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FRESHWATER ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT AND WATER USE AUTHORISATION PROCESSES FOR THE PROPOSED MINING EXPANSION ACTIVITIES AT THE BEESHOEK IRON ORE MINE, NEAR POSTMASBURG, NORTHERN CAPE PROVINCE

Prepared for

Envirogistics (Pty) Ltd

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EXECUTIVE SUMMARY

During the site assessments undertaken in June 2019 and March 2021, numerous (over 50) potential areas of increased wet response were identified in the study area. Twenty-one of these possessed unique characteristics not observed in other features, including floral species and aquatic macroinvertebrates which led to their characterisation as "cryptic wetlands" (as defined by Day *et al*, 2010), whilst one was characterised as an episodic drainage line with a weakly defined riparian zone. Both the cryptic wetlands and the episodic drainage line were classified as watercourses from an ecological perspective and thus assessed as such. The remaining features were characterised as seasonal depressions, preferential flow paths and a "recharge zone" associated with a small unnamed tributary of the Groenwaterspruit, none of which were classified as watercourses. These were excluded from further assessment.

The 21 cryptic wetlands identified within the proposed mine expansion footprint were found to be of increased ecological integrity, and of moderate ecological importance and sensitivity (EIS). Although true hydrophytic vegetation was absent from all but one of these cryptic wetlands, additional biotic and abiotic factors were used to define, delineate and characterise these features, including the presence of macroinvertebrate communities within two of the features. It is likely that all identified cryptic wetlands are primarily important in terms of biodiversity maintenance and habitat provision for threatened or protected species.

Based on the layout provided to the specialist in July 2021, two of the 21 cryptic wetlands will be irreversibly lost should the proposed expansion of the Village Pit and future opencast areas proceed. Whilst the results of the risk assessment indicate that the associated risk significance is 'medium' it is the specialist's opinion that this is understated due to the impact only occurring once, and therefore the score is '1'; thus a more accurate representation of the risk significance is 'high'. Restoration of the affected cryptic wetlands will not be practical nor viable, therefore the proponent must engage with the relevant authorities to implement appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent with regards to the outright loss of the affected CWs.

The expansion of the existing Waste Rock Dumps and detrital area, and proposed activities within already disturbed areas are anticipated to have a 'low' or even negligible risk significance, provided that strict enforcement of mitigation measures takes place. Therefore, those activities may be considered acceptable from a freshwater ecological management perspective.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct an investigation considering the freshwater ecology as part of the Environmental Impact Assessment (EIA) and Authorisation process for the consolidation, upgrade and expansion activities at the Assmang (Pty) Ltd Beeshoek Iron Ore Mine, near Postmasburg, Northern Cape Province, henceforth referred to as the “Beeshoek Mine”.

Assmang (Pty) Ltd is the holder of the new order mining rights in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) in respect of high-grade hematite iron ore deposits at Beeshoek on the farms Beesthoek and Olynfontein. The mining method currently entails an opencast mining operation, which consists of five (5) active opencast pits (Village Opencast Pit, HF Opencast Pit, BF Opencast Pit, East Opencast Pit, and BN Opencast Pit). The purpose of the Beeshoek Mine project is to give effect to the Regulation 23 MPRDA requirements for the optimisation of the Mining Right, as well as the implementation of the best practical environmental management measures for the operation and management of the WRDs. The proposed Beeshoek Low-Grade Beneficiation Optimisation Project is to allow Beeshoek Mine to optimise the mining process and reduce mineral waste on site (in line with the National Waste Management Hierarchy), by implementing two additional Beneficiation Projects, namely a new WHIMS Plant to rework the existing slimes from the Slimes Dam and a new Jig Plant to rework the existing low-grade stockpile (Discard Dump). These activities are split into five (5) projects (or listing activities) and was assessed by SAS to determine the freshwater ecological habitats within the five (5) proposed projects as well as their associated characteristics, as described in Section 1.2 of this report, including determining the impact that the five (5) proposed projects will have on the receiving freshwater environment.

The purpose of this report is to define the ecology of the study area from a freshwater ecological management perspective, including mapping and classification of the areas of increased wet response and any areas that can be defined as watercourses based on the definitions contained in the NWA and based on regional best practice guidelines and research for features that do not conform to the traditional definition of a watercourse.

Numerous (over 50) areas of increased wet response were identified using desktop methods prior to the site assessment. During the site assessment, 21 of these areas of increased wet response were found to possess distinctive characteristics including topography, soil form and specific floral species which led to the classification of these features as “cryptic wetlands”. These are features which are often “hidden” in the landscape, due to their ephemeral nature caused by, for example, arid or semi-arid climatic conditions. There is no broadly accepted definition of a “cryptic wetland”, but according to Day *et al* (2010) these are generally accepted to be systems which may remain dry (and potentially desiccated) for several seasons, only displaying certain characteristics when sufficient rainfall has occurred. For the purposes of this study, SAS defined the 21 cryptic wetlands based on a distinct topographic setting, specifically an endorheic (inward-draining) depression, the presence of at least two of five identified floral indicators and subtle yet easily discernible changes in the vegetation assemblages associated with the cryptic wetlands, as well as the presence in many of the features of mottling, although this was not present throughout and was not deemed a definitive indicator. Additionally, a single episodic drainage line possessing a weakly defined riparian zone was identified, along with numerous seasonal depressions, preferential flow paths, and a “recharge zone” associated with a small unnamed tributary of the Groenwaterspruit, which do not meet the definition of a watercourse from an ecological perspective and were therefore excluded from further assessment.

As part of this assessment a desktop study was conducted, and the results thereof are contained in Section 3 of this report. Two field assessments were undertaken, initially from 10-14 June 2019, and subsequently between 1-5 March 2021 due to an amendment of the proposed mining expansion footprints. The purpose of the site assessments was to identify, delineate and assess any potential surface water features of interest and areas of increased wet response as identified on digital satellite imagery which were present within the study area, and to ground-truth other pre-defined areas of interest.

Twenty-one “cryptic wetlands” were identified within the Beeshoek Mine boundary, two of which will be irreversibly impacted should the proposed mining expansion proceed, whilst the others may be impacted indirectly by the various activities. The episodic drainage line will not be directly impacted, although edge effects may occur. Factors influencing the habitat integrity of these cryptic wetlands were noted along with their functional state, and the environmental and socio-cultural services provided by the cryptic wetlands were determined. Due to the semi-arid climate as well as the effects of prolonged drought in the region prior to the March 2021 assessment, the cryptic wetlands do not display the soil morphological characteristics commonly associated with wetlands in wetter regions, nor was hydrophytic vegetation present except in one cryptic wetland in which surface water was present in March 2021. In addition, other factors such as topography/landscape position, vegetation and sediment deposits were used to characterise these features and determine the boundaries thereof. A key indicator which further aided in defining these systems is the determination of the presence of macroinvertebrates such as Branchiopods. Whilst the application of aquatic indices such as the South African Scoring System, version 5 (SASS 5) did not form part of the scope of this study, surface water was present within two cryptic wetlands at the time of the 2021 assessment and a brief survey of biota in the wetlands was undertaken. Populations of macroinvertebrates were present in both systems, including Anostraca and Ostracoda in one of the cryptic wetlands.

Since the numerous seasonal depressions, preferential flow paths and the "recharge zone" were not characterised as watercourses, these were not assessed further, nor were they assigned buffer zones or included in the risk assessment. The indices used to determine the PES and EIS were applied collectively to all CWs which are under 1 ha in extent, and separately to CWs 4, 14 and 19 as those are greater than 1 ha in extent, are more likely to hold water for longer periods, and are therefore considered of greater ecological importance and sensitivity. Furthermore, the nature and extent of existing impacts noted throughout the assessed areas are deemed to be similar and minimal, and it is the opinion of the specialist that application of the various indices to each individual CW is not likely to yield significantly different results to those obtained. The results of the field assessment are contained in Section 4 of this report and are summarised in the table below.

Table A: Summary of results of the field assessment of the identified cryptic wetlands as discussed in Section 4.

Cryptic Wetlands	Present Ecological State (PES)	Ecological Importance and Sensitivity (EIS)	Ecoservices Provision	Recommended Ecological Category (REC) / Recommended Management Objective (RMO) / Best Attainable State (BAS)
1-3, 5-13, 15-18, 20 and 21	A	Moderate	Moderately Low	REC: A RMO: A (Maintain) BAS: A (Maintain)
4	A	Moderate	Moderately Low	REC: A RMO: A (Maintain) BAS: A (Maintain)
14	A	Moderate	Moderately Low	REC: A RMO: A (Maintain) BAS: A (Maintain)
19	B	Moderate	Moderately Low	REC: B RMO: B (Maintain) BAS: B (Maintain)

Following the assessment of the cryptic wetlands, the Department of Water and Sanitation (DWS) Risk Assessment Matrix as defined in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) was applied to ascertain the significance of possible impacts which may occur as a result of the proposed mining expansion activities. The risk assessment was undertaken based on the amended layout plan provided to the specialist in January 2021, which indicates that ultimately, all identified cryptic wetlands will be irreversibly impacted as a result of the proposed opencast mining activities. The episodic drainage line will not be directly impacted, but edge effects relating to the expansion of the detrital area may occur.

Table B below provides a summary of the outcome of the DWS Risk Assessment, however it must be noted that as the loss of cryptic wetland habitat will only occur once, the risk rating for the expansion of the Village Pit is understated, and it is the specialist's opinion that a true reflection of the impact significance is 'high'.

Table B: Summary of the results of the risk assessment applied to the cryptic wetlands and episodic drainage line at risk of potential impacts arising from the development.

Phases	Activity	Aspect	Impact	Significance	Risk Rating	Reversibility
Perceived Impacts: Expansion of Village Pit WRD, West Pit WRD and East Pit WRD						
Construction Phase	*Clearing and levelling of land for the expansion of the Village Pit WRD within 100 m of CW 21, for expansion of West Pit WRD within 380 m of CW17 and for expansion of East Pit WRD within 150 m - 225 m of CWs 2, 10 and 11. *Removal of topsoil from WRD expansion areas, and stockpiling thereof for rehabilitation.	*Clearing of vegetation / levelling of soil, and creation of temporary topsoil stockpiles. *Earthworks, creating potential sources of sediment, which may be transported via wind to the various CWs. *Altered topography, leading to altered runoff patterns and potential formation of preferential surface flow paths. *Potential loss of catchment yield (*considered very low risk due to semi-arid climate).	*Exposure of soil, leading to increased runoff, erosion and wind-blown sediment, and thus potential increased sedimentation of the CWs; *Increased sedimentation of CW habitat, leading to smothering of flora and benthic biota and potentially altering surface water quality when water is present; *Decreased ecoservice provision; and *Proliferation of alien vegetation or encroacher species as a result of disturbances.	**54**	**L**	**Fully Reversible**
	*Construction of stormwater trenches / berms around the downgradient boundaries of the respective WRDs to direct clean stormwater run-off around and away from the WRD.			**54**	**L**	**Fully Reversible**
Perceived impacts: Expansion of Village Pit						
Construction Phase	Site clearing prior to commencement of construction activities related to the open pit expansion area, including placement of contractor laydown areas and storage facilities.	*Vehicular movement and access to the site. *Removal of vegetation and associated disturbances (rubble and litter) to soil and CWs 15 and 21. *Movement of construction equipment through the CWs.	*Outright loss of CW habitat, specifically CWs 15 and 21; *Damage to or outright loss of vegetation, leading to exposure and compaction of soil, in turn leading to increased risk of wind erosion and wind-blown sediment reaching surrounding CWs; *Increased sedimentation of the surrounding CWs may lead to changes to habitat, potentially altered surface water quality, smothering of vegetation and/or altered vegetation composition and altered macroinvertebrate assemblages (if present in the affected CWs); *Decreased ecoservice provision; *Decreased ability to support biodiversity; and *Proliferation of alien vegetation as a result of disturbances.	**88**	**M**	**Partially reversible**
	Surface impact during blasting and initial removal of overburden.	*Altered water quality of adjacent CWs (to the south) as a result of wind-blown sediments, nitrates from blasting and so forth. *Increased sedimentation and erosion resulting from altered run-off patterns or wind-blown transportation to adjacent CWs may have a negative impact on geomorphological processes, habitat and/or biota.		**108**	**M**	**Irreversible**
Perceived Impacts: Future Strategic Exploration Block (Exploration Drilling)						

Construction Phase	Proposed exploration drilling: Clearing of vegetation and site preparation adjacent to, and within the catchments of cryptic wetlands associated with each drill site.	Site clearing, removal of vegetation and associated disturbances to soils.	*Potential direct loss of cryptic wetland habitat (where drill sites encroach on delineated boundary thereof); *Increased hardened surfaces within the catchment of various cryptic wetlands and compacted soils thus reducing integrity of interflow. *Localised landscape alterations within the catchment of affected cryptic wetlands, potentially leading to loss of recharge as surface water is directed away from CWs, and/or formation of preferential surface flow paths leading to erosion; *Increased surface water runoff, leading to erosion, and sedimentation of freshwater resource habitat. *Loss of foraging and breeding habitat for wetland-dependent fauna. *Proliferation of alien vegetation as a result of disturbances.	**52**	**L**	**Fully Reversible**
		*Altered drainage patterns due to reduced vegetation cover and increased impermeable surfaces; *Risk of contaminated storm water runoff (e.g. hydrocarbons, sediment, originating from impermeable surfaces) entering the cryptic wetlands.	*Increased water inputs to cryptic wetlands in the vicinity of drill pad;. *Possible contamination of surface water runoff from drill pads; *Possible erosion/incision of the cryptic wetlands adjacent to drill pads due to concentration of storm water runoff.	**55,25**	**L**	**Fully Reversible**
		Stockpiling of topsoil, earthworks, movement of vehicles within delineated cryptic wetlands and their catchments	*Sediment-laden runoff entering cryptic wetland habitat leading to altered water quality (when present), and smothering of vegetation and macroinvertebrate egg banks, leading to impacts on macroinvertebrate and faunal assemblages. *Altered topography/geomorphology, leading to altered runoff patterns and formation of preferential flow paths.	**44**	**L**	**Fully Reversible**
		Potential disposal of hazardous and non-hazardous materials in cryptic wetlands.	*Altered water quality, possible changes to flow patterns as a result of blockages caused by solid waste/rubble; *Possible damage to or smothering of macroinvertebrate egg banks, leading to impacts on macroinvertebrate and faunal assemblages.	**32**	**L**	**Partially Reversible**
	Removal of topsoil from drill sites, and stockpiling thereof for rehabilitation.	*Topsoil removal; *Creation of temporary stockpiles.	Increased risk of transportation of sediment from exposed soils in wind or storm water runoff, leading to increased turbidity of surface water, sedimentation of cryptic wetlands, smothering of vegetation and/or altered vegetation composition and smothering of macroinvertebrate egg banks.	**38**	**L**	**Partially Reversible**
Perceived Impacts: Detrital Area Expansion						

	Expansion of existing detrital area to the south and east of the current location	*Clearing of vegetation / levelling of soil, and creation of temporary topsoil stockpiles. *Earthworks, creating potential sources of sediment, which may be transported via wind to the episodic drainage line (unnamed tributary of the Groenwaterspruit River). *Altered topography, leading to altered runoff patterns and potential formation of preferential surface flow paths. *Potential loss of catchment yield to the episodic drainage line (*considered very low risk due to semi-arid climate).	*Sediment-laden runoff or wind-blown sediment entering riparian habitat leading to altered water quality, and changes to aquatic habitat; and *Altered drainage/flow regimes, leading to altered runoff patterns and formation of preferential flow paths, leading to further erosion.	30	L	Fully Reversible
OPERATIONS PHASE IMPACTS						
Perceived Impacts: Expansion of Village Pit WRD, West Pit WRD and East Pit WRD						
Operational phase	Seepage and runoff from WRDs	*Increased risk of pollution of groundwater, potentially leading to the formation of a contaminated groundwater plume, which may migrate downgradient of the WRD, thus possibly affecting the downgradient CWs. *Increased risk of sediment transport in surface runoff (low risk due to climate) or via wind from the WRD to CWs, leading to altered water quality and sedimentation of CWs.	*Possible contamination of surface and ground water, leading to impaired water quality and salinations of soil (CWs are not driven by groundwater; risk is therefore considered negligible); and *Sedimentation of CWs could lead to altered water quality, altered vegetation community composition and smothering of macroinvertebrate taxa and/or their egg banks.	**32**	**L**	**Partially reversible**
	Alteration of the hydrological characteristics of the local catchment due to the deposition of the waste rock.	Altered drainage patterns, potentially leading to the formation of preferential flow paths and/or concentrated flows.	*Potential erosion of terrestrial areas as preferential flow paths are formed in the landscape; *Altered runoff peaks leading to changes in the pattern, flow and timing of water in the landscape.	**30**	**L**	**Partially reversible**
	Presence of clean and dirty separation infrastructure around downgradient areas of WRDs	Loss of catchment yield due to stormwater containment	*Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to sedimentation of the downgradient CWs; *Reduction in volume of water entering the CWs, potentially impacting vegetation and macroinvertebrate communities.	**30**	**L**	**Fully reversible**
Perceived impacts: Expansion of Village Pit						
Operational phase	Operation of expanded Village Pit	*Removal of topsoil and overburden; *Potential stockpiling of overburden ; *Transport of ore to processing plant.	*Complete loss of CWs 15 and 21; *Increased risk of sediment transport in surface runoff or via wind from the overburden stockpile into neighbouring CWs, leading to altered water quality, altered vegetation community composition and	**90**	**M**	**Irreversible**

			potentially smothering biota and/or affecting egg banks; and *Increased risk of erosion, leading to further altered topography/geomorphology, in turn resulting in altered runoff patterns and formation of preferential flow paths.			
		*Blasting/mining activities in order to remove overburden and to extract the ore; *Removal of ore and overburden from the open cast pits.	*Nitrates from blasting leading to potential eutrophication of the receiving environment and resulting in impairment of water quality within the catchment; *Complete loss of the CWs within the Village Pit expansion area.	**90**	**M**	**Irreversible**
		*Potential decant from the open pit; *Potential creation of a cone of depression; and *Dewatering of the opencast area.	*Increased risk of pollution of surface water resulting from decant from the open pit; *Risk of *Risk of formation of a cone of depression along the open cast area.	**36**	L	**Irreversible**

Perceived Impacts: Future Strategic Exploration Block (Exploration Drilling)						
Operational phase	Operation of drill rigs	Increased risk of pollution of surface water resulting from spills (hydrocarbons) from drill rigs.	*Possible contamination of surface water (if present during operations), leading to impaired water quality and salination of soils within cryptic wetlands. *Sedimentation of cryptic wetlands could lead to altered water quality, altered vegetation community composition, smothering of macroinvertebrate egg banks.	**52**	**L**	**Parti ally**
		Increased risk of sediment transport due to movement of drill rigs and activities within freshwater resources, leading to altered water quality and sedimentation of freshwater system.		**52**	**L**	**Partially reversible**
	Alteration of the hydrological characteristics of the cryptic wetlands due to disturbances directly within the delineated boundaries of the CWs and/or their respective catchments.	Altered drainage patterns, potentially leading to the formation of preferential flow paths and/or concentrated flows	*Potential for erosion and sedimentation of cryptic wetlands, leading to altered vegetation community composition and smothering of biota. *Altered runoff peaks leading to changes in the hydrological regime of the cryptic wetlands.	**52**	**L**	**Partially reversible**
Perceived Impacts: Detrital Area Expansion						
Operational phase	Mining of ore (where economically viable) from the detrital area	*Altered water quality of the downgradient episodic drainage line as a result of wind-blown sediments; *Increased sedimentation and erosion resulting from altered run-off patterns or wind-blown transportation to downgradient episodic drainage line may have a negative impact on geomorphological processes, habitat and/or biota.	*Damage to or outright loss of vegetation, leading to exposure and compaction of soil, in turn leading to increased risk of wind erosion and wind-blown sediment reaching downgradient episodic drainage line; *Increased sedimentation of the episodic drainage line may lead to changes to habitat, potentially altered surface water quality, smothering of vegetation and/or altered vegetation composition;; *Decreased ecoservice provision; *Decreased ability to support biodiversity; and *Proliferation of alien vegetation as a result of disturbances.	**24**	**L**	**Fully reversible**

Adherence to all mitigation measures provided in this report will aid in reducing the risk significance of most anticipated indirect impacts arising from the expansion of the WRDs and detrital area; however, the loss of cryptic wetland habitat as a result of the expansion of Village Pit cannot be mitigated. Assuming that a high level of mitigation takes place, the anticipated impact significance of the proposed development activities ranges from 'low' to 'moderate' throughout the construction and operational phases. Decommissioning activities are considered similar in nature and impact significance to those during the construction and operations phases although these activities were not assessed.

Based on the findings of the freshwater ecological assessment, the recommended mitigation measures as provided in Section 5 should be implemented to minimise the impact on the ecology of the cryptic wetlands and episodic drainage line directly within, adjacent to or downgradient of the proposed project footprint, with specific mention of the following:

- All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential to ensure that edge effects are minimised;
- It is strongly recommended that a suitably qualified specialist be consulted to ascertain the catchments of cryptic wetlands located within and adjacent to the proposed expansion activities, including those located outside of the Beeshoek Mine, to ensure that as much as possible, the catchments of adjacent cryptic wetlands are not impacted to allow for the continued ecological functioning of those systems;
- All Clean and Dirty Water separation areas are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation;
- Water to be collected by means of stormwater trenches/berms, and recycled and utilised within the Beeshoek Mine water circuit to minimise water use;
- Excess water should be pumped to a Pollution Control facility for evaporation;

- Pollution prevention through infrastructure design, in order to prevent, eliminate and/or control the potential groundwater pollution plume;
- Reduce airborne dust during blasting activities through damping dust generation areas with water (although not in sufficient quantities to generate runoff);
- If water is to be pumped from the pit, it must be ensured that the pipes are appropriately managed to ensured that leaking water of poor quality does not impact on the cryptic wetlands in the landscape; and
- Measures to contain and reuse as much water as possible within the mine process water system must be sought, and very strict control of water consumption must take place. Detailed monitoring must be implemented and maintained to ensure that all water usage is continuously optimised.

The cryptic wetlands and episodic drainage line identified in the Beeshoek Mine boundary are deemed to be in a natural to largely natural condition, since few discernible impacts have occurred. Although not necessarily important for the provision of ecological services such as flood attenuation, these systems are deemed important for biodiversity maintenance, and may potentially provide important breeding and foraging habitat for various fauna, particularly since the presence of macroinvertebrates was confirmed at two cryptic wetlands. These cryptic wetlands may provide habitat for floral SCC.

Responsible implementation of the mitigation hierarchy as well as strict adherence to cogent, well-developed mitigation measures must take place throughout all phases of the proposed mining expansion to minimise the significance of impacts to the receiving freshwater environment. This is particularly important in a semi-arid region to protect the scarce water resources of the region. Should the proponent commit to such adherence to the mitigation hierarchy and mitigation measures, the significance of potential impacts arising from some of the proposed mining activities can be reduced although the direct impact to those cryptic wetlands which will be mined through is irreversible. Restoration of the affected cryptic wetlands will not be practical nor viable, therefore the proponent must engage with the relevant authorities to implement appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent with regards to the outright loss of the affected CWs.

Due to the outright loss of two cryptic wetlands, it is the specialist's opinion that the proposed mining expansion has the potential to result in impacts of very high significance on the receiving freshwater environment, particularly of a wetland type which is under-researched and of scientific interest. It is however noted that, based on the layout provided at the time of preparing this report, the extent of direct impact will be contained to the local area and will equate to less than 3 ha of wetland habitat. Thus, consideration of the value of this landscape must be considered from a freshwater and terrestrial biodiversity resource management point of view and juxtaposed with the responsibility to comply with Regulation 23 of the Mining and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) MPRDA pertaining to the optimisation of the Mining Right as well as the socio-economic and socio-cultural impact the project will have and the decision should be made and aligned with the principles of sustainable development and Integrated Environmental Management.

The expansion of the existing Waste Rock Dumps and detrital area, proposed exploration drilling and proposed activities within already disturbed areas are anticipated to have a 'low' or even negligible risk significance, provided that strict enforcement of mitigation measures takes place. Therefore, those activities may be considered acceptable from a freshwater ecology management perspective.

DOCUMENT GUIDE

The table below provides the specialist report requirements for the assessment and reporting of impacts on aquatic biodiversity in terms of Government Notice 320 as promulgated in Government Gazette 43110 of 20 March 2020 in line with the Department of Environmental Affairs screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirements	Section in report/Notes
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Cover Page and Annexure G.
2.2	Description of the preferred development site , including the following aspects-	
2.2.1	a. Aquatic ecosystem type b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution and movement patterns	Section 3 and 4
2.2.2	Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified	Section 3: Table 1
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status	Section 3: Table 1
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: 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.); b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater)	Section 3: Table 1
2.3	Identify any alternative development footprints within the preferred development site which would be of a "low" sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification	None. Entire site considered very high sensitivity.
2.4	Assessment of impacts – a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	Section 5: Table 8
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	No. Implementation of the proposed mitigation measures will minimise the impacts.
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	
2.4.3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including: 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); b. Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment; c. The extent of the modification in relation to the overall aquatic ecosystem (i.e. 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 d. Assessment of the risks associated with water use/s and related activities.	Section 5: Table 7
2.4.4	How will the development impact on the functionality of the aquatic feature including:	Section 5: Table 7

	a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system); 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); c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchanneled valley-bottom wetland to a channelled valley-bottom wetland); d. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and f. 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).	
2.4.5	How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage.	Section 5: Table7
2.4.6	How will the 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?	N/S
2.4.7	In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: size of the estuary; availability of sediment; wave action in the mouth; protection of the mouth; beach slope; volume of mean annual runoff; and extent of saline intrusion (especially relevant to permanently open systems).	N/A
3.	The report must contain as a minimum the following information:	
3.1	Contact detail of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae.	Annexure G
3.2	A signed statement of independence by the specialist.	Annexure G
3.3	A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment.	Section 2
3.4	The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant.	Section 2, Annexure C and Annexure D
3.5	A description of the assumptions made, any uncertainties or gaps in knowledge or data.	Section 1.3
3.6	The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant.	Section 4.5
3.7	Additional environmental impacts expected from the proposed development.	Section 5
3.8	Any direct, indirect and cumulative impacts of the proposed development on site.	Section 5
3.9	The degree to which impacts and risks can be mitigated.	Section 5
3.10	The degree to which impacts and risks can be reversed.	Section 5
3.11	The degree to which the impacts and risks can cause loss of irreplaceable resources.	Section 5
3.12	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	Section 5 & 6
3.13	Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).	Section 5
3.14	A motivation must be provided if there were development footprints identified as per paragraph 2.3 for reporting in terms of Section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) that were identified as having a "low" aquatic biodiversity and sensitivity and that were not considered appropriate.	None. The entire study area falls within a very high aquatic biodiversity sensitivity
3.15	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not.	Section 6
3.16	Any conditions to which this statement is subjected.	Section 6

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animans and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
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.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Endorheic	As it relates to a depression wetland: inward-draining with no transport of water into downstream systems via subsurface or surface flow. Water leaves via evapotranspiration and infiltration only.
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas.
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurrences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

°C	Degrees Celsius.
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CSIR	Council of Scientific and Industrial Research
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
m	Meter
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NBA	National Biodiversity Assessment
NWA	National Water Act
PES	Present Ecological State
REC	Recommended Ecological Category
RMO	Resource Management Objective
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SQR	Sub quaternary catchment reach
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WULA	Water Use License Application

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct an investigation considering the freshwater ecology as part of the Environmental Impact Assessment (EIA) and Authorisation process for the consolidation, upgrade and expansion activities at the Assmang (Pty) Ltd Beeshoek Iron Ore Mine, near Postmasburg, Northern Cape Province, henceforth referred to as the “Beeshoek Mine” (Figures 1 and 2). Beeshoek Mine holds an existing Mining Right on the farms Beeshoek 448, and Olynfontein 475 and is situated within the Tsantsabane Local Municipality, and the ZF Mgcawu District Municipality, approximately 2.6 km west of the town of Postmasburg, and 70 km south of Kathu. Beeshoek Mine is traversed by the R385 regional road, as well as the Ore Export (OREX) Railway Line. A detailed project description is provided in Section 1.2 of this report.

In order to identify all watercourses that may potentially be impacted by the proposed mining expansion activities, a 500m “zone of investigation” around the Beeshoek Mine boundary, in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), was used as a guide in which to assess possible sensitivities of the receiving watercourse environment. This area – i.e. the 500m zone of investigation around the study area - will henceforth be referred to as the “investigation area”.

SAS undertook an initial site investigation from 10-14 June 2019. Subsequently, the proposed mining expansion footprints were amended, necessitating a second site visit, which was undertaken between 1-5 March 2021.

Several areas of increased wet response were identified during the site assessments undertaken by SAS in 2019 and 2021. Twenty-one of these areas within the Beeshoek Mine boundary had distinctive characteristics, in particular, topography and specific floral species as well as soil form which led to the classification of these features as “cryptic wetlands”. These are features which are often “hidden” in the landscape, due to their highly ephemeral nature caused by, for example, arid or semi-arid climatic conditions. There is no standard definition of a “cryptic wetland”, but according to Day *et al* (2010) these are generally accepted to be systems which may remain dry (and potentially desiccated) for several seasons, only displaying certain characteristics when sufficient rainfall has occurred. For the purposes of this study, SAS defined the 21 identified cryptic wetlands based on a distinct topographic setting, specifically an endorheic (inward-draining) depression, the presence of at least two of five identified floral indicators and subtle yet easily discernible changes in the vegetation assemblages associated with the cryptic wetlands, as well as the presence in many of the features of soil mottling, although this was not present throughout and was not deemed a definitive indicator. Two of these features also had surface water at the time of the 2021 assessment, and although sampling of macroinvertebrates did not form part of the scope of work of this investigation, informal sampling took place and the presence thereof confirmed.

The purpose of this report is to define the ecology of the area from a freshwater ecosystem management point of view, including mapping and classification of the areas of increased wet response and any areas that can be defined as watercourses based on the definitions contained in the NWA and based on regional best practice guidelines and research for features that do not conform to the definition of a watercourse as generally applied in South Africa. In terms of global best practice, the Ramsar Commission defines wetlands as "*areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres*" (Article 2.1, Ramsar Commission)[1]. As per this definition, the cryptic wetlands identified in the study area may be considered wetlands, despite lacking hydrophytic vegetation.

In addition, the purpose of this report is to, within those areas of increased wet response, define those areas deemed to be of increased Ecological Importance and Sensitivity (EIS), and to define the Present Ecological State (PES) of the cryptic wetlands and watercourses associated with the study area and specifically the proposed project footprint. Additionally, this report aims to define the socio-cultural and ecological service provision of these cryptic wetlands or watercourses, and the Recommended Management Objectives (RMO) and Recommended Ecological Category (REC) thereof. It is a further objective of this study to provide detailed information when considering the proposed mining expansion activities in the vicinity of the cryptic wetlands and watercourses, to ensure the ongoing functioning of the ecosystems, such that local and regional conservation requirements and the provision of ecological services in the local area are supported while considering the need for sustainable economic development.

[1] Retrieved from http://archive.ramsar.org/cda/en/ramsar-about-faqs-what-are-wetlands/main/ramsar/1-36-37%5E7713_4000_0__ 27 October 2018

The Department of Water and Sanitation (DWS) Risk Assessment Matrix (2016) as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) was applied to determine the significance of the perceived impacts associated with the proposed mining expansion activities, and the operational activities impact on the receiving freshwater environment. In addition, mitigatory measures were developed which aim to minimise the perceived impacts associated with the proposed mining expansion activities, followed by an assessment of the significance of the impacts after mitigation, assuming that they are fully implemented.

This report, after consideration and a description of the ecological integrity of the cryptic wetlands and watercourses associated with the proposed mining expansion activities, must guide the Environmental Assessment Practitioner (EAP) as well as the proponent and the relevant authorities, by means of a reasoned opinion and recommendations, as to the viability of the proposed mining expansion activities from a freshwater resource management point of view and provide recommendations to minimise the impacts on the receiving freshwater environment in line with the requirements of the mitigation hierarchy as advocated by the Department of Environmental Affairs (DEA) and DWS.

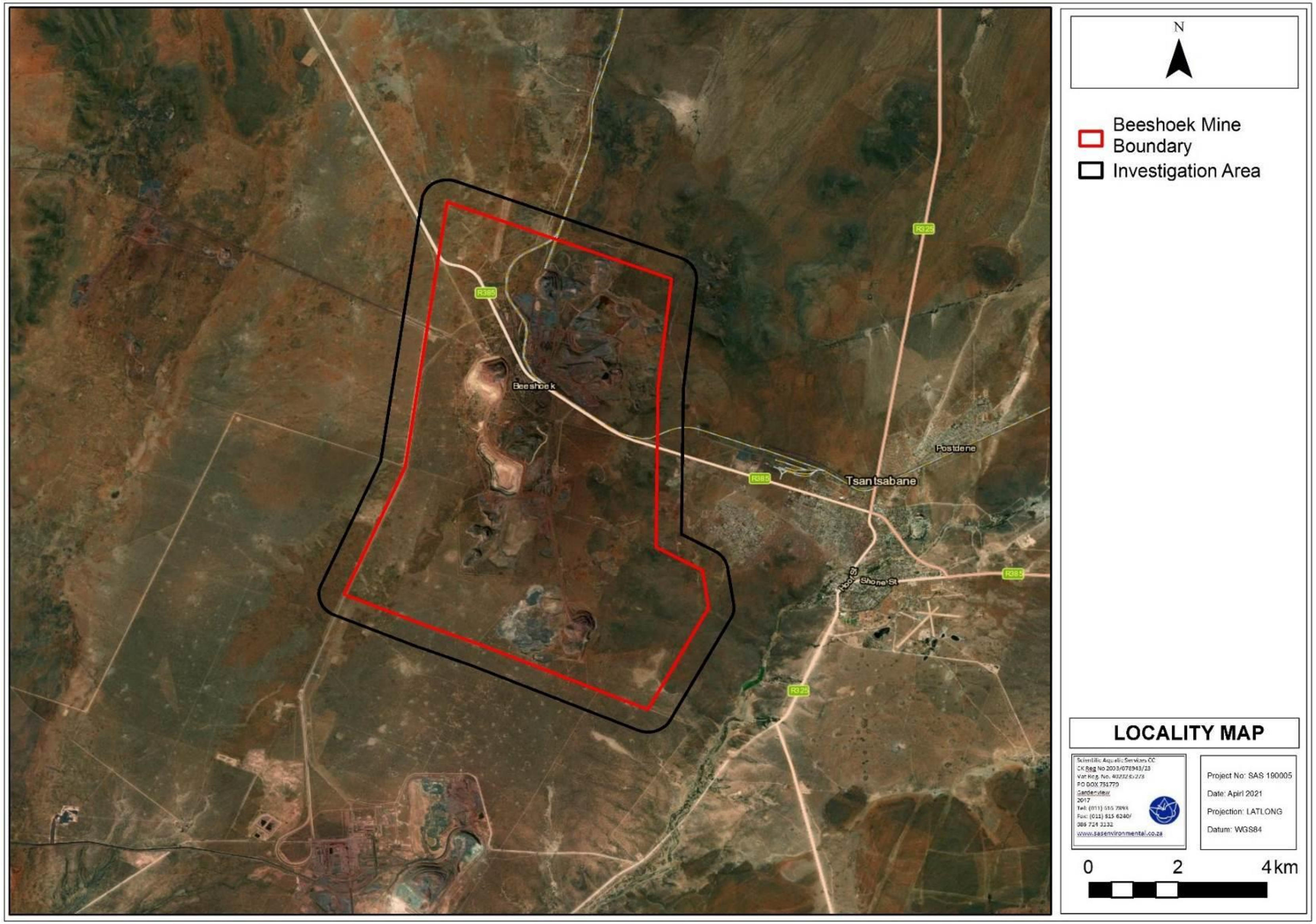

Figure 1: Locality of Beeshoek Mine and the associated investigation area in relation to the surrounds, depicted on digital satellite imagery.

