ASSESSMENT OF TWO WETLANDS IN THE VICINITY OF THE LAFARGE CEMENT FACTORY IN LICHTENBURG

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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
By Author	Wetland Ecologist	Jake Alletson		March 2022
Checked by	Executive Associate	Phillip Hull		March 2022
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1. INTRODUCTION

The Lafarge Industries South Africa (Pty) Ltd (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. In addition to the WULA application, the company has been served with a Notice of Intention to issue a Compliance Notice in regard to failure to comply with sections of the National Environmental Management Act (Act No. 107 of 1998 as amended) (NEMA) at its cement factory site in Lichtenburg (See Section 2 below). Lafarge has responded to the Notice by undertaking a number of stipulated actions including the appointment of a wetland specialist to assess the conditions at the site and to propose measures to remediate the impacts on the wetland which lies adjacent to the factory. JG Afrika (Pty) Ltd was appointed to undertake a specialist survey and compile a report (JG Afrika, 2021) on a suite of management recommendations, which was issued in April 2021. That document is in the process of being reviewed by the Department of Forestry, Fisheries and Environment ("DFFE") and Lafarge awaits a response to authorise Lafarge to proceed with the rehabilitation. However, there is also need under the National Water Act (Act No. 36 of 1998) to licence the activities by means of a Water Use Licence and this study and report is a part of that process. It draws on material from the earlier investigations but considers the wetlands at the factory site in further detail. A further study and report (JG Afrika, 2022*)* will address the wetlands in the vicinity of the Tswana Mine.

2. ACTIVITIES UNDERTAKEN BY LAFARGE

The pre-compliance notice dated 27 November 2020 from the DFFE indicates that the Lafarge cement factory in Lichtenburg (See Figure 1) has unlawfully carried out the following activities in terms of Regulations under NEMA without prior authorisation:

- Infilling of a watercourse and or a wetland with more than 10 cubic metres of material (See Annexure A); and
- The clearing of indigenous vegetation.

At the time of the site visit by the specialist on 30 March 2021 it was observed that the area in question had indeed been used as a spoil site, and the progress of the infilling as is apparent from Google Earth images and which are documented in Annexure B of the pre-compliance notice could be confirmed. See Annexure A below. Examples of the infill are shown in Plates 1 to 3 and an overview of the infill area is shown in Plate 4 and Figure 2.

While much of the earlier infilling was done in the vicinity of the two large lime silos, more recent satellite images and ground observations indicate that there has been dumping and other activity in the area adjacent to the Manana road. A pre-existing northern access road into the factory area now runs over this material.

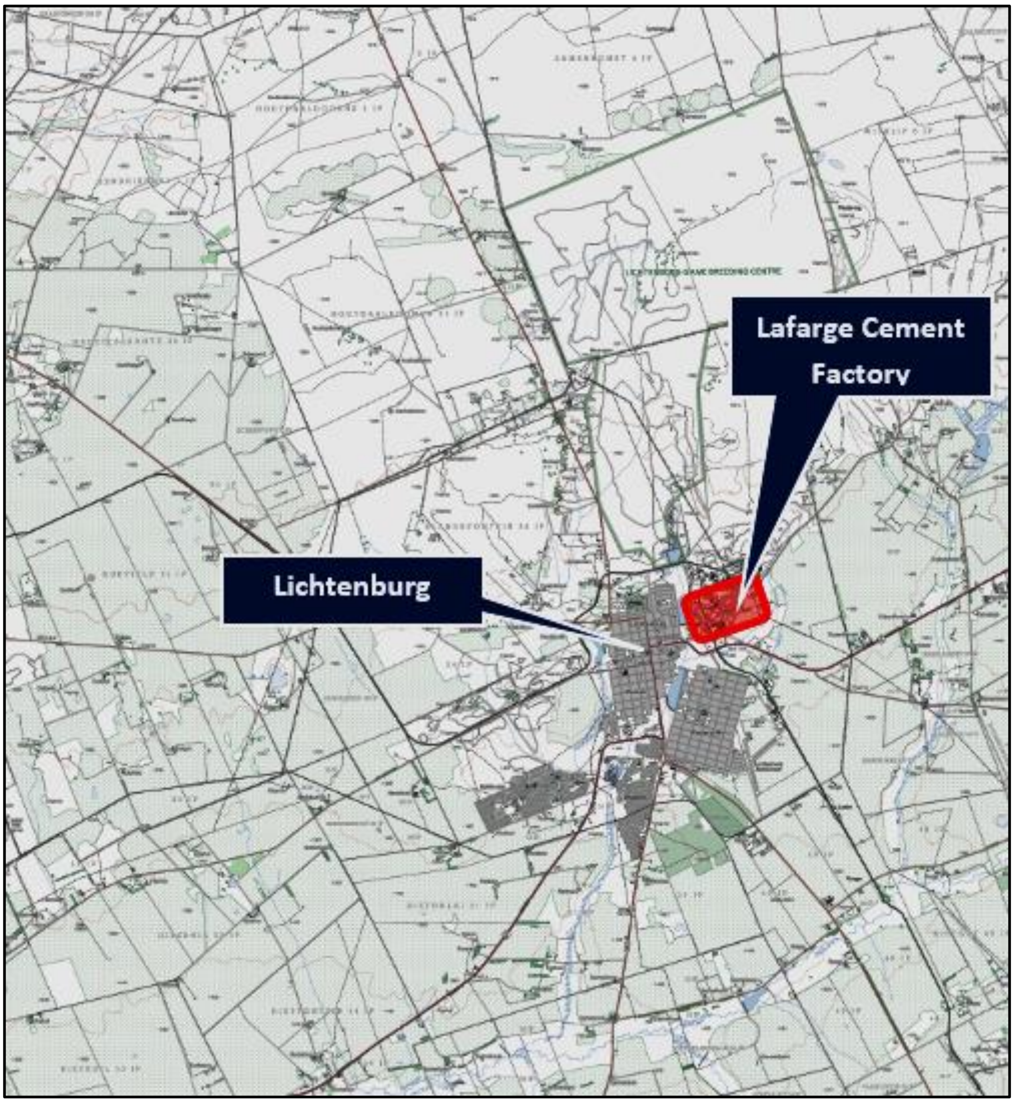

Figure 1: Recent aerial image of the infill area (Map Sheet 2626AA LICHTENBURG)

Plate 1: Infill heap of factory waste material

Plate 2: Infill heaps of factory waste material

Plate 3: Solid wastes dumped in the wetland area

Plate 4: Oblique view of the area where infilling has been undertaken

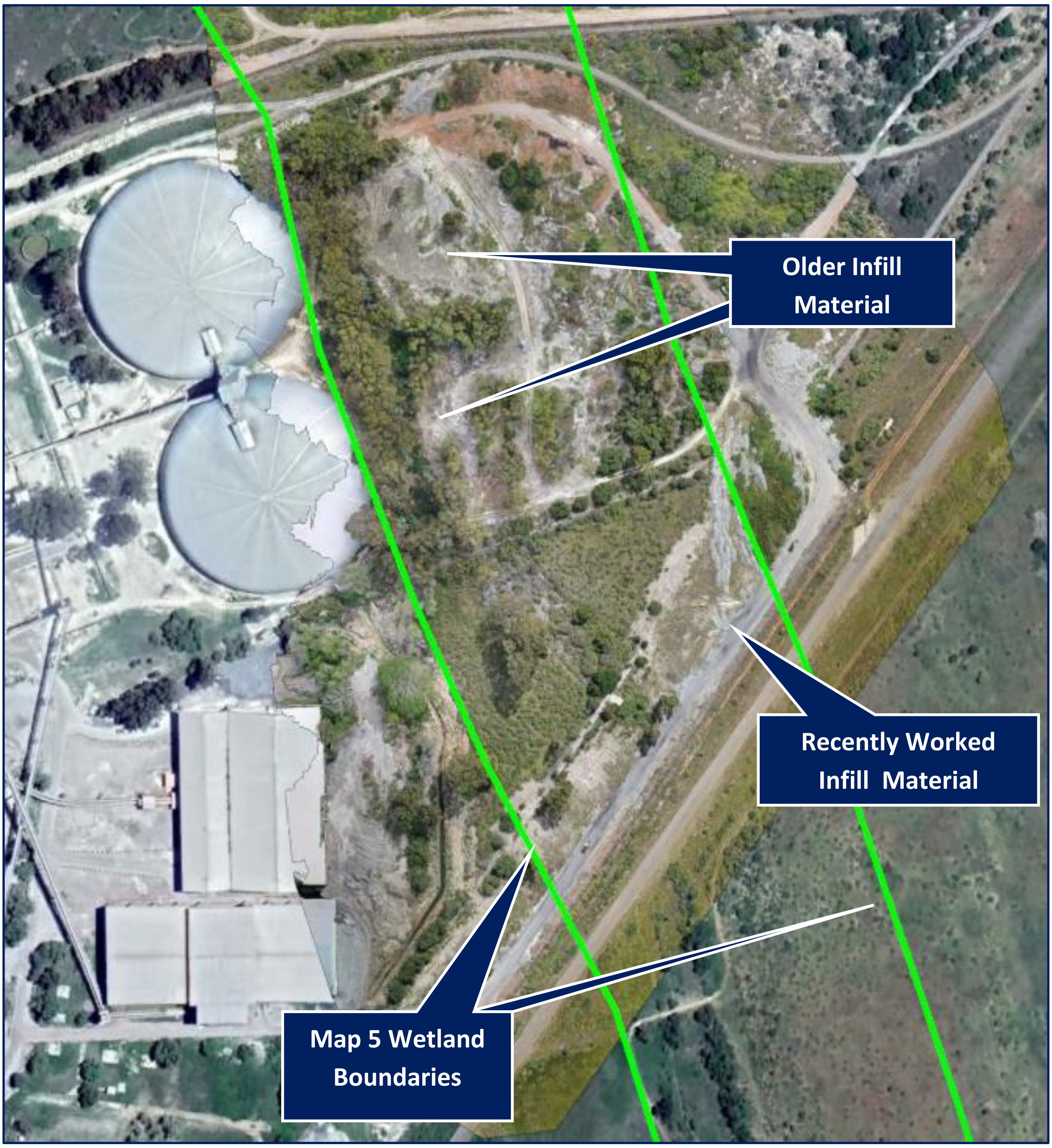

Figure 2: Recent aerial image of the infill area

3. 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.

1	Introduction
2	Terms of reference
3	Knowledge gaps
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8.9	The PES assessment of the remaining wetland areas
8.10	The EIS assessment of the remaining wetland areas
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)
6) Risk Assessment Protocol and associated Matrix (DWS document on DWS Website)

4. STUDY AREA

This report includes assessments of four wetlands which are:

- The Wetland Map 5 listed linear system which passes through the Lafarge cement factory property;
- The NFEPA listed mine pit wetland which lies adjacent to the northern side of the Lafarge cement factory property;

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

5. EXPERTISE OF THE SPECIALISTS

The *curriculum vitae* of the specialist, Mr J. Alletson is attached in Annexure A.

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 Honours 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 terrestrial plant survey. 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.

6. AIMS AND OBJECTIVES

The objectives of the report may be summarised as follows:

- To investigate the field conditions wetlands at the Larfarge factory and mine sites.
- To gain an understanding of the functionality and condition of the sites;
- 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

[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.

- Any conditions for inclusion in the Environmental Authorisation and/or Water Use Licence;

7. METHODOLOGY

7.1 Data Collection

The objectives of this report are to assess biological and ecological conditions of the three 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. The field survey entailed visiting each of the three sites and walking over them as much as possible. 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 Data Processing

- The spatial data collected were mapped in Google Earth. Where necessary, for example, when the data was 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 provide data that is used in determining the following:
  - ✓ Ecological integrity of the wetlands
  - ✓ Present Ecological State of the wetlands
  - ✓ Ecological Importance and Sensitivity (EIS) of the wetlands

  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.

- In order to identify the various Hydrogeomorphic Units (HGUs), a standard classification system (Ollis *et al,* 2013) was used.

The WET-EcoServices tool (Kotze *et al,* 2020) 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 *1*** below.

Table 1: 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 and 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 **Error! Reference source not found.** and the PES Categories are shown in Table 3.

Table 2: 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 3: 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**

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.*

While the above criteria are considered at both sites, the actual wetland area around which a study area was considered, was adapted to suit conditions on the ground. While the original study area was based on a Notice of Intention to serve a Compliance Notice, the area was voluntarily enlarged to include an adjacent space which was not so heavily impacted.

9. RESULTS FOR THE CEMENT FACTORY WETLAND

9.1 Study Area

The cement factory wetland is a Wetland Map 5 listed wetland, which originates approximately 1.0 km to the north of the factory property and then flows southwards through the factory area before turning westwards to join another, and larger, wetland/watercourse system flowing southwards past the town of Lichtenburg. See Figure 3. These two wetlands form a tributary of the Harts Rivier. A core area within the wetland was determined as a result of the infill material which had been placed by the cement factory, and this area was expanded to include all of the wetland area on the factory grounds. See Figure 4. This expanded area was then surrounded by a 500 m wide strip which constitute the greater study area.

