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FRESHWATER ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL AUTHORISATION AND WATER USE LICENSE APPLICATION PROCESSES FOR THE PROPOSED MINING EXPANSION ACTIVITIES AT THE KOLOMELA MINE, NEAR POSTMASBURG, NORTHERN CAPE PROVINCE

Prepared for

EXM Advisory Services (Pty) Ltd

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EXECUTIVE SUMMARY

During the site assessments undertaken in May and June 2021, numerous (over 200) areas of increased wet response were identified in the assessment area. 75 of these possessed distinctive 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 12 were characterised as episodic drainage lines with riparian zones (albeit weakly-defined in some areas). These were classified as watercourses from an ecological perspective and thus were assessed as such. The remaining features were characterised as episodic depressions, preferential flow paths and anthrpogenically-derived drainage channels, none of which were classified as watercourses from an ecological perspective and were therefore excluded from further assessment.

Watercourses located within 200 m of the assessment area formed the focus of the assessment as these are perceived to be at increased risk from the proposed activities. The watercourses were found to be of increased ecological integrity and of moderate importance and sensitivity (EIS). Although true hydrophytic vegetation was absent from the cryptic wetlands, additional biotic and abiotic factors were used to define, delineate and characterise these features. Although no surface water was present at the time of assessment, it is known that regular biomonitoring is undertaken within several of these features by the University of the Free State, and that those features host populations of aquatic macroinvertebrates. 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 proposed expansion layout received by the specialist in August 2021, it is anticipated that the risks posed to the various watercourses range from 'low' to 'medium' significance, depending on the nature and extent of the activity and its proximity to watercourses. However, it is the specialist's opinion that perceived risks can be successfully mitigated to minimise the significance thereof.

Provided that strict implementation of cogent, well-developed, site specific mitigation measures takes place throughout the life of mine, the proposed mining expansion may be considered for authorisation.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct an investigation considering the freshwater ecology as part of the Environmental Authorisation (EA) process for the proposed expansion activities at the Kolomela Mine, located approximately 8 km south west of Postmasburg, Tsantsabane Local Municipality, Northern Cape Province. The proposed expansion activities are henceforth referred to as the "assessment area".

The purpose of this report is to define the ecology of the assessment area from a freshwater ecology 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 200) areas of increased wet response were identified using desktop methods prior to the site assessment. During the site assessment, 75 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 75 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, 12 episodic drainage lines possessing riparian zones (albeit weakly defined in some areas) were identified, along with numerous seasonal depressions, preferential flow paths, and anthropogenically-derived channels 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, the first on the 19th May 2021 and the second between the 29th of June and the 1st of July 2021, with the aim of identifying, delineating and assessing any potential surface water features of interest and areas of increased wet response and to ground-truth other pre-defined areas of interest. Where relevant, previous studies undertaken by SAS (2015) were consulted. 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 numerous cryptic wetlands (CWs) and episodic drainage lines (EDLs) within the assessment area, the watercourses were grouped according to location in relation to the proposed and existing mining areas and assessed collectively in these groups, except where specific wetlands were distinctly altered and/or isolated from others; these were then 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. 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.

Watercourse Grouping	PES Category	EIS Category
CW 1	B (1.08)	High
CW 2	B (1.57)	High
CW Group 3	B (1.08)	High
CW Group 4	B (1.26)	High
CW Group 5	B (1.11)	High
CW 55	D (4.71)	High
EDL 1 (western portion of assessment area)	B / C	Moderate
Welgevondenspruit system	B / C	Moderate
Unnamed tributaries of the Groenwaterspruit	B / C	Moderate

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 August 2021 which indicates that some infrastructure (mostly linear such as haul roads and conveyors) will traverse or partially encroach on various watercourses. Table B below provides a summary of the outcome of the DWS Risk Assessment.

Table B: Summary of the results of the risk assessment applied to the various watercourses at risk of potential impacts arising from the development.

Phases	Activity	Aspect	Significance	Risk Rating	Confidence level	Reversibility
Perceived Impacts: Haul Road (traverses episodic drainage lines within Welgevondespruit system in four sections)						
Construction	Site preparation prior to construction / upgrade of roadway, including placement of contractor laydown areas and storage facilities.	*Vehicular transport and access to the site, site clearing; *Removal of vegetation and associated disturbances to soils; *Miscellaneous activities by construction personnel.	**54**	**L**	80	**Partially reversible**
	Excavation within watercourse for culvert foundations (where stipulated by hydrologist)	Possible temporary in-channel diversion of watercourses to allow for excavations and sealing of foundations to take place (only required if work is undertaken during rainy season)	**71,5**	**M**	80	
		*Movement of construction equipment/vehicles within the applicable watercourse; and *Possible spills / leaks from construction vehicles	**65**	**M**	80	
		*Disturbances to soil of the watercourses; *Removal of topsoil and creation of soil stockpiles	**65**	**M**	80	
	Installation of pre-fabricated concrete box culverts and energy dissipators (where stipulated by hydrologist)	Temporary in-channel diversion of watercourse to allow for installation of pre-fabricated infrastructure (only required if work is undertaken during the rainy season)	**58,5**	**M**	80	
		*Movement of construction equipment/vehicles within the watercourses; *Possible spills / leaks from construction vehicles.	**58,5**	**M**	80	
		*Possible discard of construction material within the watercourse.	**52**	**M**	80	
		*Ongoing disturbances to soil	**71,5**	**M**	80	
	Re-profiling of drainage line slopes in the vicinity of the crossings	*Ongoing disturbances to soils; and *Removal of vegetation	**61,75**	**M**	80	
Perceived impacts: New Water Diversion Berm around KS Pits and KS WRDs (eastern sections of Episodic Drainage Line 1)						
Construction	Site clearing prior to commencement of construction activities, including placement of contractor laydown areas.	*Vehicular movement and access to the site; Possible indiscriminate movement of construction equipment through the episodic drainage line; and *Removal of vegetation (terrestrial and riparian) and associated disturbances (rubble and litter) to soils and the watercourse.	**42**	**L**	**80**	**Partially reversible**
	Construction of permanent diversion structures (to divert flow from upper catchment areas of both Episodic Drainage Line 1 and episodic drainage lines associated with the Welgevondenspruit)	*Ground-breaking associated with the excavation of the diversion structures; *Removal of topsoil; and *Excavation activities leading to the stockpiling of soil.	**32**	**L**	**80**	
Perceived Impacts: Conveyor to Kapstevel At pit and Conveyor from DMS to DSO (EDL, CWs 1, 49, 50)						
Construction	Construction of conveyor to Kapstevel At pit over CW 1.	*Vegetation clearing, excavation and compaction of soils within the watercourses; *Potential indiscriminate movement of construction equipment within the watercourses; *Potential contamination of soils within the watercourses; *Alterations to the sediment loads and potential deposition of waste material into the watercourses; and	**112**	**M**	**80**	**Partially reversible**
	Construction of conveyor from DMS to DSO over an episodic drainage line, CW 49 and CW 50		**112**	**M**	**80**	

Phases	Activity	Aspect	Significance	Risk Rating	Confidence level	Reversibility
		*Potential changes to the channel capacity and flow through the episodic drainage line.				
Perceived Impacts: Railway option (CWs 46 and 55)						
Construction	Construction of railway option through the remaining portion of CW55 and within 10 m of CW 46	*Vegetation clearing, excavation and compaction of soils within the watercourses; *Potential indiscriminate movement of construction equipment within the watercourses; *Potential contamination of soils within the watercourses; *Alterations to the sediment loads and potential deposition of waste material into the watercourses.	**96**	**M**	**80**	**CW 46: fully reversible** **CW 55: Irreversible**
Perceived Impacts: Expansion of Exploration Core yard (within 25 m of episodic drainage line associated with Welgevondenspruit system)						
Construction	Site clearing prior to commencement of construction activities, including placement of contractor laydown areas.	*Vehicular movement and access to the site; and *Removal of vegetation (terrestrial) and associated disturbances (rubble and litter) to soil upgradient of watercourse.	**61,75**	**M**	80	**Fully reversible**
	Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.	Possible indiscriminate movement of construction equipment through the watercourse; *Potential contamination of watercourse by stormwater runoff containing hydrocarbons/sediment.	**61,75**	**M**	80	
	Potential indiscriminate disposal of hazardous and non-hazardous materials wastes within freshwater resource.	*Increased risk of transportation of sediment from exposed soils in storm water runoff.	**61,75**	**M**	80	
	Construction of storage buildings	*Altered water quality; and *Possible changes to flow patterns as a result of blockages caused by solid waste/rubble.	**61,75**	**M**	80	**Partially reversible**
Perceived impacts: Tyre Management Area (CWs 48 and 51)						
Construction	Site clearing prior to commencement of construction activities, including vegetation clearing, levelling of ground and placement of contractor laydown areas.	*Vehicular movement and access to the site; and *Removal of vegetation and associated disturbances to surrounding soil within the catchment of the cryptic wetlands	**55,25**	**M**	**80**	**Partially reversible**
Perceived Impacts: Kapstevel Park-up area and Soil Stockpiles (CWs 30, 32, 33 and 34, and unnamed tributaries of Groenwaterspruit)						
Construction	Site clearing prior to commencement of construction activities, including vegetation clearing, levelling of ground and placement of contractor laydown areas.	*Clearing of vegetation and levelling of ground.	**36**	**L**	**80**	**Fully reversible**
Perceived impacts: Solar PV Plant (episodic drainage line associated with Welgevondenspruit system).						
Construction	Site preparation prior to construction activities of surface infrastructure components located outside the watercourses and the 32 m NEMA ZoR.	Vehicular movement (transportation of construction materials)	**52**	**L**	80	Fully reversible
		Removal of vegetation and associated disturbances to soil.	**52**	**L**	80	
	Construction of surface infrastructure outside the watercourses and the 32 m NEMA ZoR	*Removal of vegetation and topsoil and associated stockpiling; *Ground-breaking and earthworks relating to foundations and trenches; *Mixing and casting of concrete for construction purposes; *Backfilling of excavated and disturbed areas; and *Miscellaneous activities by construction personnel.	**36**	**L**	70	

Phases	Activity	Aspect	Significance	Risk Rating	Confidence level	Reversibility
OPERATIONAL PHASE IMPACTS						
Perceived Impacts: Haul Road (traverses episodic drainage lines within Welgevondespruit system in four sections)						
Operational	Discharge of water into the traversed watercourses	*Increased impermeable surface areas adjacent to watercourses, resulting in increased volume of stormwater entering watercourses	**55**	L	80	Partially reversible
Operational	Regular vehicular traffic on all haul roads (new and existing South 2 Haul Road)	*Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff	**82,5**	M	80	
Operational	Rehabilitation and maintenance of culverts and road crossings	*Revegetation of crossings (requiring personnel to work temporarily within the watercourses); *Possible indiscriminate movement of vehicles through watercourses during rehabilitation activities.	**38,25**	L	80	
Perceived impacts: New Water Diversion Berm around KS Pits and KS WRDs (eastern sections of Episodic Drainage Line 1)						
Operational	Operation and maintenance of the diversion structure	*Containment/diversion of all stormwater (clean water) runoff into the clean water system and clean water being released only within the downgradient reach of the freshwater resource.	**60**	M	80	Partially reversible
Perceived Impacts: Conveyor to Kapstevel At pit and Conveyor from DSO to DMS plant (EDL CWs 1, 49, 50)						
Operational	Operation of conveyors	Transportation/transfer of iron ore via the conveyor, potentially resulting in spillages from the conveyor.	**36**	L	**80**	Partially reversible
Perceived Impacts: Railway option (CWs 46 and 55)						
Operational	Operation of railway line	Transportation/transfer of iron ore via the railway, potentially resulting in spillages.	**52**	L	80	Partially reversible
Perceived Impacts: Expansion of Exploration Core yard (within 25 m of episodic drainage line associated with Welgevondenspruit system)						
Operational	Operation of the exploration core yard.	*Transportation and storage of drill cores. *Increased vehicular activity and impermeable surfaces in the catchment of the episodic drainage line.	**60**	**M**	80	Partially reversible
Perceived impacts: Tyre Management Area (CWs 48 and 51)						
Operational	Operation of the tyre management area	*Increased vehicular activity and impermeable surfaces in the catchment of CWs 48 and 51	**39**	L	80	Partially reversible
Perceived Impacts: Kapstevel Park-up area and Soil Stockpiles (CWs 30, 32, 33 and 34, and unnamed tributaries of Groenwaterspruit)						
Operational	Creation of soil stockpiles within 100 m of cryptic wetlands	*Increased volume of loose / uncompacted sediment within 100 m of cryptic wetlands.	**42**	L	80	Fully reversible
Operational	Regular use by heavy vehicles	*Increased presence of hydrocarbons;	**56**	**M**	80	
Perceived impacts: Solar PV Plant (episodic drainage line associated with Welgevondenspruit system).						
Operational	Operation and maintenance of the surface infrastructure outside the watercourses and the 32 m NEMA ZoR	*Potential indiscriminate movement of maintenance vehicles within the watercourses or within close proximity to the watercourses; *Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff from the surface infrastructure (specifically during the cleaning of the solar PV arrays).	**52**	L	80	Partially reversible

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 assessment 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 Authorisation (EA) process for the proposed expansion activities at the Kolomela Mine, near Postmasburg, Northern Cape Province, henceforth referred to as the "assessment area" (Figures 1 and 2).

The assessment area is located within the Tsantsabane Local Municipality which is an administrative area in the Siyanda District Municipality of the Northern Cape. The Kolomela Mine is located approximately 8,7 km south-west of the town of Postmasburg while the R309 / R383 roadway is located approximately 1,6 km east of the Kolomela Mine. 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 assessment area, 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 assessment area - will henceforth be referred to as the "investigation area".

SAS undertook a brief, initial site investigation on the 19th of May 2021 and subsequently between the 29th of June and the 1st of July 2021. The data gathered during these site assessments was supplemented with data obtained during 2015, when SAS undertook a freshwater assessment for Kolomela Mine, albeit predominantly in the northern and eastern portions of the Mining Right Area (MRA).

During the initial study undertaken in 2015 and the subsequent investigations in 2021, several areas of increased wet response were identified. Seventy-five (75) of these areas within the assessment and investigation areas 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 75 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. Additionally, several linear drainage systems were identified and characterised (refer to Section 4).

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 National Water Act, 1998 (Act No. 36 of 1998) 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 and investigation areas 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 assessment area and specifically the proposed project footprint. Furthermore, 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 mine expansion activities, and the related 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 mine 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 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 the DWS.

1.2 Project Description

The Sishen Iron Ore Company (Pty) Ltd, part of Kumba Iron Ore Limited (hereafter referred to as Kumba), owns and operates Kolomela Mine located approximately 8 km south west of Postmasburg in the Tsantsabane Local Municipality, Northern Cape Province. The Minister of Mineral Resources granted a mining right for the mining of iron ore at Kolomela Mine on the 5th of May 2008, {Ref: (NC) 069 MR} and is valid until the 17th of September 2038, unless cancelled or suspended.

Kolomela mine operates as a conventional open cast mine where ore is extracted by means of drilling, blasting, loading and hauling. Ore extracted from the pits is transported to a Direct Shipping Ore (DSO) Plant which involves the crushing and screening of recovered ore material into stockpiles of 'lump' and 'fines'. The processed iron ore is loaded onto an internal railway line which is connected to a direct rail link to Transnet's Sishen-Saldanha railway line from where the iron ore is transported to the Port of Saldanha for export. Kolomela Mine also utilises a Modular Dense Media Separation (DMS) Processing Plant for the processing of low grade ore not suitable for processing at the DSO Plant. Kolomela produced 10.8 million tonnes during its first full year of production in 2013 and currently produces 13-14 million tonnes per

annum (Mtpa) facilitated by enhanced stripping techniques and processing of 1-3 Mtpa of lower grade of ore at the Tierbult DMS Modular Plant.

Iron ore is currently extracted from three opencast pits, namely Klipbankfontein, Leeuwfontein and Kapstevel North. Kolomela is in the process of developing the Kapstevel South Pit which is required to sustain the mining production at approximately 14 Mtpa (Mtpa) until 2031. The current the Life of Mine (LoM) including the Kapstevel South Pit currently stands at 2032, but with the potential to be extended in future with the development of the Ploegfontein, Tierbult and Heuningkranz ore bodies, the mining of which are already authorised.

Kolomela proposes to expand and amend some of the existing activities and also develop new infrastructure to support continued and future production at the mine. This includes:

- Amendment of the Kapstevel South Pit footprint area.
- Amendment of the Kapstevel Waste Rock Dumps and haul roads.
- Amendment of Kapstevel Evaporation Ponds and stormwater management infrastructure.
- Additional park-up, laydown and ore stockpile areas.
- Development of new DMS tailings management infrastructure
- A new Photovoltaic Solar Facility.
- A new Waste Tyre Management Facility.
- A conveyor and railway line to transfer material to and from the DMS plant.
- Amendment to the future Kapstevel DMS conveyor footprint to facilitate widened haul roads.
- Amendment of Kapstevel Waste Rock Dumps and Additional Waste Rock Dumps.
- Additional Low Grade Ore Storage Areas.
- New radio masts.
- Provision for an area of relaxation and safety berms around pits.

The existing and planned infrastructure at Kolomela Mine are shown in Figure 3.
Authorisation is thus being sought from the Department of Mineral Resources & Energy (DMRE) for activities listed under the National Environmental Management Act, 1998 (No. 107 of 1998) and the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) as well as amendment of the environmental management programme in terms of Section 102 of the Minerals & Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).

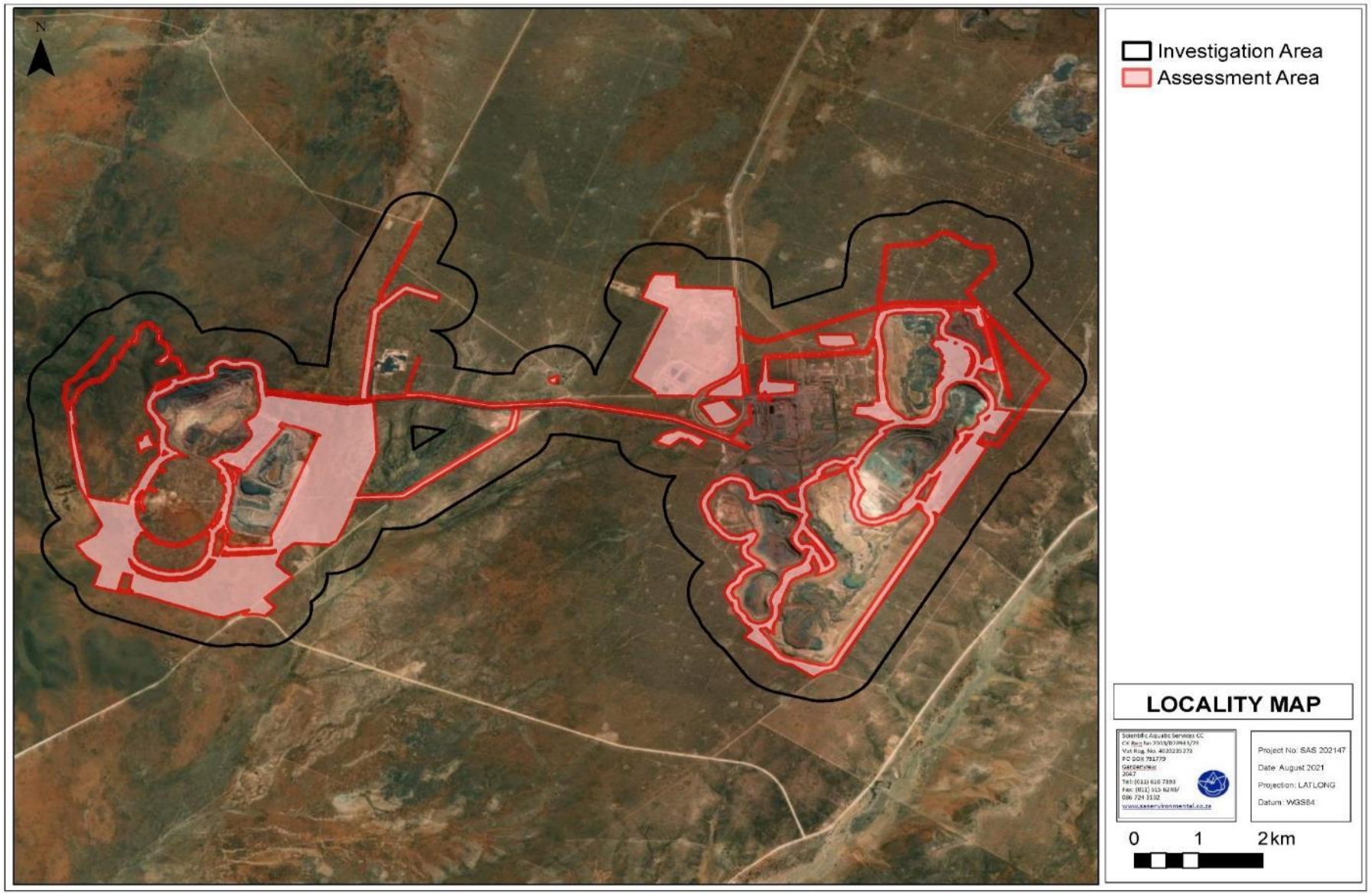


Figure 1: Locality of assessment area and the associated investigation area in relation to the surrounds, depicted on digital satellite imagery.

