BASIC ASSESSMENT REPORT:

THE UPGRADING OF THE RIMER'S WATER TREATMENT (PURIFICATION) WORKS, BARBERTON

Report prepared for: Umjindi Local Municipality

Report dated: June 2015 (draft)

Report number: BA 2015/01

DARDLEA Ref. no.: 1/3/1/16/1E-8

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PROJECT INFORMATION SUMMARY

PROJECT TITLE	The upgrading of the Rimer's Water Treatment (Purification) Works, Barberton

CLIENT	Umjindi Local Municipality
CONTACT DETAILS	PO Box 33 Barberton 1300

CONSULTANT	Clean Stream Environmental Services
CONTACT DETAILS	P.O. Box 647 Witbank 1035 013-697 5021

CSES REFERENCE NO.	BA 2015/01
DARDLEA REF. NO.	1/3/1/16/1E-8

REPORT VERSION	Draft Basic Assessment Report – Version 1
DATE	June 2015
REPORT VERSION	Version 1

COMPILED BY:

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Adie Erasmus *Pr. Sci. Nat.*
Managing Member

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1. INTRODUCTION

The Umjindi Local Municipality proposes to upgrade the Rimer's Water Treatment (Purification) Works (that supplies Barberton and Umjindi with potable water) from 10Ml/d to a total treatment capacity of 15Ml/d.

The Rimer's Water Treatment (Purification) Works is located on the Remaining Extent of Portion 14 of the farm Barberton Townlands 369 JU, within the Barberton Private Nature Reserve, to the southeast of Barberton. The site can be accessed via a gravel road from Lee Street in Barberton. An area to the eastern side of the existing fenced works area has been identified for the new infrastructure.

The Minister of Environmental and Water Affairs listed in terms of Sections 24(2), 24(5), 24D and 44, read with section 47A(1)(b) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), a number of activities that require an environmental impact assessment (either a Basic Assessment or a full Environmental Impact Assessment) before undertaking these activities.

The proposed activity would involve the following listed activities as identified in terms of Section 24(2) and 24D of the National Environmental Management Act, 1998:

Listing	Description
Listing Notice 1 (GN R983), Listed Activity 9:	The development of infrastructure exceeding 1000 metres in length for the transportation of water or storm water (i) with an internal diameter of 0.36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where (a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve; or (b) where such development will occur within an urban area.
Listing Notice 1 (GN R983), Listed Activity 12:	The development of (i) canals exceeding 100 square metres in size; (ii) channels exceeding 100 square metres in size; (iii) bridges exceeding 100 square metres in size; (iv) dams, where the dam, including infrastructure and water surface area, exceeds 100 square metres in size; (v) weirs, where the weir, including infrastructure and water surface area, exceeds 100 square metres in size; (vi) bulk storm water outlet structures exceeding 100 square metres in size; (vii) marinas exceeding 100 square metres in size; (viii) jetties exceeding 100 square metres in size; (ix) slipways exceeding 100 square metres in size; (x) buildings exceeding 100 square metres in size; (xi) boardwalks exceeding 100 square metres in size; or (xii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a water course;- excluding (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; or (ee) where such development occurs within existing roads and road reserves.
Listing Notice 1 (GN R983), Listed Activity 19:	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from (i) a watercourse; (ii) the seashore; or (iii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater but excluding where such infilling, depositing, dredging, excavation, removal or moving – (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or (c) falls within ambit of activity 21 in this Notice, in which case that activity applies.

Listing Notice 1 (GN R983), Listed Activity 27:	The clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.
Listing Notice 1 (GN R983), Listed Activity 45:	The expansion of infrastructure for the bulk transportation of water or storm water where the existing infrastructure (i) has an internal diameter of 0.36 metres or more; or (ii) has a peak throughput of 120 litres per second or more; and (a) where the facility or infrastructure is expanded by more than 1000 metres in length; or (b) where the throughput capacity of the facility or infrastructure will be increased by 10% or more; excluding where such expansion (aa) relates to transportation of water or storm water within a road reserve; or (bb) will occur within an urban area.

In order to obtain environmental authorisation, a Basic Assessment must be conducted as described in Regulations 19 and 20 of the Environmental Impact Assessment Regulations 2014 as promulgated in terms of Section 24(5) and 44 of the National Environmental Management Act, 1998 (Act 107 of 1998).

The objective of the Basic Assessment process is, through a consultative process:

a) Determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
b) Identify the alternatives considered, including the activity, location, and technology alternatives;
c) Describe the need and desirability of the proposed alternatives;
d) Through the undertaking of an impact and risk assessment process inclusive of cumulative impacts which focussed on determining the geographical, physical, biological, social, economic, heritage and cultural sensitivity of the sites and locations and the risk of impact of the proposed activity and technology alternatives on these aspects to determine: (i) the nature, significance, consequence, extent, duration and probability of the impacts occurring; and (ii) degree to which these impacts (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated.
e) Through a ranking of the site sensitivities and possible impacts the activity and technology alternatives will impose on the sites and location identified through the life of the activity to: (i) identify and motivate a preferred site, activity and technology alternative; (ii) identify suitable measures to avoid, manage or mitigate identified impacts; and (iii) identify residual risks that need to be managed and monitored.

Clean Stream Environmental Services was appointed as independent environmental consultant to conduct the required Basic Assessment and compile the necessary documentation. This Basic Assessment Report (BAR) is compiled in accordance with Appendix 1 of the Environmental Impact Assessment Regulations, 2014 and indicates the environmental outcomes, impacts and residual risks of the proposed activity.

2. DETAILS OF THE PROJECT APPLICANT AND ENVIRONMENTAL CONSULTANT

Name and address of applicant:	
Umjindi Local Municipality P.O. Box 33 Barberton 1300	
Contact Person:	Mr. D.P. Msibi
Telephone number:	013 – 712 8800
Fax number:	013 – 712 5120
Cell number:	082 400 4813
E-mail:	mm@umjindi.gov.za

Name and address of environmental consultant:	
Clean Stream Environmental Services P.O. Box 647 Witbank 1035	
Contact persons:	Mrs. A. Erasmus *Pr. Sci. Nat.* Ms. R. Janse van Rensburg
Cell number:	083 271 8260
Telephone number:	013-697 5021
Fax number:	013-697 5021
Email:	adie@cleanstreamsa.co.za riana@cleanstreamsa.co.za

A copy of the application form and the declaration of independence by the applicant and environmental consultant are provided in Appendix 1.

A copy of the Curriculum Vitae of both Mrs. A. Erasmus and Ms. R. Janse van Rensburg are provided in Appendix 2 together with a list of projects completed to date.

3. DESCRIPTION OF THE ACTIVITY

3.1 Description of the existing Rimer's Water Treatment Works

The Rimer's Water Treatment (Purification) Works is owned by the Umjindi Local Municipality and supplies Barberton and Umjindi with potable water. The said Works is registered in terms of Section 26 of the National Water Act, 1998 (Act 36 of 1998) as a CLASS B WORKS with regards to the purification/treatment of water. A copy of the registration certificate is provided in Appendix 3.

3.1.1 Description of existing WTW

The main source of water for the Rimer's Creek WTW is the Lomati Dam, constructed in the Lomati River. The dam has an effective capacity of 4.6 million m^3. The surface area at full supply level is 57ha. The catchment area of the dam is approximately 31.2km^2 with an average Mean Annual Precipitation (MAP) of 975mm. The estimated Mean Annual Runoff (MAR) for the Lomati River (at the dam) is approximately 9 million m^3.

Water from the Lomati Dam flows through the Saddleback Tunnel (Photo 3.1) and is released into the Rimer's Creek Weir located upstream of the Works (Photo 3.2). From the diversion weir (Photo 3.3), water is diverted via a 300mm diameter steel gravity supply pipeline (Photo 3.4) to the Works.

Photo 3.1: View of Saddleback Tunnel (close to outfall) (taken from Kotze, 2015)

Photo 3.2: View of Lomati water transfer site (taken from Kotze, 2015)

Photo 3.3: View of diversion weir (taken from Kotze, 2015)

Photo 3.4: View of pipeline (taken from Kotze, 2015)

The existing Rimer's WTW has a treatment capacity of 10Ml/day and consists of the following components:

- 300mm diameter steel pipe from diversion weir to flocculation column;
- Flocculation column;
- Pressure control tower;
- Backwater reservoir;
- 400 mm diameter and 350mm diameter steel pipes to Works;
- Flow control chamber;
- Existing rapid sand filters;
- Existing slow sand filters (not in use);
- Chlorine dosing room;
- Chlorine contact tank;
- Lime dosing and storage room;
- Chemical dosing room;
- Lapa;
- Gravel access road to Works;
- Dirt road to diversion weir.

Figure 3.1 provides the layout of the existing Rimer's Water Treatment Works while Figure 3.2 provides an aerial view thereof.

CoordInate LIst			
Name	Y-Coord	X-Coord	Z-Coord
BM1	-6364.561	2854407.020	957.808
BM2	-6429.015	2854389.036	964.714
BM3	-6500.007	2854359.677	972.938

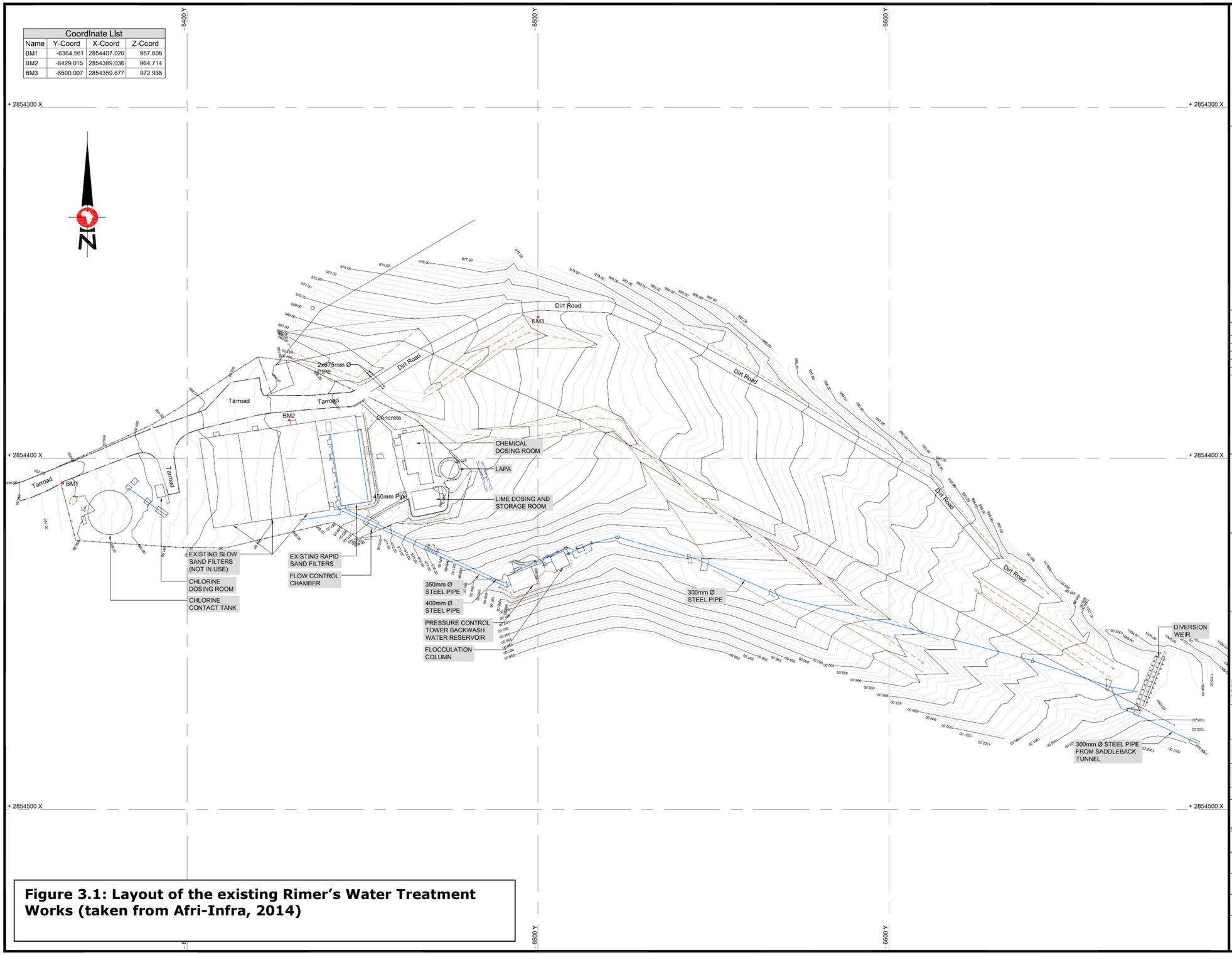

Figure 3.1: Layout of the existing Rimer's Water Treatment Works (taken from Afri-Infra, 2014)

NOTAS/NOTES

LEGENDE/LEGEND

WYSIGINGS/AMENDMENTS

NR./KODE NO./CODE	DATUM DATE	VOORLETTERS INITIALS	BESKRYWING DESCRIPTION

KLIENT/CLIENT

EHLANZENI DISTRICT MUNICIPALITY

PO BOX 3333
NELSPRUIT, 1200
8 VAN NIEKERK STR
NELSPRUIT 1201

TEL (013) 759 8500
FAX (013) 755 3157
e-MAIL :
council@ledc.co.za

PROJEK/PROJECT

DESIGN AND IMPLEMENTATION OF THE UPGRADING OF RIMER'S CREEK WTW

TEKENING TITEL/DRAWING TITLE

LAYOUT PLAN

AFRI-INFRA GROUP (Pty) Ltd
CONSULTING ENGINEERS AND PROJECT MANAGERS
PO BOX 1815
MIDDELBURG, 1050
MIDLANDS OFFICE PARK,
UNIT 9, BLOCK C
2 WALTER SISULU STREET, MIDDELBURG
TEL. (013) 282 8426/8
FAX. (013) 282 8424
e-MAIL : marie@afrihlnfra.com
: hennie@afrihlnfra.com

sanas ISO 9001:2008 AfriCert

ONTWERP DEUR DESIGNED BY	H.S.S.	GETEKEN DEUR DRAWN BY	L.J.B.
ONTWERP NAGESIEN DESIGN CHECKED	B.C.L.	TEKENING NAGESIEN DRAWING CHECKED	B.C.L.

GOEDGEKEUR DEUR/APPROVED BY

FOR AFRI-INFRA GROUP (PTY) LTD. DATE

KONTRAK NR./CONTRACT NO.
EDM/02/20/2014-15

LEER NR./FILE NO.
2014/09-L01

SKAAL/SCALE	SHEET SIZE
1:500	A1

DATUM/DATE
AUGUST 2014

TEKENING NR./DRAWING NO.

2014/09/L01 REV.A

Figure 3.2: Aerial view of the existing Rimer's Water Treatment Works (taken from Afri-Infra, 2014)

3.1.2 Description of existing water treatment process

The existing Rimer's WTW utilizes a conventional water treatment process to produce potable water. The plant currently comprises of the following unit processes:

- Abstraction of raw water;
- Chemical dosing;
- Flocculation (Floc Columns);
- Filtration (Up Flow Filters);
- Disinfection;
- Sludge Handling.

Further details regarding the existing water treatment process are provided in Section 4.5.

According to Afri-Infra (2014), the raw water is of excellent quality (Table 4.1) and may be classified as Type 4 water, with a Total Alkalinity (TA) in the range of 10 to 20 mg/l. Afri-Infra (2014) indicated that this type of water is the most difficult to treat especially when employing sedimentation systems to remove micro determinants.

When treating this type of water, lime must be dosed in sufficient quantities prior to coagulation. This increases the alkalinity of the water and neutralizes the acidification effect of metal coagulants. No lime dosing facilities are currently provided.

Afri-Infra (2014) indicated that the following raw water parameters need to be addressed in view of the findings of the raw and treated water analyses:

- Iron;
- Manganese;
- Water stability.

In addition, it was found that traces of zinc were present in the municipal tap water (sampled at point of use), which could most likely be attributed to the leaching of galvanized pipes and fittings within the distribution network.

In view of the above-mentioned, the upgrading of the existing Rimer's WTW was proposed in order to address the water quality issues.

3.2 Upgrading of the Rimer's Water Treatment Works

The Umjindi Local Municipality proposes to upgrade the Rimer's Water Treatment (Purification) Works from 10Ml/d to a total treatment capacity of 15Ml/d. The upgrading will entail the addition of new unit processes as well as the extension of existing unit processes in an effort to provide clean and potable water to the towns of Barberton and Umjindi.

The concept and viability report with regards to the upgrading of the Rimer's Water Treatment Works (compiled by Afri-Infra Group (Pty) Ltd) is provided in Appendix 3. This report is referred to as Afri-Infra (2014).

3.2.1 Proposed upgraded treatment process

Afri-Infra (2014) indicated that the following unit processes will be required in order to ensure that the treated water complies with the quality requirements:

- Chemical treatment (stabilization and coagulation) – addition of coagulant and lime at one central point;

- Aeration – a hydraulic cascade will be constructed immediately upstream of the WTW;
- Flocculation – two clarifiers (clari-floccular type) will be provided;
- Sedimentation – resultant sludge will be conveyed to the sludge drying beds (refurbished slow sand filters);
- Filtration – one additional up-flow filter system will be constructed. The existing blower will be used to backwash the new filters and not raw water as is currently the practice. Two new backwash pumps will be provided, which will use treated water from the final storage reservoir for backwashing purposes. This water will be recovered and pumped back into the system.
- Disinfection – The pre-chlorination dosing point will be situated in the clarifier feed division box and will be used to allow for oxidation of iron during periods when the iron concentration in the raw water exceeds 1.0mg/l.
- Sludge handling - The sludge disposal system will be upgraded so that wash water and decant from the sludge handling system is returned to the works in order to ensure zero discharge from the works.

Further details regarding this water treatment process is provided in Section 4.5.

3.2.2 Description of proposed upgrading

The following infrastructure will be constructed within the existing fenced works area (Figure 3.3):

- new sedimentation tanks with sludge handling (i.e. convert slow sand filters to sludge drying beds),
- new supernatant facility with recycle pump station,
- 3 new upflow filters,
- new chlorine dosing facility,
- new backwash pump station.

A new aeration facility (2 new clarifiers), a new chemical dosing facility (including a cascade) and new access road will be constructed outside of the existing fenced works area, to the eastern side of the existing WTW (Figure 3.3).

A portion of Rimer's Creek located below the existing weir will be diverted/rerouted into a reinforced concrete lined channel (3.6m depth, 5.0m width, 275m length) that will be provided with a reinforced concrete stilling basin before the water is released back into Rimer's Creek (Figure 3.3). According to Afri-Infra, this will ensure that the new infrastructure is not flooded.

Summary of area to be developed:

- Area within existing fenced works area to be developed = 4200m^2.
- Area outside of existing fenced works area to be developed = 8100m^2 (i.e. for new infrastructure).
- Area of proposed new access road = 1025m^2.
- Diverted/rerouted stream area = 1375m^2.

Coordinate List			
Name	Y-Coord	X-Coord	Z-Coord
BM1	-6364.561	2854407.020	957.808
BM2	-6429.015	2854389.036	964.714
BM3	-6500.007	2854359.677	972.938

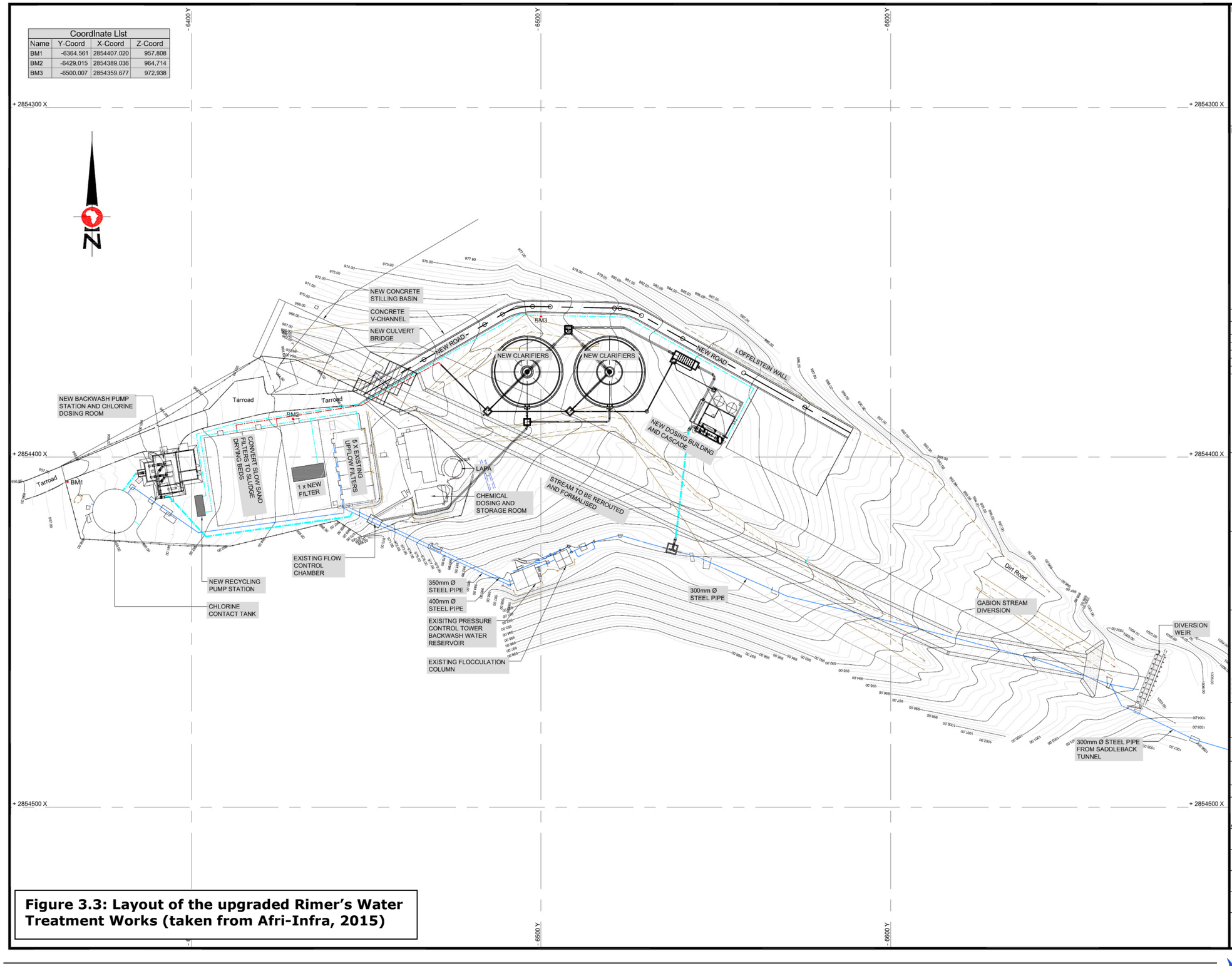

Figure 3.3: Layout of the upgraded Rimer's Water Treatment Works (taken from Afri-Infra, 2015)

NOTAS/NOTES

LEGENDE/LEGEND

= ISSUED FOR CONSTRUCTION =
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CONSULTING ENGINEERS AND PROJECT MANAGERS
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WYSIGINGS/AMENDMENTS

NR./KODE NO./CODE	DATUM DATE	VOORLETTERS INITIALS	BESKRYWING DESCRIPTION

KLIENT/CLIENT
EHLANZENI DISTRICT MUNICIPALITY
PO BOX 3333
NELSPRUIT, 1200
8 VAN NIEKERK STR
NELSPRUIT 1201
TEL (013) 759 8500
FAX (013) 755 3157
e-MAIL :
council@edc.co.za

PROJEK/PROJECT
DESIGN AND IMPLEMENTATION OF THE UPGRADING OF RIMER'S CREEK WTW

TEKENING TITEL/DRAWING TITLE
GENERAL LAYOUT PLAN

AFRI-INFRA GROUP (Pty) Ltd
CONSULTING ENGINEERS AND PROJECT MANAGERS
PO BOX 1815
MIDDELBURG, 1050
MIDLANDS OFFICE PARK,
UNIT 9, BLOCK C
2 WALTER SISULU STREET, MIDDELBURG
TEL. (013) 282 8426/8
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: hennie@afri-infra.com

sanas ISO 9001:2008

ONTWERP DEUR DESIGNED BY	D.T. / K.C. / A.S.C. / F.J.v	GETEKEN DEUR DRAWN BY	L.J.B.
ONTWERP NAGESIEN DESIGN CHECKED	B.C.L.	TEKENING NAGESIEN DRAWING CHECKED	B.C.L.

GOEDGEKEUR DEUR/APPROVED BY
FOR AFRI-INFRA GROUP (PTY) LTD. DATE

KONTRAK NR./CONTRACT NO.
EDM/02/20/2014-15

LEER NR./FILE NO.
2014-09-L01 General Layout

SKAAL/SCALE	SHEET SIZE
1:500	A1

DATUM/DATE
January 2015

TEKENING NR./DRAWING NO.
2014/09-L01 REV.0

3.2.3 Need and desirability of proposed upgrading

The upgrading of the existing Rimer's WTW is needed in order to:

- Provide the increasing population of Barberton and Umjindi with potable water;
- Improve the quality of water produced by the Rimer's Water Treatment Works;
- Address the identified water quality issues in order to ensure potable water;
- Address the water losses in the system – major water losses have been recorded in the creek between the tunnel outlet and the diversion weir;
- Improve the bulk water supply system from the Lomati Dam and Rimer's Water Treatment Works;
- Improve the operation and maintenance of the Rimer's WTW.

3.3 Services required

3.3.1 Water

As indicated in Section 3.1.1, water is obtained from the Lomati Dam via the Saddleback Tunnel.

3.3.2 Electricity

Eskom provides electricity to the Rimer's Water Treatment Works.

3.3.3 Sewage

Ablution facilities are provided as part of the existing facilities. A septic tank is provided.

3.3.4 Waste management

A small amount of general waste is generated that is collected by the Umjindi Local Municipality.

As indicated in Section 3.2.1, the sludge disposal system will be upgraded so that wash water and decant from the sludge handling system is returned to the works in order to ensure zero discharge from the works.

3.3.5 Storm water control measures

Where the two clarifiers will be built, a loffelstein wall (interlocking concrete retaining wall blocks) with a top vdrain will be provided in order to stabilise the steep cut in the mountain and to channel mountain run-off westwards to the new concrete stilling basin (Figure 3.3). In addition, storm water control measures will be provided as part of the new road construction as indicated in Section 3.3.6.

3.3.6 Access road

The upgrading will include the construction of a new 4m wide concrete block paved (CBP) access road (Figure 3.3) of approximately 250m with associated storm water drainage infrastructure and roadside furniture. A culvert bridge will form part of the said road.

According to the TRH4 classification system, the proposed access road will be classified as a category D, Class ES0, 003 road with a bearing capacity of less than 0.03x104 80kN axles/lane. Herewith further details regarding the said road to be built:

ELEMENT OF DESIGN	
Design speed: Ceiling speed:	40km/h 40km/h
VERTICAL/HORIZONTAL ALIGNMENT	
Minimum curve radius:	20m
Minimal horizontal radius:	15m
Maximum gradient:	12%
Minimum gradient:	0.5%
Minimum k-value:	Crest curves:10
Sag curves:	16
CROSS SECTION DESIGN	
Lanes:	One lane, two way
Lane width:	4m
Cross fall:	2.0%
STORM WATER DRAINAGE DESIGN	
Design flood:	1:5 Years (surface run-off) 1:20 Years (major collection systems)
Run-off calculations:	Rational method
Channel design:	Manning's formula
Ngravel:	0.022
Nstone:	0.025
Nconcrete:	0.014
Nasphalt:	0.015
PAVEMENT DESIGN	
Road bed preparation (in-situ or imported)	(150mm) 93% Mod AASHTO (G9) Min CBR = 7; PI <12
Selected layer	(150mm) 95% Mod AASHTO (G7) Min CBR = 15; Max PI = 12
Cemented stabilized sub-base	(150mm) 97% Mod AASHTO mix (C4) UCS 0.75 – 1,5 MPa PI <6
Surfacing	60mm thick concrete block paving (Type S-A)

3.4 Phasing of project

According to the engineers, the construction will take place as follows:

- Phase 1: Construction of new infrastructure (including access road) to the eastern side of the existing WTW;
- Phase 2: Construction of stream diversion;
- Phase 3: Upgrading of existing structures within the existing WTW.

3.5 Nature of the activity

The upgrading of the Rimer's Water Treatment Works would involve the following listed activities as identified in terms of Section 24(2) and 24D of the National Environmental Management Act, 1998:

Listing	Description
Listing Notice 1 (GN R983), Listed Activity 9:	The development of infrastructure exceeding 1000 metres in length for the transportation of water or storm water (i) with an internal diameter of 0.36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where (a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve; or (b) where such development will occur within an urban area.
Listing Notice 1 (GN R983), Listed Activity 12:	The development of (i) canals exceeding 100 square metres in size; (ii) channels exceeding 100 square metres in size; (iii) bridges exceeding 100 square metres in size; (iv) dams, where the dam, including infrastructure and water surface area, exceeds 100 square metres in size; (v) weirs, where the weir, including infrastructure and water surface area, exceeds 100 square metres in size; (vi) bulk storm water outlet structures exceeding 100 square metres in size; (vii) marinas exceeding 100 square metres in size; (viii) jetties exceeding 100 square metres in size; (ix) slipways exceeding 100 square metres in size; (x) buildings exceeding 100 square metres in size; (xi) boardwalks exceeding 100 square metres in size; or (xii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a water course;- excluding (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; or (ee) where such development occurs within existing roads and road reserves.
Listing Notice 1 (GN R983), Listed Activity 19:	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from (i) a watercourse; (ii) the seashore; or (iii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater but excluding where such infilling, depositing, dredging, excavation, removal or moving – (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or (c) falls within ambit of activity 21 in this Notice, in which case that activity applies.
Listing Notice 1 (GN R983), Listed Activity 27:	The clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.
Listing Notice 1 (GN R983), Listed Activity 45:	The expansion of infrastructure for the bulk transportation of water or storm water where the existing infrastructure (i) has an internal diameter of 0.36 metres or more; or (ii) has a peak throughput of 120 litres per second or more; and (a) where the facility or infrastructure is expanded by more than 1000 metres in length; or (b) where the throughput capacity of the facility or infrastructure will be increased by 10% or more; excluding where such expansion (aa) relates to transportation of water or storm water within a road reserve; or (bb) will occur within an urban area.

In order to obtain environmental authorisation, a Basic Assessment must be conducted as described in Regulations 19 and 20 of the Environmental Impact Assessment Regulations, 2014 as promulgated in terms of Section 24(5) and 44 of the National Environmental Management Act, 1998 (Act 107 of 1998).

3.6 Applicable legislation, policies and/or guidelines

Table 3.12 provides an indication of legislation, policies and/or guidelines applicable to the said project. The list below merely serves to highlight key legislation and obligations and is thus not definitive or exhaustive.

Table 3.1: Applicable legislation, policies and/or guidelines

Title of legislation, policy or guideline:	Administering authority:	Aim of legislation, policy or guideline
The Constitution of the Republic of South Africa, 1996 (Act 108 of 1996)	Department of Justice and Constitutional Development	To establish a Constitution with a Bill of Rights for the RSA. It sets out of a number of fundamental environmental rights (Section 24).
Development Facilitation Act, 1995 (Act 67 of 1995) and amendments	Department of Rural Development and Land Reform	To provide for planning and development.
Environment Conservation Act, 1989 (Act 73 of 1989) and amendments	Department of Environmental Affairs	To control environmental conservation.
National Environmental Management Act, 1998 (Act 107 0f 1998) and amendments	Department of Environmental Affairs	To provide for the integrated management of the environment.
National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004) and amendments	Ehlanzeni District Municipality	To reform the law regulating air quality in order to protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting justifiable economic and social development; to provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government; for specific air quality measures; and for matters incidental thereto.
National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) and amendments	Department of Environmental Affairs	To provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act, 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African Biodiversity Institute; and for matters connected therewith.
Alien and Invasive Species Regulations, 1 August 2014	Department of Environmental Affairs	Regulations regarding alien and invasive species.
List of Protected Tree Species under the National Forests Act, 1998 (Act No. 84 of 1998)	Department of Agriculture, Forestry and Fisheries	Provides a list of protected tree species.
National Environmental Management: Waste Act, 2008 (Act 59 of 2008) and amendments	Department of Environmental Affairs	To reform the law regulating waste management in order to protect health and the environment by providing for the prevention of pollution and ecological degradation and for securing ecologically sustainable development.
National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): National List of Ecosystems that are threatened and in need of protection (9 December 2011).	Department of Environmental Affairs	The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to preserve witness sites of exceptionally high conservation value.
National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) and amendments	Department of Environmental Affairs	To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all

Title of legislation, policy or guideline:	Administering authority:	Aim of legislation, policy or guideline
		national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.
Environmental Impact Assessment Regulations, 2014 (Government Gazette No. 38282 of 4 December 2014) and amendments	Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA)	Regulations pertaining to environmental impact assessments.
National Water Act, 1998 (Act 36 of 1998) and amendments	Department of Water and Sanitation	To control water management aspects.
National Veld and Forest Fire Act, 1998 (Act 101 of 1998) and amendments	Department of Agriculture, Forestry and Fisheries	To prevent and combat veld, forest and mountain fires throughout South Africa.
National Heritage Resources Act, 1999 (Act 25 of 1999) and amendments	South African Heritage Resources Agency	This legislation aims to promote good management of the national estate, and to enable and encourage communities to nurture and conserve their legacy so that it may be bequeathed to future generations.
Protection of Personal Information Act, 2013 (Act 4 of 2013)	Department of Justice and Constitutional Development	The purpose of this act is to give effect to the constitutional right to privacy by safeguarding personal information and to regulate the manner in which personal information may be processed.
Promotion of Access to Information Act, 2000 (Act 2 of 2000) and amendments	Department of Justice and Constitutional Development	To give effect to the constitutional right of access to any information held by the State and any information that is held by another person and that is required for the exercise or protection of any rights; and to provide for matters connected therewith.
Promotion of Administrative Justice Act, 2000 (Act 3 of 2000) and amendments	Department of Justice and Constitutional Development	The Act aims to make the administration (e.g. Government and Parastatals) effective and accountable to people for its actions.
Conservation of the Agricultural Resources Act, 1983 (Act 43 of 1989) and amendments	Department of Agriculture, Forestry and Fisheries	To provide control over the utilization of the natural resources of the Republic in order to promote the conservation of soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith.
Occupational Health and Safety Act, 1993 (Act 85 of 1993) and amendments	Department of Labour	To provide for the health and safety of persons at work and for the health and safety of persons in connection with the activities of persons at work and to establish an advisory council for occupational health and safety.
Health Act, 1977 (Act 63 of 1977) and amendments	Department of Health	To promote public health.
National Building Regulations and Standards Act, 1977 (Act 103 of 1977) and amendments	Department of Trade and Industry	To provide for the promotion of uniformity in the law relating to the erection of buildings in the areas of jurisdiction of local authorities; for the prescribing of building standards; and for matters connected therewith.
Various by-laws of the Umjindi Local Municipality, e.g.: ▪ Waste Management; ▪ Street and Miscellaneous; ▪ Spatial Planning and Land Use Management; ▪ Outdoor Advertising.	Umjindi Local Municipality	To regulate land use within the Umjindi Local Municipal area.
Umjindi Local Municipality Integrated Development Plan, 2014/2015 (final)	Umjindi Local Municipality	Broad spatial framework guidelines for the Umjindi Local Municipality.

Title of legislation, policy or guideline:	Administering authority:	Aim of legislation, policy or guideline
Umjindi Local Municipality Integrated Development Plan, 2015/2016 (draft)		
Umjindi Spatial Development Framework 2009	Umjindi Local Municipality	Spatially based policy guidelines whereby changes, needs and growth in the region can be managed to benefit the whole community.
Ehlanzeni District Municipality Integrated Development Plan Review, 2015/2016	Ehlanzeni District Municipality	Broad spatial framework guidelines for the Ehlanzeni District Municipality.
Integrated Environmental Management Guideline Series (Guideline 5 – 10 October 2012) – Companion to the Environmental Impact Assessment Regulations, 2010	Department of Environmental Affairs	To provide clarity on the processes to be followed when applying for an environmental authorisation in terms of the EIA Regulations and gives a comprehensive interpretation of the listed activities.

4. DESCRIPTION OF ALTERNATIVES

4.1 Alternative water treatment works

4.1.1 Upgrading of existing Rimer's WTW

The Rimer's Water Treatment (Purification) Works is located on the Remaining Extent of Portion 14 of the farm Barberton Townlands 369 JU, within the Barberton Private Nature Reserve, to the southeast of Barberton (Figure 5.1).

The Rimer's Water Treatment (Purification) Works is owned by the Umjindi Local Municipality and is the only water treatment works that supplies Barberton and Umjindi with potable water. The said Works is registered in terms of Section 26 of the National Water Act, 1998 (Act 36 of 1998) as a CLASS B WORKS with regards to the purification/treatment of water. A copy of the registration certificate is provided in Appendix 3.

The main source of water for the Rimer's WTW is the Lomati Dam, constructed in the Lomati River. Water from the Lomati Dam flows through the Saddleback Tunnel and is released into the Rimer's Creek Weir located upstream of the Works. From the diversion weir, water is diverted via a 300mm diameter steel gravity supply pipeline to the Works.

As indicated in Section 3.1, existing infrastructure is present that requires upgrading in order to improve the quality and quantity of the water provided to the residents of Barberton and Umjindi.

4.1.2 New water treatment works

A new treatment works was not considered in view of the source of water being the Lomati Dam, the presence of the existing infrastructure transferring the water through the Saddleback Tunnel and the rugged topography of the area making the possibility of constructing a completely new water treatment works impossible.

4.1.3 No Project Option

More information with regards to the implication of the 'No Project Option' is provided in Section 4.5.

4.2 Alternative development sites

4.2.1 Within the existing fenced Rimer's WTW area

As indicated in Section 3.1.1 and Figure 3.1, existing infrastructure is already present within the fenced WTW area. Limited space is however, available for upgrading.

As indicated in Section 3.2.2 and Figure 3.3, the following infrastructure will be constructed within the existing fenced works area (Figure 3.3):

- new sedimentation tanks with sludge handling (i.e. convert slow sand filters to sludge drying beds),
- new supernatant facility with recycle pump station,
- 3 new upflow filters,
- new chlorine dosing facility,
- new backwash pump station.

However, the proposed upgrading requires additional infrastructure that cannot be accommodated within the existing fenced area. In view of this, an additional area outside of the fenced area was identified.

4.2.2 Eastern side of WTW

An area to the eastern side of the existing WTW extending towards the diversion weir was identified for the proposed construction of the additional infrastructure required.

This area slopes evenly westward at a gradient of 1:10 with a slightly steeper gradient closer to the existing WTW. Limited area is however, available in view of the adjacent rugged topography (steep slopes) and the presence of the Rimer's Creek.

This area has already been impacted in terms of the construction of a road that was cut out of the mountain side and the spoil levelled onto the creek bed which subsequently became overgrown.

4.2.3 Western side of WTW

Development to the western side of the existing WTW is not possible as a more or less level area is not available due to the presence of the Rimer's Creek and the rugged topography (steep sloped area).

4.2.4 Combination of sites

In view of the above-mentioned, a combination of sites was decided upon in terms of the upgrading of the Rimer's WTW namely:

- construction of some infrastructure within the fenced Rimer's WTW area;
- construction of additional infrastructure to the eastern side of the existing fenced Rimer's WTW.

4.2.5 No Project Option

More information with regards to the implication of the 'No Project Option' is provided in Section 4.5.

4.3 Alternative layout plans

4.3.1 Layout Plan No. 1 (Figure 4.1)

Figure 4.1 provides Layout Plan No. 1 where the new aeration facility (2 new clarifiers) and new chemical dosing facility (including a cascade) were located in close proximity to the diversion weir.

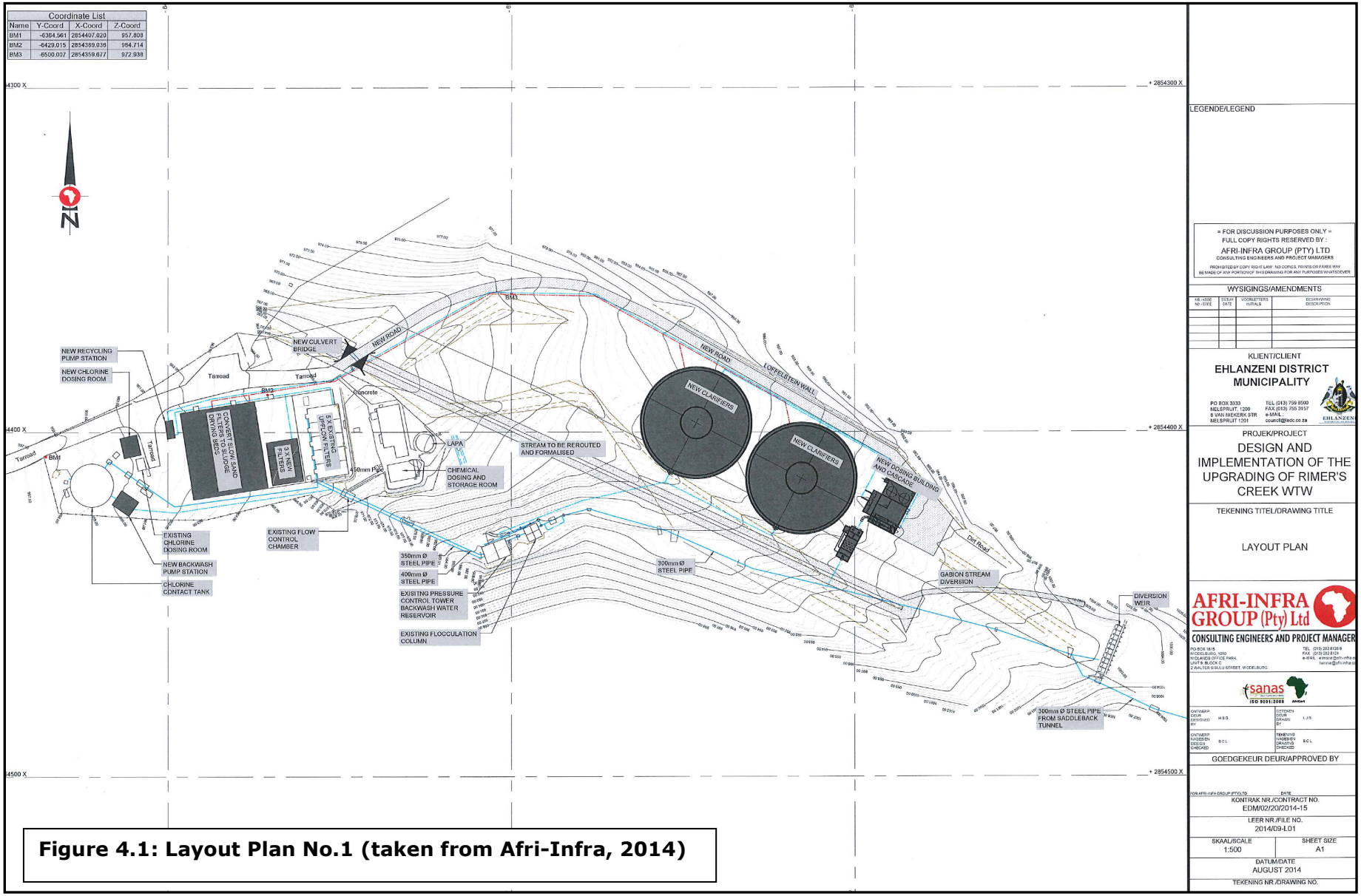

Figure 4.1: Layout Plan No.1 (taken from Afri-Infra, 2014)

According to Afri-Infra, this preliminary layout was based on discussions with the client before any calculations were done.

