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DRAFT BASIC ASSESSMENT REPORT

**CONSTRUCTION OF THE P303 PIPE CULVERTS AND BRIDGE
EDUMBE LOCAL MUNICIPALITY**

THE KWAZULU-NATAL DEPARTMENT OF TRANSPORT

EIA REF NO: DC26/0006/2019



KZN DoT



EVP1154

This report was prepared by EnviroPro Environmental Consulting in terms of Appendix 1 to GNR 982

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Executive Summary

The KwaZulu-Natal Department of Transport (DoT) propose to construct one (1) bridge (along a new alignment) and replace two (2) culverts along the P303 road, within Ward 1 of the eDumbe Local Municipality. The existing bridge structure at river crossing (RC) 3 will be repaired. The structures are located approximately 11.6km west of Paulpietersburg (as the crow flies) at the following RC locations, RC1: 27°24'43.15"S; 30°41'54.68"E, RC2: 27°24'42.61"S; 30°41'10.08"E, RC3: 27°24'45.30"S;30°40'38.64"E, and RC4: 27°24'33.93"S;30°40'0.48"E. RC1 crosses a tributary of the Mpipambi River whereas RC2-4 crosses tributaries of the Bazangoma River. Existing structures are severely damaged and will be replaced. Existing structures at RC1-2 are severely damaged and will each be upgraded to 1 x 1200mm pipe culverts whereas a bridge will be constructed along a new alignment at RC4. The bridge will consist of a three (3) span pre-stressed concrete beam and reinforced concrete slab deck simply supported on reinforced concrete abutments and piers with piled foundations.

The following key impacts and mitigation measures were assessed:

- **Damage to the tributaries of Bazangoma and Mpipambi Rivers due to construction activities:** Caution must be exercised when working near and within the tributaries of the Bazangoma and Mpipambi Rivers. Construction materials must be stockpiled more than 32m from the Bazangoma and Mpipambi Rivers. Heavy vehicles must be kept at least 32m away from the Bazangoma and Mpipambi Rivers except where needed for the construction process. The footprint of the bridge and culverts must not be widened more than is necessary.
- **Encroachment of alien vegetation into areas disturbed during the upgrade:** Alien vegetation must not be allowed to encroach onto the sites and must be continually removed during construction. Construction must not promote further alien plant disturbances in the surrounding area.
- **Damage to surrounding properties, services, and businesses:** The construction activities could disrupt access along the P303 Road. All services must be identified prior to construction and all stakeholders must be notified prior to any service disruptions.
- **Improved safety and connectivity:** The structures that are in place are constantly overtopped with water. Therefore, the new structures will be optimally designed to ensure that the new structures are not overtopped. This will allow pedestrians and vehicles to utilize these crossings even during high rainfall events.

These impacts can be mitigated by following the recommendations in this report and EMP. Construction activities will be monitored and controlled through the implementation of the Environmental Management Programme (EMP).

No additional site alternatives were considered for RC1-2 as positioning the crossing structures upstream or downstream of the existing crossing point would also result in the transformation of previously undisturbed areas therefore, there is only one preferred site location for the two culverts. The site alternative for RC4 is the preferred location due to the proposed P303 road realignment. Design alternatives have been assessed, namely the construction of box culverts at RC1, 2, and 4 however, the preferred designs (1x1200mm pipe culverts each at RC1-2 and the bridge at RC4) was the preferred design due to the cost and suitability of the structures at each crossing point.

Taking into consideration the above impacts and mitigation measures, it is the EAP's opinion that there are no significant environmental impacts associated with the proposal which cannot be mitigated. Therefore, it is recommended that the preferred site and technology alternative 1 be authorised for the one bridge and two culverts along the P303 road.

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Section 1: Scope of Work and Location of Activity

1.1 Project Title

Construction of the P303 Pipe Culverts and Bridge.

1.2 A Description of the Activities to Be Undertaken Including Associated Structures and Infrastructure As per Section 3(d) (ii)

The KwaZulu-Natal Department of Transport (DoT) propose to construct one (1) bridge (along a new alignment) and replace two (2) culverts along the P303 road, within Ward 1 of the eDumbe Local Municipality. The existing bridge structure at river crossing (RC) 3 will be repaired. The structures are located approximately 11.6km west of Paulpietersburg (as the crow flies) at the following RC locations, RC1: 27°24'43.15"S; 30°41'54.68"E, RC2: 27°24'42.61"S; 30°41'10.08"E, RC3: 27°24'45.30"S;30°40'38.64"E, and RC4: 27°24'33.93"S;30°40'0.48"E. RC1 crosses a tributary of the Mpipambi River whereas RC2-4 crosses tributaries of the Bazangoma River. Existing structures are severely damaged and will be replaced. Existing structures at RC1-2 are severely damaged and will each be upgraded to 1 x 1200mm pipe culverts whereas a bridge will be constructed along a new alignment at RC4. The bridge will consist of a three (3) span pre-stressed concrete beam and reinforced concrete slab deck simply supported on reinforced concrete abutments and piers with piled foundations. Figures 1-7 below illustrate the locality and provide an overview of the proposed development (Additional locality maps have been attached as appendix A).

The watercourse crossing structures at RC1 and RC2 will each comprise of 1x1200mm diameter concrete pipe culverts. The culverts will be supported by an inlet and headwall on either side of the road. Gabion Baskets may be constructed for additional protection at each of the crossing points if required. The existing structure at RC3 will be repaired. Please see the table below describing the structures to be constructed:

Crossing Structure	Culvert Type	Width	Length	Height	Area (m ²)	Volume (m ³)
RC1	1x1200mm (pipe)	4.96m	8m	1.8m	39.68	71.42
RC2	1x1200mm (pipe)	4.96m	8m	1.8m	39.68	71.42
TOTAL					79.36	142.84

The proposed 1x1200mm (RC1 and RC2) pipe culverts will comprise:

- Wing walls downstream and upstream on either side of the watercourses. Compacted backfill will be placed between the walls;
- The approaches will be backfilled with selected material; and
- Gabion Baskets will be constructed for additional protection at the crossing points where required.

The proposed Bridge (RC4) will be a three (3) span pre-stressed concrete beam and reinforced concrete slab deck simply supported on reinforced concrete abutments and piers with piled foundations. The Department of Transport proposes to construct the Bridge, along a new alignment, to the following specifications:

- The bridge will be 72.65 m in length and 10.83 m wide:
 - The deck will be 3 m in height maximum above the natural ground level;
 - The bridge will have two piers and will be spaced as per the following:
 - Abutment 1 ↔ Pier 1 = 21.38 m
 - Pier 1 ↔ Pier 2 = 21.75 m (River channel)
 - Pier 2 ↔ Abutment 2 = 21.38 m
 - Large spans have been incorporated into the design to try and avoid blocking the macro-channel of the river.
- The total area of the construction footprint is as follows:
 - Total area – **559m²** (abutments, piers and temporary crossing)
- The volumes of soil/sand this will be removed is as follows:
 - Total volume – **280m³** (piers and temporary crossing – abutments are outside the watercourse).

Crossing Structure	Bridge Type	Width	Length	Height	Area (m ²)	Volume (m ³)
RC4	Three (3) span pre-stressed concrete beam and reinforced concrete slab deck	10.83m	72.65m	3m	559	280
TOTAL					559	280

No temporary structure will be constructed as the pre-existing structure along the P303 will be utilized as the temporary crossing while the proposed bridge is being constructed.

The construction of the two pipe culverts at RC1 and RC2 and bridge at RC4 will have a positive impact on local access and the community living in this area as the current crossings; (i) do not provide a safe means for the community to cross the watercourses, and (ii) are unable to manage the flow of the tributaries of the Bazangoma and Mpipambi Rivers. Therefore, these structures are constantly overtopped with water. The proposed culverts will ultimately allow pedestrians and vehicles to cross the Bazangoma and Mpipambi River tributaries safely and efficiently even during heavy rainfall events. The reparation of the existing bridge at RC3 will increase the safety of pedestrians and vehicles crossing the bridge.

1.2.1 Construction Methodology

Please note construction of the culverts and bridge will commence in the dry season in order to ensure there is little to no water within the watercourses. If required for construction purposes the water within the watercourses will be temporarily redirected around the active work zone, however the flow of the watercourse will still remain in the river channel. Sand bags acting as impeding structures will be manually placed within the watercourses to redirect the flow. Once work has been completed or there is no longer the need to redirect the flow the sand bags will be removed allowing the water to flow on along its natural course.

1.2.1.1. RC1 and RC2 (1x1200mm pipe culverts)

The proposed construction methodology for the two pipe culverts (1x1200mm) can be summarised as follows:

- Necessary clearing and grubbing of the site for access and construction of the works will be done. This will include the clearing and cleaning of vegetation within the construction footprint of the site which will also include a 5m construction servitude on either side of the culvert's footprint;
- Clearing and grubbing of the site will be undertaken by heavy machinery i.e. a TLB. Bulk earthwork will take place once the site has been prepared;
- Once the above has been completed the construction of the new culverts will commence;
- Bedding material will be compacted into the area excavated by a TLB;
- Once the pipes have been cast there will be no further major works within the watercourse;
- Once the culvert has been completed the area surrounding the culvert will be completely rehabilitated back to its original state;
- Finally, rehabilitation / re-vegetation of all areas affected by the upgrade and construction activities will be undertaken using intensive grass sod planting or hydro seeding with a suitable indigenous grass seed mix, characteristic of the Paulpietersburg Moist Grassland (Gm 15) (i.e. vegetation type pertinent to the proposed site). The indigenous grass seed mix will be chosen for the rehabilitation.

1.2.1.2. RC4 (Bridge)

- Necessary clearing and grubbing of the site for access and construction of the works will be done. This will include the clearing and cleaning of vegetation within the construction footprint of the site which will also include a 5m construction servitude on either side of the structures footprint.
- There is very limited vegetation within the watercourse that is to be cleared. The only vegetation that will be cleared from both sides of the river are heavily grazed veld and a few indigenous *Acacia* trees however, these trees are not of conservation importance. Numerous alien invasive vegetation will also be cleared.
- Clearing and grubbing of the site will be undertaken by heavy machinery i.e. a TLB. Bulk earthwork will take place once the site has been prepared.
- The existing bridge and approach road will not be demolished. The existing bridge will be used as a diversion while the proposed bridge is being constructed.
- Heavy machinery i.e. a TLB will be used to excavate soil this will be at the position of the two piers and abutments. Bedding material will then be compacted into this excavation, rebar and formwork will be placed on this bedding material in preparation for the concrete base slab to be cast.
- A piling rig will be used to insert piles at these excavated sites for the abutments and piers. Foundation rebar will be tied to these piles.
- Ready-mixed concrete will be brought to site and used to cast the base slab to attach to these piles.

- Formwork will then be used to form the shape of the abutments and piers and ready-mixed concrete will be poured to form these abutments and piers.
- Once the piers and abutments have been cast there will be no further major works within the watercourse.
- The contractor will then install staging for the deck and place the deck rebar.
- Ready-mixed concrete will be brought to site again and used to cast the bridge deck.
- Wing walls will also be cast and selected material will then be used to backfill behind the wing walls. This material will then also be used to form the shape of each approach.
- Once the bridge has been completed the temporary crossing will be completely rehabilitated back to its original state. This will include removing the concrete pipes and the ripping up of the compacted earth along the detour and contouring the watercourse banks if necessary.
- Finally, rehabilitation / re-vegetation of all areas affected by the upgrade and construction activities will be undertaken using intensive grass sod planting or hydro seeding with a suitable indigenous grass seed mix, characteristic of the Paulpietersburg Moist Grassland (Gm 15) (i.e. vegetation type pertinent to the proposed site). The indigenous grass seed mix will be chosen for the rehabilitation.

1.3 Description of Feasible Alternatives as Per Section 3(h)(i)

1.3.1. Site Alternatives

1.3.1.1. RC1 and RC2 Pipe Culverts 1 (Preferred Alternative)

There is only one site location for each of the two pipe culverts. No additional sites were considered as positioning the culverts upstream or downstream of the existing crossing points as this would also result in the transformation of previously undisturbed areas, therefore there is only one preferred site alternative for both culverts.

1.3.1.2. RC4

The bridge will be constructed at RC4 across the tributary of the Bazangoma River at 27°24'33.93"S; 30°40'0.48"E. The new alignment was selected based on the current P303 road alignment.

1.3.2. Design Alternatives

Alternative 1 (Preferred Alternative)

1.3.2.1. RC1 and RC2

The preferred design alternative for RC1 and RC2 is to construct a 1x1200mm pipe culvert at each of the crossings. The proposed 1x1200mm pipe culverts will be comprised of wing walls downstream and upstream. Compacted backfill will be placed between the walls. The approaches will be backfilled with selected material, and gabion Baskets will be constructed for additional protection at the crossing points where required. Please refer to Section 1.2 above for a detailed description of the structure and Appendix A for design drawings.

1.3.2.2. RC4

The Bridge will be a three (3) span pre-stressed concrete beam and reinforced concrete slab deck simply supported on reinforced concrete abutments and piers with piled foundations. Please refer to Section 1.2 above for a detailed description of the bridge and Appendix A for design drawings.

1.3.3. Alternative 2

1.3.3.1. RC1 and RC2

Concrete box (1.5m x 1.5m) culverts will be constructed on the same alignment as the proposed 1x1200mm pipe culverts. The box culvert will have concrete slabs within the watercourse beds, concrete approach slabs, and gabion baskets.

1.3.3.2. RC4

Alternative 2 for the RC4 would be to construct a concrete box (12 x 1.5m x 1.5m) causeway on the same alignment as the proposed bridge. The causeway will be a lower structure and a more expensive structure to construct compared with the proposed bridge.

1.3.4. The No-Go Alternative

1.3.4.1. RC1 and RC2

The proposed construction of the two 1x1200mm pipe culverts will not take place. Therefore, the current problems experienced whereby the structures are overtopped by water making them impassable will remain unresolved.

