GEORGE
TEL: +27 (0) 44 873 4923 **FAX:** +27 (0) 44 874 5953
EMAIL: info@sescc.net **WEBSITE:** www.sescc.net
ADDRESS: 102 Merriman Street, George 6530
PO BOX: 9087, George , 6530

CAPE TOWN
TEL: +27 (0) 21 554 5195 **FAX:** +27 (0) 86 575 2869
EMAIL: betsy@sescc.net **WEBSITE:** www.sescc.net
ADDRESS: Tableview, Cape Town, 7441
PO BOX: 443, Milnerton, 7435

AQUATIC BIODIVERSITY RISK ASSESSMENT

FOR THE

PERIODIC MAINTENANCE OF TR03103, MR00295, MR00294, DR01356, OP06046 AND ASSOCIATED INFRASTRUCTURE NEAR MONTAGU, LANGEBERG LOCAL MUNICIPALITY, WESTERN CAPE

PREPARED FOR: Western Cape Government: Department of Transport and Public Works: Road Network Management Branch

PREPARED BY: Sharples Environmental Services

Contact Person: Debbie Fordham
Email: debbie@sescc.net

DATE: 6th of August 2021

DECLARATION OF INDEPENDENCE

Independent Specialist Consultant

I, Debbie Fordham, declare that I:

- Act as an independent specialist consultant, in this application, in the field of wetland and riparian ecology;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014 (as amended);
- Have, and will have, no vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the amended Environmental Impact Assessment Regulations, 2017; and
- Will provide the competent authority with access to all the information at my disposal regarding the application, whether such information is favourable to the applicant or not. Provided I have been suitably remunerated for the work.

The following report has been prepared:

- As per the requirements of Section 32 (3) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment Regulations 2017 as per Government Notice No. 326 Government Gazette, 7 April 2017.
- In accordance with Section 13: General Requirements for Environmental Assessment Practitioners (EAPs) and Specialists as well as per Appendix 6 of GNR 326 - Environmental Impact Assessment 2017 Regulations and the National Environmental Management Act, 1998.
- With consideration to Cape Nature's standard requirements for biodiversity assessments.
- In accordance with DEA&DP's Guideline on Involving biodiversity specialists in the Environmental Impact Assessment process.
- Independently of influence or prejudice by any parties.

Report citation:
Sharples Environmental Services cc, 2021. Aquatic Risk Assessment for the periodic maintenance of TR03103, MR00295, MR00294, DR01356, OP06046 and associated infrastructure near Montagu, Western Cape Province.

SPECIALIST

The author of this report is in agreeance with the 'Declaration of Independence'.

SPECIALIST	QUALIFICATIONS	DETAILS
DEBBIE FORDHAM	M.Sc - Environmental Science BA (Hons) - Environmental Science BA - Environmental Science and Geography	Debbie is a qualified aquatic ecologist and environmental scientist. Debbie holds a BA (Environmental Science and Geography), BA (Hons) and M.Sc in Environmental Science from Rhodes University. She was awarded her Master of Science degree, by thesis, in Wetland Science, entitled: The origin and evolution of the Tierkloof Wetland, a peatland dominated by *Prionium serratum* in the Western Cape. She has specialised in aquatic habitat assessment and has produced numerous aquatic habitat impact assessment reports. She is well established in her specialist field and has worked in various provinces within South Africa.

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1 INTRODUCTION

Sharples Environmental Services cc (SES) has been appointed *by SNA Civil and Structural Engineers* (PTY) LTD on behalf of the Western Cape Government (WCG) Department of Transport and Public Works to conduct an Aquatic Habitat Risk Assessment for the proposed periodic maintenance of TR03103, MR00295, MR00294, DR01356, OP06046 and associated culverts and bridges near Montagu, Western Cape. As the maintenance activities have the potential to degrade aquatic ecosystems, specialist input is required to identify and mitigate against any potential impacts. The overall objective is to provide the necessary guidance for well-informed management of maintenance activities in order to reduce the risk of negative impacts on the surrounding environment and prevent further deterioration to the condition of affected watercourses.

1.1 Background

The above-mentioned road sections (and associated bridges and culverts) require periodic maintenance work within watercourses for management of essential infrastructure. In terms of the National Environmental Management Act (Act No.107 of 1998 'NEMA'), such maintenance activities can be undertaken by compiling a Maintenance Management Plan (MMP), for adoption by the Competent Authority. A MMP allows the applicant to act accordingly to flood damage or complete maintenance whenever necessary, allowing for more efficient management of infrastructure. Additionally, the document will act as the river maintenance management plan to inform the General Authorisation (GA) application for the Section 21 (c) and (i) water uses, in terms of the National Water Act (Act 36 of 1998 'NWA'), associated with the project (Table 1).

It must be noted that authorisation is required to cover the periodic maintenance work within all watercourse crossings along the entire length of the road sections, and not limited to point locations. The SNA Engineering plans only list specific bridges and culverts which are identified for immediate maintenance work, but future maintenance of other structures along the routes also requires authorisation as part of this MMP, and thus it should be treated as a linear activity.

Table 1: Box of important definitions relevant to this report

"Maintenance" means actions performed to keep a structure or system functioning or in service on the same location, capacity and footprint. **"Maintenance Management Plan"** means a management plan for maintenance purposes defined or adopted by the competent authority. "**River Management Plans**" as defined in the 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) and 21(i) (GN. 509 of 26 August 2016), any river management plan developed for the purposes of river or storm water management in any municipal area or described river section, river reach, entire river or sub quaternary catchment that considers the river in a catchment context.

1.2 Location

The project is located around the town of Montagu in the Cape Winelands District Municipality of the Western Cape. The route for which maintenance is proposed is situated between Barrydale, Montagu and the N1 road turn-off to Touws River, within the Langaberg-Wes mountain catchment area (Figure 1).

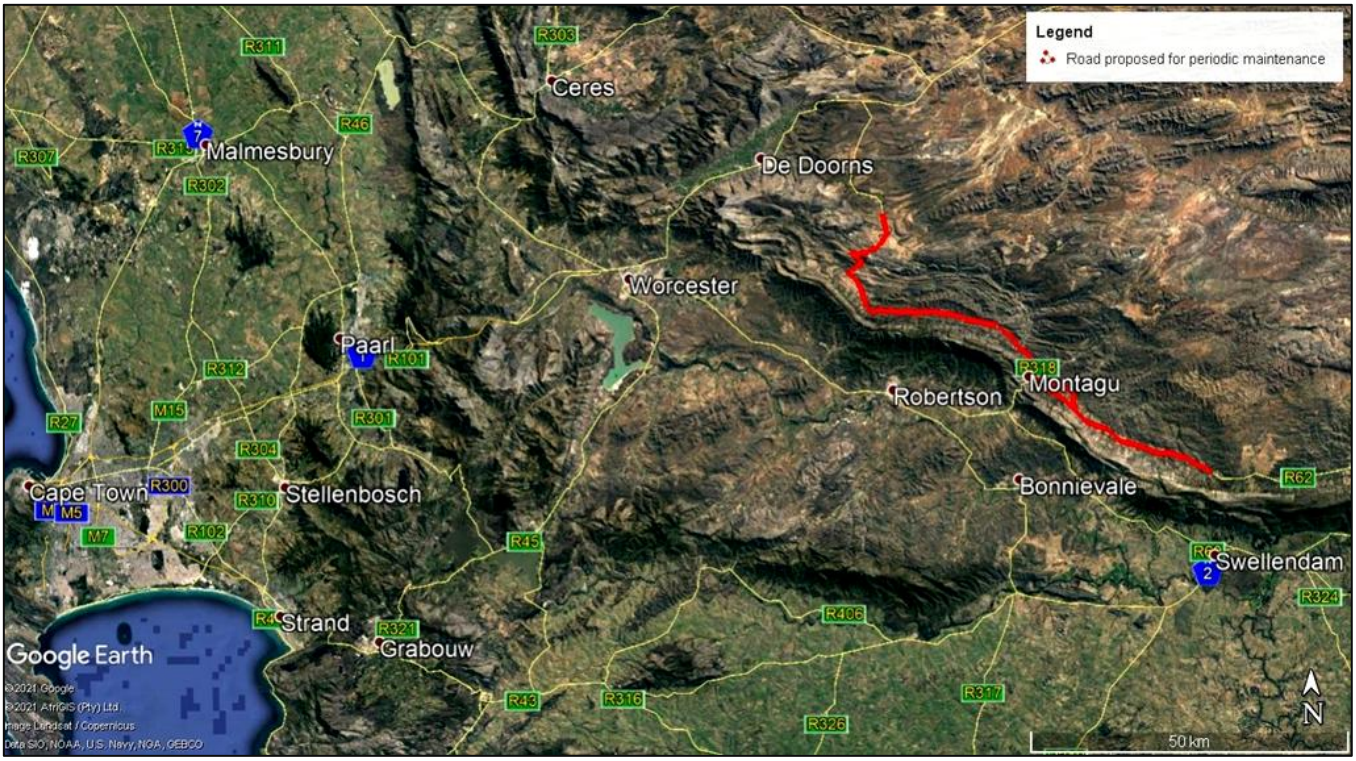


Figure 1: Google map indicating the location of the roads in relation to Cape Town and Montagu

The route is shown to be divided into 3 carriage ways, the first being north of Montagu – MR295, the second exits Montagu in a southeasterly direction, consisting of the MR294, DR1356 and OP6046 carriage ways. The third carriage way also exits Montagu in a southeasterly direction towards Barrydale- TR31/3 (Figure 2).

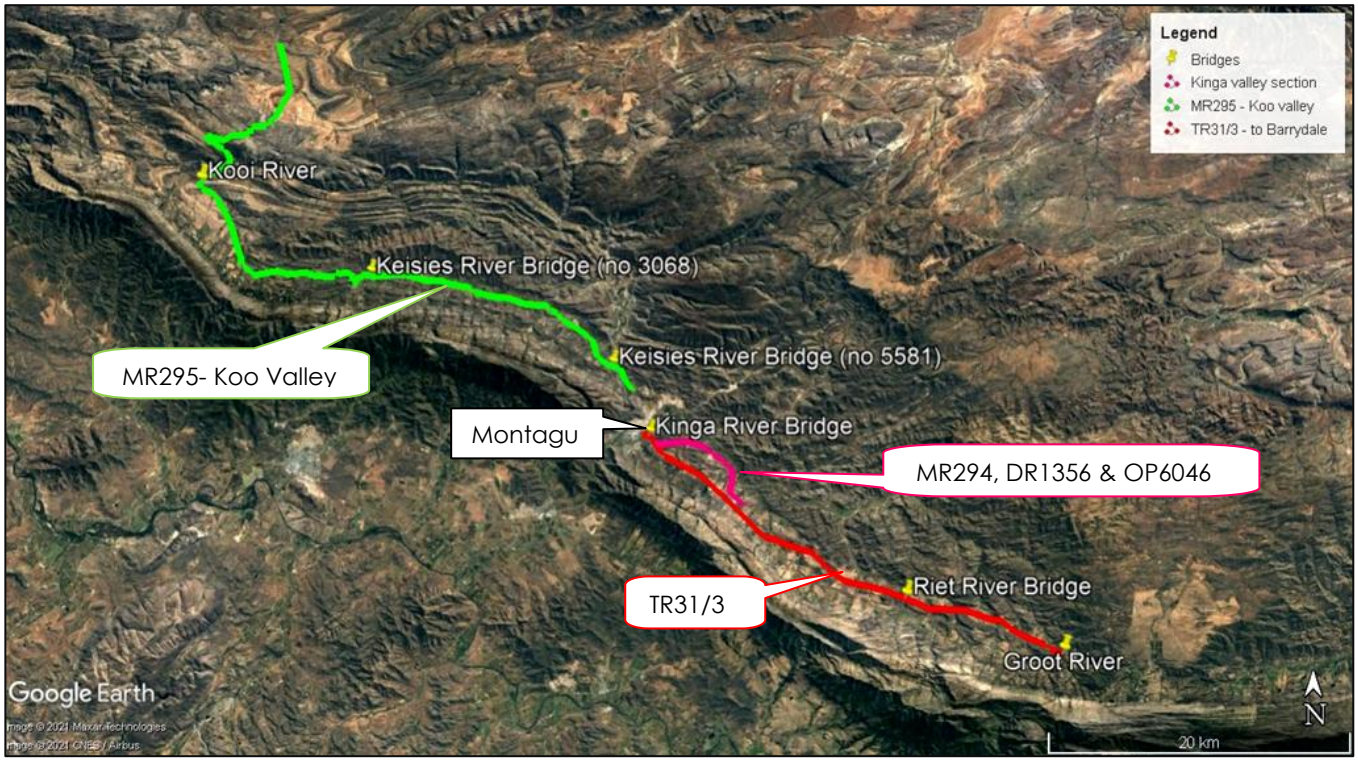


Figure 2: Google map showing the three sections of roads proposed for maintenance in relation to Montagu

1.3 Maintenance activities

According to the proposal provided by SNA Engineers (1 April 2021), the following maintenance activities are proposed as part of the periodic maintenance of TR03103, MR00295, MR00294, DR01356, OP06046 and associated infrastructure:

- Resealing of TR03103 (TR31/3) from km 1.22 to km 33.00
- Resealing of MR00295 (MR295) from km 20.00 to km 75.49
- Resealing of MR00294 (MR294) from km 0.00 to km 1.59
- Resealing of DR01356 (DR1356) from km 13.06 to km 17.47
- Resealing of OP06046 (OP6046) from km 0.75 to km 3.22

Table 2 below provides a list of infrastructure proposed for maintenance with co-ordinate locations. Figures 3 and 4 are the proposed key plans provided by SNA Engineers (2021) for the project.

Table 2: Location of the infrastructure for which maintenance is proposed in the immediate future

Infrastructure	Location	Latitude (S)	Longitude (E)
Roads			
TR03103 (TR31/3)	From km 1.22 to km 33.00	Start 33° 47' 15.15" End 33° 55' 36.23"	Start 20° 7' 51.16" End 20° 26' 54.65"
MR00295 (MR295)	From km 20.00 to km 75.49	Start 33° 45' 5.75" End	Start 20° 7' 34.9" End

		33° 33' 18.67"	19° 52' 13.64"
MR00294 (MR294)	From km 0.00 to km 1.59	Start 33° 47' 30.60348" End 33° 47' 30.82"	Start 20° 8' 14.88" End 20° 9' 15.56"
DR01356 (DR1356)	From km 13.06 to km 17.47	Start 33° 47' 30.82819" End 33° 48' 39.86"	Start 20° 9' 15.56" End 20° 11' 35.07"
OP06046 (OP6046)	From km 0.75 to km 3.22	Start 33° 48' 39.86" End 33° 49' 50.65"	Start 20° 11' 35.07" End 20° 12' 6.04"
Bridges			
Kingna River Bridge (2645)	TR31/3 - 1.25	33° 47' 16.33"	20° 7' 58.24"
Riet River Bridge (5739)	TR31/3 - 21.96	33° 53' 48.55"	20° 22' 56.74"
Kruispad River Bridge (5740)	TR31/3 - 28.34	33° 53' 3.55"	20° 18' 58.43"
Scheeperrus River Bridge (5741)	TR31/3 - 30.55	33° 54' 24.84"	20° 24' 9.748"
Koo River Bridge (3064)	MR295 - 37.88	33° 38' 16.5"	19° 48' 46.80"
Kiesie River Bridge (3065)	MR295 - 54.39	33° 41' 33.93"	19° 56' 2.32"
Keisie River bridge (5581)	MR295 - 72.58	33° 44' 47.414"	20° 6' 25.084"
Major Culverts			
Major culvert (no structure number)	TR31/3 - 1.92	33° 47' 36.68"	20° 8' 18.86"
Major culvert (C10615)	TR31/3 - 6.69	33° 49' 1.97"	20° 10' 40.80"
Major culvert (no structure number)	TR31/3 - 8.61	33° 49' 45.1"	20° 11' 34.10"
Major culvert (C10616)	TR31/3 - 14.27	-33° 51' 20.45"	20° 14' 34.10"
Major culvert (C10617)	TR31/3 - 14.96	33° 51' 26.86"	20° 15' 0.17"
Major culvert (C10148)	TR31/3 - 18.68	33° 52' 33.01"	20° 16' 56.22"
Major culvert (C10167)	TR31/3 - 19.54	33° 52' 39.21"	20° 17' 28.66"
Major culvert (C10618)	TR31/3 - 23.87	33° 53' 26.66"	20° 20' 6.9"
Major culvert (C10619)	TR31/3 - 25.32	33° 53' 27.48"	20° 21' 3.57"
Major culvert (C10503)	MR295 - 36.03	33° 37' 40.719"	19° 49' 36.30"
Major culvert (C10504)	MR295 - 36.27	33° 37' 48.19"	19° 49' 36.17"
Major culvert (C10505)	MR295 - 36.75	33° 37' 54.88"	19° 49' 19.73"
Major culvert (C10507)	MR295 - 38.36	33° 38' 28.96"	19° 48' 55.42"
Major culvert (C10508)	MR295 - 39.01	33° 38' 37.56"	19° 49' 18.62"
Major culvert (C10509)	MR295 - 41.10	33° 38' 59.6"	19° 49' 38.70"
Major culvert (C10510)	MR295 - 43.61	33° 40' 15.7"	19° 50' 16.9"
Major culvert (C10512)	MR295 - 45.780	33° 41' 17.68"	19° 50' 46.23"
Major culvert (C10513)	MR295 - 64.14	33° 42' 28.3"	20° 2' 17.07"

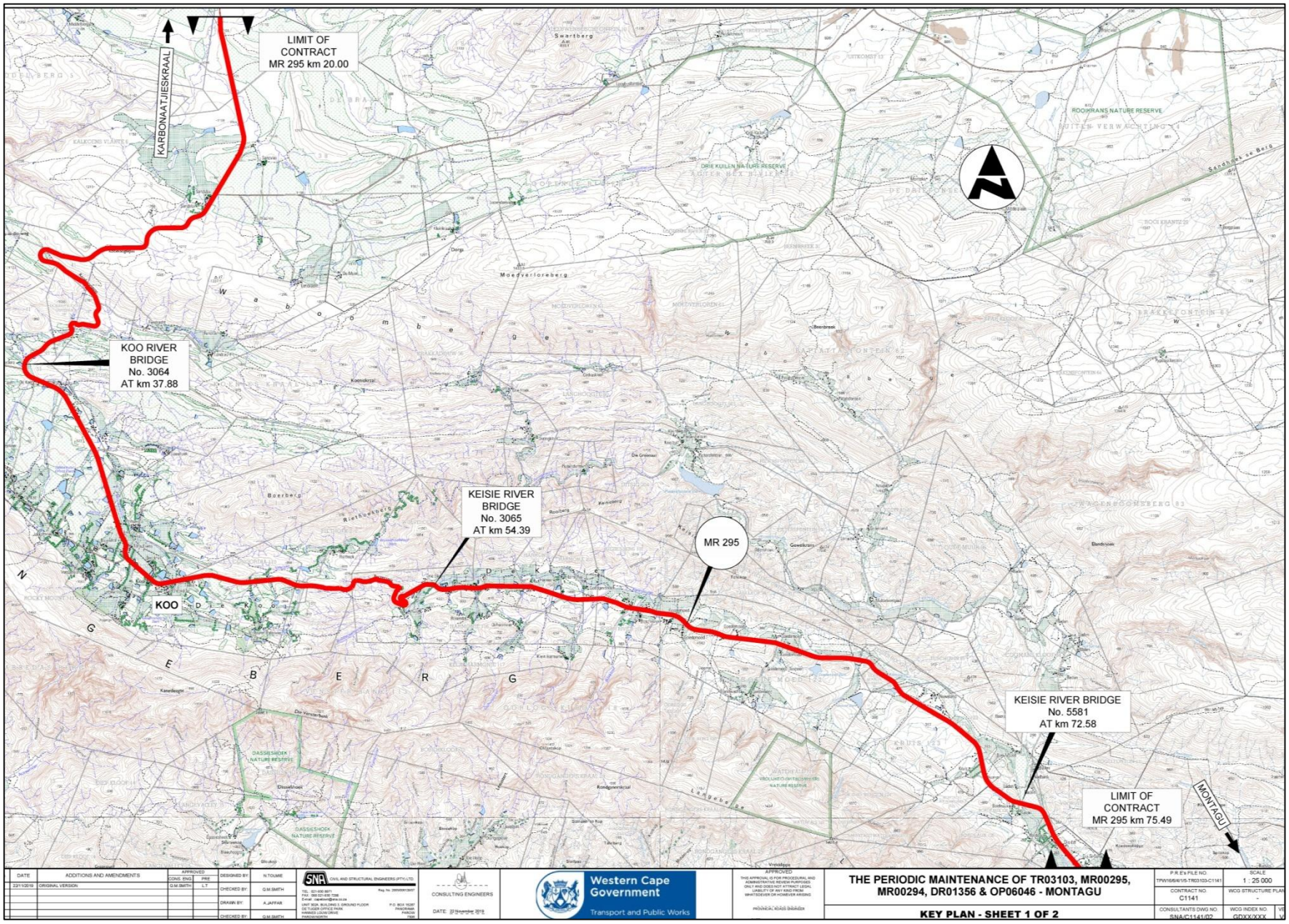


Figure 3: Locality plan (Sheet 1 of 2) showing the segment of MR 295 proposed to be re-sealed

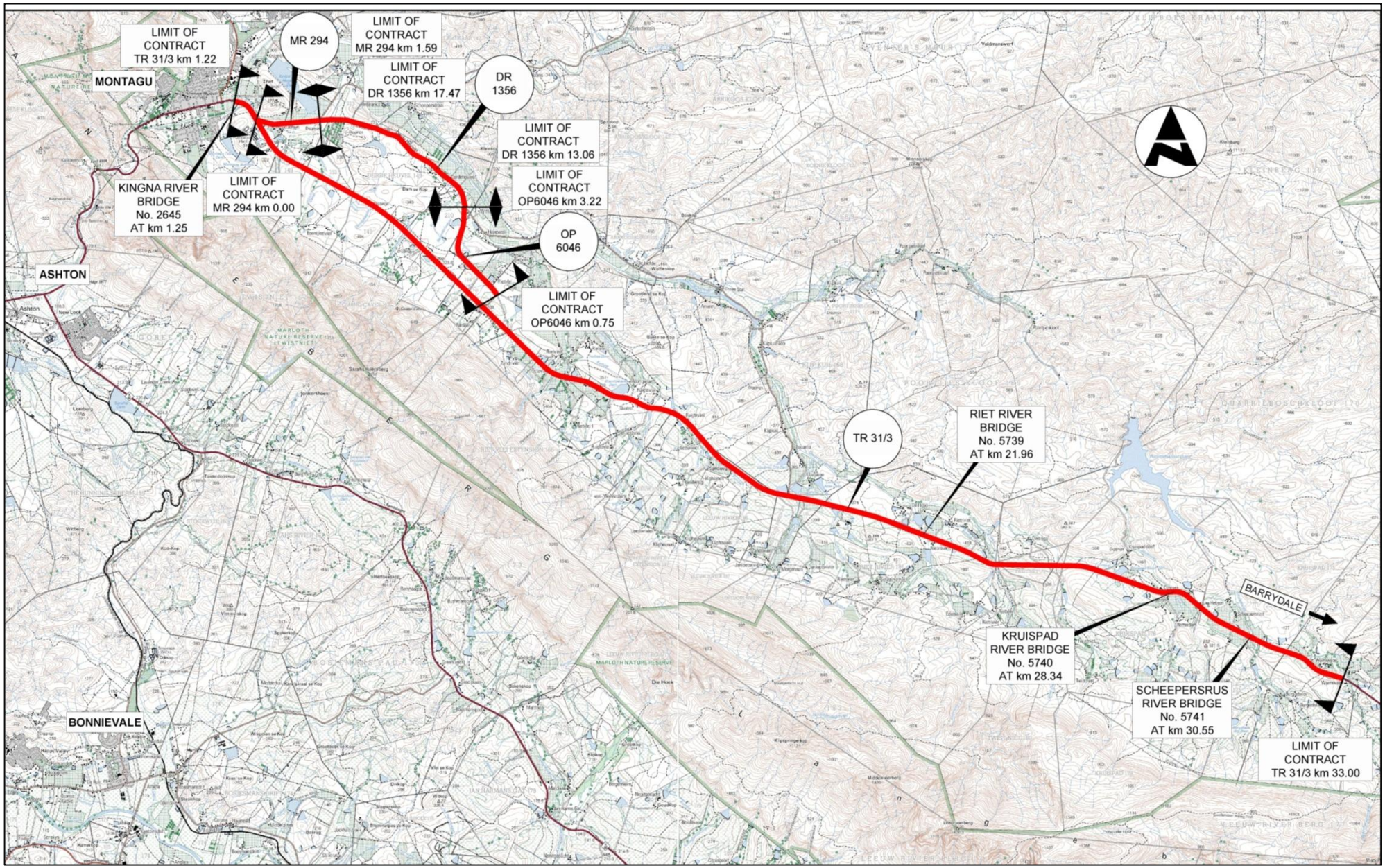


Figure 4: Locality plan (Sheet 2 of 2) showing the segment of TR31/3, MR 294, DR 1396 and OP 6046 proposed to be re-sealed

1.3.1 Road works

All roads proposed to be resealed are single carriageways and are situated in the road district falling under the jurisdiction of the Paarl District Roads Engineer (DRE). Work envisaged to be undertaken regarding Main Road works will include the following:

- Establishment on site.
- Provision of offices and laboratory for the Employer's Agent's site personnel.
- Importing of construction materials from commercial sources.
- Setting-out of the Works.
- Accommodation of traffic.
- Application of texture slurry on identified sections of the road (excluding sections to be reworked).
- Repair of identified defects as shown on the drawings.
- Rut filling.
- Reseal of TR31/3, MR295, MR294 and DR1356 with a R14 single seal (14 mm aggregate) using S-R2 bitumen-rubber binder.
- Reseal of OP6046 with a 7 mm single seal and fog spray by hand (Labour Enhancement).
- Side and cross drainage improvements.
- Repair of gabion retaining walls on MR295 between km 50.070 – km 50.190 LHS, km 50.190 – km 50.350 LHS and km 50.74 – km 50.76 RHS.
- Roadside furniture maintenance and/or improvements.

1.3.2 Accesses

- Major accesses to be upgraded, if required.
- All major surfaced accesses to receive a 30 mm asphalt overlay. A slurry will be applied on intersections where ravelling of the seal occurs due to truck movements.
- Concrete edge beams to be installed at all accesses/intersections.

1.3.3 Side drains

- Existing unlined open drains will be cleared and shaped. Concrete lined side drains and subsoil drainage to be constructed at limited areas to WCG specifications.

1.3.4 Bridges

1.3.4.1 Riet River bridge 5739

- Install river name signs.
- Clear flow paths at inlet and outlet.

- Minor cracks in surfacing adjacent to bridge joints.
- Install 700 mm wide "TRC-GRID 30" geosynthetic grids at abutment joints between concrete/layerworks and surfacing due to the cracking evident at this location and the absence of adequate joints.

1.3.4.2 Kruispad River bridge 5740

- Install river name signs.
- Clear flow paths at inlet and outlet.
- Repair minor spalling and cracking on pier head.
- Remove loose piece of concrete slab under bridge.
- Install outlet protection and repair existing apron slab.

1.3.4.3 Scheepersrus River bridge 5741

- Install river name signs.
- Clear flow paths at inlet and outlet.
- Replace expansion joints with new Thormajoints.

1.3.4.4 Koo River bridge 3064

- Install river name signs.
- Clear flow paths at inlet and outlet.
- Install gabion protection at inlet abutment RHS (Figure 5).
- Extend abutment wingwall at outlet abutment RHS.
- Install 700 mm wide "TRC-GRID 30" geosynthetic grids at abutment joints between concrete/layerworks and surfacing due to the cracking evident at this location and the absence of adequate joints.
- Replace pier expansion joints with new Thormajoints.
- Grit blast parapets and apply a protective coating.

1.3.4.5 Kiesie River bridge 3065

- Install river name signs.
- Clear flow paths at inlet and outlet.
- Install 700 mm wide "TRC-GRID 30" geosynthetic grids at abutment joints between concrete/layerworks and surfacing due to the cracking evident at this location and the absence of adequate joints.
- Grit blast parapets and apply a protective coating.