The engineers (Afri-Infra) indicated that the level of the new infrastructure is governed by the level of the existing filters. Once the required calculations were done, it was found that the infrastructure could move to a lower level nearer the existing WTW reducing the length and cost of the road and pipework required.

In addition, flow calculations indicated that the diameter of the clarifiers would increase requiring more space with a flatter gradient to minimise earthworks.

Based on the above-mentioned, Layout Plan No. 1 was discarded.

4.3.2 Layout Plan No. 2 (Figure 4.2)

Figure 4.2 provides Layout Plan No. 2 where the new aeration facility (2 new clarifiers) and new chemical dosing facility (including a cascade) would be located in close proximity to the existing WTW.

To avoid flooding the new infrastructure, it was decided to formalize and align a section of Rimer's Creek in the vicinity of the extension. A portion of Rimer's Creek located below the existing weir will be diverted/rerouted into a reinforced concrete lined channel (3.6m depth, 5.0m width, 275m length) that will be provided with a reinforced concrete stilling basin before the water is released back into Rimer's Creek (Figure 3.4).

Layout Plan No. 2 is the preferred option.

4.3.3 No Project Option

More information with regards to the implication of the 'No Project Option' is provided in Section 4.5.

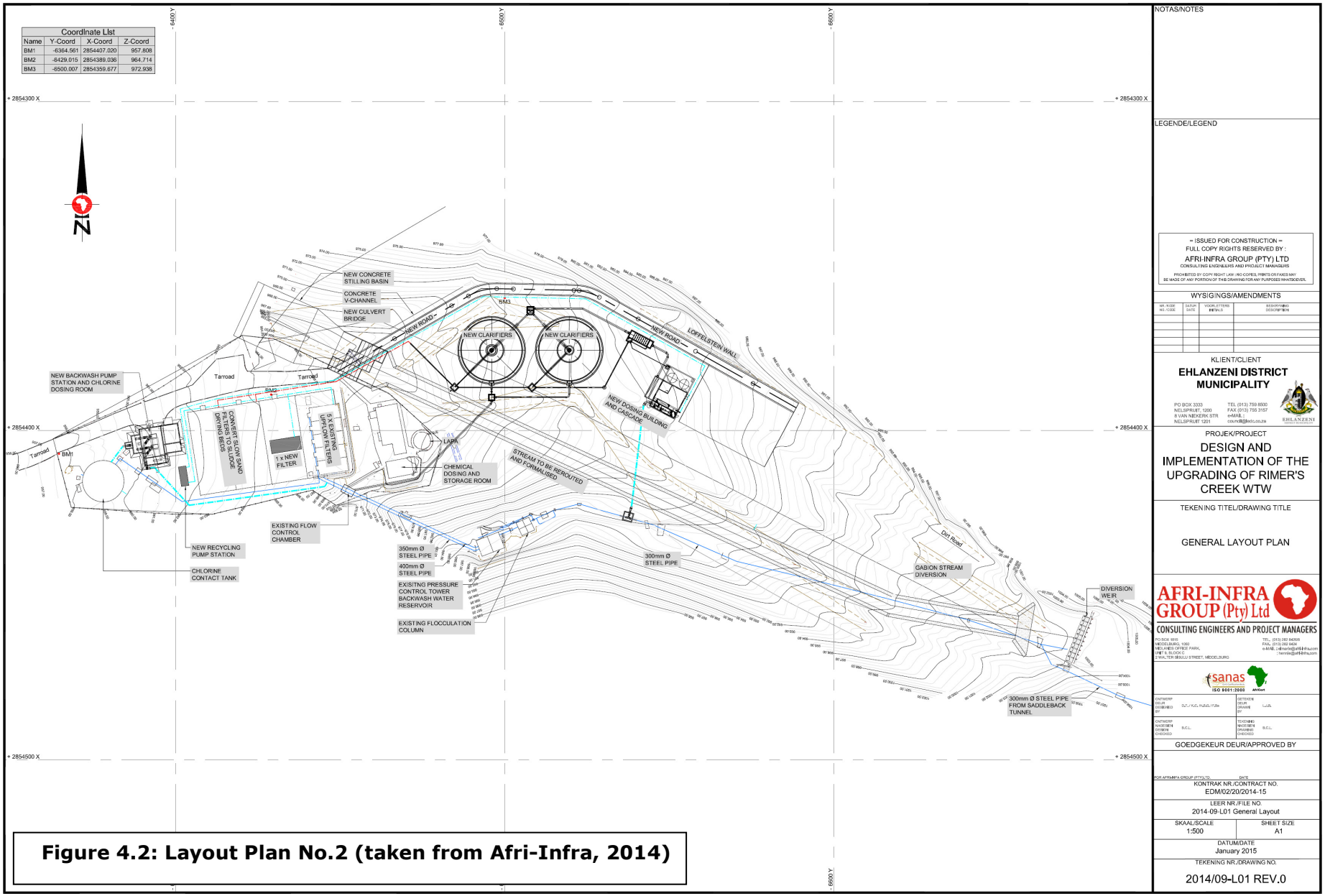

Figure 4.2: Layout Plan No.2 (taken from Afri-Infra, 2014)

4.4 Alternatives in terms of water abstraction

The main source of water for the Rimer's WTW is the Lomati Dam, constructed in the Lomati River. Water from the Lomati Dam flows through the Saddleback Tunnel and is released into the Rimer's Creek Weir located upstream of the Works. From the diversion weir, water is diverted via a 300mm diameter steel gravity supply pipeline to the Works.

According to Afri-Infra (2014), raw water can either be abstracted from the Rimer's Creek diversion weir or from the outlet of the Saddleback Tunnel.

4.4.1 Abstraction of water from the Rimer's Creek diversion weir

Water is currently abstracted from the Rimer's Creek diversion weir instead of at the outlet of the Saddleback Tunnel, since the iron concentration at the diversion weir is generally lower than at the outlet of the Saddleback Tunnel. In addition, the flow of water along the Saddleback Tunnel allows for the successful aeration of the water by the time the water reaches the weir. However, it results in water losses in the creek between the outlet of the tunnel and the weir which is of concern to the Umjindi Local Municipality.

BSL (2000) recommended that Rimer's Creek be lined in order to reduce some of the water losses.

The engineers, Afri-Infra, indicated that the lining of Rimer's Creek from the Saddleback Tunnel outlet to the diversion weir as suggested by BSL (2000) was not considered in view of the following:

- There is an existing pipeline that can be used;
- The proposed upgrade allows for an aeration process that the stream/creek performed.

Continuing to abstract water from the Rimer's Creek diversion weir was discarded in view of the water losses.

4.4.2 Abstraction of water from the outlet of the Saddleback Tunnel

According to Afri-Infra (2014), water will be piped from the Saddleback Tunnel outlet to the WTW as there is an existing pipe in place. The pipeline from the outlet of the Saddleback Tunnel bypasses the weir and connects to an existing pipeline immediately downstream of the weir. The said pipe was installed at great cost by the Umjindi Local Municipality a few years ago in order to address the water losses.

The preferred conveyance system from the Saddleback Tunnel is the bulk pipeline as water losses are then minimized.

If the bulk pipeline is to be used, an aeration system will have to be constructed immediately upstream of the WTW which will have a cost implication in terms of construction and maintenance. Due to the large hydraulic head available, the most feasible aeration system would be a hydraulic cascade. The cascade system will allow the water to be successfully aerated to a minimum acceptable Dissolved Oxygen (DO) level of 4mg/l. The cascade system may also be used to facilitate rapid mixing.

The proposed upgrade will allow for aeration using a hydraulic cascade in order to treat the water to the required standard. In addition, the existing pipeline will be repaired as part of the upgrading project. This option will thus ensure that the expensive existing infrastructure (existing pipeline) is utilised.

This option is the preferred option and addresses the issue of water losses.

4.4.3 No Project Option

More information with regards to the implication of the 'No Project Option' is provided in Section 4.5.

4.5 Alternatives in terms of water treatment process

4.5.1 Existing water treatment process

As indicated in Section 3.1.2, the existing Rimer's WTW utilizes a conventional water treatment process to produce potable water. The plant currently comprises of the following unit processes:

- Abstraction of raw water;
- Chemical dosing;
- Flocculation (Floc Columns);
- Filtration (Up Flow Filters);
- Disinfection;
- Sludge Handling.

Figure 4.3 provides the flow diagram with regards to the existing water treatment process.

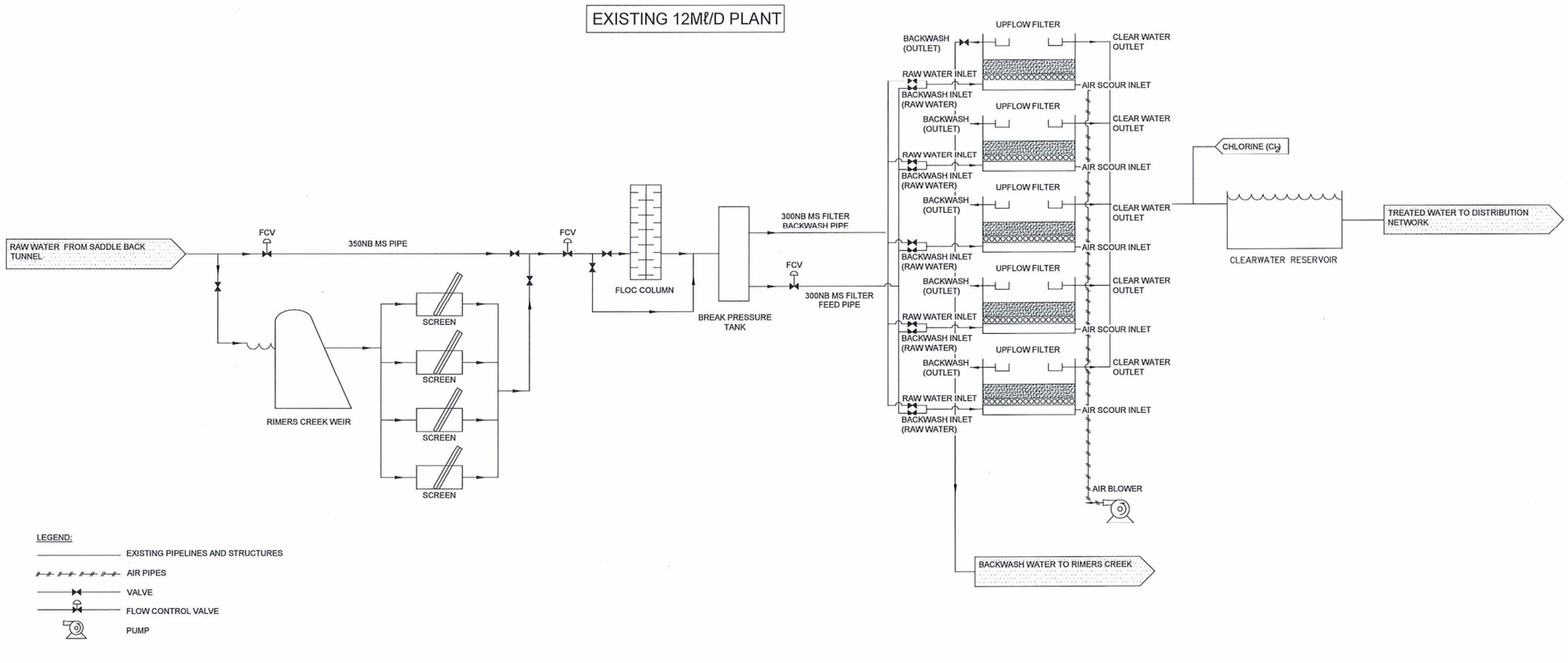

Figure 4.3: Flow diagram of existing water treatment process

NOTAS/NOTES

LEGENDE/LEGEND

WYSIGINGS/AMENDMENTS

NR./KODE NO./CODE	DATUM DATE	VOORLETTERS INITIALS	BESKRYWING DESCRIPTION

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PROJEK/PROJECT

DESIGN AND IMPLEMENTATION OF THE UPGRADING OF RIMER'S CREEK WTW

TEKENING TITEL/DRAWING TITLE

PROCESS FLOW DIAGRAM - EXISTING WTW

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ONTWERP NAGESIEN DESIGN CHECKED	BCL	TEKENING NAGESIEN DRAWING CHECKED	KC

GOEDGEKEUR DEUR/APPROVED BY

FOR AFRI-INFRA GROUP (PTY) LTD. DATE

KONTRAK NR./CONTRACT NO.
EDM/02/20/2014-15

LEER NR./FILE NO.
2014/09-L02 AND L03

SKAAL/SCALE	SHEET SIZE
1:500	A1

DATUM/DATE
AUGUST 2014

TEKENING NR./DRAWING NO.
2014/09-L02 REV.A

4.5.1.1 Raw water abstraction

According to Afri-Infra (2014), raw water can either be abstracted from the Rimer's Creek diversion weir (Photo 3.3) or from the outlet of the Saddleback Tunnel (Photo 3.2).

The gravity supply pipeline that transports water directly from the Saddleback Tunnel (constructed at great cost) is currently not being used as a result of corrosion caused by the high quantity of soluble irons in the raw water (Afri-Infra, 2014).

The iron concentration at the diversion weir is generally lower than at the outlet of the Saddleback Tunnel and this abstraction point is normally used. However, this results in water losses in the creek between the outlet of the tunnel and the weir.

At the weir, the raw water is screened before being conveyed via a pipeline to the Flocculation Column (Figure 3.1).

The pipeline from the outlet of the Saddleback Tunnel bypasses the weir and connects to the above-mentioned pipeline immediately downstream of the weir.

Flow to the WTW is measured by means of magnetic flow meter (magflow) and the rate of flow is controlled by means of an actuated flow control valve, immediately upstream of the Flocculation Column (Figure 3.1).

4.5.1.2 Chemical Dosing and Stabilisation

The Flocculent Dosing Building (east of the filter block, Figure 3.1) is used to house the flocculent. Makeup tanks from where the flocculent can be pumped to the dosing point are also located within this building.

When the iron concentration is high, flocculent is dosed upstream of the Flocculation Column directly into the main raw water inlet pipes at a point located downstream of the flow control valve. Rapid mixing is facilitated via an in-line flash mixer directly downstream of the dosing point.

Afri-Infra (2014) indicated that no lime stabilization takes place as no lime dosing facilities are provided.

4.5.1.3 Flocculation

Flocculation is achieved in the Flocculation Tower located directly upstream of the Pressure Control Tower (Figure 3.1).

The Flocculation Tower is divided into four flocculation columns operating in series. Each column has been equipped with steel baffles which facilitate flocculation. The baffles are the same size and equally spaced resulting in equal compartment sizes. This scenario is not ideal as flocculation channels should be tapered in order to promote floc growth.

4.5.1.4 Filtration

According to Afri-Infra (2014), the existing filter plan consists of five filter beds, each with an effective bed size of 27m^2.

The existing filtration system consists of up-flow pressure filters that are more robust than rapid gravity sand filters. These filters are normally installed where there is no sedimentation system in the process train and the raw

water is generally of a good quality with some expected variance in suspended solids content.

During times of high suspended solids in the raw water, up-flow filters must be backwashed regularly in order to prevent filter clogging. Excessive clogging may result in pressure build-up, lifting the filter media and causing suspended particles to break through the media, affecting the final water quality. One of the main disadvantages of up-flow filters is the complex backwashing procedure, which consists of six steps.

4.5.1.5 Disinfection

Disinfection is currently done with chlorine gas. The 68kg chlorine gas cylinders are housed in the chlorine dosing room (Figure 3.1) located adjacent to the distribution reservoir which also serves as the chlorine contact tank.

During normal operation, the dosage rate is estimated to be 2.4kg/hr. Based on the measured flow rates on site, this equates to a dosage rate of approximately 1.71 mg/l (within the normal design criteria of 1 to 2 mg/l).

4.5.1.6 Sludge handling

According to Afri-Infra (2014), filter wash water is currently being discharged directly into the Rimer's Creek stream downstream of the treatment works. This practice is no longer permissible.

4.5.1.7 Water quality

For the Rimer's Creek WTW, the applicable target water quality is SANS 241 which ensures that the consumer is safeguarded against ill health effects over a lifetime of consumption. The water must also be aesthetically acceptable to the end user (smell, taste, colour). In addition, the water must be stable to ensure that there are no operational problems (e.g. corrosion, excessive deposition in the distribution network, etc.).

Table 4.1 provides an indication of the quality of water produced by the existing treatment process.

Table 4.1: Raw Water Analyses (taken from Afri-Infra, 2014)

ANALYSIS RESULTS	UNIT	RAW WATER		POTABLE WATER		SANS STANDARDS -241 (2005)	
		SADDLEBACK TUNNEL	RIMER'S CREEK WEIR	Cl CONTACT CHANNEL	BARBERTON TOWN	CLASS I (RECOMMENDED OPERATIONAL LIMIT)	CLASS II (MAX. ALLOWABLE FOR LIMITED DURATION)
Total Dissolved Solids	mg/l	36	64	NT	72	< 1000	>1000- 2400
Nitrate (NO_3) as N	mg/l	0.337	0.274	NT	0.274	< 10	>10-20
Nitrite (NO_2) as N	mg/l	0.089	0.069	NT	0.066	< 10	>10-20
Chlorides as Cl	mg/l	6.37	5.64	<5	6.26	< 200	>200-600
Total Alkalinity as $CaCO_3$	mg/l	16	NT	20	NT		
Ammonium (NH_4) as N	mg/l	0.127	0.087	NT	0.123		
Fluoride as F	mg/l	0.113	0.113	NT	0.157	< 1.0	>1.0-1.5
Sulphate as SO_4	mg/l	6.42	6.36	5	5.76	< 400	>400-600
Total Hardness as $CaCO_3$	mg/l	15	NT	22	NT		
Calcium Hardness as $CaCO_3$	mg/l	7	NT	10	NT		
Magnesium hardness as $CaCO_3$	mg/l	8	NT	12	NT		
Calcium as Ca	mg/l	3	NT	4	NT	< 150	>150-300
Magnesium as Mg	mg/l	2	NT	3	NT	< 70	>70-100
Sodium as Na	mg/l	2.82	2.73	NT	2.86	< 200	>200-140
Iron as Fe	mg/l	<0.003	<0.003	NT	0.105	< 0.20	>0.20-2.0
Copper as Cu	mg/l	<0.001	<0.001	NT	0.004	< 1000	>1000-2000
Zinc as Zn	mg/l	<0.002	<0.002	NT	0.06	< 5.0	>5.0-10.0
Manganese as Mg	mg/l	<0.001	<0.001	NT	<0.001	< 0.10	>0.10-1.0
Conductivity at 25°C	mS/m	5.87	8.08	8.2	8.97	< 150	>150-370
pH-value at 25°C	mg/l	7.8	7.8	7.3	7.83	5.0 – 9.5	>4.0-10.0
pHs by 21°C	mg/l	9.6	NT	9.4	NT		
Corrosivity ratio	N/A	0.6	NT	0.7	NT		
Precipitation Potential as $CaCO_3$ at 25°C	N/A	-8.00	NT	-7.95	NT		

ANALYSIS RESULTS	UNIT	RAW WATER		POTABLE WATER		SANS STANDARDS -241 (2005)	
		SADDLEBACK TUNNEL	RIMER'S CREEK WEIR	Cl CONTACT CHANNEL	BARBERTON TOWN	CLASS I (RECOMMENDED OPERATIONAL LIMIT)	CLASS II (MAX. ALLOWABLE FOR LIMITED DURATION)
Langelier Saturation Index	N/A	-2.35	NT	-2.11	NT		
Ryznar Index at 25°C	N/A	11.98	NT	11.51	NT		
E. coli	CFU/ml	<1	1	NT	<1		
Total coliform	CFU/ml	<1	1200	NT	<1		
Total Viable Count	CFU/ml	33	220	NT	500		
Turbidity	N.T.U.	1.57	0.57	NT	0.365	< 1	>1-5
Taste	FTN	<5	<5	NT	<5	< 5	>5-10
Odour	TON	<5	<5	NT	<5	< 5	>5-10
Free Residual Chlorine Cl_2	mg/l	>0.1	<0.1	NT	<0.1		
Aluminium as Al	mg/l	<0.003	<0.003	NT	<0.003	< 0.30	>0.30-0050

Legend: NT = Not Tested

As indicated in Table 4.1, the raw water is of excellent quality and may be classified as Type 4 water, with a Total Alkalinity (TA) in the range of 10 to 20 mg/l. Afri-Infra (2014) indicated that this type of water is the most difficult to treat especially when employing sedimentation systems to remove micro determinants.

When treating this type of water, lime must be dosed in sufficient quantities prior to coagulation. This increases the alkalinity of the water and neutralizes the acidification effect of metal coagulants. Afri-Infra (2014) however, indicated that no lime dosing facilities are currently provided.

Afri-Infra (2014) indicated that the following raw water parameters need to be addressed in view of the findings of the raw and treated water analyses:

- Iron;
- Manganese;
- Water stability.

In addition, it was found that traces of zinc were present in the municipal tap water (sampled at point of use), which could most likely be attributed to the leaching of galvanized pipes and fittings within the distribution network.

In view of the above-mentioned, the upgrading of the existing Rimer's WTW was proposed in order to address the water quality issues.

4.5.2 Proposed water treatment process

Afri-Infra (2014) indicated that the following unit processes will be required in order to ensure that the treated water complies with the quality requirements:

- Chemical treatment (stabilization and coagulation);
- Flocculation;
- Sedimentation;
- Filtration;
- Disinfection.

Figure 4.4 provides the flow diagram with regards to the upgraded water treatment process.

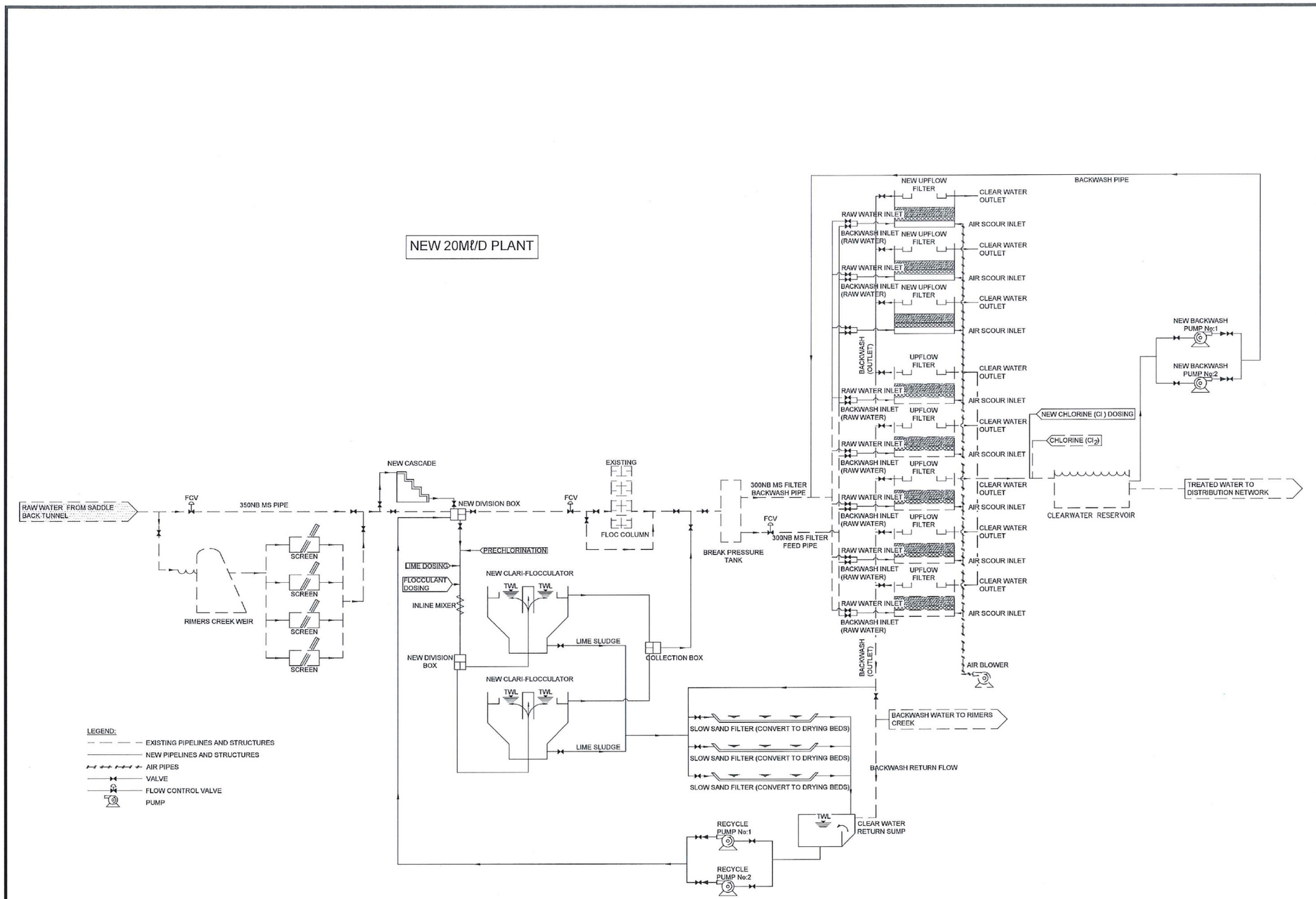

Figure 4.4: Flow diagram of the upgraded water treatment process

NOTAS/NOTES

LEGENDE/LEGEND

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WYSIGINGS/AMENDMENTS

NR./KODE NO./CODE	DATUM DATE	VOORLETTERS INITIALS	BESKRYWING DESCRIPTION

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PROJEK/PROJECT
DESIGN AND IMPLEMENTATION OF THE UPGRADING OF RIMER'S CREEK WTW

TEKENING TITEL/DRAWING TITLE
PROCESS FLOW DIAGRAM - PROPOSED EXTENSION

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GOEDGEKEUR DEUR/APPROVED BY
FOR AFRI-INFRA GROUP (PTY) LTD — DATE

KONTRAK NR./CONTRACT NO.
EDM/02/20/2014-15

LEER NR./FILE NO.
2014/09-L02 AND L03

SKAAL/SCALE	SHEET SIZE
1:500	A1

DATUM/DATE
AUGUST 2014

TEKENING NR./DRAWING NO.
2014/09-L03 REV.A

4.5.2.1 Chemical treatment (coagulation and stabilization)

A new chemical dosing building (Figure 3.3) will be constructed, which will ensure that all the dosing is done from a single location. The existing raw water feed will be diverted to the new building from where coagulant will be dosed as well as lime.

The coagulant, SudFloc:PAC 9SF, is currently used and is functioning as required. At an expected dosing rate of 5mg/l and the new design flow of 15Ml/d, the monthly requirement will be approximately 2000l. In order to ensure sufficient storage is provided, two 5000l GRP tanks will be provided.

In order to stabilize the raw water, lime will also be dosed from the chemical dosing building. Two dry lime hoppers will be provided, acting in a duty standby configuration.

4.5.2.2 Aeration

During periods of drought, water is abstracted from the bottom of the Lomati Dam. This water is anaerobic and often contains dissolved iron and manganese, as well as certain noxious gases (e.g. hydrogen sulfide). In order for the iron and manganese to be successfully removed, the Dissolved Oxygen (DO) content of the water needs to be increased, which will allow the molecular oxygen to oxidise the dissolved metals.

If the bottom water is released directly into the Rimer's Creek, successful aeration is mostly achieved by the time the water reaches the weir. However, it has been indicated that the preferred conveyance system from the Saddleback Tunnel, is the bulk pipeline as water losses are then minimized.

If the bulk pipeline is to be used, an aeration system will have to be constructed immediately upstream of the WTW. Due to the large hydraulic head available, the most feasible aeration system would be a hydraulic cascade. The cascade system will allow the water to be successfully aerated to a minimum acceptable Dissolved Oxygen (DO) level of 4mg/l. The cascade system may also be used to facilitate rapid mixing.

4.5.2.3 Flocculation and sedimentation

According to Afri-Infra (2014), the existing Flocculation Tower will not provide sufficient flocculation for the proposed 15Ml/d sedimentation system and a new flocculation structure with 15Ml/d capacity will have to be constructed.

A sedimentation system (to successfully remove iron and manganese) will be provided which will allow for the precipitation of suspended particles and insoluble particles (formed during lime stabilization).

Two clarifiers (Figure 3.3) of the clari-floccular type will be provided. The clarifiers will be designed at a loading rate of 1.5m/hr and will each have a diameter of 20 metres.

Flocculation will occur in the central flocculation zone and will be facilitated by paddle flocculators equipped with variable speed drives, which will maintain the velocity gradient at 40 s^{-1} over varying operating conditions. The paddle system will also be equipped with slow speed gearboxes in order to reduce the revolutions to approximately 8.5 rpm. The flocculation zone will be approximately 7.0 meters in diameter with a total retention time of 18 minutes.

Each clarifier will be provided with a rotating de-sludging bridge which will scrape sludge to the central sludge hopper from where it can be withdrawn by a de-sludging valve. The sludge will be conveyed to the sludge drying beds (refurbished slow sand filters).

4.5.2.4 Filtration

Afri-Infra (2014) indicated that the existing up-flow filter system performs well but proposed that one additional similar filter be constructed (with an effective bed area of 27m^2).

The backwash rate will be approximately 35m/hr and the air scour rate will be 0.9m^3/m^2.min. The existing blower will be used to backwash the new filters. Currently, raw water is used to backwash water, which is not ideal as this water contains iron and manganese.

Two new backwash pumps will be provided, which will use treated water from the final storage reservoir for backwashing purposes. This water will be recovered and pumped back into the system.

The new filter bed system design will allow for false floors, similar in design to the existing filters. Allowance will also be made in the design for maintenance access to the filter under-drain area.

4.5.2.5 Disinfection

Afri-Infra (2014) indicated that the existing chlorine dosing building does not comply with the latest Health and Safety Regulations and will be upgraded accordingly.

The total daily chlorine requirement will be 30 kg/day (i.e. taking into account the final design capacity of the plant and the conventional chlorine dosage rate of 2mg/l). A new chlorination building (Figure 3.3) will therefore be designed to accommodate 1 ton cylinders giving a changeover rate of 33 days.

The pre-chlorination dosing point will be situated in the clarifier feed division box and will be used to allow for oxidation of iron during periods when the iron concentration in the raw water exceeds 1.0mg/l.

4.5.2.6 Sludge and wash water

The sludge disposal system will be upgraded so that wash water and decant from the sludge handling system is returned to the works in order to ensure zero discharge from the works.

Afri-Infra (2014) proposed that the old slow sand filters be converted in order to function as sludge drying beds in order to prevent discharge of sludge into the Rimer's Creek. Facilities will be provided to draw off supernatant which will be pumped back to the head of works.

Currently, there is no wash water recovery pump station.

It is foreseen that on average the clarifier sludge will contain 2% solids by mass. Assuming total suspended solids content of 25 mg/l in the raw water, including lime and flocculant, 375kg of dry sludge will be produced per day, which equates to approximately 18.75m^3 of wet sludge per day.

The current slow sand filters have an approximate area of 250m^2 each. With a filtration rate of 0.5m/hr, each of the three filters can handle approximately 125m^3/day.

Each filter backwashing sequence will last approximately 10 minutes and the rate will be 35m/hr. The total backwash volume will thus be 9.45m^3 per backwash. The backwash return pump station and pumps will be sized accordingly.

The above-mentioned water treatment process will address the water quality issues identified with regards to the existing WTW.

4.5.3 No Project Option

More information with regards to the implication of the 'No Project Option' is provided in Section 4.6.

4.6 The 'No Project Option'

The 'No Project Option' is the alternative of not going ahead with the proposed development. The 'No Project Option' is only considered if it is found that the development will have significant negative impacts on the environment, which cannot be mitigated or managed.

If the 'No Project Option' in terms of the proposed project was exercised, it would mean that:

- The increasing population of Barberton and Umjindi will not be provided with potable water;
- The quality of water produced by the Rimer's Water Treatment Works will not be improved;
- The identified water quality issues will not be addressed in order to ensure potable water;
- Water losses in the system will not be addressed – major water losses have been recorded in the creek between the tunnel outlet and the diversion weir;
- The bulk water supply system from the Lomati Dam and Rimer's Water Treatment Works will not be improved;
- The operation and maintenance of the Rimer's WTW will not be improved.

5. BIOPHYSICAL DESCRIPTION OF THE SITE

5.1 Location of the site

The Rimer's Water Treatment (Purification) Works is located on the Remaining Extent of Portion 14 of the farm Barberton Townlands 369 JU, within the Barberton Private Nature Reserve, to the southeast of Barberton (Figure 5.1). The site can be accessed via a gravel road from Lee Street in Barberton. An area to the eastern side of the existing fenced works area has been identified for the new infrastructure.

Co-ordinates for the centre of the site are:

- 25°47'50.75"S
- 31°03'54.90"E

The Surveyor-General 21 digit site reference number for the proposed project is:

T	O	J	R	0	0	0	0	0	0	0	0	0	3	6	9	0	0	0	1	4

The said property falls under the jurisdiction of the Umjindi Local Municipality.

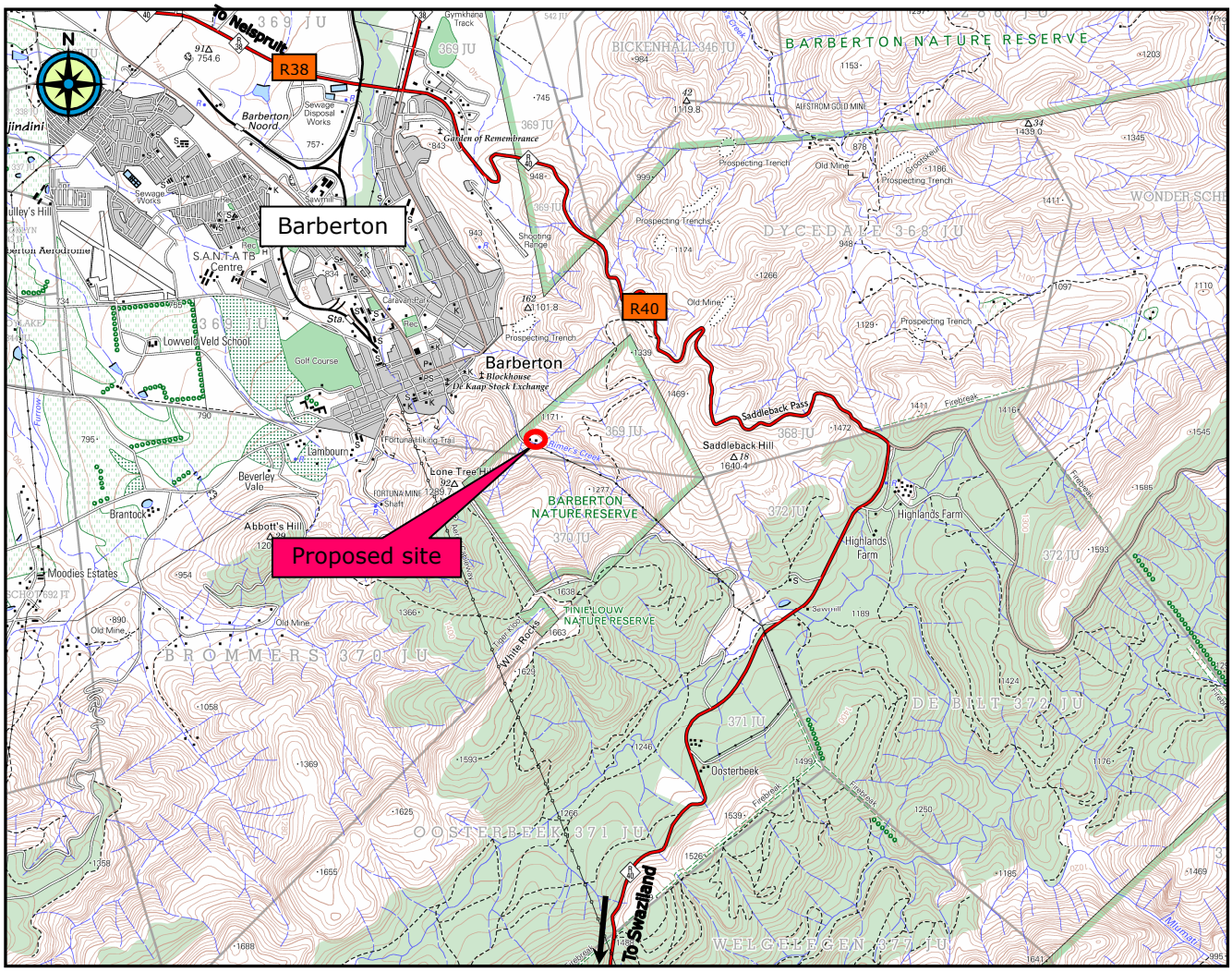

Figure 5.1: Location of site *(taken from 1: 50 000 2531CC)*

5.2 Climate

The climate of Barberton can be described as subtropical and falls within the *Csa* Köppen-Geiger climate classification (i.e. Interior Mediterranean) which is described as follows:

> *Mild with dry, hot summer. Warmest month has average temperature more than 22°C. At least four months with average temperatures over 10°C. Frost danger in winter. At least three times as much precipitation during wettest winter months as in the driest summer month.*

The average temperature is 20.3°C with an annual average high temperature of 25.9°C and an annual average low temperature of 14.6°C. The warmest month is January (average of 23.3°C). The average temperature in June (winter) is 15.2°C.

Precipitation (rainfall) occurs mostly during the summer months with the most rain falling during December (average of 129mm). June/July (winter) are the driest months (6 – 8mm). The average annual precipitation for Barberton is 779mm. Thunderstorms occur during the summer months.

5.3 Land use

5.3.1 Land ownership

The site is located on Portion 14 of the farm Barberton Townlands 369 JU (Figure 5.1) which belongs to the Umjindi Local Municipality (i.e. the project applicant).

5.3.2 Zoning of the site

As indicated in Figure 5.2, the site is located within the Barberton Private Nature Reserve (i.e. a protected area).

The Barberton Private Nature Reserve was gazetted on 27 January 1965 by the then Transvaal Provincial Administration (Official Gazette Extraordinary No. 3134; Appendix 11). In terms of the Mpumalanga Biodiversity Sector Plan (MBSP, 2013), it has been classified as a Level 1 Protected Area, i.e. an area that has been declared or recognised in terms of the National Environmental Management: Protected Areas (NEM: PAA) and is managed by provincial or national government.

The owner of the Barberton Private Nature Reserve is the Umjindi Local Municipality (the project applicant).

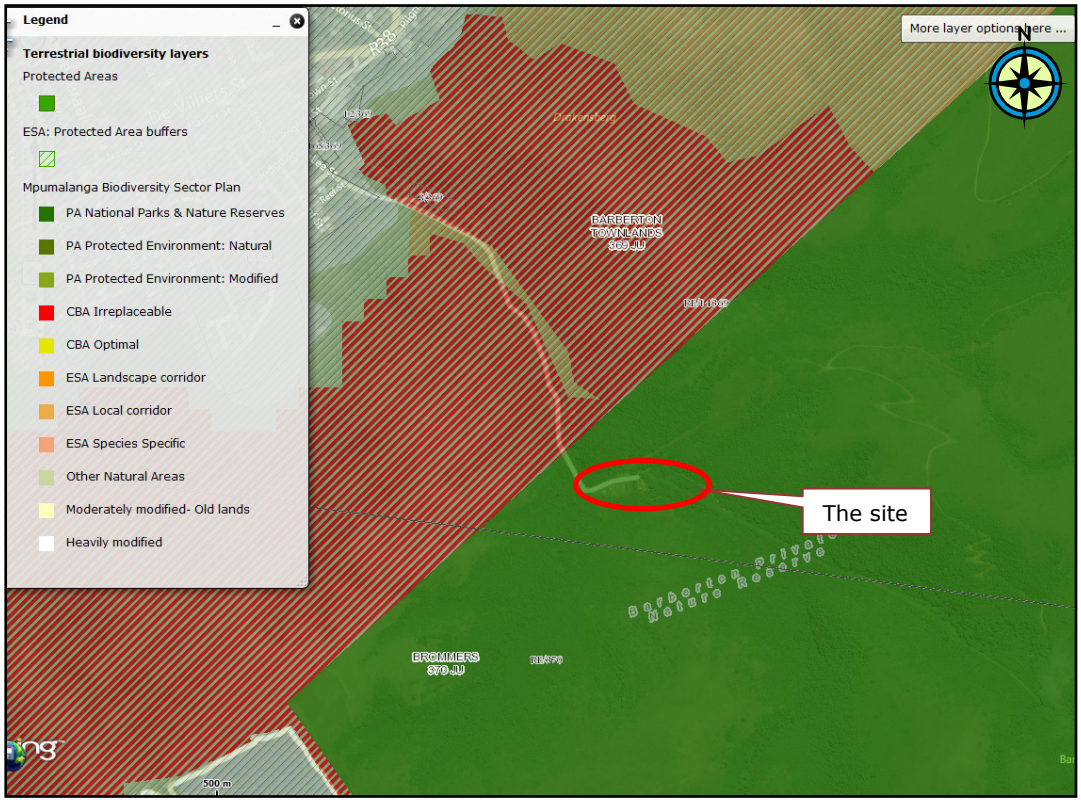

Figure 5.2: Zoning of site (taken from MBSP, 2013)

5.3.3 Size of the site

The site is 2.6 hectares in extent.

5.3.4 Servitudes

No servitudes are known to be registered within the said area.

