ASSESSMENT OF TWO WETLANDS IN THE VICINITY OF THE LAFARGE TSWANA LIMESTONE MINE NEAR BODIBE IN RELATION TO A WATER USE LICENCE APPLICATION

March 2022

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SYNOPSIS

Two wetlands associated with the Lafarge cement factory are surveyed and assessed for a Water Use Licence Application

KEY WORDS:

Wetlands, Impact and Risk Assessment, Management Recommendations.

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO 9001: 2015 which has been independently certified by DEKRA Certification.

Verification	Capacity	Name	Signature	Date
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1. INTRODUCTION

The LafargeHolcim ("Lafarge") cement factory located in Lichtenburg in the North West Province is in the process of undertaking separate Water Use Licence Applications (WULA) for operations in its cement factory in Lichtenburg, and the associated Tswana limestone mine located near Bodibe. A part of the application process includes an assessment of the wetlands in the vicinity of each of the areas. In line with this, JG Afrika (Pty) Ltd were appointed to undertake the necessary specialist wetland and plant surveys. The WULA for Tswana Mine, although for the same company, is to be regarded as an entirely separate matter to that of the cement factory and so this document has no bearing on the studies and reports relating to the cement factory site.

The mine is located near the settlement of Bodibe and is some 37 Km west of the cement factory in Lichtenburg as shown in Figure 1.

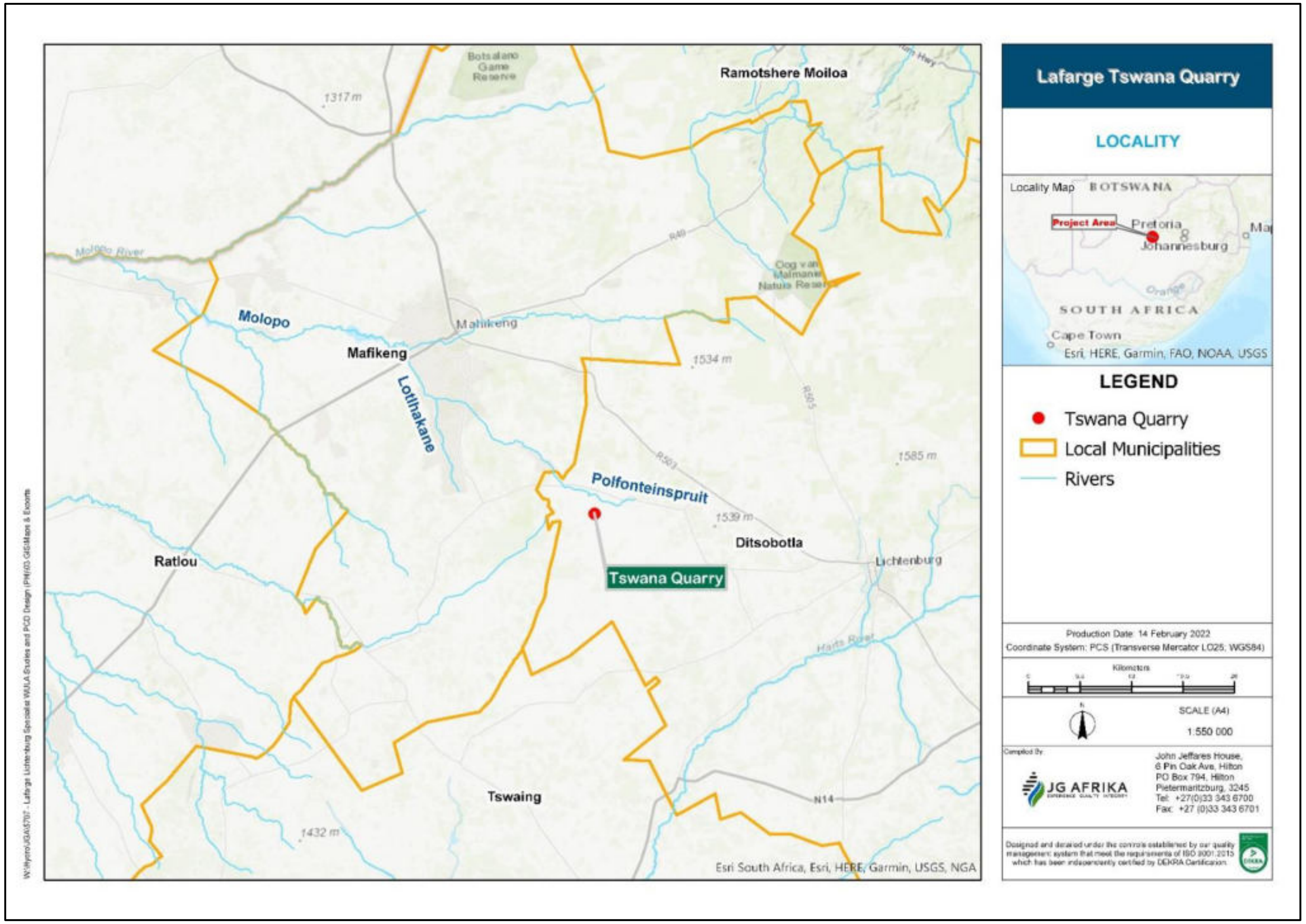

Figure 1: Location of the Lafarge Tswana Mine

2. TERMS OF REFERENCE

The terms of reference for this report are based on Annexure 6 "Wetland Delineation Report" of the Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals of 24 March 2017.

These requirements are copied below:

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2 Terms of reference
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8.9 The PES assessment of the remaining wetland areas
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9 Impact assessment discussions
10 Conclusions and recommendations
11 References

The following are to be used as relevant to the site and circumstances:

1) Wetland and riparian habitat delineation document (DWS report on DWS website),
2) Wetland Buffer Guideline (SANBI WRC project and Report, on DWS website),
3) Wetland Offset (WRC report TT660116; on DWS website),
4) High Risk Wetland Atlas (WRC Report TT659116, on DWS website),
5) Wetland Rehabilitation in mining landscapes (WRC Report TT658116, on DWS website), and
6) Risk Assessment Protocol and associated Matrix (DWS document on DWS Website).

3. KNOWLEDGE GAPS

The information on which this report is produced is based on a two-day visit to the mine site and surrounds by two people in February 2022 and on information provided by staff members of Lafarge and JG Afrika. During the site visits, it was possible to visit all areas of the mine. Heavy rains had fallen in the weeks prior to the site visit and the area was exceptionally wet.

For reasons of safety and security it was not possible to undertake nighttime surveys for frogs.

4. STUDY AREA

This report includes assessments of two wetlands which are:

- The Wetland Map 5 listed systems which are located within 500 m of the mine property. The systems include a length of the Polfontein Spruit and four palustrine sites, and
- The NFEPA listed mine pit wetlands, which lie within and close to the mine pit area.

The precise areas for each are described in the relevant sections below.

5. EXPERTISE OF THE SPECIALISTS

Mr. Alletson is a registered ecologist with SACNASP (No.125697) and is a member if IAIASA (No. 035). He holds a BSc degree in Biological Sciences from the University of Natal and a BSc Honors degree in Zoology from Rhodes University. He served as the aquatic ecologist in the (then) Natal Parks Board and has been an environmental consultant since 1997. Mr. Alletson has in excess of 40 years' experience in the field of aquatic and terrestrial ecological studies in Southern Africa.

In this study Mr. Alletson was assisted my MS M. Holder who undertook the plant survey in the vicinity of the wetlands found. She has received training at the Bews Herbarium (University of KwaZulu-Natal) and is a member of CREW[1] (Custodians of Rare and Endangered Wild Flowers). She has more than 20 years of experience in undertaking such surveys.

[1] CREW: The Custodians of Rare and Endangered Wildflowers (CREW) programme is a citizen science initiative that involves members of the South African public in the surveying, monitoring and conservation of plants.

6. AIMS AND OBJECTIVES

The objectives of the report may be summarised as follows:

- To investigate the field conditions wetlands at the Lafarge mine site,
- To gain an understanding of the functionality and condition of the site,
- To identify any environmental risks posed by the mine activities and an assessment of the potential impacts that could arise out of the project,
- To identify any areas that are to be avoided, including provision of buffers,
- To list any assumptions made and any uncertainties or gaps in knowledge, and
- Any conditions for inclusion in the Environmental Authorisation and/or Water Use License.

7. METHODOLOGY

7.1 Data Collection

The objectives of this report are to assess biological and ecological conditions of the wetlands listed above. The following framework is to be followed:

- A desktop survey of each area was undertaken. This survey included:
  - ✓ Examination of the NFEPA and SANBI wetland mapping. This mapping not only indicated the possible presence of wetlands, but also was used to define the extent of the study area around each.
  - ✓ Examination of various biological and ecological databases and data sources. These included the provincial Biodiversity Stewardship Plan, Critical Biodiversity Areas, vegetation maps and descriptions, the DFFE Screening Tool, and various Animal Demography Unit maps for vertebrate faunas.
  - ✓ Use was also made of Google Earth imagery, and of historic aerial survey photography.

The desktop survey was used to guide the field survey which followed. All of the Wetland Map 5 sites were visited and much of the mining right area was also either driven over, walked over, or photographed with a drone.

Observations were made on the wetlands and plant and animal species seen were noted. As relevant, and especially for wetland delineation, use was made of a handheld Garmin GPS unit. A photographic inventory, including drone photography was compiled.

7.2 Wetland Delineation

Wetland delineation was to be done in accordance with the procedures set out in DWAF (2005), and DWAF (2008). These two documents are based on the identification of four indicators which are as follows:

- ***Terrain Unit Indicator*** – Identification of the part of the landscape where wetlands are more likely to occur;
- ***Soil Form Indicator*** – Identification of the soil types which are associated with prolonged and frequent saturation;
- ***Soil Wetness Indicator*** – Identification of the morphological signatures that develop in soil profiles as a result of prolonged and frequent saturation; and
- ***Vegetation Indicator*** – Identification of the hydrophilic vegetation associated with frequently saturated soil.

These indicators are used to not only identify wetland margins but also the pattern of zonation of saturated conditions within a wetland site as summarised in Figure 2.

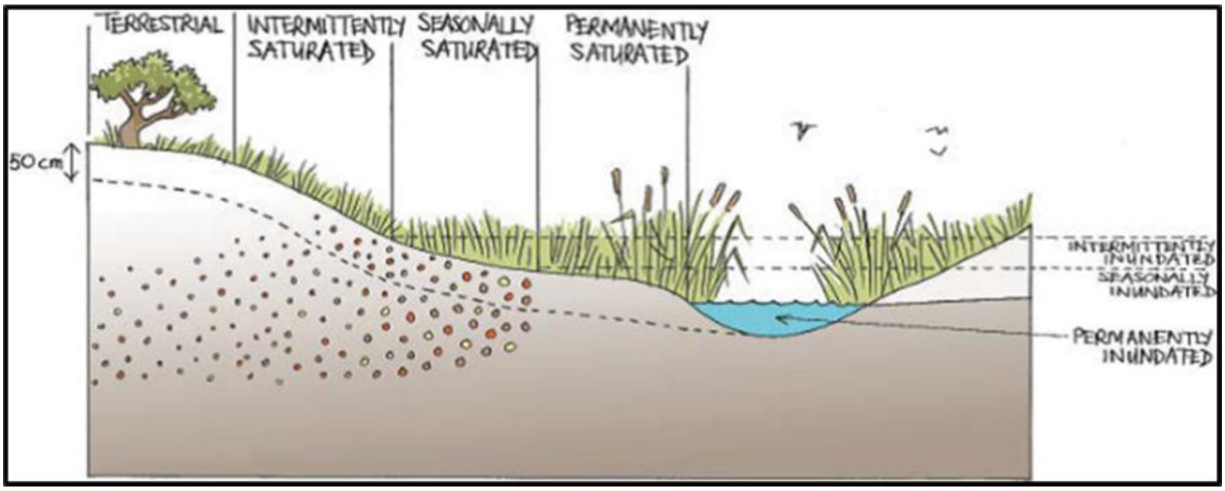


Figure 2: Zones of saturation around a typical wetland

Further refinement of the wetland delineation is then undertaken by dividing the wetland into a number of hydrogeomorphic units as defined by Ollis *et al* (2013) and shown in

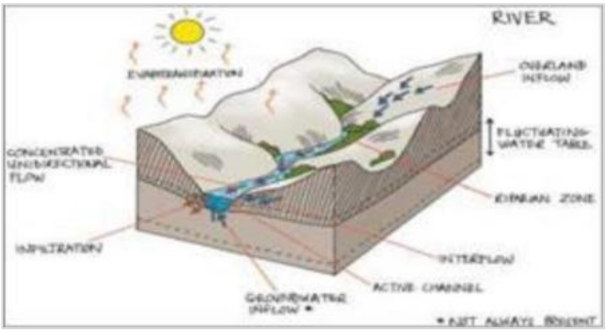
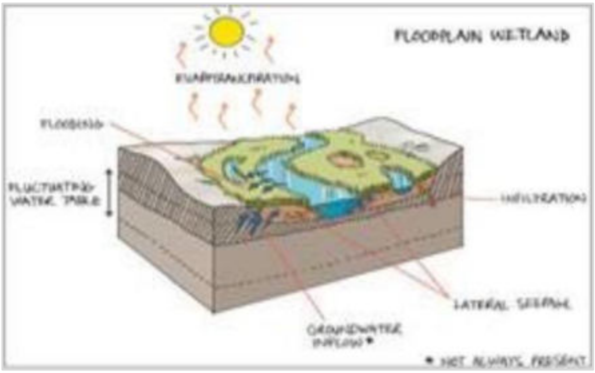
Table ***1***.