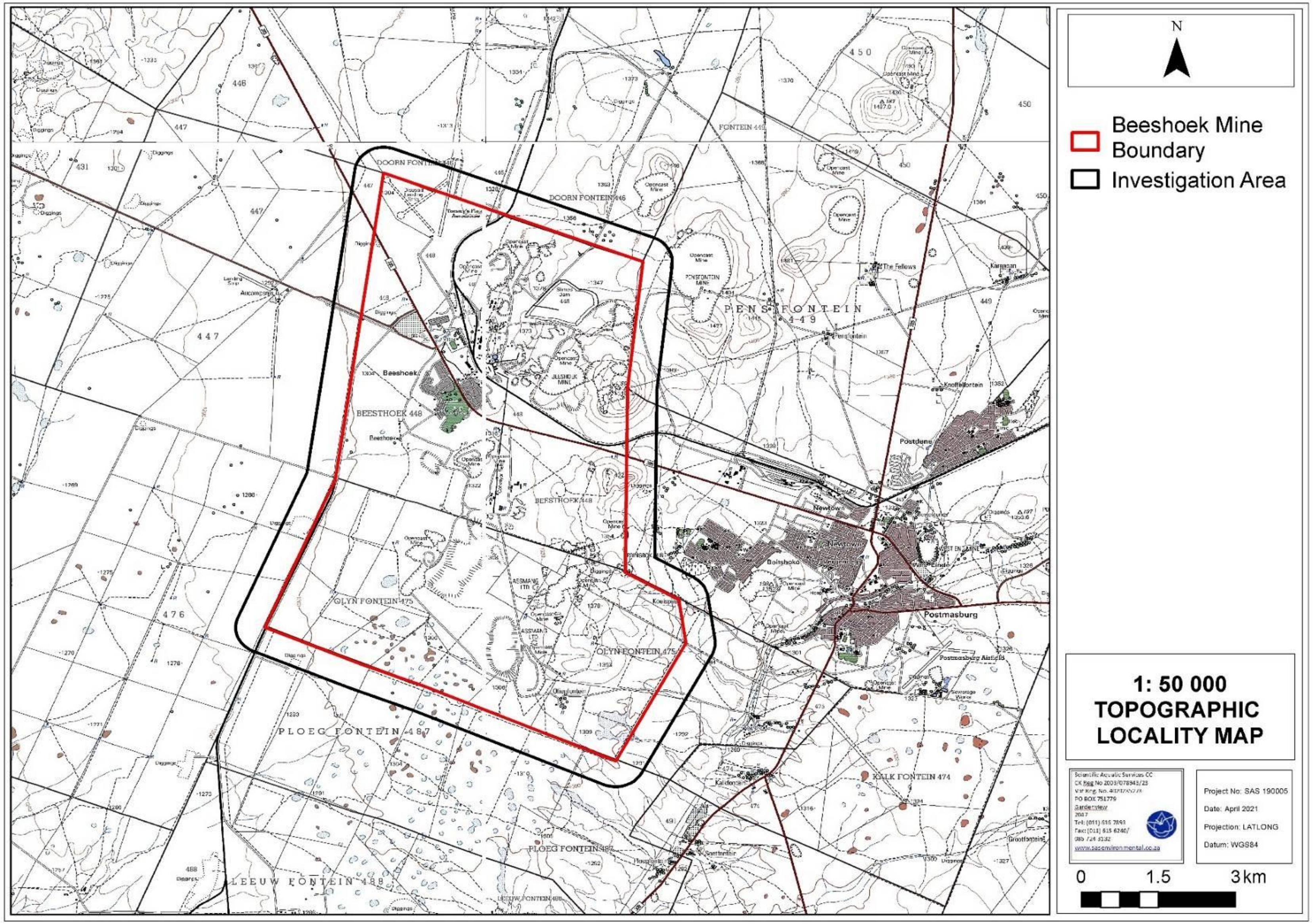

Figure 2: Locality of Beeshoek Mine and the associated investigation area in relation to the surrounds, depicted on a 1:50,000 topographic map.

1.2 Project description

Note: the information in this section was extracted from the "Second DRAFT Environmental Scoping Report for in terms of NEMA and NEM:WA: Mine Optimisation Project. Mining Right Ref: 223MRC. Project Ref: 21910. Version: Working Report", prepared by Envirogistics (Pty) Ltd. SAS takes no responsibility for the accuracy of the information presented below.

Assmang (Pty) Ltd is the holder of the new order rights in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) in respect of high-grade hematite iron ore deposits at Beeshoek on the farms Beesthoek and Olynfontein. The mining method currently entails an opencast mining operation, which consists of five (5) active opencast pits (Village Opencast Pit, HF Opencast Pit, BF Opencast Pit, East Opencast Pit, and BN Opencast Pit). Although other opencast pits are dormant at this time, these are continuously assessed in terms of their economic value. The current resources of the Mine are approximately 87 million tonnes with a reserve of about 26 million tonnes.

Beeshoek Mine can broadly be categorised as follows:

- Northern Mining Area ("North Mine"): This area comprises active as well as historical mining areas. Several small quarries and mine residue dumps of various categories are located within this area. The area also includes the existing iron ore beneficiation plant, tailings storage facility (slimes dam), as well as the North Opencast Pit (BN Opencast Pit);
- Main Offices, village (since demolished) and recreational area; and
- Southern Mining Area ("South Mine"): This area comprises large opencast pits and associated Waste Rock Dumps (WRDs). The Village Opencast Pit and associated WRD are the main activities in this area. This area also includes a crushing and screening area as pre-preparation of the Run of Mine (ROM) iron ore before being routed by overland conveyor to the Iron Ore Beneficiation Plant located at North Mine.

The purpose of the Beeshoek Mine project is to give effect to the Regulation 23 MPRDA requirements for the optimisation of the Mining Right, as well as the implementation of the best practical environmental management measures for the operation and management of the WRDs. Further to this, the proposed Beeshoek Low-Grade Beneficiation Optimisation Project is to allow Beeshoek Mine to optimise the mining process and reduce mineral waste on site (in line with the National Waste Management Hierarchy) by implementing two additional Beneficiation Projects, namely a new WHIMS Plant to rework the existing slimes from the Slimes Dam and a new Jig Plant to rework the existing low-grade stockpile (Discard Dump).

The above-mentioned purpose of the Beeshoek Mine is split into five (5) projects (or listing activities) and was assessed by the biodiversity team to determine the floral and faunal associations and occurrence within the five (5) proposed projects, as further described below, including determining the impact that the five (5) proposed projects will have on the terrestrial biodiversity.

The five (5) projects will collectively be referred to as the "**focus area**". See also Figures 3 - 6 for a depiction of the proposed five projects, with detailed descriptions of each provided below.

1.2.1 Project 1: Consolidation of Run of Mine (ROM) Stockpiles on South Mine (Figure 3).

In areas where individual ROM stockpiles are located (OM Stockpile, South Contaminated ROM 1 and Contaminated Dump 2), these will be consolidated to allow for further capacity and operational management – referred to as the "**Consolidated ROM Footprint**". The ROM stockpile area on South Mine will thus be demarcated as a combined ROM stockpile area for both on-grade, off-grade and BIS.

Specific details include:

- Overall Area: 35 ha.
- No clearance of vegetation is required; this area is located on the north-eastern perimeter of the West Pit Waste Rock Dump (WRD) in a legally disturbed area.
- Heights will not exceed 10 m.

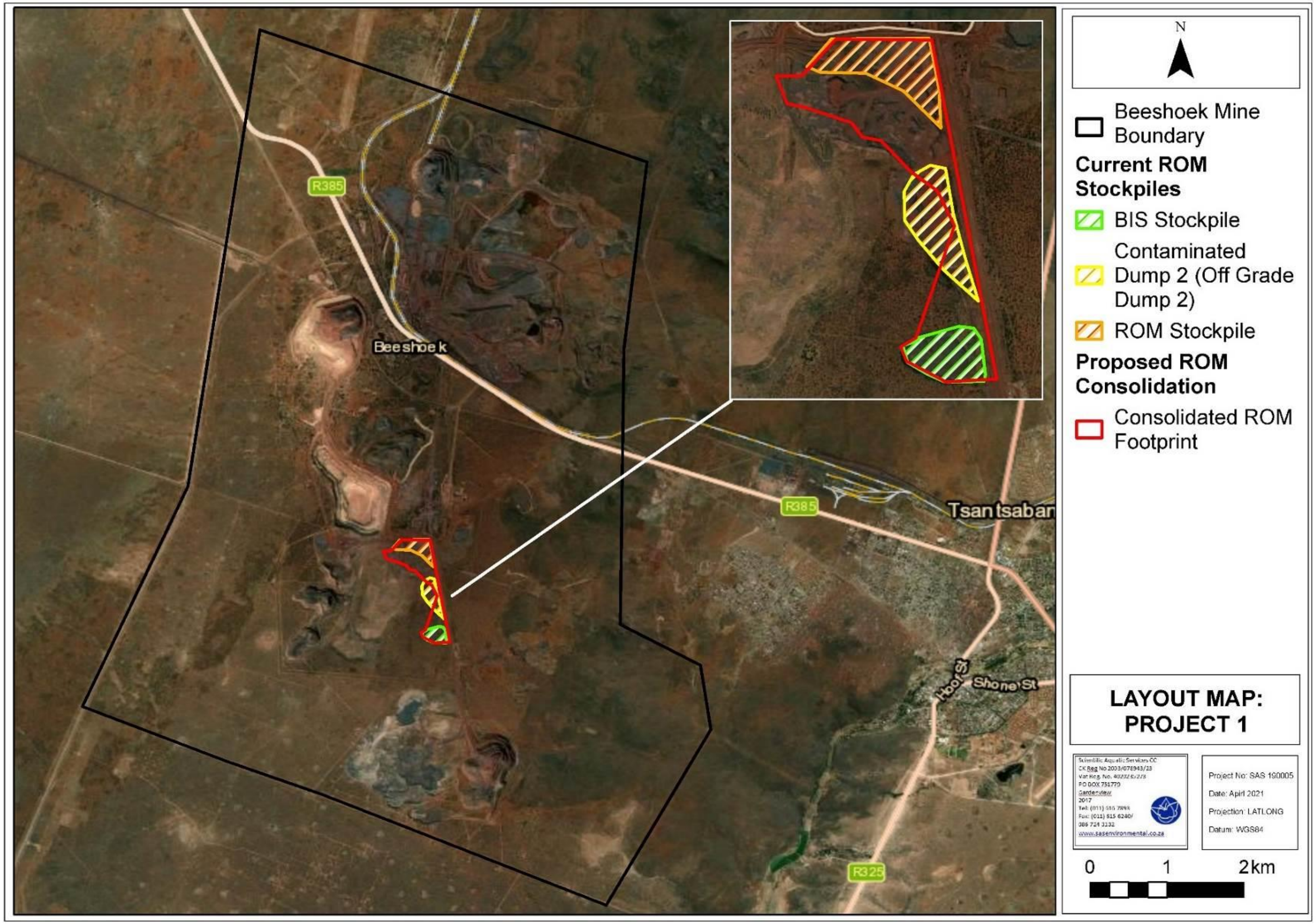

Figure 3: Layout map of Project 1 - Consolidation of Run of Mine (ROM) Stockpiles on South Mine.

1.2.2 Project 2: Amendments to the design of existing Waste Rock Dumps (WRDs) in terms of the increase in heights, and allowance for final slope, which will result in extension of footprints (Figure 4).

The Beeshoek Mine proposes to increase the heights of several existing WRDs. The increase in the height will also require the increase in the footprint areas, to allow for the correct slope at closure. The below list of WRDs is targeted for height and footprint increase:

- Village Waste Rock Dump (VP1): Current area approximate 70 ha, to be increased with approximately 26 ha (final area 96 ha) to allow for final slope and footprint upon rehabilitation (area pending designs but will involve clearance of about 25 ha). Dimensions are as follows:
  - Footprint: 96 m
  - Height: 120 m, upon rehabilitation 70 ha.
- GF Waste Rock Dump: Current area approximately 48 ha, to be increased by about 6 ha (final area about 54 ha) to allow for final slope and footprint upon rehabilitation (area pending designs). Dimensions are as follows:
  - Footprint: 54 ha.
  - Height: 120 m, upon rehabilitation 97 ha.
- East Pit Waste Rock Dump: Current area approximately 144 ha, to be increased by about 26 ha (final area about 170 ha) to allow for final slope and footprint upon rehabilitation (area pending designs but will involve clearance more than 25 ha). Dimensions are as follows:
  - Footprint: 170 ha.
  - Height: 120 m, upon rehabilitation 114 ha.
- West Pit Waste Rock Dump (VP2): Current area approximately 80 ha, to be increased with about 55 ha (final area 135 ha) to allow for final slope and footprint upon rehabilitation (area pending designs but will likely involve clearance of about 35 ha). Dimensions are as follows:
  - Footprint: 135 ha.
  - Height: 110 m, upon rehabilitation 707 ha.
- HF Waste Rock Dump (new dump on historic dump footprint): Current area approximately 20 ha and used for BIS stockpiling, to be reused to allow for HF Pit waste rock disposal, as well as final slope and footprint upon rehabilitation (area pending designs). This area is located on an existing WRD footprint (no additional clearance therefore required). Dimensions are as follows:
  - Footprint: 20 ha.
  - Height: 50 ha, upon rehabilitation 50 ha.

- Discard Dump: Current area approximately 28 ha, to be increased to about 60 ha. This area is located within the mining area, between WRDs, Slimes Dam and Opencast Pits, no clearance will be required. Dimensions are as follows:
  - Footprint: 60 ha.
  - Height: 50 m.

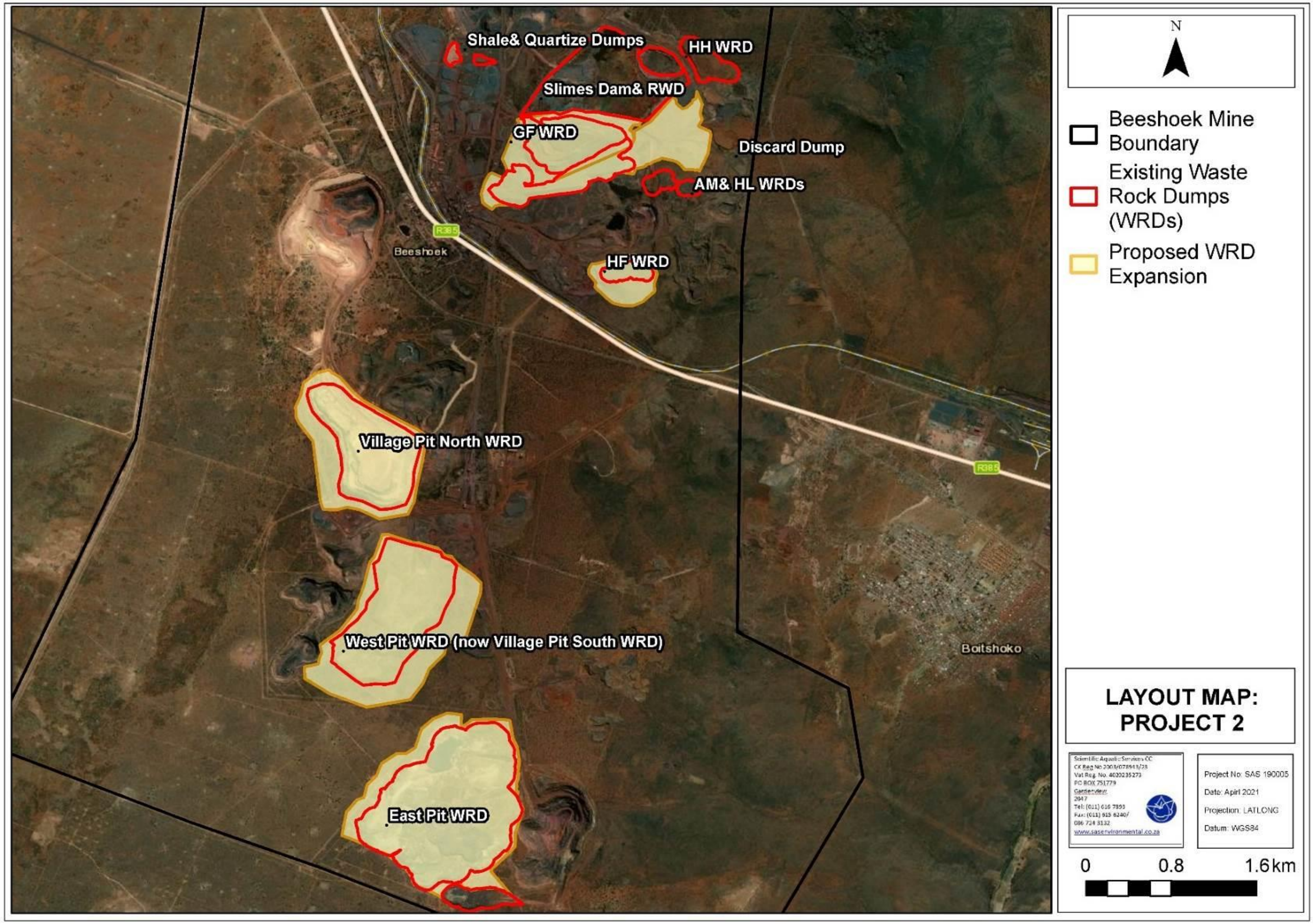

Figure 4: Layout map of Project 2 - Amendments to the design of existing Waste Rock Dumps in terms of the increase in heights, and allowance for final slope, which will result in extension of footprints.

1.2.3 Project 3: Increase of Opencast footprint areas, as well as the undertaking of detrital mining for shallow iron ore reserves, including transportation routes (haul roads) (Figure 5).

The mine would like to make use of the opportunity to increase the approved footprints of active pits, which will include:

- **BN Pit**
  - Depth: 162 m.
  - Area: 137 ha.
  - Planned to be expanded by 66 ha to approximately 137 ha.
  - Approximately 25 ha will require vegetation clearance.
- **Village Pit (VP North)** will be expanded by 203 ha in the future to 269 ha and will further include two satellite pits: **Pit East** and **Pit South**, each with and area of about 37 ha and 22 ha respectively. Clearance of vegetation will be required. Overall dimensions are as follows:
  - VP North Depth: 180 m.
  - VP East Depth: 160 m.
  - VP South Depth: 60 m.
  - Area: 436 ha.
- **Village Exploration Block Area**: To the west of the proposed Village Pit expansion area, an area for specific target exploration drilling has been demarcated. This area is about 170 ha in extent.
- **BF Pit Expansion** will be expanded from about 30 ha (comprising three pits) to about 86 ha. Approximately 25 ha may require clearance.
  - Depth: 180 m.
  - Area: 86 ha.
- **East Pit**: will not result in an increase in the footprint but rather in the depth of mining within the mining shell. The depth of East Pit is planned at approximately 220 m.
  - Depth: 200 – 220 m.
  - Area: 50 ha.
- **Future Strategic Exploration Block Area[2]:** Around the East Pit potential strategic iron ore resources have been identified. The area in question is about 976 ha. Various

[2] **Note in terms of the Future pit**: For this activity it is important to note that the future pit is in its planning phase, and further exploration will be required in this area. Once the final designs for the mining schedule are available this will be submitted to the DMRE for approval. It will also be at this time that a detailed waste management strategy will be developed for the management of waste rock and overburden in this area. Once this information is available the necessary Waste Management License and Water Use License will be applied for from the DMRE and DWS respectively.

wetland systems are present within this area, as well as a potential recharge zone. Due to the presence of these sensitive ecosystems, strategic exploration drilling will be undertaken to determine the potential resources within this area. The drilling will be undertaken in terms of a management plan to ensure the least amount of disturbance to these systems.

- The **Detrital Mining area** of about 238 ha will be established – it should be noted that entire area will not be utilised, only where minerals are found economically viable. Clearance of vegetation will be required. Dimensions are as follows:
  - Depth: 20 - 40 m.
  - Area: 238 ha.

One additional haul road will be required:

- **Village Haul Road**: 1100 m (about 3.3 ha) with a width of 30 m. The road will be located in areas mostly disturbed with exiting mining activities or along exiting roads.

Backfilling of Opencast Pits

The 2004 Environmental Management Plan (EMP) clearly states that mine waste produced in the northern mining area will be used for the in-filling of available opencast pits areas. The Mine will backfill as far as practically possible as part of the ongoing development of the annual and long-term rehabilitation plans, but voids may remain where enviroberms will be established for safety.

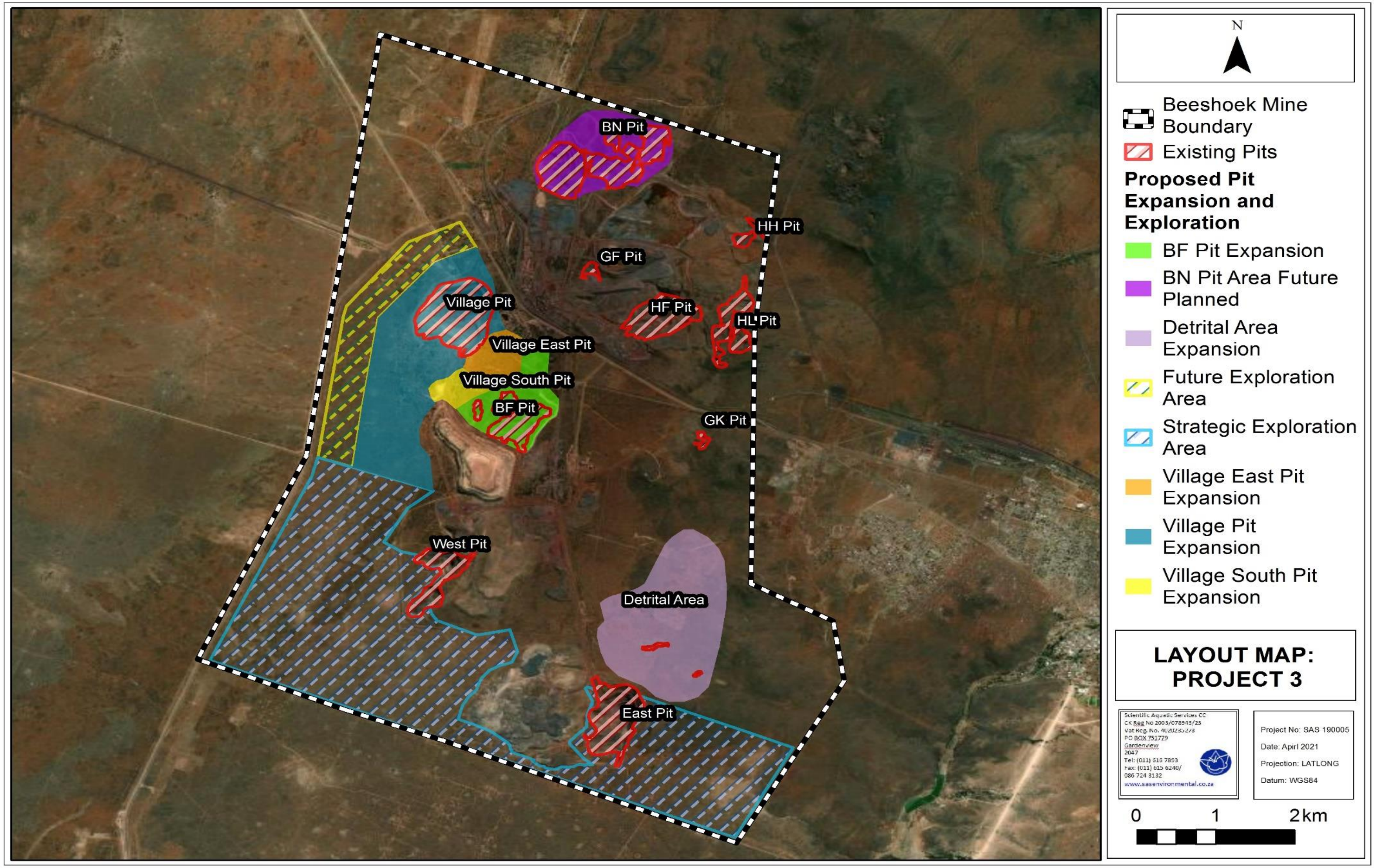

Figure 5: Layout map of Project 3 - Increase of Opencast footprint areas, as well as the undertaking of detrital mining.

1.2.4 Project 4: Development of the Beneficiation Project which will comprise of a WHIMS Plant and Jig Plant at Beeshoek (Figure 6).

Beeshoek Mine has identified the opportunity to recover and economically beneficiate existing and arising low-grade resources. The intent being the construction, commissioning and bringing into production two additional beneficiation sections capable of processing ≈ 520 tph of material to produce ≈ 1 Mtpa of export quality sinter fines product.

The project includes the following footprints:

- WHIMS Plant: 13.2 ha;
- JIG Plant: Footprint: approximately 2.6 ha on already disturbed areas. Jig Plant Laydown Area: 2 ha on existing Discard Dump footprint;
- Staging Stockpile (WHIMS);
- Tailings Pipeline HDPE: 315 mm diameter at 750 m^3/hr (208.3l/s):
  - 1.1 km northern perimeter to Slimes Dam;
  - 1.4 km southern perimeter to Slimes Dam; and
  - Existing pipeline of 1.3 km to be rerouted directly to the WHIMS Plant.
- Jig Plant Road System:
  - Road 1: 240 m with a width of approx. 16 m.
  - Road 2: 700 m with a width of approx. 16 m.
  - Road 3: 280 m with a width of 16 m.
  - Road 4: 135 m with a width of about 30 m.
  - Decommissioning of existing haul road: about 800-1000 m length of about 30 m width.
- Overhead Powerline: 22 kV powerline of approx. 620 m;
- Underground electrical cable: 22 kV of approx. 380 m;
- Clearance (potentially 5.6 ha), note that the clearance associated with the road does not contribute to the listing activity for clearance.:
  - Road 1 – potential clearance of 0.1 ha (considered disturbed area).
  - WHIMS Laydown Area: approximately 1.5 ha.
  - WHIMS Plant footprint, including access road of 160 m: approximately 4 ha.
  - WHIMS Plant Central Process Water Dam: 0.4 ha, capacity less than 50 000 m^3.

1.2.5 Project 5: Water Management (Figure 7).

The Beeshoek Mine will also establish additional water storage tanks on site which will include:

- An additional storage tank for clean water at the current D300 tank on South Mine. The current intended capacity is about 250 m^3.

- A new additional storage tank near the existing BN Tank of 500 m^3. The purpose is to provide sufficient storage space for water from the approved in-pit dewatering activities;
- Four 10 m^3 plastic tanks at the existing clarifier, thickener area. To allow for the storage of water in the water balance system of the mine to capacitate the plant process to start up without delay;
- One 2000 m^3 process water tank adjacent to the existing Clarifier connected with a “balancing pipe”. To allow for the storage of water in the water balance system of the mine to capacitate the plant process to start up without delay;
- Existing Dam: Steel Dam 250 m^3 with capacity to store process water and allow for the storage of top-up water; and
- Existing Dam: Zinc Dam: 90 m^3 with capacity to store input water where required.

Ancillary infrastructure: Topsoil stockpiles

With the expansion of area, soil layers will be stripped and place on the existing topsoil stockpiles near the detrital area, this will be dependent on the outcomes of the specialist studies.

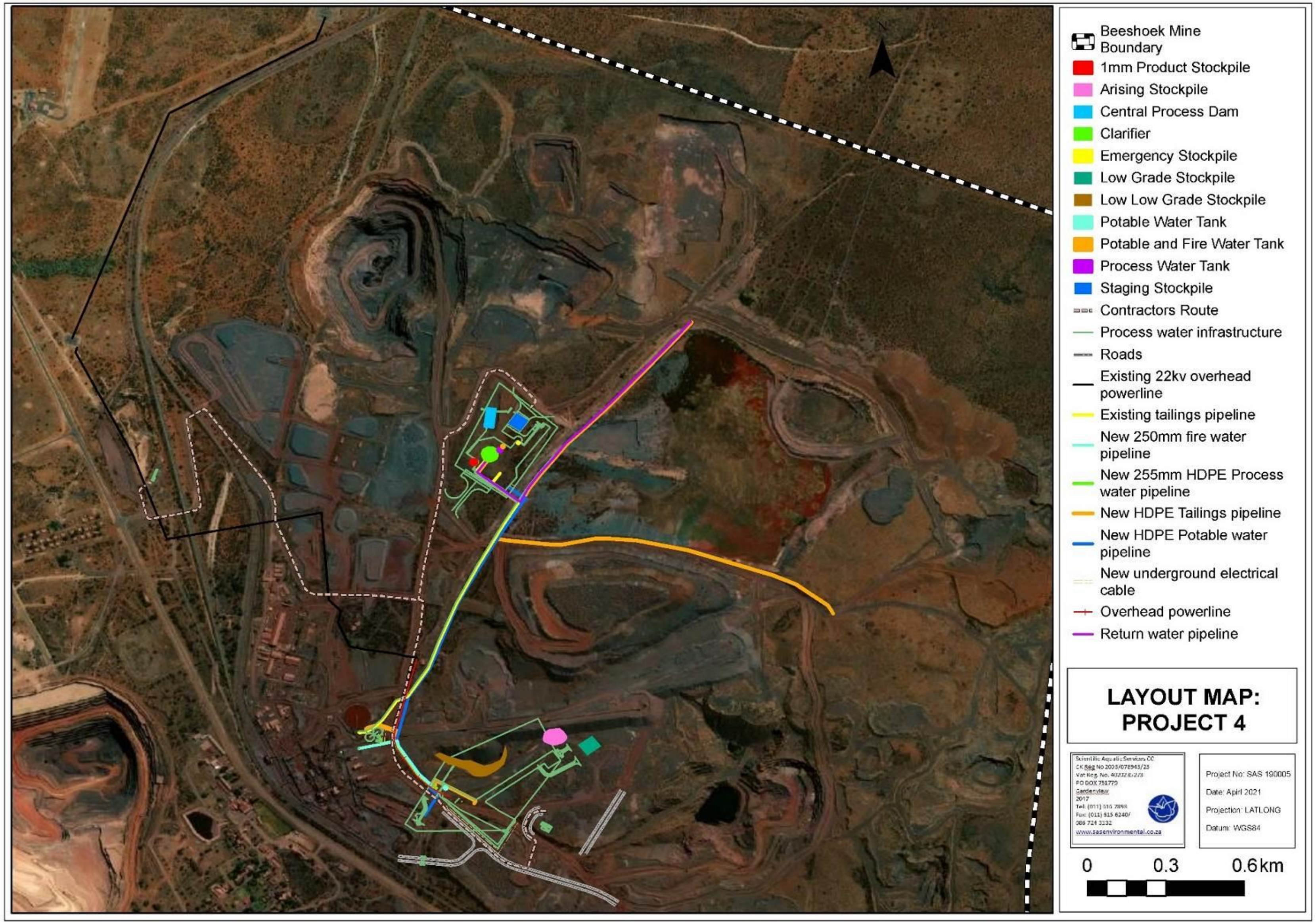

Figure 6: Layout map of Project 4 - Optimisation of Beneficiation and implementation of the Waste Management Hierarchy, as well as Project 5 - Water Management.

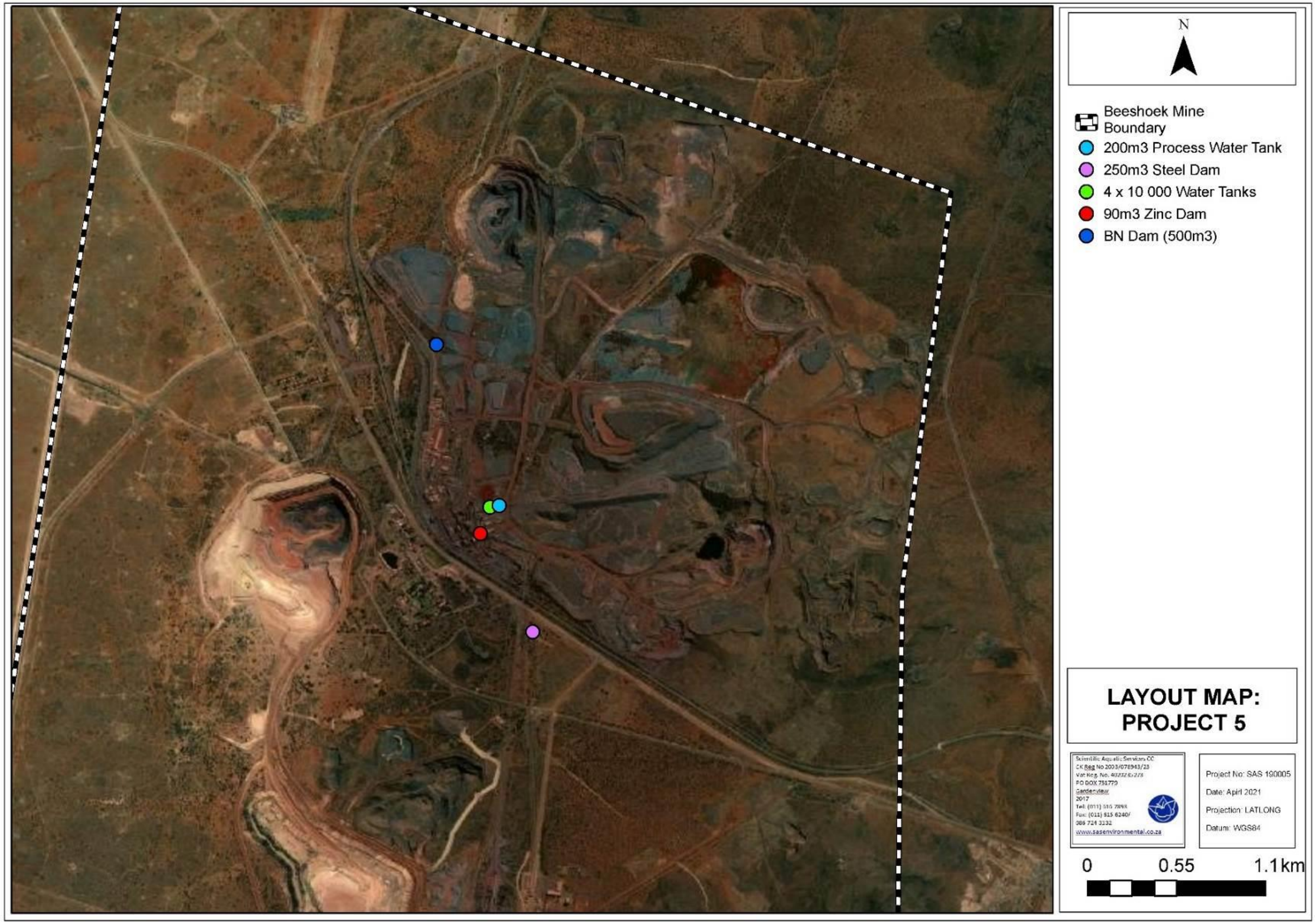

Figure 7: Layout map of Project 5 - Water Management.