1.3.4.2. RC4

The proposed construction of the Bridge at RC4 will not take place. Therefore, the current situation of structures not being able to adequately allow two cars to simultaneously cross the existing bridge at the same time will

remain. The inability of the existing bridge to sufficiently drain the Bazangoma River will remain and therefore the structure will still be overtopped with water. Pedestrians and vehicles will not be able to cross the tributary of the Bazangoma River safely and efficiently.

See Appendix A for Engineering Drawings.

1.4 All Listed and Specific Activities to Be Triggered and Being Applied For As Per Section 3(d) (i)

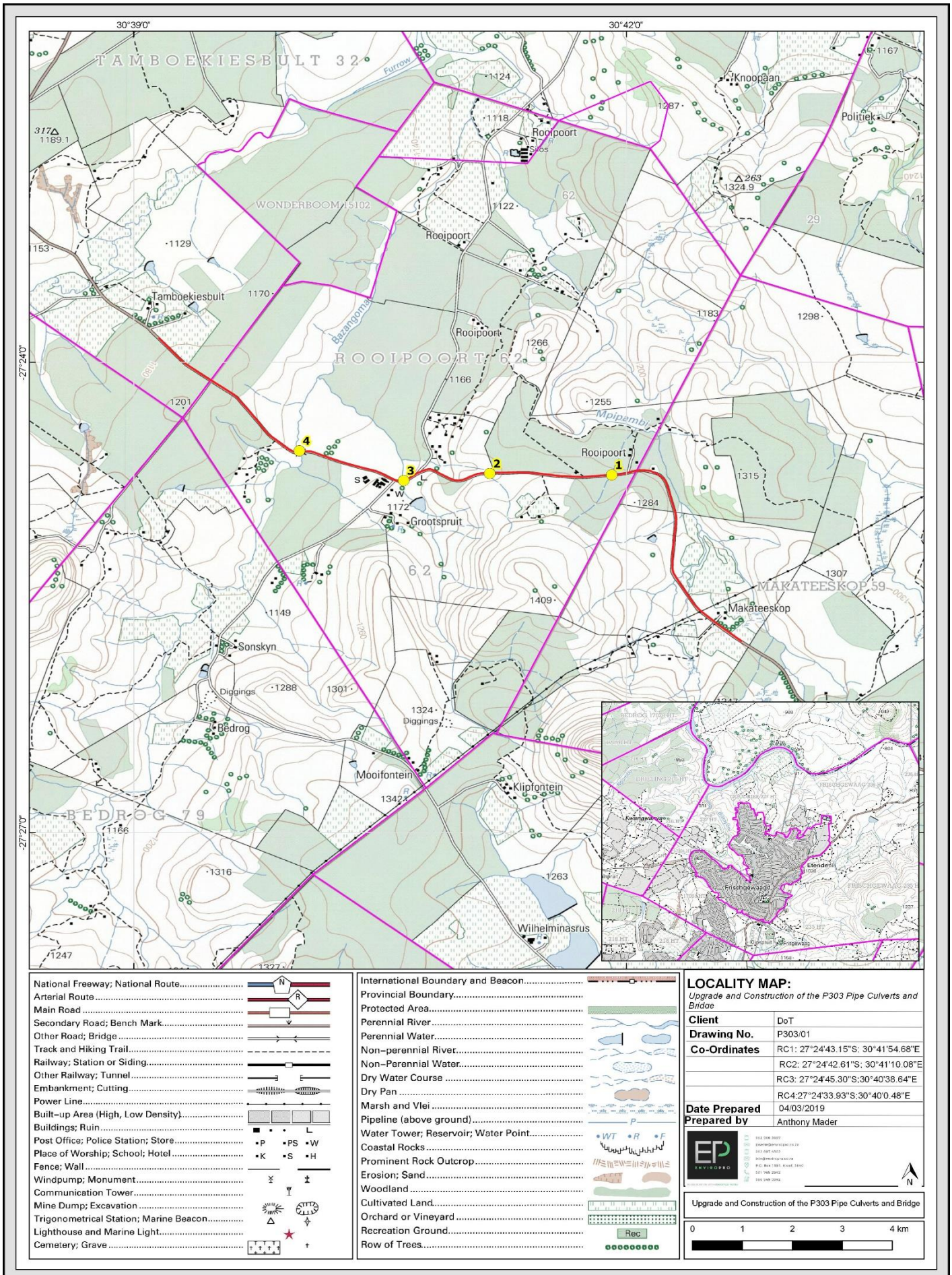
GNR	Activity Number	Activity as per the legislation	Activity as it applies to the proposal
Listing Notice 1; 4 th December 2017 as amended	12	<p><i>The development of—</i></p> <p><i>(ii) bridges exceeding 100 square metres in size;</i></p> <p><i>excluding—</i></p> <p><i>(ee) where such development occurs within existing roads, [or] road reserves or railway line reserves;</i></p>	The existing road reserve will be realigned for the construction of the bridge at RC4. The construction of the bridge (559m ²) will exceed the 100m ² threshold. The development of the bridge will be constructed in a new alignment and not form part of the existing road reserve.
Listing Notice 1; 4 th December 2017 as amended	19	<p><i>The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;</i></p> <p><i>but excluding where such infilling, depositing, dredging, excavation, removal or moving—</i></p> <p><i>(a) will occur behind a development setback;</i></p> <p><i>(b) is for maintenance purposes undertaken in accordance with a maintenance management plan;</i></p> <p><i>(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies;</i></p> <p><i>(d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or</i></p> <p><i>where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.</i></p>	<p>The construction two 1x1200mm pipe culverts (RC1 and RC2) and the bridge at RC4 will take place along the P303 Road at the following points RC1: 27°24'43.15"S; 30°41'54.68"E, RC2: 27°24'42.61"S; 30°41'10.08"E, RC4: 27°24'33.93"S; 30°40'0.48"E.</p> <p>These activities will result in more than 10m³ (RC1 - 71.42m³, RC2 - 71.42m³, and RC4 - 280m³) of material being removed and deposited within the tributaries of the Bazangoma and Mpipambi Rivers.</p>
GNR 327 Listing Notice 1; 7th April 2017	31	<p><i>The decommissioning of existing facilities, structures or infrastructure for—</i></p> <p><i>(i) any development and related operation activity or activities listed in this Notice, Listing Notice 2 of 2014 or Listing Notice 3 of 2014;</i></p> <p><i>(ii) any expansion and related operation activity or activities listed in this Notice, Listing Notice 2 of 2014 or Listing Notice 3 of 2014;</i></p> <p><i>(iii) [any development and related operation activity or activities and expansion and related operation activity or activities listed in this Notice, Listing Notice 2 of 2014 or Listing Notice 3 of 2014;] ...</i></p>	The existing structures (at RC1-2) will be decommissioned. This will result in the expansion of the physical footprint of the existing structure.

		<p>(iv) any phased activity or activities for development and related operation activity or expansion or related operation activities listed in this Notice or Listing Notice 3 of 2014; or</p> <p>(v) any activity regardless the time the activity was commenced with, where such activity:</p> <p>(a) is similarly listed to an activity in (i)[,] or (ii)[, or (iii)] above; and</p> <p>(b) is still in operation or development is still in progress;</p> <p>excluding where—</p> <p>(aa) activity 22 of this notice applies; or</p> <p>(bb) the decommissioning is covered by part 8 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies.</p>	
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1.5 Location of Activity as per Section 3 (b)(i)-(iii)

Local Municipality	eDumbe																				
District Municipality	Zululand																				
Wards	Ward 1																				
Area / Town / Village	Approximately 16km west of Paulpietersburg Ridge Town (as the crow flies)																				
Co-ordinates:	Latitude									Longitude											
RC1:	27°24'43.15"S									30°41'54.68"E											
RC2:	27°24'42.61"S									30°41'10.08"E											
RC3:	27°24'45.30"S									30°40'38.64"E											
RC4 (Bridge):	27°24'33.93"S									30°40'0.48"E											
Property Description:	Parent Farm:									Farm Portion:											
	Rooipoort No. 62 (in DoT Road Reserve)									31											
										15											
19																					
21 Digit Surveyor General no.	N	0	H	T	0	0	0	0	0	0	0	0	0	0	6	2	0	0	0	3	1
	N	0	H	T	0	0	0	0	0	0	0	0	0	0	6	2	0	0	0	1	5
	N	0	H	T	0	0	0	0	0	0	0	0	0	0	6	2	0	0	0	1	9

Figure 1: 1:50 000 Map Indicating the locations of the two proposed 1 x 1200mm pipe culverts (RC1-2), repairs of the existing bridge at RC3, and bridge at RC4.



National Freeway; National Route.....	
Arterial Route.....	
Main Road.....	
Secondary Road; Bench Mark.....	
Other Road; Bridge.....	
Track and Hiking Trail.....	
Railway; Station or Siding.....	
Other Railway; Tunnel.....	
Embankment; Cutting.....	
Power Line.....	
Built-up Area (High, Low Density).....	
Buildings; Ruin.....	
Post Office; Police Station; Store.....	
Place of Worship; School; Hotel.....	
Fence; Wall.....	
Windpump; Monument.....	
Communication Tower.....	
Mine Dump; Excavation.....	
Trigonometrical Station; Marine Beacon.....	
Lighthouse and Marine Light.....	
Cemetery; Grave.....	

International Boundary and Beacon.....	
Provincial Boundary.....	
Protected Area.....	
Perennial River.....	
Perennial Water.....	
Non-perennial River.....	
Non-Perennial Water.....	
Dry Water Course.....	
Dry Pan.....	
Marsh and Vlei.....	
Pipeline (above ground).....	
Water Tower; Reservoir; Water Point.....	
Coastal Rocks.....	
Prominent Rock Outcrop.....	
Erosion; Sand.....	
Woodland.....	
Cultivated Land.....	
Orchard or Vineyard.....	
Recreation Ground.....	
Row of Trees.....	

LOCALITY MAP:
Upgrade and Construction of the P303 Pipe Culverts and Bridges

Client	DoT
Drawing No.	P303/01
Co-Ordinates	RC1: 27°24'43.15"S; 30°41'54.68"E RC2: 27°24'42.61"S; 30°41'10.08"E RC3: 27°24'45.30"S; 30°40'38.64"E RC4: 27°24'33.93"S; 30°40'0.48"E
Date Prepared	04/03/2019
Prepared by	Anthony Mader

EP ENVIRONMENTAL PRACTICES

Upgrade and Construction of the P303 Pipe Culverts and Bridges

0 1 2 3 4 km

Figure 2: Aerial photograph showing an overview of the two pipe culverts (RC1 and 2), one bridge to be repaired (RC3), and one bridge to be constructed (RC4), respectively. QGIS, ver. 3.2.2.

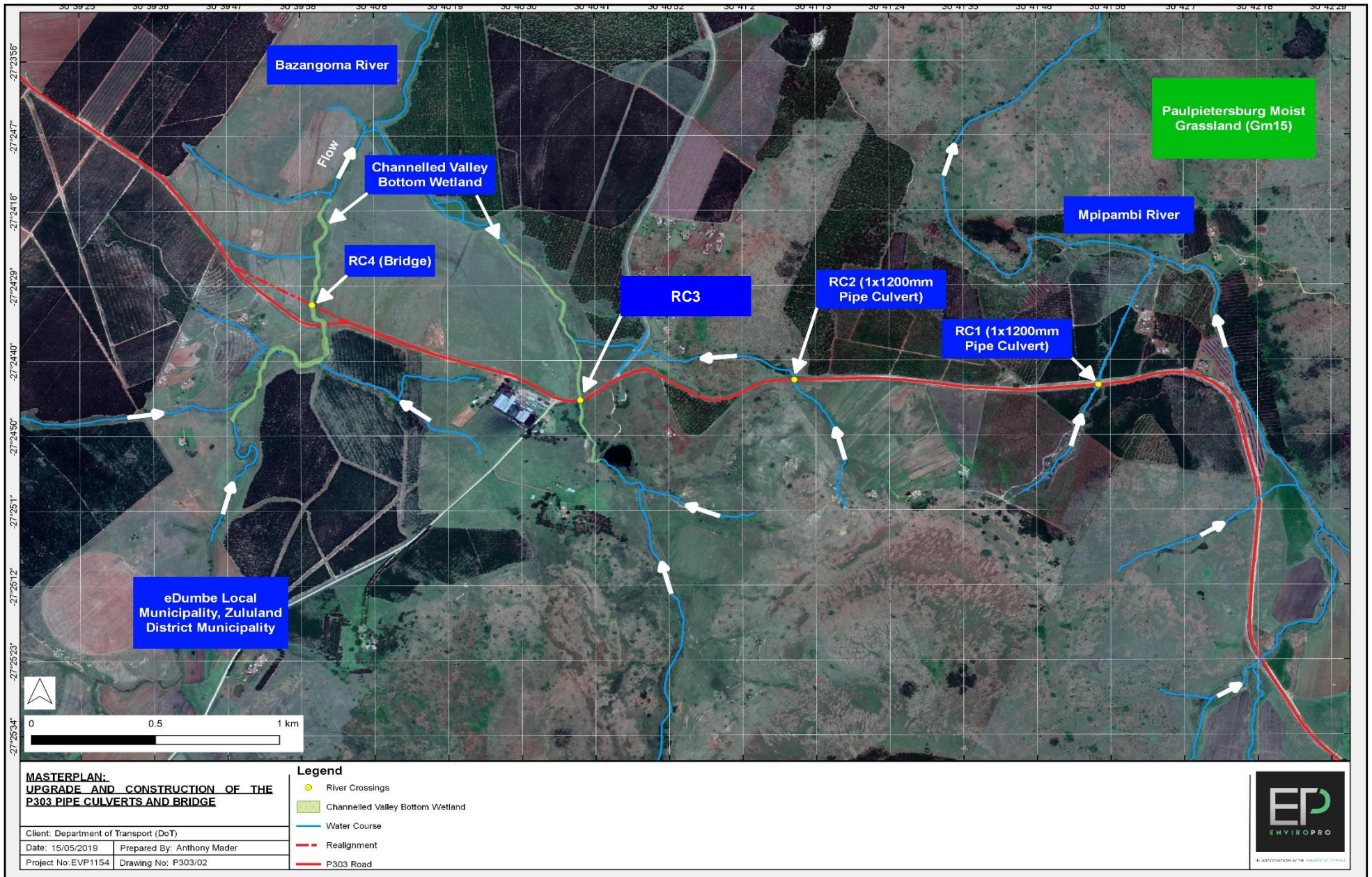


Figure 4: Aerial photograph showing RC1 located at 27°24'43.15"S; 30°41'54.68"E. QGIS, ver. 3.2.2.



