafter WET-Health was developed (Macfarlane, Kotze, Ellery, Walters, Koopman, Goodman, and Goge, 2007), and recently updated (Macfarlane, Ollis and Kotze, 2020). WET-Health uses indicators based on hydrology, geomorphology, water quality and vegetation for assessing the PES of wetland systems, with these indicators inferred from landcover within a wetland, its 200m buffer, and its catchment. A WET-Health level 1B assessment was applied to each wetland HGM unit identified and delineated within the core study area.

For the purpose of this assessment, landcover (disturbance units) within the wetlands and a 200m buffer around the wetlands was manually digitised off recent aerial imagery, as informed by observations of landcover collected during the field surveys.

Wetland catchments were manually digitised using 5m contours as available from the National Geospatial Institute. For the wetland catchment, landcover data from the National Landcover 2020 dataset was used as is. The “*inflowing stream buffers*” component of the assessment methodology was not used during the current study.

Table 2. Table showing the rating scale used for the PES assessment.

Description	Combined impact score	PES Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	F

A number of important considerations and limitations apply to the PES assessment methodology utilised:

- The PES assessment methodology is based on landcover/disturbance units mapped within the wetland, its buffer, and its catchment. Impacts to wetlands that are not associated with a specific landcover class, such as point source discharges of water (e.g. from Waste Water Treatment Works) or flow reduction due to groundwater abstraction (e.g. as is known to be the case within the Nylsvley), can therefore be underestimated or excluded from the Level 1B assessment.
- Landcover classes were mapped based on field observations and supplemented with review of aerial imagery.
- The Level 1B assessment is limited to 30 pre-defined landcover classes for wetlands (and 25 landcover classes for the 200m buffer zone). All landcover units mapped had to be allocated to these pre-defined landcover classes.
- The impact intensity scores ascribed to the landcover classes were generally used in the assessment as captured in the Level1B assessment spreadsheets and not changed, with the exception of the vegetation intensity score for the “Natural / Minimally Impacted” land use, which was adjusted downwards from 1.0 to 2.0 to more accurately reflect vegetation within the Floodplain (high prevalence of the alien *Sorghum halepense* [NEMBA Category 2]).
- For landcover within the catchments of wetlands, use was made of the National Landcover 2020 dataset. As this data is already several years old, some changes in landcover may have taken place on site which are not reflected in this assessment.
- It is also noted that the National Landcover dataset typically overestimates the extent of natural vegetation. This may result in elevating the PES scores somewhat, though only for the catchment component of the assessment, and thus has only a minor impact on the final PES results.

4.2.5 Wetland Importance and Sensitivity Assessment

A wetland importance and sensitivity (IS) assessment was conducted for each wetland system assessed. This was done in order to provide an indication of the conservation value and sensitivity of the wetlands. For the purpose of this study, the Rountree *et al.* (2013) assessment criteria were used. The scale used to rate the various components of wetland IS is provided in **Table 3** below.

Table 3. Rating scale used for the IS assessment.

Wetland Importance and Sensitivity Categories	Range of IS score
Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and ≤4
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and ≤3
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and ≤2
Low/marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and ≤1

4.2.6 Impact Assessment

To ensure uniformity, the assessment of potential impacts was addressed in a standard manner so that a wide range of impacts is comparable. For this reason a clearly defined rating scale was utilised to assess the impacts associated with the proposed development. Each impact identified was assessed in terms of status, extent, duration, probability and magnitude.

Table 4. Impact assessment criteria

Status		
Positive	+	Impact will be beneficial to the environment (a benefit).
Negative	-	Impact will not be beneficial to the environment (a cost).
Neutral	0	Where a negative impact is offset by a positive impact, or mitigation measures, to have no overall effect.
Magnitude		
Minor	2	Negligible effects on biophysical or social functions / processes. Includes areas / environmental aspects which have already been altered significantly, and have little to no conservation importance (negligible sensitivity*).
Low	4	Minimal effects on biophysical or social functions / processes. Includes areas / environmental aspects which have been largely modified, and / or have a low conservation importance (low sensitivity*).
Moderate	6	Notable effects on biophysical or social functions / processes. Includes areas / environmental aspects which have already been moderately modified, and have a medium conservation importance (medium sensitivity*).
High	8	Considerable effects on biophysical or social functions / processes. Includes areas / environmental aspects which have been slightly modified and have a high conservation importance (high sensitivity*).
Very high	10	Severe effects on biophysical or social functions / processes. Includes areas / environmental aspects which have not previously been impacted upon and are pristine, thus of very high conservation importance (very high sensitivity*).
Extent		
Site only	1	Effect limited to the site and its immediate surroundings.
Local	2	Effect limited to within 3-5 km of the site.
Regional	3	Activity will have an impact on a regional scale.
National	4	Activity will have an impact on a national scale.
International	5	Activity will have an impact on an international scale.
Duration		
Immediate	1	Effect occurs periodically throughout the life of the activity.
Short term	2	Effect lasts for a period 0 to 5 years.
Medium term	3	Effect continues for a period between 5 and 15 years.
Long term	4	Effect will cease after the operational life of the activity either because of natural process or by human intervention.
Permanent	5	Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Probability of occurrence		
Improbable	1	Less than 30% chance of occurrence.
Low	2	Between 30 and 50% chance of occurrence.
Medium	3	Between 50 and 70% chance of occurrence.
High	4	Greater than 70% chance of occurrence.
Definite	5	Will occur, or where applicable has occurred, regardless or in spite of any mitigation measures.

Once the impact criteria have been ranked for each impact, the significance of the impacts was calculated using the following formula:

$$\text{Significance} = (\text{Magnitude} + \text{Duration} + \text{Extent}) \times \text{Probability}$$

As is evident from the above equation, the extent (spatial scale), magnitude, duration (time scale) and the probability of occurrence of each identified impact was assigned a value according to the impact assessment criteria (presented in **Table 4**, above) and used to calculate the significance of each impact.

A Significance Rating was then calculated by multiplying the Severity Rating with the Probability. The maximum value that can be reached through the described impact evaluation process is 100 SP¹. The scenarios for each environmental impact were rated as High (SP≥60), Moderate (SP 31-60) and Low (SP<30) significance as shown in **Table 5**.

Table 5. Definition of significance rating.

Significance of predicted NEGATIVE impacts		
Low	0-30	Where the impact will have a relatively small effect on the environment and will require minimum or no mitigation.
Medium	31-60	Where the impact can have an influence on the environment and should be mitigated.
High	61-100	Where the impact will definitely influence the environment and must be mitigated, where possible.
Significance of predicted POSITIVE impacts		
Low	0-30	Where the impact will have a relatively small positive effect on the environment.
Medium	31-60	Where the positive impact will counteract an existing negative impact and result in an overall neutral effect on the environment.
High	61-100	Where the positive impact will improve the environment relative to baseline conditions.

Once the significance rating of an impact before mitigation has been determined, the reversibility of the impact, 'replaceability' of the affected resources and the potential of the impact to be further mitigated were also determined. These factors are explained in **Table 6** below and play an important role in the determination of the level and type of mitigation

¹SP: Significant Points.

performed or to be implemented. **Table 6** sets out the criteria that were used to assess the reversibility, loss of resources and potential for further mitigation.

Table 6. Mitigation prediction criteria.

Reversibility of impact		
Reversible	1	The impact on natural, cultural and / or social structures, functions and processes is totally reversible.
Partially	2	The impact on natural, cultural and / or social structures, functions and processes is partially reversible.
Irreversible	3	Where natural, cultural and / or social structures, functions or processes are altered to the extent that it will permanently cease, i.e. impact is irreversible.
Irreplaceable loss of resources		
Replaceable	1	The impact will not result in the irreplaceable loss of resources.
Partially	2	The Impact will result in a partially irreplaceable loss of resources.
Irreplaceable	3	The impact will result in the irreplaceable loss of resources.
Potential of impacts to be mitigated		
High	1	High potential to mitigate negative impacts to the level of insignificant effects, or to improve management to enhance positive impacts.
Medium	2	Potential to mitigate negative impacts. However, the implementation of mitigation measures may still not prevent some negative effects.
Low	3	Little or no mechanism exists to mitigate negative impacts.

5. ASSUMPTIONS AND LIMITATIONS

This report has been prepared for the particular purpose outlined in the Introduction and Terms of Reference above and no responsibility is accepted for the use of this report, in whole or in part, in any other context or for any other purpose.

- This report has been prepared for the particular purpose outlined in the Introduction and Scope of Work above and no responsibility is accepted for the use of this report, in whole or in part, in any other context or for any other purpose.
- This assessment was based on the project description and proposed development and activity descriptions as detailed and illustrated in this report.
- In addition, it is recognised that the passage of time may affect the information and assessment provided in this report. WCS's opinions are therefore based upon the information that was made available to WCS and which existed at the time of compiling this report.
- This report must be read as part of a larger suite of specialist studies undertaken for the EIA of the proposed Volspruit Mine Project, and the results and findings must be understood and interpreted within the context, findings and recommendations of these other specialist studies.
- Wetland boundaries reflect the ecological boundary where the interaction between water and plants influences the soils, but more importantly the plant communities. The depth to the water table where this begins to influence plant communities is approximately 50 centimetres. This boundary, based on plant species composition, can vary depending on antecedent rainfall conditions, and can introduce a degree of variability in the wetland boundary between years and/or sampling period. This variability also affects the suitability of aerial imagery for the identification and delineation of wetland boundaries as the specific time period and season captured by aerial imagery only reflects a single snapshot of the inherent variability in the wetland boundary between years and/or sampling periods. Therefore, the variability in colour signatures on aerial imagery limits to some degree the accuracy with which wetland boundaries can be mapped.
- The wetlands systems have been mapped from the most recent aerial imagery available at a scale of 1:5000, using imagery sources such as ESRI World Imagery Basemap and Google Earth imagery. Due to the extent of the area and the mapping scale used, the actual extent of the boundaries of these systems may be underestimated or overestimated in places. This may range from metres to tens of metres but generally is regarded as being of sufficient accuracy for the purposes of this study.

6. BASELINE ASSESSMENT

6.1 Regional Characteristics

6.1.1 Project Study Area

The project study area has been defined as the amended Volspruit mining right area (Volspruit MRA) together with a 500m buffer surrounding the amended Volspruit MRA – the 500m buffer is required to ensure consideration of the 500m Regulated Area around a wetland (as defined in GN509).

The project study area is located along the Nyl River to the south of Mokopane and near the intersection of the N1 and N11 highways, in the Limpopo Province. The regional location of the Volspruit MRA is illustrated in Figure 1, while Figure 2 provides aerial imagery of the project study area.

The amended Volspruit MRA covers approximately 3 330 hectares.

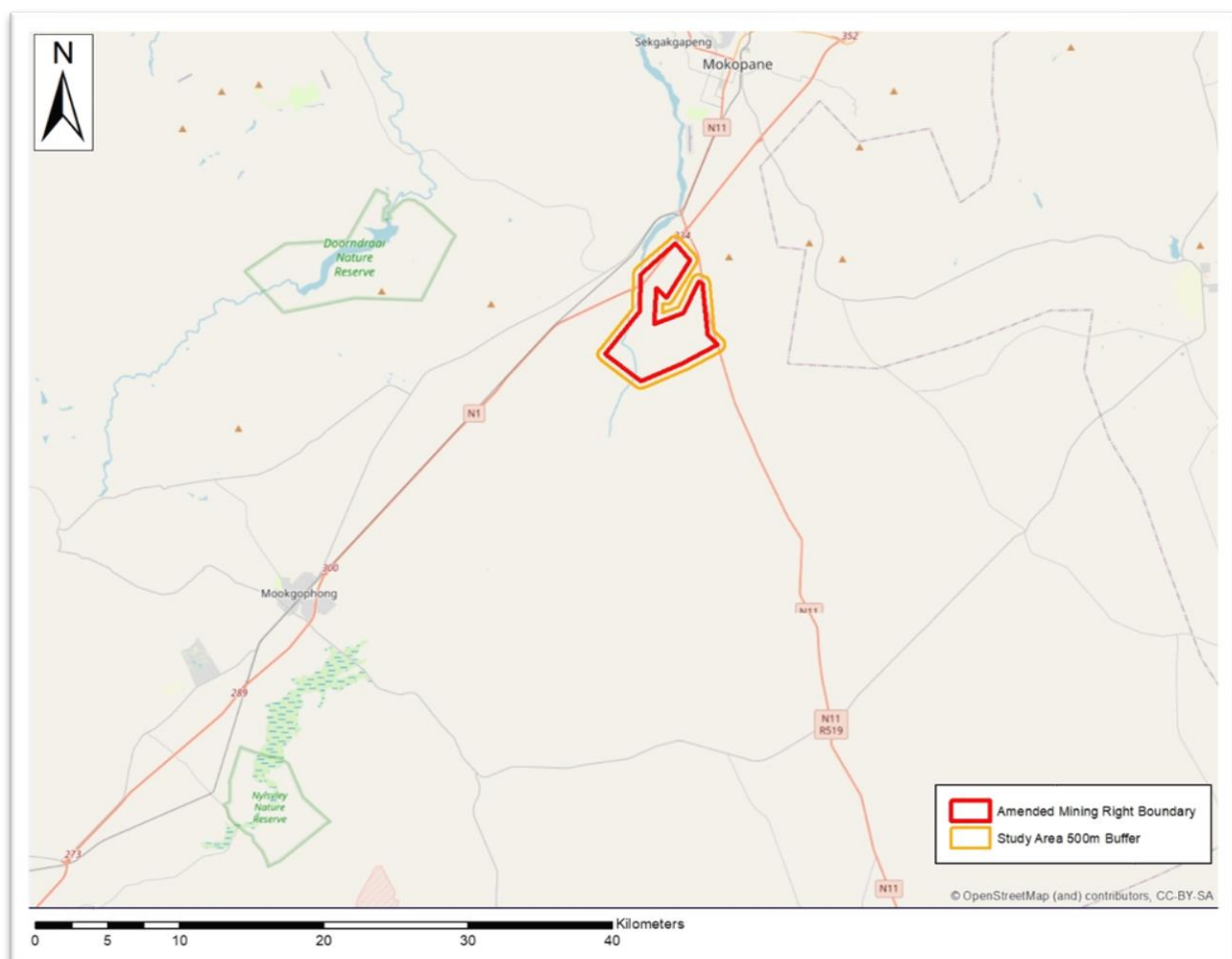


Figure 2. Map showing the regional location of the study area.

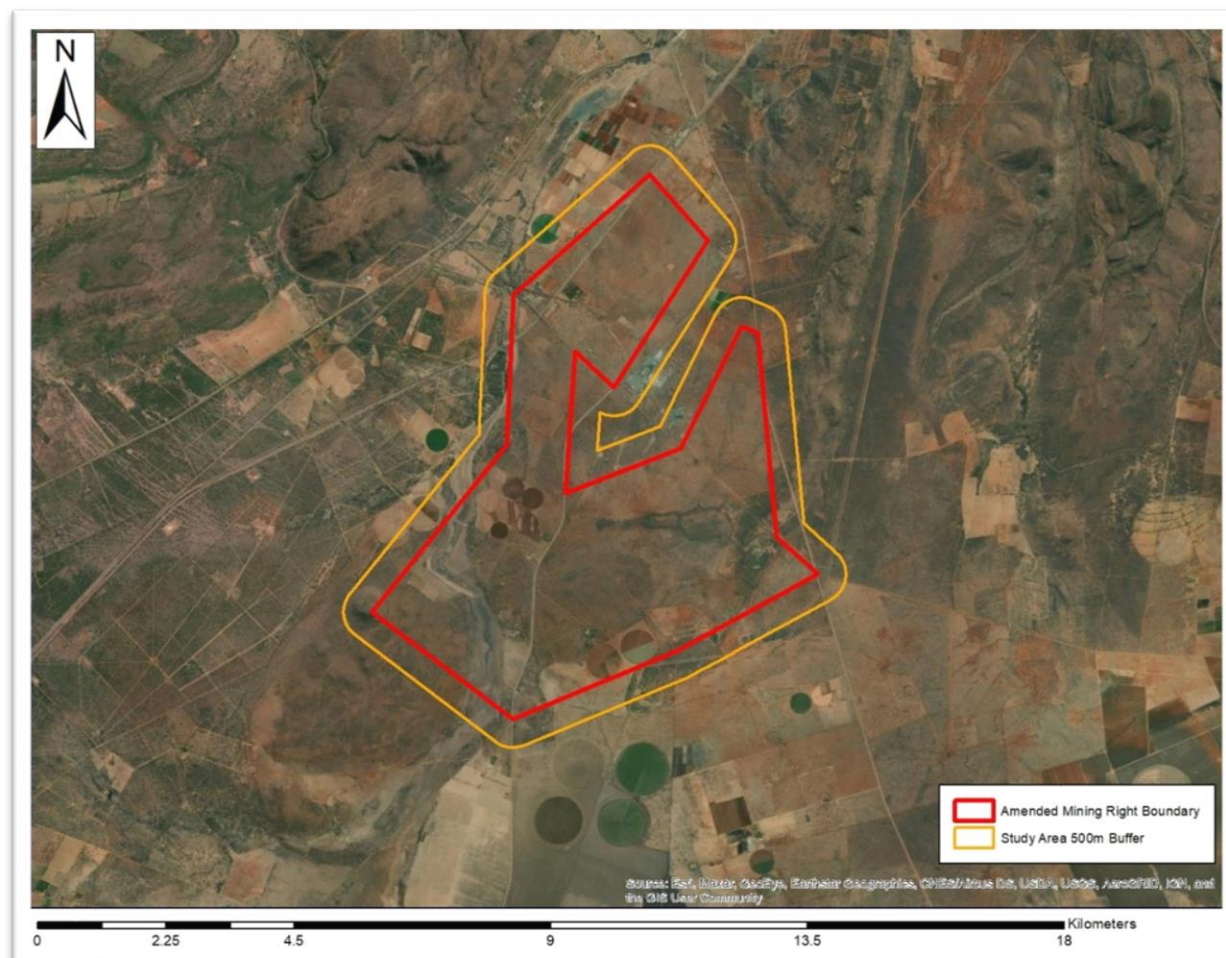


Figure 3. Map showing the study area overlain on aerial imagery.

6.1.2 Affected Catchments and River Systems

The study area is located within the Limpopo River Catchment (Primary Catchment A), and more specifically within quaternary catchment A61E. The catchment is drained by the Nyl River and its tributary the Andriesspruit. Other catchments contributing towards the Nyl River flowing across the study area include A61A, A61B, A61C, and A61D (Water Resources of South Africa, 2012 Study, Bailey and Pitman, 2015).

Downstream of the study area the Nyl River becomes the Mogalakwena River which feeds into the Glen Alpine Dam and eventually drains into the Limpopo River approximately 50km upstream of the Mapungubwe National Park.

Information regarding catchment size, mean annual rainfall, runoff, and potential evaporation for the quaternary catchment is provided in Table 7 below (sourced from Water Resources of South Africa, 2012 Study, Bailey and Pitman, 2015, as included in Macfarlane et al., 2020). Figure 4 indicates the position of the study area in relation to the affected quaternary catchment.

Table 7. Table showing the mean annual precipitation, run-off and potential evaporation per quaternary catchment (data sourced from Water Resources of South Africa, 2012 Study, Bailey and Pitman (2015) as included in Macfarlane et al., 2020).

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP	Potential Evaporation (PE) in mm	MAP:PE
A61E	54 735	615	20.5	3.33 %	1 738	0.35

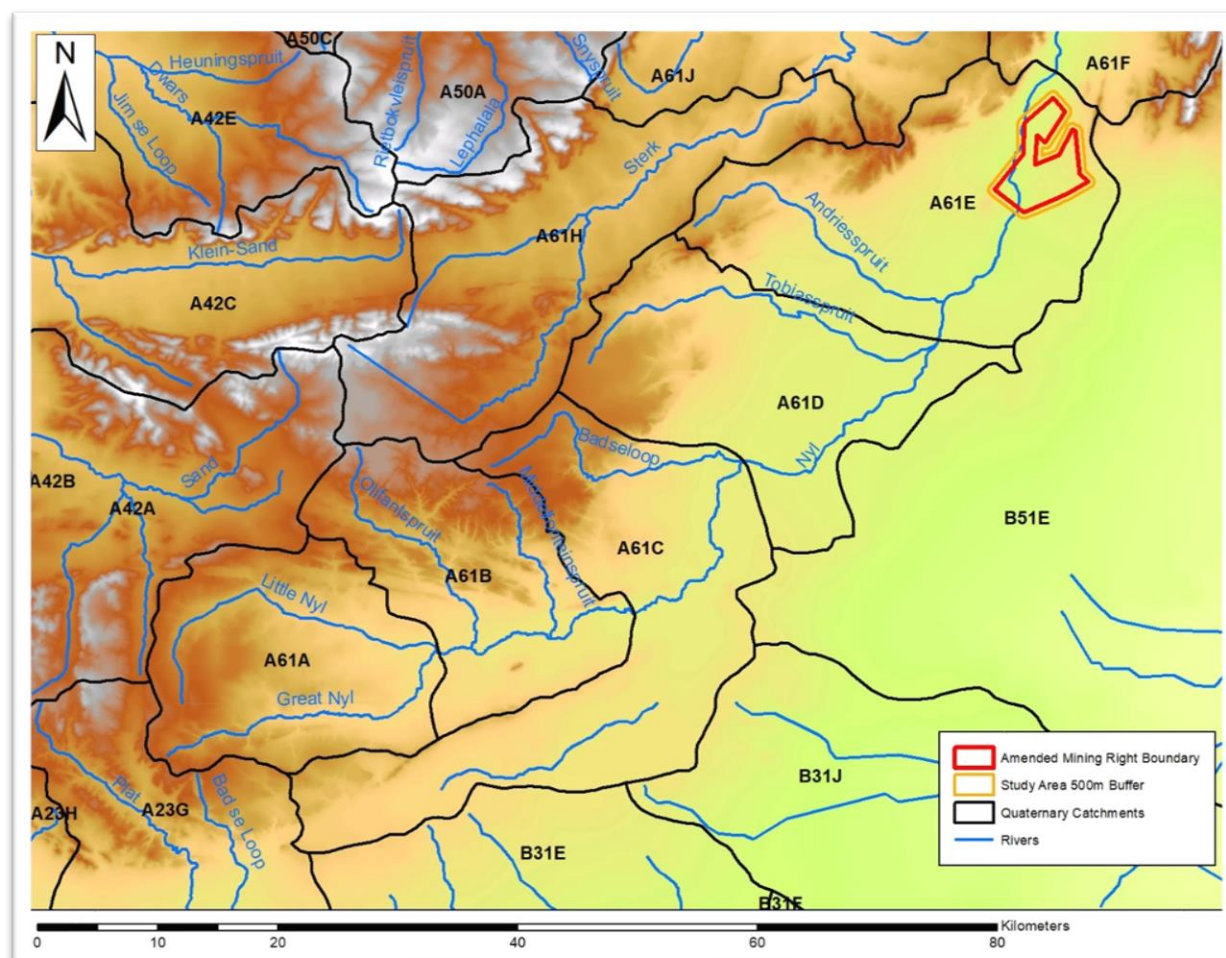


Figure 4. Map showing the study area in relation to the quaternary catchment (catchment boundaries sourced from Water Resources of South Africa, 2012 Study, Bailey and Pitman, 2015).