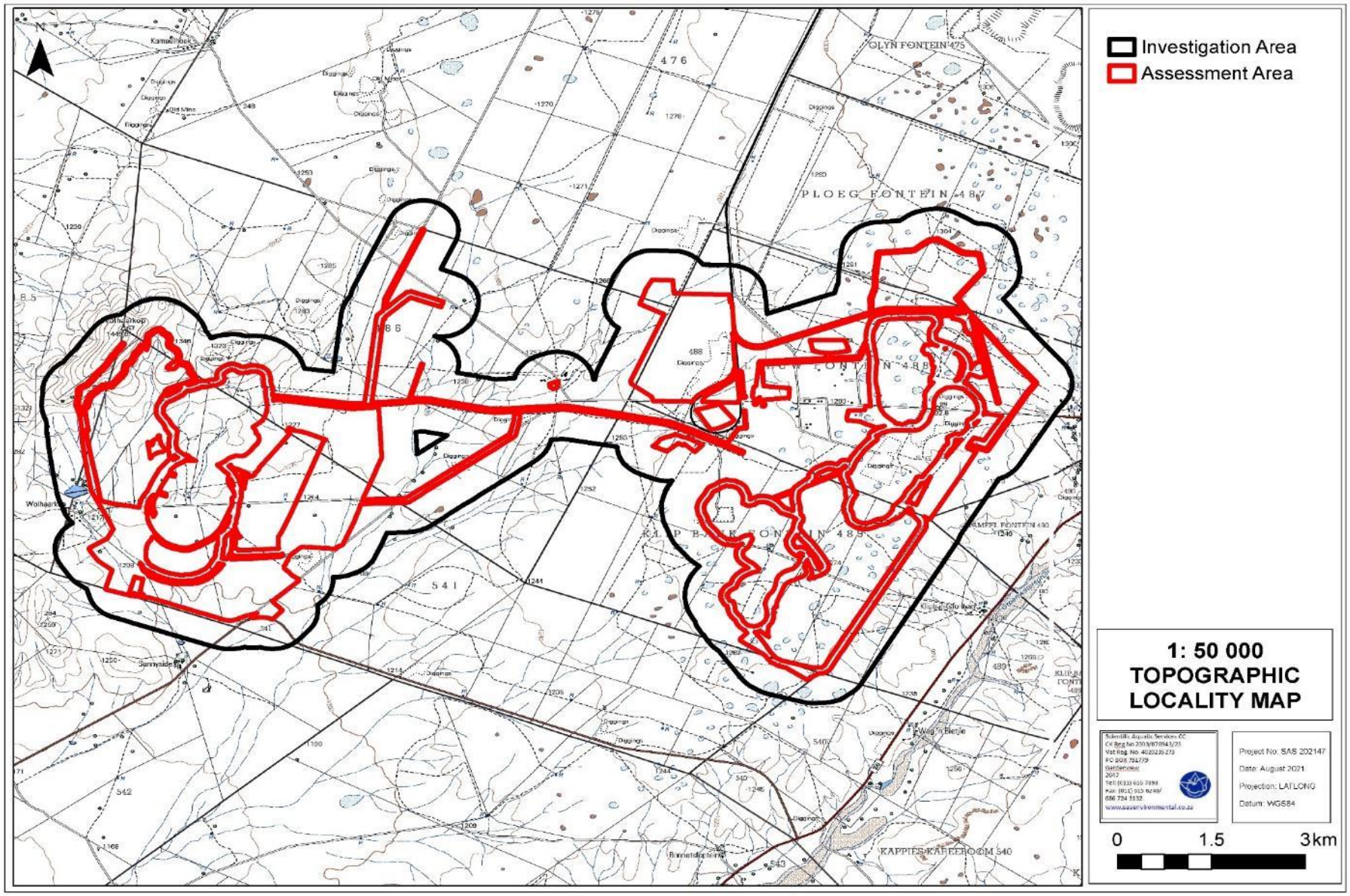


Figure 2: Locality of assessment area and the associated investigation area in relation to the surrounds, depicted on a 1:50,000 topographic map.

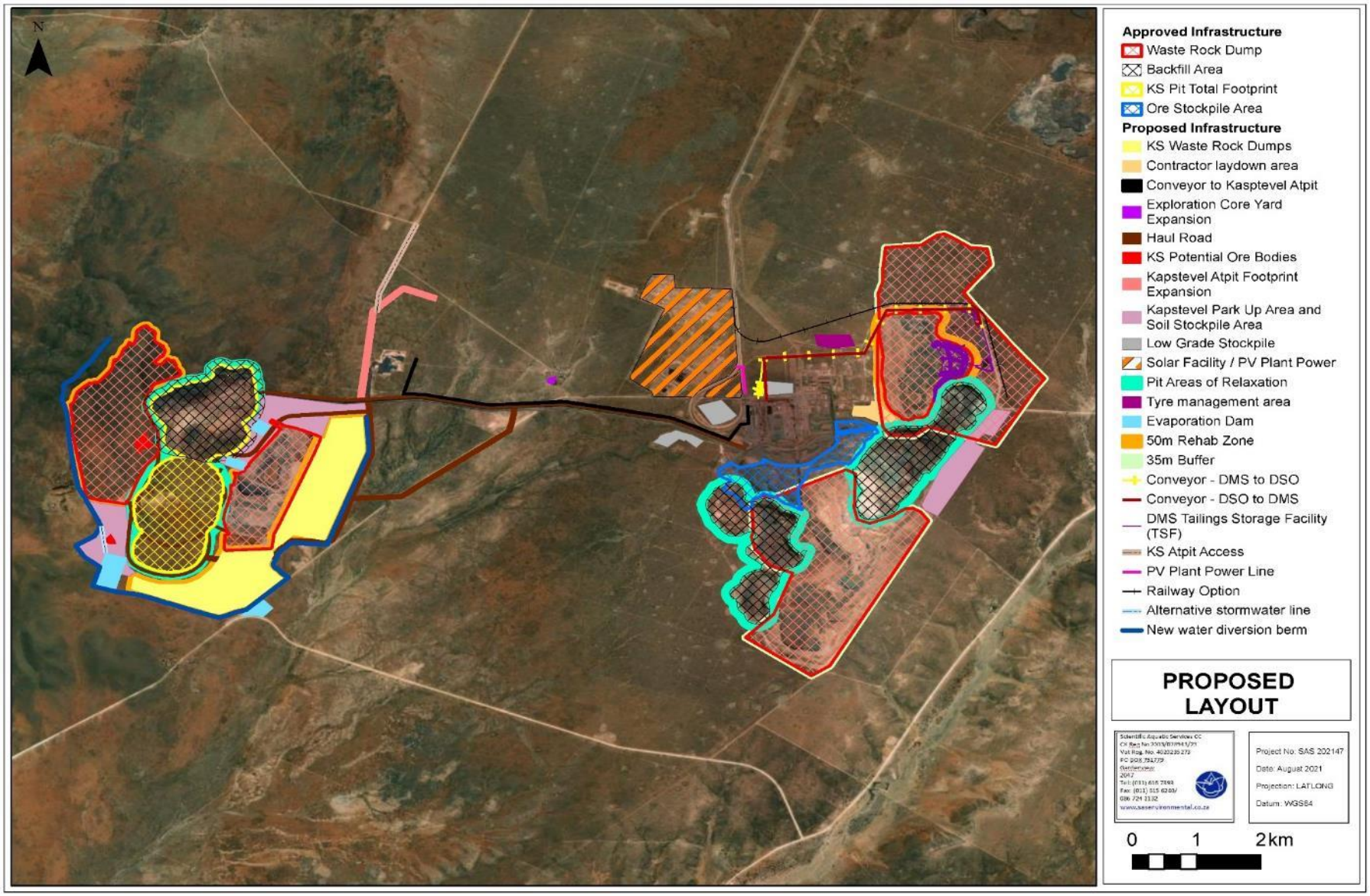


Figure 3: Locality of existing and planned infrastructure in relation to the surrounds, depicted on digital satellite imagery.

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 assessment 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 assessment and investigation areas as illustrated in Figures 1 and 2 and does not include the neighbouring and surrounding properties outside of the assessment area. The general surroundings were, however considered in the desktop analysis of the assessment area;

- All watercourses identified within 500 m of the assessment area were delineated in fulfilment of GN 509 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 assessment area, 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 assessment 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, the wetlands were grouped according to location in relation to the proposed and existing mining areas and assessed collectively in these groups, except where specific wetlands were distinctly altered and/or isolated from others; these were then 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. However, for the purposes of presenting a concise yet accurate discussion, the cryptic wetlands were discussed collectively;
- Watercourses located outside the assessment area were not assessed as they are located on privately owned property and access could not be gained. However, it should be noted that some may be impacted by edge effects of proposed expansion of the mining activities and thus the mitigation measures provided in this report are of utmost importance to protect watercourses which are located outside of the assessment area but downgradient of the assessment area activities;
- The DWS Risk Assessment Matrix (2016) was only applied to proposed infrastructure. Infrastructure which has already received authorisation (such as the WRDS to the north and west of the Kapstevel pit) was not included in the risk assessment;
- The assessment area is located within a semi-arid region, receiving an average annual rainfall of less than 500 mm per annum. The assessment was conducted during the mid-winter season. Whilst key floral species indicative of increased soil moisture were present within the assessment area, and usually identifiable, the season of assessment meant that reliance on floral indicators was useful but reduced;
- 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 assessment area;

- Limitations in the accuracy of the delineation in some areas due to anthropogenic disturbances such as access roads and historical agricultural activities 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 assessment 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 utilising 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 May and June 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; and
    - 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 assessment 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 assessment 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 assessment 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 assessment area and surrounding region.

Aquatic ecoregion and sub-regions in which the Assessment area 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
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 8)	
Sub-quaternary reach	D73A – 02933 (Unnamed trib. Of Soutloop River)
Proximity to the assessment area	Traverses the central portion
Assessed by expert?	NA (Ephemeral)
PES Category Median	NA
Mean Ecological Importance (EI) Class	Low
Mean Ecological Sensitivity (ES) Class	NA
Stream Order	1
Default Ecological Class (based on median PES and highest EI or ES mean)	Low to Very Low

Detail of the Assessment area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The assessment area 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 4 & 5)	According to the NFEPA Database there are numerous natural wetland features located within the eastern portion of the assessment area, and numerous natural wetland features and two artificial wetlands situated within the investigation area. The majority of these wetlands are classified as depressions and flat wetlands, and the artificial wetlands are classified as a seep wetland and an unchanneled valley bottom wetland. At the time of the database collation the natural wetlands are considered in a natural or good condition (Class AB) while the artificial wetlands are considered as heavily to critically modified (Class Z3).
Wetland Vegetation Type (Figure 6)	The majority of the assessment area falls within the Eastern Kalahari Bushveld Group 3, although a portion of the western section of the assessment area falls within the Eastern Kalahari Bushveld Group 4 WetVeg type, both of which are considered Least Threatened (Mbona *et al.* 2015).
NFEPA Rivers (Figure 4)	An unnamed tributary of the Soutloop and Skeifonteinspruit Rivers traverses the central portion of the assessment area and is known locally as the Welgevondenspruit. According to the NFEPA Database the unnamed tributary is considered in a natural or good ecological condition (Class AB), and largely natural (Class B) according to the PES 1999 Classification. The unnamed tributary is further classified as a FEPA river.
Detail of the Assessment area in terms of the Northern Cape Critical Biodiversity Areas (2016) (Figure 7)	
Critical Biodiversity Area (CBA): Category 1	The middle section of the assessment area falls within an area identified as a Category 1 CBA, which seems to be a buffer associated with the unnamed tributary of the Soutloop and Skeifonteinspruit Rivers. Critical Biodiversity Area (CBA) 1 areas are areas that are considered irreplaceable or near-irreplaceable (i.e. high selection frequency) for meeting biodiversity targets. There are no or very few other options for meeting biodiversity targets for the features associated with these areas.
Ecological Support Area (ESA)	Small western portions of the assessment area falls within areas identified as ESAs. According to the Technical Guidelines for CBA Maps document ESAs are areas that 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 the 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).

<table>
<tr><th colspan="2">Detail of the Assessment area in terms of Mining and Biodiversity Guidelines (2013)</th><th></th></tr>
<tr><td rowspan="2">According to the mining and biodiversity guidelines database (2013), the CBA1 area identified by the Northern Cape CBA Map (2016) is classified as an area considered of highest biodiversity importance (Figure 9).

Implications for mining: Environmental screening, EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide a site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision making for mining, water use licences, and environmental authorisations. If they are confirmed, the likelihood of a fatal flaw for new mining projects is very high because of the significance of the biodiversity features in these areas and the associated ecosystem services.</td><td>Other Natural Areas (ONA)</td><td>The majority of the assessment area falls within an area that is identified as ONAs.

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).</td></tr>
<tr><td>CBA Reasons</td><td>The Northern Cape Critical Biodiversity Areas (2016) database also includes the “reasons” layer, which is based on the planning units used in the spatial analysis and provides a list of biodiversity and ecological features found in each planning unit, which contribute to the biodiversity target (CBA Map Reason Metadata).

According to this Northern Cape Critical Biodiversity Areas Reasons layer, the triggering biodiversity and ecological features for the CBA and ESAs within the Assessment area include the below:
All natural wetlands; FEPA catchment; Conservation Areas; Landscape structural elements; Postmasburg Thornveld; Kuruman Mountain Bushveld</td></tr>
<tr><th colspan="3">National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figures 10 & 11)</th></tr>
<tr><td colspan="3">According to the NBA 2018: SAIIAE there are numerous depression wetlands located within the assessment and investigation areas. The two artificial wetlands identified by the NFEPA Database are classified as dams according to the NBA Dataset. The depression wetlands are either in a natural or good ecological condition (Class AB), moderately modified (Class C) or in a heavily to critically modified ecological condition (Class DEF) – these are affected by mining activities, according to the NBA Dataset. The wetlands currently have no threat status (Ecosystem Threat Status (ETS)) – mainly due to limited field assessment data collected for these wetlands at the time the dataset was collated, and are poorly protected (Ecosystem Protection Level (EPL)). According to the NBA Dataset the unnamed tributary of the Soutloop and Skeifonteinspruit Rivers is not protected (EPL) and considered endangered (ETS). Furthermore, at the time of the data collation for the NBA Dataset (2018), the unnamed tributary must have been dry as it was rendered data deficient.</td></tr>
<tr><th colspan="3">National Web Based Environmental Screening Tool (2020).</th></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td colspan="3">According to the screening tool the overall aquatic sensitivity of the assessment area and surrounds is very high due to the area being classified as a FEPA catchment, the presence of wetlands and the assessment area 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 assessment area is located within the Southern Ghaap Plateau groundwater SWSA (Figure 12).

The Strategic Water Source Areas for groundwater (SWSA-gw) reflect areas that have high groundwater recharge and where the groundwater forms a nationally important resource. The areas are delineated for the purposes of research, and the outcomes are useful to national level planners and decision makers as an indication of the location of strategic groundwater sources and resources. Sub-national WSAs for groundwater were also identified.</td></tr>
</table>

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; EPL = Ecosystem Protection Level; ES = Ecological Sensitivity; ESA = Ecological Support Area; ETS = Ecosystem Threat Status; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitatio; NBA = National Biodiversity Assessment; NFEPA = National Freshwater Ecosystem Priority Areas; ONA = Other Natural Areas; PES = Present Ecological State; SAIIAE = South African Inventory of Inland Aquatic Ecosystems; SWSA = Strategic Water Source Areas; WMA = Water Management Area;

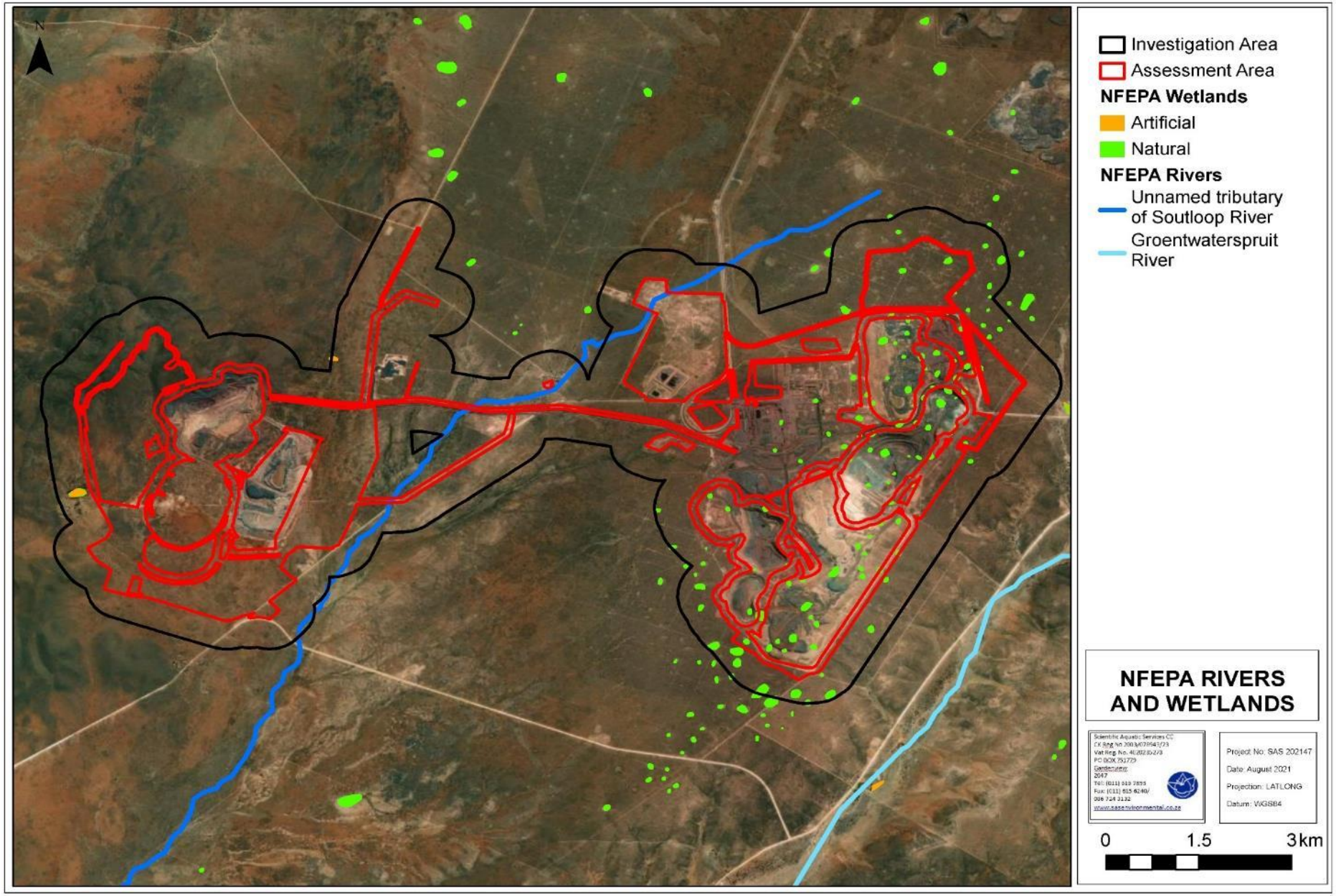


Figure 4: The rivers and wetland features associated with the assessment area and investigation area (NFEPA, 2011).

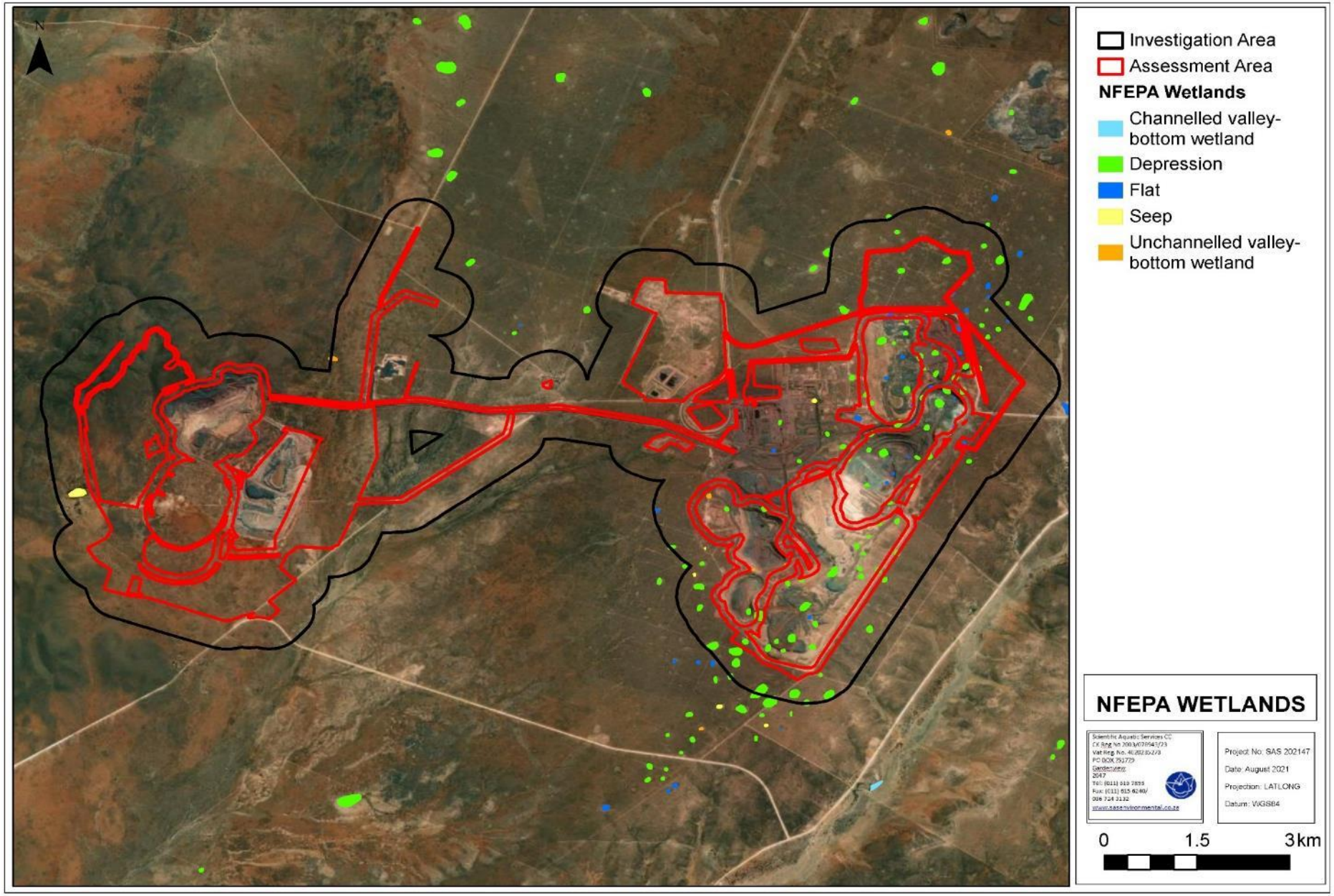


Figure 5: The various hydrogeomorphic units associated with the assessment area and investigation area (NFEPA, 2011).

