



Afrimat Bethlehem Quarry, Bethlehem, Free State Province.

Aquatic Biodiversity Assessment

April 2026

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EXECUTIVE SUMMARY

Limosella Consulting (Pty) Ltd has been appointed by Afrimat, specifically for the Afrimat Bethlehem Quarry, to undertake a desktop follow-up aquatic biodiversity assessment for the existing quarry operation located near Bethlehem in the Free State Province. The assessment is required to inform the amendment of the existing Environmental Management Programme Report (EMPr) for the quarry and to provide updated aquatic specialist input in relation to the validity, applicability and management recommendations contained in the previous Aquatic Biodiversity Assessment compiled for the site in October 2021.

Fieldwork was conducted on the 29th and 30th of October 2021. The terms of reference for this assessment were as follows:

- Confirm, at a desktop level, whether the watercourse delineations and aquatic sensitivity findings presented in the 2021 Aquatic Biodiversity Assessment remain applicable to the current EMPr amendment process.
- Review available aerial imagery, available layout information and relevant project information to determine whether any obvious changes to the quarry footprint, stormwater flow paths or receiving aquatic environment are evident when compared with the conditions assessed in 2021.
- Confirm the classification of the previously identified watercourse units according to the system proposed in the National Wetland Inventory, where relevant.
- Review the previous functional, integrity and sensitivity assessment findings for the wetland areas within the assessment area, as previously undertaken in accordance with the requirements of General Notice 267 of 24 March 2017.
- Review the previous buffer recommendations and confirm whether the buffer zones recommended in the 2021 assessment remain applicable, with reference to General Notice 267 of 24 March 2017 and the buffer zone guidelines of Macfarlane & Bredin (2017).
- Undertake a desktop-level review of potential aquatic impacts associated with the ongoing quarry operation, with specific reference to the requirements of the NEMA 2014 Environmental Impact Assessment Regulations, as amended.
- Undertake a desktop-level review of potential water use risks associated with the ongoing quarry operation, with reference to the Revised General Authorisation published under Government Notice 4167 of 8 December 2023, where applicable. The revised General Authorisation applies to section 21(c) and 21(i) water uses within the regulated area of a watercourse and is the current gazetted framework for such risk assessment considerations.
- Identify the key aquatic risk areas relevant to the EMPr amendment process, with particular emphasis on stormwater management, sediment mobilisation, erosion, water quality deterioration, dust deposition where relevant to aquatic receptors, and possible impacts on the floodplain wetland and Loch Athlone Dam.
- Assess, at a desktop level, the likely cumulative implications of the continued quarry operation on the watercourse assemblages within the local receiving environment, based on the findings of the 2021 assessment and available updated information.



- Provide practical, implementable and auditable management and mitigation measures for incorporation into the amended EMPr, including measures to avoid, minimise, manage and monitor potential impacts on watercourse ecology.
- Provide recommendations regarding opportunities and constraints associated with the ongoing operation of the existing quarry, with the aim of preventing deterioration of the identified watercourses and maintaining the ecological condition of the downstream aquatic receiving environment.

The 2021 assessment confirmed that no natural watercourses occur within the Mining Right Authorisation Area itself. However, three wetland systems were identified within the broader 500 m Department of Water and Sanitation regulated area, namely an unchannelled valley bottom wetland, a hillslope seepage wetland and a floodplain wetland associated with Loch Athlone Dam and the Jordaan River system. The Loch Athlone Dam system drains into the Jordaan River, which flows into the Liebenbergsvlei River and ultimately into the Vaal Dam.

The previous wetland classifications, ecological descriptions and buffer recommendations are considered to remain applicable for the purposes of the current desktop follow-up assessment, provided that the quarry footprint, stormwater flow paths and operational infrastructure have not materially changed since the 2021 assessment. The previously calculated buffers are 47 m for the unchannelled valley bottom wetland, 62 m for the hillslope seepage wetland and 39 m for the floodplain wetland. These wetlands and their buffers must be treated as sensitive no-go areas for unauthorised disturbance, stockpiling, dumping, vehicle movement, dirty water discharge or infrastructure expansion.

The unchannelled valley bottom wetland and hillslope seepage wetland are unlikely to be directly affected by the existing quarry operation due to their location relative to the quarry and the local topography. The floodplain wetland associated with Loch Athlone Dam and the Jordaan River system is the primary aquatic receptor of concern, as this system is the most likely to receive indirect impacts from quarry-related stormwater, sediment mobilisation, erosion, dirty water movement, dust deposition or water quality deterioration.

The main management requirement for the amended EMPr is therefore the effective control, maintenance and monitoring of stormwater and surface water movement from the quarry. Clean and dirty water separation must be maintained, dirty water must be contained on site, stormwater outlets must be stabilised, sediment-control structures must be maintained, and erosion-prone areas must be monitored and rehabilitated where required. Particular attention should be given to stormwater outlet points, wetland-facing drainage pathways, dirty water containment areas, haul roads, stockpiles, exposed disturbed surfaces and any areas where runoff may move towards the floodplain wetland or Loch Athlone Dam.

The DWS Risk Assessment Matrix was limited to operational-phase activities associated with the existing quarry footprint, stormwater and surface water management, and ancillary operational infrastructure such as haul roads, stockpiles, overburden areas, workshops, fuel or chemical storage areas and vehicle movement. Based on the current assessment assumptions and the mitigation measures provided in this report, the operational risks are expected to remain within the Low risk category after mitigation. No impact is expected to remain above Low risk after mitigation, provided that the quarry footprint remains outside the delineated wetlands and buffers and that the recommended management measures are implemented.



A Water Use Licence Application would become more clearly motivated from a risk perspective if any operational activity scores Medium or High after mitigation, or if future site changes result in direct wetland disturbance, encroachment into calculated buffers, uncontrolled dirty water discharge, active erosion into a watercourse, or materially altered runoff pathways towards the wetlands. Any future expansion of the quarry footprint, stockpile areas, access roads, processing areas or stormwater infrastructure should therefore be screened against the delineated wetlands, calculated buffers and DWS regulated area before implementation.

The important factors relevant to Environmental Authorisation for the project, are summarised in the table below:

Quaternary Catchment and WMA areas	B11F Vaal-Orange (VOCMA) #5, Vaal Major: rivers include the Wilge, Liebenbergsvlei, Mooi, Renoster, Vals, Sand, Vet, Harts, Molopo and Vaal		
Watercourse	Non-perennial drainage features occur west and southwest of the quarry, while mapped wetland areas occur mainly to the east and southeast in association with Loch Athlone Dam and the Jordaan River floodplain. • Two nearby dams are listed as Rank 6 wetlands, Loch Athlone Dam to the east and Gerrards Dam 1.36km to the south		
Classification (SANBI, 2013)	Valley Bottom Wetland	Floodplain	Seepage Wetland
PES (Macfarlane <i>et al.</i>, 2020).	3.4 C - Moderately modified.	5.6 D - Largely modified.	1.3 B- Largely natural with few modifications.
WetEcoServices	All scores very low and only cultivated foods scoring a low	Ranging from very low to very high with tourism and water for human use scoring the highest.	Generally, very low to low with Biodiversity management and tourism scoring very high
EIS (Kotze, <i>et al.</i>, 2020)	High Category	Moderate Category	High
REC (Rountree <i>et al.</i>, 2013)	Maintain the EC at C.	Improve the EC to a High D or C.	Improve the EC to a High B or A.
Buffer Zone (Macfarlane <i>et al.</i>, 2015)	47 m	39 m	62 m
DWS 2024 Risk Assessment	The risks fall within the Low Risk (1–29) category, reflecting the established nature of the infrastructure, the limited direct footprint within wetland boundaries, and the implementation of existing water management controls.		
National Screening Tool Findings	This study confirms that the natural wetlands are highly sensitive as indicated on the screening report.		



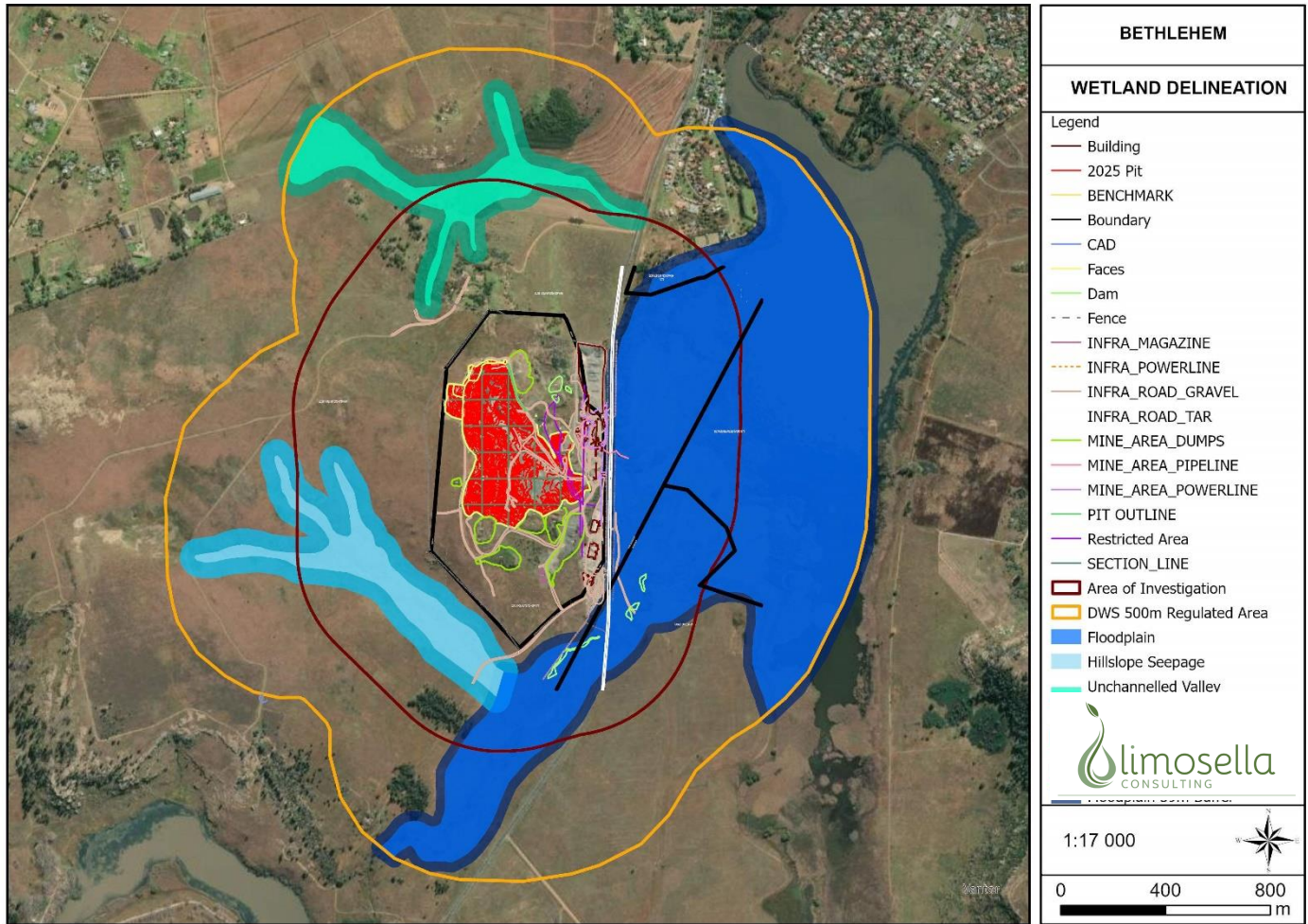


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1 Introduction

Limosella Consulting (Pty) Ltd has been appointed by Afrimat, specifically for the Afrimat Bethlehem Quarry, to undertake a desktop follow-up aquatic biodiversity assessment for the existing quarry operation located near Bethlehem in the Free State Province. The assessment is required to inform the amendment of the existing Environmental Management Programme Report (EMPr) for the quarry and to provide updated aquatic specialist input in relation to the validity, applicability and management recommendations contained in the previous Aquatic Biodiversity Assessment compiled for the site in October 2021.

Fieldwork was conducted on the 29th and 30th of October 2021.

1.1 Description of the Project:

Afrimat Bethlehem Quarry is an existing quarry operation located south of the town of Bethlehem in the Free State Province. The quarry is situated adjacent to the R26 road, with Loch Athlone Dam forming the eastern boundary of the site. Gerrards Dam is located to the southwest of the quarry, while the broader aquatic receiving environment is associated with the Jordaan River system, which ultimately drains into the Liebenbergsvlei River and thereafter into the Vaal Dam. The approximate central coordinates of the site are 28°15'52.96"S and 28°18'0.44"E.

The quarry is an established aggregate-producing operation. Public information available from Afrimat identifies the operation as Afrimat – Bethlehem Quarry / Afrimat Bethlehem Aggregates, forming part of Afrimat's construction materials business. The quarry produces aggregate materials including road stone, concrete stone, ballast, base, subbase, blasted rock and overburden.

The aquatic biodiversity assessment undertaken by Limosella Consulting in 2021 assessed the quarry in relation to the Water Use Licence Application process and the potential effects of the quarrying activities on nearby watercourses. That assessment found that no natural watercourses occur within the Mining Rights Area itself. However, three watercourse units were identified within the 500 m regulated area surrounding the quarry, namely an unchannelled valley bottom wetland, a hillslope seepage wetland and a floodplain wetland. The floodplain wetland is associated with Loch Athlone Dam and the Jordaan River system, while the hillslope seepage wetland is located within the Wolhutterskop Nature Reserve.

The previous assessment concluded that the local topography limits the likelihood of direct impacts from the quarry on the unchannelled valley bottom and hillslope seepage wetlands. These systems are positioned in such a way that surface runoff from the quarry is unlikely to drain directly into them. The floodplain wetland and Loch Athlone Dam, however, remain the primary aquatic receptors of concern, particularly in relation to stormwater runoff, sediment mobilisation, erosion, water quality deterioration and the possible discharge or movement of dirty water from quarry-related operational areas.

The current project relates to the amendment of the existing Environmental Management Programme Report for the Afrimat Bethlehem Quarry. The EMPr amendment is required because the existing EMPr is understood to be outdated and requires alignment with current site conditions, recent observations and the requirements of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended. As part of this process, the previous specialist studies are required to be reviewed to confirm whether they remain valid and aligned with the specific conditions that were previously assessed.



The present follow-up study is therefore limited to a desktop review of the previous aquatic biodiversity assessment, available aerial imagery and relevant project information. No additional field verification was undertaken as part of this follow-up assessment. The purpose of the current study is not to re-delineate the watercourses or repeat the 2021 functional assessments, but to determine whether the previous aquatic findings remain applicable and to provide additional practical, implementable and auditable management recommendations for inclusion in the amended EMPr.

The key focus of the current assessment is therefore the identification and refinement of aquatic risk areas associated with the existing quarry operation, with particular emphasis on stormwater management, sediment and erosion control, protection of the floodplain wetland and Loch Athlone Dam, and the prevention of deterioration of downstream wetland systems. The recommendations provided in this report are intended to support the drafting of measurable environmental outcomes and associated management actions for the amended EMPr.

1.2 Terms of Reference

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

- Confirm, at a desktop level, whether the watercourse delineations and aquatic sensitivity findings presented in the 2021 Aquatic Biodiversity Assessment remain applicable to the current EMPr amendment process.
- Review available aerial imagery, available layout information and relevant project information to determine whether any obvious changes to the quarry footprint, stormwater flow paths or receiving aquatic environment are evident when compared with the conditions assessed in 2021.
- Confirm the classification of the previously identified watercourse units according to the system proposed in the National Wetland Inventory, where relevant.
- Review the previous functional, integrity and sensitivity assessment findings for the wetland areas within the assessment area, as previously undertaken in accordance with the requirements of General Notice 267 of 24 March 2017.
- Review the previous buffer recommendations and confirm whether the buffer zones recommended in the 2021 assessment remain applicable, with reference to General Notice 267 of 24 March 2017 and the buffer zone guidelines of Macfarlane & Bredin (2017).
- Undertake a desktop-level review of potential aquatic impacts associated with the ongoing quarry operation, with specific reference to the requirements of the NEMA 2014 Environmental Impact Assessment Regulations, as amended.
- Undertake a desktop-level review of potential water use risks associated with the ongoing quarry operation, with reference to the Revised General Authorisation published under Government Notice 4167 of 8 December 2023, where applicable. The revised General Authorisation applies to section 21(c) and 21(i) water uses within the regulated area of a watercourse and is the current gazetted framework for such risk assessment considerations.
- Identify the key aquatic risk areas relevant to the EMPr amendment process, with particular emphasis on stormwater management, sediment mobilisation, erosion, water quality deterioration, dust



deposition where relevant to aquatic receptors, and possible impacts on the floodplain wetland and Loch Athlone Dam.

- Assess, at a desktop level, the likely cumulative implications of the continued quarry operation on the watercourse assemblages within the local receiving environment, based on the findings of the 2021 assessment and available updated information.
- Provide practical, implementable and auditable management and mitigation measures for incorporation into the amended EMP, including measures to avoid, minimise, manage and monitor potential impacts on watercourse ecology.
- Provide recommendations regarding opportunities and constraints associated with the ongoing operation of the existing quarry, with the aim of preventing deterioration of the identified watercourses and maintaining the ecological condition of the downstream aquatic receiving environment.



1.3 Assumptions and Limitations

- The current assessment is a desktop follow-up review and did not include a new field investigation. The findings are therefore based on the 2021 Aquatic Biodiversity Assessment, available spatial information, aerial imagery, available project information, and professional interpretation of whether the previously identified aquatic sensitivities and management recommendations remain applicable to the current EMPr amendment process.
- The 2021 Aquatic Biodiversity Assessment included fieldwork undertaken on 29 and 30 October 2021 and forms the primary baseline for the current desktop review. The current assessment does not replace the original wetland delineation, classification, functional assessment, buffer assessment or risk assessment, but reviews these findings in relation to the current EMPr amendment requirements.
- No additional soil sampling, vegetation sampling, wetland boundary pegging or in-field verification of watercourse boundaries was undertaken as part of the current follow-up assessment. The previously delineated watercourse boundaries are therefore accepted as the baseline delineations, unless obvious changes are identifiable from desktop information or aerial imagery.
- In accordance with Department of Water and Sanitation authorisation requirements, the previous assessment considered wetlands within 500 m of the quarry activities. Natural watercourses occurring outside the Mining Rights Area but within the regulated area were previously delineated through a combination of field verification and desktop interpretation. For the current desktop review, these delineations were reviewed using available aerial imagery and existing spatial information.
- The current assessment assumes that the existing quarry footprint, stormwater flow paths and operational areas have not changed in a manner that materially alters the hydrological relationship between the quarry and the previously identified watercourses. Should updated layout information, survey data, stormwater infrastructure plans or evidence of quarry expansion indicate a material change to runoff patterns, the findings and recommendations of this report may require amendment.
- The desktop review specifically focuses on aquatic biodiversity, watercourse risk areas, stormwater-related risks, erosion and sedimentation risks, water quality risks, and practical management measures relevant to the amended EMPr. It does not constitute a full new aquatic biodiversity assessment, wetland delineation study, hydrological study or engineering design review.
- The assessment is not intended to confirm the engineering adequacy of existing or proposed stormwater infrastructure. Stormwater-related recommendations are provided from an aquatic ecological risk perspective only. A suitably qualified civil or stormwater engineer should confirm the capacity, design, routing and maintenance requirements of stormwater infrastructure where required.
- Detailed floodline determinations, hydrological modelling, geohydrological modelling, hydrogeological assessment and surface-water balance modelling fall outside the scope of the current assessment.
- A Red Data species scan, detailed terrestrial fauna assessment, detailed terrestrial flora assessment, avifaunal assessment and aquatic macroinvertebrate assessment were not included as part of the current desktop follow-up study.
- Vegetation descriptions and ecological interpretations are based on the previous field assessment and available desktop information. They are intended to characterise dominant and representative wetland



and riparian assemblages only and do not constitute a comprehensive survey for cryptic, rare, threatened or seasonally emergent species.