The affected sub-quaternary reach (SQR) of the Nyl River was considered to be **Largely Modified (PES D)** and of **Moderate ecological importance (EI)** and **Moderate ecological sensitivity (ES)** during the 2014 desktop PES assessment undertaken by the Department of Water and Sanitation (DWS, 2014). A prior assessment undertaken as part of the NFEPA Project considered the Nyl River within the affected reach to be Moderately Modified (PES C).

6.1.3 Strategic Water Source Areas

Strategic Water Resource Areas (SWSAs) within South Africa were identified by Le Maitre, Seyler, Holland, Smith-Adao, Nel, Maherry, and Witthüser, (2018) as part of a Water Research Commission Project (Report No. TT 743/1/18) and are defined by the authors “as areas of land that either: (a) supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or (b) have high groundwater recharge and where the groundwater forms a nationally important resource; or (c) areas that meet both criteria (a) and (b).”

Figure 5 below shows project study area in relation to the delineated Strategic Water Source Areas (Le Maitre et al., 2018). The project study area falls within the Nyl & Dorps River Valley Groundwater Strategic Water Source Area. This highlights the area as being nationally important due to a high groundwater availability and due to the fact that the available groundwater forms an important resource for water supply.

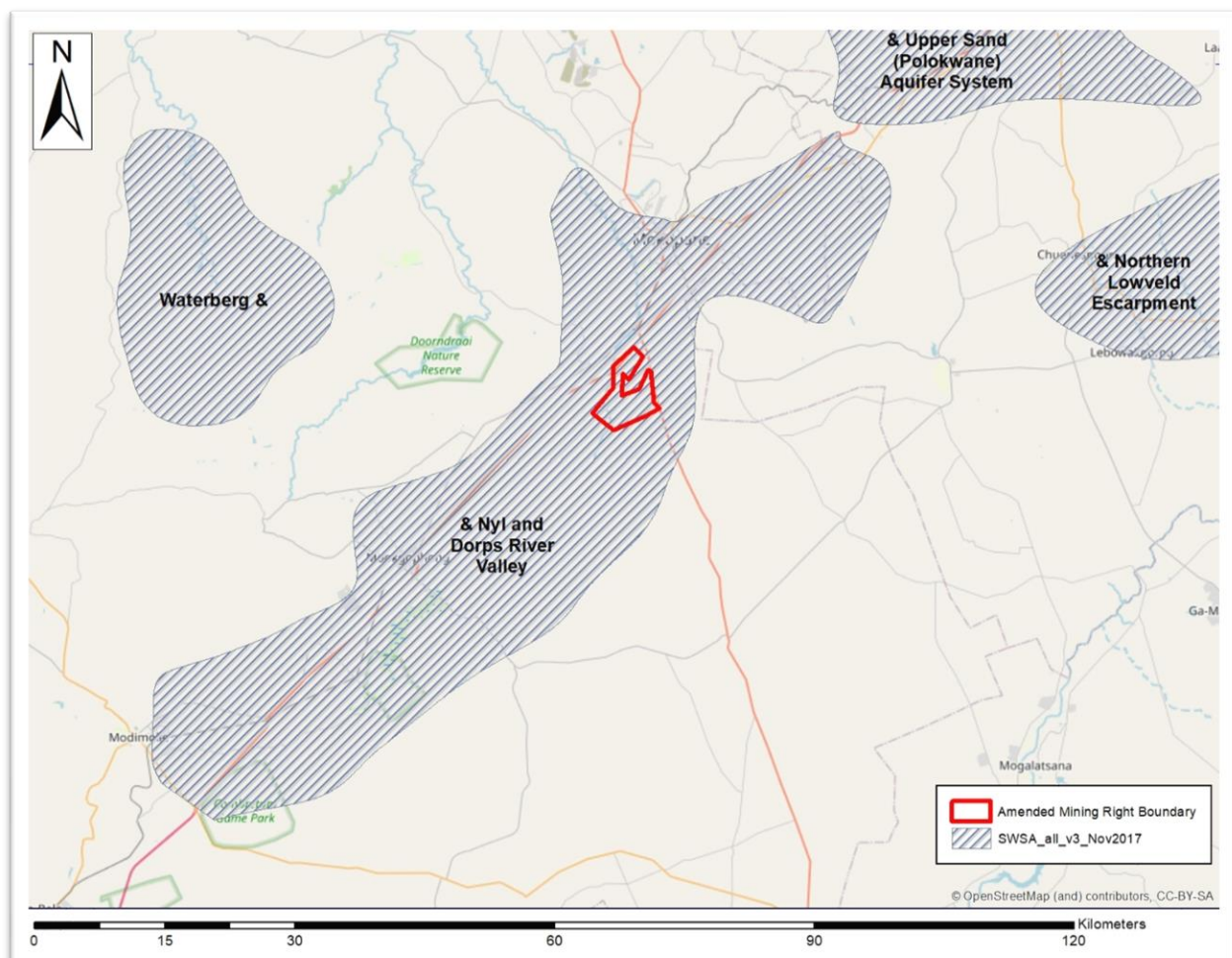


Figure 5. Map showing the project study area in relation to Strategic Water Source Areas (Le Maitre et al., 2018). The project study area falls within the Nyl & Dorps River Valley Groundwater Strategic Water Source Area.

6.1.4 National Wetland Databases

The most recent national wetland dataset, the National Wetland Inventory 5 (CSIR, 2018), was consulted to provide an indication on the occurrence of wetland habitat on site and within the immediate area, as illustrated in Figure 6. Based on the National Wetland Map 5 a large Floodplain wetland associated with the Nyl River extends into the project study area. Only 2 further wetland types are highlighted as occurring within the general vicinity of the study area, being Depression and Seep wetlands. However, it is noted that the National Wetland Map 5 dataset is based predominantly on desktop and/or remote sensing data and as such must be considered Low Confidence data, especially at the scale of an individual project site. Field verification (refer to Section 6.2 below) is thus always required to provide a more accurate representation of wetland extent and types on site.

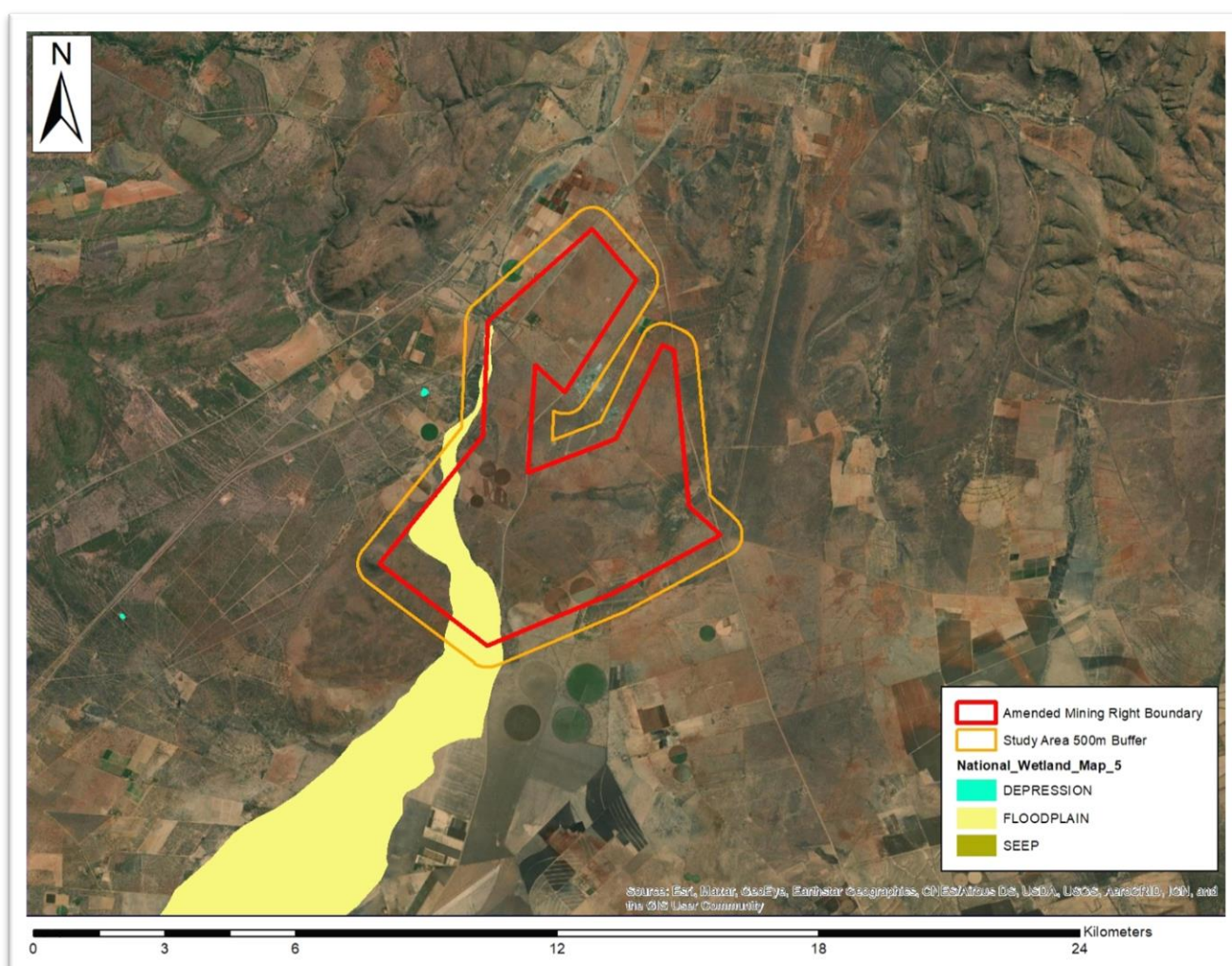


Figure 6. Extract of the National Wetland Map 5 for the project study area and surrounds.

The National Wetland Map 5 (CSIR, 2018) also determined the Ecosystem Threat Status (ETS) and Ecosystem Protection Level (EPL) for all wetland ecosystem types in South Africa. Threat categories for the wetland ecosystem types represented within the project study area and surrounds are indicated in Table 8.

Table 8. Wetland ecosystem type, and its assigned threat status category (Mbona et al., 2015), occurring on site. ETS – Ecosystem Threat Status, EPL – Ecosystem Protection Level.

Wetland Ecosystem Type	EPL	ETS
Central Sandy Bushveld Bioregion (Floodplain)	Not Protected	Critically Endangered
Central Sandy Bushveld Bioregion (Depression)	Poorly Protected	Least Concern
Central Sandy Bushveld Bioregion (Seep)	Not Protected	Critically Endangered

An earlier iteration of the National Wetland Map was included in the National Freshwater Ecosystem Priority Areas Project (NFEPA), which culminated in the Atlas of Freshwater Ecosystem Priority Areas (Nel et al, 2011). This report provided a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. Freshwater Ecosystem Priority Areas (FEPAs) were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat. An extract of the FEPA Wetlands dataset is provided in Figure 6. ***The Nyl River and associated wetland habitat are classified as a wetland FEPA.***

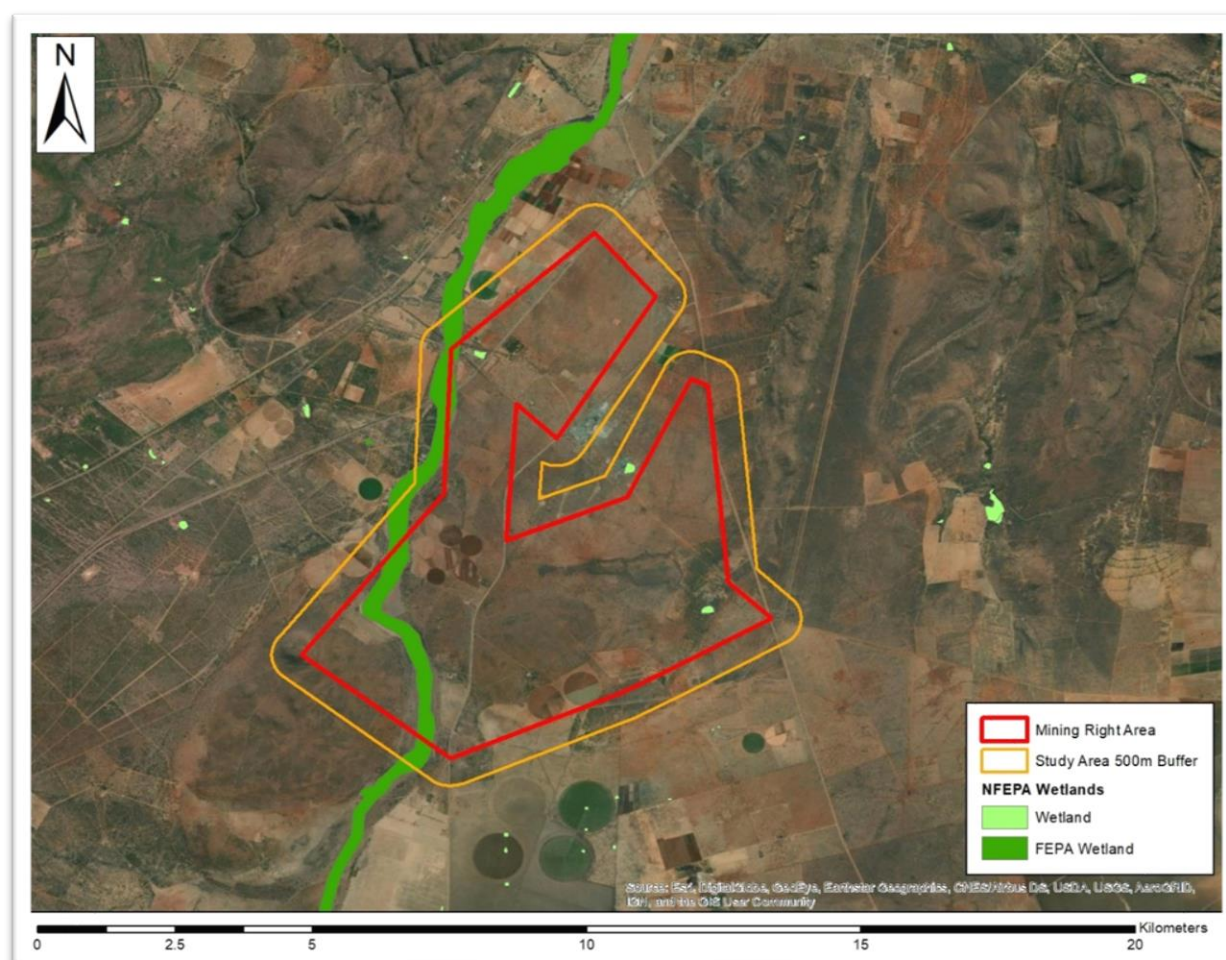


Figure 7. Extract of the FEPA Wetlands dataset (Nel et al., 2011) for the project study area and surrounds.

6.1.5 Vegetation Types

The study area is located within the Savannah Biome and the Central Bushveld Bioregion of South Africa. The specific vegetation type expected to occur on site has been classified as Central Sandy Bushveld across most of the site, while a small section of Springbokvlakte Thornveld occurs in the extreme south of the project area (SANBI, 2006-2018). Springbokvlakte Thornveld is considered Vulnerable in terms of the National List of Ecosystems that are Threatened and in Need of Protection (GN1002 of 2011).

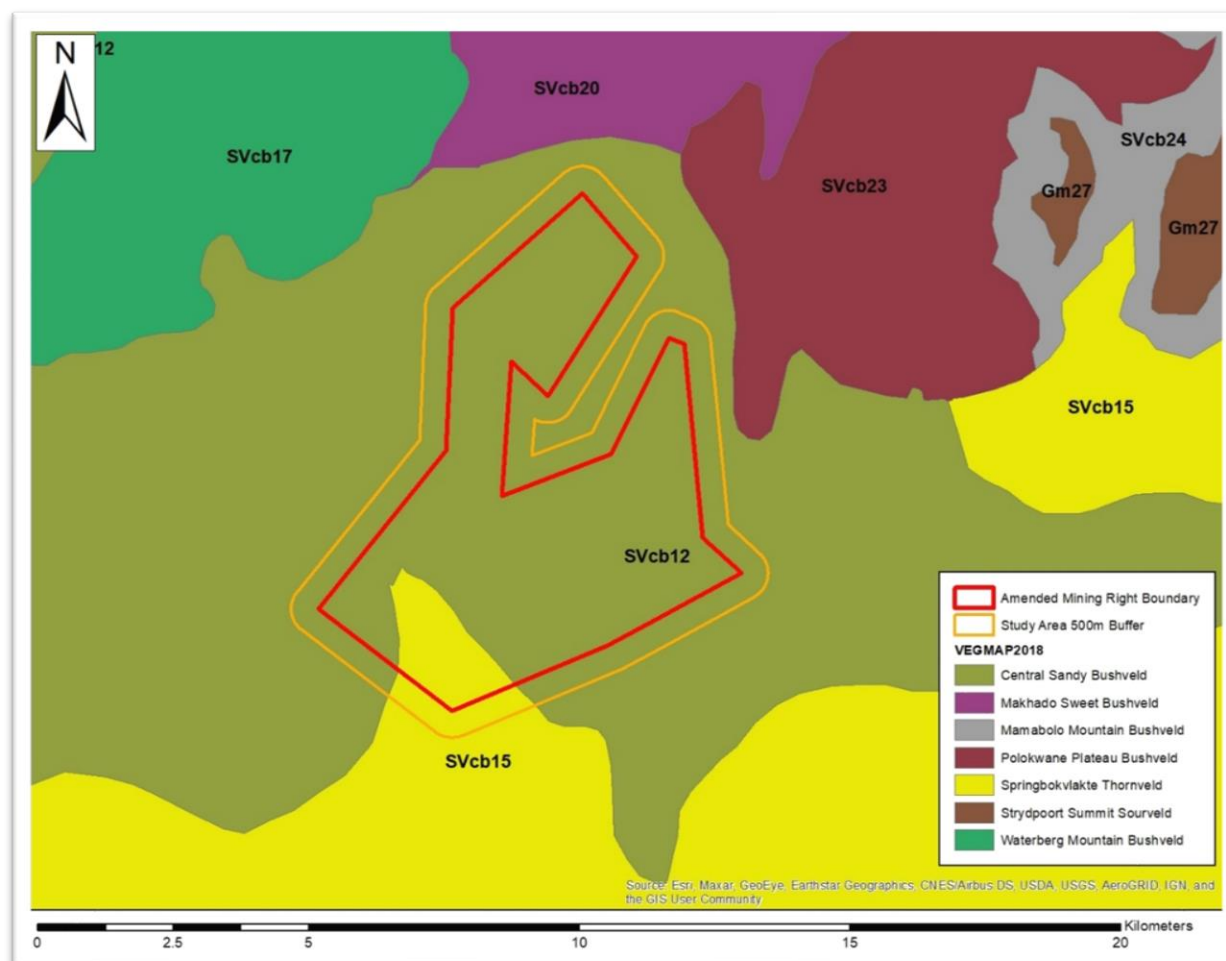


Figure 8. Map showing the vegetation types occurring within the project study area and surrounds.

6.1.6 Provincial Conservation Plan and Protected Areas

An extract of the Limpopo Conservation Plan, as updated for the area through the Waterberg District Bioregional Plan (LEDET, 2016) shows the bulk of the project study area being classified as a Critical Biodiversity Area 1.

Critical Biodiversity Areas (CBA's) are described in the Draft Ecosystem Environmental Assessment Guideline as "sites selected to be the most efficient configuration in the landscape for meeting biodiversity targets of representivity and persistence. CBAs are irreplaceable or 'important and

necessary' in terms of meeting targets for biodiversity patterns and processes and are large enough and connected enough to be functional and persist in the long-term."



Figure 9. Extract from the Waterberg District Bioregional Plan (LEDET, 2016) showing the terrestrial biodiversity assessment for the project study area and surrounds.

The Nylsvley Nature Reserve, a Ramsar wetland of international importance, is located along the Nyl River approximately 35km upstream (as the crow flies) of the project study area – refer to Figure 10.

