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Environmental Impact Assessment for the Proposed Surface Water Developments for Augmentation of the Western Cape Water Supply System

ENVIRONMENTAL MANAGEMENT PROGRAMME



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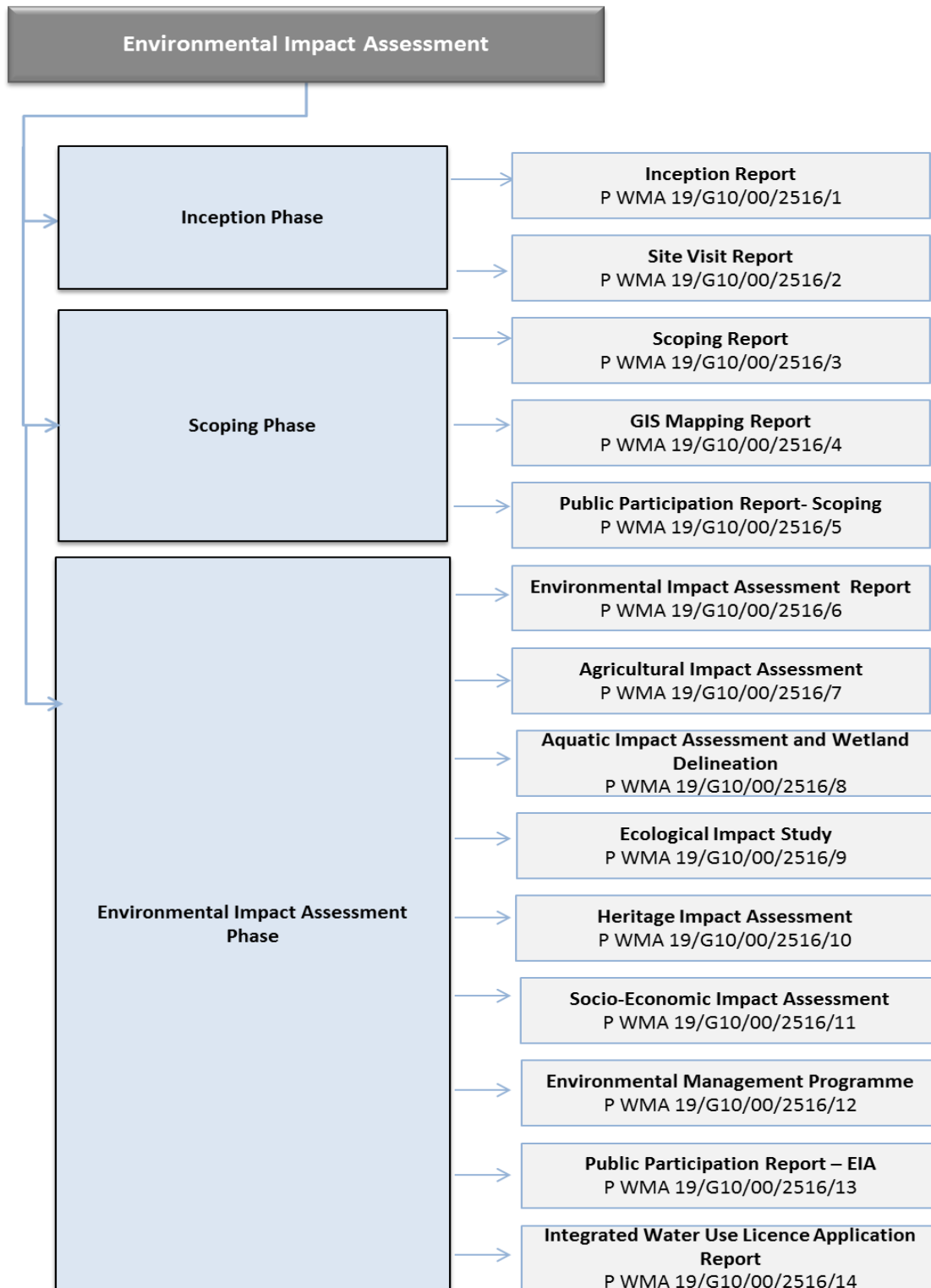
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List of Study Reports



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List of Abbreviations

AGIS	Agricultural Geographic Information System
BBTS	Breede-Berg Transfer Scheme
BID	Background Information Document
BPEO	Best Practicable Environmental Option
BRVAS	Berg River – Voëlvlei Augmentation Scheme
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Areas
CCT	City of Cape Town
CCTMM	City of Cape Town Metropolitan Municipality
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
CFR	Cape Floristic Region
CPS	Cape Piscatorial Society
CR	Critically Endangered
DEA	Department of Environmental Affairs
DEAT	(Department of Environmental Affairs and Tourism
DAFF	Department of Forestry and Fisheries
DMR	Department of Mineral Resources
DWA	Department of Water and Sanitation
DWAF	Department of Water and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EBA	Endemic Bird Area
ECO	Environmental Control Officer
EDC	Endocrine Disrupting Compounds
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMPr	Environmental Management Programme
EN	Endangered
ESA	Ecological Support Areas
ESAge	Early Stone Age
EWR	Environmental Water Requirements
FAI	Fish Assemblage Integrity Index
GDP	Gross Domestic Product
GI	Geomorphical Index

GIS	Geographic Information System
GN	Government Notice
GRP	Glass-Fibre Reinforced Polyester
HIA	Heritage Impact Assessment
IAPs	Interested and Affected Parties
IBA	Important Bird and Biodiversity Areas
IMI	Index of Habitat Integrity
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resource Management
MRPDA	Mineral Resources and Petroleum Development Act (No 28 of 2002)
NEMA	National Environmental Management Act (No 107 of 1998)
NEM:BA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NEM:PA	National Environmental Management: Protected Areas Act (Act No. 57 of 2003)
NEM:WA	National Environmental Management Waste Act (Act No. 56 of 2008)
NFEPA	National Freshwater Ecosystem Priority Areas
NT	Near Threatened
NWA	National Water Act (No 36 of 1998)
NWRP	National Water Resources Planning
OHS	Occupational Health and Safety
PES	Present Ecological Status
PIP	Public Involvement Process
POP	Persistent Organic Pollutants
PRESIS	Pretoria Computerised Information System
PSC	Project Steering Committee
PSP	Professional Service Provider
QDS	Quarter Degree Squares
RID	Record of Implementation Decision
RMP	Resource Management Plan
RVI	Riparian Vegetation Index
SABAP	Southern African Bird Atlas Project
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SASS	South African Scoring System
SAWS	South African Weather Services
SDF	Spatial Development Framework
SIP	Strategic Infrastructure Project
TAC	Tulbagh Angling Club
ToR	Terms of Reference

VU	Vulnerable
VYC	Vogelvlei Yacht Club
WAC	Witzenberg Angling Club
WCAD	Western Cape Adventure
WC DEA&DP	Western Cape Department of Environmental Affairs and Development Planning
WCDM	West Coast District Municipality
WCH	Western Cape Heritage
WCRSS	Western Cape Reconciliation Strategy Study
WCWC-JV	Western Cape Water Consultants Joint Venture
WCWSS	Western Cape Water Supply System
WIP	Weeds and Invasive Plants
WMA	Water Management Area
WPALAS	Western Province Artificial Lure Angling Society
WPFAA	Western Province Freshwater Angler's Association
WTW	Water Treatment Works
WULA	Water Use Licence Application
WWTW	Waste Water Treatment Works

1 PURPOSE OF THIS DOCUMENT

Nemai Consulting was appointed by the Department of Water and Sanitation (DWS) as the Independent Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment (EIA) for the proposed surface water developments for augmentation of the Western Cape Water Supply System (WCWSS), which is also known as the First Phase Augmentation of Voëlvlei Dam.

The proposed project consists of the following:

- A low level weir, abstraction works and 4 m³/s raw water pump station on the Berg River;
- A rising main pipeline from the Berg River to Voëlvlei Dam;
- A potential new summer release connection at the existing Swartland Water Treatment Works (WTW) to facilitate summer releases into the Berg River for environmental requirements thus eliminating the need to utilize the existing canal from which water losses occur.

All the infrastructure and activities that require environmental authorisation need to be assessed as part of the EIA. In this regard, the following main components have been identified:

- Abstraction works;
- Rising main pipeline and pump station;
- Diversion weir;
- Access roads during construction;
- Access roads during operation; and
- Construction camp (footprint).

This document serves as the Environmental Management Programme (EMPr) for the pre-construction, construction and operational phase, as contemplated in Regulation 23 of Government Notice (GN) No. R. 982 (04 December 2014), for the proposed. It was developed in support of the EIA for the project.

2 DOCUMENT ROADMAP

As a minimum, the EMPr aims to satisfy the requirements stipulated in Appendix 4 of GN No. R. 982 (04 December 2014). **Table 1** presents the document's composition in terms of the aforementioned regulatory requirements.