- The current assessment is limited by the resolution, date and quality of available aerial imagery and spatial datasets. Small-scale changes to drainage features, erosion, sediment deposition, stormwater discharge points, vegetation composition or artificial ponding areas may not be visible from desktop imagery alone.
- Environmental systems are inherently dynamic. Natural events, quarry-related activities, stormwater changes, erosion, sedimentation, vegetation change, alien invasive plant establishment, rehabilitation interventions or other land-use changes may alter the condition, extent or functioning of watercourses after completion of this assessment.
- The specialist reserves the right to amend the report, including its findings, recommendations and conclusions, should new or material information become available, including updated quarry layouts, stormwater management plans, monitoring data, authority comments or new field-based observations.
- The positional accuracy of the original watercourse delineations was subject to the limitations of the GPS and mapping methods used during the 2021 assessment. Digitally plotted watercourse and wetland boundaries may therefore be offset by several metres due to GPS accuracy limitations, aerial imagery alignment, GIS processing and map reproduction. Where precise boundaries are required for implementation, these should be confirmed by a surveyor in consultation with the aquatic specialist.
- Maps, figures and spatial interpretations presented in the report are intended for environmental planning and management purposes. Their accuracy may be affected by scale, reproduction, printing, photocopying or conversion between spatial formats.
- The findings of the current desktop review are considered suitable for informing the EMPr amendment process, provided that the quarry layout and operational drainage conditions have not materially changed since the 2021 field assessment. Where material changes are identified, a targeted field verification may be required.



2 Definitions and Legal Framework

2.1 Wetlands and Riparian Areas

The **National Water Act, 1998 (Act No. 36 of 1998) [NWA]** establishes the legal basis for water resource management in South Africa, ensuring pollution prevention, ecological conservation, and sustainable utilisation. Under this Act, all water resources are state property and regulated by the Department of Water and Sanitation (DWS). The NWA outlines principles for water use decisions that may significantly affect water resources, defining a water resource to include watercourses, surface water, estuaries, and aquifers. A watercourse encompasses rivers, springs, natural channels with intermittent or regular water flow, wetlands, lakes, pans, dams, and any water collection declared as such by the Minister, along with their beds and banks. The NWA defines a wetland as land transitioning between terrestrial and aquatic systems, with the water table usually near the surface or covered periodically by shallow water, supporting vegetation adapted to saturated soil conditions.

Riparian habitats are vital for ecological and hydrological functions, similar to wetlands, and serve as indicators for delineating river footprints. The NWA defines riparian habitat as areas associated with watercourses, characterised by alluvial soils, and inundated or flooded to support distinct vegetation compared to adjacent lands.

2.2 Authorisations for Water Use Activities

The table below presents a consolidated, site-specific assessment of operational activities, associated impacts/risks, and mitigation measures, with explicit linkage to relevant Section 21 water uses in terms of the National Water Act (Act 36 of 1998). This ensures alignment between identified risks, regulatory triggers, and required management actions (**Table 1**):



Table 1: Water uses associated with the project

Aspect Affected	Activity / Infrastructure	Section 21 Water Use	Impact / Risk
Floodplain wetland associated with Loch Athlone Dam and the Jordaan River system	Existing quarrying activities within the DWS regulated area of nearby wetlands	Section 21(c): Impeding or diverting the flow of water in a watercourse; Section 21(i): Altering the bed, banks, course or characteristics of a watercourse	Although no natural watercourses occur within the Mining Rights Area, the quarry is located within the regulated area of nearby wetlands. Ongoing quarrying may indirectly affect downstream aquatic systems through altered runoff patterns, sediment mobilisation, erosion, dust deposition, or deterioration of water quality if not appropriately managed.
Floodplain wetland and Loch Athlone Dam	Stormwater runoff from operational quarry areas, haul roads, exposed surfaces and disturbed areas		Stormwater runoff may transport sediment, suspended solids, hydrocarbons, dust residues or other contaminants towards the floodplain wetland and Loch Athlone Dam. Poorly controlled runoff may contribute to erosion, sedimentation, altered hydrological inputs and localised water quality deterioration.
Floodplain wetland and downstream receiving environment	Stormwater outlet points, discharge points, drainage lines, berms, channels, culverts, sumps or related stormwater control infrastructure		Concentrated flows from stormwater infrastructure may result in localised erosion, scouring, incision, sediment deposition or vegetation disturbance downslope of outlet points. Where outlets direct runoff towards wetland areas, ongoing monitoring and maintenance are required to ensure that no deterioration of the wetland occurs.
Wetland buffers and regulated areas	Existing operational infrastructure, stockpile areas, haul roads, vehicle movement areas and associated disturbed surfaces		Activities within the regulated area may increase the risk of sediment mobilisation, dust deposition, compaction, vegetation disturbance, altered runoff and indirect degradation of nearby watercourses. These risks are expected to remain manageable provided that the existing buffer areas are maintained and no operational expansion occurs into delineated watercourses or their recommended buffers.
Hillslope seepage wetland within/near Wolhuterskop Nature Reserve	Ongoing quarry operation and associated surface disturbance within the broader regulated area		The previous assessment indicated that the local topography limits direct hydrological connectivity between the quarry and the hillslope seepage wetland. The principal residual risks are indirect and relate mainly to dust, airborne pollutants, possible changes to catchment condition, and cumulative disturbance if the quarry footprint expands or runoff pathways change.
Unchannelled valley bottom wetland north of the quarry	Ongoing quarry operation and associated surface disturbance within the broader regulated area		The previous assessment indicated that the local topography limits direct runoff from the quarry towards the unchannelled valley bottom wetland. Residual risks are therefore expected to be low, provided that the quarry footprint and drainage



			patterns remain materially unchanged and no new infrastructure is placed within the wetland or its buffer.
Downstream watercourse assemblage and cumulative receiving environment	Continued operation of the quarry in combination with surrounding land uses, road runoff, existing dams, agriculture, grazing and urban influences		Cumulative risks include progressive sedimentation, altered runoff volumes, reduced water quality, alien invasive plant establishment, localised erosion and incremental degradation of aquatic ecological condition. Management must therefore focus on maintaining effective stormwater controls, preventing dirty water release, monitoring outlet points, and responding rapidly to erosion or sedimentation.
Floodplain wetland, Loch Athlone Dam and downstream Jordaan River system	Management, containment, reuse or release of dirty water from quarry operational areas	Section 21(c) and Section 21(i), where water management infrastructure affects flow or watercourse characteristics. Section 21(f) or Section 21(g) may be relevant only where waste or water containing waste is discharged into a water resource or disposed of in a manner that may detrimentally impact a water resource.	Dirty water generated from quarry areas may pose a water quality risk if allowed to leave the operational footprint in an uncontrolled manner. Risks include increased turbidity, sediment loading, hydrocarbon contamination, elevated suspended solids, and deterioration of downstream wetland or dam water quality.
Artificial ponding areas within the quarry footprint	Ponding of water within quarry-created depressions, pits or disturbed operational areas	Not regarded as a natural watercourse where confirmed to be artificial and isolated; Section 21 water uses may become relevant only where such areas discharge to, divert flow towards, or affect a natural watercourse	Artificial ponding areas may provide temporary habitat for hydrophytic vegetation but are not regarded as natural wetlands requiring formal protection. The main risk is that accumulated dirty water may overflow, leak, or be released towards natural watercourses, thereby creating sediment and water quality impacts.

Government Notice 4167 of 8 December 2023 replaced Government Notice 509 of 2016 and regulates these activities under Section 21(c) and (i). This notice provides General Authorisation (GA) for low-risk activities as determined by the Risk Assessment matrix. Medium or high-risk activities require a Water Use Licence (WUL) from the DWS.

Conditions for activities impacting watercourses include site selection criteria to avoid bends, high gradient areas, unstable slopes, actively eroding banks, interflow zones, springs, and seeps.

2.3 Additional Legislation and Frameworks

Compliance with the following national legislation, conventions, and regulations is required for wetlands, riparian zones and other aquatic areas (



Table 2).

Table 2: Legislation/Regulation and Relevance to the WULA and Existing Development

Legislation	Relevance to Existing Development
Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP)	Establishes international and national obligations for the conservation and wise use of wetlands. Although no Ramsar-listed wetlands occur within the immediate project area, the Convention and SAWCP inform national policy and best practice for wetland protection, rehabilitation, and mitigation measures applicable to wetlands.
National Environmental Management Act, 1998 (Act No. 107 of 1998)	Provides the overarching environmental management principles applicable to all organs of state, including sustainable development, duty of care, and the mitigation hierarchy. These principles underpin the assessment of wetland and aquatic impacts and inform avoidance, minimisation, rehabilitation, and management measures proposed in support of the WULA.
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)	Regulates the conservation of biodiversity and ecosystems, including threatened ecosystems and species that may be associated with wetlands and riparian areas. The Act informs the consideration of ecological sensitivity, habitat loss, and ecosystem integrity in areas affected by mining activities within regulated watercourse areas.
National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003)	Provides for the declaration and management of protected areas. While no formally declared protected areas occur within the mining footprint, the Act is relevant in ensuring that mining activities do not compromise the integrity of nearby protected or conservation areas through indirect hydrological or ecological impacts.
NEMA Environmental Impact Assessment Regulations, 2014 (GN R.982, R.983, R.984 and R.985, as amended)	Prescribes the procedural requirements for environmental authorisation of listed activities. The Regulations are relevant where mining-related infrastructure and watercourse-related activities require alignment between environmental authorisation and water use authorisation processes, ensuring consistent assessment of impacts on wetlands and watercourses.
Regulations and Guidelines on Water Use under the National Water Act	Provide technical and procedural guidance for the assessment, authorisation, and management of water uses, including activities within regulated watercourse areas. These instruments guide the identification of applicable Section 21 water uses and the level of assessment required for the existing development.
South African Water Quality Guidelines (DWAF/DWS)	Establish water quality objectives and thresholds for the protection of aquatic ecosystems and water users. These guidelines inform the assessment of potential water quality impacts associated with mining activities, including dirty-water management, pollution control dams, and dust suppression practices.
Department of Water and Sanitation General Notice 267 of 24 March 2017	Provides regulatory clarification on water uses that may be authorised under General Authorisations, including limitations and exclusions. This notice is relevant in determining whether specific watercourse-related activities associated with the project qualify for a GA or require authorisation through a full WULA.
Revised General Authorisation GN 4167 of 8 December 2023	Sets out the current General Authorisation framework for Section 21(c) and 21(i) water uses. The applicability of this GA is considered in the context of the existing activities; however, due to the scale, sensitivity, and proximity of mining infrastructure to watercourses, a Water Use Licence remains the appropriate authorisation pathway for the project.
National Water Act, 1998 (Act No. 36 of 1998)	Provides the primary legal framework governing the protection and use of water resources in South Africa. The existing mining activities trigger multiple water uses in terms of Sections 21(c), 21(i), 21(g), and 21(j), necessitating a Water Use Licence Application supported by specialist wetland and aquatic assessments.
Hazardous Substances Act, 1973 (Act No. 15 of 1973)	Regulates the control, handling, and storage of hazardous substances that may pose a risk to water resources. This Act is relevant to fuel storage, lubrication facilities, wash bays, and other mining support infrastructure located within regulated watercourse areas.
Electricity Regulation Act, 2006 (Act No. 4 of 2006)	Regulates electricity generation, transmission, and distribution infrastructure. The Act is relevant where power supply infrastructure associated with mining operations may traverse or be located within regulated watercourse areas, potentially triggering water uses under the NWA.



This legal framework ensures that the environmental impacts of activities related to aquatic and wetland resources are properly assessed and managed, promoting sustainable development and conservation.

3 Locality of the study site

The Afrimat Bethlehem Quarry is located south of the town of Bethlehem in the Free State Province. The Mining Right Authorisation Area is situated adjacent to the R26 arterial route, which passes along the eastern side of the quarry area and provides regional access between Bethlehem and surrounding areas. The N5 national route occurs to the north of the site (**Figure 1**).

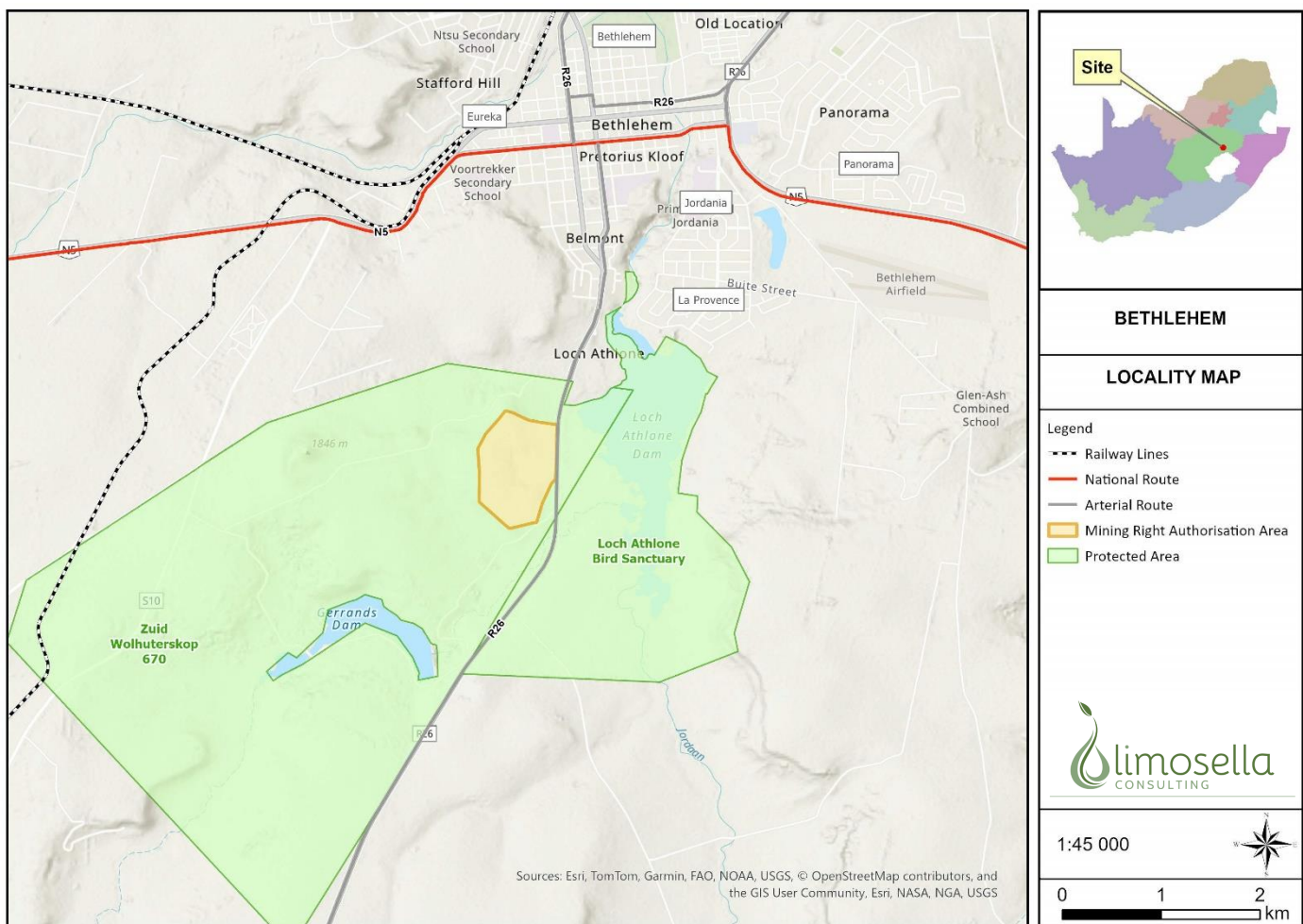


Figure 1: Locality Map.



4 Description of the Receiving Environment

A review of available literature and spatial data formed the basis for the characterisation of the biophysical environment in its theoretically undisturbed state, and consequently an analysis of the degree of impact to the ecology of the study site in its current state. **Table 1** below provides a summary of the important aspects.



Table 3: A summary of relevant site information obtained from a review of available spatial data.

National Screening Tool (https://screening.environment.gov.za/screeningtool)	
	The study area is located on an area classified as having Low Sensitivity. The nearby Joraa River is classified as Very High Aquatic Sensitivity.
General Description (Mucina & Rutherford , 2006))	
Broad Vegetation Units	Gm 3 - Eastern Free State Clay Grassland
Conservation Status	Endangered
Topography	Flat to gently rolling land
Climate	Summer-rainfall region, with MAP around 630 mm. Much of the precipitation falls in form of thunderstorms between November and March. One of the coldest regions of the Highveld. Frost is very frequent in winter.
Hydrology and National Freshwater Ecosystem Priority Area (NFEPA, 2011) (NBA, 2018) Database	
Important Rivers (Figure 2) National Freshwater Ecosystem Priority Areas (NFEPA) (Driver, et al., 2012) and National Biodiversity Assessment (NBA) (SANBI, 2018)Wetlands	Non-perennial drainage features occur west and southwest of the quarry, while mapped wetland areas occur mainly to the east and southeast in association with Loch Athlone Dam and the Joraa River floodplain. Two nearby dams are listed as Rank 6 wetlands, Loch Athlone Dam to the east and Gerrards Dam 1.36km to the south
Quaternary Catchment	B11F
Catchment Management Areas (CMA) Invalid source specified.	Vaal-Orange (VOCMA)
Water Management Areas (WMA) (Government Gazette, 16 September 2016)	#5, Vaal Major: rivers include the Wilge, Liebenbergsvlei, Mooi, Renoster, Vals, Sand, Vet, Harts, Molopo and Vaal
Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES) Model (DWA, 2024)	The Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES) were determined per Sub-Quaternary Reaches (SQR) for Secondary Catchments in South Africa. The SQRs of the study site is: Reach 2825 of the Joraa River (PES=E)(EI=Moderate)(ES=Moderate)



	Reach 2901, tributary of the Jordaan River (PES=D)(EI=Moderate)(ES=High)
Surface Strategic Water Source (GSWS) (Driver, et al., 2014)	Not located on a SWSA
Biodiversity Sector Plan	
Critical Aquatic Biodiversity Areas (Figure 3)	The Afrimat Bethlehem Quarry occurs within areas mapped as Ecological Support Area 1 (ESA1) and Ecological Support Area 2 (ESA2). The surrounding landscape includes important ecological and aquatic features, including Zuid Wolhuterskop, Loch Athlone Bird Sanctuary, Loch Athlone Dam, mapped wetlands and the Jordaan River system. The ESA mapping indicates that the quarry is located within a broader ecological support landscape, where management should focus on maintaining hydrological connectivity, preventing deterioration of nearby wetland systems and protecting the downstream receiving environment. The highest sensitivity is associated with the mapped wetlands, Loch Athlone Dam and the Jordaan River corridor east and southeast of the quarry.



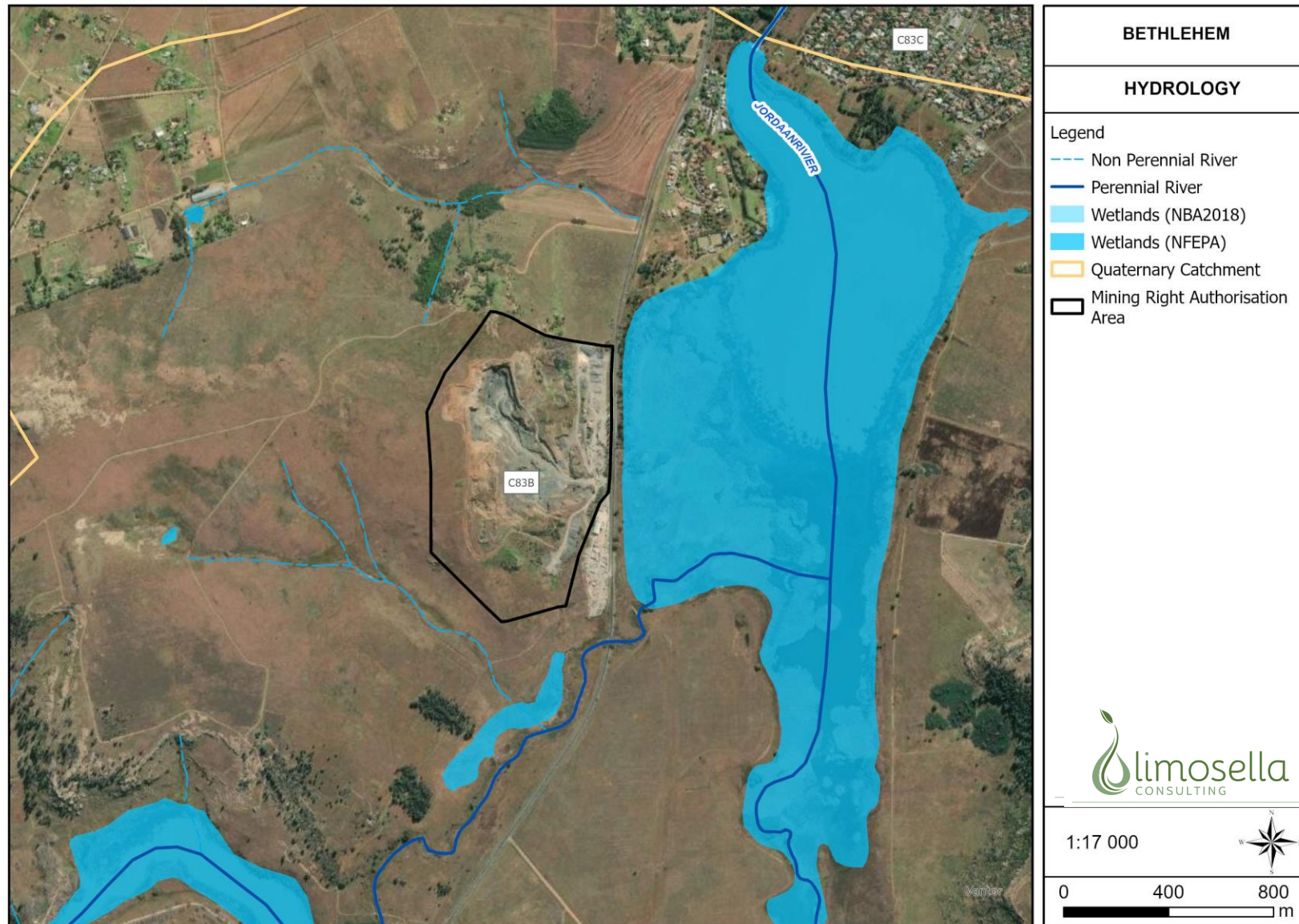


Figure 2: Regional hydrology relative to the study site.