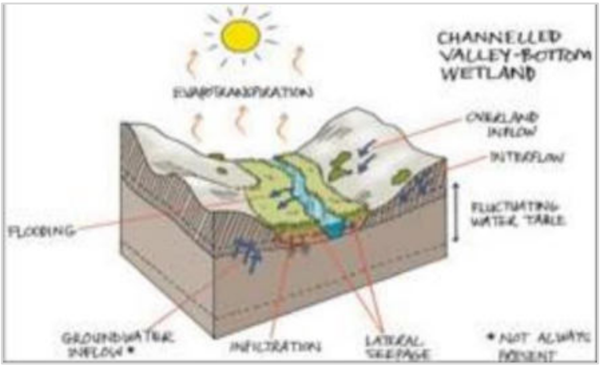
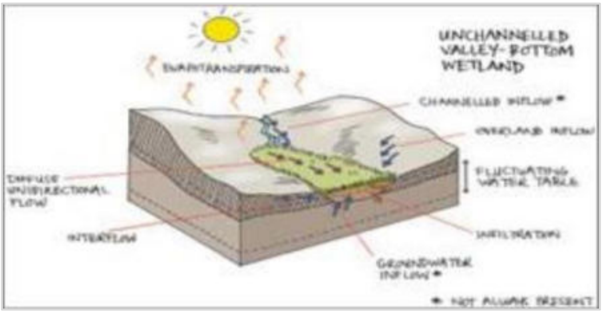
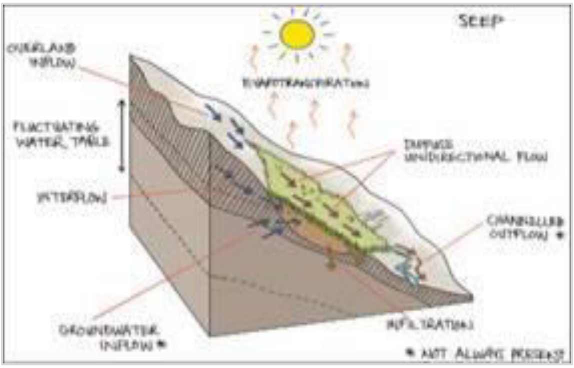
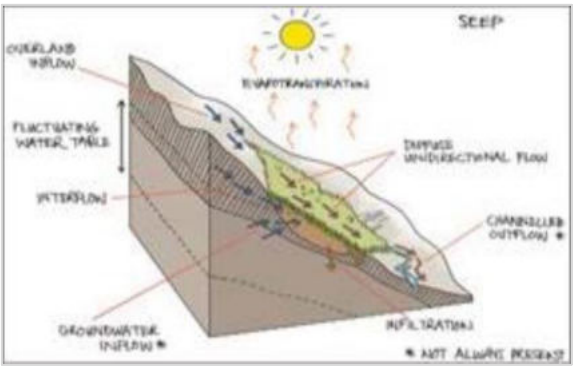
7.3 Data Processing

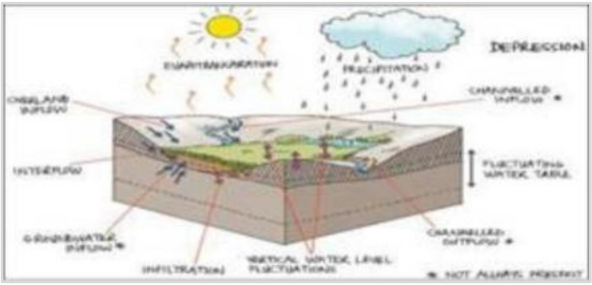
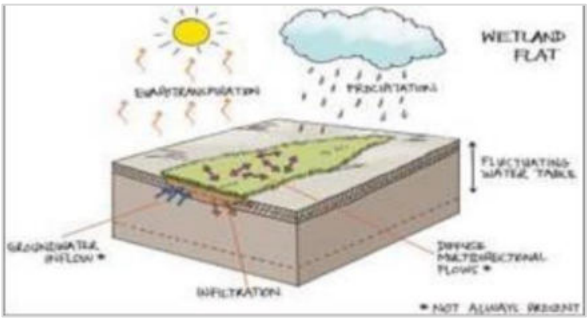
The following procedures were to be used:

- The spatial data collected were mapped in Google Earth. Where necessary, as when the data were to be used in engineering drawings, it was converted to either shapefiles or to a CAD format.
- Modelling of the wetland data was with the WET-Health and WET-EcoServices models. The outputs would provide data to be used in determining the following:
  - ✓ Ecological integrity of the wetlands;
  - ✓ Present Ecological State of the wetlands; and
  - ✓ Ecological Importance and Sensitivity (EIS) of the wetlands.

Table 1: Hydrogeomorphic units as recognised by Ollis *et al* (2013)

Hydrogeomorphic types		Description
River		Rivers are linear landforms with clearly discernible banks and a channel, which permanently or periodically, carries a contained and defined flow of water. A river is taken to include both the active channel and the riparian zone.
Floodplain		Valley bottom areas with a well-defined stream channel, gently sloped and characterised by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.

Hydrogeomorphic types		Description
Valley bottom with channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs are mainly sub-surface flow and outflow is usually via a well- defined stream channel connecting the area directly to a stream channel.
Isolated Hillslope seepage		Similar to other hillslope seeps but with no direct surface water connection to a stream channel. Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow primarily by diffuse sub-surface and/or limited surface flow.

Hydrogeomorphic types		Description
Depression (includes Pans)		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.
Wetland Flat		A flat wetland with no apparent inlet or outlet points. Water is obtained from surface or near surface flows and is lost either by downward percolation or evapotranspiration. May be only seasonal in terms of its wetness and hydromorphic soils may be only weakly developed or else be absent. Vegetation may be the strongest indicator.

It was however found that not all of the sites could be addressed in this way since some of the wetlands, although ecologically significant, are entirely artificial, and the models were not designed for use under such conditions.

Functionality was derived using the WET-EcoServices tool (Kotze *et al,* 2020) which delivers an assessment of the ecosystem services provided by a wetland and is intended for palustrine wetlands, i.e. marshes, floodplains, vleis and seeps. This model takes into account the biophysical and social conditions around a wetland and uses the information to generate a score for a series of defined ecosystem services. The services include the following:

- Flood Attenuation
- Sediment trapping
- Nitrate Assimilation
- Erosion control
- Maintenance of biodiversity
- Provision of harvestable resources
- Cultural significance
- Education and research
- Streamflow regulation
- Phosphate assimilation
- Toxicant Assimilation
- Carbon storage (sequestration)
- Provision of water for human use
- Provision of cultivated food
- Tourism and recreation

The maximum score for any service is a value of 4 and the rating of the probable extent of the service is shown in Table 2 below.

Table 2: Ecoservices rating of the probable extent to which a benefit is being supplied

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

The WET-Health model which produces values for PES was used and also for inputs into the EIS considers the integrity of the site in terms of its hydrology, geomorphology, and vegetation cover. Anthropogenic changes or impacts are assessed along with the relevant role of the site in its catchment and the extent of the impacts on the three criteria is determined. The results are then combined in a weighted formula to give a value for the PES of that site. The formula used to combine the impacts into the PES score is shown below:

Health = ((Hydrology value x 3) + (Geomorphology value x 2) + (Vegetation value x 2))/7

The impact score ratings are shown in Table 3 and the PES Categories are shown in Table 4.

Table 3: Definitions of the PES impact categories (Macfarlane et al, 2008)

Impact Category	Description	Score
None	No Discernible modification or the modification is such that it has no impacts on the wetland integrity	**0 to 0.9**
Small	Although identifiable, the impact of this modification on the wetland integrity is small.	**1.0 to 1.9**
Moderate	The impact of this modification on the wetland integrity is clearly identifiable, but limited.	**2.0 to 3.9**
Large	The modification has a clearly detrimental impact on the wetland integrity. Approximately 50% of wetland integrity has been lost.	**4.0 to 5.9**
Serious	The modification has a highly detrimental effect on the wetland integrity. More than 50% of the wetland integrity has been lost.	**6.0 to 7.9**
Critical	The modification is so great that the ecosystem process of the wetland integrity is almost totally destroyed, and 80% or more of the integrity has been lost.	**8.0 to 10**

Table 4: Definitions of the PES impact categories (Macfarlane et al, 2008)

Impact Category	Description	Impact Score Range	Present State Category
None	**Unmodified, natural**	**0 to 0.9**	**A**
Small	**Largely Natural** with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	**1.0 to 1.9**	**B**
Moderate	**Moderately Modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	**2.0 to 3.9**	**C**
Large	**Largely Modified.** A large change in ecosystem processes and loss of natural habitat and biota has occurred.	**4.0 to 5.9**	**D**
Serious	**Seriously Modified.** The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	**6.0 to 7.9**	**E**
Critical	**Critical Modification.** The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	**8.0 to 10**	**F**

7.4 Impact Assessment – Mitigation Hierarchy

The impact assessment process was guided by reference to the Mitigation Hierarchy which, in turn, is supported by the draft National Biodiversity Offset Policy (RSA, 2017). This widely used concept is illustrated Figure 3 which indicates the flow of the decision-making process. It entails iterative consideration of the impacts of a proposed development and means of reducing those impacts. It starts at the top level ("Avoid/Prevent") and only when the options in that level are considered and exhausted, does the process move progressively down through the lower levels.

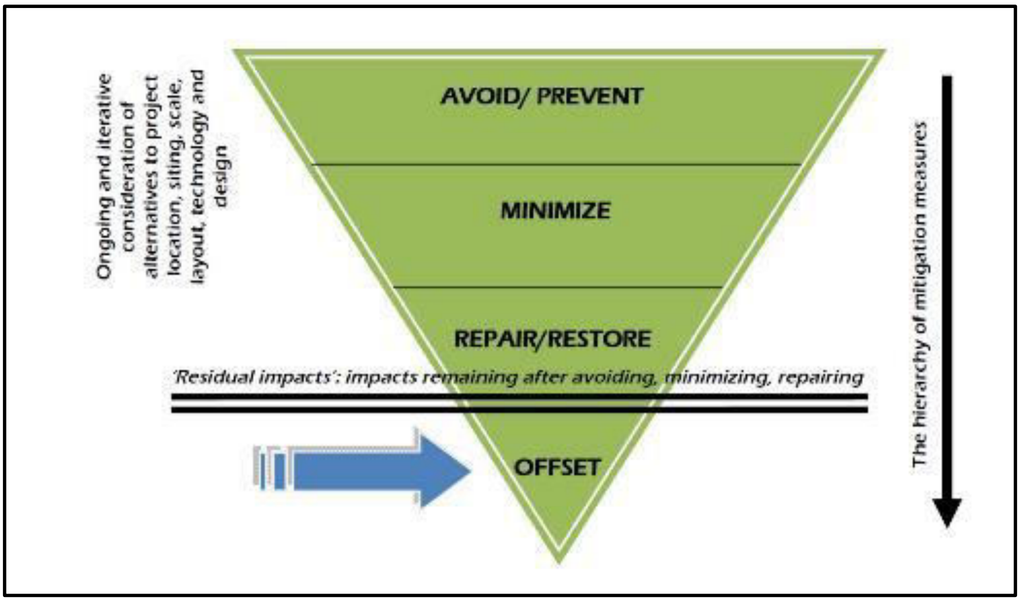


Figure 3: Schematic representation of the Mitigation Hierarchy

In the present case, the existence and activities of the mine imply that the avoid/prevent option may no longer be tenable for all activities, as they might be if the operation were being assessed as a new development. Therefore, the top layer may have to be bypassed in some cases. However, through mitigatory measures, which are either currently being applied or are yet to be applied during the operational phase, it should not be necessary to move any impacts to the lowest level of the hierarchy which calls for off-site mitigation including geared offsetting or other related measures.

8. STUDY AREA CRITERIA

The study areas for each of the wetland sites are included in the relevant sections covering each site. However, for all of the sites the definition of the Regulated Area of a wetland or watercourse was taken into consideration. Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21(c) and (i)", Notice 509 of 2016, specifies that the "regulated area of a watercourse" is to mean:

- *The outer edge of the 1 in 100-year flood line and / or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam,*
- *In the absence of a determined 1 in 100-year flood line or riparian area, the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench, or*
- *A 500m radius from the delineated boundary (extent) of any wetland or pan.*

9. RESULTS FOR THE TSWANA MINE AREA PALUSTRINE WETLANDS

9.1 Study Area

While the above criteria are considered, the actual wetland study area was taken to be the 500 m radius around the mine since it also captured a length of the Polfontein Spruit. The wetlands in the vicinity of Tswana Mine, as shown in Figure 4, are all Wetland Map 5 listed but three, all within the mining right area, are also NFEPA listed.