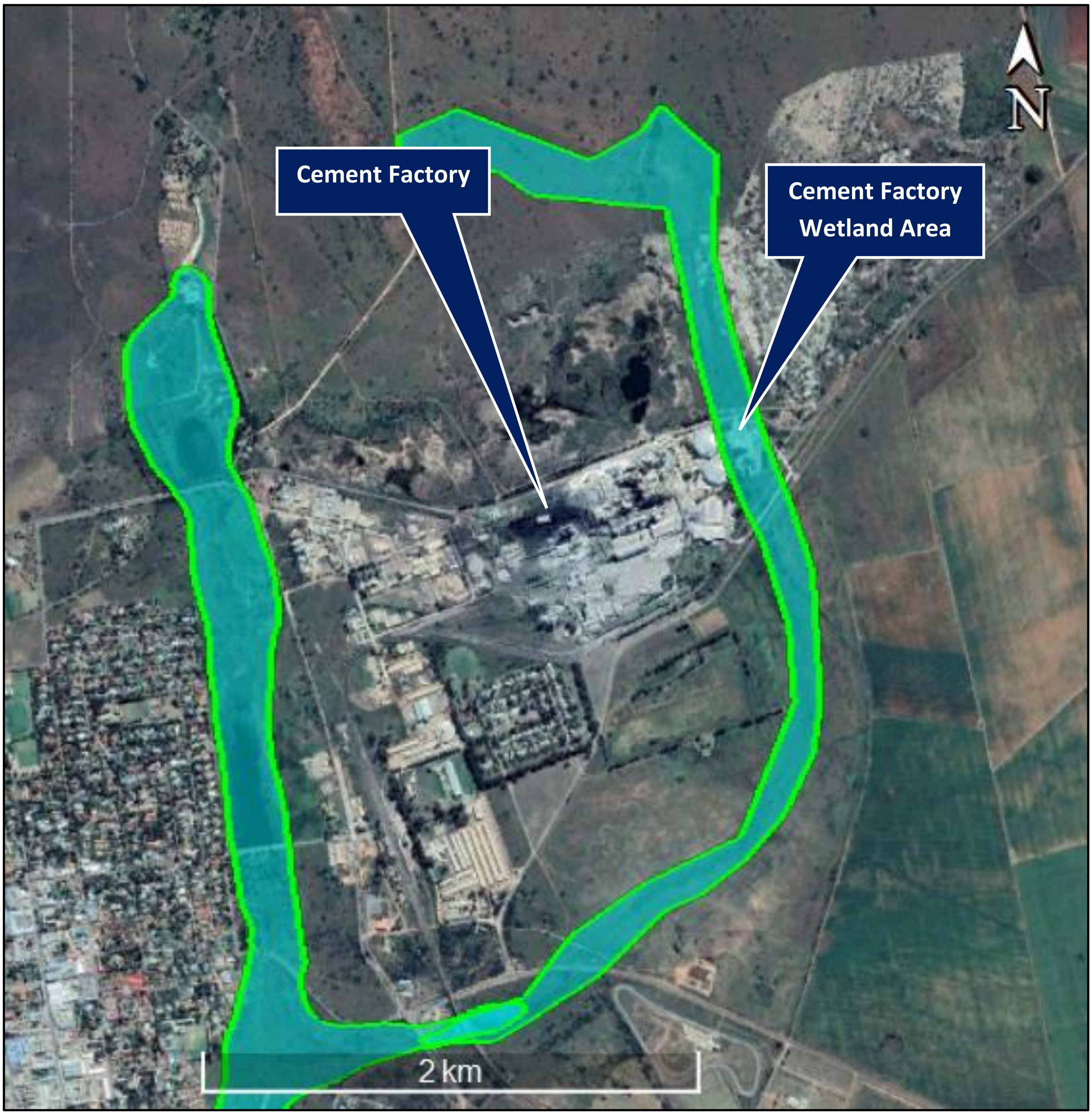


Figure 3: Wetland Map 5 wetlands around the town of Lichtenburg

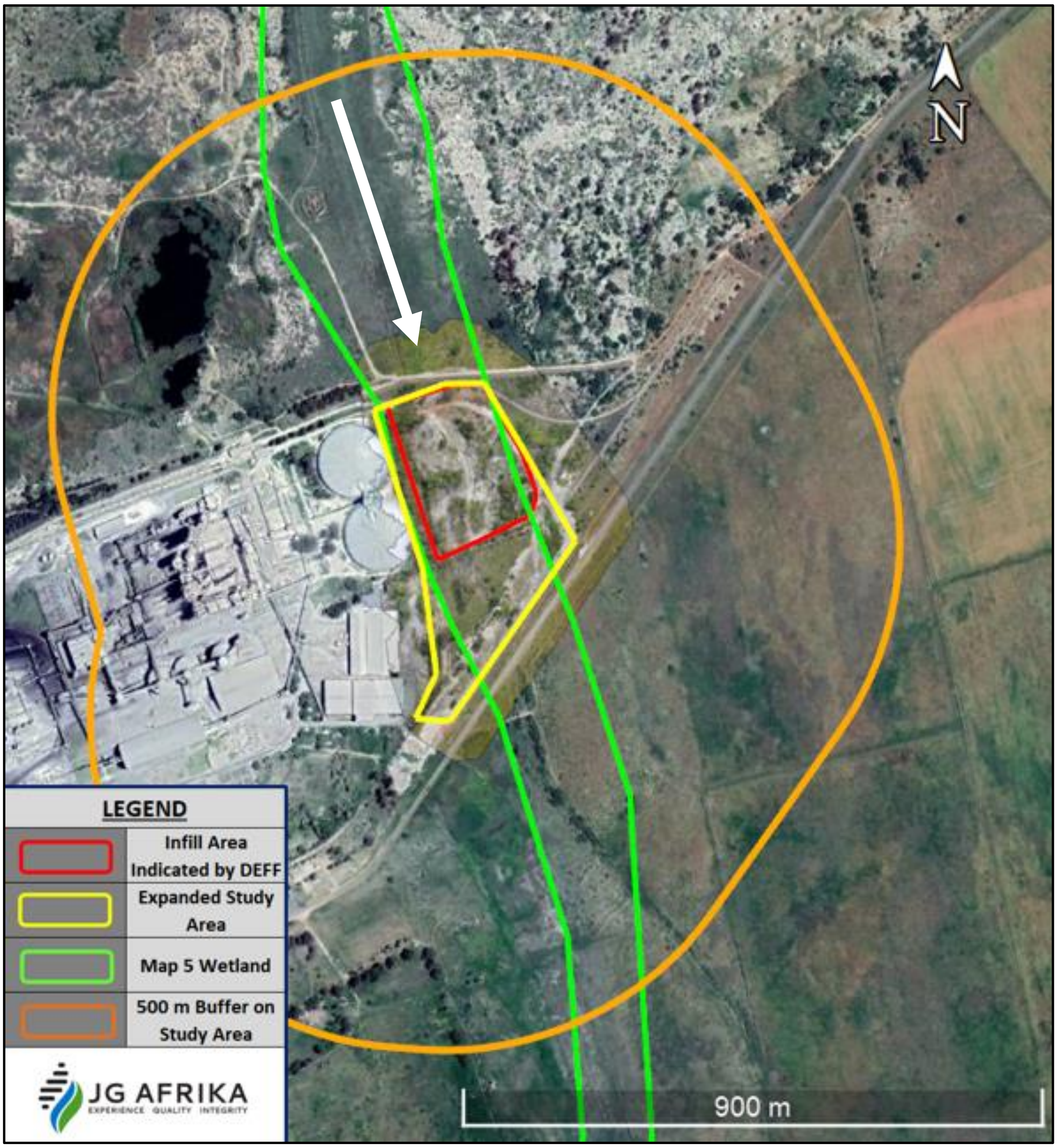


Figure 4: Project study area. The direction of water flow is indicated

9.2 Wetland Delineation and Description of Conditions

9.2.1 Core wetland area

Within the expanded study area shown in Figure 4 it was not possible to delineate the wetland edges using the soil indicators. Within the core infill area no trace could be found of the wetland since it had been entirely covered over by infill material. A man-made channel passed through the area on the side adjacent to the factory but this too included infill and waste materials. Within the study area, further infill had taken place along the property boundary adjacent to the district road (Manana Road). It was therefore concluded that the wetland could not be meaningfully delineated within the factory property. A recent high resolution aerial photograph confirms this conclusion. See Figure 5.

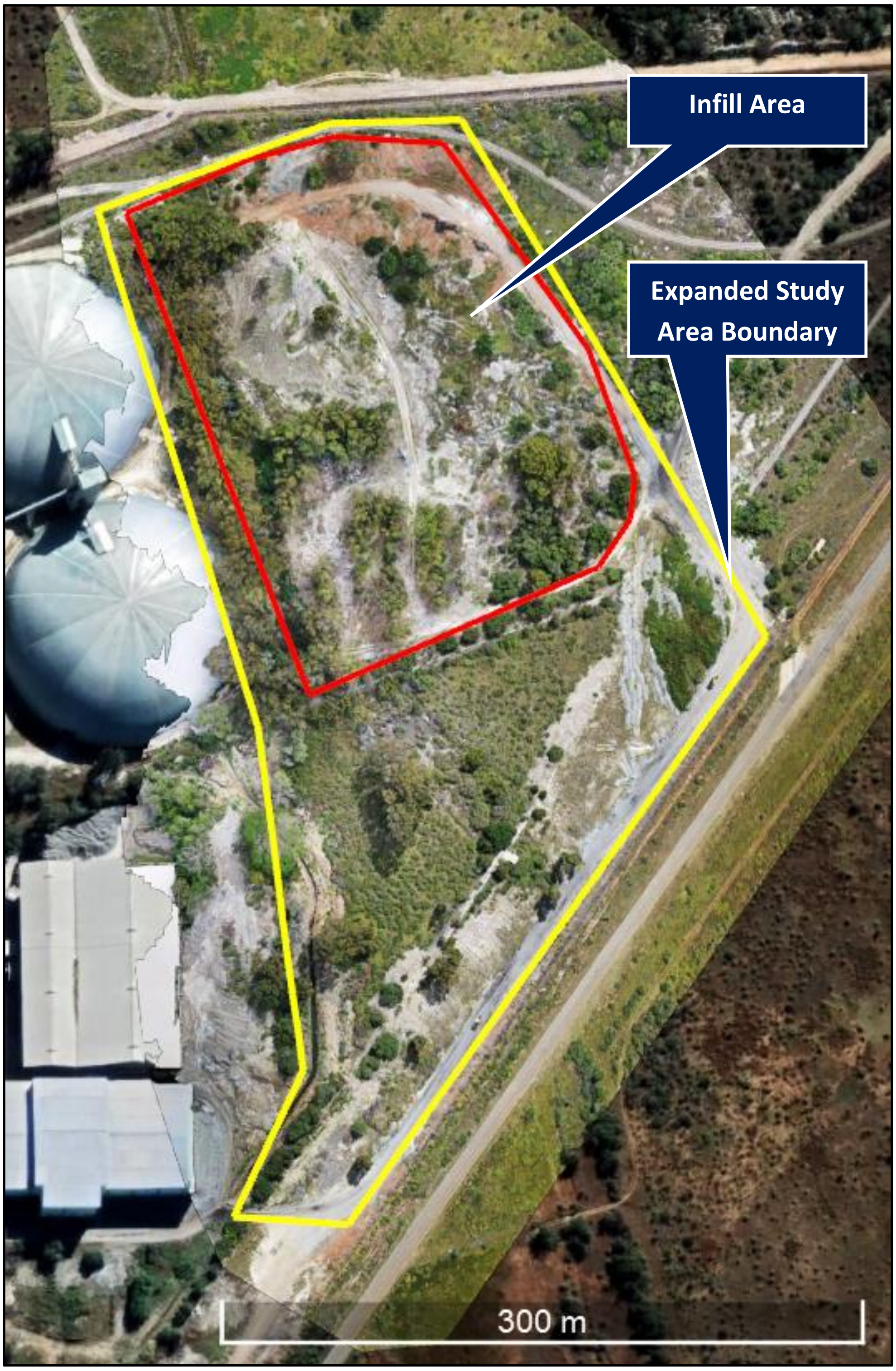


Figure 5: Detailed view of the study area showing absence of wetland features

9.2.2 *Upstream wetland*

Upstream (North) of the cement factory the wetland is clearly visible on the basis of the vegetation. Both Google Earth and drone images show it on the basis of the vegetation but examination of the soil characteristics is confusing for two reasons. The first of these is that very few 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 took place in the early years of the 21st century. See Figure 6. Almost all of the wetland area, from the source to the factory boundary, was affected and so few areas of natural soil remain.

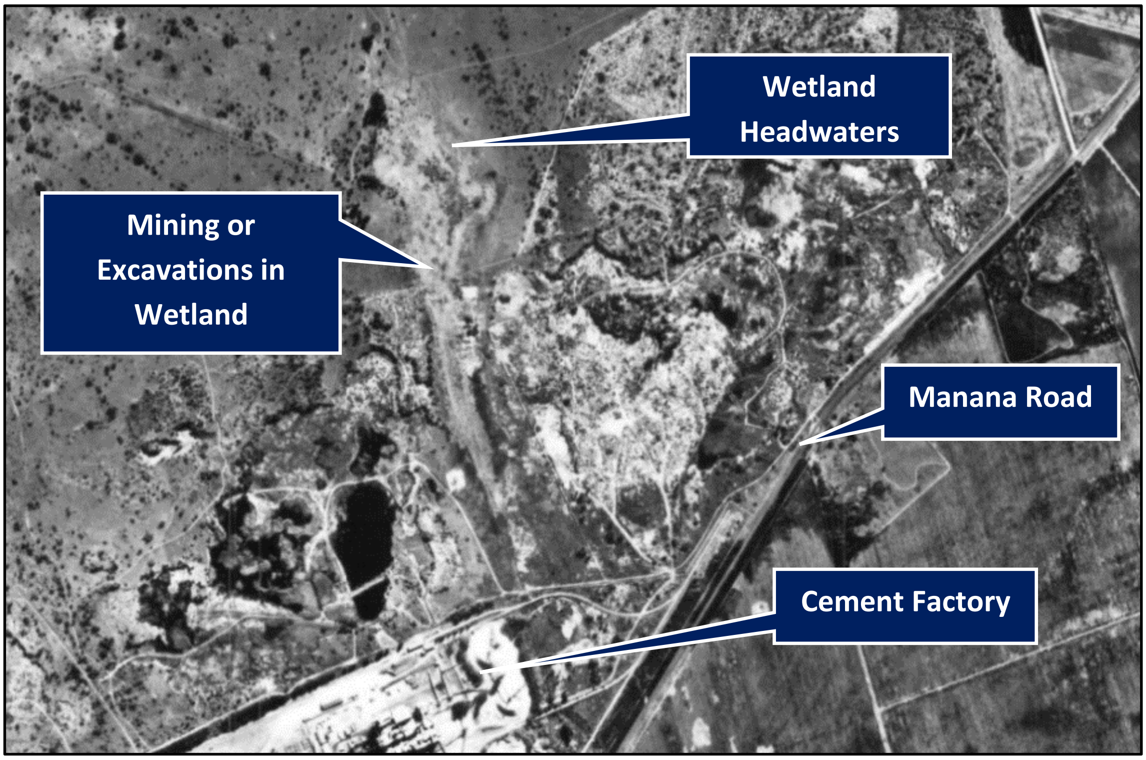


Figure 6: Aerial image of the wetland upstream of the cement factory taken on 28/05/2006

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 the 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. Therefore, since Wetland Map 5 outlines closely approximate the visible vegetation, it is accepted as the marking the wetland edge. See Figure 7. The reason for the westward extension of the area is not understood as no wetland traces have been found there.