5.3.5 Land use and existing infrastructure

As indicated above, the site falls within the Barberton Private Nature Reserve as does the existing Rimer's Water Treatment (Purification) Works. The following infrastructure is located within the fenced area as indicated in Figure 5.3a:

- 300mm diameter steel pipe from Saddleback Tunnel;
- Diversion weir;
- 200mm diameter steel pipe from diversion weir;
- Pressure control tower backwash water reservoir;
- Flocculation column;
- 350mm diameter and 400mm diameter steel pipes;
- Lime dosing and storage room;
- Lapa;
- Chemical dosing room;
- Existing rapid sand filters;
- Flow control chamber;
- Existing sludge drying beds;
- Chlorine dosing room;
- Chlorine contact tank;
- 2 x 675mm diameter pipe;
- Tarred access road.

An Eskom substation (located in close proximity to the existing Rimer's WTW) and powerlines are also present.

Figure 5.3a: Aerial view of the existing Rimer's Water Treatment (Purification) Works and surrounding area

Proposed site east of existing WTW

Existing weir

View of the existing WTW

Figure 5.3b: Photographic view of the site

5.3.6 Surrounding land uses

As indicated in Figure 5.2, the surrounding land use is nature conservation (i.e. Barberton Private Nature Reserve). However, the said area is also used for activities other than nature conservation. The Barberton Trials Motorcycling Park (Photo 5.1) is located downstream of the site as indicated in Figure 5.3a.

Photo 5.1: Barberton Trials Motorcycling Park.

Two heritage sites, The Turbine and Fernlea House, are located downstream of the site as indicated in Figure 5.3a. Further details regarding these sites are provided in Section 5.14 of this report.

The Rimer's Creek area is used for hiking and bird watching purposes. The Rimer's Creek Bird Trail (Photo 2) starts at Fernlea House (Figure 5.3a) and is a 2km circular route developed by the Barberton Bird Club. There is also a 500m walk to the Lookout (Photo 5.2).

Photo 5.2: Rimer's Creek Bird Trail notice at Fernlea House

The Roses/Rimer's Creek Trail and the Coco Pan Trail also extend along the Rimer's Creek area.

Urban development (i.e. Barberton) is located about 1km northwest of the site (Figure 5.3a).

5.4 Geology

Hansmeyer (2015) indicated that the Rimer's Creek WTW site (including the Eastern Extension) is generally underlain by argillaceous sediments of the Fig Tree Group, Barberton Sequence/Supergroup. The Fig Tree Group comprises greywacke, shale, interlayers of chert, lavas and schists and older mafic rocks and sediments of the Tjakastad Subgroup.

The site is underlain by reworked talus deposits as a result of recent and older rock and mud slides from the valley sides which resulted in choking the Rimer's Creek (Hansmeyer, 2015). The Rimer's Creek is therefore littered with boulders, rocks, etc. of various sizes.

5.5 Topography

According to the AGIS Comprehensive Map drafted by the Department of Agriculture, Forestry and Fisheries, the topography of the site is indicated as open high hills or ridges (Figure 5.4).

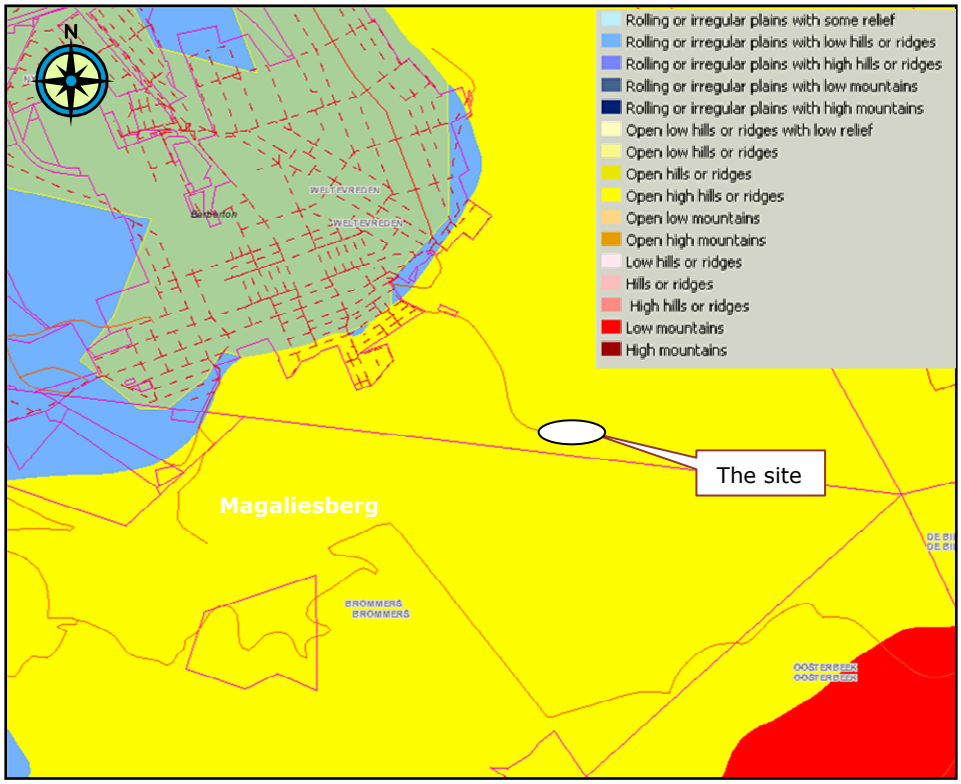

Figure 5.4: Terrain type of the site (taken from Department of Agriculture, Forestry and Fisheries)

The site is located within a valley floor that drains from east to west, while steep foot slopes border the site to the north and south. Rimer's Creek extends through the site (Figure 5.1).

Figure 5.3a provides an indication of the topography of the existing Rimer's WTW and the immediate surrounding area which is very rugged.

Within the site (Figure 5.3a), the elevation range is less dramatic, ranging from 1030 masl at the diversion weir to 985 masl at the existing WTW (Grobler, 2015). This area slopes evenly westward at a gradient of 1:10 with a slightly steeper gradient closer to the existing WTW (Hansmeyer, 2015).

The change in elevation of 40m from the highest point (approximately 1000 masl) to the lowest point (approximately 960 masl) occurs across a channel length of approximately 380m. The gradient of the stream segment within the site is therefore 10.5% (Grobler, 2015).

The gradient of the valley floor becomes even steeper as the valley floor narrows further upstream (Grobler, 2015).

5.6 Soil

5.6.1 General

According to the AGIS Comprehensive Atlas of the Department of Agriculture, Forestry and Fisheries, the site falls within the FA169 land type, which is characterised by Glenrosa and/or Mispah soil forms (Figure 5.5). Other soil forms may occur. Lime is rare or absent in the entire landscape.

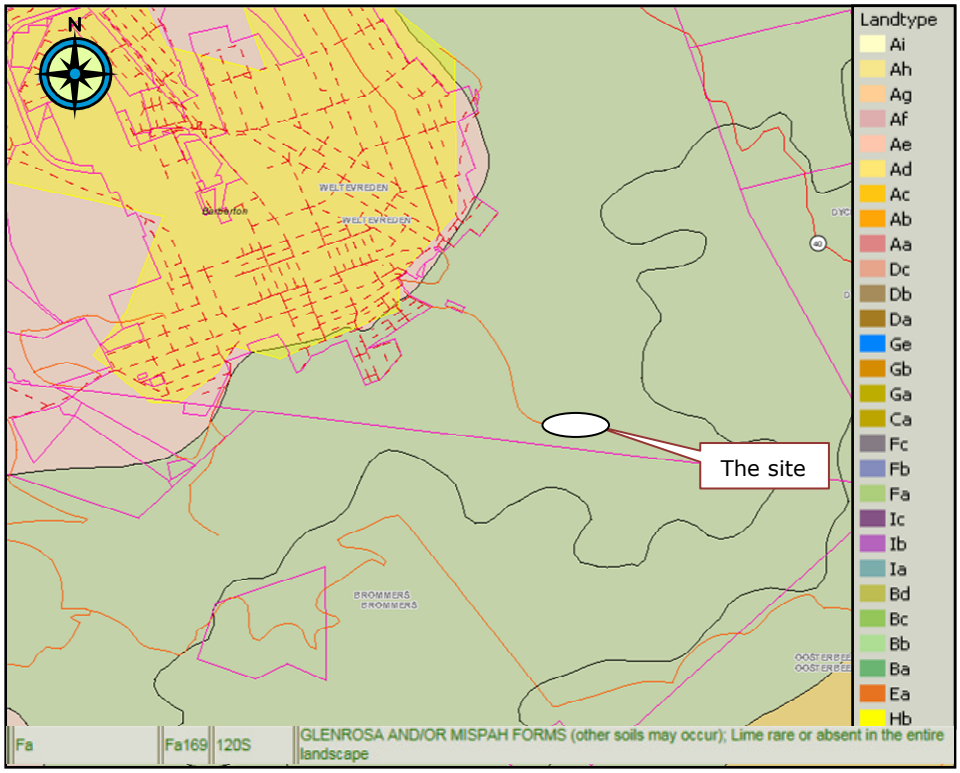

Figure 5.5: Land type of the site (taken from Department of Agriculture, Forestry and Fisheries)

As indicated in Figure 5.6, the site is characterised by LP1 soils. These are soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils.

The soils of the riparian area are predominantly shallow and rocky with deeper alluvial soils between larger rocks. The soils of the riverbed and low, alluvial terraces are relatively deep, dark brown alluvial soils in between boulders. At the base of the slopes just above the riparian zone (on either side of the river), the soils are dark brown with a relatively deep organic horizon (McCleland and de Castro, 2015).

The soil within the existing fenced WTW area had already been impacted in terms of the presence of the existing infrastructure (as indicated in Section 5.3.5) and associated activities.

This area has already been impacted in terms of the construction of a road that was cut out of the mountain side and the spoil levelled onto the creek bed which subsequently became overgrown.

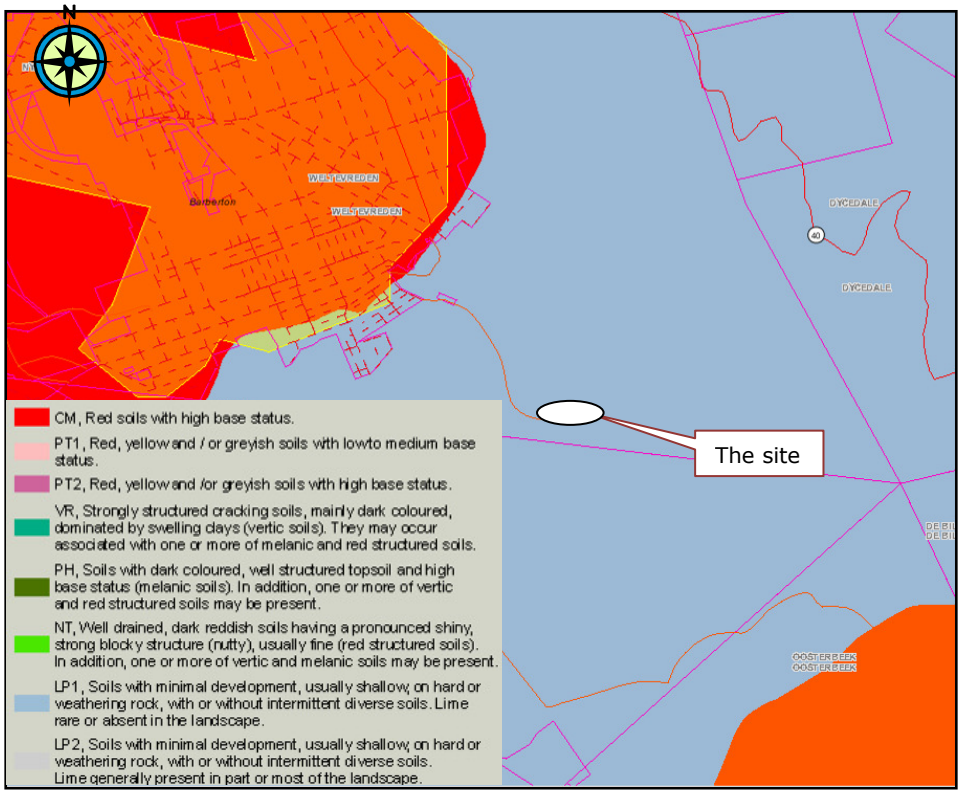

Figure 5.6: Soils of the site (taken from Department of Agriculture, Forestry and Fisheries)

5.6.2 Geotechnical study

A geotechnical investigation of the site was undertaken by Engeolab Earth Science Consultants (referred to as Hansmeyer, 2015). A copy of the said report is provided in Appendix 4 and should be consulted with regards to the methodology used.

According to Hansmeyer (2015), the founding conditions are good with no seepage, no ponding and good drainage within the existing fenced WTW area.

The soil profiles of the seven test pits excavated (except for TP1, TP4 and TP7) recorded gravels and boulders with sand-clay mixes with low plasticity (Hansmeyer, 2015). Building rubble mixed with soil was recorded in TP4 (excavated near the chloride contact tank). In TP1 (excavated within the slow drain settling dam i.e. to assess the founding conditions for the new filter), overgrown and loosely packed graded silica sand overlying 19mm size ballast stone was recorded. Refusal occurred at 1m on a reinforced concrete slab. TP7 (located between the upflow filters and the tarred road) also recorded shallow refusal at 0.6m on a concrete apron.

Hansmeyer (2015) indicated that weathered but sound bedrock (with an estimated safe bearing capacity of 450kPa) is generally present at 1.8 – 2.5m below surface.

Table 5.1 provides a summary of the excavatability characteristic of the area within the existing WTW area.
Hansmeyer (2015) indicated that no slumping of the testpits excavated within the existing fenced WTW area occurred.

Within the proposed extension area (i.e. to the east of the existing WTW), the founding conditions are also good with no seepage, no ponding and good drainage (Hansmeyer, 2015).

The soil profiles of the four test pits excavated recorded reworked gravels and boulders devoid of finer matrix material (having being washed out and deposited further downstream) (Hansmeyer, 2015). This reworked talus is further underlain by bedrock at an average depth of 2.5m.

Hansmeyer (2015) indicated that weathered but sound bedrock (with an estimated safe bearing capacity of 450kPa) is generally present at 1.8 – 2.5m below surface.

According to Hansmeyer (2015), the area where the new infrastructure will be built is underlain by reworked talus and bedrock at an average depth of 2.5m.

The steeper cut along the foothills from the WTW to the diversion weir are partially overlain by a thin layer of soil anchored by creeper and tree roots with other places exhibiting a steeply dipping bedrock face (Hansmeyer, 2015).

Table 5.1 provides a summary of the excavatability characteristic of the proposed extension area.

Table 5.1: Excavatability summary (taken from Hansmeyer, 2015)

STRUCTURE	MATERIAL/ROCK TYPE	EXCAVATABILITY SABS 1083	AVERAGE DEPTH (m)	PROPOSED EXCAVATION METHOD
Within fenced WTW area				
Slow filter – WTW	Imported material	Soft to 1m – refusal on concrete slab	Surface to 1m	Hand, TLB
New backwash pump station and chlorine dosing room	Cover soil up to 0.2m followed by loosely packed gravels and boulders with subordinate matrix material comprising silt-sand-clay mixes	Boulder excavation followed by hard ripping > 1.8m	Surface to 1.8m	Powerful excavator
Eastern Extension				
New road, stilling basin and culvert	Exposed bedrock in base of Rimer's Creek	Intermediate to hard ripping	Surface to 0.5	Powerful excavator
New road	Steep dipping decomposed to medium weathered bedrock blanketed by thin residuum, hillwash & talus in cut along foothill to the diversion weir	Soft, intermediate to hard ripping with boulder excavation in places	Surface to approx. 2m	Powerful excavator and/or D9 bulldozer
Rerouted stream bed, clarifiers, cascades feature, new dosing building	2.5m thick unsorted angular to sub-rounded gravels and large (>2m long) boulders underlain by sound bedrock	Mainly boulder excavation with intermediate to hard ripping of bedrock	Surface to 2.5m	Powerful excavator/ D9 bulldozer

Hansmeyer (2015) indicated that ravelling and sliding of the coarse gravelly material into the test pits excavated (in the vicinity of the two clarifiers, new dosing building and cascade feature) was common. The said test pits had to

be over-excavated to expose the bedrock at a deeper reach of the excavator's boom.

The bedrock associated with the Fig Tree and Tjakastads Formation that underlie the northerly portion of the site and immediate surroundings, trend NNE-SSW, dipping south-east at an angle of 70° to the horizontal.

Hansmeyer (2015) indicated that several historic and more recent slides had been observed on aerial photographs of the terrain and surroundings. These slides occur as oblong to tear drop shaped furrows down the south-western face of the mountain, depositing the soil, gravels and large boulders in Rimer's Creek. These deposits fanned outwards, with the slide edge restricting the steady flow of Rimer's Creek and thereby translocating the stream to its current, more southerly position. This supposition is confirmed by large boulders, partially 'talus-covered' and overgrown dry and slightly elevated stream bed near TP's 9 & 10, which were excavated more or less where the new clarifiers are to be constructed.

5.6.3 Agricultural potential/land capability

In terms of land capability, the site is indicated according to the Department of Agriculture, Fisheries and Forestry as non-arable, low potential grazing land (Figure 5.7).

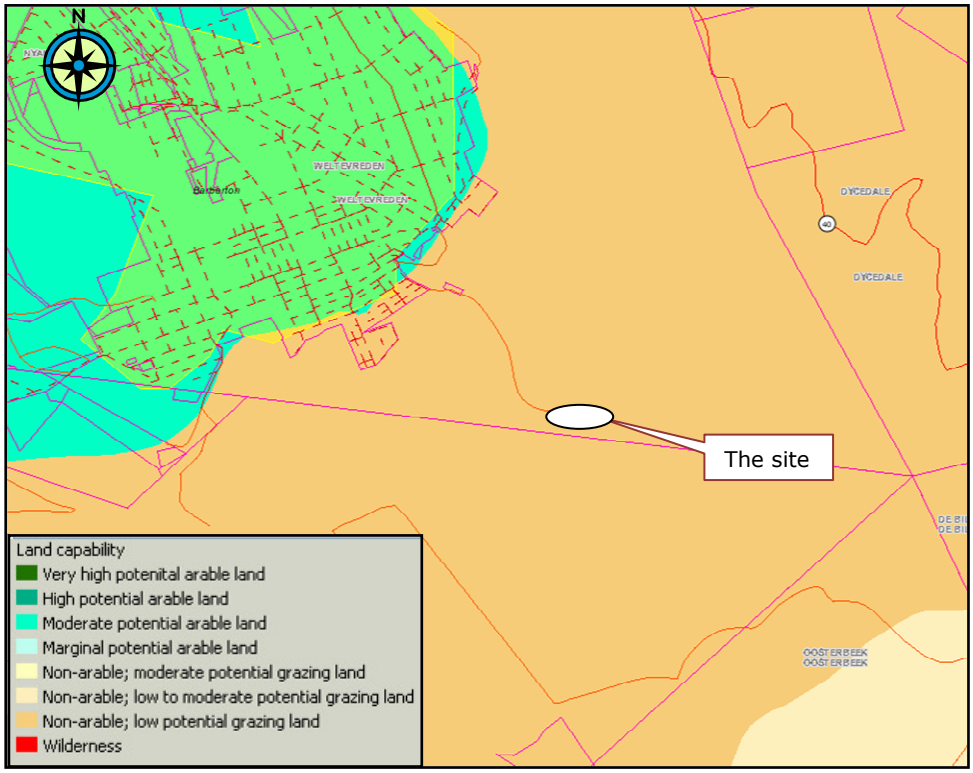

Figure 5.7: Land capability of the site (taken from Department of Agriculture, Forestry and Fisheries)

Looking at grazing capacity, Figure 5.8 indicates the grazing capacity as 14-17 and 18-21 ha per animal unit (AU).

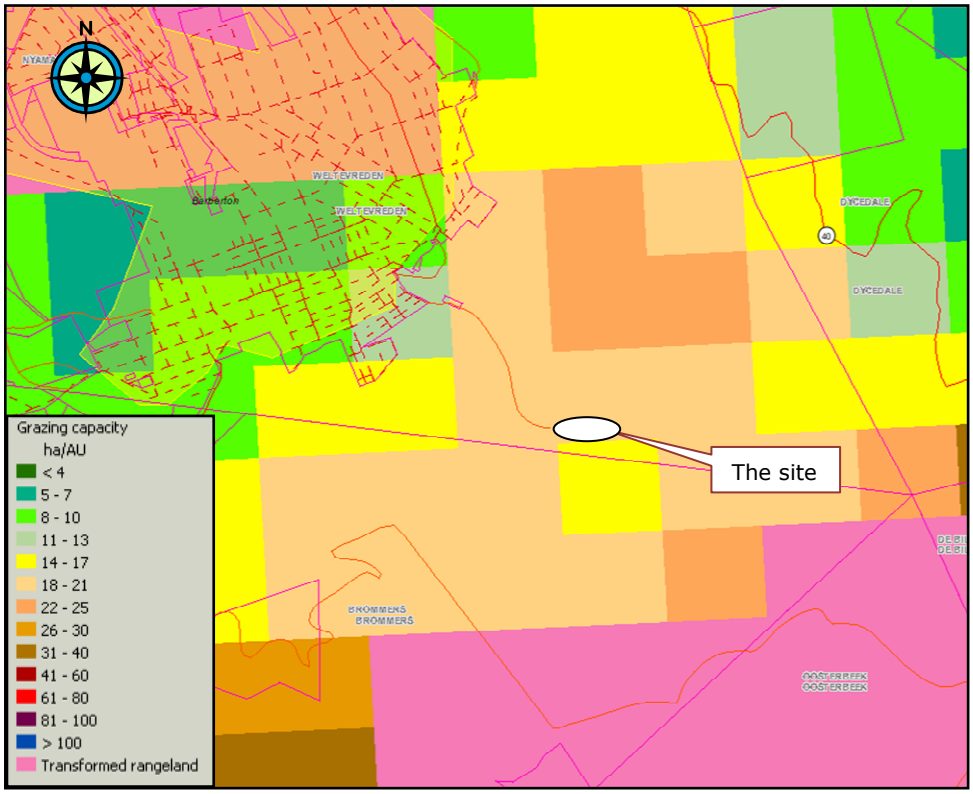

Figure 5.8: Grazing capacity of the site (taken from Department of Agriculture, Forestry and Fisheries)

5.7 Natural vegetation

5.7.1 General vegetation description

According to Mucina & Rutherford (2006), the vegetation of the site is classified as Scarp Forest which is embedded in Barberton Montane Grassland and Kaalrug Mountain Bushveld.

Scarp Forest is a poorly defined forest type that is widespread from the Eastern Cape to Mpumalanga, although highly fragmented throughout its distribution. Lötter *et al*. (2014b) provide a more refined description of the forest types of Mpumalanga and define the Scarp Forest vegetation of the Barberton area as falling within the Eastern Scarp Forest category of Von Malitz *et al.* (2003), and classify it as Barberton Scarp Forest. This is a forest type occurring between an elevation of 480 and 1170 masl and is restricted to the deep kloofs and narrow valleys between Barberton and Nelshoogte (about 20 km to the west).

Table 5.2 provides an indication of the dominant, common and conspicuous plant taxa of the Barberton Scarp Forest.

Table 5.2: Dominant/common/conspicuous plant taxa of Barberton Scarp Forest, as extracted from Lötter *et al*. (2014b).

Growth Form	Species
Barberton Scarp Forest (part of the Scarp Forest vegetation type)	
Canopy Trees	*Anthocleista grandiflora, Celtis africana, Combretum kraussii (d), Croton sylvaticus, Cryptocarya woodii (d), Harpephyllum caffrum (d),*

Growth Form	Species
	Protorhus longifolia, Syzygium gerrardii, Xymalos monospora/
Small Trees and Woody Climbers	*Acridocarpus natalitius, Canthium inerme, Dalbergia armata (d), Englerophytum magalismontanum (d), E.natalense (d), Erythroxylum emarginatum, Gymnosporia rubra, Kraussia floribunda, Monanthotaxis cafra (d), Pavetta galpinii, Rawsonia lucida, Tabernaemontana ventricosa*
Herbs	*Pseuderanthemum subviscosum, Asparagus setaceus, Tragiella natalensis*
Grasses	*Oplismenus hirtellus*
Ferns	*Cheilanthes pentagona*

Legend: Dominant species indicated by the letter d.

Scarp Forest has a status of Least Threatened according to Mucina & Rutherford (2006) due to a relatively high level of protection (20%). However, forests outside of protected areas are heavily exploited.

Scarp Forest is recognised as the most valuable forest type in South Africa from a biogeographical and species diversity perspective (Mucina & Rutherford, 2006).

According to McCleland and de Castro (2015), no vegetation that is representative of Barberton Montane Grassland is present within the site, while vegetation representing Kaalrug Mountain Bushveld is present just outside of the site on the lower hillslopes.

The site is situated within a listed Threatened Ecosystem according to the 2011 Schedule (Government Gazette of December 2011) of the Biodiversity Act (Act 10 of 2004), namely Barberton Mountainlands (MP13), which is categorised in the Schedule as Vulnerable.

In addition, the site is located within the Barberton Centre of Endemism (Van Wyk and Smith, 2001), which is shared between Mpumalanga and Swaziland. This Centre is home to an estimated 1500 plant species, of which about 80 (5.3%) are endemic to the Centre and at least 30 species thereof edaphic specialists adapted to serpentine soils. Although the Centre has a fairly high level of protection in large protected areas (e.g. Songimvelo Game Reserve and Barberton Mountainlands, Mpumalanga; Malolotja Nature Reserve in Swaziland), it is severely threatened by commercial afforestation, bush encroachment and mining.

As indicated in Section 5.3.2 and Figure 5.2, the site is located within the Barberton Private Nature Reserve, which was gazetted on 27 January 1965 by the then Transvaal Provincial Administration (Official Gazette Extraordinary No. 3134; Appendix 11). In terms of the Mpumalanga Biodiversity Sector Plan (MBSP, 2014), it has been classified as a Level 1 Protected Area i.e. an area that has been declared or recognised in terms of the National Environmental Management: Protected Areas (NEM: PAA) and is managed by provincial or national government. The owner of the Barberton Private Nature Reserve is the Umjindi Local Municipality.

5.7.2 Vegetation found on site and surrounds

A biodiversity study (including a vegetation survey) of the site was undertaken by Warren McCleland and Tony de Castro of De Castro and Brits Ecological Consultants (referred to as McCleland and de Castro, 2015). A copy

of the said report is provided in Appendix 6 and should be consulted with regards to the methodology used.

Three vegetation units were identified within the site namely:

- Secondary Riparian Scrub (light green; Figure 5.9);
- Untransformed Riparian Forest (dark green; Figure 5.9);
- Untransformed Low Forest/Thicket on Steep Hillslopes (brown; Figure 5.9).

Figure 5.9 provides an indication of the location of the three vegetation units identified while Figure 5.10 provides the botanical biodiversity conservation value and sensitivity of each vegetation unit identified.

Table 5.3 provides an indication of the area occupied by each vegetation unit identified, species richness and perceived botanical biodiversity conservation value and sensitivity.

Table 5.3: Vegetation units identified – area covered, species richness and botanical biodiversity conservation value and sensitivity (taken from McCleland and de Castro, 2015)

Vegetation and land-cover type units	Surface area covered by unit within study area	Species richness within vegetation unit	Botanical Biodiversity Value and Sensitivity
1. Secondary Riparian Scrub	0.72 ha (28%)	73	Low
2. Untransformed Riparian Forest	0.41 ha (16%)	70	High
3. Untransformed Low Forest / Thicket on steep hillslopes	0.84 ha (32%)	58	Moderate
TOTAL	1.97ha		

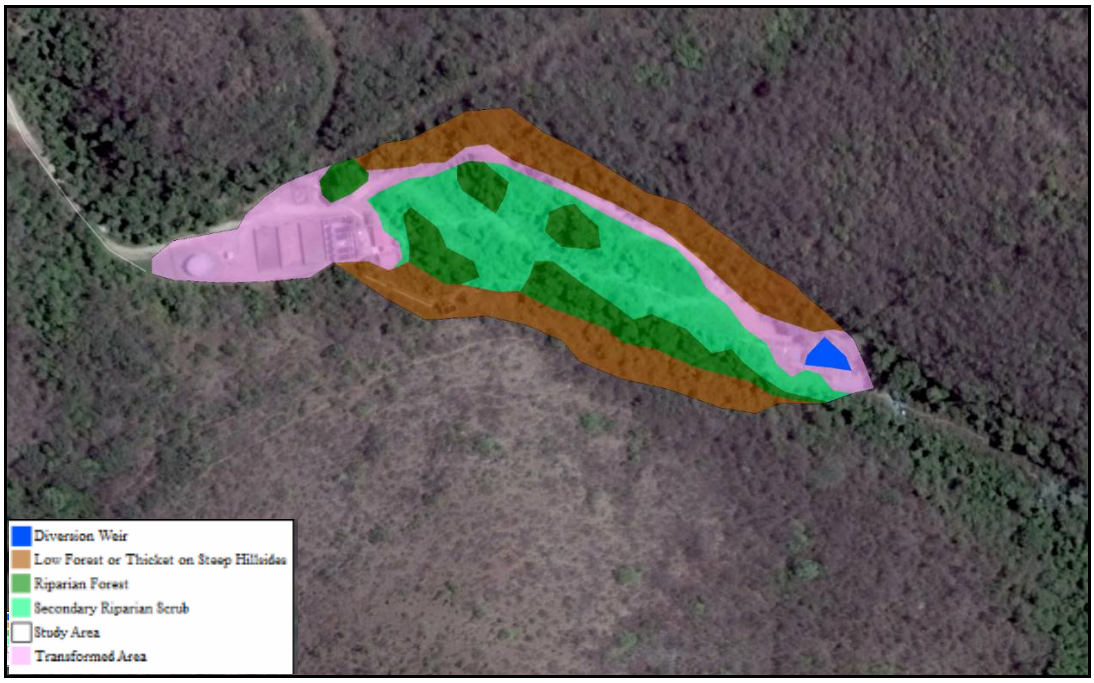

Figure 5.9: Vegetation units identified (taken from McCleland and de Castro, 2015)

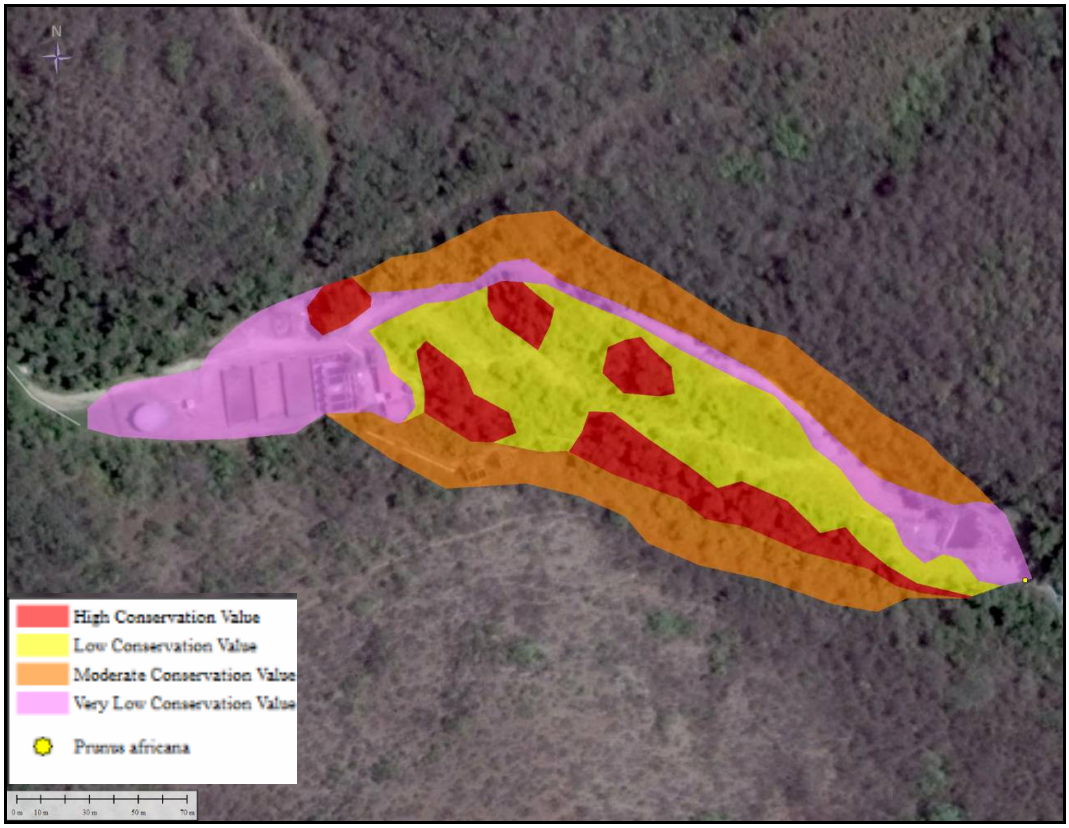

Figure 5.10: Botanical biodiversity conservation value and sensitivity (taken from McCleland and de Castro, 2015)

Secondary Riparian Scrub (Figure 5.9)
Secondary Riparian Scrub is the dominant vegetation unit of the site and covers 0.72 ha (28% of the site; Figure 5.9).

This vegetation unit is restricted to the riparian zone and occurs on soils that are predominantly shallow and rocky with deeper alluvial soils between larger rocks.

Vegetation structure is Low to Tall Closed Shrubland (Edwards, 1983) with the understorey being dense and imprenetrable.

This unit has high species richness (α-diversity), but low plant community diversity (β-diversity). It does not contain any plant species of conservation concern and also does not provide habitat for plant species of conservation concern identified within the surrounding area.

Seventy-four species of plants were recorded (Table 5.3), of which 30 species (41% of the list) are invasive alien species (see Appendix 1 of Appendix 6).

Tall herbs and shrubs dominate (in terms of projected canopy cover) within this vegetation unit, with relatively few species comprising much of the unit's canopy cover e.g. *Tithonia diversifolia* T. rotundifolia*; Solanum mauritianum** and *Ricinis communis**.

Woody climbers (including the aliens *Caesalpinia decapetala*; Passiflora subedulis**) and scrambling shrubs (such as *Acacia atazacantha, Rubusniveus** and *R. pinnatus*) are quite prominent.

The understorey has a relatively high diversity of herbs (e.g. *Verbena bonariense*; Ageratum conyzoides*, Argemoneo chraleuca*; Bidens pilosa*; Conyza bonariensis*; Galinsoga parviflora and Achyranthes aspera**) and grasses (such as *Dactyloctenium aegyptium; Eleusine coracana*; Eragrostis curvula; Eragrostis plana; Paspalum urvillea** and *Sorghum bicolor* subsp. *arundinaceum*).

Trees do not form much of a canopy and are mostly isolated emergents, with characteristic species being *Trema orientalis, Celtis Africana, Phytolacca dioica*, Berchemia zeyheri, Melia azedarach** and *Ziziphus mucronata*.

Although Secondary Riparian Scrub falls within the Vulnerable Barberton Mountainlands (MP13) vegetation type, it is not an untransformed vegetation type and has none of the species of conservation concern that characterize this Threatened Ecosystem.

The Secondary Riparian Scrub does not have the functional value that the Untransformed Riparian Forest (the original vegetation cover) has and should be considered to have impaired functionality. **This vegetation unit is therefore considered to have a Low conservation value and sensitivity in terms of botanical biodiversity and functional value (Table 5.3; Figure 5.10).**

Untransformed Riparian Forest (Figure 5.9)
McCleland and de Castro (2015) indicated that only a few small and fragmented patches of Untransformed Riparian Forest (which would have comprised the original riparian vegetation cover) exist within the site. This vegetation unit covers 0.41 ha (16%) of the site.

It comprises untransformed but disturbed riparian forest on relatively deep, dark brown alluvial soils trapped between boulders in the riverbed and on low alluvial terraces.

Vegetation structure is Tall Forest and comprises distinct herbaceous understorey and woody shrub and tree strata. The forest canopy is 10 – 15 metres high, but is not unbroken, even within the small fragments.

Seventy species of plants were recorded (Table 5.3), of which only 9 species (13% of the list) are invasive alien species (see Appendix 1 of Appendix 6).

Tall evergreen tree species (especially *Harpephyllum caffrum, Trema orientalis, Celtis africana, Heteropyxis canescens* and *Syzygium cordatum*) dominate the canopy. Species richness in the canopy is high and other prominent species include *Kiggelaria africana, Brachulaena transvaalensis, Ficus sur, Cussonia spicata, Combretum kraussii, Halleria lucida, Protorhus longifolia, Cryptocarya woodii* and *Ekebergia capensis*.

Woody shrubs in the mid-stratum include *Dombeya pulchra, Allophylus africana, Acalypha glabrata, Clerodendrum glabrum, Bowkeria cymosa, Gymnanthemum myrianthum, Gymnosporia rubra, Abutilon* cf. *galpinii* and *Maesalance olata*.

Woody and herbaceous climbers are a prominent life-form in Riparian Forest. Common species are *Rhoicissus tomentosa, R. rhomboideus, Caesalpinia decapetala*, Seneciota moides, Dalbergia armata,*

Dioscoreaco tinifolia, Cissampelos torulosa, Acacia ataxacantha, Tylophora lycioides and *Solanum seaforthianum**.

The herbaceous understory is relatively sparse in places, especially where shade is deep, and characterised by species such as the forest sedge *Cyperus albostriatus*, forest grasses such as *Setaria megaphylla, S. lindenbergiana* and *Oplismenus hirtellus*, and a variety of forbs and geophytes such as *Impatiens hochstetteri, Crocosmia aurea, Dietes iridioides* and *Asparagus virgatus*. Elsewhere the understory is quite dense and is dominated by low Acanthaceae shrubs such as *Hypoestes cf. aristata* and *Barleria obtusa*, particularly at forest edges. *Plectranthus fruticosus* is a prominent shrub along the stream at the forest edge.

While no plant species of conservation concern were located within this unit (i.e. within the boundaries of the site), two species were located just upstream and downstream of the study area within Untransformed Riparian Forest, namely the tall forest tree *Prunus africana* (Vulnerable) and the forest climber *Adenia gummifera* (Declining). This vegetation unit also provides potentially suitable habitat for several species of conservation concern occurring in the vicinity of the study area.

Untransformed Riparian Forest falls within the Scarp Forest vegetation type as mapped by Mucina & Rutherford (2006), which has a status of Least Threatened. The forest is intact in places and has species composition that is strongly representative of Scarp Forest, particularly Barberton Scarp Forest.

Riparian Forest in the site is situated within a listed Threatened Ecosystem in terms of the Biodiversity Act (No. 10 of 2004), namely Barberton Mountainlands (MP13), which is categorised as Vulnerable, and is representative of one of the vegetation communities that characterise this Threatened Ecosystem.

The fragmented patches of Riparian Forest still have the functional value that larger tracts of Riparian Forest (the original vegetation cover) have and should be considered to have only slightly impaired functionality. **This vegetation unit is therefore considered to have a High conservation value and sensitivity in terms of botanical biodiversity and functional value (Table 5.3; Figure 5.10).**

Untransformed Low Forest/Thicket on steep hillslopes

This vegetation unit is confined to the edges of the site and dominates the steep hillslopes on either side thereof (Figure 5.9).

Within the site, it occurs on the base of the slopes just above the riparian zone on either side of the river (Figure 5.9). Soils are dark brown with a relatively deep organic horizon.

Vegetation structure is Low Forest where distinct vegetation strata are visible, or Low Thicket where this is not the case (as defined by Edwards, 1983).

Species richness (α-diversity) is high considering the small proportion of the study area covered by this unit (Table 5.3). Species composition is moderately similar to Riparian Forest, apart from obligate riparian forest species, and is also representative of the Scarp Forest vegetation type of Mucina & Rutherford (2006), and more specifically the Barberton Scarp Forest of Lötter *et al*. (2014b).

Fifty-nine species of plants were recorded within Low Forest/Thicket (Table 5.3), comprising 40% of the total plant list (Appendix 1 of Appendix 6).

Woody shrubs and trees are the dominant life-forms in this community. The forest or thicket canopy is 5-10 metres high, and is mostly unbroken. Common tree species in the canopy include *Harpephyllum caffrum, Celtis africana, Olea europaea* subsp*. africana, Combretum kraussii, Apodytes dimidiata* and *Brachylaena transvaalensis*. The large tree Aloe, *Aloe barberiae*, and *Cussonia spicata* are prominent emergent trees. Other scattered canopy trees are *Erythrina lysistemon, Ficus burkei, Searsia chirindensis, Schrebera alata, Combretum molle* and *Pleurostylia capensis*.

The highest plant diversity within this vegetation unit is in the woody shrub stratum, with common species being *Dombeya pulchra, Hippobromus pauciflorus, Allophylus africana, Trimeria grandifolia, Euclea crispa, Acalypha glabrata, Scolopia zeyheri, Englerophytum magalismontanum, Lantana camara*, Grewia occidentalis, Carissa bispinosa, Dovyalis rhamnoides, Gymnosporia harveyana* and *Kraussia floribunda*.

Two scrambling shrubs are particularly common, forming dense, impenetrable thickets in places, namely *Acacia ataxacantha* and *Bauhinia galpinii*.

Woody and herbaceous climbers are common and include *Rhoicissus tomentosa, Caesalpinia decapetala*, Clematis brachiata, Senecio deltoideus, S. pleistocephalus, Dalbergia armata, Dioscorea cotinifolia, Cissampelos torulosa, Secamone filifolius, Tylophora lycioides* and *Helinis integrifolius*.

The herbaceous understory is sparse where shade is deep, while sunny clearings or forest edges are characterised by a dense low shrub layer that is dominated by low Acanthaceae shrubs such as *Hypoestes cf. aristata, Justicia protracta* and *Barleria obtusa,* as well as *Clutia pulchella* and *Triumfetta pilosa*.

While no plant species of conservation concern were located within this unit, potentially suitable habitat for several species of conservation concern is present, although most of these species are more likely to occur higher up the slopes outside of the study area boundaries.

Low Forest/Thicket falls within the Scarp Forest vegetation type as mapped by Mucina & Rutherford (2006), which has a status of Least Threatened. The forest is intact and has species composition that is strongly representative of Scarp Forest, particularly Barberton Scarp Forest.

This vegetation unit is situated within a listed Threatened Ecosystem in terms of the Biodiversity Act (No. 10 of 2004), namely Barberton Mountainlands (MP13), which is categorised as Vulnerable, and is representative of one of the vegetation communities that characterise this Threatened Ecosystem.