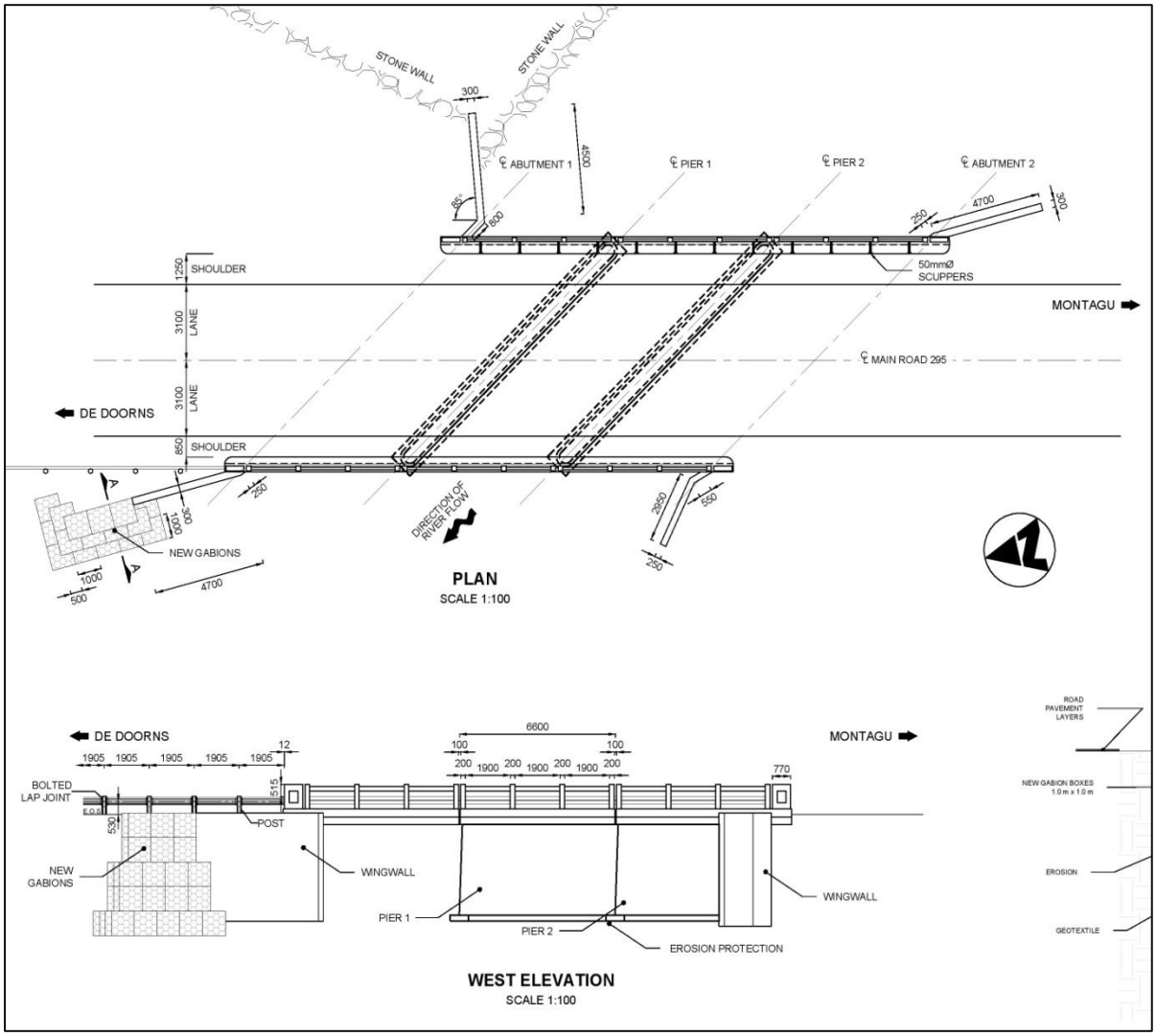


Figure 5: Structure plan for the maintenance work proposed on the Koo River Bridge 3064 (SNA Engineers, 2021)

1.3.4.6 Kiesie River bridge 5581

- Install river name signs.
- Clear flow paths at inlet and outlet.
- Replace expansion joints with new Thormajoints.
- Grit blast parapets and apply a protective coating.
- Exposed pier piles to be protected by means of mass concrete pumped underneath the foundations and protected with a layer of packed large riprap, 750 mm minimum diameter placed along the foundations (Figure 6).

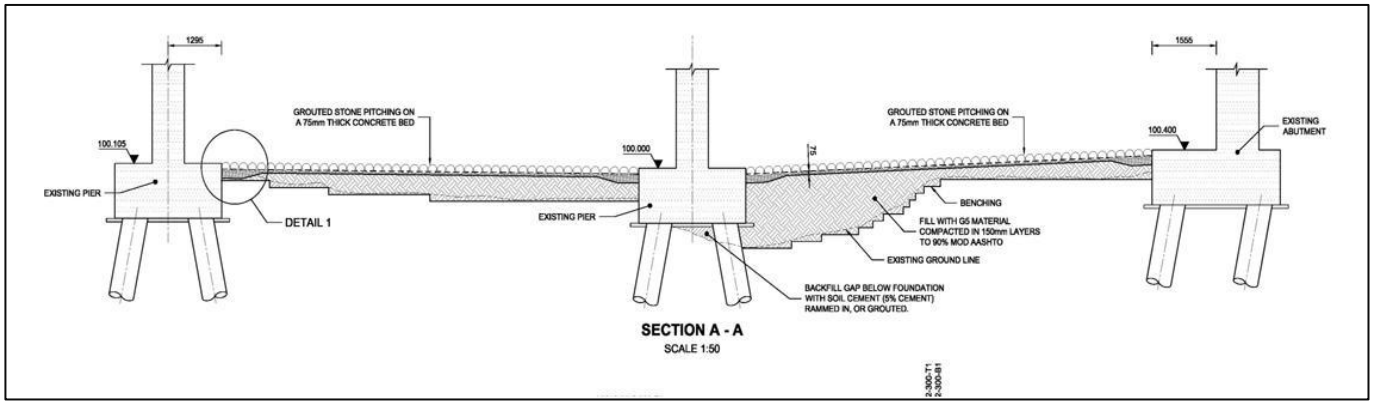


Figure 6: Cross sectional plan of the proposed erosion protection to be installed at Keisies River Bridge 5581

1.3.5 Major Culverts

- Clear flow paths at inlet and outlet.
- Break out loose concrete at soffit joints and repair by means of crack injection and a non-shrink grout.
- Crack sealing where required.
- Install scour protection at the outlet by means of gabion boxes and mattresses.

1.3.6 Minor Culverts

In general, the following remedial work is proposed on the lesser culverts:

- All flow paths must be cleared of silt and vegetation.
- Culverts, which are not functional, working or in sound condition, are to be repaired to WCG standards.
- Protection works at outlets should be done to prevent scouring, where identified.
- Danger plates must be installed at culvert crossings.

1.4 Relevant Legislation

The protection of water resources is essential for sustainable development and therefore many policies and plans have been developed, and legislation promulgated, to protect these sensitive ecosystems. The proposed project must abide by the relevant legislative requirements. Table 3 below shows an outline of the environmental legislation relevant to the project.

Table 3: Relevant environmental legislation

Legislation	Relevance
South African Constitution 108 of 1996	The constitution includes the right to have the environment protected
National Environmental Management Act 107 of 1998	Outlines principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state.
Environmental Impact Assessment (EIA) Regulations	The 2014 regulations have been promulgated in terms of Chapter 5 of NEMA and were amended on 7 April 2017 in Government Notice No. R. 326. In addition, listing notices (GN 324-327) lists activities which are subject to an environmental assessment. The MMP for which this report is required, specifically relates to Activities 19 and 27 as listed in the National Environmental Management Act, 1998 (Act No. 107 of 1998), (NEMA) EIA Regulations Listing Notice 1 of 2014 (GN R. 327), as amended, as well as Activity 12 as listed in the NEMA EIA Regulations Listing Notice 3 of 2014 (GN R. 324), as amended. The adoption of a MMP does not absolve the holder of the MMP from its general "duty of care" set out in Section 28(1) of the NEMA.
The National Water Act 36 of 1998	Chapter 4 of the National Water Act addresses the use of water and stipulates the various types of licensed and unlicensed entitlements to the use of water. The water uses under Section 21 (NWA) that are associated with the periodic maintenance will be section 21 (c) and (i). Also, according to the Department of Water and Sanitation (DWS), any structures within a 500 metre radius from the boundary of a wetland constitutes a Section 21(c) and (i) water use and as such requires a water use licence.
General Authorisations (GAs)	Any uses of water which do not meet the requirements of Schedule 1 or the GAs, require a license which should be obtained from the Department of Water and Sanitation (DWS).The project will require a Water Use Authorisation or General Authorisation in terms of Section 21 (c) and (i) of the National Water Act (NWA), Act 36 of 1998, as watercourses will be affected. Government Notice R509 of 2016 was issued as a revision of the General Authorisations (No. 1191 of 1999)

	for section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA. Determining if a water use licence is required is associated with the risk of impacting on that watercourse. A low risk of impact could be authorised in terms of a General Authorisations (GA).
National Environmental Management: Biodiversity Act No. 10 of 2004	This is to provide for the management and conservation of South Africa's biodiversity through the protection of species and ecosystems; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; and the establishment of a South African National Biodiversity Institute.
Conservation of Agricultural Resources Act 43 of 1967	To provide for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith.

1.5 Scope of Work

The Scope of Work as provided in the specific Terms of Reference supplied by SES are described below:

- Provide a comprehensive description of the identified watercourses including the locality in relation to the relevant catchment;
- Illustrate the segment and affected reach of the watercourse in relation to regulated area;
- Identify and assess the proposed remedial works on the characteristics of the watercourse;
- Describe the Present Ecological State as well as the Ecological Importance and Sensitivity of the watercourses;
- Provide an overview of the evaluation of Habitat Integrity and characteristics of the watercourse including the biota, water quality as well as the riparian and instream habitat;
- Identify and assess anticipated impacts on the watercourse associated with the construction
- The assessment of the anticipated impacts on the watercourse must be done using the Risk Matrix which is specified in the 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), 2016 (Notice 509);
- Provide mitigation and management measures for anticipated impacts;

- The report which documents the findings of the study must conform to the requirements laid down in Appendix 6 of the National Environmental Management Act 107 of 1998 Environmental Impact Assessment Regulations 2014 (as amended);
- Provide concluding remarks and references in the report.

2 STUDY AREA

Due to the vast nature of the route proposed for maintenance has been divided into four Segments and is shown in Figure 7 and Table 4. The route proposed for maintenance capsulates the stretch of road for which all maintenance activities is proposed.

Table 4: Coordinates for the start and end point for each Segment

Point of Segment	Latitude (S)	Longitude (E)
Start of Segment A	33° 33' 18.66"	19° 52' 13.61"
Start of Segment B	33° 42' 17.66"	20° 1' 7.88"
Start of Segment C	33° 47' 15.52"	20° 7' 51.44"
Start of Segment D	33° 52' 44.36"	20° 17' 49.27"
End of Segment D	33° 55' 36.25"	20° 26' 54.67"

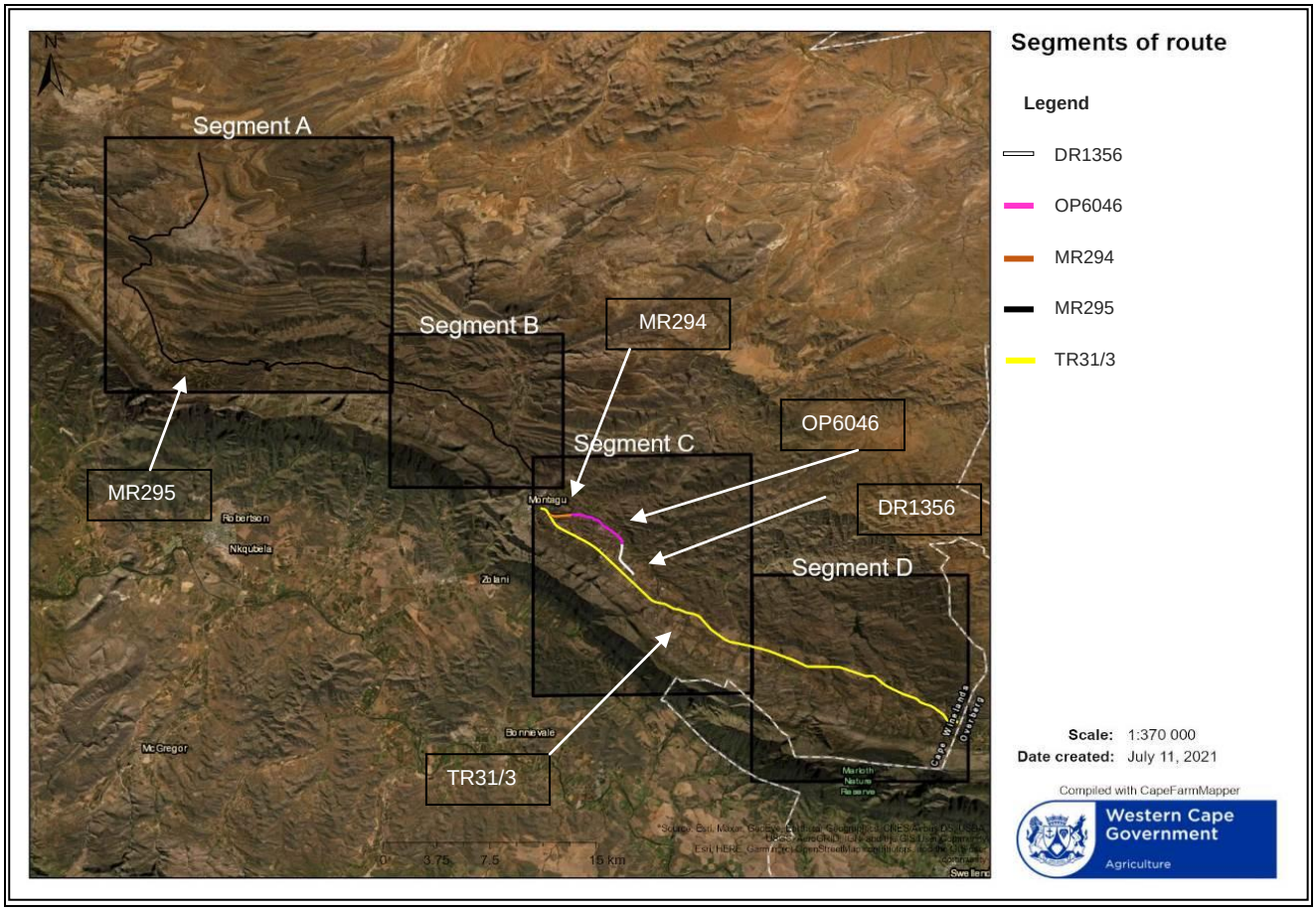


Figure 7: Segments of route proposed for maintenance

2.1 Segment A and B

Segment A capsulates the first half the western section of MR 295, as shown in Figure 8. Segment B includes the remaining section of MR295 for which maintenance is proposed. Segment B leads into the town of Montagu (Figure 9).

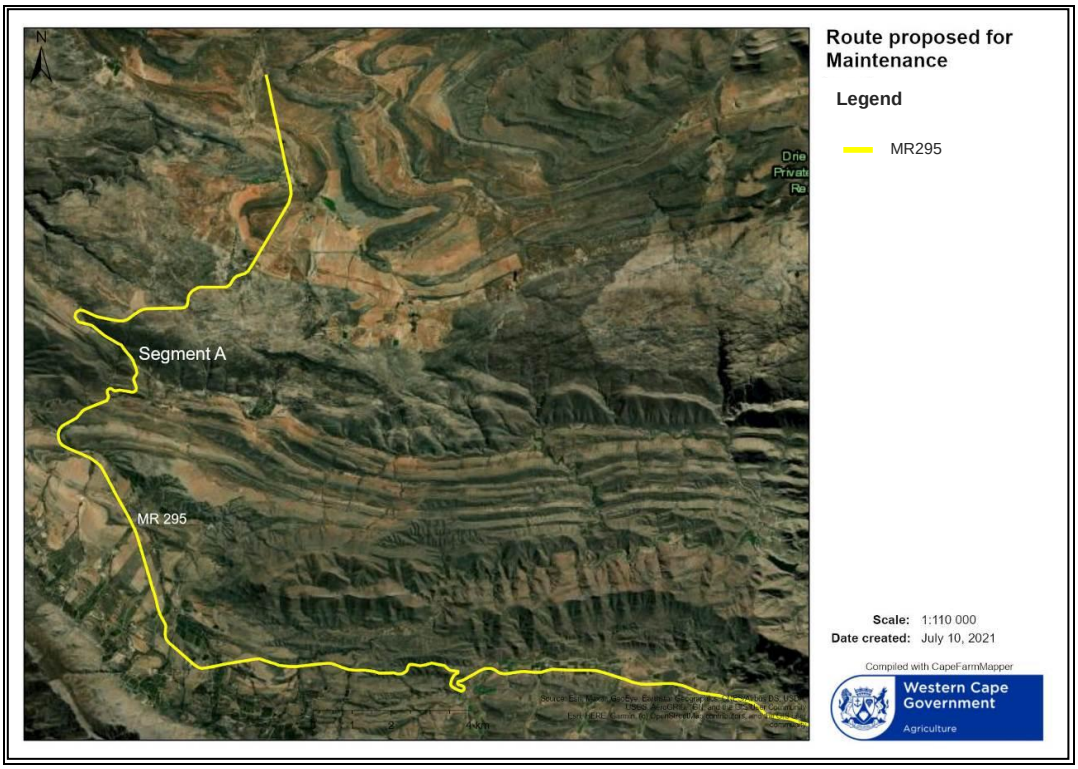


Figure 8: Locality of Segment A

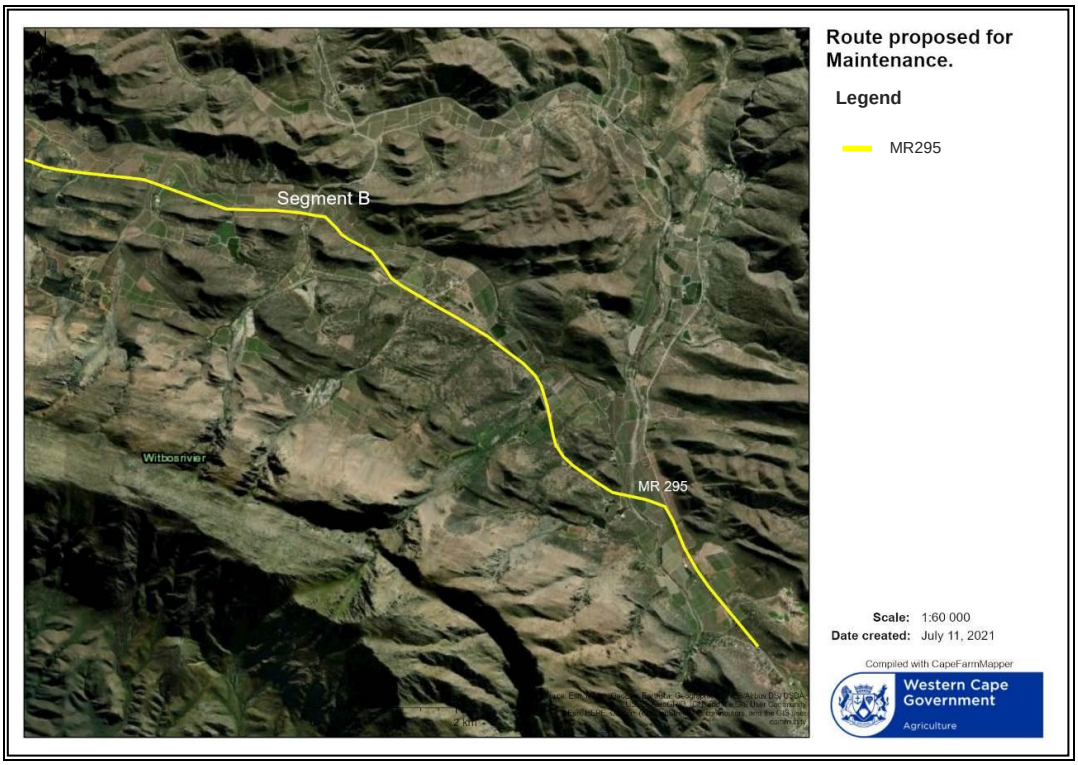


Figure 9: Locality of Segment B

2.2 Vegetation and Geology

Segment A of the route proposed for maintenance is located within the Succulent Karoo and Fynbos Biomes, the Rainshadow Valley Karoo, Western Fynbos-Renosterveld, Southern Fynbos and Western Fynbos-Renosterveld Bioregions. The Segment traverses a range of different Vegetation

types, as seen in Figure 10. According to CapeFarmMapper (Accessed July 2021) and the South African Vegetation Map (SANBI, 2018), Segment A begins within vegetation described as low to medium tall, open to medium dense narrow-leaved shrubland mapped as Matjiesfontein Shale Renosterveld. Segment A then traverses North Langeberg Sandstone Fynbos and South Langeberg Sandstone Fynbos, characterized by a complex of gentle to very steep, South and North facing slopes. A large portion of vegetation classified as Montagu Shale Renosterveld engulfs Segment A in two areas, identified by tall shrubland in a matrix of short divaricate shrubs dominated by renosterbos. A fragmented unit from the Western Little Karoo vegetation type– Montagu Shale Fynbos is traversed by Segment A and characterized by moderately undulating uplands and undulating foothills to steep mountains, supporting the moderately tall and dense shrublands. Vegetation identified as Western Little Karoo, adjacent to the Montagu Shale Fynbos is traversed towards the end of Segment A. The vegetation is characterized by the available datasets by moderately tall and dense shrubland, predominantly proteoid and asteraceous fynbos, with some graminoid fynbos. However, agriculture and the existing road have resulted in habitat transformation. The proposed work will be within the road reserve and already disturbed vegetation.

Segment B of the route proposed for maintenance is located within the Succulent Karoo Biome and the Rainshadow Valley Karoo Bioregion. Segment B traverses one main Vegetation type, as seen in Figure 11. According to CapeFarmMapper (Accessed July 2021) and the South African Vegetation Map (SANBI, 2018), Segment B begins and ends within vegetation mapped as Western Little Karoo. This vegetation type is described to be found in flat or slightly undulating landscapes, the vegetation is described as a mosaic of Karoo shrublands of low and medium height encompassing (as dominants) both non-succulent and succulent shrubs.

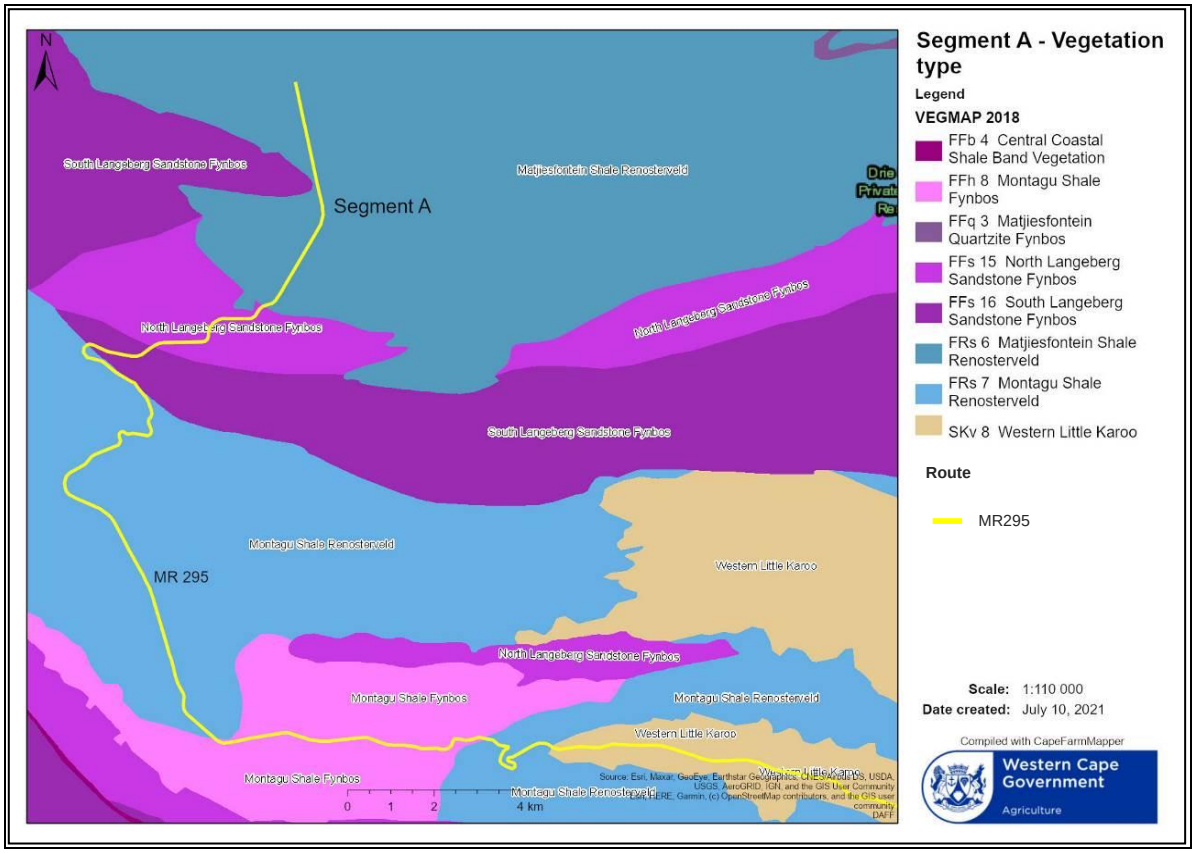


Figure 10: Segment A in relation to the 2018 Vegetation Map

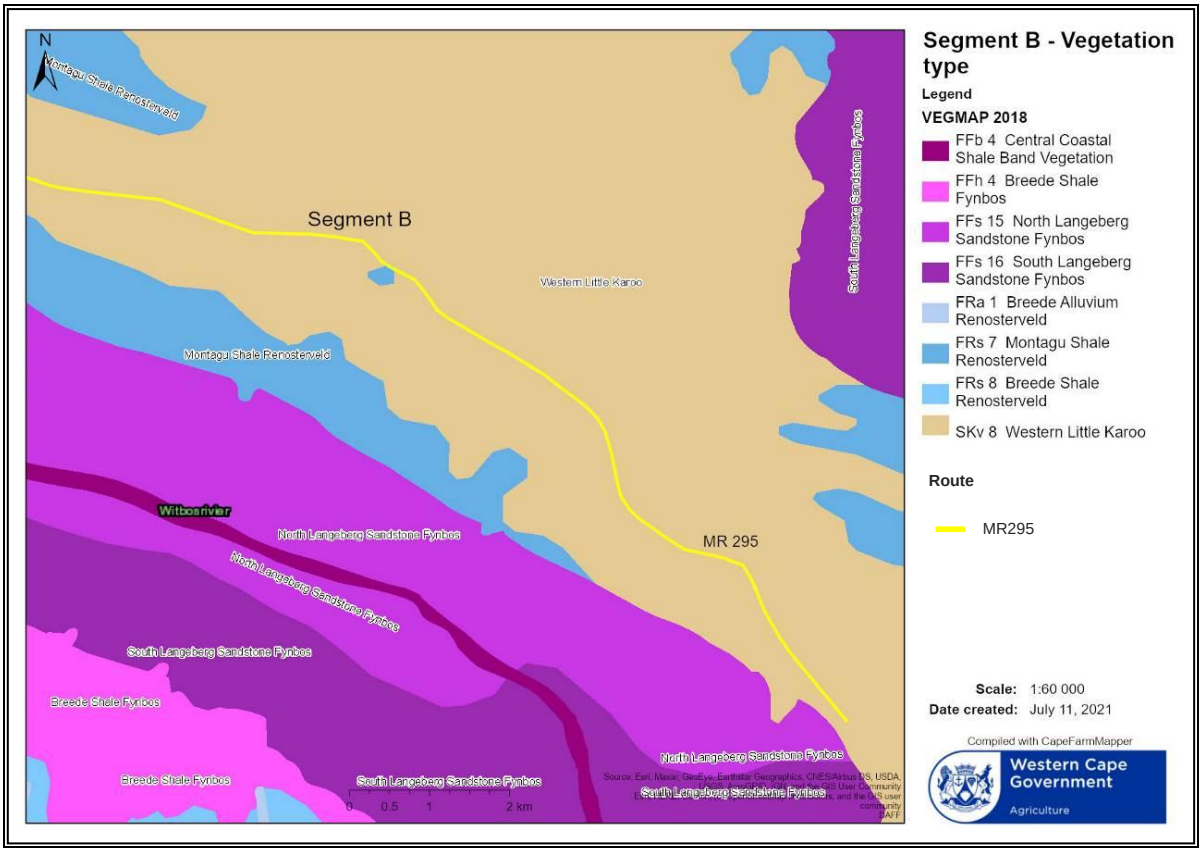


Figure 11: Segment B in relation to the 2018 Vegetation Map

Segment A traverses a range of geologic formations, as seen in Figure 12. According to CapeFarmMapper (Accessed July 2021), Segment A traverses the Ceres, Nardouw and Bidouw subgroups. Majority of Segment A traverses the Ceres Subgroup, Mudrock, shale, siltstone, feldspathic arenite and wacke is often found within this subgroup. The belt of the Nardouw subgroup traversed is characterized by white, coarse-grained to fine-grained, thick-bedded pebbly quartz arenite, thin bedded feldspathic and ferruginous sandstone, very subordinate shale and siltston. The belt of the Bidouw Subgroup traversed is characterized by its dark grey mudrock, siltstone, with feldspatic/micaceous and quartz arenite.

Segment B traverses one main geologic formations, as seen in Figure 13. According to CapeFarmMapper (Accessed July 2021), Segment B traverses the Ceres subgroup. The subgroup is characterized by its abundance of Mudrock, shale, siltstone, feldspathic arenite and wacke is often found within this subgroup.