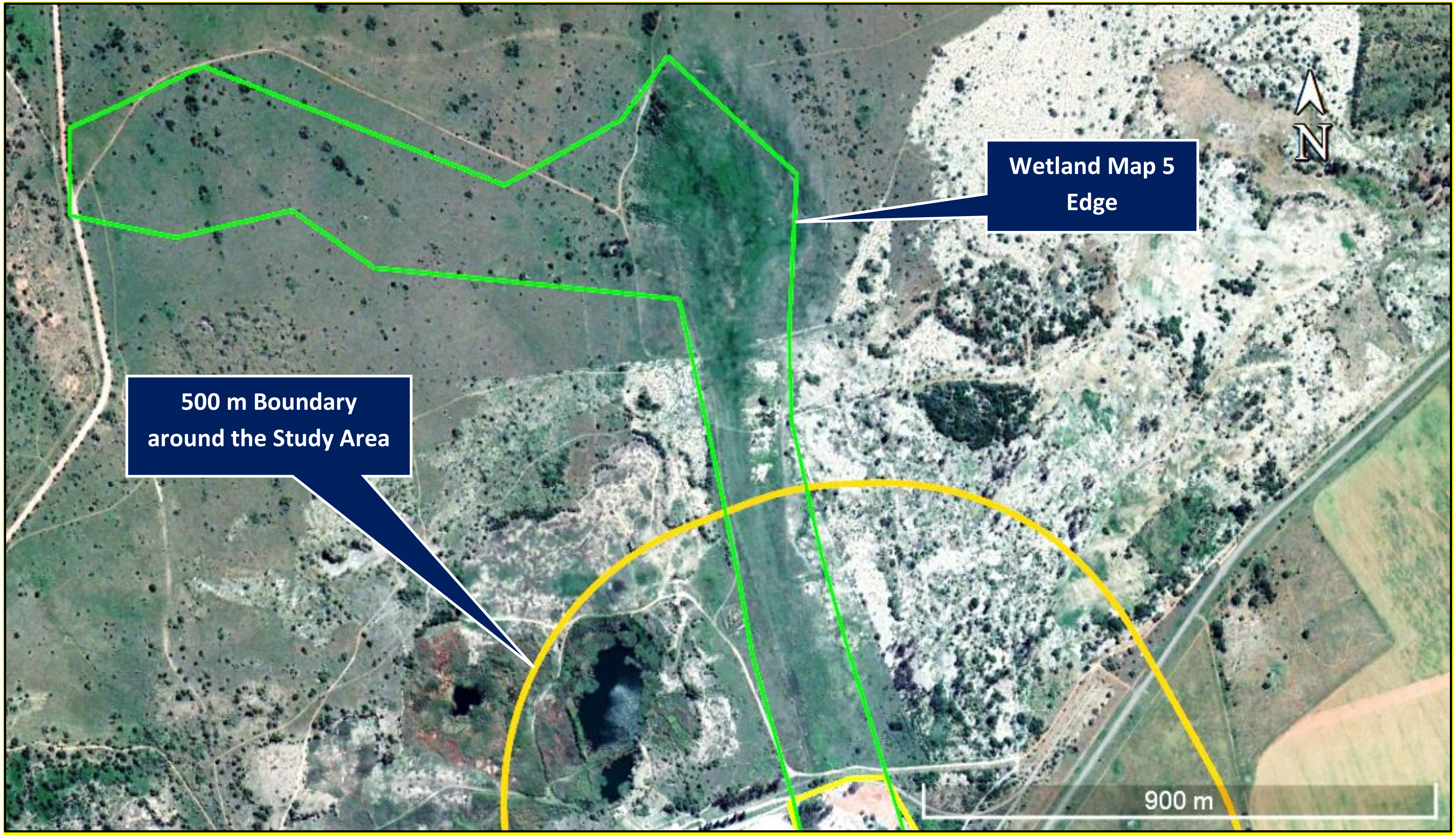


Figure 7: Upstream wetland as marked by Wetland Map 5

Plate 5: View of the wetland upstream of the cement factory. Note the cattle.

Plate 6: View of the upstream wetland at a point close to the cement factory

9.2.3 Downstream wetland

The wetland downstream of the Manana road was considered for a distance of 500 m. It is however noted that it continues on down to the confluence with the Groot Harts River. The distance from the road to the confluence is approximately 3.25 km. See Figure 3.

Within the study area, including the 500 m buffer, the wetland has historically been severely impacted upon by agricultural activities. These include cultivation for crops, and grazing by livestock. Examination of historic and current aerial imagery reveals the presence of cultivated areas, some of which extend downstream as far as Road R503. Flows have been canalized in this section, presumably to allow the outer edges of the wetland to become arable. In the lower reaches are a number of bridges and causeways, some which may be pinch-points for water flows.

As with the upstream wetland, past activities have destroyed soil structures and so normal delineation using the soil indicators is not possible. The vegetation indicator has also been disrupted but present conditions suggest that, for a distance of approximately 750 m downstream of the Manana road, the wetland lies slightly to the west of the Wetland Map 5 boundaries. See Figure 8.

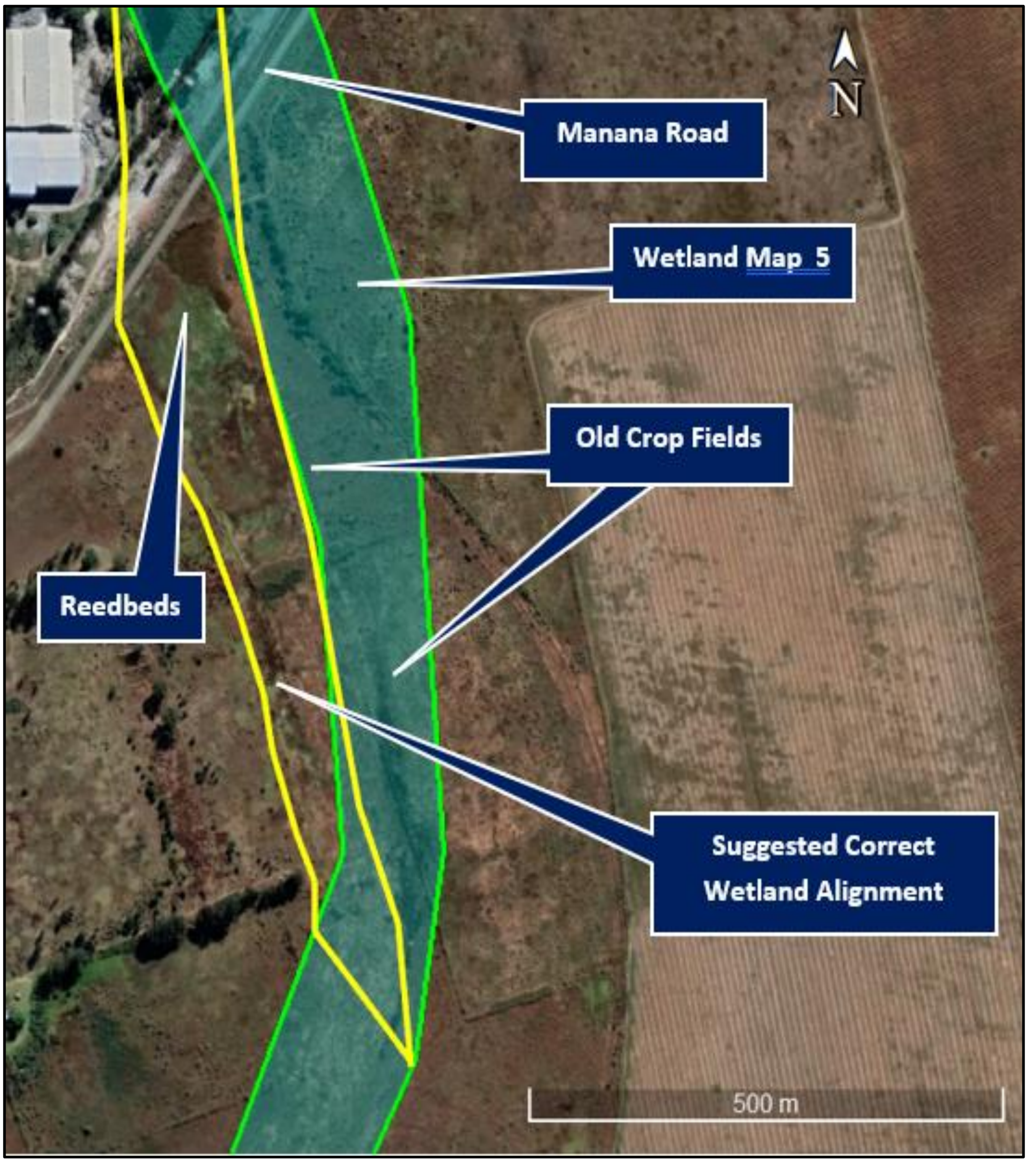


Figure 8: Portion of the wetland downstream of the cement factory, with suggested mapping correction

9.3 Wetland Unit Identification

The wetland was determined to be an Unchannelled Valley Bottom (UVB) system (Ollis, *et al,* 2013). It could also be considered as a seep system since there is little surface water inflow. See Figure 9. However, because the system is linear the listing as a UVB is preferred.

It was noted that, despite much rain in the days preceding the site visits, only very few and limited puddles of surface water were seen. The rapid downward percolation of water into the ground is in line with what would be expected with the dolomitic geology of the area. Historic (before the establishment of the Cement Factory) attempts to canalize the wetland downstream of the Manana road have generally failed since the ditch is become less distinct and the wetted area is spreading.

9.4 Wetland Setting

The wetland lies in an area which generally has low topography. The valley within which it is situated is some 1.5 km wide but the elevation difference between the wetland near the factory, and the hill crest is only about 5 metres. The linear gradient upstream of the factory is approximately 0.3%, and from the Manana road downstream to the Road R52 bridge is approximately 0.4%. Further details are shown in Table 4 below.

Table 4: *Characteristics of the UVB wetland system*

Quaternary Catchment	River System	Wetland Map 5 Type	Wetland Map 5 Condition Rating	Water Management Area	Bioregion
C31A	Harts – Vaal - Orange	Unchannelled Valley Bottom	Category D/E/F	Lower Vaal	Dry Highveld Grassland

The natural vegetation in the area is Carltonville Dolomite Grassland. (Type Gh 15). The vegetation of the wetland system upstream of the cement factory is dominated by a dense growth of Kweek Grass (*Cynodon dactylon*) but with a sparse inclusion of wetland facultative species such as Cottonwool Grass (*Imperata cylindrica*). See Plate 5. A herd of cattle was seen in the area and appeared to be grazing primarily on this grass. The wetter patches, which increased in extent as the lower areas near the factory were approached, were characterised by sedges with a *Juncus* species being predominant. See Plate 6. A few Knotweed (*Persicaria* sp.) were noted as well but could not be identified as they were not flowering at the time.

Downstream of the cement factory the wetland includes reeds (*Phragmites australis*), bullrushes (*Typha capensis*) and other wetland obligate and facultative plant species such as *Juncus effusus, Cyperus congestus, Andropogon eucomus, Cladium mariscus,* and *Imperata cylindrica.* The plant diversity, as well as traces of the past agriculture, may be seen in Plate 7 and Plate 8.

Plate 7: View upstream of the downstream wetland at a point close to the cement factory

Plate 8: View downstream of the downstream wetland at a point close to the cement factory

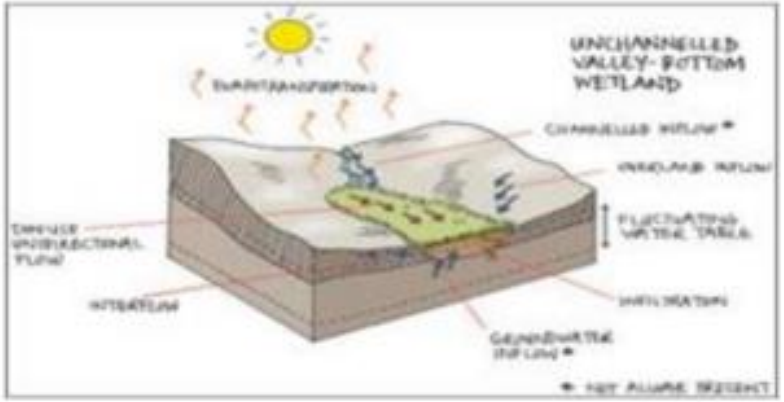
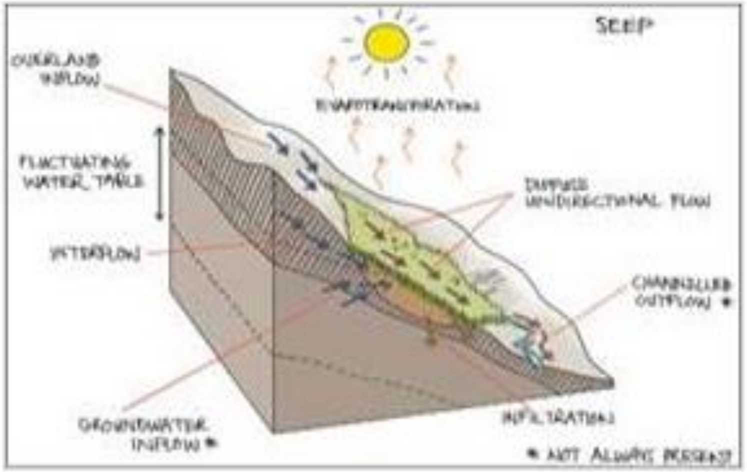
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.
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.