The Low Forest/Thicket community is intact and relatively undisturbed on hillsides above the site and is therefore considered to have functional attributes that contribute to the ecological integrity of the site, such as prevention of erosion on steep slopes. **This vegetation unit is considered to have a Moderate conservation value and sensitivity in terms of botanical biodiversity and functional value (Table 5.3; Figure 5.10).**

5.7.3 Plant species of conservation concern

According to McCleland and de Castro (2015), the site is situated within an area with one of the largest concentrations of threatened plant species in Mpumalanga, many of which are edaphic specialists confined to serpentine soils. Further details are provided in Appendix 6.

Only one Vulnerable species, *Prunus africana,* was confirmed at one site at the diversion weir and another site several hundred metres downstream of the site (Table 5.4).

In terms of the species of conservation concern, only one Declining species, *Adenia gummifera*, was confirmed to occur just upstream of the diversion weir outside of the site (Table 5.4) , while the other forty species have a Low to Very Low likelihood of occurring within the site.

Table 5.4: List of plant species of conservation concern (*sensu* Raimondo *et al*., 2009) recorded adjacent to the site (taken from McCleland and de Castro, 2015)

Species	Latest (IUCN version 3.1) Conservation Status Category*	Vegetation unit and localities where recorded
Prunus africana (Family: Rosaceae)	Vulnerable A4acd; C1+2a(i)	A single young tree was located along the streambank at the diversion weir, while two adult trees were located in Riparian Forest 685 - 785 metres downstream of the water treatment works. These localities are listed in Appendix 3 (Appendix 6) and shown on map in Appendix 6 (Appendix 6).
Adenia gummifera (Family: Passifloraceae)	Declining	A single plant was located at the edge of Riparian Forest along Rimer's Creek several hundred metres upstream of the diversion weir. This locality is listed in Appendix 3 (Appendix 6) and shown on map in Appendix 6 (Appendix 6).

Further details regarding these plant species of conservation concern are provided in Appendix 6.

5.7.4 Protected plant species

The following legislation affords protected status to selected indigenous plant species:

- National Forests Act (Act 84 of 1998),
- NEMA Biodiversity Act (Act 10 of 2004, as amended in 2007), and
- Mpumalanga Nature Conservation Act (No.10 of 1998).

National Forests Act (Act 84 of 1998)

The National Forests Act lists 47 tree species that may not be removed or damaged without a license from the National Department of Agriculture.

According to McCleland and de Castro (2015), one of the 47 tree species listed in Schedule A of this Act occurs on the boundary of the site namely, African Almond (*Prunus africana*).

NEMA Biodiversity Act (Act 10 of 2004, as amended in 2007)

The intention of the Biodiversity Act is to protect plant and animal species that are directly threatened in terms of their utilisation. The destruction, collection or trading of any species listed in this Act requires a permit.

According to McCleland and de Castro (2015), none of the species listed in the Biodiversity Act was recorded within the boundaries of the site.

Mpumalanga Nature Conservation Act (No.10 of 1998)

A number of plant species occurring in Mpumalanga Province are not considered to be threatened or listed as being of 'Conservation Concern' (*sensu* Raimondo *et al*., 2009) but are protected under Schedule 11 of the Mpumalanga Nature Conservation Act (No.10 of 1998).

Five species recorded within the site (Table 5.5) are protected plants for which, under Schedule 11 of the Mpumalanga Nature Conservation Act (Act no. 10 of 1998), a permit has to be obtained prior to their removal.

Table 5.5: List of plants recorded within the site that are protected under Schedule 11 of the Mpumalanga Nature Conservation Act (No. 10 of 1998) (taken from McCleland and de Castro, 2015).

Species	Family	Vegetation Unit
Aloe barberiae	Asphodelaceae	Untransformed Low Forest/Thicket on steep hillslopes
Dioscorea cotinifolia	Dioscoreaceae	
Olea europaea subsp. *africana*	Oleaceae	
Adenia gummifera	Passifloraceae	Untransformed Riparian Forest
Berchemia zeyheri	Rhamnaceae	Secondary Riparian Scrub, Untransformed Low Forest/Thicket on steep hillslopes

5.7.5 Invader or exotic species

McCleland and de Castro (2015) recorded a total of 146 plant species and infraspecific taxa (Appendix 1 of Appendix 6), of which 114 (78%) are indigenous taxa and 31 (21%) are naturalized aliens.

The highly degraded state of Secondary Riparian Scrub is the primary reason for this high total of alien species. Twenty-two of the alien species are confined to this vegetation unit within the site boundary, while the other two units have much lower proportions of alien species.

Of the 31 alien species listed in Appendix 1 (of Appendix 6), fourteen are declared Alien Invasive Plant Species in terms of the Alien Invasive Species (AIS) regulations as defined in the National Environmental Management: Biodiversity Act (Act no. 10 of 2014), published in the Government Gazette No. 37886, Notice 599 of 1 August 2014. According to the Regulations, declared invasive plant species must be eradicated or controlled by the landowner depending on the measures stipulated for the said category.

McCleland and de Castro (2015) indicated that the following eight confirmed alien species pose a significant threat to the indigenous vegetation of the study area and its immediate surrounds, namely both *Tithonia* species, *Lantana camara*, Passiflora subpeltata*, Solanum mauritianum*, S.seaforthianum*, Rubus niveus** and *Caesalpinia decapetala*.* These species are highly invasive transformers of natural habitats on the Escarpment and should be controlled as a matter of urgency.

5.8 Animal life

A biodiversity study (including an animal survey) of the site was undertaken by Warren McCleland and Tony de Castro of De Castro and Brits Ecological Consultants (referred to as McCleland and de Castro, 2015). A copy of the said report is provided in Appendix 6 and should be consulted with regards to the methodology used.

An aquatic biodiversity baseline assessment of the Rimer's Creek in the vicinity of the site was undertaken by Dr. P. Kotze of Clean Stream Biological Services (Pty) Ltd (referred to as Kotze, 2015). The results of this study are provided in Section 5.10 of this report.

5.8.1 Faunal assemblages identified

McCleland and de Castro (20150) identified two broad faunal assemblages within the said area namely:

- Riparian Assemblage;
- Wooded Hillside Assemblage.

Riparian Assemblage

The Riparian Assemblage is quite a diverse assemblage occupying three habitats namely:

- Fragments of tall riparian forest;
- Dense low riparian scrub;
- Surface water of Rimer's Creek.

Wooded Hillside Assemblage

The Wooded Hillside Assemblage is a marginal one better represented on the steep hillslopes above the site.

A distinctive Afromontane Forest Assemblage is present several hundred meters upstream of the diversion weir, at a higher elevation than that of the site. There is likely to be some altitudinal movement from this assemblage through the site to more intact stretches of riparian forest downstream thereof.

5.8.1.1 Mammals

According to McCleland and de Castro (2015), the dense vegetation structure and relatively homogenous understory of the low forest on steep hillsides make it unlikely that the mammal component of the Wooded Hillside Assemblage is a diverse one.

As indicated in Table 5.6, only three mammal species were recorded during fieldwork.

Table 5.6: Mammals recorded on site (taken from McCleland and de Castro, 2015)

COMMON NAME/ SCIENTIFIC NAME	FAUNAL ASSEMBLAGE	
	RIPARIAN	WOODED HILLSIDE
Bushbuck *(Tragelaphus scriptus)*	X	X
Vervet Monkey *(Chlorocebus pygerythrus)*	x	x
South African Porcupine *(Hystrix africaeaustralis)*		X

Small, forest-dwelling ungulates (such as Bushbuck, Red Duiker and Bushpig) and South African Porcupine are likely to be the dominant mammals in the understory. Vervet Monkey and Thick-tailed Galago will be the most common mammals in the forest canopy. These are species that will occur in the riparian habitats in the site and are most likely the dominant mammals in the Riparian Assemblage.

Large-spotted and Small-spotted Genets are the most likely small carnivores to forage in both assemblages, although other less common species such as African Civet and Honey Badger are possible.

The primary difference in the mammal component of the two faunal assemblages will be in small mammals, namely bats, rodents and insectivores. The lack of grassy microhabitats on the wooded hillsides means that the rodent and insectivore diversity in that assemblage is likely to be low, while the dense grassy and herbaceous vegetation in the Secondary Riparian Scrub habitat is likely to support generalist rodents (such as Natal Multimammate Mouse and Pygmy Mouse) and shrews with wide habitat tolerances (such as Reddish-grey Musk Shrew and Lesser Red Musk Shrew).

It is unlikely that any bat species are part of the Wooded Hillside Assemblage because of the closed canopy and dense vegetation structure, although many species possibly forage above the forest canopy. The broken canopy and patches of tall forest in the riparian zone make it likely that a few species roost in this zone and are part of the Riparian Assemblage, particularly Wahlberg's and Peters' Epauletted Fruit Bats, both of which are known to favour riparian forest for roosting in the Kruger National Park (Rautenbach et al., 1996).

5.8.1.2 Birds

Rimer's Creek is not situated within Important Bird Areas as defined by Barnes (1998), although the Songimvelo Game Reserve Important Bird Area (SA017) is approximately 8 km south and 7 km south-east of the study area.

The site is situated in the quarter-degree grid 2531CC, which has a diverse array of habitats and consequently a high list (286) of bird species that have been recorded in the grid during the second South African Bird Atlas Project (SABAP2).

The site is situated in the pentad 2545_3100 which has a bird list of 243 species recorded since 2007 (http://sabap2.adu.org.za/

pentad_info.php?pentad=2535_2955; accessed 26 March 2015). However, the pentad 2545_3100 has much greater variation of habitats than that represented in the site.

According to McCleland and de Castro (2015), it is unlikely that the bird diversity within the site is much higher than 100 species due to the small size of the site and the relatively limited habitat types.

As indicated in Table 5.7, 52 species were recorded during fieldwork. Many bird species are present in both assemblages due to the strong similiarties between the two assemblages, particularly between riparian forest and low forest on hillsides.

Table 5.7: Birds recorded on site (taken from McCleland and de Castro, 2015)

Common Name (Scientific names provided in Appendix 4 of Appendix 6)	Riparian Forest	Riparian Scrub	Hillside Thicket / Low Forest	Overhead	River
BIRDS					
African Black Swift				x	
African Dusky Flycatcher	x				
African Firefinch		x	x		
African Goshawk	x			x	
Amethyst Sunbird		x	x		
African Olive Pigeon	x				
African Paradise Flycatcher	x		x		
Barn Swallow				x	
Bar-throated Apalis	x				
Black-backed Puffback	x	x	x		
Black-collared Barbet			x		
Black-headed Oriole			x		
Blue-mantled Crested Flycatcher			x		
Bronze Mannikin		x			
Brown-hooded Kingfisher		x	x		
Cape Batis	x		x		
Cape White-eye	x	x	x		
Collared Sunbird		x	x		
Crowned Hornbill	x		x		
Dark-capped Bulbul	x		x		
Eastern Nicator	x		x		
European Bee-eater				x	
Forest Canary	x	x			
Golden-tailed Woodpecker	x		x		
Green-backed Camaroptera	x	x	x		
Hadeda Ibis	x			x	
Knysna Turaco	x				
Lesser Striped Swallow				x	
Marsh Warbler		x			
Mountain Wagtail					x
Natal Spurfowl			x		

Common Name (Scientific names provided in Appendix 4 of Appendix 6)	Riparian Forest	Riparian Scrub	Hillside Thicket / Low Forest	Overhead	River
Olive Bush Shrike	x				
Olive Sunbird	x				
Olive Woodpecker	x				
Orange-breasted Bush Shrike			x		
Purple-crested Turaco	x		x		
Red-capped Robin Chat	x		x		
Red-eyed Dove	x		x		
Red-winged Starling			x	x	
Sombre Greenbul	x		x		
Southern Boubou	x	x	x		
Southern Tchagra			x		
Speckled Mousebird		x	x		
Spectacled Weaver			x		
Square-tailed Drongo	x				
Tambourine Dove	x	x	x		
Tawny-flanked Prinia		x			
Terrestrial Brownbul	x		x		
Trumpeter Hornbill	x				
Yellow-breasted Apalis	x	x	x		
Yellow-fronted Tinkerbird	x		x		
Yellow-rumped Tinkerbird	x				
TOTAL (= 52)	**31**	**15**	**31**	**7**	**1**

Twelve of the species observed during fieldwork are obligate forest specialists that are mostly confined to untransformed forest habitat, although some will forage in adjacent dense woodland or thickets.

Five of these specialists are primarily confined to Afromontane Forest and more likely to be more prominent components of the Afromontane Forest Assemblage higher up the valley above 1200 masl. These species are African Olive Pigeon, Knysna Turaco, Olive Woodpecker, Cape Batis and Forest Canary (Table 5.7).

The other seven obligate forest specialists are African Goshawk, Blue-mantled Crested Flycatcher, Olive Bush Shrike, Olive Sunbird, Square-tailed Drongo, Tambourine Dove and Yellow-rumped Tinkerbird (Table 5.7). Eight of these obligate forest specialists were only recorded in the Riparian Assemblage during fieldwork, while four species were also recorded in the Wooded Hillside Assemblage (Table 5.7).

Nine other bird species are equally common in untransformed forest and dense woodland or thickets along streams, and would be accurately be termed facultative forest species. One of these, Southern Tchagra (Table 5.7), has a restricted range in Mpumalanga, being confined to dense habitats along the Escarpment foothills between Barberton and Mariepskop. A single bird was found foraging at the edge of a dense patch of Low Forest at the edge of the study area. The other seven facultative forest species are Bar-throated Apalis, Eastern Nicator, Green-backed Camaroptera, Red-capped Robin Chat, Sombre Greenbul, Southern Boubou, Terrestrial Brownbul and Trumpeter Hornbill Table 5.7). Six of the facultative forest species were

recorded in both assemblages in the study area, while Southern Tchagra was only found in the Wooded Hillside Assemblage and Bar-throated Apalis and Trumpeter Hornbill were only recorded in the Riparian Assemblage (Table 5.7).

A few bird aerial insectivores such as African Black Swift, Barn Swallow and Lesser Striped Swallow (Table 5.7) were recorded foraging above the site and are unlikely to utilise the habitats represented in the site.

The rest of the bird species composition is mostly made up of generalist woodland species such as Dark-capped Bulbul, Red-eyed Dove, Black-backed Puffback, Cape White-eye, Golden-tailed Woodpecker, Speckled Mousebird and Yellow-breasted Apalis (Table 5.7).

A number of small seed-eaters and insectivores were only recorded in the dense grass and herbaceous understory and edges of Secondary Riparian Scrub and are confined to the Riparian Assemblage, including Bronze Mannikin, Tawny-flanked Prinia and Marsh Warbler, while African Firefinch was also present in the Wooded Hillside Assemblage but foraged in the Secondary Riparian Scrub (Table 5.7).

Mountain Wagtail was the only species confined to the rocky stream bed within the Riparian Assemblage (Table 5.7) and is unlikely to forage in the adjacent terrestrial habitats.

5.8.1.3 Reptiles

The Barberton area is considered to be an area of high reptile diversity, with the quarter-degree grid 2531CC placed in a species diversity range of 25-37 reptile species by Branch (2014).

According to McCleland and de Castro (2015), the site is also situated within the Mpumalanga Escarpment reptile endemism hotspot, an area that supports 12-24 endemic reptile species per quarter-degree grid, particularly endemic lizard species (Branch, 2014).

Reptiles were searched for incidentally while surveying birds and no nocturnal surveys or dedicate trapping exercises were undertaken.

Only one reptile species was observed during fieldwork, namely Variable Skink, a widespread habitat generalist.

While there are certainly other reptile species present in the site, the homogenous nature of the dense understory and lack of micro-habitats (such as rocky outcrops and exposed sheetrock) suggest that reptile diversity is very low.

Common species that have a high likelihood of being present include Spotted Bush Snake, Brown Water Snake, Water Monitor, Rainbow Skink and Flap-necked Chamaeleon.

5.8.1.4 Frogs

The site is situated along the boundary of two zoogeographical regions, namely the Eastern Escarpment/Coastal District and Bushveld District (Minter et al., 2004).

The Eastern Escarpment/Coastal District is characterised by species such as Natal Sand Frog, Striped Grass Frog, Snoring Puddle Frog, Common River Frog and Bubbling Kassina, while typical Bushveld District species include Banded Rubber Frog, Plain Grass Frog, Foam-nest Frog, Olive Toad and Red Toad.

The quarter-degree grid 2531CC, in which the site is located, is in an area of high species richness and had 22 species recorded during the Frog Atlas Project (Minter et al., 2004). However, wetland habitat is limited to the mostly degraded riparian zone and it is therefore unlikely that frog species richness is high in the study area.

The only species confirmed during fieldwork was Common River Frog, but widespread species such as Guttural Toad, Red Toad, Painted Reed Frog, Snoring Puddle Frog and Common Platanna have a high likelihood of occurring.

Habitat specialists such as Plaintive Rain Frog and Northern Ghost Frog are more likely to be present in the larger tracts of Afromontane Forest upstream of the site, particularly above 1200 masl.

5.8.2 Potentially occurring faunal species of conservation concern

5.8.2.1 Mammals

Table 5.8 provides an indication of the one threatened and four Near Threatened mammal species confirmed to occur within the quarter degree grids 2531CC and 2531CA. It is only the bats that could have a high possibility of foraging within the site as indicated in Table 5.8.

Table 5.8: Threatened and Near Threatened mammal species confirmed to occur within the quarter-degree grids 2531CC and 2531CA (taken from McCleland and de Castro, 2015)

Common Name	Conservation Status	Habitat	Probability of Occurrence
Highveld Golden Mole	Near Threatened	Wetlands in or near high-altitude grassland	Very Low. Unsuitable habitat and altitude.
African Wild Dog	Endangered	Various savannah types, avoiding dense woodland and forest; mostly confined to protected areas, but occasionally wanders far from these areas	Very Low. No recent records in vicinity of Barberton. Unsuitable habitat in study area
Temminck's Hairy Bat	Near Threatened	Various woodland types, usually in mountainous areas in close vicinity to caves where it roosts	**High as a foraging visitor.** No roosting habitat in study area.
Geoffroy's Horseshoe Bat	Near Threatened	Various woodland types and riparian forest, usually in close vicinity to caves where it	**High as a foraging visitor.** No roosting habitat in study area.

Common Name	Conservation Status	Habitat	Probability of Occurrence
		roosts	
Hildebrandt's Horseshoe Bat	Near Threatened	Various woodland types, usually in close vicinity to caves where it roosts.	**High as a foraging visitor.** No roosting habitat in study area.

Further details regarding these species are provided in Appendix 5 of Appendix 6.

5.8.2.2 Birds

Sixteen threatened species and eight Near Threatened species have been confirmed to occur in the quarter-degree grids 2531CC and 2531CA during SABAP2 and in the MTPA threatened species database (Table 5.9). This unusually high proportion of threatened species reflects the outstanding importance of the area for conservation-important bird species. The two quarter-degree grids represent a far larger area and greater variety of habitats than are present in the vicinity of Rimer's Creek and most of the species listed (Appendix 5 of Appendix 6) have a Very Low likelihood of occurring.

One threatened and two Near Threatened species (Table 5.9) are considered to have a Moderate or High likelihood of occurrence within the site.

Table 5.9: Birds that have moderate to high probability of occurrence on site (taken from McCleland and de Castro, 2015)

Common Name	Conservation Status	Habitat	Probability of Occurrence
Half-collared Kingfisher	Near Threatened	A resident of small, fast-flowing streams with relatively dense riparian vegetation.	**High**. Patches of suitable habitat present within study area.
Magpie Mannikin	Near Threatened #	In Mpumalanga occurs in dense riparian growth with adjacent gardens in which it feeds	**Moderate**. Some suitable foraging habitat present in study area
African Crowned Eagle	Vulnerable	Various forest types, sometimes in dense woodland.	**High.** Suitable habitat and prey species (monkeys) present within study

Further details regarding these species are provided in Appendix 5 of Appendix 6.

5.8.2.3 Reptiles

Two threatened and seven Near Threatened reptile species have been recorded within the grids 2531CC and 2531CA (Appendix 5 of Appendix 6). Most of these are habitat specialists occurring in habitats or altitudes not represented within the site and thus have a Low or Very Low likelihood of occurring.

Two species have a Moderate to High Likelihood of occurring as indicated in Table 5.10.

Table 5.10: Reptiles that have moderate probability of occurrence on site (taken from McCleland and de Castro, 2015)

Common/Scientific Name	Conservation Status	Habitat	Probability of Occurrence
Giant Legless Skink (*Acontias plumbeus)*	Near Threatened #	Occurs in mesic microhabitats under leaf litter in forest or partly wooded habitats, although also occurring in grassland, mostly below 1500 masl.	High. Confirmed record from Barberton Townlands 369 JU. Suitable habitat present in study area.
Northern Dwarf Chamaeleon (*Bradypodion transvaalensis)*	Vulnerable #	Afromontane and mistbelt forest and adjacent grassland; sometimes in deep gorges.	Moderate. Some potential habitat present in study area, although altitude possibly too low.

Further details regarding these species are provided in Appendix 6 of Appendix 5.

5.8.2.4 Frogs

None of the frogs occurring in the grids 2531CC and 2531CA have been classified as threatened or Near Threatened by Minter *et al*. (2004). However, Williamson & Theron (2002) assessed the Northern Ghost Frog and Yellow-striped Reed Frog as Vulnerable.

While suitable riverine habitat is present upstream for Northern Ghost Frog, the river stretch within the site is too degraded and at a lower altitude than this species prefers and it is considered to have a Low likelihood of occurring.

Yellow-striped Reed Frog occurs in shallow water lily covered wetlands in savannah and grassland, and is only represented by a pre-1996 record in 2531CC. It has a Very Low likelihood of being present.

5.9 Surface water

5.9.1 Catchment

The said site falls within the Inkomati Water Management Area (i.e. WMA6) and the Quarternary Catchment X23F (Figure 5.11).

Lomati Dam, the water source of the Rimer's WTW, is located in another Quaternary Catchment (X14A) of the Inkomati WMA which is seen as a Strategic Water Source area.

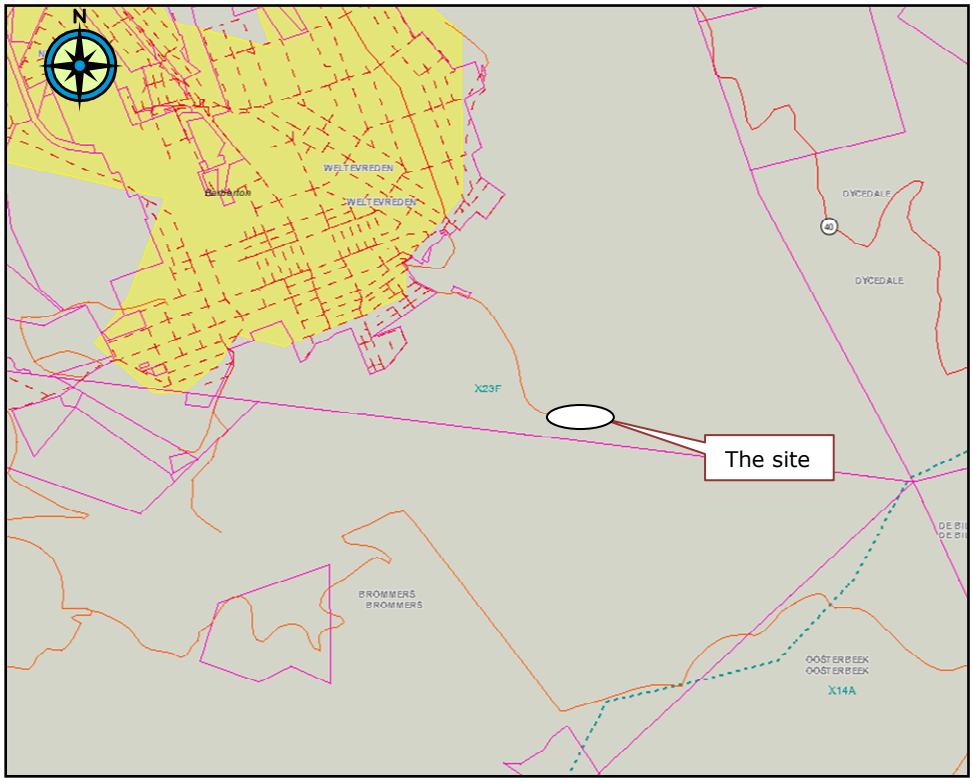

Figure 5.11: Quaternary Catchment (taken from Department of Agriculture, Forestry and Fisheries)

The site comprises a 240m stretch of Rimer's Creek that arises in the Makhonjwa Mountains south-east of the site at approximately 1420 masl and flows northwest through the site and the town of Barberton, joining the Suid-Kaap River, a tributary of the Crocodile River, about 6km north of Barberton.

According to Kotze (2015), the Rimer's Creek was not assigned a sub-quaternary (SQ) code, being a tributary of SQ X23F-1120 (Suidkaap River).

5.9.2 Flood line

As indicated, the site comprises a 240m stretch of the Rimer's Creek. The watercourse has been severely transformed by the current WTW compared to its reference condition. Existing WTW impacts include an impoundment in the form of a weir, water abstraction and diversion of flows via the weir and pipeline system (Kotze, 2015).

Figure 5.12 provides an indication of the catchment area used in the Rimer's Creek flood calculations.

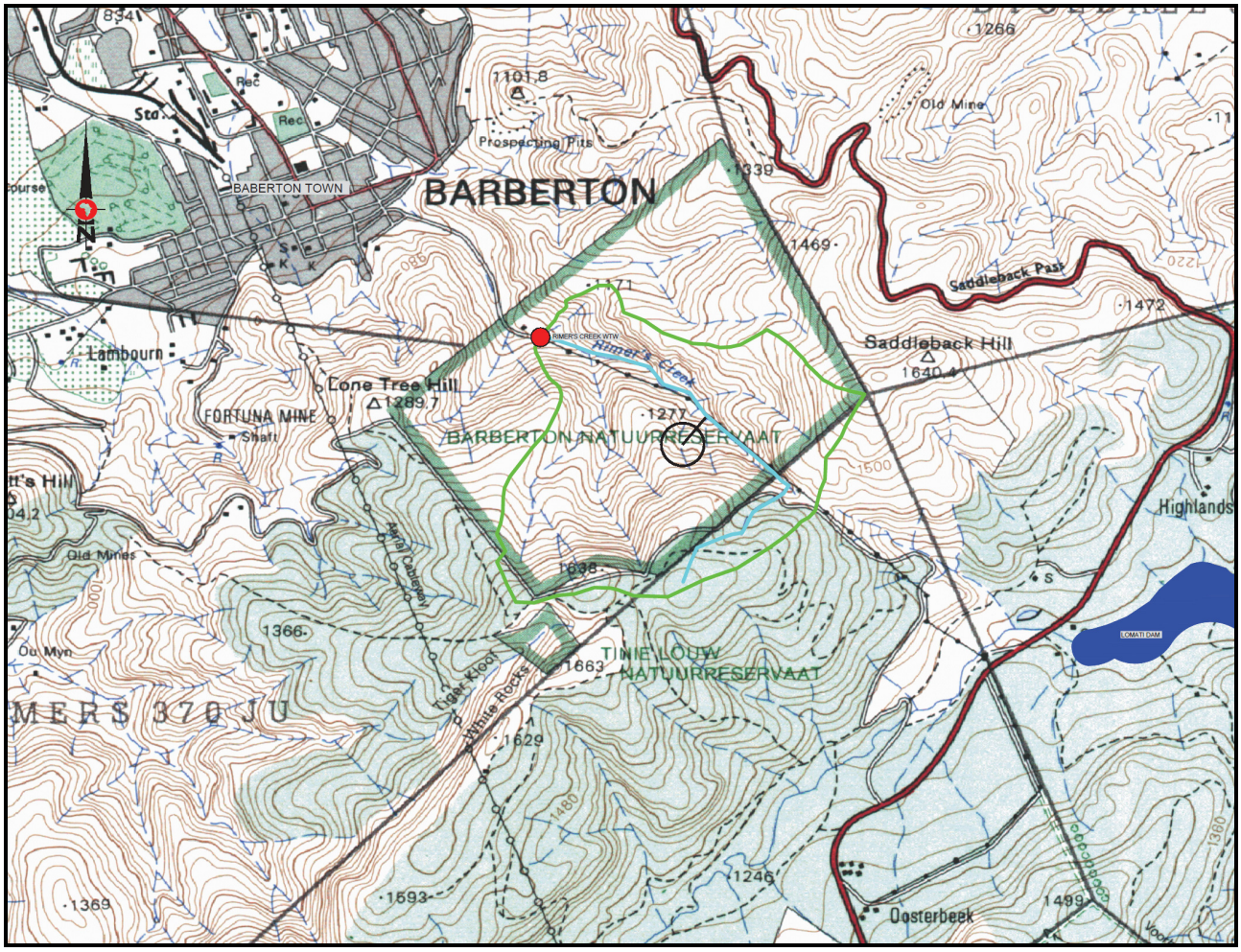

Figure 5.12: Catchment area of Rimer's Creek (Afri-Infra, 2014)

Table 5.11 provides an indication of the input parameters used to determine the flow rates while Table 5.12 provides the flow rates calculated for the various flood scenarios.

Table 5.11: Input parameters used to determine flow rates (taken from Sinotech, 2014)

INPUT PARAMETER	RIMER'S CREEK CATCHMENT
Drainage basin	
Catchment area (km^2)	2.355
Mean Annual Runoff (MAR) (mm)	760
Length of longest watercourse (km)	2.636
Flow of water	Defined water course
Height difference along 10-85 Slope (m)	518.5m
Average slope (m/m)	0.26227

Table 5.12: Design Flood Flow Rates (taken from Sinotech, 2014)

SUMMARY OF PEAK FLOWS (m^3/s)	METHOD				
	Rational	Alternative rational	Unit hydrograph	Standard design flood	Empirical
1:2	19.45	15.74	15.21	5.609	
1:5	28.20	28.32	25.24	17.42	
1:10	37.84	39.36	36.87	28.24	16.09
1:20	49.36	51.49	51.55	40.41	21.84
1:50	67.50	68.05	78.01	58.45	30.27
1:100	87.15	82.53	108.47	73.54	38.31
1:200		93.44		89.51	

Afri-Infra (2014) indicated run-off calculations revealed a 1:100 year flood magnitude of approximately $100m^3/s$ which is relatively small. According to Afri-Infra (2014), all new infrastructure will be located above the 1:100 year flood line.

5.9.3 Surface water runoff

The 1:50 000 topographical map (2531CC) indicates Rimer's Creek that drains through the site as a non-perennial river.

Kotze (2015) indicated that Rimer's Creek is expected to have existed as a non-perennial stream in its reference condition prior to the construction of the WTW, the abstraction weir and water pipeline system.

The release of permanent inter-basin flow from Lomati Dam through Saddleback Tunnel located upstream, has however changed the hydrology of the watercourse.

Surface flow has been reduced in the Rimer's Creek as the abstraction weir intercepts flow and diverts it into a series of pipes that transport water to the WTW, where after it is released immediately downstream of the site.

Surface flow within the delineated riparian habitat and associated stream reach is therefore bypassed. Kotze (20150 indicated that this coincides with the absence of surface flow recorded in channels surveyed during the assessment.

The abstraction and diversion of water not only reduces surface flow within the delineated riparian area, but also prevents the inflow of transported sediment. The riparian habitat therefore receives less sediment and nutrient inputs as a result of the weir and pipeline bypass system (Kotze, 2015).

It should be noted that water is released from the top of the storage reservoir and flows into the Rimer's Creek downstream of the site. In addition, return flow from the WTW is released via a pipe outlet directly into the Rimer's Creek channel located at the western edge of the site.

It remains uncertain to what frequency and magnitude flooding patterns within the delineated riparian areas are changed as a result of the combined weir and pipeline interception system along with inter-basin transfer from Lomati Dam. Limited information is available regarding changes to surface flows within the watercourse (Afri-Infra Group, 2014; Kotze, 2015).

Kotze (2015) indicated that Rimer's Creek can probably be classified as a seasonal system under natural conditions.

5.9.4 Water quality

Table 5.13 provides the in-situ water quality of Rimer's Creek.

Table 5.13: In-situ water quality results (taken from Kotze, 2015)

REACH & MONITORING SITE*	EC (mS/m)	pH	Oxygen saturation (%)	Dissolved oxygen (mg/l)	Water temperature (°C)	Turbidity (visual)
A – RC 1	13.7	7.40	N/A	N/A	N/A	CLEAR
B – RC2/3	7.7	7.35	96.9	7.48	22.1	CLEAR
C – RC4/5	7.7	7.32	102.0	7.46	25.2	CLEAR
D – RC6	10.0	7.10	95.4	7.71	22.4	CLEAR TURBID (417 NTU's)
D – RC7	11.7	7.62	97.3	7.62	20.7	CLEAR

*: See Section 5.10.2 for information regarding the reach and monitoring site.

As indicated in Table 5.13, the electrical conductivity (EC) ranged between 7.7 mS/m to 13.7 mS/m.

The highest salinity (Table 5.13) was measured in Reach A (RC1; Figure 5.13), which is located upstream of the water transfer outfall. This indicates that the increased salinity in the Upper Rimer's Creek is attributed to natural phenomena (such as geological weathering). The water from the Lomati Dam (via Saddleback tunnel) is of much lower salinity (Table 5.13) and results in a decreased salinity in Rimer's Creek in Reach B (Figure 5.13). The salinity remained very similar in Reach C indicating that the water in this reach is primarily seepage and leaks from the abstraction weir and the WTW pipeline.

Salinity in the lower Reach D (Figure 5.13) was again slightly higher, indicating potential contribution from tributaries as well as WTW activities (releases). The salinity values measures should not be limiting to the aquatic biota.

As indicated in Table 5.13, the pH was neutral at all sites, ranging from 7.10 to 7.62, which fell within the target range for fish health (between 6.5 and 9.0). It is expected that most species will tolerate and reproduce successfully within this pH range (Kotze, 2015).

Dissolved oxygen and oxygen saturation levels were also high at all sites falling above the guideline levels of >5mg/l and should therefore not be limiting to the ecological integrity at these sites (Kotze, 2015).

The turbidity/clarity of the water at most sites were generally clear (Table 5.13). The increased turbidity at RC6 (Figure 5.13) was as a result of the flushing of highly turbid water from the WTW as well as releases.

As indicated in Table 3.1, the raw water is of excellent quality and may be classified as Type 4 water, with a Total Alkalinity (TA) in the range of 10 to 20 mg/l. Further details are provided in Section 3.1.3 and Table 3.1.

5.10 Aquatic faunal assessment

An aquatic biodiversity baseline assessment of the Rimer's Creek in the vicinity of the site was undertaken by Dr. P. Kotze of Clean Stream Biological Services (Pty) Ltd (referred to as Kotze, 2015). A copy of the said report is provided in Appendix 5 and should be consulted with regards to the methodology used.

5.10.1 Ecological status of Rimer's Creek

Rimer's Creek lies within Level II EcoRegion 10.02 (Northern Escarpment Mountains) (sites RC1 to RC6; Figure 5.13) and 4.05 (Site RC7; Figure 5.13) (North Eastern Highlands) (Kleynhans et al., 2005).

The said site falls within the Inkomati Water Management Area (i.e. WMA6) and the Quaternary Catchment X23F (Figure 5.11). This quaternary catchment has a Moderate conservation state and a Moderately modified (Class C) Present Ecological State (PES) based on available information on a national scale (Middleton and Bailey, 2008).

Kotze (2015) indicated that the recent desktop PES-EI-ES study (DWA, 2013) indicated the sub-quartenary reach (X23F-1120, Suidkaap River) to have a:

- present ecological status of C (moderately modified),
- ecological importance of moderate;
- ecological sensitivity of high.

The following impacts/activities were indicated to be of concern within this reach:

- Critical: none;
- Serious: none;
- Large: Irrigation;
- Moderate: Abstraction, Agricultural fields, algal growth, bed and channel disturbance, small (farm) dams, alien vegetation, inundation, runoff/effluent: irrigation, sedimentation, grazing (land-use), vegetation removal;
- Small: recreation, roads

According to the Freshwater Assessment of the Mpumalanga Biodiversity Sector Plan (2013), the site falls within other natural areas. It is not indicated as an important subcatchment in terms of Ecological Support Areas (ESA). The site does not overlap with any wetland habitat indicated on the National Freshwater Ecosystem Priority Area (NFEPA) spatial dataset of 2011.

5.10.2 Site selection

Kotze (2015) divided Rimer's Creek into four (4) reaches (Figure 5.13; Table 5.14) namely:

- Reach A: Upstream of Saddleback tunnel;
- Reach B: Tunnel outfall to abstraction weir;
- Reach C: Weir to WTW;
- Reach D: WTW to Museum.

Within each reach, aquatic sampling points as indicated in Table 5.14 and Figure 5.13 were identified.

Figure 5.13: Four reaches and aquatic sampling points

Table 5.14: Aquatic sampling sites selected (taken from Kotze, 2015)

Reach A: Upstream of Saddleback Tunnel	
This reach extends from the source of the Rimer's Creek to the Saddleback water transfer tunnel outfall (from Lomati Dam). The reach is mostly un-impacted by human activities and provides an indication of the status of the Rimer's Creek before any impacts associated with the current water transfer and water treatment works activities.	Sampling site: RC1 – just upstream of tunnel release site.
Reach B: Tunnel outfall to abstraction weir	
This reach stretches from the tunnel outfall (water transfer) to the WTW abstraction weir. This reach consists of higher than natural and constant flow (approximately 10Ml/d) of water transferred from the Lomati Dam.	Sampling site: RC2 – middle of reach; RC3 – just upstream of weir.
Reach C: Weir to WTW	
This reach stretches from the abstraction weir to the WTW. Flow in this reach is currently greatly reduced as most of the water is impounded and abstracted at the weir and piped to the WTW.	Sampling site: RC4 – just downstream of weir; RC5 – middle of reach.
Reach D: WTW to Museum	
This reach stretches from the abstraction weir, past the WTW, to the museum. This reach is also impacted by reduced flow due to impoundment by the weir and abstraction by the WTW, as well as water quality impacts due to WTW effluents. A small earthen dam is located downstream of the museum.	Sampling site: RC6 – middle reach at motocross picnic site; RC7 – at museum.

5.10.3 Habitat assessment

Table 5.15 provides an indication of the habitat assessment of Rimer's Creek flowing through the site.

Table 5.15: Habitat assessment (taken from Kotze, 2015)

REACH	CONDITION CATEGORY		IMPACTS
	INSTREAM	RIPARIAN ZONE	
A	A Very good (near natural)	A Very good (near natural)	Due to invasive alien vegetation and vegetation removal associated with the Saddleback tunnel activities (i.e. on riparian zone).
B	D/E Largely to seriously modified from natural conditions	D/E Largely to seriously modified from natural conditions	Due to current water transfer scheme (Lomati Water via Saddleback tunnel to Rimer's Creek), an associated pipeline and electricity distribution line that runs along the river in this reach and the abstraction weir)
C	D/E Largely to seriously modified from natural conditions	E Seriously modified from its natural state	Due to impoundment by the abstraction weir, abstraction by the WTW and associated pipelines running along or in the channel.
D	E Seriously modified from its natural state	E Seriously modified from its natural state	Abstraction by the WTW, operation of the WTW (especially sludge releases), a road, recreational areas and extensive invasion by alien vegetation.

Reach B (Figure 5.13):

Kotze (2015) indicated the following notable impacts in Reach B:

- **Flow modification:** Kotze (2015) indicated that the flow is critically modified (increased) in Reach B compared to natural as a result of the constant release of water from the Lomati Dam via the Saddleback Tunnel. This has resulted in transformation of the natural habitat diversity (loss of slow habitats) and scouring of the stream bed and banks. This impact is more notable in the instream zone than the riparian zone.
- **Bed and channel modification**: The transfer has increased volumes and velocities of water, resulting in scouring of the bed and channel banks, while erosion as a result of construction activities may have resulted in increased sedimentation of the beds and a few eroded areas along the channel. The higher than natural flows has also resulted in longitudinal alterations to the channel. The weir is also responsible for alteration in bed and channel conditions as a result of sedimentation and inundation.
- **Water quality:** Although the water quality is good, the fact that water is transferred from a neighbouring catchment has resulted in a change in water quality when compared to natural conditions.
- **Inundation:** Increased flows due to the water transfer has resulted in flooding of the natural instream habitats. The abstraction weir in the

lower section of this reach further contributes slightly to inundation of habitats upstream of the weir.

- **Vegetation removal:** Associated with both the increased flows, as well as the pipeline and power line construction activities, along this reach.
- **Alien vegetation**: A relatively high abundance of alien vegetation was noted primarily due to disturbance during construction activities.

Reach C (Figure 5.13):

Kotze (2015) indicated the following notable impacts in Reach C:

- **Water abstraction and flow modification:** Most of the flow in Rimer's Creek is impounded and abstracted at the abstraction weir and piped to the WTW. The only flow in this reach is seepage and spills from the weir and pipeline (especially during low flow). The flow in this reach is therefore critically modified (lower) than natural and a major loss in the diversity of, particularly, instream habitat, is expected.
- **Bed and channel modification**: The interception of most of the water by the weir has resulted in an altered channel and beds, while previous construction activities (pipeline, road) resulted in slightly increased erosion.
- **Water quality:** The water quality has been altered from its natural state as a result of the significantly reduced flow, together with contribution of Lomati River water in this reach. The low flows would result in decreased oxygen levels and increased temperatures. Sediment regime may also be altered by the upstream abstraction weir.
- **Vegetation removal:** Riparian vegetation has declined as a result of decreased flows and has been removed in association with construction of the weir, pipeline and road.
- **Alien vegetation**: A relatively high abundance of alien vegetation was noted primarily in response to disturbance during previous construction activities.

Reach D (Figure 5.13):

Kotze (2015) indicated the following notable impacts in Reach D:

- **Water abstraction and flow modification:** Most of the flow in the Rimer's Creek is impounded by the weir and abstracted by the WTW. The only flow in this reach is seepage and spills from the weir and pipeline, releases from the WTW and tributary inflow. Maintenance releases from the WTW (backwash) result in dramatic fluctuations (weekly) and also contribute to a loss in natural seasonality. The flow in this reach is therefore critically modified (lower) than natural and a major loss in the diversity of especially instream habitat is expected.
- **Bed and channel modification**: The abstraction of most of the water results in altered channel and beds, while construction activities (pipeline, road) resulted in slightly increased erosion. Sludge released from the WTW during maintenance of filters result in deterioration of bottom substrate quality. High flow volumes and velocities as a result of the releases of sludge have also straightened the channel (or former side channels) and caused erosion in places. Sedimentation is evident in the dam downstream of the museum.
- **Water quality:** The water quality has been altered from its natural state as a result of the significantly reduced flow and contribution of Lomati River water in this reach that would result in decreased oxygen

levels and increased temperatures. Water quality is furthermore seriously compromised by the sludge releases from the WTW.