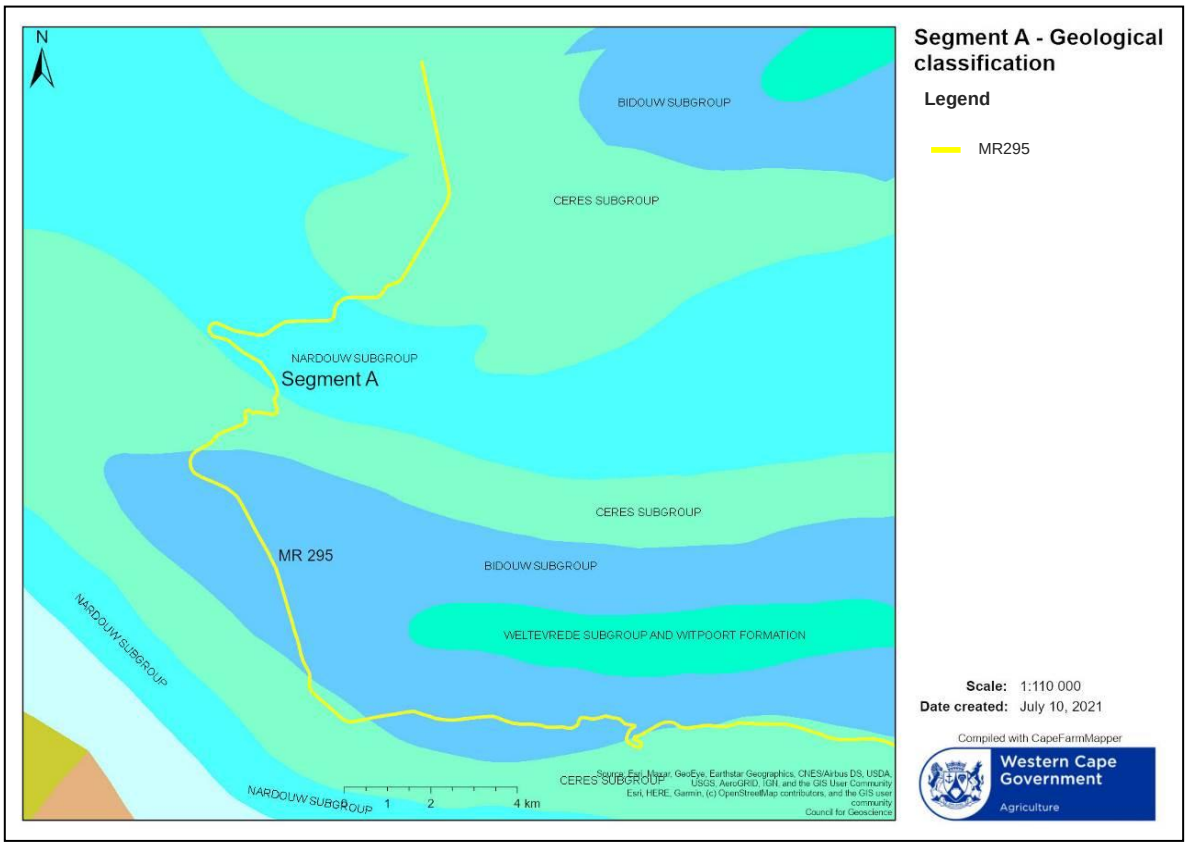


Figure 12: Segment A in relation to the Geological Map of South Africa

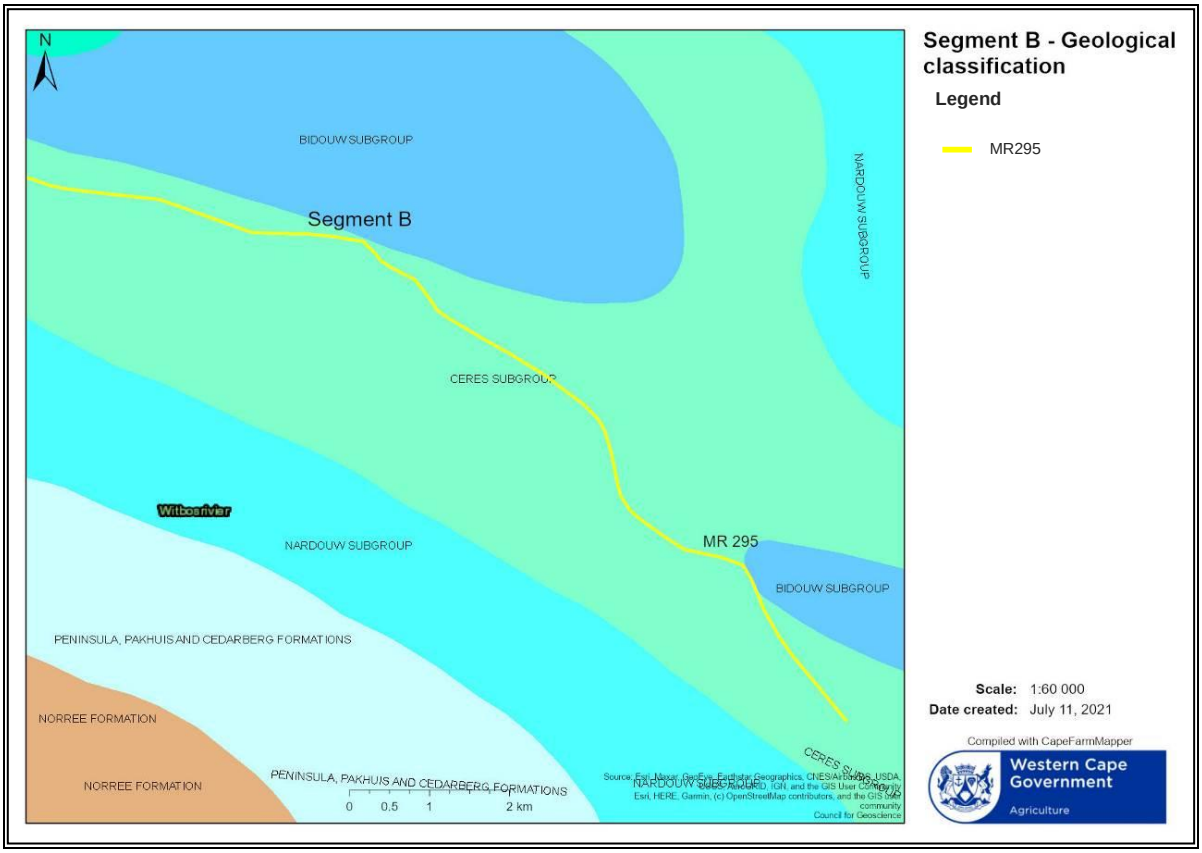


Figure 13: Segment B in relation to the Geological Map of South Africa

2.3 The Drainage Network

The study area is located within the Rainshadow Valley Karoo, Western Fynbos-Renosterveld, Southern Fynbos and Western Fynbos-Renosterveld Bioregions. The reach of road assessed is situated within the H40A, H40B, H40C and H40D quaternary catchments of the Gouritz Water Management Area (Figure 14). Segment A traverses main perennial rivers such as the Koo River and Keisie River (National Geo-spatial Information). The Pietersfontein non-perennial river is also traversed within Segment A. The topography traversed by Segment A begins relatively flat and gentle until it drops to the Koo River leading into steep rise and fall towards the Keisie River, after which a steeper gradient upward is traversed. Steep gradients are present on either side of the Segment A. The Langeberg Mountain Range situated within close proximity to the south acts as a large watershed and contributes the Langeberg-Wes Mountain Catchment Area. This results in runoff having high velocity rates.

The study area of which Segment B is located in is situated within the Rainshadow Valley Karoo Bioregion. The reach of road assessed is situated within H40D quaternary catchments of the Gouritz Water Management Area (Figure 15). Segment B traverses main perennial rivers such Keisie and the Pietersfontein River. The topography traversed by Segment B is relatively flat and gentle with steep gradients on either side of the route. The Langeberg Mountain Range situated

closely to the south acts as a large watershed and contributes the Langeberg-Wes Mountain Catchment Area. This results in a velocity runoff rates.

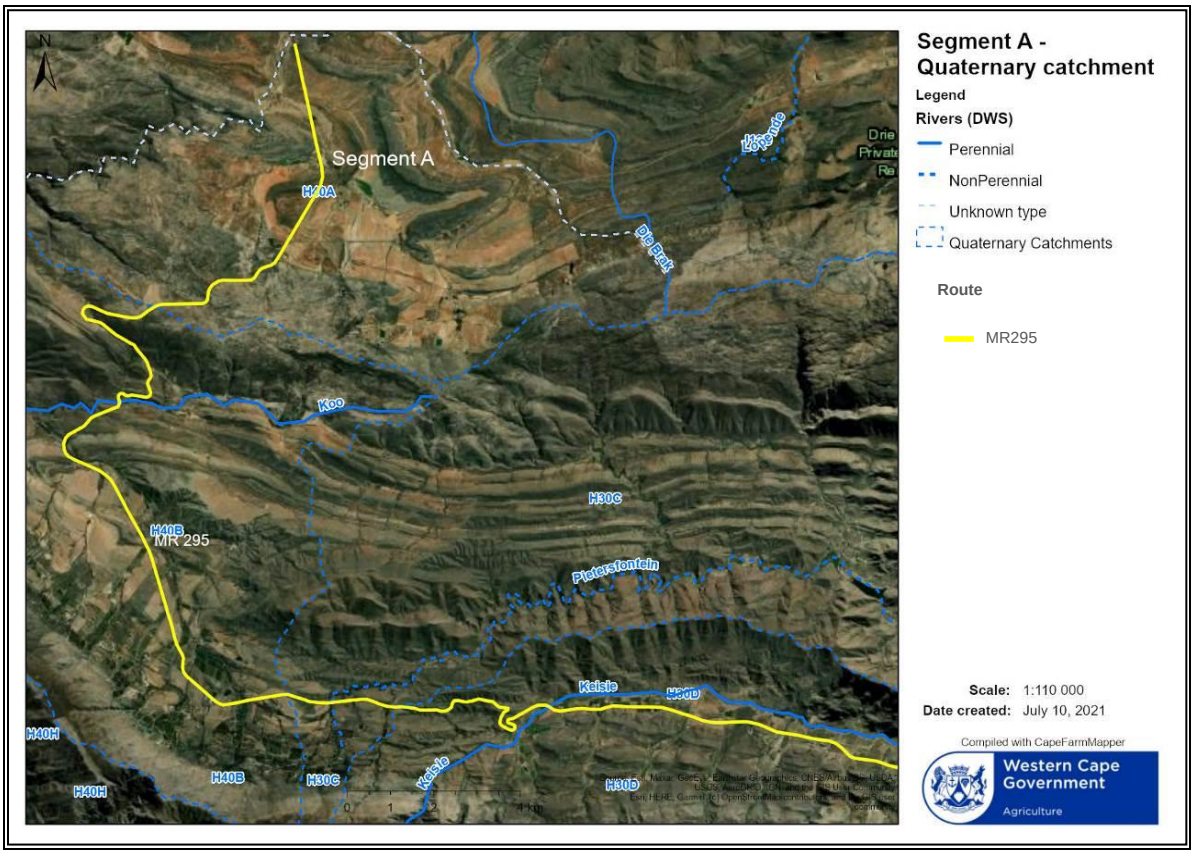


Figure 14: Drainage of the region in relation to Segment A

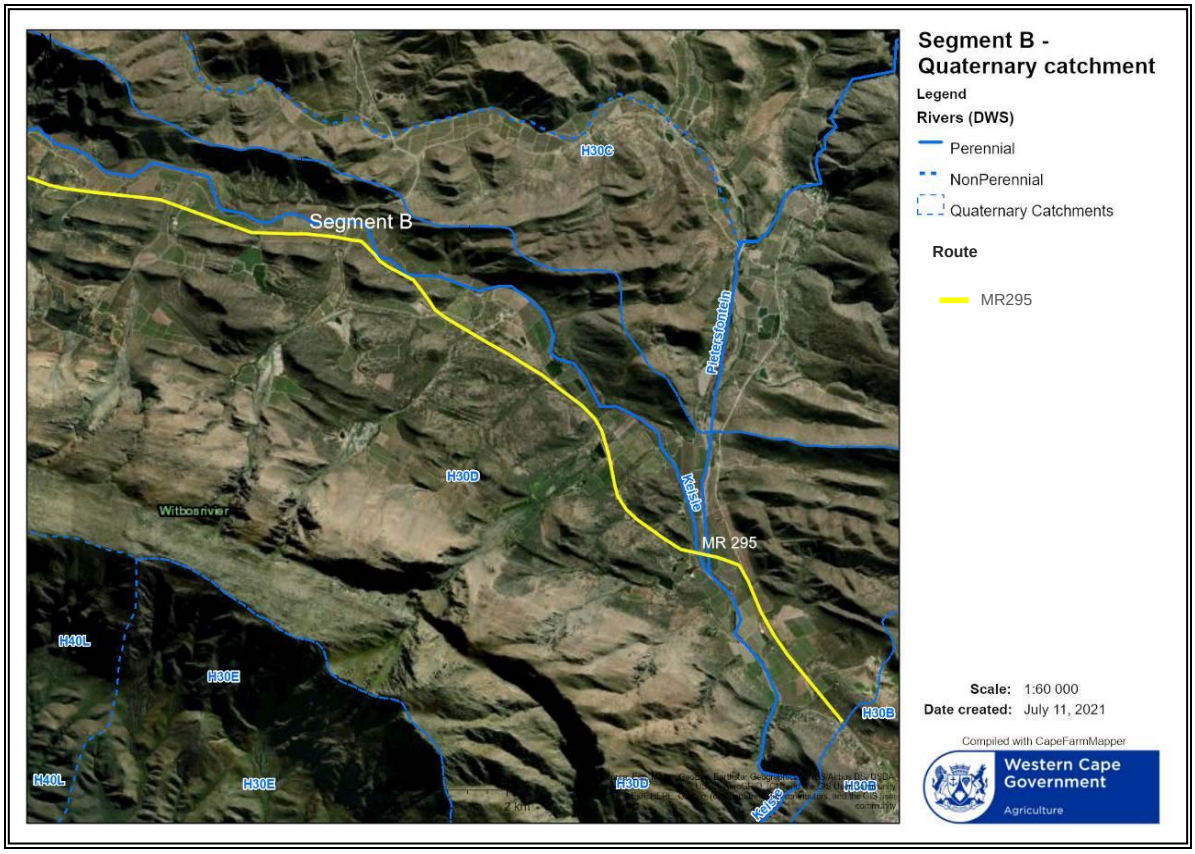


Figure 15: Drainage of the region in relation to Segment B

2.4 National Freshwater Ecosystem Priority Area project (NFEPA)

The National Freshwater Ecosystem Priority Area project (NFEPA) aims to provide strategic spatial priority areas for conserving South Africa's aquatic ecosystems and supporting sustainable use of water resources. These priority areas are called Freshwater Ecosystem Priority Areas (FEPAs) and the main output of the NFEPA project was the creation of FEPA maps. FEPAs were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries (Driver et al. 2011).

According to CapeFarmMapper (Accessed July 2021) and shown in Figure 16, multiple scattered and isolated Artificial Wetlands have been identified along Segment A as NFEPA projects. The identified Artificial Wetlands represent wetland areas that have formed due to the damming of watercourses and creation of dams/storage ponds for agricultural purposes, as is accustomed to agricultural areas, thus the wetlands being classed as artificial by the NFEPA. According to CapeFarmMapper (Accessed July 2021) and shown in Figure 17, a small number of scattered and isolated Artificial Wetlands have been identified along the carriage way within Segment B as NFEPA projects. The identified Artificial Wetlands represent Wetland areas that have formed due to the

damming of watercourses and creation of dams/storage ponds for agricultural purposes, as is accustomed to Agricultural areas, thus the Wetlands being classed as Artificial by the NFEPA.

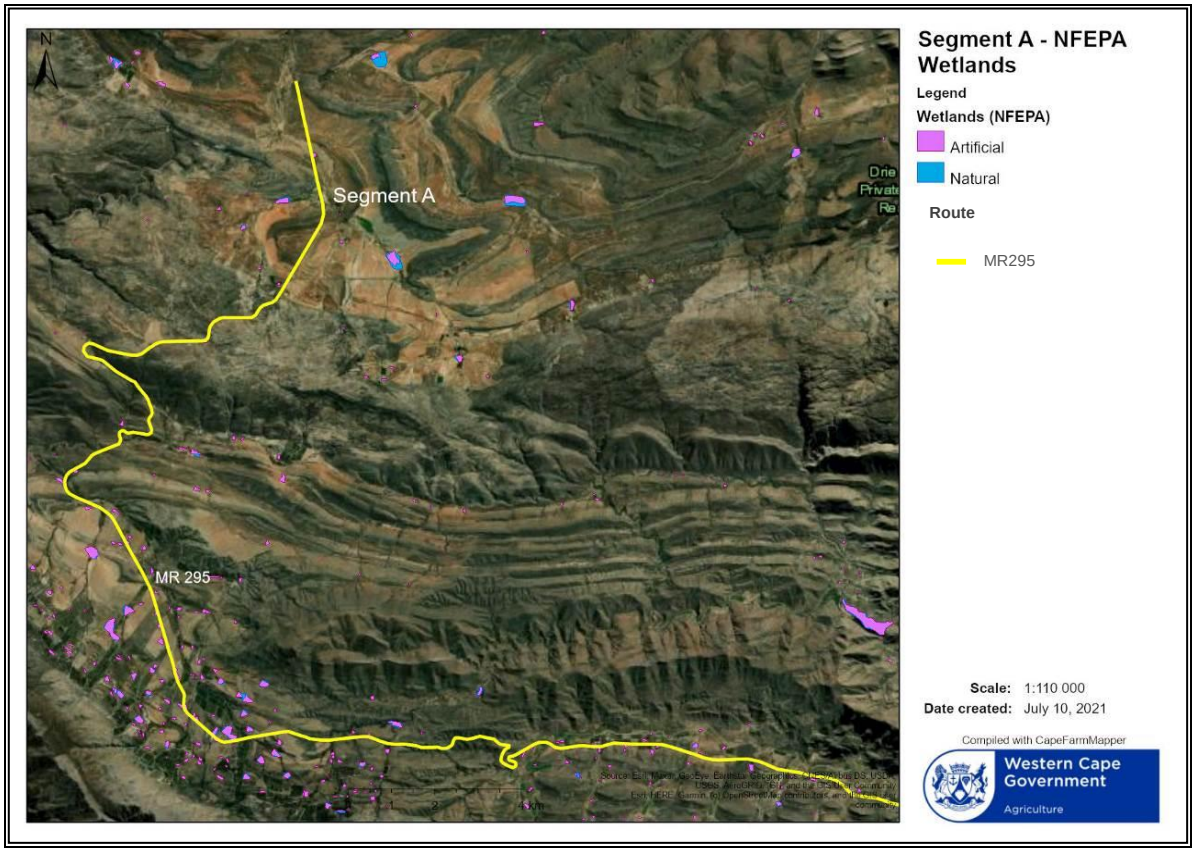


Figure 16: Segment A in relation to Wetland Freshwater Priority Areas

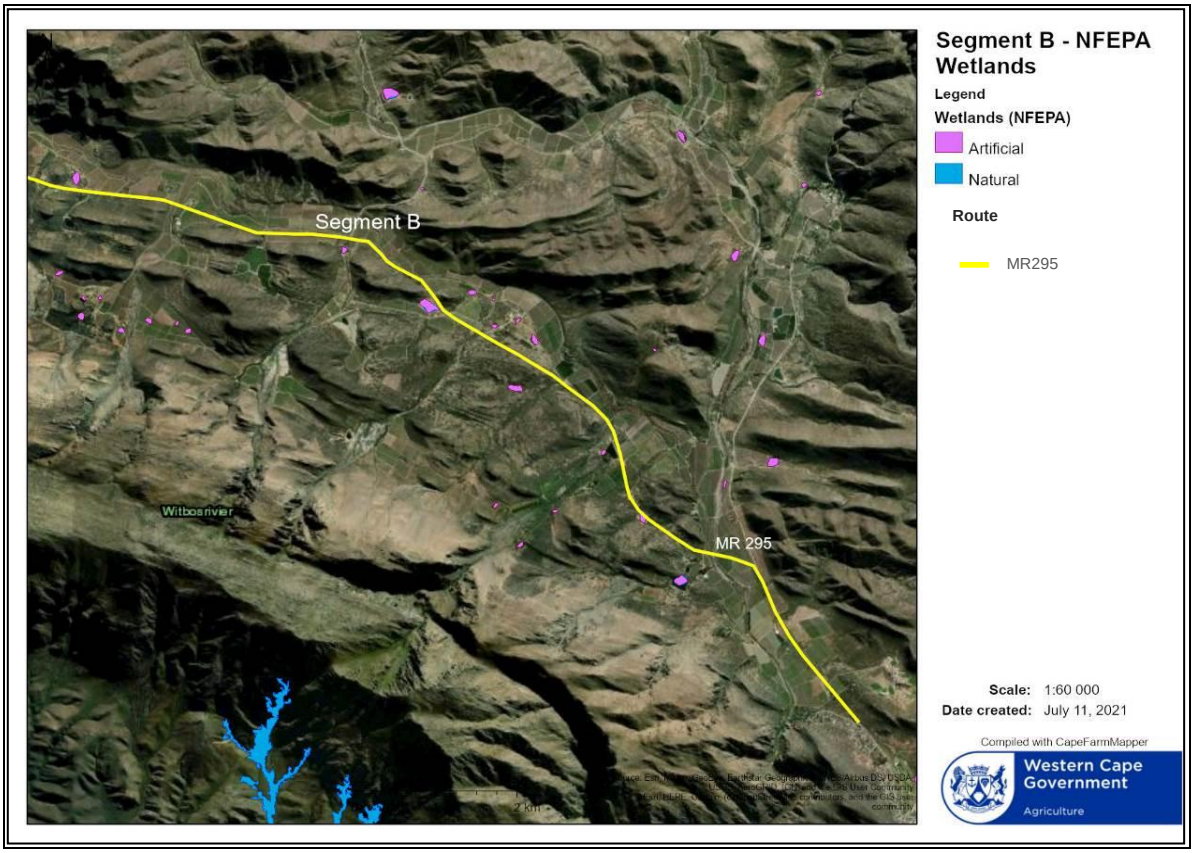


Figure 17: Segment B in relation to Wetland Freshwater Priority Areas

2.5 National Wetland Map

A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the National Biodiversity Assessment of 2018 (Van Deventer et al. 2018). The SAIIAE offers a collection of data layers pertaining to ecosystem types and pressures for both rivers and inland wetlands. National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) 2018. Mapping the locality of wetlands is essential so that they may be classified into the different wetland ecosystem types across the country, which in turn can be used along with other data to identify wetlands of conservation significance.

As shown in Figure 18, the National Wetland Map 5 identified one Wetland (No.1038) approximately 40m away from the carriage way within Segment A. As shown in Figure 19, no wetlands were identified by the National Wetland Map 5 near the Carriage way within Segment B.

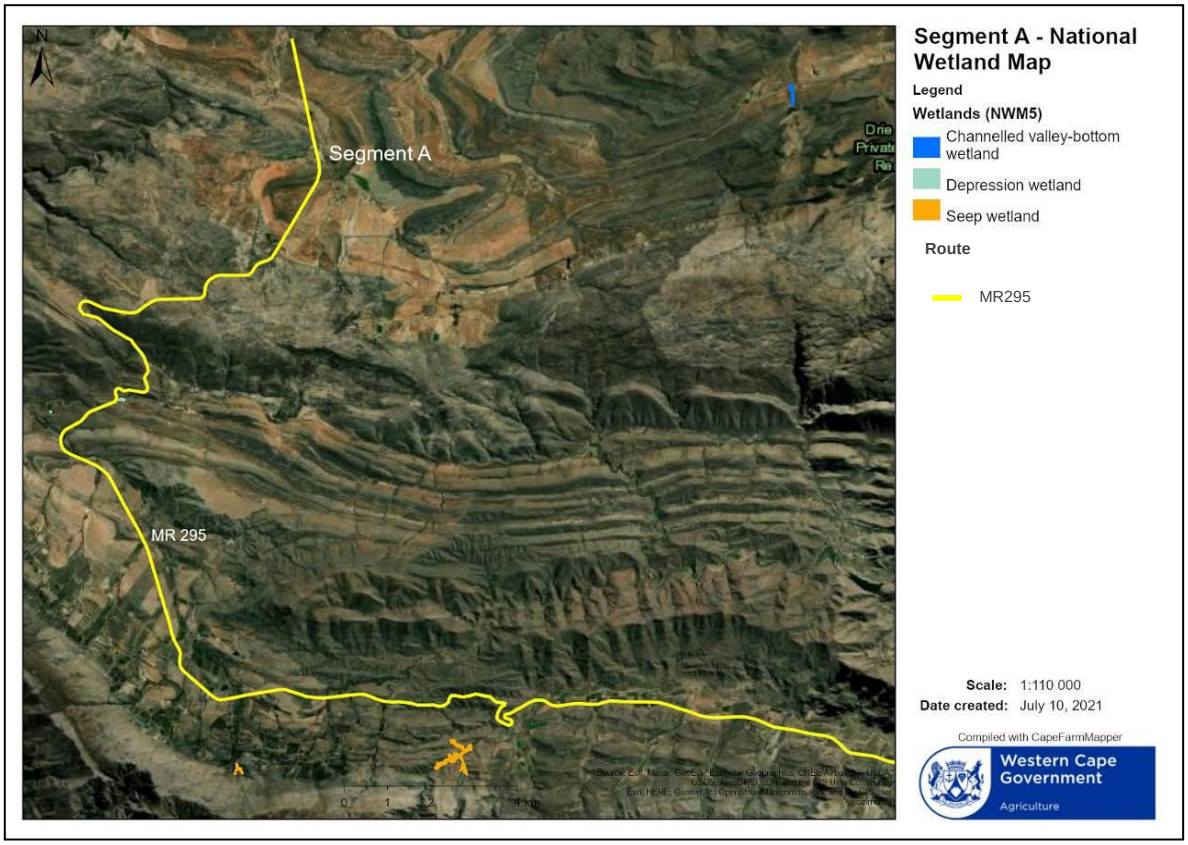


Figure 18: Segment A in relation to the National Wetland Map 5

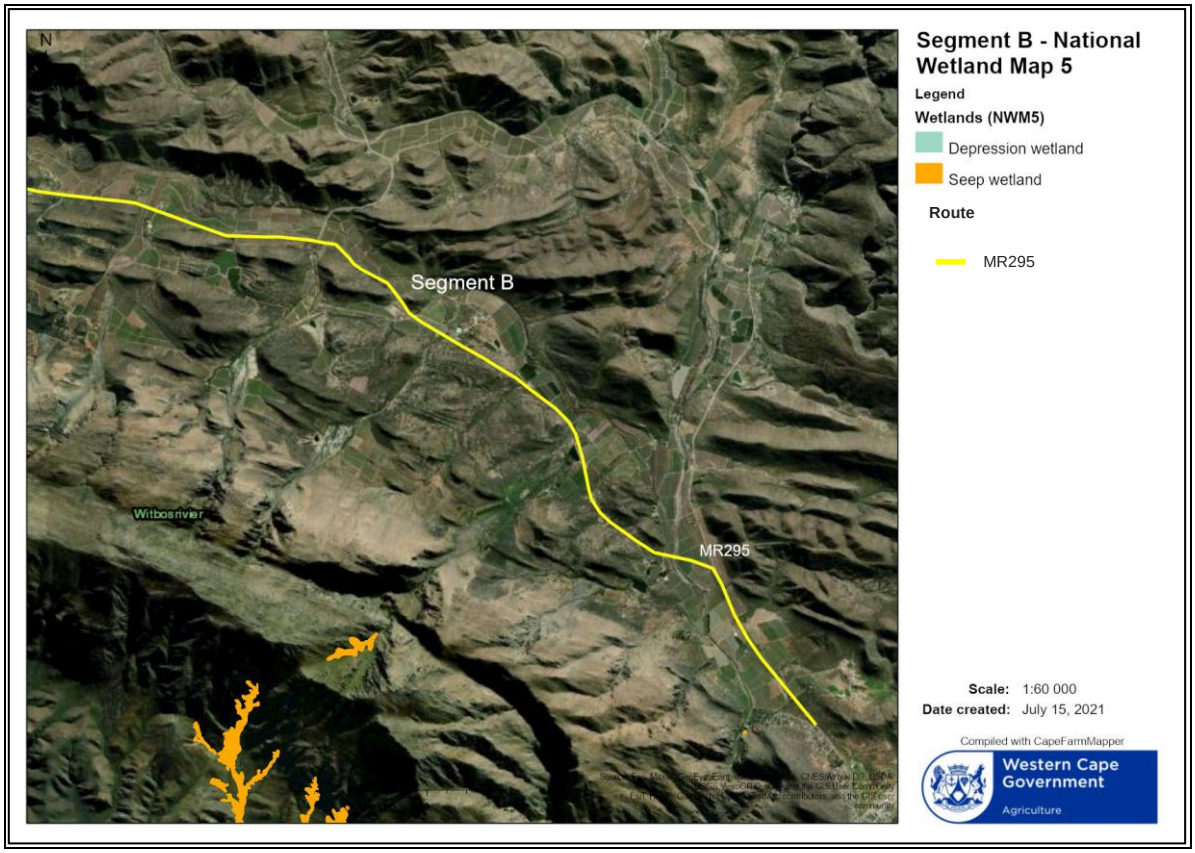


Figure 19: Segment B in relation to the National Wetland Map 5

2.6 Conservation Context

The primary purpose of a map of Critical Biodiversity Areas and Ecological Support Areas is to guide decision-making about where best to locate development. Critical Biodiversity Areas (CBA's) are required to meet biodiversity targets. These areas have high biodiversity and ecological value and therefore must be kept in a natural state without further loss of habitat or species. Low-impact, biodiversity sensitive land uses are the only land uses allowed in CBA's. The WCBSP made a distinction between areas likely to be in a natural condition (CBA1) and areas that could be degraded (CBA2). Ecological Support Areas (ESA's) are not essential for meeting biodiversity targets but are important as they support the functioning of CBA's and Protected Areas (PA's). ESA's support landscape connectivity, surrounds ecological infrastructure that provide ecosystem services, and strengthen resilience to climate change. These areas include Endangered vegetation; water source and recharge areas; and riparian habitat around rivers and wetlands. The WCBSP also made a distinction between ESA's in a functional condition (ESA1) and degraded areas in need of restoration (ESA2).

According to CapeFarmMapper (Accessed July 2021), a large area mapped as a Category 1 Terrestrial CBA is identified and traversed by the carriage way within Segment A and B. Scattered and isolated Category 1 Aquatic CBA area were noted along the entirety of the carriage way within Segment A. A section of the carriage way within Segment A traverses an area mapped as a Category 1 Terrestrial ESA, representing a water recharge area. A high number of Category 1 Aquatic ESA areas are traversed by the carriage way, representing a watercourse or recharge area (Figure 20). As mapped by the Western Cape Biodiversity Spatial Plan (WCBSP) 2017.

