THE PROPOSED CONSTRUCTION OF A WATER PIPELINE BETWEEN NOENIEPUT AND SWARTKOPSDAM, NORTHERN CAPE PROVINCE

FRESHWATER ASSESSMENT AND DWS SECTION 21 (C) & (I) RISK MATRIX

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Prepared for:

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1. DOCUMENT CONTROL

1.1. Quality and revision record

1.1.1. Quality approval

	Capacity	Name	Signature	Date
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This report has been prepared in accordance with Enviroworks Quality Management System.

1.1.2. Revision record

Revision Number	Objective	Change	Date
1	Draft Report	N/A	N/A

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5. INTRODUCTION

BVi Consulting Engineers Northern Cape (Pty) Ltd appointed Enviroworks (Pty) Ltd, as independent Environmental Consultants on behalf of Kalahari-East Water Users Association (The Applicant) to undertake the required Water Use Licence process for the Noenieput water pipeline construction (hereafter referred to as the proposed project), Northern Cape Province.

The Kalahari-East Water Users Association proposes the construction of a portable water supply pipeline (approximately 25km) in Noenieput. Noenieput is located approximately 160km northwest of Upington within the ZF Mgcawu District Municipality in the Northern Cape Province (Figure 1). It is the centrum of a farming community with sheep and cattle farming as the main source of income (as in BVi Consulting Engineers, 2019).

The purpose of this Freshwater Impact Assessment and Risk Matrix is to assess the risk associated with Section 21 (c) & (i) Water Uses- Impeding and diverting the flow of water. The proposed pipeline will cross watercourses and construction will take place within the regulated zone of watercourses thus triggering the need for a Risk Assessment according to Section 21 (c) & (i) Water Uses.

5.1. Receiving environment

5.1.1. Geology

Geologically the Kalahari is a structural basin. When about 200 million years ago Southern Africa was still flat, it was covered by a shallow sea, as evidenced by the sea shells still to be found everywhere in the arid interior. Upheavals came and massive volcanic surges created the mountains along the coasts, creating a huge dent in the earth’s crust that was to become the Kalahari. Gradually this enormous basin was filled through erosion of the surrounding rocks and although it is not known where the red sand originated from, enough rain must have fallen to wash down the colloidal deposits. Later prevailing winds formed the parallel dunes stretching in a north-westerly direction (as in BVi Consulting Engineers, 2019).

5.1.2. Climate and Climate Change

The dry season in the Kalahari is between April and September. Rainfall usually starts late in January, and stops towards the end of April. The average rainfall in the project target area is 120 to 150mm per. Maximum midsummer temperatures are between 35 degrees Celsius and 42 degrees with normal temperatures averaging between 30 and 35 degrees. During winter, daytime temperature is about 27 degrees Celsius, dropping to 0 degrees at night. It occasionally drops below freezing point to -6 degrees. Evaporation of 2900 millimeters per year in the area is the highest in South Africa. Rainfall over the last 20 years was very inconsistent which impacted grazing conditions and subsequently stock production negatively (as in BVi Consulting Engineers, 2019).

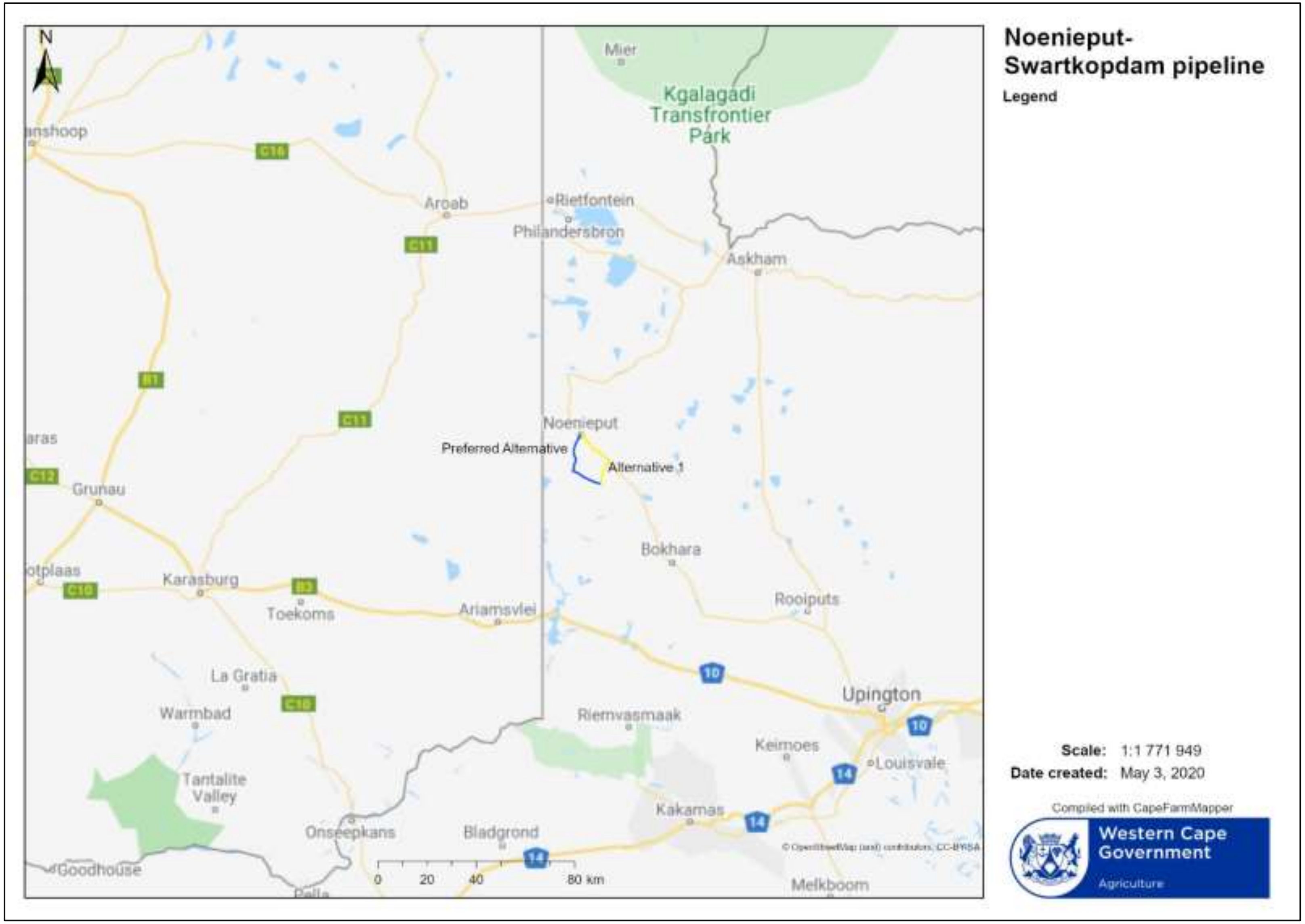

Figure 1 Locality map of the propose Noenieput - Swartkopsdam water pipeline

5.1.3. Geo-hydrology

The ground water quality in the region is poor as can be seen on the South African ground water quality map (Figure 2) below; the pink and red color represents the poorest water quality. Conductivity, which is an indication of the quality of the groundwater, ranges in the project target area between 150 mS/m - >520 mS/m (Department of Water & Sanitation, 2012). SANS 241-2001 states that a conductivity of 150ms/m is still acceptable but 370ms/m is the maximum allowable conductivity suitable for drinking water. The map below shows that only a small area has water suitable for human consumption.

Borehole yield ranges between 0.1 to 0.5 l/s - 0.5 to 2.0 l/s 40 with a fractured aquifer type (Department of Water and Sanitation, n.d.; see Figure 3). This data shows that poor quality as well as the availability of the water is a major concern in the project area. Noenieput and Swartkopsdam are totally dependent on groundwater for water supply, which is unsuitable in terms of quality and quantity. The boreholes cannot meet the summer peak demand and the quality of the water is detrimental to the health of the communities.

5.2. Need and desirability

Water service delivery in the Kalahari area has been severely impacted by the drought situation over the past years. With the extension of the Kalahari-East Water Supply Scheme to Mier in 2017, the water supply problems for all the towns in the area were addressed, except for the three towns of Welkom, Noenieput and Swartkopsdam. These towns still depend solely on groundwater supply from boreholes in the vicinity. The water from 75% of these boreholes have an Electrical Conductivity (EC) of more than 200 mS/m and is thus not suitable for long term human consumption. The towns are also surrounded by commercial and small famers which face the same challenge in terms of sustainable water availability for farming purposes (as in BVi Consulting Engineers, 2019).

In 2018 the Dawid Kruiper Municipality joined forces with the Kalahari-East Water Users Association to co-fund a project to provide potable water from the Kalahari-East to Mier Pipeline to Noenieput. The project will also give access to sustainable water supply for all the commercial and small farms along the proposed pipeline route. In addition, the design of the proposed pipeline caters for future extension to supply potable water to Swartkopsdam and farms further south of Noenieput (BVi Consulting Engineers, 2019).

Water is essential for all animals. It is important for both animal welfare and business profitability that sheep and cattle have an adequate supply of good quality water. Amount and quality of water required vary between species of livestock, between classes of stock within the species, and in response to the environment in which the stock are kept. The main factor which determines the suitability of water for stock is the concentration of dissolved salts in the water. Dissolved salts in water are expressed in parts per million (ppm) or in terms of the electrical conductivity of the water, measured in milliSiemens per metre (mS/m) (BVi Consulting Engineers, 2019).

It is difficult to determine exactly what the effect of the water quality on the production of stock in the project target area is. This is due to the fact that the figures are not presented on the same scale and that the effects are not exactly quantified (BVi Consulting Engineers, 2019).

The respondents of a survey indicated in a questionnaire that under the current circumstances 15% of sheep and 10% of cattle will die before being ready for the market. Respondents feel that this rate can be brought down with 5% to the optimum of 10% and 5% respectively if the water situation is improved. Furthermore, the respondents feel that they produce 30% less lamb and 20% less cattle due to lower reproduction as a result of the current water situation. They also think that they can improve the quality of meat with 60% through water with better quality and a more reliable water supply (BVi Consulting Engineers, 2019).

The current lack of availability of water and poor quality of groundwater on which the project area depends on, have the following restrictions in development (in addition to the livestock production mentioned above) (from BVi Consulting Engineers, 2019):

- Lack of sustainable water provision restrict further township development. There are currently 100 stands in Noenieput for which the township establishment cannot be concluded due to insufficient water availability.
- Both commercial and small-scale farmers will not be able to survive another summer season without adequate and sustainable water resources. The past droughts and inadequate rainfall had a detrimental effect on grazing resources and stock loss will be inevitable.
- Access to basic services such as water and sanitation is a constitutional right. The dignity and social welfare of the communities are being violated.

5.3. Project description

The connection point (start point) will be at Noenieput where the water supply pipeline- that is currently under construction- terminates. The water will flow from the connection point at Noenieput to Swartkopsdam (end point). Connection points will be provided for small and commercial farmers along the pipeline route. The pipeline material is UPVC of various pipe classes and diameters (110-160mm). The pipeline shall be installed in a trench with at least 600mm cover above the pipe. At the river crossings the pipe cover will be 1.2 meters. The pipeline design will take into account the approximate usage per month that anticipates 0.9l/s at peak summer demand (BVi Consulting Engineers, 2019).