- **Vegetation removal:** Riparian vegetation has declined in response to decreased flows, as well as vegetation clearing for roads and recreational areas.
- **Alien vegetation**: A relatively high abundance of alien vegetation was noted primarily in response to disturbance during previous construction activities.

5.10.4 Aquatic macro-invertebrate diversity

5.10.4.1 Taxa richness and relative intolerance to water quality alterations

Kotze (2015) indicated that 39 aquatic invertebrate tax (family level) were sampled at the aquatic sampling sites. Further information regarding the taxa is provided in Appendix 5.

Only one taxon with a high requirement for unmodified water quality, namely Amphipoda, was sampled in the study area.

Nine taxa (23% of all taxa sampled) with a moderate requirement for unmodified water quality were also sampled. These are the most valuable indicator taxa to be used to monitor potential deterioration associated with the proposed or other activities in the catchment, especially in terms of water quality and flow modification as well as increased sedimentation due to their preference for substrate habitats.

Twenty-one taxa (54% of all taxa sample) have a low requirement for unmodified water quality, while eight of the observed invertebrate taxa (21% of all taxa sampled) have a very low requirement for unmodified water quality.

5.10.4.2 Habitat preferences

Kotze (2015) indicated that the invertebrates of the study area require a diversity of habitats to ensure the maintenance of the present ecological integrity.

Certain taxa observed have a preference for slow or very slow habitat (18 taxa, 46%) and may be negatively influenced by unnatural increase in flows, such as through unnaturally high return flows and water transfer schemes.

Some taxa again have a preference for moderately fast to fast (>0.3m/s) flow (14 Taxa, 36%) and may be negatively influenced by a reduction of flow, through activities such as dam and weir construction, water abstraction, etc.

In terms of substrate and cover requirements, the highest proportion of the invertebrate taxa have a preference for cobbles (28%), while several prefer vegetation (21%), gravel-sand-mud (18%), water column (15%) and bedrock (3%). It is therefore particularly important to maintain good quality cobble (substrate) habitats, while a diversity of cover features will be essential to maintain the diversity of invertebrates. The substrate habitat features can be impacted by aspects such as erosion (resulting in sedimentation and clogging of interstitial spaces between rocks) and excessive algal growth, often associated with nutrient enrichment.

Further information regarding the taxa and their habitat preferences is provided in Appendix 5.

5.10.4.3 Biotic integrity based on aquatic macro-invertebrates

Rimer's Creek was probably, under natural conditions, a seasonal system, especially in the upper and middle reaches of the system. This system has been radically transformed by a water transfer scheme and large scale abstraction for potable water provision.

The SASS5 results were primarily used to assess the current variation in the invertebrate assemblages and their general indication of conditions in each reach.

SASS scores ranged between 50 (sites RC4 and 7; Figure 5.13) and 120 (RC3; Figure 5.13), while ASPT scores ranged between 4.17 (site RC7; Figure 5.13) and 5.45 (site RC3; Figure 5.13).

The conditions in Reach A (in terms of habitat and water quality) are estimated to be very close to natural, and hence the aquatic macroinvertebrate composition of this site could therefore also be expected to reflect near-natural conditions. The SASS5 score of 107 and an ASPT of 5.10 calculated for this reach (site RC1) is therefore probably a reflection of scores that could be attained in this reach under undisturbed conditions.

The SASS5 scores decreased notably between sites RC1 and RC2 (Figure 5.13) indicating that the water transfer resulted in a deterioration in the biotic status of this reach.

A higher SASS5 and ASPT score was calculated in the lower section of Reach B at site RC3 (Figure 5.13), primarily due to the presence of the weir that resulted in a higher habitat diversity (both fast and slow habitats as well as improved marginal vegetation).

Conditions deteriorated notably between site RC3 and RC4 due to the extensive loss in habitat as a result of impoundment and abstraction of most of the water at the weir (between sites RC3 and RC4; Figure 5.13). This was also reflected by the decrease in total habitat suitability scores from 18 at site RC3 to only 6 at site RC4. Conditions recovered slightly towards site RC5 primarily due to improved habitat suitability but still remained fairly poor due to the radical alteration of flow in this reach.

Conditions deteriorated further between Reach C and D with the lowest SASS5 and ASPT scores recorded at site RC7 (Figure 5.13). Although there was an improvement in habitat suitability between Reach C and D, this was not reflected by the macroinvertebrate assemblages. It is thought that water quality alteration in this reach is mostly as a result of impacts by the WTW silt releases.

The ecological status of Reach D (based on macroinvertebrates) is therefore expected to be in a largely reduced condition from natural status.

5.10.5 Icthyofauna (fish)

5.10.5.1 Fish habitat assessment

Kotze (2015) indicated that the diversity and availability of habitats for fish were very low in Reach A with only very shallow pools connected by a trickle

being available. Limited cover, in the form of substrate and overhang, was available.

Habitat conditions changed notably between Reach A and Reach B due to the addition of a large amount of water by the transfer scheme. The middle and upper section of this reach had three of the four velocity-depth categories while all four were represented in the lower section of the reach. This habitat composition is, however, mostly unnatural due to the modified flows, and one can assume that Reach B would have had similar habitats as Reach A under natural conditions.

Reach C again had a very low diversity of habitats for fish, with only slow-shallow habitats being available (due to water abstraction at weir).

Habitat conditions again improved slightly towards Reach D due to inflow from a tributary and possibly also releases from the WTW.

The habitat composition at a site plays an important role in determining the expected fish species assemblage of the site, which is furthermore influenced by the prevailing water quality.

5.10.5.2 Fish species composition

Kotze (2015) indicated that no fish species could be located at any of the sites after thorough sampling of available habitats (@ February 2015).

The absence of fish in this reach of the Rimer's Creek may be attributed to natural phenomenon as this stream seems to have been primarily seasonal under natural conditions. Under natural conditions, fish may have colonised the study area (especially lower reaches) from the Suidkaap River during periods of good flow. No data is available of pre-disturbance fish surveys and therefore this assumption cannot be verified.

Under present conditions, various factors may be responsible for, or contributing to, the absence of fish (assuming that certain fish may have utilised the stream under natural conditions during good flow conditions).

Currently, the presence of a built up area (Barberton town), canalization and dams, create both physical and chemical migration barriers to fish, preventing any movement between the Suidkaap River and the Rimer's Creek. The existing abstraction weir as well as the high velocities related to the water transfer, provide further physical migration barriers that currently prevent or impede on relocation or movement of fish within this reach.

5.11 Wetlands

A wetland delineation and classification of the site and immediate surroundings was undertaken by Retief Grobler of De Castro and Brits Ecological Consultants (referred to as Grobler, 2015). A copy of the report is provided in Appendix 7 and should be consulted with regards to the methodology used.

5.11.1 Wetland types

According to Grobler (2015), no natural wetlands are present on site or within the surrounding 500m buffer (Figure 5.14).

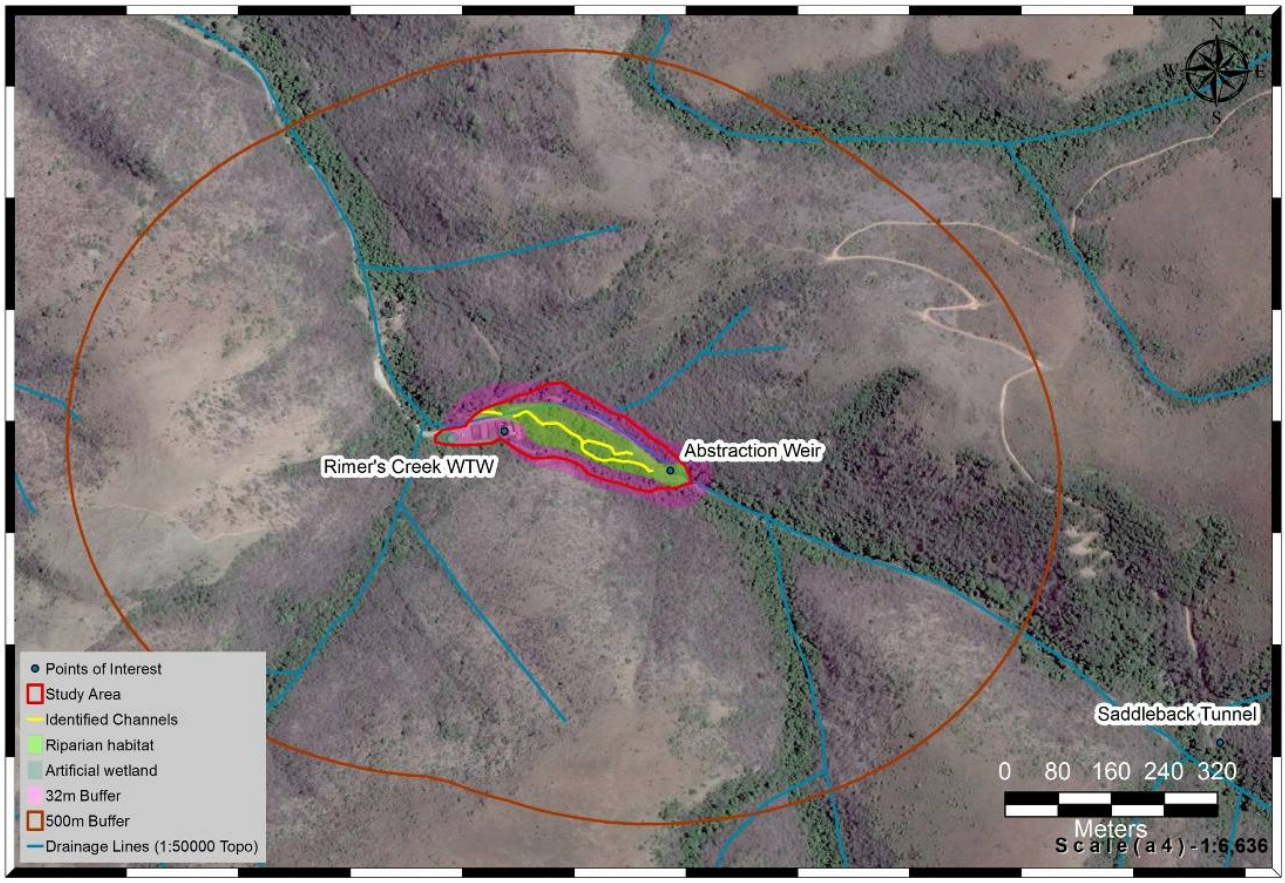

Figure 5.14: Delineated riparian habitat within the site (taken from Grobler, 2015)

Habitat suitability for the potential occurrence of wetlands within the 500m buffer is regarded as low due to the steep mountainous slopes that surround the site and dominate the 500m buffer area (Figure 5.14).

Drainage lines were identified within and outside the 500m buffer zone as indicated in Figure 5.14. These drainage lines are ephemeral, i.e. only contain surface flow after rainfall events.

The Rimer's Creek stream that flows through the site also lacks wetland features. No hydromorphic features are present and no surface flow was recorded in identified channels located between the abstraction weir and downstream (i.e. west of the water treatment works) of the site.

A well-developed riparian habitat that contains alluvial clast material (mainly in the form of boulders, cobbles and gravel, with some sand and fine silt in between) is however associated with the Rimer's Creek (Figure 5.14). This habitat covers an area of 1.29 ha of the 2.63 ha site and continues both upstream and downstream thereof.

The presence of more than one channel is most likely the result of a decrease in the gradient of the stream channel and a widening in the valley floor, which creates an area more suitable for deposition compared to the upper reaches of Rimer's Creek. The deposition of material transported from upstream sources result in the creation of new channels from time to time.

Rimer's Creek is expected to have existed as a non-perennial stream in its reference condition prior to the construction of the WTW, the abstraction weir and water pipeline system.

The release of permanent inter-basin flow from Lomati Dam through Saddleback Tunnel located upstream, has however changed the hydrology of the watercourse.

Surface flow has been reduced in the Rimer's Creek as the abstraction weir intercepts flow and diverts it into a series of pipes that transport water to the WTW, where after it is released immediately downstream of the site.

Surface flow within the delineated riparian habitat and associated stream reach is therefore bypassed. Kotze (2015) indicated that this coincides with the absence of surface flow recorded in channels surveyed during the assessment.

The abstraction and diversion of water not only reduces surface flow within the delineated riparian area, but also prevents the inflow of transported sediment. The riparian habitat therefore receives less sediment and nutrient inputs as a result of the weir and pipeline bypass system (Kotze, 2015).

An artificial wetland was identified and delineated at the western most portion of the site (Figure 5.14). It is regarded as a man-made feature, as it is formed by water released from the top of a storage reservoir (Figure 5.14). Regular water releases have resulted in erosion along the dirt road and the formation of an artificial wetland that flows into the Rimer's Creek downstream of the site. A furrow (to drain away released return water more efficiently) is present in the artificial wetland.

5.11.2 Vegetation associated with riparian area

Two types of vegetation units were described by McCleland and de Castro (2015) namely:

- Secondary Riparian Scrub – covers the majority (63.7%) of the delineated riparian habitat (Figure 5.9);
- Untransformed Riparian Forest – occurs in patches (Figure 5.9) and accounts for 36.3% of the delineated riparian habitat.

Further details regarding these vegetation units are provided in Section 5.7.2.

The artificial wetland is not regarded as a natural watercourse but does contain hydrophytic plant species such as the grasses *Paspalum urvillea (exotic)*, cf. *Calamagrostic epigejos* and the forb *Verbena bonariensis*. A few suspected species of cf. *Psidium guajava* (invader) are also present.

Grobler (2015) indicated that the combined riparian area, consisting of both types of vegetation units, has to be assessed as a whole in order to provide an indication of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the delineated watercourse.

5.11.3 Present Ecological State (PES)

Kotze (2015) indicated that the Instream Habitat Integrity (IHI) of Reach C has a PES category of D/E (largely modified to seriously modified; Table 5.15) while the surrounding riparian zone integrity is further transformed to a category E (seriously modified; Table 5.15) PES. The primary activities responsible for habitat deterioration in this reach is associated with

impoundment by the abstraction weir, abstraction by the WTW and associated pipeline (located within the southern channel).

The PES of the watercourse is expected to decrease further over time as a result of continued encroachment of alien species (including dense stands of invasive alien species that are already well established in the Secondary Riparian Shrub vegetation unit) if an alien control plan is not implemented.

Recent soil disturbances identified within the watercourse is localised and mainly restricted to an area immediately upstream of the abstraction weir. The presence of the abstraction weir helps restrict downstream sedimentation of mobilised material.

No PES category can be assigned to the artificial wetland as no natural reference condition exists for it.

5.11.4 Ecological Importance and Sensitivity (EIS)

The EIS of the delineated riparian habitat as a whole is regarded as High (Kotze, 2015; McCleland and de Castro, 2015) due to the following:

- The presence of remaining patches of Untransformed Riparian Forest within the watercourse;
- The presence of two plant species of conservation concern (*Prunus africana*; *Adenia gummifera*) that were recorded just outside of the site in Untransformed Riparian Forest.

5.12 Groundwater

Groundwater would be associated with Rimer's Creek and its associated riparian area as identified by Grobler (2015).

Hansmeyer (2015) indicated that no ponding was noticed on site, which was found to be dry. There was no evidence of leaking pipelines or leaking water-holding structures.

Some seepage was noted in TP1 (excavated within the slow sand filter) but was attributed to rainwater (Hansmeyer, 2015).

An artificial wetland was identified (Figure 5.14) and is regarded as a man-made feature, as it is formed by water released from the top of a storage reservoir.

5.13 Air quality

The Rimer's Water Treatment (Purification) Works is located on the Remaining Extent of Portion 14 of the farm Barberton Townlands 369 JU, within the Barberton Private Nature Reserve, to the southeast of Barberton. The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.).

The Barberton Trials Motorcycling Park is located downstream of the site and could impact on air quality in terms of dust generation.

Urban development (i.e. Barberton) is located about 1km northwest of the site.

No contributors to air pollution (such as industries or mines) are located in the immediate area.

5.14 Noise

As already indicated the site is located within the Barberton Private Nature Reserve. The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.) resulting in the area being very tranquil.

Urban development (i.e. Barberton) is located about 1km northwest of the site and would not impact on the ambient noise level of the site.

The major contributing factors to ambient noise level of the site would be as a result of:

- The operation of the water treatment plant and associated infrastructure;
- Vehicles utilising the access road to the site;
- The utilisation of the Barberton Trials Motorcycling Park located downstream of the site (if still utilised).

5.15 Sites of archaeological and cultural interest

5.15.1 Background historical information

In 1884, Fred and Henry Barber and their cousin, Graham Barber, discovered the 'Makongwa' gold reef higher up the Umvoti Creek. Barberton (named after the Barbers) was subsequently established at the base of the Umvoti Creek (where it enters the De Kaap Valley) on 24 July 1884.

Umvoti Creek was subsequently renamed Rimer's Creek after James Cook Rimer whose party discovered the Umvoti Reef below the Barber's Reef. Rimer's Creek is therefore closely associated with the discovery of gold in Barberton.

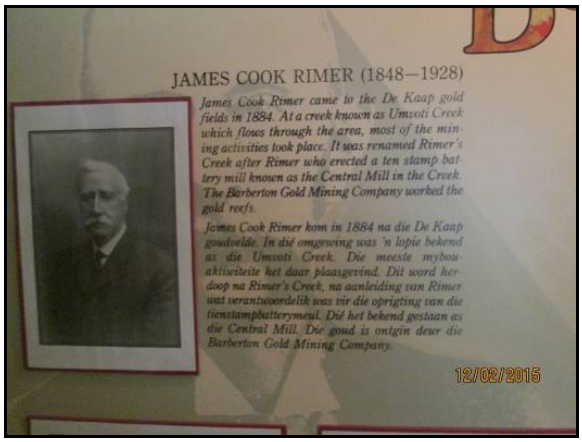

Photo 5.3: Photograph of James Cook Rimer

According to the records, Rimer's Creek became a popular recreational corner of Barberton. A tearoom, The Sportsman Lodge, situated above the site of the Turbine, was particularly popular on Wednesdays when it was frequented by the barmaids of the town.

5.15.2 Archaeology and cultural sensitivity

A Phase 1 Heritage Impact Assessment was undertaken by Dr. Anton van Vollenhoven (an accredited archaeologist) of Archaetnos Culture and Cultural Resource Consultants (referred to as Van Vollenhoven, 2015). A copy of the said report is provided in Appendix 12. This report should be consulted with regards to the methodology used.

5.15.2.1 Cultural heritage sites

Many declared heritage sites are found lower down in Rimer's Creek and within the built environment of the town of Barberton. Rimer's Creek is a well-known heritage area within the historical heart of Barberton. Community members have been actively involved in attempts to preserve and protect the environment and heritage features it contains.

Fernlea House (a wood and iron house built in the early 1890's for Mrs. Emily Fernandes) is located about 1 km towards the northwest of the WTW (Figure 5.3a and Photo 5.4). Today this building houses an exhibition mainly about Rimer's Creek and the restoration of the house. It is unlikely that Fernlea House will be directly impacted upon in terms of the proposed development.

Photo 5.4: Fernlea House

Photo 5.5: The Turbine

The Gilbert Gikes and Gordon Turbine (referred to as the Turbine) is situated about 720 metres from Fernlea House (Figure 5.3a) and was installed in 1931 to purify the town's water. This turbine was manufactured in Kendal, Cumbria, England. In 1986 the turbine was donated to the museum and reinstalled in its original building (Photo 5.5).

According to Van Vollenhoven (2015), no sites of cultural heritage significance or graves are located within the site.

Van Vollenhoven (2015) however, identified some historical and archaeological artefacts as indicated below.

5.15.2.2 Stone Age tools

Some Middle and Late Stone Age tools were identified within the site (Photo 5.6). However, these tools were found to be out of context and were probably washed down from higher up slope.

Photo 5.6: Middle and Late Stone Age tools picked up in the surveyed area (taken from Van Vollenhoven, 2015)

Although the Stone Age tools were found out of context, one will have to be on the lookout for these during construction. Mitigation measures included in Section 8 (Environmental Management Plan) of this report must be implemented if the development is to continue.

5.15.2.3 Iron Age tools

No Iron Age material was identified within the site. The steepness of the valley most likely made it a difficult area to inhabit. Homesteads may have been located higher or lower down the mountains.

A few historical artefacts (Photo 5.7), that appear to date from the late 19th/early 20th century, were identified along Rimer's Creek within the site. These artefacts most likely washed down from the mountains or could be associated with the gold digging activities around the turn of the century.

Photo 5.7: Historical artefacts (shards from glass bottles and a bar of iron) found in the surveyed area. The glass bottles represent alcoholic and non-alcoholic bottles from the late 19th/early 20th century (taken from Van Vollenhoven, 2015).

Based on the findings of the specialist study, Van Vollenhoven (2015) indicated that the proposed development could continue subject to the implementation of the recommended mitigation measures.

5.15.3 Palaeontological sensitivity

According to the palaeontological map supplied by the South African Heritage Resources Agency (SAHRA, 2014), a desktop palaeontological study is

required for the said site. The palaeontological sensitivity is deemed to be moderate.

Dr. Heidi Fourie (Heidi Fourie Consulting) was appointed to conduct a Palaeontological Impact Assessment (referred to as Fourie, 2015). A copy of the said report is provided in Appendix 12 and should be consulted with regards to the methodology used.

According to Fourie (2015), the site is covered mainly by the Moodies Group sediments (sandstone, shale, conglomerate) of the Barberton Supergroup.

For the Barberton Supergroup, the palaeontological sensitivity is LOW and therefore the palaeontological impact of the proposed development would be low.

5.16 Sensitive landscapes

The Rimer's Water Treatment (Purification) Works is located on the Remaining Extent of Portion 14 of the farm Barberton Townlands 369 JU, within the Barberton Private Nature Reserve, to the southeast of Barberton. The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.). The site would be located to the east of the existing water treatment works within this Protected Area.

Rimer's Creek and its associated riparian area (Grobler, 2015) would be seen as sensitive landscapes. The Ecological Importance and Sensitivity (EIS) of the delineated riparian habitat as a whole is regarded as High (Kotze, 2015; McCleland and de Castro, 2015) due to the following:

- The presence of remaining patches of Untransformed Riparian Forest (High Botanical Biodiversity Value and Sensitivity) within the watercourse;
- The presence of two plant species of conservation concern (*Prunus africana*; *Adenia gummifera*) that were recorded just outside of the site in Untransformed Riparian Forest (Moderate Botanical Biodiversity Value and Sensitivity).

5.17 Visual aspects

As already indicated the Rimer's Water Treatment Works and site are located within the Barberton Private Nature Reserve. The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.).

The topography of the existing Rimer's WTW and the immediate surrounding area is very rugged. The site is located within a valley floor that drains from east to west, while steep foot slopes border the site to the north and south.

Urban development (i.e. Barberton) is located about 1km northwest of the site.

The site is visible from the existing Rimer's Water Treatment Works but would not be visible from any residential or urban area. Being located within a valley bottom, the site is screened by the rugged topography and lush vegetation present on site and immediate surrounding area.

5.18 Traffic

The Rimer's Water Treatment Works can be accessed via a narrow gravel road from Lee Street in Barberton that extends to the works. This road is not of good quality and is in need of repair. It was not constructed for use by heavy vehicles or high traffic volumes.

A gravel road extending from the Water Treatment Works provides access to the site located to the east of the existing works as well as the diversion weir.

5.19 Sense of place

The Rimer's Water Treatment (Purification) Works is located on the Remaining Extent of Portion 14 of the farm Barberton Townlands 369 JU, within the Barberton Private Nature Reserve. The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.) resulting in the area being very tranquil.

Urban development (i.e. Barberton) is located about 1km northwest of the site.

The site would be located to the east of the existing water treatment works within this Protected Area.

As indicated in Section 5.14.1, the Rimer's Creek area has been associated with water treatment (purification) since 1931 when the Turbine was installed to purify the town's water.

The Rimer's Water Treatment Works is of high strategic importance, as it is currently the primary source of potable water for the town of Barberton and Umjindi.

6. DESCRIPTION OF THE PUBLIC PARTICIPATION PROCESS

6.1 Advertising of the project

6.1.1 Press advertising

A block advert (150mm x 95mm), according to the Environmental Impact Assessment Regulations, 2014, was placed in the regional newspaper, The Lowvelder, on Friday, 27 February 2015. A copy of the advert is provided in Appendix 8.

6.1.2 On-site advertising

Notices according to the Environmental Impact Assessment Regulations, 2015, were displayed at the following locations:

- On-site at the entrance to the Rimer's Water Treatment Works (A1 size; Figure 6.1-Photo 1);
- Adjacent to the tarred road leading to the Rimer's Water Treatment Works, opposite Fernlea House (A1 size; Figure 6.1 – Photo 2);
- On the noticeboard at the Barberton Public Library (A3 size; Figure 6.1 – Photo 3);
- On the noticeboard at the Umjindi Local Municipal offices (A3 size; Figure 6.1 – Photo 4);
- A copy of the notice was also loaded onto the company website: www.cleanstreamsa.co.za.

A copy of the notice is provided in Appendix 8.

No alternative sites were identified for the proposed development. No notices were thus placed on an alternative site.

6.1.3 Informing I&APs via the internet

Interested and affected parties were informed via the above-mentioned adverts and notices that a copy of the following documentation could be downloaded from the Clean Stream Environmental Services website (www.cleanstreamsa.co.za):

- Copy of the notice;
- Background Information Document (BID; Appendix 9).

This information was available on the website for the duration of the basic assessment phase.

A copy of the webpage printouts is provided in Appendix 8.

6.1.4 Feedback from the advertising process

No persons registered as interested and affected parties in terms of the advertising process (site and newspaper advertising) within the 30 day registration period provided.

6.1.5 Public meeting

As indicated in Section 6.1.4, no persons registered as interested and affected parties in terms of the advertising process (site and newspaper advertising) within the 30 day registration period provided. There was thus no need for a public meeting

Photo 1: Notice placed at the entrance to the Rimer's Water Treatment Works

Photo 2: Notice placed adjacent to the tarred road leading to Rimer's Water Treatment Works, opposite Fernlea House.

Photo 3: Notice placed on notice board at the Barberton Public Library.

Photo 4: Notice placed on notice board at the Umjindi Local Municipal offices.

Figure 6.1: Notices displayed

6.2 Directly affected landowner/user

The proposed development site is located on Portion 14 of the farm Barberton Townlands 369 JU (Figure 5.1) which belongs to the Umjindi Local Municipality (i.e. the project applicant).

As indicated in Figure 5.2, the proposed development site is located within the Barberton Private Nature Reserve (i.e. a protected area), which also belongs to the Umjindi Local Municipality (the project applicant).

6.3 Identified local authorities/government departments and stakeholders

Table 6.1 provides an indication to which local authorities/government departments and stakeholders Background Information Documents (BIDs; Appendix 9) were forwarded in order to inform them of the proposed project and to obtain their issues of concern.

Table 6.1: Identified local authorities/government departments and stakeholders who received BIDs

IDENTIFIED AUTHORITY/DEPARTMENT/ STAKEHOLDER	CORRESPONDENCE SENT	COMMENTS
Department of Water and Sanitation (DWS) (Contact person: J. Jooste)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None
Department of Mineral Resources (DMR) (Contact person: M. Mokonyane)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Department of Agriculture, Forestry and Fisheries (DAFF) (Contact person: F. Mashabela)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Department of Co-operative Governance and Traditional Affairs (COGTA) (Contact person: M. Loock)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Department of Culture, Sports and Recreation (Contact person: S. Singh)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Department of Agriculture, Rural Development, Land and Environmental Affairs (Contact person: J. Venter)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Department of Rural Development and Land Reform (Commission on Restitution of Land Rights) (Contact person: N.D. Nkambule; G.N. Mathonsi; T. Mkhabela)	Email (dated: 5 March 2015; Appendix 10) requesting if any land claims registered against property.	Email (dated: 5 March 2015; Appendix 10) from T. Mkhabela indicating that Ntokozo Nkambule would assist in the matter.
South African Heritage	Loaded BID onto	None.

IDENTIFIED AUTHORITY/DEPARTMENT/ STAKEHOLDER	CORRESPONDENCE SENT	COMMENTS
Resources Agency (SAHRA) (Contact person: J. Lavin (SAHRA website))	SAHRA website (print out from SAHRIS website dated: 3 March 2015; Appendix 10)	
Mpumalanga Tourism and Parks Agency (MTPA) – Land Advisory Unit (Contact person: K. Narasoo)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	Email (dated: 6 March 2015; Appendix 10) acknowledging receipt of email.
Mpumalanga Tourism and Parks Agency (Contact person: B. Morris; M. Lotter)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded. Also requested information regarding the proclamation status of the Barberton Nature Reserve.	Email (dated: 5 March 2015; Appendix 10) received with a copy of the official gazette regarding the proclamation of the nature reserve (Appendix 11).
Inkomati-Usuthu Catchment Management Agency (Contact person: F. Celliers)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Eskom Transmission (Contact person: E. Lennox; N. Maake; L. Motsisi)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	Email (dated: 5 March 2015; Appendix 10) indicating that *Eskom Transmission is not affected by this application*.
Eskom Mpumalanga Land and Rights (Contact person: M. Moloko)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Ehlazeni District Municipality (Contact person: T. Shabangu (Environmental Manager))	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Umjindi Local Municipality (Contact person: T. Venter)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Ward Councillor (Ward 9) (Contact person: E. Jacobs)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Barberton Museum (Contact person: A. Bornman (curator))	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Barberton Tourism (Contact person: A. Christianson)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Barberton Bird Club (Contact person: J. Bunning; D. Mourant)	Email (dated: 5 March 2015; Appendix 10) with BID forwarded.	None.
Rose's Creek Hiking Trail (Contact person: A. Botha)	Email (dated: 5 March 2015; Appendix 10)	None.

IDENTIFIED AUTHORITY/DEPARTMENT/ STAKEHOLDER	CORRESPONDENCE SENT	COMMENTS
	with BID forwarded.	

6.3.1 Umjindi Environmental Committee

An email from Mrs. AM Nuns (dated: 5 March 2015; Appendix 10) was received indicating that a Background Information Document (BID) had been received from Dr. A. van Vollenhoven.

Mrs. Nuns wanted to know in which publication the advertisement appeared. In addition, Mrs. Nuns indicated that 'it is the intention of the Umjindi Environmental Committee to register as an I&AP in the proposed development and I will send you the relevant contact details shortly".

An email from CSES (dated: 5 March 2015; Appendix 10) was forwarded to Mrs. Nuns indicating that the said project was advertised in the Lowvelder on 27 February 2015 and that notices were also placed on site and in Barberton.

Subsequently, an email from Mrs. Nuns (dated: 8 March 2015; Appendix 10) was received requesting that the following organisations be registered as I&APs:

- Umjindi Environmental Committee (Contact person: T. Ferrar (chairman); Mrs. Marjorie Nuns (Secretary));
- Barberton/Umjindi Ratepayers Association (Contact person: Andy Nuns (chairman)).
- Ward Councillor – Cllr Elsabe Jacobs (see Table 6.1).

In addition, comments regarding the proposed project was also provided as indicated in Table 6.2.

Table 6.2: Comments received from the Umjindi Environmental Committee

COMMENTS	ISSUE
Rimer's Creek – a registered heritage site – is the historical heart of Barberton and well loved by the local community. As such any notices regarding public meetings in connection with the above should also appear in the Barberton Times, our local newspaper.	Advertising of public meeting in local newspaper, Barberton Times.
The Barberton Makhonjwa Mountain Land is also formally recognised as a Tentative World Heritage Site (WHS) and the specific land areas include all formally proclaimed Protected Areas within the Barberton Mountain Land region, which includes four major nature reserves and several other minor ones, including the Barberton Provincial Nature Reserve which encompasses the whole of Rimer's Creek valley where the water purification plant is located.	Proposed site falls within the Barberton Provincial Nature Reserve as well as the Barberton Makhonjwa Mountain Land (a Tentative World Heritage Site).

An email from CSES (dated: 9 March 2015; Appendix 10) was forwarded to the above-mentioned indicating that the said organisations had been

registered as I&APs. In addition, it was indicated that the comments received were noted and would be addressed in the Basic Assessment Report.

6.3.2 Barberton/Umjindi Ratepayers Association

As indicated in Section 6.3.1, the Barberton/Umjindi Ratepayers Association was registered as an I&AP. To date, no comment from the said Association has been received.

6.3.3 Mpumalanga Tourism and Parks Agency

A copy of the proclamation of the Barberton Private Nature Reserve (Appendix 11) was forwarded by M. Lotter (email dated: 5 March 2015; Appendix 10). Replying to the question if the reserve falls under the MTPA or the Umjindi Local Municipality, it was indicated (email dated: 9 March 2015; Appendix 10) that the reserve is a municipal reserve with no management agreements or arrangements with the MTPA.

No further comments regarding the proposed project was received from the MTPA.

6.3.4 Eskom Transmission

An email from Eskom Transmission (dated: 5 March 2015; Appendix 10) was received indicating *'that the Transmission Division of Eskom is not affected by this application'.*

It was further indicated that the application was forwarded to Eskom's Distribution Division for comments. To date, no comment has been received.

6.3.5 Department of Agriculture, Rural Development, Land and Environmental Affairs

The project was registered with the Department of Agriculture, Rural Development, Land and Environmental Affairs on 22 May 2015 (see letter from Clean Stream Environmental Services dated: 22 May 2015; Appendix 1).

Subsequently, a letter from the Department (dated: 25 May 2015; Appendix 1) was received acknowledging receipt of the application form and providing a reference number and the name of the responsible officer. The following was also indicated: *'Please note that you must, within 90 days from 22 May 2015, submit to this office a basic assessment report – inclusive of specialist reports and an EMPr – which has been already subjected to the public participation process, and was provided to interested and affected parties for a period of 30 days for comments, and which reflects the incorporation of any comments received, including any comments from this office. Please note that in terms of the provisions of regulation 45, the application will lapse, and this office will deem the application to have lapsed, if the applicant fails to submit a basic assessment report within the timeframe specified above'.*
The above-mentioned is noted and will be complied with.

A site meeting with the responsible officer (X. Nkosi) and Ms. R. Van Rensburg of Clean Stream Environmental Services took place on Friday, 12 June 2015. During this site meeting, the following was recorded:

COMMENTS	ISSUE
What specialist studies were conducted for the proposed project?	Specialist studies conducted
Was an aquatic study and heritage impact study done?	Specialist studies: Aquatic and Archaeological

COMMENTS	ISSUE
Were any archaeological artefacts or important heritage sites found on site?	Archaeological artefacts
A hard copy of the Draft Basic Assessment must be forwarded to the Mpumalanga Tourism and Parks Agency and the Department of Water and Sanitation.	Draft Basic Assessment to Mpumalanga Tourism and Parks Agency and Department of Water and Sanitation
The results from the specialist studies must be included in the Draft Basic Assessment Report.	Specialist studies – results
A hard copy of the Draft Basic Assessment Report must also be forwarded to DARDLEA for comment.	Draft Basic Assessment to DARDLEA

6.4 Summary of issues of concern

Table 6.3 provides a summary of the issues of concern raised by the interested and affected parties as well as in which section of this report the issues are addressed.

Table 6.3: Summary of issues of concern raised by I&APs

COMMENTS	ISSUE	ADDRESSED IN SECTION
Umjindi Environmental Committee	Advertising of public meeting in local newspaper, Barberton Times.	Section 10
Umjindi Environmental Committee	Proposed site falls within the Barberton Provincial Nature Reserve as well as the Barberton Makhonjwa Mountain Land (a Tentative World Heritage Site).	Barberton Private Nature Reserve - Section 5.3.2; Appendix 11. Tentative World Heritage Site - Section 9.1; Appendix 6
Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA)	Specialist studies conducted and results thereof to be included in the Basic Assessment Report	Biodiversity (vegetation and animal life) study – see Section 5.7, 5.8 & Appendix 6; Aquatic study – see Section 5.10 & Appendix 5; Geotechnical study – see Section 5.6.2 & Appendix 4; Wetland delineation study – see Section 5.11 & Appendix 7; Archaeological study – see 5.14.2 & Appendix 12; Palaeontological study – see Section5.14.3 & Appendix 12.
	Archaeological artefacts	Archaeological artefacts were found but were out of context as indicated in Section 5.14.2.2 & 5.14.2.3.
	Draft Basic	Section 10

	Assessment to Mpumalanga Tourism and Parks Agency, Department of Water and Sanitation and DARDLEA	

6.5 List of Interested and Affected Parties

From the above public participation process, the following list of Interested and Affected Parties was compiled:

INTERESTED AND AFFECTED PARTY LIST	
Organisation	**Name**
Government Departments	
Department of Agriculture, Forestry and Fisheries	F. Mashabela
Department of Agriculture, Rural Development, Land and Environmental Affairs	X. Nkosi
Department of Mineral Resources	M. Mokonyane
Department of Rural Development and Land Reform/Commission on Restitution of Land Rights	N.D. Nkambule; G.N. Mathonsi; T. Mkhabela
Department of Water and Sanitation	J. Jooste
Department of Co-operative Governance and Traditional Affairs (COGTA)	M. Loock
Department of Culture, Sports and Recreation	S. Singh
Department of Agriculture, Rural Development, Land and Environmental Affairs (Natural Resource Investigations)	J. Venter
Other Organisations	
South African Heritage Resources Agency (SAHRA)	J. Lavin (SAHRA website)
Mpumalanga Tourism and Parks Agency (MTPA) – Land Advisory Unit	K. Narasoo
Mpumalanga Tourism and Parks Agency	B. Morris; M. Lotter
Inkomati-Usuthu Catchment Management Agency	F. Celliers
Eskom Transmission	E. Lennox; N. Maake; L. Motsisi
Eskom Mpumalanga Land and Rights	M. Moloko
Local Municipality and Municipal Councillor	
Ehlazeni District Municipality	T. Shabangu (Environmental Manager)
Umjindi Local Municipality	T. Venter
Ward Councillor (Ward 9)	E. Jacobs
Community	
Barberton Museum	A. Bornman (curator)

INTERESTED AND AFFECTED PARTY LIST	
Organisation	**Name**
Barberton Tourism	A. Christianson
Barberton Bird Club	J. Bunning; D. Mourant
Rose's Creek Hiking Trail	A. Botha
Umjindi Environmental Committee	T. Ferrar (chairman); AM Nuns (secretary)
Barberton/Umjindi Ratepayers Association	Andy Nuns (chairman)

7. ENVIRONMENTAL IMPACT DESCRIPTION AND EVALUATION

7.1 Introduction

This section of the report describes and evaluates the potential impact of the proposed development on the environment. The impact of the development has to be assessed in terms of the following development phases:

- **Planning and design phase**
- **Construction phase**
- **Operational phase**
- **Decommissioning phase**

7.2 Evaluation of impacts

The evaluation of impacts is conducted in terms of the following criteria:

- **Nature of impact**

- **Extent of impact**

Site	Effect limited to the site and its immediate surroundings
Local	Effect limited to within 3-5 km of the site
Regional	Effect will have an impact on a regional scale

- **Duration of impact**

Short	Effect lasts for a period 0 to 5 years
Medium	Effect continues for a period between 5 and 10 years
Long	Effect will cease after the operational life of the activity either because of natural process or by human intervention
Permanent	Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient

- **Probability**

Improbable	Less than 33% chance of occurrence
Probable	Between 33 and 66% chance of occurrence
Highly probable	Greater than 66% chance of occurrence
Definite	Will occur regardless of any prevention measures

- **Significance of impact**

Low	Where the impact will have a relatively small effect on the environment and will not have an influence on the decision
Medium	Where the impact can have an influence on the environment and the decision and should be mitigated
High	Where the impact definitely has an impact on the environment and the decision regardless of any possible mitigation

- **Status**

Positive	Impact will be beneficial to the environment
Negative	Impact will not be beneficial to the environment
Neutral	Positive and negative impact

It must be noted that many of the potential negative consequences can be mitigated successfully. It is however, necessary to make a thorough assessment of all possible impacts in order to ensure that environmental considerations are taken into account, in a balanced way, as far as possible, supporting the aim of creating a healthy and pleasant environment.

7.3 Planning and design phase

The planning and design phase involved office work and site surveys with regards to the design of the water treatment works and the Basic Assessment Report. It also involves obtaining the necessary authorisations for the said development.

Apart from the existing activities on site, no actual construction work took place regarding the proposed upgrading of the infrastructure. Therefore, no impacts.

7.4 Construction phase

The Umjindi Local Municipality proposes to upgrade the Rimer's Water Treatment (Purification) Works from 10Ml/d to a total treatment capacity of 15Ml/d. The upgrading will entail the addition of new unit processes as well as the extension of existing unit processes in an effort to provide clean and potable water to the towns of Barberton and Umjindi.

According to the engineers, the construction will take place as follows:

- Phase 1: Construction of new infrastructure (including access road) to the eastern side of the existing WTW;
- Phase 2: Construction of stream diversion;
- Phase 3: Upgrading of existing structures within the existing WTW.

Outside of existing fenced works area, to the eastern side of the existing WTW (Figure 3.4)

The construction phase would involve the following:

- **Construction of new aeration facility (2 new clarifiers) and a new chemical dosing facility (including a cascade)**
  - removal of the vegetation;
  - terracing of the site as required;
  - excavation of the required foundations and service trenches;
  - construction of the new aeration facility (2 clarifiers) and a new chemical dosing facility (including a cascade).
- **Construction of new access road**
  - removal of the vegetation;
  - levelling of the route;
  - construction of the road and associated storm water measures.
- **Construction of stream diversion (i.e. a reinforced concrete lined channel (3.6m depth, 5.0m width, 275m length) and reinforced concrete stilling basin (Figure 3.4)).**
  - removal of the vegetation;
  - excavation of the required foundations;
  - construction of the concrete lined channel and reinforced concrete stilling basin.

Summary of area to be developed:

- Area outside of existing fenced works area to be developed = 8100m^2 (i.e. for new infrastructure).
- Area of proposed new access road = 1025m^2.
- Diverted/rerouted stream area = 1375m^2.

Within existing fenced area:
The construction phase would involve the following:

The following infrastructure will be constructed within the existing fenced works area (Figure 3.4):

- **Construction of new sedimentation tanks with sludge handling (i.e. convert slow sand filters to sludge drying beds),**
  - Removal of any existing sludge/soil/sand/etc. from slow sand filters;
  - refurbishment of slow sand filters to sludge drying beds.
- **Construction of new supernatant facility with recycle pump station,**
  - removal of the vegetation;
  - excavation of the required foundations;
  - construction of the supernatant facility with recycle pump station.
- **Construction of 3 new upflow filters,**
  - removal of the vegetation;
  - excavation of the required foundations;
  - construction of the 3 new upflow filters.
- **Construction of new chlorine dosing facility,**
  - removal of the vegetation;
  - excavation of the required foundations;
  - construction of the new chlorine dosing facility.
- **Construction of new backwash pump station.**
  - removal of the vegetation;
  - excavation of the required foundations;
  - construction of the new backwash pump station.