Table 1: Document Roadmap

Chapter	Title	Correlation with G.N. No. R982	
1	Purpose of the Document	-	
2	Document Roadmap	-	
3	Project Background and Motivation	-	
4	Project Location and Catchment Context	-	
5	Project Description	-	
6	Alternatives	-	
7	Environmental Assessment Practitioners	1(a)	Details of – (i) the EAP who prepared the EMPr; and (ii) the expertise of that EAP to prepare an EMPr, including curriculum vitae.
8	Legislation and Guidelines Considered	-	
9	Roles & Responsibilities	1(i)	An indication of the persons who will be responsible for the implementation of the impact management actions contemplated in paragraph (f).
10	Monitoring	1(g)	The method of monitoring the implementation of the impact management actions contemplated in paragraph (f).
		1(h)	The frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f).
		1(k)	The mechanism for monitoring compliance with the impact management actions contemplated in

Chapter	Title	Correlation with G.N. No. R982	
			paragraph (f).
		1(l)	A programme for reporting on compliance, taking into account the requirements as prescribed by the Regulations.
11	Environmental Training & Awareness Creation	1(m)	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.
12	Environmental Activities, Aspects and Impacts	1(b)	A detailed description of the aspects of the activity that are covered by the final environmental management plan.
13	Sensitive Environmental Features	1 (c)	A map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers.
14	Impact Management	1(d)	Information on any proposed management or mitigation measures that will be taken to address the environmental impacts that have been identified in a report contemplated by the EIA Regulations, including environmental impacts or objectives in respect of – (i) planning and design; (ii) pre-construction activities; (iii) construction activities; (iv) rehabilitation of the environment after construction and where applicable post closure; and (v) where relevant, operation activities.
		1(e)	A description and identification of impact management outcomes required for the aspects contemplated in paragraph (d).
		1(f)	A description of proposed impact management sections, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (d) and (e) will be achieved, and must, where applicable, include actions to -

Chapter	Title	Correlation with G.N. No. R982	
			(i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; (ii) comply with any prescribed environmental management standards or practices; (iii) comply with any applicable provisions of the Act regarding closure, where applicable; and (iv) comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable.
		1(j)	The time periods within which the impact management actions contemplated in paragraph (f) must be implemented.
		1(l)	A programme for reporting on compliance, taking into account the requirements as prescribed by the Regulations.
	N/A	1(n)	Any specific information that may be required by the competent authority

3 PROJECT BACKGROUND AND MOTIVATION

3.1 The Western Cape Water Supply System

The WCWSS serves the City of Cape Town (CCT), surrounding urban centres and irrigators. It consists of infrastructure components owned and operated by both the CCT and the DWS (Department of Water Affairs, 2012). In 2007, the WCRSS was commissioned by DWS (then the Department of Water Affairs and Forestry – DWAF) to facilitate the reconciliation of predicted future water requirement scenarios for a 25 year planning horizon. The WCRSS investigated a number of options such as desalination, effluent treatment for re-use, groundwater development and possible surface water augmentation options (DWAF, 2007).

According to the WCRSS undertaken in 2007, the WCWSS's total present water use was estimated at about 465 million m³/a with the existing sources yielding only about 475 million m³/a (DWAF, 2007). The study also noted that whilst the Berg Water Project (Berg River Dam and its supplement scheme) would increase the yield to 582 million m³/a from 2007, the estimated water requirement (even with water conservation and demand management) by 2019 could exceed this. The implication is that the system supply would then be fully

utilised and thus additional interventions would thus be required to come online by that time (Figure 1) (DWAf, 2007).

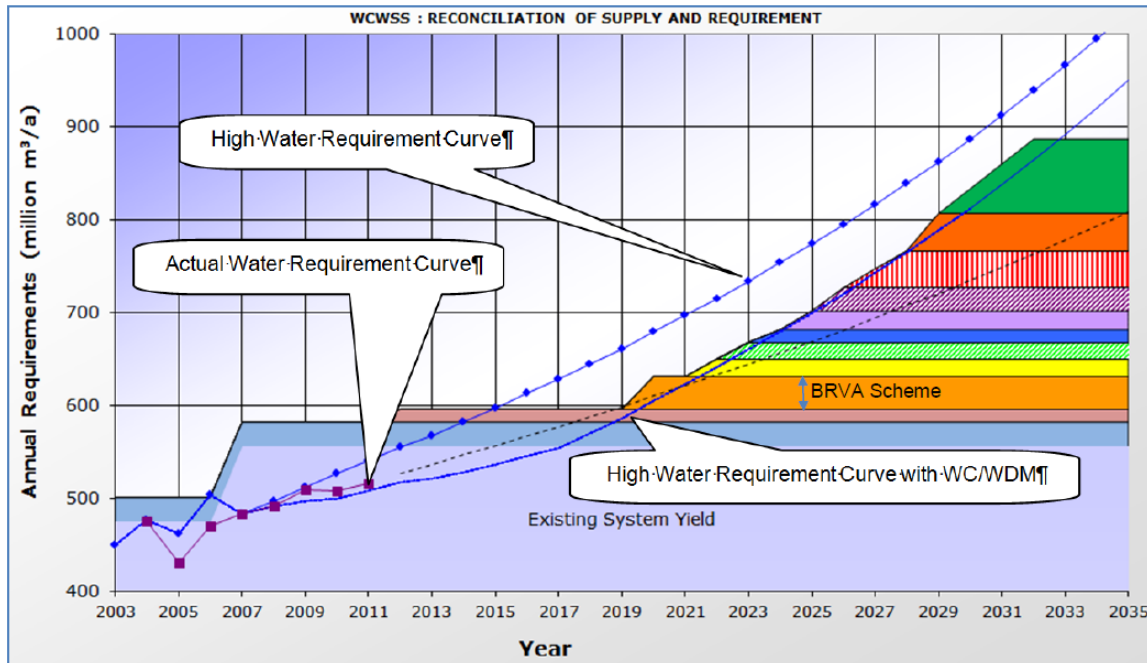


Figure 1: WCWSS Reconciliation of Supply and Requirements (DWA, 2012a)

Based on the figure above, the WCRSS has therefore identified the need for augmentation of the WCWSS by 2019. Based on this, the DWS appointed the Western Cape Water Consultants Joint Venture (WCWC JV) to undertake pre-feasibility level (Phase 1) investigations into six potential surface water development options. These options included the following:

- Michell’s Pass Diversion Scheme;
- First Phase Augmentation of Voëlvlei Dam;
- Further Phases of Voëlvlei Dam Augmentation;
- Molenaars River Diversion;
- Upper Wit River Diversion; and
- Further Phases of the Palmiet Transfer Scheme.

The location of the six possible options is shown in **Figure 2** below.

Both DWS and the CCT are currently also undertaking further feasibility studies into alternative sources, such as sea water desalination, groundwater abstraction from the Table Mountain Group Aquifer, and water reclamation. These further studies are being implemented in order to timeously identify the next most feasible option for further augmentation of the system in the future.