1.3 Scope of Work

Specific outcomes in terms of this report are outlined below:

- A background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database, the National Biodiversity Assessment (2018), Northern Cape Critical Biodiversity Areas Map (2016) and the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS], 2014 database was undertaken to aid in defining the PES and EIS of the watercourses;
- The watercourse classification assessment was undertaken according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The EIS of the watercourses were determined according to the method described by Rountree and Kotze (2013);
- The PES of the watercourses were assessed according to the resource directed measures guideline as advocated by Macfarlane *et al.,* (2008);
- The watercourses were mapped according to the ecological sensitivity of each hydrogeomorphic unit in relation to the study area. In addition to the watercourse boundaries, the appropriate provincial recommended buffers and legislated zones of regulation were depicted where applicable;
- Allocation of a suitable Recommended Ecological Category (REC) and Recommended Management Objective (RMO) to the watercourses based on the results obtained from the PES and EIS assessments;
- The DWS Risk Assessment Matrix (2016) was applied to identify potential impacts that may affect the watercourses as a result of the proposed mining expansion activities, and to aim to quantify the significance thereof; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving watercourse environment.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The watercourse assessment is confined to the Beeshoek Mine boundary as illustrated in Figures 1 and 2 and does not include the neighbouring and surrounding properties outside of the study area. The general surroundings were however considered in the desktop assessment of the study area;

- All watercourses identified within 500m of the study area were delineated in fulfilment of GN509 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) using desktop methods including use of topographic maps, historical and current digital satellite imagery and aerial photographs; however, these watercourses were not field-verified nor assessed individually;
- Due to the extent of the Beeshoek Mine boundary, every effort was made to ground-truth as many pre-identified features as possible during the site assessment however, due to the extent, access restrictions relating to mine-related safety protocols and semi-arid nature of the study area, not all pre-identified features could be ground-truthed and less distinct features may not have been identified;
- Due to the numerous cryptic wetlands within the proposed mining expansion areas, those which were under 1 hectare in extent and which display similar characteristics were assessed collectively. Three cryptic wetlands which are greater than 1 hectare in extent, and which displayed slightly different characteristics to the other 18 (including surface water in two of these) were assessed separately. Due to the homogeneity of the grouped cryptic wetlands as well as their proximity to each other and the similarity of impact type and extent, this was deemed adequate to provide the necessary information required for informed decision-making;
- Watercourses located outside the Beeshoek Mine boundary were not assessed as they are located on privately owned property and access could not be gained. However, it should be noted that some, particularly those cryptic wetlands to the south, may be impacted by edge effects of proposed open cast mining activities and thus the mitigation measures provided in this report are of utmost importance to protect watercourses which are located outside of the Beeshoek Mine boundary but downgradient of the Beeshoek Mine activities;
- The determination of the hydropedological properties associated with the cryptic wetlands and other features such as the 'recharge zone' situated in the south-east of the Beeshoek Mine boundary did not form part of the scope of work of this study. Nevertheless, it is strongly recommended that a suitably qualified specialist be consulted in this regard, to ensure that sufficient understanding of the driver sof this watercourse is achieved and thereby ensure the continued ecological functioning of watercourses which may be situated outside of the mine boundary but could be adversely impacted by activities therein;
- At the time of preparing this report, the specialist surface water study and modelling of floodlines had not been completed by the appointed specialist (Hydrospatial). Therefore, knowledge gaps pertaining to aspects such as the location of floodlines and

catchments of various watercourses exist which in turn limits the accuracy of some aspects of impact prediction in terms of extent and severity;

- The study area is located within a semi-arid region, receiving an average annual rainfall of less than 500mm per annum. The initial assessment was conducted during the mid-winter season (June 2019), following an extended period of several years of significantly below-average annual rainfall in the region. Whilst key floral species indicative of increased soil moisture were present within the study area, and usually identifiable, the season of the initial assessment combined with persistent dry conditions and severe over-grazing in some portions of the study area meant that reliance on floral indicators was useful but reduced. Where feasible, the specialist returned in March 2021 to previously assessed areas to obtain confirmation however it was not possible to return to all previously visited areas and thus data obtained during the 2019 assessment was utilised where necessary;
- The basis of South African methodologies for the formal identification and delineation of wetlands is primarily that of soil morphological indicators such as mottling and gleying, and presence of hydrophytic vegetation. However, a number of wetland types and conditions have been identified in which these soil morphological indicators do not readily apply, including temporary wetlands in very arid areas, which are often either 'too shallow, too saline, or too temporarily inundated" to exhibit typical wetland indicators in their soils (Day *et al*, 2010). According to Day *et al* (2010) such wetlands are referred to as "cryptic" and cannot always be reliably identified as wetlands during either normal dry season (depending on locality) or extended dry periods (such as in very arid regions or following prolonged drought) on the basis of standard wetland identification and delineation tools (i.e. the use of DWAF, 2008). Nevertheless, a number of abiotic and biotic features indicate periodic wetness and were thus used in conjunction with visual analysis of soils and topography to identify possible watercourses within the study area;
- Limitations in the accuracy of the delineation in some areas due to anthropogenic disturbances such as access roads and historical agricultural activities (particularly over-grazing) are deemed possible and therefore the delineations presented in this report are regarded as a best estimate of the watercourse boundaries based on site conditions present at the time of the assessment. The presented delineations are however considered sufficiently accurate for decision making purposes;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required, the watercourse zones will need to be surveyed and pegged according to surveying principles; and

- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. It is, however, expected that the watercourses within the study area have been accurately assessed and considered, based on the field observations undertaken in terms of the freshwater ecology.

1.5 Legislative Requirements and Provincial Guidelines

The following legislative requirements and relevant provincial guidelines were taken into consideration during the assessment. A detailed description of these legislative requirements is presented in Appendix B:

- The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996);
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- Government Notice R598 Alien and Invasive Species Regulations as published in the Government Gazette 37885 dated 1 August 2014 as it relates to the National Environmental Management Biodiversity Act, 1998 (Act No. 107 of 1998);
- The Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA); and
- The Northern Cape Nature Conservation Act, 2009 (Act No 9 of 2009).

2 ASSESSMENT APPROACH

2.1 Watercourse Field Verification

For the purposes of this investigation, the definition of a watercourse and wetland habitat were taken as per that in the National Water Act, 1998 (Act No. 36 of 1998). The definitions are as follows:

A **watercourse** means:

(a) a river or spring;

(b) a natural channel in which water flows regularly or intermittently;

(c) a wetland, lake or dam into which, or from which, water flows; and

(d) any collection of water which the Minister may, by notice in the *Gazette,* declare to be a watercourse,

and a reference to a watercourse includes where relevant, its bed and banks.

Wetland habitat is "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."

Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas.

As noted in Section 1.3 it was necessary to further refine the ground-truthed delineations using desktop methods. Use was made of historical aerial photographs, historical and current digital satellite imagery, topographic maps, and available provincial and national wetland databases to aid in the delineation of the numerous cryptic wetlands and watercourses following the field assessment. The following was taken into consideration when utilizing the above during delineation:

- Linear features: since water flows/moves through the landscape, watercourses often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- Vegetation associated with watercourses: a distinct increase in density as well as shrub size near flow paths;
- Hue: with water flow paths often show as white/grey or black and outcrops or bare soils displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation with watercourse vegetation often indicated on black and white images as areas of darker hue (dark grey and black). In colour imagery these areas mostly show up as darker green and olive colours or brighter green colours in relation to adjacent areas where there is less soil moisture or surface water present; and
- Texture: with areas displaying various textures, created by varying vegetation cover and soil conditions.

During the field assessments undertaken in June 2019 and March 2021, the presence of any watercourse characteristics as defined by DWAF (2008) and by the National Water Act, 1998 (Act No. 36 of 1998), were noted (please refer to Section 4 of this report). However, as noted in Section 1.3 of this report, in certain circumstances such as arid conditions, the identification and delineation of possible wetlands cannot always be undertaken utilising the DWAF (2008) guidelines. Thus, whilst the method presented in "A practical field procedure for identification and delineation of wetlands and riparian areas" published by DWAF in 2008 provided a basis for identifying and delineating wetlands during the site assessment, additional factors were taken into consideration. The foundation of the DWAF, 2008 method is based on the fact that watercourses have several distinguishing factors including the following:

- Landscape position;
- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils; and
- Vegetation adapted to saturated soils.

DWAF (2005) notes that "not all soils associated with wetlands exhibit these characteristics [i.e. mottling, gleying typical of hydromorphic soils] and thus may lack the characteristic mottles." Whilst it is unusual for wetland soils to lack the characteristic soil morphological characteristics described by DWAF (2005; 2008), wetlands lacking these characteristics should not be excluded from being classified as wetlands simply on the basis of absence of common soil morphological characteristics (DWAF, 2005).

According to Day *et al*, 2010, in particularly arid conditions, the above factors (with the exception of landscape position) cannot always be reliably utilised, in particular, soil wetness indicators since soils in "cryptic" wetlands are by definition not exposed to the specific conditions under which such indicators are formed (Day *et al,* 2010). Therefore, Day *et al* (2010) in "The Assessment of Temporary Wetlands During Dry Conditions" provide a number of alternative abiotic and biotic indicators which can be utilised to identify temporary wetlands, some of which – such as landscape setting - are included in the DWAF (2008) guidelines:

Abiotic indicators (Day *et al*, 2010):

- Topography / position in the landscape;
- Soil wetness (albeit an unreliable indictor in arid areas);
- Presence of a "muck" layer;
- Sediment deposits on plants and/or rocks;
- Biotic crusts; and
- Water marks.

Biotic indicators (Day *et al*, 2010):

- Invertebrates hatched out from dry season sediments under laboratory conditions;
- Presence of old cases, exoskeletons, shells of aquatic invertebrates in sediments;
- Vegetation (one or a combination of the following):

  - Presence of perennial or annual hydrophytes (either actively growing or identifiable plant remains);
  - Presence of facultative wetland species;
  - Presence of terrestrial, often ruderal species not adapted to life in saturated soils;
  - Absence of both dryland and wetland plants from the site;
  - Presence of halophytes.
- Presence of algae, either developing in incubated samples or presence of dried algal remnants at the site.

It is important to note that the absence of any given indicator does not necessarily equate to the absence of a wetland, and that "no single indicator provides adequate information pertaining to the presence or absence of a wetland, the type, hydroperiod, biodiversity, function and principle ecological and hydrological drivers to be useful on its own, particularly with regards to actual or suspected cryptic and/or temporary wetlands" (Day *et al*, 2010).

In addition to the delineation process, a detailed assessment of the cryptic wetlands and / or watercourses associated with the study area was undertaken, whereby factors affecting the integrity of the cryptic wetlands and linear watercourses were taken into consideration and aided in the determination of the functioning as well as the provision of ecological and socio-cultural services by the watercourses. A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

2.2 Sensitivity Mapping

All cryptic wetlands and linear watercourses identified in the study area were considered and sensitive areas were delineated with the use of a Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these cryptic wetlands and watercourses onto digital satellite imagery and topographic maps. The sensitivity map provided in Section 4.3 should guide the design and layout of the proposed mining expansion activities.

2.3 Risk Assessment and Recommendations

Following the completion of the assessment, a risk assessment was conducted (please refer to Appendix D for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed mining expansion activities. These recommendations also include general 'best practice' management measures, which apply to the proposed development activities as a whole, and which are presented in Appendix F. Mitigation measures have been developed to address issues in all phases throughout the life of the operation including planning, construction and operation. The detailed site-specific mitigation measures are outlined in Section 5 of this report.

3 RESULTS OF THE DESKTOP ANALYSIS

3.1 Analyses of Relevant Databases

The following section contains data accessed as part of the desktop assessment and are presented as a "dashboard style" report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible in order to allow for integration of results by the reader to take place. It is important to note that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate indication of the study area's actual site characteristics at the scale required to inform the environmental authorisation and/or water use licencing processes. Given these limitations, this information is considered useful as background information to the study. It must however be noted that site verification of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process. Thus, this data was used as a guideline to inform the watercourse assessment and to focus on areas and aspects of increased conservation importance during the site assessment.

Table 1: Desktop data relating to the character of the watercourses associated with the Beeshoek Mine and surrounding region.

Aquatic ecoregion and sub-regions in which the Beeshoek Mine is located	
Ecoregion	Southern Kalahari
Catchment	Orange
Quaternary Catchment	D73A
WMA	Lower Vaal
subWMA	Molopo
Dominant characteristics of the Southern Kalahari (29.01) Aquatic Ecoregion Level 2 (Kleynhans *et al.*, 2007)	
Dominant primary terrain morphology	Plains: moderate relief. Closed Hills and Mountains: moderate and high relief. Extremely irregular plains (almost hilly), lowlands and hills, slightly irregular plains (scattered low hills and pans.
Dominant primary vegetation types	Karroid Kalahari Bushveld, Kalahari Mountain Bushveld, Kalahari Plateau Bushveld
Altitude (m a.m.s.l)	700 to 1500
MAP (mm)	0 to 500
Coefficient of Variation (% of MAP)	30 to 40
Rainfall concentration index	60 to >65
Rainfall seasonality	Late Summer
Mean annual temp. (°C)	16 to 22
Winter temperature (July)	0 - 22 °C
Summer temperature (Feb)	16 to > 32 °C
Median annual simulated runoff	<5 to 40

Detail of the Beeshoek Mine in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The Beeshoek Mine Boundary is situated within a subWMA considered a FEPA. River FEPAs achieve biodiversity targets for river ecosystems and threatened fish species, and were identified in rivers that are currently in a good condition (A or B ecological category). Although the FEPA status applies to the actual river reach, shading of the whole sub-quaternary catchment reach indicate that that the surrounding land and smaller stream network need to be managed in a way that maintains the good condition of the river reach.
NFEPA Wetlands (Figure 8)	According to the NFEPA Database there are numerous natural wetland features situated within the Beeshoek Mine boundary. The majority of these wetlands are classified as depressions, although one unchanneled valley bottom wetland is indicated within the Beeshoek Mine. The wetlands situated within the Beeshoek Mine boundary are considered either in a natural or good condition (Class AB) or moderately modified (Class C).
Wetland Vegetation Type (Figure 9)	The majority of the Beeshoek Mine boundary falls within the Eastern Kalahari Bushveld Group 3, although a portion of the eastern section of the mine falls within the Eastern Kalahari Bushveld Group 4 WetVeg type, both of which are considered Least Threatened (Mbona *et al.* 2015)
NFEPA Rivers (Figure 10)	The Groenwaterspruit is situated approximately 1.5km southeast of the Beeshoek Mine. Additionally, an unnamed tributary of the Soutloop River is situated approximately 1.3km south of the Beeshoek Mine. According to the NFEPA Database these rivers are FEPA rivers and are considered in a natural or good (Class AB) ecological condition, while the PES 1999 Classification indicates both to be largely natural (Class B).
Detail of the Beeshoek Mine in terms of the Northern Cape Critical Biodiversity Areas (2016) (Figure 11)	
Ecological Support Area (ESA)	Portions of the northern, eastern and southern sections of the Beeshoek Mine fall within an ESA. According to the Technical Guidelines for Critical Biodiversity Area (CBA) Maps document ESAs are areas which must retain their ecological processes in order to meet biodiversity targets for ecological processes that have not been met in CBAs or protected areas; meet biodiversity targets for representation of ecosystem types or Species of special concern when it's not possible to meet them in CBAs; support ecological functioning of protected areas or CBAs or a combination of these (SANBI, 2017)
Other Natural Area (ONA)	The western portion of the Beeshoek Mine falls within the ONA category. According to the Technical Guidelines for CBA Maps document ONA consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs (SANBI, 2017).
Detail of the Beeshoek Mine in terms of Mining and Biodiversity Guidelines (2013)	
The Beeshoek Mine is situated within an area currently not ranked under the mining and biodiversity guidelines.	

Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 12)		
Sub-quaternary reach	D73A – 02705 (Groenwaterspruit)	D73A – 02933
Proximity to the Doornfontein Mine Boundary	±1.5km east of Beeshoek Mine	±1.1km southwest of Beeshoek Mine
Assessed by expert?	No - Ephemeral	No – Ephemeral
PES Category Median	NA	NA
Mean Ecological Importance (EI) Class	Moderate	Low
Mean Ecological Sensitivity (ES) Class	Low	NA
Stream Order	1	1
Default Ecological Class (based on median PES and highest EI or ES mean)	Moderate (Class C)	Low to Very Low (Class D)
Fish and invertebrate species data	As both systems are ephemeral, no fish species or invertebrate species were recorded for either SQR.	
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figures 13 to 15)		
According to the NBA 2018: SAIIAE there are numerous depression wetlands located within the southern portion of the Beeshoek Mine, as well as a large seep wetland indicated within the south eastern portion of the Beeshoek Mine, associated with the Groenwaterspruit. Although the area indicated by the NBA as a seep wetland was not extensively investigated, visual observations in the area whilst travelling around the site, analyses of digital satellite imagery as well as professional experience of the general area indicates that there is no seep wetland. The NBA further indicates an open reservoir and dam within the central portion of the Beeshoek Mine. The majority of the depression wetlands are in a natural or good ecological condition (Class AB), one depression is moderately modified (Class C) and three depression wetlands as well as the "seep" wetland is considered in a heavily to critically modified ecological condition (Class DEF) according to the NBA Dataset. The depression wetlands are of least concern (Ecosystem Threat Status (ETS)), and therefore poorly protected (Ecosystem Protection Level (EPL)), whereas the "seep" wetland is not protected (EPL), and is currently affected by mining activities, roads, and artificial features, therefore the "seep" wetland is indicated as critically endangered (ETS). According to the NBA Dataset the Groenwaterspruit and unnamed tributary of the Soutloop River is not protected (EPL) and considered endangered (ETS). Furthermore, at the time of the data collation for the NBA Dataset (2018), the rivers must have been dry as it was rendered data deficient.		
National Web Based Environmental Screening Tool (2020).		
The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.		
According to the screening tool the overall aquatic sensitivity of the Beeshoek Mine and surrounds is **very high** due to the area being classified as a FEPA catchment, the presence of wetlands and the Beeshoek Mine falling within a strategic water source area. The FEPA catchment and numerous wetlands corresponds with the NFEPA Database (2011) and the NBA 2018 Dataset. According to the Strategic Water Source Areas (SWSA) Database (2017) the south eastern portion of the Beeshoek Mine Boundary is located within the Southern Ghaap Plateau groundwater SWSA.		

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitation; MBSP = Municipal Biodiversity Summary Project; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State WMA = Water Management Area

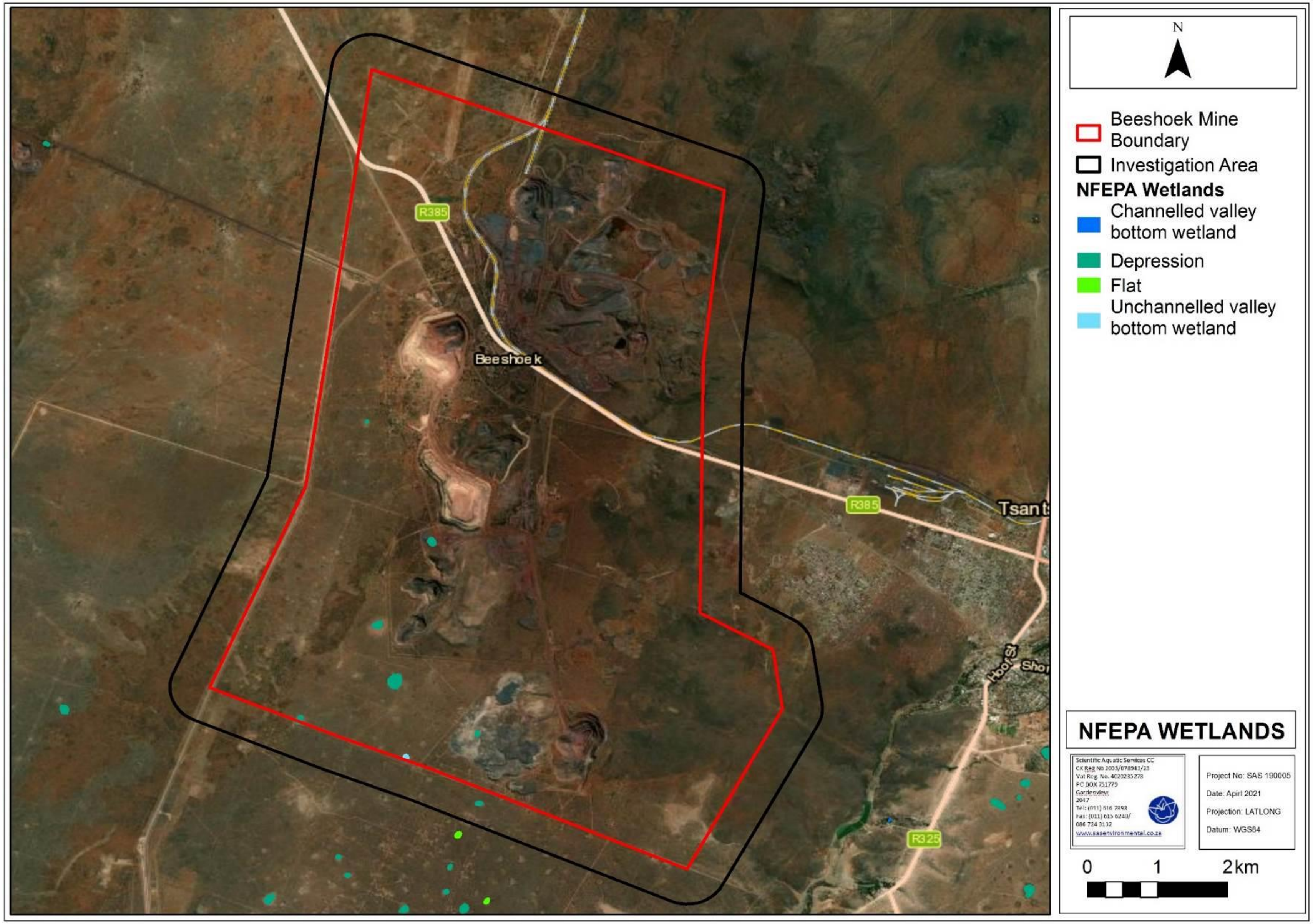

Figure 8: The natural and artificial wetland features associated with the study area and investigation area (NFEPA, 2011).

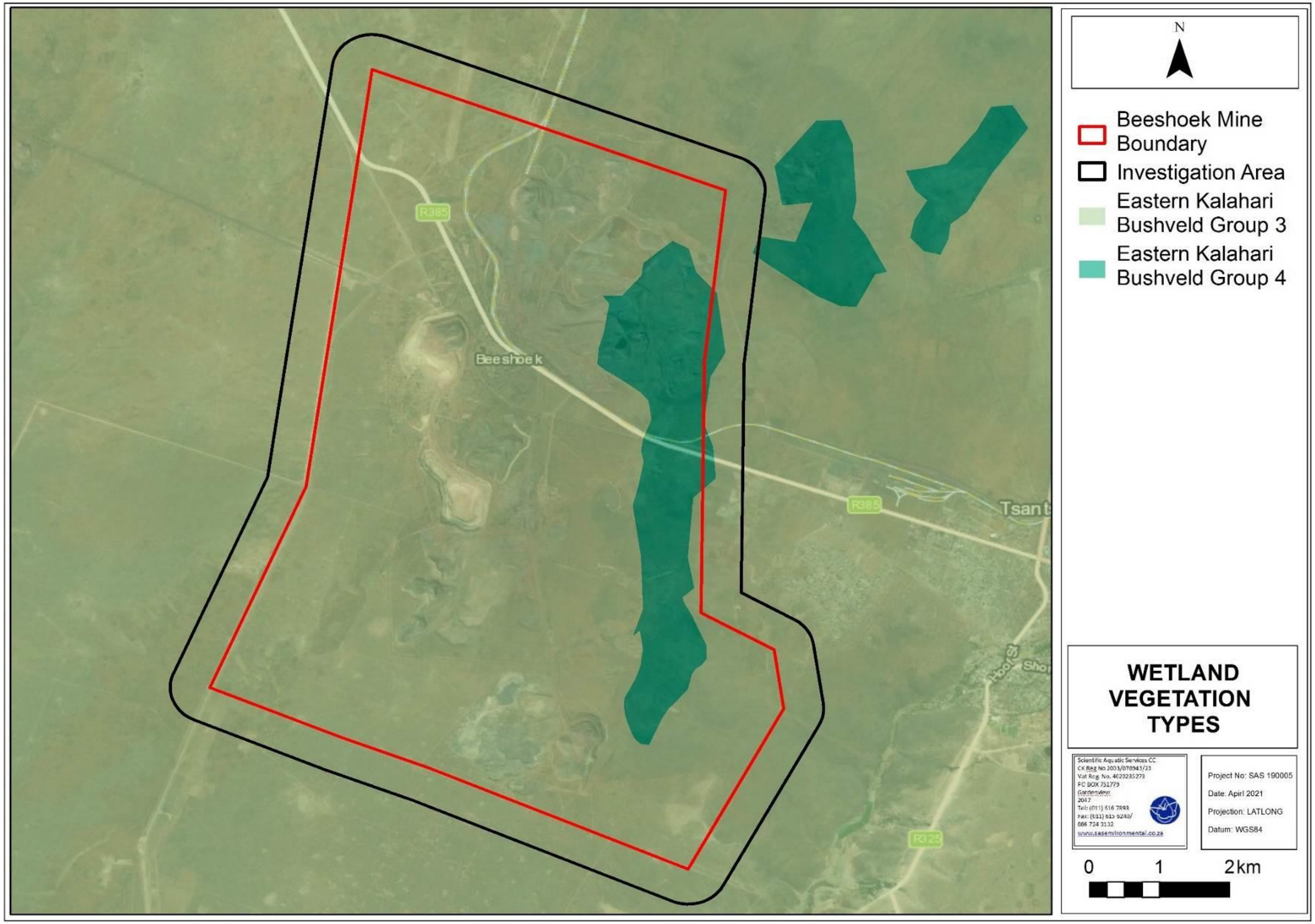

Figure 9: The WetVeg Types applicable to the Beeshoek Mine according to NFEPA (2011).

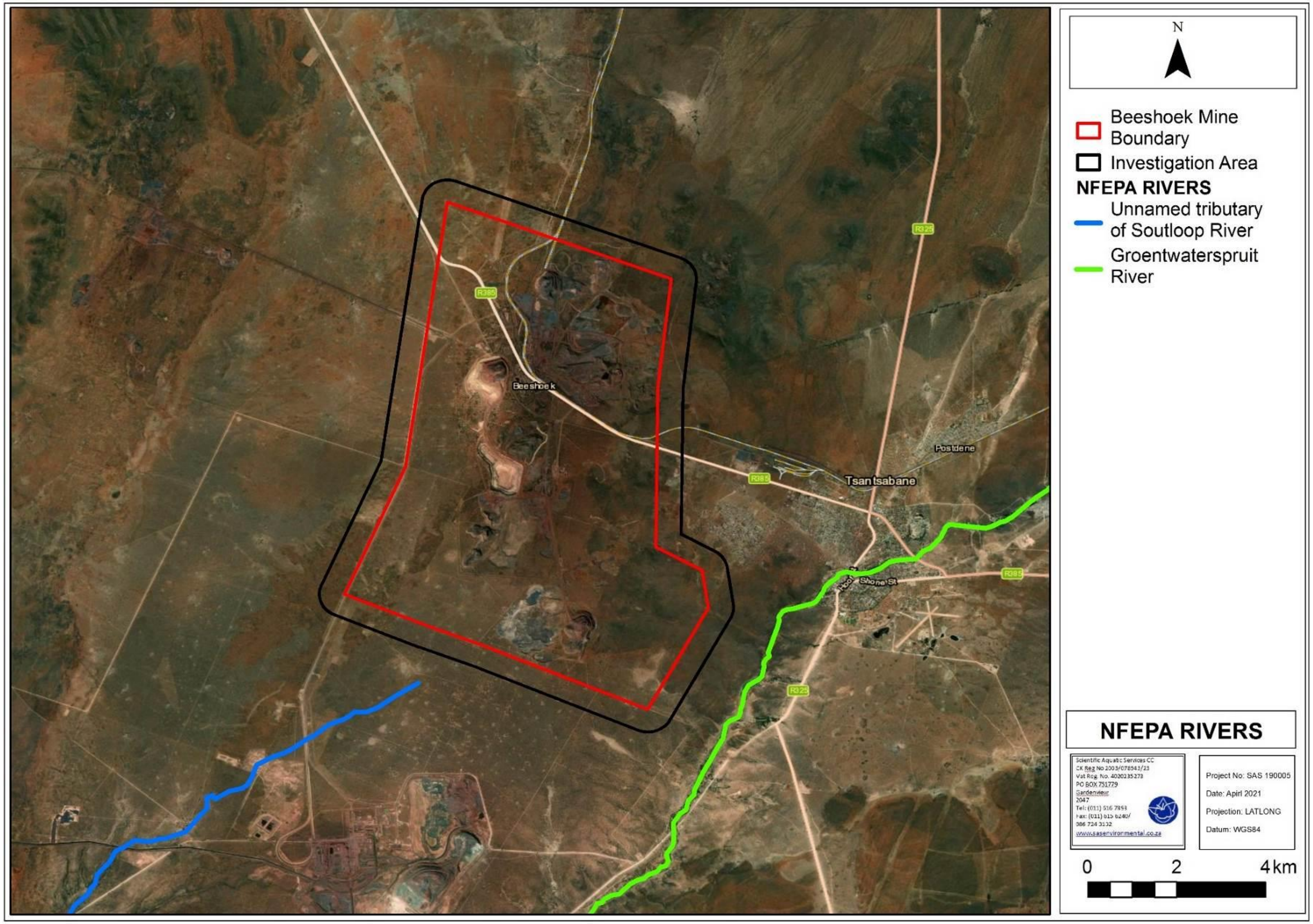

Figure 10: Rivers associated with the Beeshoek Mine property according to NFEPA (2011).

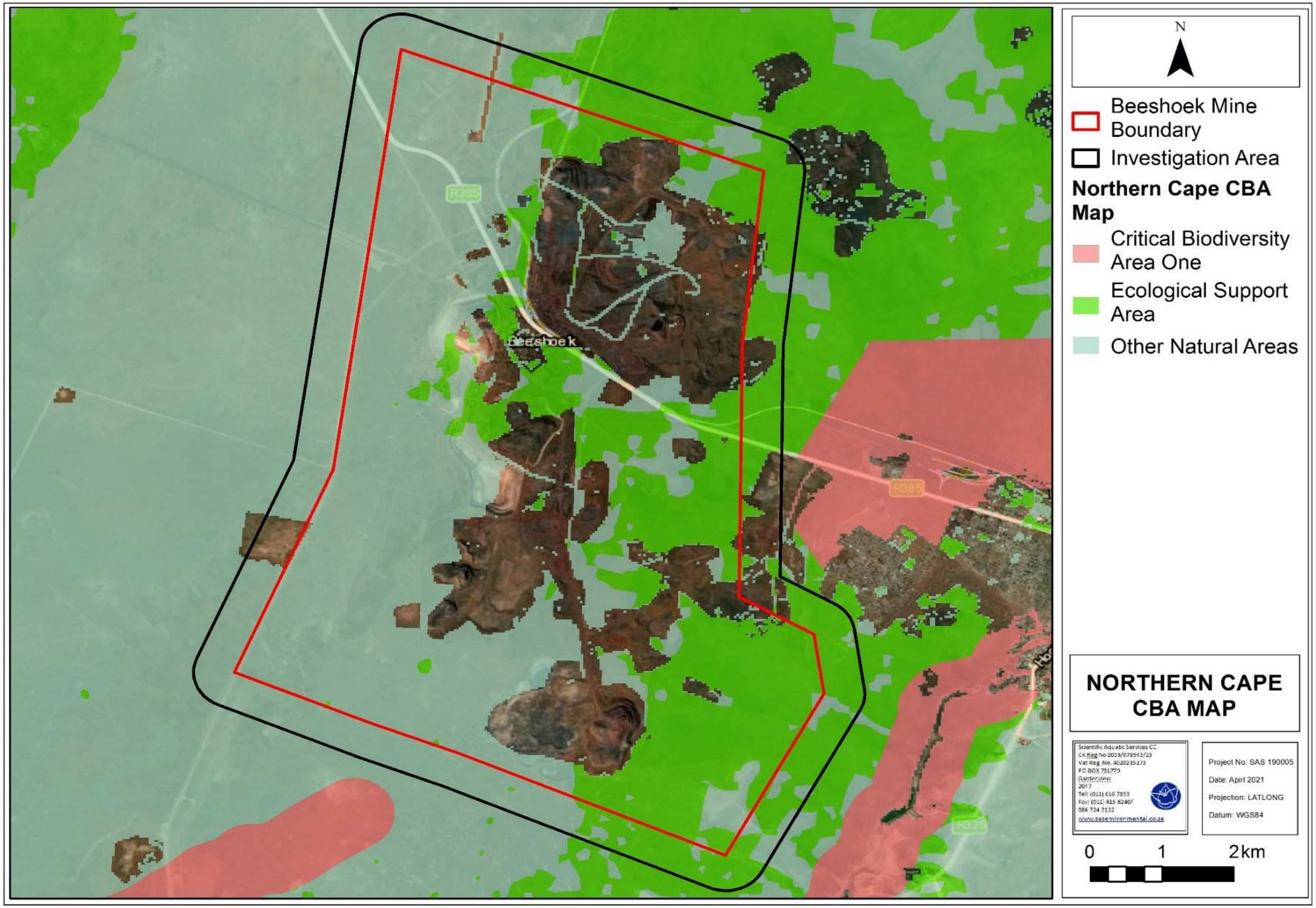

Figure 11: Critical Biodiversity Areas associated with the study area as per the Northern Cape Critical Biodiversity Area dataset (2016).