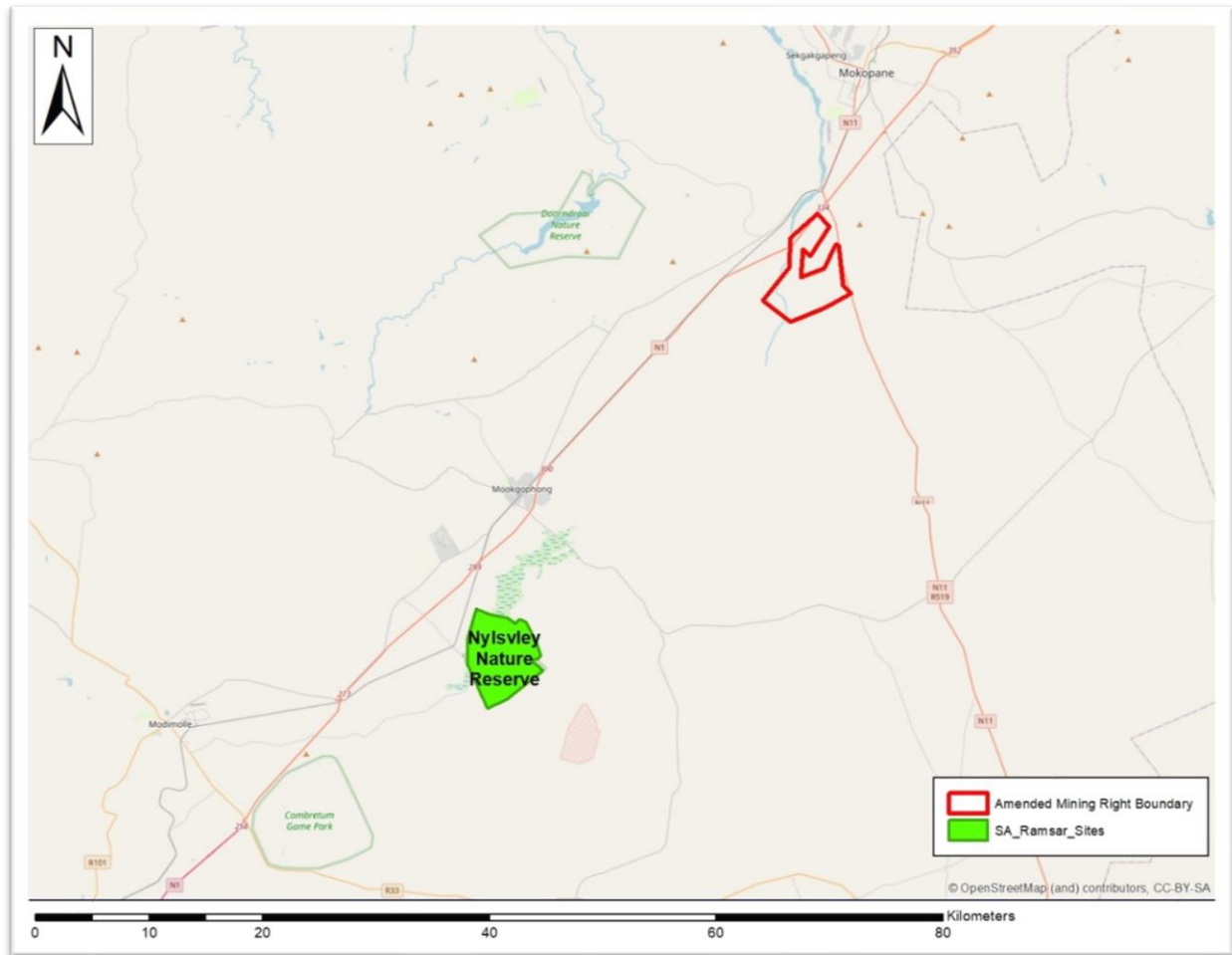


Figure 10. Map showing the location of the project study area in relation to the Nylsvley Nature Reserve and Ramsar site.

6.1.7 Background to the Nylsvley Wetland

6.1.7.1 Ramsar Wetland

The greater Nylsvley wetland is approximately 65km long and varies in width from approximately 5km at its widest point to 100m at its narrowest (Kleynhans et al., 2007 in WRC Report TT441/09). Overall it covers approximately 24 250 ha, which makes it the largest floodplain vlei in South Africa (Higgins and Rogers, 1993). The Nylsvley Nature Reserve, a Ramsar wetland of international importance, is located along the floodplain and conserves approximately 3 000 ha of the floodplain (Higgins and Rogers, 1993). A map of the greater Nylsvley wetland showing the approximate extent of the floodplain as well as the location of the study area and the Nylsvley Nature Reserve is provided below.

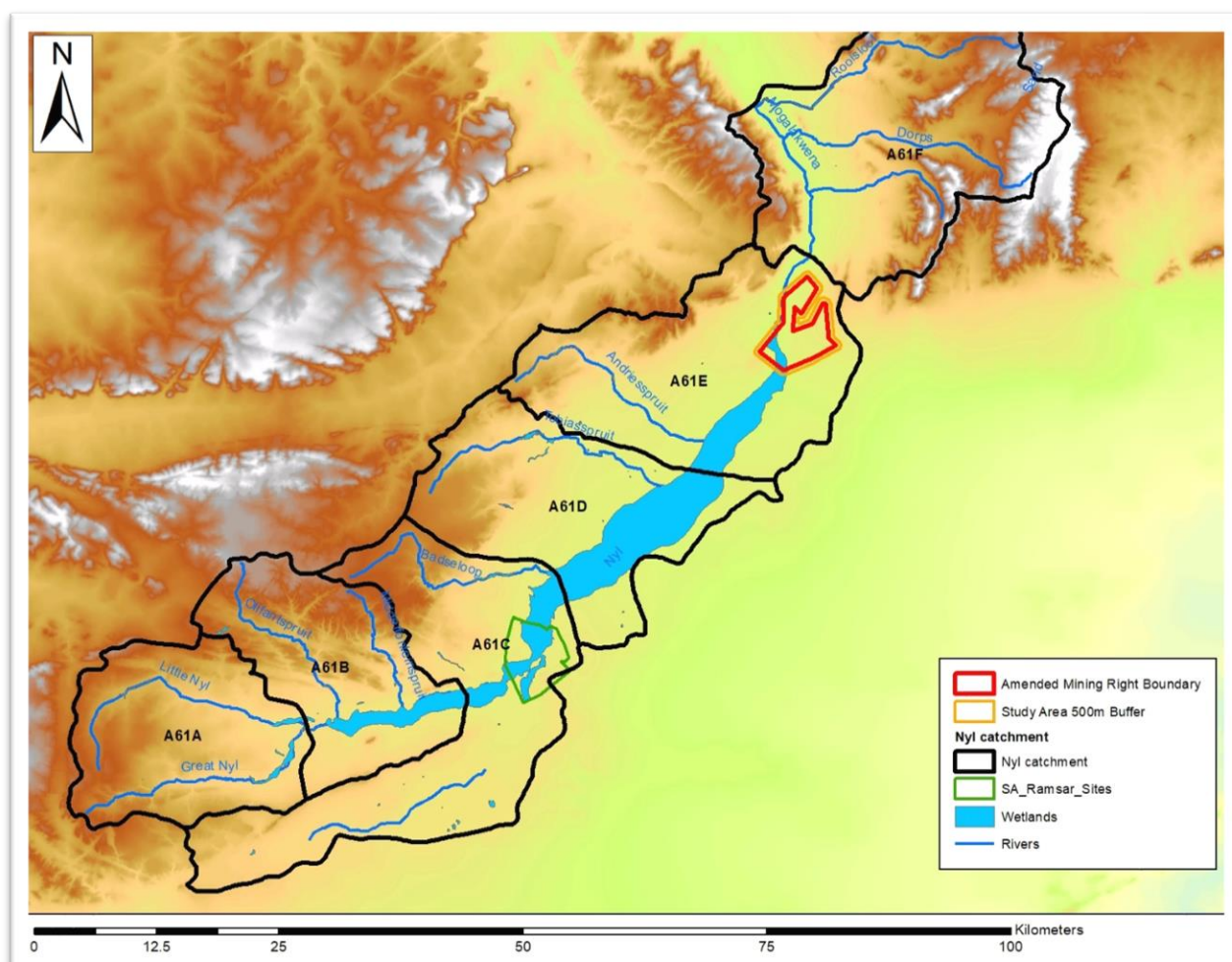


Figure 11. Map of the greater Nylsvley Wetland within its catchment, indicating the location of the Nylsvley Nature Reserve and the study area in relation to the entire floodplain as mapped in the National Wetland Map 5.

6.1.7.2 Formation of the Nyl Floodplain

The Nyl River has as its source the Groot Nyl and Klein Nyl Rivers that originate in the Waterberg Mountains in the extreme southwest of the catchment (see Figure 11 above). These two rivers converge just to the east of the town of Modimolle to form the Nyl River, which then flows in a north-easterly direction and supports the large Nylsvley wetland. A number of significant tributaries join the Nyl River from the western side of its catchment, draining out of the Waterberg Mountains (e.g. Olifantspruit, Bad-se-Loop, Tobiasspruit, and Andriesspruit). It is noteworthy that no significant tributaries enter the Nyl River from the Springbok Flats on the eastern side of the catchment. The Springbok Flats are an extensive area of low-relief and low-gradient with no defined drainage systems and the watershed/catchment boundary of the Nyl River is very poorly defined in this area, though generally the Springbok Flats drain into the Olifants River catchment and away from the Nyl River.

Further to the north, across the Zebediela Fault which forms the northern limit of the Springbok Flats, the Maribashoek and Buffelshoek Mountains lie to the east of the Nyl River. These mountains are the source of a number of steep tributaries that enter the Nyl River, including the Rooisloot, Dorpspruit and Pholotsi rivers. In contrast, no major tributaries join the Nyl River from the west in this reach, until the confluence with the Sterkspruit further north.

It has been proposed by McCarthy *et al.* (2011) that “*progradation of coarse-grained tributary fans across the narrow river valley*” in these northern reaches of the Nyl River resulted in the partial impoundment of the Nyl River and created the accommodation space for sedimentation in the upper reaches of the Nyl River. The steep eastern tributaries, specifically the Rooisloot, Dorpspruit and Pholotsi, are the source of these alluvial fans. The reduction in upstream gradient resulting from the obstruction of river flow by these alluvial fans across the river valley allowed sediments transported into the upper Nyl from its western tributaries in the south to accumulate in the river valley, over time filling up the floodplain basin to its current level. Sediment accumulation is still active on the floodplain, and sediments have attained a depth of roughly 35m (McCarthy *et al.*, 2011).

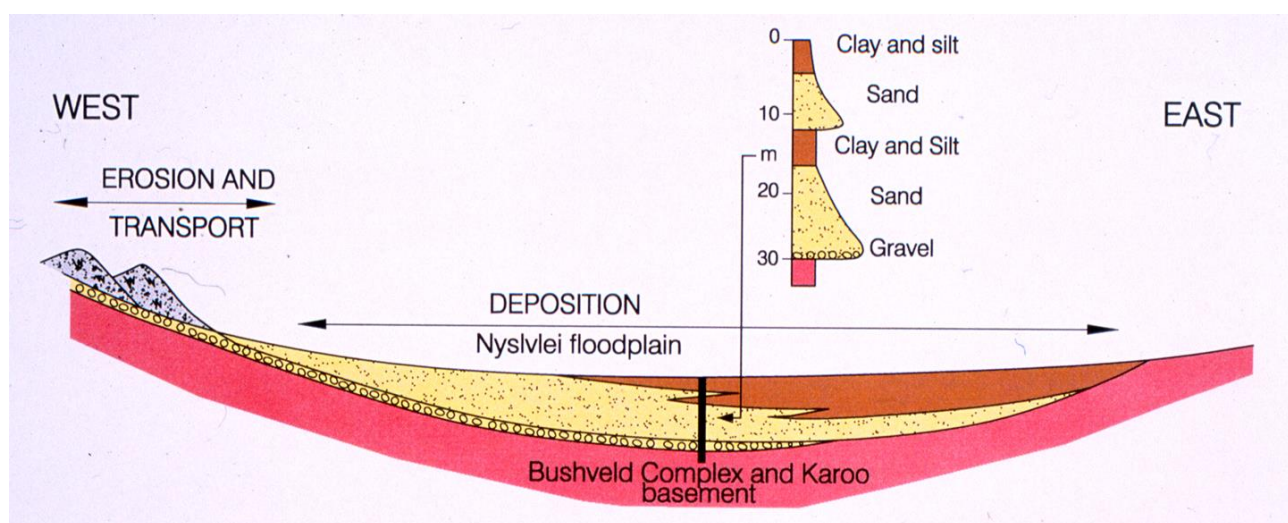


Figure 12. Schematic cross section through the Nylsvlei (McCarthy, 2012).

The main source of sediments to the Nylsvley wetland is the tributaries draining from the Waterberg Mountains to the west in the southern and middle reaches of the wetland. Figure 12 above, reproduced with permission of Prof. Terence McCarthy (Presentation: *Geohydrology of the Nylsvlei floodplain*, presented 12/11/2012, McCarthy), shows a cross section through the sediments in the wetland basin and adjacent areas. As sediment rich flows from the west reach the lower gradients east of the mountains, sediment loads are deposited. Initially the heavier coarse grained material (gravel) is deposited, followed by finer sand and eventually clay particles. Over time, as the basin filled and gradients became lower, the area of clay deposition slowly progressed westwards, closer to the mountains. This has resulted in the wetland under current conditions being characterised by a thick clay layer across the full width of the floodplain. Underlying this clay layer is a series of interleaved clay and sand layers, with greater depths dominated by sandy deposits and eventually coarser gravel overlying the bedrock.

6.1.7.3 Hydrology & Flooding

Flow within the tributaries feeding the Nyl River is strongly seasonal, with peak flows during the wet summer months. Rainfall in the catchment however varies considerably in time, space and intensity, with average rainfall ranging from 740mm in the west to 600mm in the east. The 69-year mean annual rainfall at Nylsvley Nature Reserve is 623 mm with an annual coefficient of variation of 24% (Frost, 1987). Given this variability in rainfall and water inputs to the wetland, the seasonality of the system is easy to understand, with flooding of the Nylsvley occurring on average only 3 out of 5 years.

Analysis of satellite imagery (McCarthy et al., 2011) indicates that the Nyl wetland receives most of its surface water from the Groot and Klein Nyl Rivers in the south, as well as from several of its western tributaries, with virtually no water inputs from the east. Work undertaken by McCarthy et al (2011) indicates that up to a 100% of annual flow within the western tributaries of the Nyl River infiltrates into the sandy sediments along the western edge of the Nylsvley wetland prior to reaching the floodplain. This view is based on the decreasing channel sizes and eventual disappearance of the channels, and the loss of water that this represents, of the western tributaries as they approach the floodplain. Thus in order for flooding of the Nylsvley floodplain to occur, 110% or more of the average annual rainfall is required (McCarthy, 2012) so that surface runoff generated within the Waterberg mountains reaches the Nylsvley wetland and is not all lost to groundwater recharge.

Water lost to groundwater recharge by the western tributaries is expected to support a large alluvial aquifer within the sandier sediments underlying the Nylsvley floodplain. The existence of this alluvial aquifer, and its response to rainfall, can be verified through monitoring of water levels within and immediately adjacent to the wetland. In the case of the Volspruit study area, shallow groundwater levels within and in close proximity to the wetland have been monitored by GPT since 2011 (GPT, 2022). Initially, during periods of normal/average rainfall, groundwater levels were 5-12mbgl and showed little response to rainfall. Following a flood event in 2014, groundwater levels in many (but not all) of the shallow boreholes quickly rose to 2-3mbgl. However, it was noteworthy that the shallow piezometer boreholes reacted differently, indicating variability in terms of permeability of the sediments along and within the wetland.

The general consensus of a number of researchers (Kleynhans, 2006) has been that the alluvial aquifer is separated from the surface water within the Nylsvley wetland by clay layers of low permeability. In the same study, Kleynhans found that soil permeability on the floodplain was governed by the soil layer with the lowest permeability, and that several of these layers yielded permeability rates too low to measure with a Guelph Permeameter, and that recorded infiltration rates varied from 0.036 mm/hour to 0.864 mm/hour. It is thus considered unlikely that flood waters within the wetland play a significant role in recharging the alluvial aquifer underlying the wetland, though the response of water levels within the alluvial aquifer to flooding does show that the aquifer is recharged during a flood (Morgan, 1996), though this likely takes place on the sandier sediments along the edges of the floodplain, rather than within the floodplain itself.

Once flows enter the wetland and flow past the end of the channel, flow through the wetland typically occurs as “laterally extensive, slow moving, shallow (< 1 m deep) sheetflow” (Tooth et al. 2002). Only approximately 30 % of inflow to the Nylsvley catchment is estimated to leave the wetland as surface flow (Morgan, 1996), with the remainder lost to evapotranspiration and presumably infiltration to groundwater. However given that the floodplain does not flood every year, outflow does also not occur every year.

6.2 Site Specific Assessment

Field surveys informing this assessment were undertaken as part of the original wetland assessment study in 2012, as well as during an additional field survey undertaken over 2 days, 20 - 21 January 2022.

6.2.1 Wetland Delineation and Classification

The floodplain covers approximately 317 ha of the project study area (amended MRA with 500m buffer), with 199.6 ha of wetland habitat falling within the amended MRA. A small Seep wetland along the western edge of the Floodplain and two small Depression wetlands make up an additional 5.1 hectares of wetland habitat. Two small farm dams and a water-filled quarry add a further 1.2 ha of artificial wetland habitat. Natural wetland habitat thus makes up 6.2 % of the study area and 6% of the amended MRA. Within the context of the greater Nyl River floodplain, the section of floodplain on site represents approximately 1.6 % of the entire Nyl floodplain (based on the National Wetland Map 5 mapping of the greater Nyl floodplain)².

Within the study area, the southern reaches of the floodplain are characterised by a broad, flat, grassed wetland approximately 380 m across. No defined channel was observed in these areas, as is the case with large portions of the greater Nyl Floodplain to the south of the site. Zonation of the vegetation on site does however indicate that the central region of the floodplain is inundated more frequently and that most surface flows will be confined to this section. This central section of the floodplain is dominated by a variety of sedges (grass-like plants) and some grass species. As one moves outward from the centre of the floodplain the sedges then make way for a grass dominated community. This area is expected to be inundated only during larger flood events, though the soils

² The figures quoted in this paragraph differ from the WCS 2012 study mostly due to changes in the extent of the project study area, though minor revision of the extent of wetland habitat identified on site also contributes.

would still become saturated for short periods during most years, as indicated by the presence of many facultative wetland grass species.

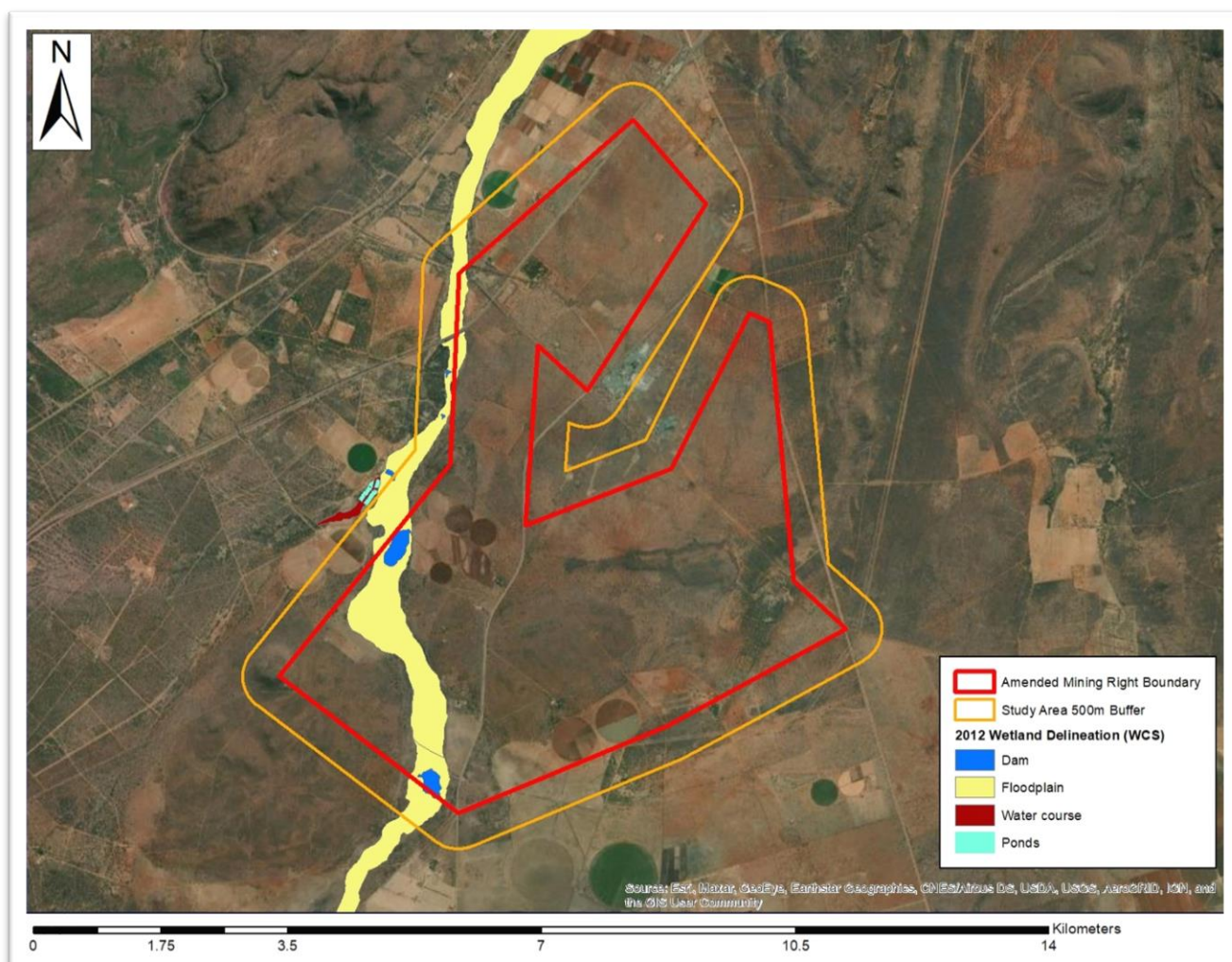


Figure 13. Map of the delineated wetlands within the study area.