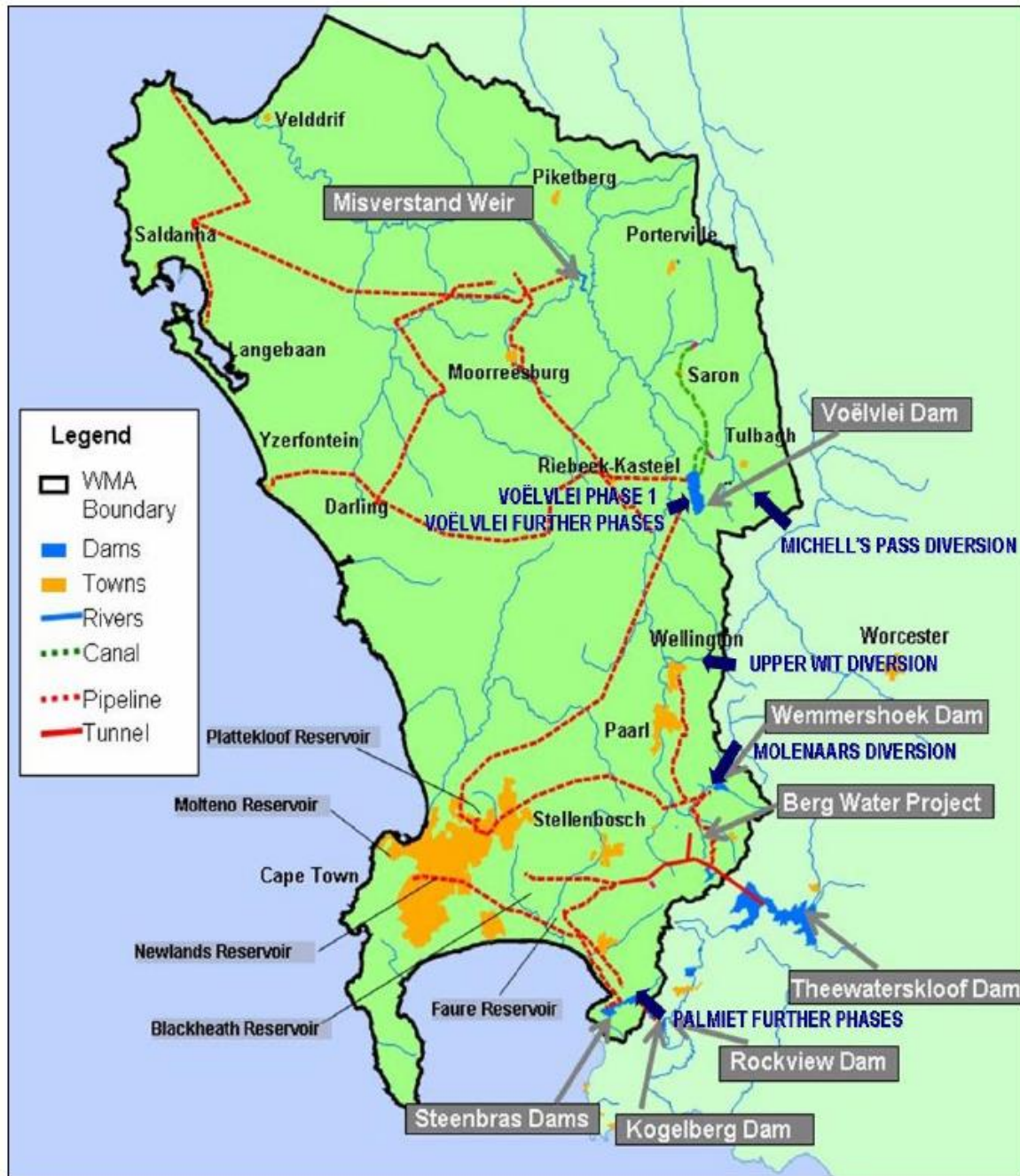


Figure 2: The WCSS and the Location of the Options Investigated (DWA, 2010)

Based on the findings of the pre-feasibility study, the six possible options investigated were then prioritized to identify the two most viable options for further investigation at a Feasibility Study level in Phase 2. The Phase 1 outcome indicated the following two priority schemes.

- Berg River-Voëlvlei Augmentation Scheme (BRVAS) (also known as the First Phase Augmentation of Voëlvlei Dam); and
- Breede-Berg Transfer Scheme (BBTS) (also known as the Michell's Pass Diversion Scheme).

Both of these schemes would be based on the overall operating rule that only surplus winter water would be abstracted and only such amounts after provision is made for the downstream ecological flow requirements. No abstraction will take place outside of those periods.

The Feasibility Study recommended that the BRVAS option was the most favourable of the size potential schemes for a number of reasons which include the following:

- The proposed abstraction site from the Berg River at Lorelei Farm has favourable geology and sedimentation control characteristics. It would also provide the shortest possible pipeline route to convey the abstracted water in winter into the Voëlvlei Dam, where it would be stored;
- The proposed pipeline route offers opportunity to limit environmental impacts on the Voëlvlei Conservancy;
- The proposed rising main from the Berg River to Voëlvlei Dam could also serve as a closed conduit for making releases from the dam in summer, back into the Berg River. These releases are required for providing water to downstream users including irrigators and parts of the West Coast District Municipality. This could replace the existing open discharge concrete canal which currently serves to make those releases, but which experiences substantial losses;
- The water quality impacts of transferring winter water from the Berg River into the Voëlvlei Dam have been investigated and are not considered to be a limitation on the implementation of the scheme;
- Planning by the CCT's Bulk Water Department for future reservoirs and link pipelines to the existing CCT pipeline (feeding the Platteklouf Reservoir) would facilitate improved integration of this scheme into the WCWSS;
- The estimated capital cost of BRVAS scheme is relatively attractive; and
- The potential delivery of water by the BRVAS scheme could be possible by 2019, which is when the next water supply scheme to augment the WCWSS would be required.

3.2 Existing Voëlvlei Government Water Scheme

Voëlvlei Dam was commissioned in 1952 and was the first large water supply scheme in the Berg River Catchment. It was constructed by impounding the natural Vogelvlei Lake near Gouda in the Drakenstein Local Municipality (DWAF 2004). The natural catchment of the Dam is very small (only 31 km²) and additional water was obtained via a concrete lined canal feeding water from the Klein Berg River to the dam (max 1.3 million cubic metres per day; DWAF 2004). In 1969, Cape Town's increasing water demand resulted in the dam wall being raised. Additional water was then abstracted from the Klein Berg River (max. 1.7 million

cubic metres per day). In addition, a new canal was constructed to divert water from the Twenty Four River and Leeu River (max. 2.9 million cubic metres per day) into the dam.

The main purpose of the dam is to supply water for domestic use to the West Coast District Municipality (WCDM) including Riebeeck-Kasteel, Riebeeck-Wes, Malmesbury, Darling, Moorreesburg and the CCT Metropolitan Municipality. The dam also supplies water for irrigation purposes along the Lower Berg River.

Voëlvlei Dam is owned by DWS and has an estimated yield of 105 million m³/annum which supplies the City of Cape Town, the Lower Berg River irrigators and the WCDM. Therefore, the dam is currently over-allocated. It has a very small incremented catchment over and above the transfers (31km²) and thus relies on existing diversion schemes from the Klein Berg River, as well as the Leeu River and the Twenty Four River whereby water from these rivers is diverted into two canal systems into the dam (DWA, 2012b). The Klein Berg canal is 8 km long and has a capacity of 20 m³/s whilst the canal from the Leeu River and Twenty Four River is 29 km long with a capacity of 34 m³/s (DWA, 2012a).

Both the WCDM and the CCT own and operate Water Treatment Works (WTW) which are supplied from the Voëlvlei Dam. From the CCT WTW, a 1.5 m diameter pipeline of 80 km length conveys treated water that is pumped from the WTW to the City's Plattekloof Reservoir. This pipeline only has spare capacity in winter and this places a key constraint on the future uptake of water from the proposed scheme.

In addition, treated water is supplied to users in the WCDM (Malmesbury to St Helena Bay) via the Swartland WTWs (owned and operated by the WCDM) at the Voëlvlei Dam. Water is also released from the Voëlvlei Dam via the existing outlet canal into the Berg River from whence abstraction takes place at Misverstand Dam into the Withoogte WTW (also owned and operated by the WCDM) (DWA, 2012a).

As the dam is located within a winter rainfall area, characterised by wet winters and dry summers, it is filled during the wet winter months, from May to October, when about 90% of the annual runoff occurs. During this period the water requirement comprises only about 30% of the annual requirement. During the dry summer months, from November to April, inflows to the dam in the Western Cape are small and irrigation and garden watering requirements in the urban areas are large. Approximately 50% of the dams' storage is required for storage during the winter so that the high water requirement during the summer can be met. The remaining 50% of the dams' storage is required to provide long-term carry-over storage for periods of drought (DWA, 2012a).

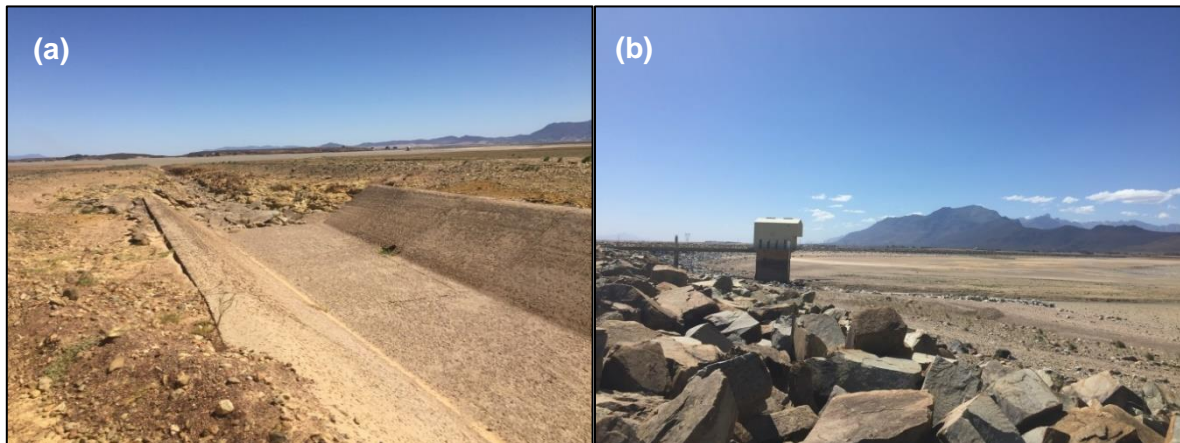


Figure 3: Canal feeding Voëlvlei Dam (a) and a dry Intake tower at Voëlvlei Dam (during the summer of 2016 (b))

4 PROJECT LOCATION AND CATCHMENT CONTEXT

The project area is situated in Western Cape in the Drakenstein Local Municipality of the Cape Winelands District Municipality as well as the Swartland Local Municipality of the West Coast District Municipality (**Figures 6 and 7**). A locality map is provided in **Figure 4**. Please note larger maps are provided in **Appendix D**.