Figure 5: Aerial photograph showing RC2 located at 27°24'42.61"S; 30°41'10.08"E. QGIS, ver. 3.2.2.

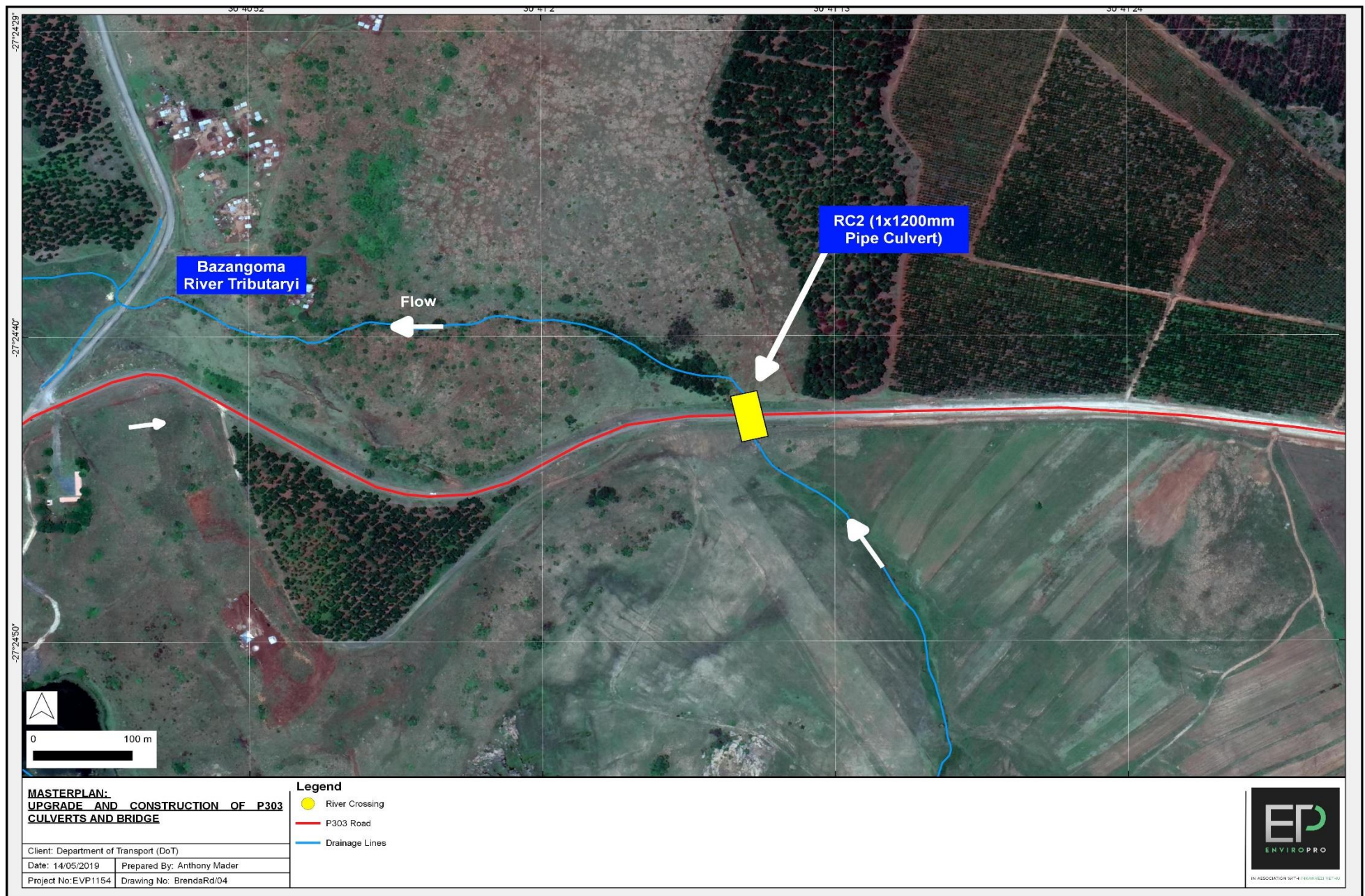


Figure 6: Aerial photograph showing RC3, located at 27°24'45.30"S; 30°40'38.64"E, to be repaired. QGIS, ver. 3.2.2.



Figure 7: Aerial photograph showing RC4 located at 27°24'33.93"S; 30°40'0.48"E. QGIS, ver. 3.2.2



Section 2: Site Description and Surrounding Land Use as per section 3(h)(iv) and (k)

2.1 Topography and Physical Characteristics of Site

The following applies to the area surrounding the sites as per the Figures 1-7 above.

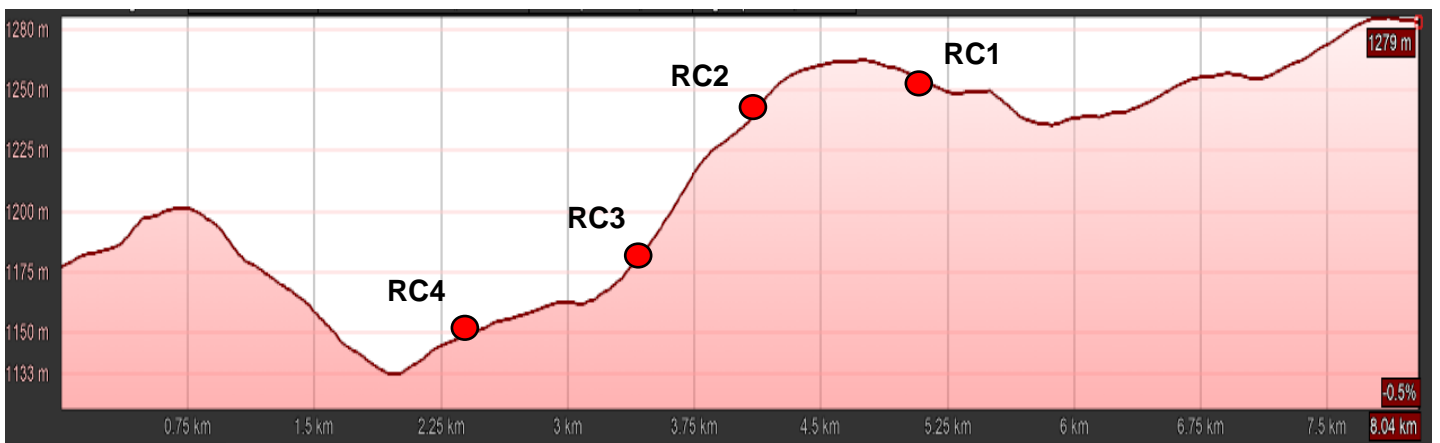
The gradient of the sites are as follows:

Gradient	Description
Flat	N/A
1:50 – 1:20	The sites associated with the pipe culverts and bridge can be described as having a gentle gradient.
1:20 – 1:15	N/A
1:15 – 1:10	N/A
1:10 – 1:7,5	N/A
1:7,5 – 1:5	N/A
Steeper than 1:5	N/A

The topographical features and landforms of the site and surrounding area are as follows:

Topographical Feature	Description
Ridgeline	N/A
Plateau	N/A
Side slope of hill/mountain	N/A
Closed valley	N/A
Open valley	All sites are located in open valleys.
Plain	N/A
Undulating plain/low hills	N/A
Dune	N/A
Sea-front	N/A

Figure 8: Elevation profile for the two pipe culverts (RC1 and RC2) and proposed Bridge (RC4) (red dots). Google Earth, 2019.



2.2 Surface Water and Ground Water

The project area is situated in the quaternary catchment W42B, within the Pongola to Mtamvuna Water Management Area (WMA 4). RC1 is drained by a tributary of the Mpipambi River whereas RC2-4 are drained by tributaries of the Bazangoma River. The study area falls under the Tsakwe sub-quaternary reach (SQR).

2.2.1 Drainage Lines¹

Each drainage line associated with the four river crossings (RC) (S1-4 in the specialist report) were sampled to characterise the state of the systems, each site was sampled for *in situ* water quality, and macroinvertebrates. Note that *in situ* water quality and aquatic macroinvertebrate assessments were conducted at RC2-4 whereas only the *in situ* water quality was assessed of RC1 due to no water flow being present at the time of the site visit. Please see below for the results from the assessment.

2.2.1.1. *In situ* water quality

Overall, sites were classified as largely natural whereas low dissolved oxygen (DO) levels for S2 (RC2) and S3 (RC3) were attributed to low surface water flow at the time of the assessment. The water temperatures fell within guideline limits and expected temperatures for the region during a high flow survey. The water quality within the aquatic systems measured *in situ* would not be considered limiting factors to local aquatic biota.

Table 1: *In situ* surface water quality monitoring results (February 2019)

Site	pH	Conductivity (µS/cm)	DO (mg/l)	Temperature (°C)
TWQR*	6.5-8.5**	-	>5.00*	5-30*
S1	7.27	100.0	6.33	26.6
S2	7.36	107.3	2.13	25.8
S3	7.76	179.6	4.00	26.6
S4	7.92	215.0	5.20	24.4

2.2.1.2. Intermediate Habitat Integrity Assessment

Results of the habitat assessment in the tributaries of the Bazangoma River indicate that the instream (Class C) and riparian habitats (Class C) are moderately modified (class C), which is largely attributed to the modification of the overall river system as a result of the river crossing structures (formal and informal), livestock influence (trampling and defecation), agricultural land use. These factors have resulted in the modification of river flow, river bed and banks, which ultimately alter the aquatic ecosystem functioning and ability to maintain a diversity of aquatic biota.

2.2.1.3. Status of the sub-quaternary reach W42B-2325

The Present Ecological Status (PES) category of the reach is classed as moderately modified (class C). The Ecological Importance (EI) of the reach is classified as Moderate. The Ecological Sensitivity (ES) is categorised as very high due to the presence of macroinvertebrate taxa that are sensitive to flow and physico-chemical water modifications. Anthropogenic impacts identified within the sub-quaternary catchment included rural communities, cultivated lands, alien invasive plants, roads, and instream dams within the reach.

Present Ecological Status	Moderately modified (class C)
Ecological Importance	Moderate
Ecological Sensitivity	Very High

¹ The Biodiversity Company (2019) Water Resource Assessment for the proposed P303 Road-Realignment and River Crossing Upgrades, Paulpietersburg, KwaZulu-Natal – Appendix B

2.2.1.4. Aquatic Macroinvertebrate Assessment

The Biotope category, in accordance with Tate and Husted, (2015), was rated as poor (Category F). Habitat availability within the assessed tributary was rated as poor. The biotope score can be attributed to the limited diversity of stones in and out of current, bedrock, and diverse gravel biotopes. Furthermore, the low diversity/abundance of vegetation biotopes reduced the overall biotope diversity score. The biotope results indicate that habitat availability would be a limiting factor to the macroinvertebrate assemblage at site.

Site 2 assessment derived an invertebrate class B (or largely natural) whereas Sites 3 and 4 derived largely modified categories.

Site	SASS Score	No. of Taxa	Average Score per Taxon (ASPT)	Category (Dallas, 2007)**
S1	N/A			
S2	60	10	6.0	B
S3	89	17	5.2	D
S4	80	18	4.4	D

The proposed construction and upgrade of the P303 bridge and pipe culverts will provide an improved formalised watercourse crossing point for pedestrians and vehicles across the tributaries of the Bazangoma and Mpipambi River Tributaries. The structures will promote the free flow of water underneath the structures, improving the functionality of the Bazangoma and Mpipambi Rivers at all crossing points as there will no longer be artificial barriers within the rivers, impeding the flow. This should have a positive impact on the Bazangoma and Mpipambi River and the greater catchment at large. Improved storm water management will also prevent further scouring and erosion of the area. The construction of the bridge and pipe culverts is expected to have an impact on the watercourse with the risk determined by the specialist being low provided that the mitigation measures provided in this report and EMPr are followed. Therefore, if all provided mitigation measure are implemented at both sites there should be no lasting impacts on the Bazangoma and Mpipambi Rivers.

2.2.2 Wetlands¹

Two (2) HGM units were distinguished within the project area, namely Channelled Valley Bottom (HGM 1) and Channelled Valley Bottom (HGM 2), where both HGM 1 and HGM 2 are associated with the Bazangoma River.

- The overall PES scores for HGM 1 and HGM 2 was that of C (Moderately Modified). Please see below.

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 1	C: Moderately Modified	3.5	C: Moderately Modified	3.2	C: Moderately Modified	3.5
Overall PES Score	3.4		Overall PES Class		C: Moderately Modified	
HGM 2	C: Moderately Modified	3.5	C: Moderately Modified	3.0	C: Moderately Modified	3.2
Overall PES Score	3.2		Overall PES Class		C: Moderately Modified	

- HGM 1 and HGM 2 had overall Intermediate levels of service. The following shows services with moderately high levels or higher for both units:
 - Flood attenuation;
 - Streamflow regulation
 - Sediment trapping;
 - Water quality enhancement benefits (including sediment trapping, erosion control, and phosphate, nitrate and toxicant assimilation.
- The EIS assessment showed that all aspects were rated as Moderately Important (C) for both HGM1 and HGM2. The EIS was determined to be moderate as there were no signs of ecologically important taxa within the wetland areas and none had been recorded within the area. The wetland did however, provide a suitable habitat for birds and other faunal species.

- The Hydrological Functionality of the wetlands determined to have a Moderate (C) level of importance. The wetlands' hydrology ensured that there was a constant water source within the area. Furthermore, the flood attenuation and streamflow regulation offered by the wetlands contributes to the protection of the local area from flooding and drought. The Direct Human Benefits were calculated to have a Marginal (D) level of importance.