The middle reach of the floodplain on site has been markedly influenced by the construction of the large dam across the floodplain. The dam maintains an open water body (with scattered stands of reeds) of approximately 10 ha and significantly increases the depth and duration of inundation of the floodplain for several hundred meters upstream of the dam. Along this section of the floodplain a shallow berm has also been constructed along the western bank of the floodplain to prevent large floods spilling into the cultivated fields (now fallow) adjacent to the floodplain. The presence of the dam has altered the vegetation within the floodplain wetland and resulted in the presence of a vegetation community adapted to near permanent water and characterised by reeds such as *Phragmites australis* and *Typha capensis*, as well as tall emergent sedges. Adjacent to this permanent wet area the seasonal sedge dominated community occurs (but much reduced in extent) followed by the extensive grass dominated temporary wet edge of the floodplain. The terrestrial edge of the floodplain coincides roughly with the treeline, where a narrow riparian fringe occurs. At its widest point, the floodplain in this reach is more than 800m across.

Downstream of the large dam a channel becomes readily apparent within the floodplain, roughly along the centreline of the wetland. This section of the floodplain is also still significantly impacted by the large dam as well as by smaller downstream dams that increase the duration and depth of inundation. At the time of the site visit in December 2010 more than 1m of standing water was encountered in this section of the floodplain (in the vicinity of the main channel) despite the southern reaches of the floodplain on site being dry. Further to the north the wetland narrows to less than 100m in width, before widening again to around 350m at the N1 crossing. While it is possible to speculate that the construction of the large dam and/or the N1 road crossing has resulted in the channel formation, it is necessary to remember that the floodplain naturally becomes narrower in this reach and channel formation is thus likely to have happened naturally.

At the time of the most recent field survey in January 2022, a sizable flood event had just occurred, with a large proportion of the Floodplain habitat on site being inundated. The approximate extent of inundation is shown in Figure 14, with photos of the flooded wetland provided in Figures 15 and 16 below.

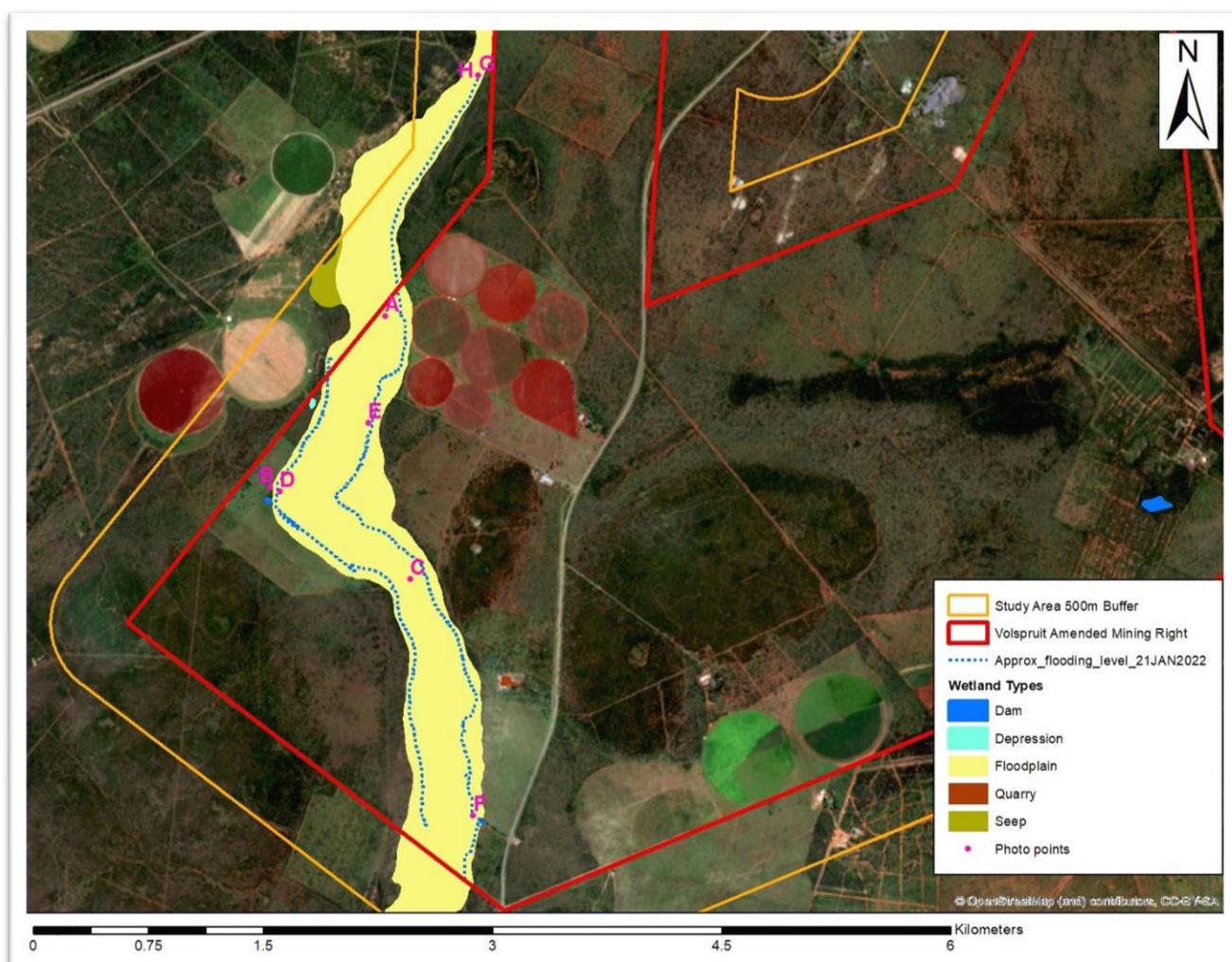


Figure 14. Map showing delineated wetlands in relation to the flood level recorded on 20-21 January 2022. Photo points refer to photos in Figures 15 and 16 below.

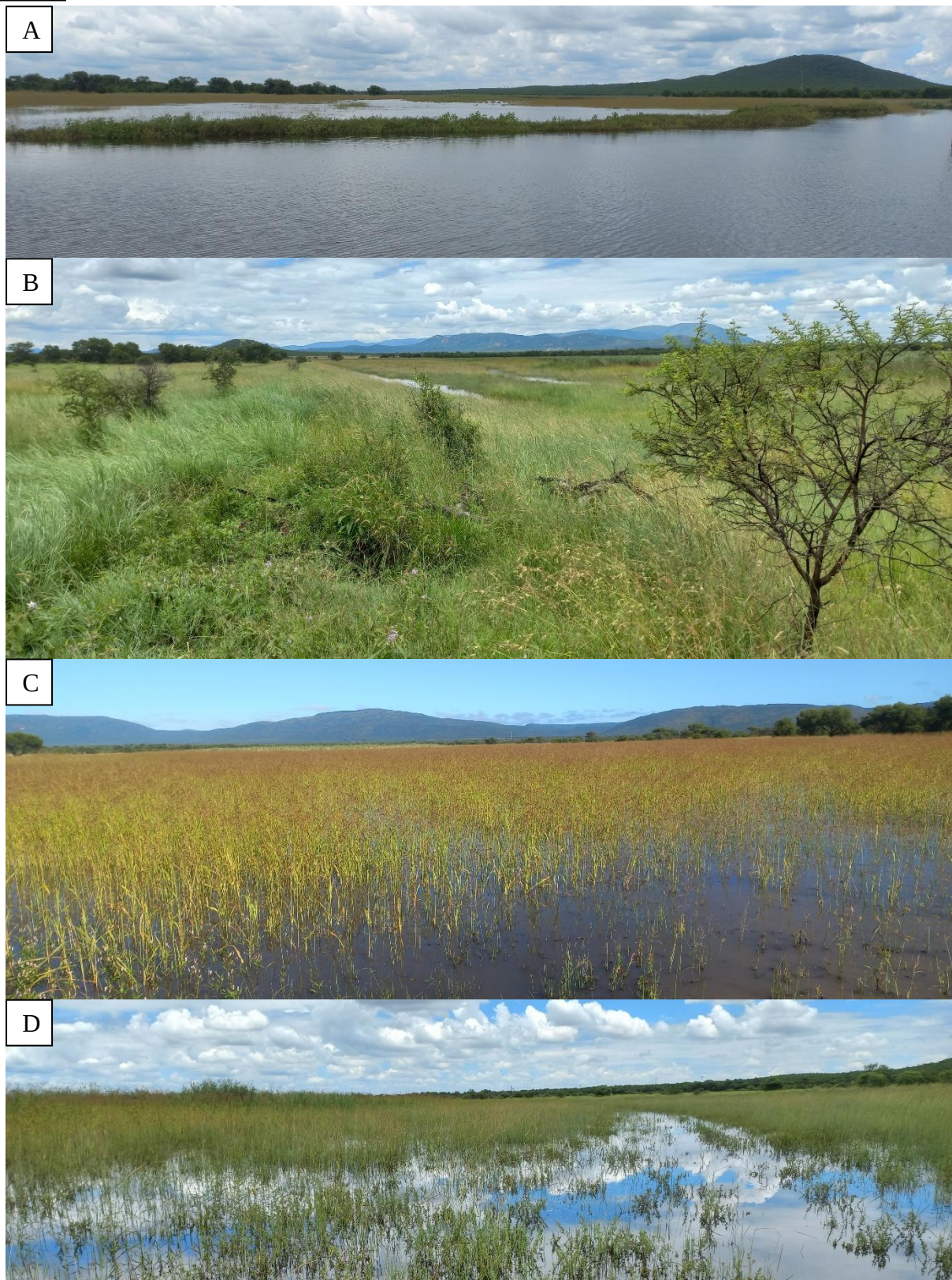


Figure 15. Photographs wetland habitat associated with the Floodplain wetland on site: A shows open water habitat associated with the large dam; B shows an old flood protection berm along the western edge of the floodplain; C shows extensive *Sorghum halepense* in the central reaches of the floodplain on site; D shows inundated habitat upstream of the large dam.

E



F



G



H



Figure 16. Photographs wetland habitat associated with the Floodplain wetland on site: E shows marginal habitat in the central reaches of the site; F shows flooded habitat near the southern edge of the study area; G shows the downstream dam across the Floodplain; H is a view looking north from the downstream dam.

Two very small depression wetlands were identified to the west of the Floodplain in the MRA. These Depressions represent little more than shallow puddles that retain sufficient water for long enough

after rainfall events to support hydrophytes, i.e. wetland vegetation. Together the two Depression wetlands cover 0.06 hectares (600m²). These Depressions are located on the western bank of the Floodplain and will thus not be impacted by proposed mining and associated infrastructures.



Figure 17. Photos of the two small Depression wetlands recorded on site.

6.2.2 Functional Assessment

The recently updated WET-EcoServices Version 2 assessment methodology was utilised to assess Nylsvley Floodplain within the project study area in terms of ecosystem services. The method considers wetlands in terms of 16 ecosystem services across groupings of Regulating and Supporting Services, Provisioning Services, and Cultural Services. Results of the assessment indicate the Supply and Demand for ecosystem services, with Supply indicating the ability of a wetland to perform a specific ecosystem service, while Demand indicates the need for a particular ecosystem service based on within-wetland and surrounding land uses and impacts.

The results of the WET-EcoServices assessment are presented on a radial plot in Figure 18, from which a number of observations can be made:

- The Floodplain wetland is well placed to provide ecosystem services related to water quality maintenance such as Nitrate Assimilation, Phosphate Assimilation, and Toxicant Assimilation. The diffuse nature and extended residence of flows within the wetland provide ample opportunity for biogeochemical cycling. These characteristics also provide ideal opportunities for sediment trapping.
- The highest scores were obtained for Biodiversity Maintenance, with both the Demand and Supply scores being Very High.
- A High demand was identified for “Water for Human Use” – although little direct abstraction takes place from the wetland, the wetland does contribute towards recharge of the shallow aquifer, which provides the main source of agricultural water on site.
- Livestock grazing was highlighted as an important provisioning service.
- Supply scores for Cultural Services were High to Very High, though Demand was only High for Tourism and Recreation. The Nylsvley is considered to be well placed to provide Cultural

and Spiritual value, though little information is available in this regard, resulting in the demand scores being very low

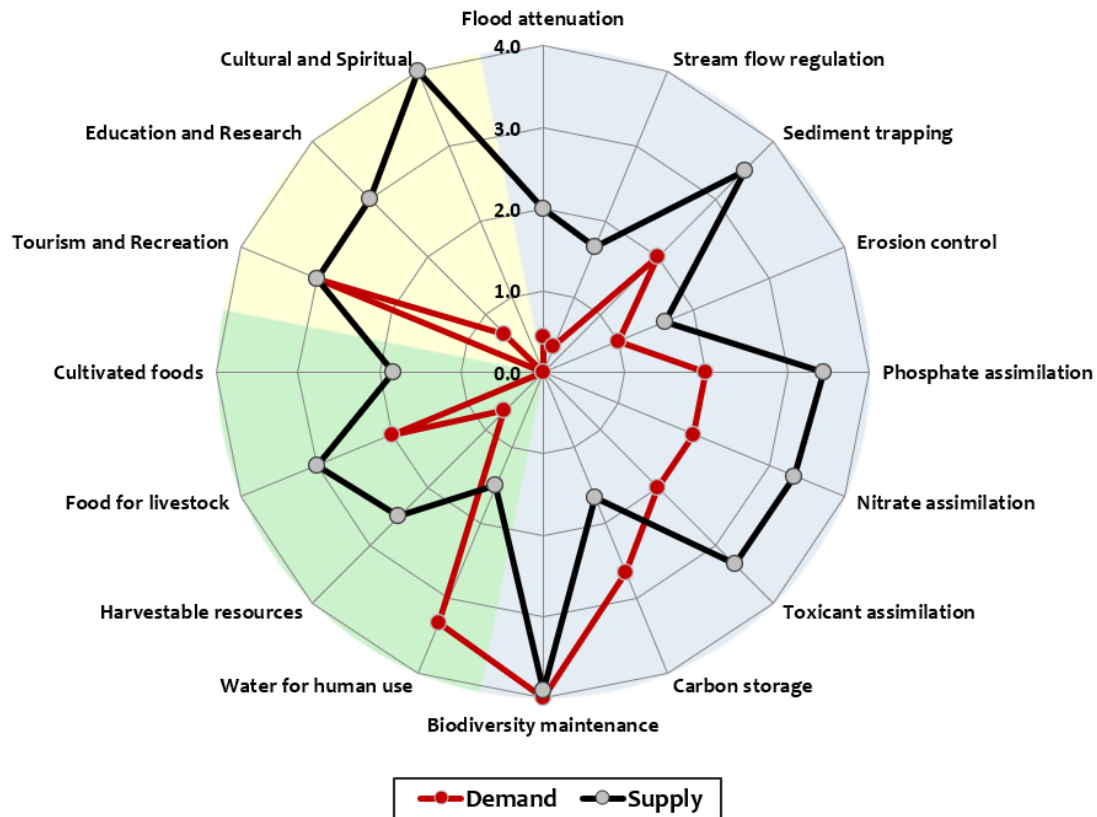


Figure 18. Results of the WET-EcoServices assessment.

6.2.3 Wetland Biodiversity

6.2.3.1 Flora

Within the Nylsvley Ramsar site roughly 600 plant species have been recorded, though this includes wetland species as well as adjacent woodland species (Kleynhans et al., 2007 in WRC Report TT 441/09). Of special significance is the wetland plant *Oryza longistaminata* (wild rice), with stands of wild rice on the floodplain representing what was used to be thought of as the southernmost extent of this species' range, though it has in recent years also been observed along the Pienaars River floodplain further to the south. This species was recorded in several locations within the study area during both the 2010 and 2022 field surveys, though generally only in smaller, somewhat isolated stands.

As already briefly mentioned above, the vegetation of the floodplain shows clear zonation related to the depth and duration of inundation. This zonation is evident in the southern reach of the floodplain on site where the central, most frequently inundated section of the floodplain is dominated by a variety of sedges (*Eleocharis* and *Schoenoplectus* spp.) and other mostly obligate wetland species (e.g. *Panicum schinzii*), while the sides and perimeter of the floodplain are grass dominated and characterised by various facultative wetland species such as *Dichanthium annulatum*, *Digitaria eriantha*, *Dinebra retroflexa*, *Eragrostis superba*, *Fingerhuthia africana*, *Ischaemum fasciculatum*,

Panicum maximum, *Setaria sphacelata*, *Setaria incrassata*, *Sorghum halepense*, and *Cenchrus ciliarus*.

Vegetation zonation within the greater floodplain occurs not only laterally away from the channel, but also vertically above the channel and downstream along the channel, with the extent and duration of inundation decreasing along all three directions (Higgins et al., 1996). The location of the study area towards the extreme lower end of the floodplain would thus appear to indicate that the floodplain on site, under natural conditions, is characterised by less frequent flooding and flooding of shorter duration than the upper Nyl floodplain around Nylsvley Nature Reserve, with resultant differences in vegetation between these areas. This is reflected in the vegetation, with *Oryza longistaminata* being observed only in small, isolated stands on site. However, the presence of the dams within the floodplain has extended the periods of water retention within this section of the wetland and the vegetation has responded accordingly, with areas affected by dam inundation being characterised by species more commonly associated with extended/permanent saturation.

In terms of the vertical axis, studies undertaken by Coetzee and Rogers (cited in Havenga et al., 2007) indicate that a statistically significant change in vegetation species composition can be detected for a 90mm change in elevation. Activities that alter the flooding regime of the floodplain by as little as 90mm (increase or decrease) could thus be expected to have a significant impact on vegetation composition. In addition, specific species have specific depth and duration of flooding requirements. *Oryza longistaminata* for example grows best in water depths of 100-500mm and requires a minimum of 25 days of flooding (Marneweck 1988, as cited in Havenga, et al., 2007). Greater flooding depths reduce flowering of the wild rice, while too short or no flooding increases stress on the wild rice and over several years can reduce the viability of the plant due to a loss in reserves. The importance of the hydrological regime that drives the floodplain ecosystem in terms of determining the vegetation of the floodplain is thus clearly illustrated

Higgins et al. (1996) recognise three different flood events based on the frequency, spatial extent and duration of the flood. These flood events coincide with the vegetation zonation observed in the Nylsvley Nature Reserve.

- Channel zone flood – Occurs in 7 out of 10 years. Only the channel is inundated for a period of about 3-4 months. Provides habitat for the truly aquatic species on the floodplain.
- Floodplain zone flood – Occurs in 4 out of 10 years. Such a flood would roughly coincide with the sedge dominated area of the floodplain. Also has a duration of approximately 50 days.
- Hydromorphic zone flood – Occurs approximately 3 out of 10 years, with flooding lasting for a period sufficient for the breeding of water birds (more than 50 days). Such a flood would inundate the entire (or at least most of the) delineated wetland area

(Very rare flood events such as the 1:100 year flood events which need to be considered as part of the environmental and mining application processes and which are depicted by the 1:100 year floodlines, flood an area in excess of the delineated floodplain area (hydromorphic area) and extend well into the surrounding terrestrial Bushveld vegetation.)

During the field survey in January 2022 large stands of the alien grass, *Sorghum halepense*, were observed within the Floodplain wetland, especially within the central reaches on site. *S. halepense* (Johnson grass) is listed by SANBI as a naturalised exotic and is characterised by NEMBA as a

Category 2 invader. This is a problematic species as it a very large robust grass forming spreading stands that can exclude less vigorous species (<https://invasives.org.za/fact-sheet/johnson-grass/>). Once established it is a difficult species to remove due to its deep rhizomes. The presence of this species at high densities across large areas of the Floodplain wetland on site is a concern, especially as it is a species that was not noted in such high prevalence during an earlier field survey in 2011. It thus appears to be spreading within the wetland habitat on site and may overtime replace some of the indigenous species within the wetland.

6.2.3.2 Fauna

The Nyl floodplain is probably best known for its avian biodiversity and abundance, though the floodplain is also of importance in supporting other biodiversity. The following excerpts are taken from the WRC Report number TT 441/09:

The Nyl floodplain is renowned for its avifauna. The site is designated as one of the Important Bird Area's of Southern Africa (IBA) (Barnes, 1998) and also a Ramsar Wetland of International Importance. Barnes and Tarboton (1998) describe both the huge abundance of birdlife (estimated up to 80 000 individuals during floods) and exceptional diversity (426 species are recorded on the floodplain, approximately 46% of all species found in Southern Africa). Many of the birds utilizing the floodplain's habitat are threatened species. Over a hundred species of waterfowl alone are recorded on the floodplain, 58 of which are known to breed there and 23 are Red Data listed (eight of which breed on the floodplain) (DEAT, 1998). Nylsvley is the only site in South Africa where the Rufousbellied Heron *Butorides rufiventris* has been known to breed and is the only place in the country³ with a record of the Striped Crake *Aenigmatolimnas marginalis* and Streakybreasted Flufftail (DEAT, 1998).