Figure 9: Schematic representations of an Unchannelled Valley Bottom Wetland and a Seep Wetland. (Ollis et al,2013)

9.5 Wetland Functionality

The functionality of the wetland was modelled with the WET-EcoServices tool. The area modelled included the UVB wetland from its source down to the 500 m margin of the extended study area. However, the area within the cement factory was excised since the wetland there is lost due to local impacts and so delivers either no ecosystem services or very few ecosystem services.

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 5 and in Figure 10 as they display both the Supply and Demand capabilities.

Table 5: *Present ecosystem service delivery scores for the Wetland Map 5 system in the study area*

ECOSYSTEM SERVICE		Supply	Demand	Balance of Supply/Demand
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,9	0,0	+0,9
	Stream flow regulation	2,5	0,0	+2,5
	Sediment trapping	3,0	0,0	+3,0
	Erosion control	0,8	1,7	-0,9
	Phosphate assimilation	2,0	1,0	+1,0
	Nitrate assimilation	2,9	1,0	+1,9
	Toxicant assimilation	2,9	1,0	+1,9
	Carbon storage	1,1	0,0	+1,1
	Biodiversity maintenance	2,5	2,5	0,0
PROVISIONING SERVICES	Water for human use	0,0	0,3	-0,3
	Harvestable resources	0,5	0,0	+0,5
	Food for livestock	2,3	1,0	+1,3
	Cultivated foods	2,0	0,0	+2,0
CULTURAL SERVICES	Tourism and Recreation	0,0	0,0	0,0
	Education and Research	1,5	0,0	+1,5
	Cultural and Spiritual	0,0	0,3	-0,3

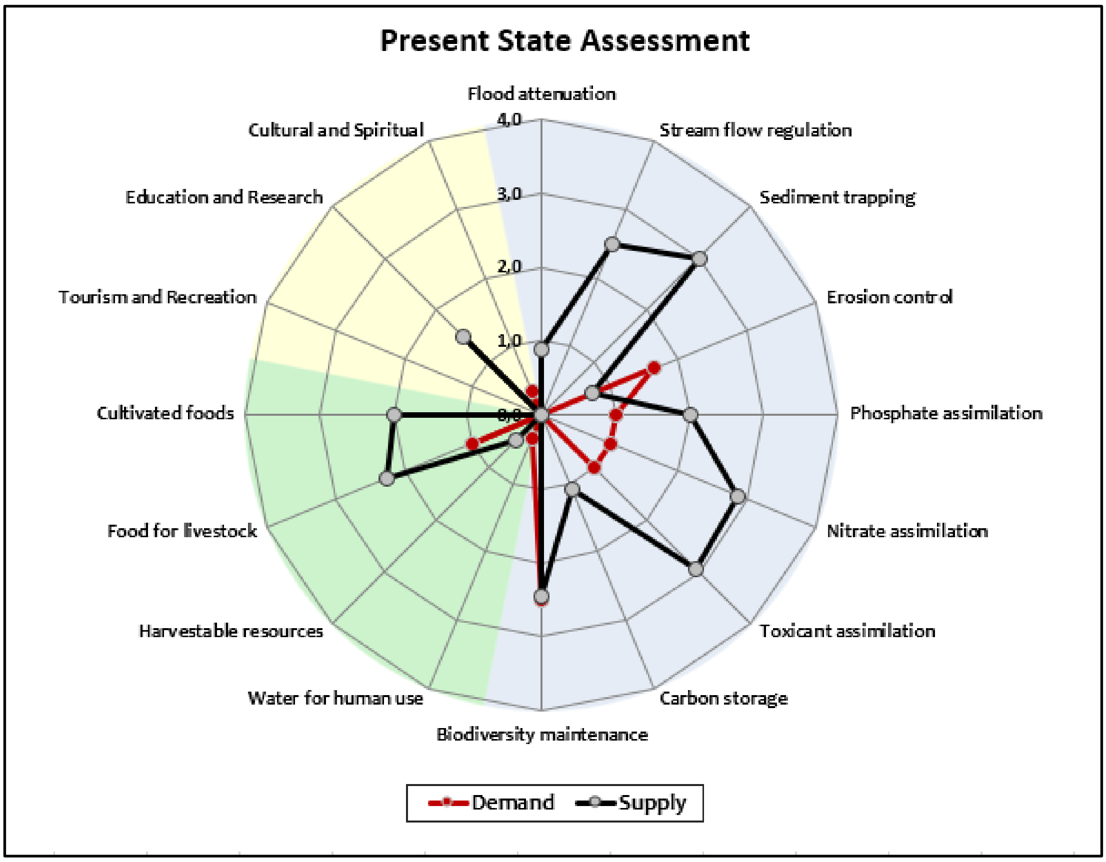


Figure 10: Ecoservice delivery scores for the Cement Factory Wetland in the study area

The results indicate that the wetland has a Moderately High ecosystem service delivery capability in relation to Stream Flow Regulation, Sediment Trapping, Nitrate Assimilation, Toxicant Assimilation, Biodiversity Maintenance, and Grazing for Livestock. Low delivery services are Water for Human Use, Harvestable Resources, Tourism and Recreation, and Cultural and Spiritual. On balance, the supply meets or exceeds demand in 13 of the listed services and with only a further three services having demand exceed supply. They are Erosion Control, Water for Human Use, and Cultural and Spiritual.

9.6 Wetland Health

The Present Ecological State (PES) of the wetland was modelled with the WET-Health tool. It is to be noted that only data from the areas above the factory property (HGM 1 = 22.6 ha) and below the factory property (HGM 2 = 7.5 ha) were included in the model. The study area section within the factory area (6.4 ha) was excluded and the Wetland Map 5 assessment of PES Category E is accepted as the surface wetland there is totally destroyed by infill but sub-surface water continues to move through area. See Table 6 and Figure 11.

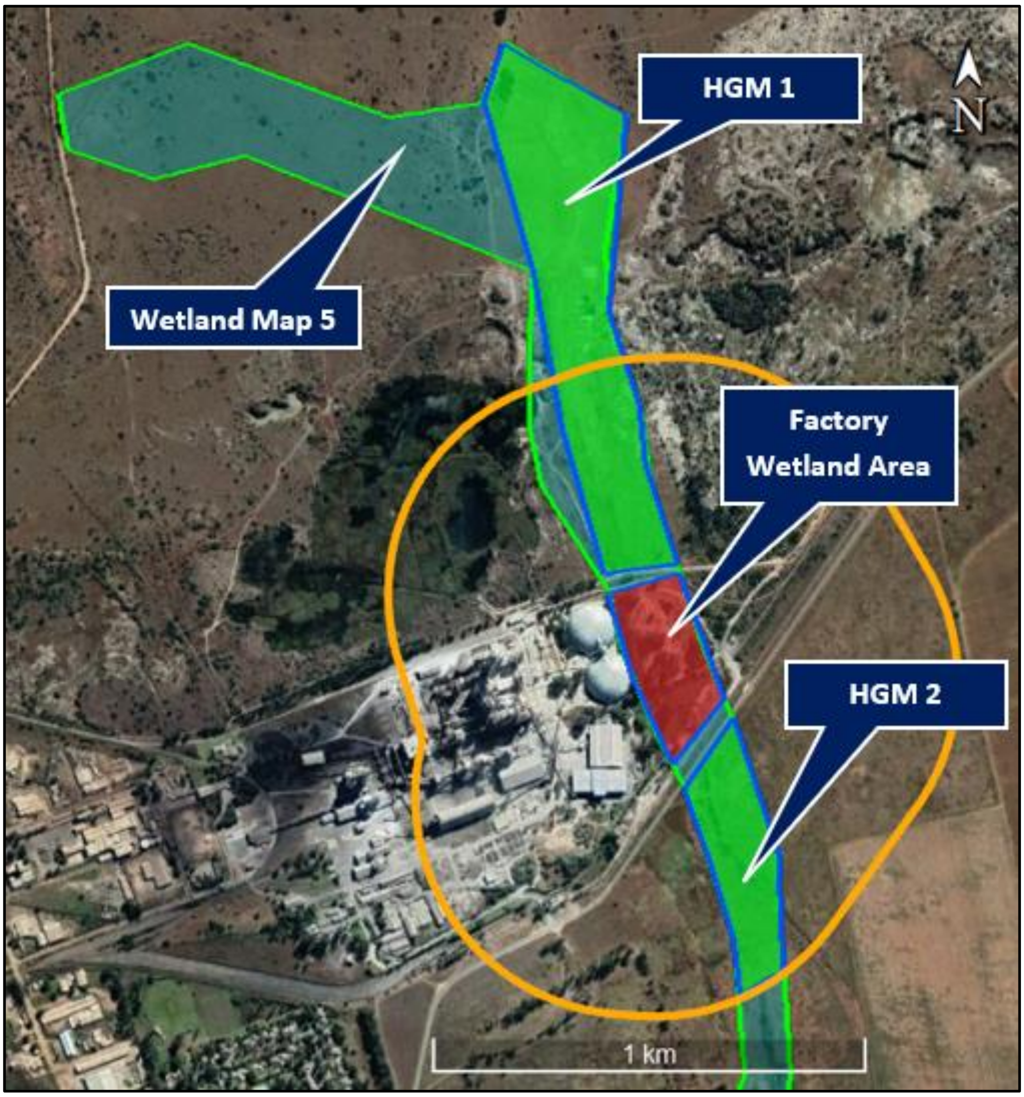


Figure 11: Wetland HGM units used.

Table 6: Present Ecological State scores for the HGM 1 and HGM 2 areas

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation	
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	22	73	3,5	0	2.0	0	3,0	1
2	8	27	1,0	1	0,8	1	4,5	1
Area weighted impact scores			**2,8**	**0,3**	**1,7**	**0,3**	**3,4**	**1,0**
PES Category			**C**	**↑**	**B**	**↑**	**C**	**↑**
Overall PES Category			**PES Score: 2,7 (Category C)**					

9.7 Wetland Ecological Importance and Sensitivity (EIS)

The modelling of the EIS was derived from the WET_Ecoservices tool outputs and the data from HGM Unit 1 and HGM Unit 2 were combined. No listed red data species were observed but a search of the Animal Demography Unit Virtual Museum suggested that the Giant Bullfrog (*Pyxicephalus adspersus*) could be present and so was included. The results are indicated in Table 7.

Table 7: Ecological Importance and Sensitivity

Ecological Importance	Score	Confidence
Biodiversity support	1,00	*2,00*
Presence of Red Data species	1,00	2,00
Populations of unique species	1,00	2,00
Migration/breeding/feeding sites	1,00	2,00
Landscape scale	1,60	3,40
Protection status of the wetland	1,00	4,00
Protection status of the vegetation type	1,00	3,00
Regional context of the ecological integrity	2,00	3,00
Size and rareity of the wetland type/s present	2,00	3,00
Diversity of habitat types	2,00	4,00
Sensitivity of the wetland	1,50	2,33
Sensitivity to changes in floods	0,50	2,00
Sensitivity to changes in low flows/dry season	2,00	3,00
Sensitivity to changes in water quality	2,00	2,00
ECOLOGICAL IMPORTANCE & SENSITIVITY	**1,6**	2,6

The finding is that the site is of Intermediate EIS. This was not unexpected since it has been subject to numerous impacts in the past. The presence of the reedbeds and other such aquatic vegetation in the lower area did raise the score slightly. It is to be expected that, once the factory section of the wetland has been rehabilitated, the score will be further improved.

10. IMPACT ASSESSMENT

The impacts considered below relate to the same extant section of wetland as was considered for the functionality and ecological criteria. The impacts on the wetland within the factory area were assessed in an earlier report (J.G. Afrika, 2021).

The relevant impacts under consideration are as follows (as presented in Table 8):

- Disturbance of the soil and topography of the wetland area as a result of past mining activities in the area upstream of the cement factory;
- Disturbance of the wetland in the lower area as a result of past draining and agricultural activities.

- Grazing by livestock in the upper section, reducing the plant biomass and potentially reducing plant diversity; and
- Disruption of any surface flows through the wetland as a result of infilling and road and rail crossings in the factory area.

In order to rate the impacts, a numeric scoring system has been used, as presented in Annexure B. The results are shown in Table 9. All the impacts are negative and have already taken place. However, some have self-mitigated to the extent that they may now be considered to be of "Low" consequence. Only the impact relating to infill and road/rail crossings of the wetland at the factory site remains in place. This impact was the subject of a Pre-Compliance Notice from the DFFE and an assessment study was undertaken and a management plan has been submitted. This plan has been acknowledged and final comment is pending. Once obtained, and with joint approval from the Department of Water and Sanitation (DWS), will be implemented. The consequence will be that water will have free flow through the area and that supplementary inputs from a neighbouring flooded mine pit will improve the overall condition of the system. Means of addressing the remaining impacts are given in Table 8.

Table 8: Mitigatory measures for the wetland outside of the cement factory property

Listed Impact	Mitigatory Measures
Disturbance of the soil and topography of the wetland area as a result of past mining activities in the area upstream of the cement factory.	The mined areas have been left largely undisturbed for over 10 years and have largely recovered in terms of establishing a vegetation cover which has wetland characteristics. Underlying the vegetation are soils that would appear to be typical of wetlands in the region. In the absence of any erosion and alien weed invasion, it is recommended that the site be left to continue self-repair as at present.
Disturbance of the wetland in the lower area as a result of past draining and agricultural activities.	The area downstream of the mine is no longer used for agriculture and the recovery of the wetland vegetation is well advanced. The following recommendations are put forward: • It is recommended that it should be kept free of alien weeds; and • Any remaining drainage ditched should be plugged. NOTE: These actions are not the responsibility of Lafarge.
Grazing by livestock in the upper section is reducing the plant biomass there and is probably also reducing plant diversity.	This impact is taking place but the removal of the cattle will be controversial. Since there is minimal impact on the hydrology of the site it would be acceptable to leave the *status quo*.