The same construction and rehabilitation methods applied during construction of the Kalahari-East to Mier Pipeline project will be utilized for this project (BVi Consulting Engineers, 2019):

- The pipeline was designed using the same standards as applicable to the original Kalahari East Water Supply System project (completed in 1995) and the Extension to Mier pipeline project (completed in 2015).
- Air valves will be installed at every high point and specifications on metered off take.

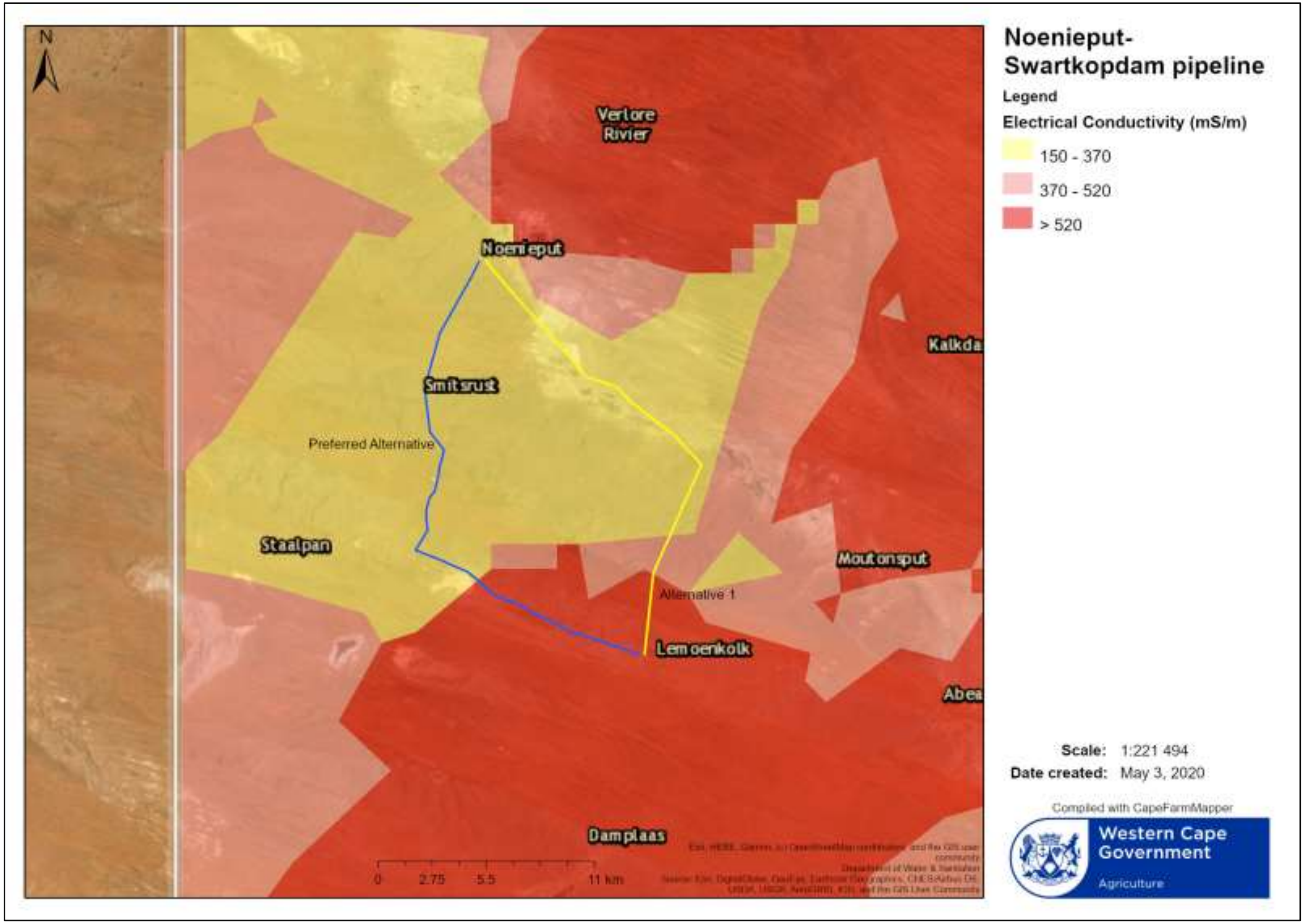

Figure 2 Map of the groundwater quality of the proposed Noenieput-Swartkopsdam pipeline

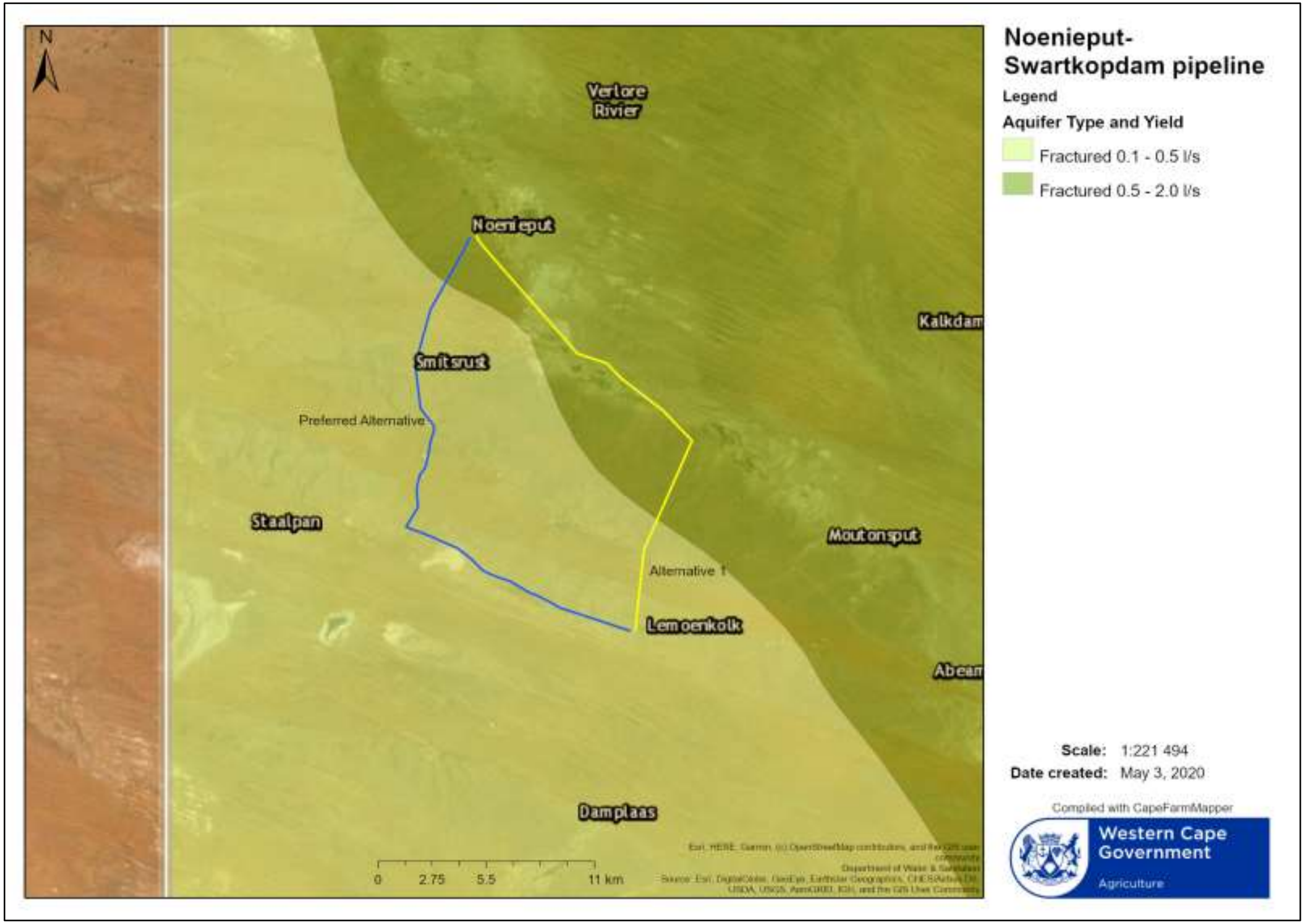

Figure 3 Map of the aquifer type and yield of the proposed Noenieput-Swartkopsdam pipeline

- "Swarthaak" branches will be used to protect the pipeline over the crest of the dunes against wind erosion. This will also help a lot for the re-growth of natural vegetation.
- Soil from the trench excavation will be used for bedding and blanket material.

5.3.1. Alternatives

Two route alternatives were proposed for the water pipeline: the Preferred Alternative and Alternative 1 (Figure 1). The Preferred Alternative is mostly within the road reserve of the route connecting Swartkopsdam and Noenieput via Smitsrust. Alternative 1 follows the road connecting Noenieput to the R360 for roughly 14km before it cuts across private property towards Swartkopsdam.

6. BACKGROUND

6.1. Legislation

The Constitution of the Republic of South Africa (1996) promotes sustainability and social, ecological and developmental issues are considered to be equally important. The South African National Water Policy (1997) and the National Water Act, 1998 (Act No. 36 of 1998)[NWA] were promulgated to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in an equitable, efficient and sustainable manner (Department of Water and Sanitation, 2014).

According to Government Notice 509 of 2016 - GENERAL AUTHORISATION IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) FOR WATER USES AS DEFINED IN SECTION 21(C) OR SECTION 21(I), IMPEDING OR DIVERTING THE FLOW OF WATER IN A WATERCOURSE (SECTION 21(C)), OR ALTERING THE BED, BANKS, COURSE OR CHARACTERISTICS OF A WATERCOURSE (SECTION 21(I)) OF THE NATIONAL WATER ACT (ACT NO. 36 OF 1998) this project is excluded from a General Authorisation according to Section 3 – unless it triggers any of the activities from (a) to (e) of Section 3, and Section 6 that's states –

> (2) All State Owned Companies (SOC's), and other institutions specified in Appendix D2 having lawful access to that property or land may on that property use water in terms of section 21(c) or (i) of the Act as specified under each of the relevant SOC's and other institution (Appendix D2).
>
> According to Appendix D2 (Figure 4) below:

APPENDIX D2: **Activities that are generally authorized for SOC's and institutions subject only to compliance to the conditions of this Notice.**

SOC's, INSTITUTION or Individual	ACTIVITIES
ESKOM and other institutions	**Construction of new** transmission and distribution power lines, and **minor maintenance** of roads, river crossings, towers and substations where footprint will remain the same.
SANPARKS and provincial conservation agencies	All bridges, low water bridge crossings and pipe lines below 500 mm in diameter.
SANRAL and other provincial Departments of Transport or municipalities.	All maintenance of bridges over rivers, streams and wetlands and new construction of bridges done according to SANRAL Drainage Manual or similar norms and standards.
TRANSNET and other institutions	All 1.5 meter diameter and smaller pipe lines (*except pipelines excluded in terms of this Notice - paragraph 3 (e)*) and maintenance of railway line crossings of rivers and wetlands outside the boundary of a wetland.
Gautrain Management Agency	Maintenance of existing infrastructure and expansion to crossings of rivers within the existing servitude.
TELKOM and other communication companies	All cables crossing rivers and wetland outside delineated wetland boundary.
RAND WATER and other water boards	All raw water 1.5 meter diameter and smaller pipe lines crossings river and wetlands outside delineated wetland boundary.
Municipalities and other institutions.	Mini-scale hydropower developments with a maximum capacity of 10kW – 300kW. (*Read together with General notice 665 of 6 Sept 2013 General Authorisation section 21 (e) or as amended*) These hydropower plants will provide basic, non-grid electricity to rural communities and agricultural land and must in no way affect the flow regime, flow volume and/or water quality including temperature.