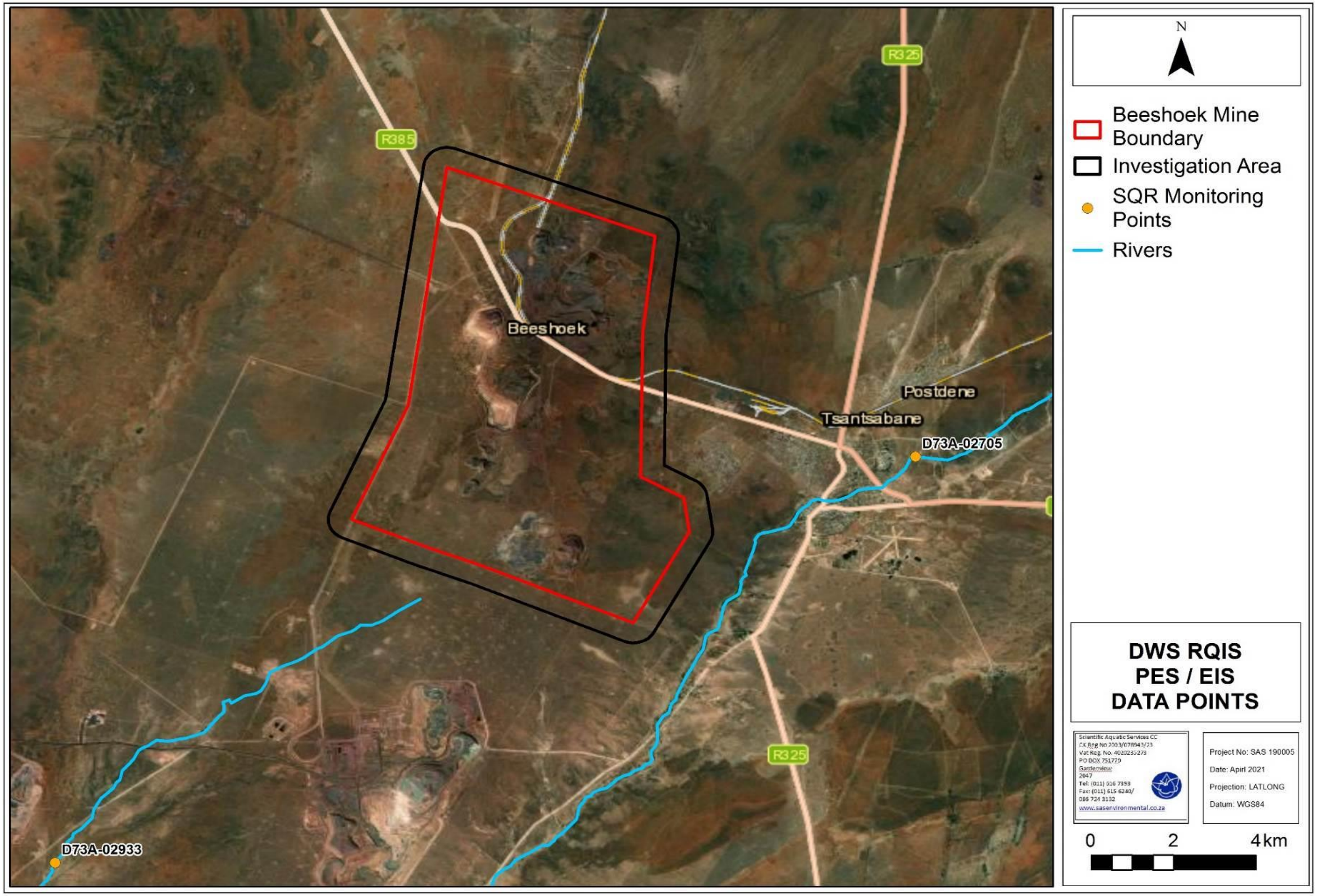

Figure 12: Relevant SQR Monitoring Points associated with the study area and investigation area.

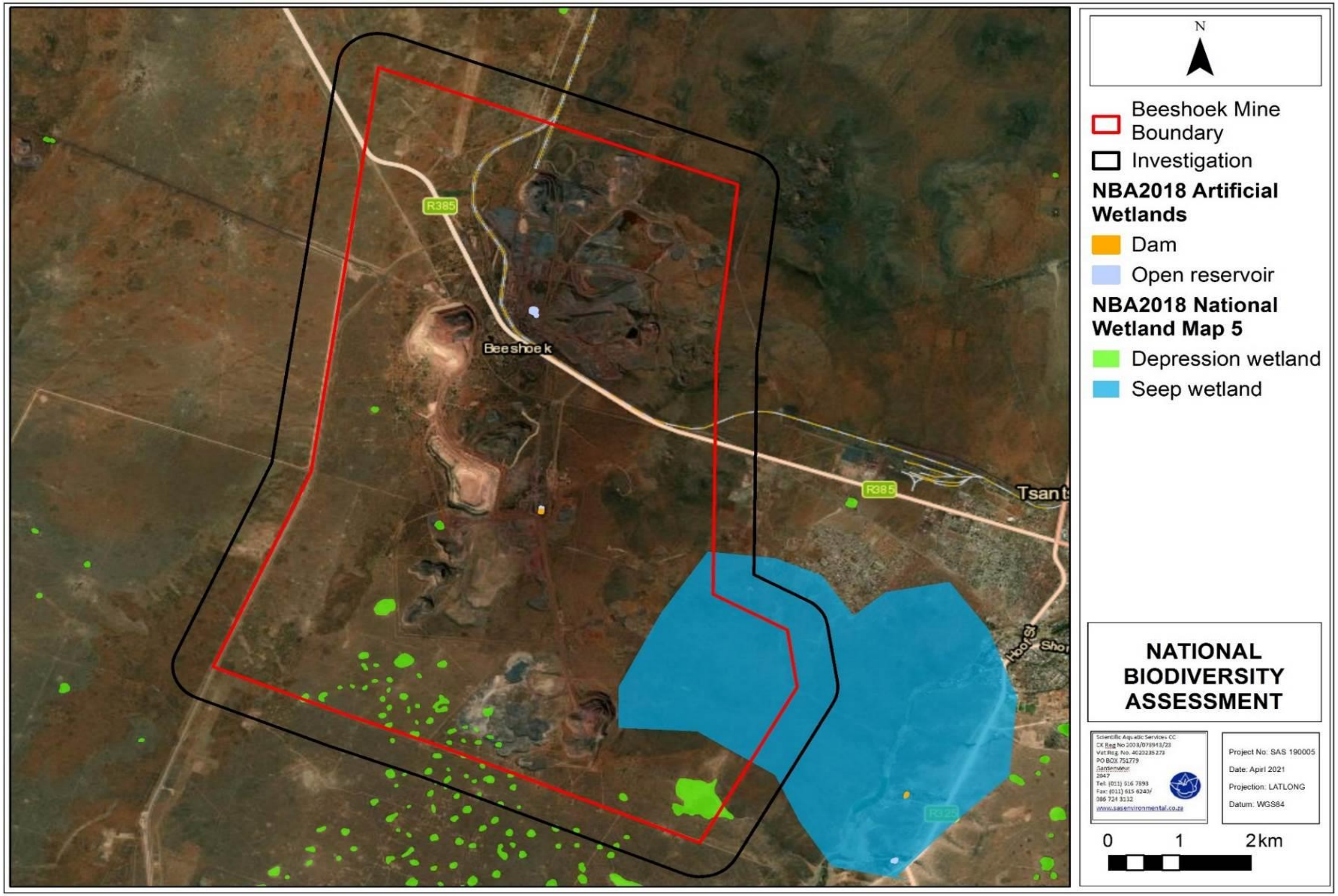

Figure 13: The National Biodiversity Assessment 2018 indicating natural and artificial wetlands associated with the study area and investigation area.

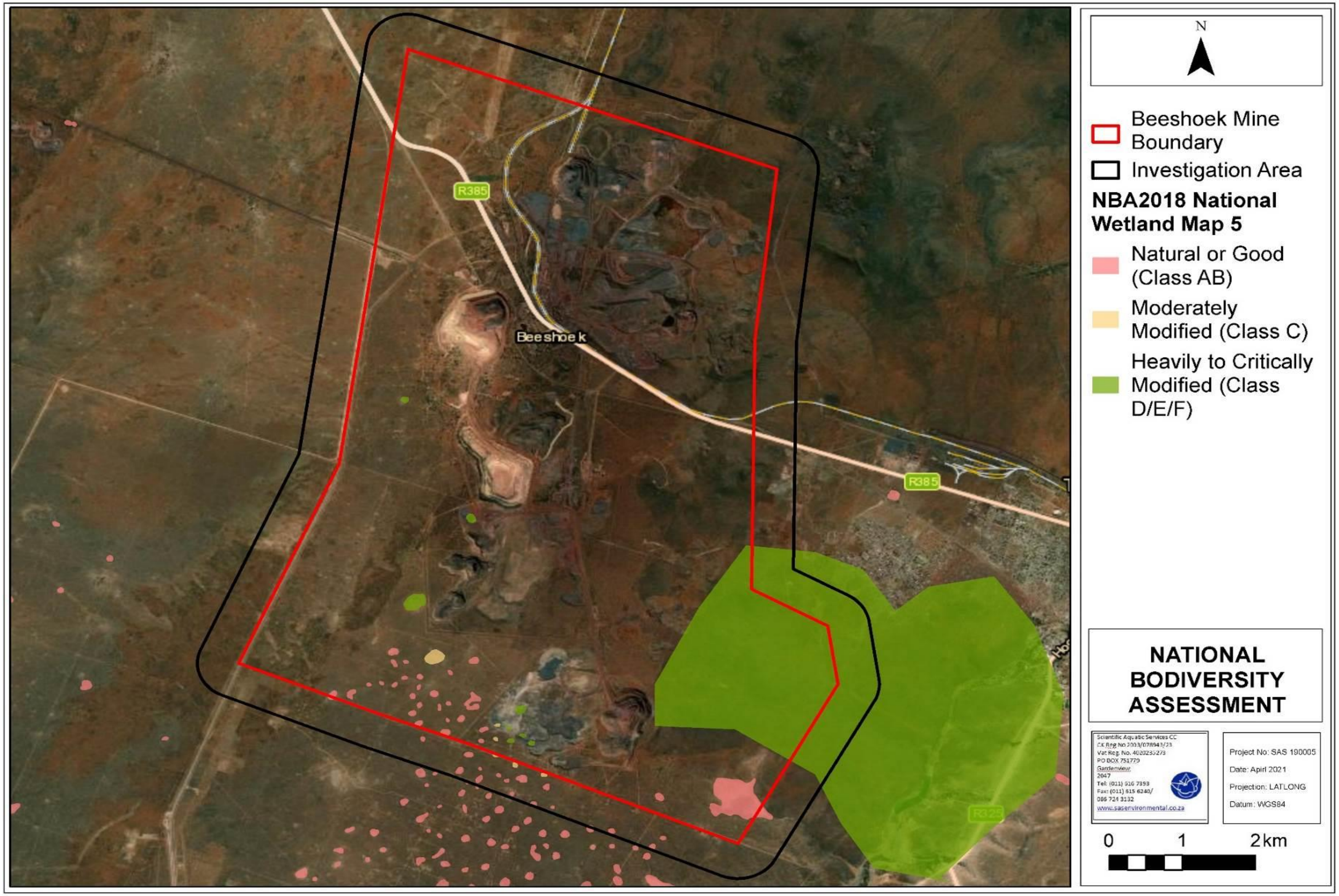

Figure 14: The condition of the wetlands associated with the study area and investigation area (NBA, 2018).

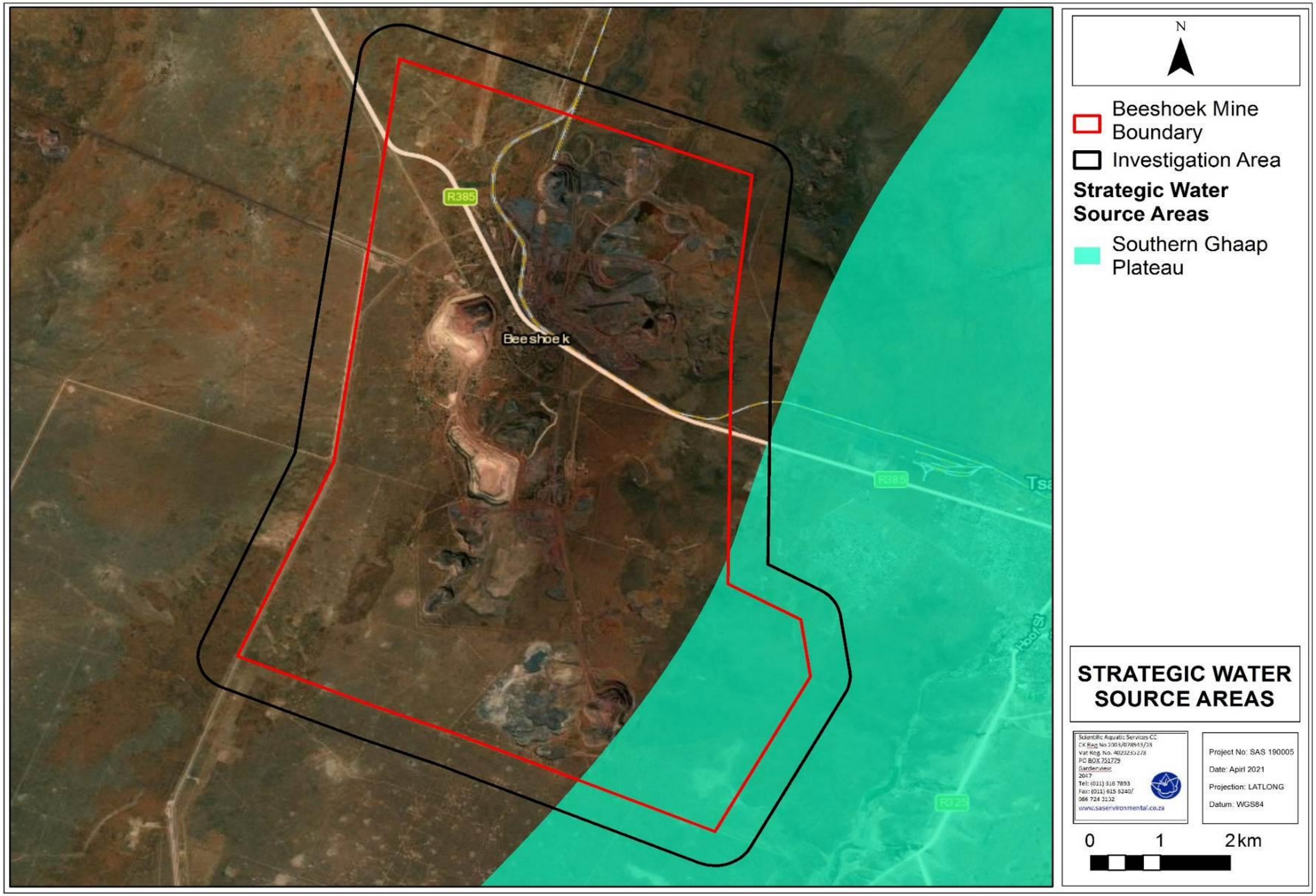

Figure 15: The Strategic Water Source Area applicable to Beeshoek Mine according to the National Biodiversity Assessment 2018.

4 RESULTS: WATERCOURSE ASSESSMENT

4.1 Watercourse Delineation

As discussed in Section 2.1, the industry standard guidelines provided by DWAF (2008) for the identification and delineation of wetlands and riparian zones was used as a basis for the delineation of the features identified on site. However, due to the typically arid conditions of the region, additional indicators, as provided by Day *et al* (2010) were utilised. Whilst the presence of “vegetation typically adapted to life in saturated soil” under “normal circumstances” is the key determinant in the definition of a wetland according to the NWA, but was absent throughout the study area, 21 features identified within the study area are nevertheless defined as “cryptic” wetlands as per Day *et al*, 2010. During the field assessments undertaken in 2019 and subsequently in 2021, over 60 features were ground-truthed by the specialist (as illustrated in Figure 16) and defined as either cryptic wetlands, seasonal depressions, episodic drainage lines with riparian vegetation or preferential flow paths. The characterisation of these features is discussed in greater detail in Section 4.2 below.

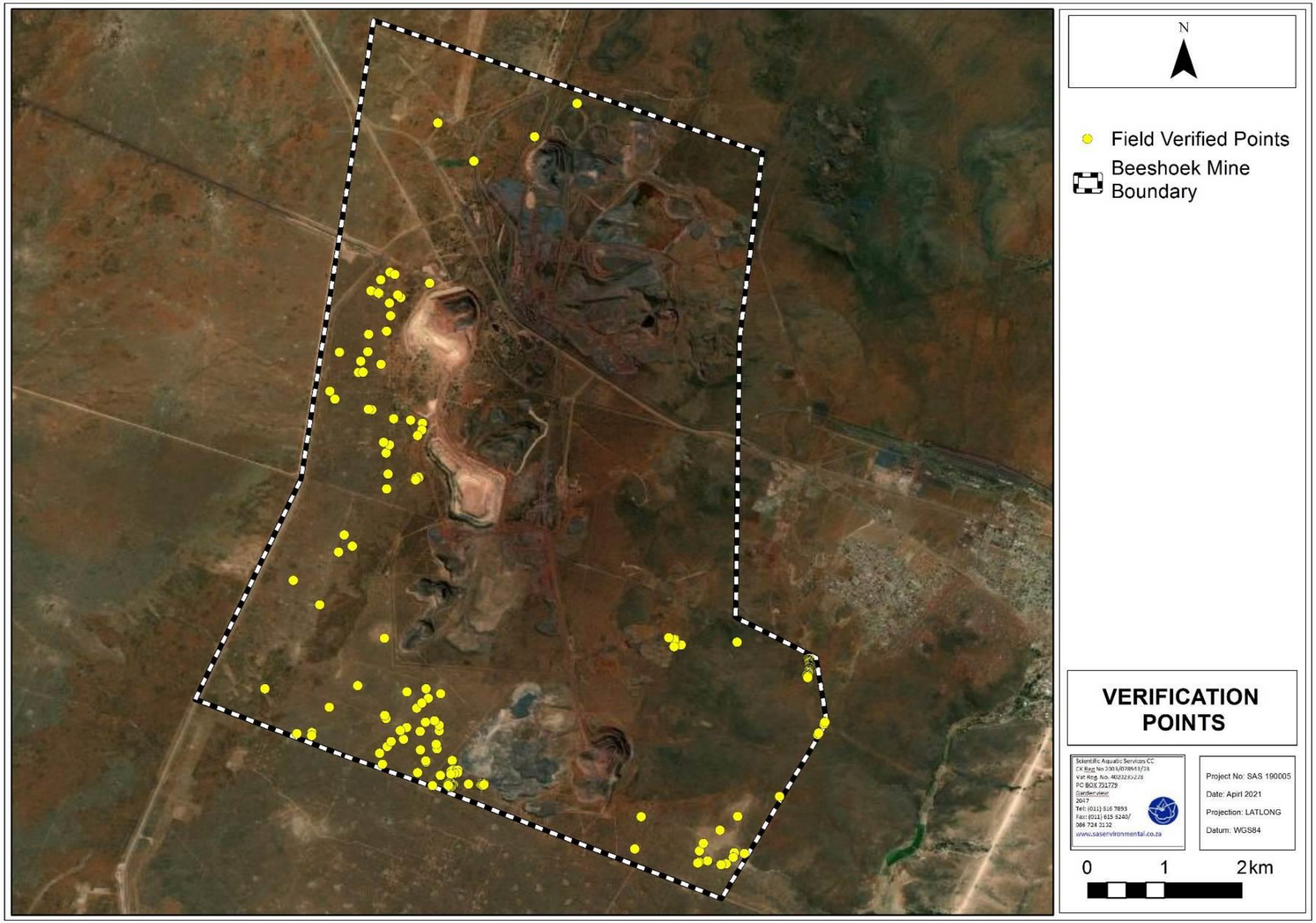

Figure 16: Visual representation of the field-verified points of interest.

During the assessment, the following indicators were used to identify and delineate the boundaries of the cryptic wetlands:

- ***Topography/elevation*** was a key determinant in the identification of these features. Twenty cryptic wetlands were identified within the study area, all of which were situated within distinct, low-lying depressions in the landscape. All were clearly defined endorheic systems where surface water, when sufficient is present, will accumulate. At the time of the assessment in March 2021, surface water was present within two of these systems;
- ***Presence of macroinvertebrates:*** Although the application of aquatic indices such as the South African Scoring System, version 5 (SASS 5) did not form part of the scope of this study, sampling was nevertheless undertaken in the two cryptic wetlands were surface water was present at the time of the 2021 assessment, and macroinvertebrates were found in both;
- ***Sediment deposits on plants*****:** the presence of sediment deposits on rocks or plants indicates minimum levels of inundation; thus a feature displaying such deposits is assumed to be seasonally inundated. The absence of such sediment deposits is inconclusive, and other indicators may be required to determine whether a feature is seasonally inundated. Whilst this is a subtle determinant of possible wetland conditions in some of the assessed features, it was nevertheless apparent in sufficient features to be utilised as an indicator;
- ***Soil wetness / morphological characteristics*****:** whilst soil wetness is considered by Day *et al* (2010) to be an unreliable indicator of wetlands in arid areas, consideration was nevertheless given to the soil classification and morphological characteristics, such as mottling, when present;
- ***Vegetation***: Due to the semi-arid climate of the study area, the absence of obligate[3] floral species was expected, and were only identified in one wetland which contained surface water at the time of the 2021 assessment. According to Day *et al* (2010), the **absence** of both dryland and wetland plants from a site may equally be an indicator of a cryptic wetland. However, five floral indicators were generally present within the cryptic wetlands, and a combination of at least two of these within any given feature was considered sufficient, in conjunction with other indicators, to classify a feature as a cryptic wetland. These floral indicators were *Eragrostis bicolor, Eragrostis echinochloidea, Aristida congesta* subsp. *congesta, Cullen tomentosum* and *Ziziphus mucronata*;

[3] Species almost always found in wetlands (>99% of occurrences).

- ***Vegetation associated with riparian zones*** of the episodic drainage line in the east of the mine was distinctly different from the surrounding upland areas in terms of both species composition and community structure. The riparian zones were well-defined vegetation communities associated with the episodic drainage lines and as such provided a clear indication of the boundaries, enabling delineation of the drainage lines.

Although the cryptic wetlands identified in the study area do not possess one of the key indicators typically associated with wetlands in South Africa, specifically, hydrophytic vegetation, they are nevertheless deemed to be potentially ecologically important and may play a significant role in the ecology of the area. Wetlands in arid areas are under-researched, particularly cryptic wetlands such as those identified in the study area, and little is known about the biodiversity associated with such systems (Henschel, unknown date, retrieved from http://fbip.co.za/wp-content/uploads/2018/08/Henschel-Abstract-2017-Small-Project.pdf, 18th March 2020). For example, cryptic wetlands such as those identified may host populations of invertebrates (mostly Branchiopods but also Phyllopods) which are considered keystone species of ephemeral pans globally, playing a pivotal role in the food web as prey (Henschel; unknown date of publication). Although it was not possible to identify to genus or species level as this would need to be undertaken in a laboratory, one of the cryptic wetlands identified was found to host a population of Anostraca (fairy shrimp), one of the four orders of crustaceans in the class Branchiopoda.

Thus, it is the opinion of the specialist that the cryptic wetlands identified in the study area should be afforded the same protection as a wetland which meets the legislated definition thereof, and that suitable mitigation measures be implemented to minimise impacts to these features.

4.2 Characterisation of the Watercourses and Drainage Features

As noted above, over 60 features were investigated during the site assessment and categorised according to their dominant characteristics, primarily topography, vegetation and soil characteristics. Of these features, 21 were defined as “cryptic wetlands”, 45 as “seasonal depressions”, an unnamed tributary of the Groenwaterspruit as an episodic drainage line (with riparian vegetation), one fairly distinct preferential flow path (lacking in either wetland or riparian characteristics) and one recharge zone, which may be important for recharge of a small tributary of the Groenwaterspruit.

Seasonal Depressions

The seasonal depressions (Figure 17 and Figures 20 to 22 below) were defined as areas which are low-lying in the landscape, usually but not always possessing closed contours and being inwardly draining. However, the floral species associated with those depressions were completely different from those depressions classified as cryptic wetlands. The seasonal depressions were dominated floristically by *Tarchonanthus camphoratus* (camphor bush) and *Chrysocoma obtusata* as well as *Eragrostis x pseudo-obtusa* (false tick grass). Additionally, the woody component associated with the seasonal depressions occurred throughout the depression, whereas the woody component associated with the cryptic wetlands was largely limited to the outer boundaries thereof. Furthermore, the soil characteristics differed between the two types of features, with those in the cryptic wetlands predominantly lacking in chroma whilst the soils in seasonal depressions were generally high-chroma, sandy soils.

Figure 17: Examples of seasonal depressions identified. The endorheic topographic setting is apparent in the photograph on the left, whilst the presence of woody species in the centre of the feature is notable in the photograph on the right.

Preferential Flow Paths

The large preferential flow path illustrated in Figure 18 and indicated in Figure 20 is defined as an area where, when present, surface water flows but is not retained in the landscape for a sufficient period to encourage the establishment of a floral community indicative of periodic saturation. Several smaller, poorly-defined preferential flow paths were identified but not mapped, as they do not meet the definition of a watercourse from an ecological perspective.

Figure 18: Representative photographs of the large preferential flow path situated adjacent to Village Pit WRD, which flows from the WRD in the east to the west of the Beeshoek Mine boundary.

Recharge Zone of the Unnamed Tributary of the Groenwaterspruit

The "recharge zone" of the small unnamed tributary of the Groenwaterspruit (indicated in Figure 22) does not possess well-defined characteristics indicative of either wetland or riparian conditions, as illustrated in Figure 19 below. Nevertheless, it is a clearly defined low-lying area, which possesses a unique digital signature and based on analysis of available digital satellite imagery, it is very likely that water from this area flows to the Groenwaterspruit and may contribute to the continued ecological functioning thereof. The importance of this feature from a hydropedological perspective in terms of its contribution to the recharge to the downstream system would need to be determined by a suitably qualified specialist. It is also recommended that the 1:100 year floodline determined by Hydrospatial (2020) be considered during planning as the minimum extent of the area to be excluded from mining, to ensure that no adverse impact to the downstream system occurs.

Figure 19: Portions of the recharge zone located upgradient of the small unnamed tributary of the Groenwaterspruit, in the south-eastern portion of the Beeshoek Mine property.

Neither the seasonal depressions, the preferential flow paths nor the recharge zone met the definitions of “cryptic wetlands” or watercourses from an ecological perspective (as defined by the NWA) and were therefore excluded from further assessment. Nevertheless, should any of these features be found to possess a 1:100 year floodline, from a legal perspective they would be considered as watercourses and would enjoy protection as such. Refer to the surface water specialist study prepared by Hydrospatial (2021) for details thereof.

Classification of the cryptic wetlands (CWs) and episodic drainage lines was undertaken at Levels 1-4 of the Classification System (Ollis *et al*, 2013) as outlined in Appendix C of this report. These systems were classified as Inland Systems falling within the Southern Kalahari Aquatic Ecoregion and the Eastern Kalahari Bushveld Group 3 Wetland Vegetation (WetVeg) group, considered “least threatened” by SANBI (2012) and Mbona *et al* (2015). The table below presents the further classification of these cryptic wetlands and episodic drainage lines at Levels 3 and 4 of the Classification System (Ollis *et al*, 2013).

Table 2: Characterization of the “cryptic wetlands” identified within the study area, according to the Classification System (Ollis *et al*., 2013).

Drainage system	Level 3: Landscape unit	Level 4: Hydrogeomorphic Unit
		HGM Type
Cryptic wetlands (CWs)	**Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land.	**Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
Episodic drainage lines with riparian vegetation	**Valley floor:** The base of a valley, situated between two distinct valley side-slopes.	**River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.

The various features and drainage systems as described above are presented in relation to the Beeshoek Mine boundary and proposed mining expansion areas in the figures below.

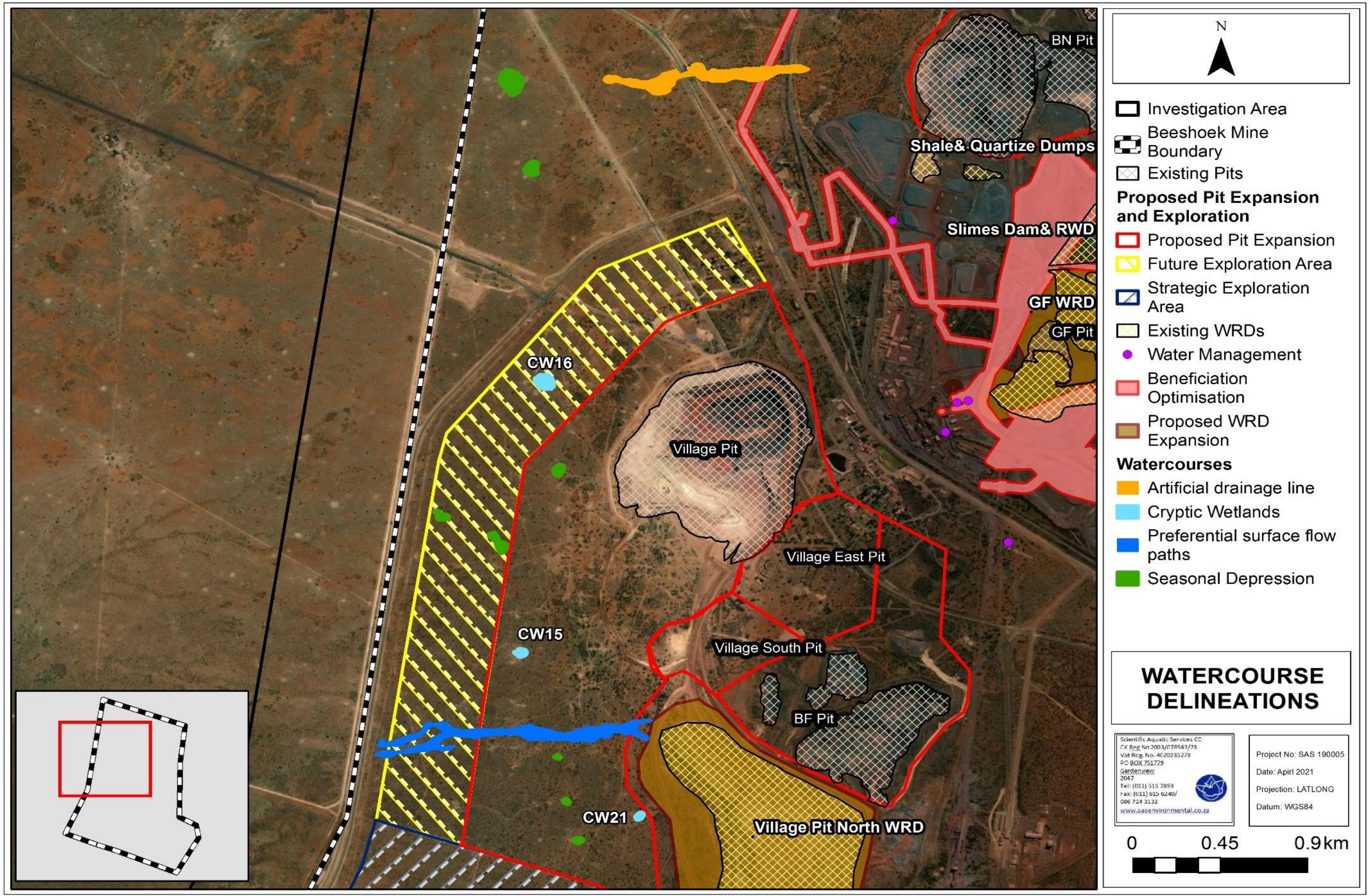

Figure 20: The location of the delineated cryptic wetlands (CWs), seasonal depressions and preferential flow paths within the north-western portion of the Beeshoek Mine boundary.

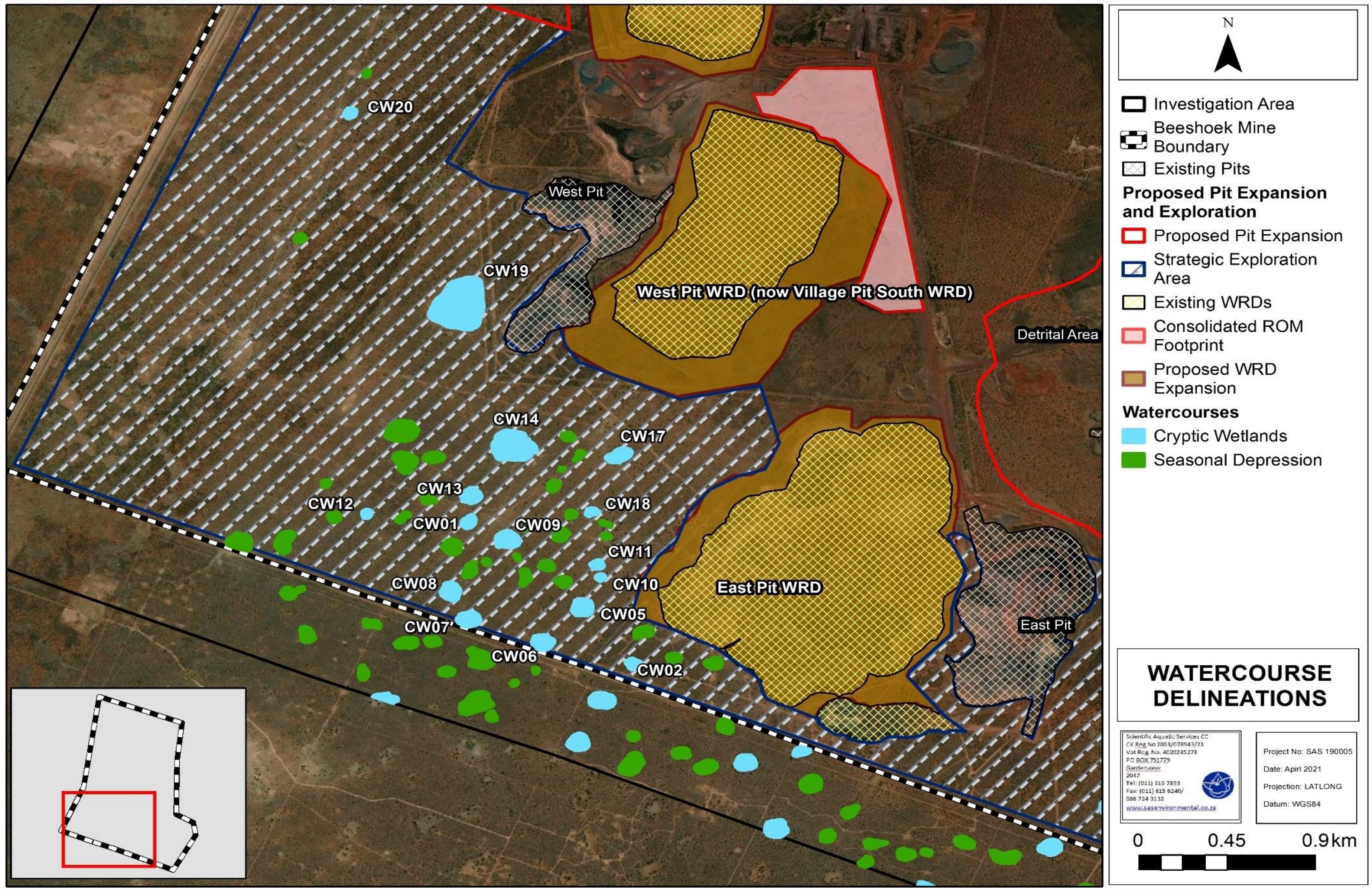

Figure 21: The location of the delineated cryptic wetlands (CWs) and seasonal depressions within the south-western portion of the Beeshoek Mine boundary and investigation area.