9.2 Wetland Delineation and Description of Conditions

Examination of the terrain within the mining right area revealed that much of it had, at some time in the past, been mined down to a level where the pit base was a short distance below the natural ground surface. See Figure 5. As a result, the water table, which is naturally shallow, has co-incidentally been exposed in many places. Following the heavy rains that had fallen in the time prior to the site inspection, every deeper mine pit was at least partially filled with water and extensive areas of flat ground outside the mine pits were water-logged. Since the region within which the mine is situated has experienced a prolonged period of wetter than average rainfall, much of the vegetation in the mined area now has characteristics of a hygrophilous grassland, which blends into wetland in many places. See

Table **5** and Plate 1. It was, however, noted that such conditions are not permanent since plants such as *Hyparrhenia tamba* (Thatch Grass), *Gomphocarpus fruticosus* (Cotton Milkweed), and *Searsia lancea* (Karee), which are not commonly found in waterlogged conditions, were also present. Plants found in more natural conditions in the 500 m radius around the mining right area are listed in Table 9.

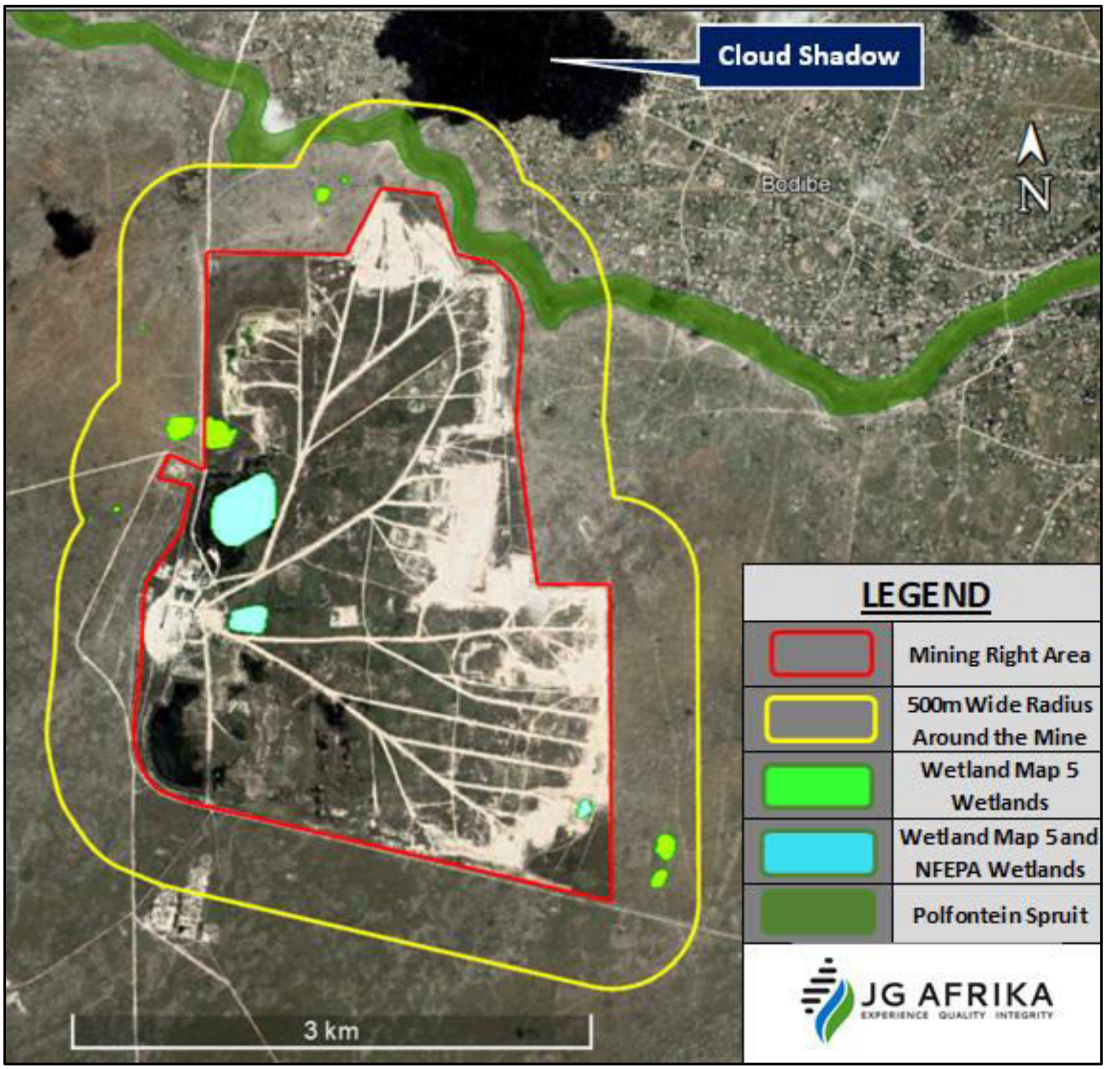


Figure 4: Wetland Map 5 Wetlands in the Tswana Mine study area

Table 5: Plant species observed in mined areas

Water Dependence	Scientific Name	Common Name
Wetland Facultative	*Andropogon eucomus*	Snowflake Grass
	Eragrostis gummiflua	Gum Grass
	Imperata cylindrica	Cottonwool Grass
	Melinis repens	Natal redtop Grass
	Paspalum scrobiculatum	Ditch grass
Wetland Obligate	*Typha capensis*	Bullrush
	Phragmites australis	Common Reed
	Elionurus muticus	Lemon Grass
	Leersia hexandra	Wild Rice Grass
	Persicaria Spp.	Knot weeds

Figure 5: Tswana Mine study area showing the extent of excavation

It was found that examination of the soil characteristics for typical wetland indicators is confusing for two reasons. The first of these is that no traces of the mottling, typically associated with hydromorphic (redoximorphic) soils, could be found. This is partly thought to be a consequence of the mining that has been undertaken. See Figure 5.

The second reason for the lack of mottling in the soils may be a natural characteristic of the region. The auger holes produced a heavy dark grey to black organic (not peat) and clay-rich soil. DWAF (2008) states as follows:

Where modifications of the generic approach may be necessary:

In areas where there are:
- highly organic soils, such as peat;
- very recent alluvial deposits (such as recent alluvial fans in wetlands);
- very iron-poor soils, such as on sandy aquifers/old marine sediments; or
- very free-draining soils, such as Dolomitic or Quartzitic material;

there may be a requirement to slightly modify the way that the indicators are interpreted.

For example, in DOLOMITE and QUARTZITE areas, the soils are extremely free draining – usually the soil water drains very deep (often directly to the deep groundwater). Thus the water does not generally stay in the soil long enough for hydric indicators to develop. In these cases, the standard Landscape Position, Soil Form and Vegetation indicators can be applied, but mottles may be absent in top 50cm. Instead one should examine for high organic carbon (peat) in the soil as a redoxymorphic indicator of wetland soils. The seasonal and temporary wetland zones are often constricted or absent in these settings.

Since region where the factory is located is strongly dolomitic in terms of its geology the above condition applies. It was noted that wetness was commonly found at depths of less than 50 cm to 60 cm.

A further issue relating to the difficulty in delineating wetlands is that there were originally very few wetlands in the area, other than those directly associated with the Polfontein Spruit. Figure 6 shows a 1971 aerial survey image, with the approximate outline of the mine superimposed. There are only two visible candidate sites within the mine area. Of these two, only the more southern one which is now NFEPA and Wetland map 5 listed, could be found.

Because of the difficulty in determining the edges of wetlands, areas of wetland are mapped based on both the Wetland Map 5 sites and on direct field observations. In order to make the delineation as meaningful as possible, the sites are grouped into two categories and candidate sites are examined more closely. These categories are defined as follows:

- **Mine Pit Wetlands.** Mine pit wetlands are those which have developed in mine pits, and which have a well-developed wetland vegetation assemblage, consisting of both wetland obligate and facultative species, as listed in Table 6.

Table 6: Plant species noted in the well-developed mine pit wetlands

Scientific Name	Common Name
Phragmites australis	Common reed
Typha capensis	Bullrush
Cyperus congestus	Unknown
Juncus effusus	Soft rush

Scientific Name	Common Name
Juncus dregeanus	Biesie
Cladium mariscus	Saw grass
Schoenoplectus corymbosus	Unknown
Schoenoplectus cf. decipiens	Unknown
Imperata cylindrica	Cottonwool grass
Leersia hexandra	Wild Rice grass
Hemarthria altissima	Red Swamp grass
Paspalum scrobiculatum	Ditch grass
Potamogeton schweinfurthii	Broad-leaved pondweed

Included in the mine pit wetlands is the original southern wetland, seen in Figure 6 but which has now been significantly enlarged and modified.

- **Shallow Depression Wetlands.** Shallow depression wetlands are wetlands which are apparent at scattered places within the mining right area. It is evident that all these wetlands will be artificial in that they are a result of the mining and other soil disturbance and removal that have taken place. Although wet at the time of the site visit, they will tend to be seasonal or even ephemeral and so usually either lack wetland obligate plants or have only the faster growing species.

Table 7: Plant species noted in the shallow depression wetland areas

Scientific Name	Common Name
Juncus effusus	Soft rush
Juncus dregeanus	Biesie
Schoenoplectus corymbosus	Unknown
Schoenoplectus cf. decipiens	Unknown
Imperata cylindrica	Cottonwool grass
Leersia hexandra	Wild Rice grass
Hemarthria altissima	Red Swamp grass
Paspalum scrobiculatum	Ditch grass

It must be noted that the separation of the two wetland types is not absolute since the wetlands are highly dynamic in terms of their extent and properties. Shallow areas that have been mined can appear to be mine pit wetlands but lack the necessary inundation period to develop true wetland vegetation. The classification of such sites was then sometimes based on examination of Google Earth images from several different times to see if the site ever dries out or not. The conditions found in the mine area are illustrated in Plates 2 to 5 and the observable wetlands are shown in Figure 7.

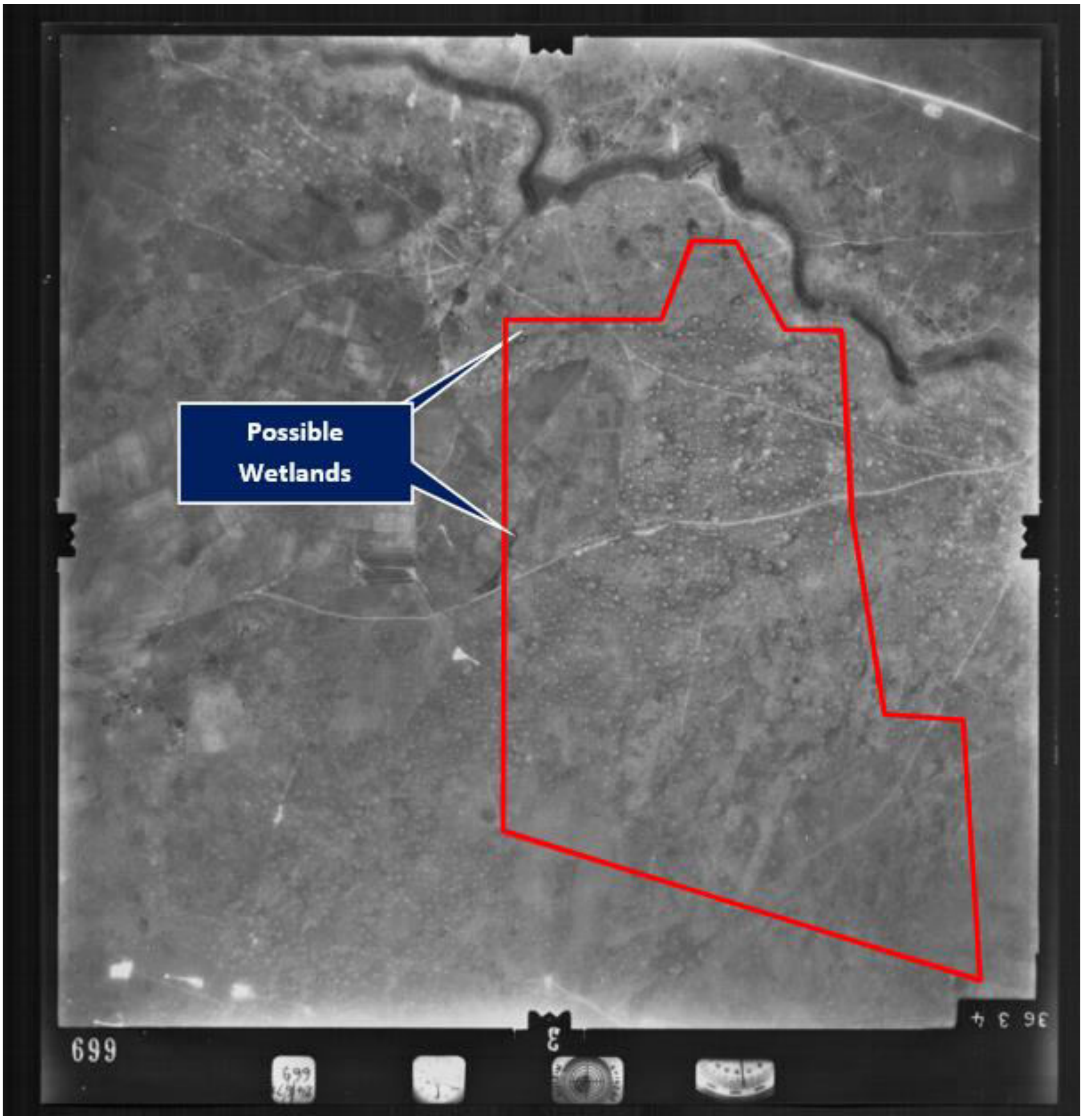


Figure 6: Aerial image from 1971 showing the approximate outline of the present mining area