Figure 4 Appendix D2 as taken from GN 506 of 2016

6.2. Objective

Watercourses are essential for the maintenance of adequate supply of surface and underground water; hydrological stability and flooding- and erosion-control; as well as sustaining biota. As S21(c) & (i) water use related activities impact watercourses and thus their functions, the objectives of regulating S21(c) & (i) water use entail inter alia (taken from Department of Water and Sanitation, 2014):

Protecting watercourses by:

- promoting sustainable utilisation;
- prevention of degradation; and
- ensuring rehabilitation of watercourses;

Preventing pollution of watercourses, i.e. the direct or indirect alteration of the physical, chemical or biological properties of a watercourse so as to make it:

- less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- harmful or potentially harmful-
    - to the welfare, health or safety of human beings;
    - to any aquatic or non-aquatic organisms;
    - to the resource quality; or
    - to property.

7. STUDY AREA

Less than 1% of the Gross Domestic Product (GDP) of South Africa originates from the Lower Orange Water Management Area (WMA), which is the second lowest of all WMAs in the country. The main future economic growth in the WMA is dependent on mining and agriculture as the primary production sectors. The Lower

Orange WMA has a large variety of minerals and metals found in the region. The mining sector in the Lower Orange WMA is relatively more competitive than the remainder of South Africa. Most of the deposits are already being mined and although no large new developments are anticipated, there are also no indications of a serious decline in activity. The sector can therefore be regarded as relatively stable over the medium term, but may decline over the longer term (Basson and Rossow, 2003).

The Lower Orange WMA covers the most sparsely populated part of South Africa and although it is the WMA with the largest geographic area, it has the second lowest population of all WMAs. Over 70% of the population are classified as urban, living in regional and mining towns throughout the WMA. In the Orange Mainstream sub-area, where farming communities are concentrated along the river, the rural proportion of the population is slightly higher at about 40%. In the more remote and sparsely populated parts of the WMAs, less than 20% of the population is regarded as rural (Basson and Rossow, 2003).

The Lower Orange WMA is different to other WMAs, in that it has a particularly dry, arid climate, with tributaries to the Orange River that are typically non-perennial and have erratic flows. This WMA is also characterised by a series of unique systems of irrigation canals, and water transfer schemes, resulting in human settlement and associated activities being concentrated (Basson and Rossow, 2003).

This area is largely arid and desolate with the only key agricultural activities taking place on the highly irrigated banks for the Orange River. Agricultural activities in this sub-area of the WMA are dominated by the production of grapes for both, table grapes and wine production, as well as dried fruit. Other farming activities include game farms and stock farming (mainly cattle and goats), and as a result several abattoirs are located in the area. On a smaller scale, Koi farming, subsistence farming, and smallscale diamond prospecting can also be observed. Sections within this sub-area also contain popular tourism and recreation areas with canoeing, rafting, boat cruises, fishing and birding proving to be popular activities (Department of Water and Environmental Affairs, 2009).

The water uses for the area are variable and include mostly irrigators for agricultural activities, diamond mines, recreational and domestic users. Extensive abstractions for domestic, agricultural and mining use could exacerbate water quality problems by reducing flow. Agricultural return flows can contribute towards higher salinity, phosphate and nitrate levels (Basson and Rossow, 2003).

As a result of the extremely low and infrequent nature of rainfall over most of the WMA, little usable surface runoff is generated. The runoff, which does occur, is highly variable and intermittent. Flow in the Hartebeest River for example, in one year of high runoff may exceed the cumulative flow during the preceding forty years. Although occasional runoff occurs in the upper reaches of the Molopo River and its tributaries, it is an endoreic river and no record exists of flow having reached the Orange River. Flow in the Orange River, which is the main source of water in the WMA, mostly originates from the Upper Orange WMA (and Lesotho). Inflows from the Vaal River are limited to small quantities of high salinity irrigation return flows and flood spillage/releases from Bloemhof Dam. Flows from the Fish River in Namibia are also infrequent and uncontrolled and therefore not practically abstractable for use. The Fish River does beneficially contribute to the maintenance of the estuary (Basson and Rossow, 2003).

There are no natural lakes in the WMA although many large depressions or pans are found, the better known of which are Grootvloer Pan, Verneukpan and Van Wyksvlei. The Orange River Estuary is of specific importance as a wildlife conservation area, and also supports a wetland of Ramsar status. As a result of the arid climate there are no commercial forests in the WMA. Notable infestation of invading alien vegetation occurs in tributary watercourses and on the banks of the Orange River (Basson and Rossow, 2003).

In the natural state the quality of water in the Orange River was good, although of high turbidity during flood flows. Water from the tributary streams tends to be of high salinity. Both the flow regime and water quality in the Orange River has, however, been severely impacted upon by extensive upstream developments. Salinity in the Orange River has increased due to the transfer of high quality water away from the Orange River (in Lesotho and the Upper Orange WMA) and as a result of high salinity irrigation return flows along the Orange River. Poor quality water from the Vaal River, which contains a high proportion of irrigation return flows as well as treated urban effluent, may also periodically enter the Orange River. Development of surface water from tributary streams in the WMA has reached its potential and all the water is being fully utilised. The Orange River (together with its main tributary the Vaal River) is controlled through storage reservoirs in the upper WMAs and in Lesotho, with limited regulation capacity in the Lower Orange WMA (Basson and Rossow, 2003).

Groundwater utilisation is of major importance in the Lower Orange WMA, as mentioned in Section 5 above, and constitutes the only source of water over much of the WMA. It is mainly used for rural domestic supplies, stock watering and water supplies to inland towns. As a result of the low rainfall over the WMA, recharge of groundwater is limited and only small quantities can be abstracted on a sustainable basis. Aquifer characteristics (borehole yields and storage of groundwater) are also typically unfavourable because of the hard geological formation underlying most of the WMA. Groundwater is the primary source of water for those parts of the WMA remote from the Orange River. The quantities available are relatively small, however, and may be of poor quality in some parts (Basson and Rossow, 2003).

8. METHODOLOGY

8.1. Defining a river

Rivers: have a general morphology distinguishing the active river channel or bed, the river banks, and in the lower systems, the floodplains associated with the river banks. The river ecosystem is formed by the interaction between river biota and their hydro-geochemical environment.

Riparian Habitat: Includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised 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 land areas.

For the purpose of this report, the definition and motivation for a regulated area for the protection of the freshwater resources can be summarised as follows:

The extent of a watercourse as per the Water Use Authorisation (WUA) in terms of the NWA (Act 36 of 1998) defines a watercourse as:

"*(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) reference to a watercourse includes, where relevant, its bed and banks".

Further to this, GN 509 of 2016 defines a regulated area of a watercourse for Section 21 (c) or (i) of the Act water uses 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"

Any of the above will trigger a WUA in terms of Section 21 (c) and (i) of the NWA, 1998 (Act 36 of 1998).

Instream habitat: includes the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse.

Section 21(c) and (i) Water Use: Defined as activities taking place within a watercourse and regulated area that potentially or actually obstruct or redirect flow of water and/or change the characteristics (i.e. resource quality) of the watercourse are regarded as Section 21(c) and/or (i) water use.

Section 21(c) & (i) water uses are non-consumptive and their impacts are often more difficult to detect and manage. Undetected impacts can significantly change various attributes and characteristics of a watercourse, especially if left unmanaged and uncontrolled. Thus, the risks posed by Section 21(c) & (i) water uses on watercourses are an important consideration.

In terms of determining the impact and risks of proposed activities on resource quality, the following definition was used-

Resource quality: The quality of all the aspects of a water resource including -
(a) the quantity, pattern, timing, water level and assurance of instream flow;
(b) the water quality, including the physical, chemical and biological characteristics of the water;
(c) the character and condition of the instream and riparian habitat; and

(d) the characteristics, condition and distribution of the aquatic biota.

Impacts were identified and assessed based on the following understanding: Impacts arising from project inputs and outputs (e.g. water use, changes in surface drainage or water quality, emissions, effluent, chemicals, solid waste, introduction of invasive species and disturbances).

Watercourses were delineated following the standard national methods developed for the delineation of wetlands and riparian areas (Rountree et al., 2008). Terrestrial vegetation surrounding pans and drainage lines usually however have a distinctive, more robust growth form that can be utilized for delineation of the pans and watercourses. Satellite imagery was thus used for the delineation of all watercourses using growth form and structure of vegetation associated with watercourses and was relatively easily observable, as done by other studies (Dabrowski, 2019).

In arid regions such as the Northern Cape Province, vegetation is the best indicator for delineation of riparian zones along drainage lines as there is a very distinct change in vegetation structure characterized by robust growth forms compared to adjacent terrestrial areas. For pans (wetlands) in arid areas the conventional methods of wetland delineation are not appropriate. The soils of temporary wetlands in very arid areas are often too shallow, too saline, or too temporarily inundated to exhibit typical wetland features such as gleying and mottling (Dabrowski, 2019; Day et al., 2010).

Hydrophytic vegetation indicators are also not reliable indicators of wetlands in arid environments. The centre of arid pans in the area of inundation may be bare of vegetation or have vegetation growing on sediments (Dabrowski, 2019; Day et al., 2010).

Watercourses were firstly identified from a desktop study and use was made of National data sets of watercourses and satellite imagery (Collins, 2017; Council for Scientific and Industrial Research, 2018a, 2018b). A site visit was conducted on 24 March 2020 to verify the desktop study's results of watercourses and make observations about the general conditions and state of the watercourses, including the surrounding environment.

Since the area has an arid climate, no standing surface water was observed at the time of the site visit. The area did receive rains prior to the site visit, as was evident from new plant growth. Significant reliance on visual eco-morphological observations, was made in order to derive an understanding of the state of the habitat within the subject site. This state may change under a different meteorological regime.

8.2. Determining the State of a Watercourse

The state of a watercourse is expressed in terms of its bio-physical components (characteristics):

- Drivers (physico-chemical, geomorphology, hydrology) which provide a particular habitat template; and
- Biological responses (fish, riparian vegetation and aquatic invertebrates).

The **Present Ecological State** (PES) refers to the current state or condition of a watercourse in terms of all its characteristics and reflects the change to the watercourse from its reference condition. Drainage lines were assessed collectively and grouped per drainage basin in the study area, numbered 1 to 4 (Figure 5). Drainage lines per basin were determined to be in a very similar state with minimal impacts and were thus summarised for the entire study area. The method used to determine the PES was the Index of Habitat Integrity (IHI) which measures the impact of human disturbance on riparian and instream habitats (Kleynhans, 1996). The IHI is a rapid assessment of the severity of impacts affecting habitat integrity within a river reach. It can be applied to both perennial and non-perennial watercourses (Dabrowski, 2019; Kleynhans, 1996). Each impact on the riparian and instream habitat is given a score based on the degree of modification. An IHI class is then determined based on the resulting score (Table 1).