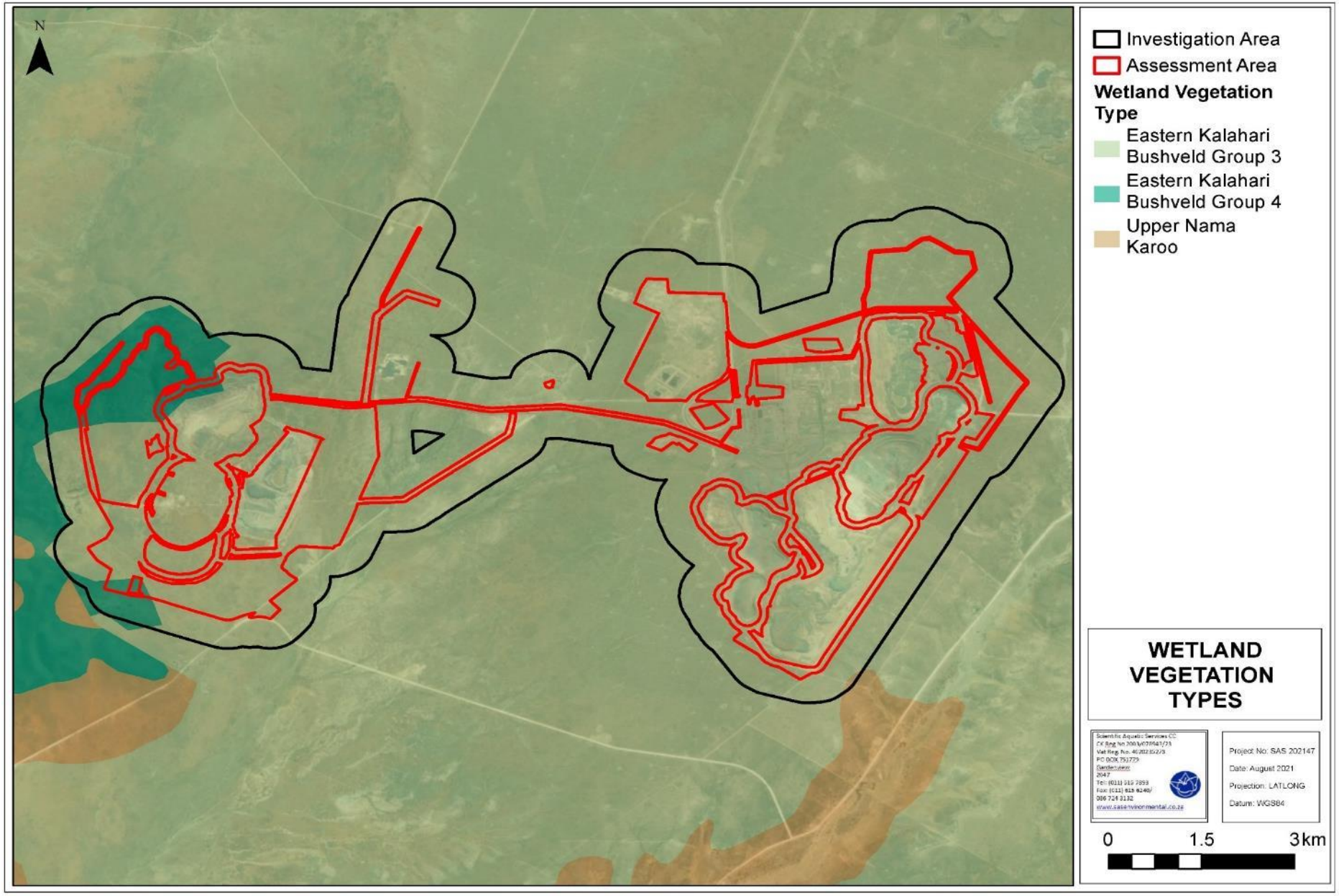


Figure 6: The WetVeg Types applicable to the assessment area according to NFEPA (2011).

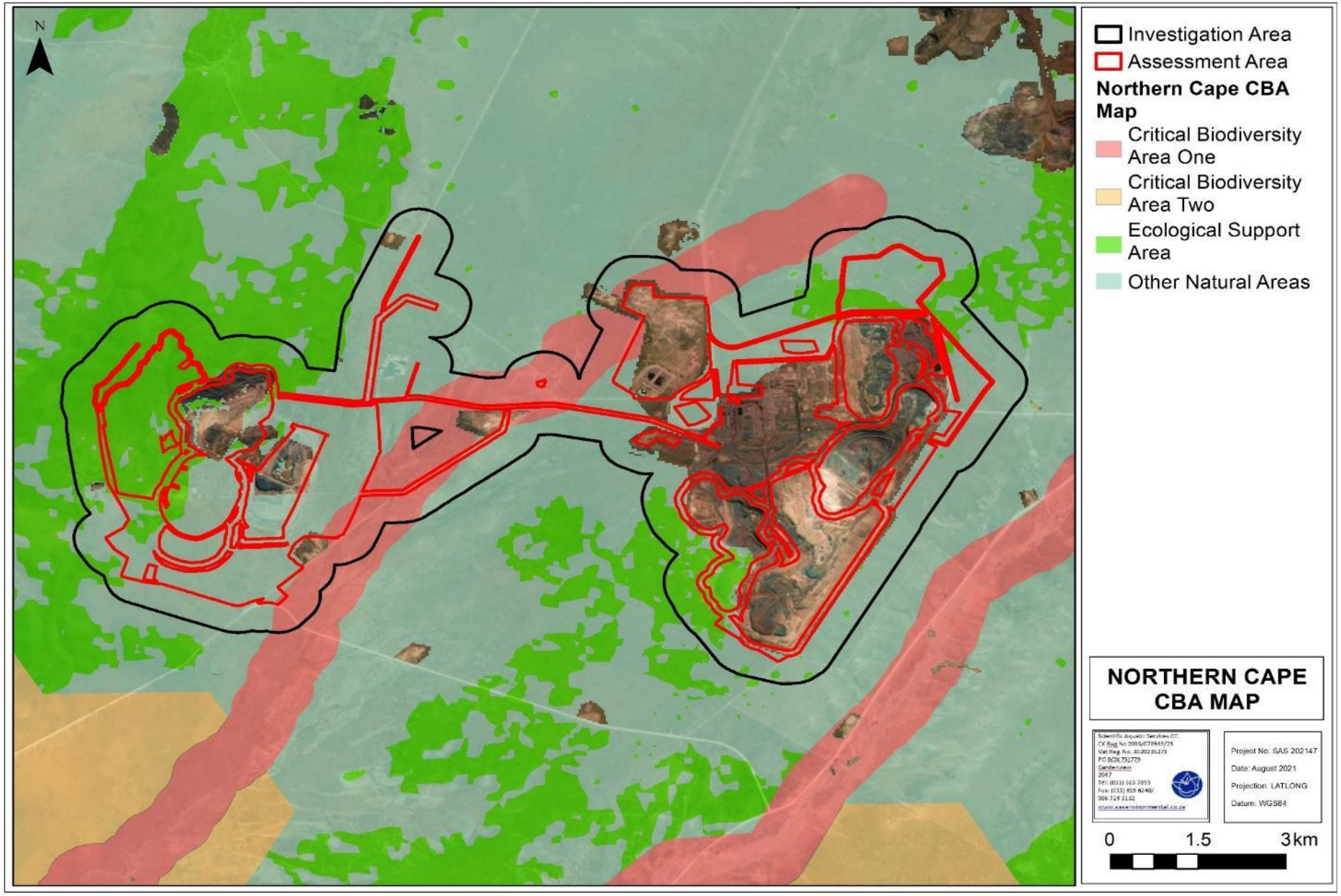


Figure 7: Critical Biodiversity Areas associated with the assessment area as per the Northern Cape Critical Biodiversity Area dataset (2016).

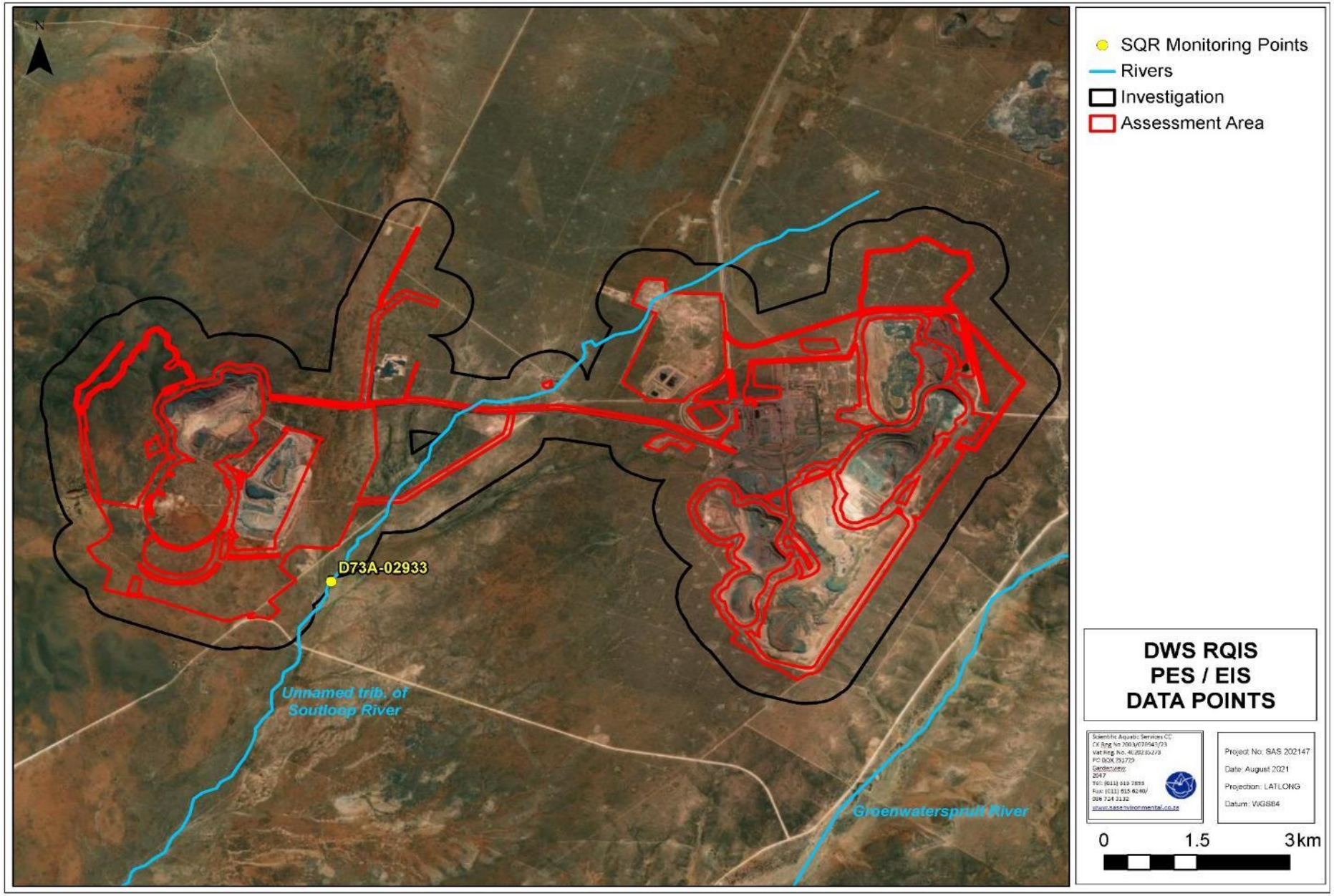


Figure 8: Relevant SQR Monitoring Points associated with the assessment area and investigation area.

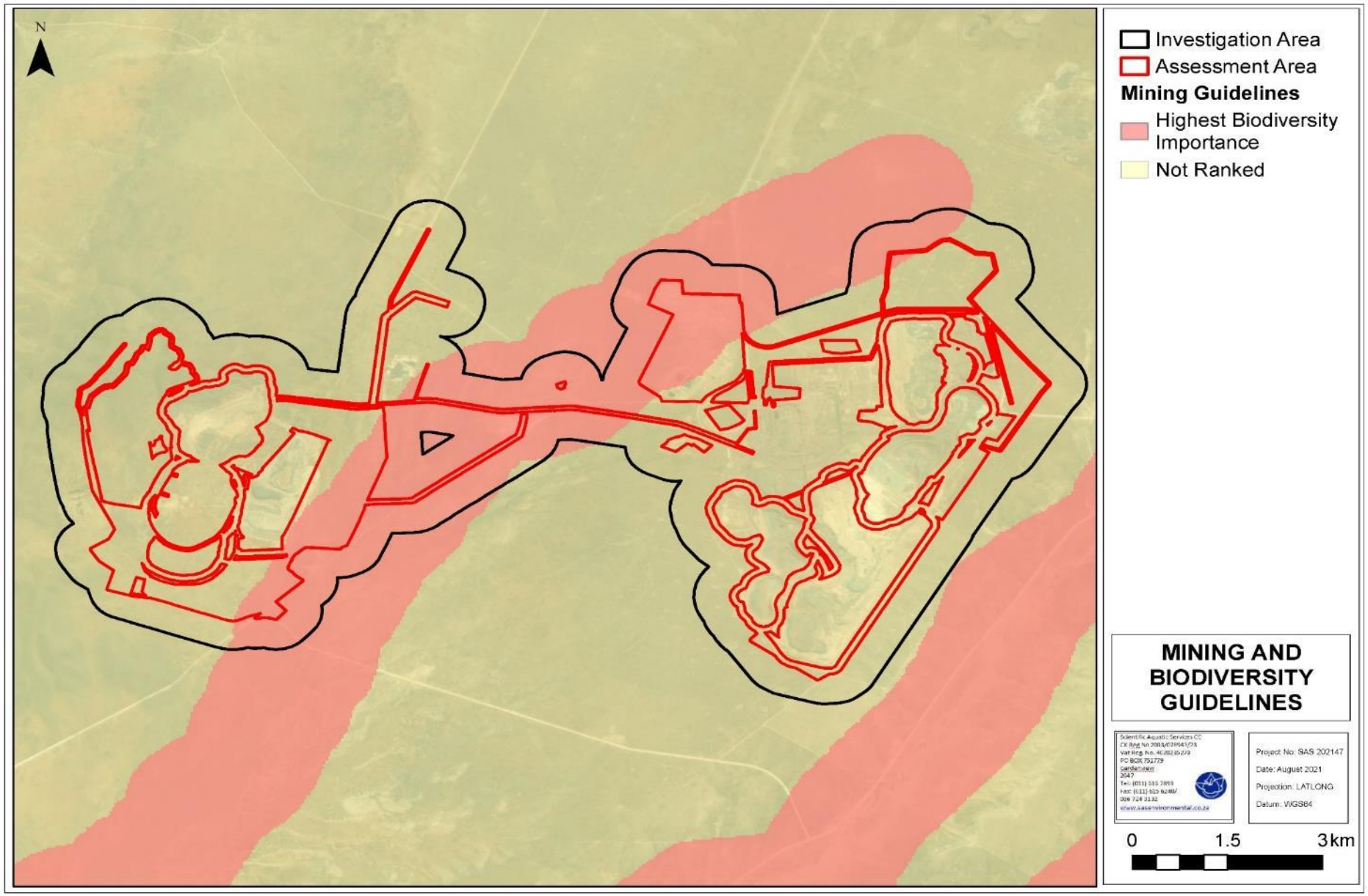


Figure 9: The highest biodiversity importance areas associated with the assessment and investigation areas, according to the Mining and Biodiversity Guidelines (2013).

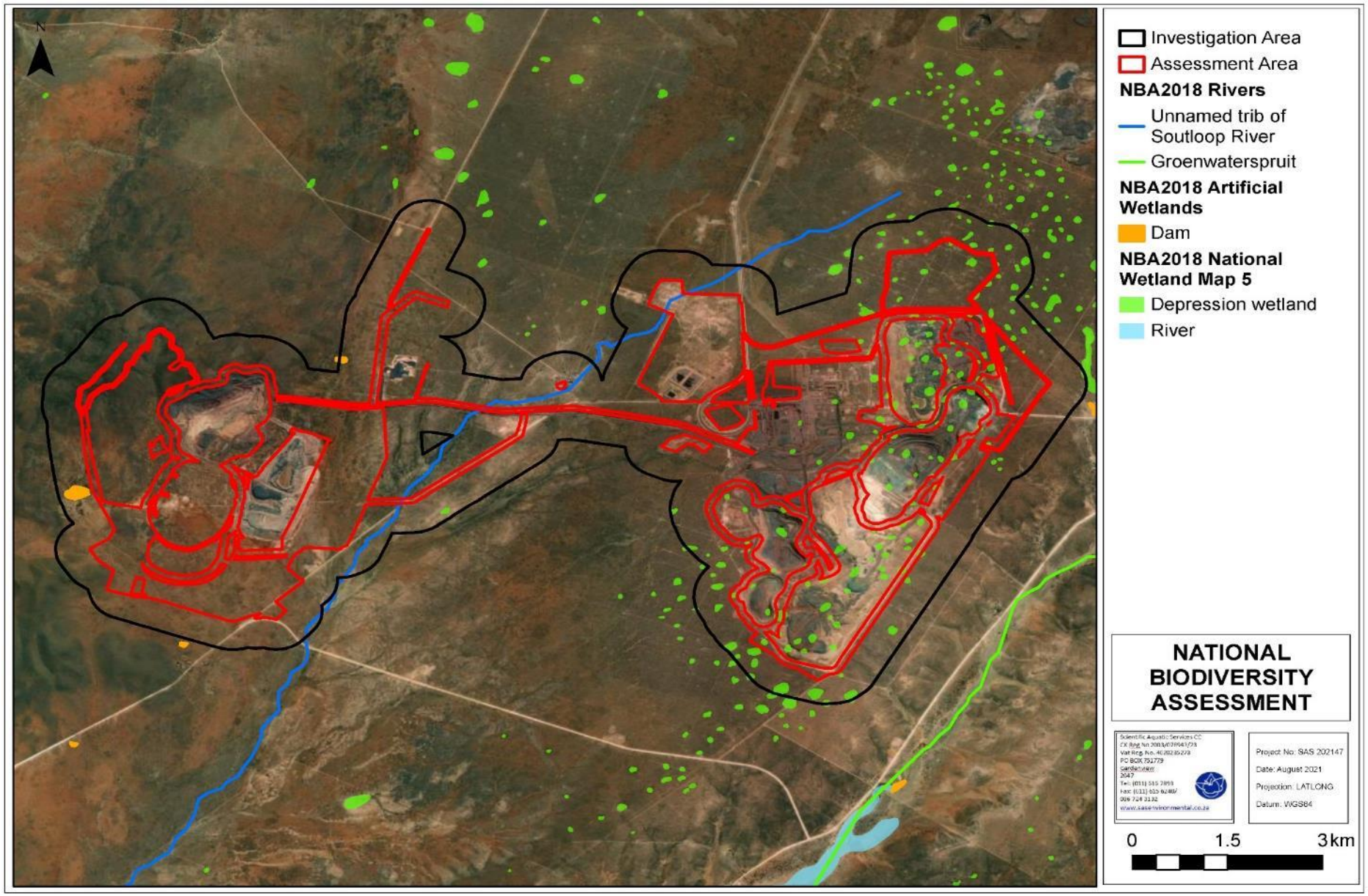


Figure 10: The National Biodiversity Assessment 2018 indicating natural and artificial wetlands and the rivers associated with the assessment area and investigation area.

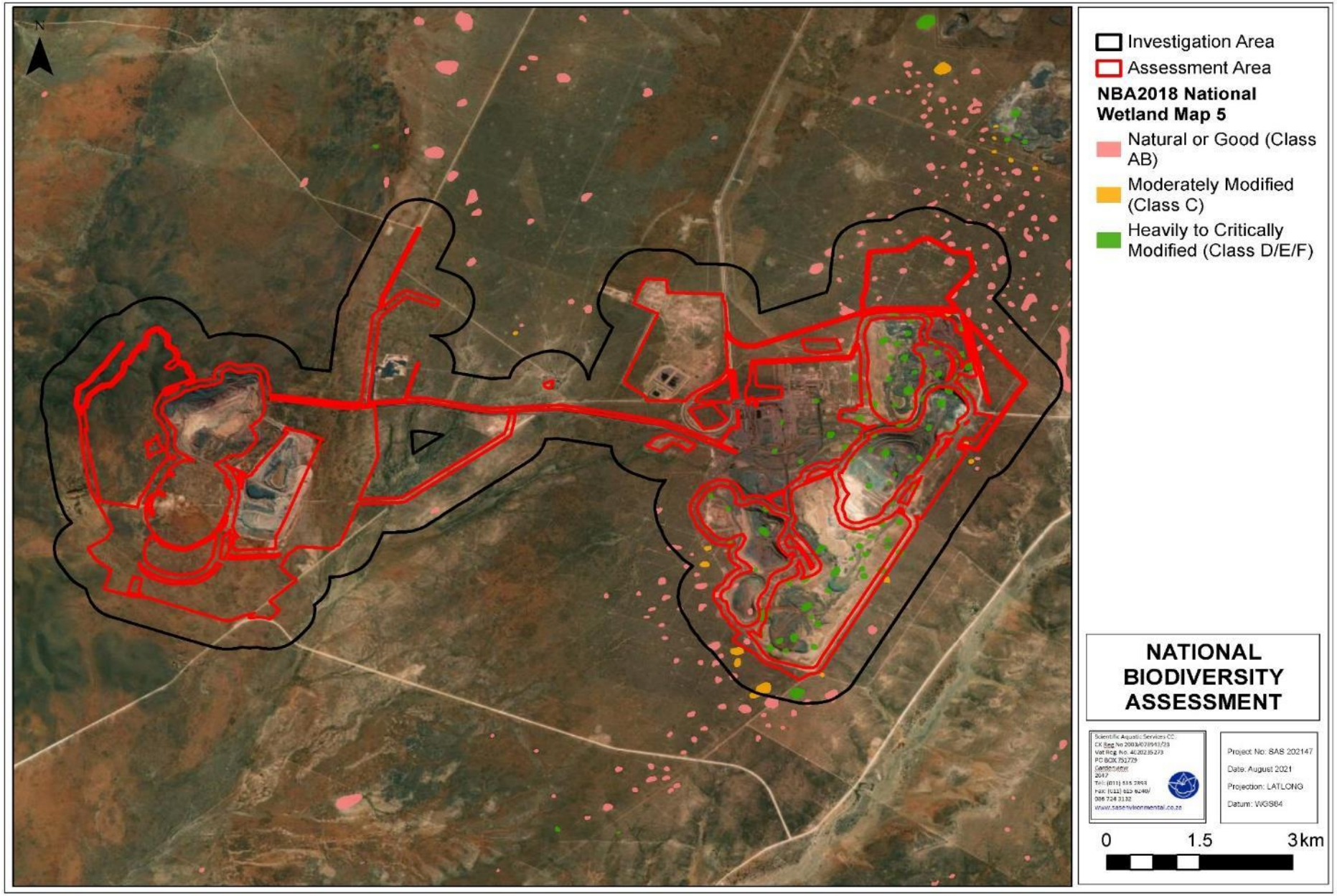


Figure 11: The condition of the wetlands associated with the assessment area and investigation area (NBA, 2018).