According to CapeFarmMapper (Accessed July 2021), majority of the area along the carriage way of Segment B is mapped as a Category 1 Terrestrial ESA, representing a water recharge area. A high number of Category 1 Aquatic ESA areas are traversed by the carriage way, representing a watercourse or recharge area (Figure 21). As mapped by the Western Cape Biodiversity Spatial Plan (WCBSP) 2017.

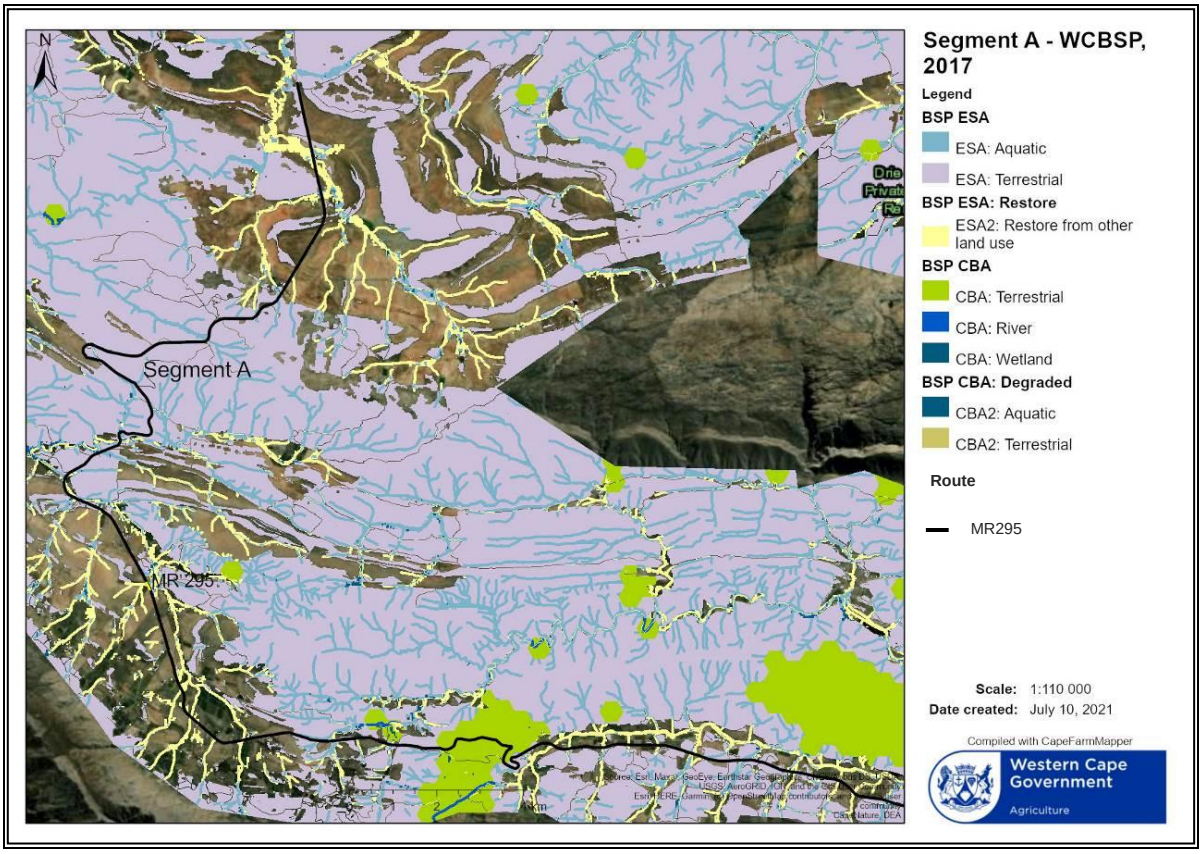


Figure 20: Segment A in relation to the Western Cape Biodiversity Spatial Plan 2017

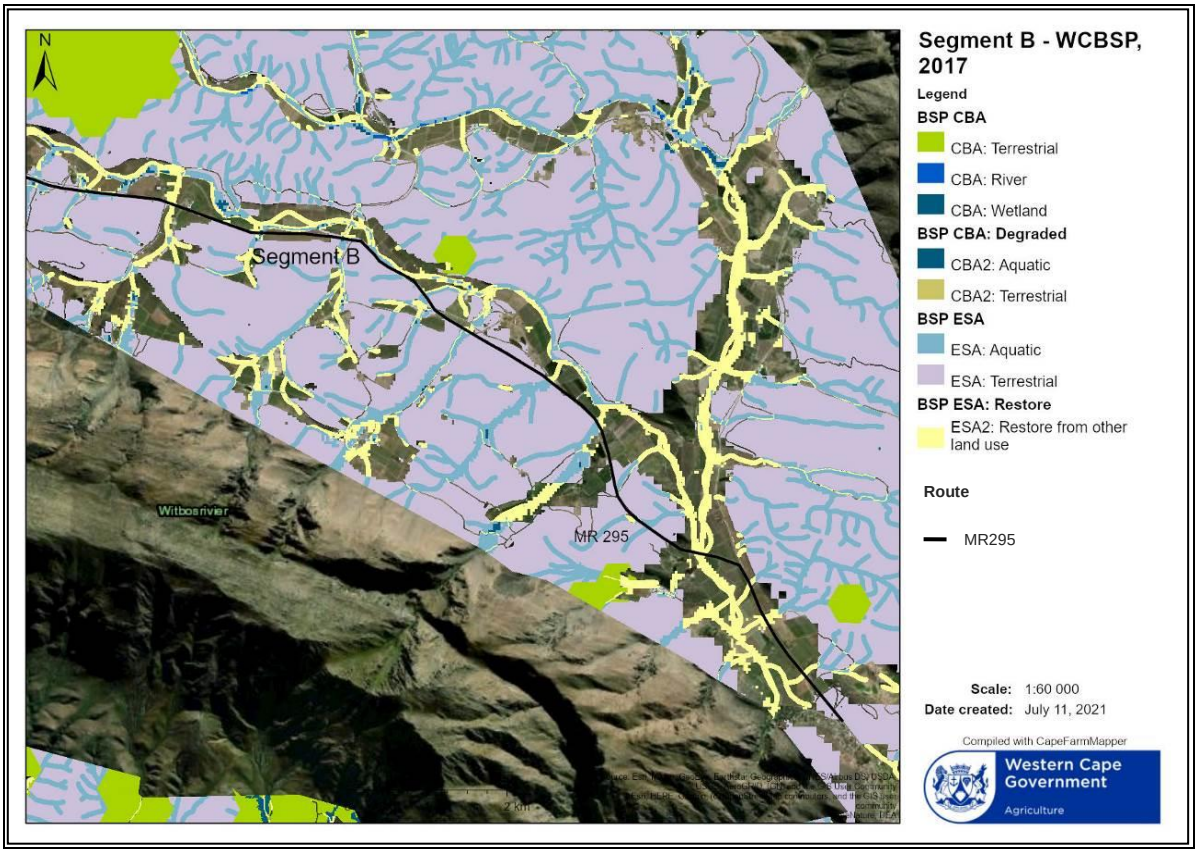


Figure 21: Segment B in relation to the Western Cape Biodiversity Spatial Plan 2017

2.7 Ecosystem Threat Status

The Western Cape Biodiversity Spatial Plan (2017) determines the ecosystems the carriage way traverse within Segment A to have an Ecosystem threat status of LT and VU. The Ecosystem Threat Status traversed by the carriage way within Segment B is dominated by an Ecosystem threat status of LT (Figure 22).

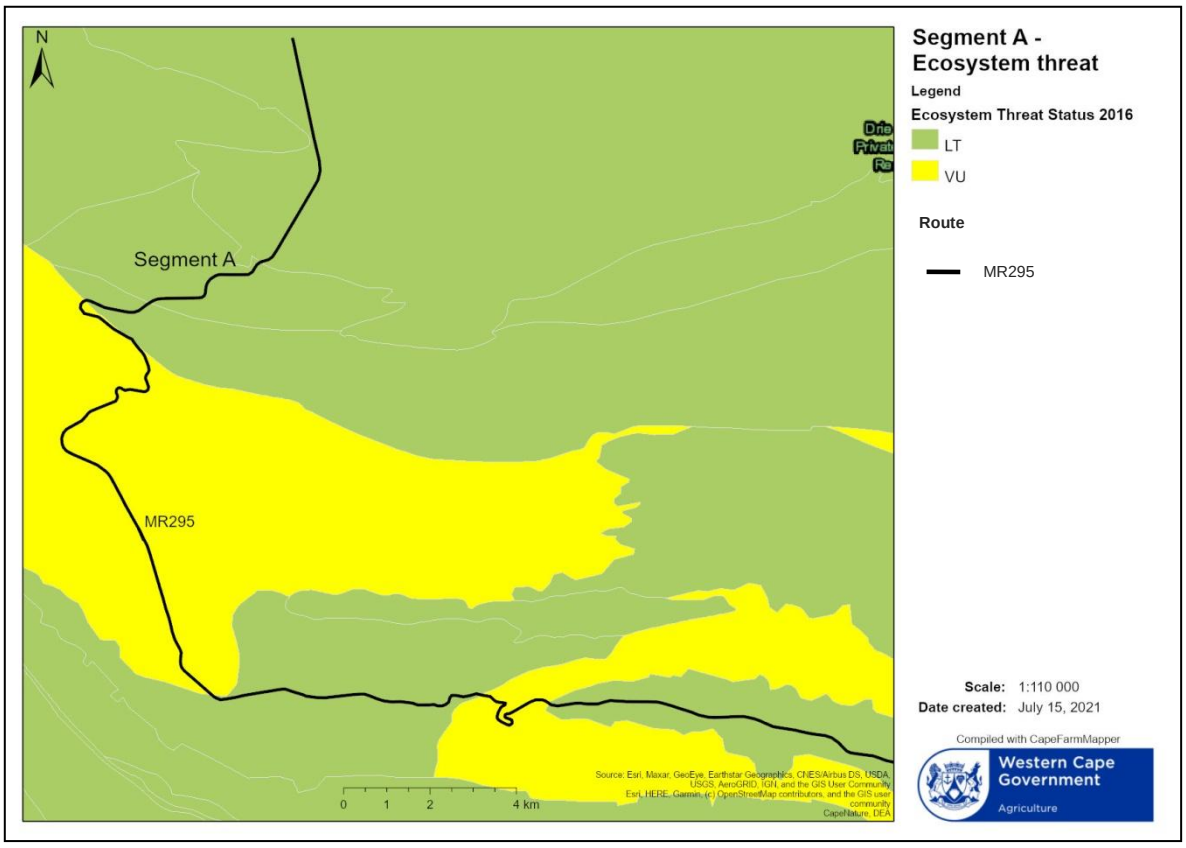


Figure 22: Ecosystem Threat Status in relation to Segment A

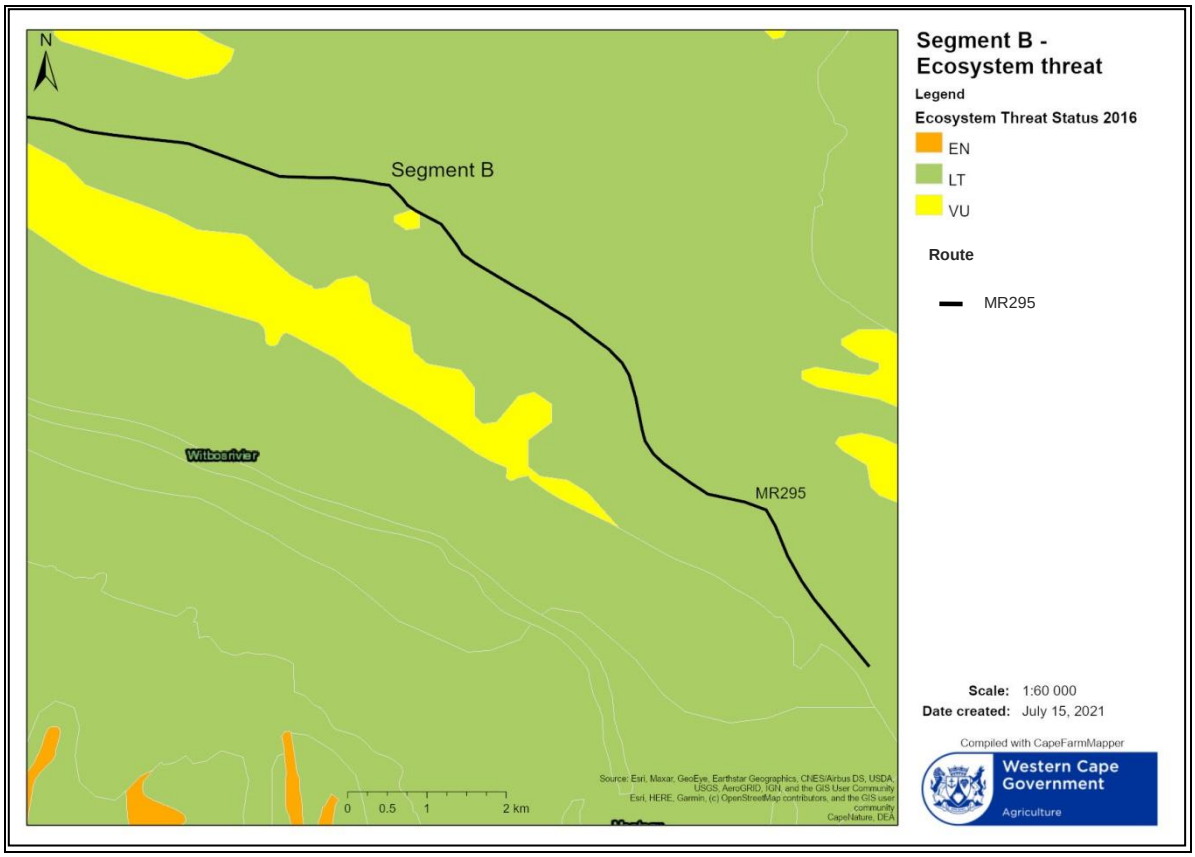


Figure 23: Ecosystem Threat Status in relation to Segment B

2.8 Segment C and D

Segment C begins within Montagu and includes maintenance works proposed on MR 294, DR 1356, OP 6046 and a Segment of TR31/3. Segment D continues with TR31/3 and leads towards Barrydale to the east.

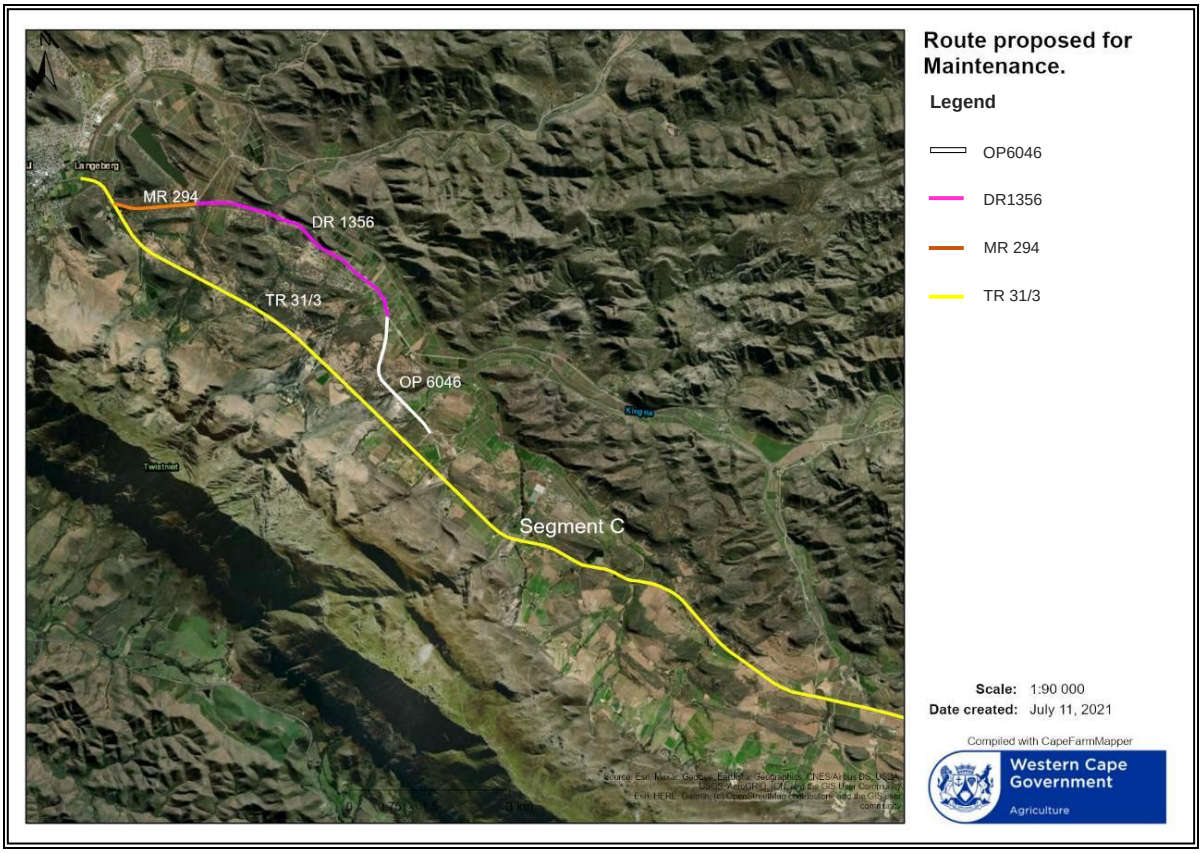


Figure 24: Locality of Segment C

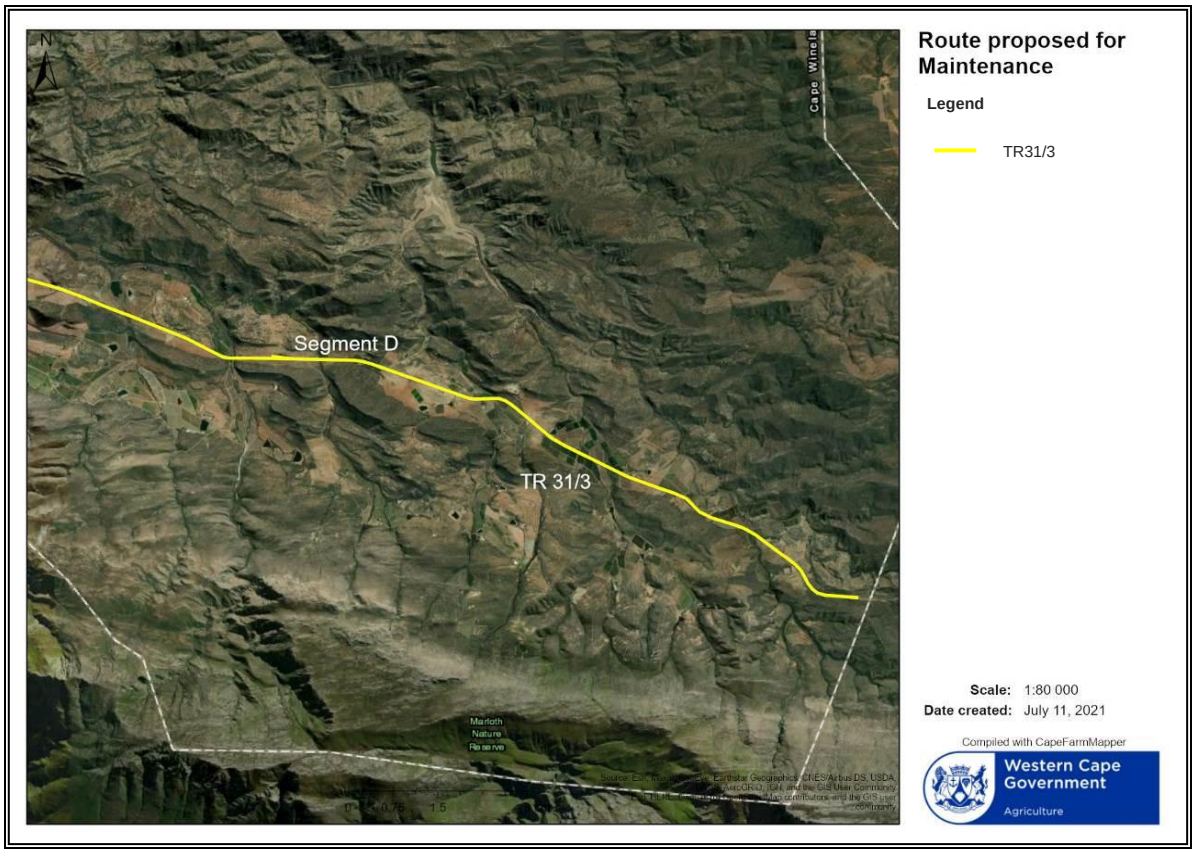


Figure 25: Locality of Segment D

2.9 Vegetation and Geology

Segment C of the route proposed for maintenance is located within the Fynbos and Succulent Karoo Biomes, the Southern Fynbos, Rainshadow Valley Karoo and Western Fynbos-Renosterveld Bioregions. The Segment traverses a number of different Vegetation types, as seen in Figure 26. According to CapeFarmMapper (Accessed July 2021) and the South African Vegetation Map (SANBI, 2018), Segment C begins within vegetation mapped as Western Little Karoo. This vegetation type is described to be found in flat or slightly undulating landscapes, the vegetation is described as a mosaic of Karoo shrublands of low and medium height encompassing (as dominants) both non-succulent and succulent shrubs. Segment C then traverses the borders of North Langeberg Sandstone Fynbos and Montagu Shale Renosterveld. North Langeberg Sandstone Fynbos is well represented within the area and naturally characterized by a complex of gentle to very steep North facing slopes, mainly dominated by proteoid and restioid fynbos, with ericaceous fynbos at higher altitudes and asteraceous fynbos on the lower slopes. Montagu Shale Renosterveld is characterized by an undulating hilly landscape with broad valleys supporting open, tall shrubland in a medium dense matrix of short, divaricate shrubs, dominated by renosterbos.

Segment D of the route proposed for maintenance is located within the Fynbos Biome, the Southern Fynbos and Western Fynbos-Renosterveld Bioregions. The Segment traverses two different Vegetation types, as seen in Figure 27. According to CapeFarmMapper (Accessed July 2021) and the South African Vegetation Map (SANBI, 2018), Segment D begins within vegetation mapped Montagu Shale Renosterveld. Montagu Shale Renosterveld is characterized by an undulating hilly landscape with broad valleys supporting open, tall shrubland in a medium dense matrix of short, divaricate shrubs, dominated by renosterbos. A small section of Segment D ends within Vegetation mapped as Montagu Shale Fynbos. A fragmented unit from the Western Little Karoo vegetation type– Montagu Shale Fynbos is characterized by moderately undulating uplands and undulating foothills to steep mountains, supporting the moderately tall and dense shrublands.

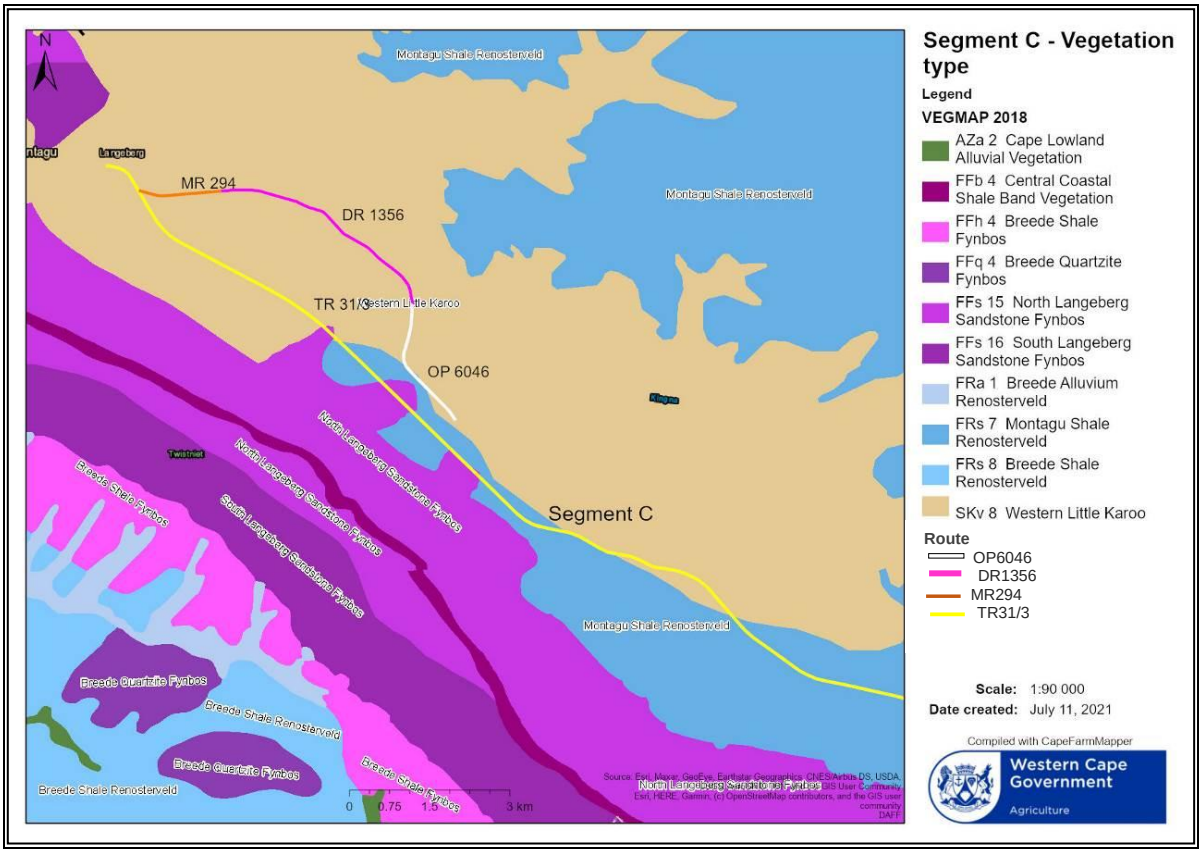


Figure 26: Segment C in relation to the 2018 Vegetation Map

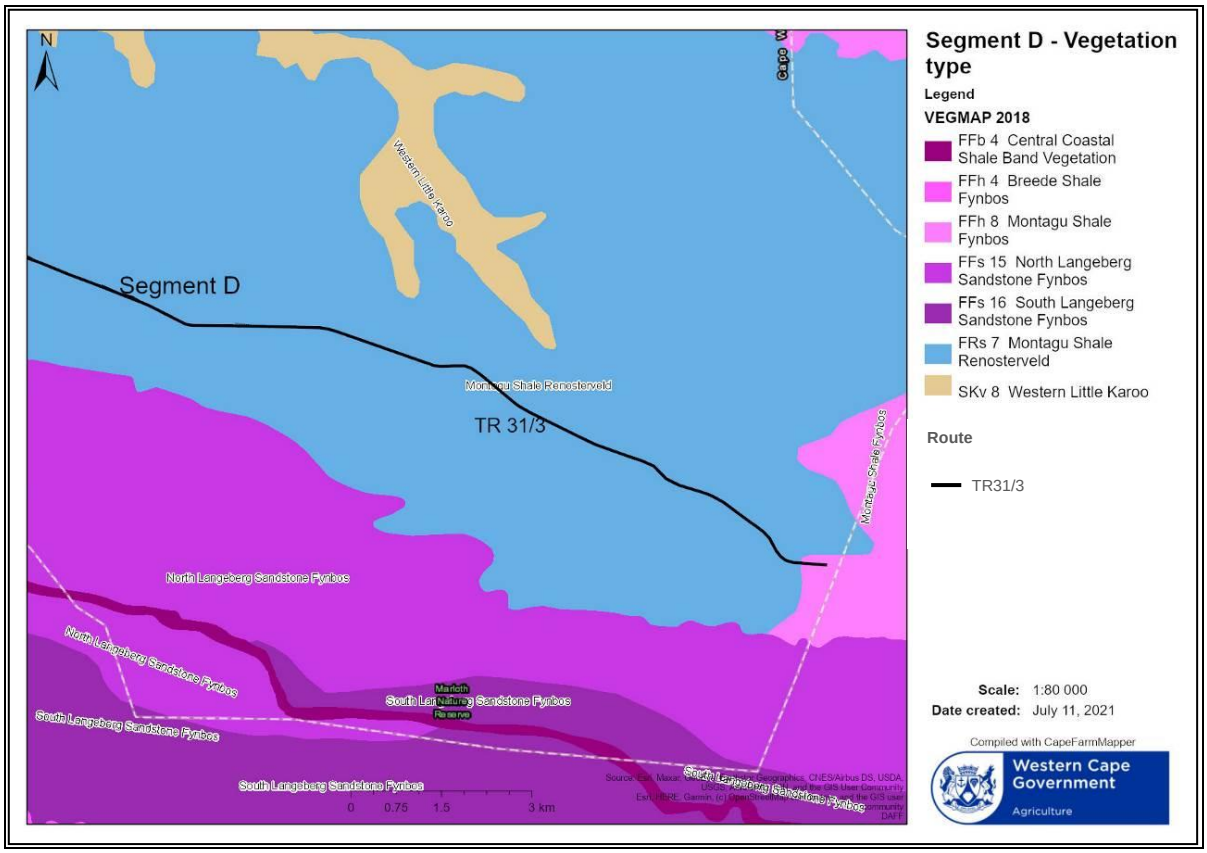


Figure 27: Segment D in relation to the 2018 Vegetation Map

According to CapeFarmMapper (Accessed July 2021), Segment C of the route proposed for maintenance is entirely encapsulated within the Ceres subgroup, as seen in Figure 28. The subgroup is characterized by its abundance of Mudrock, shale, siltstone, feldspathic arenite and wacke is often found within this subgroup.