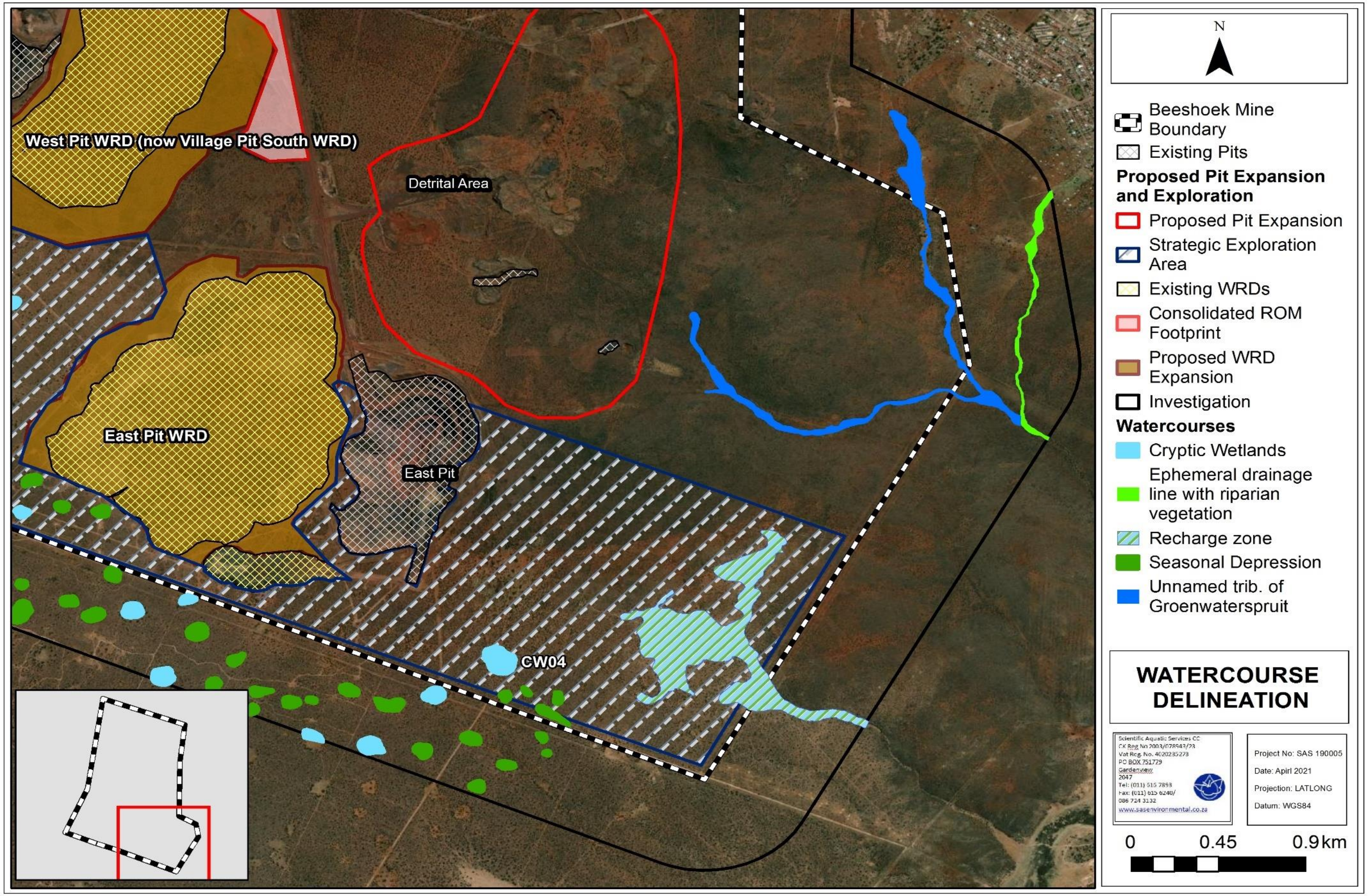

Figure 22: The location of the delineated cryptic wetlands (CWs), episodic drainage line, seasonal depressions and 'recharge zone' within the south-eastern portion of the Beeshoek Mine boundary and investigation area.

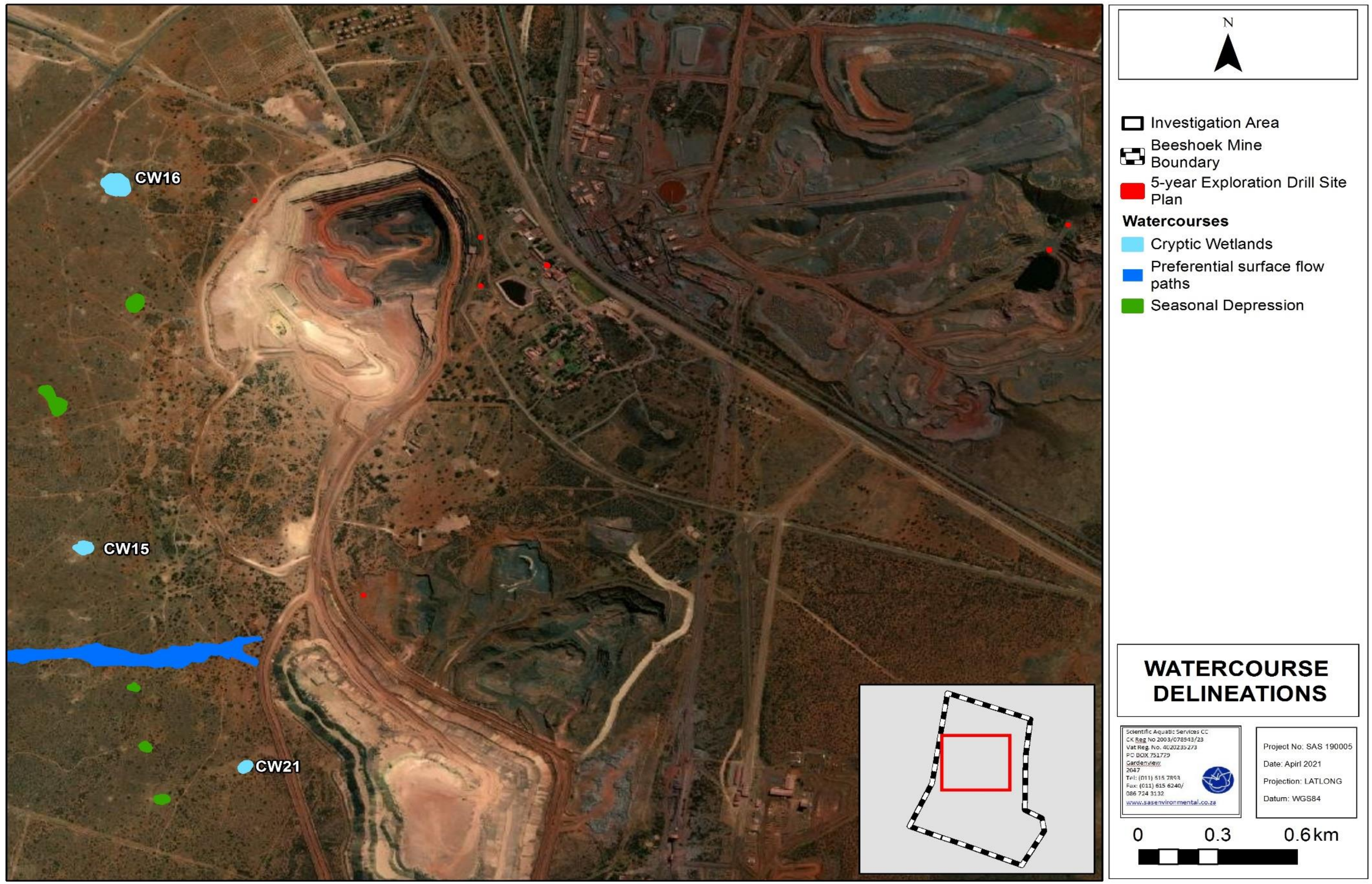

Figure 23: The location of the delineated cryptic wetlands (CWs), preferential surface flow path and seasonal depressions within the central portion of the Beeshoek Mine boundary and investigation area.

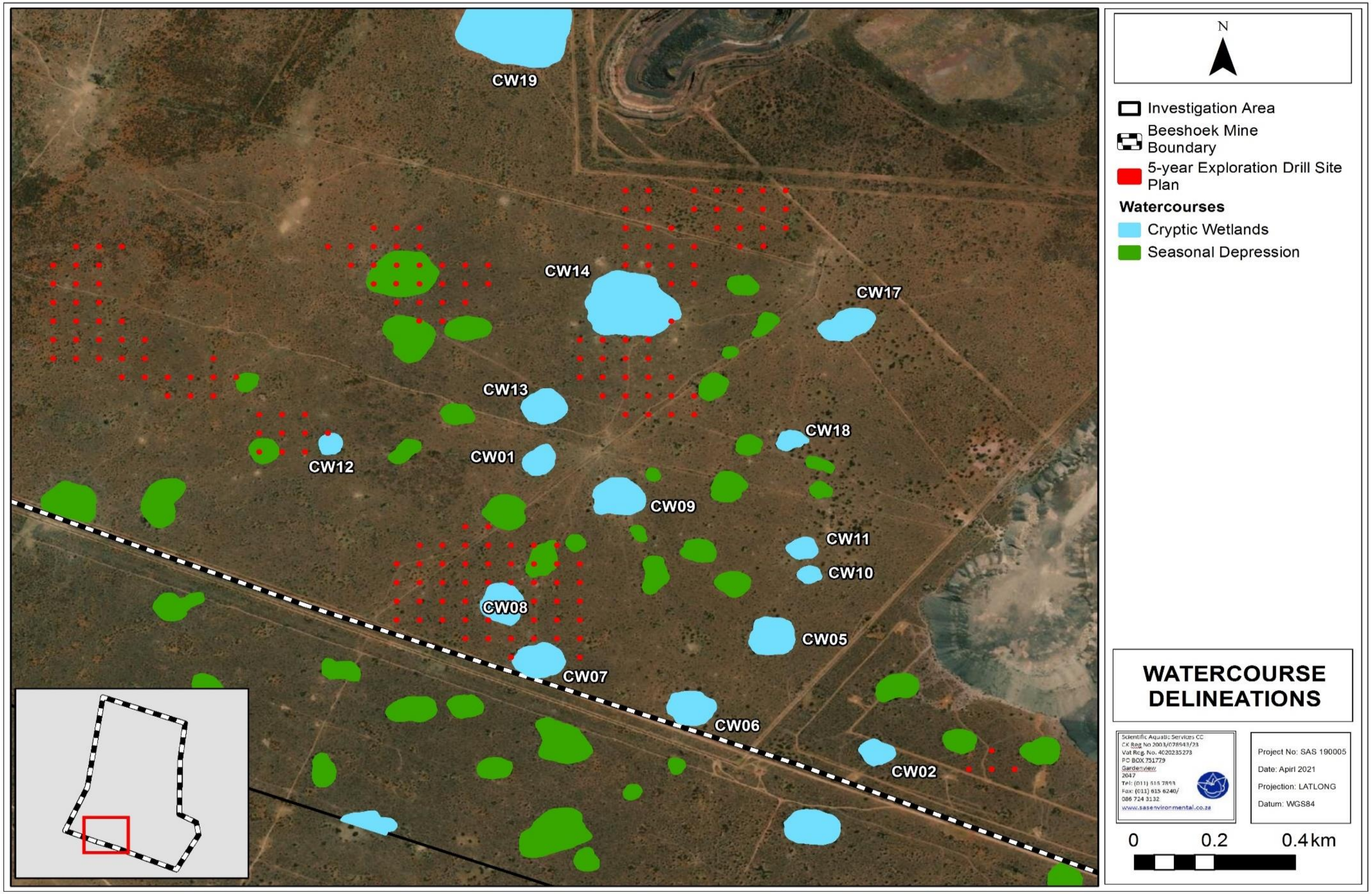

Figure 24: The location of the delineated cryptic wetlands (CWs) and seasonal depressions within the southern portion of the Beeshoek Mine boundary and investigation area.

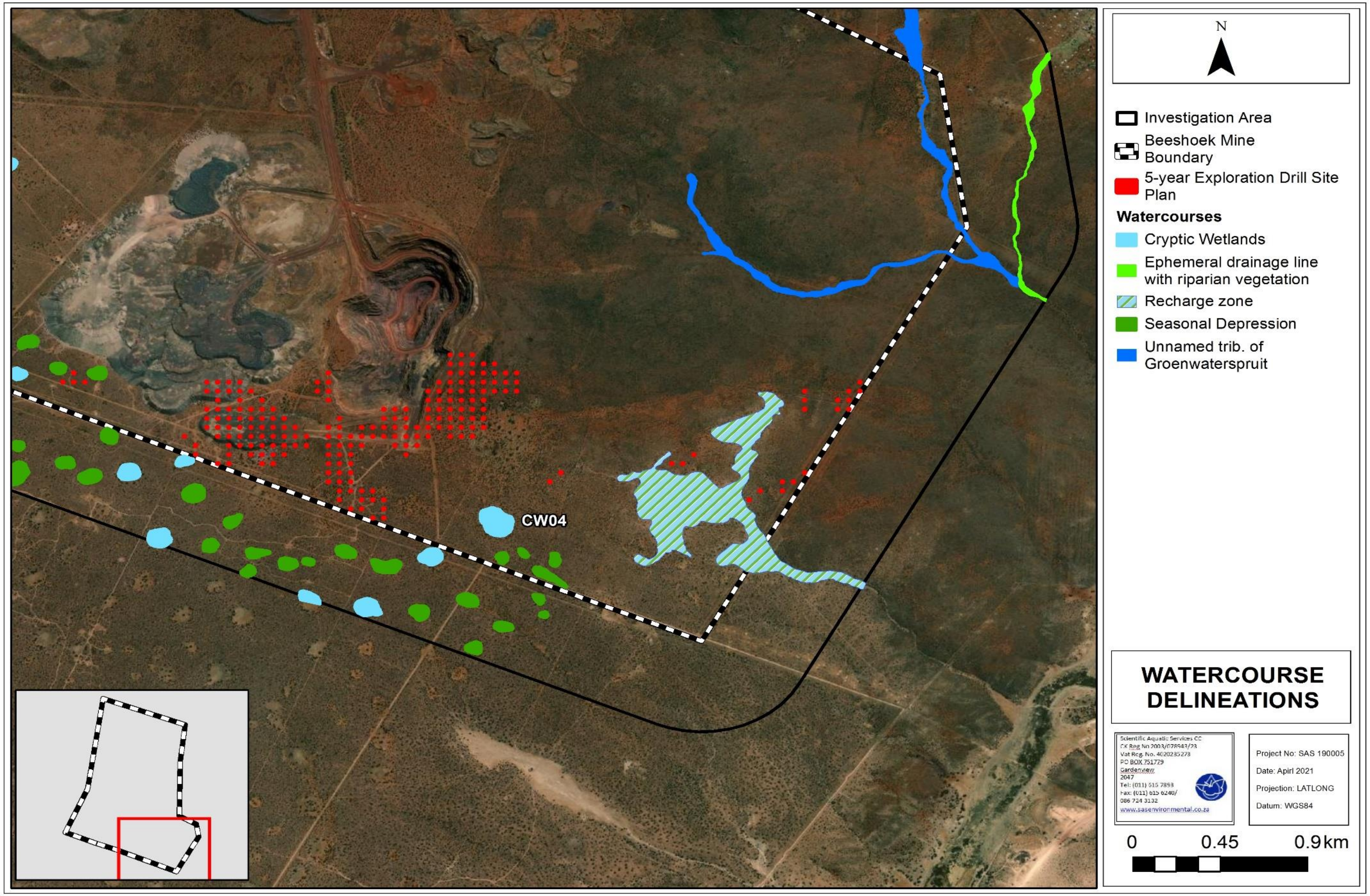

Figure 25: The location of the delineated cryptic wetlands (CWs), episodic drainage line, seasonal depressions and 'recharge zone' within the south-eastern portion of the Beeshoek Mine boundary and investigation area.

4.3 Field Verification Results

4.3.1 Cryptic wetlands located within the proposed mining expansion footprint

Following the site visit, various assessments were undertaken in order to determine the PES, EIS, and ecological service provision as well as to assign an appropriate REC, RMO and BAS as described in Section 1.2 of this report.

Whilst the various indices available in South Africa (such as WET-Health) are more appropriate for use in assessing drainage systems in wetter areas and are less suited to the assessment of systems in arid areas, in the absence of more appropriate protocols, the various indices listed in Section 1.2 were applied with the aim of characterising ecological integrity, importance and sensitivity of the systems as best as possible.

Due to the extent of the proposed mining expansion footprint areas, as well as the quantum of watercourses identified, the focus of this study and specifically the detailed assessment focused on the cryptic wetlands situated within the proposed expansion footprint area. The unnamed tributary of the Groenwaterspruit, defined as an episodic drainage line with riparian vegetation, is located approximately 170 m from the proposed Detrital Area expansion (Project 3) and is therefore not at direct risk of impact from the proposed activity. This watercourse is therefore discussed and included in the risk assessment (Section 5) but was not assessed in detail. Provided that adequate mitigation measures are implemented, the quantum of risk to the episodic drainage line is deemed low.

The indices used to determine the PES and EIS was applied collectively to all CWs which are under 1 ha in extent, and separately to CWs 4, 14 and 19 as those are greater than 1 ha in extent, are more likely to hold water for longer periods, and are therefore considered to be of greater ecological significance. Furthermore, the nature and extent of impacts noted throughout the assessed areas are deemed to be similar and minimal, and it is the opinion of the specialist that application of the various indices to each individual CW is not likely to yield significantly different results to those obtained. The detailed assessment results are presented in Appendix E of this report.

Table 3: Summary of the assessment of the 18 smaller (< 1 ha) “cryptic wetlands” identified within the proposed mining expansion footprint areas.

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Ecological & socio-cultural service provision graph:

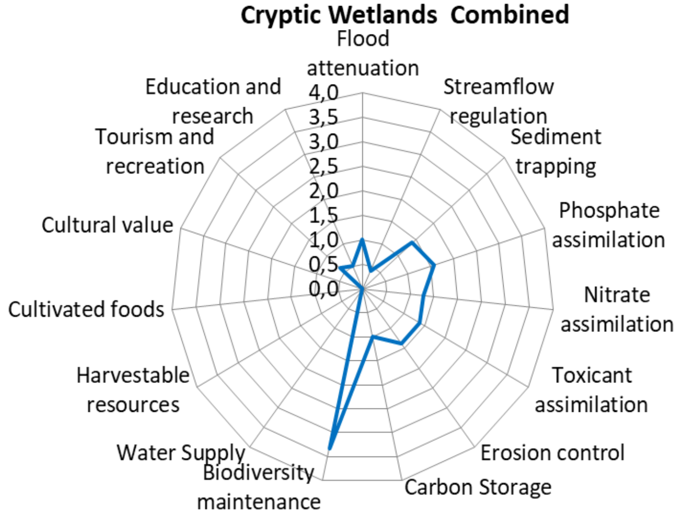

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Figure 26: Representative photographs of two of the smaller CWs, illustrating the distinct endorheic setting, and the absence of woody species within the centre of the depression.

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PES/ discussion

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PES Category: A (0.78)
The majority of the smaller CWs within the proposed mining expansion areas have been subjected to few impacts, and the extents thereof are relatively minor. No significant impacts to the hydraulic regimes were discerned during the two site assessments, with the exception of reduced surface roughness, attributed to a reduction in vegetation cover (usually due to grazing pressure). Some of the CWs identified in the south-western portion of the Beeshoek Mine property were noted to have been trampled, either by cattle or wildlife, leading to disturbed soil profiles and possible sedimentation when surface water is present. Sedimentation may be problematic, as the inward-draining character of the CWs will lead to accumulation of sediment, in turn potentially leading to reduced capacity for retention of surface water, which in turn may impact on ecological service provision. However, aside from slight disturbances to soils within the CWs, no significant alterations to geomorphological processes were noted. The floral communities tended to be homogenous, with the same floral species observed throughout.

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Ecoservice provision

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Moderately low
Due to the highly ephemeral nature of the cryptic wetlands, as well as the endorheic geomorphological setting, ecological service provision is generally of low levels, with the exception of biodiversity maintenance, which is deemed ‘high’. A potential floral Species of Conservation Concern (SCC) observed directly within one of the cryptic wetlands included *Nerine laticoma* (protected under the Northern Cape Nature Conservation Act, 2009 (Act No 9 of 2009), however the absence of inflorescences precluded positive identification. Although no other SCC were noted at the time of either assessment, the limitations posed by the duration of the assessments present a “snap shot” of conditions, and further detailed studies would need to be undertaken over a greater period of time to ascertain the occurrence of floral and/or faunal SCC. However, suitable habitat for certain species is present within some of the CWs, and therefore in line with the precautionary principle, it was considered likely that other SCC may occur within, or utilise, the cryptic wetlands.

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EIS discussion

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EIS Category: Moderate
The pans are deemed important both in terms of biodiversity maintenance and on a landscape scale. They may provide important habitat, refugia, foraging and migratory sites for various faunal species on a seasonal basis. Additionally, whilst no floral SCC were confirmed during the site assessment, the possible occurrence of *N. laticoma* was recorded within one of the CWs and many flora in this region, particularly geophytic species, have restricted growth and flowering periods.

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REC, RMO & BAS Category (All CWs)

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REC Category: A
BAS: A (Maintain)
RMO: A (Maintain)
Since the majority of the CWs associated with the proposed mining expansion footprint are in a largely natural condition, ideally, they should remain as such. However, it is acknowledged that several CWs may be directly and irreversibly impacted as a result of the proposed development and therefore, maintenance of the PES will not be feasible. Please refer to the discussion below pertaining to impacts and mitigation measures.

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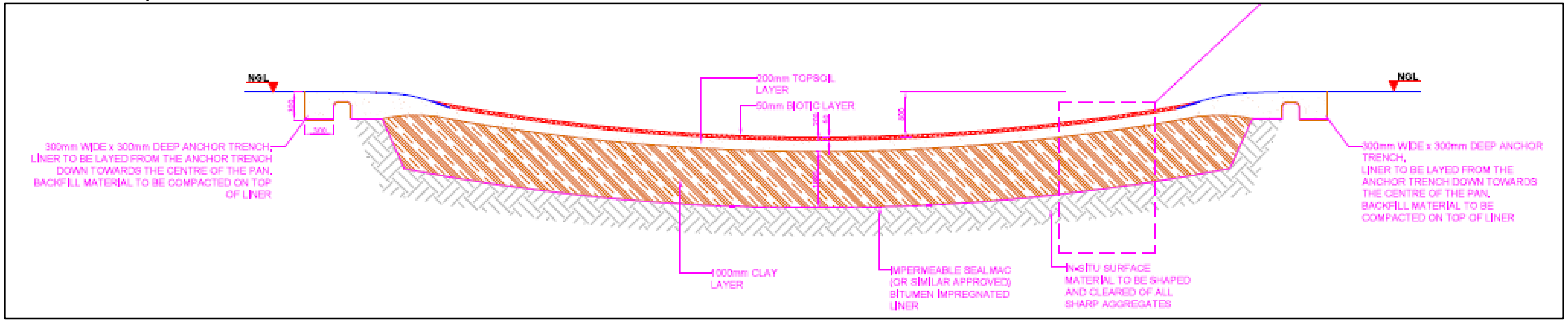
Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):	
Very few impacts to the hydraulic regime and geomorphological processes were discerned during the site assessment, with the exception of the aforementioned topsoil disturbances caused by trampling of livestock and wildlife. The region is characteristically semi-arid, and although rainfall had been received between December 2020 - February 2021, at the time of conducting the assessment in March 2021, surface water only remained in two of the CWs (refer to Tables 4 and 5 for details). Nevertheless, based on the remote locality and absence of impacts such as industry, mining or cultivation, water quality, when present, will be the result of precipitation and therefore unpolluted. The vegetation communities associated with the CWs were largely limited to graminoid species (such as *Eragrostis bicolor,* and *Aristida congesta subsp. congesta*) and the forb *Cullen tomentosum*. Where disturbances were evident, the small shrub *Chrysocoma obtusata* were occasionally present. It was evident during the assessment that many of the CWs are favoured for grazing both by domestic livestock and wildlife. The relative absence of fauna during the site assessment can be attributed to the crepuscular and secretive nature of many faunal species potentially occurring on site. Notwithstanding this, various avifauna and small antelope species were observed in the vicinity of each CW, indicating potentially increased faunal activity when surface water is present. Whilst few to no faunal species were observed within the assessed CWs during the site visit, as noted in Section 4.1, features such as those identified in the study area are noted to be important habitat for various Branchiopod species in the region, which are able to withstand extended periods of desiccation. Confirmation of the presence of these invertebrates by means of hatching out eggs under laboratory conditions did not form part of the scope of work thus their presence or absence in this group of CWs cannot be ruled out without further investigation; however, Branchiopods and tadpoles were found in CW 14 (refer to Table 4 below), inferring that they may be present in the other CWs assessed. It is therefore strongly recommended that sampling of the cryptic wetlands to determine the presence (or absence) of macroinvertebrates be undertaken. Sampling under dry conditions can be achieved by obtaining soil samples from the top layer (0-50 mm) of soil within each CW, which would hold the egg banks of any invertebrates present. These soils samples are then processed under laboratory conditions to hatch out and enumerate the invertebrate taxa present. Should invertebrate taxa be present, a detailed rescue and relocation plan should be developed by a suitably qualified specialist, to relocate egg banks, either to cryptic wetlands that will be undisturbed, or to recreated wetlands (refer to the figure below for a concept diagram). Such a rescue and relocation plan could potentially form part of and offset initiative, should it be required by the relevant authority.  **Figure 27: Conceptual diagram of a recreated cryptic wetland.**	
Extent of modification anticipated	No direct impacts (and therefore significant modification) to the CWs are anticipated as a result of the proposed activities associated with Projects 1, 4 or 5, although increased dust generation associated with a general increase in mining activity is expected, which may potentially lead to smothering of biota and reduced water retention capacity. Indirect impacts may arise as a result of the expansion of the Village Pit, West Pit and East Pit WRDs, (Project 2) and the proposed exploration drilling within the Future Strategic Exploration Block and the Village Exploration Block areas (Project 3) poses potential indirect impacts to numerous CWs. Although proposed drill sites for the Village Exploration Block area had not been provided at the time of preparing this report, proposed drill sites within the Future Strategic Exploration Block were provided. Some drill sites are located along the delineated boundary of CWs and/or within catchments thereof, specifically CWs 7, 8, 12 and 14 (refer to Table 5 for further detail pertaining to CW 14). Indirect impacts associated with the proposed WRD expansions and the proposed exploration drilling can be appropriately mitigated to reduce modification and risk significance.

	The proposed expansion of Village Pit (Project 3) will however result in the irreversible loss of cryptic wetland habitat (specifically CW 15 and CW 21), which cannot be mitigated. Therefore, the extent of modification anticipated ranges from "none" to "irreversible", depending on the nature of the proposed activity.
Impact Significance & Business Case:	
Low	Activities associated with Projects 1, 4 and 5 will pose a negligible risk to the CWs, since those activities are located within already heavily disturbed areas, where existing infrastructure provides adequate barriers between the activities and the cryptic wetlands. The expansion of the Village Pit, West Pit and East Pit WRDs, (Project 2) is expected to be of 'low' risk significance provided that suitable mitigation is strictly implemented, as these activities are situated further than 100 m from the cryptic wetlands. Settling of wind-borne sediment from the WRDs within the cryptic wetlands is considered one of the most likely impacts, and therefore, dust suppression must be undertaken throughout the life of mine to reduce this risk.
Moderate	The proposed exploration drilling within the Future Strategic Exploration Block encroaches on the delineated boundaries of CW12, and on the catchments of CWs 7 and 8. Whilst exploration drill sites are generally relatively small (usually approximately 10 m^2) and temporary in nature, the disturbances caused by drilling can lead to (for example) localised alterations to landscape which could potentially result in altered runoff patterns. This is important in the context of the cryptic wetlands which have relatively small catchments and are recharged by surface water runoff, as any loss of recharge could contribute to altered ecological state and functioning thereof. It is strongly recommended that the proponent makes provision for the modelling of the catchments to be undertaken by a suitably qualified specialist, and that thereafter during future planning phases, exploration drill sites are planned to be located outside of the cryptic wetlands and their catchments. The risk posed to CWs 15 and 21 as a result of the proposed expansion of Village Pit, was calculated as 'moderate', although it is the specialist's opinion that this is understated, due to the scoring methodology. These activities will result in the outright loss of all cryptic wetland habitat, which cannot be mitigated or reversed. Therefore, a more accurate description of the risk significance is 'high', and the proposed expansion of Village Pit is not supported by the specialist. It is strongly recommended that the proponent engage with the relevant authorities to implement appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent with regards to the outright loss of the affected CWs. Please refer to Section 5 for the results of the risk assessment and mitigation measures.

Table 4: Summary of the assessment of CW 4 (Figure 22) identified within the south-eastern portion of the proposed future opencast pit area (south-west of the existing East pit)

Ecological & socio-cultural service provision graph:

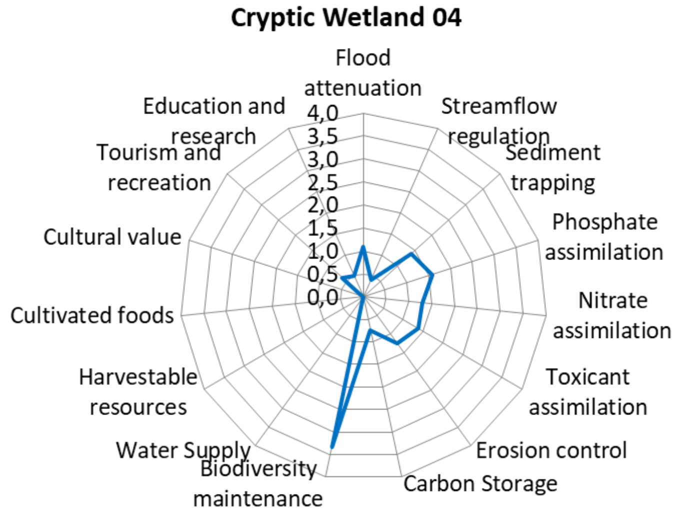


Figure 28: Representative photographs of CW 4 in June 2019 (left) and March 2021 (right). The effects of prolonged drought can be seen in the photograph on the left, whilst the vegetation has recovered to some extent in the photograph on the right, although it is clear that the CW is still utilised for grazing.

PES/ discussion	**PES Category: A (0.92)** Few discernible impacts to the hydraulic and geomorphological regimes were noted during either assessment, although faunal utilisation has resulted in the disturbance of topsoil (trampling and burrow excavations). Grazing pressure resulted in reduction in surface roughness, affecting the hydraulic regime marginally as water retention time may be slightly reduced as a result of exposure. However, overall the CW is deemed to be in a largely natural condition.	**Ecoservice provision**	**Marginally low** The inward-draining and highly ephemeral character of the CW minimises the degree to which it can perform various ecological functions, although it is apparent that biodiversity maintenance is one of the important functions performed by the wetland.
EIS discussion	**EIS Category: Moderate** The CW is deemed important both in terms of biodiversity maintenance and on a landscape scale. Although no fauna was observed at the time of either assessment, spoor, scat and burrows around the outer perimeter indicate that the CW is utilised regularly by various fauna. The occurrence of Branchiopods within this system cannot be discounted, and if present, the wetland may be important on a seasonal basis for migratory avifaunal species.	**REC, RMO & BAS Category (All CWs)**	**REC Category: A** **BAS: A (Maintain)** **RMO: A (Maintain)** Ideally, CW 4 should remain in a largely natural condition. However, it is located within the proposed future opencast mining area, and should the activity be authorised and proceed, maintenance of the PES will not be feasible. Please refer to the discussion below pertaining to impacts and mitigation measures.

Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):	
Very few impacts to the hydraulic regime and geomorphological processes were discerned during the site assessment, with the exception of the aforementioned topsoil disturbances caused by trampling of livestock and wildlife. As illustrated above, no surface water was present during either assessment. Based on the relatively remote location, surface water, when present, is likely to be mostly unimpaired, although proximity to the East pit may result in wind-borne sediment reaching the CW and potentially causing some turbidity. The vegetation community is largely limited to a graminoid layer, with the forb *C. tomentosum* present at the time of the 2021 assessment. The woody layer surrounding the CW consisted almost solely of *Zizphus mucronata*. As discussed above, faunal utilisation, particularly by small mammals, was apparent and infers that when surface water is present, a more diverse faunal component is expected, particularly if macroinvertebrates occur.	
Extent of modification anticipated	No significant modification to CW 4 is anticipated as a result of any of the activities associated with Projects 1, 2, 4 or 5, although indirect impacts relating to increased dust generation as a result of a general increase in mining operations may occur. Similarly, no direct or indirect impacts are anticipated as a result of the majority of the activities associated with Project 3, with the exception of the proposed future opencast areas. Based on the layout received in January 2021, the expansion of opencast mining into the south-east of the Beeshoek Mine boundary will result in the irreversible loss of CW4.
Impact Significance & Business Case:	
Low	Activities associated with all proposed projects will pose a negligible risk to CW4, as none of the proposed activities will occur within proximity to the CW, although the general increase in mining activity is likely to result in increased dust generation, which may potentially reach the wetland. Therefore, although it is a low risk, dust suppression must be implemented throughout the life of mine to minimise the risk of wind-borne sediment reaching this, and other, cryptic wetlands (including those located outside the mine boundary but within close enough proximity that wind-borne sediment may pose a risk). Please refer to Section 5 for the results of the risk assessment and mitigation measures.

Table 5: Summary of the assessment of CW 14 (Figure 21) identified within the south-western portion of the proposed future opencast pit area (south of the existing West pit)

Ecological & socio-cultural service provision graph:

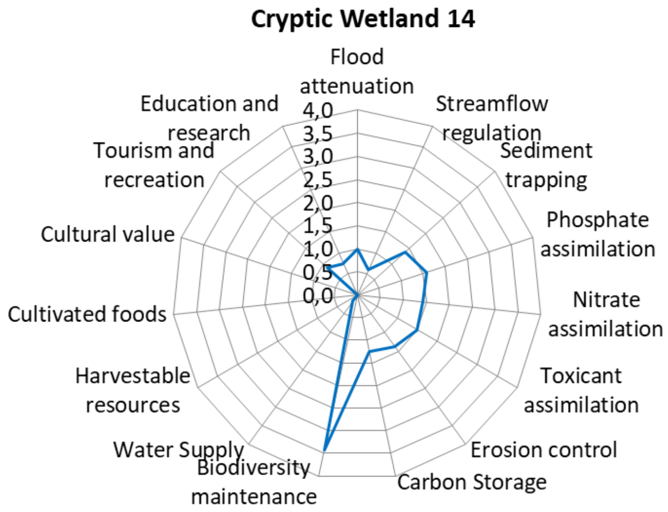


Figure 29: CW 14 in late February 2021 (left; photograph acknowledgement: A. Pirie) and in early March 2021 (right). The diminished extent of surface water is apparent.