Plate 1: View of hygrophilous grassland (the ground was damp underfoot)

Plate 2: View of depression wetlands (these areas dry out completely during the drier winter moths)

Plate 3: View of a mine pit wetland (note the marginal emergent vegetation)

Plate 4: View of a depression wetland area (note the reworked ground surface)

Plate 5: View of a depression wetland outside the mining area (note the intact vegetation)

Plate 6: View of an excavated ditch leading from a depression wetland to a pit wetland

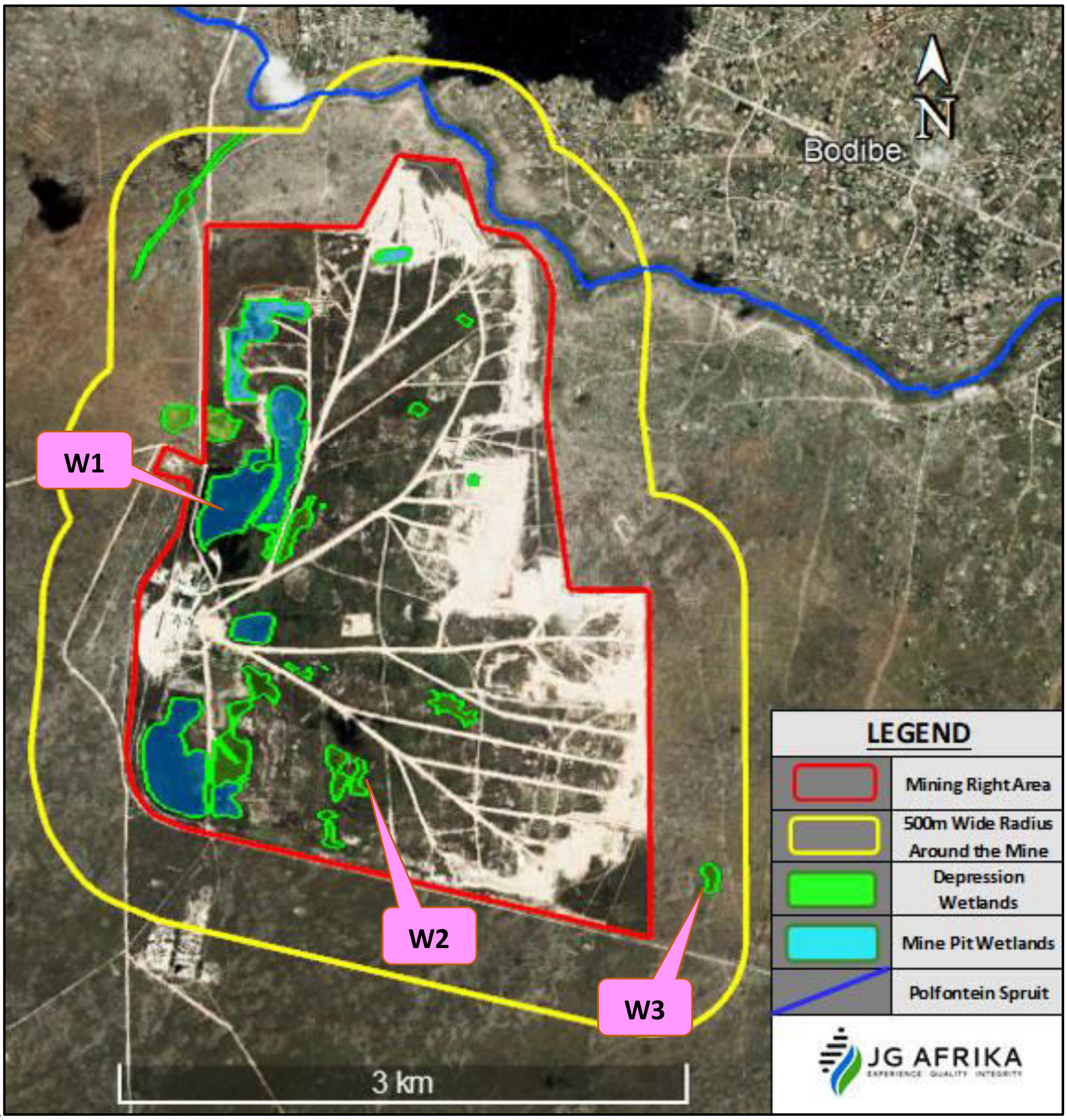


Figure 7: Tswana Mine wetlands (sites W1, W2, and W3 are modelled)

9.3 Wetland Unit Identification

As indicated above, two palustrine wetland types, which are Mine Pit wetlands and Depression Wetlands, are recognised. Both types are artificial as they most closely fit the definition of a Depression Wetland, as given by Ollis *et al* (2013) and shown in Figure 8.

Water levels in the mine pits will be closely associated with the ground water table with rainfall and surface flows only making up some of the volume. In contrast, the depression wetlands are often too shallow to expose the ground water, although certain plants there are able to access such water for at least some of the time since they have deep roots which can reach through the Vadose Zone down to the Capillary Fringe Zone and even to the underlying

Saturated (Phreatic) Zone. See Figure 9. Rainfall is of considerable importance to these wetlands as the depth of water table will be driven by it. In general, the mine pit wetlands have no channeled outflow, and so are endorheic, while some of the depression wetlands do have excavated outflow channels which usually lead to a nearby mine pit wetland. See Plate 6.

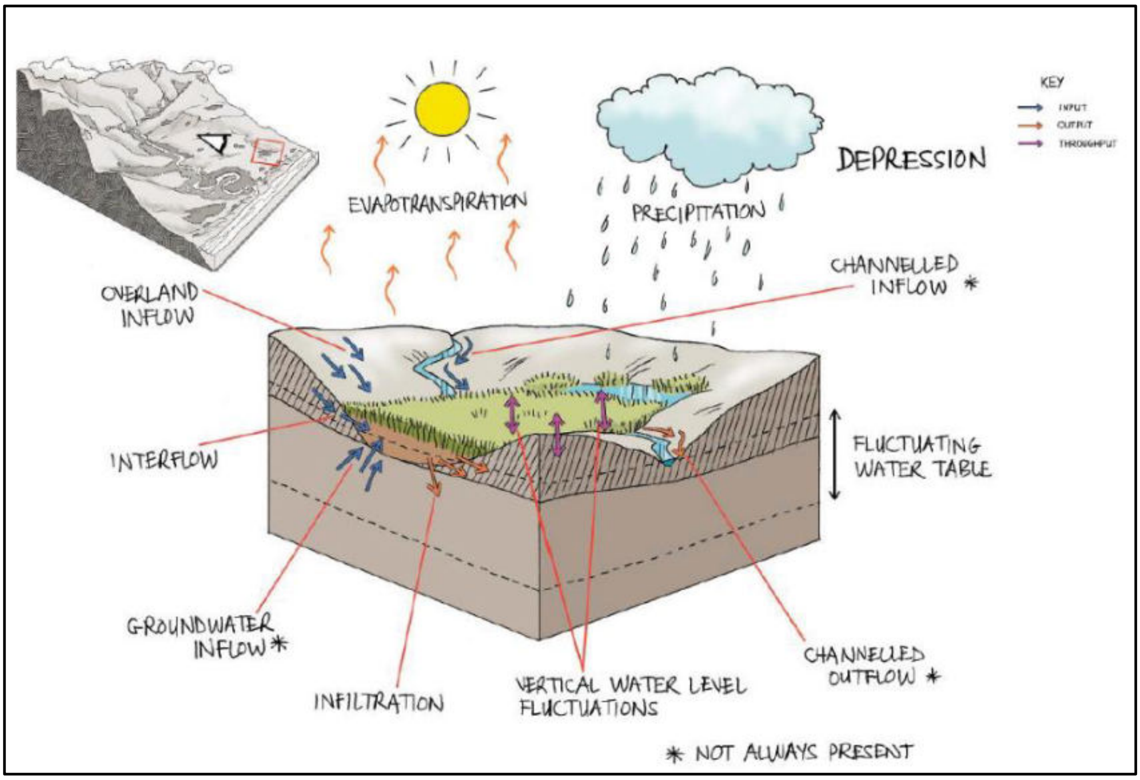


Figure 8: Schematic representations of a Depression Wetland

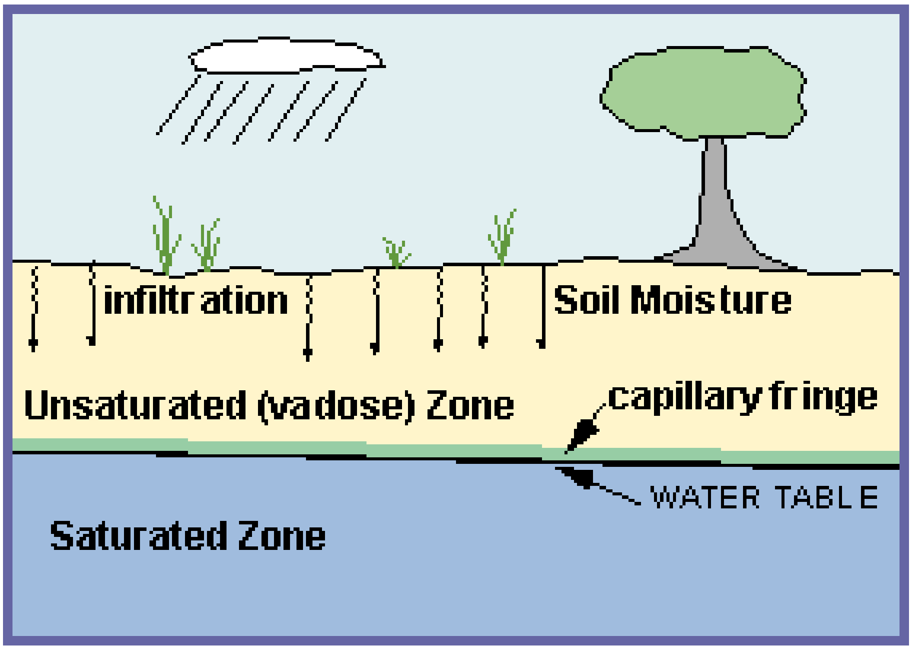


Figure 9: Schematic representation of soil moisture zones

9.4 Wetland Unit Setting

The Tswana Mine lies in an area which has generally low topography. The valley within which it is located slopes toward the PolfonteinSpruit and the linear gradient down the length of the mine is approximately 0.1%. Further details are shown in Table 8 below.

Table 8: Characteristics of the mine wetlands

Quaternary Catchment	River System	Wetland Type	Condition Rating	Water Management Area	Bioregion
D41A	Molopo - Orange	Artificial Depressions	Category Z/1	Crocodile (West) and Marico	Dry Highveld Grassland

The natural vegetation in the area is Carltonville Dolomite Grassland. (Type Gh 15). Due to the mining activities, the vegetation on the site is severely transformed but a list of indigenous terrestrial plant species found within the 500 m radius around the mine is given in Table 9.

Table 9: List of indigenous plant species.

SCIENTIFIC NAME	COMMON NAME	STATUS
Alectra sessiliflora	Verfblommetjies	LC
Aloe maculata	Common soap aloe	LC
Anthericum cooperi	Cooper's anthericum	LC
Aristida congesta	Buffalo grass	LC
Asparagus laricinus	Cluster-leaved asparagus	LC
Barleria macrostegia	Bush violet	LC
Berkheya radula	Stout perennial herb	LC
Bulbine angustifolia	Robust bulbine	LC
Centella Sp.	Centella	LC
Chamaecrista mimosoides	Dwarf cassia	LC
Commelina africana	Yellow commelina	LC
Corchorus asplenifolium	Prostrate shrublet	LC
Corchorus confusus	Slender perennial herb	LC
Crabbea angustifolia	Narrow-leaved prickle head	LC
Cryptolepis transvaalensis	Twining climber	LC
Cucumis zeyheri	Wild cucumber	LC
Cynodon dactylon	Kweek grass	LC
Dicoma anomala	Reclining dicoma	LC
Dicoma macrocephala	Prostrate herb	LC
Elephantorrhiza elephantina	Elephant's root	LC

SCIENTIFIC NAME	COMMON NAME	STATUS
Eragrostis Spp	Love Grass	Lc
Euphorbia inaequilatera	Milkweed	LC
Euphorbia striata	Milkweed	LC
Felicia muricata	White felicia	LC
Geigeria burkei	Vermeerbos	LC
Gomphocarpus fruticosus	Cotton milkweed	LC
Helichrysum aureonitens	Golden helichrysum	LC
Helichrysum nudifolium	Hottentot's tea	LC
Hermannia depressa	Creeping red hermannia	LC
Hermannia erodioides	Perennial herb	LC
Hibiscus pusillus	Dwarf hibiscus	LC
Hypoxis rigidula	Star flower	LC
Imperata cylindrica	Cottonwool Grass	LC
Ipomoea crassipes	Trailing Ipomoea	LC
Ipomoea obscura	Yellow morning glory	LC
Ipomoea plebeia	Annual twiner	LC
Jamesbrittenia aurantiaca	Cape saffron	LC
Lactuca inermis	Small marsh daisy	LC
Ledebouria marginata	Edge-leaved squill	LC
Leersia hexandra	Wild Rice Grass	LC
Lobelia erinus	Trailing lobelia	LC
Menodora africana	Balbossie	LC
Nidorella resedifolia	Stinkkruid	LC
Oxalis obliquifolia	Sorrel	LC
Pollichia campestris	Waxberry	LC
Polygala amatymbica	Dwarf polygala	LC
Scabiosa columbaria	Wild scabiosa	LC
Seersia lanceolata	Karee	LC
Sida dregei	Spiderlegs	LC
Solanum panduriforme	Bitter apple	LC
Thesium utile	Besembossie	LC
Wahlenbergia grandiflora	Giant bell flower	LC
Walafrida densiflora	Many flowered herb	LC

Note: LC = Least Concern

9.5 Wetland Functionality

The functionality of the wetlands was modelled with the WET-EcoServices tool. Because the wetlands are artificial and constitute a complex and variable mosaic of different sites it was considered rational to identify key sites which would be representative of their type and to model only those. The sites chosen are indicated in Figure 7 and details are provided in Table 10.