CapeFarmMapper (Accessed July 2021) indicates Segment D of the route proposed for maintenance is located entirely within the Ceres subgroup, as shown in Figure 29. The subgroup is characterized by its abundance of Mudrock, shale, siltstone, feldspathic arenite and wacke is often found within this subgroup.

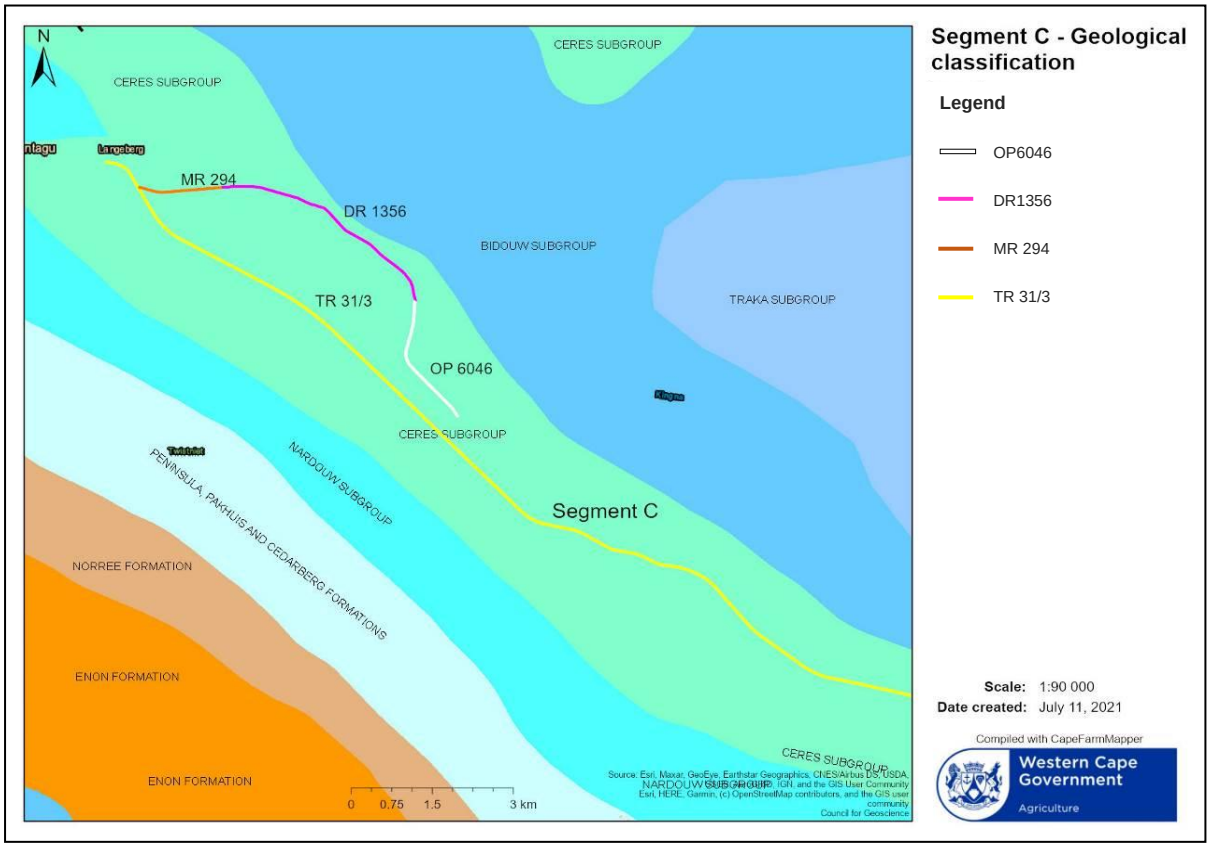


Figure 28: Segment C in relation to the Geological Map of South Africa

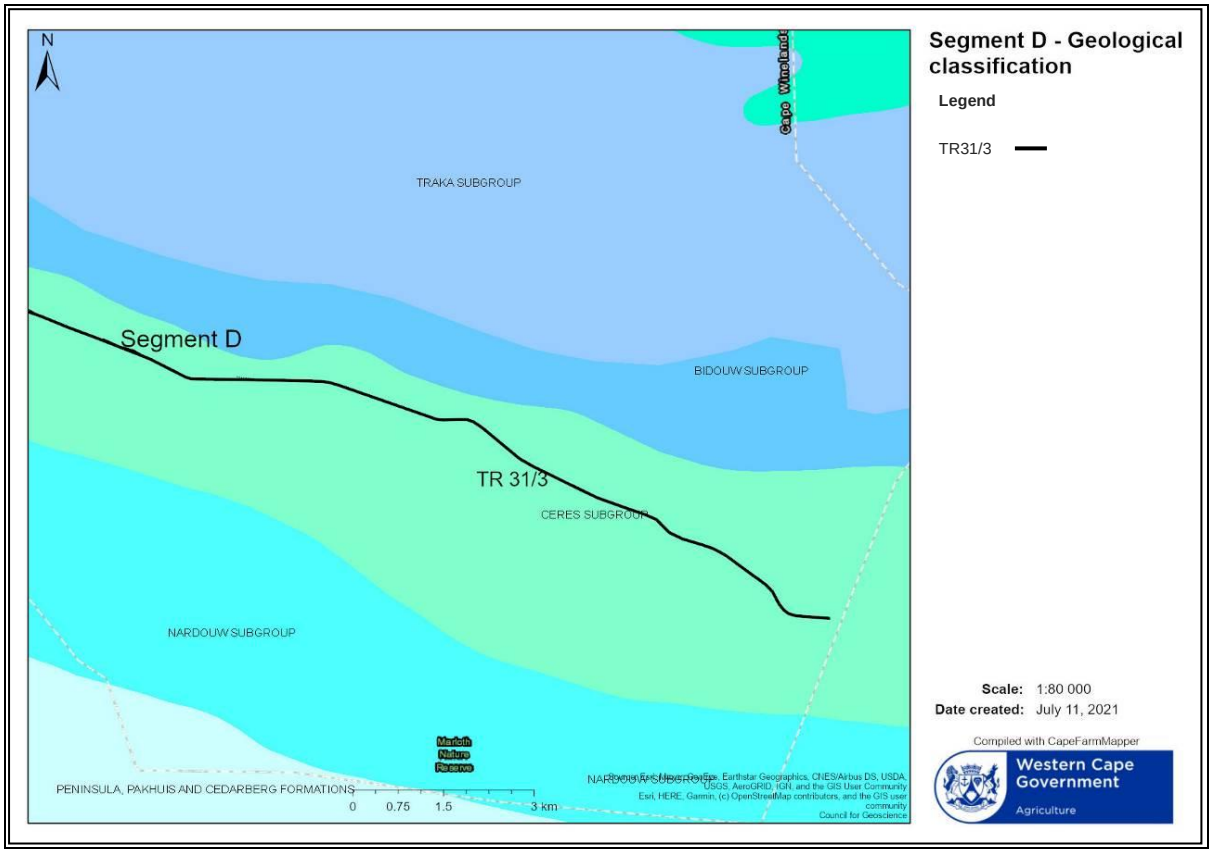


Figure 29: Segment D in relation to the Geological Map of South Africa

2.10 The Drainage Network

Segment C is located within the Southern Fynbos, Rainshadow Valley Karoo and Western Fynbos-Renosterveld Bioregions. Segment C is situated within the H30A and H30B quaternary catchments of the Gouritz Water Management Area (Figure 30). Segment C traverses no main perennial rivers. The topography traversed by Segment C begins relatively flat and gentle as it leaves Montagu until it gently rises towards Segment D. Gentle gradients are present on either side of the Segment C, the gradient increases dramatically towards Segment D on either side of the carriage way. The Langeberg Mountain Range situated closely to the south acts as a large watershed and contributes the Langeberg-Wes Mountain Catchment Area. This results in high velocity runoff rates. Segment D is located within the Southern Fynbos and Western Fynbos-Renosterveld Bioregions. The reach of road within this Segment is situated entirely within the H30A quaternary catchment of the Gouritz Water Management Area (Figure 31). Segment D traverses the Dwariega perennial River. The topography traversed by Segment D gently rises towards Barrydale with steep gradients present on either side of the carriage way. The Langeberg Mountain Range situated closely to the south acts as a large watershed and contributes the Langeberg-Wes Mountain Catchment Area. This results in high velocity runoff rates.

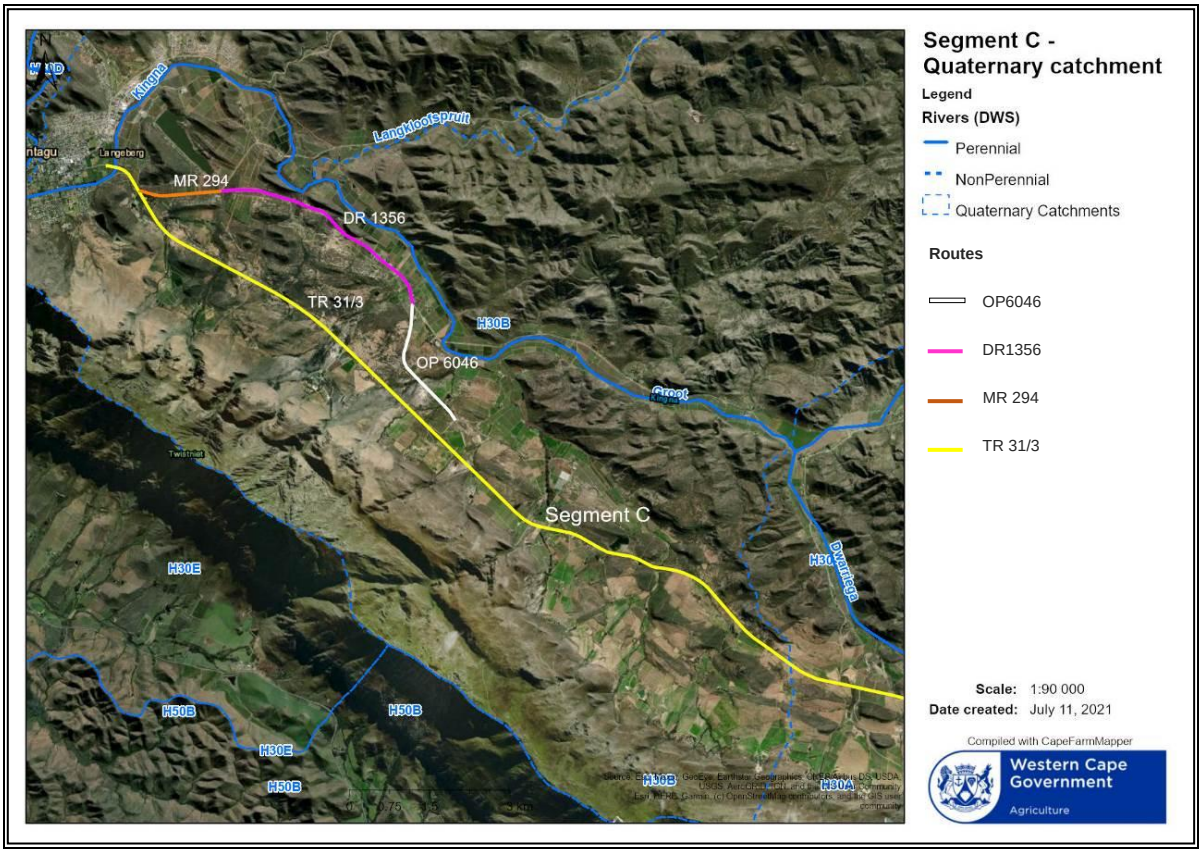


Figure 30: Drainage of the region in relation to Segment C

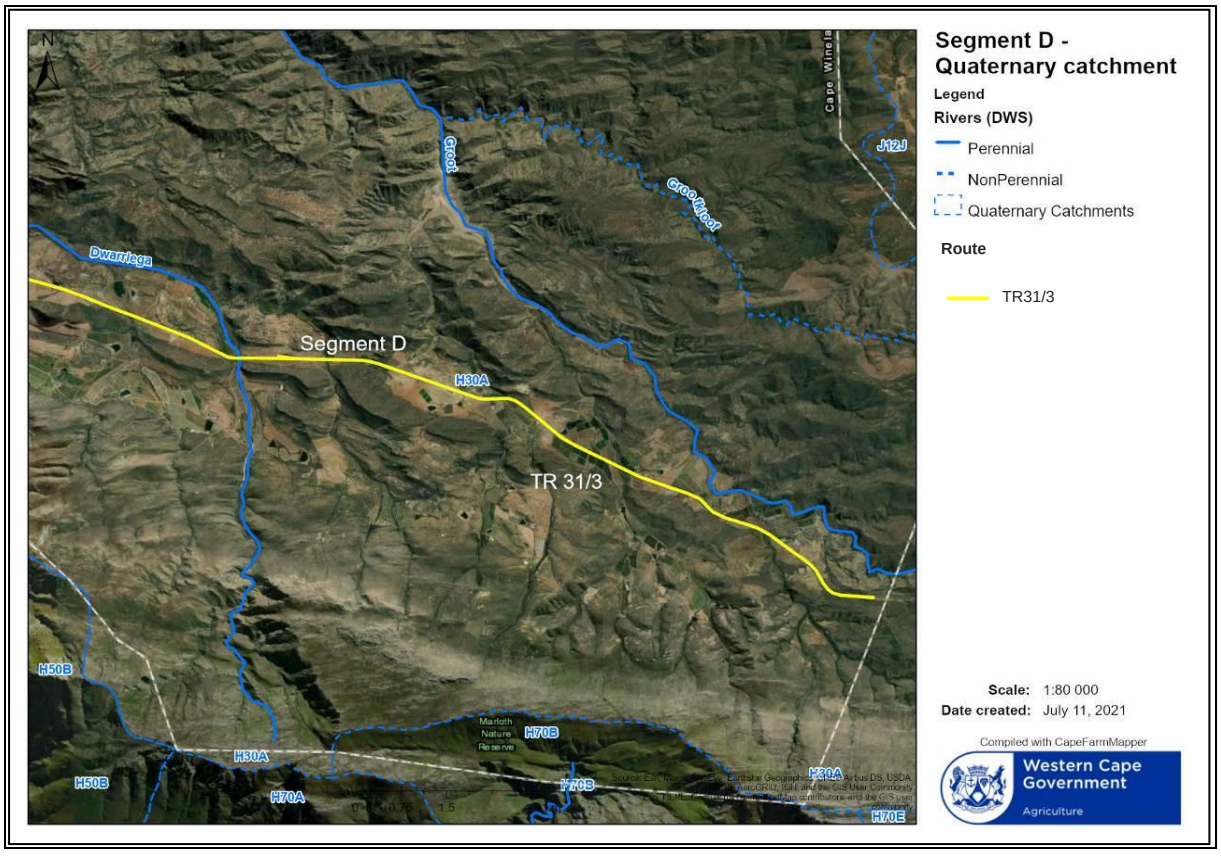


Figure 31: Drainage of the region in relation to Segment D

2.11 National Freshwater Ecosystem Priority Area project (NFEPA)

According to CapeFarmMapper (Accessed July 2021) and shown in Figure 32, multiple scattered and isolated Artificial Wetlands have been identified along the two carriage ways within Segment C as NFEPA projects. The identified Artificial Wetlands represent Wetland areas that have formed due to the damming of watercourses and creation of dams/storage ponds for agricultural purposes, as is accustomed to Agricultural areas, thus the Wetlands being classed as Artificial by the NFEPA. According to CapeFarmMapper (Accessed July 2021) and shown in Figure 33, multiple scattered and isolated Artificial Wetlands have been identified along Segment D as NFEPA projects. The identified Artificial Wetlands represent Wetland areas that have formed due to the damming of watercourses and creation of dams/storage ponds for agricultural purposes, as is accustomed to Agricultural areas, thus the Wetlands being classed as Artificial by the NFEPA.

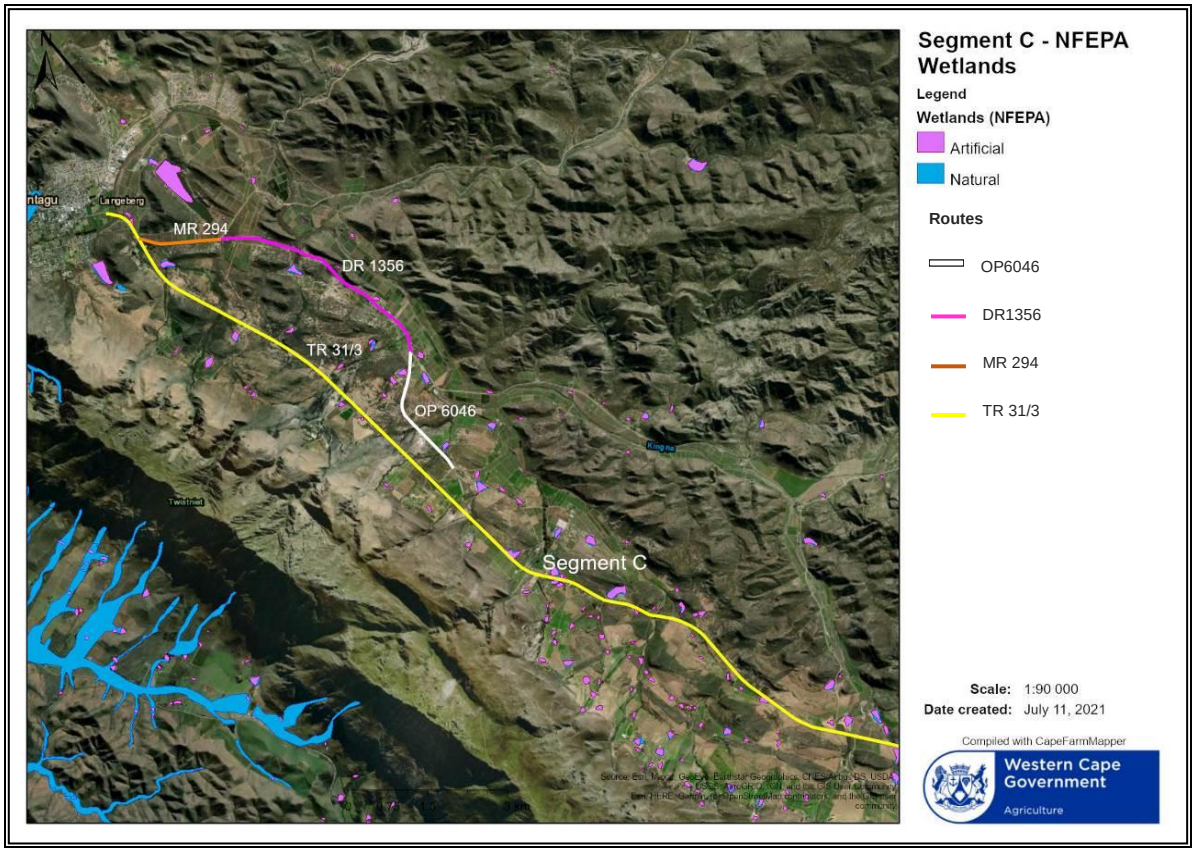


Figure 32: Segment C in relation to Wetland Freshwater Priority Areas

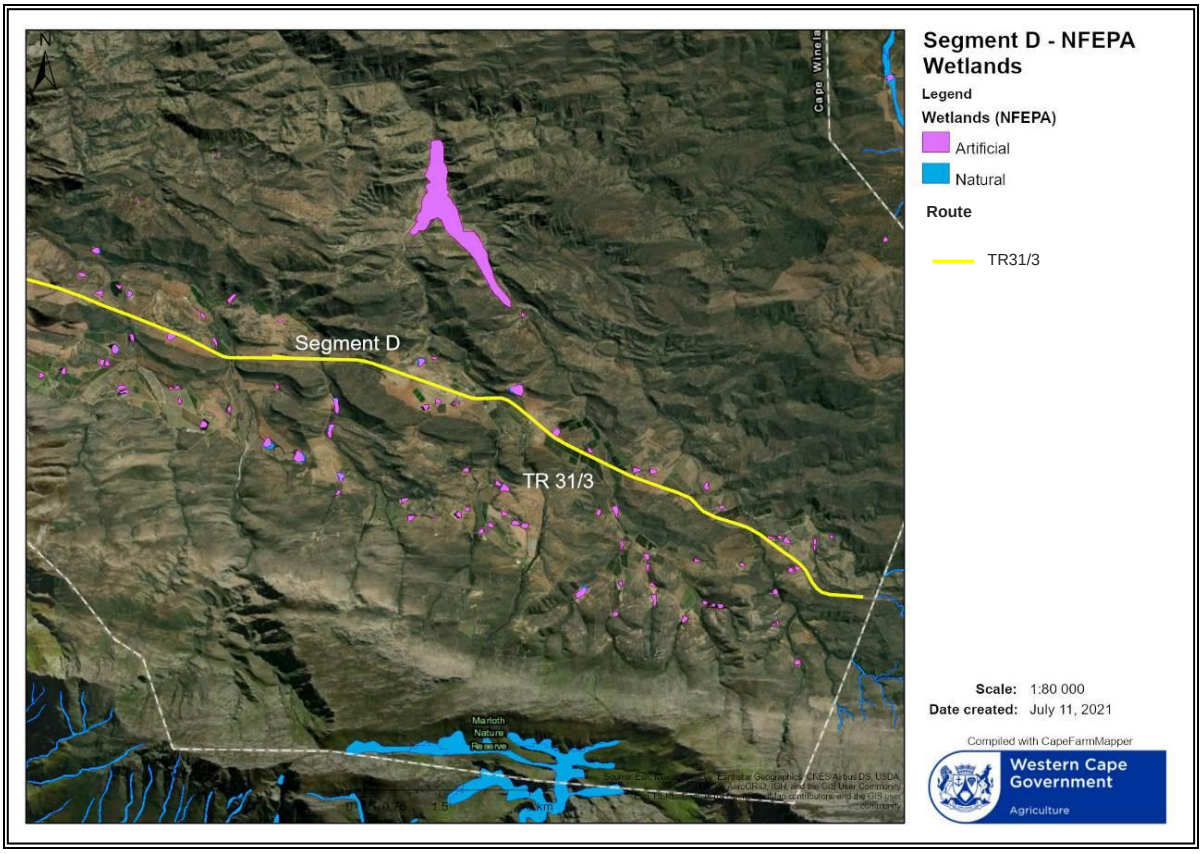


Figure 33: Segment D in relation to Wetland Freshwater Priority Areas

2.12 National Wetland Map

As shown in Figure 34 and Figure 35, no Wetlands were identified by the National Wetland Map 5 near the Carriage ways within Segment C and D.

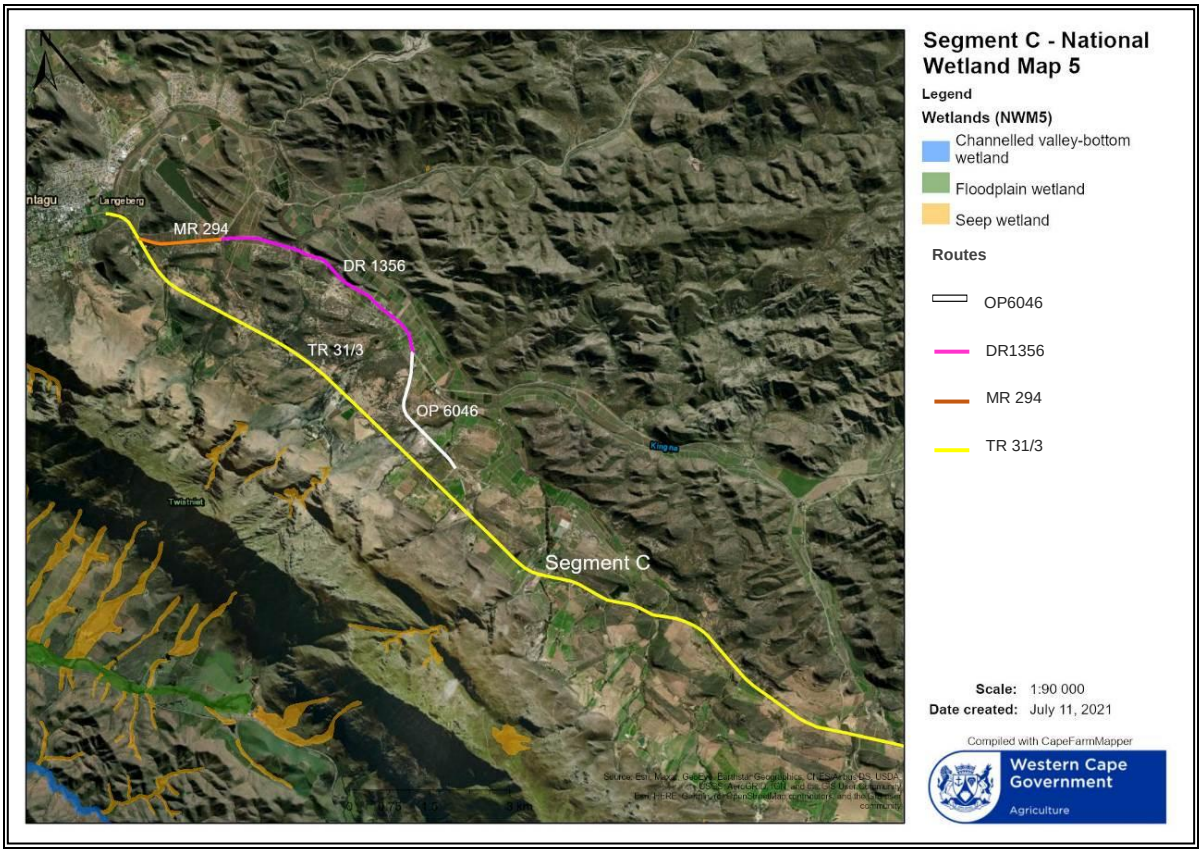


Figure 34: Segment C in relation to the National Wetland Map 5

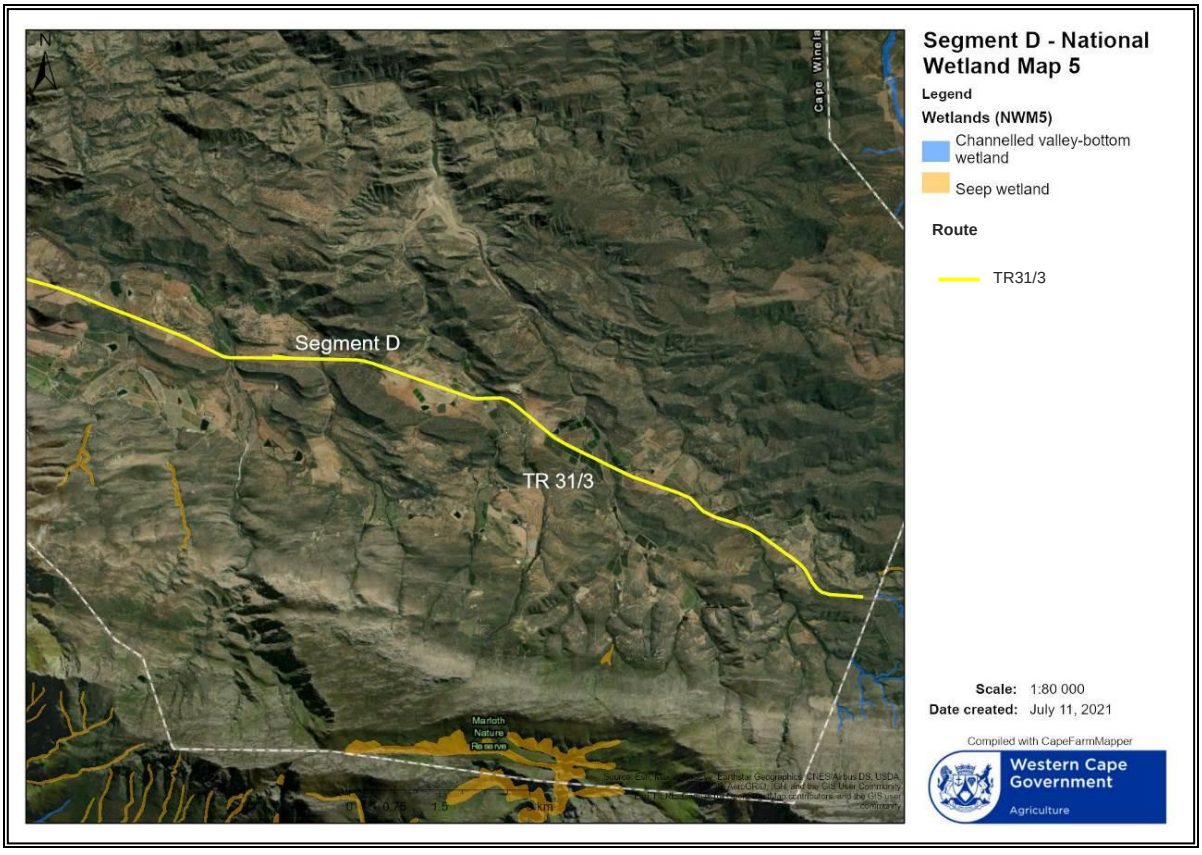


Figure 35: Segment D in relation to the National Wetland Map 5

2.13 Conservation Context

According to CapeFarmMapper (Accessed July 2021), two areas mapped as Category 1 Terrestrial CBA's are identified along the carriage way, as well as scattered and isolated Category 1 Aquatic CBA areas present along the entirety of the carriage ways within Segment C. A large section of the carriage way within Segment C traverses an area mapped as a Category 1 Terrestrial ESA, representing a water recharge area. Multiple Category 1 Aquatic ESA areas are traversed by the carriage way, representing a watercourse or recharge area (Figure 36). As mapped by the Western Cape Biodiversity Spatial Plan (WCBSP) 2017. According to CapeFarmMapper (Accessed July 2021), scattered and isolated Category 1 Aquatic CBA areas and Category 2 Wetland CBA Areas are present along the entirety of the carriage way within Segment C. The carriage way traverses a small section of the carriage way within Segment D which is mapped as a Category 1 Terrestrial ESA, representing a water recharge area. Multiple Category 1 Aquatic ESA areas are traversed by the carriage way, representing a watercourse or recharge area (Figure 37). As mapped by the Western Cape Biodiversity Spatial Plan (WCBSP) 2017.