Table 9: 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	Disruption of any surface flows through the wetland as a result of infilling, and road and rail crossings in the factory area.	The infilling of the wetland has resulted in a loss of any surface flows through the area.	2	4	4	3	4	4	68 Negative Very High
With Mitigation			2	2	2	2	2	2	20 Negative Low
Without Mitigation	Disturbance of the soil and topography of the wetland area as a result of past mining activities in the area.	The mining activities have damaged the soil structure and have reduced its capacity to retain water.	1	4	2	3	3	2	26 Negative Medium
With Mitigation			Cannot be mitigated but the system has largely repaired itself to the extent that it now has a PES ranking of Category C (Moderately Modified)						Not Scored Negative Medium
Without Mitigation	Disturbance of the wetland in the lower area as a result of past draining and agricultural activities.	The degradation would have reduced wetland condition and functionality.	2	4	2	3	2	3	39 Negative Medium
With Mitigation			2	1	1	2	2	1	8 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	3	2	22 Negative Low
With Mitigation			1	1	1	1	1	1	5 Negative Low

11. 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 the cement factory has been operational for over 60 years and that, at the present time, poses few new risks to the wetland system other than from the infill area on its own land, and from possible contamination of stormwater emanating from the factory. The outputs from the matrix are shown in Table 10.

It is shown that the risks arising from the infill are rated as “Moderate” despite the fact that the wetland at the site is completely buried. However, the following factors serve to reduce the score from the matrix:

- *Water flows.* It is apparent that the wetland area downstream of the factory is still obtaining water since there are extensive reedbeds and other stands of hygrophilous vegetation. This water has to be derived from sub-surface flow and so is thought to be a continuation of similar flows upstream of the factory. Were this water to have been cut off or diverted, then the matrix score would have been higher.
- *Toxicity of the infill material.* The infill material has been tested and found to be non-hazardous. It is therefore unlikely to be impacting on the biota downstream of the infill site.

12. CONSIDERATION OF BUFFERS

The UVB wetland lies in an area which is now very largely undeveloped, except for the section where it passes by the cement factory. Almost all of the space around the wetland, from its source down to Road R52 has been disturbed in the past, either by mining or by agriculture. It is therefore recommended that a strip of 100 m be kept clear on either side to act as a buffer. The purposes of the strip are as follows:

- To maintain an area close to the wetland in which rain water can penetrate the soil and move downslope toward the wetland. Rain falling more than 100 m away from the wetland may have opportunity to percolate to a level deeper than the wetland and so not be contributing to the wetland.
- The 100 m wide strip will serve to keep developments far enough away that the wetland will not be drained toward them.

Table 10: Assessment of current risks to the wetland in the study area

With/ Without Mitigation	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk rating	Confidence Level
Pre-mitigation	Infilling with factory wastes and road and rail crossings in the factory area.	Disruption of any surface flows through the wetland as a result of channel infilling.	Possible loss of water from the greater wetland system	4,25	11,25	12	135	MODERATE RISK	100
Post-mitigation				1,5	3,5	8	28	LOW RISK	90
Pre-mitigation	Infilling with factory wastes.	Such wastes include paper, plastics, cement material, rubble, etc, but are not toxic.	The natural soil has been buried under the waste causing loss of indigenous plant biodiversity. The area is invaded by weed species.	3,75	9,75	13	126,75	MODERATE RISK	100
Post-mitigation				1,5	3,5	9	31,5	LOW RISK	90
Pre-mitigation	Stormwater and other surface flows entering the wetland	Contamination of the system could result even though the materials are non-toxic.	Contamination of the system with fine sediment which could impact on aquatic biodiversity.	2	6	11	66	MODERATE RISK	80
Post-mitigation				1,5	3,5	11	38,5	LOW RISK	80

13. RESULTS FOR THE NFEPA WETLANDS

In addition to the wetland system which is shown on Wetland Map 5 and which is covered in Sections 9 to 11 above, the NFEPA Map 4 database shows two other wetland areas in the vicinity of the cement factory. These wetlands are under consideration as a means of partially mitigating for the impacts on the factory wetland area which has been infilled. This proposal was put forward in the wetland rehabilitation plan (J.G. Afrika, 2021). It is fully recognised that the wetlands are of two different types, however because both are on Lafarge-owned land, and because of their proximity, it has been considered rational to put conservation/rehabilitation measures in place as though they are a single entity. Lafarge refers to the site as the “Townlands Dam” but it is not actually a dam. Therefore, the terms “NFEPA Wetlands” or “NFEPA Wetland” are used in this document.

The NFEPA wetlands are listed as being “Natural” but are in fact old mine pits which have become filled in with water. While some of the inflow is natural, a portion of the surface water flows to the wetland is also from the factory. Water is abstracted from the wetland for use as a coolant water and is returned to the wetland. Despite this the water levels fluctuate substantially, however, sufficient water levels have remained long enough in the wetland area to allow for extensive reedbeds to have developed. In dry seasons the system shrinks into two separate pools but, because they join during the rainy season, allowing fish and other fauna to move between them, they are considered here to be a single entity.

13.1 Study Area

The NFEPA wetlands lie on the northern side of the cement factory and, at the closest point, are approximately 70 m from the factory fence. See Figure 12. The NFEPA mapping clearly does not show the full extent of the wetland and so the site was delineated as shown in Figure 13. However, the system changes substantially in drier seasons, as shown in a Google Earth image dated from May 2016. See Figure 14.

13.2 Wetland Delineation and Description of Conditions

Because the wetland is in an old mine, the delineation was done by marking out the wall of the pit. The water does reach to this edge in at least some places at all times but obviously retreats some distance from it in dry seasons. The usual wetland soil indicators are not present and the vegetation changes with the water level. Areas that might have submerged aquatic macrophytes such as *Potamogeton schweinfurthii* in one year may have dryland grasses the next year. The normal pattern of permanent, seasonal, and temporary zones is not present.