Both Versions 1 and 2 of WET-EcoServices were used but the results for present conditions were largely same from each. Therefore, the Version 2 results are presented in Table 11 and in **Error! Reference source not found.** as they display both Supply and Demand capabilities.

Table 10: Details of the three wetlands subjected to assessment.

Site	Area (Ha)	Wetland Type	Landuse
W1	11.2	Pit	Mining Area
W2	3.1	Depression	Mining Area
W3	0.98	Depression	Unmined Area

Table 11: Present ecosystem service delivery scores for the three wetlands assessed.

ECOSYSTEM SERVICE		Mine Pit W1	Depression W2	Depression W3
REGULATING AND SUPPORTING SERVICES	Flood attenuation	2.0	2.0	2.0
	Stream flow regulation	1.8	1.5	1.5
	Sediment trapping	2.0	2.3	2.3
	Erosion control	2.3	2.1	2.8
	Phosphate assimilation	*1.4*	1.8	2.0
	Nitrate assimilation	1.9	1.9	2.0
	Toxicant assimilation	1.5	1.6	1.7
	Carbon storage	1.0	0.3	1.0
	Biodiversity maintenance	1.7	1.7	1.7
PROVISIONING SERVICES	Water for human use	1.0	0.3	0.3
	Harvestable resources	0.0	0.0	0.5
	Natural Resources	0.0	0.0	1.3
CULTURAL SERVICES	Tourism and Recreation	1.0	0.3	0.3
	Education and Research	0.5	0.3	0.3
	Cultural and Spiritual	0.0	0.0	0.0
	Total Scores	18.1	16.0	19.5
	Average Scores	1.2	1.1	1.3
	Level of Threats	0.0	2.0	2.0
	Opportunities for Improvement	1.0	0.0	0.0

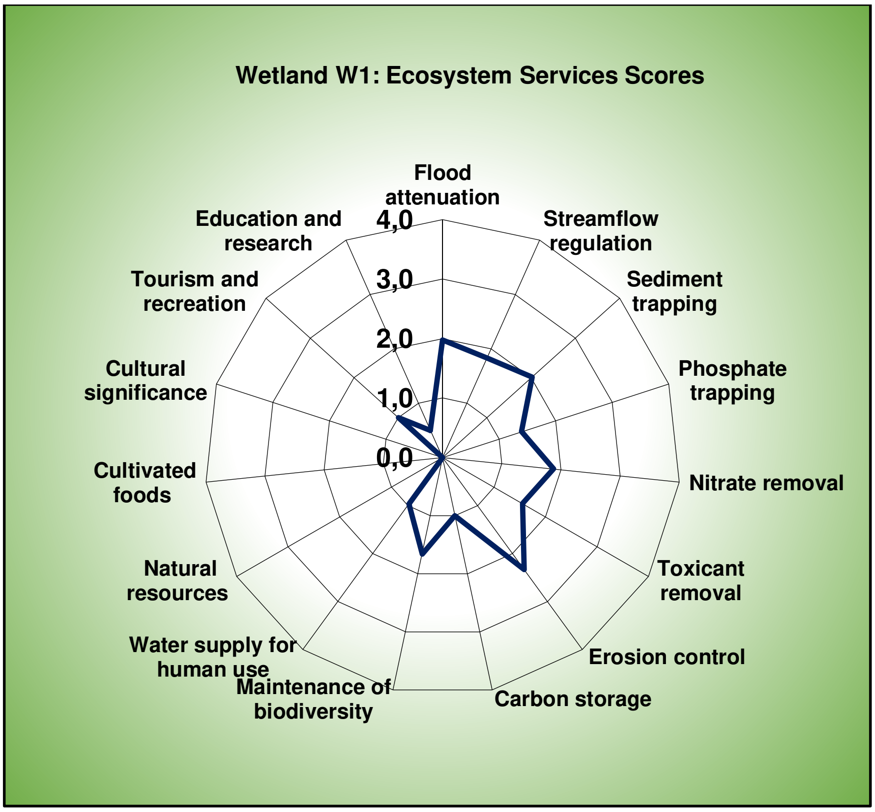


Figure 10: Ecosystem service delivery at Wetland W1

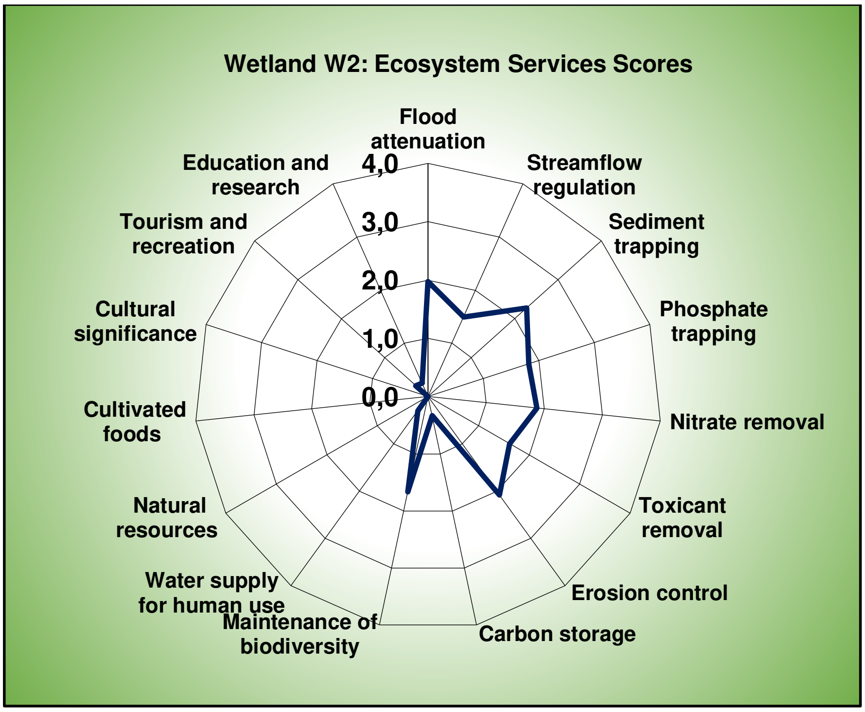


Figure 11: Ecosystem service delivery at Wetland W2

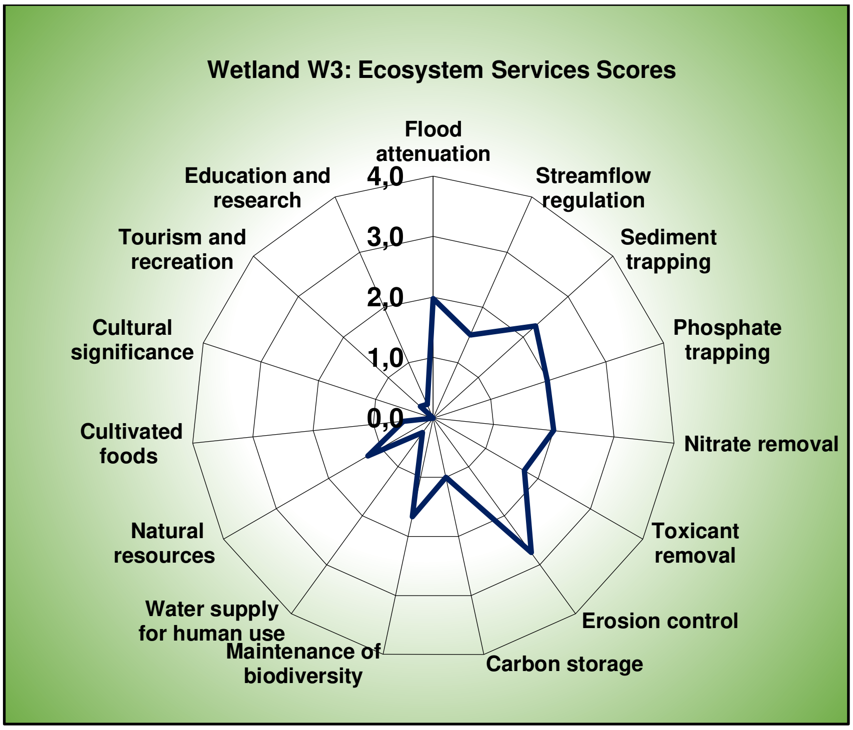


Figure 12: Ecosystem service delivery at Wetland W3

The WET-Ecoservices model indicates that the levels of ecosystem service delivery from the three wetlands are generally "Intermediate" to "Low". Even the higher scores obtained for services such as "Flood Attenuation", "Sediment Trapping" and "Erosion Control" are misleading since the figures are based on the vegetation cover in the sites but are meaningless as the sites generally have no inflows or outflows that leave the area. Wetland W3 does offer some benefit in the form of "Natural Resources" (provision of grazing for livestock) which the others do not offer.

9.6 Wetland Health

While the WET-Health tool would normally be used to determine the PES of the three wetlands, its required inputs cannot be met by the conditions at the sites since there are no relevant surface catchment features, either upstream or downstream. For this reason, an assessment of the PES is based on professional opinion. In doing so the following assumptions were made:

- Sites W1 and W2 are taken as being "natural", although it is known that they are an unnatural consequence of the mining operations.
- Site W3 is assumed to be natural but is impacted upon by livestock trampling and grazing.
- That the two mine sites and the depression wetland outside the mining area (W3) will remain approximately as they are for the next five years.

In addition, it is noted that the three sites can vary considerably between wet and dry years and so their ecological state will also vary accordingly. Therefore, they are rated to have a variable PES ranking. At times their functionality would suggest a PES Category A system but application of this score to an artificial wetland may be questionable. The results are shown in Table 12.

Table 12: Estimated Present Ecological State scores for the three assessed wetlands

Site	Ha	Hydrology		Geomorphology		Vegetation		PES Category	Potential PES Range
		Impact Score	Change Score and Trend	Impact Score	Change Score and Trend	Impact Score	Change Score and Trend		
W1	11.2	1.0	0.0 →	1.0	0.0 →	1.0	0.0 →	**B**	**B – C**
W2	3.1	1.0	0.0 →	1.0	0.0 →	1.5	0.0 →	**B**	**B - D**
W3	0.98	0.1	0.0→	0.2	0.0 →	1.5	0.0 →	**A**	**A - C**

9.7 Wetland Ecological Importance and Sensitivity

Because the wetland models are not able to properly assess the three sites, the EIS is also stated on the basis of professional opinion. It is believed that the sites have Moderately Low to Intermediate Ecological Importance as they are able to support aquatic biodiversity in a region which is very dry at times. See Table 13. Site W1 is able to function as a refuge at times when other systems are completely dry on the surface, and so act as a source of recolonisation for times of wetter conditions.

Table 13: Ecological importance and sensitivity ratings for the three assessed wetlands

Component Assessed	W1	W2	W3
Ecological Importance & Sensitivity	1.0	1.0	1.5
Hydrological/ Functional Importance	1.7	1.7	1.9
Importance of Direct Human Benefits	0.4	0.1	0.5
Overall Importance Score	**1.0**	**0.9**	**1.3**
EIS Class	**Moderately Low**	**Moderately Low**	**Intermediate**

10. IMPACT ASSESSMENT

The impacts considered below relate to the same types of wetlands as were considered for the functionality and ecological criteria, but include all sites and not just the three assessed. In the present case, the existence and activities of the mine imply that the avoid/prevent option may no longer be tenable for all activities. Therefore, the top layer of the Mitigation Hierarchy may have to be bypassed. However, through mitigatory measures, which are either currently being applied or are yet to be applied during the operational phase, it should not be necessary to move to the lowest level of the hierarchy which calls for off-site mitigation, including geared offsetting or other related measures.