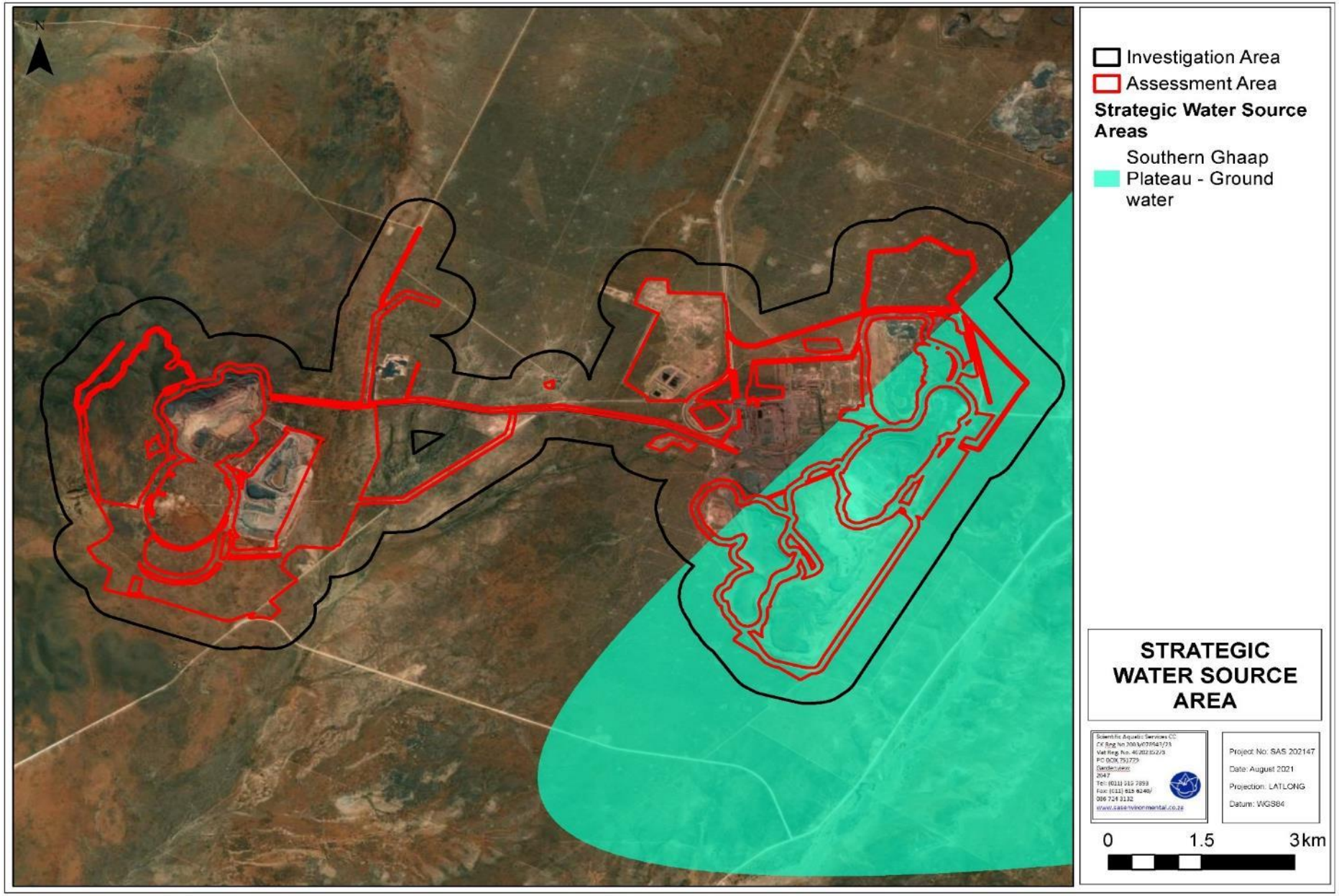


Figure 12: The Strategic Water Source Area applicable to assessment area according to the National Biodiversity Assessment 2018.

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 National Water Act, 1998 (Act No. 36 of 1998), but was absent throughout the assessment area, 75 features identified within the assessment area are nevertheless defined as "cryptic" wetlands as per Day *et al*, (2010). During the field assessments undertaken, numerous features were ground-truthed by the specialist and defined as either cryptic wetlands, seasonal depressions, episodic drainage lines with riparian vegetation or preferential flow paths without riparian or wetland characteristics. The characterisation of these features is discussed in greater detail in Section 4.2 below.

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. Fifty-five cryptic wetlands were identified within the assessment 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;
- ***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 assessment area, the absence of obligate[2] floral species was expected. 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*;
- ***Vegetation associated with riparian zones*** of the episodic drainage lines was distinctly different from the surrounding upland areas in terms of both species composition and community structure. The riparian zones were often poorly-defined in some sections, but nevertheless were considered sufficiently distinct vegetation communities associated with the episodic drainage lines to provide a clear indication of the boundaries, enabling delineation of the drainage lines.

Although the cryptic wetlands identified in the assessment 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 assessment 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 of 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).

Thus, it is the opinion of the specialist that the cryptic wetlands identified in the assessment 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.

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

4.2 Characterisation of the Watercourses and Drainage Features

As noted above, numerous features displaying visual indicators of increased wetness were investigated during the site assessment and categorised according to their dominant characteristics, primarily topography, vegetation and soil characteristics. Of these features, 75 were defined as “cryptic wetlands”, 123 as “seasonal depressions”, several episodic drainage lines with riparian vegetation including those associated with a system locally referred to as the Welgevondenspruit and various unnamed tributaries of the Groenwaterspruit, and one extensive preferential flow path (lacking in either wetland or riparian characteristics).

Seasonal Depressions

The seasonal depressions (Figure 13 and Figures 16 to 19 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 13: Examples of a seasonal depression identified. The presence of woody species in the centre of the feature is notable in the photographs.

Preferential Flow Path

The large preferential flow path illustrated in Figure 14 and indicated in Figure 16 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. However, should a 1 in 100 year floodline be modelled for this preferential flow path, it will meet the legal definition of a watercourse and enjoy the relevant protection as such.

Figure 14: Representative photographs of the large preferential flow path situated east of the Kapstevel Atpit Footprint Expansion.

Anthropogenically derived linear features

Three linear features, two of which are hydraulically linked to naturally occurring linear watercourses, were identified. These are thought to have originated subsequent to the commencement of mining operations (based on historical aerial imagery and the distinctly different characteristics of these features in comparison to naturally occurring features, such as the presence of *Typha capensis* which typically does not occur in arid areas).

Figure 15: Representative photographs of an anthropogenically derived linear feature located to the west of the mine's administration buildings.

Neither the seasonal depressions, the preferential flow path nor the anthropogenically derived features met the definitions of "cryptic wetlands" or watercourses from an ecological perspective (as defined by the National Water Act, 1998 (Act No. 36 of 1998)) and were therefore excluded from further assessment. Nevertheless, should any of these features be found to possess a 1 in 100 year floodline, from a legal perspective they would be considered as watercourses and would enjoy protection as such.

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 and Group 4 Wetland Vegetation (WetVeg) group, both 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: Characterisation of the "cryptic wetlands" identified within the assessment 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 assessment area and proposed mining expansion areas in the figures below.

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 episodic drainage lines and cryptic wetlands situated within the proposed expansion footprint area and within 200 m thereof. Those situated further than 200 m were not deemed to be at risk of being impacted by the proposed expansion activities and were therefore not assessed and thus not assigned a numerical reference.

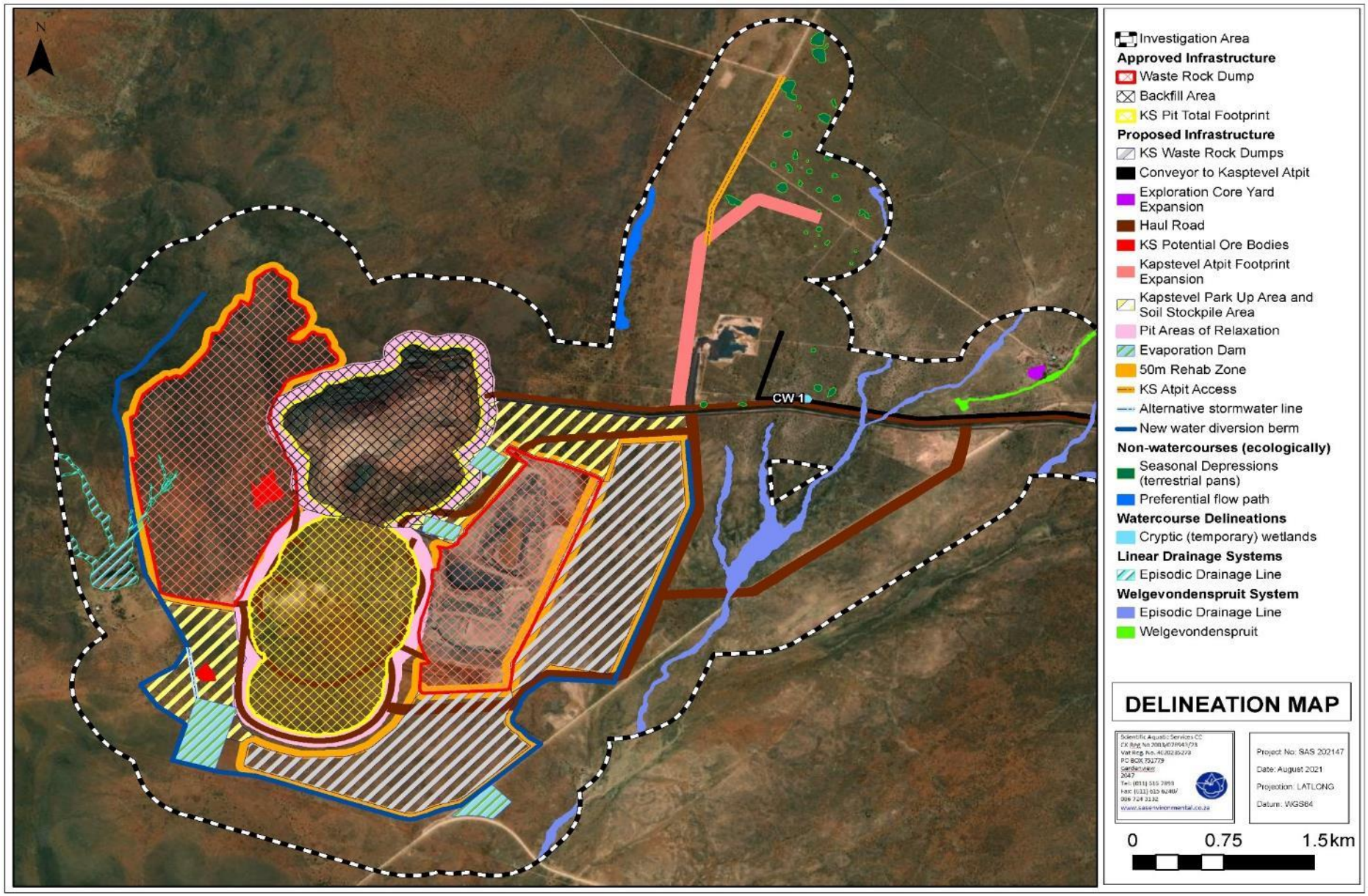


Figure 16: The location of the delineated episodic drainage lines, seasonal depressions, cryptic wetlands and preferential flow path within the north-western portion of the assessment area.

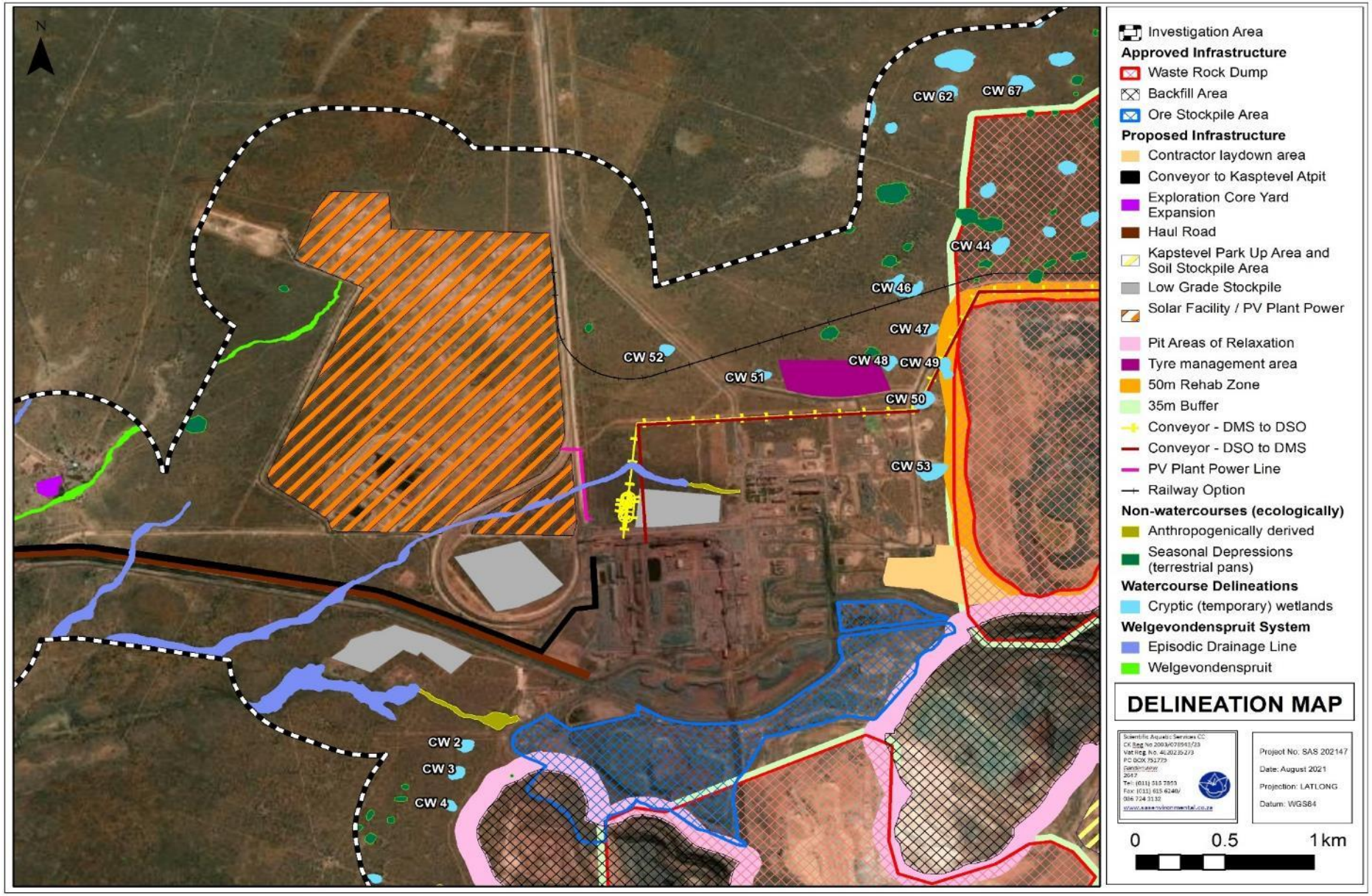


Figure 17: The location of the delineated cryptic wetlands (CWs), episodic drainage lines, anthropogenically derived drainage features and seasonal depressions within the central-eastern portion of the assessment area and investigation area.

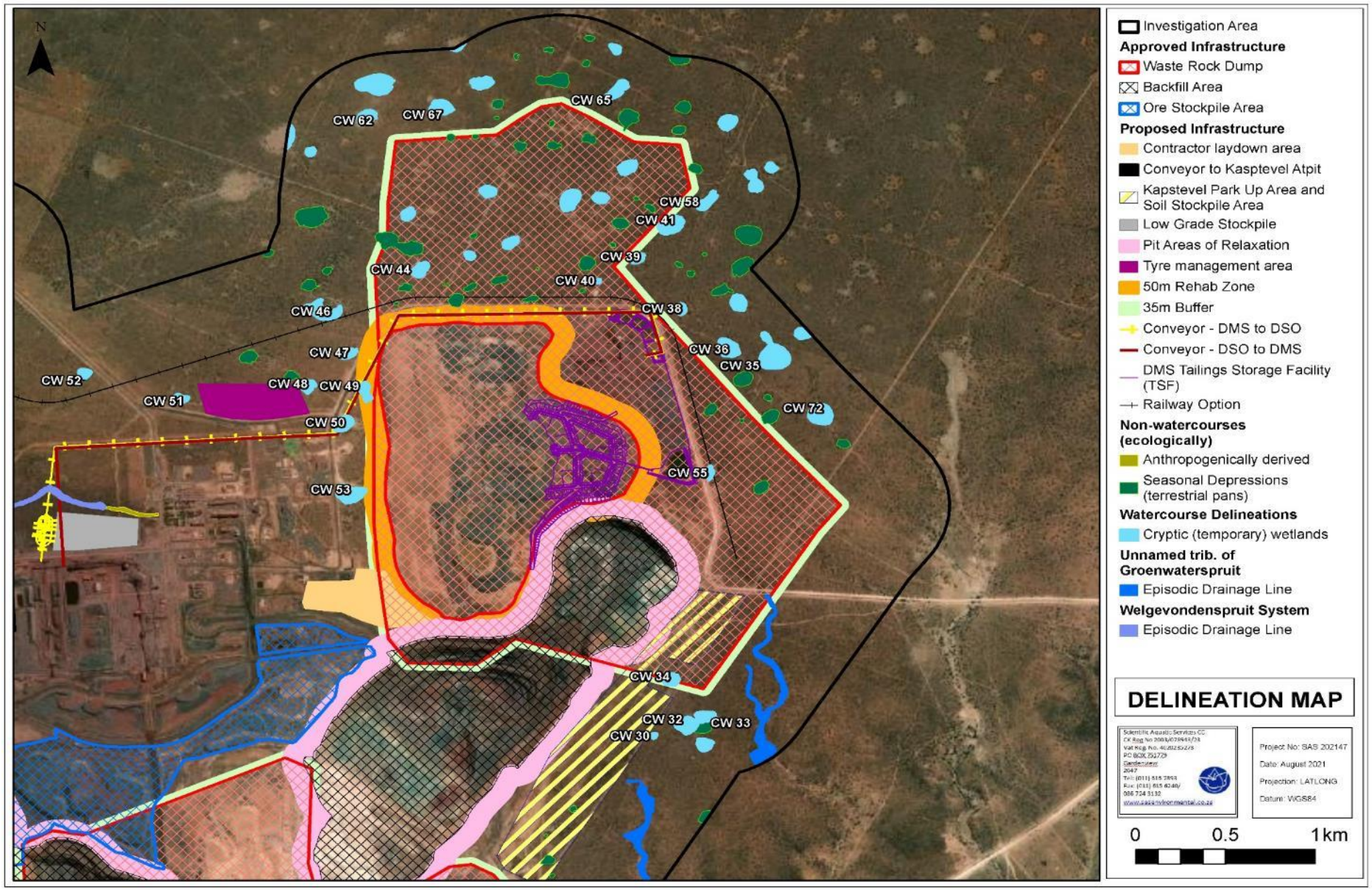


Figure 18: The location of the delineated cryptic wetlands (CWs), episodic drainage lines, seasonal depressions within the north-eastern portion of the assessment area and investigation area.

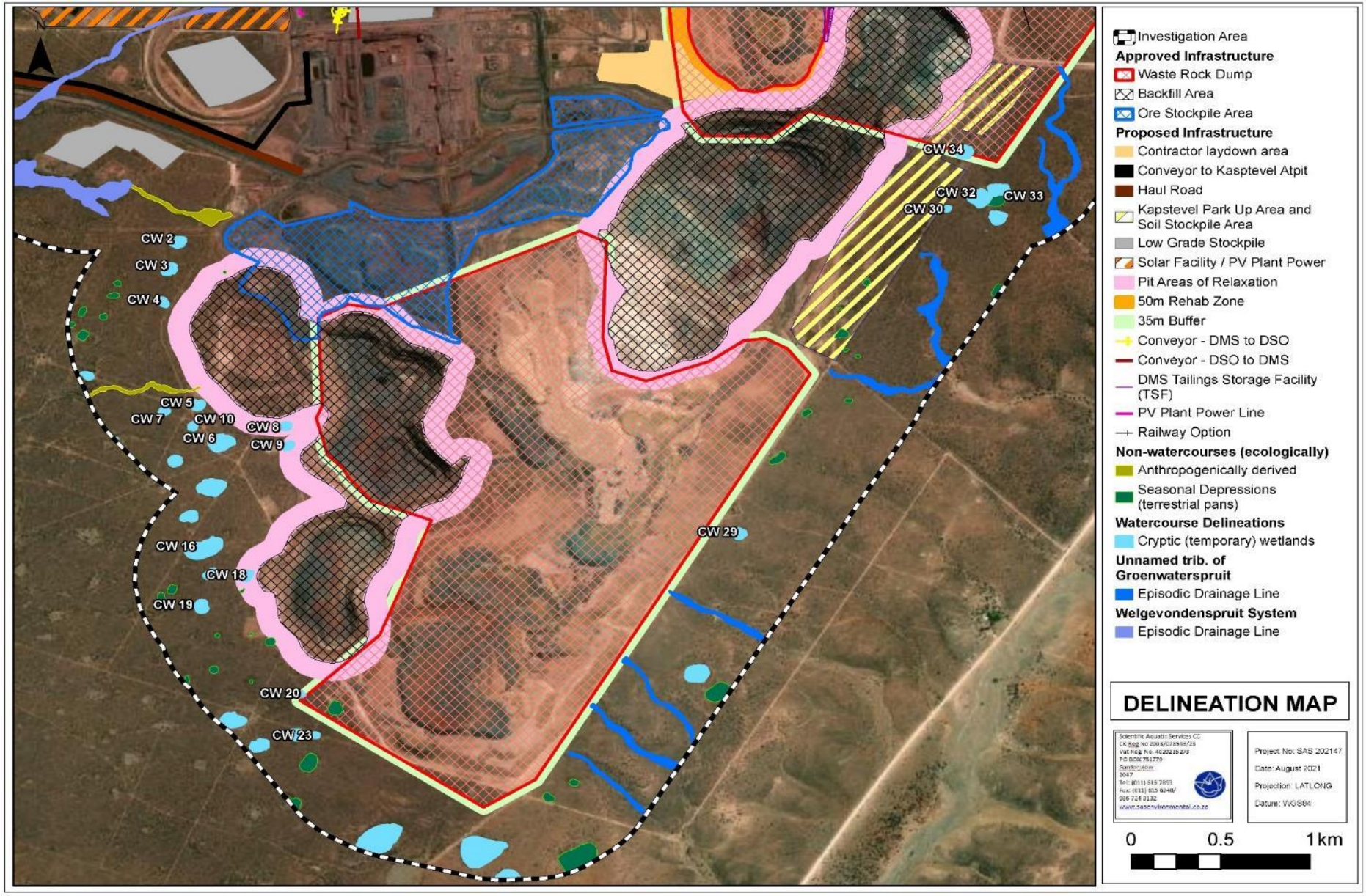


Figure 19: The location of the delineated cryptic wetlands (CWs), episodic drainage lines, and seasonal depressions within the south-eastern portion of the assessment area and investigation area.