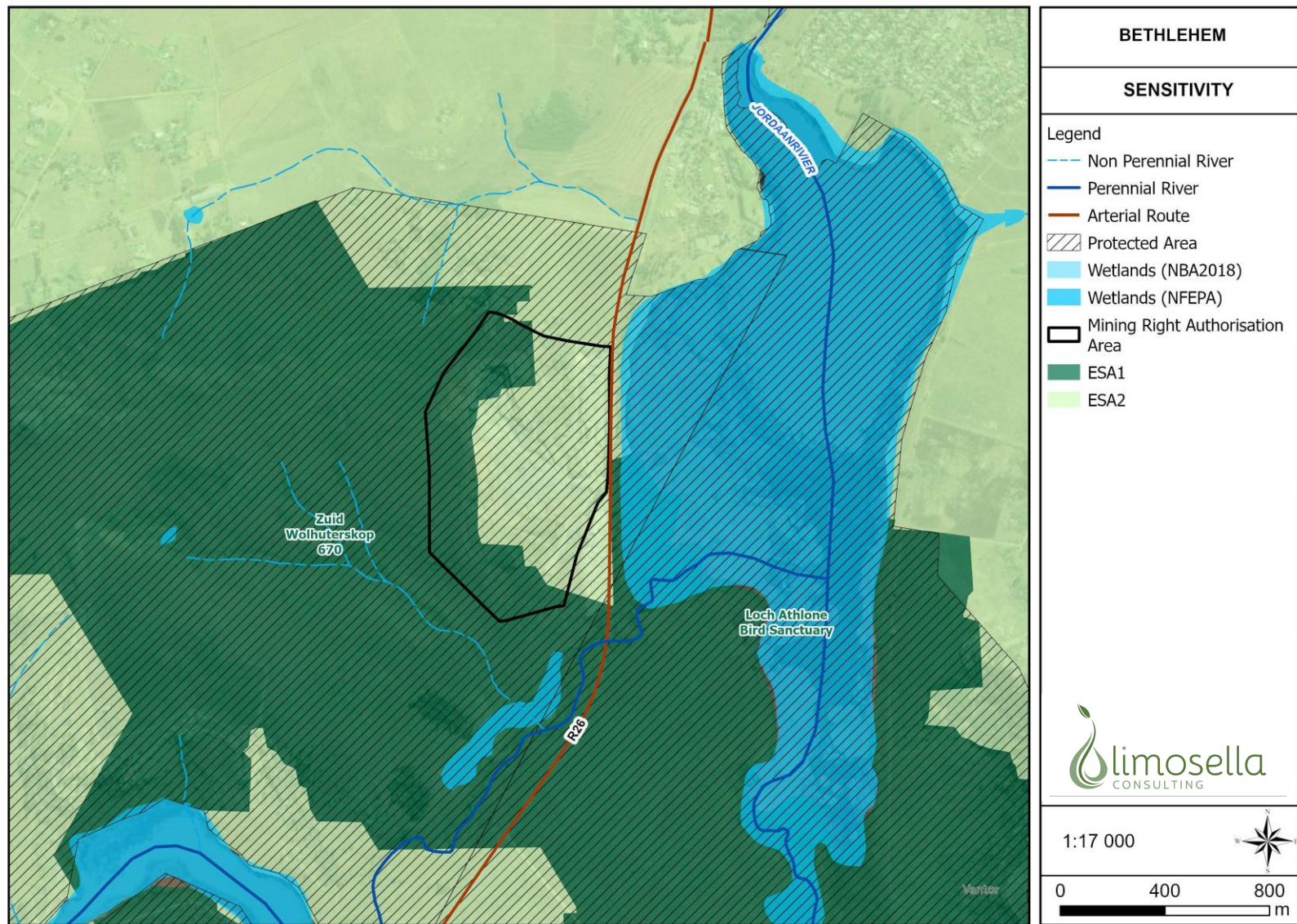


Figure 3: Critical Biodiversity Areas relevant to the study site.



5 Methodology

The delineation method documented by the DWS in their document “**Updated manual for identification and delineation of wetlands and riparian areas**” (DWAF, 2008), as well as the **Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems** (Ollis, et al., 2013) was followed throughout the field survey.

These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas such as soil and vegetation forms, as well as the terrain unit indicator.

A smartphone was used to capture GPS co-ordinates in the field. 1:50 000 cadastral maps and available GIS data were used as reference material for the mapping of the preliminary watercourse boundaries. These were converted to digital image backdrops, and delineation lines and boundaries were imposed accordingly after the field survey. Applications used on the smartphone includes GPX Viewer Pro and Google Earth.

Following a desktop assessment highlighting wetland area to be groundtruthed in the field, soil and vegetation sampling on site informed a fine-scale delineation. In the current study, the wetland area was assessed using Wet-Health (Macfarlane , et al., 2020), EIS and WetEcoServices, (Kotze, et al., 2020). The assessment of potential impacts follows the 2014 NEMA regulations (as amended) and the DWS 2023 Risk Assessment.

In order to ease the legibility of the report, details regarding the methods used in each phase of the watercourse assessment are presented in a separate document, attached to this report as Appendix C, entitled (Bezuidenhoudt, 2024): R.Bezuidenhoudt (2024) . Appendix C: Aquatic Methodology. Limosella Consulting. Pretoria.



6 Results

6.1 Historical Land Use, Cover and Aquatic Ecological State

Historical aerial imagery indicates that the broader landscape surrounding the Afrimat Bethlehem Quarry has been subject to long-term modification. By 1958, Loch Athlone Dam and Gerrards Dam were already present, the R26 road corridor was established, and agricultural land uses were evident in the surrounding catchment. The quarrying footprint was also already visible during this period, indicating that extraction activities have formed part of the local land-use context for several decades. The 2026 aerial imagery indicates that the quarry remains the dominant land-use feature within the Mining Right Authorisation Area. The active quarry footprint, internal access roads, disturbed surfaces, stockpile or processing areas, and associated operational areas are clearly visible. The surrounding landscape remains a mix of open grassland, protected open space, aquatic habitat, road infrastructure and agricultural or semi-modified land. Loch Athlone Dam and its associated floodplain/wetland habitat remain the most prominent aquatic features east of the site, with the R26 road forming a partial physical separation between the quarry and the dam/wetland system.

No obvious natural watercourse is visible within the Mining Right Authorisation Area itself, which is consistent with the findings of the 2021 assessment. However, wetland and drainage features are clearly present in the broader receiving environment, particularly east and southeast of the quarry in association with Loch Athlone Dam and the Jordaan River system, and southwest of the quarry in association with lower-lying drainage features and Gerrards Dam. Some artificial ponding or wet areas may occur within disturbed quarry areas, but these are considered to be quarry-related features rather than natural wetland systems.

From an aquatic ecological state perspective, the receiving environment is already modified by historic dam construction, road infrastructure, agriculture, grazing and long-term quarrying. The floodplain wetland associated with Loch Athlone Dam is considered the most directly relevant aquatic receptor due to its position downslope and east/southeast of the quarry. The previous assessment indicated that this floodplain wetland is largely modified, primarily as a result of impoundment and associated historical changes to the natural hydrological regime.

The hillslope seepage wetland and unchannelled valley bottom wetland occur outside the active quarry footprint and are less likely to be directly affected by quarry runoff due to local topography. The main aquatic management concern therefore remains the prevention of indirect impacts to the floodplain wetland, Loch Athlone Dam and downstream Jordaan River system. These potential impacts include sediment mobilisation, erosion at stormwater outlets, dirty water movement, dust deposition, altered runoff patterns and water quality deterioration.





Figure 4: Historical aerial imagery 1947 and 1958 (CDNGI, 2024) comparing the land-use changes.



6.2 Buffer Zones

In line with national regulatory requirements and best-practice guidelines, all delineated wetlands and watercourses within and adjacent to the existing development footprint have been assessed to determine appropriate buffer zones and whether the project triggers environmental authorisation thresholds under the National Environmental Management Act (NEMA) and the National Water Act (NWA).

The “regulated area of a watercourse” means:

- a. The outer edge of the 1 in 100-year flood line or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, dams and lakes.
- b. In the absence of a determined 1 in 100-year flood line or riparian area as contemplated in (a) above the area within 100m distance from the edge of a watercourse where the edge of the watercourse (excluding flood plains) is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the National Water Act 36 of 1998).
- c. In respect of a wetland: a 500 m radius around the delineated boundary (extent) of any wetland (including pans).

Site-specific aquatic buffer zones were previously calculated for the three wetland units identified within the 500 m DWS regulated area. The calculated buffers are 39 m for the floodplain wetland, 62 m for the hillslope seepage wetland, and 47 m for the unchannelled valley bottom wetland.

In addition to the calculated wetland buffers, a 500 m DWS regulated area was also delineated and illustrated on the maps in accordance with Department of Water and Sanitation requirements. Wetlands occurring within this 500 m regulated area were identified through desktop extrapolation using available spatial datasets and historical imagery. The inclusion of this regulated area is intended to provide regulatory context and to indicate the presence of nearby wetlands that may be relevant for authorisation screening, rather than to imply that all wetlands within the 500 m zone were subjected to detailed field-based delineation or functional assessment.

Access to wetland areas must be strictly controlled, and off-road vehicle movement within wetlands or buffer zones is prohibited. Any disturbance within these areas must be rehabilitated immediately, and ongoing monitoring must be undertaken to ensure that no further degradation occurs.



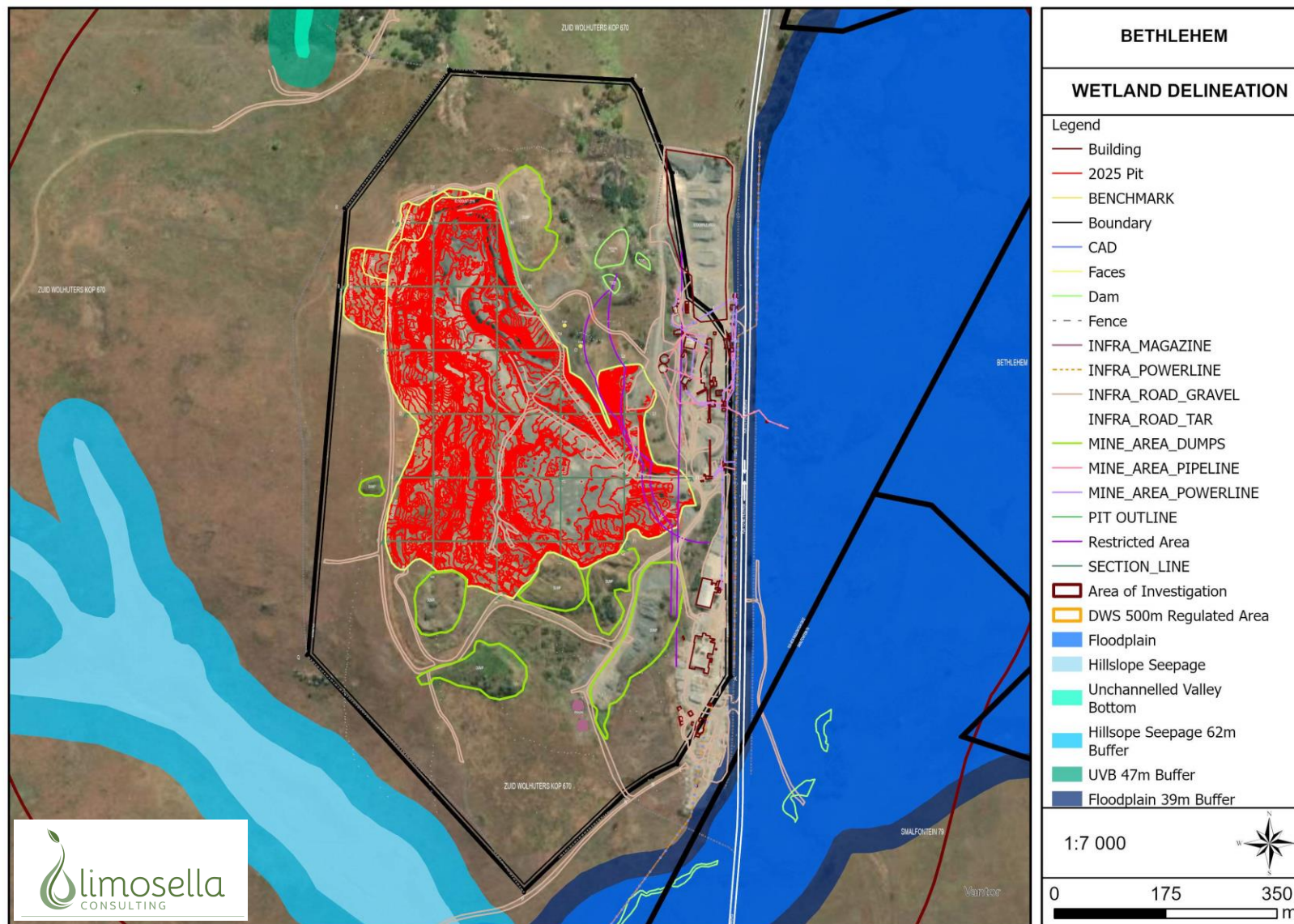


Figure 5: The watercourse delineation with calculated buffer zones.



6.2.1 Wetland/Riparian Delineation

The Classification System for Wetlands and Other Aquatic Ecosystems (Ollis, et al., 2013) in South Africa is a hierarchical framework designed to standardise the identification and categorisation of aquatic ecosystems. The following table (**Table 4**) provides a detailed classification of the watercourse based on the six-tiered framework for aquatic ecosystem description. This framework considers biophysical, geomorphological, and hydrological factors, as well as specific site descriptors. The classification is essential for understanding the ecological character, functioning, and sensitivity of the system, and it informs appropriate management and mitigation measures related to the existing activities.

Table 4: Classification System for Wetlands and Other Aquatic Ecosystems in South Africa (Ollis, et al., 2013)

Level	Name	Description	Purpose
1	System	Broadly categorises ecosystems as marine, estuarine, inland, or artificial systems.	Defines the overarching environment where the aquatic ecosystem is located.
2	Regional Setting	Places the system within a bioregional context (e.g., ecoregions, climatic zones).	Provides insight into the climatic and geographical influences shaping the ecosystem.
3	Landscape Unit	Defines the geomorphological context (e.g., valleys, plateaus, floodplains).	Establishes how the landscape influences hydrology and ecosystem structure.
4	Hydrogeomorphic (HGM) Unit	Categorises ecosystems based on hydrology, geomorphology, and water sources.	Differentiates systems like rivers, floodplains, depressions, or seepage wetlands.
5	Hydrological Regime	Focuses on the hydrology, including:	Provides detailed understanding of water movement and its influence on ecosystems.
		- 5A: Inundation Period - Frequency and duration of surface water presence.	
		- 5B: Saturation Period - Duration of soil saturation without surface water.	
6	Descriptors	Adds specific characteristics, such as: - Natural vs. Artificial systems - Salinity, pH, substratum type, vegetation cover, and geology.	Offers detailed descriptions of physical and ecological attributes for site-specific management.

The watercourses associated with the Afrimat Bethlehem Quarry were previously classified using the hydrogeomorphic approach applied in the National Wetland Inventory and the classification system for inland aquatic ecosystems. No natural watercourses were identified within the Mining Right Authorisation Area itself; however, three natural wetland units were identified within the broader 500 m regulated area around the quarry. These were classified as an unchannelled valley bottom wetland, a hillslope seepage wetland and a floodplain wetland.



The unchannelled valley bottom wetland occurs north of the quarry and represents a linear, valley-bottom wetland system without a distinct channel. This wetland drains towards Loch Athlone Dam, approximately 880 m north of the site. Based on the previous assessment and the current desktop review, this wetland remains spatially separated from the active quarry footprint and is unlikely to be directly affected by quarry-related runoff, provided that the quarry footprint and stormwater flow paths remain materially unchanged.

The hillslope seepage wetland is associated with the Wolhutterskop Nature Reserve area. This wetland occurs on a hillslope setting where groundwater or subsurface interflow contributes to seasonal or temporary soil saturation. The wetland drains towards a tributary of the Jordaan River upstream of Loch Athlone Dam. The previous assessment indicated that this system is also unlikely to be directly affected by the quarry due to the local topography, although indirect risks such as dust deposition and broader catchment disturbance should still be managed.

The floodplain wetland is associated with Loch Athlone Dam and the Jordaan River system east and southeast of the quarry. Large portions of this floodplain system have been inundated as a result of the construction of Loch Athlone Dam, which has substantially modified the natural hydrological character of the floodplain. Although artificial in origin, Loch Athlone Dam is long established and forms part of the local aquatic receiving environment and bird sanctuary. The floodplain wetland remains the most important aquatic receptor from an operational management perspective because stormwater and surface runoff from the quarry may potentially be directed towards this system.

The hillslope seepage and unchannelled valley bottom wetlands both ultimately drain towards the floodplain wetland/Loch Athlone Dam system. Loch Athlone Dam discharges into the Jordaan River, which flows into the Liebenbergsvlei River and ultimately into the Vaal Dam. The classification and hydrological setting therefore indicate that the quarry is positioned within a sensitive downstream aquatic context, even though no natural watercourse occurs within the Mining Right Authorisation Area itself.

Small isolated ponded areas and wet patches may occur within the active quarry area due to water collecting in depressions created by quarrying activities. These features may support hydrophytic vegetation; however, they were previously regarded as artificial quarry-related features rather than natural wetland systems requiring formal aquatic buffer protection. The primary management focus should therefore remain the protection of the natural wetland systems outside the quarry footprint, particularly the floodplain wetland and Loch Athlone Dam receiving environment.

The watercourse is classified (Ollis, et al., 2013) from level 1 to 4 (**Table 5**)



Table 5: Summary of the result of the study area with application of Levels 1 to 4 of the Classification System for Wetlands and Other Aquatic Ecosystems in South Africa (Ollis, et al., 2013)

Level 1	Level 2	Level 3	Level 4: HGM unit
System	NFEPA Wetland Vegetation Group	Landscape Unit	Level 4A
Inland	Mesic Highveld Grassland Group 8 Ecosystem Threat Status: Least Threatened Protection Level: Not Protected	Slope and Valley Bottom	- Floodplain - Unchannelled Valley Bottom - Seepage Wetland

6.3 Wetland Soil and Vegetation

The wetland soil and vegetation characteristics described in the 2021 assessment remain relevant as the baseline description for the current desktop follow-up study. The previous field assessment noted that, although rainfall had been limited prior to the site visit and some grass and forb species were not fully developed for identification, the broader wetland areas appeared relatively species rich (**Figure 6**).

The soils associated with the three wetland units were generally characterised by deep, dark clay soils with moderate to strong structure. Sandstone-dominated areas were also recorded interspersed with the heavy clay soils. Evidence of bank erosion was observed along sections of the floodplain and hillslope seepage wetlands, indicating localised geomorphological disturbance within parts of the watercourse system.

The floodplain wetland vegetation differed from the vegetation immediately surrounding Loch Athlone Dam and the downstream active channel of the Jordaan River. Around the dam margins, the vegetation was characterised by woody alien invasive species, dense stands of robust emergent vegetation and areas of floating vegetation. These areas provide habitat for aquatic and faunal species, despite the modified nature of the floodplain system. Downstream of the floodplain, the active channel was more clearly defined, with medium to tall grass species occurring along the banks.

The unchannelled valley bottom wetland north of the quarry showed greater evidence of historical disturbance from grazing and agricultural activities. These impacts were visible on historical aerial imagery dating back to the 1950s. The vegetation in this system was therefore less intact than the hillslope seepage wetland and included a higher abundance of alien invasive and disturbance-tolerant species. *Seriphium plumosum* was locally dominant and was interpreted as an indicator of overgrazing and possible bush encroachment.