The relevant impacts under present consideration are as follows:

- Contamination of wetlands through spillage of hydrocarbons such as fuel and oils. This impact is one which should not happen and so is in the “Avoid/Prevent” level of the hierarchy,
- Future loss or change of wetlands as a result of mining activities. This impact is unavoidable and is in the “Repair/Restore” level of the hierarchy,
- Abstraction of water for uses in the mine such as dust suppression. This impact is in the “Minimise” level of the hierarchy, and
- Grazing by livestock at site W3 is reducing the plant biomass there and is probably also reducing plant diversity. This impact, although taking place in the study area, is not the responsibility of Lafarge. It would belong to the “Minimise” level of the hierarchy.

In order to rate the impacts a numeric scoring system has been used, and is presented in Annexure A. The results are shown in Table 14. All the impacts are negative and have already taken place to at least some degree, although more will happen in the future. Means of addressing the remaining impacts are given in Table 15.

Table 14: Assessment of impacts on the wetland in the mining area

Mitigation	Environmental Impact	Consequences of the impact	Spatial extent	Probability	Reversibility	Resource Loss	Duration	Severity/Intensity / Magnitude	Significance
Without Mitigation	Contamination of wetlands through spillage of hydrocarbons such as fuel and oils	Hydrocarbons are toxic and could lead to loss of aquatic biodiversity.	2	2	2	3	1	3	30 Negative Low
With Mitigation			1	1	2	2	1	2	14 Negative Low
Without Mitigation	Future loss of wetlands as a result of mining activities.	Loss of wetland will result in loss of aquatic biodiversity. (Note: Depression wetlands might be replaced by pit wetlands which will be expected to have a longer persistence.)	2	4	3	1	3	3	39 Negative Medium
With Mitigation			2	4	2	1	3	3	36 Negative Medium
Without Mitigation	Abstraction of water for uses in the mine such as dust suppression.	Water abstraction will result in a lowered water surface and loss of wetland space.	1	2	1	2	3	1	9 Negative Low
With Mitigation			1	1	1	1	2	1	7 Negative Low
Without Mitigation	Grazing by livestock in the upper section is reducing the plant biomass there and may be reducing plant diversity.	Biodiversity and functionality are reduced.	1	4	1	2	2	2	20 Negative Low
With Mitigation			1	1	1	1	1	1	5 Negative Low

Table 15: Mitigatory measures for the wetlands in the mining area

Listed Impact	Wetlands Affected	Mitigatory Measures
Contamination of wetlands through spillage of hydrocarbons such as fuel and oils	Pits and Depressions	• It must be ensured that all hydrocarbons are stored in designated areas that are sign-posted, lined with an appropriate barrier and bunded to 110% of the volumes of liquid being stored to prevent the bio-physical contamination of the environment (ground and surface water and soil contamination). • MSDS' for hydrocarbon materials must be easily accessible on site and the relevant personnel are to be familiar with their content; • All stationary vehicles, equipment and receptacles of hydrocarbon waste must be supplied with drip trays to prevent spills and soil contamination; • All refueling of vehicles must be done in the workshop area or in a designated fueling area; • When decanting hydrocarbons, drip trays must be used. Drip trays are to be cleaned out daily and material collected disposed of as hydrocarbon waste; • Should a spillage occur, absorbent materials such as sawdust (or appropriate alternative as supplied in spill kit) must be spread on the affected areas. Soil is not considered the preferred absorbent material, and alternatives are preferred. The contaminated soil must be lifted and placed within an impermeable container or a high-density plastic bag and disposed of at a recognised disposal site; • Any contaminated water associated with project activities must be contained in separate areas or receptacles such as Jo-Jo tanks or water-proof drums, and must not be allowed to enter into natural drainage systems; • An Incident Report must be completed for all spills; • Significant spills must be reported to the Department of Water and Sanitation and the Department of Economic Development, Tourism and Environmental Affairs. Contamination

Listed Impact	Wetlands Affected	Mitigatory Measures
		assessments must follow significant spillage events to determine specific risks, impacts and mitigation actions; • Staff dealing with these materials / substances must be aware of their potential health and environmental impact and follow the appropriate safety measures; • Spill kits must be clearly marked and visible when utilising hazardous or dangerous materials to ensure that all spills are immediately contained and removed; • All vehicles and equipment shall be kept in good working order to reduce the likelihood of oil leaks occurring; • All stationery vehicles must be supplied with drip trays to prevent soil contamination; and • Generators and fuel storage bowsers must be contained within drip trays or be appropriately bunded.
Future loss of wetlands as a result of mining activities.	Depressions	Loss of wetland area is inevitable as the mine is operated. Some measure of mitigation may be achieved through leaving worked out pits in a condition that will hold water at least some of the time so that wetlands may have some change of becoming established.
Abstraction of water for uses in the mine such as dust suppression.	Pits	This is a minor impact and is only likely to become an issue during periods of exceptionally low rainfall. Mitigation may be achieved by means of drawing water from different mine pits in a rotational fashion
Grazing and trampling by livestock is reducing the plant biomass there and is probably also reducing plant diversity.	Site W3 only	This impact is taking place but the removal of the cattle will be controversial as the wetland is located on community land outside the mine. Since there is minimal impact on the hydrology of the site it would be acceptable to leave the *status quo*.

11. CONSIDERATION OF BUFFERS

While it is normal to consider buffers around wetlands in order to protect them from local or catchment impacts, it is unlikely that provision of buffers would be of any benefit to the wetlands within the mine area. There are no incoming or outgoing watercourses and so the wetlands are all endorheic. The mining activities tend to leave unworked spaces in a network around the various pits and so the wetlands are largely separated into compartments, which may or may not be joined at times of high rainfall. These unworked spaces do have some buffering effects and so formal provision of buffers need not be recommended.

The wetland areas outside of the mine are on community land used for grazing of livestock. It is not possible to provide buffers in such areas, however, should any form of developed landuse ever take place there, then buffers should be developed as may be appropriate at the time.

12. CONSIDERATION OF RISKS

In order to assess the risks posed to the wetlands that are present in and around the mine, the DWS Risk Assessment Matrix (DWS, 2014) was used. The outputs from the matrix are shown in Table 16.

It is shown that the risks arising from possible spillage or leakage of hydrocarbons, and from loss of wetlands from future mining activities are both rated as "Moderate" before any mitigatory measures are taken. While the risks associated with hydrocarbons can be managed (See Table 15) and be significantly reduced or even avoided, any losses due to future mining cannot be remediated to any great extent. Such losses must be accepted but the following must be considered:

- *Loss of wetland as a result of mining.* The area is being operated under an authorisation and so the excavations are a part of the operator's core business and must be accepted as being inevitable,
- *Toxicity of the mined material.* The extracted limestone is non-hazardous and so will not lead to contamination or pollution of the area and the Polfontein Spruit which flows from it,
- *Recovery of wetland sites.* The mine pits will in the future fill with water to some extent as has already happened with the existing worked-out pits. These areas will develop wetland habitat as has happened before,
- *Status of the wetlands*. The wetlands in the mining area are, with one possible exception, artificial. In the distant future it is possible that they will all cease to exist but no time scale for such change can be provided.

Table 16: Assessment of current risks to the wetlands in the study area

With/ Without Mitigation	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk rating	Confidence Level
Pre- mitigation	Contamination of wetlands through spillage of hydrocarbons such as fuel and oils	Hydrocarbons could be spilled or leaked from the workshop and vehicle servicing facilities or from leakage from vehicles or machines working in the mine pits.	Pollution of aquatic ecosystems	3	7	8	56	MODERATE RISK	90
Post- mitigation				2,25	5,25	8	42	LOW RISK	90
Pre- mitigation	Future loss of wetlands as a result of mining activities	Loss of wetland habitat	Loss of wetland habitat	3,5	10,5	10	105	MODERATE RISK	90
Post- mitigation				2,75	7,75	10	77,5	MODERATE RISK	90
Pre- mitigation	Abstraction of water for uses in the mine such as dust suppression	Lowering of the ware surface in old mine pits	Loss of habitat on the wetland margins	1,75	4,75	9	42,75	LOW RISK	60
Post- mitigation				1	4	9	36	LOW RISK	60
Pre- mitigation	Grazing by livestock at site W3 is reducing the plant biomass and is also reducing plant diversity	Grazing and trampling of the wetland results in damage to the plant diversity and can result in invasion by alien weed species	Loss of wetland habitat	1,5	4,5	10	45	LOW RISK	70
Post- mitigation				1	4	10	40	LOW RISK	70

13. RESULTS FOR THE POLFONTEIN SPRUIT IN THE TSWANA MINE AREA

13.1 Study Area

The 500 m radius around the mining right area includes a section of the Polfontein Spruit. While a riverine (lotic) system usually has a Regulated Area of 100 m in width, there are two reasons for including the spruit within the project study area. They are as follows:

- There is reason to believe that the Polfontein Spruit may have an associated floodplain wetland or other wetland type in places; and
- The mining right area approaches to 100 m of the channel in places.

The wetlands in the vicinity of Tswana Mine as shown in Figure 4 and `further detail of the Polfontein Spruit area is shown in Figure 13.

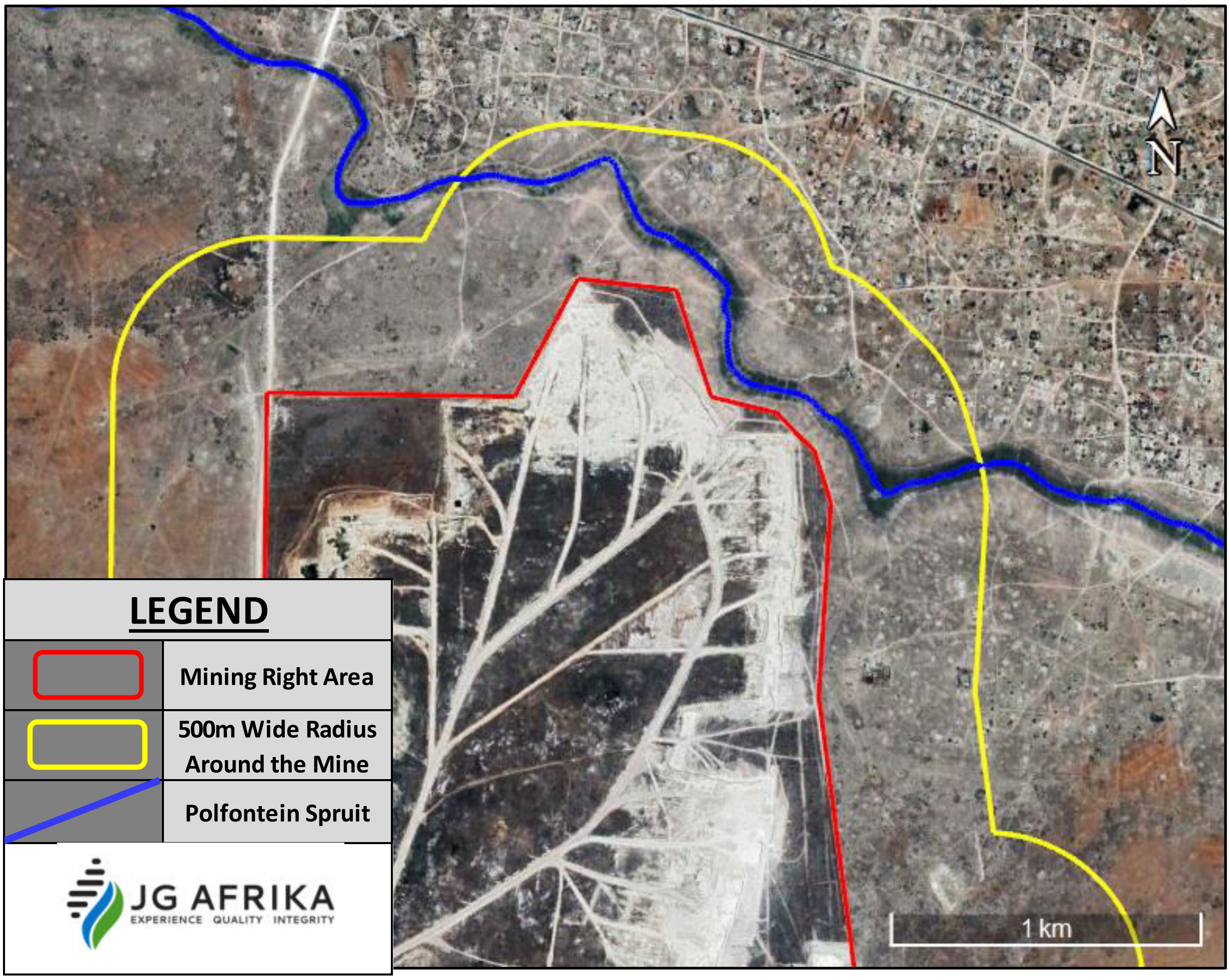


Figure 13: Northern section of the Tswana Mine showing the proximity of the Polfontein Spruit

13.2 Wetland Delineation and Description of Conditions

The Polfontein Spruit flows past the Tswana Mine in a southeast to northwest direction. The source is located some 7.5 km upstream of the mine and the stream eventually joins the Molopo River some 45 km away near Mafikeng. For the purposes of this study, a section of approximately 3.3 km in length, enclosed by two convenient roads, and which included all of the channel study area, was delineated. It was found in practice that the soils did not offer any information as no mottling along the edges of the system could be found. The auger holes produced a heavy dark grey to black organic (not peat) and clay-rich soil. DWAF (2008) states as follows:

> **Where modifications of the generic approach may be necessary:**
>
> In areas where there are:
> - highly organic soils, such as peat;
> - very recent alluvial deposits (such as recent alluvial fans in wetlands);
> - very iron-poor soils, such as on sandy aquifers/old marine sediments; or
> - very free-draining soils, such as Dolomitic or Quartzitic material;
>
> there may be a requirement to slightly modify the way that the indicators are interpreted.
>
> For example, in DOLOMITE and QUARTZITE areas, the soils are extremely free draining – usually the soil water drains very deep (often directly to the deep groundwater). Thus the water does not generally stay in the soil long enough for hydric indicators to develop. In these cases, the standard Landscape Position, Soil Form and Vegetation indicators can be applied, but mottles may be absent in top 50cm. Instead one should examine for high organic carbon (peat) in the soil as a redoxymorphic indicator of wetland soils. The seasonal and temporary wetland zones are often constricted or absent in these settings.