The proposed development falls within the Berg River Catchment of the Berg–Olifants Water Management Area (WMA). The Berg River Catchment covers an area of almost 9 000 km² in the Western Cape Province, and is subdivided into 12 quaternary catchments ranging in size from 125 km² near the headwaters to 2000 km² in the drier western parts of the catchment (**Figure 5**) (C.A.P.E., 2008). Both Voëlvlei Dam and the proposed Berg River abstraction site are located in quaternary catchment, G10F of the Berg River Catchment.

The Berg River Catchment receives most precipitation during the winter rainfall season, with the east of the catchment receiving relatively high volumes of rain (ca. 5 000 mm per annum) in contrast to the lower-lying foothills and floodplains to the west receiving only 400 – 500 mm per annum, decreasing towards the sea. The river headwaters (perennial and semi-perennial mountain streams that rise in the Franschhoek and Drakenstein Mountains) therefore supply most of the water to the system. Mean annual runoff for the entire catchment is approximately 682 Mm³ (C.A.P.E., 2008).

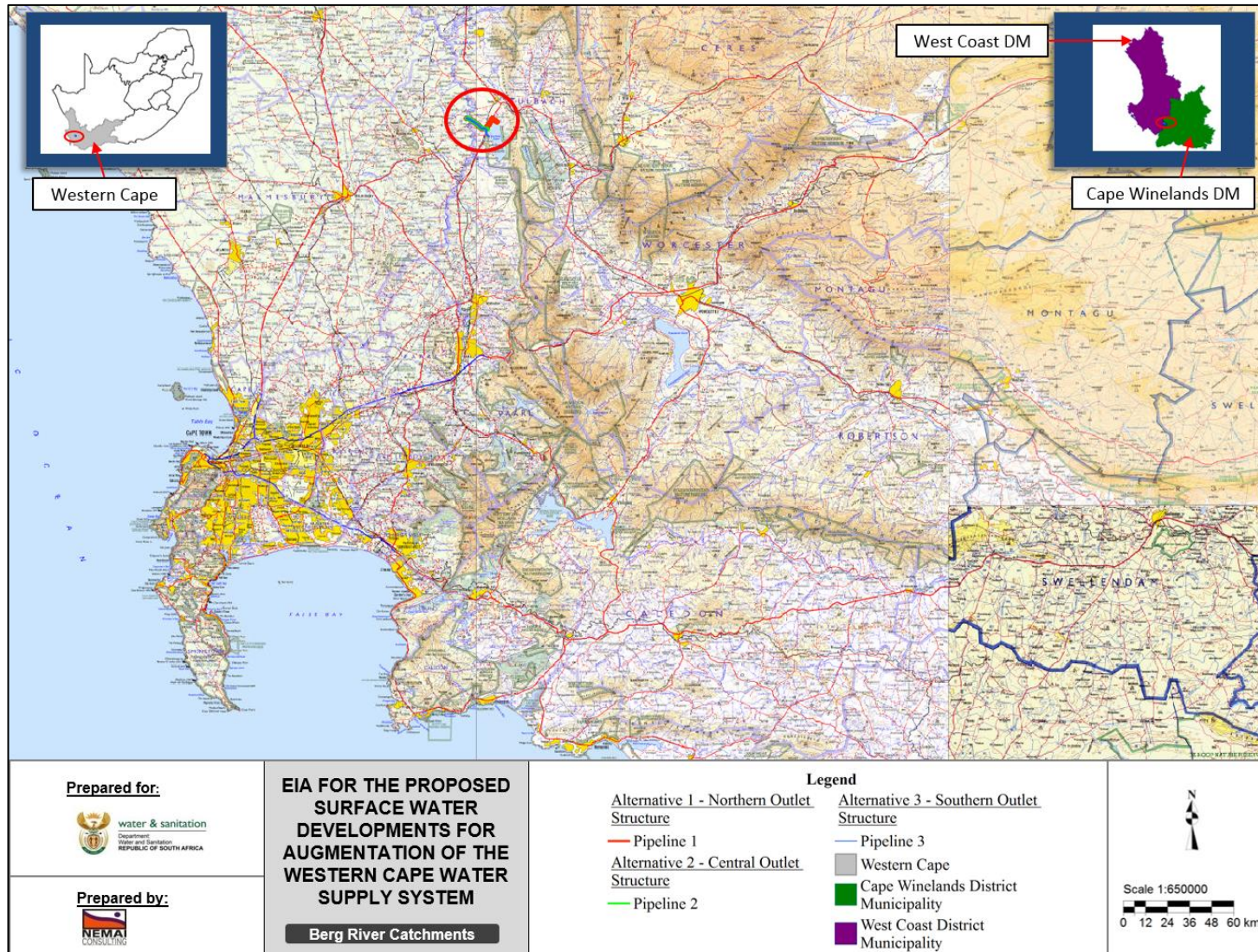


Figure 4: Locality Map

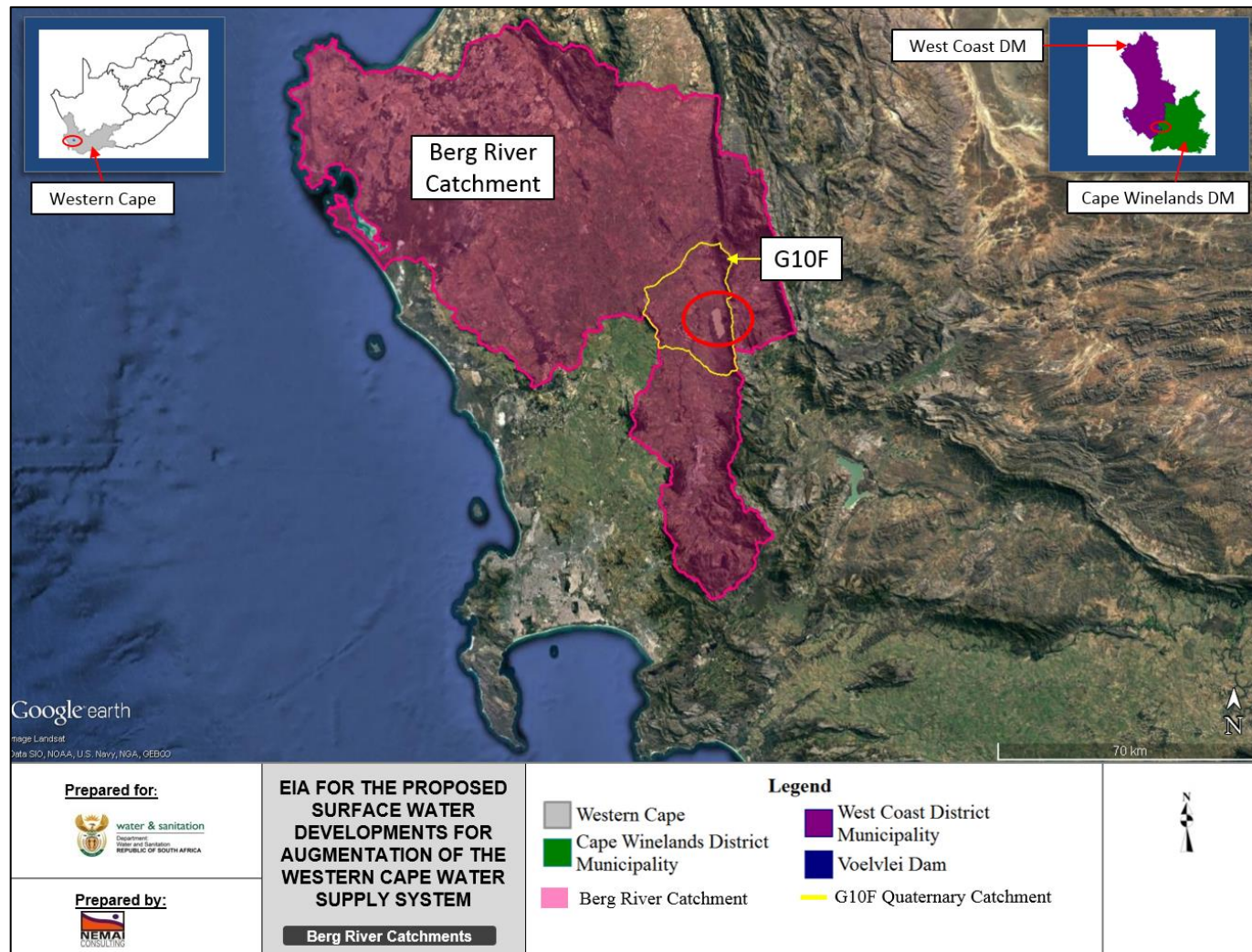


Figure 5: Berg WMA and Berg River Catchment

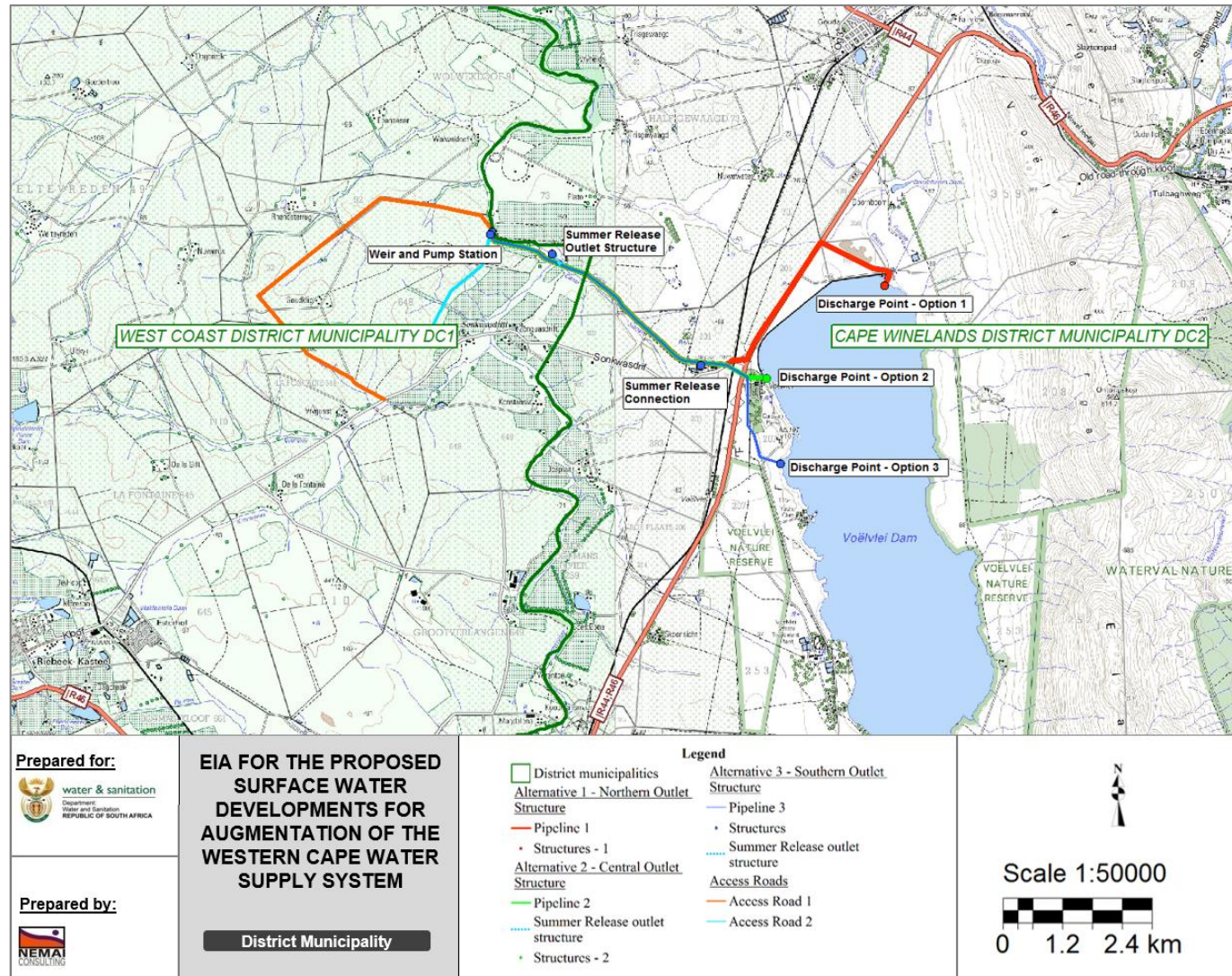


Figure 6: District Municipality Map

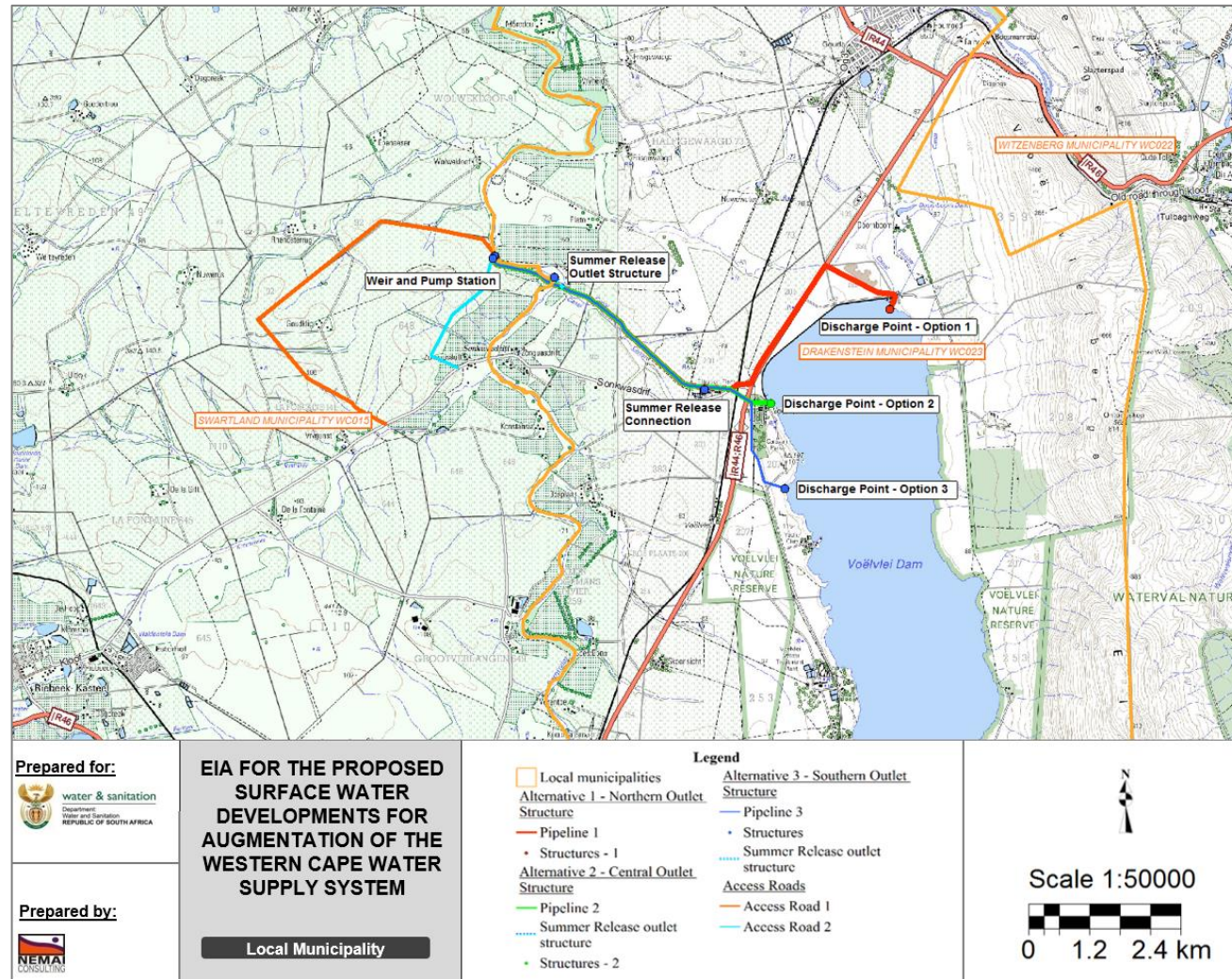


Figure 7: Local Municipalities Map

The closest town to the proposed scheme is Gouda and it is located approximately 5km away from the proposed developments. The project developments are mostly located on privately-owned properties that are primarily used for agricultural practices, except for one property located north of the proposed pipeline which is owned by the Drakenstein Local Municipality. The properties that are directly affected by the proposed development are shown in **Figure 6** and listed in **Table 3**.