Wetlands were assessed collectively and grouped per drainage basin in the study area, numbered 1 to 4. Wetlands per basin were determined to be in a very similar state with minimal impacts and were thus summarised for the entire study area. A Department of Water Affairs and Forestry (DWAF) protocol for rapid assessment of palustrine wetlands (on depressions or flats) was applied to assess the PES of the pans (wetlands) (MacKay, 1999). The Wetland Index of Habitat Integrity (IHI) and WET-Health methods were not used in this case because they were not developed for application to wetland flats or depressions. These methods were developed for floodplain, peat and valley-bottom wetlands (Dabrowski, 2019; Macfarlane et al., 2008). The DWAF method evaluates a range of impacts potentially affecting the hydrology, water quality, geomorphology and biota of depressions and wetland flats. These impacts are scored from 0 – 5, with 0 being critically modified, and 5 being natural. Each score is allocated a level of confidence ranging from 1 being low confidence up to 4 being very high confidence. The end result is a PES score with the same categories as those presented in Table 1.

The **Ecological Importance and Sensitivity (EIS)** of a watercourse is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales, and both abiotic and biotic components of the system are taken into consideration (Table 2). Sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The EIS was also grouped separately per wetlands and drainage lines per drainage area.

In addition to describing the ecological state and importance of a watercourse, the **Socio-cultural Importance (SI)** should also be considered. SI reflects the dependency of people on a healthy functioning watercourse and also to the cultural and tourism potential of the watercourse.

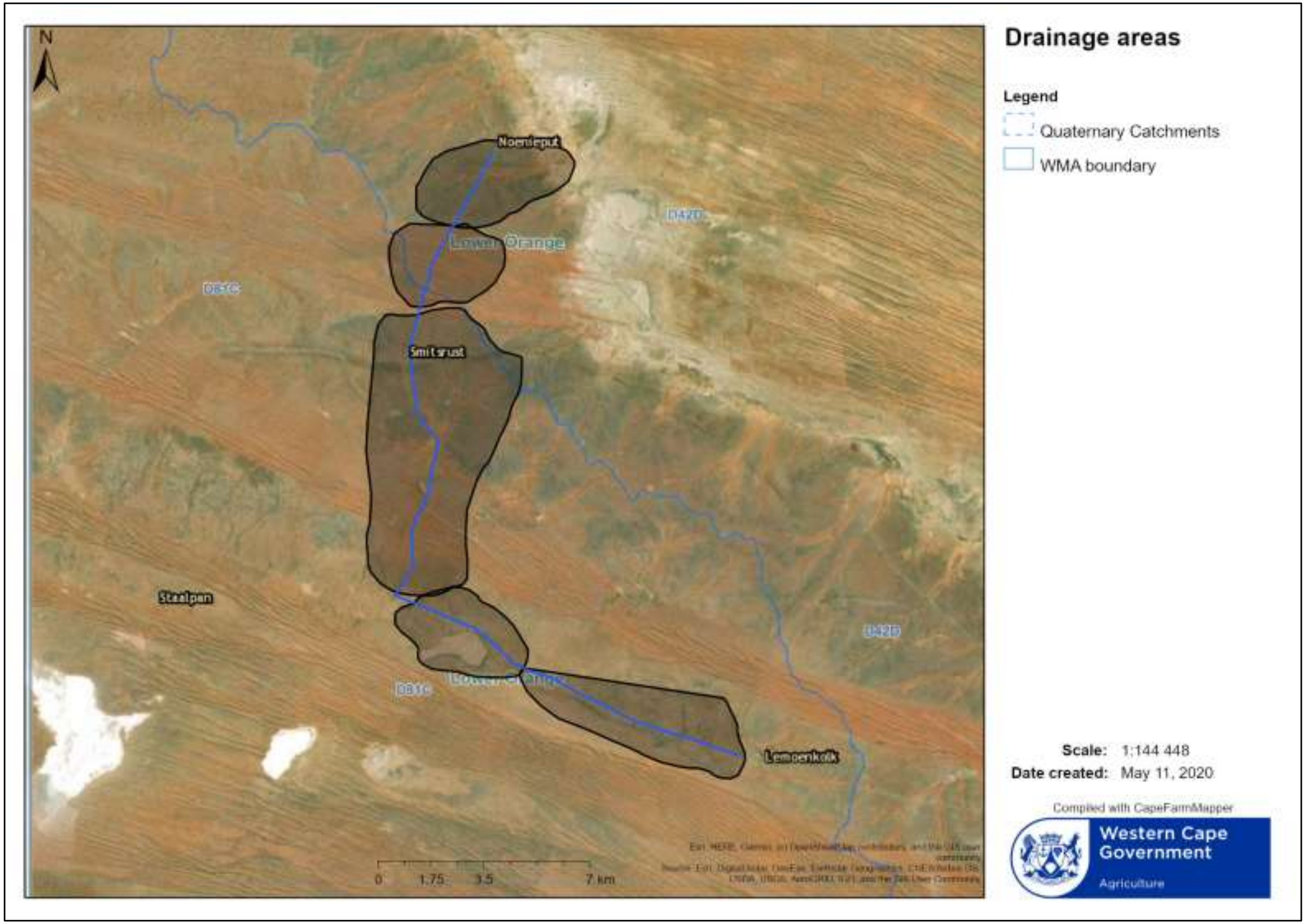

Figure 5 Rough delineation of drainage basins of the study area which the proposed pipeline (Preferred Alternative route displayed only) traverses, also indicating quaternary catchments of the site

Table 1 Criteria for PES calculations.

Ecological Category	Score	Description
A	> 90-100%	**Unmodified**, natural.
B	80-90%	**Largely natural** with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C	60-79%	**Moderately modified**. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D	40-59%	**Largely modified**. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E	20-39%	**Seriously modified**. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	0-19%	**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.

Table 2 Criteria for EIS calculations.

EIS Categories	Score	Description
Low/Marginal	**D**	Not ecologically important and sensitive at any scale. Biodiversity ubiquitous and not sensitive to flow and habitat modifications.
Moderate	**C**	Ecologically important and sensitive on provincial/local scale. Biodiversity not usually sensitive to flow and habitat modifications.
High	**B**	Ecologically important and sensitive. Biodiversity may be sensitive to flow and habitat modifications.
Very High	**A**	Ecologically important and sensitive. On national even international level. Biodiversity usually very sensitive to flow and habitat modifications.

8.3. Comparing Alternatives

The two alternatives were compared via a desktop study. The results of the desktop study were used to exclude one of the alternatives from further assessment and only the resulting Preferred Alternative was investigated during the site visit.

9. ASSUMPTIONS AND LIMITIATIONS

- 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 watercourses will need to be surveyed and pegged according to surveying principles.
- The risk assessment was applied on the basis that the stipulated mitigation measures and all specialist recommendations will be implemented as recommended, and therefore the results presented demonstrate the impact significance of perceived impacts on the receiving freshwater environment post-mitigation.
- All information provided by the applicant and engineering design team to the environmental specialist was correct and valid at the time that it was provided.

- The proposed project footprint as provided by the engineering design team is correct and will not be significantly deviated from.
- Significant reliance on visual eco-morphological observations, was made in order to derive an understanding of the state of the habitat within the subject site. This state may change under a different meteorological regime.
- Investigations were confined to the road and road reserve. In some instances not all watercourses or areas > 4m from the road edge could be investigated due to farm fencing restricting access.

10. RESULTS

10.1. Desktop comparison of alternatives

The desktop analysis used two maps and three datasets to compare alternative routes: the Northern Cape Critical Biodiversity Areas (CBA; Holness and Oosthuysen, 2016) and the National Rivers- and Wetland Maps from the 2018 National Biodiversity Assessment (Van Deventer et al., 2020, 2019). From the maps below (Figure 6 & 7), the following general observations can be made:

- The Preferred Alternative closely follows a dirt road (not clear on the map scale), whereas Alternative one only follows a surfaced road for a section, then crosses over private land from the road to Swartkopsdam.
- The Preferred Alternative crosses over a landscape classified as 'Other Natural Areas' (ONA) only, whereas Alternative 1 goes through a large portion classified as 'Ecological Support Areas (ESA). The ESA area of Alternative 1 corresponds to the corridor surrounding the Molopo River.
- Alternative 1 crosses through a large depression wetland.

From a general environmental and ecological perspective it is highly undesirable to choose a route that will go through a relatively large distance of 'natural' area, were no existing linear access routes are easily available. Disturbing areas within the CBA network (CBA1, CBA2 an ESA) when areas not part of the network or classified as ONA is rather available. From the desktop assessment it is concluded that Alternative 1 is not a feasible option and this conclusion is further supported by the fact that the Preferred Alternative does not cross any ESAs or National Wetlands, in contrast to Alternative 1.

The Preferred Alternative was thus further investigated in the field and more detailed watercourse delineations were done in the 100m radius of the proposed route.

The watercourses delineated during the desktop and subsequent field assessment revealed small drainage lines and depression pans. Watercourses were only identified within a 100m buffer from the proposed pipeline, in order to determine where crossings with watercourses will occur. No surface water was present in the pans or drainage lines, despite evidence of recent rains (https://www.worldweatheronline.com/noenieput-weather-averages/northern-cape/za.aspx), thus indicators for watercourses had to be used.