(WRC Report TT 441/09)

Sixteen species of fish are known to occur in the Nyl system. The fish in the Nyl system proliferate to an estimated 300-600 tons during floods (DEAT, 1998) while the frogs multiply almost as astoundingly. A total of 75 species of herpetofauna and 62 mammal species have been recorded in the Nylsvley Nature Reserve alone (Jacobson, 1977), but additional species are found outside of the reserve. A number of the mammal and herpetofauna species are also threatened species.

(WRC Report TT 441/09)

During the WCS (2022) wetland assessment field work a total of 121 bird species were recorded within the project study area (109 species during the 2012 field survey). At the time of the field survey in January 2022 the floodplain had only recently flooded, and wetland vegetation had only just started to respond to the flood water. This suggests that bird numbers, specifically of species dependant on wetland habitat, were also still in the process of responding to the recent flood and that numbers and diversity could be expected to increase. When the floodplain on site is fully inundated, it is believed that the habitat provided by the wetland would be suitable to support most if not all of the water bird species that have been recorded within the Nylsvley Nature Reserve, including the Red Data listed species.

³ Subsequent to the publication of the document referenced (DEAT, 1998), the Striped Crake has also been recorded in the Moretele Floodplain.

6.2.4 Present Ecological State (PES)

6.2.4.1 Reference Conditions

The reach of the Nylsvley Floodplain falling within the project study area has been affected by a number of activities and disturbances that have occurred within the delineated wetland habitat. Foremost among these is the building of dams within the Floodplain. These dams inundate sections of the wetland, resulting in loss of vegetation cover and creation of open water habitat. Although the open water habitat is generally confined to a localised area immediately upslope of the dam wall, the very low longitudinal slope of the Floodplain results in an extensive area of increased wetness (increased depth and duration of flooding) associated with each of the dams. This has affected vegetation assemblages within the wetland, with species such as *Phragmites australis* and *Typha capensis* restricted largely to those sections of the Floodplain affected by impoundments and forming large stands in these areas.

These changes are clearly evident when comparing recent aerial imagery with historical aerial imagery showing the wetland prior to dam construction (refer to Figure 19 below).

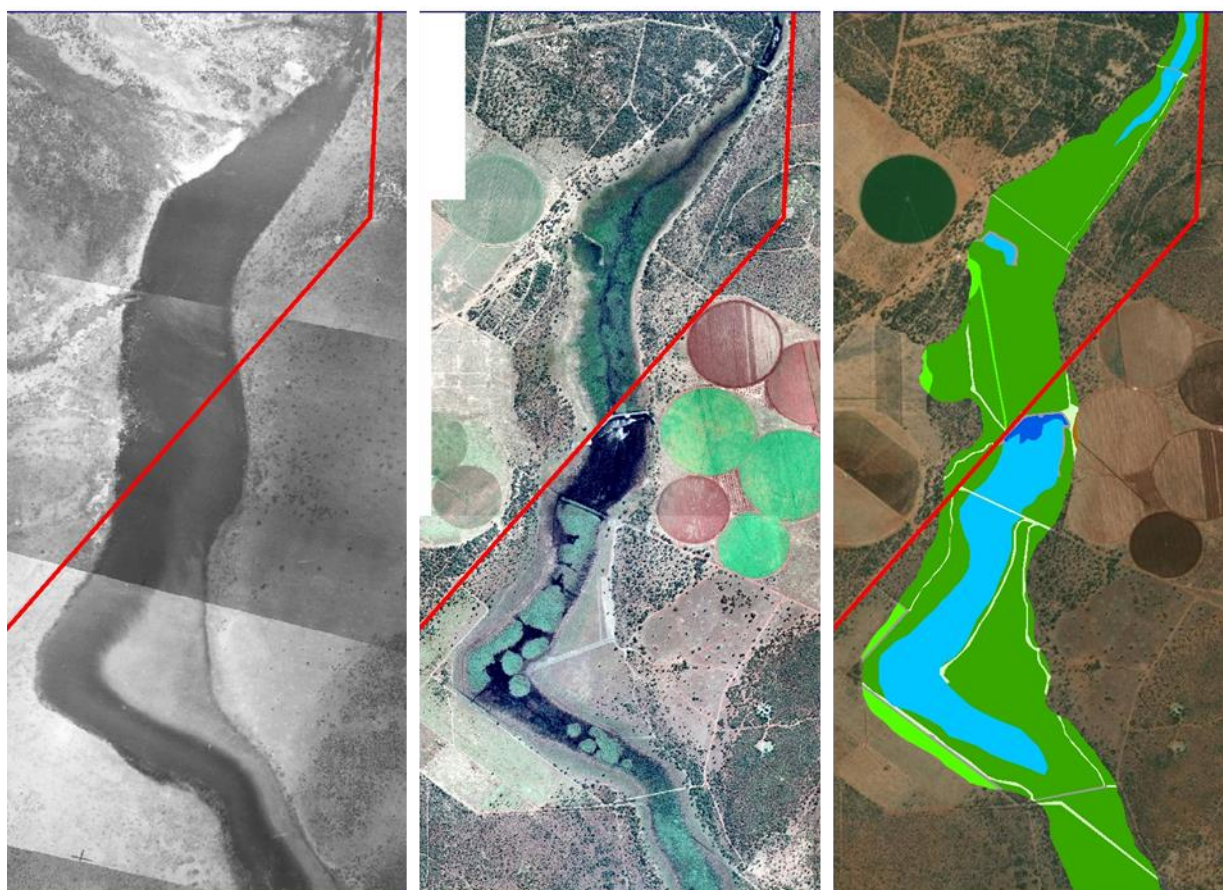


Figure 19. Images illustrating changes to wetland habitat and vegetation within the affected reach of the Nylsvley Floodplain. Left image shows historical aerial imagery from 1939 (Flight Plan 182), middle image shows current Google Earth imagery, and right image shows disturbance units mapped within the wetland.

The historical aerial image shown in Figure 19 above dates from 1939 (Flight Plan 182) and appears to coincide with a significant flooding event on the Nylsvley Floodplain at the time. A number of

observations can be made from this image, though it must be noted that the historical image shows a single snapshot in time and appears to coincide with a flood event, which may result in some features being obscured by flood waters.

- In 1939 there are no dams or road crossings visible on the affected reach of the Floodplain;
- The wetland habitat appears uniform in nature, with no sign of the large roughly circular stands of *Phragmites australis* that are clearly visible upstream of the large dam on recent aerial imagery;
- There is no indication of a channel or preferential flow path on the historical imagery, whereas a clear preferential flow path is visible below the large dam on recent aerial imagery;
- The wetland habitat appears to be wider and more extensive on the 1939 imagery. This may be related to the size of the flood event that occurred in 1939 and may be a temporary expression of wetness signature, but it may also be indicative of shrinking wetland habitat due to decreased flows within the Nylsvley Floodplain. Figure 20 below shows a further comparison of wetland extent within the reach of the large dam. Although the overall extent of wetland habitat mapped is largely similar, there is clear indication on the recent image of woody vegetation encroaching onto the Floodplain. This is considered an indication of decreased wetting along the wetland margins and an increase in extent of the temporary zone (and shrinking of the seasonal zone). This has occurred despite the increased wetness within this section of the Floodplain resulting from the large dam.



Figure 20. Map showing a comparison in wetland extent between 1939 (green line) and wetland extent mapped in 2022 (yellow line) as well as wetland habitat on 1939 aerial image (left) and recent aerial image (right).

The Nyl River Hydrological Analysis report by eScience Associates (2015) indicates the Mean Annual Runoff (MAR) for the Nylsvley under virgin conditions (natural conditions) to have been 20.74mm with transmission losses of 0.77mm. Under current conditions, the base case, MAR has been determined as 18.07mm with transmission losses of 2.66mm. **This represents a 12.9% reduction in MAR that has already occurred**, which corroborates the observations of decreased wetland extent and wetness on site.

Of further note is the finding by eScience Associates (2015) that evapotranspiration from groundwater under virgin conditions is estimated as 18.14mm, and that this has reduced to 6.68mm under current conditions. Evapotranspiration represents the sum of evaporation off the land surface and transpiration from plants, and if this occurs from groundwater, indicates a groundwater table in contact with the rooting zone of plants, which can for example lead to the exclusion of certain plant species from such areas (e.g. exclusion of many woody species). Lowering of the groundwater table decreases contact with the rooting zone of plants, resulting in decreased evapotranspiration losses, and allowing for encroachment of woody species into previously wet areas. This further corroborates observations on site in relation to encroachment of woody species onto the Floodplain margins.

6.2.4.2 PES Assessment Results

The present ecological state assessment undertaken as part of this study was specifically applicable to the section of the floodplain located within the study area boundaries and **found the Floodplain wetland to be in a Moderately Modified condition (PES category C)**. While certain of the impacts that have led to changes within the wetland habitat on site are applicable to the entire floodplain system (e.g. reduced catchment water yield to the floodplain, drawdown of groundwater), a number of impacts are site specific in nature and are not necessarily applicable to the entire floodplain (e.g. the large dam on site), thus the focus on only the affected reach of the floodplain.

Increased water usage within the catchment of the Nyl River floodplain catchment has resulted in decreased flows within the Nyl River and has thus also affected the extent, depth and duration of flooding. Given the sensitivity of the vegetation on the floodplain to changes in the depth and duration of inundation, the changes in flows have undoubtedly led to changes in the vegetation composition of the floodplain on site. Further changes to the vegetation have been brought about by livestock grazing, burning, cultivation along the margins of the wetland and disturbances due to roads constructed through the wetland. Changes in vegetation typically also affected other aspects of biodiversity associated with the floodplain through changes in the habitat utilised by these species, making the habitat potentially less suitable for occupation by the species.

The dams on site have also markedly altered the vegetation of the floodplain on site through increasing the depth and duration of flooding at a local level immediately upstream and downstream of the dams. This is clearly evident on site through the presence of *Typha capensis* and *Phragmites australis* which is only associated with those areas affected by the dams.

Additional impacts include:

- Deterioration in water quality due to changes in land use within the wetland catchment impacting on the quality of water entering the floodplain;

- Flow impoundment and concentration through the construction of roads with culverts across the floodplain;
- Construction of berms within the floodplain and also along the edges of the floodplain to restrict flood flows;
- Alien and pioneer vegetation that has invaded disturbed areas resulting from dam, berm or road construction; and
- Alien vegetation such as the tall grass *Sorghum halepense* (NEMBA category 2) which occurs throughout the Floodplain habitat within the amended MRA and appears to have increased markedly between the initial 2010 survey and the most recent field survey in 2022.

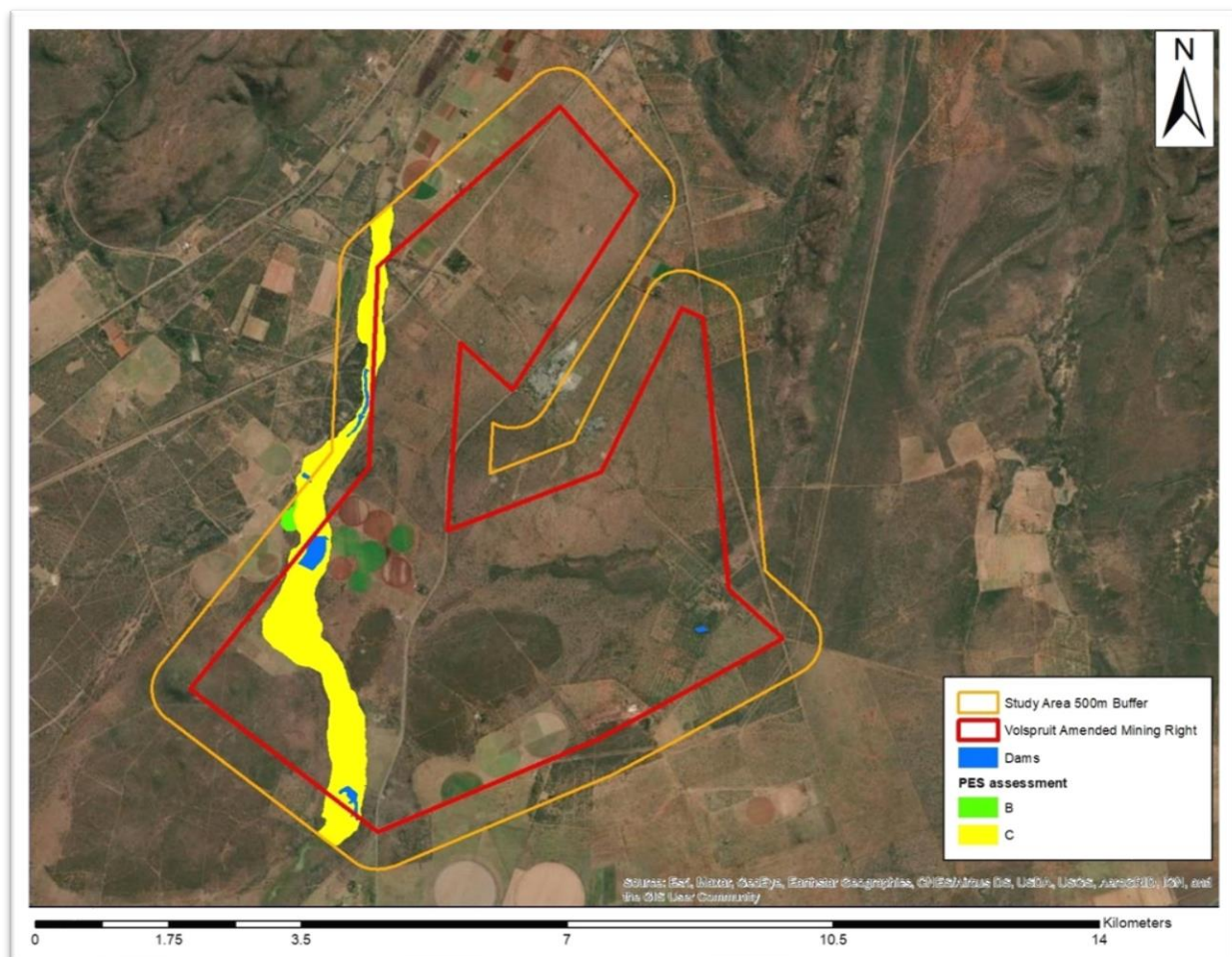


Figure 21. Map showing results of the PES assessment.

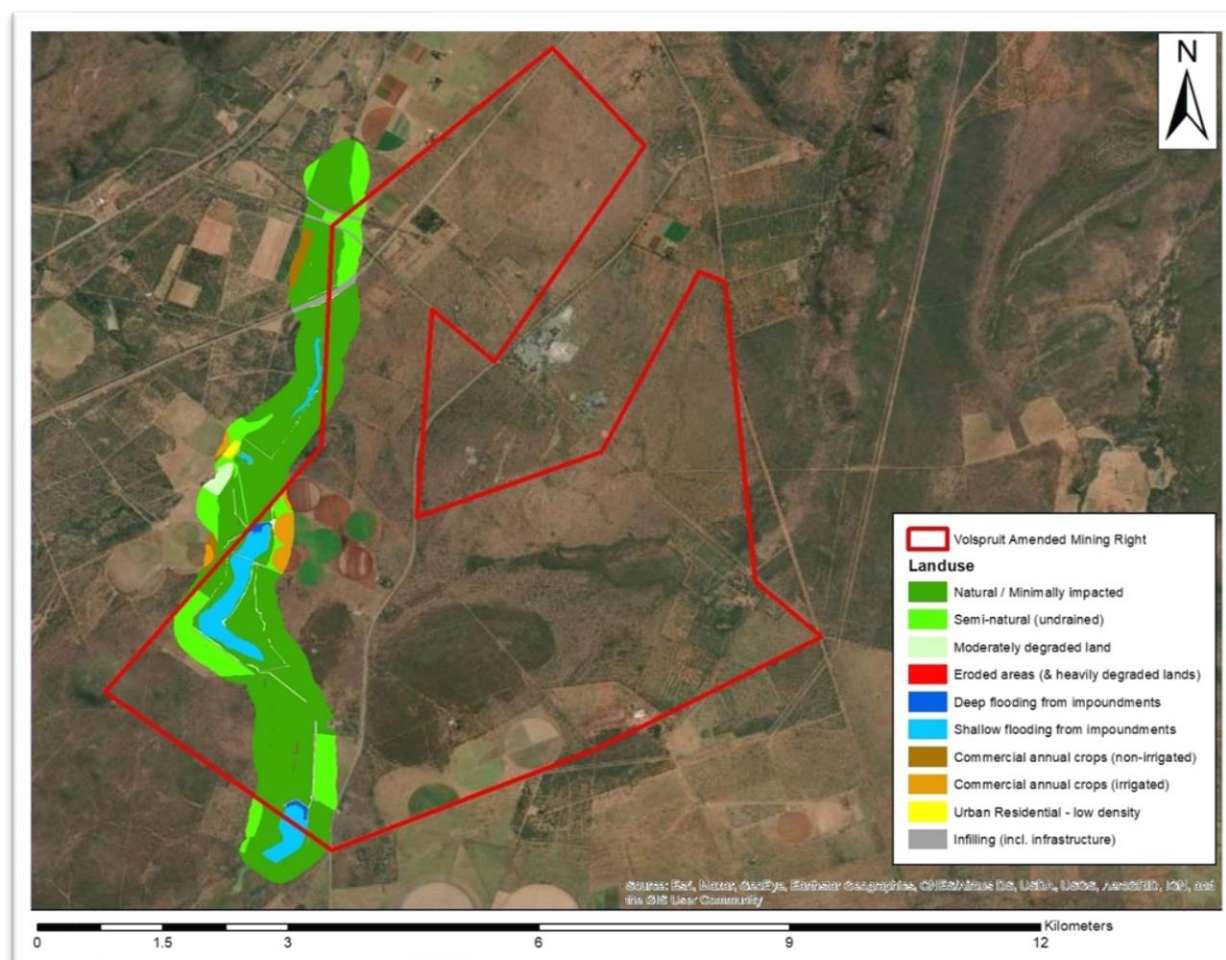


Figure 22. Map showing results of disturbance units / land cover classes mapped within the wetland and its 200m buffer.

6.2.4.3 Desktop PES Assessment of Entire Nylsvley Floodplain.

In addition to the site-specific PES assessment, a WET-Health Version 2 Level 1A assessment was undertaken as part of this current study to determine a desktop estimation of the PES of the greater Nyl River Floodplain. Use was made of the Nyl Floodplain delineation as captured in the National Wetland Map 5 and land use data from the National Landcover 2018 dataset. Results of this desktop PES assessment are summarised in Table 9, while Table 10 summarises the extent of different land uses recorded within the Floodplain, it's 200m buffer, and its greater catchment.

Based on this desktop PES assessment, the greater Nyl Floodplain is considered to be in a Largely Natural condition (PES category B). In our opinion, this is likely to represent an overestimate of the PES of the Nylsvley resulting from the National Landcover 2018 overestimating extent of natural habitat, and also in some hydrological impacts such as groundwater abstraction not being properly accounted for in a land use based assessment. The Department of Water and Sanitation recently released the determination of the ecological water requirements (EWR) for the upper section of the Nyl River Floodplain (upstream of the R519, with specific reference to the Nyl upstream of the N1 and the Olifantsspruit) (Department of Water and Sanitation, 2024) in which the

PES of the Floodplain was determined, using the WET-Health Version 1 Level 1 assessment, to be a category C. The outcomes of that study stipulate that the EWR for the Nyl River floodplain upstream of the R519 road is to maintain a PES (2022) Ecological Category C (Department of Water and Sanitation, 2024).

Table 9. Results of the desktop PES assessment of the greater Nyl Floodplain using the WET-Health Version 2 Level 1A assessment tool.

Wetland_ID		Nyl Floodplain
Wetland area (Ha)		18459.9
HYDROLOGY	Impact Score	1.7
	PES Score (%)	82.80%
	Ecological Category	B
GEOMORPHOLOGY	Impact Score	1.1
	PES Score (%)	88.70%
	Ecological Category	B
WATER QUALITY	Impact Score	2.2
	PES Score (%)	78.40%
	Ecological Category	C
VEGETATION	Impact Score	1.7
	PES Score (%)	83.50%
	Ecological Category	B
OVERALL CONDITION	Combined Impact Score	1.7
	Overall PES Score (%)	83.30%
	Combined Ecological Category	B
HECTARE EQUIVALENTS (based on Overall PES)		15371.1

Table 10. Summary of land use categories and extents recorded within the Nyl Floodplain, the 200m buffer, and the greater Nyl catchment (landcover data extracted and summarised from the National Landcover 2018 dataset).

Landuse (WET-Health Level 1A categories)	Catchment (ha)	200m Buffer (ha)	Floodplain (ha)
Open Water – Natural	0	0	0
Open Water - Artificial	180	1	19
Natural / Minimally impacted	147 138	1 983	16 726
Semi-natural	28 904	453	880
Orchards and vineyards	478	0	0
Sugar cane	0	0	0
Commercial annual crops (irrigated)	1 936	16	1
Commercial annual crops (non-irrigated)	26 412	693	817
Subsistence crops	0	0	0
Plantations and dense alien vegetation	570	0	0
Mining - low risk	0	0	0
Mining - medium risk	324	1	1

Landuse (WET-Health Level 1A categories)	Catchment (ha)	200m Buffer (ha)	Floodplain (ha)
Mining - high risk	0	0	0
Eroded areas (& heavily degraded land)	45	0	0
Urban Industrial/Commercial	560	7	8
Urban Informal	153	0	0
Urban Residential – high density	2 450	2	8
Urban Residential – low density	2 095	0	0
Urban Open Space	415	0	0
TOTAL	211 660	3 156	18 460

6.2.5 Ecological Importance and Sensitivity

In terms of ecological importance and sensitivity, given the biodiversity supported by the Nyl floodplain especially in terms of avifauna, the floodplain on site is considered to be of **Very High** ecological importance and sensitivity. The hydrological functions supported by the floodplain have been found to be somewhat more limited than would generally be expected from a floodplain of the size of the Nyl floodplain. However, some sediment trapping and water quality enhancement is likely to occur. In addition, should significant infrastructure be constructed downstream of the Nyl floodplain in close proximity to the Mogalakwena River, the flood attenuation value of the floodplain could increase. Direct human benefits include the provision of grazing and the tourism value of the floodplain as highlighted in Section 6.2.2 above.