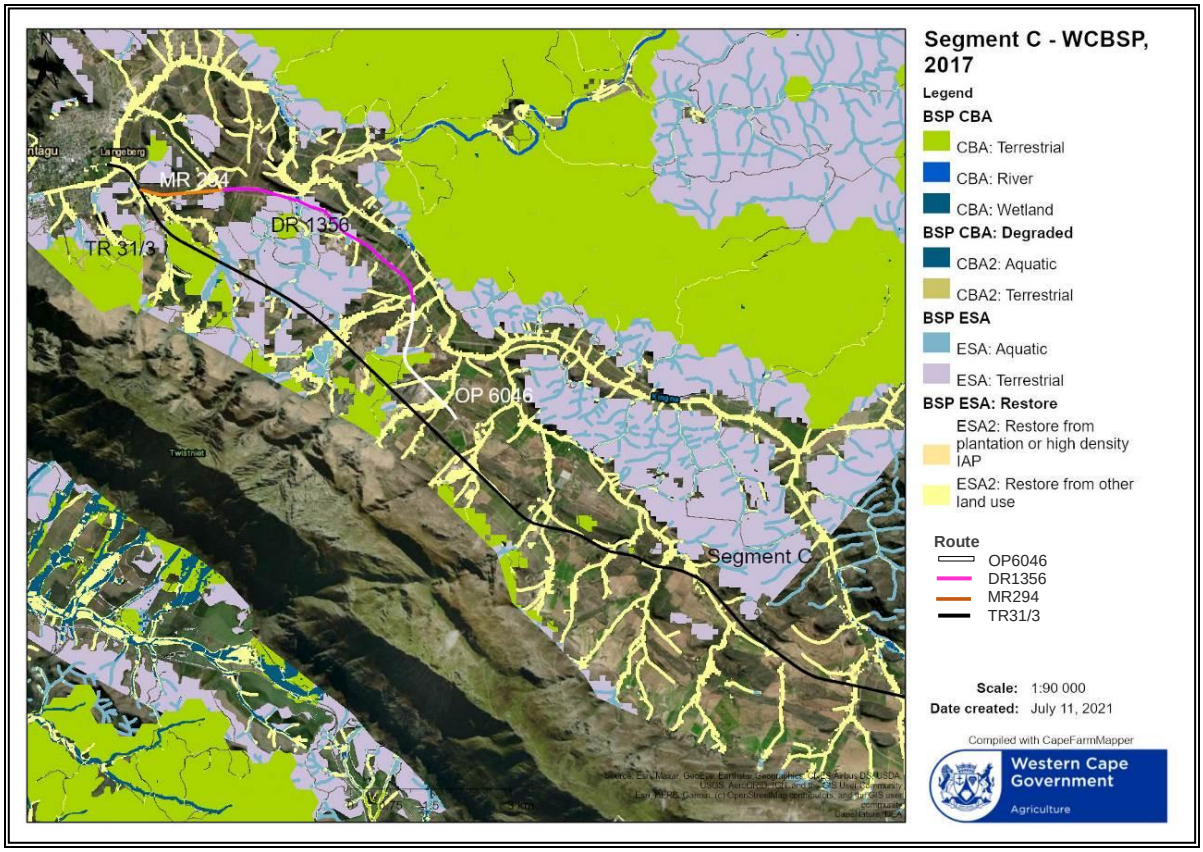


Figure 36: Segment C in relation to the Western Cape Biodiversity Spatial Plan 2017

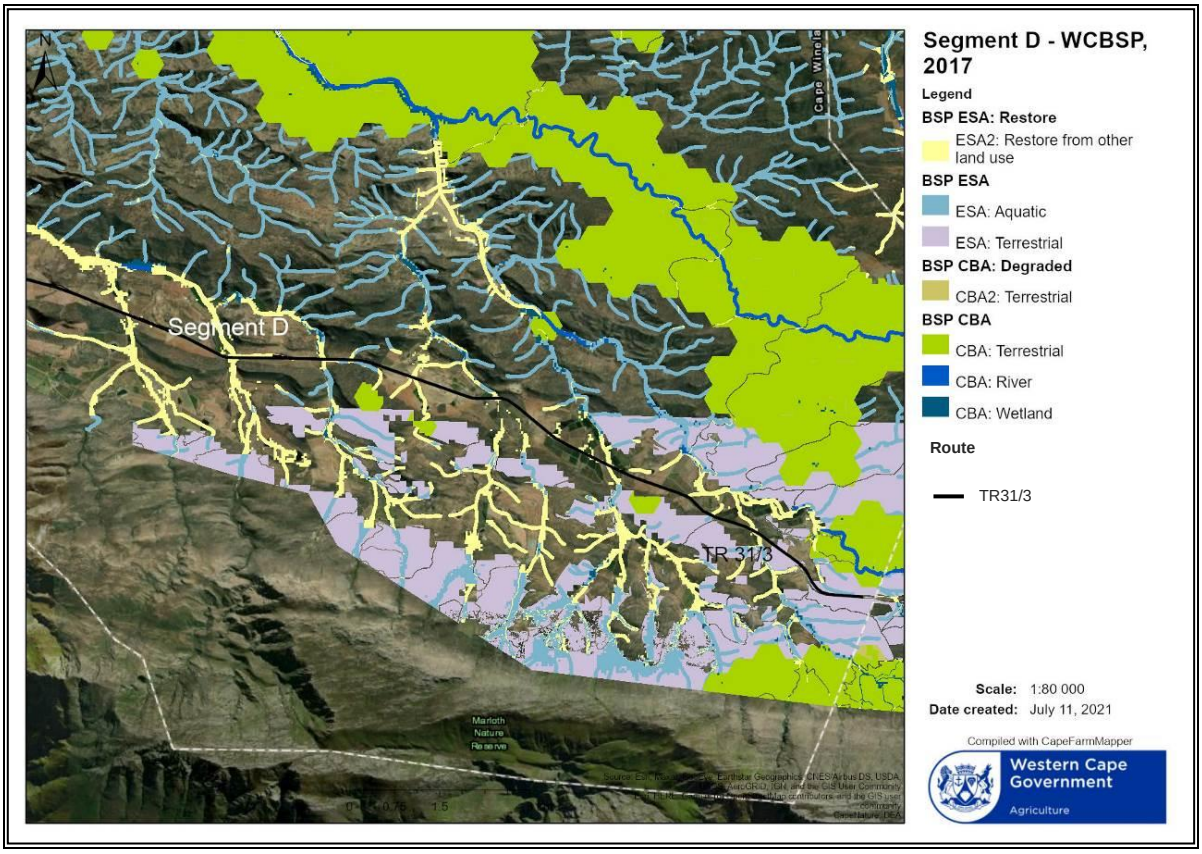


Figure 37: Segment D in relation to the Western Cape Biodiversity Spatial Plan 2017

2.14 Ecosystem Threat status

The Western Cape Biodiversity Spatial Plan (2017) determines the ecosystem the carriage way traverses within Segment C at the beginning of the Segment to have an Ecosystem threat status of LT. The remaining carriage way within Segment C and the entire carriage way within Segment D traverses an ecosystem mapped as VU by the Western Cape Biodiversity Spatial Plan (2017).

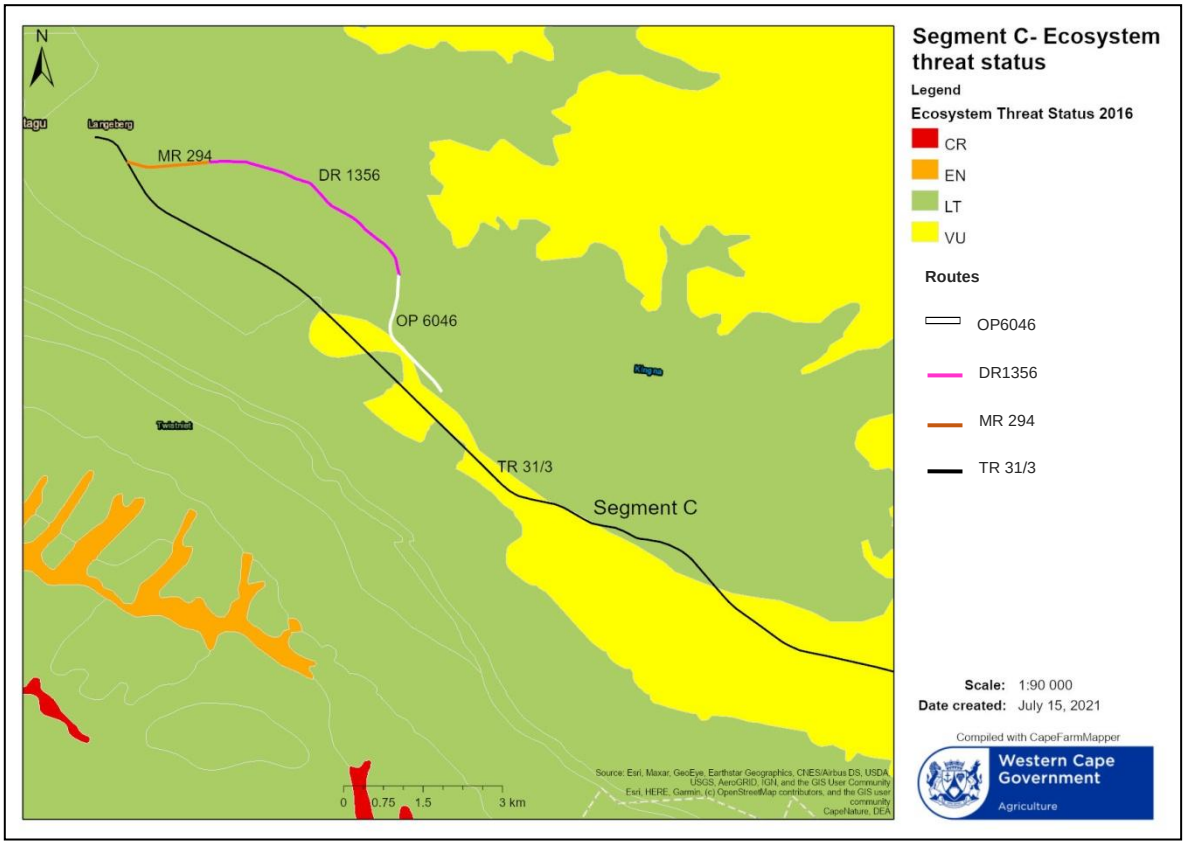


Figure 38: Ecosystem Threat Status in relation to Segment C

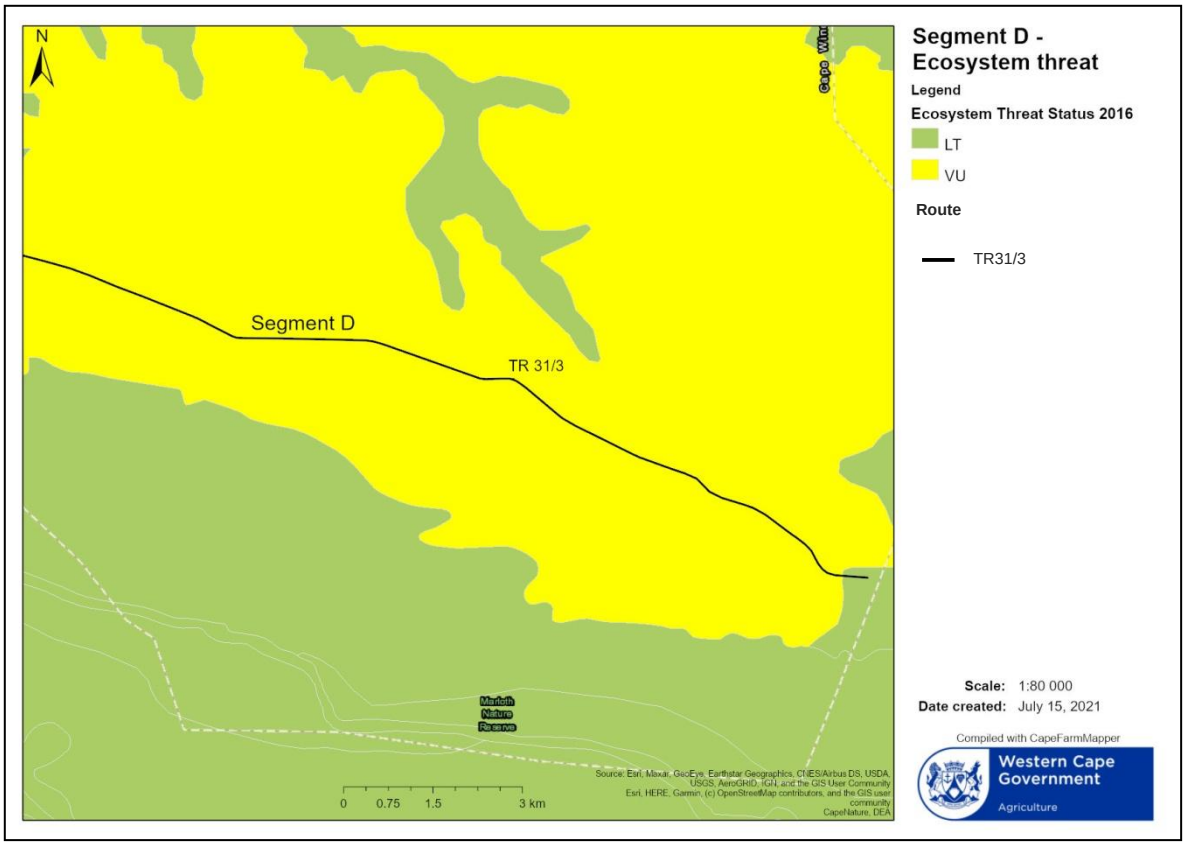


Figure 39: Ecosystem Threat Status in relation to Segment D

2.15 Existing Impacts

Agricultural activities have the largest impact on the watercourses of the area and there has been substantial loss of floodplain habitat due to grazing and cultivation. Cultivated lands and planted pastures replace natural habitat, alter surface water movement, and reduce flows. The periodic harvesting of the plants exposes bare earth that potentially results in large sediment inputs into the valleys. Additionally, excessive use of fertilisers can result in eutrophication and habitat modification in watercourses. Overuse of water can result in high salinity levels. Grazing in riparian areas and wetlands is a natural phenomenon, but excessive grazing, or conversion from natural vegetation cover to planted pastures, reduces vegetation and habitat complexity, and is usually associated with a reduction in vegetation robustness (reduced stature and resistance offered to floods). These changes reduce the flood attenuation and sediment trapping efficiencies. Other indirect effects of grazing include trampling of riverbeds, and the creation of localised erosion gullies in river banks, while severely trampled riparian areas may be more vulnerable to erosion.

Road crossings that concentrate diffuse flow, where the floodplain flows into a single culvert can lead to erosion. Deposition of sediment upstream of structures also restricts flow movements as it accumulates against culverts or blocks culverts. The impacts that may result from the clearance of vegetation and sand deposits are arguably existing impacts and the habitat is already disturbed. Additionally, during flooding events it is natural for the river morphology to alter and for scouring to remove vegetation in high flow velocity areas.

3 APPROACH AND METHODS

3.1 Desktop Assessment Methods

- The contextualization of each study area was undertaken in terms of important biophysical characteristics and the latest available aquatic conservation planning information in a Geographical Information System (GIS). It is imperative to develop an understanding of the regional drainage setting and longitudinal dynamics of the watercourse. The conservation planning information aids in the determination of importance and sensitivity, management objectives, and the significance of potential impacts.
- Following this, desktop delineation and illustration of all watercourses within the study area was undertaken utilising available site-specific data such as aerial photography, contour data and water resource data. Digitization and mapping were undertaken using QGIS 2.18 GIS software (Table 5).

- These results, as well as professional experience, allowed for the identification of specific watercourses that could potentially be impacted by the maintenance and therefore required groundtruthing and detailed assessment. The following data sources listed within Table 5 assisted with the assessment.

Table 5: Utilised data and associated source relevant to the proposed project

Data	Source
Google Earth Pro™ Imagery	Google Earth Pro™
DWS Eco-regions (GIS data)	DWS (2005)
South African Vegetation Map (GIS Coverage)	Mucina, Rutherford & Powrie (2018)
National Biodiversity Assessment Threatened Ecosystems (GIS Coverage)	SANBI (2011)
Contours (elevation) - 5m intervals	Surveyor General
NFEPA river and wetland inventories (GIS Coverage)	CSIR (2011)
NEFPA river, wetland and estuarine FEPAs (GIS Coverage)	CSIR (2011)
Western Cape Biodiversity Framework 2017: Critical Biodiversity Areas of the Western Cape.	Pence (2017)

3.2 Baseline Assessment Methods

- An infield site assessment was conducted on the 1st of July 2021 to confirm the location and extent of the systems identified as likely to be impacted by the proposed project. The site visit followed a rainfall event and many of the non-perennial watercourses were flowing. The identified aquatic ecosystems were classified in accordance with the, '*National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa'* (Ollis *et al*. 2013) and *WET-Ecoservices* (Kotze *et al*. 2009).
- Infield delineation was undertaken with a hand-held GPS, for mapping of any potentially affected aquatic ecosystems, in alignment with standard field-based procedures in terms of the Department of Water and Sanitation (DWAF 2008) *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas*. The delineation is based upon observations of the landscape setting, topography, vegetation and soil characteristics. Figure 40 below shows the Garmin Montana 6 GPS data from fieldwork which was utilised to delineate the watercourses along the three road sections proposed for maintenance.

Figure 40: Map showing the GPS tracks and waypoints collected during fieldwork on the 1st of July 2021

- Determination of the Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland habitats.
    - The health/condition or Present Ecological State (PES) of the wetland was assessed using the Level 2 WET-Health assessment tool (Macfarlane *et al.* 2008), which is based on an understanding of both catchment and on-site impacts and the impact that these aspects have on system hydrology, geomorphology and the structure and composition of wetland vegetation.
    - Wetland benefits can be classified into goods/products (directly harvested from wetlands), functions/ services (performed by wetlands), and ecosystem scale attributes. The WET-Ecoservices tool (Kotze *et al*., 2009) is utilised to assess the goods and services that the individual wetlands under assessment provide, thereby aiding informed planning and decision-making. The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing).
    - The Ecological Importance and Sensitivity (EIS) of freshwater habitats is an expression of the importance of the water resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007). There Wetland EIS Tool was utilised to determine EIS (Kleynhans, 1999).

- Determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) assessment of the delineated river/riparian habitats was undertaken utilising:
  - Qualitative Index of Habitat Integrity (IHI) tool adapted from (Kleynhans, 1996) – PES
  - DWAF (DWS) River EIS tool (Kleynhans, 1999) - EIS
- The PES and EIS results then allowed for the determination of management objectives for the potentially impacted aquatic ecosystems. Refer to the Table 6 below and Annexure 11 for a list and description of the tools utilised.

Table 6: Tools utilised for the assessment of water resources impacted upon by the proposed project.

METHOD/TOOL*	SOURCE	REFERENCE	ANNEXURE
Delineation of wetland and/or Riparian areas	*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas.*	(DWAF 2005)	11.1
Classification of wetlands and/ or other aquatic ecosystems	*National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa & WET-Ecoservices*	(Ollis *et al*., 2013), Kotze *et al*., 2009)	11.2
Present Ecological State (PES) Assessment (Wetland)	*WET-Health Assessment*	(McFarlane *et al.* 2009)	11.3
Functional Importance Assessment (Wetland)	*WET-Ecoservices Assessment*	(Kotze *et al*., 2009)	11.5
Ecological Importance & Sensitivity (EIS) Assessment (wetland)	*DWAF Wetland EIS Tool*	(Duthie 1999)	11.6
Present Ecological State (PES) Assessment (River)	*Rapid IHI (Index of Habitat Integrity) tool developed Kleynhans (1996), Modified by DWAF*	(Ecoquat)	11.4
Ecological Importance & Sensitivity (EIS) Assessment (River)	*DWAF EIS tool developed by Kleynhans (1999)*	(Kleynhans, 1999)	11.7

3.3 Impact Assessment Methods

- The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined.
- The Impact significance was determined by the Risk Assessment Matrix. The assessment of the anticipated impacts on the watercourse were done using the Risk Matrix which is specified in the 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), 2016 (Notice 509). Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: the measurable characteristics of the impact (e.g. intensity, extent and duration),

the importance societies/communities place on the impact, and the likelihood / probability of the impact occurring.

- Actions are thereafter recommended to prevent and mitigate the identified impacts on aquatic habitat, in alignment with the mitigation hierarchy, as well as any measures necessary to restore disturbed areas or ecological processes.

3.4 Opportunities and Constraint Analysis

- Identify legislation and permit requirements that are relevant to the development proposal from an aquatic perspective.
- Determine limits of disturbance allowed instream and in the riparian area on both the upstream and downstream side of culverts in order to restrict negative impacts and risks associated with the maintenance.

4 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are relevant:

- The locations of the proposed infrastructure were extrapolated from maps provided by the client.
- It is assumed that the maintenance work will only occur within the road reserve, directly within, up and downstream of the culvert, and no further. There is to be no recontouring of the stream bed or alterations to the channel, bed or bank dimensions or morphology (excepting the proposed erosion control at Keisies River and Koo River bridges).
- Aquatic ecosystems vary both temporally and spatially. Once-off surveys such as this are therefore likely to miss certain ecological information due to seasonality, thus limiting accuracy and confidence. The watercourses in the area have a highly dynamic nature and a single site visit presents only a snapshot that is assessed within the broader context.
- Infield soil and vegetation sampling was only undertaken within a specific focal area around the proposed development, while the remaining watercourses were delineated at a desktop level with limited accuracy.
- No detailed assessment of aquatic fauna/biota was undertaken.
- The vegetation information provided is based on observation not formal vegetation plots. As such species documented in this report should be considered as a list of dominant and/or indicator wetland/riparian species and only provide a very general indication of the composition of the riverine vegetation communities.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor's

working knowledge and experience with similar development projects. The degree of confidence is considered good.

5 RESULTS AND FINDINGS

Following desktop assessment of the study area, infield site inspection of the watercourse crossings was undertaken along all of the listed road routes. The site assessments were not limited to those watercourses identified within the SNA Engineering report, but covered the entire length of the linear routes. The reach of each watercourse assessed was restricted to the crossing location, and areas directly up and downstream, which would be affected by any activities on the bridges and culverts.

All maintenance work is to be located within the road reserve and not all work requires encroachment into the river habitat at every location. The maintenance activities proposed at the Keisies River Bridge (near Montagu) and the Koo River Bridge have the highest risk of impacting the associated watercourses (due to the additional erosion protection work) and these are discussed in detail. The majority of maintenance work along the route does not require any significant alterations to the watercourses and the level of magnitude and nature of impacts will be shared. Therefore, due to similarities, not every crossing is described in detail below, but the results account for all aquatic habitats affected by the project.

Figure 41 below shows the location of the bridges identified in the SNA Engineering plans as requiring immediate maintenance work. The sections that follow are summaries of the aquatic habitat field assessment at these and the other river crossings.

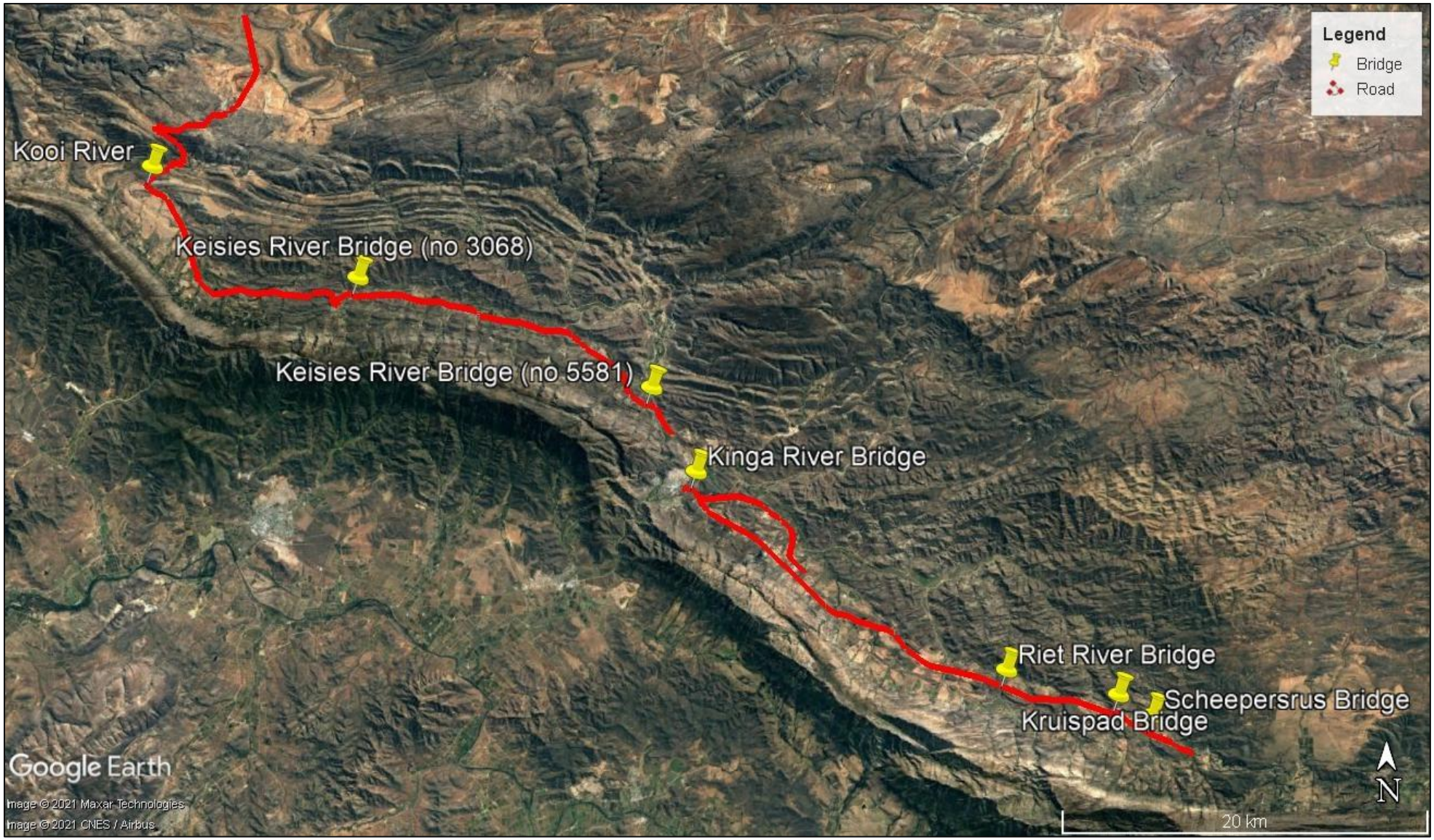


Figure 41: Google satellite map showing the location of the bridges identified for immediate maintenance work in relation to the sections of road north and south of Montagu

5.1 River crossings along Trunk Road 31/3 (Barrydale to Montagu)

Figure 42 below is a map showing the watercourse crossings along the southern section of Trunk Road 31/3 with select rivers described below.