PES/ discussion	**PES Category: A (0.79)** With the exception of some disturbance to soil and vegetation as a result of trampling and grazing respectively by livestock, no significant impacts to CW were discerned during the 2021 assessment.	**Ecoservice provision**	**Marginally low** Whilst surface water was present at the time of assessment, the highly ephemeral and endorheic nature of the CW is a limiting factor in its ability to perform various ecological functions. Biodiversity maintenance is the most important function provisioned by this CW, as evidenced by the populations of macroinvertebrates (Astrocoda and Ostracod), and tadpoles which were sampled in this cryptic wetland (refer to Figure 27 below).
EIS discussion	**EIS Category: High** The presence of surface water, macroinvertebrates and amphibians at the time of assessment contributed to the increased EIS score for this CW, as it is clear that it is an important system for migratory fauna, as well as for populations of unique aquatic species particularly in the context of the greater region. It is also considered important on a landscape scale and the biota (macroinvertebrates) may be susceptible to changes in water quality or to the sediment regime.	**REC, RMO & BAS Category (All CWs)**	**REC Category: A** **BAS: A (Maintain)** **RMO: A (Maintain)** Ideally, CW 14 should remain in a largely natural condition. However, it is located within the proposed future opencast mining area, and should the activity be authorised and proceed, maintenance of the PES will not be feasible. Please refer to the discussion below pertaining to impacts and mitigation measures.

Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):

As illustrated above, the cryptic wetland is driven primarily by surface water (precipitation). No discernible impacts to the hydraulic regime such as barriers restricting surface water runoff which may recharge the wetland, were observed. Some trampling was noted around the perimeter of the wetland however no turbidity was noted indicating that sediment settles quickly. However, the macroinvertebrates present may be sensitive to changes in the sediment balance, specifically increased sediment volumes entering the system.

Basic water quality parameters were measured, and indicated that the water quality was unimpaired, although Dissolved Oxygen (DO) was not measured (pH 8.75, Electrical Conductivity [EC] 16mS/m and temperature 28.8˚C). Changes in water quality as a result of increased hydrocarbons or other pollutants are also likely to have an adverse effect on the biota present. These values may be attributed to biological processes.

Unlike all other CWs assessed, facultative vegetation was present at the time of assessment, although the presence thereof is thought to be strongly related to the presence of surface water. Although no floral SCC were observed at the time, their presence cannot be discounted as it is possible that their occurrence correlates with the absence of surface water. Whilst faunal utilisation was limited to avifauna during the time of sampling, the presence of small burrows around the slightly raised perimeter of the CW infers use by small mammals during times when less surface water is available.

Figure 30: Aquatic plants (*Marsilea sp*) observed in CW 14 (left), Ostracod (centre) and Anostraca (fairy shrimp) (right) observed within CW 14.

Extent of modification anticipated	No direct impacts to CW14 are anticipated as a result of the activities associated with Projects 1, 4 and 5. Indirect impacts associated with an increase in mining projects are related to the general increased activity, which will lead to increased dust generation. This could potentially lead to smothering of biota and diminished water retention capacity of the wetland. Indirect impacts may arise as a result of the expansion of the Village Pit, West Pit and East Pit WRDs, (Project 2) the expansion of Village Pit (Project 3) and the proposed exploration drilling within the Future Strategic Exploration Block, however, these can be appropriately mitigated to reduce the risk significance.
Impact Significance & Business Case:	
Low	Activities associated with Projects 1, 4 and 5 will pose a negligible risk to CW14, as none of the proposed activities will occur within proximity to the CW, although the general increase in mining activity is likely to result in increased dust generation, which may potentially reach the wetland smothering biota and leading to diminished water retention capacity and thus the value of the system as a refuge biota associated with these episodic systems. Therefore, although it is a low risk, dust suppression must be appropriately implemented throughout the life of mine to minimise the risk of wind-borne sediment reaching this, and other, cryptic wetlands (including those located outside the mine boundary but within close enough proximity that wind-borne sediment may pose a risk). The proposed exploration drilling within the Future Strategic Exploration Block encroaches on the boundary and catchment of CW14, potentially resulting in direct and indirect impacts to the cryptic wetland. Localised alterations to the catchment as a result of drilling could lead to altered runoff patterns, thus impacting on the recharge mechanism of the wetland and potentially altering the ecological state and function. The modelling of the catchment of this wetland should be undertaken by a suitably qualified specialist, and thereafter during future planning phases, exploration drill sites around this wetland must planned to be located outside of the delineated boundary and associated catchment of the cryptic wetland as a precautionary measure to prevent impact on the system, should the area not be mined in future. It is worth nothing that should the exploration drilling within the Future Strategic Exploration Block latterly translate to open cast mining, CW14 could, potentially, be mined out. Due consideration must be given to this possibility during future planning phases to ensure that engagement with the relevant authorities takes place to ensure that appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent can be planned for and implemented appropriately. Please refer to Section 5 for the results of the risk assessment and mitigation measures.

Table 6: Summary of the assessment of CW 19 (Figure 21) identified within the south-western portion of the proposed future opencast pit area (west of the existing West pit)

Ecological & socio-cultural service provision graph:

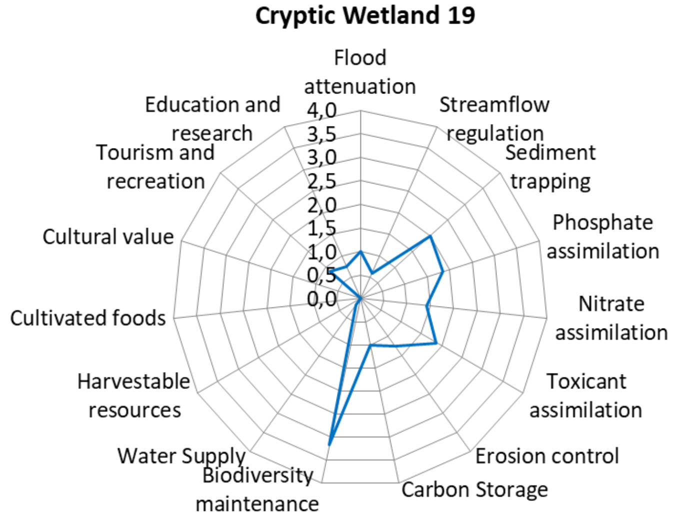


Figure 31: Representative photographs of CW19, illustrating the red sediment which is thought to be wind-borne from the West Pit situated approximately 162 m east of the cryptic wetland.

PES/ discussion	**PES Category: B (1.42)** The proximity of mining activities to this cryptic wetland have likely contributed to the altered ecological state thereof, primarily through wind-borne sediment deposition. It is likely that increased sediment volumes entering the depression have resulted in reduced capacity to retain surface water and may potentially be partially responsible for the erosion noted around the northern perimeter. Vegetation has been lost, either through grazing and/or trampling, and through smothering.	**Ecoservice provision**	**Moderately low** Although CW19 is the largest of all the assessed cryptic wetlands, ecological service provision is limited, primarily due to the ephemeral character of the wetland. Nevertheless, it is considered important for sediment trapping (largely due to opportunity and not necessarily due to capacity to trap sediment) and may provide a 'sink' for various wind-borne toxicants. Biodiversity maintenance is considered the most important function provisioned by the CW. Avifaunal activity was noted at the time of assessment, and various macroinvertebrates and amphibian metamorphs were present (refer to Figure 29).
EIS discussion	**EIS Category: Moderate** The slightly reduced ecological integrity of the CW plays a role in reducing the ecological importance thereof, although the confirmed presence of macroinvertebrates increases its relative importance as a foraging site for various fauna, especially migratory birds.	**REC, RMO & BAS Category (All CWs)**	**REC Category: B** **BAS: B (Maintain)** **RMO: B (Maintain)** Ideally, the PES of CW19 should at minimum be maintained, and the wetland not permitted to degrade further. However, it is located within the proposed future opencast mining area, and should the activity be authorised and proceed, maintenance of the PES will not be feasible. Please refer to the discussion below pertaining to impacts and mitigation measures.

Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):

Although few discernible impacts were noted during the assessment, it was apparent that sediment deposition poses a risk to the ongoing ecological functioning of the CW. As illustrated in Figure 28, the water has a distinctly red hue, attributed to increased inputs of iron-rich sediment, most probably the result of daily disturbances (e.g. blasting, movement of vehicles) associated with the nearby mining activities. Given the semi-arid conditions of the area, this sediment is not likely to be transported to the CW in stormwater runoff but is likely to be wind-borne. The increased volume of sediment settling in the CW has altered the characteristics of the wetland base and may potentially be a contributing factor to the erosion noted along the northern perimeter of the CW.

Measurement of basic water quality parameters indicates that water quality is relatively unimpaired, although a full suite of parameters would need to be assessed to confirm this. The EC was higher than that in CW 14 (32mS/m) and was attributed to the presence of iron-rich sediment, however, pH was similar to that at CW14 at 8.57.Water temperature at the time of assessment was 30.6˚C.

Although it could not be confirmed during the assessment, it is possible that sedimentation of the system has contributed to altered macroinvertebrate assemblages, as no Anostraca or Ostracod were sampled in CW19. According to Dr Betsie Milne (*Pers. Comm.,* March 2021) many species of Anostraca are habitat specialists, preferring clear water. Their presence in CW14 and absence from CW19 may be attributable to the increased sediment. Nevertheless, the presence of other macroinvertebrate taxa contributes to the overall capacity of the wetland for biodiversity maintenance, as evidenced by the presence of water-dependent avifauna, and amphibians, although use by large mammals seemed to be reduced, judging by the absence of spoor and scat observed at other CWs. The floral community was notably different to that observed within the other assessed CWs, specifically, the absence of a well-established graminoid and forb layer. Although grasses were present, their distribution was sparse. This may potentially be the result of smothering by wind-borne sediment.

Figure 32: Fauna associated with CW19, identified through informal sampling. Left to right: *Kassina senegalensis* metamorph, a giant water bug (Belostomatidae) and Coenagrionidae (Damselfly) larvae.

Extent of modification anticipated	No direct impacts to CW19 are anticipated as a result of the activities associated with Projects 1, 4 and 5. Indirect impacts associated with an increase in mining projects are related to the general increased activity, which will lead to increased dust generation. It is apparent that CW19 is already being impacted by wind-borne sediment settling in the wetland; additional inputs have the potential to result in irreversible impacts. Indirect impacts may arise as a result of the expansion of the Village Pit, West Pit and East Pit WRDs, (Project 2) and as a result of the expansion of Village Pit (Project 3) however, these can be appropriately mitigated to reduce the risk significance (Refer to Section 5). At the time of preparing this report, no exploration drill sites (Project 3) were located in the area surrounding CW19.

Impact Significance & Business Case:	
Low	Activities associated with Projects 1, 2, 3, 4 and 5 will pose a negligible risk to CW19, as none of the proposed activities will occur within proximity to the CW, although the general increase in mining activity is likely to result in increased dust generation, potentially posing a moderate to high risk significance to the wetland. Therefore, dust suppression must be implemented throughout the life of mine to minimise the risk of wind-borne sediment reaching this, and other, cryptic wetlands.

4.3.2 Watercourses situated outside the proposed mining expansion footprint

A single watercourse, specifically a small unnamed tributary of the Groenwaterspruit, was identified approximately 162 m east of the proposed detrital area expansion. This watercourse was characterised as an episodic drainage line with a weakly-defined riparian zone (Figure 30) and was only assessed during the June 2019 site visit. Since the proposed detrital area expansion is located outside of the Zone of Regulation (100 m in terms of both GN 704 and GN 509 as they relate to the National Water Act, 1998 (Act No. 36 of 1998) of this watercourse, a quantitative assessment of the PES and EIS was not undertaken. Although the proposed detrital area expansion is situated outside the applicable Zones of Regulation, it is located upgradient of the watercourse, and therefore, it is considered imperative that suitable mitigation measures are implemented to ensure that no indirect impacts occur. The watercourse was therefore included in the risk assessment (Section 5) and mitigation measures provided to aid in achieving this.

Although not quantitively ascertained, it is the specialist's opinion that the watercourse is in a moderately modified ecological state, and of moderate ecological importance and sensitivity. The watercourse has been subjected to few impacts; those observed included overgrazing and trampling by livestock, altered hydraulic regime particularly in the lower reaches where road crossings have resulted in concentrated flow, and in the upper reach to the east, erosion was noted on digital satellite imagery. Isolated occurrence of litter and debris was also noted within the system, which may restrict flow and impair water quality when surface water is present. It is likely to provide an important faunal migratory corridor, and some degree of ecological services such as sediment trapping, contribution to the recharge of the downstream system, and assimilation of nutrients, although the ephemeral character of the watercourse limits the opportunity to do so. The watercourse is likely to be sensitive to increased flood peaks which may alter the floral community composition, and potentially to changes in water quality.

Representative photographs of the watercourse are presented in Figure 30 below.

Figure 33: Representative photographs of portions of the unnamed tributary of the Groenwaterspruit. As illustrated, the riparian zone is weakly defined in some reaches.

4.4 Sensitivity Mapping

4.4.1 Legislative requirements, national and provincial guidelines pertaining to the application of buffer zones

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be "a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another". Buffer zones are considered to be important to provide protection of basic ecosystem processes (in this case, the protection of aquatic and wetland ecological services), reduce impacts on water resources arising from upstream activities (e.g. by removing or filtering sediment and pollutants), provision of habitat for aquatic and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted however that buffer zones are not considered to be effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

Legislative requirements were first taken into consideration when determining a suitable buffer zone for the cryptic wetlands and unnamed tributary of the Groenwaterspruit. The definition and motivation for a regulated zone of activity as well as buffer zone for the protection of the cryptic wetlands and episodic drainage lines can be summarised as follows:

Table 7: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) Environmental Impact Assessment (EIA) Regulations, 2014 (as amended). **The Department of Environmental Affairs**	➢ Activity 12 of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment (EIA) regulations, 2014 (as amended) states that: The development of: (xii) infrastructure or structures with a physical footprint of 100 square metres or more; Where such development occurs— a) Within a watercourse; b) In front of a development setback; or c) If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse.
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). **The Department of Water and Sanitation**	**Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act (Act No. 36 of 1998) (NWA).** In accordance with GN509 of 2016 as it relates to the NWA, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation, as well as Government Notice no. 509 of 2016 as it relates to the NWA.

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). **The Department of Water and Sanitation**	**Government Notice 704 as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).** These Regulations, forming part of the NWA, were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the Beeshoek Mine complies with GN 704 of the NWA, which states that: *No person in control of a mine or activity may:* *(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the <u>activity footprint must fall outside of the 1:100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest.</u> Authorisation for activities within the regulated zone must be obtained.

The Zones of Regulation outlined in the table above are conceptually depicted in Figures 31 to 34 below.

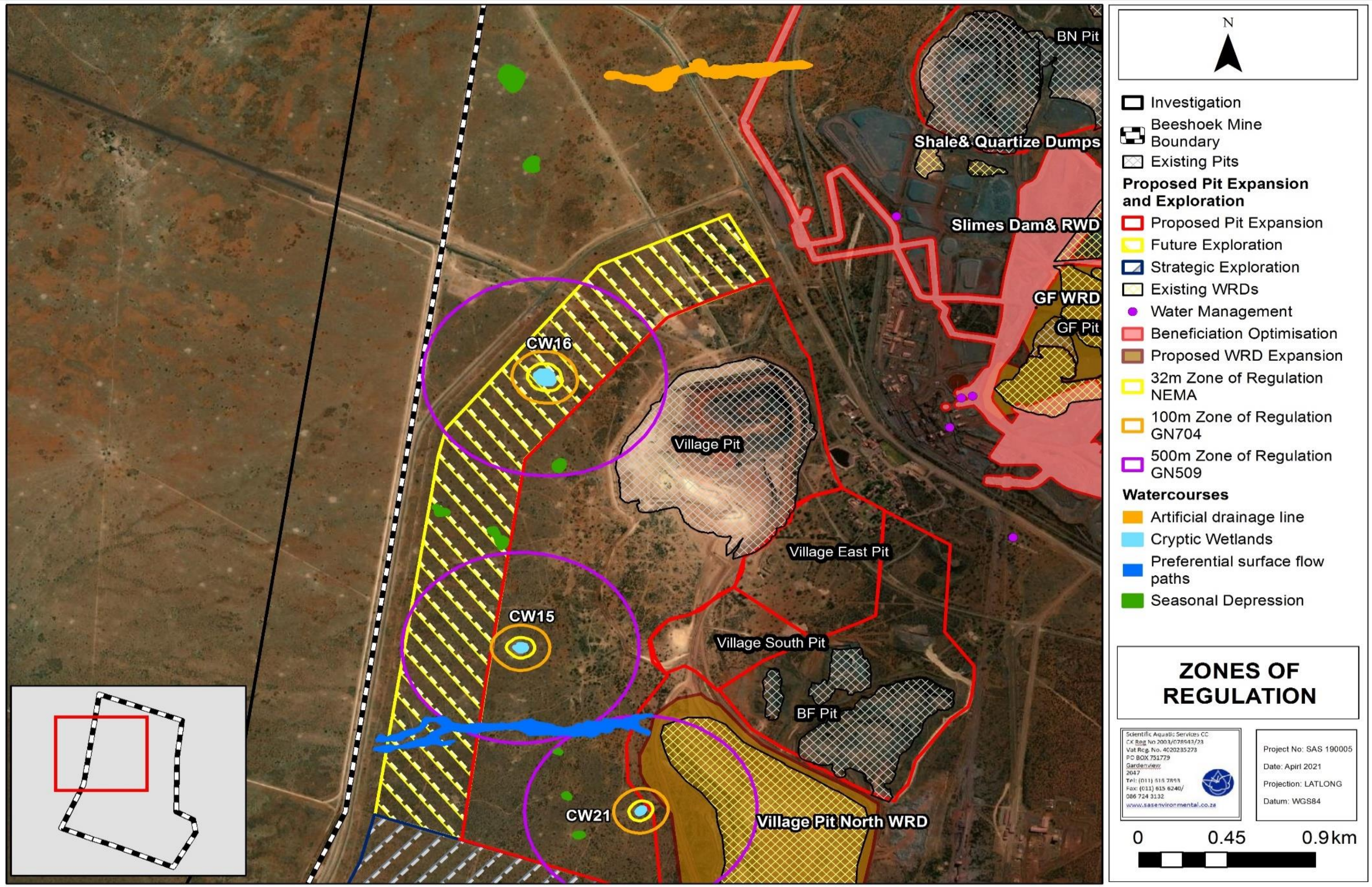


Figure 34: Conceptual presentation of the zones of regulation in terms of NEMA, GN704 and GN509 of 2016 as they relate to the NWA in relation to the cryptic wetlands located in the north-western portion of the Beeshoek Mine.

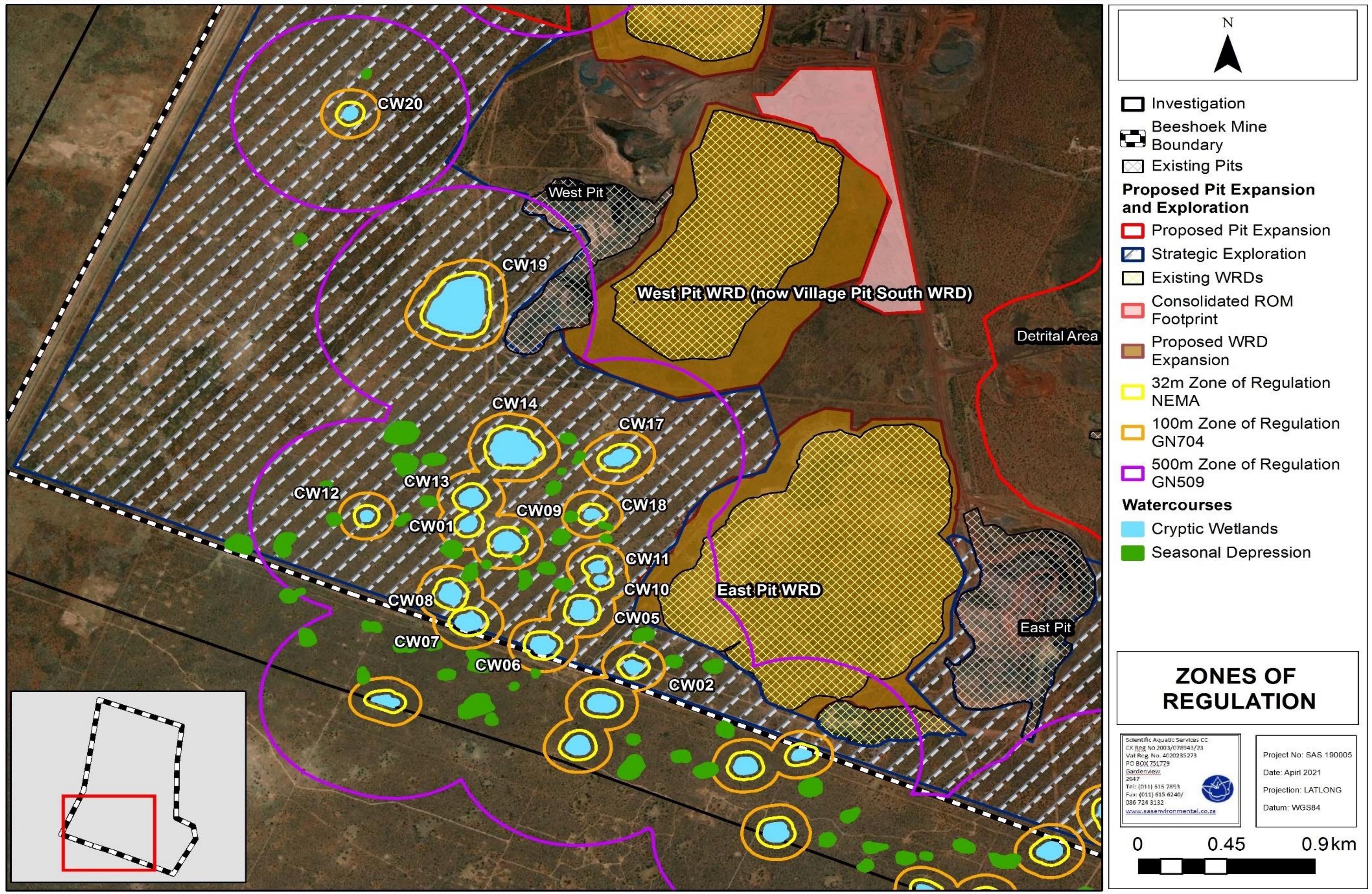


Figure 35: Conceptual presentation of the zones of regulation in terms of NEMA, GN704 and GN509 of 2016 as they relate to the NWA in relation to the cryptic wetlands located in the north-western portion of the Beeshoek Mine.

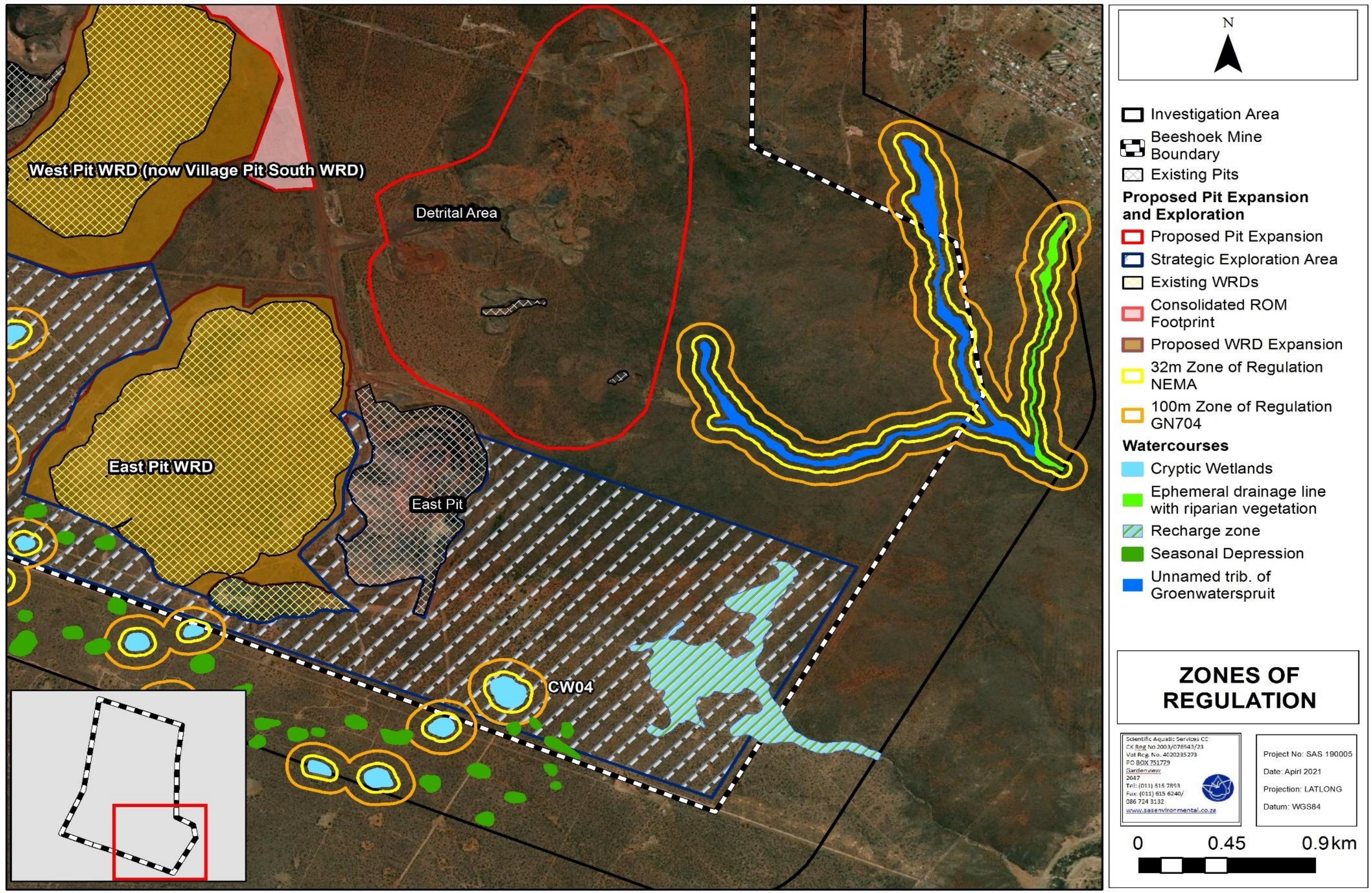


Figure 36: Conceptual presentation of the zones of regulation in terms of NEMA and GN704 as it relates to the NWA in relation to the cryptic wetlands and episodic drainage line located in the south eastern portion of the Beeshoek Mine.

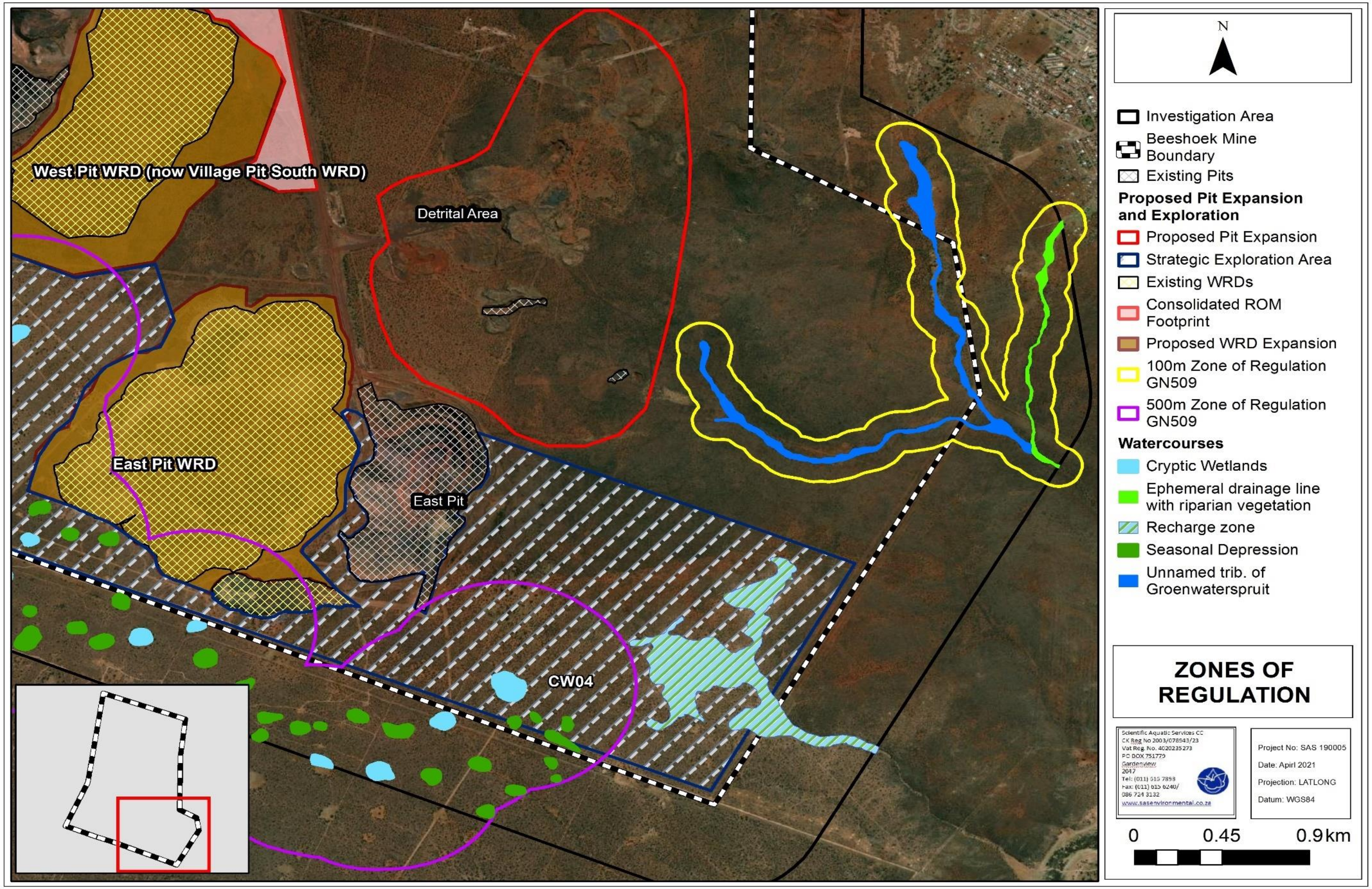


Figure 37: Conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA in relation to the cryptic wetlands and episodic drainage line located in the north-western portion of the Beeshoek Mine.

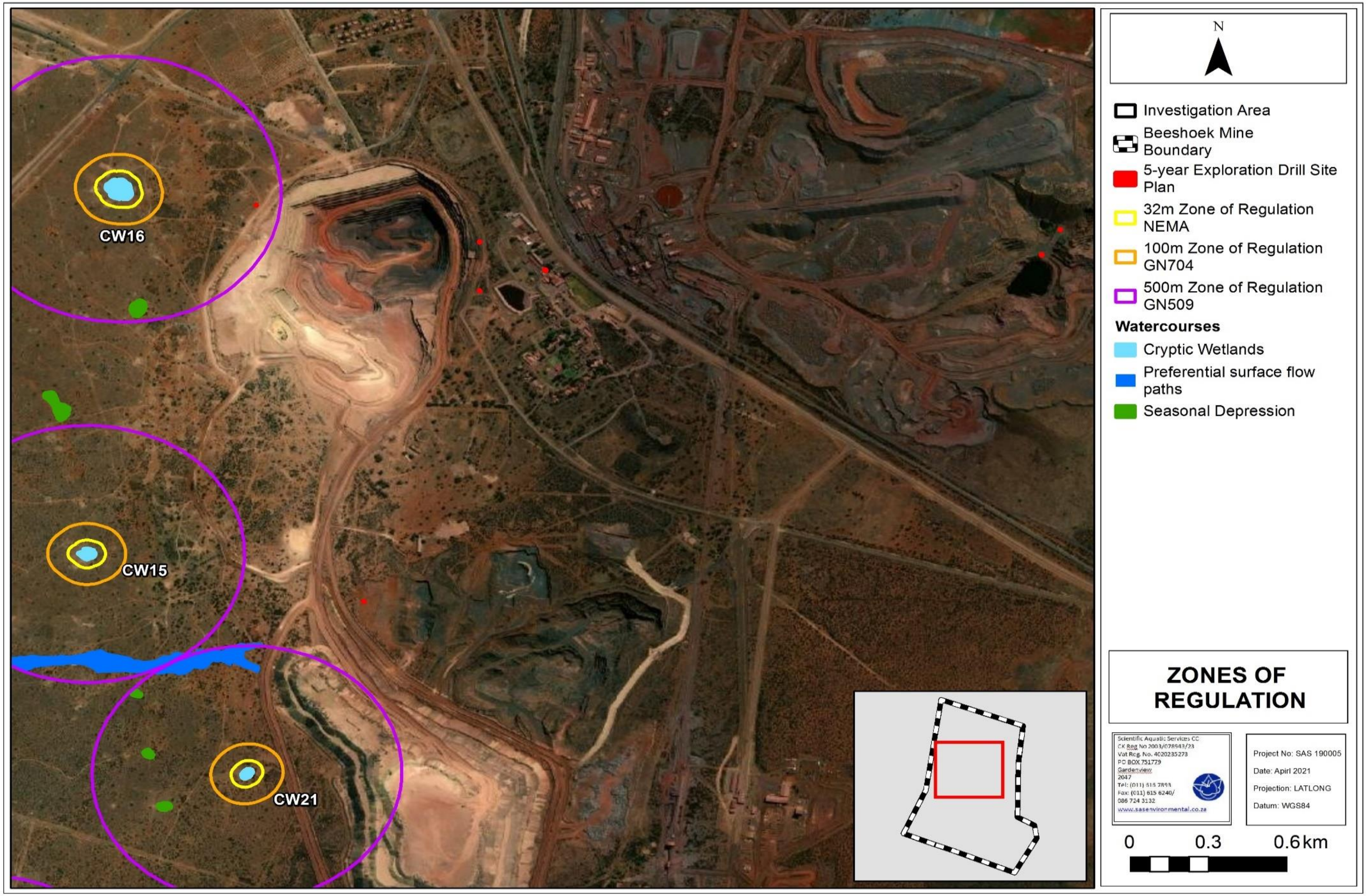


Figure 38: Conceptual presentation of the zones of regulation in terms of NEMA, GN509 of 2016 and GN704 as it relates to the NWA in relation to the cryptic wetlands located in the central portion of the Beeshoek Mine.