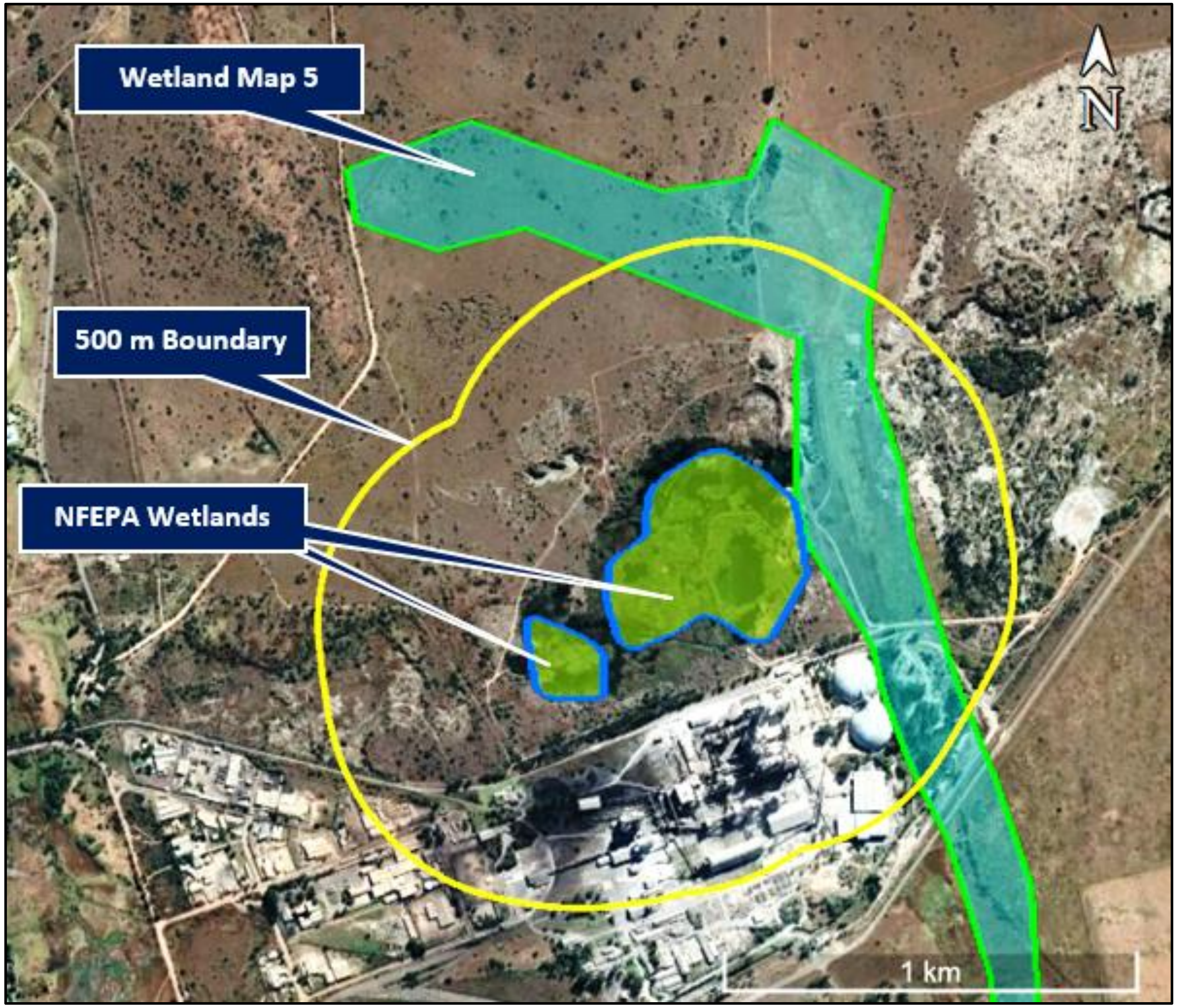


Figure 12: NFEPA wetlands adjacent to the cement factory

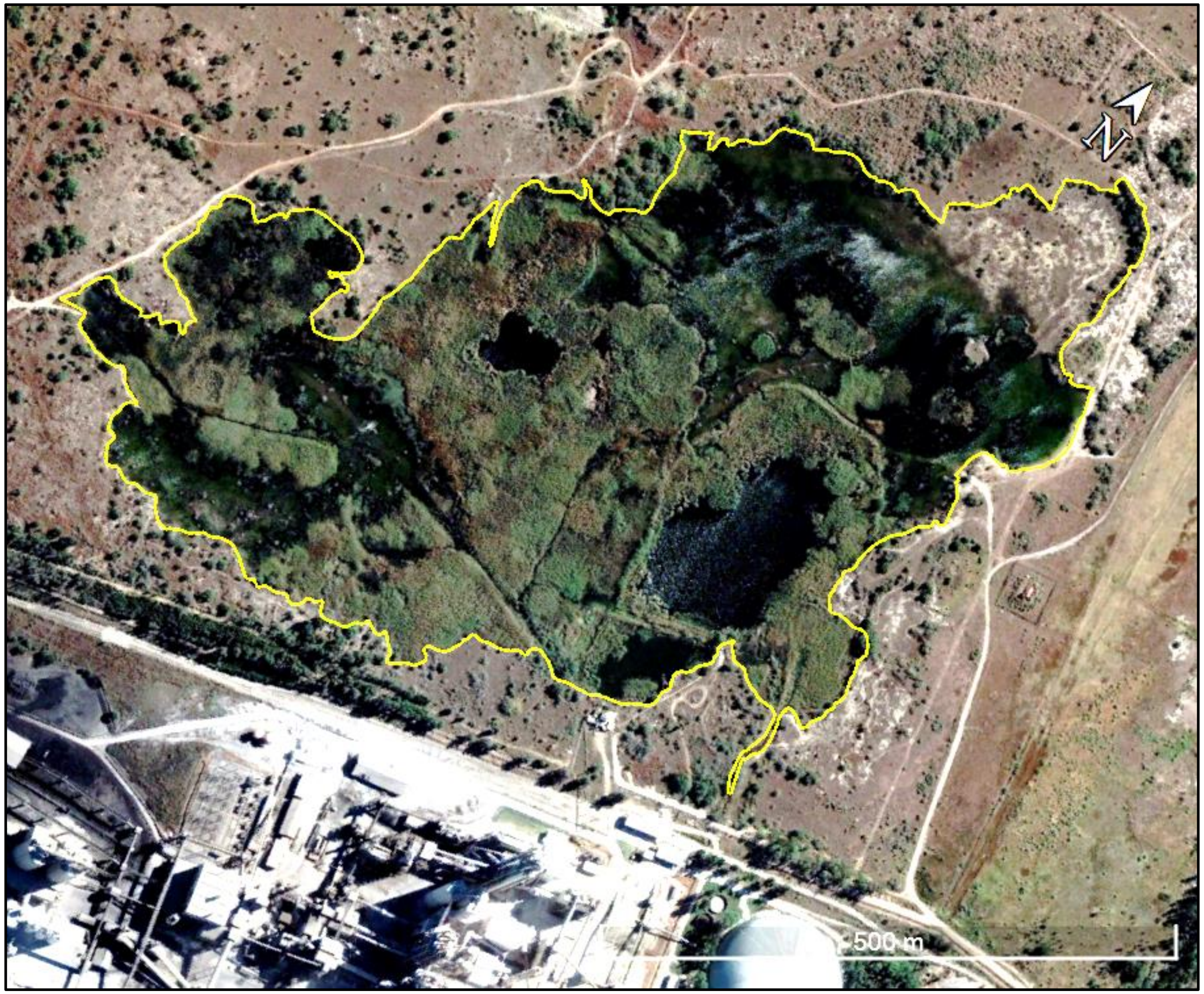


Figure 13: NFEPA wetland at a near full water level

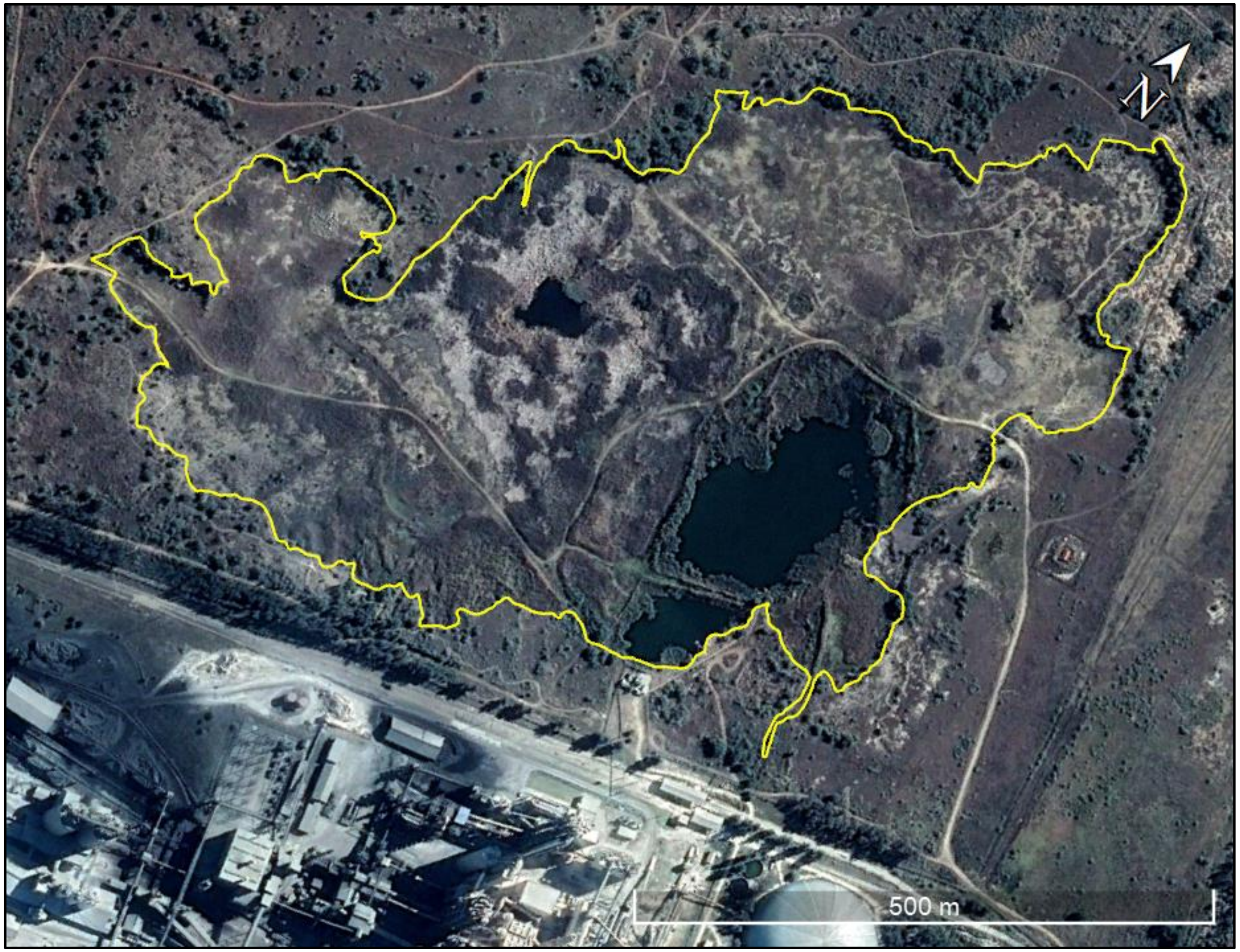


Figure 14: NFEPA wetland in a dry year (May 2016)

It is clear that the wetland is totally artificial as an aerial survey picture from 1944 shows no such feature at the site. See **Error! Reference source not found.**.

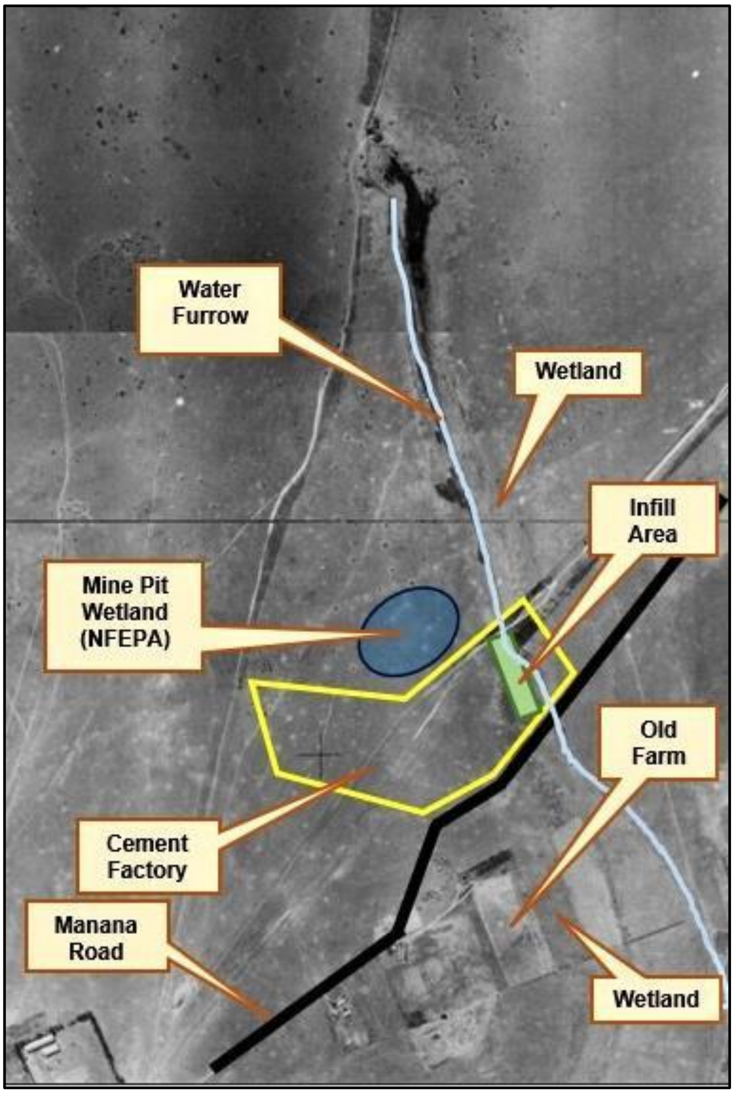


Figure 15: Aerial photo from 1944 showing features in the study area

Within the wetland, the vegetation is a complex and variable mosaic of wetland obligate and facultative plant species with a surrounding fringe of trees, bushes and forbs. Table 11 lists the aquatic plant species observed.

Table 11: Plant species noted in the NFEPA wetland area

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

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

In the veld on the northern and eastern sides of the wetland, and within the security fence which surrounds the area, the indigenous and alien terrestrial plant species listed in Table 12 and

Table **13** were investigated.

Table 12: Indigenous plant species observed in the veld around the NFEPA wetland

Scientific Name	Common Name	Status
Alectra sessiliflora	Verfblommetjies	LC
Aloe maculata	Common soap aloe	LC
Anthericum cooperi	Cooper's anthericum	LC
Anthospermum cf hispidulum	Herb	LC
Aristida congesta	Buffalo grass	LC
Asparagus laricinus	Cluster-leaved asparagus	LC
Barleria macrostegia	Bush violet	LC
Berkheya radula	Stout perennial herb	LC
Berkheya speciosa	Beautiful berkheya	LC
Bulbine angustifolia	Robust bulbine	LC
Chamaecrista mimosoides	Dwarf cassia	LC
Clutia cf cordata	Grassland clutia	LC
Corchorus asplenifolium	Prostrate shrublet	LC
Crabbea angustifolia	Narrow-leaved prickle head	LC
Crotolaria orientalis	Besembos	LC
Cucumis zeyheri	Wild cucumber	LC
Cynodon dactylon	Kweek grass	LC
Dicoma anomala	Reclining dicoma	LC
Dicoma macrocephala	Prostrate herb	LC
Dimorphotheca fruticosus	Trailing African daisy	LC
Eragrostis chloromelas	Blue love grass	LC
Eragrostis curvula	African love grass	LC
Euphorbia inaequilatera	Milkweed	LC
Euphorbia striata	Milkweed	LC
Felicia muricata	White felicia	LC
Geigeria burkei	Vermeerbos	LC
Gomphocarpus fruticosus	Spindle shaped fruit	LC

Scientific Name	Common Name	Status
Gymnosporia senegalensis	Confetti tree	LC
Helichrysum aureonitens	Golden helichrysum	LC
Helichrysum cf caespititium	Mat forming herb	LC
Helichrysum ecklonis	Everlasting	LC
Helichrysum nudifolium	Hottentot's tea	LC
Helichrysum rugulosum	Tufted helichrysum	LC
Hermannia depressa	Creeping red hermannia	LC
Hyparrhenia hirta	Thatch grass	LC
Hypoxis cf rigidula	Star flower	LC
Indigofera cf ingrata	Red flowered indigofera	LC
Indigofera daleoides	Perennial herb	LC
Indigofera hilaris	Perennial shrublet	LC
Ipomoea crassipes	Trailing Ipomoea	LC
Ipomoea obscura	Yellow morning glory	LC
Ipomoea plebeia	Annual twiner	LC
Jamesbrittenia aurantiaca	Cape saffron	LC
Lactuca inermis	Bird's brandy	LC
Lantana rugosa	Small marsh daisy	LC
Ledebouria marginata	Edge-leaved squill	LC
Leucas capensis	Small shrubby herb	LC
Lippia rehmannii	Lemon bush	LC
Lobelia erinus	Trailing lobelia	LC
Melhania rehmannii	Dwarf shrub	LC
Melinis repens	Natal red-top grass	LC
Nidorella resedifolia	Stinkkruid	LC
Oxalis obliquifolia	Sorrel	LC
Pollichia campestris	Waxberry	LC
Polygala amatymbica	Dwarf polygala	LC
Polygala hottentotta	Small purple broom	LC
Protasparagus laricinis	Cluster-leaved Asparagus	LC
Rhus (Seersia) cf lancea	Karee	LC
Salvia repens	Perennial herb	LC
Scabiosa columbaria	Wild scabiosa	LC
Setaria sphacelata	Bristle grass	LC
Senecio isatideus	Dan's cabbage	LC
Sida dregei	Spiderlegs	LC
Solanum panduriforme	Bitter apple	LC
Thesium utile	Besembossie	LC
Tristachya leucothrix	Hairy trident grass	LC
Typha capensis	Bulrush	LC
Wahlenbergia grandiflora	Giant bell flower	LC
Wahlenbergia undulata	Herb	LC
Walafrida densiflora	Many flowered herb	LC
Ziziphus zetheriana	Haakbessie	LC

Note: LC Least Concern

Table 13: Alien plant species observed in the veld around the NFEPA wetland

Scientific Name	Common Name	Status
Anagalis arvense	Bird's eye	
Argemone ochroleuca	White Mexican poppy	Invader 1b
Bidens pilosa	Blackjack	
Circium vulgare	Scotch thistle	Invader 1b
Conyza albida	Tall fleabane	
Coronopus didymus	Carrot Weed	
Euphorbia heterophylla	Wild pointsettia weed	
Flaveria bidentis	Smelter's bush	Invader 1b
Galinsoga parviflora	Gallant soldiers	
Gomphrena celosioides	Bachelor's buttons	
Heliotropium amplexicaule	Blue heliotrope	
Hypochaerus radicata	Hairy wild lettuce	
Ipomoea purpurea	Common morning glory	Invader 1b
Lantana camara	Common lantana	Invader 1b
Melilotus albus	White Sweet Clover	
Melilotus indicus	Annual Yellow Sweet Clover	
Nicotiana glauca	Wild tobacco	Invader 1b
Oenothera rosea	Pink evening primrose	
Oenothera speciosa	Large pink flower -Garden escape	
Oenothera indecora	Evening primrose	
Opuntia cf ficus-indica	Sweet prickly pear	Invader 1b
Opuntia imbricata	Imbricate prickly pear	
Plantago lanceolata	Narrow leaved ribwort	
Pyracantha angustifolia	Yellow firethorn	Invader 1b
Tagetes minuta	Tall khaki weed	
Taraxacum officinale	Common dandelion	
Tragopogon dubius	Yellow goat's beard	
Verbena bonariensis	Tall verbena	Invader 1b
Verbena brasiliensis	Slender verbena	Invader 1b
Verbena officinalis	Common vervain	
Verbena tenuisecta	Fine leaved verbena	
Verbesina ancelioides	Wild sunflower	
Zinnia peruviana	Redstar zinnia	

Birdlife around the wetland was abundant with birds such as Herons, Coots, Grebes, Moorhens, Ducks and Fish Eagle (*Haliaeetus vocifer*) being noted. Fish species seen included Carp (*Cyprinus carpio*), Mocambique Tilapia (*Oreochromis mossambicus*), and Banded Tilapia (*Tilapia sparmanii*). Aquatic invertebrates such as Dragonflies, Damselflies, and Chironomids were present in large numbers. Thus a healthy aquatic system is indicated.

13.3 Wetland Unit Identification

The wetland may be classified as a Depression after Ollis *et al* (2013) as shown in Figure 16, but must be recognised as being artificial. The site has no natural channels for either inflow or outflow of water and so is largely dependent on ground water and rainwater for its inputs. Further inputs come from flows from the factory area, and from pumped water from Borehole 3.