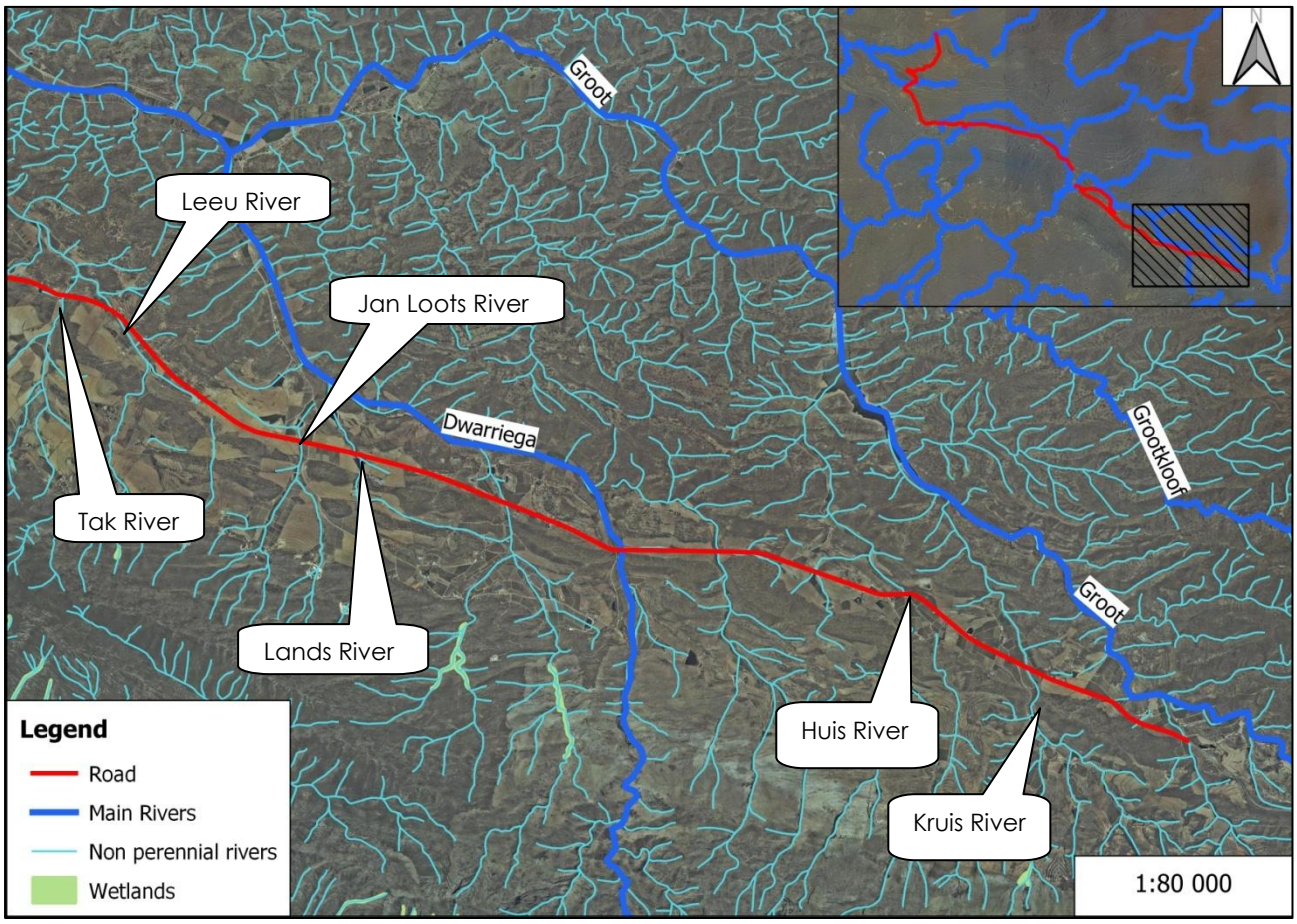


Figure 42: Map showing the watercourse crossings along the southern section of Trunk Road 31/3

5.1.1 Kruis River

Scheerpersrus Bridge is situated within the Kruis River and requires immediate maintenance (Figure 43). The river has intermittent flow over a bedrock substrate with a relatively gentle longitudinal gradient. It is surrounded by agricultural fields but a narrow riparian zone of thicket vegetation remains intact upstream. Alien invasive plant species such as Kikuyu grass and Gum trees have encroached into the river. There is evidence of active bank erosion which worsens downstream. The river can no longer erode down and therefore significant lateral erosion is occurring. Although erosion is part of the natural river dynamic, anthropogenic impacts may have initiated and maintained the degraded state. This could be a combined result of agricultural impacts and the angled bridge design causing incision. The short reach assessed is therefore is a poor ecological condition and falls within the 'D' PES category. No further degradation is likely to occur from the maintenance of the bridge (provided that the recommended mitigation measures and EMP are adhered to).

Figure 43: Photographs of the reach of the Kruis River assessed, directly upstream and downstream of the Scheerpersrus Bridge, which is proposed for immediate maintenance work

5.1.2 Huis River

The Kruispad Bridge is situated within the Huis River and requires immediate maintenance (Figure 44). The river has intermittent flow over a sandy substrate. The river has been subjected to fewer direct agricultural impacts and is densely vegetated largely with thicket species. Due to some flow alteration caused by the bridge there is a pocket of wetland habitat covered by *Phagmites australis* reeds. The maintenance work is unlikely to encroach into the wetland area as it is outside the road reserve. There is significant gully erosion within the catchment upslope which is resulting in sedimentation downstream as the river gradient lessens. The sediment is required to be cleared from the flow path below the bridge. The short reach assessed is slightly less modified and therefore falls within the 'C' PES category. No further degradation is likely to occur from the maintenance of the bridge (provided that the recommended mitigation measures and EMP are adhered to).

Figure 44: Photographs of the reach of the Huis River assessed due to proposed maintenance work on the Kruispad Bridge within it

5.1.3 Dwarriga River

The Dwarriga River Bridge is not proposed for immediate maintenance work but may require periodic maintenance in the future (Figure 45). The reach of river assessed has been subjected to a number of physical alterations. Upstream of the bridge there is a weir structure which would slow flows during flood events and reduce impacts upon the bridge infrastructure. It has trapped sediment from upslope resulting in the upstream reach having a cobble bed. Low flows are diffuse upon entering the culvert. Downstream the river has incised down to a flat bedrock channel and erosion protection measures have been installed to halt lateral erosion of the banks. The bridge has contributed to the erosion by initiating incision downstream due to the sudden drop of elevation at the culvert outlet and the the concentration of flow during flood events resulting in scouring from increased velocity of flows. Although the gabion walls on the bank have resulted in some lateral disconnection, the riparian zone of thicket vegetation remains intact. The short reach assessed is therefore is a poor ecological condition and falls within the 'D' PES category. No further degradation is likely to occur from the future maintenance of the bridge (provided that the recommended mitigation measures and EMP are adhered to).

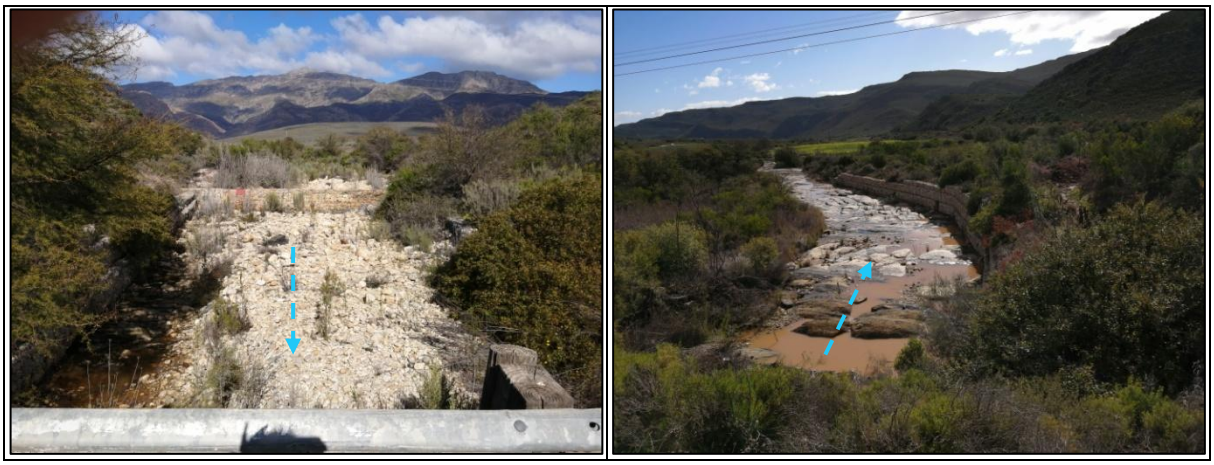


Figure 45: Photographs of the assessed reach of the Dwarriga River, directly upstream and downstream of the bridge, which may require future maintenance

Figure 47 below is a map showing the watercourse crossings along the northern section of Trunk Road 31/3, nearest to Montagu. Table 7 describes the Kinga River, which is largest river in this section.

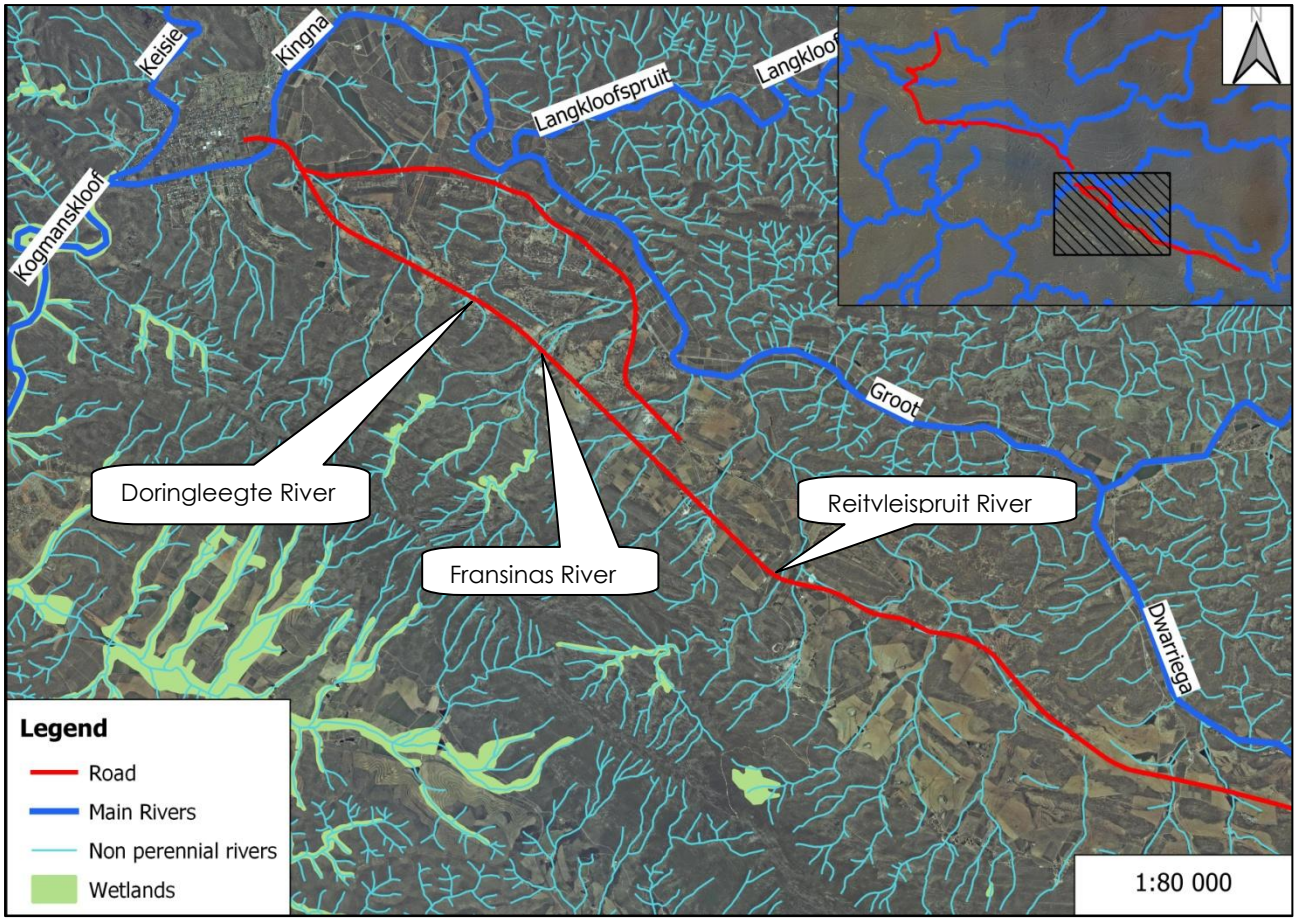
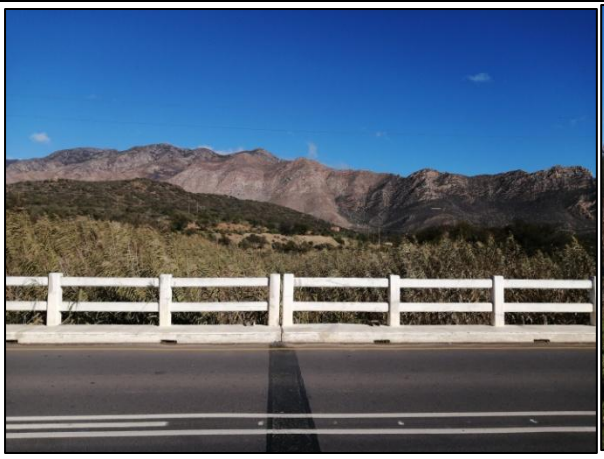
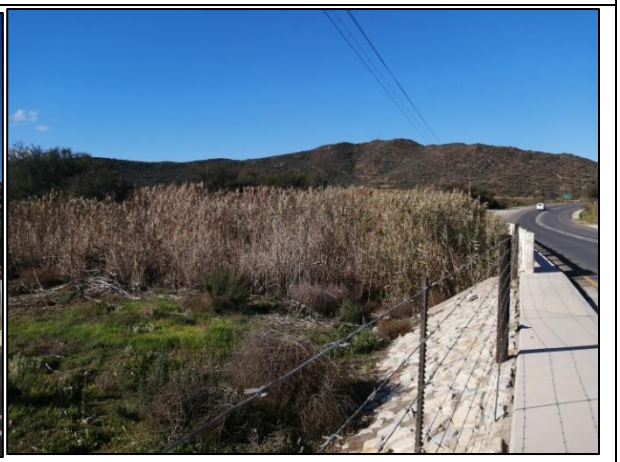


Figure 46: Map showing the watercourse crossings along the northern section of Trunk Road 31/3, nearest to Montagu

5.1.4 Kinga River

Table 7: Characteristics of the Kinga River on Trunk Road 31/3

River Name		**Kinga**
Quaternary catchment		H30B
Order		2
Flow		Perennial
Geomorphological zonation		Lower Foothills River
PES	**1999**	C – Moderately Modified
	2018	D – Largely Modified
EIS		Moderate
Ecosystem Threat Status		Endangered
Ecosystem Protection Level		Moderately Protected
Important ecosystems downstream		Kogmanshoof channelled valley bottom wetland
Management Objective		Recommended ecological category is C and future management of the system should strive to improve the ecological health, but for the purposes

	of this project it is sufficient that the status quo is maintained and no further degradation allowed due to the project.
Description of reach impacted	Unchannelled valley bottom wetland dominated by *Phragmites australis* surrounded by urban infrastructure. Receives significant amount of pollutants from stormwater runoff and a malfunctioning wastewater pump station. The banks are gentle and the bridge is easily accessible for maintenance activities. The vegetation is likely to naturally re-establish after any disturbances in this area. It is important that the gradient of the watercourse is not altered during maintenance (i.e. no humping or hollowing) to avoid initiating erosion.
	

5.2 Rivers on MR295 road within the Koo Valley

The main rivers along the MR295 road are the Koo River towards the north, Pietersfontein River, and the Keisies River (which is crossed by the road in two different locations) within the Koo Valley. In the southern-most section of this route, near the town of Montagu, the road crosses the Keisies River (Figure 48). This is one of the larger bridges of the project requiring additional erosion protection. It has been damaged by flood waters and requires immediate maintenance work. In the northern section of the route there is another crossing on the upper reaches of the Keisies River (Figure 49) which has also been identified for immediate maintenance work. Table 8 is a summary of the river characteristics for both reaches of the Keisies River t be affected by the project. Table 9 is a summary of the characteristics of the Pietersfontein River, which is not requiring immediate maintenance work, but will periodically in the future. The Koo Bridge is the northern-most structure detailed within the Engineering plan as requiring immediate work. As with the southern Keisies River crossing, the maintenance work needed on this bridge is more significant than most bridges and culverts. Table 10 summarises the characteristics of the Koo Bridge crossing.

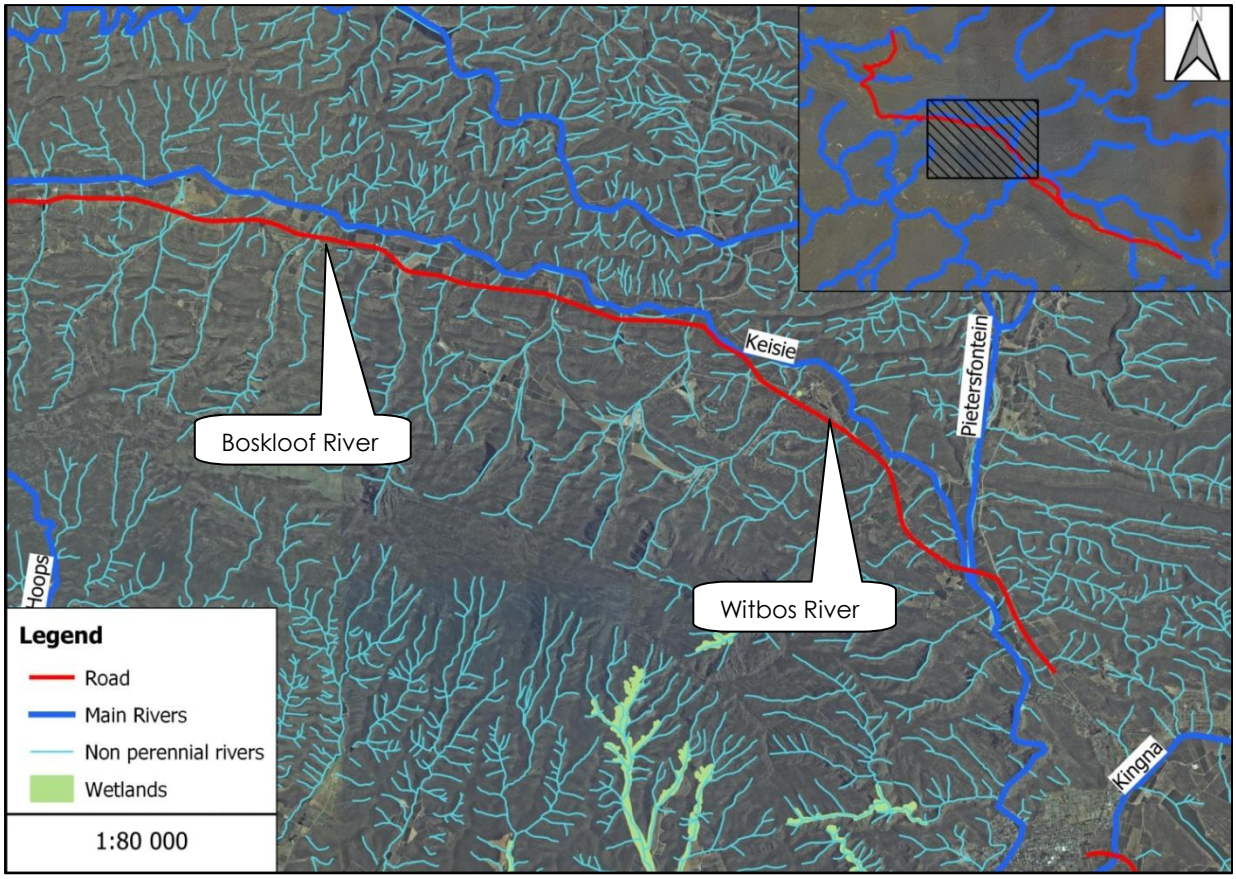


Figure 47: Map showing the watercourses along the southern section of the MR295 road (near Montagu), specifically the Keisies River Bridge

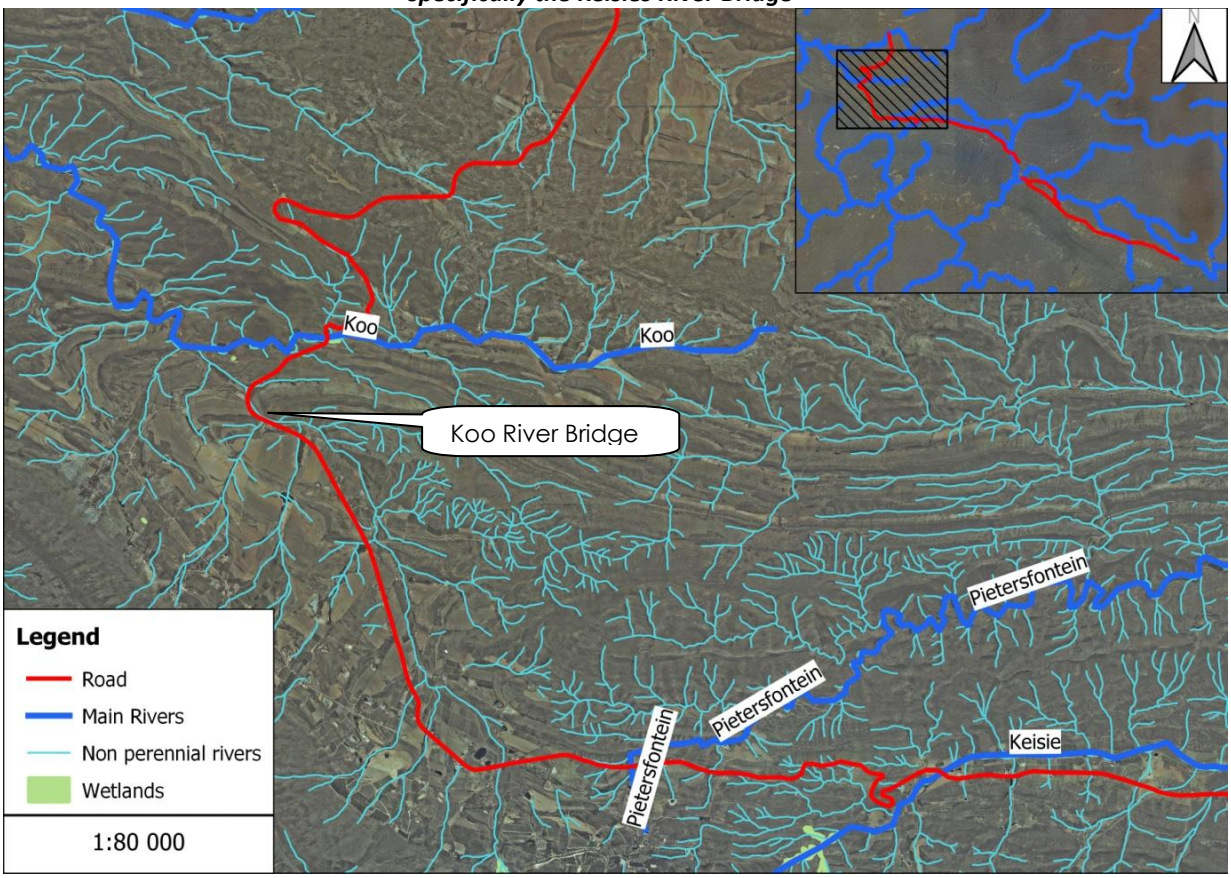
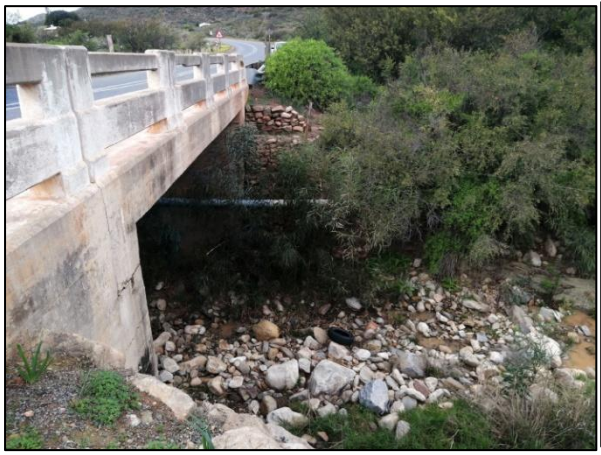


Figure 48: Map showing the watercourses along the northern section of the MR295 road (through the Koo Valley), specifically the Koo River Bridge

5.2.1 Keisies River

Table 8: Summary of the characteristics of the Keisies River

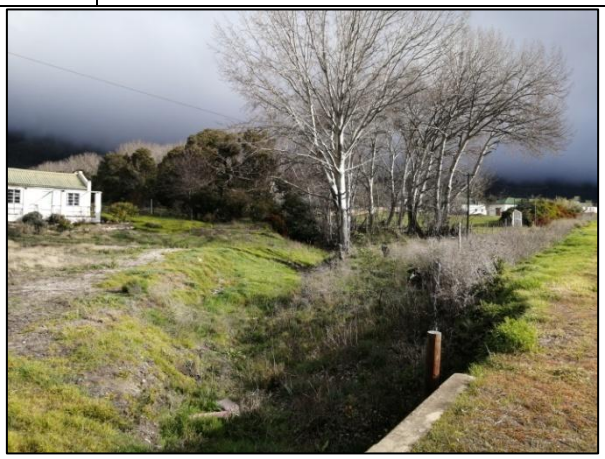
River Name		**Kiesie**
Quaternary catchment		H20D
Order		1
Flow		Perennial
Geomorphological zonation		Upper Foothills River
PES	**1999**	C – Moderately Modified
	2018	D – Largely Modified
EIS		Moderate – important for its provision of water from agriculture but ecologically degraded and there are no known endemic or sensitive species.
Ecosystem Threat Status		Endangered
Ecosystem Protection Level		Partially Protected
Management Objective		Recommended ecological category is C and future management of the system should strive to improve the ecological health, but for the purposes of this project it is sufficient that the status quo is maintained and no further degradation allowed due to the project
Description of reach impacted (Crossing 1 near Montagu town)		Non perennial lower foothills river with broad and shallow channel on a boulder and sand substrate. Loss of riparian zone and possible over abstraction in the catchment due to agriculture. Apart from the indigenous *Phagmites australis* within the river bed, the alien reed species *Arundo donax* is also present. *Arundo donax* can cause soil erosion within the narrow floodplain and channel incision (as these reeds are more robust compared to indigenous species and do not allow uniform flow during flood events). The loss of permanent flow within this system is likely from reduced inflow from the upper mountain areas where streams are captured and from over abstraction throughout the catchment. The degradation (from clearer areas and invasion of alien species) contributes drastically to flood damage. In this reach the changes have resulted in flash flooding which has impacted this bridge during periods of high rainfall.

	
Description of reach impacted (Crossing 2 in the Koo Valley)	Non perennial uplands river with a narrow boulder and cobble channel. Incised and eroding banks due to agricultural impacts as well as some alien invasive tree infestation. There has been a change in flow regime from perennial inundation to intermittent flows as a result of increased upslope water use and an increase in droughts.
	

5.2.2 Pietersfontein River

Table 9: Summary of the characteristics of the Pietersfontein River

River Name		**Pietersfontein River**
Quaternary catchment		H30C
Order		1
Flow		Ephemeral
Geomorphological zonation		Mountain stream
PES	**1999**	C – Moderately Modified
	2018	D – Largely Modified
EIS (of reach affected)		Low
Ecosystem Threat Status		Least Threatened
Ecosystem Protection Level		Well Protected
Management Objective		Recommended ecological category is D and future management of

	the system should strive to maintain the ecological health with no further degradation allowed due to the project.
Description of reach impacted	Road crossing is in the upper source zone of the river as it is diverted beneath the road through a box culvert. The channel has been modified for conflicting agricultural land uses and flow is intermittent. There is a moderate level of alien invasive infestation, largely from planted Oak and Poplar trees.
	

5.2.3 Koo River

Table 10: Summary of the characteristics of the Koo River Bridge crossing

River Name		**Koo River**
Quaternary catchment		H40B
Order		1
Flow		Perennial
Geomorphological zonation		Uplands river
PES	**1999**	C – Moderately Modified
	2018	D – Largely Modified
EIS (of reach affected)		Moderate
Ecosystem Threat Status		Endangered
Ecosystem Protection Level		Partially Protected
Management Objective		Recommended ecological category is C and future management of the system should strive to improve the ecological health, with no further degradation allowed due to the project.
Description of reach impacted		Road crossing is in the upper zone of the river as it.

5.3 Culverts

There are numerous minor watercourse crossings along the routes which are included within the maintenance plan (Figure 50).

Figure 49: Photographs of culvert structures along the road which require normal maintenance work, such as clearing the flow paths

6 IDENTIFIED IMPACTS

Aquatic ecosystems are particularly vulnerable to human activities and these activities can often result in irreversible damage or longer term, cumulative changes. The significance of an impact to the environment or ecosystem can only be assessed in terms of the change to ecosystem services, resources and biodiversity value associated with that system or component being assessed. The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined.

There will be direct physical disturbance to the river habitats as a result of the proposed maintenance activities. The operational phase activities (i.e. any future maintenance such as proposed) will involve the same impact upon the rivers as the currently proposed activities (construction phase). The impacts associated with the maintenance plan are unlikely to be of any significant threat to the freshwater habitat. The impacts associated with the project are identified as:

6.1 Disturbance of riparian vegetation

The disturbance or loss of aquatic vegetation and habitat refers to the direct physical destruction or disturbance of aquatic habitat caused by vegetation clearing, disturbance of riparian habitat, encroachment and colonisation of habitat by invasive alien plants. Indigenous aquatic vegetation and riparian zone species may be removed/ disturbed during construction activities such as machinery and workers on site. However, the maintenance activities will be restricted to the road reserve and the already disturbed areas. Although alien invasive vegetation has already established in the riparian habitat, individuals may encroach further into any disturbed areas. Alien invasive plant encroachment into disturbed areas can outcompete indigenous vegetation, cause erosion, and reduce aquatic biodiversity.

6.2 Erosion and sedimentation

Sedimentation and erosion refers to the alteration in the physical characteristics of rivers as a result of increased turbidity and sediment deposition, caused by soil erosion and earthworks that are associated with construction activities, as well as instability and collapse of unstable soils during project operation. These impacts can result in the deterioration of aquatic ecosystem integrity and a reduction/loss of habitat for aquatic dependent flora & fauna. Erosion and deposition are part of the natural dynamic of these systems. During flood events, the high velocity flows have the capacity to erode and a significant amount of sediment is transported by the rivers. However, between such events, the river is dominated by the deposition of sediment. The deposition of sediment, however,

has increased from the natural condition, due to sediment inputs from the change in land cover in the catchment (i.e. overgrazing). In the context of these larger river characteristics, the clearance of sediment and vegetation, within the road reserve and localised to certain crossings, will not alter the greater river dynamics. Measures must however consider the likelihood of high rainfall periods that may wash the mobile soils and construction materials downslope during construction.

6.3 Flow modification

Flow modification, such as impeding and diverting flows, refers to any direct alterations in the quantity, timing and distribution of water inputs and flows within a river. The indirect impacts will cause deterioration in aquatic ecosystem integrity, a reduction of habitat for aquatic dependant biota, and a reduction in the provisioning of ecosystem services.

The existing road and bridges have already modified the distribution of flows within the rivers. The footprint of the structures is not increasing, and the flows will not be permanently modified. However, in order to work on the infrastructure within the river bed (such as the abutments) temporary flow impedance or diversion may be required (depending on flow). Additionally, the clearance of sediment and vegetation upstream and downstream of culvert openings will have a localised impact upon flow pattern. However, during large flood events, such modifications will not alter the flow direction due to their magnitude.