4.3 Field Verification Results

4.3.1 Watercourses located within the proposed mining expansion footprint or 200 m thereof

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.

The applicable indices used to determine the PES and EIS were applied to the various watercourses per grouping summarised below. As the nature and extent of impacts noted throughout the assessed areas are deemed to be similar and minimal, it is the opinion of the specialist that application of the various indices to each individual CW or episodic drainage line is not likely to yield significantly different results to those obtained; where it was deemed to be possible the watercourse was assessed separately. The detailed assessment results are presented in Appendix E of this report and summarised in the tables below. For the purposes of presenting a concise discussion, the assessment results are presented in 'dashboard style' reports below; one dashboard per group of episodic drainage lines, and one dashboard for all CWs.

For assessment purposes, the watercourses were grouped as follows:

- Episodic drainage line 1: a network of small, episodic drainage lines situated in the far west of the assessment area;
- Welgevondenspruit system: a network of episodic drainage lines which form part of the network feeding the system locally referred to as the Welgevondenspruit, which ultimately flows into the Soutloop River approximately 9 km south-west of the assessment area;
- Unnamed tributaries of the Groenwaterspruit: several small episodic drainage lines located to the east of the existing mining activities which flow into the Groenwaterspruit, located approximately 1 km east of the assessment area;

- Cryptic Wetland 1 (CW 1): an isolated cryptic wetland in the west, which will be traversed by the proposed conveyor to the Kapstevel Atpit;
- Cryptic Wetland 2 (CW 2): located approximately 200 m to the west of the existing ore stockpile area, this wetland was assessed separately as it is clear that the modifiers to this wetland are slightly different to those of the other wetlands;
- Cryptic Wetlands Group 3, comprising CWs 3 to 10, 16 to 20, and CW 23. These are located to the west of the existing ore stockpile area and open pit (which will in due course be the Klipbankfontein Backfill Area);
- Cryptic Wetlands Group 4, comprising CWs 29, 30, 32, 33 and 34 (CW 34 is also known locally as Leeuwpan) located to the east of the existing open pit. CWs 30, 32, 33 and 34 are also located east of the proposed Kapstevel Park Up Area and Soil Stockpile Area;
- Cryptic Wetlands Group 5, comprising CWs 35, 36, 38, 39, 40, 41, 44, 46 to 53, 62, 65, 67 and 72. These are situated to the north-east and north-west of the existing open pit, which will in time become the Leeuwfontein north WRD (already approved) and DMS TSF, and are also associated with the proposed 35 m rehabilitation buffer around the approved Leeufontein North WRD expansion and the eastern portion of the proposed railway option; and
- Cryptic Wetland 55: this wetland is located on the eastern boundary of the existing pit and was assessed separately as it was clear from historical digital satellite imagery that it has been compromised to a greater degree than the other wetlands.

The results of the PES and EIS assessments of the cryptic wetlands per group are summarised in Table 3 below and discussed in Table 7:

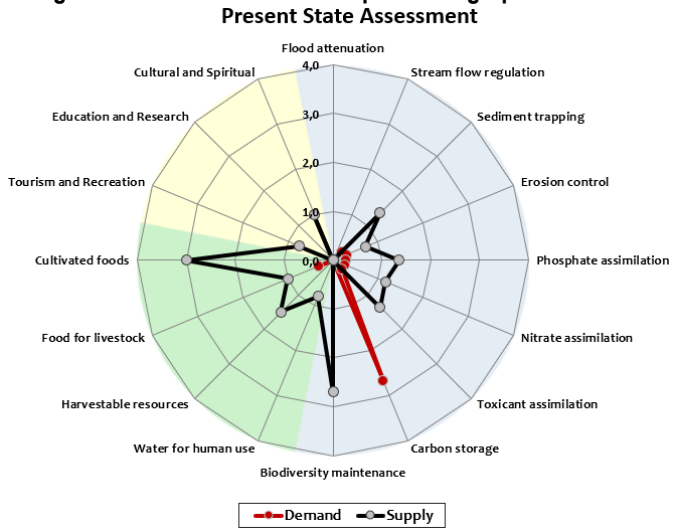
Table 3: Summary of the PES and EIS assessments applied to the Cryptic Wetlands.

Cryptic Wetland Grouping	PES Category	EIS Category
CW 1	B (1.08)	High
CW 2	B (1.57)	High
CW Group 3	B (1.08)	High
CW Group 4	B (1.26)	High
CW Group 5	B (1.11)	High
CW 55	D (4.71)	High

Tables 4 to 7 provide a summary of the ecological assessment of the above mentioned watercourse groups in terms of relevant aspects (hydrology, geomorphology and vegetation components) associated with the watercourses. It should be noted that although the WET-Ecoservices tool calculated a high score for the supply of cultivated foods in all HGM units, this is a function of the availability of organic soils and the absence of saturated soils both of

which are considered suitable conditions for crop cultivation. However, no crops are grown in the HGM units. It should also be noted that streamflow regulation is excluded from the suite of services assessed for riparian areas owing to a lack of relevant studies (Kotze *et al*, 2020).

Table 4: Summary of the assessment of the network of episodic drainage lines in Episodic Drainage Line 1, identified within the western portion of the proposed mining expansion footprint areas.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td colspan="2"> 
Figure 20: Representative photographs of two of the small episodic drainage lines comprising the ‘Episodic Drainage Line 1” network.</td></tr>
<tr><td>PES/ discussion</td><td>PES Category:
IHI: B
VEGRAI: C
The network of small episodic drainage lines comprising ‘Episodic Drainage Line 1’ have been subjected to very few modifiers. Encroachment of Senegalia mellifera has likely transformed the riparian zones associated with the drainage systems in terms of flora community species composition and structure. However, very few alien species were observed in this area, and although there have been some impacts to the flow paths as a result of the creation of new roads and associated vegetation clearing these impacts are isolated in extent. The modifier likely to have impacted the most on the system is the impoundment thereof; this is clearly a historical impoundment associated with previous agricultural activities in the vicinity and has led to hydraulic isolation of the upper reaches of the drainage lines.</td><td>Ecoservice provision</td><td>Moderately low
The absence of water for much of the year reduces reliance on the drainage lines from both a faunal (biodiversity) and human perspective, as well as being the primary limiting factor in the provision of ecological services such as nutrient and toxicant assimilation, sediment trapping and flood attenuation. Contribution to the functioning of downstream systems can no longer occur as a result of an impoundment located within the drainage line.</td></tr>
<tr><td>EIS discussion</td><td>EIS Category: Moderate
Although the numerous small episodic drainage lines in this network are limited by water availability in terms of providing various ecoservices, they nevertheless provide habitat and migratory cover for fauna, particularly as they are located relatively far from disturbances and have good connectivity to surrounding undisturbed areas.</td><td>REC, RMO & BAS Category (All CWs)</td><td>REC Category: B/C
BAS: B/C (Maintain)
RMO: B/C (Maintain)
Based on the proposed infrastructure layout provided by the proponent, the majority of these drainage lines should remain relatively unaffected by the proposed activities, with the exception of approximately 3 ha of the eastern section of the drainage lines which will be affected by the approved “KS South WRD Approved EG Dump” and the proposed new water diversion berm. Thus, it should be possible to maintain the PES class, although there is likely to be a reduction in the score obtained when applying the IHI and VEGRAI assessment tools.</td></tr>
</table>

Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):	
The primary modifier of the hydraulic regime is the impoundment of the drainage network, which has caused the upper reaches of the drainage lines to become hydraulically isolated from the lower reaches. It is therefore very unlikely that any hydraulic link to the downstream system remains; any remaining link will be tenuous and will only flow in the case of sustained periods of high rainfall (which are rare in the region). However, aside from the impoundment, few to no impacts on the hydraulic regime were noted. The geomorphological regime has similarly been impacted by the impoundment as this has resulted in altered topography of the lower reach of the drainage network. Additional impacts noted included the early stages of construction of new gravel access roads in the east, presumably required for access to the approved and proposed new infrastructure. Some sediment deposition was noted in the lower reaches, however it was considered to be the result of natural processes. The absence of surface water at the time of assessment precluded water quality testing. Given the relatively remote locality and the absence of mining activities in the local catchments of each drainage line, it is likely that when present, water quality is likely to be unimpaired. Bush encroachment by *S. mellifera* has occurred throughout the area surrounding the drainage lines, leading to altered floral characteristics. Although a graminoid layer was observed in many sections of the surveyed drainage lines, it was apparent that bush encroachment has led to a reduction in the graminoid and forb layer that was present along the drainage systems associated with the Welgevondenspruit and unnamed tributaries of the Groenwaterspruit (refer to Tables 5 and 6). Nevertheless, the drainage lines comprising Episodic Drainage Line 1 are well-connected to surrounding undisturbed areas and as such, provide migratory cover for fauna.	
Extent of modification anticipated	Approximately 3 ha of the eastern portion of the network is likely to be partially or wholly transformed when the approved KS South WRD Approved EG Dump is constructed (not assessed as part of this report). As such, construction of the proposed new water diversion berm, the only activity as part of the amendments that is anticipated to impact on this drainage line, is likely to have minimal impact. Although the loss of habitat resulting from these two infrastructure areas may lead to loss of recharge of the remaining lower reach of the system, the diversion of clean water around the WRD is likely to compensate for the loss of recharge. Thus, the extent of modification anticipated is low to medium.
Impact Significance & Business Case:	
Construction **Low**	The construction of the proposed water diversion berm is anticipated to result in low significance impacts, as the actual encroachment of the berm on the episodic drainage line is minimal. Although the risk assessment did not assess the risk significance of the previously approved Kapstevel South WRD, as the activity has already been authorised, the eastern reaches of the network of the episodic drainage line will ultimately be infilled by the WRD and therefore, loss of habitat and recharge area will occur even without construction of the water diversion berm.
Operation **Medium**	However, the operation of the diversion berm may lead to long-term loss of catchment yield, placing downgradient freshwater ecosystems under further moisture stress, thus the operational phase risk significance is deemed to be 'medium'. Mitigation measures are presented in Section 5 of this report, and include the following key measures: • The clean water diversion structure must be designed to accommodate a peak flow expected for a minimum 1 in 50 year flood event; • The stormwater outlet should be constructed from energy dissipating structures (such as Armorflex or reno mattresses) to slow down the velocity of water inflow into the downgradient areas; • After construction of the outlet, the area surrounding the outlet should be re-seeded with indigenous wetland vegetation; and • Monitoring of the edges of the diversion structures for erosion and incision and alien vegetation control is essential throughout the life of the project.

Table 5: Summary of the assessment of the episodic drainage lines comprising the Welgevondenspruit system in the central portion of the assessment area.

Ecological & socio-cultural service provision graph:

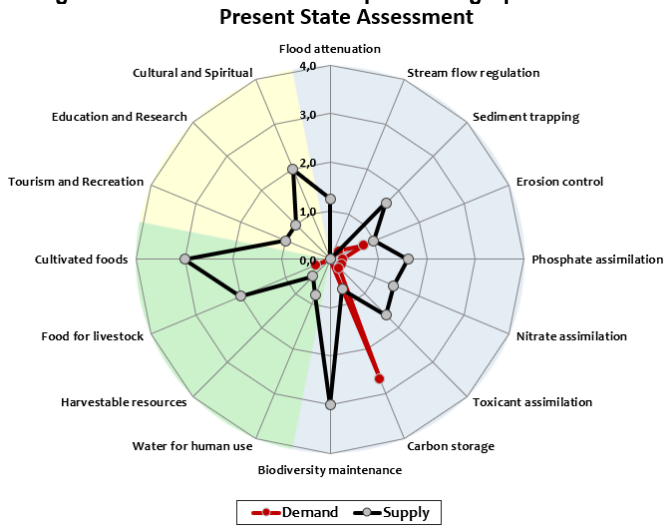


Figure 21: Representative photographs of an episodic drainage line forming part of the larger Welgevondenspruit drainage system (left) and a section of the Welgevondenspruit, north-east of the existing Exploration Core Yard (and proposed expansion thereof).

PES/ discussion	**PES Category:** **IHI: B** **VEGRAI: C** The various drainage lines comprising the Welgevondenspruit drainage system have been minimally modified, except where historical agriculture and current mining operations have resulted in impacts. These include the impoundment of the Welgevondenspruit (most likely utilised as a farm dam pre-mining activities) which, in conjunction with mine roads has resulted in no discernible hydraulic connection to the downstream reach of the system. Artificial release of water into two of the smaller episodic drainage lines in the eastern portion of the system were noted during the site assessment; however, due to high temperatures and rate of evapotranspiration in the area, the water does not flow into the downstream reaches of the system.	**Ecoservice provision**	**Marginally low** The Welgenvondenspruit system provides various ecological services, albeit at a moderately low level, primarily due to the absence of surface water for most of the year. Nevertheless, when water is present to transport nutrients and toxicants, these will be assimilated throughout the system to a degree, whilst the relatively dense riparian and instream vegetation cover will aid in flood attenuation in the event that sufficient water is in the system.
EIS discussion	**EIS Category: Moderate** The Welgevondenspruit system is deemed moderately ecologically important primarily for the connectivity it provides to undisturbed areas especially to the south of the assessment area and to the Soutloop River. It is likely to be sensitive to increased flood peaks, for example if discharge of mine process water was to occur into the system on a regular basis this would lead to altered ecological structure and processes.	**REC, RMO & BAS Category (All CWs)**	**REC Category: B/C** **BAS: B/C (Maintain)** **RMO: B/C (Maintain)** Several proposed linear structures (conveyors, haul roads) will traverse the various episodic drainage lines which comprise the Welgevondenspruit system, whilst other infrastructure such as the propose solar PV plant and low-grade stockpiles will be within 100 m thereof. Care must be taken therefore to ensure that direct and indirect impacts are mitigated to minimise the potential for reduction of the PES class.

Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):	
The hydraulic regime of the various episodic drainage lines in the Welgevondenspruit system has been modified by the historical impoundment of the Welgevondenspruit itself, as well as by various mine road crossings, the latter of which allow hydraulic connectivity via culverts. In the lower reaches of the system, few modifiers were observed, although it is clear that as the topography to the south levels out, hydraulic connectivity is likely to decrease as water (when present) slows and spreads out rather than being channelled. Similarly, few modifiers of the geomorphic processes were observed, with the primary impacts noted including the impoundment as well as increased sediment inputs particularly in the portions of the drainage lines within approximately 300 m of mining operations. This is likely due to wind-borne sediment generated by blasting and movement of vehicles reaching and settling in the drainage lines. When surface water is the result of precipitation and not originating within the mine, water quality within the drainage lines is likely to be relatively unimpaired although increased turbidity and elevated Electrical Conductivity may occur in the vicinity of mining operations. Although faunal activity and migration along the sections of the drainage lines located close to mining operations is likely to be minimal, the drainage lines nevertheless provide important refugia and migratory corridors between the northern and southern portions of the assessment area and greater Mining Right Area (MRA). Various avifauna species were noted at various assessment sites along the drainage lines including a pair of owls (most likely *Bubo africanus* (Spotted Eagle Owl) although species could not be confirmed due to the distance of the observer from the birds) in the norther-most reach of the Welgevondenspruit approximately 800 m from the existing Exploration Core Yard. Floral assemblages within the marginal and non-marginal zones are dominated by indigenous species, primarily graminoid species.	
Extent of modification anticipated	Should the proposed PV plant within the centre of the existing railway loop to the west of the existing administration buildings proceed, there is potential for approximately 1.5 ha of episodic drainage line to be directly impacted and impacts to this section of the drainage line may lead to the desiccation of the section upstream of the proposed PV plant. The design of the proposed solar PV in that area specifically will need to be carefully considered and as much as possible, direct impacts to the drainage line avoided. The proposed linear infrastructure (conveyors and roads) may potentially have localised impacts on the drainage lines particularly during the construction phase. Overall, the extent of modification of the various drainage lines associated with the proposed infrastructure is likely to be low to moderate (the latter is assuming that appropriate mitigation measures are not implemented).
Impact Significance & Business Case:	
Low	The significance of risks posed to the various episodic drainage lines comprising the Welgevondenspruit system range from low to medium, depending on the nature of the activity. The construction of linear infrastructure crossings (haul roads and conveyors) may result in medium risk significance however the operation of such infrastructure is likely to be of low significance. Assuming that care is taken during the planning phase to avoid placing infrastructure within the episodic drainage line or 32 m thereof within the solar PV area, risk significance is anticipated to be low during both construction and operation. Although the risk significance of the construction of the proposed expansion of the exploration core yard was calculated to be 'medium', this is partially due to the encroachment of the expansion on the regulated zone of the watercourse, and this risk can be easily mitigated through good planning and strict implementation of simple mitigation measures such as erection of a silt trap downgradient of construction activities. Detailed mitigation measures for the various activities associated with the Welgevondenspruit system are provided in Section 5.
Medium	

Table 6: Summary of the assessment of the various unnamed tributaries of the Groenwaterspruit.

Ecological & socio-cultural service provision graph:

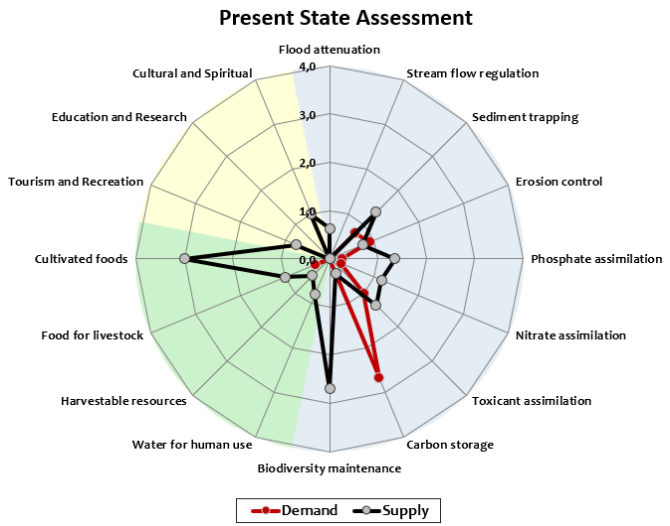


Figure 22: Representative photographs of the northern-most unnamed tributary of the Groenwaterspruit, illustrating a weakly defined riparian zone largely dominated by graminoid species with isolated woody species lining the marginal zones.

PES/ discussion	**PES Category:** **IHI: B** **VEGRAI: B/C** The various tributaries of the Groenwaterspruit are episodic drainage lines characterised by poorly defined riparian zones which are dominated by graminoid species and isolated woody species within the marginal zone. Few discernible impacts were noted, although proximity to current mining operations (between 50 m to 200 m) may result in increased sediment loads primarily transported by wind.	**Ecoservice provision**	**Marginally low** Ecological service provision is limited by the absence of water for most of the year, naturally sparse vegetation cover as well as the extent of these drainage lines. Nevertheless, they are deemed important contributors to biodiversity maintenance (refer to drivers and receptors discussion below) and will contribute, albeit minimally, to functions such as recharge of the Groenwaterspruit, trapping of sediment and assimilation of excess nutrients and toxicants.
EIS discussion	**EIS Category: Moderate** Although the tributaries of the Groenwaterspruit have limited opportunity to provide various ecological services, they nevertheless contribute to recharge of the downstream system when surface water is present and provide connectivity to open areas south-east of the mine.	**REC, RMO & BAS Category (All CWs)**	**REC Category: B/C** **BAS: B/C (Maintain)** **RMO: B/C (Maintain)** The headwaters of one of the unnamed tributaries is located within the expansion footprint of the approved Leeuwfontein north WRD, and the headwaters of four tributaries are located within the proposed 50 m rehabilitation zone around the existing Dump BD - Leeuwfontein WRD south footprint. Direct and indirect impacts arising from these activities could potentially lead to lowered ecological integrity and therefore the implementation of site-specific mitigation measures is essential if the PES and EIS are to be maintained.

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

Few discernible impacts or modifiers were noted, with the exception of a few gravel road crossings which have very localised impacts. Wind-borne sediment from the adjacent mining activities may contribute to an altered sediment balance within the drainage lines, although at the time of assessment there was no visual evidence of this.

Although poorly-defined, the riparian zones associated with the drainage lines comprised predominantly indigenous species, and there was no indication of bush encroachment or alien vegetation. It is important that going forward, activities in the vicinity of these drainage lines be carefully managed to ensure that there is no spread of alien vegetation which could over time spread further downstream. Whilst small in extent in comparison to other drainage systems in the assessment area, the unnamed tributaries provide important faunal breeding and foraging habitat. During the assessment, one individual of *Ardeotis kori* (Kori Bustard) was observed near the northern-

most drainage line. This is a species listed as "Near Threatened" by the National Biodiversity Assessment (2018) and the IUCN (2021) and is a protected species in terms of the Threatened or Protected Species regulations, 2007 (GN152 in Government Gazette 29657 of February 2007 as it relates to the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)).	
Extent of modification anticipated	No direct impacts to the various unnamed tributaries of the Groenwaterspruit are anticipated as a result of the proposed expansion activities. Those sections of the unnamed tributaries located in the rehabilitation buffers may benefit from rehabilitation activities and therefore, no negative modification is expected as long as care is taken to ensure that heavy machinery or vehicles associated with the rehabilitation activities do not move through the drainage lines as this may lead to various unintended localised impacts,
Impact Significance & Business Case:	
Low	As none of the proposed expansion activities encroach on the unnamed tributaries, no direct risks associated with the proposed expansion are anticipated. Risks associated with previously authorised activities were not assessed. Care must be taken during the construction and operation of the proposed Kapstevel park up and soil stockpile area to ensure that edge effects do not occur. Detailed mitigation measures for this activity are provided in Section 5.