The woody vegetation recorded in the wetland areas was dominated by alien invasive species, with relatively few indigenous woody species. Alien or exotic woody species included *Salix babylonica*, *Pinus* spp., *Malus floribunda*, *Populus nigra*, *Populus deltoides*, *Populus x canescens*, *Pyracantha angustifolia* and *Eucalyptus* spp. Indigenous woody species were more limited and included *Searsia pyroides*, *Searsia lancea* and *Celtis africana*.

The grass layer was broadly similar between the wetland units and included species such as *Leersia hexandra*, *Paspalum dilatatum*, *Aristida congesta*, *Cynodon dactylon*, *Elionurus muticus*, *Heteropogon contortus*, *Miscanthus capensis*, *Pennisetum sphacelatum*, *Themeda triandra* and *Setaria sphacelata*. *Imperata cylindrica*



formed dense stands in parts of the downstream floodplain and hillslope seepage wetland, while *Phragmites australis* and *Typha capensis* formed dense stands and floating islands along parts of Loch Athlone Dam.

Sedge, rush and wetland-associated herbaceous species recorded during the previous assessment included *Cyperus congestus*, *Carex acutiformis*, *Fuirena pubescens*, *Cyperus longus*, *Kyllinga erecta*, *Pycnus macranthus*, *Schoenoplectus corymbosus*, *Vernonia oligocephala*, *Haplocarpha scaposa*, *Helichrysum rugulosum*, *Crinum bulbispermum*, *Ranunculus multifidus*, *Berkheya radula* and *Monopsis decipiens*. Alien invasive or disturbance-associated herbaceous species included *Cirsium vulgare*, *Conyza bonariensis*, *Plantago lanceolata*, *Verbena bonariensis* and *Xanthium strumarium*.

Overall, the wetland vegetation reflects a combination of natural wetland species, hydrophytic emergent vegetation, grassland wetland elements and substantial disturbance-related components. The floodplain wetland remains ecologically important due to its association with Loch Athlone Dam, aquatic habitat and faunal use, but is modified by impoundment, road infrastructure and alien invasive vegetation. The hillslope seepage wetland appears to retain a comparatively higher level of ecological integrity, while the unchannelled valley bottom wetland reflects a longer history of grazing, agriculture and vegetation disturbance.





Figure 6: General soil and vegetation characteristics of the wetlands on the study area.



A summary of the dominant vegetation and soil characteristics for a level 6 assessment are described in the table below (Table 6).

Table 6: Summary of the Level 6 dominant soil and vegetation characteristics of the wetlands on the study site.

Dominant Descriptor Categories (Level 6)			
6A: Natural vs Artificial	Vegetation Cover, Form and Status		
	6A: Veg Cover	6B, C & D Primary Form	6E: Veg Conditions
Natural	Vegetated	Sedges and Grasses	Indigenous



7 The National Climate Change Adaptation Strategy

South Africa's policy framework for climate resilience is guided by the **National Climate Change Adaptation Strategy (NCCAS)** and more recently formalised through the **Climate Change Act, 2024 (Act No. 22 of 2024)**. These frameworks aim to ensure that development projects account for climate-related risks, strengthen ecological resilience, and promote sustainable water resource management. The table below outlines key objectives from each policy and their relevance to the existing activities (**Table 7**).

Table 7: Climate Change Adaptation Strategies and relation to the development.

Policy / Strategy	Relevant Objective / Requirement	Relevance to Existing Project
National Climate Change Adaptation Strategy (NCCAS)	Promote climate-resilient development by integrating climate change adaptation into planning, infrastructure management and environmental decision-making.	The existing Afrimat Bethlehem Quarry should ensure that operational management, particularly stormwater control, erosion prevention and rehabilitation planning, remains resilient to increased rainfall intensity, altered runoff patterns and potential extreme weather events.
	Reduce vulnerability of ecosystems, water resources and communities to the impacts of climate change.	The quarry occurs near sensitive aquatic receptors, including wetlands, Loch Athlone Dam and the Jordaan River system. Management actions should therefore prevent sedimentation, water quality deterioration and altered hydrological inputs that may reduce the resilience of these systems.
	Strengthen adaptive capacity through monitoring, early warning, risk management and responsive environmental management.	The EMPr should include practical and auditable monitoring of stormwater outlets, erosion features, sediment deposition, dirty water containment areas and rehabilitation success, allowing management actions to be adjusted where climate-related impacts become evident.
Climate Change Act, 2024 (Act No. 22 of 2024)	Provide a coordinated legal framework for climate change response, including adaptation and mitigation measures across sectors.	Although the quarry is an existing operation, its amended EMPr should align with climate-resilient environmental management by ensuring that operational controls reduce avoidable impacts on watercourses and surrounding ecological infrastructure.
	Support adaptation to climate change impacts and strengthen the resilience of natural systems and socio-economic activities.	Wetlands and associated aquatic systems provide ecological infrastructure functions such as flow regulation, sediment trapping and biodiversity support. Preventing further degradation of these systems contributes to local climate resilience.
	Encourage consideration of climate-related risks in planning, authorisation and environmental management processes.	The EMPr amendment should consider the potential for increased stormwater volumes, erosion risk, dirty water overflow, sediment mobilisation and reduced effectiveness of existing stormwater infrastructure under changing rainfall conditions.
	Promote responsible management of activities that may contribute to environmental degradation or reduce ecosystem resilience.	Quarry operations should maintain effective stormwater separation, dirty water containment, dust suppression, alien invasive plant control and rehabilitation of disturbed areas to avoid cumulative degradation of the receiving aquatic environment.



8 Watercourse Functional Assessment

Watercourse functionality is assessed by determining the degree to which the structure and ecological functioning of a watercourse have deviated from its natural or reference condition. The reference condition represents the theoretical, least-disturbed state of the system and is inferred from the regional geomorphology, hydrology, vegetation, land-use history and known ecological characteristics of comparable systems.

The 2021 Aquatic Biodiversity Assessment assessed the functional condition, ecological importance and management requirements of the three wetland units identified within the 500 m regulated area of the Afrimat Bethlehem Quarry, namely the unchannelled valley bottom wetland, hillslope seepage wetland and floodplain wetland. No natural watercourses were identified within the Mining Right Authorisation Area itself. The current desktop follow-up assessment does not repeat the full functional assessment, but reviews and carries forward the previously determined scores and ecological interpretations where these remain applicable to the current EMPr amendment process.

The functional assessment methods applied to the wetland units are summarised in **Table 8**.

Table 8: Assessments undertaken in the current assessment

Watercourse Type	Assessment Method
All Wetlands	• Ecological Category - Wet-Health (Macfarlane et al., 2020), • Ecosystem Services: WetEcosystem Services V2 (ES) (Kotze et al., 2020). • Ecological Importance and Sensitivity (EIS) - (Kotze et al., 2020) • Recommended Ecological Category (REC) (Rountree, et al., 2013)



8.1 Present Ecological Status (PES)

8.1.1 Present Ecological Status (PES) (Macfarlane et al. (2020) – Unchannelled Valley Bottom

The combined Wetland system received a combined Impact Score of **3.4 C - Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact** (Kotze et al., 2020). The wetland condition is likely to remain stable over the next 5 years (**Table 9**).

Table 9: Summary of the results of the WetHealth (Version 2) assessment conducted for the Unchannelled Valley Bottom

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3.1	2.1	3.2	5.3
PES Score (%)	69%	79%	68%	47%
Ecological Category	C	C	C	D
Trajectory of change	→	→	→	→
Confidence (revised results)	Moderate			
Combined Impact Score	3.4			
Combined PES Score (%)	66%			
Combined Ecological Category	C			

8.1.2 WetEcoServices Kotze et al., (2020) – Unchannelled Valley Bottom

The unchannelled valley bottom wetland provides generally limited ecosystem service value in its present state. Most regulating and supporting services, including flood attenuation, streamflow regulation, sediment trapping, erosion control, nutrient assimilation, toxicant assimilation and biodiversity maintenance, scored within the Very Low importance category. Provisioning and cultural services were also predominantly Very Low, with the only slightly elevated service being cultivated foods, which scored Low. Overall, the wetland is considered to provide low ecosystem service importance, likely reflecting historical disturbance, grazing and surrounding land-use modification (**Table 10**).



Table 10: Summary of the Ecosystem Services provided by the *Unchannelled Valley Bottom*

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.5	0.0	0.0	Very Low
	Stream flow regulation	2.0	0.0	0.5	Very Low
	Sediment trapping	1.5	0.0	0.0	Very Low
	Erosion control	1.4	0.0	0.0	Very Low
	Phosphate assimilation	1.4	0.0	0.0	Very Low
	Nitrate assimilation	1.4	0.0	0.0	Very Low
	Toxicant assimilation	1.4	0.0	0.0	Very Low
	Carbon storage	1.7	0.0	0.0	0.0
	Biodiversity maintenance	0.6	0.0	0.0	Very Low
PROVISIONING SERVICES	Water for human use	1.5	0.3	0.2	Very Low
	Harvestable resources	1.5	0.0	0.0	Very Low
	Food for livestock	1.5	0.0	0.0	Very Low
	Cultivated foods	2.5	0.0	1.0	Low
CULTURAL SERVICES	Tourism and Recreation	0.3	0.0	0.0	Very Low
	Education and Research	0.0	0.0	0.0	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low



8.1.3 Ecological Importance and Sensitivity (EIS) (Rountree, et al., 2013) – Unchannelled Valley Bottom

The Ecological Importance and Sensitivity (EIS) score forms part of a larger assessment called the Importance and Sensitivity scoring system which also addresses hydrological importance and direct human benefits. Both EC and EIS form part of a larger reserve determination process documented by the Department of Water and Sanitation.

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (Rountree, et al., 2013). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity such as species diversity and abundance.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use.

The highest EIS score of **1.4 - Moderate EI category**: Wetlands in this category are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers.

- *Biodiversity maintenance importance: 1.0 (Low)*
- *Regulating services importance: 1.3 (Moderate)*
- *Provisioning and cultural services importance: 1.8 (Moderate)*

8.1.4 Recommended Ecological Category (REC) – Unchannelled Valley Bottom

The REC is determined by the Present Ecological State of the water resource and the importance and/ or sensitivity of the water resource. Water resources which have Present Ecological State categories in an E or F ecological category, are deemed unsustainable by the DWS. In such cases the REC must automatically be increased to a D.

Where the PES is in an A, B, C, D or E category, the EIS components must be checked to determine if any of the aspects of importance and sensitivity (Ecological Importance, Hydrological Functions and Direct Human Benefits) are high or very high. If this is the case, the feasibility of increasing the PES (particularly if the PES is in a low C or D category) should be evaluated. This is recommended to enable important and/ or sensitive wetland water resources to maintain their functionality and continue to provide the goods and services for the environment and society (**Table 11**).



- If:
- PES is in an E or F category:
The REC should be set at least a D, since E and F EC's are considered unsustainable.
 - The PES category is in a A, B, C or D category, AND the EIS criteria are low or moderate OR the EIS criteria are high or even very high, but it is not feasible or practicable for the PES to be improved:
 - The REC is set at the current PES.
 - The PES category is in a B, C or D category, AND the EIS criteria are high or very high AND it is feasible or practicable for the PES to be improved:
 - The REC is set at least one Ecological Category higher than the current PES.” (Rountree, et al., 2013)

Following the method set out in Rountree *et al.*, (2013), the **PES value of C and a Moderate EIS class**, leads to the identification of an REC of C (**Table 11**). This means the rehabilitation should be done in such a way as to try and **Maintain the EC at C**.

Table 11: Generic Matrix for the determination of REC and RMO for the Unchannelled Valley Bottom

			EIS			
			Very high	High	Moderate	Low
EC	A	Pristine/Natural	A Maintain	A Maintain	A Maintain	A Maintain
	B	Largely Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good - Fair	B Improve	B/C Improve	C Maintain	C Maintain
	D	Poor	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Very Poor	D Improve	E/F Improve	E/F Maintain	E/F Maintain



8.2 Seepage Wetland

8.2.1 Present Ecological Status (PES) (Macfarlane et al. (2020) – Seepage Wetland

The combined Wetland system received a combined Impact Score of **1.3 B- 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** (Kotze et al., 2020). The wetland condition is likely to remain stable over the next 5 years. (**Table 9**).

Table 12: Summary of the results of the WetHealth (Version 2) assessment conducted for the Seepage Wetland

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1.1	2.0	0.7	1.7
PES Score (%)	89%	80%	93%	83%
Ecological Category	B	C	A	B
Trajectory of change	→	→	→	→
Confidence (revised results)	Moderate	Moderate	Moderate	Moderate
Combined Impact Score	1.3			
Combined PES Score (%)	87%			
Combined Ecological Category	B			

8.2.2 WetEcoServices Kotze et al., (2020) – Seepage Wetland

The hillslope seepage wetland provides mixed ecosystem service value in its present state. Most regulating services, including flood attenuation, sediment trapping, erosion control, nutrient assimilation, toxicant assimilation and carbon storage, scored as Very Low. However, biodiversity maintenance scored Very High, reflecting the ecological value of the wetland within the surrounding natural/protected landscape. Provisioning services were generally Low to Moderately Low, while cultural services were more important, with tourism and recreation scoring Very High and cultural/spiritual value scoring Moderate. Overall, the seepage wetland is considered ecologically important primarily due to its biodiversity and cultural/recreational value (**Table 10**).



Table 13: Summary of the Ecosystem Services provided by the Seepage Wetland

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.3	0.0	0.0	Very Low
	Stream flow regulation	1.8	0.0	0.3	Very Low
	Sediment trapping	0.9	0.0	0.0	Very Low
	Erosion control	1.0	0.0	0.0	Very Low
	Phosphate assimilation	0.9	0.0	0.0	Very Low
	Nitrate assimilation	0.8	0.0	0.0	Very Low
	Toxicant assimilation	0.8	0.0	0.0	Very Low
	Carbon storage	1.6	0.0	0.0	Very Low
	Biodiversity maintenance	4.0	3.5	4.0	Very High
PROVISIONING SERVICES	Water for human use	2.4	0.0	0.9	Low
	Harvestable resources	3.0	0.0	1.5	Moderately Low
	Food for livestock	3.0	0.0	1.5	Moderately Low
	Cultivated foods	3.0	0.0	1.5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	4.0	3.0	4.0	Very High
	Education and Research	2.0	0.3	0.7	Very Low
	Cultural and Spiritual	3.0	0.7	1.8	Moderate



8.3 Ecological Importance and Sensitivity (EIS) (Rountree, et al., 2013) – Seepage Wetland

The Ecological Importance and Sensitivity (EIS) score forms part of a larger assessment called the Importance and Sensitivity scoring system which also addresses hydrological importance and direct human benefits. Both EC and EIS form part of a larger reserve determination process documented by the Department of Water and Sanitation.

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (Rountree, et al., 2013). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity such as species diversity and abundance.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use.

The highest EIS score of 2.0 - High EI category: Wetlands in this category are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.

- ***Biodiversity maintenance importance: 2.3 (High)***
- ***Regulating services importance: 1.5 (Moderate)***
- ***Provisioning and cultural services importance: 2.2 (High)***



8.3.1 Recommended Ecological Category (REC) – Seepage Wetland

Following the method set out in Rountree *et al.*, (2013), the **PES value of B and a High EIS class**, leads to the identification of an REC of A/B (**Table 11**). This means the rehabilitation should be done in such a way as to try and **Improve the EC to a High B or A**.

Table 14: Generic Matrix for the determination of REC and RMO for the Seepage Wetland

			EIS			
			Very high	High	Moderate	Low
EC	A	Pristine/Natural	A Maintain	A Maintain	A Maintain	A Maintain
	B	Largely Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good - Fair	B Improve	B/C Improve	C Maintain	C Maintain
	D	Poor	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Very Poor	D Improve	E/F Improve	E/F Maintain	E/F Maintain

8.4 Floodplain

8.4.1 Present Ecological Status (PES) (Macfarlane et al. (2020) – Floodplain

The combined Wetland system received a combined Impact Score of **5.6 D - Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred** (Kotze et al., 2020). The wetland condition is likely to remain stable over the next 5 years (**Table 9**).

Table 15: Summary of the results of the WetHealth (Version 2) assessment conducted for the Floodplain

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.8	6.6	3.4	3.0
PES Score (%)	32%	34%	66%	70%
Ecological Category	E	E	C	C
Trajectory of change	→	→	→	→
Confidence (revised results)	Moderate	Moderate	Moderate	Moderate
Combined Impact Score	5.6			
Combined PES Score (%)	44%			
Combined Ecological Category	D			



8.4.2 WetEcoServices Kotze et al., (2020) – Floodplain

The floodplain wetland provides comparatively high ecosystem service value despite its modified condition. Streamflow regulation, biodiversity maintenance, water for human use, harvestable resources, and tourism and recreation all scored Very High, while education and research scored High and cultural/spiritual value scored Moderately High. Sediment trapping scored Moderate, with nutrient and toxicant assimilation generally ranging from Low to Moderately Low. Overall, the floodplain wetland is considered an important aquatic feature due to its role in supporting water supply, biodiversity, recreation and broader ecological functioning associated with Loch Athlone Dam and the Jordaan River system (Table 10).

Table 16: Summary of the Ecosystem Services provided by the Floodplain

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.9	0.3	0.0	Very Low
	Stream flow regulation	3.0	4.0	3.5	Very High
	Sediment trapping	2.3	2.0	1.8	Moderate
	Erosion control	0.8	3.0	0.8	Very Low
	Phosphate assimilation	2.1	1.0	1.1	Low
	Nitrate assimilation	2.3	1.0	1.3	Moderately Low
	Toxicant assimilation	2.0	1.0	1.0	Low
	Carbon storage	2.0	1.0	1.0	Low
	Biodiversity maintenance	3.9	2.5	3.7	Very High
PROVISIONING SERVICES	Water for human use	4.0	4.0	4.0	Very High
	Harvestable resources	3.5	3.0	3.5	Very High
	Food for livestock	1.0	1.3	0.2	Very Low
	Cultivated foods	2.0	0.3	0.7	Very Low
CULTURAL SERVICES	Tourism and Recreation	4.0	4.0	4.0	Very High
	Education and Research	4.0	0.7	2.8	High
	Cultural and Spiritual	4.0	0.3	2.7	Moderately High



8.5 Ecological Importance and Sensitivity (EIS) (Rountree, et al., 2013) – Floodplain

The Ecological Importance and Sensitivity (EIS) score forms part of a larger assessment called the Importance and Sensitivity scoring system which also addresses hydrological importance and direct human benefits. Both EC and EIS form part of a larger reserve determination process documented by the Department of Water and Sanitation.

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (Rountree, et al., 2013). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity such as species diversity and abundance.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use.

The highest EIS score of 2.7 **falls within the High Category**. Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers

- ***Biodiversity maintenance importance: 2.2 (High)***
- ***Regulating services importance: 1.9 (Moderate)***
- ***Provisioning and cultural services importance: 2.7 (High)***



8.5.1 Recommended Ecological Category (REC) – Floodplain

Following the method set out in Rountree *et al.*, (2013), the **PES value of D and a High EIS class**, leads to the identification of an REC of B/C (**Table 11**). This means the rehabilitation should be done in such a way as to try and **Improve the EC to a High D or C**.

Table 17: Generic Matrix for the determination of REC and RMO for the Floodplain

			EIS			
			Very high	High	Moderate	Low
EC	A	Pristine/Natural	A Maintain	A Maintain	A Maintain	A Maintain
	B	Largely Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good - Fair	B Improve	B/C Improve	C Maintain	C Maintain
	D	Poor	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Very Poor	D Improve	E/F Improve	E/F Maintain	E/F Maintain



8.6 Summary of Findings

The Following table (**Table 18**) is a summary of the functional assessment for the wetlands within the study site.

Table 18: Summary of wetland functionality.