Summary of area to be developed:

- Area within existing fenced works area to be developed = 4200m^2.

Section 7.7 provides further details with regards to potential impacts identified.

7.5 Operational phase

The operational phase would involve the utilisation of the upgraded water treatment works (including the stream diversion).

Section 7.7 provides further details with regards to potential impacts identified.

7.6 Decommissioning phase

If required, this phase would involve the decommissioning of the facilities constructed as part of this project (see Section 7.4).

The decommissioning phase will not be discussed in detail. It is recommended that at the time of decommissioning, a specific Environmental Management Plan (EMP) be compiled which specifically addresses this phase. This EMP would have to address issues such as the removal of building rubble and the rehabilitation of the site. Soil conservation measures would also have to be implemented.

7.7 Identification of potential impacts

The following tables provide an indication of the environmental features that will be impacted (directly and indirectly) during the construction, operational and decommissioning phases of the proposed project as indicated above.

7.7.1 CONSTRUCTION OF NEW INFRASTRUCTURE OUTSIDE OF THE FENCED AREEA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 8100 m^2 (AERATION FACILITY & CHEMICAL DOSING BUILDING)** **1025m^2 (NEW ACCESS ROAD)**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
A new aeration facility (2 new clarifiers) and a chemical dosing building (including a cascade) will be constructed to the eastern side of the existing Rimer's Water Treatment Works (Figure 3.3). A new access road extending from the existing gravel access road will be constructed behind the new aeration facility and chemical dosing building as indicated in Figure 3.3 in order to provide access to the said facilities. The said road will be provided with a culvert bridge extending over the Rimer's Creek. Two engineered terraces will be constructed on which the infrastructure will be built. The footprint of the aeration facility and the chemical dosing building will be 8100m^2 m in extent. The footprint of the new access road will be 1025m^2.						
TOPOGRAPHY	▪ The topogpraphy of this area has already been impacted in terms of the construction of a road that was cut out of the mountain side and the spoil levelled onto the creek bed which subsequently became overgrown. ▪ The new aeration facility (two clarifiers), chemical dosing building and new road will impact on an area sloping evenly westwards at a gradient of 1:10. Hansmeyer (2015) indicated that the slope of the site will require the construction of two terraces – an upper, slightly smaller terrace for the chemical dosing building (with cascade) and a larger terrace to accommodate the two clarifiers. This will impact on the topography of the area.	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Hansmeyer (2015) indicated that the new road would seemingly be cut deeper into the steeply dipping bedrock which is partially exposed in the existing cut along the foothill of the mountain.	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ In general, the removal of vegetation, levelling of the site, excavation and construction of the terraces and the subsequent construction of the infrastructure would result in changed runoff patterns and an increased risk of soil erosion, especially in view of the gradient/slope of the site in close proximity to Rimer's Creek.	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
GEOLOGY	▪ The underlying geology consisting of loosely packed, poorly sorted flaky gravels and large boulders with numerous voids and no matrix material (as a result of recent and older rock and mud slides from the valley sides) will be impacted upon by the levelling of the site and excavation of required terraces for the aeration facility and the chemical dosing building. This could impact on the construction of the said structures if not found on two 1.5m thick terraced engineered fills as recommended by Hansmeyer (2015).	SITE	PERMANENT	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ The geology of the foothill will be impacted if the new road is cut deeper into the steeply dipping bedrock (which is partially exposed) along the foothill of the mountain.	SITE	PERMANENT	PROBABLE	MEDIUM NEGATIVE	MEDIUM NEGATIVE
	▪ The proposed clarifiers, chemical dosing building and road could be impacted in terms of possible mud and rock slides from the adjacent mountain.	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.1 CONSTRUCTION OF NEW INFRASTRUCTURE OUTSIDE OF THE FENCED AREEA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 8100 m² (AERATION FACILITY & CHEMICAL DOSING BUILDING)** **1025m² (NEW ACCESS ROAD)**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
SOILS	▪ The construction of the aeration facility (two clarifiers) and chemical dosing building (including cascade) will impact on shallow, rocky soils and in places, deeper alluvial soils between the larger rocks. Closer to Rimer's Creek, relatively deep alluvial soils in between boulders will be impacted upon. Mitigation measures will have to be implemented in view of the type of soils and the slope of the site as recommended by Hansmeyer (2015).	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Hansmeyer (2015) indicated that the new road would seemingly be cut deeper into the steeply dipping bedrock which is partially exposed in the existing cut along the foothill of the mountain. Here, construction activities will impact on soils that are dark brown with a relatively deep organic content. Mitigation measures will have to be implemented to prevent possible mud and rock slides as recommended by Hansmeyer (2015).	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ This area has already been impacted in terms of the construction of a road that was cut out of the mountain side and the spoil levelled onto the creek bed which subsequently became overgrown. ▪ During construction, the above-mentioned soils will be directly impacted when the vegetation and topsoil are removed, the site is levelled and excavation activities take place. The construction activities will probably lead to changes in soil structure, nutritional and chemical values as well as the compaction of the soil. This impact cannot be mitigated.	SITE	LONG	PROBABLE	LOW NEGATIVE	LOW NEGATIVE
	▪ Sediment transport and erosion may occur following the clearing of the vegetation, especially along the western boundary of the site where the slope is the steepest. Erosion may impact on the delineated riparian habitat and Rimer's Creek. The chances of erosion taking place would be highest during the rainy season.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Soil pollution may occur if the construction vehicles are not maintained/repaired resulting in oil leaks and fuel spills and if waste management measures (building rubble, etc.) are not implemented, etc.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
NATURAL VEGETATION / ANIMAL LIFE	▪ The construction of an aeration facility (two clarifiers) and chemical dosing building will impact mostly on Secondary Riparian Scrub (Figure 5.9; McCleland and de Castro, 2015) that has a low likelihood of providing habitat for flora and fauna species of conservation concern, has a floristic composition that is heavily dominated by invasive alien species, and has compromised functional value. This vegetation unit has been assessed as having a LOW biodiversity conservation value. This vegetation unit is also associated with the delineated riparian area as identified by Grobler (2015).	SITE	LONG	DEFINTIE	LOW NEGATIVE	LOW NEGATIVE

7.7.1 CONSTRUCTION OF NEW INFRASTRUCTURE OUTSIDE OF THE FENCED AREEA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 8100 m^2 (AERATION FACILITY & CHEMICAL DOSING BUILDING)** **1025m^2 (NEW ACCESS ROAD)**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
	▪ Patches of Riparian Forest (Figure 5.9; McCleland and de Castro, 2015) would also be impacted upon that is a prominent vegetation unit in the riparian zone and the delineated riparian area as identified by Grobler (2015). The forest canopy is broken and the forest edges have a fairly high density of invasive alien species. Riparian Forest is relatively intact structurally and therefore still has a high functional value. It has been allocated a biodiversity conservation value of HIGH.	SITE	PERMANENT	DEFINITE	HIGH NEGATIVE	HIGH NEGATIVE
	▪ The construction of the new road would impact on Transformed Areas (Figure 5.9; McCleland and de Castro, 2015) that have no possibility of supporting species of conservation concern and have little or no ecological functional value. These areas have been assessed as having VERY LOW biodiversity conservation value. It would also result in the removal of alien vegetation associated with this vegetation unit.	SITE	LONG	DEFINITE	LOW NEUTRAL	LOW NEUTRAL
	▪ In addition, it is possible that the construction of the new road could impact on the Low Forest/Thicket of Steep Hillslopes (Figure 5.9; McCleland and de Castro, 2015) if the road is cut deeper into the steeply dipping bedrock which is partially exposed in the existing cut along the foothill of the mountain. This vegetation is a marginal vegetation unit but does have the potential to support flora and fauna species of conservation concern, although this is more likely higher up the slopes than on site. This unit also does support protected species and consequently has been assigned a biodiversity conservation value of MODERATE.	SITE	PERMANENT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ McCleland and de Castro (2015) however, considered the overall Ecological State of the site to be Low because of the previous and current land use activities along the stretch of Rimer's Creek that extends through the site.	SITE	PERMANENT	DEFINITE	LOW NEGATIVE	LOW NEGATIVE
	▪ The tall forest tree *Prunus africana* (Vulnerable) and the forest climber *Adenia gummifera* (Declining) were recorded in Riparian Forest associated with riparian habitat located in close proximity to the site (McCleland and de Castro, 2015). Construction activities could impact on these species if not controlled.	SITE	SHORT	IMPROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Bird life associated with the Riparian Forest and the Secondary Riparian Scrub could be impacted upon in terms of the removal of trees, dust and noise as a result of the construction activities.	SITE	LONG	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Sediment transport and erosion may occur following the clearing of the vegetation, especially along the western boundary of the site where the slope is the steepest. Erosion may impact on the delineated riparian habitat and Rimer's Creek. The chances of erosion taking place would be highest during the rainy season.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.1 CONSTRUCTION OF NEW INFRASTRUCTURE OUTSIDE OF THE FENCED AREEA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 8100 m² (AERATION FACILITY & CHEMICAL DOSING BUILDING)** **1025m² (NEW ACCESS ROAD)**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
	▪ The placement of spoil from the excavation activities could also impact on the Secondary Riparian Scrub, the Riparian Forest, the delineated riparian habitat and Rimer's Creek depending on where the spoil is stockpiled.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
SURFACE WATER/ SENSITIVE LANDSCAPES	▪ No direct impact on any surface water environments or sensitive landscapes (wetlands) since the aeration facility and chemical dosing building will be located outside of the 1: 100 year floodline of Rimer's Creek.					
	▪ The access road will impact on Rimer's Creek through the construction of a culvert bridge. An existing road already crosses Rimer's Creek at the said position.	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ The removal of the natural vegetation on site could lead to increased runoff and associated erosion of the adjacent delineated riparian area and Rimer's Creek if proper storm water control measures are not implemented especially along the western boundary where the slope is steepest.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Although the construction of the aeration facility and the chemical dosing building (including cascade) will not have a direct impact on any surface water environments, it will impact on the surface water runoff from the site (i.e. reduced subsurface seepage and increased volumes and velocities of surface flows). This could result in an altered hydrology within the adjacent delineated riparian area associated with the Rimer's Creek.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ The water quality of Rimer's Creek could be impacted upon by run-off water containing contaminants such as hydrocarbons, nutrients, sediment, litter, etc. if mitigation measures (e.g. waste management) are not implemented by the contractors.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
GROUNDWATER	▪ Hansmeyer (2015) indicated that no ponding was noticed on site, which was found to be dry. No wetlands are located on site (Grobler, 2015). It is therefore unlikely that the construction activities will have a direct impact on the groundwater of the site.					
SITES OF ARCHAEOLOGICAL/CULTURAL INTEREST	▪ According to Van Vollenhoven (2015), no sites of cultural heritage significance or graves will be impacted by the proposed construction activities.					
	▪ It is possible that stone tools could be unearthed during the construction phase. These could however, be located out of context.	SITE	SHORT	PROBABLE	LOW NEGATIVE	LOW NEGATIVE

7.7.1 CONSTRUCTION OF NEW INFRASTRUCTURE OUTSIDE OF THE FENCED AREEA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 8100 m² (AERATION FACILITY & CHEMICAL DOSING BUILDING)** **1025m² (NEW ACCESS ROAD)**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
	▪ According to Fourie (2015), the palaeontological sensitivity is Low and therefore the palaeontological impact of the development would be low.	SITE	SHORT	IMPROBABLE	LOW NEGATIVE	LOW NEGATIVE
AIR QUALITY	▪ Dust generation and emissions due to construction activities and use of heavy machinery could potentially impact on contractors and site workers. The extent of the impact would depend on the time of year, wind direction and velocity. ▪ It could indirectly impact on hikers, bird watchers, wildlife, etc. utilising the surrounding nature reserve area.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
VISUAL	• The construction activities could be visible from the existing Rimer's Water Treatment Works but would not be visible from any residential or urban area (located about 1km northwest of the site). • Being located within a valley bottom, the site is screened by the rugged topography and lush vegetation present on site and immediate surrounding area. • It could however, be visible to hikers, bird watchers, etc. utilising the surrounding nature reserve area and therefore the site must be kept neat and tidy at all times.	SITE	SHORT	PROBABLE	LOW NEGATIVE	LOW NEGATIVE
NOISE	▪ The site is located within the Barberton Private Nature Reserve. The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.) resulting in the area being very tranquil. ▪ The major contributing factors to ambient noise level of the site would be as a result of the operation of the water treatment plant and associated infrastructure and vehicles utilising the access road to the site. ▪ Heavy machinery used during the construction phase will contribute to increased ambient noise levels in the area. ▪ Noise generation could potentially impact on contractors and site workers if the necessary health and safety measures are not implemented. ▪ Noise could also impact on hikers, bird watchers, wildlife (especially birds), etc. utilising the surrounding nature reserve area.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
TRAFFIC	▪ The construction activities will not have a direct impact on traffic since no road utilised by the general public will be impacted. ▪ Heavy machinery and delivery vehicles will however, utilise the gravel access road to the site which was not built for this kind of traffic. This will impact on the condition of the said road if not maintained on a regular basis.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.1 CONSTRUCTION OF NEW INFRASTRUCTURE OUTSIDE OF THE FENCED AREEA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 8100 m^2 (AERATION FACILITY & CHEMICAL DOSING BUILDING)** **1025m^2 (NEW ACCESS ROAD)**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
LAND USE/ SENSE OF PLACE	▪ The site (currently vacant) is located to the east of the existing Rimer's WTW which is located within the Barberton Private Nature Reserve. An area of 9125m^2 will be impacted by the construction of infrastructure. ▪ The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.) resulting in the area being very tranquil. ▪ As indicated in Section 5.14.1, the Rimer's Creek area has been associated with water treatment (purification) since 1931 when the Turbine was installed to purify the town's water. ▪ The proposed extension of the WTW will thus be seen as a much needed extension of this existing activity in order to provide the residents of Barberton and Umjindi with potable water. It is not seen as a conflict of land use.	SITE	LONG	DEFINITE	LOW NEUTRAL	LOW NEUTRAL
INTERESTED AND AFFECTED PARTIES	▪ The switch over to the new water treatment works could lead to an interrupted water supply, which could have a negative impact on the local community if the necessary arrangements were not made in advance.	LOCAL	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Job opportunities could be provided during the construction phase (possibly 20 persons will be required).	SITE	SHORT	DEFINITE	MEDIUM POSITIVE	MEDIUM POSITIVE
	▪ Contractors working on site could be directly impacted upon if the necessary safety and occupational health measures are not adhered to.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.2 CONSTRUCTION OF STREAM DIVERSION OUTSIDE OF THE FENCED AREA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA = 1375m^2**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
Construction of stream diversion (i.e. a reinforced concrete lined channel (3.6m depth, 5.0m width, 275m length) and reinforced concrete stilling basin (Figure 3.4)). Diverted/rerouted stream area = 1375m^2.						
TOPOGRAPHY	▪ Hansmeyer (2015) indicated that the reinforced concrete canal should be found on bedrock, some 2.5m below current surface. The topography of Rimer's Creek will definitely be impacted upon in terms of this construction.	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ In general, the removal of vegetation, levelling of the site, excavation and construction of the stream diversion would result in changed runoff patterns and an increased risk of soil erosion, especially in view of the gradient/slope (1:10) associated with Rimer's Creek. This could impact especially on the downstream reaches of Rimer's Creek. Mitigation measures will have to be implemented.	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
GEOLOGY	▪ Hansmeyer (2015) indicated that the reinforced concrete canal should be found on bedrock, some 2.5m below current surface. This would not only ensure that in the event of a flood that the stream will be well below the terraces on the eastern bank but also prevent erosion of loosely packed gravelly foundation material which is devoid of binding matter (clay-sand-silt mixes). ▪ Hansmeyer (2015) indicated that the stilling basin and new culvert bridge will invariably be found or be anchored to sound bedrock. ▪ The excavations would thus have a direct impact on the underlying geology of the site. The possible impact on the underlying geology cannot be mitigated.	SITE	PERMANENT	DEFINITE	MEDIUM NEGATIVE	MEDIUM NEGATIVE
SOILS	▪ Hansmeyer (2015) indicated that the reinforced concrete canal should be found on bedrock, some 2.5m below current surface. This would not only ensure that in the event of a flood that the stream will be well below the terraces on the eastern bank but also prevent erosion of loosely packed gravelly foundation material which is devoid of binding matter (clay-sand-silt mixes). Relatively deep alluvial soils in between boulders are associated with Rimer's Creek that will be impacted upon. Mitigation measures will have to be implemented in view of the type of soils and the slope of the site as recommended by Hansmeyer (2015).	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ During construction, the above-mentioned soils will be directly impacted when the vegetation and topsoil are removed, the site is levelled and excavation activities take place. The construction activities will probably lead to changes in soil structure, nutritional and chemical values as well as the compaction of the soil.	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Sediment transport and erosion may occur following the clearing of the vegetation, especially where the slope is the steepest. Erosion may impact on the delineated riparian habitat and Rimer's Creek. The chances of erosion taking place would be highest during the rainy season.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.2 CONSTRUCTION OF STREAM DIVERSION OUTSIDE OF THE FENCED AREA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA = 1375m^2**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
	▪ Soil pollution may occur if the construction vehicles are not maintained/repaired resulting in oil leaks and fuel spills and if waste management measures (building rubble, etc.) are not implemented, etc.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
NATURAL VEGETATION / ANIMAL LIFE	▪ The construction of the stream diversion will impact mostly on Secondary Riparian Scrub (Figure 5.9; McCleland and de Castro, 2015) that has a low likelihood of providing habitat for flora and fauna species of conservation concern, has a floristic composition that is heavily dominated by invasive alien species, and has compromised functional value. This vegetation unit has been assessed as having a LOW biodiversity conservation value. This vegetation unit is also associated with the delineated riparian area as identified by Grobler (2015).	SITE	LONG	DEFINTIE	LOW NEGATIVE	LOW NEGATIVE
	• Patches of Riparian Forest (Figure 5.9; McCleland and de Castro, 2015) would also be impacted upon that is a prominent vegetation unit in the riparian zone and the delineated riparian area as identified by Grobler (2015). The forest canopy is broken and the forest edges have a fairly high density of invasive alien species. Riparian Forest is relatively intact structurally and therefore still has a high functional value. It has been allocated a biodiversity conservation value of HIGH.	SITE	PERMANENT	DEFINITE	HIGH NEGATIVE	MEDIUM NEGATIVE
	▪ McCleland and de Castro (2015) however, considered the overall Ecological State of the site to be Low because of the previous and current land use activities along the stretch of Rimer's Creek that extends through the site. It would also result in the removal of alien vegetation associated with this vegetation unit.	SITE	LONG	DEFINITE	LOW NEGATIVE	LOW NEGATIVE
	▪ The tall forest tree *Prunus africana* (Vulnerable) and the forest climber *Adenia gummifera* (Declining) were recorded in Riparian Forest associated with riparian habitat located in close proximity to the site (McCleland and de Castro, 2015). Construction activities could impact on these species if not controlled.	SITE	SHORT	IMPROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Bird life associated with the Riparian Forest and the Secondary Riparian Scrub could be impacted upon in terms of the removal of trees, dust and noise as a result of the construction activities.	SITE	LONG	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	Currently there are no fish in the reach under investigation and it is unlikely that fish would be utilising this reach due to the high level of transformation (habitat and flow modifications, migration barriers and water quality alteration). It is therefore estimated that the proposed development will cause no further change in the status of fish in this reach of the Rimer's Creek (Kotze, 2015).					

7.7.2 CONSTRUCTION OF STREAM DIVERSION OUTSIDE OF THE FENCED AREA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA = 1375m^2**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
	▪ Sediment transport and erosion may occur following the clearing of the vegetation, especially where the slope is the steepest. Erosion may impact on the delineated riparian habitat and Rimer's Creek. The chances of erosion taking place would be highest during the rainy season.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ The placement of spoil from the excavation activities could also impact on the Secondary Riparian Scrub, the Riparian Forest, the delineated riparian habitat and Rimer's Creek depending on where the spoil is stockpiled.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
SURFACE WATER/SENSITIVE LANDSCAPES	The stream diversion will impact directly on Rimer's Creek. **Expected/predicted change in habitat integrity:** ▪ Reach C of Rimer's Creek will be canalised to address storm water and flood impacts on the WTW infrastructure and therefore a significant loss in habitat diversity and availability can be expected (Kotze, 2015). ▪ The habitat integrity of Reach C is expected to decrease from a D/E (instream) and E (riparian) to a category F. Due to the limited extent of Reach C this further deterioration is not thought to be significant at a catchment level. It does however disrupt the longitudinal connectivity of instream and riparian habitats between upstream and downstream reaches. ▪ Due to the current activities (WTW) and weir there is already very little connectivity between the upstream and downstream reaches (Kotze, 2015). ▪ Construction activities may also result in increased erosion and hence sedimentation of bottom substrates (Kotze, 2015).	SITE	PERMANENT	DEFINITE	MEDIUM NEGATIVE	MEDIUM NEGATIVE
	Expected predicted change in invertebrate assemblage: Reach C will be canalised and therefore a significant loss in habitat diversity and availability can be expected. Although Reach C is already (currently) in a deteriorated state due to decreased flow and habitat alterations, a significant further decrease (as indicated above) could be expected. Due to the limited extent of this reach, this further deterioration should not be significant at a catchment level (Kotze, 2015).	SITE	PERMANENT	DEFINITE	MEDIUM NEGATIVE	MEDIUM NEGATIVE

SURFACE WATER/SENSITIVE LANDSCAPES	**Water quality deterioration:**
	• Water quality may potentially deteriorate during construction (Kotze, 2015) in terms of the following:
	  • Accidental spills (fuels, oils, cement, etc.);
	  • Reduced flows in downstream reaches which may lead to increases in temperature and decreases in oxygen;
	  • Flushing of sediment from construction site may cause a decline in water quality and an increase in turbidity.
	  • Removal of vegetation during construction may also mobilise sediments which will increase turbidity in the receiving watercourse and result in sedimentation of benthic habitats (Kotze, 2015).
		LOCAL	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.2 CONSTRUCTION OF STREAM DIVERSION OUTSIDE OF THE FENCED AREA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA = 1375m^2**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
	Grobler (2015) identified no natural wetlands within the site or the surrounding 500m buffer. A riparian habitat associated with the Rimer's Creek was delineated (2.63 ha in extent) that contains more than one channel and two types of disturbed vegetation namely, Secondary Riparian Scrub (covers majority of the delineated riparian habitat) and patches of Untransformed Riparian Forest (McCleland and de Castro, 2015). **Expected/predicted change in riparian habitat:** • The delineated riparian habitat will be canalised and there a significant loss in habitat diversity and availability can be expected. The habitat of the reach is therefore expected to decrease from a D/E (instream) and E (riparian zone) to a category F (critically and irreversibly transformed PES) (Kotze, 2015; Grobler, 2015). • Due to the limited extent of this reach this further deterioration is not thought to be significant at a catchment level. It does however disrupt the longitudinal connectivity of instream and riparian habitats between upstream and downstream reaches (i.e. of the site) (Kotze, 2015; Grobler, 2015). Due to the current WTW activities and weir there is already very little connectivity between the upstream and downstream reaches (Kotze, 2015; Grobler, 2015).	SITE	PERMANENT	DEFINITE	MEDIUM NEGATIVE	MEDIUM NEGATIVE
	Expected/predicted impact i.t.o. sediment mobilisation on the riparian habitat: The narrow valley coupled with the steep gradient of the stream channels and adjacent hillslopes, makes sediment mobilisation a likely impact, especially if flooding events that exceeds the abstraction weir's retention capacity should occur.	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
GROUNDWATER	▪ Hansmeyer (2015) indicated that the reinforced concrete canal should be found on bedrock, some 2.5m below current surface. This could impact on the groundwater associated with Rimer's Creek.	SITE	LONG	PROBABLE	LOW NEGATIVE	LOW NEGATIVE
SITES OF ARCHAEOLOGICAL/ CULTURAL INTEREST	▪ According to Van Vollenhoven (2015), no sites of cultural heritage significance or graves will be impacted by the proposed construction activities.					
	▪ It is possible that stone tools could be unearthed during the construction phase. These could however, be located out of context.	SITE	SHORT	PROBABLE	LOW NEGATIVE	LOW NEGATIVE
	▪ According to Fourie (2015), the palaeontological sensitivity is Low and therefore the palaeontological impact of the development would be low.	SITE	SHORT	IMPROBABLE	LOW NEGATIVE	LOW NEGATIVE

7.7.2 CONSTRUCTION OF STREAM DIVERSION OUTSIDE OF THE FENCED AREA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA = 1375m^2**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
AIR QUALITY	▪ Dust generation and emissions due to construction activities and use of heavy machinery could potentially impact on contractors and site workers. The extent of the impact would depend on the time of year, wind direction and velocity. ▪ It could indirectly impact on hikers, bird watchers, wildlife (including aquatic environment), etc. utilising the surrounding nature reserve area.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
VISUAL	• The construction activities could be visible from the existing Rimer's Water Treatment Works but would not be visible from any residential or urban area (located about 1km northwest of the site). • Being located within a valley bottom, the site is screened by the rugged topography and lush vegetation present on site and immediate surrounding area. • It could however, be visible to hikers, bird watchers, etc. utilising the surrounding nature reserve area and therefore the site must be kept neat and tidy at all times.	SITE	SHORT	PROBABLE	LOW NEGATIVE	LOW NEGATIVE
NOISE	▪ The site is located within the Barberton Private Nature Reserve. The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.) resulting in the area being very tranquil. ▪ The major contributing factors to ambient noise level of the site would be as a result of the operation of the water treatment plant and associated infrastructure and vehicles utilising the access road to the site. ▪ Heavy machinery used during the construction phase will contribute to increased ambient noise levels in the area. ▪ Noise generation could potentially impact on contractors and site workers if the necessary health and safety measures are not implemented. ▪ Noise could also impact on hikers, bird watchers, wildlife (especially birds and aquatic environment), etc. utilising the surrounding nature reserve area.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
TRAFFIC	▪ The construction activities will not have a direct impact on traffic since no road utilised by the general public will be impacted. ▪ Heavy machinery and delivery vehicles will however, utilise the gravel access road to the site which was not built for this kind of traffic. This will impact on the condition of the said road if not maintained on a regular basis.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.2 CONSTRUCTION OF STREAM DIVERSION OUTSIDE OF THE FENCED AREA TO THE EASTERN SIDE OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA = 1375m^2**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
LAND USE/ SENSE OF PLACE	▪ The site (currently vacant) is located to the east of the existing Rimer's WTW which is located within the Barberton Private Nature Reserve. An area of 9125m^2 will be impacted by the construction of infrastructure. ▪ The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.) resulting in the area being very tranquil. ▪ As indicated in Section 5.14.1, the Rimer's Creek area has been associated with water treatment (purification) since 1931 when the Turbine was installed to purify the town's water. ▪ The proposed extension of the WTW will thus be seen as a much needed extension of this existing activity in order to provide the residents of Barberton and Umjindi with potable water. It is not seen as a conflict of land use.	SITE	LONG	DEFINITE	LOW NEUTRAL	LOW NEUTRAL
INTERESTED AND AFFECTED PARTIES	▪ Job opportunities could be provided during the construction phase (possibly 20 persons will be required).	SITE	SHORT	DEFINITE	MEDIUM POSITIVE	MEDIUM POSITIVE
	▪ Contractors working on site could be directly impacted upon if the necessary safety and occupational health measures are not adhered to.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.3 UPGRADING OF EXISTING STRUCTURES WITHIN THE FENCED AREA OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 4200m²**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
The following infrastructure will be constructed within the existing fenced works area (Figure 3.4): new sedimentation tanks with sludge handling (i.e. convert slow sand filters to sludge drying beds), new supernatant facility with recycle pump station, 3 new upflow filters, new chlorine dosing facility, new backwash pump station. Area within existing fenced works area to be developed = 4200m².						
TOPOGRAPHY	▪ The existing slow sand filters will be converted to sludge drying beds (i.e. new sedimentation tanks with sludge handling). Being located within an existing structure, the construction will not impact on the topography of the site. ▪ The 3 new upflow filters will be found within the slow sand filter (just below the 5 upflow filters). Being located within an existing structure, the construction will not impact on the topography of the site.					
	▪ The new chlorine dosing facility and the new backwash pump will be located between the toe of the slow sand filter and the chlorine contact tank. Here the site slopes westwards with an even slope of 1:10. In view of this slope, mitigation measures will have to be implemented as recommended by Hansmeyer (2015). ▪ Hansmeyer (2015) indicated that the new recycling pump station must be found on an engineered fill in view of the slope of the site.	SITE	LONG	DEFINITE	MEDIUM NEGAITVE	LOW NEGATIVE
	▪ In general, the removal of vegetation, levelling of the site, excavation and construction of the engineered fills and the subsequent construction of the infrastructure would result in changed runoff patterns and an increased risk of soil erosion, especially in view of the gradient/slope of the site and the close proximity of Rimer's Creek.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
GEOLOGY	▪ The existing slow sand filters will be converted to sludge drying beds (i.e. new sedimentation tanks with sludge handling). Being located within an existing structure, the construction will not impact on the geology of the site. ▪ The 3 new upflow filters will be found within the slow sand filter (just below the 5 upflow filters). Being located within an existing structure, the construction will not impact on the geology of the site.					
	▪ The construction of the chlorine dosing facility, new backwash pump and new recycling pump station will impact on the geology of the site as engineered fills will be required in view of the slope of the site.	SITE	PERMANENT	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.3 UPGRADING OF EXISTING STRUCTURES WITHIN THE FENCED AREA OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 4200m²**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
SOILS	▪ The existing slow sand filters will be converted to sludge drying beds (i.e. new sedimentation tanks with sludge handling). Being located within an existing structure, the construction will not impact on the soil of the site. ▪ The 3 new upflow filters will be found within the slow sand filter (just below the 5 upflow filters). Being located within an existing structure, the construction will not impact on the soil of the site.					
	▪ The construction of the chlorine dosing facility, new backwash pump and new recycling pump station will impact on the soil of the site as engineered fills will be required in view of the slope of the site. ▪ The soil of the site was originally impacted in terms of the construction of the infrastructure of the existing Rimer's WTW. The construction activities would however, probably lead to changes in soil structure, nutritional and chemical values as well as the compaction of the soil.	SITE	LONG	DEFINITE	LOW NEGATIVE	LOW NEGATIVE
	▪ Sediment transport and erosion may occur following the clearing of the vegetation, especially where the slope is the steepest. Erosion may impact on the adjacent road, adjacent delineated riparian habitat and Rimer's Creek. The chances of erosion taking place would be highest during the rainy season.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Soil pollution may occur if the construction vehicles are not maintained/repaired resulting in oil leaks and fuel spills and if waste management measures (building rubble, contaminated soil, etc.) are not implemented, etc.	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.3 UPGRADING OF EXISTING STRUCTURES WITHIN THE FENCED AREA OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 4200m²**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
NATURAL VEGETATION/ ANIMAL LIFE	▪ The existing slow sand filters will be converted to sludge drying beds (i.e. new sedimentation tanks with sludge handling). Being located within an existing structure, the construction will not impact on the natural vegetation/animal life of the site (indicated as Transformed Area (McCleland and de Castro, 2015)). ▪ The 3 new upflow filters will be found within the slow sand filter (just below the 5 upflow filters). Being located within an existing structure, the construction will not impact on the natural vegetation/animal life of the site (indicated as Transformed Area (McCleland and de Castro, 2015)).					
	▪ The construction of the chlorine dosing facility, new backwash pump and new recycling pump station will impact on a Transformed Area (McCleland and de Castro, 2015) that has no possibility of supporting species of conservation concern and has little or no ecological functional value. This area was assessed as having Very Low biodiversity conservation value.	SITE	LONG	DEFINITE	LOW NEGATIVE	LOW NEGATIVE
	▪ Sediment transport and erosion may occur following the clearing of the vegetation, especially where the slope is the steepest. Erosion may impact on the adjacent road, adjacent delineated riparian habitat and Rimer's Creek. The chances of erosion taking place would be highest during the rainy season.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ The placement of spoil from the excavation activities could also impact on the Transformed Area, adjacent road, the delineated riparian habitat and Rimer's Creek depending on where the spoil is stockpiled.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.3 UPGRADING OF EXISTING STRUCTURES WITHIN THE FENCED AREA OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 4200m²**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
SURFACE WATER/SENSITIVE LANDSCAPES	▪ The existing slow sand filters will be converted to sludge drying beds (i.e. new sedimentation tanks with sludge handling). Being located within an existing structure, the construction will not impact on any surface water environments or sensitive landscapes (including wetlands). ▪ The 3 new upflow filters will be found within the slow sand filter (just below the 5 upflow filters). Being located within an existing structure, the construction will not impact on any surface water environments or sensitive landscapes (including wetlands). ▪ The construction of the chlorine dosing facility, new backwash pump and new recycling pump station will not impact on any surface water environments or sensitive landscapes (including wetlands).					
	▪ Sediment transport and erosion may occur following the clearing of the vegetation, especially where the slope is the steepest. Erosion may impact on the delineated riparian habitat and Rimer's Creek. The chances of erosion taking place would be highest during the rainy season. This would impact on the downstream water quality of Rimer's Creek.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ The placement of spoil from the excavation activities could also impact on the Transformed Area, the delineated riparian habitat and Rimer's Creek depending on where the spoil is stockpiled. This would impact on the downstream water quality of Rimer's Creek.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Soil pollution may occur if the construction vehicles are not maintained/repaired resulting in oil leaks and fuel spills and if waste management measures are not implemented, etc. This could lead to the pollution of the nearby Rimer's Creek impacting on the downstream water quality.	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
GROUNDWATER	▪ Hansmeyer (2015) indicated that no ponding was noticed on site, which was found to be dry. No wetlands are located on site (Grobler, 2015). ▪ The existing slow sand filters will be converted to sludge drying beds (i.e. new sedimentation tanks with sludge handling). Being located within an existing structure, the construction will not impact on the groundwater of the site. ▪ The 3 new upflow filters will be found within the slow sand filter (just below the 5 upflow filters). Being located within an existing structure, the construction will not impact on the groundwater of the site. ▪ The construction of the chlorine dosing facility, new backwash pump and new recycling pump station will not impact on the groundwater of the site.					
SITES OF ARCHAEOLOGICAL/ CULTURAL INTEREST	▪ According to van Vollenhoven (2015), no sites of cultural heritage significance or graves will be impacted by the proposed construction activities.					
	▪ It is possible that stone tools could be unearthed during the construction phase. These could however, be located out of context and would have a low impact.	SITE	SHORT	PROBABLE	LOW NEGATIVE	LOW NEGATIVE

7.7.3 UPGRADING OF EXISTING STRUCTURES WITHIN THE FENCED AREA OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 4200m²**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
	▪ According to Fourie (2015), the palaeontological sensitivity is Low and therefore the palaeontological impact of the development would be low.	SITE	SHORT	PROBABLE	LOW NEGATIVE	LOW NEGATIVE
AIR QUALITY	▪ Dust generation and emissions due to construction activities and use of heavy machinery could potentially impact on contractors and site workers. ▪ It could indirectly impact on hikers, bird watchers, wildlife, etc. utilising the surrounding nature reserve area. ▪ The extent of the impact would depend on the time of year, wind direction and velocity	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
VISUAL	• The construction activities could be visible from the existing Rimer's Water Treatment Works but would not be visible from any residential or urban area (located about 1km northwest of the site). • Being located within a valley bottom, the site is screened by the rugged topography and lush vegetation present on site and immediate surrounding area. • It could however, be visible to hikers, bird watchers, etc. utilising the surrounding nature reserve area and therefore the site must be kept neat and tidy at all times.	SITE	SHORT	PROBABLE	LOW NEGATIVE	LOW NEGATIVE
NOISE	▪ The site is located within the Barberton Private Nature Reserve. The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.) resulting in the area being very tranquil. ▪ The major contributing factors to ambient noise level of the site would be as a result of the operation of the water treatment plant and associated infrastructure and vehicles utilising the access road to the site. ▪ Heavy machinery used during the construction phase will contribute to increased ambient noise levels in the area. ▪ Noise generation could potentially impact on contractors and site workers if the necessary health and safety measures are not implemented. ▪ Noise could also impact on hikers, bird watchers, wildlife (especially birds), etc. utilising the surrounding nature reserve area.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
TRAFFIC	▪ The construction activities will not have a direct impact on traffic as all construction activities will take place within the fenced WTW area. ▪ Heavy machinery and delivery vehicles will however, utilise the gravel access road to the site which was not built for this kind of traffic. This will impact on the condition of the said road if not maintained on a regular basis.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.3 UPGRADING OF EXISTING STRUCTURES WITHIN THE FENCED AREA OF THE EXISTING RIMER'S WTW						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT CONSTRUCTION PHASE** **AREA: 4200m^2**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
LAND USE/ SENSE OF PLACE	▪ The site (currently vacant) is located to the east of the existing Rimer's WTW which is located within the Barberton Private Nature Reserve. An area of 4200m^2 will be impacted by the construction of infrastructure. ▪ The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.) resulting in the area being very tranquil. ▪ As indicated in Section 5.14.1, the Rimer's Creek area has been associated with water treatment (purification) since 1931 when the Turbine was installed to purify the town's water. ▪ The upgrading of the WTW is seen as a much needed upgrading of this existing water treatment works in order to provide the residents of Barberton and Umjindi with potable water of the required quality. It is not seen as a conflict of land use in view of the existing WTW already present within the said area.	SITE	LONG	DEFINITE	LOW NEUTRAL	LOW NEUTRAL
INTERESTED AND AFFECTED PARTIES	○ The site is located within the Barberton Private Nature Reserve. The surrounding land use is thus nature conservation and recreation (e.g. hiking; bird watching, etc.) resulting in the area being very tranquil. The construction activities could indirectly impact on I&Aps utilising the said area for hiking, bird watching, etc. in terms of dust and noise as indicated in the preceding sections.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Job opportunities could be provided during the construction phase (possibly 20 persons will be required).	SITE	SHORT	DEFINITE	MEDIUM POSITIVE	MEDIUM POSITIVE
	▪ Contractors working on site could be directly impacted upon if the necessary safety and occupational health measures are not adhered to.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.4 UTILIZATION OF THE UPGRADED RIMER'S WTW (INCLUDING STREAM DIVERSION)						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT OPERATIONAL PHASE**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
TOPOGRAPHY	▪ The new infrastructure (i.e. aeration facility (two clarifiers)), chemical dosing building (including a cascade) will create topographical highs in the landscape, which will continue to impact on the runoff patterns of the site and an increased risk of erosion. ▪ The road will also continue to impact in terms of runoff patterns of the site and the increased risk of erosion. ▪ The erosion risk is highest on the western boundary of the site where the slope is the steepest (i.e. closest to Rimer's Creek). Erosion could impact on the adjacent riparian habitat and Rimer's Creek if storm water mitigation measures are not implemented.	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
GEOLOGY	▪ None, since no further construction will take place.					
SOILS	▪ Direct impact on soil will continue i.t.o. soil structure, nutritional and chemical values and soil compaction as a result of the presence of the infrastructure.	SITE	LONG	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Soil pollution would occur if proper waste management does not take place, especially in terms of the use of chemicals and waste products (sludge) resulting from the water treatment process.	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Soil erosion could occur if proper storm water control and rehabilitation measures are not implemented, especially along the gravel access road and where the slope is the steepest. The soil erosion could impact on the delineated riparian habitat and Rimer's Creek.	SITE	LONG	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Erosion of Rimer's Creek and the delineated riparian area could take place if storm water control measures are not put into place. This would impact especially on the downstream area.	LOCAL	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
NATURAL VEGETATION / ANIMAL LIFE	▪ None, since no further construction will take place. ▪ However, if the disturbed areas were not properly rehabilitated and the necessary storm water mitigation measures not implemented, it could lead to erosion (especially in the western portion of the site where the gradient is steepest) and the establishment of invader species.	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.4 UTILIZATION OF THE UPGRADED RIMER'S WTW (INCLUDING STREAM DIVERSION)						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT OPERATIONAL PHASE**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
NATURAL VEGETATION / ANIMAL LIFE	McCleland and de Castro (2015) indicated that the total removal of water from the watercourse between the diversion weir to the WTW would have a detrimental effect on the long stretch of riparian forest along the current active channel. The loss of this stretch of forest may result in a significant barrier to upstream and downstream movement by certain forest-dependent fauna species, although this is not certain since the adjacent low forest on steep hillsides has a similar vegetation structure and may facilitate a migration corridor. McCleland and de Castro (2015) recommended that a specific volume of water is allowed to continue flowing from the diversion weir through the active channel. The specific volume should be determined through consultation with the other specialists that have experience with the ecological flow requirements of riparian forest trees.	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	MEDIUM NEGATIVE
	If no flow is released into the downstream reaches (especially during the wet season), it will impact on the continuity and biota associated with the aquatic ecosystem (including birds and mammals).	SITE	LONG	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
SURFACE WATER/SENSITIVE LANDSCAPES	The hydrology of the Lomati River will be impacted to some extent due to the increased abstraction of water from the Lomati Dam (i.e. from 10 Ml/d to 15 Ml/d). Kotze (2015) indicated that it will be important to ensure that the ecological reserve flows are met in the Lomati River.	REGIONAL	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
	Kotze (2015) indicated that the hydrology of Reach B in the Rimer's Creek will also be altered due to increased flow, while the rest of the reaches should remain largely unchanged. However, Kotze (2015) indicated that the small increase from the present situation (i.e. 10Ml/d to 15Ml/d) is not expected to impact significantly on the overall hydrology.	REGIONAL	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
	In Reach B, an increase in flow (10 to 15Ml/d) is expected as a result of the upgrading. This will result in further increases in velocities, decreased habitat diversity as well as the potential increase in scouring and erosion. Due to the existing level of transformation of this reach and the relatively rocky and, hence, stable nature, the expected change in habitat integrity should not be highly significant (Kotze, 2015).	SITE	LONG	DEFINITE	LOW NEGATIVE	LOW NEGATIVE
	The utilisation of the existing pipeline from Saddleback Tunnel to the diversion weir will have a negative impact on the water quality (Afri-infra, 2014).	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	LOW NEGATIVE
	Reach C will be canalised in order to address storm water and flood impacts on the WTW infrastructure and therefore a significant loss in aquatic habitat diversity and availability can be expected. The habitat integrity of the reach is therefore expected to decrease significantly. Due to the current activities (WTW) and weir there is already very little connectivity between the upstream and downstream reaches (Kotze, 2015).	SITE	LONG	DEFINITE	MEDIUM NEGATIVE	MEDIUM NEGATIVE

7.7.4 UTILIZATION OF THE UPGRADED RIMER'S WTW (INCLUDING STREAM DIVERSION)						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT OPERATIONAL PHASE**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
SURFACE WATER/SENSITIVE LANDSCAPES	The increased velocities in Reach B and the canalisation of Reach C will further decrease the continuity of Rimer's Creek (Kotze, 2015). The significance of this impact is Low in view of the current level of transformation and the absence of fish that require connectivity between the reaches (Kotze, 2015).	LOCAL	LONG	DEFINITE	LOW NEGATIVE	LOW NEGATIVE
	The flow in Reach D may be further decreased should abstraction increase and the infrastructure of the WTW upgraded (fewer leaks and spills will reduce the amount of water in the channel). Contributions from tributaries should however maintain a consistent flow regime in this reach. No significant change is therefore expected in terms of flow modification by this activity (Kotze, 2015).	LOCAL	PERMANENT	DEFINITE	LOW NEGATIVE	LOW NEGATIVE
	The aim of reducing/preventing future silt/sludge releases from the WTW as a result of the proposed upgrade can be expected to improve the water quality and possibly substrate condition (reduced sedimentation and embeddedness) in Reach D. An improvement in the habitat and invertebrate assemblage in Reach D could be expected should this be achieved (Kotze, 2015).	LOCAL	LONG	DEFINITE	MEDIUM POSITIVE	MEDIUM POSITIVE
	Water quality may potentially deteriorate during the operational phase (Kotze, 2015) in terms of the following: • Accidental spills (fuels, oils, cement, etc.); • Reduced flows in downstream reaches which may lead to increases in temperature and decreases in oxygen; • Any potential effluents originating from the WTW (backwash, flocculants, chlorine, etc), • Release of sludge may cause a decline in water quality and an increase in turbidity.	LOCAL	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	The WTW upgrade aims to address the flushing of sludge into the downstream environment. Turbidity levels in the river downstream of the WTW may therefore improve (Kotze, 2015).	LOCAL	LONG	HIGHY PROBABLE	MEDIUM POSITIVE	LOW POSITIVE
GROUNDWATER	▪ It is not anticipated that the operational activities will have any direct impact on the groundwater of the site. ▪ No groundwater will be abstracted for the operational activities. Thus, no direct impact is expected in terms of groundwater quantity.					
SITES OF ARCHAEOLOGICAL/ CULTURAL INTEREST	▪ Operational activities will not impact on any sites of archaeological and/or palaeontological interest. No construction will take place.					