Wetland Importance and Sensitivity		
	HGM 1	HGM 2
Ecological Importance & Sensitivity	1.8	1.8
Hydrological/Functional Importance	2.0	1.8
Direct Human Benefits	0.7	0.7

The upgrade of the pipe culverts will take place within the existing road reserve therefore impacts are existing. As per the specialist, "Moderate risks (pre-mitigation) were also identified for the operational phase of the project, these are largely as a result of the longevity of these aspects, being for the life of the project. No aspects are considered to pose a Moderate risk with the implementation of mitigation measures. All Moderate risks were re-allocated a Low risk with the expectation that prescribed mitigation measures would be implemented". The site of the temporary crossing will be completely rehabilitated under the supervision of the independent ECO, therefore there will be no net loss of wetland. As above provided that all mitigation measure are implemented on the sites there should be no lasting impacts on the wetlands.

2.3 Fauna and Flora

The P303 is located within a rural area, which is sparsely populated by homesteads. The fauna and flora found within the area can be described as follows:

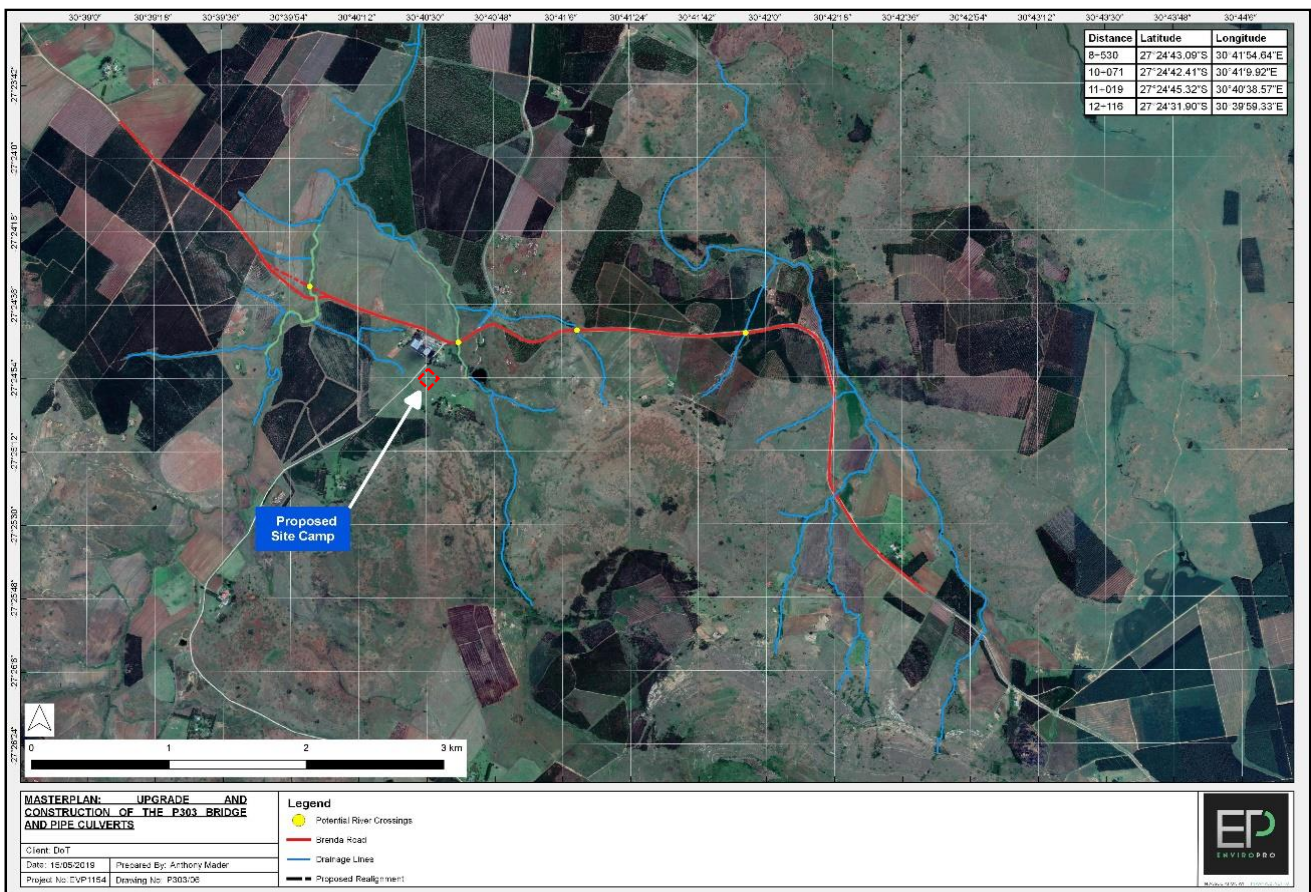
- Ecosystem Type:** Paulpietersburg Moist Grassland.
- Vegetation Type:** Paulpietersburg Moist Grassland (Gm 15) vegetation type:
- Distribution:** KwaZulu-Natal and Mpumalanga Provinces: Broad surrounds of Piet Retief, Paulpietersburg and Vryheid, extending westwards to east of Wakkerstroom. Occurs in the uppermost catchments of the Phongolo River. Altitude 920–1 500 m.
- Vegetation & Landscape Features:**
 - Semideciduous Mainly undulating with moderately steep slopes, but valley basins are wide and flat and mountainous areas occur mostly along the northern and eastern boundary. Tall closed grassland rich in forbs and dominated by *Tristachya leucothrix*, *Themeda triandra* and *Hyparrhenia hirta*. Evergreen woody vegetation is characteristic on rocky outcrops.
- Geology & Soils**
 - The This area is underlain by Archaean granite and gneiss partly covered by Karoo Supergroup sediments (Madzaringwe Formation) and intruded by Karoo Dolerite Suite dykes and sills. Dominant soils on the sedimentary parent material are yellow apedal, well drained, with a depth of >800mm and a clay content of >35%, representing the soil series: Hutton, Clovelly and Griffin. Shortlands soils are dominant on dolerite. Dominant land type Ac, with Fa and Ba of subordinate importance.
- Conservation**
 - Least Vulnerable. Target 24%. Only very small portion statutorily conserved in Witbad, Vryheid Mountain, Paardeplaats and Phongola Bush Nature Reserves. Some private reserves protect small patches (Rooikraal, Mhlongamvula, Kombewaria). About one third already transformed by plantations or cultivated land. Heavy livestock grazing and altered fire regimes have greatly reduced the area of grasslands of high conservation value. Aliens such as species of *Acacia*, *Eucalyptus* and *Pinus* are of major concern in places. Erosion very low (80%) or low (13%).
- Vegetation noted on site:**
 - There will be the clearing of 559m² vegetation for the realignment and construction of the bridge at RC4. Existing structures at RC1 and RC2, within the road reserve, are to be upgraded and thus, 39.68m² of vegetation will be cleared per pipe culvert (total = 79.36m²).
 - Dominant vegetation species include *Andropogon appendiculatis*, *Cynodon dactylon*, *Eragrostis curvula*, *Eragrostis plan*, *Harpachloa falx* *Aristida congesta* *Sporobulus africana*, *Vechelia karroo*, and *Vechelia nilotica*.
 - The vegetation components were both affected by the proliferation of alien vegetation (numerous alien invasive plant species were evident), as well as the impact of erosion and

deposition. The grazing practices have contributed to the alteration and monospecific nature of the vegetation.

- Therefore, although the sites would have historically represented the Paulpietersburg Moist Grassland (Gm 15) vegetation type, the current vegetation on site is in a degraded and transformed state due to previous clearing for the road and existing crossing points.
- No species of conservation significance were evident during the site visit.
- **Fauna**
 - No terrestrial fauna was evident around the site besides livestock.

Sites RC1-3 are existing watercourse crossing points therefore the state of the vegetation at these sites are highly disturbed. Necessary clearing and grubbing of the site for access and construction of the works will be required at all sites associated with RC1-4. However, this vegetation clearing will be restricted to only what is necessary i.e. construction footprint (RC1 -39.68m², RC2 -39.68m², and RC4 – 559m²). The location of the site camp must be approved by the ECO and must be on land that is previously disturbed however the Figures 7 below provides a recommended location for the site camp as only one site camp will be required for this project. All vegetation clearing will take place under the supervision of the ECO and Engineer. Although there will be vegetation clearing, nothing of conservation significance will be removed. Therefore, the construction of the pipe culverts are expected to have little impact on the fauna and flora provided the mitigation measures provided in this report and EMPr are followed. No vegetation clearing will take place at RC3 as the existing structure will only be repaired (e.g. hand rails).

Figure 7: Recommended locations for the site camp associated with the construction and upgrade of the P303 bridge and pipe culverts.



2.4 Heritage and Cultural Aspects

No items of archaeological were noted within the immediate area of the sites associated with RC1-4. Construction workers will be cautioned to operate with care on both sites and should any unidentified archaeologically or culturally sensitive aspects be discovered on site, construction activities are to stop immediately and the issue assessed and the authorities (AMAFA) notified if need be. The two culverts will be constructed in an existing road reserve (except for the realignment and associated bridge which is located in a moderately sensitive area according to the PalaeoSensitivity Map (<https://sahris.sahra.org.za/map/palaeo>)),

therefore, it is unlikely that other archaeological or culturally significant aspects are present within the proposed areas of construction. However, a case application will be submitted to AMAFA for comment.

2.5 Socio Economic Environment

The proposed construction and upgrade of bridge and pipe culverts will improve safety for all utilising these portions of the P303. The improved safety is due to the fact that during high flow periods both vehicles and pedestrians will be able to cross the watercourse without having to wade or drive through the fast-flowing water. This is a positive impact. Should there be a need for the relocation of any infrastructure, an agreement must be made with the contractor and the relevant stakeholder. Ultimately, society in general will have improved access across the watercourses.

2.6 Surrounding Environment and Land Uses

The land uses surrounding the sites (RC1-4) are as follows:

- Privately owned land adjacent to the P303.
- Located within a rural area.
- The land surrounding the four sites consists of:
 - Open grassland.
 - *Eucalyptus spp.* and *Pinus spp.* plantations
 - Scattered alien vegetation.

The surrounding environment and land use will not be negatively affected by the construction of the bridge and upgrade of the two pipe culverts. The new structures will improve safety for all utilising these portions of the P303 Road and will also have a positive impact on the ecological state of the system. The structures should have little negative impact or influence on the watercourses or society provided the basic mitigation measures are adhered to in this report and EMPr.

The figures below provide photographs of the site taken on the 5th and 27th February 2019.



Figure 9: (a): Photographer facing west looking towards RC1 showing the status of the P303 road (b): Image showing surrounding land uses (namely plantations and open grasslands). (c): Additional image showing surrounding land uses.



Figure 10: (a): Image showing existing structure at RC1 and P303 road. Note sedimentation of pipe; (b): Image showing upstream characteristics of the existing P303 structure (c): Additional image showing downstream of RC1.



Figure 11: (a): Image showing upstream characteristics of RC2; **(b):** Image showing downstream characteristics at RC2 **(c):** Additional image showing surrounding land use at RC2.



Figure 12: (a): Image showing P303 approaching RC3. **(b):** Photograph showing downstream characteristics at RC3 **(c):** Image showing upstream characteristics at RC3 and associated deteriorated infrastructure to be repaired. **Note, this existing structure, at RC3, will only be repaired and not upgraded.**



Figure 13: (a): Image showing existing infrastructure at RC4 **(b):** Image showing downstream characteristics at RC4 **(c):** Image showing upstream characteristics at RC4.

Section 3: Policy and Legislative Context

3.1 Identification of All Legislation, Policies, Plans, Guidelines, Spatial Tools, Municipal Development Planning Frameworks And Instruments As Per Section 3(e) (i) And Compliance Of Proposed Activity With Legislation And Policy 3(e) (ii)

Legislation	Compliance of Activity
National Environmental Management Act 1998	The National Environmental Management Act (Act 107 of 1998) (NEMA) is South Africa's overarching environmental legislation. It includes a set of principles that govern environmental management and against which all Environmental Management Programmes (EMPr) and actions are measured. These principles include and relate to sustainable development, protection of the natural environment, waste minimisation, public consultation, the right to an environment that is not harmful to one's health or wellbeing, and a general duty of care. The Environmental Impact Assessment (EIA) Regulations, 2014: GNR.982, R.983, and R.985 under Section 24 of the NEMA define the activities that require Environmental Authorisation and the processes to

	<p>be followed to assess environmental impacts and obtain Environmental Authorisation.</p> <p>Environmental authorisation is required for the construction of the three structures (RC1, RC2, and RC4) therefore this application is in line with the requirements of NEMA.</p>
National Water Act 1998	The site is located within 500m of wetlands and there will be the alterations to the bed and banks of a watercourse. Therefore, a water use authorisation will be required as per Section 21 (c) and (i) of the National Water Act.
National Waste Management Act 2008	<p>Reforms the law regulating waste management to prevent pollution and ecological degradation.</p> <p>Section 19 allows the Minister to publish a list of activities, which require a Waste Management License. The most recent list is published in Government Gazette 37083 Notice No. 921 dated 29 November 2013. It is unlikely that any activities carried out by the development will trigger a Waste Management Activity.</p>
Environmental Conservation Act 1996	Makes provisions for the application of general environmental principles for the protection of ecological processes, promotion of sustainable development and the protection of the environment. This Act has mostly been repealed by NEMA.
National Environmental Management Biodiversity Act 2004	<p>To provide the framework, norms, and standards for the conservation, sustainable use and equitable benefit-sharing of South Africa's biological resources. Section 52 allows for the publication of a list of threatened ecosystems in need of protection. The list was published in Government Gazette No. 34809 Notice No. 1002, dated 9 November 2011.</p> <p>The site is not located within a threatened ecosystem.</p>
National Heritage Resources Act 25 of 1999	For the protection of South African Heritage to nurture and conserve communities legacy. The two culverts will be constructed in an existing road reserve (except for the realignment and associated bridge), therefore, it is unlikely that other archaeological or culturally significant aspects are present within the proposed areas of construction. However, a case application will be submitted to AMAFA for comment.
Mineral & Petroleum Resources Development 28 of 2002	<p>To provide for the sustainable development of the nation's mineral and petroleum resources which includes activities carried out for the winning of any mineral on, in or under the earth (i.e. the use of borrow pits).</p> <p>The material used to construct the bridges must be obtained from a licensed source.</p>
Municipal Planning Framework	
eDumbe Local Municipality: Integrated Development Plan 2017/18 – 2021/22	This project falls in line with the eDumbe Local Municipality's goal to promote sustainable development in the municipality.