Table 7: Summary of the assessment of the various cryptic wetlands within the proposed expansion footprint and within 200 m thereof.

Ecological & socio-cultural service provision graph:

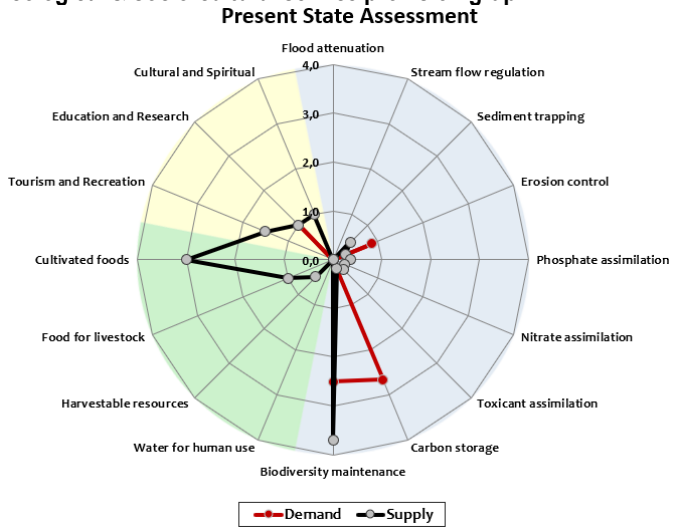


Figure 23: Representative photographs of one of the larger cryptic wetlands in the assessment area, CW 34, known by mine personnel as "Leeuwpan" located adjacent to the proposed Kapstevel park up area and soil stockpile area.

PES/ discussion	**PES Category: B and D (CW 55 only)** The majority of assessed cryptic wetlands have been subjected to impacts similar in nature and extent. Few discernible impacts to the cryptic wetlands were noted, with the exception of CW 2 and CW 9 which appear to occasionally receive water originating from the mine (based on observation of digital satellite imagery; no water was present in either at the time of assessment), and CW 55 which has been reduced in extent by approximately 50% by a haul road which traverses it. Floral assemblages and geomorphological characteristics are in keeping with the wetland type which is commonly found in the region.	**Ecoservice provision**	**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'. Although no 'charismatic' species or Species of Conservation Concern (SCC) were observed at the time of assessment, the limitations posed by the duration of the assessment 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 SCC may occur within, or utilise, the cryptic wetlands.
EIS discussion	**EIS Category: Moderate** The CWs 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, many flora in this region, particularly geophytic species, have restricted growth and flowering periods and may not have been identified due to the season of assessment.	**REC, RMO & BAS Category (All CWs)**	**REC Category: B** **BAS: B (Maintain)** **RMO: B (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 expansion and therefore, maintenance of the PES of those CWs 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):			
The majority of the assessed CWs have been subjected to minimal impacts. Impacts that have occurred include various informal road crossings, increased sediment inputs (most likely wind-borne), and slightly altered catchment characteristics (e.g., where topography has been locally altered by the construction of a road). Some CWs, such as CW 2, CW 9, and CW 55, have undergone slightly more severe impacts, although this is only apparent in the PES classification of CW 55 due to the loss of a portion of that wetland.			

With the exception of CW 55, few impacts to the geomorphological regimes of the wetlands were observed, although it is likely that wind-borne sediment inputs occur as a result of dust generation during blasting and due to vehicle movement throughout the mine. This could over time pose a serious risk to the wetlands closest to the active mining areas, as water retention capacity may decrease due to sediment accumulation and increased sedimentation could also affect biota as macroinvertebrate egg-banks and flora may be smothered.

Water quality could not be assessed at the time, however it is probable that when present, surface water in those wetlands further than 100 m from the mining operations will be relatively unimpaired, whilst surface water in those closer to mining activities may have elevated turbidity and Electrical Conductivity due to increased sediment deposition.

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 some CWs, indicating potentially increased faunal activity when surface water is present.

Whilst little to no faunal species were observed within the assessed CWs during the site visit, 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 the assessed CWs cannot be ruled out without further investigation. However, the University of the Free State undertakes regular biomonitoring of some of the cryptic wetlands within the greater Kolomela MRA (personal communication, D. van der Merwe, EXM, January 2021; personal communication I. Gouws, Kolomela, June 2021), confirming that various invertebrates are known to occur in the wetlands. Should macroinvertebrate egg banks be present in the CWs which will be directly impacted by the proposed expansion activities, 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. Such a rescue and relocation plan could potentially form part of and offset initiative, should it be required by the relevant authority.

Extent of modification anticipated	The extent of modification will vary, depending on the nature of the proposed activity and proximity to affected wetlands. CWs 8, 9, and 18: These are located within the pit area relaxation buffer and may be subjected to various impacts as a result. However, with suitable mitigation, the extent and severity of impacts can be reduced and adequately managed to prevent ecological degradation. CWs 1, 46, 49, 50, and 55 will be traversed by conveyors and the proposed railway option (for CWs 49 and 55 this is on the premise that the approved Leeuwfontein north WRD does not extend into those areas). Linear infrastructure poses a lower threat to the integrity of the wetlands than for example infilled infrastructure such as the WRD; however, as observed at CW 55 linear infrastructure nevertheless can impact negatively if not mitigated for. CW 41 is partially located within the 35 m rehabilitation buffer around the approved Leeuwfontein north WRD expansion footprint. Should it be affected by the expansion of the WRD then rehabilitation measures will need to be implemented although it is not possible to specify measures until it is known what modifications have occurred. Should the WRD expansion not be undertaken, then CW 41 should remain largely unaffected by current mining activities. The remaining CWs, located between 20 m to 200 m of the proposed and existing activities are not expected to be subjected to serious impacts or to undergo extensive modification.
Impact Significance & Business Case:	
Low	Various cryptic wetlands are either directly or indirectly at risk from the proposed expansion activities, and the risk significance is dependent on the nature of the activity and the proximity thereof to affected wetlands. It should be noted that risks associated with the rehabilitation buffers were not assessed as insufficient detail was available at the time to inform a risk assessment. When rehabilitation activities take place, it is recommended that general 'good housekeeping' mitigation measures be implemented, such as visibly demarcating the cryptic wetlands to prevent unauthorised access. Similarly, the pit relaxation area was excluded from the risk assessment as no activities are planned within that area, as it is demarcated as an area of safety, to prevent unauthorised access. Activities which directly traverse cryptic wetlands, such as haul roads, conveyors and the railway option, pose a 'medium' risk during construction however, operational phase risks are deemed to be lower, largely because of the semi-arid climate which minimises the volume of stormwater runoff (whether clean or dirty) entering the various cryptic wetlands. Sedimentation of the cryptic wetlands is a noted risk, as this is more likely to be wind-borne than transported in stormwater runoff and may lead to altered characteristics of the cryptic wetlands as well as smothering biota and macroinvertebrate egg banks. Dust suppression is therefore a key mitigation measure throughout the mining area to minimise this risk. Detailed mitigation measures per activity are provided in Section 5.
Moderate	

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 various watercourses. 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 8: 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.

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 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.
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 assessment area 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 activity footprint must fall outside of the 1 in 100 year floodline of the aquatic resource or 100 m from the edge of the resource, whichever distance is the greatest. Authorisation for activities within the regulated zone must be obtained.

The Zones of Regulation outlined in the table above are conceptually depicted in Figures 24 – 27 below.

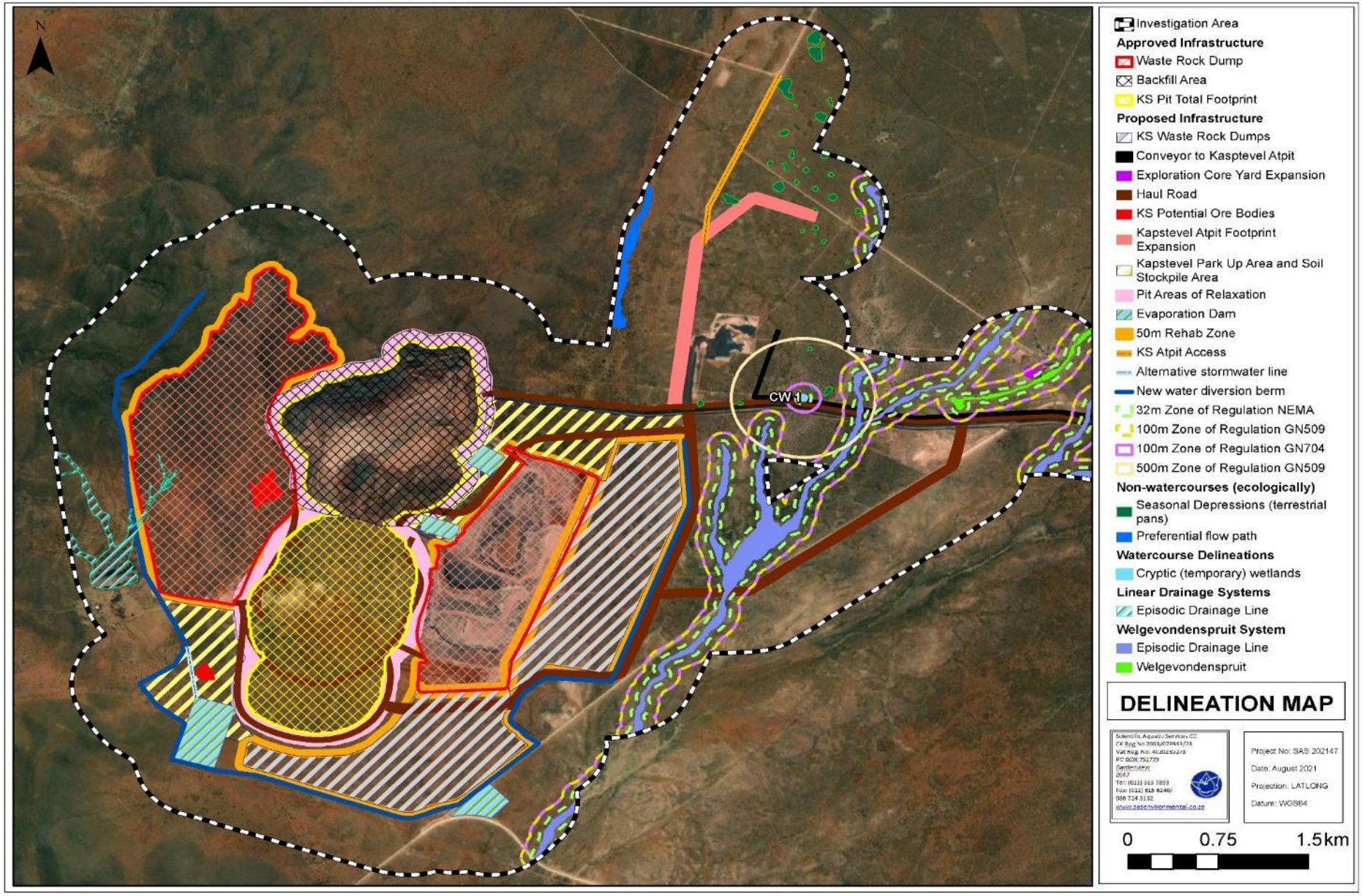


Figure 24: Conceptual presentation of the zones of regulation in terms of NEMA, GN704 and GN509 of 2016 as they relate to the NWA in relation to the watercourses located in the western portion of the assessment area.

Figure 25: 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 watercourses located in the central-eastern portion of the assessment area.

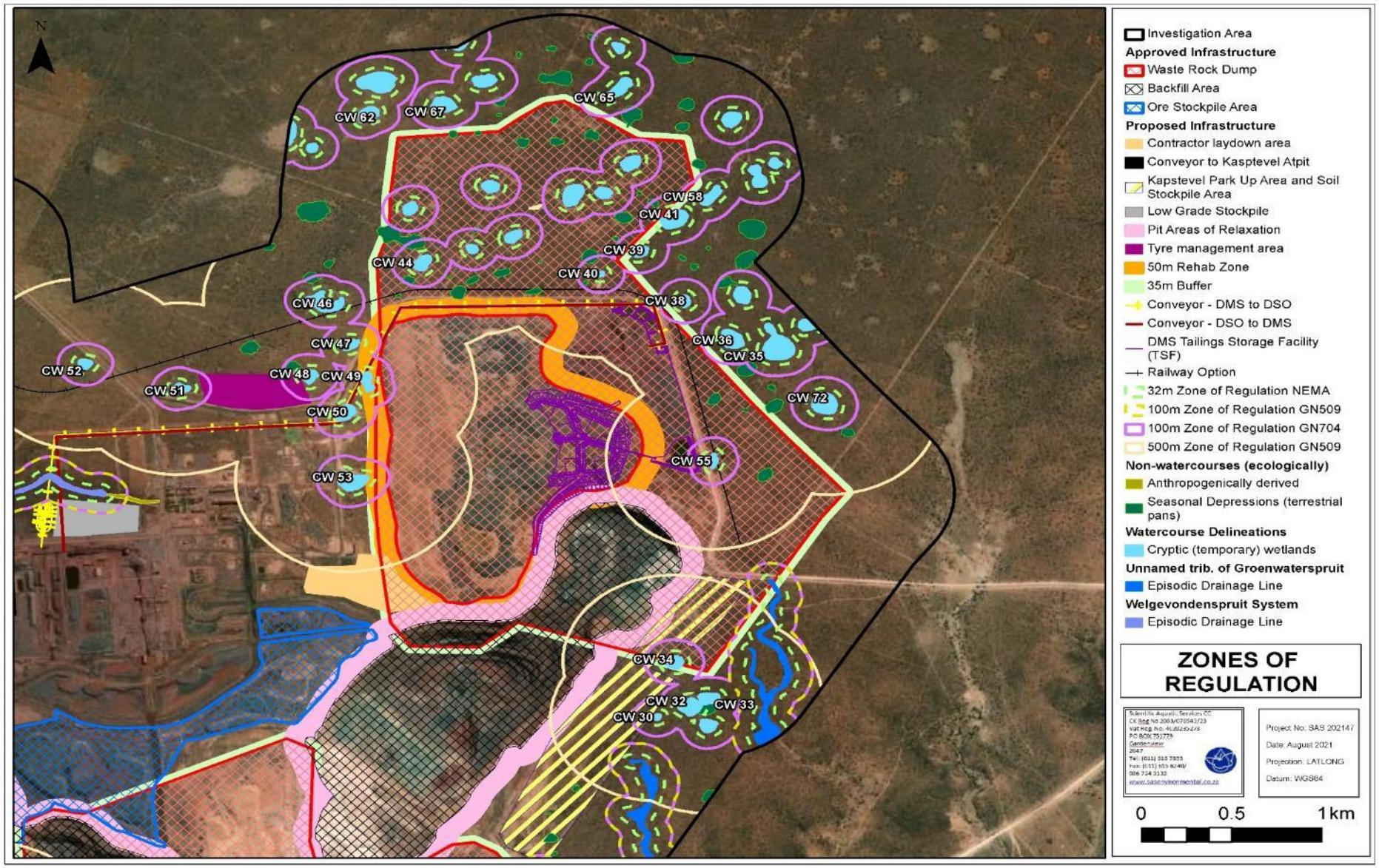


Figure 26: Conceptual presentation of the zones of regulation in terms of NEMA and GN704 as it relates to the NWA in relation to the waterourses located in the north-eastern portion of the assessment area.

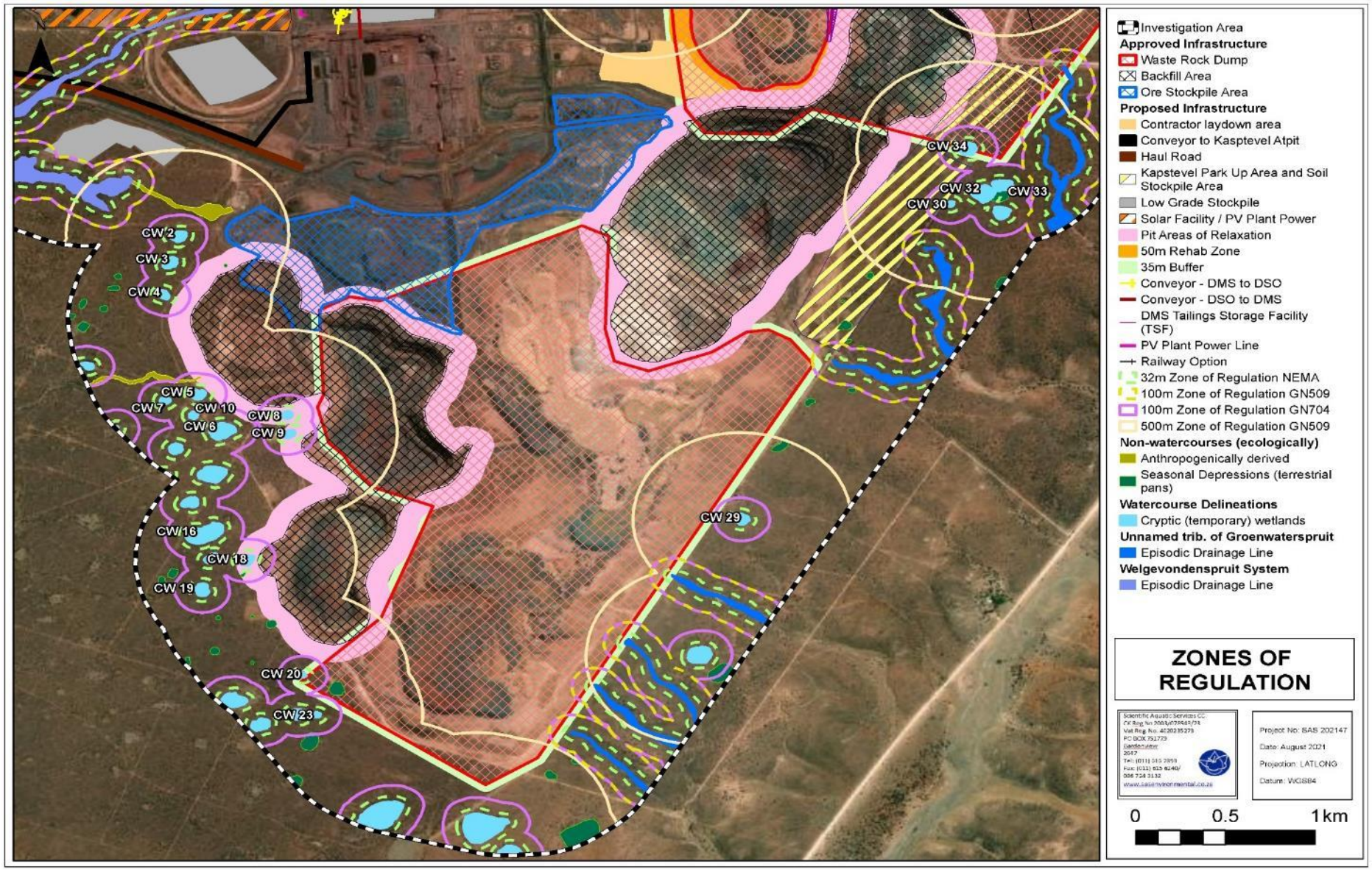


Figure 27: Conceptual presentation of the zones of regulation in terms of GN509 of 2016 as it relates to the NWA in relation to the watercourses located in the south-eastern portion of the assessment area.

5 RISK ASSESSMENT

This section presents the significance of potential impacts on the various watercourses associated with the proposed mining expansion activities. 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 August 2021;
- The Risk Assessment Matrix was only applied to proposed activities planned to occur outside existing mining areas, and those within 150 m of watercourses unless indicated otherwise. As such, the following activities were assessed:
  - Proposed haul roads;
  - Conveyors (Conveyor to Kapstevel AT Pit and from DMS to DSO);
  - Railway Option;
  - Expansion of Exploration Core Yard;
  - Tyre Management Area;
  - Kapstevel park up area and soil stockpiles; and
  - Solar PV plant (a generic assessment was undertaken as a detailed infrastructure layout was not available at the time of assessment, and this was based on the assumption that no infrastructure would be placed within the episodic drainage line or 32 m thereof).
- The pit relaxation area was not assessed, as it is presumed that as the intention of this area is to retain the area as a safety 'buffer', no activities will occur within it;
- Similarly, as detailed rehabilitation measures for the rehabilitation buffers were not available at the time of assessment, a risk assessment could not be undertaken for the rehabilitation buffers;

- 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 watercourses throughout the proposed expansion areas, this is unlikely to be achievable), minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- When assessing the risk significance of infrastructure placed within or directly traversing cryptic wetlands, the default sensitivity score (i.e, all drivers and receptors) is 5, thus resulting in a risk significance score in the 'medium' rating class. Due to the semi-arid climate of the region, it is highly unlikely that the flow regime and water quality of any watercourse is likely to be meaningfully affected by construction activities and to a certain extent by the permanent placement of infrastructure within the watercourse. Notwithstanding this, geomorphological processes, habitat and biota may be significantly impacted;
- 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 the cryptic wetlands which are indirectly affected is deemed feasible, rehabilitation/restoration of those CWs directly affected by the activities may be more difficult depending on the extent and nature of impact as well as the unique soil geological properties that support the cryptic wetlands. Thus, it is recommended that the proponent make provision for rehabilitation of any edge effects which might affect the watercourses(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 any wetlands which are irreversibly impacted during the life of mine.

5.1.2 Impact discussion and essential mitigation measures

There are four key ecological impacts on the watercourses 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 9: Summary of the results of the risk assessment applied to the watercourses associated with the proposed mining expansion activities.