7.7.4 UTILIZATION OF THE UPGRADED RIMER'S WTW (INCLUDING STREAM DIVERSION)						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT OPERATIONAL PHASE**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
AIR QUALITY	▪ During the operational phase, no direct impact on the air quality is anticipated. ▪ The site employees could be impacted upon in terms of smell if the sewer infrastructure is not maintained and proper waste management measures are not implemented. ▪ It could indirectly impact on hikers, bird watchers, wildlife, etc. utilising the surrounding nature reserve area. ▪ The extent of the impact would depend on the time of year, wind direction and velocity.	SITE	LONG	IMPROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
VISUAL	▪ The operational activities could be visible from the existing Rimer's Water Treatment Works and immediate surrounding area depending on the screening provided by the rugged topography and the lush vegetation. ▪ It could however, be visible to hikers, bird watchers, etc. utilising the surrounding nature reserve area and therefore the site must be kept neat and tidy at all times.	SITE	LONG	PROBABLE	LOW NEGATIVE	LOW NEGATIVE
NOISE	▪ The operation of the water treatment plant (specifically the various pumps) could impact on the on-site employees and hikers, bird watchers, wildlife (especially birds), etc. utilising the surrounding nature reserve area for its tranquillity. Currently, the existing water treatment plant does not have a significant impact on the ambient noise of the area. ▪ Mitigation measures would have to be implemented to keep the noise levels as low as possible, especially since the site is located within a conservation area.	SITE	LONG	PROBABLE	LOW NEGATIVE	LOW NEGATIVE
TRAFFIC	▪ Employees will have to travel to and from the water treatment works. A maintenance vehicle will occasionally have to visit the site for repairs. This could impact on the condition of the said road if not maintained on a regular basis.	SITE	LONG	PROBABLE	LOW NEGATIVE	LOW NEGATIVE
LAND USE/ SENSE OF PLACE	▪ The operational activities of the upgraded WTW will not impact on the land use/sense of place as the Rimer's Creek area has been associated with water treatment (purification) since 1931 when the Turbine was installed to purify the town's water.					
INTERESTED AND AFFECTED PARTIES	▪ The upgraded water treatment works will ensure that the local community of Barberton and Umjindi has a reliant water supply of good quality.	LOCAL	LONG	DEFINITE	MEDIUM POSITIVE	MEDIUM POSITIVE

7.7.4 UTILIZATION OF THE UPGRADED RIMER'S WTW (INCLUDING STREAM DIVERSION)						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT OPERATIONAL PHASE**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
	▪ Job opportunities could be provided during the operational phase (possibly 8 persons will be required).	SITE	LONG	HIGHLY PROBABLE	MEDIUM POSITIVE	MEDIUM POSITIVE
	▪ Employees working on site could be directly impacted upon if the necessary safety and occupational health measures are not adhered to. This is especially true whilst working with chemicals (e.g. chlorine).	SITE	LONG	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.5 DECOMMISSIONING OF THE UPGRADED RIMER'S WTW (INCLUDING STREAM DIVERSION)						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT PHASE: DECOMMISSIONING PHASE** **AREA: EXISTING RIMER'S WTW**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
TOPOGRAPHY	▪ The decommissioning and rehabilitation of the site would have a positive impact on the topography since the infrastructure will be removed and the site will be top soiled and shaped to conform to the original slope of the area. In addition, the site will be revegetated assisting to reduce erosion as a result of stormwater runoff.	SITE	LONG	DEFINITE	MEDIUM POSITIVE	MEDIUM POSITIVE
GEOLOGY	▪ None.					
SOILS	▪ In general, the decommissioning and rehabilitation of the site would have a positive impact on the soil of the site since the infrastructure will be removed and the site will be top soiled and shaped to conform to the original slope of the area.	SITE	LONG	HIGHLY PROBABLE	MEDIUM POSITIVE	MEDIUM POSITIVE
	▪ However, due to the slope of the site, the adjacent road, delineated riparian habitat and Rimer's Creek could be impacted upon in terms of erosion if the site is not revegetated/rehabilitated properly.	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Any polluted soil would be removed from site as part of the decommissioning phase activities.	SITE	LONG	PROBABLE	MEDIUM POSITIVE	MEIDUM POSITIVE
NATURAL VEGETATION/ ANIMAL LIFE	▪ During the decommissioning phase, infrastructure and building rubble will be removed from the site and disposed of accordingly. The said area will then be rehabilitated in order to establish a vegetation cover and prevent soil erosion. New animal habitat will be created.	SITE	LONG	PROBABLE	MEDIUM POSITIVE	MEDIUM POSITIVE
	▪ However, if the area was not properly rehabilitated it could lead to erosion (especially in the western portion of the site where the gradient is steepest) and the establishment of invader species. This could then impact on the adjacent delineated riparian area, Riparian Forest and Rimer's Creek.	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.5 DECOMMISSIONING OF THE UPGRADED RIMER'S WTW (INCLUDING STREAM DIVERSION)						
ENVIRONMENTAL FEATURE(S)	**PREDICTED IMPACT PHASE: DECOMMISSIONING PHASE** **AREA: EXISTING RIMER'S WTW**	**EXTENT**	**DURATION**	**PROBABILITY**	**SIGNIFICANCE (PRE-MITIGATION)**	**SIGNIFICANCE (POST MITIGATION)**
SURFACE WATER/SENSITIVE LANDSCAPES	▪ During the decommissioning phase, building rubble and other infrastructure will be removed from the site and disposed of accordingly. The said area will then be rehabilitated/revegetated in order to establish a vegetative cover to prevent soil erosion. This would result in clean runoff from the site. It would thus have a positive impact on the delineated riparian and Rimer's Creek.	SITE	LONG	PROBABLE	MEDIUM POSITIVE	MEDIUM POSITIVE
	▪ During the dismantling of the infrastructure (e.g. pumps, filters, etc.), waste oils and other pollutants (sludge) could end up in Rimer's Creek if the necessary precautions are not taken. ▪ In addition, the surface water could be polluted if the building rubble and infrastructure is not disposed of properly and left on site.	LOCAL	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ The decommissioning of the water treatment works could result in erosion of the riparian area and sedimentation of Rimer's Creek could take place if the site is not properly rehabilitated and revegetated.	SITE	LONG	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
	▪ Once rehabilitated, the site could once again become part of the Rimer's Creek system.	SITE	LONG	PROBABLE	MEDIUM POSITIVE	MEDIUM POSITIVE
GROUNDWATER	▪ It is not anticipated that the decommissioning activities will have any direct impact on the groundwater of the site. ▪ However, the removal of hard surfaces and revegetation of the area could have a positive impact on the hydrology of the adjacent riparian area and Rimer's Creek in terms of recharge.	SITE	LONG	PROBABLE	LOW POSITIVE	LOW POSITIVE
SITES OF ARCHAEOLOGICAL/ CULTURAL INTEREST	▪ Decommissioning activities will not impact on any sites of archaeological and/or palaeontological interest.					
AIR QUALITY	▪ Dust generation and vehicle emissions due to decommissioning activities and use of heavy machinery could impact on site workers. The extent of the impact would depend on the time of year, wind direction and velocity. ▪ It could indirectly impact on hikers, bird watchers, wildlife, etc. utilising the surrounding nature reserve area.	SITE	SHORT	PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.7.5 DECOMMISSIONING OF THE UPGRADED RIMER'S WTW (INCLUDING STREAM DIVERSION)

ENVIRONMENTAL FEATURE(S)	PREDICTED IMPACT PHASE: DECOMMISSIONING PHASE AREA: EXISTING RIMER'S WTW	EXTENT	DURATION	PROBABILITY	SIGNIFICANCE (PRE-MITIGATION)	SIGNIFICANCE (POST MITIGATION)
VISUAL	▪ The decommissioning activities could be visible from the existing Rimer's Water Treatment Works and immediate surrounding area depending on the screening provided by the rugged topography and the lush vegetation. ▪ It could however, be visible to hikers, bird watchers, etc. utilising the surrounding nature reserve area and therefore the site must be kept neat and tidy at all times. ▪ Once rehabilitated, the visual impact will be positive.	SITE	SHORT	PROBABLE	LOW NEUTRAL	LOW NEUTRAL
NOISE	▪ Heavy machinery used during decommissioning will contribute to increased ambient noise levels in the area. ▪ This could impact on the on-site employees and hikers, bird watchers, wildlife (especially birds), etc. utilising the surrounding nature reserve area for its tranquillity. ▪ Mitigation measures would have to be implemented to keep the noise levels as low as possible, especially since the site is located within a conservation area.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
TRAFFIC	▪ Building rubble would have to be removed from site. This could lead to a slight increase in traffic on the gravel access road which was not built for this kind of traffic. This could impact on the condition of the said road if not maintained on a regular basis.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE
LAND USE/ SENSE OF PLACE	▪ The decommissioning and rehabilitation activities will result in the natural area being restored and once again being available for nature conservation purposes as part of the Barberton Private Nature Reserve.	SITE	LONG	HIGHLY PROBABLE	MEDIUM POSITIVE	MEDIUM POSITIVE
INTERESTED AND AFFECTED PARTIES	▪ The decommissioning of the facility will have a negative impact on the local community in terms of water supply, unless other arrangements have been made.	LOCAL	LONG	DEFINITE	HIGH NEGATIVE	LOW NEGATIVE
	▪ Job opportunities could be created during the decommissioning phase but will also be lost as a result of the decommissioning of the WTW.	SITE	SHORT	DEFINITE	MEDIUM NEUTRAL	MEDIUM NEUTRAL
	▪ Contractors working on site could be directly impacted upon if the necessary safety and occupational health measures are not adhered to.	SITE	SHORT	HIGHLY PROBABLE	MEDIUM NEGATIVE	LOW NEGATIVE

7.8 Cumulative impacts

The primary impacts that will have a cumulative impact in terms of aquatic ecosystem are *water quality deterioration* and *water quantity/hydrological alterations* as described by Kotze (2015).

The stability of a system could be described by concepts such as resilience (ability of system to recover from disturbance) and elasticity (speed with which the system returns to its original state after removal of the disturbance). The important issue is however, not whether an ecosystem can be classified as stable or fragile, but how much the particular ecosystem changes after a specific disturbance (Roux, 1999).

Water quality: The proposed activity is not expected to have a significant cumulative contribution on water quality deterioration of the downstream receiving water body, and a slight improvement may, in fact, be achieved.

Water quantity: The proposed activity is expected to contribute to a decrease in the flows available, particularly in the Lomati River, due to increased abstraction. The abstraction of water is, however, an important socio-cultural commitment. It must therefore be ensured that the ecological water requirements (environmental reserves) of the Lomati River is achieved (follow adequate water use licence protocol for WTW) and that minimum flows are maintained within the Rimer's Creek to sustain ecological functions and provide consistent inputs into the SuidKaap River.

Grobler (2015) identified no natural wetlands within the site or the surrounding 500m buffer and therefore there will be no cumulative impact on wetlands as a result of this project.

The project will however impact on a riparian habitat associated with Rimer's Creek. The delineated riparian habitat will be canalised and there a significant loss in habitat diversity and availability can be expected. The habitat of the reach is therefore expected to decrease from a D/E (instream) and E (riparian zone) to a category F (critically and irreversibly transformed PES) (Kotze, 2015; Grobler, 2015). Due to the limited extent of this reach this further deterioration is not thought to be significant at a catchment level. It will therefore not have a significant cumulative impact in this regard.

The proposed project will impact on two types of disturbed vegetation namely, Secondary Riparian Scrub (covers majority of the delineated riparian habitat) and patches of Untransformed Riparian Forest (McCleland and de Castro, 2015). McCleland and de Castro (2015) however, considered the overall Ecological State of the site to be Low because of the previous and current land use activities along the stretch of Rimer's Creek that extends through the site. It will thus not have a significant cumulative impact in this regard.

8. ENVIRONMENTAL MANAGEMENT PLAN

8.1 Definition and objectives

The Environmental Management Plan (EMP) was compiled in accordance with Appendix 4 of the Environmental Impact Regulations, 2014 as well as the Western Cape Guideline for Environmental Management Plans (Lochner, 2005).

According to the Western Cape Guideline, an Environmental Management Plan (EMP) can be defined as:

> *An environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced.*

An EMPr must include-
A description of the impact management objectives, including management statements, identifying the impacts and risks that need to be avoided, managed or mitigated as identified through the environmental impact assessment process for all phases of the development including –
(i) planning and design;
(ii) pre-construction and construction activities;
(iii) operation or undertaking of the activity;
(iv) rehabilitation of the environment; and
(v) closure, where relevant.

This section therefore provides an indication of the mitigation measures to be implemented by the site operator (and site workers) in order to reduce the potential impacts identified (see Section 7).

8.2 Contact details

An EMPr must include details of-
- *(i) the EAP who prepared the environmental management programme; and*
- *(ii) the expertise of that person to prepare an environmental management programme, including a curriculum vitae;*

The contact details and expertise of the environmental consultant are provided in Section 2 (page 3) of this report.

The applicant will be responsible for the implementation of the EMP. The contact details are provided in Section 2 (page 3).

8.3 Description of the proposed project

An EMPr must provide a detailed description of the activity that are covered by the EMPr as identified by the project description.

A detailed description of the proposed development and aspects covered by the EMP is provided in Section 3 of this report.

Section 5 provides a description of the biophysical environment of the site.

Figure 5.10 provides the botanical biodiversity conservation value and sensitivity of the site.

Figure 8.1 provides an indication of the delineated riparian area associated with Rimer's Creek and the 10m buffer zone recommended by Grobler (2015).

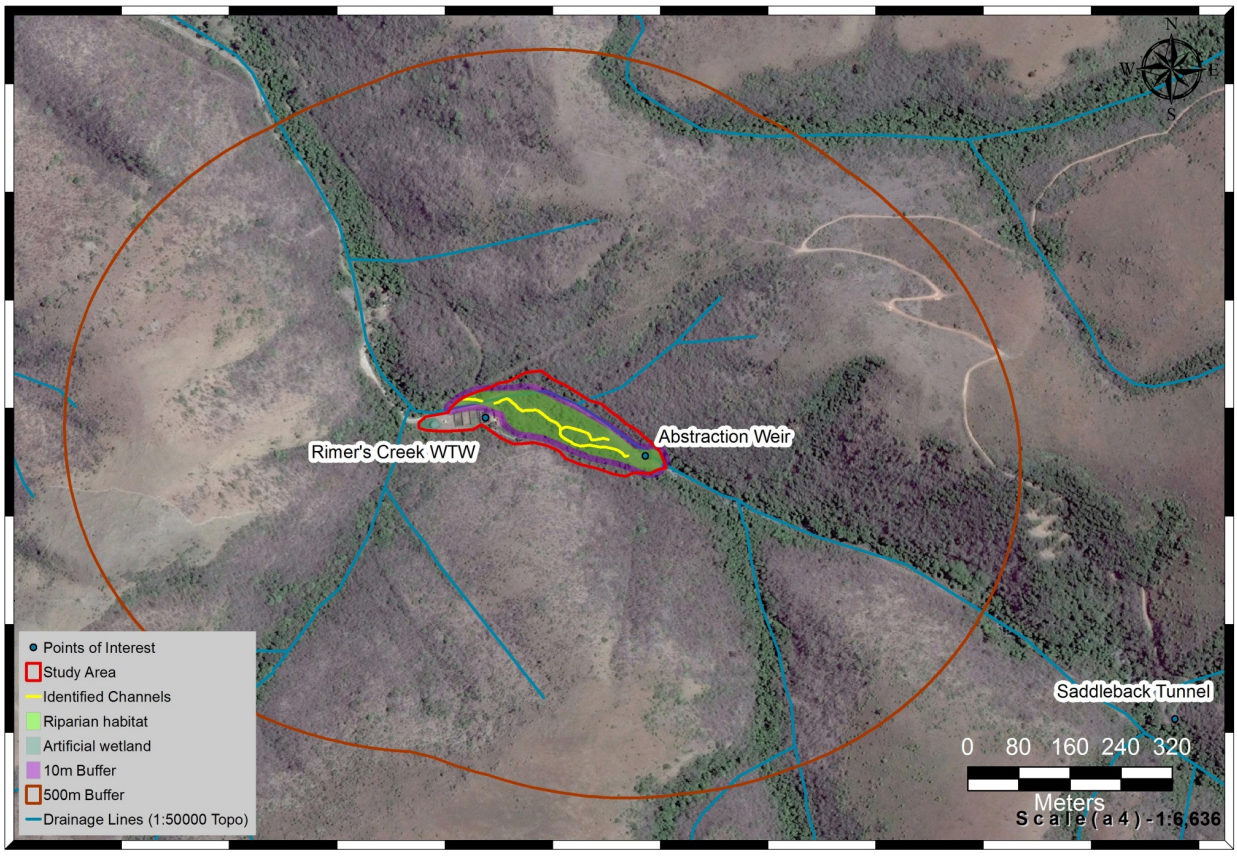

Figure 8.1: Delineated riparian area and the associated 10m buffer zone.

8.4 Phases of the development and timeframe

a) Planning and design phase

The planning and design phase involved office work and site surveys with regards to the design of the water treatment works and the Basic Assessment Report. It also involves obtaining the necessary authorisations for the said development.

Apart from the existing activities on site, no actual construction work took place regarding the proposed upgrading of the infrastructure. **Therefore, no mitigation measures need to be implemented.**

b) Construction phase

The Umjindi Local Municipality proposes to upgrade the Rimer's Water Treatment (Purification) Works from 10Ml/d to a total treatment capacity of 15Ml/d. The upgrading will entail the addition of new unit processes as well as

the extension of existing unit processes in an effort to provide clean and potable water to the towns of Barberton and Umjindi.

According to the engineers, the construction will take place as follows:

- Phase 1: Construction of new infrastructure (including access road) to the eastern side of the existing WTW;
- Phase 2: Construction of stream diversion;
- Phase 3: Upgrading of existing structures within the existing WTW.

Outside of existing fenced works area, to the eastern side of the existing WTW (Figure 3.4)

The construction phase would involve the following:

- **Construction of new aeration facility (2 new clarifiers) and a new chemical dosing facility (including a cascade)**
  - removal of the vegetation;
  - terracing of the site as required;
  - excavation of the required foundations and service trenches;
  - construction of the new aeration facility (2 clarifiers) and a new chemical dosing facility (including a cascade).
- **Construction of new access road**
  - removal of the vegetation;
  - levelling of the route;
  - construction of the road and associated storm water measures.
- **Construction of stream diversion (i.e. a reinforced concrete lined channel (3.6m depth, 5.0m width, 275m length) and reinforced concrete stilling basin (Figure 3.4)).**
  - removal of the vegetation;
  - excavation of the required foundations;
  - construction of the concrete lined channel and reinforced concrete stilling basin.

Summary of area to be developed:

- Area outside of existing fenced works area to be developed = 8100m^2 (i.e. for new infrastructure).
- Area of proposed new access road = 1025m^2.
- Diverted/rerouted stream area = 1375m^2.

Within existing fenced area:

The construction phase would involve the following:

The following infrastructure will be constructed within the existing fenced works area (Figure 3.4):

- **Construction of new sedimentation tanks with sludge handling (i.e. convert slow sand filters to sludge drying beds),**
  - Removal of any existing sludge/soil/sand/etc. from slow sand filters;
  - refurbishment slow sand filters to sludge drying beds.
- **Construction of new supernatant facility with recycle pump station,**
  - removal of the vegetation;
  - excavation of the required foundations;
  - construction of the supernatant facility with recycle pump station.
- **Construction of 3 new upflow filters,**
  - removal of the vegetation;
  - excavation of the required foundations;

  - construction of the 3 new upflow filters.
- **Construction of new chlorine dosing facility,**
  - removal of the vegetation;
  - excavation of the required foundations;
  - construction of the new chlorine dosing facility.
- **Construction of new backwash pump station.**
  - removal of the vegetation;
  - excavation of the required foundations;
  - construction of the new backwash pump station.

Summary of area to be developed:
- Area within existing fenced works area to be developed = 4200m^2.

Section 7.7 provides further details with regards to potential impacts identified.

Construction timeframe:
12 months

c) Operational phase
The operational phase would involve the utilisation of the upgraded water treatment works (including the stream diversion).

Section 7.7 provides further details with regards to potential impacts identified.

Operational timeframe:
Unknown.

d) Decommissioning and rehabilitation phase

This phase would involve the decommissioning of the buildings and infrastructure already constructed on site at that particular date, if ever required. This phase will not be discussed in detail. It is recommended that at the time of decommissioning, a specific Environmental Management Plan (EMP) be compiled which specifically addresses this phase. This EMP would have to address issues such as the removal of building rubble, ripping of the soil, the sowing of seed and the maintenance of the vegetation until it is established. Soil conservation measures would also have to be implemented.

8.5 Mitigation measures to be implemented

8.5.1 Construction site office
The construction site office must be located within the fenced existing WTW area (Grobler, 2015). Limited space for a construction site office is available outside of the fenced WTW area in view of the 10m buffer zone associated with the delineated riparian area (Grobler, 2015).

The following general management measures should be implemented for the construction site office:
- A suitable site must be selected, demarcated and fenced for the construction site office.
- No overnight accommodation may be provided on site, since the site is located in the Barberton Private Nature Reserve.

- No stockpiling of building material or equipment may take place within the delineated riparian area associated with Rimer's Creek. This should take place within the fenced WTW area.
- Chemical toilets must be provided for use by the site workers if the construction site office is not located near any existing facilities. These must be serviced on a regular basis. No long drop toilets may be allowed.
- Potable water must be made available to site workers.
- Proper waste management facilities must be provided as part of the construction site office.
- No waste may be burnt, buried or dumped on site or the surrounding area. The contractor will have to provide adequate containers for the collection of waste. The applicant will have to ensure that the contractor removes the domestic waste to a licensed waste disposal site.
- As far as practically possible, vehicles must not be serviced/repaired on site. However, should it not be possible to take the vehicle to a service centre in town for repair, the contractor must ensure that the vehicles are serviced/repaired on a cement slab and that drip trays are utilized. Waste oil, filters, etc. must be properly disposed of.
- The contractor must adhere (at all times) to the requirements of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and the Construction Regulations, 2003 as well as all applicable legislation.
- The applicant/contractor must appoint a Safety Officer and Environmental Control Officer (ECO) in order to ensure compliance with the legislation.
- The applicant/contractors must ensure that the necessary protective gear (PPE) is worn at all times and that signs are erected to warn workers to use hearing protection as well as any other hazards.

8.5.2 Construction activities

8.5.2.1 General principles

The following mitigation measures must be implemented during the construction phase in order to reduce the potential impact of the construction activities:

- Construction to take place during the dry season (winter months) in order to reduce the risk of flooding (Grobler, 2015; Kotze, 2015).
- The delineated riparian area and Rimer's Creek should be considered NO-GO AREAS as far as possible.
- The existing gravel road across Rimer's Creek to be used in order to gain access to area to the eastern side of the existing WTW. No other roads to be made.
- All construction activities must be limited to the demarcated construction sites. The said site should be properly demarcated and the footprint kept as small as possible.
- Construction within the fenced WTW area must not impact on existing infrastructure associated with the WTW.

- No unnecessary removal of vegetation should take place outside of the demarcated area (Kotze, 2015; McCleland and de Castro, 2015).
- The only threatened species likely to be directly affected by the development would be the single young *Prunus africana* tree on the eastern boundary of the site. Care should be taken to avoid any damage or disturbance of this individual tree during the construction phase. This

tree must be temporarily fenced off until construction is complete (McCleland and de Castro, 2015).

- Prior to clearing any vegetation, a suitably experienced botanist to conduct a brief survey of the immediate footprint to be cleared and search for any plants or species of conservation concern, so that appropriate *in situ* and/or *ex situ* conservation measures can be developed and implemented in conjunction with the Mpumalanga Tourism and Parks Agency (MTPA). Permission for removal of any of these species of conservation concern will need to be obtained from the MTPA (McCleland and de Castro, 2014).
- The protected species listed in Table 5 of Appendix 6 should be rescued and placed in a nursery or donated to a research institute (e.g. SANBI or regional botanical garden) prior to development, rather than simply being destroyed. Where feasible, viable sub-populations of such species can also be translocated to transformed (including rehabilitation areas) or degraded areas adjacent the site which provide potentially suitable habitats and which are not earmarked for development. Such translocations will have to be carried out in a manner that ensures that no ecological degradation of the host habitat occurs, and will have to be evaluated by a botanist for each species and each potential host area. A permit must be obtained prior to removal or destruction of any protected plant species (McCleland and de Castro).
- Illegal harvesting of medicinal plants should be monitored and discouraged through control of access to the area.

- An area outside of the 10m buffer zone associated with the delineated riparian area must be identified and demarcated for stockpiling (topsoil) and spoiling (subsoil, rocks, etc.) (Grobler, 2015).
- Topsoil must be removed and stockpiled in a demarcated area for rehabilitation of the area after construction.
- Erosion and sediment must be managed during construction (Kotze, 2015). Implement erosion control measures and sediment trapping devices, flow attenuation mechanisms and retention ponds at construction sites (Kotze, 2015).
- Downstream sedimentation should be restricted by implementing and maintaining a series of silt fences or sand bag barriers within the channel, upstream of the return flow release point (Grobler, 2015).
- Sediment movement off site should be limited by ensuring the implementation of runoff control measures and the rapid revegetation of sites following construction related activities.
- If soil erosion is noted, appropriate remediation measures must be implemented. Current eroded areas to be rehabilitated (Kotze, 2015).
- Once the construction activities have been completed, the disturbed areas must be top soiled and re-vegetated (i.e. rehabilitated) as soon as possible in order to prevent soil erosion and the establishment of alien vegetation.
- The regulations in terms of Alien Invasive Species, the Conservation of Agricultural Resources Act, 1983 and the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998) with regards to declared alien species must be noted and complied with. Emphasis should be placed on controlling and eradicating alien plants within the two riparian vegetation units identified within the site. Emphasis should be placed on controlling in particular the priority species such as both *Tithonia** species, *Lantana camara*, Passiflora subpeltata*, Solanum mauritianum*, S. seaforthianum*, Rubus niveus** and *Caesalpinia decapetala*.*

- All site workers/contractors will be informed that the construction site is located within the Barberton Private Nature Reserve and no poaching/trapping of animals or collection of medicinal or any other plants will be allowed.
- Should any animals (e.g. reptiles or mammals) be found during the construction phase, a specialist should be contacted immediately to ensure the safe removal of the specimen(s).

- All construction activities must be limited to daylight hours (preferably between 7h00 and 17h00) in order to minimize any impact on wildlife in the surrounding nature reserve.
- All machinery used during the construction phase must be properly muffled and maintained so as to reduce noise generation to a minimum.
- If blasting is required, the requirements of the Explosives Act, 2003 (Act 15 of 2003) must be put in place in order to prevent any impact on site workers, adjacent landowners/users, etc.

- Dust suppression measures must be implemented during dry and windy periods.

- Van Vollenhoven (2015) recommended a watching brief be implemented during construction in view of historical and archaeological artefacts (albeit out of context) that were discovered on site. This basically means that an archaeologist should be present on site during ground breaking activities (e.g. bulldozing, digging of trenches etc.) to ensure that any possible archaeological material that may be unearthed be handled in accordance with legislation. If identified, such artefacts should be documented and donated to the Barberton Museum.
- If any archaeological remains are exposed during the construction phase, the construction must be terminated immediately and the South African Heritage Resources Agency (SAHRA) must be notified. In this regard, the applicant must take note of the requirements in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999).
- If any graves are discovered during construction, the discovery must be reported to the SA Police Service and/or SAHRA or an archaeologist must be called in to handle the matter.

- If any palaeontological material is exposed during digging, excavating, drilling, or blasting, SAHRA must be notified. All construction activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures.

- A post-construction audit must be conducted to ensure that any shortcomings are identified and addressed.
- All pollution incidents must be reported to the Department of Agriculture, Rural Development, Land and Environmental Affairs and the Department of Water and Sanitation within 24 hours of occurrence.

Geotechnical recommendations (Hansmeyer, 2015; Appendix 4)

Hansmeyer (2015) indicated that the following mitigation measures must be implemented during construction:

General:

- Good site drainage, erosion protection of engineered fills and strict compaction control must be implemented.

- Sidewalls of all excavations deeper than 1.5m should be shored, or flattened to not more than 50° from horizontal.
- Spoil from excavations should not be placed closer than the equivalent depth of the excavation to avoid unnecessary loading of the sidewalls, especially under moist to saturated conditions.

New aeration facility (two clarifiers) and chemical dosing building (including cascade):

- The two clarifiers, cascades feature and new dosing building to be found on a terraced engineered fill. The slope of the site necessities the construction of two terraces – an upper, slightly smaller terrace for the dosing building and cascades feature with a larger terrace to accommodate the two clarifiers – each with a bearing pressure is 60KPa.
- Following the grubbing, clearing and levelling of the site, the two 1.5m thick engineered fills can be constructed as follows:-
    - Although the underlying gravelly material has settled under its own weight, some settlement may still occur and it is recommended that a 150mm thick pioneering layer of crushed stone obtained from the slow filter drain be imported, placed upon the uneven surface and compacted using a 10t smooth drum vibrating roller, sequentially followed by BIDIM and a 1.5m thick engineered fill, constructed in 150mm thick layers of imported G6 class pavement construction material compacted to 93% of Mod. AASTHO at or close to OMC.
    - The final layer may be stabilized with cement using 3.5% of PPC SureBuild CEM compacted to 95% of Mod. AASHTO at or close to OMC.
- Ample erosion protection should be allowed along the toe of the terraces. Gabions are to be placed alongside the perimeter of the engineered fill for the clarifiers and new dosing building.
- Compaction of the engineered fill's layer works should be controlled with suitable field tests to ensure that the required densities are achieved during compaction, and that the quality of the fill material is within specification.

Mud and rock slides:

- To accommodate possible future slides, sections above the cut for the new road should be benched and the proposed clarifiers, new dosing building and rerouted stream moved further westwards than originally planned.
- If the road cutting is extended, it is recommended that the exposed face be protected with gabions and if at all possible, some benching should be considered. Good drainage is a prerequisite.

Gabions:

- Gabions to be constructed using hand-sorted gravels and smaller boulders located in the stream bed between the diversion weir and the WTW. The material exposed in the stream bed below the diversion weir comprises reworked and poorly sorted, angular, flaky to sub-rounded gravels and boulders that can be hand-sorted and used for the construction of gabions. This should create much needed job opportunities and would be a major saving on construction costs.

Stream diversion:

- The reinforced concrete canal should found on bedrock, some 2.5m below current surface – this would not only ensure that in the event of a flood that the stream will be well below the terraces on the eastern bank but also prevent erosion of loosely packed gravelly foundation material which is devoid of binding matter (clay-sand-silt mixes).
- The stilling basin and new culvert bridge will invariably be found or be anchored to sound bedrock with bearing capacity in excess of 450KPa with negligible compressibility. Some bedrock is exposed in the stream bed – the decomposed and loose material has been eroded by previous floods and founding should occur on sound bedrock material
- Gabions are to be placed alongside the perimeter of the rerouted concrete lined stream.

Upgrading of existing infrastructure within fenced area:

- The new filter can be found within the slow drain filter which has sufficient bearing capacity and negligible settlement.

- The new recycling pump station in the WTW to be found on an engineered fill. The proposed pump station and dosing construction site of some 225m² slopes westwards with an even slope of 1:10, requiring a 1.5m deep cut along the northerly abutment of the slow drain filter, extending 15m towards the chlorine contact tank. Although the underlying gravelly material has settled under its own weight, some settlement may still occur and it is recommended that a 150mm thick pioneering layer of crushed stone obtained from the slow filter drain be imported, placed upon the uneven boulder and gravel surface and compacted using a 10t smooth drum vibrating roller, sequentially followed by BIDIM cloth and a 1m thick engineered fill, constructed in 150mm thick layers of imported G6 class pavement construction material compacted to 93% of Mod. AASTHO at or close to OMC. The final layer may be stabilized with cement using 3.5% of PPC SureBuild CEM compacted to 95% of Mod. AASHTO at or close to OMC. The recommended higher percentage of PPC SureBuild is to compensate for a lime demand of 2.5% and to ensure that cementation of the final imported layer takes place.

Stream diversion

The following mitigation measures must be implemented when constructing the stream diversion:

- Construction should take place during the dry season, when the flow within Rimer's Creek is low (Kotze, 2015).
- Where possible, the natural channel should be left intact (Kotze, 2015).
- Erosion and sediment should be managed during construction (Kotze, 2015).
- Implement erosion control and sediment trapping devices (Kotze, 2015).
- Current eroded areas to be rehabilitated (Kotze, 2015).
- The water within Rimer's Creek would have to be diverted in order for construction to take place. Some release of water should be allowed to maintain the flow in the reaches downstream of the weir (especially during the wet season) (Kotze, 2015).
- The cessation of flow downstream is not allowed at any given time during the construction period. The release of ecological reserve flows into the downstream reach must be ensured to reduce the potential impact (altered hydrological regimes) on the aquatic life.

- The delineated riparian area and Rimer's Creek should be considered NO-GO AREAS as far as possible.
- All construction activities must be limited to the said site (i.e. proposed stream diversion). The said site must be properly demarcated and the footprint kept as small as possible.
- Sediment movement off site should be limited by ensuring the implementation of runoff control measures and the rapid revegetation of site following construction. Any erosion should be addressed as soon as possible.
- Sediment trapping devices must be installed to prevent siltation of the river.
- No washing of equipment or accidental spills may take place within the delineated riparian area or Rimer's Creek.
- The soil removed in terms of the stream diversion construction may not be stockpiled within the delineated riparian area or within the 1: 100 year floodline. A suitable location for the stockpile or use for the excavation soil must be determined.

8.5.2.2 Waste management measures

General/building waste

- Proper waste management measures must be implemented at the sites.
- No dumping of any kind of waste (domestic, general, building rubble, etc.) to take place on site, especially within the delineated riparian area and Rimer's Creek.
- Waste skips to be provided for placement of general waste, building rubble, etc.
- Waste and building rubble not to be placed on the soil stockpiles resulting in the contamination of the soil.
- The contractor will have to provide adequate containers for the collection of waste. The applicant will have to ensure that the contractor removes the building rubble and any domestic waste to a licensed waste disposal site.
- Cement/concrete should be mixed in either demarcated areas or on metal sheeting or conveyor belts. If mixed in demarcated areas, these areas will have to be ripped and the cement/concrete removed on completion of construction activities.
- Site workers must be instructed to collect windblown rubbish which may collect in the surrounding area on the said site. This will assist with the overall visual appearance of the site.
- The applicant/contractor must ensure that all site workers receive appropriate training with regards to the overall waste management measures to be implemented for the said site.
- Site workers must be aware of the importance of the implementation of the waste management measures.

Hazardous waste management

- Proper storage facilities must be provided for the storage of oils, grease, fuels, etc. to be used during the construction phase.
- The storage and handling of fuel, lubricants and other chemicals must be done in specially demarcated impervious and bunded areas.
- Collection containers (e.g. drip trays) must be placed under all dispensing mechanisms for hydrocarbons or hazardous liquid substances to ensure that potential contamination from leaks/spillage is reduced.
- No hazardous substance is to be disposed of on site.
- No bins containing organic solvents, paint tins or bins containing thinning agents may be cleaned on site, unless containers for liquid disposal are

provided. The tins must be collected and rinsed at a central waste collection point, where it poses no threat to surface or ground water.
- All spills of chemicals or hydrocarbons (oil, grease, diesel, petrol, etc.) should be cleaned with the use of suitable absorbent materials such as drizit or oclanzorb. Appropriate soil remediation measures should be implemented where soil has been contaminated with oil.
- Contaminated soil generated as a result of fuel, oil, etc. spills will be disposed of in a specially marked drum located at the site office. An approved waste contracting firm (e.g. Enviroserv) will collect the drum and dispose of the contaminated soil at an appropriate waste disposal site.
- Contaminated soil/fuel that cannot be removed will be treated in situ with an appropriate remedial agent. In this instance, the services of an expert may be required.
- Any material impregnated with fuel or oil must be placed in a drum and arrangements made for its safe disposal at an appropriate waste disposal site by an approved waste contracting firm (e.g. Enviroserv).
- Waste oils collected on site should be stored in drums in a designated, bunded area and removed by an approved recycling contractor and disposed of at an appropriate licensed waste disposal facility.
- In all instances where a firm is contracted to collect waste (e.g. Enviroserv, Wastetech, Oilkol, etc.), the site operator will ensure that the correct documentation is completed and filed for future reference.
- Certificates of hazardous waste disposal (waybills) are to be kept for auditing purposes.
- Records of environmental related incidents should be maintained.
- The applicant must ensure that all workers receive relevant training with regards to the handling of hazardous substances and the potential health risks thereof.
- An Emergency Response Plan must be compiled in the event of major spills.

8.5.3 Operational activities

The operational phase would involve the utilisation of the upgraded water treatment works (including the stream diversion).

8.5.3.1 General principles

These mitigation measures are applicable to all the operational activities and must be implemented:

- All operational activities must be limited to the said site.
- The fence around the sites must be well maintained to prevent unauthorised access into the area.
- Waste management measures:
  - Proper waste management measures must be implemented for the site.
  - The site must be kept clean and tidy at all times and may not be littered with waste lying outside of waste bins.
  - No waste may be burnt, buried or dumped on site**.**
  - See Section 8.5.2.2 for general mitigation measures regarding hazardous waste**.**
- Regular maintenance of the sewage infrastructure to reduce the potential for blockages and leaks and thus prevent potential soil and water pollution.
- Storm water management and erosion:

  - *A stormwater management plan must be drafted and implemented for the new water treatment works and access road.*
  - *Storm water must be properly attenuated to minimize the anticipated increase in surface water runoff volume and flow velocity.*
  - *Stormwater management should include flow attenuation structures (e.g. attenuation ponds and grassed swales) to ensure diffuse runoff from the site.*
  - *Surface runoff volumes can be reduced and infiltration encouraged by maximising permeable surfaces.*
  - *Erosion protection structures (e.g. attenuation ponds and grassed swales / vegetated swales, reno or gabion mattresses or small scale baffled aprons) should be placed at all stormwater outlet points. The structure would depend on anticipated flow velocities.*
  - *Monitor for erosion and intervene and/or rehabilitate where necessary.*
- The storm water management measures must be inspected on a regular basis in order to ensure that the structures are functional (not blocked) and not causing flooding of the WTW works and access roads. This will be of particular importance at the start of the rainy season and during the rainy season.
- Monitor for erosion and intervene and/or rehabilitate where necessary.
- The landowner should develop an integrated alien plant control program, which considers all appropriate chemical, mechanical, biological and cultural control methods for the alien species listed in Appendix 1 of Appendix 6 (McCleland and de Castro, 2015). Emphasis should be placed on controlling and eradicating alien plants within the two riparian vegetation units identified within the site. Emphasis should be placed on controlling in particular the priority species such as both *Tithonia** species, *Lantana camara*, Passiflora subpeltata*, Solanum mauritianum*, S. seaforthianum*, Rubus niveus** and *Caesalpinia decapetala*.*
- Illegal harvesting of medicinal plants should be monitored and discouraged through control of access to the area.
- The applicant must ensure compliance at all times with applicable legislation e.g. Occupational Health and Safety Act, 1993 (Act 85 of 1993), etc.
- The required protective clothing and equipment will be supplied to the site workers.
- No alcohol/drugs are to be permitted on site.
- No firearms are to be allowed on site, unless used by security personnel.
- Employees must be informed to keep to low speeds along the gravel roads to reduce the amount of dust.
- Water contaminated with chemicals, disinfectants, pesticides, etc. (which is not biodegradable) must be contained on site.
- If any soil or surface water contamination is noted, appropriate remediation measures must be implemented immediately. An environmental incident report must be completed indicating the date of the incident, description of incident and action taken. The Department of Agriculture, Rural Development, Land and Environmental Affairs and the Department of Water and Sanitation must be informed of the event within 24 hours. A copy of the environmental incident report must be kept on file at the site office.
- Emergency plans must be developed to deal with fire, interruption of water supply, mechanical/electrical failure, etc.
- All staff to be aware of the emergency plans.

- Sufficient fire extinguishers must be provided as required by legislation. The site operator must ensure that the said fire extinguishers are serviced on a regular basis and are operational.