Section 4: Motivation, Need and Desirability

4.1 Need and Desirability as Per Section 3(F)

The following motivation explains the need for the construction of the two culverts (RC1 and RC2) and one bridge (RC4):

- The P303 road is an important local access route through the area;
- The three sites at which the road crosses do not provide a safe means of crossing for both vehicles and pedestrians. This is attributed to the deterioration of the existing structures and overtopping of structures during heavy rainfall. The lack of suitable formal crossing structures across these river tributaries means that both pedestrians and vehicles are unable to cross these sections of P303 during high flow events;
- The new RC structures will be a public facility and will improve the access in this area for community members, emergency services and scholars in this area;
- The construction of the bridge will improve the health and functionality of the aquatic environment in this reach of the watercourse;

- The improved access will promote growth in the area; and
- There may be temporary employment opportunities during the construction period.

4.2 Motivation for Preferred Site, Activity and Technology Alternative

4.2.1 Preferred Site Alternative

4.2.1.1. RC1-2 Site Alternative 1 (Preferred Alternative)

Site Alternative 1 for RC1 and RC2 will involve the construction of 1x 1200mm pipe culverts at the current crossing points along the Bazangoma and Mpipambi River tributaries. No additional sites were considered as positioning the culverts upstream or downstream of the existing crossing points would result in the transformation of previously undisturbed areas, therefore there is only one preferred site alternative for the two pipe culverts (RC1 and RC2).

4.2.1.2. RC4 Site Alternative 1

The preferred alternative for RC4 will involve the construction of a bridge along a realigned path (Figure 2) across the Bazangoma River tributary. The upgrade of the existing bridge at RC4 was not appropriate due to; (i) the existing road alignment's low bend radius, and (ii) the width of the road approaching the existing structure does not allow for two cars to travel along the bridge at the same time.

4.2.2 Preferred Design Alternative

4.2.2.1. RC1-2 Alternative 1 (Preferred Alternative)

The preferred alternative is to construct a 1x1200mm pipe culvert at RC1 and RC2.

4.2.2.2. RC4 Alternative 1 (Preferred Alternative)

The preferred alternative for RC4 will involve the construction of a bridge along a realigned path (Figure 2) across the Bazangoma River tributary.

4.2.3 Design Alternative 2

4.2.3.1. RC1-2 Alternative 2

Design alternative 2 is to construct a box culvert at each river crossing (RC1 and RC2). The box culvert causeways will have concrete slabs throughout the entire watercourse beds, concrete approach slabs, and gabion baskets.

4.2.3.2. RC4 Alternative 2

The alternative is to construct a box culvert causeway within the riverbed at RC4. For the proposed bridge at RC4, a three (3) span pre-stressed concrete beam and reinforced concrete slab deck simply supported on reinforced concrete abutments and piers with piled foundations (preferred design alternative 1) is considered more suitable than a concrete box culvert structure (design alternative 2). The bridge structure will have a much smaller construction footprint when compared to a box causeway as there will only be 4 points (2 abutments and 2 piers) along the bridge alignments where the bridge footprints will impact the site. The construction footprint of the concrete box causeway structures would equal the length of the structure.

- Ultimately the decision on selecting the Preferred Alternative is a measure of the risk. There will be a much higher risk of high flow damage and trapped debris associated with that of box causeways when compared to a bridges as they have much higher drainage potentials.
- In addition, due to the high risk associated with box causeways, bridge structures will require less maintenance.

Section 5: Public Participation

5.1 Notification of Interested and Affected Parties

- 1) *fixing a notice board at a place conspicuous to and accessible by the public at the boundary, on the fence or along the corridor of-*
 - i. the site where the activity to which the application or proposed application relates is or is to be undertaken; and*
 - ii. any alternative site;*

Two noticeboards (isiZulu and English) were placed adjacent at the start and end of the P303 road on the 27th February 2019. These noticeboards detailed the KwaZulu-Natal Department of Transport's proposed plan to construct the three structures, subject to a basic assessment. See Appendix C – Proof of Placement of Notice Board.

- 2) *giving written notice, in any of the manners provided for in section 47D of the Act, to-*
 - i. *the occupiers of the site and, if the proponent or applicant is not the owner or person in control of the site on which the activity is to be undertaken, the owner or person in control of the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken;*
 - ii. *the municipal councillor of the ward in which the site or alternative site is situated and any organisation of ratepayers that represent the community in the area;*
 - iii. *the municipality which has jurisdiction in the area;*
 - iv. *any organ of state having jurisdiction in respect of any aspect of the activity, and;*
 - v. *any other party as required by the competent authority;*

The project is located within a rural area with strong traditional ties, therefore the public participation method used had to ensure that existing channels of communication were used in order to notify surrounding stakeholders to avoid creating any offense. Surrounding stakeholders rely on direct means of communication through the elected officials, which in this case is the local Ward Councilor. It is important to note that any communication that takes place with community members without working through the elected officials is seen as disrespectful and to a point irrelevant as the Ward Councilor has been elected to facilitate such communications. A number of stakeholders were also tracked down electronically and information has been provided to them via email or telephone. As the structures are key safety concerns for the surrounding community, the primary purpose behind the notification was to ensure that the community was made aware of the commencement of the environmental assessment.

The following steps were followed during the public participation process.

- A meeting was held with the Ward Councilors on the 27th February 2019.
- The Ward Councilor indicated a willingness to engage with the community, agreeing that this was the best procedure for notification as detailed in the signed letters.
- The Ward Councilor was provided with information, which provides detail about the proposed project.
- Two noticeboards detailing the proposed developments were erected adjacent to the sites on the 27th February 2019.
- The Ward Councilor will be given opportunity to review complete copies of the Basic Assessment report and relay information back to the community.
- With regards to authority communications, all relevant authorities have been notified of the application and have been provided with copies of this BAR.

See Appendix D – Proof of Notification.

- i. *owners, persons in control of, and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken;*

Email notifications to all I&APs were sent out on the 5th July 2019. The Ward Councilor also confirmed in writing that all surrounding community members have been notified. See Appendix D – Proof of Notification.

- 3) *placing an advertisement in-*
 - i. *one local newspaper; or*
 - ii. *any official Gazette that is published specifically for the purpose of providing public notice of applications or other submissions made in terms of these Regulations;*
- 4) *placing an advertisement in at least one provincial newspaper or national newspaper, if the activity has or may have an impact that extends beyond the boundaries of the metropolitan or district municipality in which it is or will be undertaken: Provided that this paragraph need not be complied with if an advertisement has been placed in an official Gazette referred to in paragraph (c)(ii);and*

An English and IsiZulu advert was placed in the Ilanga newspaper on the 17th March 2019 detailing the proposed project, Basic Assessment and potential Water Use Licensing requirements and to prove contact details of EnviroPro should anyone wish to register as an I&AP. See Appendix E – Proof of Advert Placement.

5.2 Registered Interested and Affected Parties

42. *A proponent or applicant must ensure the opening and maintenance of a register of interested and affected parties and submit such a register to the competent authority, which register must contain the names, contact details and addresses of-*

- (a) all persons who, as a consequence of the public participation process conducted in respect of that application, have submitted written comments or attended meetings with the proponent, applicant or EAP;
- (b) all persons who have requested the proponent or applicant, in writing, for their names to be placed on the register; and
- (c) all organs of state which have jurisdiction in respect of the activity to which the application relates.

The contact details of all I&APs that have registered have been provided in the Registered I&AP list in Appendix F.

5.3 Comments

Comments of interested and affected parties to be recorded in reports and plans 44.

- 1) *The applicant must ensure that the comments of interested and affected parties are recorded in reports and plans and that such written comments, including responses to such comments and records of meetings, are attached to the reports and plans that are submitted to the competent authority in terms of these Regulations.*
- 2) *Where a person desires but is unable to access written comments as contemplated in subregulation (1) due to-*
 - i. *a lack of skills to read or write;*
 - ii. *disability; or*
 - iii. *any other disadvantage;*
 - iv. *reasonable alternative methods of recording comments must be provided for.*

All comments received from I&APs have been recorded in the comments and response table. The original comments provided have been provided together with the C&R table. This report has been provided to the eDumbe Local Municipality for comment. See Appendix G – Comments and Response table and Comments Received.

Section 6: Impact Assessment

6.1 Methodology to Determine and Rank Significance and Consequences of Impacts Associated With All Alternative as Per Section 3(h) (vi)

Impacts are assessed qualitatively and quantitatively, looking at the duration / frequency of the activity and likely impacts associated with that activity during both construction and operation. If the activity happens frequently, the risk of the associated impact occurring is much higher than if the activity happens less frequently. The geographical extent of the impact is assessed i.e. will the impact be restricted to the point of occurrence or will have it have a local or regional effect. Impacts are also reviewed looking at severity levels and consequences should the impact occur i.e. will the severity be low, medium or high and then probability of the impact occurring is taken into account.

Whether or not the impact can be mitigated and the extent to which it can be avoided, managed, mitigated, or reversed is assessed i.e. the probability of occurrence after mitigation has been applied. This also takes into account likelihood of human error based on construction and operational auditing experience i.e. even though spills can be completely mitigated against and prevented, there is always a small chance that spills will still occur (residual risk). Based on all of these factors, the impact is then rated to determine its significance. For example an impact can have a regional affect with severe environmental implications, however the probability of it occurring is very low, and the implementation of the proposed mitigation measures means that the ultimate rating is medium or low.

Please see below a description of the scoring. The full impact scoring tables detailing how the significance rating was calculated can be found in Appendix H.

Scoring of Impacts	
Duration / Frequency of activity likely to cause impact	0 = No impact 1 = short term / once off 2 = medium term / during operation 3 = long term / permanent
Geographical Extent	0 = No impact 1 = point of impact / restricted to site 2 = local / surrounding area 3 = regional
Severity (level of damage caused) if impact were to occur	0 = No impact

	1 = minor 3 = medium 5 = major
Probability of impact without mitigation	1 - 5 = low. 6 -10 = medium. 11 -14 = high.
Significance before application of Mitigation Measures	A score of between 1and 5 is rated as low. A score of between 6 and 10 is rated as medium. A score of between 11 and 14 is rated as high.
Will activity cause irreplaceable loss of resources?	10 = Yes 0 = No
Mitigation measures	0 = No impact - 5 = can be fully mitigated - 3 = can be partially mitigated -1 = unable to be mitigated
Probability of impact after mitigation	0 = No impact 1 = Low 2 = Medium 3 = High
Significance after application of Mitigation Measures	A score of between 1and 5 is rated as low. A score of between 6 and 10 is rated as medium. A score of between 11 and 14 is rated as high.

6.2 Preferred Site and Technology Alternative

RC1-2 (Structure and Site Specific)

See Appendix H for the full impacts scoring matrix, which assesses the impacts on the above system. The below impacts relate to the site specific preferred site and technology alternatives.

No.	Nature and Consequences of impact	Sig. rating of impacts ² :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
Construction				
Direct Impacts				
1.	There is the potential for erosion to take place within the tributaries of the Bazangoma and Mpipambi Rivers resulting in downstream sedimentation of this eroded material. This is attributed to the clearing and the operation of the construction site within the tributaries of the Bazangoma and Mpipambi Rivers.	7 (Medium)	The following measures must be carried out to mitigate against erosion on the RC1-2 sites: <ul style="list-style-type: none"> The areas of the tributaries of the Bazangoma and Mpipambi Rivers that are not within the direct project footprint must be demarcated as 'no-go' areas. All construction activities occurring within the tributaries of the Bazangoma and Mpipambi Rivers must be done so with extreme care to avoid any erosion taking place in the watercourse. All areas upstream and downstream of construction footprint must be demarcated as a 'no-go' zone for the duration of the construction process. No site staff are permitted to enter these areas. Areas exposed to erosion must be protected through the use of sand bags, berms and efficient construction processes i.e.: limiting the extent (footprint) and duration period that areas are exposed. The contractor must limit in-stream work to minimize streambank and bed disturbance. 	5 (Low)

² See Appendix H for more details.