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived Impacts: Haul Road (traverses episodic drainage lines within Welgevondenspruit system in four sections)												
1	**Construction**	Site preparation prior to construction / upgrade of roadway, including placement of contractor laydown areas and storage facilities.	*Vehicular transport and access to the site; *Site clearing; *Removal of vegetation and associated disturbances to soils; *Miscellaneous activities by construction personnel.	*Exposure of soil, leading to increased runoff, erosion and stream incision, and thus increased sedimentation of the watercourse; *Increased sedimentation of already transformed riparian habitat, leading to smothering of flora and benthic biota and potentially altering surface water quality; *Decreased ecoservice provision; and *Proliferation of alien vegetation as a result of disturbances.	**1,5**	**4,5**	**12**	**54**	**L**	80	*Contractor laydown areas, vehicle re-fuelling areas and material storage facilities to remain outside of the delineated watercourses and applicable setback area; *The watercourse areas outside of the construction/upgrade areas in which no proposed activities will occur, should be clearly demarcated by an ECO and marked as a no-go area.; *Construction footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential; *Vegetation removal to be kept to a minimum, and preferably only alien floral species to be removed; *Retain as much indigenous vegetation as possible; and *Only authorised maintenance personnel may be permitted to enter the watercourses as part of the clearing activities to prevent excessive compaction of the soils within the watercourse.	**Partially reversible**
2		Excavation within the watercourse for culvert foundations (where stipulated by hydrologist).	Possible temporary in-channel diversion of watercourses to allow for excavations and sealing of foundations to take place (only required if work is undertaken during the rainy season).	*Altered flow regime, leading to possible loss of recharge to downstream areas, impacting on downstream biota; *Possible incision/erosion in the vicinity of the diversion as a result of the (temporary) formation of a concentrated flow path; *Possible sedimentation of downstream areas during the diversion; and *Possible moisture stress to riparian vegetation downstream/downgradient of the diversion.	**1,5**	**5,5**	**13**	**71,5**	**M**	80	*All construction must take place during the dry season to limit potential impacts to the watercourse as a result of construction activities; *The duration of impacts on the freshwater areas 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 – therefore the construction period should be kept as short as possible; *Activity may result in bank destabilisation, and potential bank incision and sedimentation of the watercourses. Areas where bank failure is observed as a result of such stream crossings should be immediately repaired, and if necessary, protected by means of covering with a suitable geotextile until such time as rehabilitation and revegetation takes place; *Exposed soils to be protected by means of a suitable geotextile covering such as hessian sheeting or SoilSaver®; * Suitable sediment traps such as geotextile wrapped hay bales or geotextile nets must be constructed throughout the downstream portion of the watercourse. Should nets be	

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
											utilised, rocks must be placed both upstream and downstream of the net;  **<u>It is highly unlikely that a diversion will be required, but if it is, the following mitigation measures apply:</u>** *Ensure sediment control devices are in place prior to diverting the stream; *Ensure the creation of the diversion does not result in a significant water level difference upstream or downstream of the diversion site; and *Restrict construction of culverts to the drier months wherever possible (especially for the sake of the stream diversion), so as to limit the possibility of permanent changes to the system. *In order to maintain hydrological connectivity for the duration of construction (if construction does not occur during the dry season), the following mitigation measures are deemed relevant: - Upstream water must be diverted to the downstream reaches by means of a small sump/ temporary coffer area and a gravity PVC pipe during construction. Sediment traps must be constructed every 20 m from the pipe outlet. Rocks must be placed to line the outlet into the downgradient reach so as to prevent any risk of erosion and incision as a result of increased velocity of water but removed once construction is complete.	

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
											 - Should gravity not be sufficient/ possible to convey water to the downgradient reaches, the contractor may pump water from the upgradient area to the downstream reaches. - The pump must be suitably bunded and a drip tray provided at all times. The outlet area must be lined with rocks to assist with water dispersal across the HGM unit.	
3			*Movement of construction equipment/vehicles within the applicable watercourse; and *Possible spills / leaks from construction vehicles.	*Disturbances of soil leading to increased alien vegetation proliferation, and in turn to further altered riparian habitat; *Possible contamination of freshwater soil and surface water, leading to reduced ability to support biodiversity; and *Altered runoff patterns, leading to increased erosion and sedimentation of the instream and/or riparian habitat.	2	5	13	65	M	80	*Limit vehicle/equipment activity within the watercourse to what is absolutely essential; *Re-fuelling of vehicles to take place outside of the watercourses & associated buffer zones, on sealed surfaces; *Maintain sediment/erosion control devices to minimise risk of sedimentation of downstream areas; *Topsoil stockpiles are to be protected by means of protective coverings such as hessian sheeting; *Stockpiles are to be no more than 2 m high; and *It is highly recommended that a Soils Management Plan be developed by a suitably qualified soil scientist, and implemented to aid in the conservation of soils.	
4			*Disturbances to soil of the watercourses; and *Removal of topsoil and creation of soil stockpiles.		2	5	13	65	M	80		

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
5		Installation of pre-fabricated concrete box culverts and energy dissipators (where stipulated by hydrologist)	Temporary in-channel diversion of watercourse to allow for installation of pre-fabricated infrastructure (highly unlikely – may only required if work is undertaken during the rainy season).	*Altered flow regime, leading to possible loss of recharge to downstream areas, impacting on downstream biota; Possible incision/erosion in the vicinity of the diversion as a result of the (temporary) formation of a concentrated flow path; *Possible sedimentation of downstream areas during the diversion; and *Possible moisture stress to riparian vegetation downstream/downgradient of the diversion.	**1,5**	**4,5**	**13**	**58,5**	**M**	80	*Limit vehicle/equipment activity within the watercourse to what is absolutely essential; *Re-fuelling of vehicles to take place outside of the watercourses & associated buffer zones, on sealed surfaces; *Maintain sediment/erosion control devices to minimise risk of sedimentation of downstream areas; *Concrete and cement-related mortars can be toxic to aquatic life. Proper handling and disposal should minimize or eliminate discharges into watercourses. High alkalinity associated with cement, which can dramatically affect and contaminate both soil and ground water. The following recommendations must be adhered to: o Fresh concrete and cement mortar should not be mixed near the watercourses. Mixing of cement may be done within the Construction camp, may not be mixed on bare soil, and must be within a lined, bound or bunded portable mixer. Consideration must be taken to use ready mix concrete; o No mixed concrete shall be deposited directly onto the ground within the watercourses or its associated riparian habitat. A batter board or other suitable platform/mixing tray is to be provided onto which any mixed concrete can be deposited whilst it awaits placing; o A washout area should be designated outside of the watercourses, and wash water should be treated on-site or discharged to a suitable sanitation system; o Cement bags must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed of through the hazardous substance waste stream. *Spilled or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be provided; and *If any solid materials do enter the watercourses, they should be immediately removed and supposed at a registered waste disposal facility.	
6			*Movement of construction equipment/vehicles within the watercourses; *Possible spills / leaks from construction vehicles.	*Disturbances of soil leading to increased alien vegetation proliferation, and in turn to further altered riparian habitat; *Possible contamination of soils and surface water, leading to further reduced ability to support biodiversity.	**1,5**	**4,5**	**13**	**58,5**	**M**	80		
			*Possible discard of construction material within the watercourse.	*Alterations to flow patterns; *Possible contamination of water.	**1**	**4**	**13**	**52**	**M**	80		
			*Ongoing disturbances to soil.	*Increased sedimentation of areas downstream of the installation site.	**1,5**	**5,5**	**13**	**71,5**	**M**	80		

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
7		Re-profiling of drainage line slopes in the vicinity of the crossings.	*Ongoing disturbances to soils; and *Removal of vegetation.	*Increased sedimentation as a result of disturbances; *Potential further loss of indigenous vegetation and the increased proliferation of alien floral species due to disturbances.	**1,75**	**4,75**	**13**	**61,75**	**M**	80	*Duration of impacts must be minimised; *Re-seed with indigenous species as soon as bridge /culvert construction is completed; and *Stabilisation of the banks and side slopes are required, by employing techniques, such as: - re-sloping of banks to a maximum of a 1:3 slope; -revegetation of re-profiled slopes; - -temporary stabilisation of slopes using geotextiles; and -installation of gabions and reno-mattresses. Should gabions be required to stabilize the surrounding embankments these should be filled in situ material preferably originating from the surrounding area. Nevertheless, the material used must be sustainably sourced.	
Perceived impacts: New Water Diversion Berm around KS Pits and KS WRDs (eastern sections of Episodic Drainage Line 1)												
8	**Construction**	Site clearing prior to commencement of construction activities, including placement of contractor laydown areas.	*Vehicular movement and access to the site; Possible indiscriminate movement of construction equipment through the episodic drainage line; and *Removal of vegetation (terrestrial and riparian) and associated disturbances (rubble and litter) to soils and the watercourse.	*Damage to marginal and non-marginal vegetation, leading to exposed/compacted soils, in turn leading to potential for increased runoff and erosion; *Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourse, and thus increased potential for further sedimentation of the watercourse; *Increased sedimentation of the watercourse, leading to changes in instream habitat and potentially altering surface water quality (when present) particularly in the downstream reaches of the system; *Decreased ecoservice provision; *Decreased biodiversity maintenance capacity; and	**2,25**	**5,25**	**8**	**42**	**L**	80	*Where deemed feasible and practical by the engineers, soil and any rock removed during the excavation should be used for the lining of areas of the diversion structures with inert waste rock, in order to avoid the introduction of foreign material to the watercourse. Any excess soil or rock not utilised should be stockpiled outside of the freshwater resource and if feasible, outside of the 32m NEMA Zone of Regulation; *The watercourse and the NEMA zone of regulation (32 m) beyond the project footprint should be clearly demarcated with an appropriate barrier system and are should be marked as a no-go areas; *Contractor laydown areas, and material storage facilities to remain outside of the freshwater resource and its 32m NEMA zone of regulation; *All vehicle re-fuelling is to take place outside of the freshwater resource and its 32m NEMA zone of regulation; *All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is absolutely essential. As much indigenous vegetation as possible must be retained; *The duration of impacts within the freshwater resource should be minimised as far as possible by ensuring that the duration of time in which erosion and sedimentation will take	**Partially reversible**
9		Construction of permanent diversion structures (to divert flow from upper catchment areas of both Episodic Drainage Line 1 and episodic drainage lines associated with the Welgevondenspruit).	*Ground-breaking associated with the excavation of the diversion structures; *Removal of topsoil; and *Excavation activities leading to the stockpiling of soil.		**1**	**4**	**8**	**32**	**L**	80		

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
				*Proliferation of alien vegetation as a result of disturbances.							place is minimised. Therefore, the construction period should be kept as short as possible; *Restrict construction activities to the drier months wherever possible, as to limit the possibility of rain washing sediment into the watercourse; *It should be feasible to utilise existing roads to gain access to the diversion structure construction sites, and crossing the watercourse in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles; *Areas where bank failure is observed as a result of such watercourse crossings should be immediately repaired; *All exposed soils must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) in order to prevent erosion and sedimentation of the watercourse and associated riparian zone; and *All construction material must be removed from site upon the completion of construction.	
Perceived Impacts: Conveyor to Kapstevel At pit and Conveyor from DMS to DSO (EDL, CWs 1, 49, 50)												
10		Construction of conveyor to Kapstevel At pit over CW 1.	*Vegetation clearing, excavation and compaction of soils within the watercourses; *Potential indiscriminate movement of construction equipment within the watercourses; *Potential contamination of soils within the watercourses; *Alterations to the sediment loads and potential deposition of waste material into the watercourses; and *Potential changes to the channel capacity and flow through the episodic drainage line.	*Disturbances of soil leading to increased alien vegetation proliferation, and in turn to further altered freshwater habitat; *Altered runoff patterns and alteration to flow patterns, leading to increased erosion and sedimentation of the active channel of the episodic drainage line; *Possible contamination of soil and surface water, leading to further reduced ability to support aquatic biodiversity.	**5**	**8**	**14**	**112**	**M**	80	As per Activity 1, and additionally: *If practical and feasible, conveyor alignment should preferably be moved to avoid traversing the cryptic wetlands; and *Notwithstanding the above, where feasible, support structures for the conveyors must be placed outside of the applicable watercourse.	**Partially reversible**
11		Construction of conveyor from DMS to DSO over an episodic drainage line, CW 49 and CW 50.			**5**	**8**	**14**	**112**	**M**	80		

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived Impacts: Railway option (CWs 46 and 55)												
12		Construction of railway option through the remaining portion of CW55 and within 10 m of CW 46.	*Vegetation clearing, excavation and compaction of soils within the watercourses; *Potential indiscriminate movement of construction equipment within the watercourses; *Potential contamination of soils within the watercourses; and *Alterations to the sediment loads and potential deposition of waste material into the watercourses.	*Disturbances of soil leading to increased alien vegetation proliferation, and in turn to further altered freshwater habitat; *Altered runoff patterns and alteration to flow patterns, leading to increased erosion and sedimentation of the active channel of the episodic drainage line; *Possible contamination of soil and surface water, leading to further reduced ability to support aquatic biodiversity.	**5**	**8**	**12**	**96**	**M**	80	As per Activity 1.	**CW 46: fully reversible** **CW 55: Irreversible**
Perceived Impacts: Expansion of Exploration Core yard (within 25 m of episodic drainage line associated with Welgevondenspruit system)												
13		Site clearing prior to commencement of construction activities, including placement of contractor laydown areas.	*Vehicular movement and access to the site; and *Removal of vegetation (terrestrial) and associated disturbances (rubble and litter) to soil upgradient of watercourse.	*Damage to marginal and non-marginal vegetation, leading to exposed/compacted soil, in turn leading to potential for increased runoff from exposed areas, erosion of the watercourse and potential for increased sedimentation of the watercourse; *Increased sedimentation of the watercourse may lead to changes in instream habitat, potentially altered surface water quality particularly in the downstream reaches of the system, and smothering	**1,75**	**4,75**	**13**	**61,75**	**M**	80	*If feasible, the footprint of the proposed expansion must be optimised to remain outside of the 32 m NEMA zone of regulation; *Sediment traps must be erected between the construction site and the episodic drainage line to minimise the risk of sediment entering the watercourse; *Limit the footprint of vegetation clearing to what is absolutely essential; *Retain as much indigenous vegetation as possible; *Rehabilitation and revegetation of disturbed areas (as a result of construction) must take place immediately after construction; and *Appropriate control methods for alien vegetation in line with existing and approved alien vegetation control within the mine must be implemented.	**Fully reversible**
14		Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.	Possible indiscriminate movement of construction equipment through the watercourse; and *Potential contamination of watercourse by stormwater runoff containing hydrocarbons/sediment.		**1,75**	**4,75**	**13**	**61,75**	**M**	80		

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
15		Potential indiscriminate disposal of hazardous and non-hazardous materials wastes within freshwater resource.	*Increased risk of transportation of sediment from exposed soils in storm water runoff.	of vegetation and/or altered vegetation composition; *Potential impacts on water quality due to leaks and spills from construction machinery; *Decreased ecoservice provision and biodiversity maintenance capacity; and *Proliferation of alien vegetation as a result of disturbances.	**1,75**	**4,75**	**13**	**61,75**	**M**	80		**Fully reversible**
16		Construction of storage buildings.	*Altered water quality; and *Possible changes to flow patterns as a result of blockages caused by solid waste/rubble.		**1,75**	**4,75**	**13**	**61,75**	**M**	80		**Partially reversible**
Perceived impacts: Tyre Management Area (CWs 48 and 51)												
17		Site clearing prior to commencement of construction activities, including vegetation clearing, levelling of ground and placement of contractor laydown areas.	*Vehicular movement and access to the site; and *Removal of vegetation and associated disturbances to surrounding soil within the catchment of the cryptic wetlands.	*Increased hardened surfaces within the catchment of CWs 48 and 51, and compacted soils thus reducing integrity of interflow;. *Localised landscape alterations within the catchment of the 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 cryptic wetland habitat; *Loss of foraging and breeding habitat for wetland-dependent fauna; and *Proliferation of alien vegetation as a result of disturbances.	**1,25**	**4,25**	**13**	**55,25**	**M**	80	As for Activities 13-16	**Partially reversible**

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived Impacts: Kapstevel Park-up area and Soil Stockpiles (CWs 30, 32, 33 and 34, and unnamed tributaries of Groenwaterspruit)												
18	**Construction**	Site clearing prior to commencement of construction activities, including vegetation clearing, levelling of ground and placement of contractor laydown areas.	*Clearing of vegetation and levelling of ground.	*Sediment-laden runoff entering riparian or cryptic wetland 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**	**4**	**9**	**36**	**L**	80	As per Activities 13-16	**Fully reversible**
Perceived impacts: Solar PV Plant (episodic drainage line associated with Welgevondenspruit system).												
19	**Construction**	Site preparation prior to construction activities of surface infrastructure components located outside the watercourses and the 32 m NEMA ZoR.	Vehicular movement (transportation of construction materials)	*Loss of riparian vegetation, associated habitat and ecosystem services; *Transportation of construction materials can result in disturbances to soil, and increased risk of sedimentation/erosion; and *Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	**1**	**4**	**13**	**52**	**L**	80	As per Activities 13-16.	**Fully reversible**
20			Removal of vegetation and associated disturbances to soils.	*Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; *Exposure of soil, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourse; *Increased sedimentation of the watercourse, leading to	**1**	**4**	**13**	**52**	**L**	80		

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
				smothering of riparian and instream vegetation; and *Proliferation of alien and/or invasive vegetation as a result of disturbances.								
21		Construction of surface infrastructure outside the watercourses and the 32 m NEMA ZoR.	*Removal of vegetation and topsoil and associated stockpiling; *Ground-breaking and earthworks relating to foundations and trenches; *Mixing and casting of concrete for construction purposes; *Backfilling of excavated and disturbed areas; and *Miscellaneous activities by construction personnel.	*Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourses, with the potential to affect the watercourse habitat; *Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; *Potential impacts on the water quality of surface runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete being cast; and *Potential of backfill material to enter the watercourses, increasing the sediment load of the watercourses.	**1**	**4**	**9**	**36**	**L**	80	As per Activities 13-16.	

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
OPERATIONAL PHASE IMPACTS												
Perceived Impacts: Haul Road (traverses episodic drainage lines within Welgevondenspruit system in four sections)												
22	Operational	Discharge of water into the traversed watercourses.	*Increased impermeable surface areas adjacent to watercourses, resulting in increased volume of stormwater entering watercourses.	*Altered runoff patterns and increased water inputs to the riverine environment, resulting in altered flow regime, erosion and incision. •Altered flow regime may lead to possible impacts on vegetation (increased growth of riparian vegetation).	**1**	**5**	**11**	**55**	L	80	*The design criteria of stormwater management structures are important to mitigate the operational impacts of the release of stormwater into the watercourses; *Regular inspection of the stormwater outlet structures should be undertaken (specifically after large storm events) in order to monitor the occurrence of erosion. If erosion has occurred, it should immediately be rehabilitated through stabilisation of the embankments and revegetation; and *Only indigenous vegetation species may be used as part of the rehabilitation process and invasive plant species should be eradicated.	**Partially reversible**
23		Regular vehicular traffic on all haul roads (new and existing South 2 Haul Road).	*Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff.	*Altered water quality as a result of increased availability of pollutants	**1,5**	**5,5**	**15**	**82,5**	M	80	*Regular dust suppression of the haul roads must be undertaken, using recycled water (not dirty water) to minimise sedimentation.	
24		Rehabilitation and maintenance of culverts and road crossings.	*Revegetation of crossings (requiring personnel to work temporarily within the watercourses); *Possible indiscriminate movement of vehicles through watercourses during rehabilitation activities.	*Possible disturbances to soil, leading to further sedimentation of watercourses (particularly downstream reaches); *Disturbances to soil may further encourage proliferation of alien vegetation, leading to altered riparian habitat and reduced ability to support biodiversity; *Potentially altered runoff patterns if rehabilitation (e.g. bank stabilisation) is not successful, leading to increased erosion, further sedimentation of watercourses and further proliferation of alien vegetation due to soil disturbances.	1,25	4,25	9	**38,25**	L	80	*Limit vehicle/equipment activity within the watercourse to what is absolutely essential; *Maintain sediment/erosion control devices to minimise risk of sedimentation of downstream areas; *Following construction, suitable alien invasive management must be implemented to ensure that alien invasive plant species do not become established within the areas disturbed by construction activities; *Duration of impacts must be minimised; and *Re-seed with indigenous species as soon as construction is completed	

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived impacts: New Water Diversion Berm around KS Pits and KS WRDs (eastern sections of Episodic Drainage Line 1)												
25	Operational	Operation and maintenance of the diversion structure.	*Containment/diversion of all stormwater (clean water) runoff into the clean water system and clean water being released only within the downgradient reach of the freshwater resource.	Changes to pattern, flow timing and quantity of water reaching the natural downstream watercourses is expected to occur, which could potentially lead to the following impacts: *Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to further sedimentation of the downgradient watercourses; *Reduction in volume of water entering the watercourses due to the loss of catchment yield created by the formation and management of the dirty water containment areas, leading to loss of recharge of the downstream freshwater ecosystems; and *Altered vegetation communities due to moisture stress.	**1**	**6**	**10**	**60**	M	80	*Clean and dirty water systems must be kept separate in line with Regulation GN704; *The clean water diversion structure must be designed to accommodate a peak flow expected for a minimum 1:50 year flood event; *The stormwater outlet should be constructed from energy dissipating structures (such as Armorflex or reno mattresses) to slow down the velocity of water inflow into the freshwater resource; *After construction of the outlet, the area surrounding the outlet should be re-seeded with indigenous wetland vegetation; *Monitoring of the edges of the diversion structures for erosion and incision; *Monitoring and control of alien vegetation; and *Monitoring of riparian condition and water quality (when surface water is present) within the freshwater resource must continue throughout the operational phase of the project.	**Partially reversible**
Perceived Impacts: Conveyor to Kapstevel At pit and Conveyor from DSO to DMS plant (EDL, CWs 1, 49, 50)												
26	Operational	Operation of conveyors	Transportation/transfer of iron ore via the conveyor, potentially resulting in spillages from the conveyor.	*Potential contamination of soil, surface water and groundwater.	1	4	9	**36**	L	80	*Monitor conveyor daily for spillages; *Ensure that an Emergency Response Plan is developed and implemented in the case of a spill.	**Partially reversible**
Perceived Impacts: Railway option (CWs 46 and 55)												
27	Operational	Operation of railway line	Transportation/transfer of iron ore via the railway, potentially resulting in spillages.	*Potential contamination of soil, surface water and groundwater.	**1**	**4**	**13**	**52**	L	80	*Monitor railway daily for spillages; *Ensure that an Emergency Response Plan is developed and implemented in the case of a spill.	**Partially reversible**