Classification (SANBI, 2013)	Unchannelled Valley Bottom	Floodplain	Hillslope Seepage
PES (Macfarlane et al., 2020).	3.4 C - Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact. (Kotze et al., 2020). The wetland condition is likely to remain stable over the next 5 years.	5.6 D - Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred (Kotze et al., 2020). The wetland condition is likely to remain stable over the next 5 years.	1.3 B- 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 (Kotze et al., 2020). The wetland condition is likely to remain stable over the next 5 years.
WetEcoServices (Kotze et al, 2020) –	All scores very low and only cultivated foods scoring a low	Ranging from very low to very high with tourism and water for human use scoring the highest.	Generally, very low to low with Biodiversity management and tourism scoring very high
Environmental Importance and Sensitivity category (EIS) (Kotze et al., 2020)	1.4 Moderate EI category: Wetlands in this category are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers	High EI category: Wetlands in this category are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers	
REC (Rountree et al, 2013)	Maintain the EC at C.	Improve the EC to a High D or C.	Improve the EC to a High B or A.
Calculated Buffer Zone (Macfarlane et al, 2015)	47 m	39 m	62 m



9 General Principles of Watercourse Protection (SANBI & DWS, 2016)

1. **Avoid/Prevent:** This is the highest priority in the hierarchy and involves avoiding or preventing impacts to watercourses altogether. It focuses on identifying and selecting alternative actions or locations that do not pose a risk to watercourses. This may involve changing the design or selecting a different site altogether to avoid potential negative impacts.
2. **Minimise:** If avoidance is not possible, the next step is to minimize the potential impacts on watercourses. This involves employing measures and techniques to reduce the extent, magnitude, duration, or intensity of the impacts. Examples include implementing erosion and sediment control measures, using best management practices for stormwater management, and adopting sustainable water use practices.
3. **Rehabilitate:** If impacts occur despite avoidance and minimisation efforts, the next step is to rehabilitate or restore the affected watercourses. This involves taking actions to improve the ecological, hydrological, and geomorphological functions of the impacted areas. It may include restoring natural vegetation, improving water quality, stabilising banks, and enhancing habitat for aquatic species.
4. **Offset:** If complete avoidance, minimisation, or rehabilitation is not feasible or insufficient to mitigate the impacts, offsetting measures can be considered. Offset measures aim to compensate for the residual impacts by restoring or creating new watercourse features elsewhere. This may involve creating or enhancing watercourses, establishing buffer zones, or implementing other habitat restoration projects to achieve a net benefit for watercourses and their associated ecosystems. This should be discussed with the relevant authorities, and if deemed necessary an offset plan should be developed and approved.

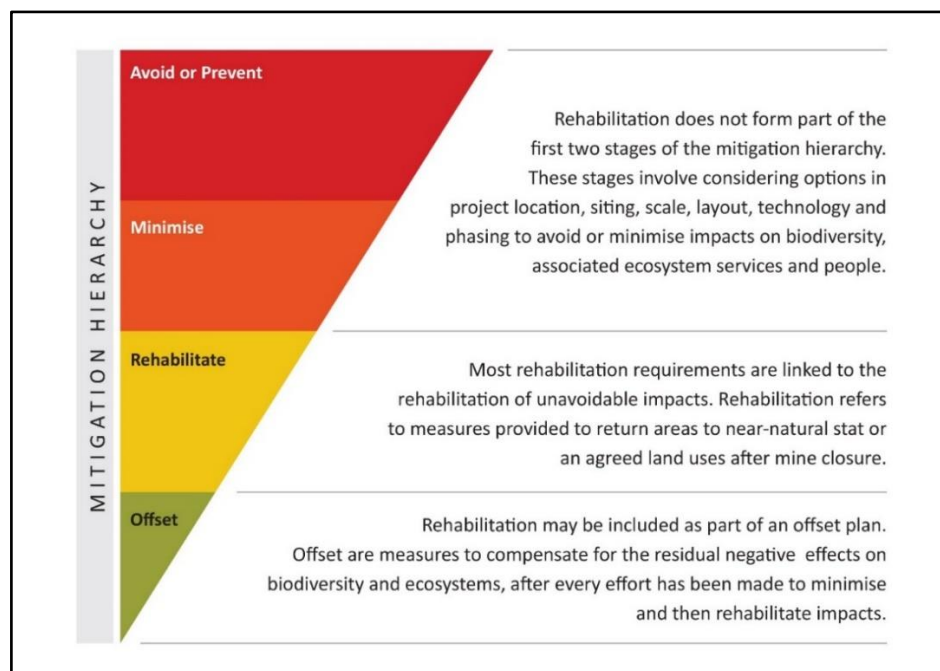


Figure 7: Mitigation Hierarchy (SANBI, 2016).



The mitigation hierarchy provides a structured approach for managing potential impacts on watercourses by prioritising avoidance and prevention before considering reduction, rehabilitation or offsetting measures. For the Afrimat Bethlehem Quarry, this approach is particularly relevant because the active quarry footprint occurs within the broader DWS regulated area of nearby wetlands, although no natural watercourses were identified within the Mining Right Authorisation Area itself. The hierarchy is therefore applied to ensure that ongoing quarry operations avoid unnecessary disturbance to delineated wetlands and buffers, minimise stormwater, sediment and water quality risks, rehabilitate any localised degradation where it occurs, and only consider offsets where residual impacts cannot be adequately addressed through on-site mitigation (*Table 19*).

Table 19: Mitigation hierarchy in relation to the Afrimat Quarry.

Mitigation Hierarchy Step	Description	Application to the Afrimat Bethlehem Quarry
Avoid / Prevent	Avoidance is the preferred mitigation measure and requires impacts to watercourses to be prevented before they occur. This includes avoiding disturbance within delineated wetlands, calculated buffers and sensitive aquatic receiving areas.	No quarry-related infrastructure, stockpiling, dirty water discharge, sediment release or unnecessary disturbance should occur within the delineated natural wetlands or their calculated buffer zones. The floodplain wetland, hillslope seepage wetland and unchannelled valley bottom wetland must be treated as sensitive no-go areas.
Minimise	Where impacts cannot be completely avoided, their extent, magnitude, duration and intensity must be reduced through appropriate management measures.	Stormwater runoff, erosion, sediment mobilisation, dust deposition and dirty water movement must be controlled through effective stormwater separation, clean and dirty water management, erosion protection, sediment trapping, outlet stabilisation and routine inspection of drainage infrastructure.
Rehabilitate	Where disturbance or degradation occurs, affected areas must be rehabilitated to restore ecological, hydrological and geomorphological functioning as far as practically possible.	Any erosion, scouring, sediment accumulation, disturbed wetland margins, degraded stormwater outlets or bare areas contributing runoff towards watercourses must be stabilised and rehabilitated using appropriate reshaping, revegetation, erosion-control measures and alien invasive plant control.
Offset	Offsetting is only considered where residual impacts remain after avoidance, minimisation and rehabilitation have been applied, and where such impacts cannot be adequately mitigated on site.	No offset is currently recommended, provided that the quarry footprint remains outside the delineated natural wetlands and their buffers, and that stormwater and dirty water are effectively managed. Should future impacts to wetlands or buffers become unavoidable, an offset requirement must be discussed with the relevant authorities and supported by an approved offset plan.



10 Impacts

The impact assessment for the Afrimat Bethlehem Quarry focuses on the potential operational risks posed by the existing quarry and associated infrastructure to the surrounding aquatic receiving environment. Although no natural watercourses were identified within the Mining Right Authorisation Area, the site occurs within the broader DWS regulated area of nearby wetlands. The floodplain wetland associated with Loch Athlone Dam and the Jordaan River system is considered the primary aquatic receptor, while the hillslope seepage and unchannelled valley bottom wetlands are less likely to be directly affected due to their position relative to the quarry and local drainage patterns. The main impact pathways are therefore associated with stormwater runoff, dirty water movement, sediment mobilisation, erosion, dust deposition, hydrocarbon contamination and cumulative degradation if operational controls are not adequately.

The anticipated operational and construction impacts of the existing project on watercourses are summarised in the table below (Table 20).

Table 20: Anticipated Operational and Rehabilitation Phase Impacts.

Infrastructure / Activity	Location Relative to Wetland	Key Impact / Risk	Risk Pathway	Mitigation Measures
Existing quarry pit and active extraction area	Located within the Mining Right Authorisation Area; outside the delineated natural wetlands and calculated buffers	Altered runoff patterns, sediment mobilisation, localised erosion and possible dirty water generation	Rainfall over exposed quarry surfaces may mobilise sediment and transport suspended solids downslope towards the floodplain wetland and Loch Athlone Dam if not contained	Maintain clean and dirty water separation; contain dirty water within operational areas; inspect and maintain stormwater controls; prevent uncontrolled discharge towards wetlands; stabilise erodible areas
Haul roads and internal access roads	Within the quarry footprint and regulated area; outside delineated wetlands	Sediment runoff, dust deposition, compaction and increased surface runoff	Vehicle movement and exposed road surfaces may generate sediment-laden runoff and dust, which may be transported by wind or stormwater towards aquatic receptors	Maintain road surfaces; use dust suppression where required; prevent runoff concentration; install and maintain diversion berms, silt traps or energy dissipaters where needed; inspect after heavy rainfall
Stockpiles, overburden areas and disturbed surfaces	Within operational areas; outside natural wetlands but within the broader regulated area	Sediment mobilisation, erosion and dust generation	Uncovered or unstable material may be mobilised by wind or stormwater and transported towards downslope wetland systems	Locate stockpiles outside buffers; shape and stabilise stockpiles; control runoff around stockpiles; implement sediment controls; progressively rehabilitate inactive disturbed areas
Stormwater channels, berms, drains and outlet points	May occur near the eastern and southern margins of the quarry, closest to the floodplain	Concentrated flow, erosion, scouring and sediment deposition at discharge points	Concentrated stormwater discharge may increase flow energy and cause erosion or sediment	Inspect outlets regularly; stabilise outlets with suitable erosion protection; install energy



Infrastructure / Activity	Location Relative to Wetland	Key Impact / Risk	Risk Pathway	Mitigation Measures
	wetland and Loch Athlone Dam		accumulation downslope of outlets	dissipaters where required; prevent direct high-energy discharge into wetland areas; monitor for scouring and sediment plumes
Dirty water containment areas, sumps or ponding areas	Within the operational quarry footprint	Water quality deterioration if overflow, leakage or uncontrolled discharge occurs	Dirty water may contain suspended solids, hydrocarbons or other contaminants and may enter downstream receptors if containment fails	Ensure dirty water is contained and reused or managed appropriately; prevent overflow; maintain freeboard; inspect after rainfall; remove accumulated sediment; repair leaks or erosion immediately
Processing areas, workshops, buildings and operational hardstand areas	Mostly located along the eastern side of the quarry near the R26 and closer to the floodplain/Loch Athlone receiving environment	Hydrocarbon, cementitious, chemical or contaminated runoff risk	Spills, wash water or contaminated runoff may move through stormwater systems towards aquatic receptors	Store hazardous substances in bunded areas; maintain spill kits; prohibit washdown water from entering stormwater drains; implement spill response procedures; inspect high-risk areas routinely
Artificial wet areas or ponding within quarry-created depressions	Within disturbed quarry areas; not considered natural wetlands	Potential overflow or unmanaged release of sediment-laden water	Ponded water may accumulate sediment or contaminants and overflow during rainfall events	Treat as dirty water unless proven otherwise; prevent discharge to natural watercourses; manage through the site water management system; monitor water levels and sediment accumulation
Dust generation from quarrying, blasting, crushing and vehicle movement	Airborne pathway from quarry towards surrounding wetland systems	Dust deposition on wetland vegetation and water surfaces	Wind may transport dust to the floodplain wetland, Loch Athlone Dam or other adjacent receptors	Implement dust suppression; maintain roads; limit excessive vehicle speeds; stabilise exposed areas where possible; monitor visible dust movement towards sensitive aquatic areas
Ongoing quarry operation within the DWS regulated area	Entire operation occurs within the broader regulated area of nearby wetlands	Cumulative degradation of the aquatic receiving environment	Long-term combined effects of runoff, sediment, dust, erosion and water quality risks may reduce wetland condition over time	Maintain all EMPr controls; undertake routine compliance inspections; monitor stormwater outlets and wetland-facing areas; keep records of corrective actions; review controls after



Infrastructure / Activity	Location Relative to Wetland	Key Impact / Risk	Risk Pathway	Mitigation Measures
				significant rainfall events
Future footprint changes or infrastructure expansion	Any expansion towards wetland buffers or altered drainage pathways	Increased risk to wetlands if runoff patterns change or buffers are encroached upon	New infrastructure may create direct disturbance or new hydrological pathways to wetland receptors	No expansion into delineated wetlands or calculated buffers without specialist review; update risk assessment if layouts change; confirm stormwater design before implementation; obtain authorisation where required

11 Opportunities and Constraints

The following section identifies the main aquatic opportunities and constraints associated with the ongoing operation of the Afrimat Bethlehem Quarry. These are intended to support the EMPr amendment by highlighting where existing site conditions can be used to reduce aquatic risk, and where operational management must be strengthened to prevent deterioration of nearby wetland systems, particularly the floodplain wetland associated with Loch Athlone Dam and the Jordaan River system. The table below outlines key aspects, associated opportunities, and constraints identified during the assessment (**Table 21**):



Table 21: Opportunities and Constraints

Aspect	Opportunities	Constraints
Existing quarry footprint	The quarry is an established, long-standing operation, and the current disturbed footprint can be managed without requiring direct disturbance of the delineated natural wetlands.	The operation occurs within the broader DWS regulated area of nearby wetlands, which requires continued aquatic risk management and compliance monitoring.
Wetland avoidance	The delineated natural wetlands and calculated buffers occur outside the main active quarry footprint, allowing avoidance to remain the primary mitigation measure.	Any future expansion or infrastructure changes towards the wetlands or buffers may trigger additional assessment, authorisation and mitigation requirements.
Stormwater management	The EMPr amendment provides an opportunity to strengthen clean and dirty water separation, sediment control, outlet stabilisation and stormwater monitoring.	Existing runoff pathways and stormwater infrastructure may require engineering review to confirm that dirty water is contained and that high-energy discharge does not reach the floodplain wetland.
Floodplain wetland and Loch Athlone Dam	The floodplain wetland and dam can be protected through practical controls focused on runoff, sediment, erosion, dust and water quality management.	This receptor is located closest to the quarry and remains the primary aquatic sensitivity due to potential stormwater movement from the eastern and southern portions of the operation.
Hillslope seepage and unchannelled valley bottom wetlands	Current topography appears to limit direct hydrological connectivity between the quarry and these wetlands, reducing the likelihood of direct operational impacts.	Indirect impacts such as dust deposition, cumulative catchment disturbance or changes to drainage patterns remain possible if the quarry footprint or infrastructure changes.
Rehabilitation of disturbed areas	Inactive disturbed areas, eroding surfaces and redundant access tracks can be stabilised or rehabilitated to reduce sediment mobilisation and improve catchment condition.	Rehabilitation success may be constrained by ongoing operations, compacted substrates, exposed rock, altered soils, steep slopes and continued vehicle movement.
Monitoring and auditability	The EMPr can include clear inspection points, photographic monitoring, rainfall-event inspections and corrective action triggers.	Desktop review alone cannot confirm the current condition of all outlet points, erosion features or dirty water systems; targeted field verification may be required where uncertainty remains.
Alien invasive plant control	Alien invasive plant management can improve wetland buffer condition, reduce disturbance-related vegetation change and support long-term ecological functioning.	The surrounding wetland and dam margins already contain alien invasive species, and long-term control requires repeated follow-up, resources and coordination with adjacent landowners or managing authorities.
Water quality protection	Dirty water containment, spill prevention and sediment control can reduce the risk of deterioration of Loch Athlone Dam and downstream aquatic systems.	The proximity of the R26, existing quarry infrastructure and surrounding modified land uses may make it difficult to separate quarry-related effects from broader catchment impacts.
Cumulative impact management	The amended EMPr provides an opportunity to align quarry management with the broader ecological support landscape and protected-area context.	The receiving environment is already modified by historic dam construction, roads, agriculture, grazing and urban influences, which increases the importance of preventing further incremental degradation.



12 Cumulative Impacts

As required by the Department of Forestry, Fisheries and the Environment (DFFE) under the **National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998)** and its associated EIA Regulations (as amended), all existing developments must consider not only direct project-specific impacts, but also cumulative impacts that may arise when added to other past, present, or reasonably foreseeable future activities in the area.

Cumulative impacts refer to the combined effects of the existing quarry operation together with other historical and current land uses within the local catchment. In the context of the Afrimat Bethlehem Quarry, the receiving aquatic environment has already been modified by long-term quarrying, road infrastructure, dam construction, agriculture, grazing, urban development and alien invasive vegetation. Although the quarry does not directly encroach into the delineated natural wetlands or their calculated buffers, continued operation within the broader regulated area may contribute incrementally to downstream aquatic degradation if stormwater, sediment, dirty water, erosion and dust are not effectively managed.

The table below identifies key cumulative impacts relevant to this project, their potential ecological consequences, and mitigation strategies to ensure compliance with DFFE's cumulative assessment expectations. (Table 22).

Table 22: The cumulative impacts of the existing development*

Cumulative Impact	Description of Impact	Cumulative Effect	Potential Result	Mitigation
Altered catchment hydrology	Historic dam construction, roads, quarrying and surrounding land-use modification have altered natural runoff patterns in the local catchment.	Increased concentration of flows, reduced natural infiltration and modified runoff timing towards the floodplain wetland and Loch Athlone Dam.	Localised erosion, sediment deposition, altered wetland hydroperiod and reduced wetland resilience.	Maintain clean and dirty water separation; ensure stormwater is attenuated and dispersed; prevent uncontrolled discharge; review stormwater infrastructure where runoff patterns change.
Sediment mobilisation	Exposed quarry surfaces, haul roads, stockpiles, road runoff and disturbed surrounding areas may contribute sediment to downstream aquatic systems.	Progressive sediment accumulation in drainage pathways, the floodplain wetland and Loch Athlone Dam.	Smothering of wetland vegetation, reduced habitat quality, increased turbidity and reduced aquatic ecological condition.	Stabilise exposed areas; maintain sediment traps and berms; rehabilitate inactive disturbed areas; inspect outlet points after rainfall; remove accumulated sediment where required.
Erosion and scouring	Concentrated runoff from operational areas, road infrastructure and stormwater outlets may increase erosion risk.	Incremental enlargement of erosion features and increased sediment delivery to downstream receptors.	Bank instability, gully, sediment plumes and deterioration of wetland geomorphological condition.	Install energy dissipaters; armour or vegetate outlets; repair scouring immediately; monitor erosion-prone areas; avoid direct high-energy discharge towards wetlands.
Water quality deterioration	Quarry runoff, road runoff, dirty water, hydrocarbons, fine sediment and other pollutants may enter the receiving environment if not contained.	Gradual decline in water quality within the floodplain wetland, Loch Athlone Dam and downstream Jordaan River system.	Reduced aquatic habitat quality, increased turbidity, possible contamination and reduced ecosystem service value.	Contain dirty water; maintain bunded storage areas; implement spill response measures; prohibit contaminated wash water discharge; monitor high-risk areas and discharge points.



Cumulative Impact	Description of Impact	Cumulative Effect	Potential Result	Mitigation
Dust deposition	Quarrying, crushing, blasting, haul roads and exposed surfaces may contribute dust to the surrounding environment.	Ongoing deposition of fine material on wetland vegetation, dam margins and surrounding habitats.	Reduced vegetation vigour, increased sediment load during rainfall and localised degradation of sensitive aquatic margins.	Implement dust suppression; maintain roads; control vehicle speeds; stabilise exposed areas; monitor visible dust movement towards aquatic receptors.
Alien invasive plant establishment	Disturbed areas, wetland margins, dam edges and stormwater outlets may provide favourable conditions for alien invasive plant recruitment.	Expansion of alien invasive plants along disturbed wetland edges and drainage pathways.	Reduced indigenous vegetation integrity, altered habitat structure and reduced ecological resilience.	Implement alien invasive plant control; prioritise wetland buffers and outlet areas; undertake follow-up clearing; rehabilitate cleared areas with suitable indigenous vegetation.
Loss of ecological resilience	The broader landscape is already modified by infrastructure, agriculture, grazing, urban influence and historic impoundment.	Reduced ability of wetland systems to absorb additional stress from sediment, water quality changes or altered runoff.	Progressive deterioration of wetland condition and reduced biodiversity-support function.	Apply the mitigation hierarchy; avoid wetland and buffer disturbance; maintain ecological corridors; strengthen monitoring and adaptive management in the EMPr.
Climate-related stormwater stress	Increased rainfall intensity and extreme storm events may reduce the effectiveness of existing stormwater controls.	Higher runoff volumes, increased erosion risk and greater probability of dirty water overflow.	Sedimentation, erosion, infrastructure failure and increased risk to the floodplain wetland and Loch Athlone Dam.	Design and maintain stormwater systems conservatively; inspect after major rainfall events; maintain freeboard in containment areas; update controls where failure points are identified.
Incremental operational expansion	Future changes to the quarry footprint, stockpile areas, roads or stormwater infrastructure may create new risk pathways.	Increased proximity to wetland buffers or altered drainage towards sensitive receptors.	Increased authorisation risk, higher aquatic impact significance and possible wetland degradation.	No expansion into wetlands or buffers without specialist review; update the risk assessment for layout changes; confirm authorisation requirements before implementation.