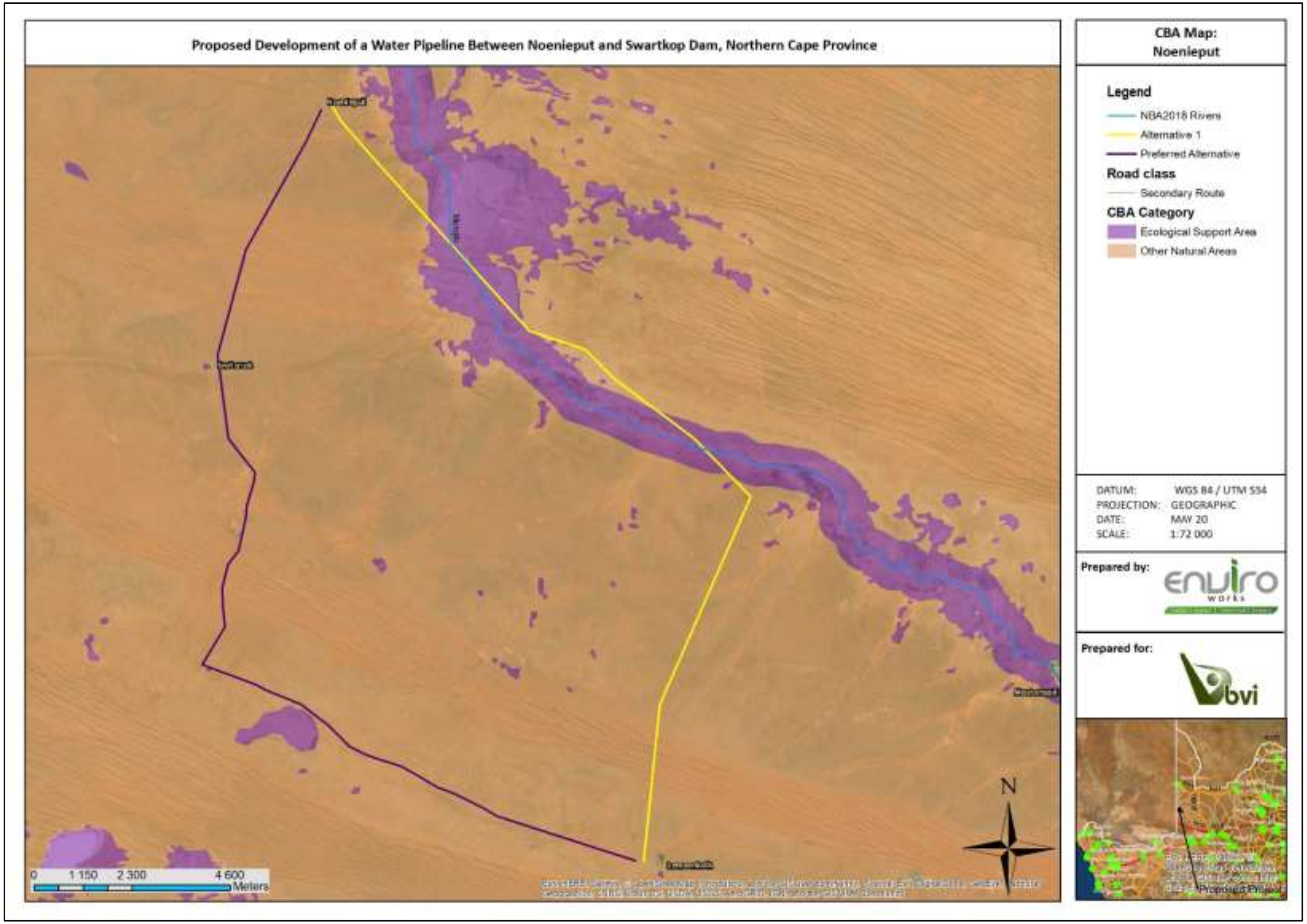

Figure 6 CBA map of the proposed pipeline alternatives

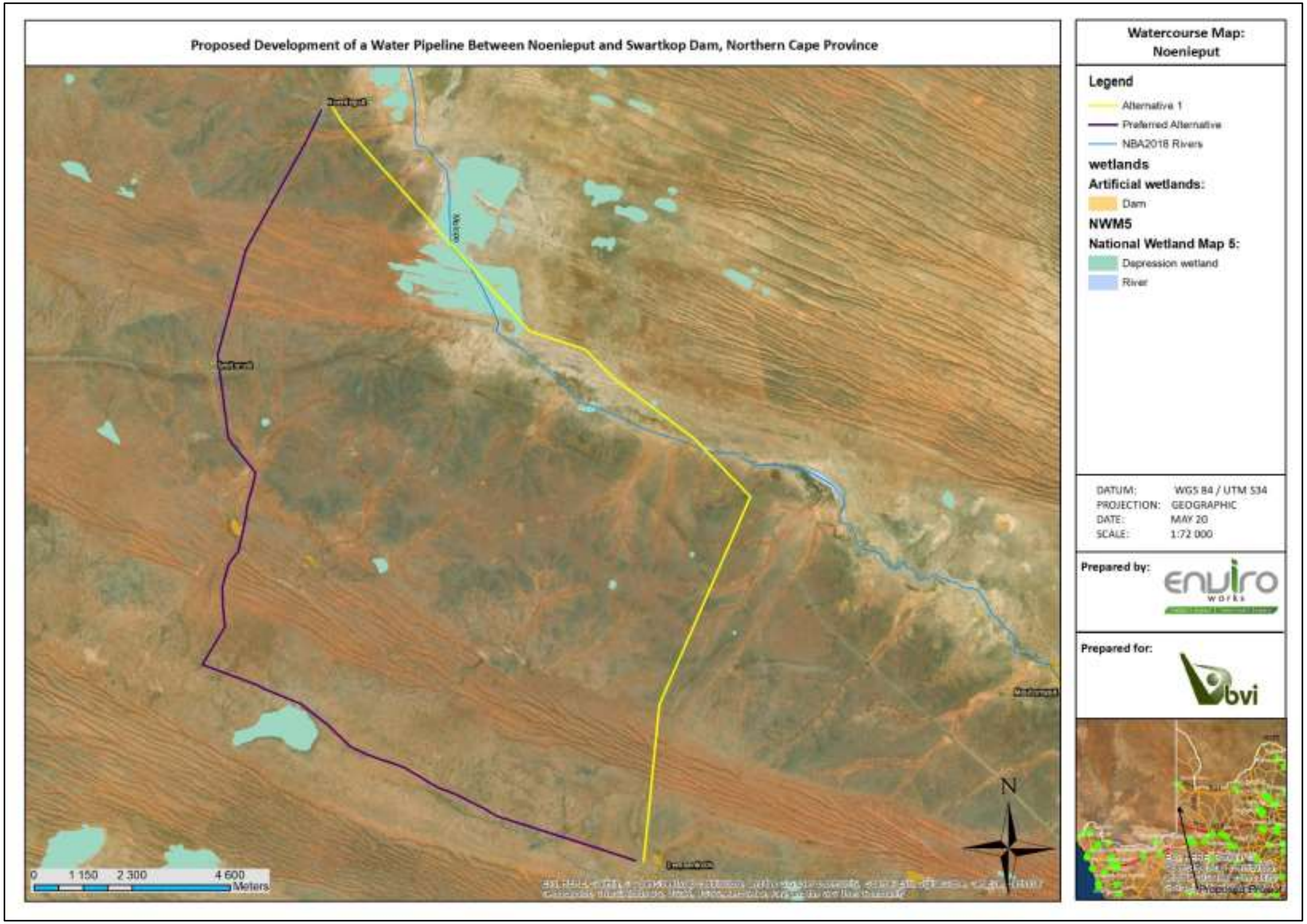

Figure 7 Watercourse map of the proposed pipeline alternatives

Surface flow through these drainage features are considered to be limited to flood or precipitation events. No perennial watercourses occur in the study area but are all classified as ephemeral that flow during heavy rainfall and run-off events. Some minor drainage lines, converge with larger drainage lines, to the south, west and north-west of the study site respectively (Figure 8 – 11). The minor drainage features are only evident through the establishment of riparian vegetation (distinguished based on different growth form and structure than surrounding vegetation) and sediment deposition in the channels. When flow does arise within these features, it is sluggish and ceases abruptly following the cessation of rains. Surface water rapidly drains from site on account of the sandy soils, or is lost to evaporation. It can therefore be argued that under even the more significant rainfalls on site, minor drainage features play only a limited hydrological role (Bundy and Maingard, 2019). It should be noted that these are closed or 'limnetic; systems, in that they do not appear to join larger rivers or flow into the ocean. It is only the drainage network in basin 5 (Figure 5) that could possibly flow into the Molopo River in extreme rainfall and run-off events.

Riparian vegetation provides cover for terrestrial fauna for feeding, breeding and dispersal in the landscape. Drainage lines act as conduits for flood waters, delivering them to main stem rivers. As such, they should be retained in good condition to ensure water quality is not negatively affected downstream habitats (Dabrowski, 2019).

Many of the watercourses were drainage lines with a distinct riparian vegetation and channel features. In some places the distinct channel and riparian vegetation disappears, giving many of the watercourses a discontinuous property. These ephemeral drainage lines form discontinues channels and small drainage networks on a relatively flat topography in a dry environment (Lichvar and Wakeley, 2004). Drainage lines in the study site are associated with alluvial fans and washes. Washes are characterized by unconsolidated alluvial sediments. Braided washes are common in low gradient arid systems with minimal valley confinement. They may have multiple channels and transient gravel bars. Washes may be cryptic and difficult to follow in the landscape as distinct channels can wash out into unconsolidated alluvium, also referred to as floodout zones. These areas play an important role in ground water recharge from floods as channelled flows are dispersed to shallow sheet flow which readily infiltrates the unconsolidated alluvium (as in Dabrowski, 2019).

No guideline document or other local documentation exist that specifically addresses the identification and delineation of these semi-arid and often unchannelled drainage lines as riparian habitat (Grobler, 2016). International literature do described these arid or semi-arid drainage lines as sensitive landscape features as arid-region drainage line channels, especially those with sandy banks, are often very responsive to large flows and recover slowly from them because of the limited vegetation growth and the large inter-annual variability in peak discharges thus arid drainage lines display a high sensitivity to change and rarely reach a state of equilibrium (Grobler, 2016; Lichvar and Wakeley, 2004).

One large pan is situated to the south of the proposed route and three smaller pans (depression wetlands) were identified (Figures 8 – 11).

The level of confidence and the indices used to delineate the pans and drainage lines are given in the table below.

Table 3 Summary of watercourses identified in the study area, indices used for delineation and confidence level of delineation and classification.

Watercourse no.	Watercourse type	Indices used for delineation	Confidence level
1	Ephemeral drainage line	Desktop, infield riparian vegetation and channel morphology	High
2	Ephemeral drainage line	Desktop, riparian vegetation and channel morphology	High
3	Ephemeral drainage line	Desktop, riparian vegetation and channel morphology	High
4	Ephemeral drainage line	Desktop riparian vegetation	Medium-high
5	Ephemeral pan (bright blue part water affected but unlikely part of pan; Figure 9)	Desktop, terrain and soil (soil cracking)	Medium-high
6	Ephemeral drainage line	Desktop riparian vegetation	Medium-high
7	Ephemeral pan (Figure 12)	Desktop, terrain and soil (soil cracking)	Low-medium
8	Ephemeral pan surrounded by water affected area (Figure 13 & 14)	Desktop, terrain and soil (soil cracking)	Medium
9	Ephemeral drainage line	Desktop, infield riparian vegetation and channel morphology	High
10	Ephemeral drainage line	Desktop, infield riparian vegetation and channel morphology	High
11	Ephemeral drainage line	Desktop, infield riparian vegetation and channel morphology	High
12	Ephemeral drainage line	Desktop, infield riparian vegetation and channel morphology	High
13	Ephemeral pan	Desktop and terrain	Medium
14	Ephemeral drainage line	Desktop riparian vegetation	Medium
15	Ephemeral drainage line	Desktop riparian vegetation	Medium
16	Ephemeral drainage line	Desktop, infield riparian vegetation and channel morphology	High

Wetlands in arid to semi-arid regions are poorly detected through remote sensing indices, which often use open water indices for extracting wetland extent. As a result, few of the palustrine and arid systems are well represented in regional to global wetland maps. Previous wetland maps for South Africa, done using remote sensing and prediction modelling, have proved to underrepresent the full extent of arid and palustrine wetlands. In semi-arid to arid countries, such as South Africa, heads-up digitising and in field verification is essential to improve our national maps (Van Deventer et al., 2020). This explains why some of the smaller pans identified in the field were not in the National Wetlands Map.

The pans on site probably receive water from a combination of rainfall, river (drainage line) flow, and ground water. Some drainage lines are interspersed by pans. Pans that retain water and do not drain to other watercourses are termed endorheic (inward draining). They lose their water through evaporation or infiltration. Exorheic (outward draining) pans may drain a portion of their water into a drainage line or wash which can be via surface flow or interflow (as in Dabrowski, 2019).