7. IMPACT ASSESSMENT

7.1 Project Description

A basic project description detailing proposed activities and developments on site was provided by EcoPartners and is reproduced below.

Volspruit Mining Company (Pty) Ltd proposes the mining of two (2) separate ore bodies through open cast mining on the farm Volspruit 326 KP, Mokopane, Limpopo Province. In addition, areas of the remaining extent of the Farm Zoetveld 294 KR are proposed for the establishment of supporting above ground infrastructure (e.g. residue stockpiles and residue deposits). The mining of these two (2) ore bodies will require the establishment of two separate opencast pits, the 'north pit' and the 'south pit'. It is estimated that the targeted ore reserves underlying the site equal approximately 56 million tonnes, which suggests that the mine will be in operation for approximately 18-20 years; where the mining of the respective pits will occur in a phased manner. The north pit will be mined between years 1-13, and the south pit between years 13-19. It is proposed that Platinum Group Metals (PGMs) will be mined to a depth of approximately 180 m at the north pit and south pit.

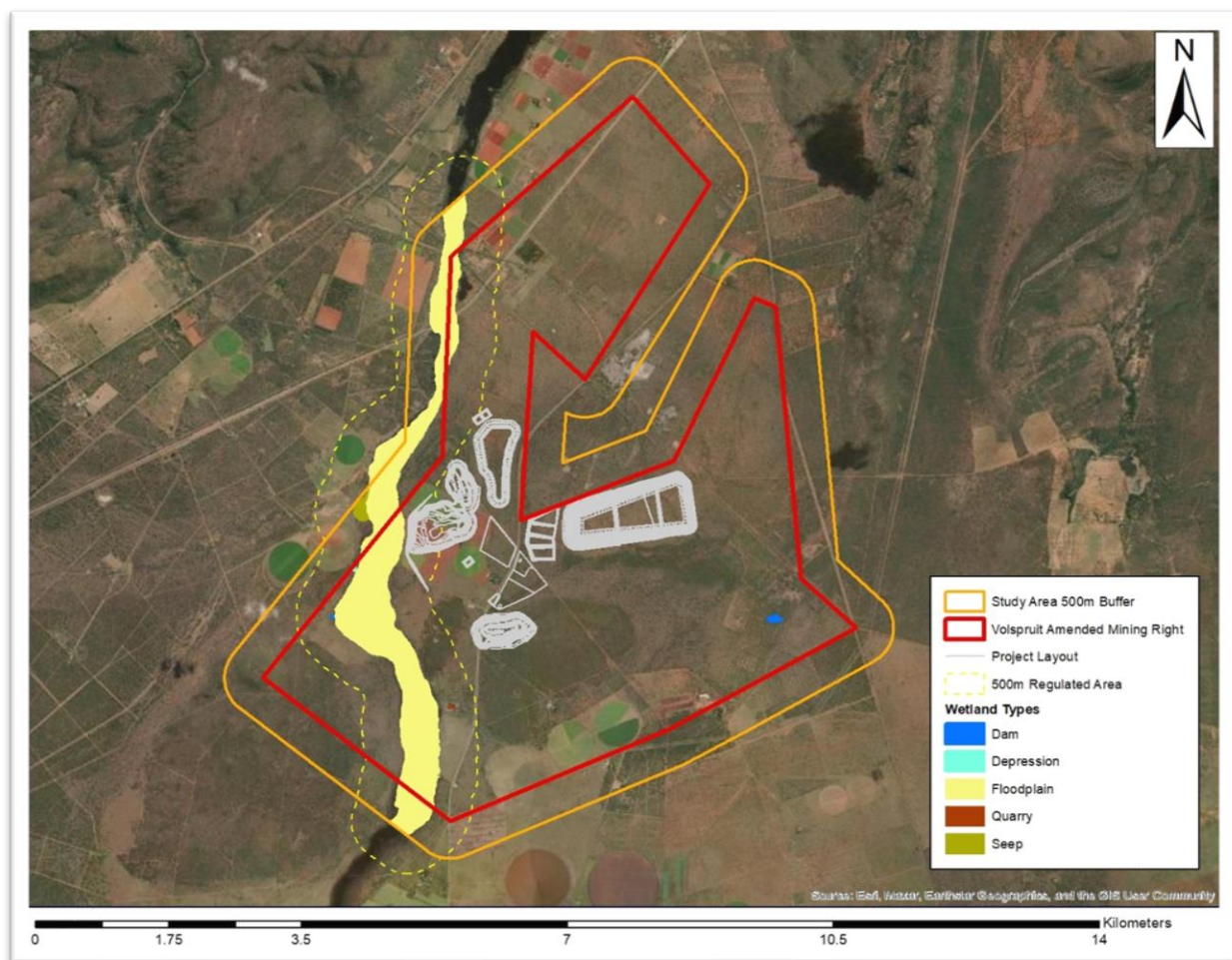


Figure 23. Map showing the proposed mine layout within the study area and in relation to the Nyl wetland.

The Volspruit Project also includes provision for the establishment of an ore processing plant (frother flotation) and smelter complex including a fluidised bed ore roasting plant, a 5MW DC Arc furnace (and an additional 5MW furnace toward ramp up a couple of years into operations) and a Chemical Vapour Metal Recovery Plant (CVMR) for the beneficiation of metal produced. These plants aim to further process the mined mineral bearing ore into saleable PGM mineral fractions and beneficiate the ore to high value pure metals. This process will produce significant volumes of waste rock and minerals residues which will require residue stockpiles (waste rock and tailings disposal facilities). The 'plant site' is proposed to be established on the farm Volspruit 326 KP, at a site centrally located to the opencast pits and away from the Nyl River and associated wetland.

The proposed project site is currently a 'Green-fields' site which is partially under intense agriculture, as well as having large tracts of undisturbed natural vegetation. All relevant surface infrastructure and other infrastructural requirements for the project will need to be developed on the site. Further to the infrastructures already mentioned, the mine's development will include provision for, inter alia, access roads, administration buildings, workshops, storage/lay-down yards, sewage treatment plants, return water- and storm water dams, explosives store, electricity sub-stations, as well as supporting electrical, sewage and water reticulations.

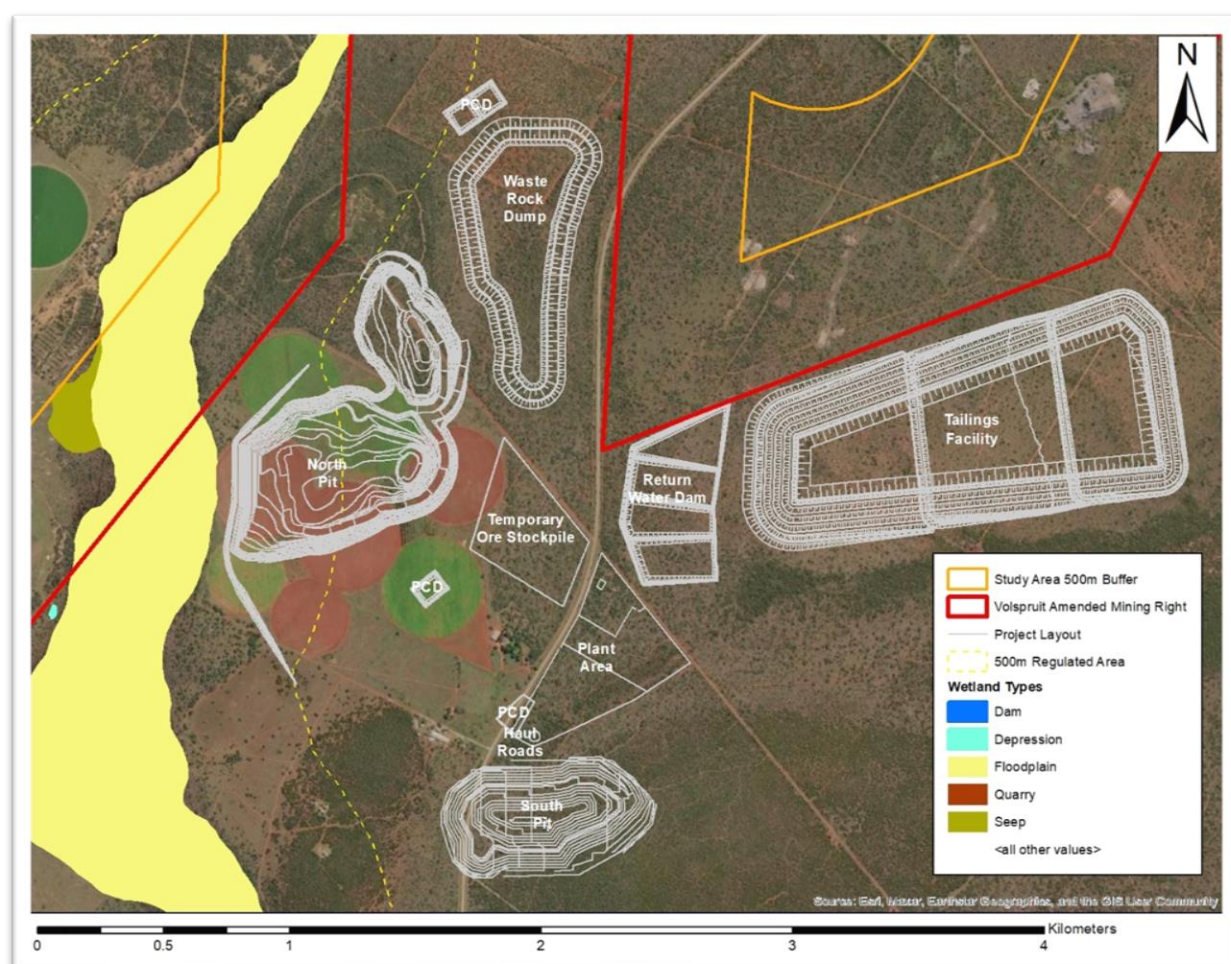


Figure 24. Map showing the proposed project activities in relation to delineated wetland habitat and associated 500m Regulated Area.

7.2 Identification of Impacts

Figure 24 above shows the proposed mine layout in relation to delineated wetland habitat and the associated 500m Regulated Area. With respect to the mine layout plan provided and illustrated in Figures 23 and 24, the proposed North Pit opencast pit and associated flood protection berm extend the closest to the Floodplain wetland and extend well into the 1:100 year floodline of the Nyl Floodplain. However, a 50m buffer around the outer edge of delineated wetland habitat will be maintained between the proposed flood protection berm and the wetland. No direct disturbance or destruction of wetland habitat is therefore expected.

An earlier iteration of the mine plan had the proposed North Pit opencast pit extending right up to the delineated wetland habitat, with the flood protection berm around the North Pit extending into the Floodplain wetland. Approximately 0.87 hectares of marginal wetland habitat would have been directly affected and lost as a result, with a disturbance edge of 330m fronting directly onto the Floodplain wetland habitat adjacent to the large dam. However, as part of the environmental authorisation process and resulting from various specialist feedback sessions and workshops, the proposed North Pit layout was adjusted to ensure that all wetland habitat and a 50m wetland buffer zone were excluded from the proposed disturbance footprint.

All other proposed activities are also located outside delineated wetland habitat, though a number of project activities fall within the 500m Regulated Area:

- North Pit
- Flood diversion berm
- Clean water outlet structures (2), located 480m and 455m from the delineated wetland edge
- Pollution Control Dam associated with the Waste Rock Dump (WRD) located 460m from the delineated wetland edge.

These activities, together with project activities falling outside the 500m regulated Area, do have the potential to result in secondary or indirect impacts to the Floodplain wetland habitat.

The Geohydrological study undertaken by GPT (2023) discusses the relationship between surface water in the Nylsvley Floodplain and groundwater. Their study asserts that “*the unsaturated zone underneath the river is filled from below, and not from the river*” (GPT, 2023, page 16), and deducing that “*the clay layer in this area is indeed impermeable and that the flood needed to overtop the clay before infiltrating*”. GPT (2023) also references the hydrological analysis undertaken by eScience Associates (2015) and indicates that “*under the existing situation ... groundwater is recharged by surface water via transmission losses due to the lowering of water levels*” (GPT, 2023, pages 53 and 100-101) and furthermore that “*the increase in transmission losses increases the duration of zero flows within the river*”. The conclusion reached is that “*the main impact of mining is to increase transmission losses to the alluvium during periods of high flow*” (GPT, 2022, pages 53 and 101). The understanding gained from this is that, during low flow periods, no loss of surface water to the alluvial aquifer is expected, but that during flood events, some surface water may be lost to the alluvial aquifer, but that such losses are according to GPT (2023, page 104) “*unlikely to have a major influence on the normal flood progression*”. The point at which a loss of surface water to groundwater starts to occur does not appear to have been accurately defined, and appears to differ across the

study area, with two piezometer transects on site monitored by GPT (2023) reacting differently to flooding.

In addition to the groundwater study, a surface water study was undertaken by Krige (2022). This study asserts that *“the seasonal floodwaters inundating the Nyl River floodplain do not contribute to any significant amount of groundwater recharge”* (Krige, 2022, page 33).

Increased loss of flood waters to groundwater can be expected to result in decreased duration and extent of flooding within the wetland, with knock-on impacts to wetland biodiversity and vegetation in particular. GPT (2023) indicates that drawdown of groundwater will only exceed the current drawdown under the wetland (from abstraction for irrigation) for approximately 3 years, with drawdown being largely similar to the current situation for the remainder of the Life of Mine.

In terms of the three different flood events recognized by Higgins et al. (1996), it would thus appear that a “hydromorphic zone flood” would be required to allow for substantial recharge of the shallow groundwater to occur, and for flow to be lost from surface waters on the floodplain. Such a “hydromorphic zone flood” occurs approximately 3 out of 10 years (Higgins et al., 1996). Given that the drawdown cone of the mine exceeds the current drawdown for only 3 years, impacts associated with the mine drawdown may fall within the ambit of natural fluctuations of the floodplain wetland system. However, it is recognised that under current conditions the wetland system is already considered under stress from reduced flow/wetness, and any activity that further increases stress on the system may result in certain as yet undefined thresholds being exceeded. Some uncertainty as to the likely impact on flow within the floodplain wetland, as well as the significance of such an impact on the wetland, remains.

Mining is also expected to impact on groundwater quality, with a groundwater pollution plume extending from the opencast pits over time. However, as the Floodplain is a losing reach (losing surface water to groundwater and not gaining water from groundwater) the risk to the wetland in this regard is considered generally low. Exceptions to this could occur under the following scenarios:

- Surface decant from the opencast pits – GPT (2023) found the risk of decant to surface being unlikely, and that mine water quality would be of acceptable quality should decant occur (GPT, 2023).
- Irrigation with contaminated groundwater, with subsequent contamination of surface runoff entering the Floodplain wetland. It is assumed that current abstraction for irrigation by surrounding landowners will continue, although abstraction for irrigation on the project study area itself will cease. The groundwater pollution plume will migrate towards such areas of abstraction (GPT, 2023) and will over time impact on irrigation water quality. Once again however GPT (2023) asserts that the mine water quality would be of acceptable quality.

Impacts expected to occur should the proposed mine be developed as currently proposed are as follows:

Construction Phase:

Destruction and disturbance of wetland habitat

Increased sedimentation within wetlands

Altered flow and flooding characteristics

Water quality deterioration

Operation Phase:

Decreased extent and duration of flooding
Changes in habitat and loss of biodiversity
Increase in alien invasive vegetation
Water quality deterioration

Decommissioning Phase:

Water quality deterioration

7.3 Assessment of Impacts

7.3.1 Construction Phase – Destruction and disturbance of wetland habitat

The provided mine layout plans indicate that the proposed North Pit will be located outside the delineated wetland edge and that a minimum 50m vegetated buffer will be maintained between the flood protection berm and the wetland edge. **No direct disturbance or loss of wetland habitat is therefore expected.**

Construction activities could however potentially result in disturbances to the adjacent wetland habitat through poorly supervised construction activities, incorrect placement of temporary stockpiles and construction camps, increased human and vehicle traffic in the area seeking access to the wetland area (e.g. fishing at the dam, illegal hunting and gathering, resting in the shade of the larger trees within the riparian fringe, washing of equipment) etc. This may realise a localized, and likely temporary, impact to biota due to proximity. It is not anticipated that these disturbances will realise a drop in wetland PES if fully mitigated as per the recommendation below.

Mitigation

The mitigation hierarchy must be followed. This requires the thorough investigation of opportunities to firstly avoid impacts and then, if impacts are unavoidable, to seek opportunities to minimize and mitigate impacts. In this regard it must be noted that the initially proposed mine layout, specifically as relevant to the North Pit and associated flood protection berm, was amended to exclude the delineated wetland habitat and an associated 50m wetland buffer. This has resulted in avoidance of all direct impacts to the wetland habitat on site.

A vegetated wetland buffer of 50m was proposed to the project team during the environmental authorisation process and has been implemented. This 50m buffer was determined through application of the Buffer Zone Guidelines for Wetlands, Rivers and Estuaries (Macfarlane and Bredin, 2017), and is based on the site characteristics of the area affected by the North Pit and associated flood protection berm. To ensure maximum effectiveness of the 50m buffer zone, the buffer zone should remain vegetated. In those sections of the buffer currently devoid of vegetation (e.g. within the cultivated fields) indigenous vegetation should be re-established and should include grass cover as well as locally occurring tree species.

The purpose of the buffer will be to prevent direct disturbances to the wetland habitat and to limit edge disturbances associated with adjacent activities to the buffer zone, keeping such disturbances out of the wetland habitat. Buffer zones can be highly effective in protecting wetlands from largely diffuse, lateral impacts such as increased sediment inputs and turbidity associated with runoff, though they are less effective for concentrated, point source discharges. Vegetated buffer zones beyond the wetland edge will also provide substantial benefits for biodiversity, by shielding the wetland habitat from mine related disturbances (e.g. light and noise pollution, people and machinery movement) and allowing for movement of species along the wetland edge.

Implementation and maintenance of the buffer zone will be most important during the construction phase of the project and it is recommended that the buffer zone be secured, rehabilitated (revegetated where necessary) and fenced prior to the onset of any large-scale vegetation clearing activities or earthworks on site. During the operational phase the presence of the flood protection berm between the North Pit and the wetland buffer will provide further protection and buffering of the wetland, with the flood protection berm providing a barrier to the movement of sediment from the mining areas towards the wetland.

The wetland area should be fenced off along the outer edge of the buffer zone and no access granted to any construction vehicles or machinery. No water may be abstracted from the dam for construction purposes and no recreational activities for construction teams should take place within the wetland area, unless recreational facilities are formalized and approved in terms of the relevant legislation (e.g. Water Use License Application) and appropriately managed.

In addition to the implementation of the 50m wetland buffer zone, the following measures should also be implemented:

- Prior to the onset of any vegetation clearing or construction activities on site, the edge of the required construction servitude (no wider than 10m beyond the edge of the flood protection berm as indicated on mine layout plans provided by EcoPartners) should be fenced off with wildlife-friendly fences.
- No construction activity or related disturbance may extend beyond the fenced off area, and no access to the wetland area should be granted to any construction machinery or construction staff.
- A sediment barrier should be installed upslope of the fence to ensure all sediments washed-off the construction site are contained within the disturbance footprint and do not enter into the adjacent wetland. Such sediment fences need to be regularly inspected and maintained, at least monthly during the rainy season, as well as after every significant (>20mm) rainfall event.
- The side-slopes of the flood protection berm must be vegetated. Vegetation, which should take the form of dense grass cover, should be established immediately following completion of the berm. Only indigenous grass species to be utilized for re-vegetation. Any weeds and/or alien species must be actively removed and controlled along the berm on a regular basis.
- Any service road and security fence associated with the berm must be placed on top of the flood protection berm or on the upslope side of the berm.
- The side slope of the flood protection berm facing the wetland must be regularly inspected for erosion and any rill erosion observed must be repaired immediately.

- No concentrated flow paths should be allowed to develop on the berm side slopes or along the base of the flood protection berm.
- The integrity of the flood protection berm must be ensured and inspections must be done after every flood event that reaches the base of the flood protection berm or higher.
- A detailed log book must be kept of all monitoring and maintenance activities undertaken along the flood protection berm.

7.3.2 Construction – Increased sedimentation in the wetland

During site clearance undertaken as part of construction of especially the northern opencast pit (but also other infrastructure developments on site), extensive areas of bare soils will be exposed to erosion during rainfall events. Earthworks associated with the excavation of the northern pit and the stockpiling of topsoil and overburden represent further erosion risks and sediment sources, as will the required flood protection berm which lies approximately 50m from the edge of the wetland habitat. Run-off from these areas is likely to be sediment rich and could enter the adjacent floodplain wetland, leading to increased sedimentation in the wetland, increased turbidity and suspended sediment loads, as well changes to the floodplain substrate where the sediment is deposited. If sediment originating from these activities and infrastructures does reach the wetland, these changes will impact on the biodiversity of the wetland, potentially with short-term deleterious effects.