No.	Nature and Consequences of impact	Sig. rating of impacts ² :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
			<ul style="list-style-type: none"> • Construct culverts in the dry season. • No excavated material or fill material may be stored within the tributaries of the Bazangoma and Mpipambi Rivers or within 32m of the tributaries of the Bazangoma and Mpipambi Rivers. • Bedding material that will be used must not be stored within 32m of the tributaries of the Bazangoma and Mpipambi Rivers before it is used. 	
2.	<p>There is the potential for sedimentation to take place within the tributaries of the Bazangoma and Mpipambi Rivers due to the temporary crossing. The sedimentation may be minor to continual usage of the crossing or major due to a complete failure of crossing</p>	7 (Medium)	<p>The following measures must be carried out to mitigate against sedimentation due to the usage of the temporary crossing:</p> <ul style="list-style-type: none"> • The entire temporary crossing must be lined with sandbags to avoid sediment water interfaces. • Any damage to the temporary crossing must be immediately repaired by the contractor. • Any blockages of the concrete pipes must be removed as soon as possible. • The temporary crossing must be designed as to allow for the flow in the river to be maintained. i.e. the structure must not cause a damming effect within the river. 	5 (Low)
3.	<p>The habitat for fauna living within the construction footprint will be modified due to the excavation and construction activities taking place within the tributaries of the Bazangoma and Mpipambi Rivers.</p>	7 (Medium)	<p>The following measures must be carried out to mitigate against excessive habitat destruction on the pipe culvert sites:</p> <ul style="list-style-type: none"> • Erosion prevention and sediment control measures must be implemented. Temporary and permanent erosion control methods may include silt fences, interceptor ditches, seeding and sodding, riprap of exposed embankments, and mulching; • The project footprint must be kept as small as possible; • Direct impacts to tributaries of the Bazangoma and Mpipambi Rivers and Channelled Valley Bottom wetland substrate/habitat outside the construction footprint must be avoided by ensuring the tributaries of the Bazangoma and Mpipambi Rivers and the Channelled Valley Bottom wetland outside the construction footprint is demarcated as a 'no-go' zone during construction. • Heavy machinery must not be permitted to move beyond the demarcated footprint; • Sand and aggregate for concrete must not be obtained from within the riverbed or riparian zone but must be sourced from a permitted source; 	5 (Low)

No.	Nature and Consequences of impact	Sig. rating of impacts ² :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
			<ul style="list-style-type: none"> • A spill containment plan is required to be in place prior to construction to minimize the potential impacts of spills or leaks of hazardous substances; • Contamination of the river system with unset cement or tributaries of the Bazangoma and Mpipambi Rivers must be prevented as it is detrimental to aquatic biota. 	
4.	Clearing of the two pipe culvert sites (RC1 and RC2) resulting in the loss of vegetation within the Paulpietersburg Moist Grassland. There will be clearing of up to 79.36m ² of vegetation for the construction of the two pipe culverts.	7 (Medium)	<p>The following measures must be carried out to mitigate against excessive vegetation clearing on the two pipe culvert sites:</p> <ul style="list-style-type: none"> • This impact cannot be fully mitigated as it will result in the loss of 79.36m² of indigenous vegetation found within the Paulpietersburg Moist Grassland (Gm 15) vegetation type. • The vegetation that will be cleared must be restricted to the construction footprint of the pipe culverts. No vegetation may be cleared within the tributaries of the Bazangoma and Mpipambi Rivers other than that required for access to the site or for the construction activities associated with the construction of the pipe culverts. • Contractors must avoid damaging any vegetation that is not within the construction footprint; • The ECO must be consulted should a tree or any vegetation require clearing outside of the designated construction footprint area. 	3 (Medium)
5.	Removal of alien invasive vegetation found within the pipe culvert construction sites.	0 (Positive)	This is a positive impact.	0 (Positive)
6.	Careless operation by the contractor within the tributaries of the Bazangoma and Mpipambi Rivers resulting in damage to these River tributaries, i.e. the riverbed, banks and riparian zones within the construction footprint and adjacent areas	6 (Medium)	<p>The following measures must be carried out to mitigate against potential damage to the tributaries of the Bazangoma and Mpipambi Rivers wetland during construction activities:</p> <ul style="list-style-type: none"> • Areas of the tributaries of the Bazangoma and Mpipambi Rivers not within the construction footprint must be demarcated as no-go areas; • Heavy vehicles must avoid working near the tributaries of the Bazangoma and Mpipambi Rivers and Channelled Valley Bottom wetland as far as possible; • A 32m buffer must be imposed on the rest of the tributaries of the Bazangoma and Mpipambi Rivers and Channelled Valley Bottom wetland with no traffic, vehicles or storage permitted within this buffer zone; • Vehicles may not cross the tributaries of the Bazangoma and Mpipambi Rivers at any 	2 (low)

No.	Nature and Consequences of impact	Sig. rating of impacts ² :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
			<p>other point than the construction footprint;</p> <ul style="list-style-type: none"> Non-essential equipment and vehicles are to remain at least 32m from the tributaries of the Bazangoma and Mpipambi Rivers at all times. 	
7.	Disturbance of the sites (RC1 and RC2) due to construction activities resulting in the encroachment of alien vegetation into disturbed areas i.e. Castor Oil.	6 (Medium)	<p>There is currently alien vegetation located within the surrounding area.</p> <ul style="list-style-type: none"> Alien vegetation must not be allowed to encroach onto the site and must be continually removed during construction. Construction must not promote further alien plant disturbances in the surrounding area 	2 (Low)
Indirect Impacts				
1.	Positive impacts for the community include potential for local employment.	0 (Positive)	This is a positive impact.	0 (Positive)
Operation				
Direct Impacts				
1.	Flood events overtopping the pipe culvert structures (located at RC1 and RC2) damaging the structure integrity of the structures, and making the way impassable for vehicles and pedestrians.	10 (Medium)	<p>The dimensions of the pipe culvert structures have been designed according to the hydrological characteristics (e.g. flow rate). Therefore, overtopping of structures by rainfall events is highly unlikely. The following measures must be carried out to mitigate against damage to the structure:</p> <ul style="list-style-type: none"> The contractor must build the pipe culverts as per the approved design, as the pipe culverts have been designed to allow for flows associated with a flood greater than a 1:20 year flood to overtop the structure without causing damage. Conduct regular inspections and maintenance must be conducted on the bridges when required. 	5 (Low)
2.	Potential alteration of flow dynamics within the tributaries of the Bazangoma and Mpipambi Rivers due to poor placement of the pipe culvert components.	9 (Medium)	<p>The following measures must be carried out to avoid potential alteration of flow dynamics within the tributaries of the Bazangoma and Mpipambi Rivers:</p> <ul style="list-style-type: none"> The contractor must construct the pipe culverts as per the approved design, as the bridge has been designed to ensure that the natural flow of the tributaries of the Bazangoma and Mpipambi Rivers is not interrupted; Conduct regular inspections and maintenance must be conducted on the pipe culverts when required. 	5 (low)
3.	Blockages of the proposed pipe culverts at RC1 and RC2 impeding flow of the tributaries of the Bazangoma and Mpipambi Rivers, resulting in flooding or drying out of tributaries of the Bazangoma and Mpipambi Rivers.	10 (Medium)	<p>The pipe culverts must be constructed as per the approved designs</p> <ul style="list-style-type: none"> The pipe culverts that will be constructed in the tributaries of the Bazangoma and Mpipambi Rivers must promote the free flow of water and must not create blockages that would result in sedimentation of the watercourses of the watercourses. 	5 (Low)

No.	Nature and Consequences of impact	Sig. rating of impacts ² :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
			<ul style="list-style-type: none"> Conduct regular inspections and maintenance must be conducted on the pipe culverts when required. 	
11	An increase in hardened surfaces due to pipe culvert designs may increase stormwater runoff resulting in increased erosion of nearby areas and impacting on the tributaries of the Bazangoma and Mpipambi Rivers.	6 (Medium)	<p>The following stormwater management measures must be implemented to prevent erosion:</p> <ul style="list-style-type: none"> Stone pitching stormwater drains must be constructed to direct stormwater flow away from the structure; Gabion mattresses must be used for slope stabilization; Kerb and channel drains may be required along steep sections of the approach roads. 	4 (Low)
Indirect Impacts				
1.	The new pipe culverts will improve the connectivity across the tributaries of the Bazangoma and Mpipambi Rivers.	0 (Positive)	This is a positive impact.	0 (Positive)
2.	Improved storm water management associated with the pipe culverts will prevent further scouring and erosion of the banks associated with the tributaries of the Bazangoma and Mpipambi Rivers.	0 (Positive)	This is a positive impact.	0 (Positive)
Cumulative				
1.	Maintenance will be required for the pipe culverts meaning pedestrians entering the tributaries of the Bazangoma and Mpipambi Rivers.	6 (Medium)	The maintenance of the pipe culverts must only be conducted when required and for short periods of time.	4 (Low)

Bridge at RC4 (Site specific)

See Appendix H for the full impacts scoring matrix, which assesses the impacts on the above system. The below impacts relate to the site specific preferred site and technology alternatives.

No.	Nature and Consequences of impact	Sig. rating of impacts ³ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
Construction				
Direct Impacts				
1.	There is the potential for erosion to take place within the tributary of the Bazangoma River and associated Channelled Valley Bottom wetland resulting in downstream sedimentation of this eroded material due to clearing and the operation of the construction site within the tributary of the Bazangoma River.	7 (Medium)	<p>The following measures must be carried out to mitigate against erosion on the RC4 Bridge site:</p> <ul style="list-style-type: none"> The areas of the tributary of the Bazangoma River and associated Channelled Valley Bottom wetland that are not within the direct project footprint must be demarcated as 'no-go' areas. All construction activities occurring within the tributary of the Bazangoma River must be done so with extreme care to avoid any erosion taking place in the watercourse. All areas upstream and downstream of construction footprint must be demarcated as a 'no-go' zone for the duration of the construction process. No site staff are permitted to enter these areas. Areas exposed to erosion must be protected through the use of sand bags, berms and efficient construction processes i.e.: limiting 	5 (Low)

³ See Appendix H for more details.

No.	Nature and Consequences of impact	Sig. rating of impacts ³ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
			<p>the extent (footprint) and duration period that areas are exposed.</p> <ul style="list-style-type: none"> • The contractor must limit in-stream work to minimize streambank and bed disturbance. • Construct the RC4 Bridge in the dry season. • No excavated material or fill material may be stored within the tributary of the Bazangoma River or within 32m of the tributary of the Bazangoma River. • Bedding material that will be used must not be stored within 32m of the tributary of the Bazangoma River before it is used. 	
2.	<p>There is the potential for erosion to take place within the Channelled Valley Bottom wetland resulting in downstream sedimentation of this eroded material due to clearing and the operation of the construction site within the Channelled Valley Bottom wetland.</p>	6 (Medium)	<p>The following measures must be carried out to mitigate against erosion on the RC4 Bridge site:</p> <ul style="list-style-type: none"> • The areas of the Channelled Valley Bottom wetland that are not within the direct project footprint must be demarcated as 'no-go' areas. • All construction activities occurring within the Channelled Valley Bottom wetland must be done so with extreme care to avoid any erosion taking place in the watercourse. • All areas upstream and downstream of construction footprint must be demarcated as a 'no-go' zone for the duration of the construction process. No site staff are permitted to enter these areas. • Areas exposed to erosion must be protected through the use of sand bags, berms and efficient construction processes i.e.: limiting the extent (footprint) and duration period that areas are exposed. • The contractor must limit in-stream work to minimize streambank and bed disturbance. • Construct the RC4 Bridge in the dry season. • No excavated material or fill material may be stored within the Channelled Valley Bottom wetland or within 32m of the Channelled Valley Bottom wetland. • Bedding material that will be used must not be stored within 32m of the Channelled Valley Bottom wetland before it is used. 	4 (Low)
3.	<p>There is the potential for sedimentation to take place within the tributary of the Bazangoma River and the associated Channelled Valley Bottom wetland due to the temporary crossing. The sedimentation may be minor to continual usage of the crossing or major due to a complete failure of crossing</p>	7 (Medium)	<p>The following measures must be carried out to mitigate against sedimentation due to the usage of the temporary crossing:</p> <ul style="list-style-type: none"> • The entire temporary crossing must be lined with sandbags to avoid sediment water interfaces. • Any damage to the temporary crossing must be immediately repaired by the contractor. • Any blockages of the concrete pipes must be removed as soon as possible. • The temporary crossing must be designed as to allow for the flow in the river to be maintained. i.e. the structure must not cause a damming effect within the river. 	5 (Low)

No.	Nature and Consequences of impact	Sig. rating of impacts ³ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
4.	The habitat for fauna living within the construction footprint will be modified due to the excavation and construction activities taking place within the tributary of the Bazangoma River and associated Channelled Valley Bottom wetland.	7 (Medium)	<p>The following measures must be carried out to mitigate against excessive habitat destruction on the RC4 Bridge site:</p> <ul style="list-style-type: none"> • Erosion prevention and sediment control measures must be implemented. Temporary and permanent erosion control methods may include silt fences, interceptor ditches, seeding and sodding, riprap of exposed embankments, and mulching; • The project footprint must be kept as small as possible; • Direct impacts to tributary of the Bazangoma River and associated Channelled Valley Bottom wetland substrate/habitat outside the construction footprint must be avoided by ensuring the tributary of the Bazangoma River and associated Channelled Valley Bottom wetland outside the construction footprint is demarcated as a 'no go' zone during construction. • Heavy machinery must not be permitted to move beyond the demarcated footprint; • Sand and aggregate for concrete must not be obtained from within the riverbed or riparian zone but must be sourced from a permitted source; • A spill containment plan is required to be in place prior to construction to minimize the potential impacts of spills or leaks of hazardous substances; • Contamination of the river system with unset cement or tributaries of the Bazangoma River and associated Channelled Valley Bottom wetland must be prevented as it is detrimental to aquatic biota. 	5 (Low)
5.	Clearing of the realigned RC4 Bridge site resulting in the loss of vegetation within the Paulpietersburg Moist Grassland (Gm 15) vegetation type. There will be clearing of up to 559m ² of vegetation for the construction of RC4 Bridge.	7 (Medium)	<p>The following measures must be carried out to mitigate against excessive vegetation clearing on the Bridge site:</p> <ul style="list-style-type: none"> • This impact cannot be fully mitigated as it will result in the loss of 559m² of indigenous vegetation found within the Paulpietersburg Moist Grassland (Gm 15) vegetation type. • The vegetation that will be cleared must be restricted to the construction footprint of RC4 Bridge. No vegetation may be cleared within the tributary of the Bazangoma River and associated Channelled Valley Bottom wetland other than that required for access to the site or for the construction activities associated with the construction of the RC4 Bridge. • Contractors must avoid damaging any vegetation that is not within the construction footprint; • The ECO must be consulted should a tree or any vegetation require clearing outside of the designated construction footprint area. 	3 (Low)