Figure 8 Watercourses delineated within the first section of the pipeline, showing watercourses 1 to 4

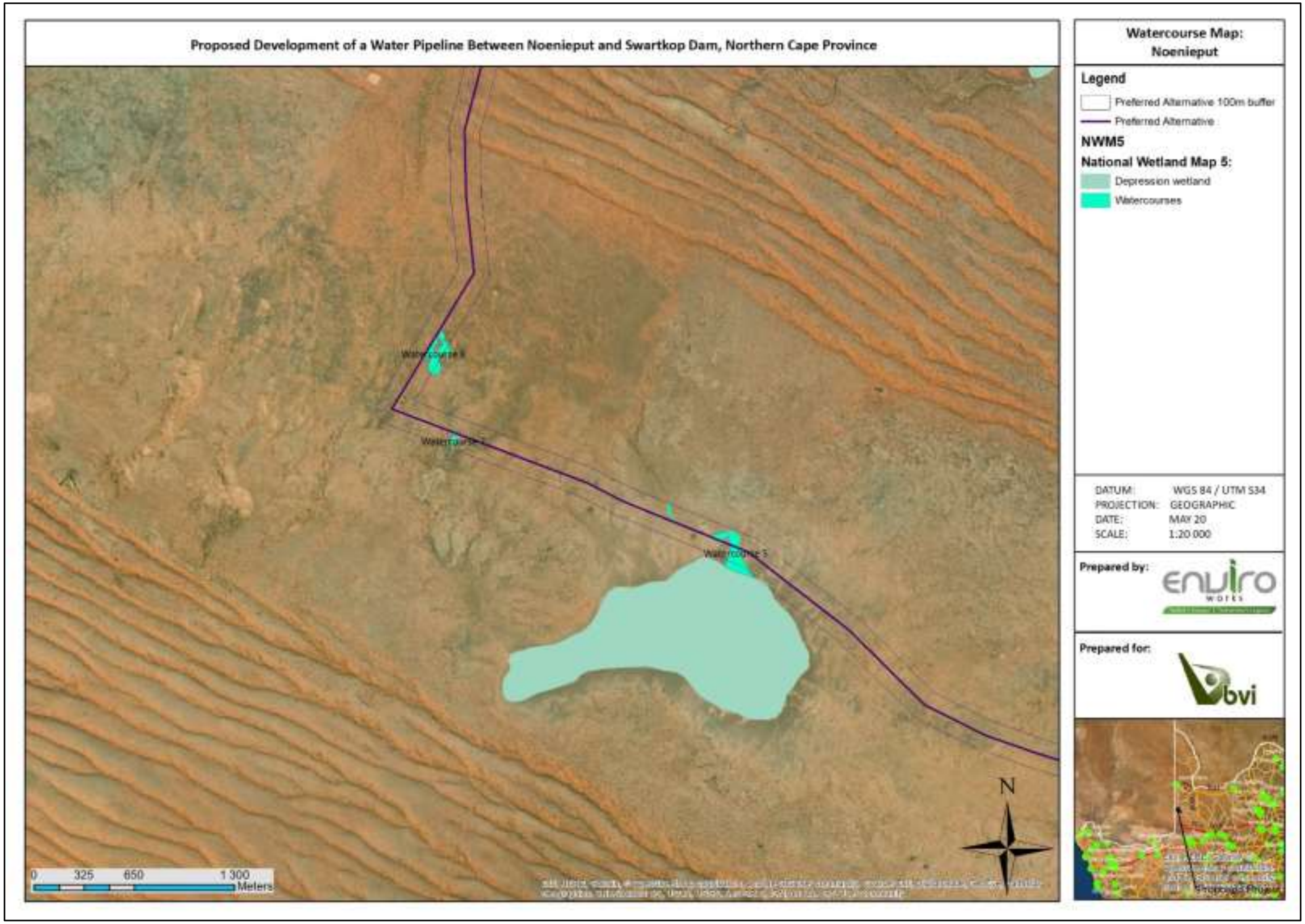

Figure 9 Watercourses delineated within the second section of the pipeline, showing watercourses 5 to 8

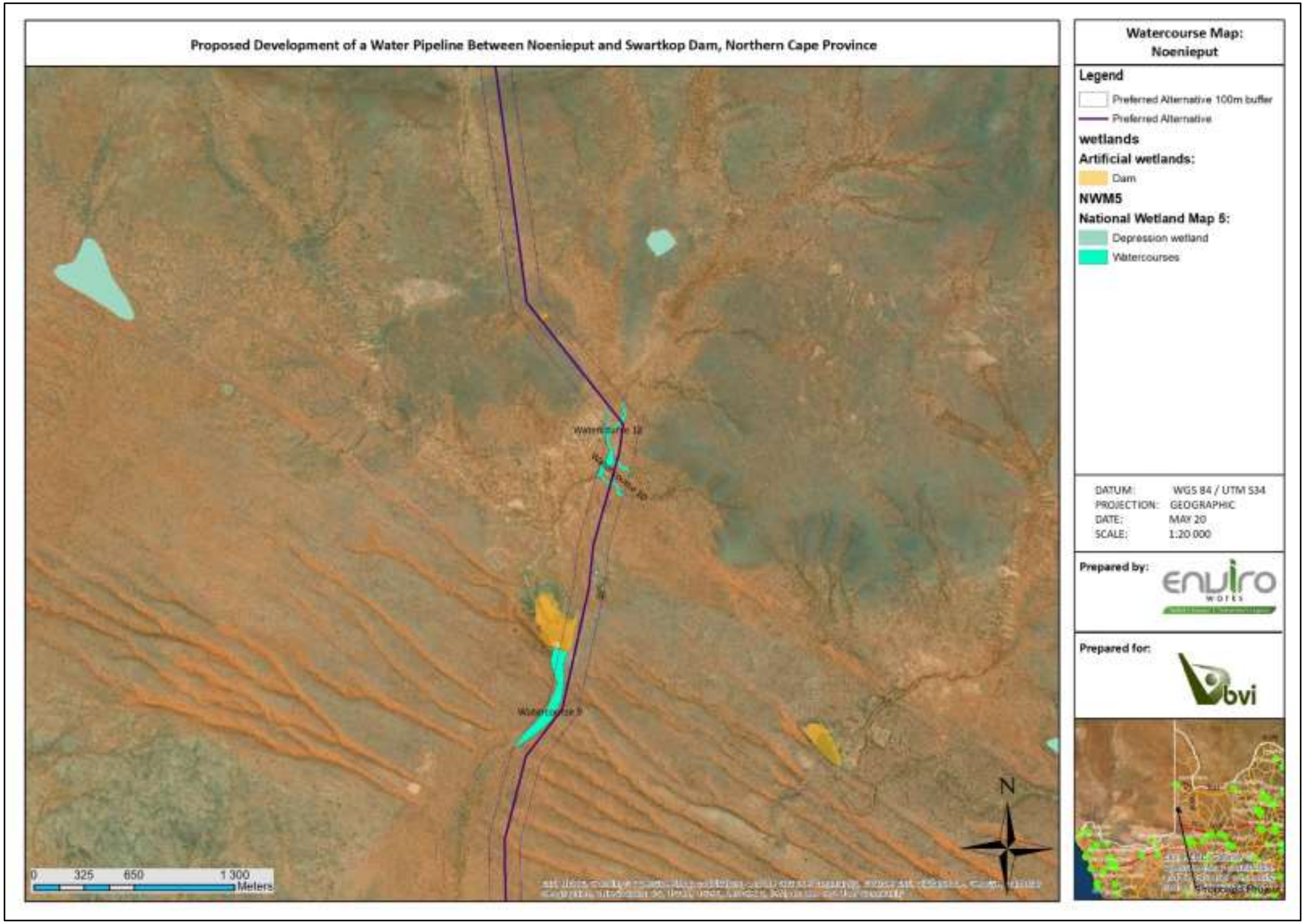

Figure 10 Watercourses delineated within the third section of the pipeline, showing watercourses 9 to 12

Figure 11 Watercourses delineated within the fourth section of the pipeline, showing watercourses 13 to 16

Figure 12 Close up satellite view of watercourse 8. The pan is delineated in black, with the blue indicating the water affected area, where signs of water were observed (cracked soil)

These pans in the study area could be of important local value as ecologists describe the value of small isolated wetlands by their aggregate role in protecting wetland-dependent species through "source-sink dynamics". More variable than larger wetlands, each small wetland in an area may fluctuate in the number of individuals of a species it contains; at times a wetland may act as a "sink" when the population of a species dies out locally from that wetland, or it may be a "source" that produces surplus individuals, which can colonize a nearby sink wetland. Populations of a species that are spread over a number of locations are referred to as "metapopulations", and this source-sink dynamic is crucial to the regional survival of species. A metapopulation of a wetland-dependent species depends on the abundance and proximity of wetlands, rather than a critical size threshold. The disappearance of small wetlands from an area that relies on source-sink dynamics could result in the loss of ecological connectedness and potentially collapse the metapopulations of wetland dependent species, causing many local extinctions (as in Grobler, 2016; Semlitsch, 2000).

All pans are also ephemeral in their hydrology but can be considered high sensitivity. They play an important role in providing standing surface following rainfall which supports drinking and feeding requirements for a range of taxa.

Images taken of some of the watercourses during the site visit can be viewed in Appendix B attached to this report.

Figure 13 View of watercourse 7, likely an ephemeral pan

Figure 14 View of ephemeral pan from the dirt road, watercourse 7

10.2. PES, EIS and SCI of watercourses

The drainage lines and pans within the study area have had very few negative impacts, restricted largely to the occasional road crossings, livestock waterering and trampling, agriculture, in stream dams, fence lines within the regulated zones of watercourses (i.e. within 500m from pans and 100m from drainage lines), farm homesteads and two small settlements (towns). The impacts also did not vary significantly spatially across the drainage basins, nor between pans and drainage lines.

The watercourse types and their associated PES and EIS scores are given below.

The PES was classified as A, natural or closely approaching natural for drainage lines and pans. The negative impacts on watercourses are at a relatively small scale, with no discernible impact, or the modification is located in such a way that it has no impact on the habitat quality, diversity, size and variability, nor do the impacts have significant effects on hydrology, water quality, geomorphology or biota of the system.

The EIS for the watercourses can be separated by drainage lines and pans. While it is acknowledged in section 10.1. the ecological functions that ephemeral drainage lines could have for the local ecosystems, these drainage lines are not classified as ESAs, nor are they part of endangered ecosystems. The importance and significance is thus local and can be classified as D, low to moderate since and are not ecologically important and sensitive at any scale. Biodiversity ubiquitous and not sensitive to flow and habitat modifications.

The pans are however more sensitive and important, and can be classified as moderate, C. These pans are ecologically important and sensitive on provincial/local scale. Biodiversity not usually sensitive to flow and habitat modifications.

The SCI can be classified as low, since these drainage lines are small and ephemeral there is very little direct use of these features. The population density is also extremely low in this area, with the main uses being livestock based with low dependence on riverine resources for livelihood (high dependence on groundwater).

10.3. Buffers and watercourse avoidance

The rationale behind choosing the Preferred Alternative is to align the pipeline as close as possible to the existing linear infrastructure between Swartkopsdam and Noenieput, namely the dirt road. From a general environmental perspective this limits the disturbance of topsoil and clearing of vegetation close to existing disturbances and also does not fragment any new habitats or ecosystems but is rather situated on the edges of existing disturbances in the landscape. If the aim is to stay within the road reserve and as close as possible to the road, totally avoiding watercourses is not practically feasible and thus recommending buffer distance around watercourses is not practical in this instance. It is however argued that should the pipeline be situated on the opposite side of the road of watercourses or crossing watercourses upstream of larger drainage systems, impacts will be mitigated by the potential disruptive effects of the road and maximizing the distance between the disturbance and watercourses, whilst also minimising the extent of instream and riparian disturbance. Thus it is recommended that for Watercourses 1 – 7 to stay on the north of the road, watercourse 8 on the west of the road, watercourses 9 – 12 on the east of the road, watercourse 13 & 14 on the west and watercourse 15 & 16 on the east.