Table 2: Directly affected properties

Project Component	Farm Name	Portion	SG Code
Pipeline and associated Discharge Points	Half Gewaagd 73	21	C0750000000007300021
	Sonquas Doordrift 647	2	C04600000000064700002
	Tulburgh Road 441	0	C07500000000044100000
	Tulburgh Road 412	0	C07500000000041200000
	Tulburgh Road 412	0	C07500000000041200000
	Farm 201	2	C07500000000020100002
	Doorn Boom 199	1	C07500000000019900001
	Farm 200	0	C07500000000020000000
	Vogel Valley 207	0	C07500000000020700000
	Sonquas Doordrift 648	1	C04600000000064800001
	Zonquasdrif 1129	3	C04600000000112900003
	Half Gewaagd 73	25	C0750000000007300025
	Farm 392	0	C07500000000039200000
	Farm 201	1	C07500000000020100001
Pump Station	Sonquas Doordrift 648	1	C04600000000064800001
Weir	Sonquas Doordrift 648	1	C04600000000064800001
Access Roads	Sonquas Doordrift 648	1	C04600000000064800001
	Sonquas Doordrift 648	2	C04600000000064800002
	Zonquasdrift 1129	5	C04600000000112900005
	Zonquasdrift 1129	0	C04600000000112900000
	Zonquasdrift 1129	6	C04600000000112900006
	Farm 441 Tulburgh Road	-	C07500000000044100000
	Farm 392	0	C07500000000039200000

Project Component	Farm Name	Portion	SG Code
	Farm 422	0	C07500000000042200000
	Farm 92	2	C07500000000009200002
Construction Camps	Vogel Valley 207	0	C07500000000020700000
	Sonquas Doordrift 648	1	C04600000000064800001

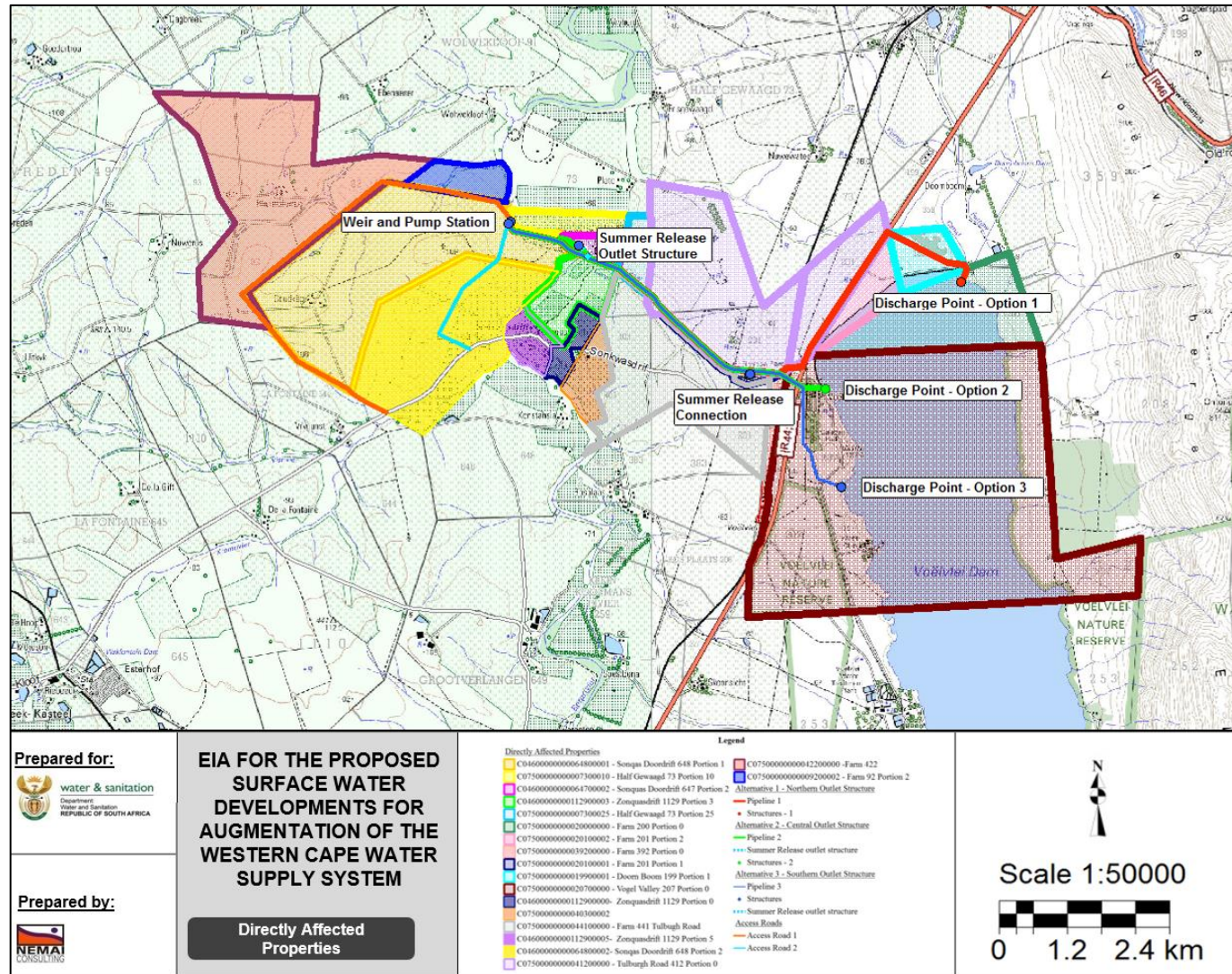


Figure 8: Directly affected properties

5 PROJECT DESCRIPTION

The following Pre-Feasibility and Technical Feasibility Study reports compiled by the WCWC-JV in 2012 informed the project design for the augmentation of the Voëlvlei Dam:

- **Report Number 1: Ecological Water Requirements. Volume 1 – Riverine Environmental Water Requirements**
 - Appendix 3: EWR data for the Berg River
- **Report Number 1: Ecological Water Requirements. Volume 3 - Berg Estuary Environmental Water Requirements**
 - Appendix C: Specialist Report – Physical dynamics and water quality
 - Appendix D: Specialist Report – Modelling
 - Appendix E: Specialist Report – Microalgae
 - Appendix F: Specialist Report – Invertebrates
 - Appendix G: Specialist Report – Fish
 - Appendix H: Specialist Report – Birds
 - Appendix I: Specialist Report – The economic value of the Berg River Estuary
- **Report Number 2: Preliminary Assessment of Options**
 - Appendix 1: Scheme Yield Assessments and Diversion Functions
 - Appendix 2: Unit Reference Value Calculation Sheets
 - Appendix 3: Yield Analysis and Dam Size Optimization
 - Appendix 4: Dam Design Inputs
 - Appendix 5: Diversion Weir Layout Drawings
 - Appendix 6: Voëlvlei Dam Water Quality Assessment
 - Appendix 7: Botanical Considerations
 - Appendix 8: Heritage Considerations
 - Appendix 9: Agricultural Economic Considerations
- **Report Number 3: Feasibility Studies. Volume 1 - Berg River - Voëlvlei Augmentation Scheme**
 - Appendix 1: Updating of the Western Cape Water Supply System Analysis for the Berg River-Voëlvlei Augmentation Scheme
 - Appendix 2: Configuration, Calibration and Application of the CEQUAL-W2 model to Voëlvlei Dam for the Berg River-Voëlvlei Augmentation Scheme

- Appendix 3: Monitoring Water Quality During Flood Events in the Middle Berg River (Winter 2011), for the Berg River-Voëlvlei Augmentation Scheme
- Appendix 4: Dispersion Modelling in Voëlvlei Dam from Berg River Water Transfers for the Berg River-Voëlvlei Augmentation Scheme
- Appendix 5: Scheme Operation and Yield Analyses with Ecological Flow Requirements for the Breede-Berg (Michell's Pass) Water Transfer Scheme
- Appendix 7: Ecological Water Requirements Assessment Summary for the Berg River-Voëlvlei Augmentation Scheme, and the Breede Berg (Michell's Pass) Water Transfer Scheme
- Appendix 8: Geotechnical Investigations for the Berg River-Voëlvlei Augmentation Scheme, and the Breede-Berg (Michell's Pass) Water Transfer Scheme
- Appendix 10: Conveyance Infrastructure Design Report, for the Berg River-Voëlvlei Augmentation Scheme, and the Breede-Berg (Michell's Pass) Water Transfer Scheme
- Appendix 11: Diversion Weirs Design for the Berg River-Voëlvlei Augmentation Scheme, and the Breede-Berg (Michell's Pass) Water Transfer Scheme

5.1 Project Components

The project components are illustrated in **Figure 8** below and include the following:

- A low level weir, abstraction works and 4 m³/s raw water pump station on the Berg River;
- A rising main pipeline from the Berg River to Voëlvlei Dam; and
- A potential new summer release connection at the existing Swartland WTW to facilitate summer releases into the Berg River for environmental requirements thus eliminating the need to utilize the existing canal from which water losses occur.

All the infrastructure and activities that require environmental authorisation need to be assessed as part of the EIA. In this regard, the following associated infrastructure was identified:

- Abstraction works;
- Rising main pipeline and pump station;
- Diversion weir;
- Access roads during construction;
- Access roads during operation;
- Powerlines for construction and operation; and
- Construction camp (footprint).

The major components of the project are discussed in the sub-sections to follow.