*Notes

1. The cumulative impacts are based on activities within a 30 km radius, aligned with DFFE requirements



13 Mitigation Measures

The mitigation measures below are intended for incorporation into the amended EMPr and focus on practical, implementable and auditable actions to prevent deterioration of the nearby wetland systems, particularly the floodplain wetland associated with Loch Athlone Dam and the Jordaan River system. As the quarry is an existing operation, the emphasis is on ongoing operational control, monitoring, maintenance and corrective action (*Table 23*).

Table 23: Mitigation Measures.

Project Phase	Mitigation Objective	Mitigation Measures
Operational Phase	Prevent direct disturbance of natural watercourses and buffers	No quarrying, stockpiling, dumping, vehicle movement, infrastructure placement or unnecessary disturbance may occur within the delineated natural wetlands or their calculated buffer zones. Wetlands and buffers must be treated as sensitive no-go areas unless otherwise authorised.
	Maintain clean and dirty water separation	Clean water must be diverted around disturbed operational areas where practical, and dirty water generated within the quarry footprint must be contained and managed within the site water management system. Dirty water may not be discharged directly into any wetland, Loch Athlone Dam or the Jordaan River system.
	Prevent sediment mobilisation into downstream wetlands	Exposed soils, stockpiles, haul roads and disturbed surfaces must be managed to minimise sediment generation. Sediment traps, berms, silt fences, check structures or other appropriate sediment-control measures must be installed and maintained where sediment-laden runoff may leave operational areas.
	Prevent erosion and scouring at stormwater outlets	Stormwater outlet points must be inspected routinely and after significant rainfall events. Where erosion, scouring or sediment plumes are observed, the outlet must be stabilised through suitable erosion protection, energy dissipation, reshaping, revegetation or engineering intervention.
	Protect water quality in the floodplain wetland and Loch Athlone Dam	Hydrocarbons, chemicals, cementitious materials, contaminated runoff and wash water must be prevented from entering stormwater systems or natural watercourses. Fuel, oils and chemicals must be stored in bunded areas, and spill kits must be available at high-risk operational areas.
	Manage artificial ponding and dirty water accumulation within the quarry	Ponded water within quarry-created depressions must be treated as potentially dirty water unless proven otherwise. Such water must be managed to prevent overflow, leakage or uncontrolled release towards natural wetlands or downstream aquatic receptors.
	Reduce dust deposition on aquatic receptors	Dust suppression must be implemented on haul roads, active working areas and other dust-generating surfaces where visible dust movement towards wetland areas or Loch Athlone Dam is observed. Vehicle speeds must be controlled on internal roads.
	Prevent alien invasive plant establishment and spread	Alien invasive plants must be monitored and controlled within disturbed areas, stormwater outlet zones, wetland-facing slopes and buffer-adjacent areas. Cleared areas must be stabilised or revegetated where necessary to prevent reinvasion and erosion.
	Maintain effective stormwater infrastructure	Stormwater berms, channels, drains, culverts, sediment-control structures and containment areas must be inspected and maintained regularly. Blockages, erosion, sediment build-up or damaged structures must be repaired timeously.
	Provide auditable monitoring for the EMPr	Fixed photographic monitoring points should be established at key stormwater outlets, wetland-facing drainage areas and erosion-prone areas. Monitoring records must include date, rainfall context where relevant, observed condition, corrective action required and confirmation of closure.
	Prevent cumulative deterioration of receiving wetlands	The quarry must ensure that sediment, dirty water, dust and erosion risks are managed continuously, not only during audits. Any recurring impact or repeated failure of a control measure must trigger a review of the relevant management action.



Project Phase	Mitigation Objective	Mitigation Measures
	Ensure adaptive management	If monitoring identifies erosion, sedimentation, water quality deterioration, dirty water overflow, alien invasive plant spread or new runoff pathways towards wetlands, corrective action must be implemented and the EMPr measures must be updated where required.
Future Changes / Expansion	Avoid creating new aquatic risk pathways	Any proposed expansion of the quarry footprint, access roads, stockpiles, processing areas or stormwater infrastructure must be screened against the delineated wetlands, calculated buffers and DWS regulated area before implementation.
	Confirm authorisation requirements before implementation	No new activity within a wetland, calculated buffer or regulated area may proceed without confirmation of the applicable environmental and water use authorisation requirements. A specialist review must be undertaken where changes may alter runoff patterns or increase risk to watercourses.
Rehabilitation / Closure Planning	Reduce long-term sediment and erosion risk	Redundant disturbed areas, inactive access tracks, unstable slopes and eroded surfaces must be progressively stabilised and rehabilitated to reduce long-term sediment delivery to downstream aquatic systems.
	Restore stable vegetation cover where practical	Rehabilitation areas should be reshaped, stabilised and revegetated using appropriate indigenous species suitable for the local grassland and wetland-edge context. Alien invasive plants must be controlled during and after rehabilitation.



13.1 Stormwater Management

Stormwater management is a key aquatic management requirement for the Afrimat Bethlehem Quarry, as the previous assessment identified the floodplain wetland associated with Loch Athlone Dam and the Jordaan River system as the primary aquatic receptor that could potentially receive surface runoff from the quarry. Although no natural watercourses were identified within the Mining Right Authorisation Area, the site occurs within the broader DWS regulated area of nearby wetlands, and uncontrolled stormwater movement may result in sediment mobilisation, erosion, dirty water discharge, water quality deterioration and cumulative degradation of the downstream receiving environment.

The objective of stormwater management must therefore be to maintain effective separation between clean and dirty water, prevent sediment-laden runoff from leaving disturbed operational areas, control the velocity and direction of stormwater flows, and ensure that stormwater outlets do not cause erosion or sediment deposition within downstream wetland areas. Stormwater controls should be practical, auditable and incorporated into the amended EMP as routine operational requirements (Table 24).

Table 24: Stormwater Management Objectives

Objective	Description	Relevance to Aquatic Receptors
Separate clean and dirty water	Clean runoff from undisturbed upslope areas should be diverted around operational quarry areas, while dirty water from disturbed areas must be contained and managed on site.	Reduces the volume of contaminated or sediment-laden water that may move towards the floodplain wetland and Loch Athlone Dam.
Prevent uncontrolled discharge	Stormwater from active quarry areas, haul roads, stockpiles and disturbed surfaces must not discharge directly into wetlands, buffers or downstream aquatic systems.	Prevents sedimentation, turbidity, erosion and water quality deterioration in the receiving environment.
Control flow velocity	Concentrated flows from channels, berms, culverts or outlets must be attenuated or dissipated before leaving operational areas.	Reduces the risk of erosion, scouring and sediment delivery downslope of outlet points.
Contain dirty water	Water that has contacted exposed quarry surfaces, operational areas, stockpiles, processing areas or contaminated surfaces must be treated as dirty water.	Prevents suspended solids, hydrocarbons and other contaminants from entering downstream wetland systems.
Maintain stormwater infrastructure	Existing stormwater controls must be inspected, maintained and repaired where required.	Ensures that stormwater infrastructure remains functional and does not become a source of erosion or sediment release.
Provide auditable monitoring	Stormwater outlets, erosion-prone areas and wetland-facing slopes must be monitored and photographed regularly.	Allows early detection of erosion, sediment accumulation, outlet failure or dirty water movement towards sensitive receptors.



13.1.1 Stormwater Risk Areas

The main stormwater risk areas are expected to be associated with exposed quarry surfaces, haul roads, stockpiles, disturbed operational areas, stormwater outlet points, dirty water containment areas and any drainage pathways that direct runoff towards the floodplain wetland and Loch Athlone Dam. The R26 road provides partial separation between the quarry and the dam/wetland system; however, this does not remove the need for stormwater control, as runoff may still be directed towards the eastern and southern receiving environment (*Table 25* and *Table 26*).

Table 25: Stormwater Risk Areas

Stormwater Source / Area	Potential Risk	Receiving Environment	Required Management Response
Active quarry pit and exposed operational areas	Generation of sediment-laden runoff during rainfall events.	Floodplain wetland, Loch Athlone Dam and downstream Jordaan River system.	Contain dirty water within the quarry water management system and prevent uncontrolled overflow or discharge.
Haul roads and internal access roads	Increased runoff, sediment mobilisation and dust-laden wash-off.	Wetland-facing slopes and downstream drainage pathways.	Maintain road surfaces, control vehicle speeds, apply dust suppression and install runoff diversion or sediment controls where needed.
Stockpiles and overburden areas	Erosion of loose material and sediment transport during rainfall.	Downslope stormwater pathways and floodplain wetland.	Locate outside wetland buffers, shape and stabilise stockpiles, divert clean water around stockpiles and install sediment traps where required.
Stormwater channels, berms and culverts	Concentrated flow causing erosion or scouring at outlet points.	Areas downslope of outlets and wetland margins.	Stabilise outlets, install energy dissipation measures and inspect after rainfall events.
Dirty water containment areas or sumps	Overflow, leakage, sediment build-up or uncontrolled release.	Downstream wetlands and Loch Athlone Dam.	Maintain freeboard, remove accumulated sediment, inspect after rainfall and repair any structural failures.
Processing, workshop or hardstand areas	Hydrocarbon, chemical or contaminated runoff entering stormwater systems.	Floodplain wetland and dam system if runoff is not contained.	Store hazardous substances in bunded areas, maintain spill kits and prevent wash water or spills from entering stormwater drains.



Table 26: Stormwater Management Measures

Management Aspect	Required Measure	Implementation Requirement
Clean water diversion	Clean runoff must be diverted around disturbed operational areas as far as practicable.	Diversion berms, drains or channels must be maintained so that clean water does not become contaminated by quarry activities.
Dirty water containment	Dirty water generated within the quarry footprint must be contained and managed within the operational water management system.	Dirty water must not be discharged directly into any delineated wetland, wetland buffer, Loch Athlone Dam or the Jordaan River system.
Sediment control	Sediment traps, check structures, silt fences, berms or similar controls must be installed where sediment-laden runoff may leave operational areas.	Controls must be inspected and cleaned regularly, particularly before and after high-rainfall periods.
Outlet protection	Stormwater outlet points must be protected against erosion and scouring.	Energy dissipaters, rock protection, vegetation stabilisation, level spreaders or other suitable controls must be used where concentrated discharge occurs.
Erosion prevention	Bare and erodible areas must be stabilised as soon as practicable.	Stabilisation may include reshaping, compaction, rock protection, revegetation, erosion blankets or other appropriate measures.
Stockpile management	Stockpiles must be positioned and shaped to reduce erosion and sediment transport.	Stockpiles must not be placed within delineated wetlands or calculated buffers and should not obstruct stormwater flow paths.
Hydrocarbon and chemical control	Contaminated runoff must be prevented from entering stormwater systems.	Fuel, oil and chemicals must be stored in bunded areas, and spill response materials must be available at high-risk locations.
Maintenance	Stormwater infrastructure must remain functional throughout the operational phase.	Blocked drains, damaged berms, eroded outlets, sediment build-up and failed controls must be repaired timeously.
Adaptive management	Repeated failure of a stormwater control must trigger review and improvement of the measure.	Corrective actions must be recorded and closed out as part of EMP compliance monitoring.



13.1.2 Stormwater Monitoring and Audit Requirements

Stormwater monitoring should be incorporated into the amended EMPr as a routine operational and audit requirement. The monitoring programme should focus on areas where runoff may leave the quarry footprint, where stormwater is concentrated, and where drainage pathways occur in the direction of the floodplain wetland and Loch Athlone Dam (*Table 27* and *Table 28*).

Table 27: Stormwater Monitoring and Audit Requirements

Monitoring Item	Monitoring Method	Frequency	Indicator of Concern
Stormwater outlet points	Visual inspection and fixed-point photographs.	Monthly and after significant rainfall events.	Erosion, scouring, sediment plumes, blocked outlets or unstable discharge areas.
Dirty water containment areas	Visual inspection of water level, freeboard, sediment accumulation and structural condition.	Weekly during wet season and after significant rainfall events.	Overflow risk, leakage, reduced capacity or sediment build-up.
Haul roads and exposed surfaces	Visual inspection for rilling, sediment movement and runoff concentration.	Monthly and after rainfall.	Rills, gullies, sediment tracks or visible runoff leaving disturbed areas.
Stockpiles and overburden areas	Visual inspection of slope stability and sediment movement.	Monthly and after rainfall.	Erosion on stockpile slopes, sediment fans or runoff from stockpile areas.
Wetland-facing slopes and drainage pathways	Visual inspection and photographic monitoring.	Quarterly and after significant rainfall events.	Sediment accumulation, erosion, new drainage pathways or dirty water movement towards wetlands.
Water quality risk areas	Inspection of workshops, fuel storage, chemical storage and washdown areas.	Monthly.	Spills, staining, contaminated runoff, lack of bunding or drainage to stormwater systems.
Floodplain wetland edge / receiving area where accessible	Visual inspection from safe and permissible access points.	Biannually or during EMPr audits.	Sediment deposition, erosion, alien invasive plant establishment or visible degradation linked to runoff.

Table 28: Stormwater Corrective Action Triggers

Trigger	Required Response
Evidence of dirty water leaving the quarry footprint	Immediately stop or contain the discharge, identify the source, repair the control failure and record the incident and corrective action.
Erosion or scouring at a stormwater outlet	Stabilise the affected area, install energy dissipation and review whether the outlet design is adequate.
Sediment deposition downslope of quarry infrastructure	Remove sediment where appropriate, install additional sediment controls and stabilise the source area.
Repeated blockage or overtopping of stormwater controls	Review the capacity and maintenance frequency of the relevant structure and upgrade where required.
Hydrocarbon or chemical spill entering a stormwater pathway	Implement spill response immediately, prevent further movement, remove contaminated material and record the incident.
New drainage pathway forming towards a wetland or buffer	Redirect or stabilise the pathway and assess whether further specialist or engineering input is required.
Stormwater control failure after high rainfall	Repair immediately, photograph before and after corrective action, and review whether climate-resilient upgrades are required.



14 Rehabilitation of Disturbed Areas

Rehabilitation within the Afrimat Bethlehem Quarry should not be limited to closure or decommissioning, but should be implemented progressively where operational areas are no longer required, where disturbance is causing erosion or sediment mobilisation, or where ineffective stormwater management has resulted in localised degradation. The purpose of rehabilitation in this context is to stabilise disturbed surfaces, reduce sediment delivery to the downstream aquatic receiving environment, improve stormwater control, limit alien invasive plant establishment, and prevent further deterioration of the floodplain wetland, Loch Athlone Dam and the broader Jordaan River system.

Rehabilitation should prioritise disturbed areas that are hydrologically connected to wetland-facing drainage pathways, stormwater outlets, exposed slopes, redundant tracks, unstable stockpile margins, bare soil areas and areas where erosion or sediment accumulation is evident. Rehabilitation measures should be practical and compatible with the continued operation of the quarry. Where areas are still actively used, stabilisation and erosion-control measures should be applied to reduce ongoing risk until final rehabilitation becomes possible ([Table 29](#)).

Table 29: Rehabilitation plan.

Disturbed Area / Feature	Rehabilitation Objective	Rehabilitation Measures
Bare or exposed disturbed surfaces	Reduce erosion and sediment mobilisation	Reshape where required, stabilise the surface, promote vegetation cover, apply mulch or erosion-control material where necessary, and prevent concentrated runoff across exposed areas.
Redundant access tracks or compacted areas	Reduce runoff concentration and restore surface stability	Rip compacted surfaces where operationally feasible, reshape to match surrounding drainage, stabilise with suitable material and revegetate with appropriate indigenous grassland species.
Eroded slopes, rills or gullies	Arrest erosion and prevent sediment transport	Reprofile unstable slopes, install check structures or energy dissipation where required, stabilise with rock, brush-packing, erosion blankets or vegetation, and monitor after rainfall.
Stormwater outlet areas	Prevent scouring and sediment discharge	Stabilise outlet zones using rock protection, level spreaders, energy dissipaters, vegetation establishment or other suitable erosion-control measures.
Stockpile or overburden margins	Prevent sediment loss and slope instability	Shape stockpiles to stable gradients, prevent runoff from flowing over stockpile faces, install sediment controls at the toe, and stabilise inactive stockpiles.
Sediment accumulation areas	Prevent mobilisation of accumulated sediment	Remove accumulated sediment where appropriate, identify and stabilise the source, and reinstate sediment-control structures.
Artificial ponding or wet areas within the quarry	Prevent uncontrolled overflow or dirty water movement	Manage ponded water as dirty water unless proven otherwise, maintain containment, remove sediment where needed, and reshape redundant ponding areas to prevent recurrent uncontrolled accumulation.
Alien invasive plant patches	Improve ecological stability and reduce reinvasion risk	Remove alien invasive plants using appropriate methods, prioritise wetland-facing slopes and stormwater pathways, and stabilise cleared areas to prevent erosion and reinvasion.
Rehabilitation areas adjacent to wetland buffers	Protect aquatic receptors and improve buffer function	Avoid soil disturbance within wetland areas, stabilise the disturbed edge, establish indigenous vegetation, prevent vehicle access and monitor for erosion or alien invasive plants.

14.1 Rehabilitation Principles

Rehabilitation should follow a risk-based and progressive approach. Areas that pose the greatest risk to the receiving aquatic environment should be prioritised first, particularly those that may contribute sediment-laden runoff or dirty water towards Loch Athlone Dam and the floodplain wetland. Rehabilitation must aim to restore stable surface conditions rather than create unnecessary additional disturbance. Where reshaping is required, slopes should be graded to stable angles that reduce runoff velocity and prevent ponding or channelised flow. Rehabilitation should avoid directing concentrated runoff towards wetland areas. Where runoff cannot be avoided, it should be dispersed, slowed and filtered through appropriate erosion and sediment-control measures. Revegetation should use suitable indigenous species representative of the local grassland and wetland-edge environment, where feasible. Fast-establishing indigenous grasses should be prioritised for erosion control on disturbed slopes and exposed soils. Alien invasive species must not be used for stabilisation, and any alien invasive regrowth must be removed during follow-up maintenance ([Table 30](#) and [Table 31](#)).

Table 30: Rehabilitation Monitoring

Monitoring Aspect	Monitoring Method	Frequency	Indicator of Concern	Corrective Action
Vegetation establishment	Visual inspection and photographic monitoring	Quarterly until stabilised	Poor cover, bare patches, failed germination or dieback	Reseed, replant, stabilise surface or improve erosion control.
Erosion stability	Inspect slopes, outlet areas, tracks and rehabilitated surfaces	Monthly during wet season and after significant rainfall	Rilling, gully, scouring or sediment movement	Reprofile, install check structures, stabilise with rock or vegetation, and repair damaged controls.
Sediment movement	Inspect drains, sediment traps, downslope areas and wetland-facing slopes	Monthly and after rainfall	Sediment accumulation outside intended control areas	Remove sediment, stabilise source area and improve sediment-control measures.
Alien invasive plants	Visual inspection of rehabilitated and disturbed areas	Quarterly	Alien invasive recruitment or spread	Remove alien invasive plants and stabilise disturbed soil after clearing.
Stormwater interaction	Inspect whether rehabilitated areas are receiving concentrated runoff	After significant rainfall events	Concentrated flow, ponding, erosion or failure of stabilisation	Redirect runoff, improve drainage control and reinforce stabilisation.
Photographic record	Fixed-point photographs of rehabilitation areas	Quarterly and after corrective actions	No improvement or recurring deterioration	Review rehabilitation method and implement additional corrective action.



Table 31: Rehabilitation Performance Targets

Rehabilitation Target	Performance Indicator
Stabilised disturbed surfaces	No active erosion or sediment movement from rehabilitated areas.
Reduced sediment risk	No visible sediment plumes or sediment fans leaving rehabilitated areas towards stormwater pathways or wetland receptors.
Effective vegetation cover	Indigenous vegetation cover established sufficiently to stabilise soil and reduce erosion risk.
Controlled alien invasive plants	Alien invasive plants removed and follow-up control implemented where regrowth occurs.
Stable stormwater interaction	Rehabilitated areas do not concentrate runoff or create new erosion pathways.

15 MONITORING PLAN

A monitoring plan is required to ensure that the management measures included in the amended EMPr are implemented effectively and that potential impacts to the receiving aquatic environment are detected early. Monitoring should focus on the main aquatic risk pathways associated with the existing quarry operation, namely stormwater runoff, erosion, sediment mobilisation, dirty water containment, dust deposition, alien invasive plant establishment and rehabilitation of disturbed areas. The monitoring plan must be practical, auditable and linked to clear corrective action triggers.

15.1 Record-Keeping and Reporting

All monitoring must be recorded in an auditable format. Records should include the inspection date, name of the person undertaking the inspection, weather or rainfall context where relevant, monitoring location, observations, photographs, identified non-compliances, corrective actions required, responsible person and close-out date. Fixed photographic monitoring points should be established at key stormwater outlet points, wetland-facing drainage areas, dirty water containment areas and rehabilitation areas. Photographs should be taken from the same position and direction during each monitoring event to allow comparison over time.