Mitigation

The flood protection berm required for the North Pit should be established as a first step in the construction process of the North Pit. The berm will create a sediment barrier between the opencast pit and the wetland and ensure that all sediments derived from the soil stripping associated with the opencast pit will be trapped by the berm. The berm itself will however be a source of sediment to the wetland. The berm should be appropriately sloped to enable rapid and successful revegetation of the side slopes. Following completion of the berm, the berm should be hydro-seeded to ensure rapid establishment of vegetation. Only indigenous grass species should be used for revegetation. To limit sediment movement into the wetland prior to the establishment of vegetation on the berm, sediment barriers such as bidim fences or straw roles should be installed along the entire lower edge of the berm parallel to the wetland edge to ensure sediments are trapped outside the wetland area.

Given the distance of all other proposed activities from the wetland area (more than 400m), sediment from these areas is unlikely to enter the wetland. However, soil conservation methods should be employed on all construction sites and bare soil areas that fall outside direct development footprints should be re-vegetated as soon as possible.

A construction stormwater management plan must be developed and implemented prior to the commencement of large-scale vegetation clearing activities or construction activities and be maintained until the end of the construction phase. Such a plan should aim to minimise the transport of sediment off site as well as prevent the discharge of high velocity flows into downslope wetlands. Sediment traps and sediment barriers should be installed where necessary, and clean water discharge points should be protected against erosion and incorporate energy dissipaters.

- Erosion within the construction site must be minimised through the following:

- Limiting the area of disturbance and vegetation clearing to as small an area as possible;
- Where possible, undertaking construction during the dry season;
- Phasing vegetation clearing activities and limiting the time that any one area of bare soil is exposed to erosion;
- Control of stormwater flowing onto and through the site. Where required, stormwater from upslope should be diverted around the construction site;
- Prompt stabilisation and re-vegetation of soils after disturbance and construction activities in an area are complete; and
- Protection of slopes. Where steeper slopes occur, these should be stabilised using geotextiles or any other suitable product designed for the purpose.
- Sediment transport off the site must be minimised through the following:
 - Establishing perimeter sediment controls. This can be achieved through the installation of sediment fences along downslope verges of the construction site. Where channelled or concentrated flow occurs, reinforced sediment fences or other sediment barriers such as sediment basins should be used (refer to US EPA guidelines on Stormwater Pollution Prevention);
 - Discharge stormwater from the construction site (dirty water) into adjacent grassland rather than directly into wetland habitat. Discharged flows must be slow and diffuse; and
 - Regular inspection and maintenance of sediment controls.

7.3.3 Construction – Altered flow and flooding characteristics

In order to allow for the safe operation of the northern opencast pit as currently proposed, a berm will need to be constructed alongside the floodplain on site to divert flood flows away from the opencast pit. Such a berm will limit the extent of the flooded area on the floodplain during large flood events, which could potentially increase the depth of flooding in the remaining floodplain and extending the flooding further up the southern bank. This could result in changes to the floodplain vegetation and other species reliant on the vegetation, as a difference in elevation (and thus flooding depth and duration) of as little as 90mm was found to lead to a statistically significant change in species composition within the floodplain (Higgins et al. 1996).

It was however indicated in the 2022 specialist surface water report (Krige, 2022) for the site that the floodlines of the site in terms of the 1:50 and 1:100 year flood events are controlled by the downstream N1 highway crossing, which acts like a dam and has increased the floodlines from the natural level. The construction of the required flood protection berm will thus have no impact on the depth of the 1:50 and 1:100 year flood on site.

In the absence of a flood protection berm, there is a risk that should flooding occur, the flood waters from the Floodplain would flow into the North Pit, resulting in significant health and safety risks but also a large loss of water from the Floodplain, impacting on flooding duration and extent in downstream reaches.

Excavation of the North Pit will also commence during the construction phase. Although the deep excavation of the North Pit will eventually result in a groundwater drawdown cone surrounding the North Pit, during the initial stages of excavation in the construction phase, the drawdown will be

limited and will not exceed the current drawdown resulting from abstraction for irrigation. As irrigation will cease with the onset of the construction phase, there may even be an initial rise in the groundwater levels for a short period.

Construction activities and the establishment of mining and related infrastructures will result in the creation of dirty water areas that will be isolated from the surrounding catchment. This may lead to a reduction in surface water runoff contributions to the floodplain. However, it was found in the hydrogeology study by WCS (2023) that the study area is dominated by recharge soils with limited signs of lateral water movement and that surface runoff from the study area is unlikely to contribute significantly to the floodplain. Creation of dirty water exclusion zones associated with proposed mining activities is thus unlikely to impact significantly on flow within the Floodplain, nor on the PES of the Floodplain.

Mitigation

If mining extends into the floodlines as currently proposed, a flood protection berm must be installed to prevent flood waters from the Floodplain entering the mine workings during large flood events. Such a berm must be located outside delineated wetland habitat and outside the 50m wetland buffer (as is proposed in the revised mine plan) and be designed to accommodate at least the 1:100 year flood.

Dirty water area exclusion zones must be kept as small as possible, with clean water diverted around dirty water areas and discharged into the environment. Dirty water areas must be effectively isolated and no discharge of contaminated water may take place on site.

7.3.4 Construction – Water Quality Deterioration

Water quality deterioration within the floodplain could take place during the construction phase predominantly due to increased turbidity and suspended solids derived from soil erosion on the bare soil surfaces exposed during construction.

In addition, use of hazardous substances such as oil, diesel explosives etc. during the construction process could lead to pollution of water resources through spillages and leakages. Stockpiling and use of cement and other polluting products pose further risks.

Mitigation

The flood protection berm required for the North Pit should be established as a first step in the construction process of the North Pit. The berm will create a sediment barrier between the opencast pit and the wetland and ensure that all sediments derived from the soil stripping associated with the opencast pit will be trapped.

Construction stormwater management plans must be developed and implemented for each construction site to limit mobilization of sediments.

All hazardous substances used on site (including all diesel, oil, explosives, cement etc.) should be stored in designated, bunded areas. No surface run-off from these areas may be allowed to enter

any clean water run-off or the wetland on site. Water from the bunded areas must be treated as dirty water and handled accordingly. Spills should be cleaned-up with approved absorbent material. These materials should be kept in sufficient quantities on site to deal with spills. Absorbent material and contaminated soil should be disposed of at a registered hazardous waste site. For cement used on site, the following guidelines apply:

- Carefully control all on-site operations that involve the use of cement and concrete (this applies to areas other than the batching plant).
- Limit cement and concrete mixing to single sites where possible.
- Use plastic trays or liners when mixing cement and concrete: Do not mix cement and concrete directly on the ground.
- Dispose of all visible remains of excess cement and concrete after the completion of tasks. Dispose of in the approved manner (solid waste concrete may be treated as inert construction rubble, but wet cement and liquid slurry, as well as cement powder must be treated as hazardous waste)

7.3.5 Operation – Decreased extent and duration of flooding

To allow for the mining of the North Pit, abstraction of groundwater will be required. This will result in a draw down cone extending around the pit and given its proximity to the Floodplain wetland, also extending under the wetland:

- The drawdown reaches the Floodplain at approximately year 5 and will be of the same magnitude as the current irrigation (GPT, 2023).
- The cone of depression will extend up to 1 km from the edge of the opencast pit and extend underneath the floodplain. At year thirteen, the year of maximum mining depth, the drawdown under the floodplain could be as much as 20m (as determined by GPT (2023)).
- The impact of the drawdown is expected to be of a limited period. Only for approximately 3 years will the drawdown underneath the floodplain exceed 10m (GPT, 2023), which is the approximate current scenario due to irrigation.
- Drawdown associated with irrigation activity on the Farm Volspruit was recorded to result in lowering of the water level in the alluvial aquifer to in the region of 10m (varying roughly between 9 and 12m across piezometers). (GPT, 2023)

The Geohydrological study undertaken by GPT (2023) further discusses the relationship between surface water in the Nylsvley Floodplain and groundwater. Their study asserts that *“the unsaturated zone underneath the river is filled from below, and not from the river”* (GPT, 2023, page 16), and deducing that *“the clay layer in this area is indeed impermeable and that the flood needed to overtop the clay before infiltrating”*. GPT (2023) also references the hydrological analysis undertaken by eScience Associates (2015) and indicates that *“under the existing situation ... groundwater is recharged by surface water via transmission losses due to the lowering of water levels”* (GPT, 2023, pages 53 and 100-101) and furthermore that *“the increase in transmission losses increases the duration of zero flows within the river”*. The conclusion reached is that *“the main impact of mining is to increase transmission losses to the alluvium during periods of high flow”* (GPT, 2022, pages 53 and 101). The understanding gained from this is that, during low flow periods, no loss of surface water to the alluvial aquifer is expected, but that during flood events, some surface water may be

lost to the alluvial aquifer, but such losses are according to GPT (2023, page 104) “*unlikely to have a major influence on the normal flood progression*”. The point at which a loss of surface water to groundwater starts to occur does not appear to have been accurately defined, and appears to differ across the study area, with two piezometer transects on site monitored by GPT (2023) reacting differently to flooding.

The understanding gained from this is that, during low flow periods, no loss of surface water to the alluvial aquifer is expected, but that during flood events, surface water will be lost to the alluvial aquifer. The point at which this loss to groundwater starts to occur does not appear to have been defined, and appears to differ across the study area, with two piezometer transects on site monitored by GPT (2023) reacting differently to flooding.

Understanding the likely consequences of the above in terms of impact to wetland and degradation of wetland habitat is however difficult and uncertain. It is recognised that the hydrology of South African wetlands and their vulnerability to reduced inflows is still poorly understood (Macfarlane *et al.*, 2008), though it is known that floodplains driven predominantly by bank overtopping (i.e. driven primarily by upstream inputs rather than lateral inputs), which the Nylsvley is, are sensitive to changes in flood peaks (Heeg and Breen, 1994, as quoted in Macfarlane *et al.*, 2008). It is also noted that studies undertaken by Coetzee and Rogers (cited in Havenga *et al.*, 2007) indicate that a statistically significant change in vegetation species composition can be detected for a 90mm change in elevation. Activities that alter the flooding regime of the floodplain by as little as 90mm (increase or decrease) could thus be expected to have a significant impact on vegetation composition. In addition, specific species have specific depth and duration of flooding requirements. *Oryza longistaminata* for example grows best in water depths of 100-500mm and requires a minimum of 25 days of flooding (Marneweck 1988, as cited in Havenga, *et al.*, 2007). Greater flooding depths reduce flowering of the wild rice, while too short or no flooding increases stress on the wild rice and over several years can reduce the viability of the plant due to a loss in reserves. The importance of the hydrological regime that drives the floodplain ecosystem in terms of determining the vegetation of the floodplain is thus clearly illustrated and would suggest that a drop in MAR could lead to degradation of the wetland habitat.

The expected increased groundwater drawdown and possible slight reduction in MAR associated with proposed mining must be further considered in terms of a Floodplain wetland system already under stress of reduced flows. The Nyl River Hydrological Analysis report by eScience Associates (2015) indicates the Mean Annual Runoff (MAR) for the Nylsvley under virgin conditions (natural conditions) to have been 20.74mm with transmission losses of 0.77mm. Under current conditions, the base case, MAR has been determined as 18.07mm with transmission losses of 2.66mm. ***This represents a 12.9% reduction in MAR that has already occurred***, which corroborates the observations of decreased wetland extent and wetness on site. Comparison of historical aerial imagery with recent images suggests a reduction in the seasonal wetting front within the wetland (increase in the temporary zone) and encroachment of woody vegetation into the wetland margins – observations which are consistent with decreased flows and wetting.

Assessing the likely impact to the wetland habitat from the expected flow reduction is difficult and uncertain. The current scenario of groundwater drawdown due to irrigation will only be exceeded by the mine for a handful of years (currently estimated as 3 years). As the Nylsvley Floodplain only floods during some years, and occasionally does not flood for consecutive years, the habitat and

biodiversity of the Floodplain is adapted to a highly variable hydrological regime. Reduced flow within the Floodplain for a period of 3-4 years may thus fall within the natural variation for a system such as the Nylsvley. However, flow within the Floodplain is already reduced, and further flow reductions may move the wetland closer to an ecological threshold, resulting in more rapid degradation of the wetland habitat.

Mitigation

There appears to be little opportunity to mitigate the groundwater drawdown and associated increased transmission losses if mining proceeds as currently proposed within the North Pit. The 50m wetland buffer proposed under Section 7.3.1 will serve little purpose in protecting the Floodplain from flow related impacts resulting from groundwater drawdown, should such impacts materialize.

Grouting of the bedrock surrounding the North Pit was investigated by GPT (2023) as a means of potentially limiting drawdown, but it was found that “*grouting does not change the impact of dewatering as hoped for*”. It is nonetheless recommended that any preferential groundwater flow paths into the pit that are discovered during mining should be sealed via grouting as soon as possible.

In light of all of the above, the following recommendations are made:

- Given the existing flow related impacts to the Nylsvley, the ecological flow requirements needed to maintain the floodplain wetland should be determined and such flows maintained.
- Under a scenario where mining of the North Pit proceeds and flow losses occur that cannot be mitigated and are found to lead to a decreased extent and duration of flooding, compensatory mitigation measures should be investigated as per the SANBI & DWS (2016) offset guidelines. Should such an approach be pursued, a suitable offset target area (to be identified in consultation with relevant authorities and NGOs) will need to be identified and secured prior to commencement of mining at the North Pit.

7.3.6 Operation – Changes in habitat and loss of biodiversity

Should changes in flooding characteristics on the floodplain be brought about by groundwater abstraction, it is likely that the vegetation on site will undergo changes to adapt to the altered flooding regime. Changes in vegetation will then also affect other biodiversity reliant on the vegetation for food, shelter or breeding sites. In addition, increased noise levels, especially from blasting, could lead to the displacement of sensitive species from this section of the floodplain. Disturbances to the edge of the floodplain through mining activities could also lead to an increase in alien vegetation, while the influx of labour to the area could result in increased poaching of small birds and mammals in the area.

Mitigation

The mitigation hierarchy must be followed. This requires the thorough investigation of opportunities to firstly avoid impacts and then, if impacts are unavoidable, to seek opportunities to minimize and

then mitigate impacts. It is therefore recommended that opportunities to amend the project layout in terms of the footprint of the North Pit and the associated flood protection berm be investigated with a view to withdrawing the disturbance footprint from the delineated wetland footprint, together with a 50m wetland buffer. Ideally no developments or associated disturbances should be allowed to intrude into the delineated wetland area or its buffer. The wetland area should be fenced off and no access granted to any construction vehicles or machinery. No water may be abstracted from the dam for construction purposes and no recreational activities for mine staff should take place within the wetland area, unless recreational facilities are formalized and approved in terms of the relevant legislation (e.g. Water Use License Application).

7.3.7 Increase in alien invasive vegetation

A key driver of invasion by alien plants is high disturbance. Exotic species are often more prevalent near infrastructural disturbances than further away. Consequences of this typically include the loss of indigenous vegetation, change in vegetation structure and habitat, increased water consumption and impaired wetland functioning.

Mitigation

Mitigation measures as detailed in the terrestrial biodiversity report (WCS, 2022) should be followed:

- Disturbance of indigenous vegetation must be kept to a minimum.
- Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible.
- Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled so as to avoid the development of a soil seed bank of alien plants within the stock-piled soil.
- An Alien Invasive Management Plan must be compiled and implemented. This should divide the area of control into logical management units, have clear objectives for detection and control, and include regular monitoring throughout the life of the project. Non-compliance should result in real and enforceable significant consequences.
- Any alien plants must be immediately controlled to avoid establishment of a soil seed bank that would take decades to remove.
- An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

7.3.8 Operation – Water quality deterioration

Seepage from the tailings dam, waste rock dump and other stockpiles is likely to be of poor quality (elevated pH, elevated sulphates and major ions). This contamination could reach the Floodplain wetland via surface runoff or as a pollution plume within shallow groundwater migrating towards surrounding irrigation abstraction boreholes and used as irrigation water, with surface runoff transporting contaminants into the wetland.

Mitigation

The tailings dam and waste rock dump must be classed as dirty water areas and runoff and seepage from these areas should be contained in return water dams and pollution control dams. Water from these dams should not be discharged to the environment. A water quality monitoring plan should be drawn up and implemented to ensure that any contamination of water in the Nyl wetland can be rapidly identified and addressed.

7.3.9 Decommissioning & Closure – Water quality deterioration

After mine closure the old opencast pits will fill with water due to the ingress of groundwater and could potentially start to decant into the floodplain, though this is currently thought to be unlikely (GPT, 2022). Water within the mine will overtime deteriorate, with elevated concentrations of sulphate and major ions likely, leading to pollution of the floodplain or, in the absence of decant, lead to a pollution plume within groundwater that may indirectly impact on the Floodplain if such contaminated water is used for irrigation by neighbouring landowners. No acid mine drainage is expected (GPT, 2022), but rather an increase in pH.

Even if mine water is determined to be of an acceptable quality, creation of a permanent decant into the Floodplain will lead to changes in the hydroperiod of the wetland at the discharge point with resultant changes to habitat and biodiversity.

Mitigation

No decant of the mine workings should be allowed to occur and an appropriate water management strategy and monitoring plan must be developed and implemented to ensure this.

Should it be necessary to abstract groundwater to prevent decant, such water should not be discharged directly into the Floodplain as this could result in impacts and degradation of habitat at the point of discharge, unless supported by a detailed assessment of potential risks and benefits to the wetland.

No contaminated water may be allowed to enter the Floodplain.

7.3.10 Impact Assessment Tables

No.	Environmental Component	Potential Impact	Rating (prior to mitigation)									Proposed Mitigation Measures	Rating (post-mitigation)				
			Status	Magnitude	Extent	Duration	Probability	Significance	Reversibility	Irreplaceable loss of resources	Potential of impacts to be mitigated		Magnitude	Extent	Duration	Probability	Significance
CONSTRUCTION PHASE																	
1	Wetland	Destruction and disturbance of wetland habitat	-	10	1	4	5	75	2	2	1	Refer to mitigation measures in Section 7.3 of the Wetland report (WCS, 2022)	6	1	4	5	55
2	Wetland	Increased sedimentation within wetlands	-	6	1	2	4	36	2	2	1		4	1	2	3	21
3	Wetland	Altered flow and flooding characteristics	-	6	2	2	4	40	1	2	2		4	1	2	4	28
4	Wetland	Water quality deterioration	-	6	2	2	4	40	1	2	2		4	1	1	4	24
OPERATIONAL PHASE																	
5	Wetland	Decreased extent and duration of flooding	-	8	3	3	3	42	2	2	3	Refer to mitigation measures in Section 7.3 of the Wetland report (WCS, 2022)	8	3	3	3	42
6	Wetland	Changes in habitat and loss of biodiversity	-	8	3	4	4	60	2	2	3		8	3	3	5	70

7	Wetland	Increase in alien invasive vegetation	-	6	2	4	4	48	2	2	1		4	1	1	4	24
8	Wetland	Water quality deterioration	-	6	2	4	3	36	2	2	2		4	1	1	4	24
DECOMMISSIONING PHASE																	
9	Wetland	Water quality deterioration	-	6	2	5	4	52	2	2	2	Refer to mitigation measures in Section 7.3 of the Wetland report (WCS, 2022)	4	2	5	4	44

7.4 Cumulative Impacts

The US Environmental Protection Agency describes cumulative impacts as resulting “*when the effects of an action are added to or interact with other effects in a particular place and within a particular time. While impacts can be differentiated by direct, indirect, and cumulative, the concept of cumulative impacts takes into account all disturbances, since cumulative impacts result in the compounding of the effects of all actions over time. Thus the cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource*”.

The greater Nyl Floodplain, viewed as a whole, as well as the section of Floodplain within the project study area, are no longer pristine. Changes in land use within the Floodplain catchment as well as direct disturbances to the wetland habitat have resulted in degradation of the Floodplain and a departure from the natural or reference state of the Floodplain. Various the Floodplain has been assessed as Largely Modified (DWS, 2014), Moderately Modified (in respect of the affected reach in the project study area – WCS, 2012 and 2022) or Largely Natural (desktop PES undertaken as part of the current study).

The friends of Nylsvley organization highlights on its website (<https://nylsvley.co.za/>) a number of threats to the Floodplain that have been identified:

- Coal prospecting
- Platinum mining
- Sewage and other effluent

Currently, the Nyl catchment supports limited active mining activity. The National Landcover 2018 dataset classified only 326 hectares of the 230 000 hectare catchment as a mining or related land cover, which makes up only 0.14 % of the surface area of the catchment. The proposed direct disturbance footprint associated with the Volspruit Mine Project would increase this by a further 340 hectares. However, mining activities have the potential to result in significant indirect impacts that can stretch far beyond the direct disturbance footprints through impacts on both the quantity of flows and the quality of flows. Where a reduction in the water quality is accompanied by a reduction in water quantity, the impact on water quality can be amplified as the effect of dilution is lost and evapotranspiration on the Floodplain can lead to concentration of contaminants over time, especially during dry seasons.

The dominant land cover identified within the Nyl catchment has been classified as “Natural/Minimally Impacted”, with 70 % of the catchment classified as such. This implies that game farming and livestock grazing are important land uses and economic activities within the area, with the Floodplain wetland forming an important focal point for both these land uses, as a tourist attraction and as an area of increased grazing capacity compared to adjacent terrestrial areas. Any proposed change in land use such as mining must therefore also be considered in terms of its impact on these activities and, certainly in the case of game farming and tourism-based activities, the impact on “sense of place”. Ecotourism has played an important role in maintaining areas of natural vegetation within the surrounding landscape. Activities that may impact negatively on ecotourism potential and “sense of place” may lead to alternative landuses other than ecotourism being pursued. This could lead to loss of natural habitats, including wetland habitats.