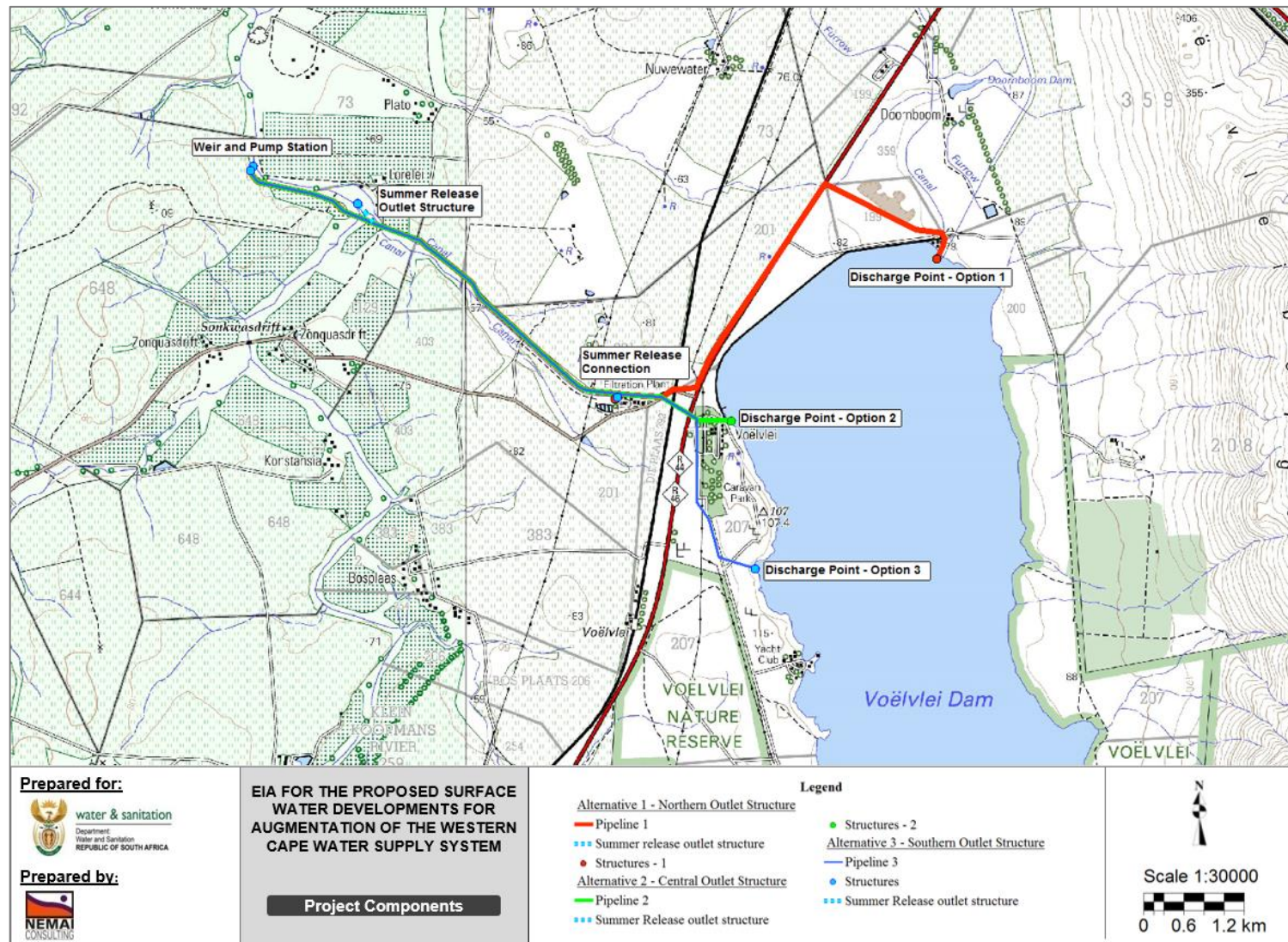


Figure 9: Project components

5.1.1 Diversion Weir and Abstraction Works

The proposed diversion weir will be located on the outer (western) bank of the Berg River (Figure 9).



Figure 10: Berg River at the Proposed Weir Site

The Technical Feasibility Study found that the flow depth would be about 10.4 m during the 1 in 100 year flood and the flow velocity about 2 m/s due to the wide floodplain (DWA, 2012a). The study also found that although the right bank floodplain would be inundated during floods, as the flow velocities would be low and the flow depth shallower, it would be possible to construct a weir/embankment on the floodplain without significantly increasing the flood levels upstream (DWA, 2012a). The proposed layout of the abstraction works is provided in **Figures 10** and **11**.

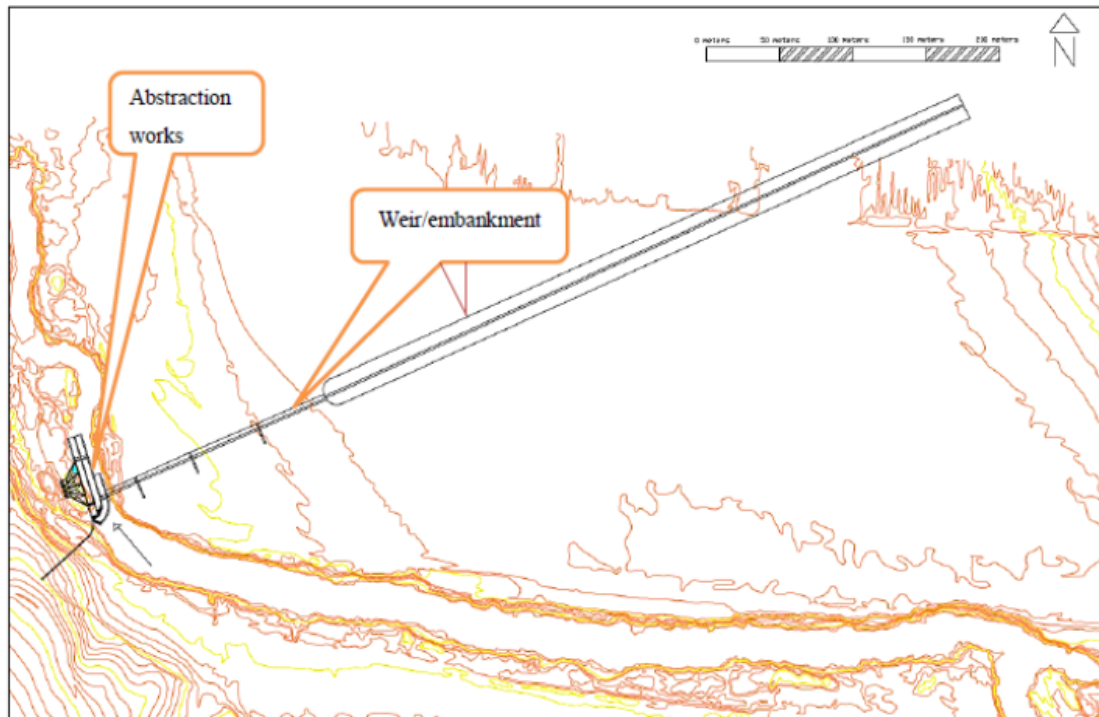


Figure 11: Layout of Abstraction Works, Weir and Embankment (DWA, 2012)

Figure 10 illustrates these works which would comprise the following components:

- An abstraction weir;
- A protected embankment on the right bank floodplain to be designed to be overtopped;
- A boulder trap with a radial gate to flush sediments;
- A gravel trap comprising two canals and a dividing wall, with radial gates downstream for flushing;
- An underwater opening would allow water to be diverted to supply the pumps, while keeping floating debris away from the trashracks; and
- The pumps would be located in a dry well and flushing durations are expected to be less than 30 minutes.

In order to minimise the increase in upstream water levels, the design would require the use of a hopper and jet pumps which would rely on the main pumps to provide a high head, whereas the preferred solution would be longer sand trap canals downstream of the trashracks that would be flushed by gravity and would also act as pump sumps.

The abstraction weir has been designed as a 3m high (average low notch height) weir with a 21 m long low notch next to the boulder trap. The crest level of the low notch is 47.9 masl while the lowest bed level is 44.923 masl. The total weir length is 160 m, consisting of four notches (**Figure 11**). The weir will be founded on solid rock, and therefore no energy dissipation structure has been added.