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived Impacts: Expansion of Exploration Core yard (within 25 m of episodic drainage line associated with Welgevondenspruit system)												
28	Operational	Operation of the exploration core yard.	*Transportation and storage of drill cores. *Increased vehicular activity and impermeable surfaces in the catchment of the episodic drainage line.	*No perceived impacts associated with storage of drill cores. *Potential contamination of stormwater runoff from hard surfaces by hydrocarbons from vehicles, leading to potential contamination of surface water, groundwater and soil; *Increased volume of stormwater runoff entering the episodic drainage line as a result of increased catchment hardening.	1	4	15	60	M	80	*The design criteria of clean and dirty water separation systems management structures are important to mitigate the operational impacts of the release of stormwater into the watercourses; *Regular inspection of the clean water outlet outlet structures should be undertaken (specifically after large storm events) in order to monitor the occurrence of erosion. If erosion has occurred, it should immediately be rehabilitated through stabilisation of the embankments and revegetation; and *Only indigenous vegetation species may be used as part of the rehabilitation process and invasive plant species should be eradicated.	Partially reversible
Perceived impacts: Tyre Management Area (CWs 48 and 51)												
29	Operational	Operation of the tyre management area.	*Increased vehicular activity and impermeable surfaces in the catchment of CWs 48 and 51.	*Potential contamination of stormwater runoff from hard surfaces by hydrocarbons from vehicles, leading to potential contamination of surface water, groundwater and soil; *Increased volume of stormwater runoff entering the cryptic wetlands as a result of increased catchment hardening.	1	3	13	39	L	80	As per Activity 28.	Partially reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived Impacts: Kapstevel Park-up area and Soil Stockpiles (CWs 30, 32, 33 and 34, and unnamed tributaries of Groenwaterspruit)												
30	Operational	Creation of soil stockpiles within 100 m of cryptic wetlands.	*Increased volume of loose / uncompacted sediment within 100 m of cryptic wetlands.	* Increased risk of transportation of sediment from stockpiles and unsealed surface in stormwater runoff, leading to increased turbidity of surface water, sedimentation of cryptic wetlands leading to smothering of vegetation and/or altered vegetation composition, smothering of benthic taxa and/or destruction of suitable macro-invertebrate habitats and egg banks; * Increased sedimentation potentially leading to altered surface water quality; and * Proliferation of alien vegetation as a result of disturbances.	**1,5**	**3,5**	**12**	**42**	**L**	80	* 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; * All stockpiles which are to remain on site post-construction are to be suitably managed to prevent erosion, either through managing the height and slope ratios, or through establishing indigenous vegetation.	Fully reversible
31		Regular use by heavy vehicles.	*Increased presence of hydrocarbons.		**1,5**	**3,5**	**16**	**56**	**M**	80	As per Activity 22	

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Reversibility
Perceived impacts: Solar PV Plant (episodic drainage line associated with Welgevondenspruit system).												
32	**Operational**	Operation and maintenance of the surface infrastructure outside the watercourses and the 32 m NEMA ZoR.	*Potential indiscriminate movement of maintenance vehicles within the watercourses or within close proximity to the watercourses; *Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff from the surface infrastructure (specifically during the cleaning of the solar PV arrays).	*Disturbance to soils and ongoing erosion as a result of periodic maintenance activities; and *Altered water quality (if surface water is present) as a result of increased availability of pollutants.	**1**	**4**	**13**	**52**	L	80	* No indiscriminate driving through the watercourses may be permitted during standard operational activities or maintenance activities. Use must be made of the existing watercourse crossings only; * Unnecessary disturbances surrounding the perimeter of the surface infrastructure must be avoided; * Vehicles used in the development site must be regularly washed to avoid the dispersal of seeds on any alien or invasive species into the watercourses; * Ensure that routine inspections and monitoring of any instream infrastructure are undertaken to monitor the establishment of indigenous vegetation and the presence of any alien or invasive plant species; * The surface infrastructure areas must be inspected to ensure that no concentrated runoff from these areas forms erosion gullies and eventually flow into the watercourses. Should this be noted, these gullies/preferential flow paths must be infilled with *in situ* material and appropriately revegetated; * Monitoring for the establishment for alien and invasive vegetation species must be undertaken, specifically at the road crossings and surface infrastructures. Should alien and invasive plant species be identified, they must be removed and disposed of as per an alien and invasive species control plan and the area must be revegetated with suitable indigenous vegetation.	**Partially reversible**

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 watercourses identified in the assessment area are predominantly 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 mining expansion footprints indicate that several watercourses will be impacted as a result; the significance of impacts varies depending on the nature of the activity and extent thereof, but none are deemed to have 'high' risk significance and most can be feasibly mitigated.

Adherence to all mitigation measures provided in this report will aid in reducing the risk significance of most anticipated direct and indirect impacts. 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.

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 temporary (cryptic wetland) systems being unrecognised, and therefore under-valued. 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 is recognised globally as being cause for concern.

Whilst the proposed assessment area 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.

6 CONCLUSION

A total of 75 cryptic wetlands and twelve episodic drainage lines with riparian zones (albeit weakly defined in some areas) were identified and classified as watercourses, along with numerous episodic depressions, preferential flow paths and anthropogenically derived channels which do not meet the definition of a watercourse from an ecological perspective.

The results of the ecological assessment indicated that the various watercourses 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 and in some areas such as road crossings over drainage lines, due to clearing. 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 assessment 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 known presence of macroinvertebrates in several cryptic wetlands due to ongoing biomonitoring conducted by the University of the Free State, 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 assessment 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, depending on the nature and extent of the activity. Whilst it is recommended that where possible, infrastructure be re-aligned (e.g., the proposed conveyors) or optimised (e.g., the exploration core yard expansion) to reduce the footprint and thus avoid encroachment on watercourses, it is acknowledged that this may not always be practical due to space or topographic limitations.

Provided that strict implementation of cogent, well-developed, site-specific mitigation measures takes place throughout all phases of the proposed mining expansion, it is the specialist's opinion that the proposed expansion may be considered for authorisation.

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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 to the National	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.

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 assessment 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 assessment area.

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

The watercourses encountered within the proposed assessment 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[3] (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.

[3] 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):

- **Slope:** 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;
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes;
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench (hilltop/saddle/shelf):** 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:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** 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;
- **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.
- **Wetland Flat:** 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
- **Seep:** 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
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

Impact category	Description	Impact score range	Present State category
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.

1. 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".[4] The assessment of the ecosystem services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2020). An assessment was undertaken that examines and rates 16 different ecosystem services, selected for their specific relevance to the South African situation, as follows:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate assimilation;
- Nitrate assimilation;
- Toxicant assimilation;
- Erosion control;
- Carbon storage;
- Biodiversity maintenance;
- Provision of water for human use;
- Provision of harvestable resources;
- Food for livestock;
- Provision of cultivated foods;

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

- Cultural and spiritual experience;
- Tourism and recreation; and
- Education and research.

For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.
*It is important to note that when assessing riparian zones associated with riverine habitats, the contribution of the riparian zone to streamflow regulation is omitted, owing to a lack of relevant studies (Kotze *et al*, 2020).

Table C3: Integrating scores for supply and demand to obtain and overall importance score

Integrating scores for supply & demand to obtain an overall importance score						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0,0	0,0	0,5	1,5	2,5
Low	1	0,0	0,0	1,0	2,0	3,0
Moderate	2	0,0	0,5	1,5	2,5	3,5
High	3	0,0	1,0	2,0	3,0	4,0
Very High	4	0,5	1,5	2,5	3,5	4,0

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than demand, with the supply score acting as the starting score for a "moderate" demand scenario. The importance score is, however, adjusted by up to one class up where demand is "very high" and by up to one class down where demand is "very low". The overall importance score can then be used to derive an importance category for reporting purposes.

Table C4: Classes for determining the likely extent to which a benefit is being supplied.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

4. Index of Habitat Integrity

The general habitat integrity of each site was discussed based on the application of the Index of Habitat Integrity (Kleynhans et al. 2008). It is important to assess the habitat at each site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at each site. The method classifies habitat integrity into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in Table C3 below.

5. Table C5: Classification of Present State Classes in terms of Habitat Integrity [Kleynhans et al. 2008]

Class	Description	Score (% of total)
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 - 89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 - 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39

F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 - 19

4. 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 Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate 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
Low/marginal 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

5. 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.

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

***PES Categories E and F are considered ecologically unnacceptable (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

6. 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'[5]. 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[6].

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.

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

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

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[7] 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.

Table D10: Reversibility of impacts on the watercourse

Reversibility Rating:	**Irreversible** (the activity will lead to an impact that is permanent)

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

	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 PES (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	
CW 1	1.0 (B)	↓	1.3 (B)	↓	1.0 (B)	↓	1.08 (B)
CW 2	2.0 (C)	↓	1.5 (B)	↓	1.0 (B)	↓	1.57 (B)
CW Group 3	1.0 (B)	↓	1.3 (B)	↓	1.0 (B)	↓	1.08 (B)
CW Group 4	1.0 (B)	↓	1.9 (B)	↓	1.0 (B)	↓	1.25 (B)
CW Group 5	1.0 (B)	↓	1.4 (B)	↓	1.0 (B)	↓	1.11 (B)
CW 55	5.0 (D)	↓	4.2 (D)	↓	4.8 (D)	↓	4.71 (D)

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

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,0	0,0	0,0	Very Low
	Stream flow regulation	0,0	0,0	0,0	Very Low
	Sediment trapping	0,5	0,0	0,0	Very Low
	Erosion control	0,3	0,9	0,0	Very Low
	Phosphate assimilation	0,4	0,0	0,0	Very Low
	Nitrate assimilation	0,3	0,0	0,0	Very Low
	Toxicant assimilation	0,3	0,0	0,0	Very Low
	Carbon storage	0,2	2,7	0,0	Very Low
	Biodiversity maintenance	3,7	2,5	3,5	Very High
PROVISIONING SERVICES	Water for human use	0,0	0,0	0,0	Very Low
	Harvestable resources	0,5	0,0	0,0	Very Low
	Food for livestock	1,0	0,0	0,0	Very Low
	Cultivated foods	3,0	0,0	1,5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	1,5	0,0	0,0	Very Low
	Education and Research	1,0	1,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

Table E4: Presentation of the results of the EIS assessment applied to the episodic drainage lines and all cryptic wetlands.

			Epi DL 1	Welgevondenspruit system	Tribs Groenwaterspruit	CWs
Ecological Importance and Sensitivity			Score (0-4)			
Biodiversity support			A (average)	A (average)	A (average)	A (average)
			1,67	2,33	2,33	2,67
Presence of Red Data species			1	2	2	2
Populations of unique species			1	1	1	3
Migration/breeding/feeding sites			3	4	4	3
Landscape scale			B (average)	B (average)	B (average)	B (average)
			1,80	2,20	1,60	2,20
Protection status of the wetland			3	3	3	3
Protection status of the vegetation type			2	2	2	2
Regional context of the ecological integrity			2	2	1	3
Size and rarity of the wetland type/s present			1	2	1	3
Diversity of habitat types			1	2	1	0
Sensitivity of the wetland			C (average)	C (average)	C (average)	C (average)
			1,33	1,33	1,33	1,00
Sensitivity to changes in floods			2	2	2	1
Sensitivity to changes in low flows/dry season			0	0	0	0
Sensitivity to changes in water quality			2	2	2	2
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**	**B**	**A**

Episodic Drainage Line 1 and Tributaries of the Groenwaterspruit:
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.

Welgevondenspruit system and Cryptic Wetlands:
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.

Hydro-Functional Importance			Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)
Regulating & supporting benefits	**Flood attenuation**		0	1	1	0
	Streamflow regulation		0	0	0	0
	Water Quality Enhancement	***Sediment trapping***	1	2	1	0
		Phosphate assimilation	1	2	1	0
		Nitrate assimilation	1	1	1	0
		Toxicant assimilation	1	2	1	0
		Erosion control	1	1	1	0
	Carbon storage		1	1	0	0
HYDRO-FUNCTIONAL IMPORTANCE			1	1	1	0
Direct Human Benefits			Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)
Subsistence benefits	***Water for human use***		0	1	1	0
	Harvestable resources		1	1	0	1
	Cultivated foods		2	1	0	0
Cultural benefits	***Cultural heritage***		1	2	0	0
	Tourism and recreation		1	1	0	0
	Education and research		0	1	0	0
DIRECT HUMAN BENEFITS			0,83	1,17	0,17	0,17

Table E5: Presentation of the results of the PES (IHI) assessments applied to Episodic Drainage Line 1.

RIPARIAN IHI	
Base Flows	0,0
Zero Flows	0,0
Moderate Floods	0,0
Large Floods	0,0
HYDROLOGY RATING	**0,0**
Substrate Exposure (marginal)	1,0
Substrate Exposure (non-marginal)	1,0
Invasive Alien Vegetation (marginal)	1,0
Invasive Alien Vegetation (non-marginal)	1,0
Erosion (marginal)	1,0
Erosion (non-marginal)	1,0
Physico-Chemical (marginal)	1,0
Physico-Chemical (non-marginal)	1,0
Marginal	1,0
Non-marginal	1,0
BANK STRUCTURE RATING	**1,0**
Longitudinal Connectivity	1,0
Lateral Connectivity	1,0
CONNECTIVITY RATING	**1,0**
RIPARIAN IHI %	**86,7**
RIPARIAN IHI EC	**B**
RIPARIAN CONFIDENCE	**2,0**

Table E6: Presentation of the results of the VEGRAI assessment applied to Episodic Drainage Line 1

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	63,0	39,4	2,0	1,0	100,0
NON MARGINAL	63,7	23,9	0,0	2,0	60,0
	2,0				160,0
LEVEL 3 VEGRAI (%)				63,2	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				1,0	

Table E7: Presentation of the results of the Ecoservices assessment applied to Episodic Drainage Line 1

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,0	0,0	0,0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!
	Sediment trapping	1,4	0,3	0,0	Very Low
	Erosion control	0,7	0,3	0,0	Very Low
	Phosphate assimilation	1,3	0,3	0,0	Very Low
	Nitrate assimilation	1,2	0,3	0,0	Very Low
	Toxicant assimilation	1,4	0,3	0,0	Very Low
	Carbon storage	0,0	2,7	0,0	Very Low
	Biodiversity maintenance	2,7	0,0	1,2	Low
PROVISIONING SERVICES	Water for human use	0,8	0,0	0,0	Very Low
	Harvestable resources	1,5	0,0	0,0	Very Low
	Food for livestock	1,0	0,3	0,0	Very Low
	Cultivated foods	3,0	0,0	1,5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	0,8	0,0	0,0	Very Low
	Education and Research	0,0	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

***Streamflow regulation is excluded from the suite of services assessed for riparian areas owing to a lack of relevant studies (Kotze *et al*, 2020).**

Table E8: Presentation of the results of the PES (IHI) assessment applied to the Welgevondenspruit system.

RIPARIAN IHI	
Base Flows	0,0
Zero Flows	0,0
Moderate Floods	0,0
Large Floods	0,0
HYDROLOGY RATING	**0,0**
Substrate Exposure (marginal)	1,0
Substrate Exposure (non-marginal)	1,0
Invasive Alien Vegetation (marginal)	1,0
Invasive Alien Vegetation (non-marginal)	1,0
Erosion (marginal)	1,0
Erosion (non-marginal)	1,0
Physico-Chemical (marginal)	0,0
Physico-Chemical (non-marginal)	0,0
Marginal	1,0
Non-marginal	1,0
BANK STRUCTURE RATING	**1,0**
Longitudinal Connectivity	1,0
Lateral Connectivity	1,0
CONNECTIVITY RATING	**1,0**
RIPARIAN IHI %	**86,7**
RIPARIAN IHI EC	**B**
RIPARIAN CONFIDENCE	**2,0**

Table E9: Presentation of the results of the VEGRAI assessment applied to the Welgevondenspruit system.

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	76,3	47,7	2,0	1,0	100,0
NON MARGINAL	77,0	28,9	0,0	2,0	60,0
	2,0				160,0
LEVEL 3 VEGRAI (%)				76,6	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				1,0	

Table E10: Presentation of the results of the Ecoservices assessment applied to the Welgevondenspruit system.

		Present State			
ECOSYSTEM SERVICE		**Supply**	**Demand**	**Importance Score**	**Importance**
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,2	0,0	0,0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!
	Sediment trapping	1,6	0,3	0,3	Very Low
	Erosion control	1,0	0,8	0,0	Very Low
	Phosphate assimilation	1,6	0,3	0,2	Very Low
	Nitrate assimilation	1,4	0,3	0,0	Very Low
	Toxicant assimilation	1,6	0,3	0,3	Very Low
	Carbon storage	0,7	2,7	0,5	Very Low
	Biodiversity maintenance	3,0	0,0	1,5	Moderately Low
PROVISIONING SERVICES	Water for human use	0,8	0,0	0,0	Very Low
	Harvestable resources	0,5	0,0	0,0	Very Low
	Food for livestock	2,0	0,3	0,7	Very Low
	Cultivated foods	3,0	0,0	1,5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	1,0	0,0	0,0	Very Low
	Education and Research	1,0	0,0	0,0	Very Low
	Cultural and Spiritual	2,0	0,0	0,5	Very Low

***Streamflow regulation is excluded from the suite of services assessed for riparian areas owing to a lack of relevant studies (Kotze *et al*, 2020).**

Table E11: Presentation of the results of the PES (IHI) assessment applied to the unnamed tributaries of the Groenwaterspruit.

RIPARIAN IHI	
Base Flows	0,0
Zero Flows	0,0
Moderate Floods	0,0
Large Floods	0,0
HYDROLOGY RATING	**0,0**
Substrate Exposure (marginal)	1,0
Substrate Exposure (non-marginal)	1,0
Invasive Alien Vegetation (marginal)	1,0
Invasive Alien Vegetation (non-marginal)	1,0
Erosion (marginal)	1,0
Erosion (non-marginal)	1,0
Physico-Chemical (marginal)	0,0
Physico-Chemical (non-marginal)	0,0
Marginal	1,0
Non-marginal	1,0
BANK STRUCTURE RATING	**1,0**
Longitudinal Connectivity	1,0
Lateral Connectivity	1,0

CONNECTIVITY RATING	1,0
RIPARIAN IHI %	86,7
RIPARIAN IHI EC	B
RIPARIAN CONFIDENCE	2,0

Table E12: Presentation of the results of the VEGRAI assessment applied to the unnamed tributaries of the Groenwaterspruit.

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	76,3	47,7	2,0	1,0	100,0
NON MARGINAL	80,0	30,0	0,0	2,0	60,0
2,0					160,0
LEVEL 3 VEGRAI (%)				77,7	
VEGRAI EC				**B/C**	
AVERAGE CONFIDENCE				1,0	

Table E13: Presentation of the results of the Ecoservices assessment applied to the unnamed tributaries of the Groenwaterspruit.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,6	0,0	0,0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!
	Sediment trapping	1,4	0,8	0,2	Very Low
	Erosion control	0,7	0,9	0,0	Very Low
	Phosphate assimilation	1,3	0,3	0,0	Very Low
	Nitrate assimilation	1,2	0,3	0,0	Very Low
	Toxicant assimilation	1,4	1,0	0,4	Very Low
	Carbon storage	0,3	2,7	0,2	Very Low
	Biodiversity maintenance	2,7	0,0	1,2	Low
PROVISIONING SERVICES	Water for human use	0,8	0,0	0,0	Very Low
	Harvestable resources	0,5	0,0	0,0	Very Low
	Food for livestock	1,0	0,3	0,0	Very Low
	Cultivated foods	3,0	0,0	1,5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	0,8	0,0	0,0	Very Low
	Education and Research	0,0	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

***Streamflow regulation is excluded from the suite of services assessed for riparian areas owing to a lack of relevant studies (Kotze *et al*, 2020).**

Table E14: Presentation of the results of the EIS (DWAF, 1999) assessment applied to Episodic Drainage Line 1, the Welgevondenspruit system and the unnamed tributaries of the Groenwaterspruit

PRIMARY DETERMINANTS	EPI DL 1	W/SPRUIT SYSTEM	G/SPRUIT TRIBS	CONFIDENCE
Biotic Determinants				
Rare & Endangered Species	3	3	2	3
Populations of unique species	1	2	1	3
Intolerant biota	0	0	0	4
Species / taxon richness	1	1	1	3
Aquatic Habitat Determinants				
Diversity of aquatic habitat types or features	1	1	1	4
Refuge value of habitat type	1	1	1	4
Sensitivity of habitat to flow changes	1	1	1	4

Sensitivity of flow-related water quality changes	1	1	1	4
Migration route/corridor for instream and riparian biota	3	3	2	4
Nature Reserves, Natural Heritage sites, Natural areas, PNEs	1	1	1	4
TOTAL	**13**	**14**	**11**	
MEAN	**1,3**	**1,4**	**1,1**	
OVERALL EIS	**Moderate**	**Moderate**	**Moderate**	

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 assessment 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 assessment 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 assessment 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 assessment 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)
Kim Marais	BSc (Hons) Zoology (Herpetology) (University of the Witwatersrand)
Amanda Mileson	Advanced Diploma: Nature Conservation (UNISA)

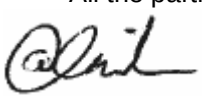
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

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 -

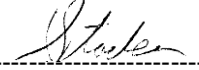
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity 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 -

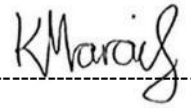
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity 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



Signature of the Specialist

I, Kim Marais, 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

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	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 Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

N. Dip Nature Conservation (UNISA)	2017
Advanced Diploma: Nature Conservation (UNISA)	2020
Post Graduate 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 Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater EcoService and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species Plan
- Freshwater Offset Plan

Biodiversity Assessments

- Ecological Scan
- Biodiversity Offset Plan

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF KIM MARAIS

PERSONAL DETAILS

Position in Company	Water Resource Manager; Senior Scientist
Joined SAS Environmental Group of Companies	2015

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 117137/17)

EDUCATION

Qualifications

BSc (Hons) Zoology (University of the Witwatersrand)	2012
BSc (Zoology and Conservation) (University of the Witwatersrand)	2011

Short Courses

Aquatic and Wetland Plant Identification (Cripsis Environment)	2019
Tools for Wetland Assessment (Rhodes University)	2018
Certificate in Environmental Law for Environmental Managers (CEM)	2014
Certificate for Introduction to Environmental Management (CEM)	2013

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, KwaZulu-Natal, Northern Cape, Eastern Cape,
Africa - Uganda

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Biodiversity Action Plans (BAP)
- Alien and Invasive Control Plans (AICP)
- Faunal Eco Scans
- Faunal Impact Assessments

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Watercourse Maintenance and Management Plans
- Freshwater Offset Plans

Aquatic Ecological Assessment and Water Quality Studies

- Riparian Vegetation Integrity (VEGRAI)
- Water quality Monitoring
- Riverine Rehabilitation Plans

Legislative Requirements, Processes and Assessments

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