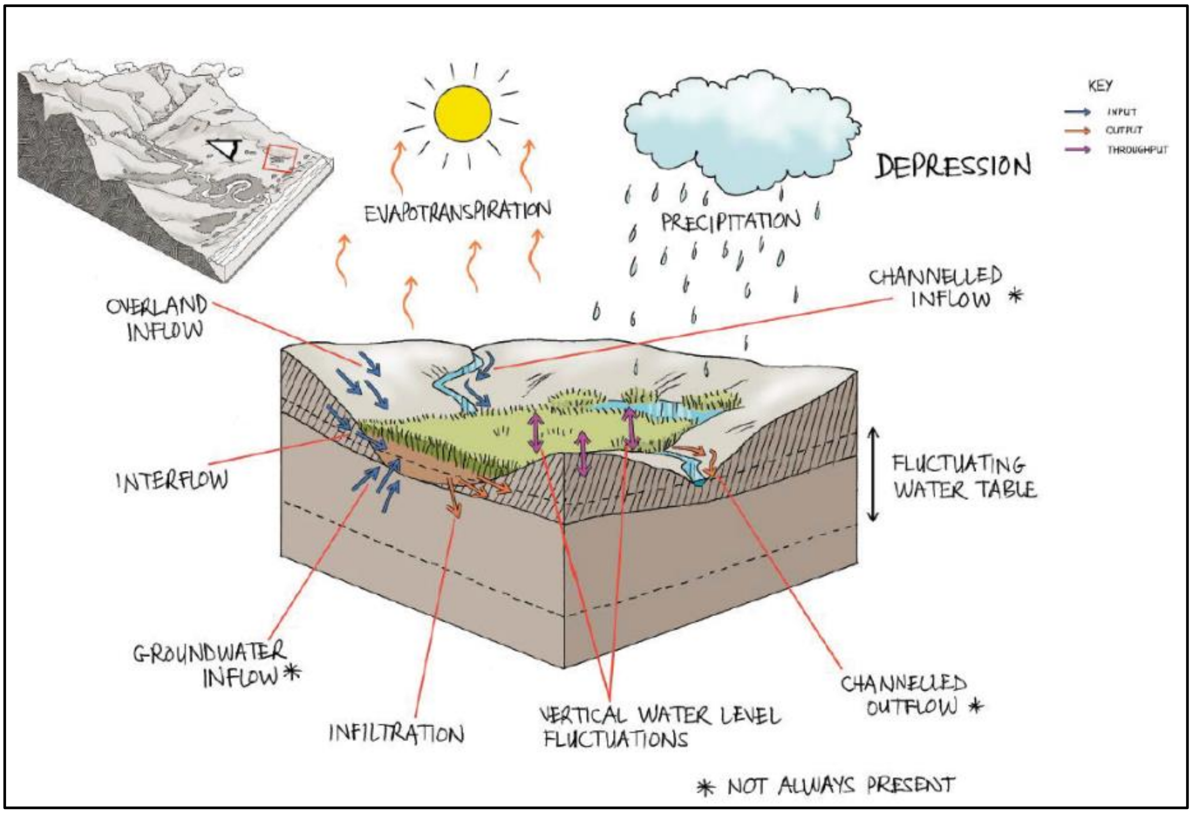


Figure 16: Schematic representations of a Depression Wetland

13.4 Wetland Setting

The wetland is located on what was originally a hillside with a low gradient. However, the area around it has been totally transformed by various human activities which are all linked to the cement factory and to past mining. To the south is the factory while the rest, including the UVB wetland, has all been mined at some time in the past. The local mining activities were all terminated at least 10 years ago but obviously the factory remains. To the north, outside the old mining area, is open veld (Carltonville Dolomite Grassland. Type Gh 15). Details of the wetland in its catchment are given in **Error! Reference source not found.**.

Table 14: Characteristics of the NFEPA wetland system

Quaternary Catchment	River System	Wetland Type	NFEPA Condition Rating	Water Management Area	Bioregion
C31A	Harts – Vaal - Orange	Depression (Artificial)	Category C	Lower Vaal	Dry Highveld Grassland

13.5 Wetland Functionality

While the WET-EcoServices tool would normally be used to determine the functionality of the site, the artificial nature of the wetland precluded some of the inputs in the model. Therefore, although Version 1 was attempted, and the outputs are shown in Table 15 and Figure 17 they are not believed to be entirely credible.

Table 15: Potential ecosystem services delivered by the NFEPA wetland system

Wetland Unit					Depression*
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		1.5
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Streamflow regulation		2.5
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Water Quality enhancement benefits	Sediment trapping	0.9
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Water Quality enhancement benefits	Phosphate assimilation	1.7
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Water Quality enhancement benefits	Nitrate assimilation	2.3
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Water Quality enhancement benefits	Toxicant assimilation	1.5
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Water Quality enhancement benefits	Erosion control	3.0
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Carbon storage		2.0
Ecosystem Services Supplied by Wetlands	Direct Benefits	Biodiversity maintenance			3.3
Ecosystem Services Supplied by Wetlands	Direct Benefits	Provisioning benefits	Provisioning of water for human use		0.9
Ecosystem Services Supplied by Wetlands	Direct Benefits	Provisioning benefits	Provisioning of harvestable resources		0.0
Ecosystem Services Supplied by Wetlands	Direct Benefits	Provisioning benefits	Provisioning of cultivated foods		0.0
Ecosystem Services Supplied by Wetlands	Direct Benefits	Cultural benefits	Cultural heritage		0.0
Ecosystem Services Supplied by Wetlands	Direct Benefits	Cultural benefits	Tourism and recreation		1.7
Ecosystem Services Supplied by Wetlands	Direct Benefits	Cultural benefits	Education and research		2.3
Overall Total Score					23.7
Average Ecosystem Service Score					1.3
Threats to Existing Ecosystem Services					1.0
Opportunities for Enhancing Ecosystem Services					2.0

The Streamflow Regulation and Erosion Control scores are derived from the presence of dense vegetation but, in the absence of surface outflows, are meaningless. The high Biodiversity Maintenance score is justified by site observations and the system clearly has potential for Education and Research.

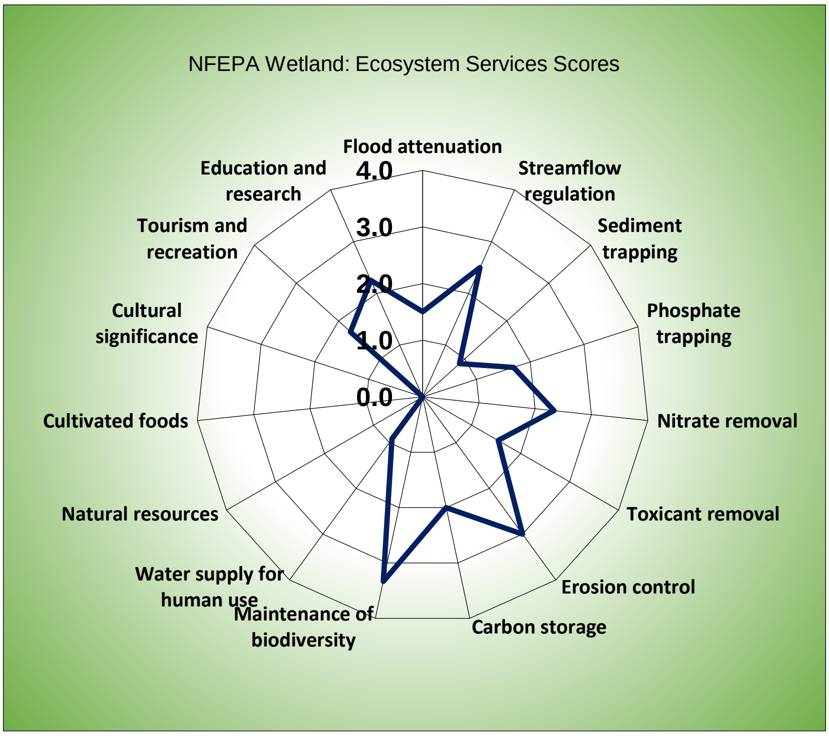


Figure 17: Ecosystem service scores potentially delivered by the NFEPA wetland system

13.6 Wetland Health

While the WET-Health tool would normally be used to determine the PES of the wetland, its required inputs cannot be met by the conditions at the NFEPA Wetland site since there are no relevant surface catchment features, either upstream or downstream. For this reason, an assessment of the PES is based on the apparent state of the wetlands when compared with other infilled mine pits in the region. In particular the site was compared to those at the Lafarge Tswana mine located some 40 km to the west. In addition, it is noted that the NFEPA site varies considerably between wet and dry years and so its ecological state will also vary accordingly. Therefore, the site is rated to have a variable PES ranking that fluctuates between Category D and Category B. At times its functionality would suggest a PES Category A system but application of this score to an artificial wetland may be questionable.

13.7 Wetland Ecological Importance and Sensitivity

Because the wetland models are not able to properly assess the NFEPA site, the EIS is stated on the basis of professional opinion. It is believed that the site has high ecological importance as it is able to support a rich aquatic biodiversity in a region which is very dry at times. It is thus able to function as a refuge at times when other systems are completely dry on the surface and so to act as a source of recolonisation for times of wetter conditions.

The terrestrial vegetation around the site is also of high value as it is protected from grazing by livestock animals and so, although mined in the past, now has good indigenous plant diversity.

14. CONSIDERATION OF IMPACTS

The NFEPA wetland is an artificial system but is ecologically dynamic. Thus, although it has no natural catchment it could still be experiencing some forms of impact and two are considered here.

- Increase of contaminant inputs from the cement factory. While some water is taken from the wetland for use in the factory, there are also return flows of water which could be contaminated. However, at present some of the stormwater from the factory area flows into the wetland as well. This water can be contaminated with dust, powdered ash, and powdered coal. Thus it has potential to degrade the quality of the water in the receiving system.
  However, Lafarge is in the process of refining its stormwater management system and the installation of several new pollution control dams is a part of the process. (JG Afrika, 2021 (2)) Thus stormwater leaving the factory area in future should be of a better quality than at present.
- Greater uptake of water from the wetland basin. At present the uptake of water from the wetland does not appear to be having any great effect on the wetland, and especially so as some is returned. However, it is possible that water demand may increase in the future and so water levels in the wetland might be drawn down.
  The coming rehabilitation of the wetland which passes through the factory area calls for some water to be pumped across from the pit wetland and this will accelerate the lowering of the water level in the donor system.

Using the impact scoring system shown in Annexure B, the impacts are rated as follows in Table 17. Mitigatory measures to reduce the impacts are set forward in Table 16.

Table 16: Mitigatory measures for the impacts on the NFEPA wetland

Listed Impact	Mitigatory Measures
Increase of contaminant inputs from the cement factory.	A stormwater management plan for upgrading the surface stormwater in the factory is under preparation. This plan includes both improved movement of the water around the factory area and a number of new pollution control dams. Water from the dams will be reused once it is suitably cleaned. If there is a surplus,

Listed Impact	Mitigatory Measures
	and if the water is sufficiently clean to meet the DWS waste water standards, some may be returned to the open environment.
Greater uptake of water from the wetland basin.	Future upgrades to the factory may require that a greater quantity of water is taken from the NFEPA wetland. The following mitigatory measures are recommended: • Future developments must be designed to be as water efficient as possible. Consideration must be given to re-use of water for different purposes before it is released from the system. • The pollution control dams must be as large as is feasible and design features such as labyrinth channels to improve circulation and surface contact should be considered. • Water pumping to the factory wetland must be stopped once the level in the NFEPA wetland drops below a specified level irrespective of the season or weather conditions. It is provisionally suggested that this level will be such that some connection between the two deepest parts of the old mine is retained.

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 the cement factory has been operational for over 60 years and that, at the present time, poses few new risks to the wetland system other than from the infill area on its own land, and from possible contamination of stormwater emanating from the factory. The outputs from the matrix are shown in Table 18.

It is shown that the risks arising from the infill are rated as “Moderate” although measures are presently under way which will reduce them to “Low”.

16. CONSIDERATION OF BUFFERS

The NFEPA wetland has relatively low need for buffers as it is an entirely artificial system which is largely disconnected from its surrounds. However, it is recommended that the area enclosed by the Lafarge security fence be regarded as a buffer on the sides opposite the cement factory. This area contains some indigenous vegetation and is an asset to the area around the wetland should it ever be used for educational or research purposes.

Table 17: Assessment of impacts on the NFEPA wetland

Mitigation	Environmental Impact	Consequences of the impact	Spatial extent	Probability	Reversibility	Resource Loss	Duration	Severity/Intensity / Magnitude	Significance
Without Mitigation	Increase of contaminant inputs from the cement factory	Increased contaminant inputs could threaten the quality of the water	1	3	2	3	1	2	20 Negative Low
With Mitigation			1	1	1	1	1	1	6 Negative Low
Without Mitigation	Greater uptake of water from the wetland basin	Greater water uptake could lower the water level and thereby affect the ability of the aquatic flora to purify the water	1	3	2	3	1	3	30 Negative Medium
With Mitigation			1	2	2	2	1	2	16 Negative Low

Table 18: Assessment of current risks to the wetland in the study area

With/ Without Mitigation	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk rating	Confidence Level
Pre- mitigation	Increase of contaminant inputs from the cement factory	Fine sediments in stormwater runoff will contaminate the wetland system	Contamination of the system with fine sediment which could impact on aquatic biodiversity.	**2**	**5**	**13**	**65**	**MODERATE RISK**	**80**
Post- mitigation				**1,25**	**4,25**	**11**	**46,75**	**LOW RISK**	**80**
Pre- mitigation	Greater uptake of water from the wetland basin	Future demand for water by the factory could result in drop of water levels in the wetland	Greater water uptake will lead to drying out of the wetland	**2,75**	**5,75**	**11**	**63,25**	**MODERATE RISK**	**90**
Post- mitigation				**1,5**	**4,5**	**9**	**40,5**	**LOW RISK**	**80**

17. CONCLUSION AND RECOMMENDATIONS

17.1 Background

The Lafarge cement factory in Lichtenburg 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 assessment. It is to be noted that the application is not linked to further development of the factory itself but merely to legislative compliance. Therefore, no new impacts on the wetlands are anticipated, although activities presently being undertaken by the company will lead to improvements in the condition of the wetlands.