Disturbance during construction phases will reduce vegetation cover and disturb soil over an extended area which is likely to increase the amount of erosion and subsequent sedimentation along the drainage line and associated drainage systems. Given the infrequency of rainfall in the area this may fortunately happen at a relatively slow rate. Wide-scale disturbance to vegetation is likely to exacerbate erosion and may lead to significant invasion by alien vegetation if this issue is not consistently managed by the various land owners and plant management.

11. IMPACTS AND RISK ASSESSMENT

Impacts were assessed using a common, defensible method that is based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol, of assessing significance that will enable comparisons to be made between risks of potential impacts and will enable transparency of the process upon which risks of impacts have been assessed. The first part of the assessment is the identification of environmental activities, aspects and impacts. The impacts are rated according to criteria set out in Appendix A. 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 and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. 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. The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures. The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. A summary of the impacts and their activities are given in the tables below (Table 4, 5 & 6). The results of the Risk Assessment are also summarized in Table 7. The full results of the risk assessment can be viewed in Appendix A of this report.

The following potential impacts have been identified and the aspects and activities associated with the construction and operational phase.

Potential impacts:

1. Loss of watercourses and watercourse habitat and ecological structure

Table 4 Aspect and activity register for the impact: Loss of watercourses and watercourse habitat and ecological structure.

Pre-Construction	Construction	Operation
Potential poor planning, resulting in the placement of the linear development within delineated watercourses, leading to altered habitat	Site clearing and the removal of vegetation leading to increased runoff and erosion during rainfall events	Poor rehabilitation of watercourses resulting in alien plant proliferation and erosion of construction areas
Increased anthropogenic activity within the watercourses	Potential indiscriminate driving through watercourse areas leading to soil compaction	Potential movement of vehicles through watercourses during maintenance activities

		(maintenance to pipeline, alien invasive control, follow-up rehabilitation)
	Earthworks in the vicinity of the watercourses and drainage system leading to loss of riparian and wetland habitat, erosion and altered runoff patterns	
	Spillage from construction vehicles and waste dumping leading to contamination of watercourses and their soils	
	Changes to the watercourse vegetation community due to alien invasion resulting in altered watercourse conditions	

2. Loss of hydrological functioning and impacting sediment balance

Table 5 Aspect and activity register for the impact: Loss of hydrological functioning and impacting sediment balance.

Pre-Construction	Construction	Operation
Potential poor planning, resulting in the placement of the linear development within delineated watercourses, leading to altered habitat	Site clearing, earthworks, soil disturbance and the removal of vegetation leading to changes in runoff, erosion, sedimentation and altered geomorphology during times of rainfall and surface runoff	Increased runoff volumes due to compacted soils
Increased disturbances within the watercourses and their regulated areas	Movement of vehicles and construction equipment through watercourse and their regulated areas leading to soil compaction	Potential soil disturbance in watercourses and their regulated areas during maintenance activities (maintenance to pipeline, alien invasive control, follow-up rehabilitation). Disturbed soils erode, leading to altered hydrological flow patterns and increased sedimentation of downstream features

3. Changes to ecological and socio-cultural service provisioning

Table 6 Aspect and activity register for the impact: Changes to ecological and socio-cultural service provisioning.

Pre-Construction	Construction	Operation
Potential poor planning, resulting in the placement of the linear development within delineated watercourses, leading to altered habitat	Loss of nutrient, sediment and toxicant removal abilities due to vegetation clearing	Reduced ability of watercourses to remove nutrients, sediments and toxicants due to loss of vegetation and increased run-off
Increased anthropogenic activity within the watercourses leading to an increased impact on the biological structure of the watercourses and the associated	Reduced ability to support biodiversity due to vegetation clearing (reduced breeding and foraging habitat)	Decrease in biodiversity due to loss of watercourse habitat and introduction and spread of alien invasive plant species

effects that this will have on service provision		
	Earthworks within watercourses and their regulated area reduce flood attenuation and streamflow regulation capability	
	Reduced water and habitat quality due to oil and chemical leaks, waste rubble dumping, increased littering, increased sedimentation and alteration of natural hydrological regimes	

Table 7 Summary of results of significance rating from impact assessment (Appendix A).

Impact	Phase	Without Mitigation	With Mitigation
Loss of watercourses and watercourse habitat and ecological structure	Pre-construction	Moderate (59.5)	Low (27.5)
	Construction	Moderate (127.5)	Low (38.5)
	Operation	Moderate (99)	Low (37.5)
Loss of hydrological functioning and impacting sediment balance	Pre-construction	Moderate (63)	Low (25)
	Construction	Moderate (112.5)	Low (42)
	Operation	Moderate (99)	Low (37.5)
Changes to ecological and socio-cultural service provisioning	Pre-construction	Moderate (63)	Low (25)
	Construction	Moderate (117)	Low (45)
	Operation	Moderate (99)	Low (31.5)

From the impact summary it can be seen that should mitigation be applied, all potential impact risks will be low but could have moderate risk should no mitigation be applied.

12. RECOMMENDATIONS

The following sections are taken from Government Notice 509 of 2016 - GENERAL AUTHORISATION IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) FOR WATER USES AS DEFINED IN SECTION 21(C) OR SECTION 21(I), IMPEDING OR DIVERTING THE FLOW OF WATER IN A WATERCOURSE (SECTION 21(C)), OR ALTERING THE BED, BANKS, COURSE OR CHARACTERISTICS OF A WATERCOURSE (SECTION 21(I)) OF THE NATIONAL WATER ACT (ACT NO. 36 OF 1998) and are the conditions and requirements of the notice and General Authorisations for c & i water uses. Items in italic are additions by the specialist.

12.1. Conditions

(1) The water user must ensure that:

(a) impeding or diverting the flow or altering the bed, banks, course or characteristics of a watercourse do not detrimentally affect other water users, property, health and safety of the general public, or the resource quality;

(b) the existing hydraulic, hydrologic, geomorphic and ecological functions of the watercourse in the vicinity of the structure is maintained or improved upon;

(c) a full financial provision for the implementation of the management measures prescribed as per the General Authorisation (GN 506 of 2016), including an annual financial provision for any future maintenance, monitoring, rehabilitation, or restoration works, as may be applicable; and

(d) upon written request of the responsible authority, they implement any additional management measures or monitoring programmes that may be reasonably necessary to determine potential impacts on the water resource or management measures to address such impacts.

(2) Prior to the carrying out of any works, the water user must ensure that all persons entering on -site, including contractors and casual labourers, are made fully aware of the conditions and related management measures specified as per the General Authorisation (GN 506 of 2016).

(3) The water user must ensure that –

(a) any construction camp, storage, washing and maintenance of equipment, storage of construction materials, or chemicals, as well as any sanitation and waste management facilities –

(i) is located outside the 1 in 100 year flood line or riparian habitat of a river, spring, lake, dam or outside any drainage feeding any wetland or pan, and

(ii) is removed within 30 days after the completion of any works.

(b) The water user must ensure that the selection of a site for establishing any impeding or diverting the flow or altering the bed, banks, course or characteristics of a watercourse works:

(i) is not located on a bend in the watercourse;

(ii) avoid high gradient areas, unstable slopes, actively eroding banks, interflow zones, springs, and seeps;

(iii) avoid or minimise realignment of the course of the watercourse;

(iv) minimise the footprint of the alteration, as well as the construction footprint so as to minimise the effect on the watercourse.

(c) The water user must ensure that a maximum impact footprint around the works is established, clearly demarcated, that no vegetation is cleared or damaged beyond this demarcation, and that equipment and machinery is only operated within the delineated impact footprint.

(d) The water user must ensure that measures are implemented to minimise the duration of disturbance and the footprint of the disturbance of the beds and banks of the watercourse.

(e) The water user must ensure that measures are implemented to prevent the transfer of biota to a site, which biota is not indigenous to the environment at that site.

(f) The water user must ensure that all works, including emergency alterations or the rectification of incidents, start upstream and proceed in a downstream direction, to ensure minimal impact on the water resource.

(g) The water user must ensure that all material excavated from the bed or banks of the watercourse are stored at a clearly demarcated location until the works have been completed, upon which the excavated material must be backfilled to the locations from where it was taken (i.e. material taken from the bed must be returned to the bed, and material taken from the banks must be returned to the banks).

(h) The water user must ensure that adequate erosion control measures are implemented at and near all alterations, including at existing structures or activities with particular attention to erosion control at steep slopes and drainage lines.

(i) The water user must ensure that alterations or hardened surfaces associated with such structures or works -

(i) are structurally stable;

(ii) do not induce sedimentation, erosion or flooding;

(iii) do not cause a detrimental change in the quantity, velocity, pattern, timing, water level and assurance of flow in a watercourse;

(iv) do not cause a detrimental change in the quality of water in the watercourse;

(v) do not cause a detrimental change in the stability or geomorphological structure of the watercourse; and,

(vi) does not create nuisance condition, or health or safety hazards.

(j) The water user must ensure that measures are implemented at alterations, including at existing structures or activities, to –

(i) prevent detrimental changes to the breeding, nesting or feeding patterns of aquatic biota, including migratory species;

(ii) allow for the free up and downstream movement of aquatic biota, including migratory species; and

(iii) prevent a decline in the composition and diversity of the indigenous and endemic aquatic biota.

(k) The water user must ensure that no substance or material that can potentially cause pollution of the water resource is being used in works, including for emergency alterations or the rectification of reportable incidents.

(I) The water user must ensure that measures are taken to prevent increased turbidity, sedimentation and detrimental chemical changes to the composition of the water resource as a result of carrying out the works, including for emergency alterations or the rectification of reportable incidents.

(m) The water user must ensure that in- stream water quality is measured on a weekly basis during construction, including for emergency alterations or the rectification of reportable incidents, which measurement must be by taking samples, and by analysing the samples for pH, EC/TDS, TSS/Turbidity, and /or Dissolved Oxygen ("DO ") both upstream and downstream from the works – *this measure will only apply if there is sufficient flow in watercourses, and this is unlikely as watercourses are ephemeral.*

(n) The water user must ensure that in- stream flow, both upstream and downstream from the works, is measured on an ongoing basis by means of instruments and devices certified by the South African Bureau of Standards ("SABS "), and that such measurement commences at least one week prior to the initiation of the works, including for emergency alterations or the rectification of reportable incidents – *this measure will only apply if there is sufficient flow in watercourses, and this is unlikely as watercourses are ephemeral.*

(o) During the carrying out of any works, the water user must take the photographs and video- recordings referred to in paragraph (p) below, on a daily basis, starting one (1) week before the commencement of any works, including for emergency structures and the rectification of reportable incidents, and continuing for one (1) month after the completion of such works (*this will be applicable to the construction time of a specific structure of watercourse crossing*):

(p) The following videos recordings and photographs must be taken as contemplated in paragraph (o) above:

(i) one or more photographs or video -recordings of the watercourse and its banks at least 20 meters upstream from the structure;

(ii) one or more photographs or video -recordings of the watercourse and its banks at least 20 meters downstream from the structure; and

(iii) two or more photographs or video -recordings of the bed and banks at the structure, one of each taken from each opposite bank.