8.5.3.2 Utilization of the water treatment works:

The following mitigation measures must be implemented during the utilization of the water treatment works:

- The existing pipeline from the Saddleback Tunnel to the WTW to be used to transfer the water to the WTW. This will reduce the potential impact on Reach B in terms of increased velocities, decreased habitat diversity as well as potential increased scouring and erosion (Kotze, 2015).
- It must be ensured that the employees at the water treatment works have the required technical skills to operate the water treatment plant, especially in terms of chemical handling and dosing. Training must therefore be provided before the upgraded infrastructure is commissioned.
- An operations manual must be available to the employees at the water treatment works site office.
- Technical support must be available to the employees at all times should there be a malfunction at the plant.
- The water treatment works must be inspected and maintained on a regular basis.
- An emergency response plan must be drafted for the water treatment works and the employees must be made aware of the procedures to follow in case of an emergency.
- The septic tank must be inspected on a regular basis to ensure that there is no overflow of sewage into the environment.
- The stormwater control measures (e.g. concrete lined V-drains, energy breakers, etc.) must be inspected on a regular basis to ensure that the control measures are effective, not blocked and that no erosion is taking place.
- Waste bins must be provided on site for the disposal of domestic waste. These bins must be emptied on a regular basis and the waste disposed of at the licensed waste disposal site.
- Any waste produced as a result of water treatment (e.g. debris removed from the raw water screens; suspended and colloidal material removed during sedimentation) must be disposed of at the licensed waste disposal site.
- Toxicity testing should be performed on any effluent that may reach the natural ecosystem to determine the risk to the environment.
- Any hazardous waste produced at site (e.g. oils, grease, etc.) must be handled and disposed of as indicated in Section 8.5.2.
- No wash water should be released directly into the natural watercourse (Kotze, 2015).
- Ensure that silt releases from WTW is terminated (Kotze, 2015).
- Identify potential areas where seepage and spills can occur into the natural environment and take necessary precautions to reduce potential spills and seepage (Kotze, 2015).
- Ensure that effluents and releases from the WTW do not reach the natural environment (Kotze, 2015).

8.5.3.3 Utilization of stream diversion

The following mitigation measures must be implemented during the utilization of the stream diversion:

- Regular maintenance of the stream diversion must be conducted to ensure that the flow paths remain open.

- It is recommended that some release should be allowed to maintain the flow in the reaches downstream of the weir. Maintenance of some flow in Reach C during operation would at least maintain and possibly improve the current ecological integrity of the area (Kotze, 2015).
- Inspect stream diversion regularly to determine if desilting is required.
- Regular inspections must be conducted to ensure that the rehabilitation of the disturbed areas along the stream diversion was effective and that no erosion is taking place. Remedial action must be taken if soil erosion is noted.

8.5.3.4 Ecological Water Requirement

Kotze (2015) indicated the following:

- it must be ensured that the ecological reserve flows are met in the Lomati River;
- some flow must be released into the Rimer's Creek downstream of the WTW to maintain the ecological integrity of this reach. Albeit short in distance, it plays an important role in maintaining the overall ecological integrity of the area.

McCleland and de Castro (2015) recommended that a specific volume of water be allowed to continue flowing from the diversion weir through the active channel. The specific volume should be determined through consultation with the other specialists that have experience with the ecological flow requirements of riparian forest trees.

The above-mentioned volumes must be determined as part of the water use licence application process and must then be implemented.

8.5.4 Monitoring

Kotze (2015) indicated that biomonitoring protocols are of limited applicability to monitor potential future change due to the seasonal nature and current level of alteration of Rimer's Creek.

Limited application of SASS5 protocol can be applied at selected sites sampled during this survey during wet season months (February) to establish the applicability of this protocol as a monitoring tool and to determine whether any deterioration in the biotic integrity of the system occurs as a result of the proposed activity.

It is furthermore also essential that toxicity testing be applied regularly (quarterly) on any potential effluent (backwash, etc.) from the WTW that may potentially reach the natural environment.

Based on the above-mentioned, the following biomonitoring sites, protocols and schedules must be implemented:

Sites	Biomonitoring Protocol	Frequency
RC1, RC2, RC3, RC4, RC5, RC6, RC7	Habitat assessment and SASS5	Bi-annually (wet season (February) and dry season)
Any other potential pollution source or effluent (such as purification plant effluents)	DWA's DEEEP protocol: Whole effluent toxicity testing using four different organisms (fish, daphnia, algae and bacteria).	Quarterly (4 times per annum)

8.6 Implementation of the EMP

The implementation of the Environmental Management Plan (EMP) as part of the daily construction and operational activities is crucial and requires commitment from all levels of management and the on-site workers. The successful implementation of an EMP has the following advantages:

- Meeting legal obligations;
- Contributes to environmental awareness;
- Can facilitate the prevention of environmental degradation;
- Can minimize impacts when they are unavoidable;
- Can ensure good environmental performance and improve community relations.

8.6.1 Environmental Awareness Plan (EAP)

An environmental awareness plan describing the manner in which-
(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and
(ii) risks must be dealt with in order to avoid pollution or the degradation of the environment.

It is recommended that the employees receive basic environmental awareness training. In order to ensure proper training, the applicant must develop and implement an Environmental Awareness Plan (EAP). This section provides an overview of what the proposed EAP will contain and how it will be implemented.

a) Development and implementation of the EAP

The following components would form an essential part of an Environmental Awareness Plan (EAP): -

- Development of an environmental policy;
- Identification of environmental impacts/risks and mitigation measures;
- Environmental training, awareness and competence;
- Environmental communication and reporting.

Development of an environmental policy
The applicant would have to compile an Environmental Policy (if they do not have one already), which is a one page statement setting out certain principles in terms of their environmental performance.

The environmental policy should indicate the following:
- The applicant's commitments in terms of the environment;
- Identify environmental impacts as a result of the activities taking place on site;
- Actions to be taken to minimize/mitigate the environmental impacts.
- Signature of management.

In order to ensure effective environmental management, it is important that the Environmental Policy is known and understood by all employees. It should thus be displayed at the offices, workshop and security access.

An Environmental Policy Template is provided to assist the applicant in the compilation of their Environmental Policy. A number of templates are also available on the internet.

Environmental Policy Template (taken from Richmond upon Thames, 2012)

*[*Insert company name here*] believe that we have a responsibility to care for and protect the environment in which we operate. We are fully committed to improving environmental performance across all of our business activities, and will encourage our business partners and members of the wider community to join us in this effort.*

*[*Insert company name here*] recognises our key impacts to be in the areas of [for example]:*

- *energy use*
- *raw material use*
- *waste generation*
- *emissions to air/water*
- *water use*
- *transport*
- *procurement*

We will strive to:

- *Adopt the highest environmental standards in all areas of operation, meeting and exceeding all relevant legislative requirements.*
- *Assess our organisational activities and identify areas where we can minimise impacts.*
- *Minimise waste through careful and efficient use of all materials and energy.*
- *Purchase sustainable products wherever feasible [e.g. recycled, FSC or low environmental impact products and energy from renewable sources].*
- *Train employees in good environmental practice and encourage employee involvement in environmental action.*
- *Reduce risks from environmental, health or safety hazards for employees and others in the vicinity of our operations.*
- *Adopt an environmentally sound transport strategy.*
- *Aim to include environmental and ethical considerations in investment decisions where appropriate.*
- *Assist in developing solutions to environmental problems.*
- *Continually assess the environmental impact of all our operations.*

*[*Insert company name here*] have developed a series of action plans to supplement each of our environmental policy objectives. These can be found* [in an appropriate place*].*

*[*Insert company name here*] will periodically review performance and publish these results [*in an appropriate manner*].*

Signed _____

Identification of environmental impacts / risks and mitigation measures

Environmental impacts/risks in terms of the development are indicated in Section 7 of this document while mitigation measures to be implemented are provided in Section 8.5.

Activities or work procedures that could have a significant impact on the environment have thus been identified and mitigation measures proposed in order to avoid pollution or the degradation of the environment.

This information must be communicated to the employees and thus forms the basis for developing an Environmental Awareness Plan (EAP) in order to ensure effective environmental management.

Environmental training, awareness and competence

The applicant must inform all his employees of their environmental responsibilities in terms of this Environmental Management Plan (EMP). Measures to protect the environment and mitigation measures formulated in this EMP must thus be implemented by the applicant and employees.

Job specific training must be conducted that will be appropriate to the activity and the responsibility of the individual employees. Ad-hoc training will be undertaken as required.

Training is necessary in order to advance the competency of employees in implementing the Environmental Policy and the EMP and to ensure effective overall environmental management.

Through training/awareness, the applicant will make his employees aware of:

- the importance of conformance with the environmental policy and the requirements of the EMP;
- the significant environmental impacts, actual or potential, of their work activities and the environmental benefits of improved personal performance;
- their roles and responsibilities in achieving conformance with the environmental policy and the requirements of the EMP, including emergency preparedness and response requirements; and
- the potential consequences of departure from the specific operating procedures and/or mitigation measures specified in the EMP.

Environmental training and development needs of employees will be identified on a regular basis through:

- Identification of significant environmental impacts;
- Analysis of non-conformance and incident reports;
- Audit reports.

Environmental communication and reporting

Environmental communication and reporting form an integral part of an Environmental Awareness Plan. It is important to maintain effective communication internally and to ensure that external communication (with adjacent landowners) is maintained.

In general, environmental communication and reporting will aim to:

- Ensure that employees understand the environmental policy and objectives;
- Ensure that information is communicated and readily accessible to the relevant parties;
- Improve feedback of operational and environmental performance to management;
- Ensure effective and constructive communication with adjacent landowners;
- Ensure that records are kept of environmental communication and interaction.

The following are some of the topics that should be discussed with new employees:

- Time of commencement and completion of duties;
- Cleaning of workplace and the importance thereof;
- Safety clothing and its importance and correct use;
- Procedure to follow in case of illness and injury;
- Annual leave and when due;
- Importance of instructions;
- Late for work and leaving workplace without permission;
- Emergency procedures;
- Environmental awareness;
- Training and its importance;
- Alcohol and drug abuse;
- Medical fitness;
- Disciplinary procedures.

The following topics should form part of the environmental awareness discussions to be held with the employees:

- Water;
- Fauna and flora;
- Smoking and fires;
- Dust;
- Noise;
- Waste management.

Various signs (including the Environmental Policy) should be displayed on site to remind site workers of the basic environmental principles and inform them of the 'DO'S' and 'DON'TS'.

The applicant must conduct regular inspections to check on site conditions and to provide training when necessary to ensure that the mitigation measures are being implemented and that the environment is carefully looked after.

8.6.2 Site documentation and record keeping

The following documentation must be available (at all times) at the site office:

- A copy of the Basic Assessment Report and Environmental Management Plan;
- A copy of the Environmental Authorisation;
- A copy of site audit reports;
- A copy of any other permits/approvals and/or service agreements from other authorities.

The documents should be kept as hard copies as well as in electronic format.

Complaints Register

A complaints register must be kept at the construction site office. Any complaints received with regards to the construction activities must be recorded in the complaints register. The following information must be recorded:

- Date complaint recorded;
- Nature of complaint;
- Details of complainant (name, address, telephone number, etc.);
- Manner in which complaint was dealt with;

- Date when complaint was reported to the Department of Agriculture, Rural Development, Land and Environmental Affairs and the Department of Water and Sanitation.

Supplementary documentation
The following supplementary documentation should be kept at the site office:
- Site instructions;
- Emergency preparedness and response procedures;
- Incident reports;
- Training records;
- Site inspection, monitoring and auditing reports.

Emergency numbers
Emergency numbers (e.g. Umjindi Local Municipality, police, fire department, ambulance, etc.) must be prominently displayed at the construction site office.

Other legislation
The following should also be displayed at the site office:
- Occupational Health and Safety Act, 1993 (Act 85 of 1993) as amended;
- Basic Conditions of Employment Act, 1997;
- Summary of the Employment Equity Act.

During the course of the development, the applicant and contractor must also comply with all other relevant legislation.

8.6.3 Auditing and corrective action

In order to ensure compliance with the EMP and to assess the continued appropriateness and adequacy thereof, the EMP should be monitored on an ongoing basis in order to determine whether it is being implemented and whether the measures proposed are adequate.

The applicant must appoint an Environmental Control Officer (ECO) who will have the responsibility of monitoring and reporting on compliance with the conditions of the Environmental Authorisation as well as monitoring and reporting on the implementation of the EMP. The ECO must be appointed before the commencement of construction and must remain employed until all rehabilitation measures as well as site clean-up are completed.

If the mitigation measures stated in the EMP are not adequately implemented, the authorities may resort to legal action and/or issue a fine.

The implementation of this EMP will ensure that any potential negative impacts due to the construction and operational activities taking place on site are prevented and/or mitigated.

9. ENVIRONMENTAL IMPACT STATEMENT

9.1 Site location

The Umjindi Local Municipality proposes to upgrade the Rimer's Water Treatment (Purification) Works that supplies Barberton and Umjindi with potable water from 10Ml/d to a total treatment capacity of 15Ml/d.

The Rimer's Water Treatment (Purification) Works is located on the Remaining Extent of Portion 14 of the farm Barberton Townlands 369 JU, within the Barberton Private Nature Reserve, to the southeast of Barberton. An area to the eastern side of the existing fenced works area has been identified for the new infrastructure.

As indicated, the site is located within a Protected Area (i.e. Barberton Private Nature Reserve). This constrains development due to strict land use guidelines associated with Protected Areas, which are to be managed to protect and maintain biodiversity.

According to the guidelines and recommendations contained in the Mpumalanga Biodiversity Sector Plan (MBSP, 2014) and relevant legislation (specifically NEMPAA), infrastructure developments are not compatible with the objectives of a Protected Area (PA) (McCleland and de Castro, 2015).

If a management plan exists for the PA, such a plan may stipulate which are acceptable activities within the PA and the maintenance and upgrade of the water reticulation system may fall within such activities. If such a plan does not exist, then the default approach stipulated by the Mpumalanga Tourism and Parks Agency (MTPA) is to use the land use guidelines for Critical Biodiversity Areas: Irreplaceable as described in Lötter *et al*. (2014), which would not include infrastructure development that causes any loss of biodiversity (McCleland and de Castro, 2015). It is understood that no management plan exists for the Barberton Private Nature Reserve.

Further, McCleland and de Castro (2015) indicated that the site is situated within an area of Very High Biodiversity Value, particularly because of the following:

- It is situated within a listed Threatened Ecosystem according to the 2011 Schedule (Government Gazette of December 2011) of the Biodiversity Act (Act 10 of 2004), namely Barberton Mountainlands (MP13), which is categorised in the Schedule as Vulnerable.
- The site is located within the Barberton Centre of Endemism (Van Wyk & Smith, 2001), which is shared between Mpumalanga and Swaziland; the centre is home to an estimated 1 500 plant species, of which about 80 (5.3%) are endemic to the centre, of which at least 30 species are edaphic specialists adapted to serpentine soils.
- A high proportion of untransformed land units, particularly north-east, east and south-east of Barberton, are considered to be Critical Biodiversity Areas, some of which are classified as Irreplaceable.
- The Barberton Mountainlands to the north-east of the study area, have been proposed as a World Heritage Site, particularly because of the area's immense geological value, which includes the oldest and best preserved sequence of volcanic and sedimentary rocks on earth.

However, the Rimer's Water Treatment Works (WTW) is already present within this Protected Area which is characterised by a Very High Biodiversity Value. This WTW is of high strategic importance, as it is currently the primary source of potable water for the town of Barberton and Umjindi.

McCleland and de Castro (2015) considered the overall Ecological State of the site to be Low because of the previous and current land use activities along the stretch of Rimer's Creek that extends through the site (see Section 9.2).

The main source of water for the Rimer's WTW is the Lomati Dam, constructed in the Lomati River. Water from the Lomati Dam flows through the Saddleback Tunnel and is released into the Rimer's Creek Weir located upstream of the Works. From the diversion weir, water is diverted via a 300mm diameter steel gravity supply pipeline to the Works.

As indicated, existing infrastructure is present that requires upgrading in order to improve the quality and quantity of the water provided to the residents of Barberton and Umjindi. The existing water treatment process does not provide water to the required standard and therefore the water treatment process must be upgraded in order to address the issues of iron, manganese, water stability and zinc. The upgrading of the water treatment process requires that additional infrastructure is constructed.

A site for a new water treatment works was not considered in view of the source of water being the Lomati Dam, the presence of the existing infrastructure transferring the water through the Saddleback Tunnel and the rugged topography of the area making the possibility of a new site for a new water treatment works impossible.

Development to the western side of the existing WTW is not possible as a more or less level area is not available due to the presence of the Rimer's Creek and the rugged topography (steep sloped area).

A combination of sites was thus decided upon in terms of the upgrading of the Rimer's WTW namely:

- construction of some infrastructure within the fenced Rimer's WTW area;
- construction of additional infrastructure to the eastern side of the existing fenced Rimer's WTW.

9.2 Construction of additional infrastructure

9.2.1 Within the fenced Rimer's WTW area

From a geotechnical point of view, Hansmeyer (2015) indicated that the site within the existing fenced WTW is seemingly dry with no seepage, ponding or perched water tables with good drainage to Rimer's Creek.

The existing slow sand filters will be converted to sludge drying beds (i.e. the new sedimentation tanks with sludge handling). The 3 new upflow filters can be found within the slow sand filter (just below the 5 upflow filters) as it has sufficient bearing capacity and negligible settlement (Hansmeyer, 2015).

The new chlorine dosing facility and the new backwash pump station will be located between the toe of the slow sand filter and the chlorine contact tank. Here the site slopes westwards with an even slope of 1:10, requiring a 1.5m

deep cut along the northerly abutment of the slow drain filter, extending 15m towards the chlorine contact tank (Hansmeyer, 2015). Hansmeyer (2015) indicated that the new recycling pump station must be found on an engineered fill.
As indicated the above-mentioned infrastructure, will either be constructed within existing structures or adjacent to existing structures within the fenced WTW area. The fenced area was indicated as a Transformed Area (McCleland and de Castro, 2015) that has no possibility of supporting species of conservation concern and has little or no ecological functional value. This area was assessed as having Very Low biodiversity conservation value.

An artificial wetland was identified in the western portion of the fenced WTW area (Grobler, 2015). It is not regarded as a natural watercourse but as a man-made wetland formed by overflow from an upstream water reservoir. The construction of the new infrastructure is not anticipated to impact on this artificial wetland.

Van Vollenhoven (2015) indicated that no site of cultural heritage significance is located within the fenced WTW area and that the upgrading may proceed. From a palaeontological point of view, Fourie (2015) indicated no objection as the palaeontological sensitivity is Low.

9.2.2 Eastern side of the existing fenced Rimer's WTW

A new aeration facility (2 new clarifiers), a new chemical dosing building (including a cascade) and new access road (with culvert bridge) will be constructed outside of the existing fenced works area, to the eastern side thereof.

This area slopes evenly westward at a gradient of 1:10 with a slightly steeper gradient closer to the existing WTW. Limited area is available in view of the adjacent rugged topography (steep slopes) and the presence of the Rimer's Creek. This area has already been impacted in terms of the construction of a road that was cut out of the mountain side and the spoil levelled onto the creek bed which subsequently became overgrown.

A portion of Rimer's Creek located below the existing weir will be diverted/rerouted into a reinforced concrete lined channel (3.6m depth, 5.0m width, 275m length) that will be provided with a reinforced concrete stilling basin before the water is released back into Rimer's Creek.

From a geotechnical point of view, Hansmeyer (2015) indicated that the site to the eastern side of the existing WTW is also seemingly dry with no seepage, ponding or perched water tables with good drainage to Rimer's Creek.

Hansmeyer (2015) indicated that the proposed clarifiers, new chemical dosing building (including cascade) and rerouted stream should be moved further westwards than originally planned in order to accommodate possible mud and rock slides from the adjacent mountain side. In addition, sections above the cut for the new road must be benched and gabions placed alongside the said cut (Hansmeyer, 2015).

In view of the slope/gradient of the area, Hansmeyer (2015) indicated that the two clarifiers and new chemical dosing building (including cascade) be found on two terraced engineered fills with gabions placed alongside the perimeter thereof.

Hansmeyer (2015) indicated that the reinforced concrete canal (i.e. rerouted stream) should be found on bedrock (present some 2.5m below current surface). In the event of a flood, this would ensure that the stream is located well below the terraces on the eastern bank and also prevent erosion of loosely packed gravelly foundation material.

The stilling basin and new culvert bridge are to be found or be anchored to sound bedrock with bearing capacity in excess of 450KPa with negligible compressibility. In addition, Hansmeyer (2015) indicated that gabions be placed alongside the perimeter of the rerouted concrete lined stream in order to prevent erosion.

It is anticipated that the new access road (with culvert bridge) will be constructed within a Transformed Area (McCleland and de Castro, 2015) that has no possibility of supporting species of conservation concern and has little or no ecological functional value. This area was assessed as having Very Low biodiversity conservation value.

The construction of the new aeration facility (2 clarifiers), chemical dosing building (including cascade) and rerouted stream will impact mostly on Secondary Riparian Scrub that has a low likelihood of providing habitat for flora and fauna species of conservation concern. It has a floristic composition that is heavily dominated by invasive alien species and a compromised functional value. This vegetation unit was assessed as having Low biodiversity conservation value (McCleland and de Castro, 2015).

However, patches of Riparian Forest, a prominent vegetation unit in the riparian zone, will be impacted in terms of the construction of this infrastructure. Although the forest canopy is broken and the forest edges have a fairly high density of invasive alien species, this vegetation unit was found to contain at least two plant species of conservation concern, one Vulnerable species (*Prunus africana* - on the eastern boundary of the site) and one Declining species (*Adenia gummifera* - several hundred metres upstream of the diversion weir). The Riparian Forest is relatively intact structurally and therefore still has high functional value. McCleland and de Castro (2015) therefore allocated this vegetation unit a biodiversity conservation value of High.

McCleland and de Castro (2015) however, considered the overall Ecological State of the site to be Low because of the previous and current land use activities along the stretch of Rimer's Creek that extends through the site.

Rimer's Creek most likely existed as a seasonal stream, or even an ephemeral stream, under natural conditions prior to the inter basin transfer system that is currently in place. The watercourse has been severely transformed by the current WTW compared to its reference condition (Kotze, 2015). Existing WTW impacts include an impoundment in the form of the weir, water abstraction and diversion of flows via the weir and pipeline system, and the encroachment of alien plant species.

McCleland and de Castro (2015) indicated that given the ecologically compromised state of much of the site, a case could be made for the proposed upgrading to be approved with application of mitigation measures.

Grobler (2015) identified no natural wetlands within the site or the surrounding 500m buffer. The proposed upgrading will thus not impact on any wetland systems.

The construction of the aeration facility (2 clarifiers), new chemical dosing building, the new access road and the stream diversion (rerouted stream) would impact on the delineated riparian habitat associated with Rimer's Creek (Grobler, 2015). In spite of the severely modified nature of the identified riparian area, the Ecological Importance and Sensitivity (EIS) of the system is still regarded as High. This is based primarily on remaining patches of the Untransformed Riparian Forest vegetation unit within the site (McCleland and de Castro, 2015).

As indicated the delineated riparian habitat will be canalised (i.e. construction of stream diversion) and therefore a significant loss in habitat diversity and availability can be expected (Kotze, 2015). The habitat integrity of the reach is therefore expected to decrease from D/E (instream) and E (riparian zone) to a category F (critically and irreversibly transformed Present Ecological State (PES)).

Kotze (2015) indicated that due to the limited extent of this reach this further deterioration is not thought to be significant at a catchment level. It does however disrupt the longitudinal connectivity of instream and riparian habitats between upstream and downstream reaches of the site. However, due to the current WTW activities and weir there is already very little connectivity between the upstream and downstream reaches.

According to Kotze (2015), the primary impacts that can be expected on the aquatic ecosystems will be related to altered hydrological regime, habitat deterioration, creation of migration barriers and potential water quality deterioration. Kotze (2015) further indicated that provided that the recommended mitigation measures are effectively applied (particularly in terms of maintaining natural flows downstream of the WTW), the impacts are likely to be of low significance.

Grobler (2015) indicated that the proposed upgrading is considered suitable from a watercourse sensitivity perspective in view of the fact that the riparian habitat is severely modified as indicated above.

Van Vollenhoven (2015) indicated that no site of cultural heritage significance is located within the site to the eastern side of the existing WTW and that the project may proceed. Fourie (2015) indicated no objection from a palaeontological point of view as the palaeontological sensitivity is Low with regards to the development of the site to the eastern side of the existing WTW.

9.3 Operation of upgraded WTW

In essence, the operation of the upgraded WTW will result in:

- increased water abstraction;
- possible reduced flow in certain reaches of Rimer's Creek;
- improved water quality.

9.3.1 Increased water abstraction

Stream flows will be altered by water transfer, impoundment and water abstraction.

The hydrology of the Lomati River will be impacted to some extent due to the increased abstraction of water from the Lomati Dam (i.e. from 10 Ml/d to 15 Ml/d). Kotze (2015) indicated that it will be important to ensure that the ecological reserve flows are met in the Lomati River. A water use licence in terms of the National Water Act, 1998 (Act 36 of 1998) would be required for the increased abstraction from the Lomati Dam.

Kotze (2015) indicated that the hydrology of Reach B in the Rimer's Creek will also be altered due to increased flow, while the rest of the reaches should remain largely unchanged. However, Kotze (2015) indicated that the small increase from the present situation (i.e. 10Ml/d to 15Ml/d) is not expected to impact significantly on the overall hydrology.

As indicated above, an increase in flow (10 to 15 Ml/d) is expected in Reach B which could result in increases in velocities, decreased habitat diversity as well as potential increased scouring and erosion (Kotze, 2015). This impact will be mitigated by utilizing the existing pipeline from the Saddleback Tunnel outlet to the WTW. The existing pipeline will be repaired as part of the upgrading project ensuring that the expensive existing infrastructure (existing pipeline) is utilised.

9.3.2 Possible reduced flow in certain reaches of Rimer's Creek

Reach C will be canalised in order to address storm water and flood impacts on WTW infrastructure resulting in the habitat integrity of this reach decreasing significantly. Kotze (2015) indicated that maintenance of some flow in this reach during the operational phase would at least maintain and possibly improve the current ecological integrity of the area (Kotze, 2015).

McCleland and de Castro (2015) indicated that the total removal of water from the watercourse between the diversion weir to the WTW would have a detrimental effect on the long stretch of riparian forest along the current active channel. The loss of this stretch of forest may result in a significant barrier to upstream and downstream movement by certain forest-dependent fauna species, although this is not certain since the adjacent low forest on steep hillsides has a similar vegetation structure and may facilitate a migration corridor. McCleland and de Castro (2015) recommended that a specific volume of water is allowed to continue flowing from the diversion weir through the active channel. The specific volume should be determined through consultation with the other specialists that have experience with the ecological flow requirements of riparian forest trees.

The flow in Reach D (i.e. downstream of the WTW) may be further decreased if abstraction is increased and the current leaks and spills at the existing WTW are reduced by infrastructure upgrades. This will reduce the amount of water in Reach D. Contributions from tributaries should however maintain a consistent flow regime in this reach. No significant change is therefore expected in terms of flow modification by the proposed activity (Kotze, 2015).

It is however recommended that some flow is released into the Rimer's Creek downstream of the WTW (Reach D) to maintain the ecological integrity of this reach. Albeit short in distance, it plays an important role in maintaining the overall ecological integrity of the area (Kotze, 2015).

As indicated by Kotze (2015), some flow must be released into the downstream reaches (especially during the wet season). This will improve continuity and should have a positive impact on biota associated with the aquatic ecosystem (including birds and mammals).

9.3.3 Improved water quality

The utilisation of the existing pipeline will have a negative impact on the water quality (Afri-infra, 2014). However, this will be addressed as the proposed upgrade will allow for aeration using a hydraulic cascade in order to treat the water to the required standard.

As part of the upgrading, two clarifiers will be provided with a rotating de-sludging bridge which will scrape sludge to the central sludge hopper from where it will be withdrawn by a de-sludging valve. The sludge will be conveyed to the sludge drying beds (refurbished slow sand filters) and will not be released into the Rimer's Creek as is presently the practice.

The aim of reducing/preventing future silt/sludge releases from the WTW as a result of the proposed upgrade can be expected to improve the water quality and possibly substrate condition (reduced sedimentation and embeddedness) in Reach D. An improvement in the habitat and invertebrate assemblage in Reach D could be expected should this be achieved (Kotze, 2015).

9.4 Overall conclusion

As indicated, some infrastructure will be constructed within the fenced Rimer's WTW area while additional infrastructure will be constructed to the eastern side of the existing fenced Rimer's WTW.

In total, an area of 10 500m^2 (i.e. 1.05 ha) would be impacted and construction would take place within an area already transformed as a result of impacts associated with the existing WTW (e.g. an impoundment in the form of the weir, water abstraction and diversion of flows via the weir and pipeline system, the encroachment of alien plant species, etc.).

The upgrading would have a positive impact in that it would:

- Provide the increasing population of Barberton and Umjindi with potable water;
- Improve the quality of water produced by the Rimer's Water Treatment Works;
- Address the identified water quality issues in order to ensure potable water;
- Address water losses in the system (i.e. major water losses have been recorded in the creek between the tunnel outlet and the diversion weir);
- Improve the bulk water supply system from the Lomati Dam and Rimer's Water Treatment Works;
- Improve the operation and maintenance of the Rimer's WTW.

Based on the above-mentioned, the upgrading of the facilities within the existing fenced area as well as the construction of the additional facilities to the eastern side thereof can proceed subject to the implementation of mitigation measures included in the Environmental Management Plan (EMP) provided in Section 8 of this Basic Assessment Report.

In addition, the following conditions should be included in the Environmental Authorisation:

- A water use licence in terms of the National Water Act, 1998 (Act 36 of 1998) is obtained with regards to the upgrading of the Rimer's Water Treatment Works.
- A water use licence in terms of the National Water Act, 1998 (Act 36 of 1998) is obtained with regards to the increased abstraction from the Lomati Dam.
- Flow is released into the Rimer's Creek downstream of the WTW (Reach D) to maintain the ecological integrity of this reach as it plays an important role in maintaining the overall ecological integrity of the area). In determining the ecological flow requirements of this reach, it may be necessary to consult with other specialists that have experience with the ecological flow requirements of riparian forest trees.

10. EVALUATION OF BASIC ASSESSMENT REPORT

10.1 Availability of Basic Assessment Report

The draft Basic Assessment Report (dated: June 2015) will be submitted to the Department of Agriculture, Rural Development, Land and Environmental Affairs for evaluation purposes. A hard copy of the document will also be forwarded to the following authorities for evaluation (30-day period):

- Department of Water and Sanitation;
- Umjindi Local Municipality;
- Mpumalanga Tourism and Parks Agency.

An electronic copy of the draft Basic Assessment Report will be made available during the above-mentioned period to the interested and affected parties and stakeholders consulted and/or registered as part of the Basic Assessment Process (refer to Section 10.2).

An advert will also be placed in the Barberton Times indicating the availability of the Draft Basic Assessment Report for evaluation purposes.

The various departments, stakeholders and interested and affected parties will be requested to forward any comments on the report to the consultant within the 30 day period provided. A register will be kept of all comments received in terms of the evaluation of the report. These comments will then be included and addressed in a final Basic Assessment Report.

The final Basic Assessment Report will once again be made available to interested and affected parties and stakeholders for comment (30-day period), whereafter it will be submitted to the Department of Agriculture, Rural Development, Land and Environmental Affairs for final decision making.

A hard copy of the Draft and Final Basic Assessment Reports will be made available at the Barberton Public Library for evaluation purposes. An electronic version will be made available on the company website (www.cleanstreamsa.co.za) and on cd (on request).

10.2 Informing Interested and Affected Parties

The following interested and affected parties and stakeholders will be notified by means of facsimile, email, etc. of the availability of the reports for evaluation:

INTERESTED AND AFFECTED PARTY LIST	
Organisation	**Name**
Government Departments	
Department of Agriculture, Forestry and Fisheries	F. Mashabela
Department of Agriculture, Rural Development, Land and Environmental Affairs	X. Nkosi
Department of Mineral Resources	M. Mokonyane

INTERESTED AND AFFECTED PARTY LIST	
Organisation	**Name**
Department of Rural Development and Land Reform/Commission on Restitution of Land Rights	N.D. Nkambule; G.N. Mathonsi; T. Mkhabela
Department of Water and Sanitation	J. Jooste
Department of Co-operative Governance and Traditional Affairs (COGTA)	M. Loock
Department of Culture, Sports and Recreation	S. Singh
Department of Agriculture, Rural Development, Land and Environmental Affairs (Natural Resource Investigations)	J. Venter
Other Organisations	
South African Heritage Resources Agency (SAHRA)	J. Lavin (SAHRA website)
Mpumalanga Tourism and Parks Agency (MTPA) – Land Advisory Unit	K. Narasoo
Mpumalanga Tourism and Parks Agency	B. Morris; M. Lotter
Inkomati-Usuthu Catchment Management Agency	F. Celliers
Eskom Transmission	E. Lennox; N. Maake; L. Motsisi
Eskom Mpumalanga Land and Rights	M. Moloko
Local Municipality and Municipal Councillor	
Ehlazeni District Municipality	T. Shabangu (Environmental Manager)
Umjindi Local Municipality	T. Venter
Ward Councillor (Ward 9)	E. Jacobs
Community	
Barberton Museum	A. Bornman (curator)
Barberton Tourism	A. Christianson
Barberton Bird Club	J. Bunning; D. Mourant
Rose's Creek Hiking Trail	A. Botha
Umjindi Environmental Committee	T. Ferrar (chairman); AM Nuns (secretary)
Barberton/Umjindi Ratepayers Association	Andy Nuns (chairman)

10.3 Comments received

This section will be completed after the completion of the above-mentioned evaluation period.

REFERENCES

Afri-Infra. 2014. Upgrading of Rimer's Creek WTW – Concept and Viability Report Rev. 5. Report compiled by: Afri-Infra Group (Pty) Ltd. Report compiled for: Ehlanzeni District Municipality. Report dated: 28 November 2014. Contract no.: EDM/02/2014-15. Project no.: 2014/09.

Fourie, H. 2015. Protocol for Finds on proposed upgrade of Rimer's Creek Water Treatment Works, Umjindi Local Municipality, Ehlanzeni District Municipality, Mpumalanga Province. Farm: Remainder of Portion 14 Barberton Townlands 369 JU. Report compiled by: Dr. H. Fourie. Report compiled for: Clean Stream Environmental Services. Report dated: 24 March 2015.

Grobler, R. 2015. Baseline Watercourse Delineation and Assessment Study for the Proposed Rimer's Creek Water Treatment Works (WTW) Upgrade (Barberton, Mpumalanga). Report compiled by: De Castro and Brits Ecological Consultants. Report compiled for: Clean Stream Environmental Services. Report dated: April 2015.

Hansmeyer, P.G. 2015. Factual report on a geotechnical investigation for the proposed upgrading of Rimer's Creek WTW. Volume 1 and Volume 2 (Figures). Report compiled by: Engeolab cc. Report compiled for: Afri-Infra Group (Pty) Ltd. Report dated: March 2015. Project no.: LL2351.

Kotze, P. 2015. Aquatic biota baseline assessment of the Rimer's Creek in the vicinity of a proposed water treatment works upgrade, Mpumalanga, South Africa. Report compiled by: Clean Stream Biological Services (Pty) Ltd. Report compiled for: Clean Stream Environmental Services. Report dated: February 2015. Report reference: RC/A/15 Version 1.

Lotter, M.C., Lechmere-Oertel, R. & Cadman, M. 2014. Mpumalanga Biodiversity Sector Plan Handbook. Mpumalanga Tourism & Parks Agency, Nelspruit.

McCleland, W and A. de Castro. 2015. Baseline biodiversity survey of the upgrade of the existing Rimer's Creek Water Treatment Works (Barberton, Mpumalanga). Report compiled by: De Castro and Brits Ecological Consultants. Report compiled for: Clean Stream Environmental Services. Report dated: March 2015.

Mpumalanga Biodiversity Sector Plan, 2013. Mpumalanga Parks and Tourism Agency.

Mucina, L. & Rutherford, M. C. (eds). 2006. The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia 19*. South African National Biodiversity Institute, Pretoria.

Van Vollenhoven, A.C. 2015. A report on a heritage impact assessment for the proposed upgrading of the Rimer's Creek WTW, Barberton, Ehlanzeni District Municipality, Mpumalanga Province. Report compiled by: Archaetnos Culture & Cultural Resource Consultants. Report compiled for: Clean Stream Environmental Services. Report dated: February 2015.

APPENDIX 1:

APPLICATION FORM

- Letter from Clean Stream Environmental Services (dated: 22 May 2015; Ref: BA 2015/01) to the Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA) regarding the submission of the application form.
- Letter from DARDLEA (dated: 25 May 2015; Ref: 1/3/1/16/1E-8) acknowledging receipt of the application form.

APPENDIX 2:

CURRICULUM VITAE

- Mrs. A. Erasmus *Pr. Sci. Nat.*
- Ms. R. Janse van Rensburg
- List of projects

APPENDIX 3:

DESIGN REPORT

- Rimer's Water Treatment Works Registration Certificate
- Afri-Infra. 2014. Upgrading of Rimer's Creek WTW – Concept and Viability Report Rev. 5. Report compiled by: Afri-Infra Group (Pty) Ltd. Report compiled for: Ehlanzeni District Municipality. Report dated: 28 November 2014. Contract no.: EDM/02/2014-15. Project no.: 2014/09.

APPENDIX 4:

GEOTECHNICAL STUDY

- Hansmeyer, P.G. 2015. Factual report on a geotechnical investigation for the proposed upgrading of Rimer's Creek WTW. Volume 1 and Volume 2 (Figures). Report compiled by: Engeolab cc. Report compiled for: Afri-Infra Group (Pty) Ltd. Report dated: March 2015. Project no.: LL2351.

APPENDIX 5:

AQUATIC STUDY

- Kotze, P. 2015. Aquatic biota baseline assessment of the Rimer's Creek in the vicinity of a proposed water treatment works upgrade, Mpumalanga, South Africa. Report compiled by: Clean Stream Biological Services (Pty) Ltd. Report compiled for: Clean Stream Environmental Services. Report dated: February 2015. Report reference: RC/A/15 Version 1.

APPENDIX 6:

BIODIVERSITY STUDY

- McCleland, W and A. de Castro. 2015. Baseline biodiversity survey of the upgrade of the existing Rimer's Creek Water Treatment Works (Barberton, Mpumalanga). Report compiled by: De Castro and Brits Ecological Consultants. Report compiled for: Clean Stream Environmental Services. Report dated: March 2015.

APPENDIX 7:

WETLAND STUDY

- Grobler, R. 2015. Baseline Watercourse Delineation and Assessment Study for the Proposed Rimer's Creek Water Treatment Works (WTW) Upgrade (Barberton, Mpumalanga). Report compiled by: De Castro and Brits Ecological Consultants. Report compiled for: Clean Stream Environmental Services. Report dated: April 2015.

APPENDIX 8:

ADVERTISING OF THE PROJECT

- A copy of the advertisement published in the Lowvelder, 27 February 2015.
- A copy of the on-site notice.
- Printout of company website page www.cleanstreamsa.co.za – New Projects – Notices.
- Printout of company website page www.cleanstreamsa.co.za – New Projects – Background Information Documents.

APPENDIX 9:

BACKGROUND INFORMATION DOCUMENT

APPENDIX 10:

CORRESPONDENCE WITH THE AUTHORITIES AND INTERESTED AND AFFECTED PARTIES

- Email from CSES (dated: 5 March 2015) to:

CONTACT PERSON	AUTHORITY/I&AP
A. Bornman (curator)	Barberton Museum
A. Botha	Rose's Creek Hiking Trail
J. Bunning; D. Mourant	Barberton Bird Club
A. Christianson	Barberton Tourism
F. Celliers	Inkomati-Usuthu Catchment Management Agency
E. Jacobs	Ward Councillor (Ward 9)
J. Jooste	Department of Water and Sanitation (DWS)
E. Lennox; N. Maake; L. Motsisi	Eskom Transmission
M. Loock	Department of Co-operative Governance and Traditional Affairs (COGTA)
M. Mokonyane	Department of Mineral Resources (DMR)
M. Moloko	Eskom Mpumalanga Land and Rights
K. Narasoo	Mpumalanga Tourism and Parks Agency (MTPA) – Land Advisory Unit
T. Shabangu (Environmental Manager)	Ehlazeni District Municipality
S. Singh	Department of Culture, Sports and Recreation
J. Venter	Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA)
T. Venter	Umjindi Local Municipality

- Email from CSES (dated: 5 March 2015) to F. Mashabela (Department of Agriculture, Forestry and Fisheries (DAFF)).
- Email from Komilla Narasoo (MTPA) acknowledging receipt of BID.
- Email from E. Lennox (Eskom Transmission) (dated: 5 March 2015) to CSES.
- Email from CSES (dated: 5 March 2015) to B. Morris and M. Lotter (MTPA).
- Email from M. Lotter (MTPA) providing the official proclamation regarding the Barberton Private Nature Reserve.
- Email from M. Lotter (dated: 9 March 2015) regarding status of Barberton Nature Reserve.
- Print out from SAHRIS website (dated: 3 March 2015).
- Email from CSES (dated: 5 March 2015) to Department of Rural Development and Land Reform (ND Nkambule; GN Mathonsi; T. Mkhabela) regarding land claims.
- Email from Thabile Mkhabela (Department of Rural Development and Land Reform (dated: 5 March 2015).
- Email from AM Nuns (dated: 8 March 2015) to CSES.
- Email from CSES to AM Nuns (dated: 5 March 2015).
- Email from AM Nuns (dated: 5 March 2015) to CSES.
- Email from CSES (dated: 9 March 2015) to AM Nuns; Tony Ferrar; Elsabe Jacobs and Andy Nuns.

APPENDIX 11:

BARBERTON PRIVATE NATURE RESERVE PROCLAMATION

- The Province of Transvaal Official Gazette Extraordinary Volume 192, No. 3124. Dated: 27 January 1965

APPENDIX 12:

HERITAGE AND PALAEONTOLOGICAL STUDIES

- Van Vollenhoven, A.C. 2015. A report on a heritage impact assessment for the proposed upgrading of the Rimer's Creek WTW, Barberton, Ehlanzeni District Municipality, Mpumalanga Province. Report compiled by: Archaetnos Culture & Cultural Resource Consultants. Report compiled for: Clean Stream Environmental Services. Report dated: February 2015.
- Fourie, H. 2015. Protocol for Finds on proposed upgrade of Rimer's Creek Water Treatment Works, Umjindi Local Municipality, Ehlanzeni District Municipality, Mpumalanga Province. Farm: Remainder of Portion 14 Barberton Townlands 369 JU. Report compiled by: Dr. H. Fourie. Report compiled for: Clean Stream Environmental Services. Report dated: 24 March 2015.