Since region where the factory is located is strongly dolomitic in terms of its geology the above condition applies. It was noted that wetness was commonly found at depths of 50 cm to 60 cm. It is also apparent that the channel area, with its wetter soils, has been used for production of crops in dry years and so soil structures will have been disturbed.

Delineation was then done primarily on the basis of the vegetation observed with a wetland facultative species of *Centella* being used as a key marker species. See Figure 14. However, use was also made of low level (drone) aerial photography and video material as shown in Plate 7 and Plate 8. The area shown in Wetland Map 5 is also indicated, however, as it includes built-up spaces, must be regarded as being partially inaccurate.

13.3 Wetland Unit Identification

The Polfontein Spruit would appear to be either a Floodplain or a Valley Bottom System. See

Table ***1***. However, no trace of oxbow lakes and other such floodplain features are apparent either in the study area or further away, and so the option of a floodplain is eliminated. Excavations in the channel area have disrupted any natural channel that may have existed and so the system, although now pitted, has no discernible channels of any significant length.

Plate 7: Aerial image of a section of the Polfontein Spruit

Plate 8: Aerial image of a section of the Polfontein Spruit

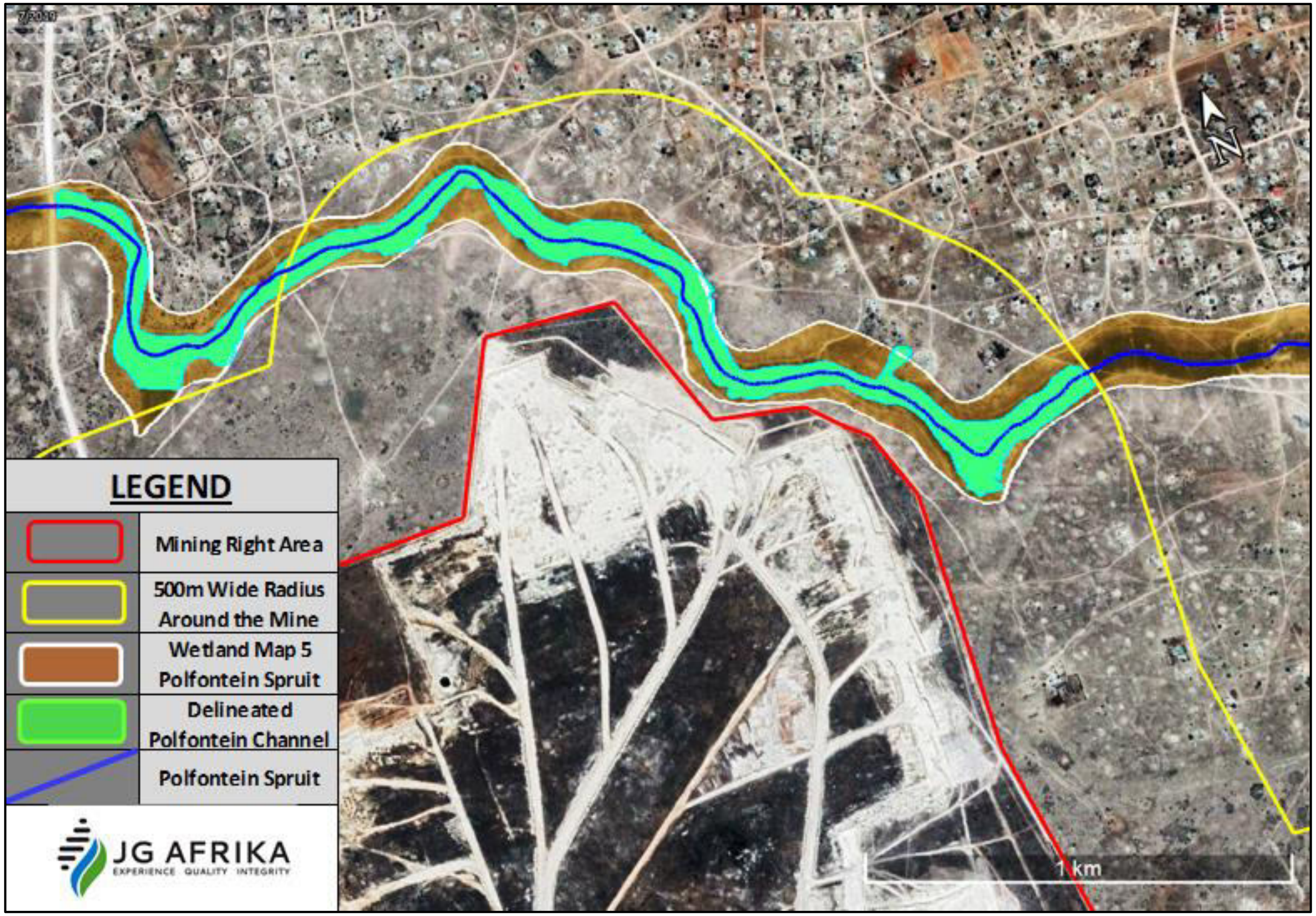


Figure 14: Northern section of the Tswana Mine showing the Polfontein Spruit channel

It is therefore thought that, in its natural state, the Polfontein Spruit in the study area was an Unchannelled Valley Bottom with some lateral flow inputs from either side, but has now become a Channeled Valley Bottom (CVB) and is classified as such in Wetland Map 5. The same conditions exist for considerable distances both upstream and downstream of the site and so the study area may be considered to be representative of a longer section of the Polfontein Spruit.

The natural vegetation in the area is Carltonville Dolomite Grassland (Type Gh 15). Due to the previous use of the area for agriculture, as well as grazing by livestock, the vegetation in the channel is severely transformed and now consists primarily of grasses such as Love Grass (*Eragrostis Spp.*), Kweek grass (*Cynodon dactylon*), and Wild Rice Grass (*Leersis hexandra*) with a few sedges such as *Juncus effusus.* A list of indigenous terrestrial plant species found in the general area is given in Table 9.

Plate 9: Excavated pit in the Polfontein Spruit with piles of blocks indicated

13.4 Wetland Unit Setting

The Polfontein Spruit has been severely impacted upon by human activities. It is apparent that the channel is far from natural as almost its entire length has been either used for agriculture in the past or has been deeply pitted. It is assumed that the pits were excavated for the purpose of providing surface water for livestock, but it is also clear that excavation for extraction of material for block making is still being done, although not on a large scale. See Plate 9.

The Tswana Mine lies in an area which has generally low topography. The Polfontein Spruit is the only watercourse in the area which has permanent or semi-permanent water even if only very little. A tributary channel flows in from the north and enters the main channel opposite the mine. It is now almost obliterated in the built-up area of Bodibe. The linear gradient of the channel down the study section is approximately 0.5%. Further details are shown in Table 17.

Table 17: Characteristics of the Polfontein Spruit

Quaternary Catchment	River System	Wetland Type	Wetland Map 5 Condition Rating	Water Management Area	Bioregion
D41A	Molopo - Orange	Channelled Valley Bottom	D/E/F	Crocodile (West) and Marico	Dry Highveld Grassland

13.5 Wetland Functionality

The functionality of the wetland was modelled with the WET-EcoServices tool. The area modelled included the CVB wetland from a road crossing at the upstream edge of the study area down to a second road crossing downstream of the study area boundary. See Figure 14.

Both Versions 1 and 2 of WET-EcoServices were used but the results for present conditions were largely the same from each. Therefore, the Version 2 results are presented in Table 18 and in Figure 15 as they display both Supply and Demand capabilities.

Table 18: Ecosystem service delivery scores for the study section of the Polfontein Spruit

ECOSYSTEM SERVICE		Supply	Demand	Balance of Supply/Demand
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,4	0,0	+1.4
	Stream flow regulation	3,0	0,0	+3.0
	Sediment trapping	2,8	0,0	+2.8
	Erosion control	0,8	2,7	-1.9
	Phosphate assimilation	2,6	1,0	+1.6
	Nitrate assimilation	2,7	1,0	1.7
	Toxicant assimilation	2,5	2,0	+0.5
	Carbon storage	1,1	0,0	+1.1

ECOSYSTEM SERVICE		Supply	Demand	Balance of Supply/Demand
	Biodiversity maintenance	2,5	2,5	0.0
PROVISIONING SERVICES	Water for human use	1,5	0,3	+1.2
	Harvestable resources	1,5	0,0	+1.5
	Food for livestock	3,0	2,0	+1.0
	Cultivated foods	2,5	0,7	+1.8
CULTURAL SERVICES	Tourism and Recreation	0,0	0,0	0.0
	Education and Research	0,8	0,0	+0.8
	Cultural and Spiritual	0,0	0,3	-0.3

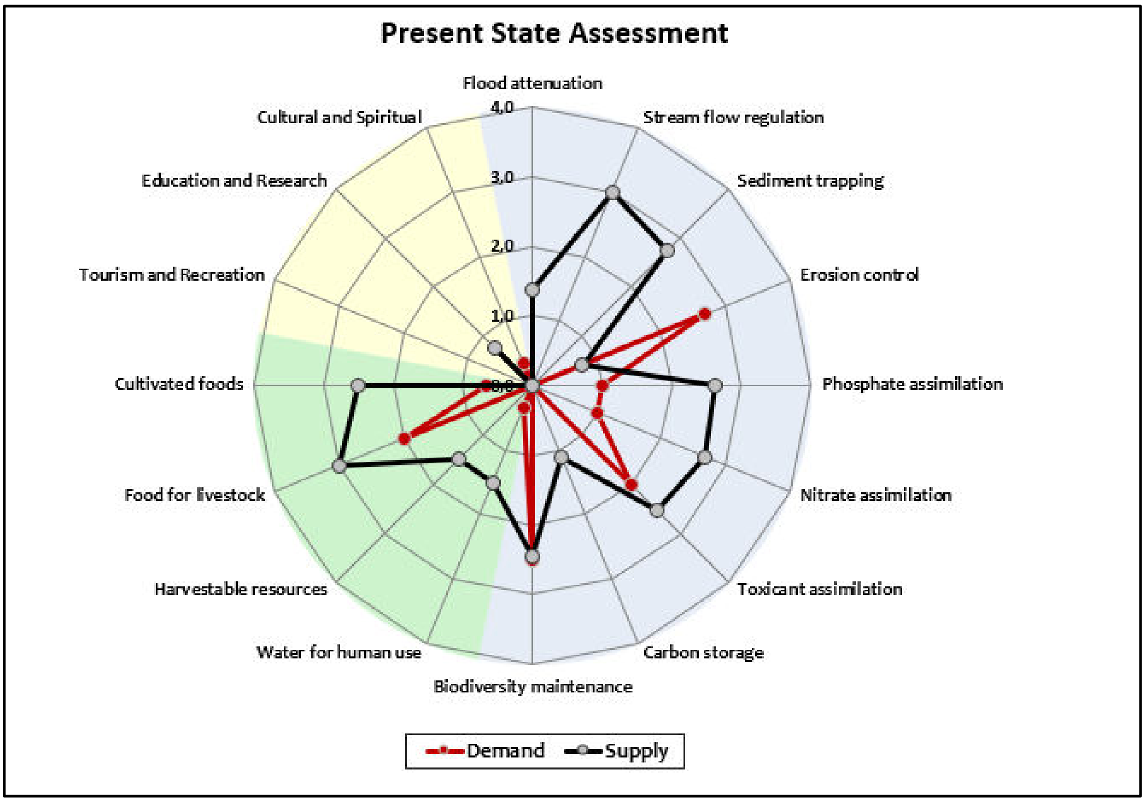


Figure 15: Ecosystem Service delivery scores for the study section of the Polfontein Spruit

The results indicate that the Polfontein Spruit has Moderately High ecosystem service delivery capability in relation to the following Stream flow regulation:

- Sediment trapping,
- Phosphate assimilation,

- Nitrate assimilation,
- Toxicant assimilation,
- Biodiversity maintenance,
- Food for livestock, and
- Cultivated foods.

Delivery levels are Moderately Low for the following:

- Flood attenuation,
- Erosion control, and
- Carbon storage.