10.2. Rehabilitation

1. Upon completion of the construction activities related to the water use –

(a) a systematic rehabilitation programme must be undertaken to restore the watercourse to its condition prior to the commencement of the water use;

(b) all disturbed areas must be re- vegetated with indigenous vegetation suitable to the area [*if vegetation does not re-establish naturally after one growth cycle (to be determined in February – April of the year following end of construction, and/or should erosion be evident on or around the footprint)]* ; and

(c) active alien invasive plant control measures must be implemented to prevent invasion by exotic and alien vegetation within the disturbed area.

2. Following the completion of any works, and during any annual inspection to determine the need for maintenance at any impeding or diverting structure, the water user must ensure that all disturbed areas are –

(i) cleared of construction debris and other blockages;

(ii) cleared of alien invasive vegetation;

(iii) reshaped to free -draining and non -erosive contours, and

(iv) re- vegetated with indigenous and endemic vegetation suitable to the area (*if vegetation cover was present priori to construction and/or if vegetation does not re-establish naturally after one growth cycle (to be determined in February – April of the year following end of construction), and/or should erosion be evident on or around the footprint)*.

3. Upon completion of any works, the water user must ensure that the hydrological functionality and integrity of the watercourse, including its bed, banks, riparian habitat and aquatic biota is equivalent to or exceeds that what existed before commencing with the works.

10.3. Monitoring and reporting

(1) The water user must ensure the establishment and implementation of monitoring programmes to measure the impacts on the resource quality to ensure water use remains within the parameters of Section 10.1.(3)(m) to (o) and results are stored – *if any water flow during construction*;

(2) Upon the written request of the responsible authority the water user must –

(a) ensure the establishment of any additional monitoring programmes; and

(b) appoint a competent person to assess the water use measurements made in terms of the General Authorisation (GN 506 of 2016) and submit the findings to the responsible authority for evaluation.

(3) The water user shall monitor and determine present day values for water resource quality before commencement of water uses in terms of section 21(c) or (i) of the Act -– *if any water flow during planning and construction*.

(4) Upon completion of construction activities related to the water use, the water user must undertake an Environmental Audit annually for three years to ensure that the rehabilitation is stable, failing which, remedial action must be taken to rectify any impacts.

(5) Rehabilitation structures must be inspected regularly for the accumulation of debris, blockages, instabilities and erosion with concomitant remedial and maintenance actions.

(6) Copies of all designs, method statements, risk assessments as done according to the Risk Matrix, rehabilitation plans and any other reports required must be made available to the responsible authority when requested to do so.

10.4. Budgetary provisions

(1) The water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this General Authorisation.

(2) The Department may at any stage of the process request proof of budgetary provisions.

10.5. Registration

(1) Subject to the provisions of the General Authorisation (GN 506 of 2016), a person who uses water as contemplated in the General Authorisation (GN 506 of 2016) must submit the relevant registration forms to the responsible authority.

(2) Upon completion of registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission.

(3) On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can only then commence with the water use as contemplated in the General Authorisation (GN 506 of 2016).

10.6. Record -keeping and disclosure of information

(1) The water user must keep a record of all the documents referred to in Section 10.3 above for a minimum period of five years.

(2) The records referred to in this Section must be made available to the responsible authority upon written request.

10.7. Inspection

Any property in respect of which a water use has been registered in terms of the General Authorisation (GN 506 of 2016) is subject to inspection in accordance with the relevant provisions of the Water Act.

10.8. Compliance by the water user

(1) The responsibility for complying with the provisions of this authorisation lies with the water user.
(2) The General Authorisation (GN 506 of 2016) is subject to the Water Act, any other applicable law, and regulation.

11. CONCLUSION

It is the opinion of the specialist, that based on the mitigation and remedial measures proposed, the land can be returned to the current state within two years or less of completion of the construction phase.

The watercourses assessed in this study were in a good ecological state. Both drainage lines and pans provide important ecological and hydrological functions in the landscape, and it is important that these functions are preserved as far as possible. The pipeline infrastructure proposed have been well planned in terms of considering environmentally sensitive areas in the planning and layout phase. The layout can be further refined using the suggested mitigation measures in this report. While impacts to watercourses within and adjacent to the footprint are inevitable, the majority of these are considered negligible in their mitigated state. Provided the site is well managed during the construction and operational phase, following suggested mitigation measures, the development is considered as a positive contribution to the water provisioning service within the area.

13. REFERENCES

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APPENDIX A

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

Negative Rating

TABLE 1- 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 2 – 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 / neighboring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

TABLE 3 – 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, a E or F	5
PES and EIS (sensitivity) must be considered.	

TABLE 4 – 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 5 – FREQUENCY OF THE INCIDENT/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 6 – 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 7 – DETECTION

How quickly/easily can the impacts/risks of the activity be observed on the resource quality, people and property?

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

TABLE 8: 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. License 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 9: CALCULATIONS

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

RISK MATRIX (BASED ON DWS 2015 PUBLICATION: SECTION 21 C AND I WATER USE RISK ASSESSMENT PROTOCOL)

			Severity																
No.	**Phases**	**Impact**	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	PES AND EIS OF WATERCOURSE
1.1.	Pre-Construction (without mitigation)	1. Loss of watercourses and watercourse habitat and ecological structure	0	1	2	2	1.25	1	2	4.25	1	5	5	3	14	59.5	Moderate	95	PES- A; EIS- D for drainage line; EIS- C for pans
1.2.	Pre-Construction (with mitigation)	1. Loss of watercourses and watercourse habitat and ecological structure	0	0	1	1	0.5	1	1	2.5	1	2	5	3	11	27.5	Low	95	PES- A; EIS- D for drainage line; EIS- C for pans
2.1.	Construction (without mitigation)	1. Loss of watercourses and watercourse habitat and ecological structure	2	2	3	3	2.5	2	3	7.5	5	5	5	2	17	127.5	Moderate	95	PES- A; EIS- D for drainage line; EIS- C for pans
2.2.	Construction (with mitigation)	1. Loss of watercourses and watercourse habitat and ecological structure	1	0	1	1	0.75	1	1	2.75	5	2	5	2	14	38.5	Low	95	PES- A; EIS- D for drainage line; EIS- C for pans
3.1.	Operation	1. Loss of watercourses and watercourse habitat and ecological structure	1	1	2	2	1.5	1	3	5.5	5	5	5	3	18	99	Moderate	95	PES- A; EIS- D for drainage line; EIS- C for pans
3.2.	Operation	1. Loss of watercourses and watercourse habitat and ecological structure	0	0	1	1	0.5	1	1	2.5	5	2	5	3	15	37.5	Low	95	PES- A; EIS- D for drainage line; EIS- C for pans

			Severity																
No.	**Phases**	**Impact**	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	PES AND EIS OF WATERCOURSE
1.1.	Pre-Construction (without mitigation)	2. Loss of hydrological functioning and impacting sediment balance	1	2	2	1	1.5	1	2	4.5	1	5	5	3	14	63	Moderate	95	PES- A; EIS- D for drainage line; EIS- C for pans
1.2.	Pre-Construction (with mitigation)	2. Loss of hydrological functioning and impacting sediment balance	0	1	1	0	0.5	1	1	2.5	1	1	5	3	10	25	Low	95	PES- A; EIS- D for drainage line; EIS- C for pans
2.1.	Construction (without mitigation)	2. Loss of hydrological functioning and impacting sediment balance	2	2	3	2	2.25	1	3	6.25	5	5	5	3	18	112.5	Moderate	95	PES- A; EIS- D for drainage line; EIS- C for pans

2.2.	Construction (with mitigation)	2. Loss of hydrological functioning and impacting sediment balance	1	1	1	1	1	1	1	3	5	1	5	3	14	42	Low	95	PES- A; EIS- D for drainage line; EIS- C for pans
3.1.	Operation	2. Loss of hydrological functioning and impacting sediment balance	1	1	2	2	1.5	1	3	5.5	5	5	5	3	18	99	Moderate	95	PES- A; EIS- D for drainage line; EIS- C for pans
3.2.	Operation	2. Loss of hydrological functioning and impacting sediment balance	0	0	1	1	0.5	1	1	2.5	5	2	5	3	15	37.5	Low	95	PES- A; EIS- D for drainage line; EIS- C for pans

No.	Phases	Impact	Severity: Flow Regime	Severity: Physico & Chemical (Water Quality)	Severity: Habitat (Geomorph + Vegetation)	Severity: Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	PES AND EIS OF WATERCOURSE
1.1.	Pre-Construction (without mitigation)	3. Changes to ecological and socio-cultural service provisioning	1	1	2	2	1.5	1	2	4.5	1	5	5	3	14	63	Moderate	95	PES- A; EIS- D for drainage line; EIS- C for pans
1.2.	Pre-Construction (with mitigation)	3. Changes to ecological and socio-cultural service provisioning	0	0	1	1	0.5	1	1	2.5	1	1	5	3	10	25	Low	95	PES- A; EIS- D for drainage line; EIS- C for pans
2.1.	Construction (without mitigation)	3. Changes to ecological and socio-cultural service provisioning	2	3	3	2	2.5	1	3	6.5	5	5	5	3	18	117	Moderate	95	PES- A; EIS- D for drainage line; EIS- C for pans
2.2.	Construction (with mitigation)	3. Changes to ecological and socio-cultural service provisioning	1	1	1	1	1	1	1	3	5	2	5	3	15	45	Low	95	PES- A; EIS- D for drainage line; EIS- C for pans
3.1.	Operation	3. Changes to ecological and socio-cultural service provisioning	1	2	2	1	1.5	1	3	5.5	5	5	5	3	18	99	Moderate	95	PES- A; EIS- D for drainage line; EIS- C for pans
3.2.	Operation	3. Changes to ecological and socio-cultural service provisioning	0	0	1	0	0.25	1	1	2.25	5	1	5	3	14	31.5	Low	95	PES- A; EIS- D for drainage line; EIS- C for pans

APPENDIX B

Figure 15 Northern view of ephemeral drainage line, watercourse 1

Figure 16 Southern view of ephemeral drainage line, watercourse 1

Figure 17 Northern view of ephemeral drainage line, watercourse 2

Figure 18 Southern view of ephemeral drainage line, watercourse 2

Figure 19 View of ephemeral pan, watercourse 5, from the dirt road

Figure 20 Northern view of likely ephemeral pan, watercourse 7

Figure 21 Southern view of likely ephemeral pan, watercourse 7

Figure 22 Water affected area associated with ephemeral pan, watercourse 8

Figure 23 View of ephemeral riparian area, watercourse 9

Figure 24 Artificial instream dam into which watercourse 9 flows

Figure 25 Sandy alluvial bed and bank of ephemeral drainage line, watercourse 12, west of the road

Figure 26 Sandy alluvial bed and bank of ephemeral drainage line, watercourse 12, east of the road

Figure 27 View of ephemeral pan, watercourse 13

Figure 28 Western view of ephemeral drainage line, watercourse 16

Figure 29 Western view of ephemeral drainage line, watercourse 16