6.4 Water Pollution

Water and/or soil pollution cause negative changes in the physical, chemical and biological characteristics of water resources (i.e. water quality). This can result in possible deterioration in aquatic ecosystem integrity and a reduction in, or loss of, species of conservation concern (i.e. rare, threatened/endangered species). Additionally, litter indirectly decreases the aesthetic value of the rivers. Hydrocarbons including petrol/diesel and oils/grease/lubricants associated with construction activities (machinery, maintenance, storage, handling) may potentially enter the systems by means of surface runoff or through dumping by construction workers. Raw cement entering the systems through incorrect batching procedure and/or direct disposal. The incorrect positioning and maintenance of the portable chemical toilets and use of the surrounding environment as ablution facilities may result in sewage and chemicals entering the systems. During maintenance of the structures there could be water pollution impacts similar to those encountered in the construction phase. However, this is highly unlikely to have any significant impact. The majority of the rivers are non-perennial in nature.

7 RISK MATRIX ASSESSMENT

The impact assessment was undertaken using the Risk Matrix which is specified in the Government Notice R509 of 2016 for section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA (1998). Determining if a water use licence is required is associated with the risk of impacting on the watercourse. A low risk of impact could be authorised in terms of a General Authorisations (GA). All of the activities associated with the proposed maintenance works have a low impact significance and Low risk rating (See Table 13 below).

The result of the risk assessment assumes that all of the recommended mitigation measures will be stringently implemented and monitored appropriately. Please see mitigation measures in the following section. There is to be no recontouring of the stream beds or alterations to the channel, bed or bank dimensions or morphology (excepting the plans for erosion protection in the Keisies River bed).

Therefore, after the adoption of the recommended mitigation measures, the activities will have a low impact upon aquatic habitat. The construction will be limited to certain activities within the road reserve and within previously disturbed habitat. No new impacts are anticipated, and most can be completely avoided. It is recommended that the proposed project be authorised under a General Authorisation (GA).

Table 11: Risk Matrix summary completed for the proposed maintenance activities on the road

PHASES	ACTIVITY	ASPECT	IMPACT	SEVERITY	CONSEQUENCE	LIKELIHOOD	SIGNIFICANCE	RISK RATING
CONSTRUCTION PHASE: Repairs and clearing	The clearance of vegetation at the river crossings, machinery and workers on site, for bridge repairs, all within the 100 yr floodline a of a river. This is unlikely to be necessary in all locations and will be very localised.	Loss and disturbance of aquatic habitat and colonisation of habitat by invasive alien plants.	There is potential for loss or disturbance of riparian zone vegetation during construction from machinery, vehicles and workers. The movement of topsoil and incorrectly placed stockpiles could bury aquatic habitat. Soil disturbance may lead to increased alien invasive species infestation and reduced aquatic biodiversity. However, the maintenance activities will be restricted to the road reserve and already disturbed areas.	1,75	5,75	9	51,75	LOW
OPERATIONAL PHASE: Maintenance	Maintenance activities similar to the construction phase.	Loss of aquatic habitat and reduced biodiversity	Although alien invasive vegetation has already established in the riparian habitat, individuals may encroach further into any disturbed areas. Alien invasive plant encroachment into disturbed areas can outcompete indigenous vegetation, cause erosion, and reduce aquatic biodiversity. On-going/frequent maintenance activities may promote the establishment of disturbance-tolerant biota including alien invasive species and decrease biodiversity.	1,25	5,25	10	52,5	LOW
CONSTRUCTION PHASE	Vegetation clearing and exposure of bare soils during construction will decrease the soil binding capacity and cohesion of the soils upslope and thus increase the risk of erosion and sedimentation downslope in the rivers.	Sedimentation and erosion	This may cause the burying of aquatic habitat and marginally sediment inputs. It could alter rivers geomorphology.	1,25	4,25	10	42,5	LOW
OPERATIONAL PHASE	Continued sedimentation from ongoing maintenance activities disturbing the river and altering the longitudinal and cross sectional profile.	Sedimentation and erosion from machinery	Where soil erosion problems and bank stability concerns initiated during the construction phase are not addressed, these can persist into the operational phase and have a negative impact downstream.	1,25	4,25	7	29,75	LOW
CONSTRUCTION PHASE	Potential pollution inputs into the river (such as hydrocarbons and raw cement). Hydrocarbons including petrol/diesel and oils/grease/lubricants associated with construction activities (machinery, maintenance, storage, handling) may potentially enter the system by means of surface runoff or through dumping by construction workers.	Water Pollution	These pollutants alter the water quality parameters such as turbidity, nutrient levels, chemical oxygen demand and pH. However, most systems are flow episodically only and this impact can be avoided easily. There is limited biota that would be affected.	1,25	6,25	9	56,25	LOW
OPERATIONAL PHASE	Maintenance activities similar to the construction phase.	Water Pollution	Water and/or soil pollution cause negative changes in the physical, chemical and biological characteristics of water resources (i.e. water quality). This can result in possible deterioration in aquatic ecosystem integrity and a reduction in, or loss of, species of conservation concern (i.e. rare, threatened/endangered species), but highly unlikely due to the non perennial nature of the rivers.	0,75	5,75	9	51,75	LOW
CONSTRUCTION PHASE	Temporary work within the riparian habitat and river channel may require that water be impeded/diverted during construction. Also, clearance of debris within culverts is proposed. At present, this is not anticipated to be necessary at every crossing during the maintenance and will not be required if the rivers are not flowing.	Flow modification for dewatering or diversions	The existing road and bridges have already modified the distribution of flows within the river. The footprint of the structures is not increasing, and the flows will not be permanently modified. However, in order to work on the infrastructure within the river bed (such as the abutments) temporary flow impedance or diversion may be required (depending on flow).	1,25	6,25	9	56,25	LOW
OPERATIONAL PHASE	Maintenance activities similar to the construction phase.	Flow modification	The clearance of sediment and vegetation in culvert openings will have a localised impact upon flow pattern However, during large flood events, such modifications will not alter the flow direction due to their magnitude.	0,75	5,75	9	51,75	LOW

8 MITIGATION MEASURES

The mitigation of negative impacts on biodiversity and ecosystem goods and services is a legal requirement for authorisation purposes and must take on different forms depending on the significance of the impact and the specific area being affected. Mitigation requires the adoption of the precautionary principle and proactive planning that is enabled through a mitigation hierarchy. Its application is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity (DEA 2013).

The mitigation measures detailed below must be taken into consideration during financial planning of the construction phase of the project. This to ensure that sufficient funds are available to implement all the measures required to maintain the current PES scores. Any potential risks must be managed and mitigated to ensure that no deterioration to the water resources takes place. Standard management measures should be implemented to ensure that any on-going activities do not result in a decline in water resource quality. Consideration should also be given to the rehabilitation of watercourses where feasible.

The monitoring of the activities is essential to ensure the mitigation measures are implemented. Therefore, compliance with the mitigation recommendations must be monitored by a suitably qualified individual. Monitoring for non-compliance must be done on a daily basis by the contractors. Photographic records of all incidents and non-compliances must be retained. This is to ensure that the impacts on the aquatic habitat are adequately managed and mitigated against and the successful rehabilitation of any disturbed areas within any system occurs.

8.1 Conditions of Authorisation

- Comply with the conditions of authorisation in the GA (Government Notice R509 of 2016), detailed in Annexure 12, for section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA (1998).

8.2 Construction footprint

- Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas. Any unnecessary intrusion into these areas is prohibited. Where intrusion is required, the working corridor must be kept to a minimum and identified and demarcated clearly before any construction commences to minimise the impact.

- Where temporary access roads/footpaths may be required, the following needs to be considered:
  - Preferably utilise existing access paths or access through disturbed/invaded vegetation before considering the clearing of vegetation.
  - Access roads must be one-way, limited to 4m width and adequate turning areas outside of the riparian areas may need to be identified and demarcated in conjunction with the ECO.
- All aquatic habitats outside of the demarcated construction area must be considered 'No-Go' areas for the duration of the construction phase.

8.3 Diversions and dewatering

- Where construction is to take place within a river channel, if flowing, temporary diversions may need to be put in place to temporarily divert water away from activities and ensure a dry work area.
- Any diversions must be temporary in nature and no permanent walls, berms or dams may be installed within the rivers. Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns.
- Where possible, construction activities should be conducted during the drier months of the year to minimise the possibility of erosion, sedimentation and transport of suspended solids associated with disturbed areas and rainfall events. Planning for such a situation must be undertaken.

8.4 Sedimentation

- Sedimentation must be minimised with appropriate measures. Silt fences must be cleaned regularly to be effective (when de-silting takes place silt must not be returned to the watercourse).
- Construction must have contingency plans for high rainfall events during construction.
- Erosion control measures including silt fences, low soil berms and/or shutter boards must be put in place around the stockpiles to limit sediment runoff from stockpiles.
- Excavated rock and sediments from the construction zone, and including any foreign materials, should not be placed within the delineated rivers and riparian areas in order to reduce the possibility of material being washed downstream.
- Stockpiling should be restricted to level areas safe from flood prone areas.

8.5 Waste

- The solid domestic waste must be removed and disposed of offsite. All post-construction building material and waste must be cleared in accordance with the EMPr.
- Spoil material must not be pushed down slope or discarded on site. The build-up of debris/sediment removed from a maintenance site may be utilised for the purpose of in-filling or other related maintenance actions related to managing erosion if in accordance with the MMP, but not to be used to enlarge the height, width or any extent of existing berms or deposited anywhere within the watercourse or anywhere along the banks of a watercourse where such action is not part of the proposed maintenance activity. Material that cannot be used for maintenance purposes must be removed out of the area to a suitable stockpile location or disposal site.
- The use of foreign material, such as concrete, rubble, woody debris and/or dry land-based soil, is strictly prohibited from being used in maintenance actions, unless for the specific purpose of repairs to existing infrastructure, coupled with appropriate mitigation measures.

8.6 Vegetation

- Clearing of riparian vegetation should be kept to a minimum. When practicable, prune or top the vegetation instead of grubbing/uprooting.
- Bare areas must be covered with geotextiles or revegetated to prevent sediments eroding into the watercourses. Remove any alien plant species within the working corridor. Where large gaps in the riparian areas have resulted (i.e. where indigenous vegetation has been replaced by dense alien plant infestations), it is recommended that cover components be reinstated appropriately. Only indigenous species are to be considered.
- It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas. Any use of herbicides in removing alien plant species is required to be investigated by the ECO before use, for the necessity, type proposed to be used, effectiveness and impacts of the product on aquatic biota.
- Rubble is often placed aside during construction and never removed. It buries habitat and alters the sediment composition of the area, allowing alien plants to encroach.

8.7 Pollutants

- Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from stormwater.

- Cement/concrete batching is to be located in an area of low environmental sensitivity away from the river channels and pre-approved by the ECO. No batching activities shall occur on unprotected ground. Adequate surface protection will be required. Concrete batching should be restricted to a level and bunded/sealed surface above the riverbanks.
- If any concrete, cast-in-place concrete, or grouting works are to be undertaken, a high potential exists for concrete and/or concrete leachate to enter the watercourse. Concrete, concrete leachate, grout and other uncured concrete substances (e.g. concrete bags for headwall construction) are highly toxic to aquatic organisms. To perform any concrete-related works, all water must be completely isolated prior to the commencement of any instream works. In addition, measures must be taken to prevent the incidence of concrete from entering a watercourse for a minimum of 48 hours after the works have been completed. This is to ensure that the concrete has fully cured.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.

8.8 Rehabilitation

- All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated immediately to the satisfaction of the ECO.
- The longitudinal gradient must not be altered in a way that results in erosion downstream or impoundment of flows upstream. The cross sectional profile of the bed and banks must also be restored as far as possible.

8.9 Monitoring

- A monitoring programme shall be in place, not only to ensure compliance with the EMPr throughout the construction phase, but also to monitor any post-construction environmental issues and impacts. The monitoring should be regular and additional visits must be taken when there is potential risk to aquatic habitat.
- Monitoring for non-compliance must be done on a daily basis by the contractors. Photographic records of all incidents and non-compliances must be retained. Monitoring should especially focus on preventing water pollution, erosion, and sedimentation. Also consult WET-RehabEvaluate (Cowden and Kotze, 2009) and the river rehabilitation manual developed by Day *et al.* 2016 for further information.
- Any contractors found working inside the 'No-Go' areas should be fined as per a fining schedule/system setup for the project.

9 CONCLUSION

It was determined that the proposed project has the potential to impact upon the biota, flow pattern, vegetation, morphology and water quality of the identified rivers. During maintenance activities there is potential for impacts such as habitat disturbance from sediment removal and vegetation clearance and water pollution due to chemicals/ cement entering freshwater habitat. However, some impacts are temporary in nature or limited in extent.

The potential significance of these impacts was assessed using the Risk Matrix which is specified in the Government Notice R509 of 2016 for section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA (1998). The result of the assessment was that the proposed road maintenance activities will have a LOW risk to aquatic habitat, after mitigation is applied. The mitigation must be included in the EMPr and its implementation strictly monitored. Therefore, under the conditions detailed within this report, it is recommended that the project be registered under GA.

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11 ANNEXURE (METHODOLOGIES)

11.1 Delineation of Riparian Areas

Riparian zones are described as "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 areas" i , Riparian zones can be thus be distinguished from adjacent terrestrial areas through their association with the physical structure (banks) of the river or stream, as well as the distinctive structural and compositional vegetation zones between the riparian and upland terrestrial areas (Figure 8). Unlike wetland areas, riparian zones are usually not saturated for a long enough duration for redoxymorphic features to develop. Riparian zones instead develop in response to (and are adapted to) the physical disturbances caused by frequent overbank flooding from the associated river or stream channel.

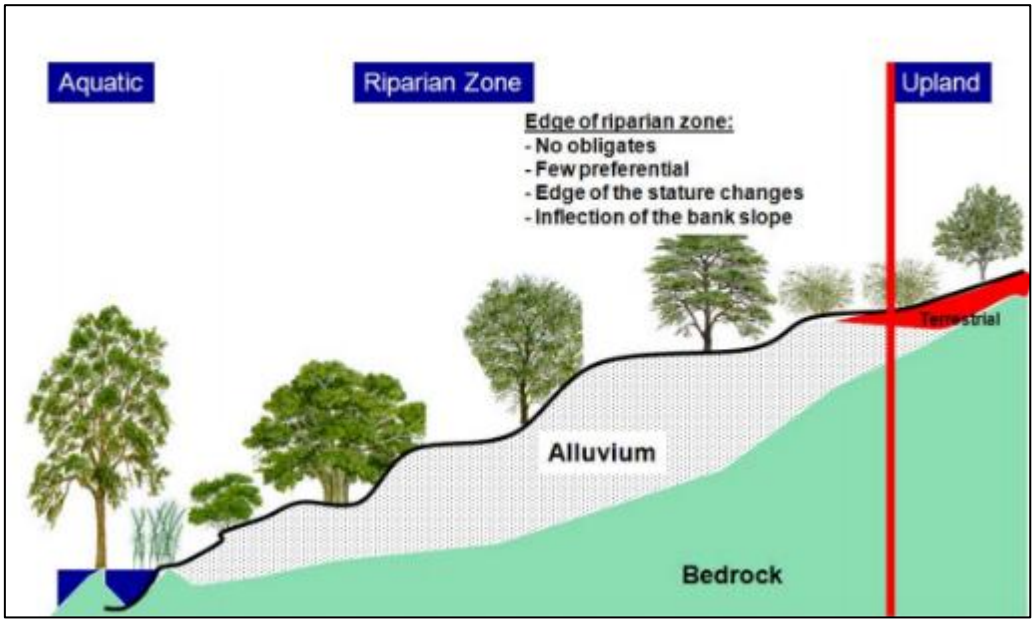
Like wetlands, riparian areas can be identified using a set of indicators. The indicators for riparian areas are: - **Landscape position**; - Alluvial soils and recently deposited material; - **Topography** associated with riparian areas; and - **Vegetation** associated with riparian areas. Landscape Position As discussed above, a typical landscape can be divided into 5 main units, namely the: - Crest (hilltop); - Scarp (cliff); - Midslope (often a convex slope); - Footslope (often a concave slope); and - Valley bottom. Amongst these landscape units, riparian areas are only likely to develop on the valley bottom landscape units (i.e. adjacent to the river or stream channels; along the banks comprised of the sediment deposited by the channel). Alluvial soils are soils derived from material deposited by flowing water, especially in the valleys of large rivers. Riparian areas often, but not always, have alluvial soils. Whilst the presence of alluvial soils cannot always be used as a primary indicator to accurately delineate riparian areas, it can be used to confirm the topographical and vegetative indicators. Quaternary alluvial soil deposits are often indicated on geological maps, and whilst the extent of these quaternary alluvial deposits usually far exceeds the extent of the contemporary riparian zone; such indicators are useful in identifying areas of the landscape where wider riparian zones may be expected to occur.

Topography and recently deposited material associated with riparian areas The National Water Act definition of riparian zones refers to the structure of the banks and likely presence of alluvium. A good indicator of the presence of riparian zones is the presence of alluvial deposited material adjacent to the active channel (such as benches and terraces), as well as the wider incised "macro-channels" which are typical of many of southern Africa's eastern seaboard rivers. Recently deposited

alluvial material outside of the main active channel banks can indicate a currently active flooding area; and thus the likely presence of wetlands. Vegetation associated with riparian areas unlike the delineation of wetland areas, where redoxymorphic features in the soil are the primary indicator, the identification of riparian areas relies heavily on vegetative indicators. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs: - in species composition relative to the adjacent terrestrial area; and - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure and/or numbers of individual plants.

As with the delineation approach for wetlands, the field delineation method for riparian areas focuses on two main indicators of riparian zones: - **Vegetation Indicators**, and - **Topography** of the banks of the river or stream.

Additional verification can be obtained by examining for any recently alluvial deposited material to indicate the extent of flooding and thus obtain at least a minimum riparian zone width. The following procedure should be used for delineation of riparian zones: A good rough indicator of the outer edge of the riparian areas is the edge of the macro channel bank. This is defined as the outer bank of a compound channel, and should not be confused with the active river or stream channel bank. The macro-channel is an incised feature, created by uplift of the subcontinent which caused many rivers to cut down to the underlying geology and creating a sort of “restrictive floodplain” within which one or more active channels flow. Floods seldom have any known influence outside of this incised feature. Within the macro-channel, flood benches may exist between the active channel and the top of the macro channel bank. These depositional features are often covered by alluvial deposits and may have riparian vegetation on them. Going (vertically) up the macro channel bank often represents a dramatic decrease in the frequency, duration and depth of flooding experienced, leading to a corresponding change in vegetation structure and composition.



A schematic diagram illustrating the edge of the riparian zone on one bank of a large river. (DWAF 2008)

11.2 Present Ecological State (PES) – Riparian

Habitat is one of the most important factors that determine the health of river ecosystems since the availability and diversity of habitats (in-stream and riparian areas) are important determinants of the biota that are present in a river system (Kleynhans, 1996). The 'habitat integrity' of a river refers to the "maintenance of a balanced composition of physic-chemical and habitat characteristics on a temporal and spatial scale that are comparable to the characteristics of natural habitats of the region" (Kleynhans, 1996). It is seen as a surrogate for the assessment of biological responses to driver changes.

DWAF have developed a modified IHI, designed to accommodate the time constraints associated with desktop assessments or for instances where a rapid assessment of river conditions is required. The protocol does not distinguish between instream and riparian habitat and addresses six simple metrics to obtain an indication of Present Ecological State (PES). Each of the criteria are rated on a scale of 0 (close to natural) to 5 (critically modified) according to the following metrics:

- Bed modification
- Flow modification
- Inundation
- Bank condition
- Riparian zone condition
- Water quality modification

This assessment was informed by (i) a site visit where potential impacts to each metric were assessed and evaluated and (ii) an understanding of the catchment feeding the river and landuses /

activities that could have a detrimental impact on river ecosystems.

The rating scale for each of the various metrics in the assessment

RATING SCORE	IMPACT CLASS	DESCRIPTION
0	**None**	*No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.*
0.5 - 1.0	**Low**	*The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.*
1.5 - 2.0	**Moderate**	*The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.*
2.5 - 3.0	**Large**	*The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.*
3.5 - 4.0	**Serious**	*The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.*
4.5 - 5.0	**Critical**	*The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.*

The six metric ratings of the HGM under assessment are then averaged, resulting in one value. This value determines the Habitat Integrity PES category for the HGM (Table A11.6b).

Table A11.6b: The habitat integrity PES categories

HABITAT INTEGRITY PES CATEGORY	DESCRIPTION
A: Natural	Unmodified, natural.
B: Good	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: Fair	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D: Poor	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E: Seriously modified	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F: Critically modified	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.

11.3 Ecological Importance & Sensitivity – Riparian

The ecological importance of a wetland/river is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from

disturbance once it has occurred (resilience) (Kleynhans & Louw, 2007; Resh et al., 1988; Milner, 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity (Table A11.7a).

Table A11.7a: Components considered for the assessment of the ecological importance and sensitivity of a riparian system. An example of the scoring has also been provided.

Ecological Importance and Sensitivity assessment (Rivers)		
Determinants		**Score (0-4)**
BIOTA (RIPARIAN & INSTREAM)	Rare & endangered (range: 4=very high - 0 = none)	0,5
	Unique (endemic, isolated, etc.) (range: 4=very high - 0 = none)	0,0
	Intolerant (flow & flow related water quality) (range: 4=very high - 0 = none)	0,5
	Species/taxon richness (range: 4=very high - 1=low/marginal)	1,5
RIPARIAN & INSTREAM HABITATS	Diversity of types (4=Very high - 1=marginal/low)	1,0
	Refugia (4=Very high - 1=marginal/low)	1,5
	Sensitivity to flow changes (4=Very high - 1=marginal/low)	1,0
	Sensitivity to flow related water quality changes (4=Very high - 1=marginal/low)	1,0
	Migration route/corridor (instream & riparian, range: 4=very high - 0 = none)	1,0
	Importance of conservation & natural areas (range, 4=very high - 0=very low)	2
MEDIAN OF DETERMINANTS		1,00
ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS)		**LOW, EC=D**

The scores assigned to the criteria in Table A11.7a were used to rate the overall EIS of each mapped unit according to Table A11.7b, below, which was based on the criteria used by DWS for river eco-classification (Kleynhans & Louw, 2007) and the WET-Health wetland integrity assessment method (Macfarlane et al., 2008).

Table A11.7b: The ratings associated with the assessment of the EIA for riparian areas

RATING	EXPLANATION
None, Rating = 0	Rarely sensitive to changes in water quality/hydrological regime
Low, Rating =1	One or a few elements sensitive to changes in water quality/hydrological regime
Moderate, Rating =2	Some elements sensitive to changes in water quality/hydrological regime
High, Rating =3	Many elements sensitive to changes in water quality/ hydrological regime
Very high, Rating =4	Very many elements sensitive to changes in water quality/ hydrological regime

12 ANNEXURE: Conditions for impeding or diverting the flow of water or altering the bed, banks, course or characteristics of a watercourse (Government Notice R509 of 2016)

9.

(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 in this General Authorisation, 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 in this General Authorisation.

(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 (~~this is not possible as the entire valley floor through the poort will be within the floodline. However, the abovementioned activities must be located in areas outside of riparian habitat and as far as possible, such as at rest stops)

(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; (~~this is not possible for this project as some work is on the existing bridges that are located near bends in the river)

(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.

(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.

(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:

(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.

(4) 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.

13 SPECIALIST CV

Debra Jane Fordham

Aquatic Ecologist working in George at Sharples Environmental Services cc as a specialist consultant and managing water use licensing applications (WULAs). Debbie holds a M.Sc. degree in Environmental Science from Rhodes University, by thesis, entitled: The geomorphic origin and evolution of the Tierkloof Wetland, a peatland dominated by *Prionium serratum* in the Western Cape.

Debbie has conducted many aquatic habitat assessments and rehabilitation plans of various spatial and temporal scales, in numerous locations within South Africa. These assessments include wetland, river, and estuary health assessments, rehabilitation plans, water quality analysis, monitoring recommendations, and generally compiling reports that clearly convey the findings and contribute to future management. She has also completed Water Use License Applications, Basic Assessment Reports and Environmental Management Plans. Debbie is highly proficient with GIS mapping software and incorporates spatial analysis in all assessments.

Key skills:

- Desktop mapping and infield assessment for wetland/ riparian habitat delineation
- Assessment of wetland and riparian functional importance (EIS) and Present Ecological State (PES) now including the WET-Health V2 tool, amongst others.
- Evaluating impacts to wetland and riparian systems from proposed developments
- Identifying mitigation measures and developing monitoring and rehabilitation plans
- WULA, EIA and BAR Applications
- ArcGIS V10, QGIS 2.18, CoralDraw X4, Strater V3, Statistica V9, MSOffice

Tertiary Education at Rhodes University, South Africa:

M.Sc. Environmental Science

Master of Science degree, by thesis, entitled:
The geomorphic origin, evolution and collapse of a peatland dominated by Prionium serratum: a case study of the Tierkloof Wetland, Western Cape.(Supervised by Prof. Fred Ellery)

BA Honours – Environmental Science

Honours Dissertation: The status and use of Aloe ferox. Mill in the Grahamstown commonage, South Africa. (Supervised by Prof. Sheona Shackleton)

Honours Subjects

- Wetland Ecology
- Environmental Water Quality /Toxicology
- Environmental Impact Assessment (EIA)
- Biodiversity, Non-Timber Forest Products (NTFPs) and Rural Livelihoods
- Statistics

BA Degree – Environmental Science and Geography

Current position: Aquatic Ecologist and WULA Manager

Sharples Environmental Services cc: 2016/08/10 - Present

Debbie fulfils the specific requirements of each project with regards to the relevant aquatic legislation, such as conducting aquatic habitat impact reports and Water Use Licence Applications (WULAs). This mostly requires undertaking ground-truthing, classification, infield identification, delineation, impact assessment and mapping of aquatic ecosystems. SES conduct Present Ecological State (PES), functional importance assessments and Ecological Importance and Sensitivity (EIS) assessments of aquatic ecosystems. She conducts environmental impact and environmental sensitivity (constraints) assessments on aquatic habitats to determine if they are at risk of being impacted upon by proposed development areas during construction and operational phases of development. Including identifying direct, indirect, and cumulative impacts that proposed developments will have on aquatic habitats and the significance of these impacts and recommend actions that should be taken to prevent impacts on aquatic habitats. She also determines and maps No-Go and buffer zones utilising professional knowledge and buffer zone guidelines for rivers, wetlands and estuaries.

Publications and memberships:

Bekker, D. J. & Shackleton, S. 2010. The status and use of *Aloe ferox Mill*. in the Grahamstown commonage. Policy Brief, Rhodes University

- Professional Wetland Scientist applicant with SWS
- Southern Cape Wetland Society (SCWS)
- South African Wetlands Society (SAWS)
- Freshwater Ecosystem Network (FEN)
- Southern African Association of Geomorphologists (SAAG)
- DWAF accredited wetland delineation

Recent Aquatic Impact Assessment Projects:

- *Installation of A Water Pipeline from An Existing Borehole to The Herbertsdale Reservoir, Mossel Bay Municipality*
- *Unauthorised Clearance of Vegetation and Construction of a Dam on Farm Angeliersbosch Re/157, Prince Albert*
- *Rehabilitation of The Excavation of a Channel Within the Brandwag River, On the Remainder of Farm Bowerf 161, Brandwacht, Mossel Bay*
- *Rehabilitation Plan for activities On A Portion of Remainder Portion 104 Of the Farm Modder Rivier No 209, George*
- *Aquatic Impact Assessment for The Proposed Extension of Walvis Street, Mossel Bay*
- *Rehabilitation Plan for the transformation of agricultural land to commercial land on Farm Re 109/209, George*
- *Aquatic assessment for the proposed Dana Bay Access Road, near Mossel Bay*
- *Invasive Alien Plant Control Plan for New Horizons Mixed-Use Development on Farm Hillview No. 437, Plettenberg Bay*
- *Cemetery expansion on Erf 566 and 480, Melkhoutfontein*
- *The expansion of Goue Akker Cemetery in Beaufort West*

- *Construction of a bulk sewerage pipeline from Green Valley township, Wittedrift, to the Plettenberg Bay WWTW*
- *Periodic Maintenance of Trunk Road 31- Barrydale To Ladismith (Km 30.89 To Km 76.06), Western Cape Province*
- *Expansion of the Gansbaai Sand en Klip Quarry*
- *Seven Oaks Residential Development, Wittedrift, Plettenberg Bay*
- *Gran Sasso Quarry water abstraction and proposed construction of a road crossing a watercourse, Tygervalley, Cape Town*
- *Maintenance of Trunk Road 33/4 and Trunk Road 34/2, though Meiringspoort, Western Cape Province*
- *Proposed Waste Water Treatment Works, Irrigation Activities & Effluent Discharge by Parmalat SA (Pty) Ltd, Bonnievale*
- *Development of Remainder of Erf 562 Kurland, Plettenberg Bay*
- *Ladismith Cheese Water Use Application*
- *Construction of A 22kv Overhead Powerline, near Humansdorp, Eastern Cape*
- *Development of Herold's Bay Country Estate on A Portion of Portion 7 Of Farm Buffelsfontein No. 204, Herold's Bay*
- *Groot Witpan and Konga Pan salt mining, Northern Cape*
- *Gemsbok Horn salt pan mine prospecting*
- *Hartenbos Estuary Habitat Integrity Assessment with Fish Survey and water quality analysis*
- *The proposed Aalwyndal Precinct Plan Development: Biodiversity Component*
- *Tweekuilen Estuary Habitat Integrity Assessment with Fish Survey*
- *Residential Development on Portion 3 of Kraaibosch 195, George*

END