No.	Nature and Consequences of impact	Sig. rating of impacts ³ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
6.	Removal of alien invasive vegetation found within the Bridge construction site.	0 (Positive)	This is a positive impact.	0 (Positive)
7.	Careless operation by the contractor within the tributaries of the Bazangoma River and associated Channelled Valley Bottom wetland resulting in damage to the tributaries of the Bazangoma River and associated Channelled Valley Bottom wetland i.e. the riverbed, banks and riparian zones within the construction footprint and adjacent areas	6 (Medium)	The following measures must be carried out to mitigate against potential damage to the tributaries of the Bazangoma River and associated Channelled Valley Bottom wetland during construction: <ul style="list-style-type: none"> • Areas of the tributaries of the Bazangoma River and associated Channelled Valley Bottom wetland not within the construction footprint must be demarcated as no-go areas; • Heavy vehicles must avoid working near the tributaries of the Bazangoma River and associated Channelled Valley Bottom wetland as far as possible; • A 32m buffer must be imposed on the rest of the tributaries of the Bazangoma River and associated Channelled Valley Bottom wetland with no traffic, vehicles or storage permitted within this buffer zone; • Vehicles may not cross the tributary of the Bazangoma River and associated Channelled Valley Bottom wetland at any other point than the construction footprint of the RC4 Bridge; • Non-essential equipment and vehicles are to remain at least 32m from the tributaries of the Bazangoma River and associated Channelled Valley Bottom wetland at all times. 	2 (Low)
8.	Disturbance of the RC4 Bridge site due to construction activities resulting in the encroachment of alien vegetation into disturbed areas i.e. Castor Oil.	6 (Medium)	There is currently alien vegetation located within the surrounding area. <ul style="list-style-type: none"> • Alien vegetation must not be allowed to encroach onto the site and must be continually removed during construction. • Construction must not promote further alien plant disturbances in the surrounding area 	2 (Low)
Indirect Impacts				
2.	Positive impacts for the community include potential for local employment.	0 (Positive)	This is a positive impact.	0 (Positive)
Operation				
Direct Impacts				
1.	Flood events overtopping the Bridge at RC4, damaging the structure integrity of the bridge, and making the way impassable for vehicles and pedestrians.	10 (Medium)	The deck of the structure has been designed to 5m above the natural ground level and therefore the potential of the structure being overtopped is highly unlikely. The following measures must be carried out to mitigate against damage to the structure: <ul style="list-style-type: none"> • The contractor must build the bridge as per the approved design, as the bridge has been designed to allow for flows associated with a flood greater than a 1:20 year flood to overtop the structure without causing damage. • Conduct regular inspections and maintenance must be conducted on the bridge when required. 	5 (Low)
2.	Potential alteration of flow dynamics within the tributaries of the Bazangoma River and associated Channelled Valley Bottom wetland due to poor placement of the piers.	9 (Medium)	The following measures must be carried out to avoid potential alteration of flow dynamics within the tributary of the	5 (Low)

No.	Nature and Consequences of impact	Sig. rating of impacts ³ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
			Bazangoma River and Channelled Valley Bottom wetland: <ul style="list-style-type: none"> The contractor must build the bridge as per the approved design, as the bridge has been designed to ensure that the natural flow of the tributary of the Bazangoma River and associated Channelled Valley Bottom wetland is not interrupted Conduct regular inspections and maintenance must be conducted on the bridge when required. 	
3.	Blockages of the proposed Bridge at RC4 impeding flow of the tributary of the Bazangoma River, resulting in flooding or drying out of tributary of the Bazangoma River and the associated Channelled Valley Bottom wetland.	10 (Medium)	The bridge will be a three-span pier bridge: <ul style="list-style-type: none"> The proposed construction of the Bridge at RC4 must be constructed as per the approved design The piers will allow for the adequate flow of material and debris underneath; The large span between piers will prevent any interruptions to the flow of the watercourses; The bridge that will be constructed in the tributary of the Bazangoma River and the associated Channelled Valley Bottom wetland must promote the free flow of water and must not create blockages that would result in sedimentation of the watercourses. Conduct regular inspections and maintenance must be conducted on the Bridge when required. 	5 (Low)
4.	An increase in hardened surfaces due to a larger bridge design may increase stormwater runoff resulting in increased erosion of nearby areas and impacting on the tributaries of the Bazangoma River and the associated Channelled Valley Bottom wetland.	6 (Medium)	The following stormwater management measures must be implemented to prevent erosion: <ul style="list-style-type: none"> Stone pitching stormwater drains must be constructed to direct stormwater flow away from the structure; Gabion mattresses must be used for slope stabilization; Kerb and channel drains may be required along steep sections of the approach roads. 	4 (Low)
Indirect Impacts				
1.	The new Bridge at RC4 will improve the connectivity across the tributary of the Bazangoma River and the Channelled Valley Bottom wetland.	0 (Positive)	This is a positive impact.	0 (Positive)
2.	Improved storm water management associated with the proposed Bridge at RC4 will prevent further scouring and erosion of the banks associated with the tributary of the Bazangoma River and the associated Channelled Valley Bottom wetland.	0 (Positive)	This is a positive impact.	0 (Positive)
Cumulative				
1.	Maintenance will be required for the proposed Bridge at RC4 meaning pedestrians entering the tributary of the Bazangoma River and the associated Channelled Valley Bottom wetland.	6 (Medium)	The maintenance of the Bridge at RC4 must only be conducted when required and for short periods of time.	4 (Low)

Pipe Culverts (RC1 and RC2) and Bridge (RC4) (Standard Construction Impacts)

See Appendix H for the full impacts scoring matrix, which assesses the impacts on the above system. The below impacts relate to the preferred site and technology alternatives – Generic Impacts.

No.	Nature and Consequences of impact	Sig. rating of impacts ⁴ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
Construction				
Direct Impacts				
No generic direct impacts				
Indirect Impacts				
1.	The increased risk to pedestrians and livestock due to construction activities.	6 (Medium)	The construction activity will pose an increased risk to pedestrians and livestock. <ul style="list-style-type: none"> • Appropriate construction safety signage must be erected to notify of construction activities and potential hazards on site; • Appropriate barriers must be used to cordon off construction excavations, hazardous areas, and areas undergoing construction. • Flagmen must be in attendance to direct traffic where required. 	1 (Low)
2.	On site erosion due to improper management of stormwater by the contractor during construction.	5 (Low)	Areas exposed to erosion must be protected. The following apply to erosion control on site: <ul style="list-style-type: none"> • Sand bags, berms, stone pitching must be used to control erosion from forming during construction. • No excavated material or fill material may be stored within the watercourses or within 32m of the watercourses. • Bedding material that will be re-worked may not be stored within 32m of the watercourses before it is used. • Temporary stormwater measures should be implemented to ensure that material does not wash off the surface into any watercourse during construction. 	1 (Low)
3.	Dusty conditions generated during the construction of the bridge.	5 (Low)	There will be increased dust generated during the construction phase; however, this will be on a temporary basis i.e. the site will be worked continuously for a few months until construction is completed. Further to this: <ul style="list-style-type: none"> • Vehicle speed limits must be reduced to 40km/hr to reduce the amount of dust raised along the gravel roads to and from the site. • The material being transported to the site in the back of the trucks must be covered. • Water carts must be used on site should dust levels elevate to a nuisance level. • Shade cloth is must be utilised for stockpiled materials where required. • The applicant must comply with the National Dust Regulations 	1 (Low)

⁴ See Appendix H for more details.

No.	Nature and Consequences of impact	Sig. rating of impacts ⁴ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
			(Government Notice R827, 2013) with regards to dust levels produced on site.	
4.	Increase in heavy truck traffic along the P303 Road as construction vehicles travel to the site for construction activities, impacting existing traffic conditions and pedestrians.	6 (Medium)	<p>This cannot be avoided as traffic will increase during the construction phase temporarily (for a few months) until construction is completed.</p> <ul style="list-style-type: none"> All drivers associated with the construction must operate within the speed limits and due caution must be exercised especially when pedestrians are on the road. All drivers must be appropriately licenced and trained. 	1 (Low)
5.	Impact on any unidentified existing services on site.	8 (Medium)	<p>No services identified on the site that will be impacted on:</p> <ul style="list-style-type: none"> As a standard construction practice the engineer and contractor must identify any potential existing services that may be affected prior to construction. Any infrastructure that is removed must be replaced and any damage caused from construction must be repaired. Should any new power lines be placed on site prior to construction, a 10m buffer must be placed between the existing power lines and the road. 	4 (Low)
6.	Emissions from construction vehicles associated with the proposed structures at RC1, RC2, and RC4.	7 (Medium)	<p>The construction phase of the project will see the increase in vehicles moving through the area which will result in the increase of emissions into the atmosphere.</p> <ul style="list-style-type: none"> All construction vehicles operating on the site must be fitted with the appropriate silencers and exhausts in order to reduce the emissions and noise into the atmosphere. 	5 (Low)
7.	Temporary increase in waste and litter due to the construction process associated with the construction of the tributary of the Bazangoma Rivers.	7 (Medium)	<p>The construction phase of the project will see an increase in construction staff on site and therefore an increase in waste on site.</p> <ul style="list-style-type: none"> Littering will not be permitted on site; Designated waste storage areas with appropriate waste receptacles must be set up within the construction site camp; Waste must be removed from site and disposed of at a registered waste disposal site; Safe disposal slips for the disposal of all waste must be obtained and kept on site as proof of safe disposal. 	2 (Low)
8.	Insufficient number of toilet facilities on site.	9 (Medium)	<p>The increase in construction personnel during the construction phase will require an appropriate number of toilet facilities for the site.</p> <ul style="list-style-type: none"> Appropriate and sufficient toilet facilities (1 toilet per 15 employees) must be provided by the contractor; All toilet facilities must be checked on a daily basis; All toilet facilities must be emptied and cleaned on a weekly basis. 	4 (Low)

No.	Nature and Consequences of impact	Sig. rating of impacts ⁴ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
9.	Inappropriate disposal of toilet waste resulting in the contamination of the environment.	6 (Medium)	The following mitigation measures must be adhered to: <ul style="list-style-type: none"> All toilet facilities on site utilised by the construction personnel must be checked on a daily basis and emptied on a weekly basis by the contractor. A registered waste removal contractor must remove sewage waste from site or sewage waste must be disposed of at a permitted Waste Water Treatment Site; Safe disposal slips for the disposal of effluent waste must be obtained and kept on site as proof of safe disposal. 	1 (Low)
10.	Generation of noise associated with the construction.	6 (Medium)	The construction phase of the project will see the increase in vehicles moving through the area which will result in the increase of noise. <ul style="list-style-type: none"> All construction vehicles operating on site must be fitted with standard silencers to reduce the noise levels produced. 	1 (Low)
11.	Damage to property, fences, or cultivated land during construction.	7 (Medium)	The following mitigation measures must be adhered to: <ul style="list-style-type: none"> All services must be identified prior to construction through notifying surrounding stakeholders prior to any potential traffic congestion; The contractor must create alternative access routes to the properties where required; The contractor must be aware of the stakeholders' movements and where possible, disruptive activities must be scheduled outside of peak traffic hours; Surrounding land owners and stakeholders must be notified prior to disruptive activities during construction; Any infrastructure that gets removed must be replaced and any damage caused from construction must be repaired. 	3 (Low)
12.	Unsustainable sourcing of raw materials such as gravel, sand, water etc. which could result in the promotion of illegal mining operations which can cause significant damage to the environment.	10 (Medium)	The construction of the structures will require raw materials to be sourced and brought to site. <ul style="list-style-type: none"> Contractors must provide proof of sustainable sourcing of materials i.e. permits for quarries and sand winning operations from which stone and sand have been obtained. 	5 (Low)
13.	Positive impacts due to potential for local employment.	0 (Positive)	This is a positive impact.	0 (Positive)
Operation				
Direct Impacts				
No generic direct impacts				
Indirect Impacts				
1.	Positive impacts for the community include potential for local employment.	0 (Positive)	This is a positive impact.	0 (Positive)
Cumulative				
1.	Improved safety along the P303 Road.	0 (Positive)	This is a positive impact.	0 (Positive)

6.3 Site and Technology Alternative 2

Pipe Culverts (RC1 and RC2) (Site specific)

See Appendix H for the full impacts scoring matrix, which assesses the impacts on the above system. The impacts relating to the Alternative 1 and Alternative 2 are very similar, therefore the impacts below include the impacts which differentiate the most between the two alternatives.

No.	Nature and Consequences of impact	Sig. rating of impacts ⁵ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
Construction				
Direct Impacts				
1.	There is a greater potential for erosion to take place within the tributary of the Bazangoma Mpipambi Rivers as the entire box causeway structure will need to be excavated due to the concrete slab.	7 (Medium)	<p>The following measures must be carried out to mitigate against erosion on the site:</p> <ul style="list-style-type: none"> The areas of the tributaries of the Bazangoma and Mpipambi Rivers that are not within the direct project footprint must be demarcated as 'no-go' areas. All construction activities occurring within the tributaries of the Bazangoma and Mpipambi Rivers must be done so with extreme care to avoid any erosion taking place in the watercourse. All areas upstream and downstream of construction footprint must be demarcated as a 'no-go' zone for the duration of the construction process. No site staff are permitted to enter these areas. Areas exposed to erosion must be protected through the use of sand bags, berms and efficient construction processes i.e.: limiting the extent (footprint) and duration period that areas are exposed. The contractor must limit in-stream work to minimize streambank and bed disturbance. Construct the causeway in the dry season. No excavated material or fill material may be stored within the tributaries of the Bazangoma and Mpipambi Rivers and Channelled Valley Bottom wetland or within 32m of the tributaries of the Bazangoma and Mpipambi Rivers Bedding material that will be used must not be stored within 32m of the tributaries of the Bazangoma and Mpipambi Rivers before it is used. 	6 (Medium)
Indirect Impacts				
Indirect Impacts will remain as per Alternative 1				
Operation				
Direct Impacts				
1.	Flood events overtopping the causeway, damaging the structure integrity of the causeway, and making the way impassable for vehicles and pedestrians.	9 (Medium)	<p>The use of concrete boxes must take into account the size of the catchment and flow rates within the channel to avoid the structure from being overtopped.</p> <ul style="list-style-type: none"> Construct the causeway as per the approved designs. Regular inspections and maintenance must be conducted on the causeway. 	7 (Medium)
2.	Blockages of causeway boxes impeding flow of the tributaries of the Bazangoma and Mpipambi Rivers, resulting in flooding or drying out of	9 (Medium)	The following measures must be carried out to avoid potential impacts associated with blockages:	7 (Medium)

⁵ See Appendix H for more details.

No.	Nature and Consequences of impact	Sig. rating of impacts ⁵ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
	tributaries of the Bazangoma and Mpipambi Rivers.		<ul style="list-style-type: none"> • Causeway 1 must be constructed as per the approved design, as to allow for the adequate flow of water and debris under the causeway, which will result in less blockages occurring. • Conduct regular inspections and maintenance must be conducted on the causeway when required. 	
Indirect Impacts				
Indirect Impacts will remain as per Alternative 1				
Cumulative				
Indirect Impacts will remain as per Alternative 1				

Bridge (RC4) (Site specific)

See Appendix H for the full impacts scoring matrix, which assesses the impacts on the above system. The impacts relating to the Alternative 1 and Alternative 2 are very similar, therefore the impacts below include the impacts which differentiate the most between the two alternatives.