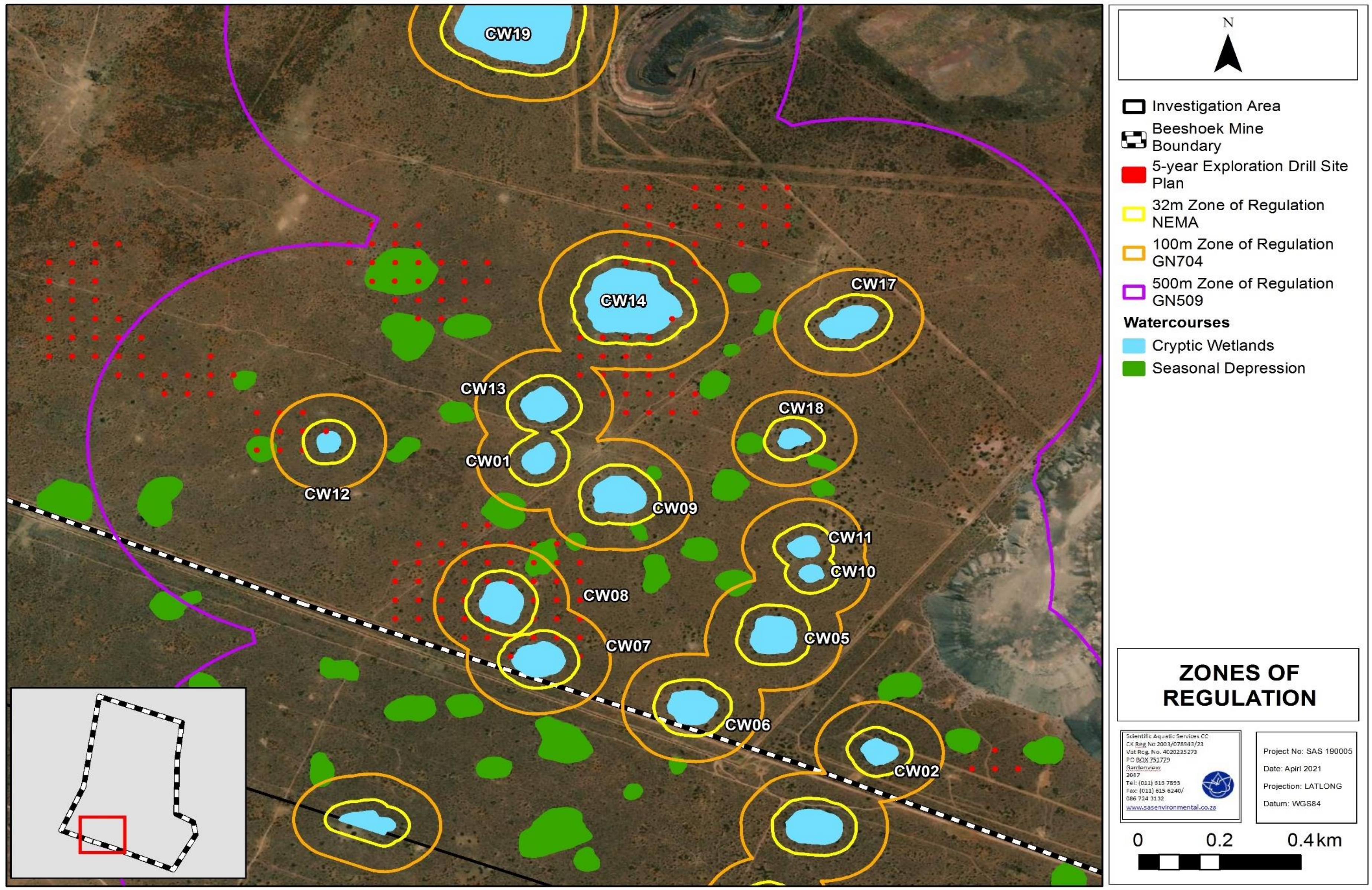


Figure 39: Conceptual presentation of the zones of regulation in terms of NEMA, GN509 of 2016 and GN704 as it relates to the NWA in relation to the cryptic wetlands located in the south-western portion of the Beeshoek Mine.

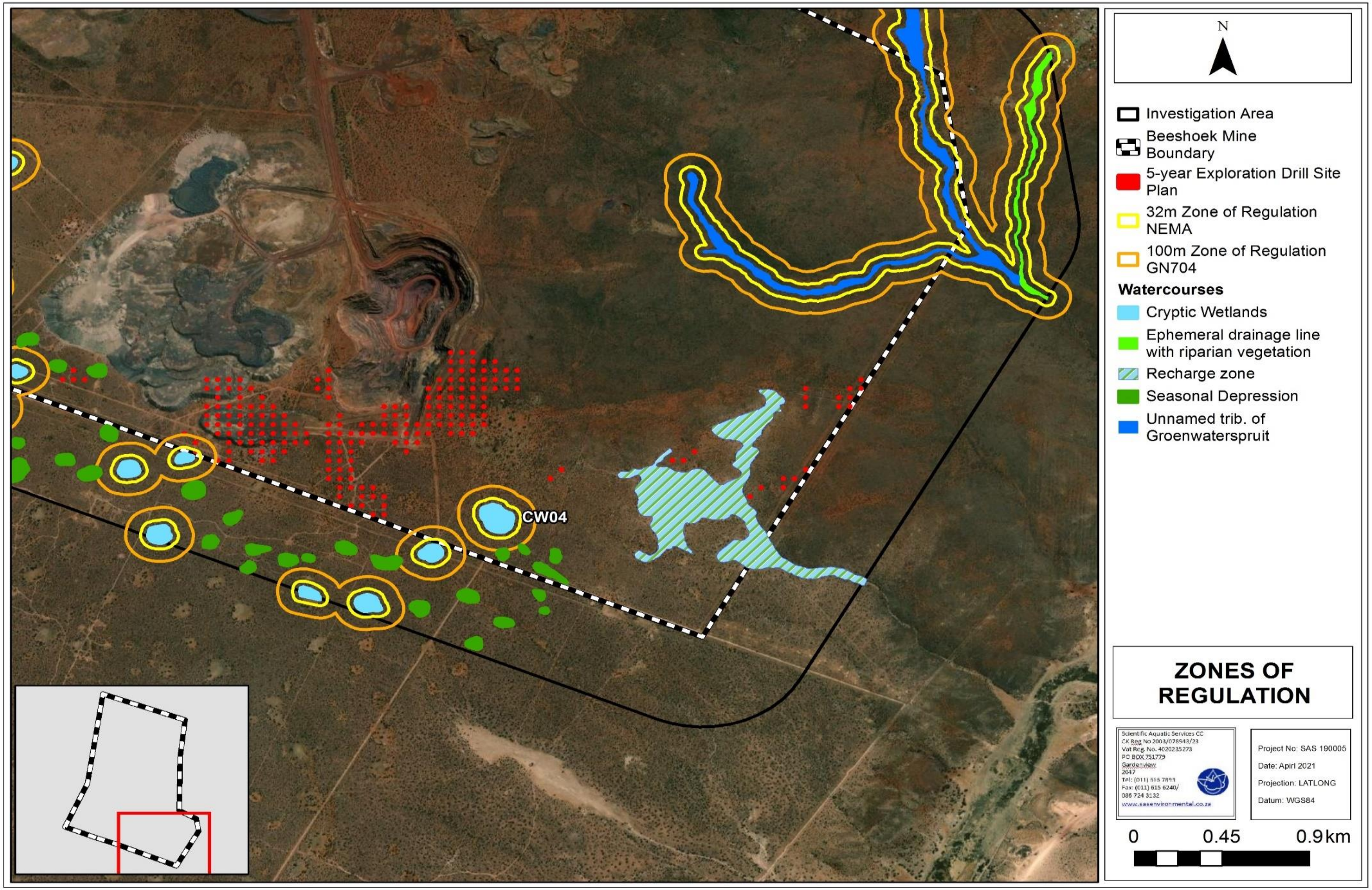


Figure 40: Conceptual presentation of the zones of regulation in terms of NEMA and GN704 as it relates to the NWA in relation to the cryptic wetlands and episodic drainage line located in the south-eastern portion of the Beeshoek Mine.

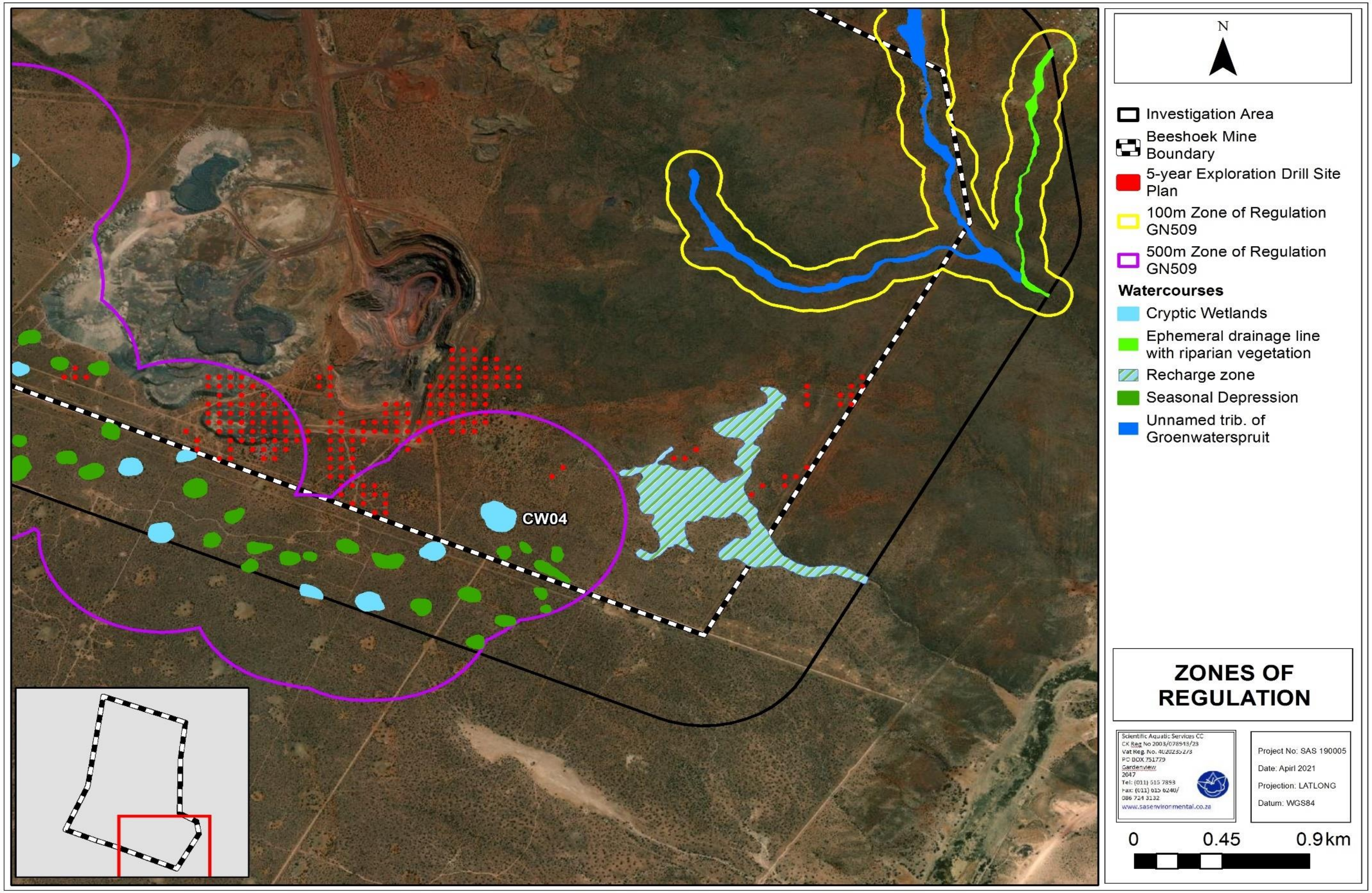


Figure 41: Conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA in relation to the cryptic wetlands and episodic drainage line located in the south-eastern portion of the Beeshoek Mine.

5 RISK ASSESSMENT

This section presents the significance of potential impacts on the cryptic wetlands associated with the proposed development. When evaluating the perceived impacts of the proposed activities on these features, the impact significance was ascertained based on the assumption that the recommended mitigation measures will be implemented, in order to reduce the impact significance. Thus, the risk assessment provided in this report presents the perceived impact significance *post-mitigation*.

5.1 Risk Analyses

5.1.1 Consideration of impacts and application of mitigation measures

The following aspects were taken into consideration when evaluating the potential impacts of the proposed development activities:

- The Risk Assessment was undertaken based on the proposed mining expansion footprint provided to the specialist in July 2021. This layout indicates that the proposed expansion of Village Pit will lead to the outright loss of two cryptic wetlands (CW15 and CW21), possible direct and indirect impacts to various cryptic wetlands as a result of the proposed exploration drilling activities, and possible indirect impacts to cryptic wetlands located south of the mine as well as to the unnamed tributary of the Groenwaterspruit;
- The Risk Assessment Matrix was only applied to proposed activities planned to occur outside existing mining areas, i.e. those activities likely to pose a risk to the identified watercourses. In this regard, the following project activities were assessed:
  - Project 2: Expansion of the Village Pit, West Pit and East Pit WRDs only. The expansion of the GF and HF WRDs will not affect the identified watercourses;
  - Project 3: Expansion of Village Pit, expansion of the detrital area, and exploration drilling within the proposed Future Strategic Exploration Block area (exploration activities within the proposed Village Pit Exploration Block were not assessed as target drill sites had not been ascertained by the proponent at the time of preparing this report). The expansion of Village East and Village South Pits, BF Pit, and GN Pit do not pose a risk to the receiving freshwater environment;
- Further to the above, activities associated with Projects 1, 4 and 5 were not assessed, as these projects will all occur within existing mining (i.e. disturbed) areas, and will therefore not pose a risk to the various watercourses;

- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA *et. al* (2013) would be followed, i.e. the impacts would first be avoided (as there are numerous CWs throughout the proposed expansion areas, this is unlikely to be fully achievable), minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- When applying the risk assessment, cognisance was taken of the semi-arid climate of the project area, thus risks associated with alteration of flow regime, stormwater runoff and so forth were scored accordingly;
- Most impacts are considered to be easily detectable; however, impacts such as surface water contamination would entail specific monitoring (when practical) to ascertain the occurrence of impacts; and
- Whilst rehabilitation of any indirect impacts to the cryptic wetlands located south of the mine as well as to the unnamed tributary of the Groenwaterspruit is deemed feasible, rehabilitation/restoration of those CWs directly within the proposed expansion footprints is not deemed viable due to the anticipated nature and extent of the impact, as well as due to the unique structure of the soil. Thus, it is recommended that the proponent make provision for rehabilitation of any edge effects which might affect watercourses affected by edge effects (although these may not be within the proponent's property), and that in consultation with the relevant authorities, implement appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent with regards to the loss of affected CWs within the Village Pit expansion footprint.

5.1.2 Impact discussion and essential mitigation measures

There are four key ecological impacts on the cryptic wetlands that are anticipated to occur namely:

- Loss of habitat and ecological structure;
- Changes to the sociocultural and service provision;
- Impacts on the hydrology and sediment balance of the cryptic wetlands; and
- Impacts on water quality.

Various activities and development aspects may lead to these impacts, however, provided that the mitigation hierarchy is followed, indirect impacts to adjacent watercourses can be avoided and/or minimised if avoidance is not feasible. The mitigation measures provided in this report have been developed with the mitigation hierarchy in mind, and the implementation and strict adherence to these measures will assist in minimising the significance of impacts on the receiving environment.

A summary of the risk assessment is provided in the table below, followed by a discussion of the outcome thereof.

Table 8: Summary of the results of the risk assessment applied to the cryptic wetlands associated with the proposed development activities.

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
Perceived Impacts: Expansion of Village Pit WRD, West Pit WRD and East Pit WRD										
1	**Construction**	*Clearing and levelling of land for the expansion of the Village Pit WRD within 100 m of CW 21, for expansion of West Pit WRD within 380 m of CW17 and for expansion of East Pit WRD within 150 m - 225 m of CWs 2, 10 and 11. *Removal of topsoil from WRD expansion areas, and stockpiling thereof for rehabilitation.	*Clearing of vegetation / levelling of soil, and creation of temporary topsoil stockpiles. *Earthworks, creating potential sources of sediment, which may be transported via wind to the various CWs. *Altered topography, leading to altered runoff patterns and potential formation of preferential surface flow paths. *Potential loss of catchment yield (*considered very low risk due to semi-arid climate).	*Exposure of soil, leading to increased runoff, erosion and wind-borne sediment, and thus potential increased sedimentation of the CWs; *Increased sedimentation of CW habitat, leading to smothering of flora and benthic biota and potentially altering surface water quality when water is present; *Decreased ecoservice provision; and *Proliferation of alien vegetation or encroacher species as a result of disturbances.	**1,5**	**4,5**	**12**	**54**	**L**	*Soil must not be exposed for longer than is necessary. *Construction-related waste must not be stored on site, and must be removed and disposed of in accordance with existing approved Beeshoek waste management policies.
2		*Construction of clean and dirty water separation systems around the downgradient boundaries of the respective WRDs to direct clean stormwater run-off around and away from the WRD.			**1,5**	**4,5**	**12**	**54**	**L**	
Perceived impacts: Expansion of Village Pit										
3	**Construction**	Site clearing prior to commencement of construction activities related to the open pit expansion area, including placement of contractor laydown areas and storage facilities.	*Vehicular movement and access to the site. *Removal of vegetation and associated disturbances (rubble and litter) to soil and CWs 15 and 21. *Movement of construction equipment through the CWs.	*Direct loss of CW habitat, specifically CWs 15 and 21; *Damage to or direct loss of vegetation, leading to exposure and compaction of soil, in turn leading to increased risk of wind erosion and wind-borne sediment reaching surrounding CWs; *Increased sedimentation of the surrounding CWs may lead to changes to habitat, potentially altered surface water quality, smothering of vegetation and/or altered vegetation composition and altered macroinvertebrate assemblages (if present in the affected CWs); *Decreased ecoservice provision; *Decreased ability to support biodiversity;	**5**	**8**	**11**	**88**	**M**	*The catchments of all identified watercourses must be determined by a suitably qualified specialist, and as far as feasible, no activities must be permitted within the delineated catchments; *Contractor laydown areas, and material storage facilities to remain outside of the CWs located beyond the extent of the planned Pit expansion; *All vehicle re-fuelling is to take place outside of the outside of the CWs located beyond the extent of the planned Pit expansion; *All clean and Dirty Water separation areas are to be developed first prior to

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
				and *Proliferation of alien vegetation as a result of disturbances.						any other major earthworks to reduce risk of erosion and sedimentation; *All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential; *Retain as much indigenous vegetation as possible; and *The watercourse areas and their associated catchments beyond the proposed footprint of expansion should be clearly demarcated with danger tape and areas in which no activities are proposed should be marked as a no-go areas.
4		Surface impact during blasting and initial removal of overburden.	*Altered water quality of adjacent CWs (to the south) as a result of wind-borne sediments, nitrates from blasting and so forth. *Increased sedimentation and erosion resulting from altered run-off patterns or wind-borne transportation to adjacent CWs may have a negative impact on geomorphological processes, habitat and/or biota.		5	9	12	108	M	*During construction, the topsoil should be removed up to the depth determined by the specialist soil and land capability assessment (ZRC, 2021) and be carefully stockpiled, for use during rehabilitation, away from any CWs beyond the footprint of the expansion and their catchments; *Excavated materials should not be contaminated and it should be ensured that the minimum surface area is taken up. The stockpiles may not exceed 2m in height; *All exposed topsoil must be protected for the duration of the construction phase in order to prevent erosion and further sedimentation of the reach of the watercourses proximal to these stockpiles.
Perceived Impacts: Future Strategic Exploration Block (Exploration Drilling)										
5		Proposed exploration drilling:	Site clearing, removal of vegetation and associated disturbances to soils.		1	4	13			

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
6		Clearing of vegetation and site preparation adjacent to, and within the catchments of cryptic wetlands associated with each drill site.	*Altered drainage patterns due to reduced vegetation cover and increased impermeable surfaces; *Risk of contaminated storm water runoff (e.g. hydrocarbons, sediment, originating from impermeable surfaces) entering the cryptic wetlands.	*Potential direct loss of cryptic wetland habitat (where drill sites encroach on delineated boundary thereof); *Increased hardened surfaces within the catchment of various cryptic wetlands and compacted soils thus reducing integrity of interflow. *Localised landscape alterations within the catchment of affected cryptic wetlands, potentially leading to loss of recharge as surface water is directed away from CWs, and/or formation of preferential surface flow paths leading to erosion; *Increased surface water runoff, leading to erosion, and sedimentation of freshwater resource habitat. *Loss of foraging and breeding habitat within the catchment of cryptic wetlands for wetland-dependent fauna. *Proliferation of alien vegetation as a result of disturbances.	1.25	4.25	13	52	L	* Ensure that drill rig and laydown area footprint does not encroach on cryptic wetland habitats and that vegetation clearing is limited to essential areas only; * Ensure soil management programme is implemented and maintained to minimise erosion and sedimentation; * Active re-vegetation of disturbed areas immediately after drilling is completed; * Vegetation covers on all topsoil stockpiles; * Implement and maintain alien vegetation management programme.
			Stockpiling of topsoil, earthworks, movement of vehicles within delineated cryptic wetlands and their catchments	*Increased water inputs to cryptic wetlands in the vicinity of drill pad;. *Possible contamination of surface water runoff from drill pads; *Possible erosion/incision of the cryptic wetlands adjacent to drill pads due to concentration of storm water runoff.	1	4	11	55.25	L	* Limit clearing of vegetation to what is absolutely essential in order to retain as much vegetation cover as possible; * Implement and maintain soil management programme to minimise risk of erosion.
			Potential disposal of hazardous and non-hazardous materials in cryptic wetlands (although highly unlikely).	*Altered water quality, possible changes to flow patterns as a result of blockages caused by solid waste/rubble; *Possible damage to or smothering of macroinvertebrate egg banks, leading to impacts on macroinvertebrate and faunal assemblages.	1	4	8	32	L	* No waste materials are permitted to be disposed of within any cryptic wetland habitat, and all waste materials must be disposed of at an appropriate disposal facility. * All cryptic wetland habitats in the vicinity of the drill rig footprint are to be designated "No Go" areas and off-limits to all personnel and vehicles.

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
		Removal of topsoil from drill sites, and stockpiling thereof for rehabilitation	*Topsoil removal; *Creation of temporary stockpiles.	Increased risk of transportation of sediment from exposed soils in wind or storm water runoff, leading to increased turbidity of surface water, sedimentation of cryptic wetlands, smothering of vegetation and/or altered vegetation composition and smothering of macroinvertebrate egg banks.	1.75	4.75	8	38	L	* No stockpiles may be placed within the cryptic wetlands; * Temporary stockpiles must be protected by means of suitable geotextiles such as hessian sheeting, silt curtains, sandbags etc. to prevent contamination of runoff and sedimentation of cryptic wetlands in the vicinity of the drill rigs; * Immediate vegetation of all stockpiles which are to remain on site post-construction.
Perceived Impacts: Detrital Area Expansion										
7		Expansion of existing detrital area to the south and east of the current location	*Clearing of vegetation / levelling of soil, and creation of temporary topsoil stockpiles. *Earthworks, creating potential sources of sediment, which may be transported via wind to the episodic drainage line (unnamed tributary of the Groenwaterspruit). *Altered topography, leading to altered runoff patterns and potential formation of preferential surface flow paths. *Potential loss of catchment yield to the episodic drainage line (*considered very low risk due to semi-arid climate).	*Sediment-laden runoff or wind-borne sediment entering riparian habitat leading to altered water quality, and changes to aquatic habitat; and *Altered drainage/flow regimes, leading to altered runoff patterns and formation of preferential flow paths, leading to further erosion.	1	5	6	30	L	As per Activities 1 and 2.
OPERATIONAL PHASE IMPACTS										
Perceived Impacts: Expansion of Village Pit WRD, West Pit WRD and East Pit WRD										
8	Operational phase	Seepage and runoff from WRDs	*Increased risk of pollution of groundwater, potentially leading to the formation of a contaminated	*Possible contamination of surface and ground water, leading to impaired water quality and salinations of soil (CWs are not driven by groundwater; risk is therefore considered negligible); and	1	4	8	32	L	*Water to be collected by means of stormwater trenches/berms, and recycled and utilised within the Beeshoek water circuit, or pumped to a Pollution Control facility for evaporation.

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
			groundwater plume, which may migrate downgradient of the WRD, thus possibly affecting the downgradient CWs. *Increased risk of sediment transport in surface runoff (low risk due to climate) or via wind from the WRD to CWs, leading to altered water quality and sedimentation of CWs.	*Sedimentation of CWs could lead to altered water quality, altered vegetation community composition and smothering of macroinvertebrate taxa and/or their egg banks.						*Pollution prevention through infrastructure design, in order to prevent, eliminate and/or control the potential groundwater pollution plume; *Implement monitoring programme to detect and determine the formation and/or extent of any potential groundwater pollution plume as per an approved groundwater management plan.
9		Alteration of the hydrological characteristics of the local catchment due to the deposition of the waste rock.	Altered drainage patterns, potentially leading to the formation of preferential flow paths and/or concentrated flows.	*Potential erosion of terrestrial areas as preferential flow paths are formed in the landscape; *Altered runoff peaks leading to changes in the pattern, flow and timing of water in the landscape.	1	3	10	30	L	*Clean and dirty water management must take place in order to prevent contaminated runoff from the WRD creating preferential flow paths which may reach downgradient CWs. *Monitoring of erosion must take place throughout the life of mine, in order to prevent the formation of erosion gullies as a result of altered flow paths, and the possible sedimentation of the receiving freshwater environment.
10		Presence of clean and dirty separation infrastructure around downgradient areas of WRDs	Loss of catchment yield due to stormwater containment	*Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to sedimentation of the downgradient CWs; *Reduction in volume of water entering the CWs, potentially impacting vegetation and macroinvertebrate communities.	1	3	10	30	L	*Determination of the loss of catchment yield did not form part of the scope of this study, however, due to the semi-arid climate and high evaporation rates of the region, loss of catchment yield is expected to be negligible.
Perceived impacts: Expansion of Village Pit										
11	**Operational phase**	Operation of expanded Village Pit, including monitoring of sump in open pit and dewatering pipeline, and repairs if necessary	*Removal of topsoil and overburden; *Potential stockpiling of overburden ; *Transport of ore to processing plant.	*Complete loss of CWs 15 and 21; *Increased risk of sediment transport in surface runoff or via wind from the overburden stockpile into neighbouring CWs, leading to altered water quality, altered vegetation community composition and potentially smothering biota and/or affecting egg banks; and *Increased risk of erosion, leading to further	5	9	10	90	M	*Pollution prevention through appropriate management and monitoring of pollution prevention systems, with specific mention of the management of clean and dirty water separation systems, in order to prevent, eliminate and/or control potential pollution of soils, groundwater and surface water must be implemented;

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
				altered topography/geomorphology, in turn resulting in altered runoff patterns and formation of preferential flow paths.						*Include in the existing monitoring programme to detect and prevent the pollution of soils, surface water and groundwater; and *If possible, the overburden stockpiles must not be located within the catchments of the identified watercourses and should be located in an area where they will not impact on any hydrological features of increased importance within the study area, nor on those within the greater MRA, and outside the 100m GN704 Zone of Regulation associated with any freshwater resources within the MRA.
12			*Blasting/mining activities in order to remove overburden and to extract the ore; *Removal of ore and overburden from the open cast pits.	*Nitrates from blasting leading to potential eutrophication of the receiving environment and resulting in impairment of water quality within the catchment; *Complete loss of the CWs within the Village Pit expansion area.	5	9	10	90	M	*In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA et al. (2013) would be followed, i.e. impacts would first be avoided. As the proposed expansion of the Village Pit will result in the irreversible impacts on three CWs, this is not feasible. *Reduce airborne dust during blasting activities through damping dust generation areas with water (although not in sufficient quantities to generate runoff).

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
13			*Potential decant from the open pit; *Potential creation of a cone of depression; and *Dewatering of the opencast area via means of pumping.	*Increased risk of pollution of surface water resulting from decant from the open pit; *Risk of formation of a cone of depression along the open cast area; *Risk of leaks along the dewatering pipeline, potentially leading to contamination of ground and surface water, contamination of soil, and formation of preferential flow paths if not attended to.	1	4	9	36	L	*If decant will occur, all water is to be treated to background water quality values prior to release into the receiving environment; *Measures to contain and reuse as much water as possible within the mine process water system must be sought, and very strict control of water consumption must take place. Detailed monitoring must be implemented and maintained to ensure that all water usage is continuously optimised; *The pipeline must be regularly inspected for leaks. Should any leaks be detected, pumping of water to the PCD must be stopped immediately whilst the leak is repaired; and *In the event of any leaks/spills, all possible steps are to be taken to prevent the pollution of the receiving freshwater environment and the surrounding environment during repair.
Perceived Impacts: Future Strategic Exploration Block (Exploration Drilling)										
14	Operational phase	Operation of drill rigs	Increased risk of pollution of surface water resulting from spills (hydrocarbons) from drill rigs.	*Possible contamination of surface water (if present during operations), leading to impaired water quality and salination of soils within cryptic wetlands. *Sedimentation of cryptic wetlands could lead to altered water quality, altered vegetation community composition, smothering of macroinvertebrate egg banks.	1	4	13	52	L	* Drilling must not take place within the delineated boundaries of cryptic wetlands or their associated catchments, which must be determined by a suitably qualified specialist; * Operation of drill rigs must preferably only take place during the dry winter period in order to minimise the risk of sedimentation;
15			Increased risk of sediment transport due to movement of drill rigs and activities within freshwater resources, leading to altered water quality and sedimentation of freshwater system.		1	4	13	52	L	

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
16		Alteration of the hydrological characteristics of the cryptic wetlands due to disturbances directly within the delineated boundaries of the CWs and/or their respective catchments.	Altered drainage patterns, potentially leading to the formation of preferential flow paths and/or concentrated flows	*Potential for erosion and sedimentation of cryptic wetlands, leading to altered vegetation community composition and smothering of biota. *Altered runoff peaks leading to changes in the hydrological regime of the cryptic wetlands.	1	4	13	52	L	* A spill prevention and emergency spill response plan should be compiled to guide the drilling works; and an emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur.
Perceived Impacts: Detrital Area Expansion										
17	**Operational phase**	Mining of ore (where economically viable) from the detrital area	*Altered water quality of the downgradient episodic drainage line as a result of wind-borne sediments; *Increased sedimentation and erosion resulting from altered run-off patterns or wind-borne transportation to downgradient episodic drainage line may have a negative impact on geomorphological processes, habitat and/or biota.	*Damage to or outright loss of vegetation, leading to exposure and compaction of soil, in turn leading to increased risk of wind erosion and wind-borne sediment reaching downgradient episodic drainage line; *Increased sedimentation of the episodic drainage line may lead to changes to habitat, potentially altered surface water quality, smothering of vegetation and/or altered vegetation composition;; *Decreased ecoservice provision; *Decreased ability to support biodiversity; and *Proliferation of alien vegetation as a result of disturbances.	1	4	6	24	L	*Retain as much indigenous vegetation as possible as this will aid in preventing runoff from reaching the episodic drainage line; *Reduce airborne dust during mining activities through damping dust generation areas with water (although not in sufficient quantities to generate runoff).

Four aspects of freshwater ecology are considered when assessing the impacts of the proposed mining activities: loss of habitat and ecological structure, changes to ecological and sociocultural service provision, hydrological function and sediment balance, and water quality impacts.

The cryptic wetlands identified in the study area and specifically within the proposed project footprint are deemed to be in a natural to largely natural condition, since few discernible impacts have occurred. Although not necessarily important for the provision of ecological services such as flood attenuation, these systems are deemed important for biodiversity maintenance, and may potentially provide important breeding and foraging habitat for various fauna, as well as potentially providing habitat for floral SCC. The proposed expansion of the Village Pit will lead to irreversible impacts to two cryptic wetlands (CW15 and CW21) should it proceed. Restoration of these cryptic wetlands will not be practical nor viable, therefore the proponent must engage with the relevant authorities to implement appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent with regards to the outright loss of the affected CWs. It is worth nothing that should the exploration drilling within the Future Strategic Exploration Block latterly translate to open cast mining, several other CWs could, potentially, be mined out. Due consideration must be given to this possibility during future planning phases, to ensure that mutually acceptable outcomes (to both the relevant authority and the proponent) can be planned for and implemented accordingly.

All other CWs within the MRA are likely to be indirectly impacted, which may lead to cumulative impacts on the freshwater ecology of the area and as such, mitigation measures must be implemented to minimise potential risks and long-term alterations to the cryptic wetlands.

Adherence to all mitigation measures provided in this report will aid in reducing the risk significance of most anticipated indirect impacts arising from the expansion of the WRDs and detrital area. Assuming that a high level of mitigation takes place, the anticipated impact significance of the proposed development activities ranges from ‘low’ to ‘moderate’ throughout the construction and operational phases although due to the impact of habitat loss only occurring once, the significance of impacts relating to the proposed expansion of Village Pit is understated. Decommissioning activities are considered similar in nature and impact significance to those during the construction and operations phases although these activities were not assessed.

5.2 Possible Latent Impacts

Even with extensive mitigation, latent impacts on the receiving freshwater environment are deemed highly likely. The following points highlight the key latent impacts that have been identified:

- Reduced availability of refugia for aquatic and wetland biota;
- Loss of wetland habitat and biodiversity representation;
- Altered wetland habitat with specific mention of increased abundance and diversity of alien invasive and encroacher species;
- Loss of sensitive species (e.g. species in the Order Anostraca); and
- Loss of surface water resources, which is considered of increased importance in the context of the semi-arid climate of the region.

5.3 Cumulative Impact Statement

Freshwater ecosystems in semi-arid zones are generally under-researched, and particularly in the Northern Cape are under increased pressure of development, particularly mining activities. The absence of research has historically led to the ecological importance and sensitivity of these systems being unrecognised, and therefore under-valued. “Cryptic” or temporary wetlands such as those found within the Beeshoek Mine boundary are amongst the most neglected and threatened ecosystems in South Africa (Davies and Day, 1998). Literature pertaining to the potential losses of such freshwater ecosystems is scarce, and as a result, accurate indications of potential loss of such ecosystems could not be determined at the time of this investigation. Nevertheless, further loss of, or irreversible modifications to freshwater ecosystems generally is recognised globally as being cause for concern.

Whilst the proposed Beeshoek Mine expansion activities may only result in localised direct impacts, the cumulative impacts associated with future mining activities in the Postmasburg area, should such projects come to fruition, may have a regional and potentially provincial influence on freshwater ecosystems and representativity conservation, in turn impacting on floral and faunal assemblages and distributions thereof.

5.4 Options Analysis

This section serves to provide an analysis on various options (or recommendations for layout alternatives) pertaining to **Project 3: Increase of Opencast footprint areas**, with specific focus on the *Future Strategic Exploration Block Area*.