The two wetlands which are the subject of this report are both currently affected by activities relating to the cement factory. The linear system which is included in Wetland Map 5 passes through the grounds of the factory and has been infilled with waste materials. A Compliance Notice from the DFFE calls for rehabilitation at the site and, to that end, an assessment was undertaken and specific management measures were recommended. That department accepted the report and has approved a suite of management measures. Similar approval from the DWS is necessary before *in situ* operations can be started and this document is a part of obtaining such approval.

The NFEPA listed wetland which lies to the immediate north of the factory is artificial as it is an old mine pit which has become filled with water. It is used as a source of water by the factory and some water is returned to it. It is proposed that some water from this site is used to accelerate recovery of the linear wetland once the infill site has been cleared and rehabilitated.

17.2 Management / Rehabilitation Measure Proposed

The rehabilitation measures for the wetland, which has been infilled, are documented in a report (JG Afrika, 2021 (2) but are summarised below:

The initial measures consist of establishing a shallow channel which is 30 m wide through the cement factory area. First, the existing culverts which are obstructing flows would be either enlarged or removed. Then the area involved would be cleared of waste material down to the natural soil surface and the banks would be gently sloped on the eastern side. They would then be covered with topsoil, is needed, and would be planted over with indigenous grass such as the Kweek grass, which is already present in the upper wetland area. The remaining area would be reshaped, topsoiled, and also planted with grass. All the waste material will be removed from the site to an appropriate site which must be at least 1000 m from the wetland. An old and disused mine pit may be used for the purpose.

In addition, the large gum (Eucalyptus) trees which are present will be felled as they both take up water from the area, and are a threat to certain factory infrastructure. A limited amount of additional water is to be supplied if needed by pumping from the mine pit wetland.

Conservation measures for the NFEPA wetland consist partly of establishing a managed area around it. An existing razor wire fence encloses the site and it is suggested that an alien weed control programme be implemented within it. The most significant species in this regard is *Pyracantha angustifolia* (Yellow Firethorn) which may respond to glyphosphate based herbicides. As a further part of the management, the area should be subject to occasional burning at the start of the rain season. Further local advice should be obtained, especially as the region is known for subterranean peat fires, but it is probable that a two or three year rotation between burns should be followed. A burning management plan should be produced if veld burning is to be undertaken.

Both of the wetlands receive runoff from the factory grounds and a new stormwater management plan has been prepared and is to be implemented. This plan includes pollution control dams which will prevent contaminated water from leaving the factory grounds. The reduction in in contaminated runoff will be a direct benefit to the ecology of the wetlands. These actions are summarised in Table 19 below. They should however be read in conjunction with the wetland rehabilitation management plan in JG Afrika (2021).

Table 19: Summary of proposed management actions

Management Action		Intended Purpose
Cement Factory Infilled Wetland		
i.	Remove alien vegetation from the infill area.	To clear the area as a first step for further management operations.
ii.	To enlarge the wetland crossings (road and rail) which are to be retained and to remove those that are no longer in use. This work is to be done as per the specifications of the 1:50 year flood control plan.	To provide space for water to flow unimpeded through the area. It is to be noted that this action will assist both surface and near surface flows.
iii.	To remove all the infill material from the area identified in the Compliance Notice issued to Lafarge. The material is to be properly disposed of.	To remove the material that is presently choking the system.
iv.	To establish a 30 m wide channel for the wetland and to landscape the adjacent cleared areas. An earth berm to separate the wetland channel from the raw stormwater control system must be raised.	To rebuild the wetland channel and to shape and stabilize the surrounds.
v.	To install a water supply system which will feed from the NFEPA wetland and boost flows in the factory wetland. The discharge point is to release the water	The augmented water supply will provide a boost for re-establishment of vegetation in the channel.

Management Action		Intended Purpose
	approximately 25 cm below ground level.	
vi.	To revegetate both the wetland channel and the surrounding areas. The initial cover will consist of grasses such as Kweek grass but introduction of wetland species may be done once the area is wetted again.	The grass will serve to initiate the revegetation of the area and so will stabilize the soil. Introduced wetland plants will rebuild a true wetland vegetation cover.
NFEPA WETLAND		
i.	The stormwater control plan (JG Afrika, 2021 (2)) must be approved and implemented as rapidly as possible.	The plan includes measure to prevent contaminated water from entering the wetlands.
ii.	Pumping of water to the rehabilitated wetland section in the factory grounds may be done but must be stopped should the water level in the NFEPA wetland drop to a predefined level.	The NFEPA wetland must not be adversely affected for the sake of wetting the factory wetland (Wetland to be rehabilitated). The issue will arise in dry seasons when the latter will be naturally dried out by the conditions.
iii.	Any future developments in the factory itself must be designed to be as water efficient as possible.	Water availability is restricted and wetland loss to provide water to the factory must be minimised to the greatest possible extent.

It is strongly recommended that the proposed management and rehabilitation measures be implemented as soon as possible. The area has been experiencing a series of good rainfall years but, inevitably, dry years will happen again at some point in the future. The stresses imposed on the wetlands under dry conditions will be relieved to some extent by the management measures and so should be implemented without delay.

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 cement factory. The wetlands have been assessed in terms of their functionality and ecological condition as is required. The finding has been that an Unchannelled Valley Bottom system which passes through the factory grounds has been totally filled in with factory wastes. However, a separate study and report (JG Afrika, 2021) provided detail on the site and a rehabilitation plan. The plan is under review by the DFFE and Lafarge may, in terms of the National Environmental Management Act (Act No. 107 of 1998) only proceed with the rehabilitation works once it is approved. This action now also awaits approval in terms of the National Water Act (Act No. 36 of 1998) from the DWS and is supported by this document.

A second, but artificial wetland, which is listed in the NFEPA wetland database, lies in a disused mine pit adjacent to the factory. This system provides some water for the factory and has a high biodiversity conservation value. It is worthy of conservation effort and relevant measures are proposed.

Lafarge has recognised the need to protect the wetlands under its care and relevant studies, documentation, and planning have been undertaken. It is recommended that the requisite legal procedures be rapidly completed so that the rehabilitation and management of the wetlands may proceed as soon as possible.

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Annexure A
Images of the infilling progression at the Lafarge cement factory site

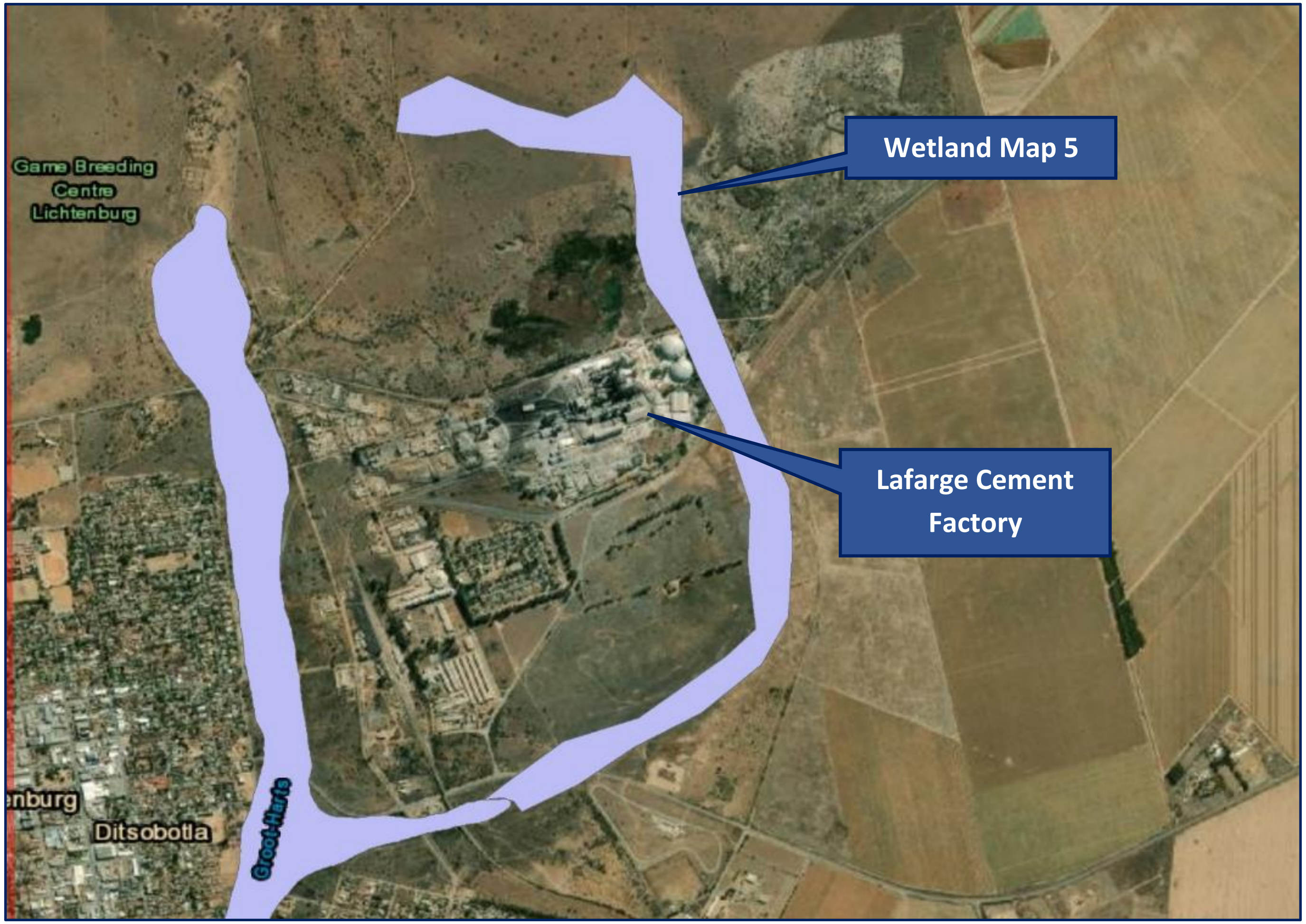

Figure 1. Lafarge cement factory showing the proximity of the National Wetland Map 5 system

Figure 2. Lafarge Infill Site. October 2003.

Figure 3. Lafarge Infill Site. July 2008.

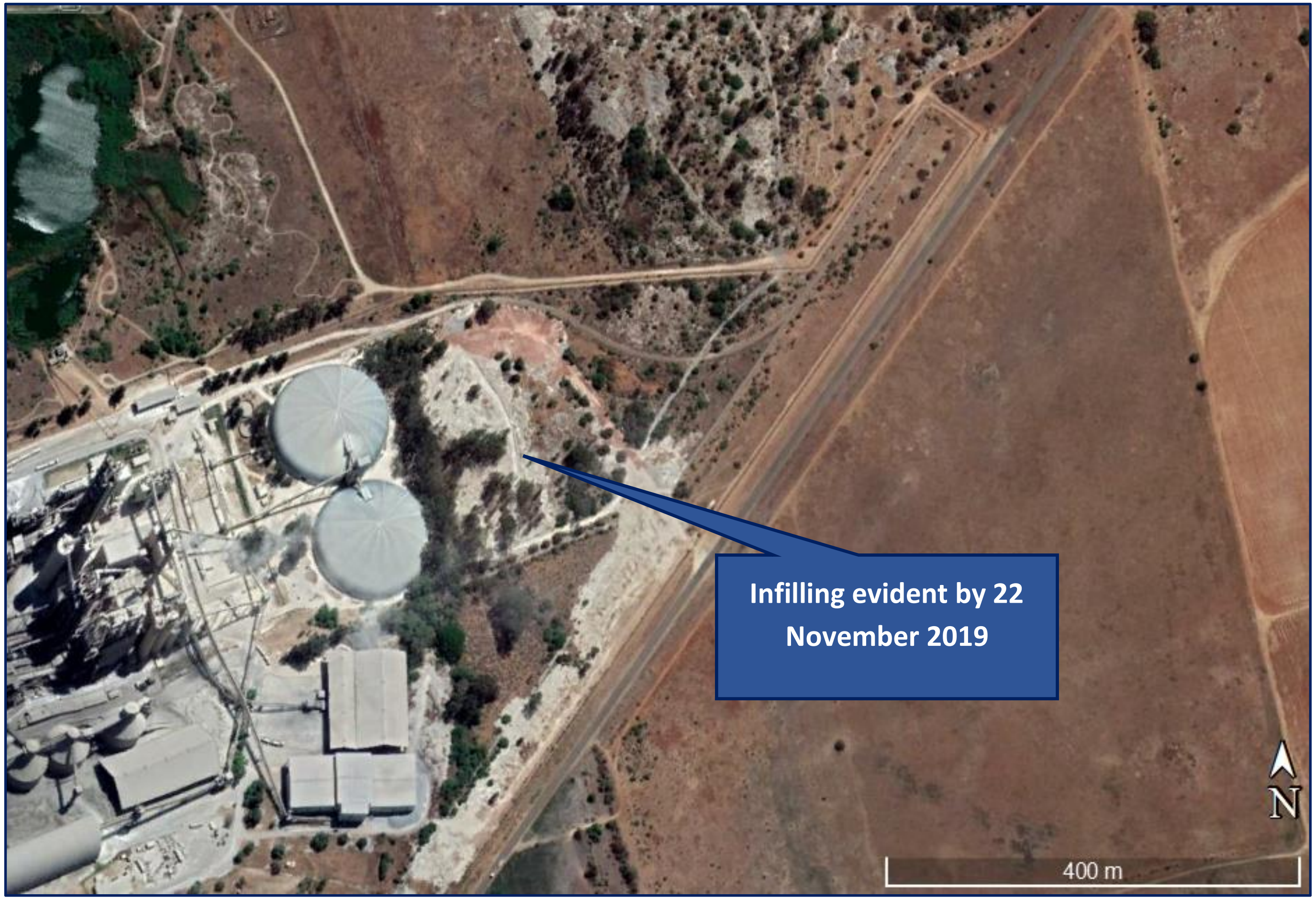

Figure 4. Lafarge Infill Site. November 2019.

Annexure B
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.