The lack of functionality in those services for the above three services is attributed to the general degradation of the system as a result of past agricultural activity and the present grazing by livestock. These factors are suppressing the wetland vegetation and so surface roughness is reduced and organic matter is removed.

Delivery levels are Low for the following:

- Tourism and Recreation;
- Education and Research; and
- Cultural and Spiritual.

The probable explanation for the above lies with the general remoteness of the site and its location on a small tributary watercourse.

13.6 Wetland Health

The Present Ecological State (PES) of the wetland was modelled with the WET-Health tool. Only a single HGM is recognised although a very small lateral wetland enters the channel near its lower end. See Figure 7 and Table 19.

Table 19: Present Ecological State score for the Polfontein Spruit

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation	
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	22	100	7,0	-1	4,5	-1	8,7	-1
Area weighted impact scores			7,0	-1,0	4,5	-1,0	8,7	-1,0
PES Category			**E**	↓	**D**	↓	**F**	↓
Overall PES Category for the Polfontein Spruit			**Score**		**6.8**	**Category**		**E**

The result of the PES modelling is similar to that listed in Wetland Map 5.

13.7 Wetland Ecological Importance and Sensitivity (EIS)

The modelling of the EIS was derived from the WET_Ecoservices Version 1 tool outputs. No listed red data species were observed and a search of the Animal Demography Unit Virtual Museum indicated no species of concern. The results are indicated in Table 20.

Table 20: Ecological Importance and Sensitivity of the Polfontein Spruit

Ecological Importance	Score	Confidence
Biodiversity support	0,00	3,00
Presence of Red Data species	0,00	3,00
Populations of unique species	0,00	3,00
Migration/breeding/feeding sites	0,00	3,00
Landscape scale	0.8	2.6
Protection status of the wetland	0,00	2
Protection status of the vegetation type	0,00	2
Regional context of the ecological integrity	2,00	2
Size and rarity of the wetland type/s present	1,00	3,00
Diversity of habitat types	1,00	4,00
Sensitivity of the wetland	1,8	2,3
Sensitivity to changes in floods	0,50	2,00
Sensitivity to changes in low flows/dry season	3.0	3,00
Sensitivity to changes in water quality	2,00	2,00
ECOLOGICAL IMPORTANCE & SENSITIVITY	**1,8**	**3.0**

The finding is that the site is of Intermediate EIS was not unexpected since it has been subject to numerous impacts in the past. Adequate protection from ongoing impacts could raise the score substantially.

14. IMPACT ASSESSMENT

The impacts considered below relate primarily to the section of the Polfontein Spruit as was considered for the functionality and ecological criteria. However, as the study section is similar to the channel sections both upstream and downstream of the site in terms of its characteristics, certain of the impacts may be seen as also taking place over a far wider area.

The relevant impacts under present consideration are as follows:

- Close proximity of the mine edge to the wetland edge. The mining right area lies well within the 500 m radius around the Polfontein Spruit channel, and at a few points, is within 100 m of the delineated edge of the system. However, the actual mine working edge is only 75m from the wetland edge at one point and 100 m at another. See Figure 16. Observations both on the ground as well as in the figure indicate that the floor of the pit is at an elevation of approximately 1.5 m lower than the water surface in the spruit. It is therefore theoretically possible that the mine is creating a cone of depression in the water table which would be affecting the channel. There is, however, no discernible impact on the vegetation either in the intervening area or on the two sides of the channel.

- The ongoing excavation of pits in the wetland to either provide open water or to extract material for block making.
- Disturbance of the wetland vegetation as a result of the grazing of livestock in the area.
- Possible soil erosion at the site of the outfall of pumped mine water.

In order to rate the impacts a numeric scoring system has been used, and is presented in Annexure A. The results are shown in Table 22. All the impacts are negative and all have already taken place. However, some have self-mitigated to the extent that they may now be considered to be of "Medium" consequence. Means of addressing the remaining impacts are given in **Error! Reference source not found.**.

Table 21: Mitigatory measures for the wetland outside of the cement factory property

Listed Impact	Mitigatory Measures
Close proximity of the mine edge to the wetland edge. The mining right area lies well within the 500 m radius around the Polfontein Spruit channel, and at a few points, is within 100 m of the delineated edge of the system. In terms of the Mitigation Hierarchy, this impact is regarded as "Minimise" should the mining right area ever be extended.	• The outer edges of the areas that are close to the must be stabilized and be planted with a grass such as Kweek (*Cynodon dactylon*). • The mining right area footprint must not, even if it is extended at some time in the future, move closer than 100m from the edge of the delineated Polfontein Spruit wetland at any point.
Disturbance of the wetland in the lower area as a result of past draining and agricultural activities.	Mitigation of these two impacts would entail a loss of resources presently available to members of the Bodibe Community. However, the impacts are not caused in any way by Lafarge and the company has no responsibility for them. Therefore, no mitigatory measures are proposed here.
Grazing by livestock in the upper section is reducing the plant biomass there and is probably also reducing plant diversity.	
Soil erosion at the outfall point of water that is pumped from the mine.	• The ground at the outfall site must be armoured against soil erosion. A structure such as a Reno Mattress is suggested but the necessary structure must suit conditions at the outfall point.

Figure 16: Northern edge of the present mine at the two points closest to the Polfontein Spruit

Table 22: Assessment of impacts on the wetland in the study area

Mitigation	Environmental Impact	Consequences of the impact	Spatial extent	Probability	Reversibility	Resource Loss	Duration	Severity/Intensity / Magnitude	Significance
Without Mitigation	Close proximity of the mine edge to the wetland edge.	The proximity of the mine to the wetland could conceivably affect the hydrology of the channel although there is no presently discernable effect	2	2	3	2	3	1	12 Negative Low
With Mitigation			2	1	2	1	3	1	9 Negative Low
Without Mitigation	The ongoing excavation of pits in the wetland	The degradation would have reduced wetland condition and functionality.	3	4	3	3	3	3	48 Negative Medium
With Mitigation			3	4	2	2	3	2	28 Negative Medium
Without Mitigation	Disturbance of the wetland vegetation as a result of the grazing of livestock in the area.	Biodiversity and functionality are reduced.	3	4	2	3	3	2	30 Negative Low
With Mitigation			3	4	1	2	3	2	26 Negative Low

15. CONSIDERATION OF RISKS

In order to assess the risks posed to the wetland which passes by the mine, the DWS Risk Assessment Matrix was used. It is to be noted that, although there has been mining activity at the site for some 40 years, the mine only approached to within 100 m of the delineated channel in 2016. However, as noted in Section 14 above, there appear to be no visible impacts on the wetland as a result of the incursion. Therefore, it is considered that, if the proposed mitigatory measures are applied, there are no new risks to the Polfontein Spruit system. The outputs from the matrix are shown in Table 23.

The risks posed by the excavation of pits in the channel, and the overgrazing by livestock, are not assessed as they are not the responsibility of Lafarge, and the company has no mandate to address them.

16. CONSIDERATION OF BUFFERS

The Polfontein Spruit passes by the northern edge of Tswana Mine area and, in that section, the spruit is fully enclosed by the 500 m radius around the mining right area. A part of the mining right area also lies within 100 m of the delineated wetland edge with the mine being within that distance at two points. Despite this there appears to be minimal, if any, impact on the wetland system. In **Error! Reference source not found.** it is recommended that the mining right area, if ever to be enlarged, approach no closer than 100 m from the delineated edge of the wetland and so this distance is recommended as a general buffer for the site. The purpose of the buffer strip is to ensure that the mine does not have any further effect on the Polfontein Spruit, which is already impacted upon by various agricultural and pastoral activities originating from the Bodibe Community.

In regard to future development on the northern (Bodibe) side of the spruit it is not possible to say what could happen. At present the area is held open for grazing of livestock but it is possible that the residential development could spread toward the spruit and so encroach on present "buffer "area. It is also possible, although unlikely, that the spruit wetland could again be used for growing crops in the event of a dry climatic spell. These issues cannot be addressed at present and are, in any event, not the responsibility of Lafarge.

Table 23: Assessment of current risks to the Polfontein Spruit

With/ Without Mitigation	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk rating	Confidence Level
Pre- mitigation	The mine edge is within 100 m of the wetland edge at two points.	The proximity of the mine to the wetland could conceivably affect the hydrology of the channel although there is no presently discernible effect.	The Polfontein Spruit could be deprived of some water.	**1,25**	**5,25**	**10**	**52,5**	**LOW RISK**	**80**
Post-mitigation				**1**	**4**	**10**	**40**	**LOW RISK**	**80**

17. CONCLUSION AND RECOMMENDATIONS

17.1 Background

The Lafarge Tswana Limestone Mine is undergoing a WULA process in order to bring its operations into compliance with current legislation. A part of the process calls for assessment of wetlands in the relevant area and this document has undertaken such an assessment. It is to be noted that the application is not linked to further development of the mine itself but merely to legislative compliance for activities which are taking place currently. Prior to the development of the mine there is little evidence for any wetlands in the area, other than the Polfontein Spruit. See Figure 6. The operation of the mine has resulted in the creation of a number of artificial wetlands which have been classified as being Depression Wetlands. However, as further areas within the mining right area are opened up for mineral extraction many of these wetlands may be lost or will be changed from their present state into mine pit wetlands. The exact extent of the changes cannot be foreseen at the present time but there will still be a net gain of wetland area at the end of the operational life of the mine.

The Polfontein Spruit, which flows by the northern end of the mining right area, is severely degraded as a result of the channel having been used for agricultural purposes in the past and there being ongoing of excavation activities within it. It is not clear of the exact reason for the excavations but it is thought that they provide surface water for livestock in dry times, and that they also provide material for block manufacturing. The areas affected in this way are large and further impacts come from overgrazing of the area by livestock. The wetland is classified in Wetland Map 5 as being in PES Category D/E/F and this is supported by assessment done in the course of this study.

17.2 Management / Rehabilitation Measures Proposed

Despite the fact that the wetlands within the mining right area are not natural, but were created by the excavation activities within the mine, impacts, existing or potential, in the mining right area are listed below and mitigatory measures are detailed in Table 15.

- Contamination of wetlands through spillage of hydrocarbons such as fuel and oils. This impact is one which should not happen and so is in the avoid/prevent level of the hierarchy;
- Future loss of wetlands as a result of mining activities. This impact is unavoidable and is in the repair/restore level of the hierarchy;
- Abstraction of water for uses in the mine such as dust suppression. This impact is in the minimise level of the hierarchy; and
- Grazing by livestock at site W3 is reducing the plant biomass there and is probably also reducing plant diversity. This impact, although taking place in the study area, is not the responsibility of Lafarge. It would belong to the “Minimise” level of the mitigation hierarchy.

Since the Polfonteinspruit, which is a natural feature of the landscape, is outside the mining area, it is not expected that the operators will be causing mine-related impacts there. The mine appears to be having little effect on the spruit despite being within 100 m of the delineated boundary in places. It is therefore recommended that the edge of the workings be stabilized and grassed in those areas. It is also recommended that, should the mining right area ever be expanded in the future, that it not be closer than 100 m from the delineated edge of the Polfontein Spruit at any point. In this way a buffer strip may be created on the southern side of the spruit.

Expansion of the built-up area of Bodibe in a direction toward the spruit may happen in the future but for the moment the area is held open for livestock grazing and so some buffering is happening. It is not known if a dry climatic spell might lead to the area once again being cultivated for food crops but nothing can be done about it for the present.

17.3 Conclusion

This document has been prepared in support of a Water Use Licence Application in terms of the National Water Act (Act No. 36 of 1998) by LafargeHolcim for its Tswana Mine operation. The application is for 21 c and i activities relating to the Polfonteinspruit. The wetlands within the mine area have been assessed in terms of their functionality and ecological condition and the finding has been that the mine has created extensive new (artificial) wetlands in an area that was previously almost entirely dry. The new wetlands are increasing but some may be lost or changed as the mine goes on with its operations. This is, however, not linked in any way to the WULA process but is documented merely as a record of current circumstances.

A second, but natural wetland which is listed in the NFEPA and Wetland Map 5 databases is the Polfontein Spruit which lies to the north of the mine. This system is severely degraded by past and present agricultural and pastoral activities emanating from the nearby Bodibe settlement but is not being affected by the mine although surplus mine water is to be pumped in to it at times of high rainfall. Since the surplus mine water is unlikely to be contaminated, it is most improbable that the transfer will have any adverse effect on the spruit although care must be taken at the outfall site to avoid causing soil erosion.

Lafarge has recognised the need to protect the wetlands under its care, and relevant studies, documentation, and planning have been undertaken. It is the opinion of the specialist that the Polfonteinspruit will not be adversely affected by the water transfer and so it is recommended that the requisite legal procedures for the Water Use Licence may proceed.

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Annexure A: Scoring System Used to Rate Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		

1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible, rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.**		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Mitigation

In terms of the assessment process the potential to mitigate the negative impacts is determined and rated for each identified impact and mitigation objectives that would result in a measurable reduction or enhancement of the impact are taken into account. The significance of environmental impacts has therefore been assessed taking into account any proposed mitigation measures. The significance of the impact "Without Mitigation" is therefore the prime determinant of the nature and degree of mitigation required.