Based on the outcome of the risk assessment (Section 5.1), there is some potential for significant residual impact on specialised habitat, i.e. the Cryptic Wetlands. Whilst other features such as the recharge zone and seasonal depressions are not considered watercourses from an ecological (or possibly legal) perspective, they nevertheless provide niche habitat and connectivity between the surrounding terrestrial and wetland habitats. The recharge zone is also likely to be important for the ongoing functioning of an unnamed tributary of the Groenwaterspruit. Loss of biodiversity and species extinction is linked to ongoing habitat loss and fragmentation globally (Mullu, 2016), although some positive effects of habitat fragmentation (versus outright loss) may occur, such as increased species richness. Nevertheless, habitat loss remains the largest single threat to biodiversity (Mullu, 2016). The proposed expansion, with specific mention of some aspects of Project 3, has the potential to result in the outright loss of unique and specialised habitat which potentially cannot be recreated or adequately offset. However, a reassessment of the mine plan may allow for the economic extraction of the ore whilst simultaneously conserving important habitat and reducing Beeshoek Mine's closure liability and rehabilitation requirements.

Three options were analysed to highlight key impacts on freshwater ecology:

- Option / Scenario A: Mining without rehabilitation: This will result in the permanent transformation of the receiving environment;
- Option / Scenario B: Mining with concurrent rehabilitation. To reduce rehabilitation effort, time, and costs down the line, this option will aim to implement concurrent rehabilitation as and when sites become available. Rehabilitation *per se* may not be viable from a freshwater ecosystem perspective but the creation of similar habitat to that loss, or potential offset opportunities, may be investigated by the mine, with the intention of implementing creation / offset initiatives in non-mining areas whilst mining is still active;
- Option / Scenario C: Avoidance and implementation of an ecological corridor, in conjunction with Kolomela Mine. This option will aim to ensure a pre-defined corridor or buffer zone will be set aside for no mining development to take place on. This option is a smart approach to ensuring ecological processes can continue concurrently with the mining processes. Concurrent rehabilitation of impacted sites is still a key aspect of this option, and potentially may include creation of cryptic wetland habitat to compensate for the loss thereof in areas which will be mined out.

The table below breaks down the options analyses to guide the mine in their decision-making process.

Table 9: Options Analyses for the proposed Future Opencast Pit Area.

<table>
<tr><th colspan="3">Option / Scenario A: Mining without rehabilitation</th></tr>
<tr><th>Impact Scale and Description</th><th colspan="2">Contribution</th></tr>
<tr><td rowspan="4">Significant.
• Broad-scale impacts on freshwater ecology anticipated.
• Permanent loss of watercourse habitat (cryptic wetlands) and significant biodiversity features (cryptic wetlands, seasonal depressions and the recharge zone).
• Permanent loss of faunal breeding and foraging habitat, particularly for migratory avifaunal species dependent on the seasonal availability of water in the cryptic wetlands.
• Potential loss of important aquatic macroinvertebrate populations found almost exclusively in temporary wetlands such as the cryptic wetlands (e.g. Anostrocada).
• Conclusive contribution towards an increase in the threat status of an under-researched wetland type in the region.</td><td>Impacts beyond the local-scale</td><td>High</td></tr>
<tr><td>Habitat Fragmentation</td><td>Permanent</td></tr>
<tr><td>Rehabilitation Costs</td><td>Negligible</td></tr>
<tr><td>Conservation of SCC and endemic vegetation types</td><td>Low - Negligible</td></tr>
<tr><th colspan="3">Option / Scenario B: Mining with concurrent rehabilitation</th></tr>
<tr><th>Impact Scale and Description</th><th colspan="2">Contribution</th></tr>
<tr><td rowspan="4">Significant.
• Localised loss of cryptic wetland habitat which may be significant on a regional scale in terms of contribution to cumulative impacts.
• Permanent loss of watercourse habitat (cryptic wetlands) and significant biodiversity features (cryptic wetlands, seasonal depressions and the recharge zone). Even with the implementation of concurrent rehabilitation, once these features have been mined out or significantly impacted in other ways (e.g. loss of egg banks due to smothering by sediment), restoration/creation thereof in the original localities is unlikely to be feasible or financially viable, given the disturbance to the underlying geology. Impacts are therefore expected to be at best, long-term, but most likely permanent in the mined areas. Viability and feasibility of the creation of the cryptic wetland habitat, or an offset initiative, in non-mining areas will need to be investigated extensively.
• Long-term or potentially permanent loss of populations of aquatic macroinvertebrates, unless egg banks can be successfully removed from cryptic wetlands and relocated to naturally occurring or created cryptic wetland habitat.</td><td>Impacts beyond the local-scale</td><td>Medium</td></tr>
<tr><td>Habitat Fragmentation</td><td>Long-term, potentially permanent</td></tr>
<tr><td>Rehabilitation Costs</td><td>Medium - High</td></tr>
<tr><td>Conservation of SCC</td><td>Low-Medium</td></tr>
<tr><th colspan="3">Option / Scenario C: Avoidance and implementation of an ecological corridor</th></tr>
<tr><th>Impact Scale and Description</th><th colspan="2">Contribution</th></tr>
<tr><td>Medium.
• Local-scale, edge effect impacts. Possible regional scale impacts depending on the number of cryptic wetlands outside of the ecological buffer which are irreversibly impacted.
• Avoidance of several key cryptic wetlands is feasible by implementing an ecological corridor, thus reducing the mine's overall rehabilitation and closure liability requirements.
• Permanent loss and habitat fragmentation of some cryptic wetland habitat is nevertheless anticipated.
• Conservation of populations of aquatic macroinvertebrates, in turn supporting faunal populations which are dependent (even seasonally) on those as a food source.
• The ecological corridor may be suitable for the creation of cryptic wetlands, to compensate for the loss of those which will be mined out.
• Reduced fragmentation of landscapes. The ecological corridor will promote the movement of fauna through the Beeshoek Surface Rights Area and consequently allow for continuation of dispersal of floral species reliant on fauna for dispersal, including flora associated with the cryptic wetlands.</td><td>Impacts beyond the local-scale</td><td>Low</td></tr>
</table>

The potential permanent loss or irreversible alteration of ecological functioning of cryptic wetlands as well as other significant biodiversity features such as the seasonal depressions and recharge zone is significant not only from a wetland conservation perspective, but also from the perspective of faunal movement patterns and floral distributions. Migratory patterns of certain avifaunal species are dictated by the availability of water in temporary (i.e. cryptic) wetlands for example, whilst the occurrence of certain floral species is limited to the cryptic wetlands. Dispersal of such floral species may be reliant on faunal utilisation of the cryptic wetlands, thus, it is strongly recommended that Option / Scenario C be considered by the mine in order to contribute to the ongoing ecological functioning on a local and provincial (potentially even regional) scale. Furthermore, retaining an ecological corridor is likely to have a financial benefit to the mine, as rehabilitation and closure liability will be reduced, as well as minimising the potential offset liability for cryptic wetland habitat lost due to open cast mining. The proposed ecological corridor is depicted in the figure below. It must be noted that the proposed ecological corridor presented herein is conceptual, and subject to amendment based on the delineation of the catchments of the individual cryptic wetlands within the corridor, as well as refinement of aspects such as the proposed exploration drilling and possibly of open cast mining areas.

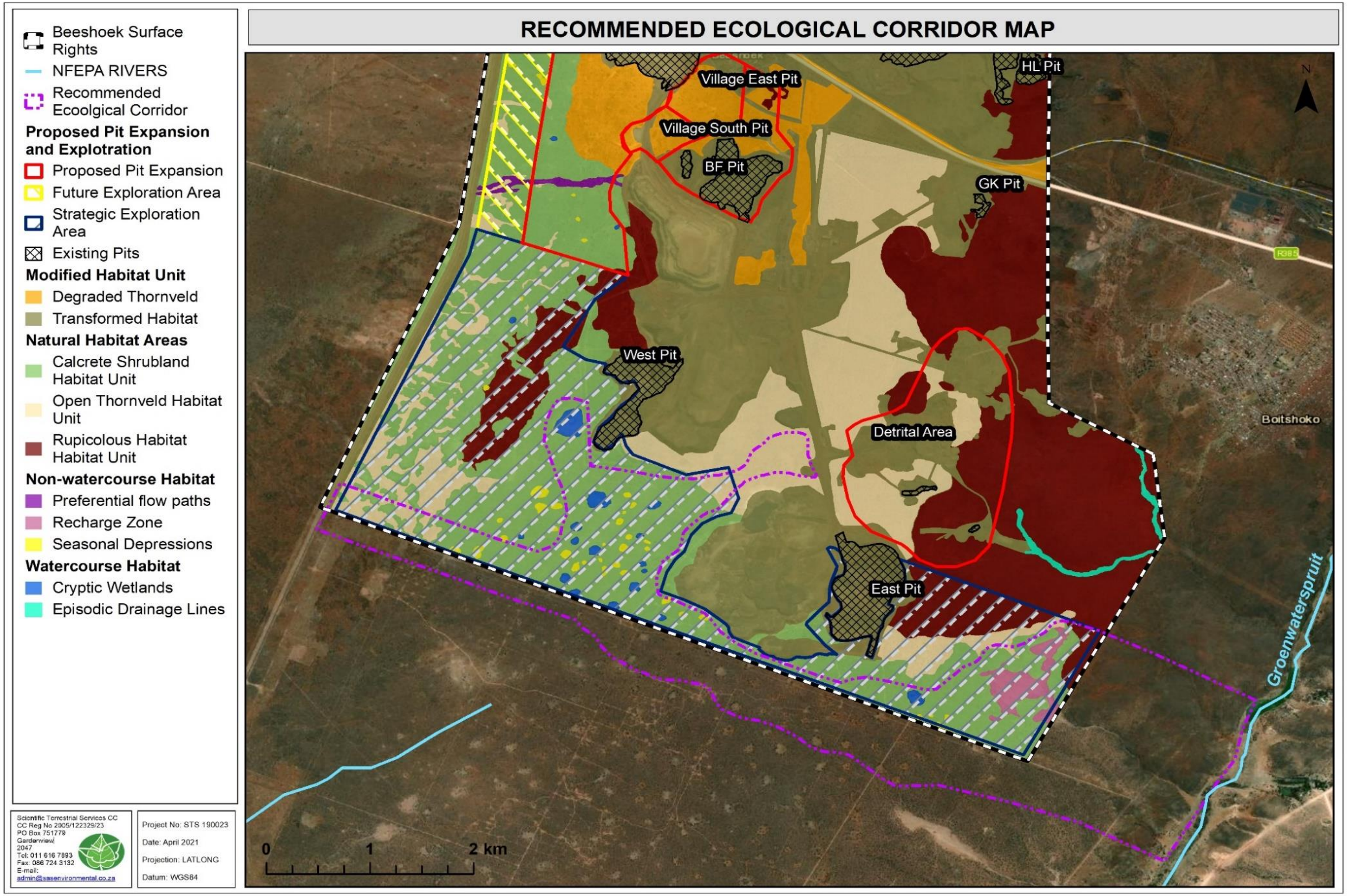


Figure 42: Conceptual presentation of the proposed ecological corridor.

6 CONCLUSION

A total of 21 cryptic wetlands and one episodic drainage line with a weakly defined riparian zone were identified and classified as watercourses, along with numerous seasonal depressions, preferential flow paths and a “recharge zone” associated with a small unnamed tributary of the Groenwaterspruit, which do not meet the definition of a watercourse from an ecological perspective.

The results of the ecological assessment indicated that the cryptic wetlands are in a largely natural to moderately modified ecological state, with few impacts on hydraulic and geomorphological processes. Vegetation has been impacted as a result of grazing pressure. Due to this and the natural semi-arid climatic conditions, assessing ecological service provision, importance and sensitivity proved to be challenging, as such freshwater systems (i.e. the cryptic wetlands) are under-researched, and little is known about the way in which they function and their contribution to the greater ecology of the area. Furthermore, the indices developed for the assessment of South African wetlands are largely focused towards assessing those systems found in higher rainfall regions than the study area and are thus geared towards systems which are less temporary in nature.

In addition, Day *et al* (2010) note that the basis of South African methodologies for the formal identification and delineation of wetlands is primarily that of soil morphological indicators such as mottling and gleying, and presence of hydrophytic vegetation; characteristics which are often absent in freshwater systems occurring in arid or semi-arid environments. However, taking into consideration aspects such as the presence of macroinvertebrates in two of the assessed cryptic wetlands, and the possibility that several of these systems are likely to host floral SCC, it is the specialist’s opinion that these are important for biodiversity maintenance. Therefore, although the cryptic wetlands located in the study area lack “vegetation typically adapted to life in saturated soil” this should not necessarily preclude them from the legal protection accorded to freshwater systems which meet the South African legal definition of a wetland, and therefore the ecological and risk assessments were conducted accordingly, to enable the relevant stakeholders, including the EAP, proponent and relevant competent authorities to make an informed decision.

Assuming that responsible implementation of the mitigation hierarchy, as well as strict adherence to cogent, well-developed mitigation measures takes place throughout all phases of the proposed mining development, the significance of potential impacts arising from the proposed mining activities is deemed to be of low to moderate levels, although it must be noted that due to the impact of irreversible habitat loss only occurring once and therefore the corresponding score is ‘1’, the significance of impacts relating to the proposed expansion of Village Pit is understated. A more accurate representation of the risk significance is, in the specialist’s opinion, ‘high’. Restoration of the affected cryptic wetlands will not be practical nor viable, therefore the proponent must engage with the relevant authorities to implement appropriate management measures in line with the mitigation hierarchy which are deemed acceptable to both the competent authorities and the proponent with regards to the direct loss of the affected CWs. It is however, strongly recommended that the proponent consider maintaining an ecological corridor, to minimise the loss of cryptic wetland habitat as well as other ecologically significant features.

Due to the direct loss of two cryptic wetlands, it is the specialist’s opinion that the proposed mining expansion has the potential to result in impacts of high to very high significance on the receiving freshwater environment, particularly of a wetland type which is under-researched and of scientific interest. it is however noted that the extent of direct impact will be contained to the local area. Thus, consideration of the value of this landscape must be considered from a freshwater and terrestrial biodiversity resource management point of view and juxtaposed with the responsibility to comply with Regulation 23 of the Mining and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) MPRDA pertaining to the optimisation of the Mining Right as well as the socio-economic and socio-cultural impact the project will have and the decision should be made and aligned with the principles of sustainable development and Integrated Environmental Management.

The expansion of the existing Waste Rock Dumps and detrital area, and proposed activities within already disturbed areas are anticipated to have a ‘low’ or even negligible risk significance, provided that strict enforcement of mitigation measures takes place. Therefore, those activities may be considered acceptable from a freshwater ecology management perspective.

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APPENDIX A – Terms of Use and Indemnity

INDEMNITY AND TERMS OF USE OF THIS REPORT

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

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APPENDIX B – Legislation

LEGISLATIVE REQUIREMENTS

The Constitution of the Republic of South Africa, 1996	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive realisation of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Environmental Management Act (NEMA) (Act No. 107 of 1998)	The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
The National Water Act (NWA) (Act No. 36 of 1998)	The National Water Act (NWA) (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
National Environmental Management: Biodiversity Act (2004) (Act 10 of 2004) (NEMBA)	**Ecosystems that are threatened or in need of protection** (1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection. *(b)* An MEC for environmental affairs in a province may, by notice in *the Gazette,* publish a provincial list of ecosystems in the province that are threatened and in need of protection. (2) The following categories of ecosystems may be listed in terms of subsection (1): *(a)* critically endangered ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation; *(b)* endangered ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems; (c) vulnerable ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and *(d)* protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs *(a), (b)* or (c).
Government Notice 598 Alien and Invasive Species Regulations (2014), including the Government Notice 864 Alien Invasive Species List as published in the Government Gazette 40166 of 2016, as it relates	NEMBA is administered by the Department of Environmental Affairs and aims to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA. This act in terms of alien and invasive species aims to: ➢ Prevent the unauthorized introduction and spread of alien and invasive species to ecosystems and habitats where they do not naturally occur, ➢ Manage and control alien and invasive species, to prevent or minimize harm to the environment and biodiversity; and ➢ Eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats.

to the National Environmental Management Biodiversity Act, 2004 (Act No 10 of 2004)	Alien species are defined, in terms of the NEMBA as: (a) A species that is not an indigenous species; or (b) An indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention. Categories according to NEMBA (Alien and Invasive Species Regulations, 2017): ➢ **Category 1a:** Invasive species that require compulsory control; ➢ **Category 1b:** Invasive species that require control by means of an invasive species management programme; ➢ **Category 2:** Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread; and ➢ **Category 3:** Ornamentally used plants that may no longer be planted.
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998)	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.

APPENDIX C – Method of Assessment

WATERCOURSE METHOD OF ASSESSMENT

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the watercourses present or in close proximity of the proposed study area are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA, 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), DWA, South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable, natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland features present in the vicinity of or within the proposed study area.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa

The watercourses encountered within the proposed study area were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et al*., 2013), hereafter referred to as the "Classification System". A summary of Levels 1 to 4 of the classification system are presented in Table C1 and C2, below.

Table C1: Proposed classification structure for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table C2: Hydrogeomorphic (HGM) Unit for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems

From the Classification System, Inland Systems are defined as aquatic ecosystems that have no existing connection to the ocean[4] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically. It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

[4] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included at Level 2 of the classification system is that of DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) group's vegetation types across the country according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the National Freshwater Ecosystem Priority Areas (NFEPA) project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

At Level 3 of the Classification System, for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et al.,* 2013):

- **<u>Slope</u>:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **<u>Valley floor</u>:** The base of a valley, situated between two distinct valley side-slopes;
- **<u>Plain</u>:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **<u>Bench (hilltop/saddle/shelf)</u>:** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the Classification System (Table C2), on the basis of hydrology and geomorphology (Ollis *et al*., 2013), namely:

- **<u>River</u>:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **<u>Channelled valley-bottom wetland</u>:** a valley-bottom wetland with a river channel running through it;
- **<u>Unchannelled valley-bottom wetland</u>:** a valley-bottom wetland without a river channel running through it;
- **<u>Floodplain wetland</u>:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **<u>Depression</u>:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
- **<u>Wetland Flat</u>:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **<u>Seep</u>:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for “channel”, “flat” and “valleyhead seep”) is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et al*., 2009).

3. WET-Health

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever-changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing to promote their conservation and wise management.

Level of Evaluation

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Framework for the Assessment

A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

Units of Assessment

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems above.

Quantification of Present State of a wetland

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial *extent* of the impact of individual activities and then separately assessing the *intensity* of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall *magnitude* of impact. The impact scores, and Present State categories are provided in the table below.

Table C3: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

Impact category	Description	Impact score range	Present State category
None	Unmodified, natural	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D

Impact category	Description	Impact score range	Present State category
Serious	The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognisable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota.	8-10	F

Assessing the Anticipated Trajectory of Change
As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (table below).

Table C4: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Overall health of the wetland
Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

4. Watercourse Function Assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[5] The assessment of the ecosystem services supplied by the identified watercourses was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;

[5] Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999

- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the watercourses. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the watercourses.

Table C5: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

5. Ecological Importance and Sensitivity (EIS) (Rountree & Kotze, 2013)

The purposed of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).
In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C6) of the wetland system being assessed.

Table C6: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High	>2 and <=3	B

EIS Category	Range of Mean	Recommended Ecological Management Class
Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.		
<u>Moderate</u> Wetlands that 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.	>1 and <=2	C
<u>Low/marginal</u> Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

6. Recommended Management Objective (RMO) and Recommended Ecological Category (REC) Determination

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability but carries a higher risk of ecosystem failure" (DWA, 1999).

The RMO (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the watercourse (sections above), with the objective of either maintaining, or improving the ecological integrity of the watercourse in order to ensure continued ecological functionality.

Table C7: Recommended management objectives (RMO) for water resources based on PES & EIS scores.

			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
PES	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
PES	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
PES	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
PES	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
PES	E/F	Poor	D* Improve	E/F* Improve	E/F* Maintain	E/F* Maintain

***PES Categories E and F are considered ecologically unacceptable (Malan and Day, 2012) and therefore, should a watercourse fall into one of these PES categories, an REC class D is allocated by default, as the minimum acceptable PES category.**

A watercourse may receive the same class for the REC as the PES if the watercourse is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the watercourse.

Table C8: Description of Recommended Ecological Category (REC) classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

7. Watercourse delineation

The watercourse delineation took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" published by DWAF in 2008. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

According to the DWA (2005) like wetlands, riparian areas have their own unique set of indicators. It is possible to delineate riparian areas by checking for the presence of these indicators. Some areas may display both wetland and riparian indicators and can accordingly be classified as both. If you are adjacent to a watercourse, it is important to check for the presence of the riparian indicators described below, in addition to checking for wetland indicators, to detect riparian areas that do not qualify as wetlands. The delineation process requires that the following be taken into account:

- topography associated with the watercourse;
- vegetation; and
- alluvial soils and deposited material.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWA, 2005).

APPENDIX D – Risk Assessment Methodology

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[6]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as watercourses, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[7].

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

[6] The definition has been aligned with that used in the ISO 14001 Standard.
[7] Some risks/impacts that have low significance will however still require mitigation

"RISK ASSESSMENT KEY" (Based on DWS 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

Table D1: Severity (How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table D2: Spatial Scale (How big is the area that the aspect is impacting on)

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table D3: Duration (How long does the aspect impact on the resource quality)

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, an E or F	5
PES and EIS (sensitivity) must be considered.	

Table D4: Frequency of the activity (How often do you do the specific activity)

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table D5: The frequency of the incident or impact (How often does the activity impact on the resource quality)

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table D6: Legal issues (How is the activity governed by legislation)

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table D7: Detection (How quickly or easily can the impacts/risks of the activity be observed on the resource quality, people and resource)

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table D8: Rating Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

A low risk class must be obtained for all activities to be considered for a GA

Table D9: Calculations

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - ➢ Primary project site and related facilities that the client and its contractors develop or controls;
  - ➢ Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - ➢ Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.

vii) Risks/Impacts were assessed for construction phase and operational phase; and
  - ➢ Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

The following points presents the key concepts considered in the development of mitigation measures for the proposed construction:

- ➢ Mitigation and performance improvement measures and actions that address the risks and impacts[8] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- ➢ Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and
- ➢ Desired outcomes are defined, and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

Recommendations were developed to address and mitigate potential impacts on the freshwater ecology of the resources in traversed by or in close proximity of the proposed infrastructure.

Reversibility and/or irreplaceable loss

The following indicates the rationale for the reversibility scoring in relation to the watercourses.

[8] Mitigation measures should address both positive and negative impacts

Table D10: Reversibility of impacts on the watercourse

Reversibility Rating:	**Irreversible** (the activity will lead to an impact that is permanent)
	Partially reversible (The impact is reversible to a degree e.g. acceptable revegetation measures can be implemented but the pre-impact species composition and/or diversity may never be attained. Impacts may be partially reversible within a short (during construction), medium (during operation) or long term (following decommissioning) timeframe
	Fully reversible (The impact is fully reversible, within a short, medium or long-term timeframe)

APPENDIX E – Results of Field Investigation

PRESENT ECOLOGICAL STATE (PES) AND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) RESULTS

Table E1: Presentation of the results of the WET-Health assessment applied to the various cryptic wetlands

Cryptic Wetland	Hydrology		Geomorphology		Vegetation		PES Category
	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
CWs 1-3; 5-13; 15-18 and 20-21	1.0 (B)	0	0.1 (A)	0	1.2 (B)	-1	0.78 (A)
CW 4	1.0 (B)	0	0.0 (A)	0	1.7 (B)	-1	0.92 (A)
CW 14	1.0 (B)	0	0.0 (A)	0	1.3 (B)	-1	0.79 (A)
CW 19	2.0 (C)	-1	0.5 (A)	-1	1.5 (B)	-1	1.42 (B)

Table E2: Presentation of the results of the Ecoservices assessment applied to the various cryptic wetlands.

Ecosystem service	CWs Combined	CW 04	CW 14	CW 19
Flood attenuation	1,0	1,1	1,0	1,0
Streamflow regulation	0,4	0,4	0,6	0,6
Sediment trapping	1,4	1,4	1,4	2,0
Phosphate assimilation	1,6	1,6	1,6	1,9
Nitrate assimilation	1,3	1,3	1,4	1,4
Toxicant assimilation	1,4	1,4	1,5	1,9
Erosion control	1,4	1,3	1,4	1,3
Carbon Storage	1,0	0,8	1,3	1,0
Biodiversity maintenance	3,3	3,3	3,4	3,2
Water Supply	0,0	0,0	0,2	0,2
Harvestable resources	0,0	0,0	0,0	0,0
Cultivated foods	0,0	0,0	0,0	0,0
Cultural value	0,0	0,0	0,0	0,0
Tourism and recreation	0,6	0,6	0,9	0,9
Education and research	0,5	0,5	0,8	0,8
SUM	**13,9**	**13,6**	**15,3**	**16,0**
Average score	**0,9**	**0,9**	**1,0**	**1,1**

Table E4: Presentation of the results of the EIS assessment applied to the various cryptic wetlands.

	Cryptic Wetlands (Combined)	CW 04	CW 14	CW 19
Ecological Importance and Sensitivity	Score (0-4)			
Biodiversity support	A (average)	A (average)	A (average)	A (average)
	1,33	1,33	2,33	2,00
Presence of Red Data species	1	1	1	1
Populations of unique species	1	1	3	2
Migration/breeding/feeding sites	2	2	3	3
Landscape scale	B (average)	B (average)	B (average)	B (average)
	1,40	1,60	1,80	1,80
Protection status of the wetland	3	3	3	3
Protection status of the vegetation type	1	1	1	1
Regional context of the ecological integrity	1	1	2	2
Size and rarity of the wetland type/s present	1	2	2	2
Diversity of habitat types	1	1	1	1
Sensitivity of the wetland	C (average)	C (average)	C (average)	C (average)
	0,67	0,67	1,00	1,00
Sensitivity to changes in floods	1	1	2	2
Sensitivity to changes in low flows/dry season	0	0	0	0
Sensitivity to changes in water quality	1	1	1	1
ECOLOGICAL IMPORTANCE & SENSITIVITY	**(max of A,B or C)**	**(max of A,B or C)**	**(max of A,B or C)**	**(max of A,B or C)**
Fill in highest score:	**B**	**B**	**A**	**A**

CWs 1-13 and 15-21:
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.

CW 14:
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.

			Cryptic Wetlands (Combined)	CW 04	CW 14	CW 19
Hydro-Functional Importance			Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)
Regulating & supporting benefits	**Flood attenuation**		1	1	1	1
	Streamflow regulation		0	0	0	0
	Water Quality Enhancement	***Sediment trapping***	1	1	1	2
		Phosphate assimilation	2	2	2	2
		Nitrate assimilation	1	1	1	1
		Toxicant assimilation	1	1	1	2
		Erosion control	1	1	1	1
	Carbon storage		1	1	1	1

HYDRO-FUNCTIONAL IMPORTANCE		1	1	1	1

		Cryptic Wetlands (Combined)	**CW 04**	**CW 14**	**CW 19**
Direct Human Benefits		Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)
Subsistence benefits	***Water for human use***	0	0	0	0
	Harvestable resources	0	0	0	0
	Cultivated foods	0	0	0	0
Cultural benefits	***Cultural heritage***	0	0	0	0
	Tourism and recreation	1	1	1	1
	Education and research	0	0	1	1
DIRECT HUMAN BENEFITS		0,17	0,17	0,33	0,33

APPENDIX F – Risk Analysis and Mitigation Measures

General management and good housekeeping practices

The following essential mitigation measures are considered to be standard best practice measures applicable to development of this nature, and must be implemented during all phases of the proposed development activities, in conjunction with those stipulated in Section 5 of this report which define the mitigatory measures specific to the minimisation of impacts on freshwater resources.

Development and operational footprint

- Sensitivity maps have been developed for the study area, indicating the location of the cryptic wetlands and the relevant regulatory zones in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), as shown in Section 4.5. It is recommended that these sensitivity maps be considered during all phases of the development and with special mention of the planning of any additional infrastructure or relocating the infrastructure footprint, to aid in the conservation of riparian habitat and environmental resources within the study area;
- All development footprint areas should remain as small as possible and should not encroach onto surrounding more sensitive areas. It must be ensured that the cryptic wetlands and episodic drainage lines and the associated regulatory zones are off-limits to construction vehicles and personnel;
- The boundaries of footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas;
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration, and wherever possible, existing roads should be utilised. If additional roads are required, then wherever feasible such roads should be constructed a distance from the more sensitive cryptic wetland / riparian areas and not directly adjacent thereto. If crossings are required they should cross the system at right angles, as far as possible to minimise impacts in the receiving environment, and any areas where bank failure is observed due to the effects of such crossings should be immediately repaired by reducing the gradient of the banks to a 1:3 slope and where needed necessary, installing support structures. This should only be necessary if existing access roads are not utilised;
- All areas of increased ecological sensitivity should be marked as such and be off limits to all unauthorised construction and maintenance vehicles and personnel;
- The duration of impacts on the freshwater system should be minimised as far as possible by ensuring that the duration of time in which flow alteration and sedimentation will take place is minimised;
- Appropriate sanitary facilities must be provided for the life of the proposed project and all waste removed to an appropriate waste facility;
- All hazardous chemicals should be stored on bunded surfaces and no storage of such chemicals should be permitted within the riparian buffer zones;
- No informal fires should be permitted in or near the construction areas;
- Ensuring that an adequate number of rubbish and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills; and
- Edge effects of activities, particularly erosion and alien/weed control need to be strictly managed.

Vehicle access

- All areas of increased ecological sensitivity should be marked as such and kept off limits to all unauthorised construction and maintenance vehicles as well as personnel;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil; and
- All spills, should they occur, should be immediately cleaned up and treated accordingly.

Alien plant species

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the project footprint, particularly as the study area is located within a sensitive area. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;

- Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) and Section 28 of the National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA)). Removal of species should take place throughout the construction, operational, closure/decommissioning and rehabilitation/ maintenance phases; and
- Species specific and area specific eradication recommendations:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Footprint areas should be kept as small as possible when removing alien plant species*;*
  - No vehicles should be allowed to drive through designated sensitive drainage line and riparian areas during the eradication of alien and weed species.

Cryptic wetland and episodic drainage line (riparian) habitat

- Ensure that as far as possible all infrastructure is placed outside of the cryptic wetlands and applicable regulatory zones and that no infrastructure is planned within the episodic drainage lines. If these measures cannot be adhered to, strict mitigation measures will be required to minimize the impact on the receiving watercourses. Such measures include those stipulated in Section 5 of this report, in addition to the following:
  - Ensuring that measures are implemented to prevent dirty runoff water entering the receiving freshwater environment; and
  - Ensuring that where necessary, exposed soils in the vicinity of cryptic wetland habitat are protected from erosion by means of reinstating natural vegetation following construction, or installation of an appropriate commercially available product such as Geojute or MacMatR;
  - Any additional measures which may be considered necessary by the project Environmental Officer during the construction and/or operational phases;
- Permit only essential construction personnel within 32m of the cryptic wetlands or episodic drainage lines, if absolutely necessary that they enter the regulatory zone;
- Limit the footprint area of the construction activities to what is absolutely essential in order to minimise environmental damage;
- During the construction phase, no vehicles should be allowed to indiscriminately drive through the wetland or riparian areas;
- The characteristics of the cryptic wetlands or episodic drainage lines could potentially be altered locally, if construction materials, such as rock and rubble created during construction which is likely to have sharp edges (and not the smooth surfaces typically associated with river rocks and pebbles) are not prevented from entering these features. Such material must therefore be prevented from entering the cryptic wetlands and episodic drainage lines or within 50m thereof, and all construction related waste must be removed from the study area once construction has been completed; and
- Implement effective waste management in order to prevent construction related waste from entering the freshwater environments.

Soils

- To prevent the erosion of soils, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas particularly susceptible to erosion;
- Install erosion berms during construction to prevent gully formation. Berms every 50m should be installed where any disturbed soils have a slope of less than 2%, every 25m where the track slopes between 2% and 10%, every 20m where the track slopes between 10% and 15% and every 10m where the track slope is greater than 15%;
- Sheet runoff from access roads should be slowed down by the strategic placement of berms and sandbags;
- Maintain topsoil stockpiles below 5 meters in height;
- As far as possible, all construction activities should occur in the low flow season, during the drier winter months;

- All soils compacted as a result of construction activities falling outside of project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas; and
- Monitor all areas for erosion and incision, particularly any riparian crossings. Any areas where erosion is occurring excessively quickly should be rehabilitated as quickly as possible and in conjunction with other role players in the catchment.

Rehabilitation

- All soils compacted as a result of construction activities falling outside of project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. Alien and invasive vegetation control should take place throughout all construction and rehabilitation phases to prevent loss of floral habitat;
- Rehabilitate all cryptic wetland habitat areas affected by construction to ensure that the ecology of these areas is re-instated during all phases. In this regard, special mention is made of the need to stockpile soils separately during the construction and/or operation phase where relevant in order for these soils to be utilised during the rehabilitation phase;
- Edge effects of activities including erosion and alien/ weed control need to be strictly managed in these areas;
- As far as possible, all rehabilitation activities should occur in the low flow season, during the drier winter months.
- As much vegetation growth (of indigenous/endemic floral species) as possible should be promoted within the proposed development area in order to protect soils;
- All alien vegetation should be removed from rehabilitated areas and reseeded with indigenous grasses as specified by a suitably qualified specialist (ecologist);
- All areas affected by construction and operation should be rehabilitated upon completion of the specific construction and operation activity throughout the life of the development;
- Cryptic wetland vegetation cover should be monitored to ensure that sufficient vegetation is present to bind the soils and prevent erosion and incision; and
- It is recommended that a detailed rehabilitation plan be developed by a suitably qualified ecologist prior to commencement of the operations phase in order to address specific rehabilitation requirements.

APPENDIX G – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

Amanda Mileson Advanced Diploma: Nature Conservation (UNISA)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Natural Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health Practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Amanda Mileson, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

Signature of the Specialist

I, Stephen van Staden, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

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Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health Practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)
5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF AMANDA MILESON

PERSONAL DETAILS

Position in Company	Senior Ecologist: Wetland Ecology
Joined SAS Environmental Group of Companies	2013

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Wetland Society (SAWS)

Member of the International Society of Wetland Scientists

Member of the Gauteng Wetland Forum (GWF) and Northern Cape Wetland Forum (NCWF)

EDUCATION

Qualifications	
N. Dip Nature Conservation (UNISA)	2017
Advanced Diploma Nature Conservation (UNISA)	2020
Postgraduate Diploma Nature Conservation (UNISA)	In progress
Short Courses	
Wetland Management: Introduction and Delineation (University of the Free State)	2018
Tools for Wetland Assessment (Rhodes University)	2017
Wetland Rehabilitation (University of the Free State)	2015

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Free State, North West, Limpopo, Northern Cape, Eastern Cape

Africa – Zimbabwe, Zambia

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Ecosystem Delineation
- Freshwater Ecosystem Verification Assessment
- Freshwater Ecosystem (wetland / riparian) Delineation and Assessment
- Freshwater Ecosystem EcoService and Status Determination
- Freshwater Ecosystem Rehabilitation Assessment / Planning
- Freshwater Ecosystem Maintenance and Management Plans
- Freshwater Ecosystem Plant Species Plans
- Freshwater Ecosystem Offset Plans

Biodiversity Assessments

- Biodiversity Ecological Assessments
- Biodiversity Offset Plans