Any incident involving dirty water release, hydrocarbon spill, erosion reaching a drainage pathway, sediment movement towards a wetland or unauthorised disturbance within a wetland buffer must be recorded as an environmental incident and addressed through corrective action. Repeated failure of the same control measure must trigger review of the relevant EMPr management action and, where necessary, engineering or specialist input.

The site Environmental Officer or appointed responsible person should undertake routine monitoring, with findings reviewed during internal environmental inspections and EMPr audits. Where recurring erosion, sedimentation, dirty water movement or wetland degradation is observed, the matter should be escalated to the mine manager, environmental manager and, where required, a suitably qualified aquatic specialist or stormwater engineer.



Table 32: Monitoring Plan

Monitoring Aspect	Monitoring Location	Monitoring Method	Frequency
Stormwater outlet stability	All stormwater discharge points, particularly those draining towards the floodplain wetland and Loch Athlone Dam	Visual inspection and fixed-point photographs	Monthly and after significant rainfall events
Clean and dirty water separation	Quarry pit, operational areas, haul roads, stockpile areas, containment areas and diversion berms	Visual inspection of berms, channels, sumps and drainage pathways	Monthly and after significant rainfall events
Dirty water containment	Sumps, settlement areas, quarry-created ponding areas and any dirty water holding areas	Visual inspection of water levels, freeboard, sediment accumulation and structural stability	Weekly during wet season and after significant rainfall events
Erosion and sediment mobilisation	Exposed surfaces, disturbed slopes, haul roads, stockpile margins, stormwater pathways and wetland-facing areas	Visual inspection for rills, gullies, sediment fans and bare erodible surfaces	Monthly and after significant rainfall events
Sediment-control structures	Silt traps, check structures, berms, sediment ponds, drains and low points where sediment accumulates	Visual inspection and removal records	Monthly and after significant rainfall events
Floodplain wetland and Loch Athlone Dam interface	Accessible and safe viewpoints east and southeast of the quarry, especially near potential runoff pathways	Visual inspection and photographic monitoring	Quarterly and during EMPr audits
Hillslope seepage and unchannelled valley bottom wetland buffers	Wetland buffer areas where access is permissible and safe	Visual inspection using fixed-point photographs or desktop imagery where access is limited	Biannually or during EMPr audits
Dust deposition risk	Haul roads, crushing/processing areas, exposed surfaces and wetland-facing slopes	Visual inspection for visible dust movement and dust accumulation	Monthly and during windy/dry periods
Hydrocarbon and chemical pollution risk	Workshop areas, fuel storage, chemical storage, parking areas and machinery service areas	Visual inspection of bunds, spill kits, staining, leaks and drainage pathways	Monthly and after spills/incidents
Rehabilitation areas	Stabilised disturbed areas, redundant tracks, eroded slopes, stormwater outlet areas and inactive stockpiles	Visual inspection and fixed-point photographs	Quarterly until stable, then biannually
Alien invasive plants	Wetland-facing areas, stormwater pathways, disturbed areas, buffer edges and rehabilitation areas	Visual inspection and mapping of priority patches	Quarterly
Compliance with no-go areas	Delineated wetlands, calculated buffers and sensitive aquatic areas	Visual inspection and audit of site activities	Monthly and during EMPr audits
Post-rainfall response	All high-risk stormwater, erosion and containment areas	Rapid inspection following significant rainfall	Within 48 hours of significant rainfall where safe and practical



16 GN320 Impacts on the Aquatic Environment

A discussion on impacts to the aquatic environment (as required in GN320 of March 2020) is summarised in **Table 33**. The numbers (e.g., 2,5,3) refer to specific impact categories outlined in GN320 of March 2020, which guides the assessment of impacts on watercourses. These numbers correspond to predefined sections in the Government Notice that categorise different types of ecological impacts. In this context, they indicate that the impact assessment addresses:

- (2) Impacts on hydrological processes, including changes to flood regimes, floodplain connectivity, and groundwater interactions.
- (5) Impacts on ecosystem functioning and resilience, particularly how the existing development may alter wetland or riparian dynamics.
- (3) Impacts related to sediment transport, erosion control, and other geomorphological changes.



Table 33: Impacts as per GN320 of March 2020.

Impact Question	Expected Impact	Mitigation Measures
How will the existing development impact on fixed and dynamic ecological processes that operate within or across the site?		
a) Impacts on hydrological functioning at a landscape level, including flood regimes	The quarry is unlikely to alter flood regimes at a catchment scale. Localised changes to runoff patterns may occur due to exposed surfaces, compacted areas, roads, stormwater infrastructure and disturbed quarry areas. The main concern is increased or concentrated runoff towards the floodplain wetland and Loch Athlone Dam.	Divert clean water around disturbed areas where practicable. Contain dirty water on site. Ensure stormwater outlets are stabilised and discharge is attenuated or dispersed. Inspect runoff pathways after significant rainfall events and correct areas of concentrated flow.
b) Change in sediment regime	Exposed quarry surfaces, stockpiles, haul roads and disturbed areas may increase sediment mobilisation during rainfall events. Sediment may be transported towards downstream aquatic receptors if controls fail.	Stabilise exposed and inactive disturbed areas. Maintain sediment traps, berms and stormwater controls. Remove accumulated sediment from drains and containment areas. Monitor wetland-facing drainage pathways and rehabilitate eroded areas.
c) Extent of modification relative to aquatic ecosystem zones	No direct modification of the delineated natural wetlands or their calculated buffers is expected if the existing footprint is maintained. The floodplain wetland remains the most exposed receptor due to its position downslope and east/southeast of the quarry.	Treat delineated wetlands and calculated buffers as no-go areas. Demarcate sensitive areas where required. Ensure no stockpiling, dumping, vehicle movement, excavation or dirty water discharge occurs within these areas.
d) Change in risk associated with water uses	The existing operation remains within the broader DWS regulated area of nearby wetlands. The principal water use risk relates to potential Section 21(c) and (i) impacts through altered flow, stormwater discharge, erosion, sedimentation and possible alteration of watercourse characteristics.	Maintain mitigation measures required for low-risk operation. Update the risk assessment if the quarry footprint, stormwater system, discharge points or drainage pathways change materially. Confirm authorisation requirements before implementing new infrastructure within the regulated area.
How will the existing development impact on the functioning of the aquatic feature?		
a) Base flows	No measurable change to base flows is expected from the existing quarry footprint, as the affected wetlands are not directly crossed or excavated. The main potential risk would arise if future activities intercept, divert or discharge water into drainage pathways.	Avoid new excavation, discharge or diversion infrastructure within wetlands or buffers. Ensure dirty water is contained and managed on site. Review any proposed change to water management infrastructure before implementation.
b) Quantity of water / hydroperiod	Localised runoff volumes may increase from disturbed and compacted quarry surfaces, particularly during rainfall events. This may alter short-term wetting patterns downslope if stormwater is discharged in a concentrated manner.	Maintain clean/dirty water separation. Attenuate and dissipate stormwater before release from operational areas. Prevent uncontrolled runoff and inspect stormwater controls after significant rainfall.
c) Change in hydrogeomorphic typing	No change in hydrogeomorphic typing is expected, as the existing quarry does not occur within the delineated natural wetlands. The unchannelled valley bottom wetland, hillslope seepage wetland and floodplain wetland classifications remain applicable.	Avoid physical disturbance, infilling, excavation or drainage modification within the wetland units. Update the specialist assessment if future footprint changes alter drainage patterns or encroach on wetland areas.
d) Water quality	Water quality may be affected indirectly if sediment-laden runoff, dirty water, hydrocarbons, chemical residues, wash water or dust-derived material reaches the floodplain wetland or Loch Athlone Dam.	Contain dirty water. Store hydrocarbons and chemicals in bunded areas. Maintain spill kits and spill response procedures. Prevent contaminated wash water from entering stormwater systems. Monitor outlet points and wetland-facing drainage pathways.
e) Fragmentation and connectivity loss	The existing quarry footprint is already established and is not expected to cause additional	Maintain wetland buffers and avoid new disturbance within ecological corridors or wetland margins.



Impact Question	Expected Impact	Mitigation Measures
	fragmentation of the delineated wetland systems if no expansion into buffers occurs. Existing roads, dams and land-use modifications already contribute to landscape fragmentation.	Prevent new roads, stockpiles or infrastructure from creating additional barriers to surface flow or ecological connectivity.
f) Loss of unique features	No direct loss of unique aquatic features is expected under the existing footprint. The main sensitive features are Loch Athlone Dam, the floodplain wetland, the hillslope seepage wetland and the unchannelled valley bottom wetland.	Avoid all disturbance within delineated wetlands and buffers. Maintain stormwater and sediment controls. Monitor for degradation of wetland margins, erosion, alien invasive plant spread or sediment deposition.
How will the existing development impact on key ecosystem regulating and supporting services?		
a) Flood attenuation	The floodplain wetland scored Very Low for flood attenuation in the previous assessment, and the existing quarry is unlikely to materially alter catchment-scale flood attenuation. Localised concentrated runoff may, however, increase erosion risk.	Attenuate and disperse stormwater flows. Avoid concentrated discharge towards wetland areas. Maintain outlet protection and inspect after rainfall events.
b) Streamflow regulation	The floodplain wetland provides Very High streamflow regulation value. Uncontrolled stormwater discharge from the quarry could locally affect timing, quality and energy of runoff entering the system.	Maintain clean and dirty water separation. Prevent dirty water release. Ensure stormwater discharge is controlled, stabilised and monitored.
c) Sediment trapping and erosion control	The floodplain wetland provides Moderate sediment trapping value but Very Low erosion control value. Increased sediment input from the quarry may exceed local assimilative capacity and contribute to sedimentation.	Stabilise exposed surfaces, haul roads, stockpiles and outlet areas. Maintain sediment traps and berms. Remove accumulated sediment from controls and rehabilitate erosion features.
d) Phosphate assimilation	Phosphate assimilation in the floodplain wetland was assessed as Low. The quarry is not expected to be a major nutrient source, but contaminated runoff or sediment-associated nutrients may contribute incrementally.	Prevent contaminated runoff from leaving site. Manage wash water, sewage, waste and organic material appropriately. Maintain sediment controls, as phosphorus may bind to fine sediment.
e) Nitrate assimilation	Nitrate assimilation in the floodplain wetland was assessed as Moderately Low. The quarry is not expected to be a major nitrate source, but contaminated runoff, sewage mismanagement or waste could create localised risk.	Ensure sewage and waste are managed through appropriate systems. Prevent discharge of contaminated water. Maintain water quality controls and investigate any evidence of nutrient enrichment.
f) Toxin assimilation	Toxin assimilation in the floodplain wetland was assessed as Low. The key risk relates to hydrocarbons, chemicals, oils, fuels or contaminated wash water reaching aquatic receptors.	Store hazardous substances in bunded areas. Maintain spill kits. Service vehicles and machinery in designated areas. Prevent spills from entering stormwater pathways and implement immediate spill response.
h) Carbon storage	Carbon storage values are generally limited to moderate within the wetland units and are not expected to be directly affected by the existing quarry footprint. Indirect degradation of wetland vegetation or hydrology could reduce carbon storage function over time.	Avoid wetland disturbance, maintain buffers, prevent erosion and sediment smothering, control alien invasive plants and rehabilitate disturbed wetland-facing areas where required.



17 Government Notices (GN) 1150 of 2020 and 3717 of 2023

Additionally, the report was conducted in terms of the Government Notices (GN) 1150 of 2020 and 3717 of 2023 which outlines the protocols for specialist assessments and minimum report content requirements for environmental impacts on aquatic animal species in South Africa.

- GN 1150 of 2020: This notice establishes the initial protocols for conducting specialist assessments concerning aquatic animal species. It specifies the necessary qualifications for specialists, the methodologies to be employed during assessments, and the essential content that must be included in environmental reports. The aim is to ensure that assessments are thorough, standardized, and provide sufficient information for decision-making processes.
- GN 3717 of 2023: This notice serves as an amendment to the original protocols established in GN 1150 of 2020. The amendments may include updates to assessment methodologies, reporting requirements, or other relevant procedures to reflect current best practices and scientific understanding.

The following table indicated the impacts as per GN1150 of 2020 and GN3717 of 2023 (**Table 34**).



Table 34: Impacts as per GN1150 of 2020 and GN3717 of 2023

Impact Question	Expected Impact	Mitigation Measures
How will the development impact aquatic animal species and their habitat?	No direct loss of natural aquatic habitat is expected within the Mining Right Authorisation Area, as no natural watercourses were identified within the quarry footprint. Indirect habitat impacts may occur if sediment-laden runoff, dirty water, hydrocarbon contamination, dust deposition or erosion affects the floodplain wetland, Loch Athlone Dam or the downstream Jordaan River system. These impacts may reduce habitat quality for aquatic invertebrates, amphibians, fish, waterbirds and other fauna dependent on aquatic or wetland-edge habitat.	Prohibit vehicle and machinery access into wetlands and buffers. Prevent spills and contaminated runoff from entering stormwater pathways. Maintain spill kits and emergency response procedures. Inspect stormwater outlets and dirty water containment areas regularly. Immediately contain and remediate any incident that may affect aquatic habitat or fauna.
How will the development impact aquatic animal species directly?	Direct impacts to aquatic animal species are expected to be limited, as quarry activities do not occur within natural wetland habitat. Potential direct impacts may occur only if contaminated runoff, spills, sediment pulses or uncontrolled dirty water reaches aquatic receptors, resulting in localised stress, displacement or mortality of sensitive aquatic organisms. Direct disturbance may also occur if vehicles, machinery or personnel enter wetland or buffer areas without authorisation.	



18 NEMA Risk Assessment Criteria (Revision 2)

The NEMA impact assessment was undertaken to evaluate the likely aquatic impacts associated with the continued operation of the existing Afrimat Bethlehem Quarry. The assessment focuses on the potential interaction between quarry-related activities and the surrounding aquatic receiving environment, particularly the floodplain wetland associated with Loch Athlone Dam and the Jordaan River system. The scoring follows the Shangoni risk assessment methodology, where probability is determined from the frequency of the activity, the availability of a pathway to the receptor, and the availability of the receptor, while magnitude considers duration, extent, intensity, toxicity/destructive effect, reversibility and receptor sensitivity (**Table 35**).



Table 35: NEMA Risk Assessment for the existing development.

Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Probability pre-mitigation	Magnitude pre-mitigation	Significance pre-mitigation	Mitigation type	Probability post-mitigation	Magnitude post-mitigation	Significance post-mitigation
Floodplain in wetland, Loch Athlone Dam and Jordaan River system	Ongoing quarry operation within the DWS regulated area	Indirect disturbance of aquatic receptors through operational runoff, sediment mobilisation, dirty water movement and altered local drainage patterns	Partially reversible	Medium degree	Operational	Localised to the quarry footprint and downstream receiving environment east and southeast of the quarry	3	3	Medium	Avoid, control and monitor	2	2	Low
Floodplain in wetland and Loch Athlone Dam	Stormwater runoff from active quarry areas, haul roads, exposed surfaces and disturbed areas	Increased sediment-laden runoff, turbidity, erosion and localised deterioration of receiving aquatic habitat	Partially reversible	Medium degree	Operational	Localised to stormwater pathways and wetland-facing areas, with potential extension beyond the quarry boundary	4	3	High	Minimise, control and monitor	2	2	Low



Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Probability pre-mitigation	Magnitude pre-mitigation	Significance pre-mitigation	Mitigation type	Probability post-mitigation	Magnitude post-mitigation	Significance post-mitigation
Floodplain in wetland, wetland buffer areas and downstream receiving environment	Stormwater outlet points, drains, channels, berms and culverts	Concentrated discharge causing scouring, erosion, sediment deposition and alteration of local wetland-edge conditions	Reversible to partially reversible	Low to medium degree	Operational	Localised at discharge points and downslope flow paths	4	3	High	Control, rehabilitate and monitor	2	2	Low
Wetland buffers and stormwater pathways	Stockpiles, overburden areas and exposed disturbed surfaces	Sediment mobilisation, erosion of loose material and transport of sediment towards aquatic receptors	Reversible	Low to medium degree	Operational	Localised to stockpile margins, drainage pathways and wetland-facing slopes	3	3	Medium	Minimise, control and rehabilitate	2	2	Low
Floodplain in wetland, Loch Athlone Dam and downstream aquatic habitat	Dirty water containment areas, sumps, artificial ponding areas and quarry-created	Overflow, leakage or uncontrolled release of dirty water containing suspended solids or	Partially reversible	Medium degree	Operational	Localised, but may extend to downstream receptors if containment fails	3	4	High	Control, contain and monitor	2	2	Low

Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Probability pre-mitigation	Magnitude pre-mitigation	Significance pre-mitigation	Mitigation type	Probability post-mitigation	Magnitude post-mitigation	Significance post-mitigation
	depressions	contaminants											
Water quality of downstream aquatic receptors	Workshops, fuel storage, machinery parking, chemical storage and maintenance areas	Hydrocarbon, oil, fuel, chemical or contaminated wash-water entering stormwater systems or aquatic receptors	Partially reversible	Medium degree	Operational	Localised spill area with potential movement along stormwater pathways	3	4	High	Avoid, control and emergency response	1	2	Low
Wetland vegetation, dam margins and wetland buffers	Dust generation from quarrying, crushing, blasting, haul roads and exposed surfaces	Dust deposition on wetland vegetation, dam margins and aquatic receiving areas, contributing to habitat stress and fine sediment wash-off	Reversible	Low degree	Operational	Localised to areas downwind of dust-generating activities	4	2	Medium	Control and monitor	2	1	Low



Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Probability pre-mitigation	Magnitude pre-mitigation	Significance pre-mitigation	Mitigation type	Probability post-mitigation	Magnitude post-mitigation	Significance post-mitigation
Wetland buffers, disturbed areas and stormwater pathways	Alien invasive plant establishment in disturbed and wetland-facing areas	Spread of alien invasive plants, reduced vegetation integrity and reduced ecological resilience of wetland margins and disturbed areas	Reversible if controlled early	Low to medium degree	Operational	Localised to disturbed areas, wetland-facing slopes and outlet zones	3	2	Medium	Control and rehabilitate	2	1	Low
Wetland buffers and receiving aquatic environment	Vehicle movement, dumping, storage or unauthorised disturbance near delineated wetlands and buffers	Encroachment into sensitive areas, vegetation disturbance, compaction and increased sediment risk	Reversible to partially reversible	Medium degree	Operational	Localised to any affected buffer or wetland-edge area	3	3	Medium	Avoid, demarcate and control	1	2	Low
Downstream aquatic ecological condition	Failure to rehabilitate redundant disturbed areas,	Continued erosion, sediment delivery and progressive	Reversible	Low to medium degree	Operational	Localised to disturbed and hydrologically	3	2	Medium	Rehabilitate and monitor	2	1	Low

Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Probability pre-mitigation	Magnitude pre-mitigation	Significance pre-mitigation	Mitigation type	Probability post-mitigation	Magnitude post-mitigation	Significance post-mitigation
	eroded surfaces or inactive operational areas	degradation of downstream receiving areas				connected areas							
Floodplain in wetland, Loch Athlone Dam and broader catchment	Continued operation in combination with road runoff, historic dam construction, agriculture, grazing and existing disturbance	Cumulative deterioration of wetland condition through incremental sedimentation, erosion, alien plant spread and water quality stress	Partially reversible	Medium degree	Operational	Local catchment scale, especially east and southeast of the quarry	4	3	High	Avoid, minimise, monitor and adaptive management	3	2	Medium
All nearby wetland systems and buffers	Future changes to quarry footprint, infrastructure, stockpiles or stormwater routing	New or increased aquatic risk pathways, possible buffer encroachment or altered drainage towards wetlands	Partially reversible	Medium degree	Future operational changes	Potentially local to broader regulated area depending on layout changes	3	3	Medium	Avoid, specialist review and authorisation confirmation	1	2	Low

19 DWS (2024) Risk Assessment

The DWS Risk Assessment Matrix was applied to evaluate the potential operational risks associated with the existing Afrimat Bethlehem Quarry in relation to nearby watercourses. The assessment focuses on Section 21(c) and 21(i) water use risks, namely activities that may impede or divert the flow of water in a watercourse, or alter the bed, banks, course or characteristics of a watercourse.

Although no natural watercourses were identified within the Mining Right Authorisation Area itself, the quarry occurs within the broader DWS regulated area of three wetland systems. These include the floodplain wetland associated with Loch Athlone Dam and the Jordaan River system, the hillslope seepage wetland, and the unchannelled valley bottom wetland. Based on the 2021 assessment and current desktop review, the floodplain wetland and Loch Athlone Dam remain the primary aquatic receptors that may be indirectly affected by operational stormwater, sediment, dirty water, dust or erosion pathways.