No.	Nature and Consequences of impact	Sig. rating of impacts ⁶ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
Construction				
Direct Impacts				
2.	There is a greater potential for erosion to take place within the tributary of the Bazangoma River and Channelled Valley Bottom wetland as the entire box causeway structure will need to be excavated due to the concrete slab.	7 (Medium)	<p>The following measures must be carried out to mitigate against erosion on the site:</p> <ul style="list-style-type: none"> • The areas of the tributary of the Bazangoma River and Channelled Valley Bottom wetland that are not within the direct project footprint must be demarcated as 'no-go' areas. • All construction activities occurring within the tributary of the Bazangoma River and Channelled Valley Bottom wetland must be done so with extreme care to avoid any erosion taking place in the watercourse. • All areas upstream and downstream of construction footprint must be demarcated as a 'no-go' zone for the duration of the construction process. No site staff are permitted to enter these areas. • Areas exposed to erosion must be protected through the use of sand bags, berms and efficient construction processes i.e.: limiting the extent (footprint) and duration period that areas are exposed. • The contractor must limit in-stream work to minimize streambank and bed disturbance. • Construct the causeway in the dry season. • No excavated material or fill material may be stored within the tributary of the Bazangoma River and Channelled Valley Bottom wetland or within 32m of the tributary of the Bazangoma River and Channelled Valley Bottom wetland. • Bedding material that will be used must not be stored within 32m of 	6 (Medium)

⁶ See Appendix H for more details.

No.	Nature and Consequences of impact	Sig. rating of impacts ⁶ :	Proposed mitigation and Extent to which impact can be reversed / avoided, managed or mitigated:	Sig. rating of impacts after mitigation:
			the tributary of the Bazangoma River before it is used.	
Indirect Impacts				
Indirect Impacts will remain as per Alternative 1				
Operation				
Direct Impacts				
3.	Flood events overtopping the causeway, damaging the structure integrity of the causeway, and making the way impassable for vehicles and pedestrians.	9 (Medium)	The use of concrete boxes must take into account the size of the catchment and flow rates within the channel to avoid the structure from being overtopped. <ul style="list-style-type: none"> Construct the causeway as per the approved designs. Regular inspections and maintenance must be conducted on the causeway. 	7 (Medium)
4.	Blockages of causeway boxes impeding flow of the tributary of the Bazangoma River, resulting in flooding or drying out of tributary of the Bazangoma River and the Channelled Valley Bottom wetland.	9 (Medium)	The following measures must be carried out to avoid potential impacts associated with blockages: <ul style="list-style-type: none"> The causeway must be constructed as per the approved design, as to allow for the adequate flow of water and debris under the causeway, which will result in less blockages occurring. Conduct regular inspections and maintenance must be conducted on the causeway when required. 	7 (Medium)
Indirect Impacts				
Indirect Impacts will remain as per Alternative 1				
Cumulative				
Indirect Impacts will remain as per Alternative 1				

Pipe Culverts (RC1 and RC2) and Bridge (RC4) (Standard Construction Impacts)

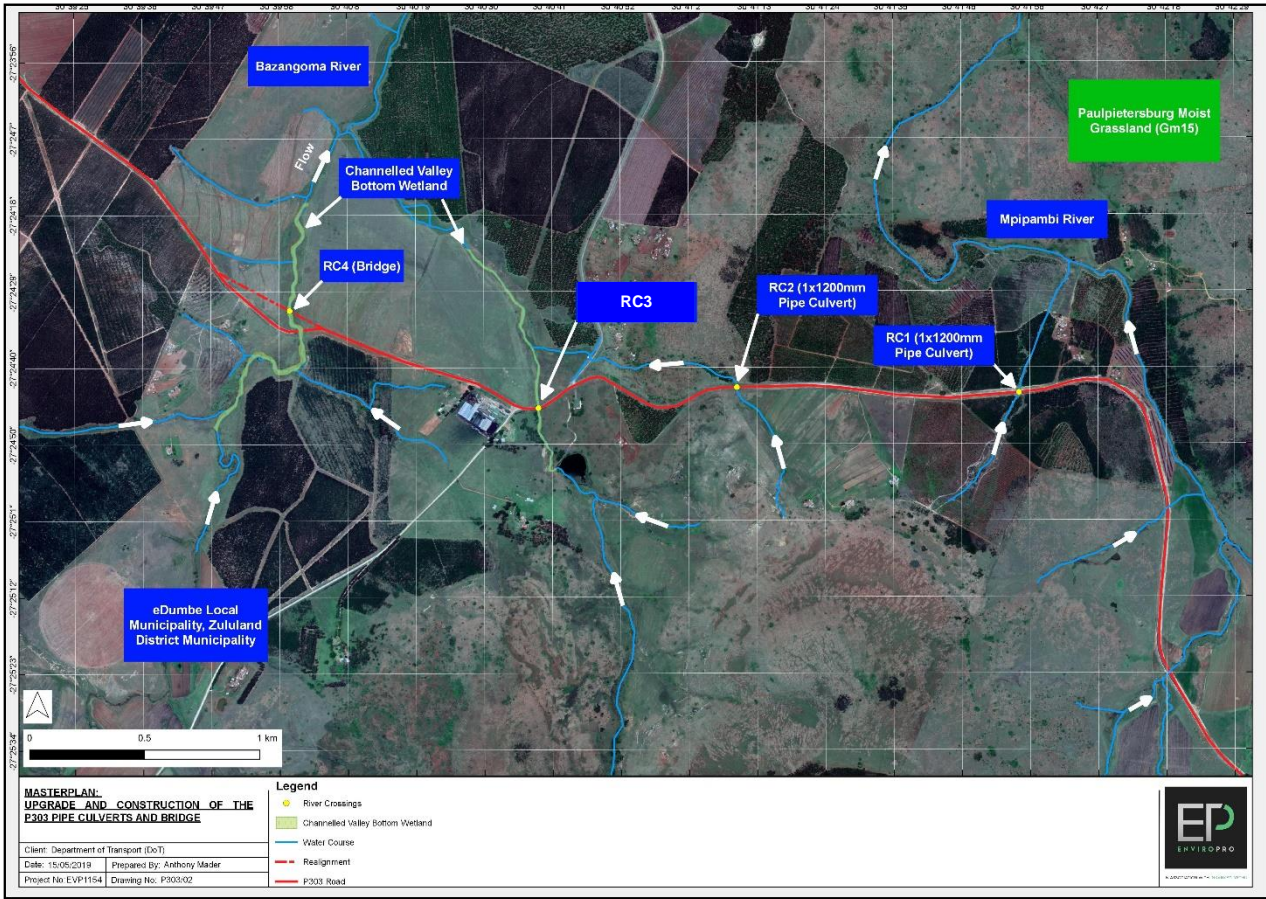
Generic impacts for the two 1 x 1200mm pipe culverts and one bridge will be same for both alternatives.

6.4 Environmental Impact Statement as per section (I)

The key impacts associated with the construction of the three structures within the tributaries of the Bazangoma and Mpipambi Rivers along the P303 relate to those during the construction period. Issues such as damaging the tributaries of the Bazangoma and Mpipambi Rivers and the associated Channelled Valley Bottom wetland at RC4, the management of erosion, and clearing of vegetation need to be addressed. These can be best managed by minimising the clearing of vegetation to the construction footprint, treating the tributaries of the Bazangoma and Mpipambi Rivers and the Channelled Valley Bottom wetlands (RC4) as sensitive no-go area and by implementing effective stormwater management measures. The reparation of RC3 will not negatively impact the associated river. A number of positive impacts may result from the construction of the three structures (i.e. two pipe culverts and one bridge) these relate to improve public safety and improved health and functionality of the aquatic environment. All construction activity must be confined to the proposed construction footprint area. Should a large tree or section of indigenous vegetation require clearing, the ECO must be consulted before clearing takes place. Once construction is complete there should be no significant impacts related to the operation of the culvert as depicted in Figure 13 below.

Taking into consideration the above impacts and mitigation measures, it is the EAP's opinion that the construction of structures at the three tributaries of the Bazangoma and of Mpipambi Rivers (two 1x1200mm pipe culverts at RC1 and RC2) and one tributary of the Bazangoma River (one Bridge at RC4) be authorised.

Figure 13: Aerial photograph showing RC1-4. QGIS ver. 3.2.2.



6.5 Impact Management Objectives and Outcomes for the Development for Inclusion in the EMPr as Per Section 3(m)

The following objectives and outcomes must be considered for this project:

- Objectives:
 - For there to be no lasting negative impacts on the environment once construction is complete, specifically within the tributaries of the Bazangoma and Mpipambi Rivers and Channelled Valley Bottom wetlands.
 - To practice responsible construction, 'best practice' with regards to housekeeping on site during construction (outlined within the EMPr) and enforce the polluter pays principle. The applicant / contractor must be responsible for their actions on site during construction and the rehabilitation of the site post construction.
- Outcomes:
 - To promote sustainable development. Create infrastructure and an environment that is healthy and sustainable for future generations to come.

6.6 Assumptions, Uncertainties and Gaps in Knowledge Relating To the Assessment and Mitigation Measures Proposed As Per Section 3(o)

No vegetation studies have been conducted on site to inform this assessment of the vegetation species surrounding both the sites. Given the minimal clearing of vegetation required for the project, the temporary nature and small-scale construction planned within the tributaries of the Bazangoma and Mpipambi Rivers and Channelled valley Bottom wetlands, specialist input with regards vegetation was not deemed necessary for this assessment.

6.7 Period for Which Authorization Is Required, Proposed Monitoring and Auditing and Post Construction Requirement's

Environmental authorisation is required for the construction of the three tributaries of the Bazangoma and Mpipambi River structures either within the 2019 or 2020 business plan for the Department of Transport, therefore the authorization would need to be valid for a period of five years, within which time construction would need to commence.

Given the nature of this project, it is recommended that **monthly** ECO audits be carried out for the duration of the construction phase of this project. One post construction audit should be conducted once construction is complete.

The EMPr details the post construction, rehabilitation, and closure objectives which will be monitored by the ECO and compliance authorities.

6.8 Financial Provisions as Per Section 3(s)

The contractor is responsible for and must ensure that the site has been rehabilitated in full before leaving the site. No upfront financial provision is required for this project.

6.9 EAP Opinion on Whether Or Not to Authorize Activity and Recommendations and Conditions for Authorisation as Per Section 3(n) and (p)

With respect to the site and technology alternatives, it is recommended that preferred alternatives 1 be authorised. The significance of the impacts associated with the construction of the bridges is considered 'low'.

6.10 Summary of Recommendations for the construction of the tributaries of the Bazangoma and Mpipambi Rivers:

Stakeholders, Properties & Services

- As standard construction practices the engineer and contractor should identify all existing services that may be affected prior to construction.
- The contractor should liaise with local community members regarding restriction of access during construction.

Traffic & Construction Pedestrians

- The contractor must take into consideration the potential movements of surrounding stakeholders.
- Appropriate signage and barriers must be used to cordon off construction areas.
- All construction vehicles should be fitted with the appropriate silencers and exhausts.
- Speed limits must be obeyed.

Housekeeping, waste management, storage, and materials handling

- Littering must not be permitted on site.
- All hazardous materials and substances should be stored within a secured area in the construction camp. The storage area should be a hard surfaced, bunded, and covered area.
- Cement mixing must be done on a hard surface that is protected from storm water runoff.
- Contractors should be required to dispose of construction rubble at an appropriate landfill site. Delivery notes and safe disposal certificates to prove appropriate disposal should be available.
- Appropriate and sufficient toilet facilities must be provided by the contractor.
- Toilet facilities must be provided by a registered company and all sewage must be disposed of at an appropriate facility. Safe disposal certificates must be kept on record.
- Toilet facilities must not be located within 32m of any watercourse.

Dust and erosion control

- A water cart should be used to dampen dusty surfaces and suppress dust.
- Exposed areas should be rehabilitated and re-vegetated as soon as possible during construction.
- Areas exposed to erosion must be protected through the use of sand bags, berms and efficient construction processes i.e.: limiting the extent (footprint) and duration period that areas are exposed. The contractor must ensure that any blockages created during construction are resolved.

Stormwater management and protection of the watercourse

- The engineer/contractor must ensure that only clean storm water runoff enters the environment. Any contaminated run off must be collected and disposed of.

- All watercourse must be identified and demarcated at the start of construction.
- No excavated material or fill material may be stored within the drainage line or within 32m of any watercourse.
- Only the area directly in the path of construction may be cleared and excavated. The remainder of the watercourse must be demarcated as a 'no-go' area.
- Heavy vehicles should avoid working near the watercourse as much as possible.
- Stormwater may not be channelled directly into any water body without the flow velocity being slowed. Channelled flows must be diffused.

Protection of Heritage Resources

- Attention is drawn to the South African Heritage Resources Act, 1999 (Act No. 25 of 1999) and the KwaZulu-Natal Heritage Act (Act no 4 of 2008) which, requires that operations that expose archaeological or historical remains should cease immediately, pending evaluation by the provincial heritage agency.

Specific conditions

- The construction footprint of the bridges must be demarcated;
- Ensure that the construction activities do not interrupt flow even during low flow periods;
- Vehicles must only use the designated crossing points;
- Heavy vehicles must remain at least 32m away from the tributaries of the Bazangoma and Mpipambi Rivers and Channelled Valley Bottom wetlands, unless required for construction purposes;
- No storage may occur within 32m of the tributaries of the Bazangoma and Mpipambi Rivers and Channelled Valley Bottom wetlands; and
- Stormwater outlets must be fitted with erosion protection features to diffuse flow.

Appendix A: Drawings and Maps

Appendix B: Specialist Reports

Appendix C: Noticeboard

Appendix D: Notification

Appendix E: Adverts

Appendix F: Registered I &Aps

Appendix G: Comments and Responses

Appendix H: Impacts Scoring Matrix

Appendix I: EAP Declaration

Appendix J: Environmental Management Programme