The proposed Volspruit mining activities in close proximity to the Floodplain pose a risk in terms of both quantity and quality of flow to the Floodplain wetland and downstream Mogalakwena River. The location of the Volspruit Mine project near the downstream end of the Floodplain and roughly 35km from the Nylsvley Nature Reserve suggests that the bulk of the Floodplain will not be directly impacted by the proposed mining activities, and no water quality or quantity impacts from mining will be experienced by the Nylsvley Nature Reserve.

However, rivers and associated floodplains form linear ecosystems and ecological corridors in the landscape that allow for movement of species along the Floodplain habitat as conditions change, i.e. as floods progress downstream along the Floodplain or, when only localised flooding occurs on the floodplain due to localized rainfall and/or localized inputs from lateral tributaries creates localized patches of suitable habitat/conditions. This is especially relevant to highly mobile species such as birds that can easily move between more distant areas. The biodiversity of the Nylsvley Nature Reserve, which protects only a small section of the greater Floodplain, is thus also dependent on the adjacent reaches of the Floodplain falling outside any formal protected areas.

Work undertaken by various specialists as part of the Volspruit Project EIA has shown that the proposed mining activities are unlikely to result in a significant reduction of flow within the Nylsvley due to increased loss of flood waters to groundwater, but some uncertainty in this regard remains. Flow losses could potentially result in decreased extent and duration of flooding within this lower end of the floodplain, impacting on wetland habitat and viability of sensitive species. This reduction in flood flows will act on a system that, in its current state, is already experiencing reduced flow (flows have reduced by 12.9 % from the virgin state to current state [eScience Associates, 2015]) and showing signs of decreased wetness. Added to this, climate change and its consequences for rainfall and evapotranspiration will likely place further stress on the Nylsvley system and reduce its resilience.

Based on the above discussion it is clear that the proposed Volspruit Mine Project has the potential to add to cumulative impacts acting on the Nyl Floodplain and which have led to some degradation of the Floodplain over time. Impacts are likely to be most severe in close proximity to the proposed project activities, i.e. at the downstream end of the Floodplain, though a number of indirect impacts that are more difficult to identify and quantify could have further negative consequences for the biodiversity associated with the greater Nyl Floodplain.

8. CONCLUSIONS

The greater Nylsvley wetland is approximately 65km long and varies in width from approximately 5km at its widest point to 100m at its narrowest (Kleynhans et al., 2007 in WRC Report TT441/09). Overall it covers approximately 24 250 ha, which makes it the largest floodplain vlel in South Africa (Higgins and Rogers, 1993). The Nylsvley Nature Reserve, a Ramsar wetland of international importance, is located along the floodplain and conserves approximately 3 000 ha of the floodplain (Higgins and Rogers, 1993). The amended Volspruit Mining Rights Area, which forms the focus of this wetland assessment, is located along the eastern bank of lower reaches of the Nylsvley wetland, approximately 30km downstream of the Nylsvley Nature Reserve.

The Nylsvley wetland, including the reach affected by the proposed mining development, is a designated Freshwater Ecosystem Priority Area (FEPA) wetland. The project study area, including the wetland habitat, has also been classified as a Critical Biodiversity Area 1 in terms of the Limpopo Conservation Plan, as updated for the area through the Waterberg District Bioregional Plan (LEDET, 2016). The value and conservation importance of the Nylsvley wetland is clear.

Within the project study area the Floodplain wetland covers approximately 317 ha, with 199.6 ha of Floodplain wetland habitat falling within the amended MRA. A small Seep wetland along the western edge of the Floodplain and two small Depression wetlands make up an additional 5.1 hectares of wetland habitat. Two small farm dams and a water-filled quarry add a further 1.2 ha of artificial wetland habitat. Natural wetland habitat thus makes up 6.2 % of the study area and 6% of the amended MRA. Within the context of the greater Nyl River floodplain, the section of floodplain on site represents approximately 1.6 % of the entire Nyl floodplain (based on the National Wetland Map 5 mapping of the greater Nyl floodplain)⁴.

The reach of the Nylsvley Floodplain falling within the project study area has been affected by a number of activities and disturbances that have occurred within the delineated wetland habitat. Foremost among these is the building of dams within the Floodplain. These dams inundate sections of the wetland, resulting in loss of vegetation cover and creation of open water habitat. Although the open water habitat is generally confined to a localised area immediately upslope of the dam wall, the very low longitudinal slope of the Floodplain results in an extensive area of increased wetness (increased depth and duration of flooding) associated with each of the dams. This has affected vegetation assemblages within the wetland, with species such as *Phragmites australis* and *Typha capensis* restricted largely to those sections of the Floodplain affected by impoundments and forming large stands in these areas. In addition, there is evidence that seems to show that flow and wetness within the Floodplain wetland has decreased over time, shown by a decreased wetting front, increases in woody vegetation, and hydrological modelling results from eScience Associates (2015) that indicate that the MAR for the Nyl has decreased by 12.9%. As a consequence the wetland habitat on site is considered Moderately Modified condition (PES category C). Despite the degradation of wetland habitat that has occurred, the Floodplain wetland is still considered to be of Very High ecological importance and sensitivity.

The proposed North Pit opencast pit and associated flood protection berm extend the closest to the Floodplain wetland and extend well into the 1:100 year floodline of the Nyl Floodplain. However, a 50m buffer around the outer edge of delineated wetland habitat will be maintained between the proposed flood protection berm and the wetland. No direct disturbance or destruction of wetland habitat is therefore expected.

All other proposed activities are located outside delineated wetland habitat, though a number of project activities fall within the 500m Regulated Area:

- North Pit
- Flood diversion berm
- Clean water outlet structures (2), located 480m and 455m from the delineated wetland edge

⁴ The figures quoted in this paragraph differ from the WCS 2012 study mostly due to changes in the extent of the project study area, though minor revision of the extent of wetland habitat identified on site also contributes.

- Pollution Control Dams associated with the Waste Rock Dump (WRD) located 460m from the delineated wetland edge.

These activities, together with project activities falling outside the 500m Regulated Area, do have the potential to result in secondary or indirect impacts to the Floodplain wetland habitat.

To allow for the mining of the North Pit, abstraction of groundwater will be required. This will result in a draw down cone extending around the pit and given its proximity to the Floodplain wetland, also extending under the wetland. There is a potential that such a drawdown cone could result in increased transmission losses from the wetland.

The understanding gained during the course of this study, as informed by findings from the groundwater specialist study (GPT, 2023) and the surface water specialist study (Krige, 2023) is that, during low flow periods, no loss of surface water to the alluvial aquifer is expected, but that during flood events, some surface water may be lost to the alluvial aquifer. The point at which this loss to groundwater starts to occur does not appear to have been accurately defined, and appears to differ across the study area, with two piezometer transects on site monitored by GPT (2023) reacting differently to flooding but such flow losses will likely only occur during very large flood events.

Relating a slight and only temporary decrease (approx. 3 years) in flow to an impact on wetland habitat and degradation of wetland habitat is difficult and uncertain. It is recognised that the hydrology of South African wetlands and their vulnerability to reduced inflows is still poorly understood (Macfarlane *et al.*, 2008), though it is known that floodplains driven predominantly by bank overtopping (i.e. driven primarily by upstream inputs rather than lateral inputs), which the Nylsvley is, are sensitive to changes in flood peaks (Heeg and Breen, 1994, as quoted in Macfarlane *et al.*, 2008) as well as changes in duration of flooding.

The expected increased groundwater drawdown and associated possible reduction in MAR must be further considered in terms of a Floodplain wetland system already under stress of reduced flows. The Nyl River Hydrological Analysis report by eScience Associates (2015) indicates the Mean Annual Runoff (MAR) for the Nylsvley under virgin conditions (natural conditions) to have been 20.74mm with transmission losses of 0.77mm. Under current conditions, the base case, MAR has been determined as 18.07mm with transmission losses of 2.66mm. **This represents a 12.9% reduction in MAR that has already occurred**, which corroborates the observations of decreased wetland extent and wetness on site.

The likely impact to the wetland habitat from the expected flow reduction is difficult to predict. The current scenario of groundwater drawdown due to irrigation will only be exceeded by the mine for a handful of years (currently estimated as 3 years). As the Nylsvley Floodplain only floods during some years, and occasionally does not flood for consecutive years, the habitat and biodiversity of the Floodplain is adapted to a highly variable hydrological regime. Reduced flow within the Floodplain for a period of 3-4 years may thus fall within the natural variation for a system such as the Nylsvley. However, flow within the Floodplain is already significantly reduced, and further flow reductions may move the wetland closer to an as yet undefined ecological threshold, resulting in more rapid degradation of the wetland habitat. A further consideration must be the impact of climate change on

the wetland, and specifically its consequences for rainfall and evapotranspiration. This is likely to place even further stress on the Nyilsvley system and reduce its resilience.

A recent EWR assessment of the Nyl River Floodplain (Department of Water and Sanitation, 2024) states that the Floodplain (at least the section upstream of the R519, with specific reference to the Nyl upstream of the N1 and the Olifantsspruit, which lies approximately 30km upstream of the project study area) is considered to be in a relatively stable state with no future water resource developments planned in the Nyl River catchment that are expected to affect water supply to the Floodplain and therefore the PES condition of the Floodplain. Under this assumption flow within the floodplain was modelled under various scenarios with combinations of alternate wet and dry years to demonstrate how the ecological condition of the floodplain is anticipated to respond to the frequency of floods and the extent and duration of floodplain inundation. Under all scenarios modelled the PES drops from the 2022 PES, with the drier scenarios leading to an anticipated drop to a PES category D/E. One of the main responses predicted was for a severe reduction in the abundance of reeds and of central and edge floodplain grasses in all the zones, with the most severe reductions predicted in the lower two thirds of the floodplain assessed in the model (Department of Water and Sanitation, 2024). Therefore, it can be predicted that activities or conditions that increase the likelihood of longer drier periods occurring would push the floodplain towards a lower ecological integrity. The project study area, which lies approximately 30km downstream of the lower end of the Nyl River floodplain modelled in the EWR report, is already drier by nature and possibly more sensitive to hydrological change, and therefore may be more susceptible to crossing a hydrological threshold that results in a drop in PES category beyond the EWR for the upper Nyl River floodplain, which is to maintain a PES Ecological Category C. The best available hydrological information gathered through this current project, and reviewed as part of this wetland assessment, indicates that the proposed project is unlikely to cause a lowering of the PES of the Floodplain wetland. However, this is not certain, as detailed above with regards to the possible reduction in MAR that has not been ruled out. It is important to note that the EWR determined is for locations far upstream of the Volspruit Mine, so the mine itself will have no impact on the EWR for the upper Floodplain. In the absence of a determined wetland EWR for the lower half of the Nyl River Floodplain (within which the study area lies), perhaps it may be appropriate to apply the upper Floodplain EWR to the lower Floodplain, though it is noted that there are significant gaps in terms of how this translates to flows and flooding frequency/inundation in the lower Floodplain.

Any proposed development for the area must thus be considered in light of the above discussion, and carefully evaluated in terms of its contribution to cumulative impacts on the Nyilsvley floodplain. Considered in isolation it is likely that the proposed mining project would not result in unacceptable and irreversible impacts to the Nyilsvley, given the location of the project at the downstream end of the floodplain and the findings of the groundwater and surface water specialist studies that suggest limited flow impacts. However existing activities and land uses have already placed the Nyilsvley under stress, whilst new developments and changes in land use could also act as a precedent or trigger for further changes in land use. A move away from ecotourism (game farming) especially is considered a threat to conservation of the wetland habitat and associated biota. Such a change could be precipitated by the establishment of land uses not compatible with ecotourism, and should thus be carefully managed and controlled. Climate change adds a further element of uncertainty to the equation and will likely add further stress to the wetland.

The National Environmental Management Act (NEMA, Act 107 of 1998) includes under its Principles (Chapter 1, Section 2) that “(4) (a) *Sustainable development requires the consideration of all relevant factors including the following: (viii) that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions*”. It is therefore our recommendation that the proposed Volspruit mining project only be considered for authorisation if it can be shown with a high degree of certainty that all aspects of the Ecological Reserve of the Nyl floodplain will be met during all phases of the mining project.

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APPENDIX A – CV OF THE SPECIALIST

Dieter Oscar Kassier

Date of Birth:	1981-09-15	Profession:	Wetland Ecologist
Identity Number:	810915 512 808 6	Nationality:	South African
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Academic History: 2012 – Honours B.Sc Environmental Science (Aquatic Ecosystem Health) - NWU

2006 – B.Sc Environmental Management (Zoology Stream) – UNISA

1999 – Matriculated from Hermannsburg School (IEB Exam)

Professional Affiliations: SACNASP: Environmental Science (400254/14)
South African Wetland Society (Reg. number R87XH0HU)

Additional Training: 2009 - Soil classification and wetland delineation (Terra Soil Science)

2009 – Rehabilitation of Mine Impacted Land (African Landuse Training)

2008 – Bringing data into ArcGIS (GIMS)

2007 – Wetland Delineation and Rehabilitation Course (University of Pretoria)

2004 – FGASA Level 1 and Trails Guide (FGASA)

Employment record: 2017- present day: Director: WCS Scientific (Pty.) Ltd. – Part of Wetland Consulting Services Group
2007 – Present day: Wetland Ecologist: Wetland Consulting Services (Pty.) Ltd.
2018 – Present day: Wetland Ecologist: WCS Scientific (Pty.) Ltd. (Part of the Wetland Consulting Services Group)
2006 – 2007: Junior Environmental Consultant: WSP Environmental
2001 – 2006: Field Guide/Game Ranger: Makutsi Safari Farm, Karongwe Game Reserve

Publications:

1. **Wetland Rehabilitation in Mining Landscapes: An Introductory Guide.** 2016. Macfarlane, D., Dlamini, B., Marneweck, G., Kassier D., Campbell, J., Young, A., Dini, J.A., Holness, S.D., de Klerk, A.R., Oberholster, P.J. and Ginsburg, A. WRC Report TT 658/16

Presentations:

1. **Wetland Rehabilitation: Understanding the Good, the Bad and the Environmentally Sustainable.** Presented as a pre-conference training workshop at the 8th World Congress on Ecological Restoration hosted by the Society for Ecological Restoration (SER).
2. **Wetland Rehabilitation Project Process & Case Studies.** Presented as a pre-conference training workshop at the 2016 Land Rehabilitation Society of Southern Africa (LaRSSA) conference.

Summarised project experience over the past 13 years:

2020 Consulting Projects:

1. Thukela Reserve Project – Review of existing information, gap analysis, field verification of wetlands, prioritisation of wetlands and compilation of management recommendations and eco-specs for wetlands.
2. Zibulo North Shaft – Wetland delineation and impact assessment study as part of environmental authorisation applications for a proposed new shaft and underground coal mine.
3. DMO Offset near Belfast – Wetland rehabilitation planning for wetlands within the Greater Lakenvlei Protected Environment as part of an offset commitment for a coal mine.
4. Graspan Colliery – conceptual pan creation and wetland offset planning.
5. iMpunzi Wetland Offset Detailed Design – wetland inputs, including detailed pre-construction monitoring, as part of the detailed design phase of the iMpunzi wetland offset project.

2019 Consulting Projects:

1. Member of wetland specialist team conducting a peat assessment, and developing a wetland rehabilitation and aquatic ecosystem management plan for a coastal wetland system in Mozambique on behalf of Coastal & Environmental Services. Ongoing.
2. Wetland delineation and impact assessment study for a Water Use Licence Application for the Seriti New Vaal Colliery.
3. Providing wetland specialist inputs towards the development of an environmental management framework for undertaking seismic surveys on the coastal plain of the Inhamitane Province.
4. iMpunzi Venture Dump - wetland delineation and impact assessment for a coal discard facility mine in the Mpumalanga Province.
5. Wetland Monitoring – annual monitoring of wetlands within a coal mining landscape.

2018 Consulting Projects:

1. Detailed wetland delineation and assessment studies for various Sasol Collieries in the Secunda and Sasolburg areas.
2. Wetland baseline assessment, prioritisation and identification of rehabilitation opportunities for a selected catchment within the Lesotho Highlands.
3. Kangra Kusipongo - wetland delineation and impact assessment for a proposed greenfields underground mine in the Mpumalanga Province.
4. Landau – wetland delineation and water use risk assessments for the relocation of power cables and fibre optic cables associated with the Landau III Project.
5. Booysendal Project – wetland delineation and impact assessment for a platinum group metals mine in the Groot Dwars River valley.

2017 Consulting Projects:

1. Update of the national wetland map – summer rainfall mesic & arid regions – Providing specialist wetland input, training of interns, and evaluation of the updated wetland map.
2. Polihali ESIA – specialist wetland study as part of an EIA being undertaken in Lesotho.
3. Metakol, Kolwezi, Democratic Republic of Congo – specialist wetland assessment as part of an EIA, including rapid peat survey of affected wetlands.
4. Khanyisa Project – wetland assessment and water use risk assessment for the Khanyisa IPP Coal Supply Project.
5. Landau Offset – determination of offset targets, identification, evaluation and assessment of suitable target wetlands, conceptual rehabilitation measures, evaluation of gains and compilation of wetland management plan.

2016 Consulting Projects:

1. Olifants Letaba Reserve Project – Review of existing information, gap analysis, field verification of wetlands, prioritisation of wetlands and compilation of management recommendations and eco-specs for wetlands.
2. Impumelelo Mine – Wetland baseline surveys (delineation and ecological assessment) for mine expansion activities over an area of over 8 000ha
3. Klipfontein Wetland Mitigation Strategy – compilation of a wetland mitigation and rehabilitation strategy in terms of the wetland offset guidelines
4. Leeuwpanspan Monitoring – Water Use License compliance monitoring for wetlands surrounding the Leeuwpanspan Mine
5. Riverfields – wetland delineation and ecological assessment as part of environmental authorisation processes for three sites in the Ekurhuleni Metropolitan Municipality

2007 - 2015 Consulting Projects:

1. SANBI Guideline for Wetland Rehabilitation in Mining Landscapes – co-author.
2. Glencore Witbank Complex Wetland Management Strategy – Compilation of a wetland management strategy for the Glencore Witbank group of mines, Mpumalanga Province.
3. De Wittekrans Coal Mine – Wetland delineation and assessment for the proposed De Wittekrans Coal Mine near Hendrina, Mpumalanga Province.
4. Sishen Ramp-Up Project – wetland delineation and water use risk assessment for the proposed relocation of a 275kV powerline near Sishen in the Northern Cape.
5. Clearwater Estates – wetland delineation and impact assessment for a proposed residential development along the Clearwater Pan in Ekurhuleni, Gauteng Province.
6. Kusile 60-year Ash Dam – Wetland delineation assessment and site selection as part of the EIA/EMP and IWULA for the proposed Kusile 60-year Ash Dam.
7. Mooifontein Uranium – Wetland assessment as part of the EIA/EMP and IWULA for a proposed uranium mine in the southern Free State Province.
8. Lydenburg Golf Course Phase 1 and 2 – Wetland assessments as part of the environmental authorisation applications for proposed residential developments near Lydenburg, Mpumalanga.
9. Du Toits Pan Kimberley – Wetland delineation and ecological assessment of the Du Toits Pan, Kimberley Mines, Northern Cape.
10. Ariesfontein Concentrated Solar Power Plant – Wetland Assessment as part of the EIA/EMP for a CSP solar power facility near Danielskuil, Northern Cape.
11. Tweefonteinspruit Clean-up Project – Ecological assessment to inform the proposed clean-up of the Tweefonteinspruit near Witbank.

12. Two Rivers Platinum Mine – Wetland and Riparian assessment as part of the EIA/EMP and IWULA for a new tailings storage facility near Steelpoort.
13. Braam Fischerville – Wetland delineation and assessment as part of the EIA for a proposed commercial development in Soweto.
14. Grass Valley Mine (Sylvania Resources) – Wetland Assessment as part of the feasibility study and for the EIA/EMP for a proposed platinum mine on the bank of the Nylsvley.
15. Middelburg Eastern Bypass – Wetland delineation and assessment as part of the EIA.
16. Brits Waste Water Treatment Works – Riparian delineation and assessment for the Basic Assessment.
17. Upington Shopping Centre – Riparian delineation and assessment in support of a Water Use Licence Application for a proposed shopping centre in Upington.
18. Springlake Colliery (Exxaro) – Wetland delineation and assessment for the proposed expansion of the Springlake Colliery near Dundee, KwaZulu-Natal.
19. Bedford/Braamhoek Pumped Storage Scheme (Eskom) – Assisted in a peat survey of the Bedford wetland.
20. Cleanstream Pan – A comparative assessment of various pans to determine the impact of urbanisation on pan habitat integrity using water quality and avifauna as indicators.
21. Brandspruit Mine, Impumelelo Shaft and Conveyor – wetland delineation and impact assessment for a proposed coal mine and associated infrastructure near Secunda, Mpumalanga (18 000ha study area).
22. Steve Bikoville School – baseline environmental assessment for the proposed Steve Bikoville School near Hammanskraal, Gauteng.
23. Nelspruit Ring Road – wetland delineation and impact assessment for the N4 Nelspruit Bypass, Nelspruit, Mpumalanga.
24. Mine Waste Solutions: Re-working of Tailings Dams – wetland delineation and impact assessment for the re-working of several tailings dams near Stilfontein, North-West.
25. Goedgevonden Mine – quarterly monitoring report for the Goedgevonden river diversions, Mpumalanga, South Africa.
26. City of Johannesburg (COJ) – desktop delineation for, and assisting in the compilation of, the COJ wetland and riparian protection and management plan, Gauteng, South Africa