The DWS RAM was therefore limited to operational activities associated with the existing quarry footprint, stormwater and surface water management, and ancillary operational infrastructure such as haul roads, stockpiles, overburden areas, workshops, fuel or chemical storage areas and vehicle movement. No construction or decommissioning phase was assessed as part of this desktop follow-up review. The risk assessment assumes that the quarry footprint remains outside the delineated wetlands and calculated buffers, that no new infrastructure is placed within these sensitive areas, and that the mitigation measures recommended in this report are implemented.

Following implementation of the recommended mitigation measures, the operational risks are expected to remain within the Low risk category. A Water Use Licence Application would only be more clearly triggered by the RAM outcome if any activity scores Medium or High after mitigation, or if future operational changes result in direct wetland disturbance, buffer encroachment, uncontrolled dirty water discharge, active erosion into a watercourse, or materially altered runoff pathways towards the nearby wetlands. (**Table 36**).



Table 36: The severity score derived from the DWS (2023) risk assessment matrix for the existing development

Phase	Activity	Impact	Potentially affected watercourses		
			Name/s	PES	Overall Watercourse Importance
OPERATIONAL	Ongoing quarrying, excavation, crushing, processing and general operational disturbance within the existing quarry footprint	Mobilisation of sediment from exposed quarry surfaces during rainfall events, resulting in increased turbidity or sediment deposition downslope	floodplain wetland / Loch Athlone Dam	C	Very high
		Dust deposition on wetland vegetation, dam margins or aquatic habitat, with possible fine sediment wash-off during rainfall	floodplain wetland / Loch Athlone Dam	C	Very high
		Localised alteration of runoff patterns from disturbed or compacted operational areas	floodplain wetland / Loch Athlone Dam	C	Very high
	Stormwater and surface water management, including berms, channels, drains, culverts, outlets, sumps and containment areas	Concentrated stormwater discharge causing erosion, scouring or sediment mobilisation at outlet points	floodplain wetland / Loch Athlone Dam	C	Very high
		Dirty water overflow, leakage or uncontrolled discharge from containment areas or quarry-created ponding areas	floodplain wetland / Loch Athlone Dam	C	Very high
		Sediment deposition downslope of stormwater infrastructure or within wetland-facing drainage pathways	floodplain wetland / Loch Athlone Dam	C	Very high
	Ancillary operational infrastructure, including haul roads, stockpiles, overburden areas, workshops, fuel/chemical storage and vehicle movement	Ancillary operational infrastructure, including haul roads, stockpiles, overburden areas, workshops, fuel/chemical storage and vehicle movement	floodplain wetland / Loch Athlone Dam	C	Very high
		Sediment and dust generation from haul roads, stockpiles and overburden areas	floodplain wetland / Loch Athlone Dam	C	Very high
		Alien invasive plant establishment and localised degradation of disturbed wetland-facing areas or outlet zones	floodplain wetland / Loch Athlone Dam	C	Very high



Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level	
Abiotic Habitat (Drivers)			Biota (Responses)												
Hydrology	Water Quality	Geomorph	Vegetation	Fauna											
2	3	2	2	2	6	1	4	11	5	55	40%	22	L	Medium	
1	1	1	1	1	2	1	4	7	5	35	40%	14	L	Medium	
2	2	2	2	2	4	1	4	9	5	45	40%	18	L	Medium	
2	2	2	2	2	4	1	4	9	5	45	40%	18	L	Medium	
2	3	2	2	2	6	1	4	11	5	55	40%	22	L	Medium	
2	2	2	2	2	4	1	4	9	5	45	40%	18	L	Medium	
1	1	1	1	1	2	1	4	7	5	35	40%	14	L	Medium	
1	1	1	1	1	2	1	4	7	5	35	40%	14	L	Medium	
1	1	1	2	2	4	1	4	9	5	45	40%	18	L	Medium	



20 Conclusion

The current desktop follow-up aquatic biodiversity assessment was undertaken to inform the amendment of the Environmental Management Programme Report for the existing Afrimat Bethlehem Quarry, Bethlehem, Free State Province. The assessment reviewed the findings of the 2021 Aquatic Biodiversity Assessment, available aerial imagery, current project information, the existing quarry layout and the aquatic management requirements relevant to the continued operation of the quarry. The 2021 assessment confirmed that no natural watercourses occur within the Mining Right Authorisation Area itself. However, three wetland systems occur within the broader 500 m DWS regulated area, namely an unchannelled valley bottom wetland, a hillslope seepage wetland and a floodplain wetland associated with Loch Athlone Dam and the Jordaan River system. These watercourse classifications and their associated ecological interpretations remain applicable to the current desktop assessment, provided that the quarry footprint and stormwater flow paths have not materially changed since the 2021 assessment.

The previous site-specific wetland buffers remain applicable for the purposes of the current EMPr amendment. These include a 47 m buffer for the unchannelled valley bottom wetland, a 62 m buffer for the hillslope seepage wetland and a 39 m buffer for the floodplain wetland. The active quarry footprint is located outside the delineated natural wetlands and calculated buffers; however, the quarry remains within the broader DWS regulated area. The delineated wetlands and their associated buffers must therefore continue to be treated as sensitive no-go areas for unauthorised disturbance, stockpiling, dumping, dirty water discharge, vehicle movement or infrastructure expansion.

The unchannelled valley bottom wetland and hillslope seepage wetland are unlikely to be directly affected by the existing quarry operation due to their position relative to the quarry and the local topography. The floodplain wetland associated with Loch Athlone Dam and the Jordaan River system remains the primary aquatic receptor of concern, as it is the most likely system to receive indirect impacts from quarry-related stormwater, sediment, dirty water, dust or erosion pathways. Consequently, the most important management requirement for the amended EMPr is the effective control and monitoring of stormwater and surface water movement from the quarry. The desktop review supports the conclusion that the continued operation of the quarry can be managed at an acceptable aquatic risk level, provided that the mitigation measures recommended in this report are implemented. Key management measures include clean and dirty water separation, containment of dirty water, stabilisation of stormwater outlets, sediment control, erosion prevention, dust suppression, hydrocarbon and chemical spill prevention, alien invasive plant control, progressive rehabilitation of disturbed areas and auditable monitoring of stormwater-related risk areas.

The DWS Risk Assessment Matrix is expected to remain within the Low risk category after mitigation for the operational phase, provided that there is no direct wetland disturbance, no encroachment into calculated buffers, no uncontrolled dirty water discharge, no active erosion into a watercourse and no material alteration of runoff pathways towards the wetland systems. No operational impact is expected to remain above Low significance after implementation of the recommended mitigation measures. A Water Use Licence Application would become more clearly motivated if future activities or observed site conditions result in Medium or High risk after mitigation, particularly in relation to dirty water discharge, stormwater outlet failure, wetland buffer encroachment or quarry expansion altering drainage towards the wetlands.



The amended EMPr should therefore include specific, practical and auditable aquatic outcomes focused on maintaining the current ecological condition of the nearby watercourses and preventing deterioration of the floodplain wetland, Loch Athlone Dam and downstream Jordaan River system. These outcomes should be supported by routine monitoring, fixed-point photographic records, rainfall-event inspections and corrective action triggers for erosion, sedimentation, dirty water movement, stormwater infrastructure failure, alien invasive plant establishment and rehabilitation failure.

The important factors, relevant to Environmental Authorisation for the existing project, are summarised in

Table 37 below:

Table 37: Summary of the findings.

Quaternary Catchment and WMA areas	B11F Vaal-Orange (VOCMA) #5, Vaal Major: rivers include the Wilge, Liebenbergsvlei, Mooi, Renoster, Vals, Sand, Vet, Harts, Molopo and Vaal		
Watercourse	Non-perennial drainage features occur west and southwest of the quarry, while mapped wetland areas occur mainly to the east and southeast in association with Loch Athlone Dam and the Jordaan River floodplain. • Two nearby dams are listed as Rank 6 wetlands, Loch Athlone Dam to the east and Gerrards Dam 1.36km to the south		
Classification (SANBI, 2013)	Valley Bottom Wetland	Floodplain	Seepage Wetland
PES (Macfarlane <i>et al.</i>, 2020).	3.4 C - Moderately modified.	5.6 D - Largely modified.	1.3 B- Largely natural with few modifications.
WetEcoServices	All scores very low and only cultivated foods scoring a low	Ranging from very low to very high with tourism and water for human use scoring the highest.	Generally, very low to low with Biodiversity management and tourism scoring very high
EIS (Kotze, <i>et al.</i>, 2020)	High Category	Moderate Category	High
REC (Rountree <i>et al.</i>, 2013)	Maintain the EC at C.	Improve the EC to a High D or C.	Improve the EC to a High B or A.
Buffer Zone (Macfarlane <i>et al.</i>, 2015)	47 m	39 m	62 m
DWS 2024 Risk Assessment	The risks fall within the Low Risk (1–29) category, reflecting the established nature of the infrastructure, the limited direct footprint within wetland boundaries, and the implementation of existing water management controls.		
National Screening Tool Findings	This study confirms that the natural wetlands are highly sensitive as indicated on the screening report.		





APPENDIX A: Requirements for Aquatic Biodiversity Assessments

The NEMA regulations of 2014 (as amended) specify required information to be included in specialist reports. **Table 38** presents a summary of these requirements, in accordance with GNR982, as amended by GN326. In March 2020, the Department of Environmental Affairs issued General Notice 320 which set out requirements of the EIA Screening Tool Protocols for the Assessment and Reporting of Environmental Themes, including Aquatic Biodiversity. These specifications overlap somewhat with the 2014 EIA regulations, as amended (GN 982 as amended by GN326). **Table 39** presents a summary of the requirements of this protocol, with notes on sections of this report applicable to each aspect. Additionally, Protocols to Follow as per GN 1150 of 2020, as Amended by GN 3717 of 2023 is indicated in **Table 40**.

Table 38: Legislative report requirements GNR982

GNR982 as amended by GN326	Report Section
(1) A specialist report prepared in terms of these Regulations must contain—	
(a) details of—	
(i) the specialist who prepared the report; and	Page 3
(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix B
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 1
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Table 3
(cB) a description of existing impacts on the site, cumulative impacts of the existing development and levels of acceptable change;	Section 8
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2 and Appendix E (Separate Document)
(f) details of an assessment of the specific identified sensitivity of the site related to the existing activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Figure 5
(g) an identification of any areas to be avoided, including buffers;	Figure 5



(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 5
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3
j) a description of the findings and potential implications of such findings on the impact of the existing activity or activities;	Section 8
(k) any mitigation measures for inclusion in the EMPr;	Section 8
(l) any conditions for inclusion in the environmental authorisation;	Section 8
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 8
(n) a reasoned opinion—	
(i) whether the existing activity, activities or portions thereof should be authorised;	Conclusion
(iA) regarding the acceptability of the existing activity or activities; and	Conclusion
(ii) if the opinion is that the existing activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Conclusion
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not Applicable
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not Applicable
(q) any other information requested by the competent authority.	Not Applicable
(2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not Applicable

Table 39: Content of Specialist report GN320

Requirement	Section
2.3.1. a description of the aquatic biodiversity and ecosystems on the site, including; (a) aquatic ecosystem types; and	Section 6.3



(b) presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns;	
2.3.2. the threat status of the ecosystem and species as identified by the screening tool;	Table 3
2.3.3. an indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or sub catchment, a strategic water source area, a priority estuary, whether or not they are free-flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area); and	Table 3
2.3.4. a description of the ecological importance and sensitivity of the aquatic ecosystem including:	Table 3
(a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and	Figure 5
(b) the historic ecological condition (reference) as well as present ecological state of rivers (in- stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater).	Figure 4
2.4. The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate.	No alternatives were available during the writing of the report.
2.5. Related to impacts, a detailed assessment of the potential impacts of the existing development on the following aspects must be undertaken to answer the following questions:	Section 8
2.5.1. Is the existing development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Section 8
2.5.2. is the existing development consistent with maintaining the resource quality objectives for the aquatic ecosystems present?	Section 8
2.5.3. how will the existing development impact on fixed and dynamic ecological processes that operate within or across the site? This must include:	Section 8



(a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g., suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes);	Section 8
(b) will the existing development change the sediment regime of the aquatic ecosystem and its sub -catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns);	Section 8
(c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary seasonal permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and	Section 8
(d) to what extent will the risks associated with water uses and related activities change;	Section 8
2.5.4. how will the existing development impact on the functioning of the aquatic feature? This must include:	Section 8
(a) base flows (e.g., too little or too much water in terms of characteristics and requirements of the system);	Section 8
(b) quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g., seasonal to temporary or permanent; impact of over -abstraction or instream or off stream impoundment of a wetland or river);	Section 8
(c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g., change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland);	Section 8
(d) quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication);	Section 8
(e) fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and	Section 8
(f) the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.);	Section 8
2.5.5. how will the existing development impact on key ecosystems regulating and supporting services especially: (a) flood attenuation;	Section 8



(b) streamflow regulation; (c) sediment trapping; (d) phosphate assimilation; (e) nitrate assimilation; (f) toxicant assimilation; (g) erosion control; and (h) carbon storage?	
2.5.6. how will the existing development impact community composition (numbers and density of species) and integrity (condition, viability, predator - prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 8
2.6. In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: (a) size of the estuary; (b) availability of sediment; (c) wave action in the mouth; (d) protection of the mouth; (e) beach slope; (f) volume of mean annual runoff; and (g) extent of saline intrusion (especially relevant to permanently open systems).	Not applicable

Table 40: Protocols to Follow as per GN 1150 of 2020, as Amended by GN 3717 of 2023

Protocol Requirement	Details	Report Section
Specialist Requirements	The assessment must be conducted by a qualified aquatic ecologist or aquatic biodiversity specialist.	Page 3
	The specialist must have proven expertise in South African aquatic ecosystems and species identification.	



Protocol Requirement	Details	Report Section
	The specialist should hold a postgraduate qualification in aquatic ecology, conservation biology, or a related field.	
	Field experience in freshwater, estuarine, or marine ecology is required.	
Assessment Methodology	Desktop Study: Review of existing aquatic biodiversity databases, including SANBI, NFEPA, and National Wetland Map.	Table 3
	Historical data analysis on species occurrences, water quality, and habitat conditions.	Section 6.1
	Identification of threatened, endemic, or indicator species.	Not recorded
	Field Surveys: Aquatic species sampling using standardised methodologies.	No flowing water to conduct these test
	Use of SASS 5 protocol for macroinvertebrates.	
	Electrofishing, seine netting, or fyke netting for fish species.	
	Dip-netting and visual observation for amphibians.	
	Habitat assessment including water quality, aquatic habitat integrity, and flow conditions.	
	Impact Assessment: Evaluation of direct and indirect impacts on aquatic habitats and species.	Section 8.1
	Assessment of potential risks from habitat loss, fragmentation, water quality degradation, and hydrological changes.	Section 17
	Cumulative impact assessment within 30 km radius.	Section 12.1
Minimum Report Content	Introduction & Background: Project description and objectives.	Section1
	Legal & Policy Framework: Compliance with NEMA, NWA, Biodiversity Acts.	Section 2.2 and 2.3



Protocol Requirement	Details	Report Section
	Study Area Description: Hydrological, geomorphological, and ecological features of aquatic ecosystems.	Table 3
	Survey Methodology: Description of sampling techniques and site selection.	Appendix E and separate document
	Findings & Discussion: Presence and status of threatened, protected, or endemic aquatic species.	Section 6
	Ecological Importance and Sensitivity (EIS) scores.	Section 6.4.2
	Present Ecological State (PES) of watercourses.	Section 6.4.2
	Water quality and hydrological changes.	Section 9
	Impact Assessment: Impacts during pre-construction, construction, and operation phases.	Section 16 and 17
	Cumulative impacts with other developments.	
	Mitigation & Management Measures: Avoidance, minimisation, rehabilitation, and offset strategies.	Tabel 15
	Buffer zones, erosion control, stormwater management, and pollution prevention.	Tabel 15
	Monitoring & Compliance: Long-term monitoring plan for aquatic species and habitats.	Section 15
	Adaptive management strategies for ongoing ecological changes.	Table 22
Compliance & Approval	The report must be submitted to DFFE, DWS, and relevant provincial authorities.	Responsibility of the client.
	The assessment should be peer-reviewed before submission.	
	Findings must be incorporated into the EIA and WULA.	



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Appendix A: CVs of Specialists



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— ECOLOGIST —

Ecologist / Botanist / Aquatic Specialist
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LANGUAGES
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MEMBERSHIPS IN SOCIETIES

- **SACNASP** (South African Council for Natural Scientific Professions) (Professional Natural Scientist Reg. No. 008867)
- **SAWS** (South African Wetland Society) Founding member
- **FEN** (Freshwater Ecosystem Network)

PERSONAL INTERESTS
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ABOUT ME

I am a skilled Scientific Professional with more than 10 years experience in various ecological fields with a specialisation in aquatic ecology and anthropogenic interactions.

EDUCATIONAL QUALIFICATIONS

FORMAL QUALIFICATIONS

- **B.Sc. (Botany & Zoology)**, University of South Africa (2008 - 2012)
- **B.Sc. (Hons) Botany**, University of South Africa (2014 - 2016)

OTHER QUALIFICATIONS

- **Introduction to wetlands**, Gauteng Wetland Forum (2010)
- **Biomimicry and Constructed Wetlands**, Golder Associates and Water Research Commission (2011)
- **Tools for Wetland Assessment**, Rhodes University (2011)
- **Understanding Environmental Impact Assessment**, WESSA (2011)
- **Wetland Seminar**, ARC-ISCW & IMCG (2011)
- **SASS 5**, Groundtruth (2012)
- **Wetland Rehabilitation Principles**, University of the Free State (2012)
- **Wetland Legislation**, University of Free-State (2013)
- **Wetland Plant Identification Course**, SANBI (2015)
- **Wetland Operations and Diversity Management Master Class**, Secolo Consulting Training Services (2015)
- **Tree Identification**, Braam van Wyk - University of Pretoria (2015)
- **Wetland Buffer Legislation** - Eco-Pulse & Water Research Commission (2015)
- **Venomous Snake Handling Course** - African Reptiles and Venom (2015)
- **Invasive Species Training**, SAGIC (2016)
- **Aquatic & Wetland Plant identification**, Cripsis Environment (2019)
- **Hydropedology Course**, Department of Water and Sanitation (2019)
- **Tropical Coastal Ecosystems**, edX (2020)
- **The Science of Hydropedology** - Department of Water and Sanitation (2020)
- **Hydropedological Grouping of SA Soil Forms** - Department of Water and Sanitation (2020)
- **Hydropedological Classification of South Africa Soil Forms** - Department of Water and Sanitation (2020)
- **Contribution of Hydropedological Assessments to the Availability and Sustainable Management of water for all** - Department of Water and Sanitation (2020)
- **Ecosystem Restoration** - United Nations Development Programme (2022)
- **Green Entrepreneurship** - United Nations Development Programme (2022)
- **Fundamentals on Reducing emissions from deforestation and forest degradation** - United Nations Development Programme (2022)
- **Using Spatial Data for Biodiversity** - United Nations Development Programme (2022)
- **Communicating the Value of Biodiversity** - United Nations Development Programme (2022)
- **Protected Areas and Sustainable Development** - United Nations Development Programme (2022)
- **Applying Resilience Thinking to National Biodiversity Plans** - United Nations Development Programme (2022)
- **New Zealand Landscape as Culture: Wai (Water)**, EDx & Victoria University of Wellington (2022)
- **New Zealand Landscape as Culture: Motu (Island)**, EDx & Victoria University of Wellington (2022)
- **New Zealand Landscape as Culture: Maunga (Mountains)**, EDx & Victoria University of Wellington (2022)
- **Exploring Volcanoes and their hazards: Iceland and New Zealand**, EDx & University of Catenbury.



APPENDIX B: GLOSSARY OF TERMS

Buffer	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Hydrophyte	Any plant that grows in water, or on a substratum, that is at least periodically deficient in oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Hydromorphic soil	Soil that, in its undrained condition, is saturated or flooded long enough during the growing season to develop anaerobic conditions, favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Seepage	A type of wetland occurring on slopes, usually characterised by diffuse (i.e. unchannelled, and often subsurface) flows.
Sedges	Grass-like plants belonging to the family Cyperaceae, sometimes referred to as nutgrasses. Papyrus is a member of this family.
Soil profile	The vertically-sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991).
Wetland	<i>“land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”</i> (National Water Act; Act 36 of 1998)
Wetland delineation	The determination and marking of the boundary of a wetland on a map using the DWAF (2005) methodology. This assessment includes identification of suggested buffer zones and is usually done in conjunction with a wetland functional assessment. The impact of the proposed development, together with appropriate mitigation measures, are included in impact assessment tables.