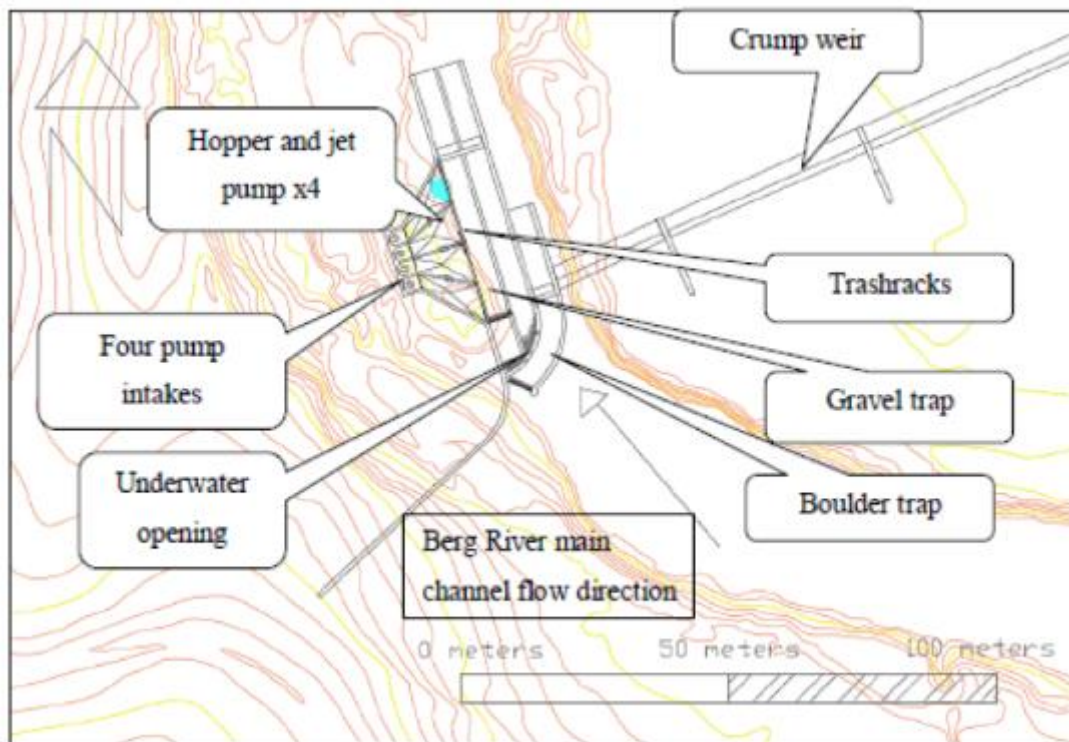


Figure 12: Components of the Proposed Abstraction Works (DWA, 2012)

A canoe chute may be required since the weir would be situated on the route of the annual Berg River Canoe Marathon. A fishway, comprising a rock-ramp type was recommended by the Aquatic and Wetland Specialist.

In addition, the weir has been designed as a low structure with a series of notches in it to minimise the impact of inundation. **Figure 12** below shows that the upstream damming caused by the proposed abstraction works and weir is very limited (for example, for the 100 year flood, the upstream water level will only be approximately 0.6m higher with the weir in place, than would be the case if the weir were not there).

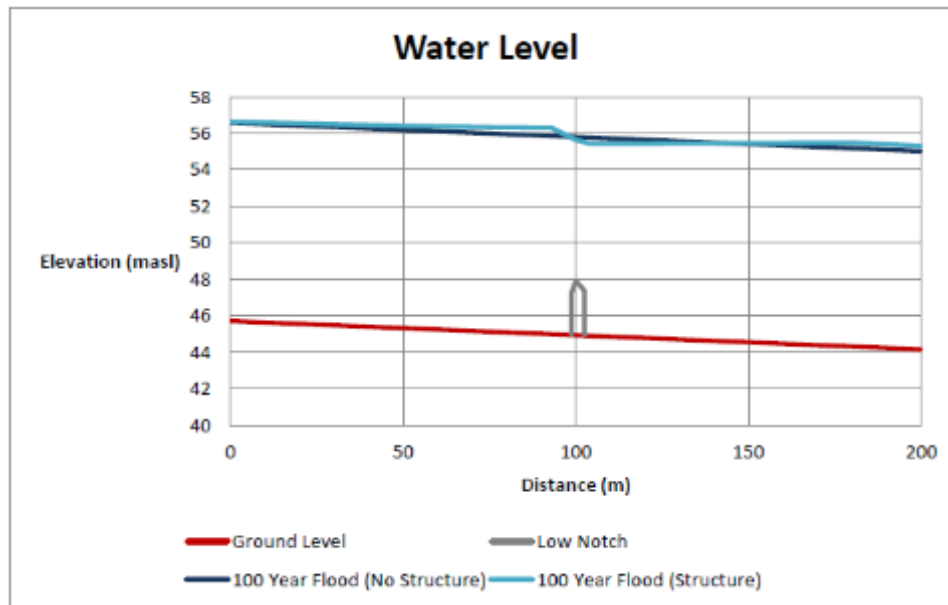


Figure 13: 100 year flood levels with the Weir in place (blue) and without the Weir in place (black)

5.1.2 Rising Main

As shown in **Figure 8**, three pipeline routes were investigated during the Technical Feasibility Study and will be assessed as part of the EIA. These routes are related to three potential discharge options into the dam from the diversion weir site. These routes are as follows:

- Pipeline route to Northern Discharge Point = 8 115 m;
- Pipeline route to Central Discharge Point = 5 000 m; and
- Pipeline route to Southern Discharge Point = 6 300 m.

The servitude for the pipeline is 25m on each side, while the pipeline itself is 1.7m wide.

Whilst design flows of 4 and 6 m³/s were considered for the rising main during the Technical Feasibility Study, the EIA will only assess the 4 m³/s option which was deemed most feasible during the Technical Feasibility Study.

The average pipe depths required for the pipeline are about 3.5 m with a minimum cover of 1 m. **Table 7** shows the design parameters adopted for the rising main between the diversion weir and Voëlvlei Dam.

Table 3: Design Parameters for the rising main between the Diversion Weir and Voëlvlei Dam

Design Parameter	4m ³ /s Design Flow
Rising Main Properties	1700 mm diameter GRP
Static Head	28.0 m
Dynamic Head	35.8 m

Maximum Flow Velocity	1.762 m/s
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5.1.3 Pump Station

The design parameters adopted for the 4m³/s Pump Station are provided in **Table 8** below.

Table 4: Design Parameters for the 4m³/s Pump Station

Design Parameter	4m ³ /s Design Flow
Abstraction	Raw water from Berg River in Winter
Rising Main Static Pressure	28.0 m
Friction Losses	7.8 m
Inlet Static Pressure	1.8 m
Pump Duty	34.0 m

During the winter abstraction period, water from the Berg River will flow into the sump at the pump station. A level transmitter on the diversion weir will provide an input value for the flow calculation to determine the amount of water to be abstracted and pumped to the Voëlvlei Dam (DWA, 2012a).

At the commencement of pumping, the pipeline could be partially empty and as such the first pump will start by means of a variable speed drive and slowly fill the pipeline until water is discharged into the dam. Flow will be measured at the pump station in order to monitor the volumes abstracted and the abstraction rates. The 4 m³/s abstraction will be based on a step-pumping operating rule, allowing a minimum flow (spill) of 1 m³/s past the abstraction point down the Berg River at all times, after abstraction. The pumps are in sets each with a 1 m³/s capacity. Each pump starts up when the river inflow to the site exceeds the sum of the required environmental base flow of 1 m³/s and the abstraction, in 1 m³/s steps (DWA, 2012a).

A schematic diagram indicating the section through the abstraction point at the proposed pump station is shown in **Figure 13**.

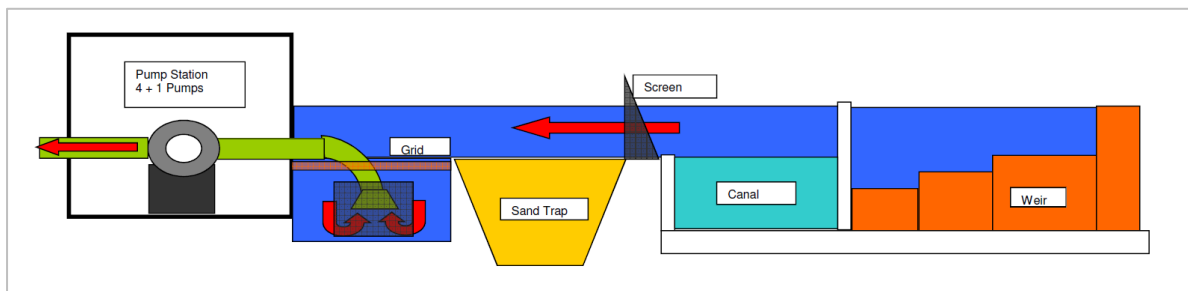


Figure 14: Abstraction point at the proposed pump station

The proposed location of the Pump Station is provided in **Figure 14** below.



Figure 15: Location of the Pump Station (DWA, 2012)

The pump station will have water and sanitation facilities, both incorporated into the footprint of the site. The sanitation facility would either be a septic tank (with a French drain), as is the case for all farm homesteads or a conservancy tank which would then require a service provider to routinely come and empty and dispose at the closest WWTW.

5.1.4 Access Roads

As most of the pipeline route follows an existing farm road, construction vehicles will be able to access the pipeline construction site from this road. Access roads to the weir and pump station site will be via existing unnamed farm roads in the study area (**Figures 15** and **16**). However, access road 2 will be constructed as a new access road to the weir and pump station. The servitude for the roads are 10m on each side (the access road width is approximately 6m).



Figure 16: Proposed access to weir and pump station

5.1.5 Electrical Supply

Eskom will be responsible for electrical supply / infrastructure. The electrical supply will be built and supplied by Eskom, while DWS will apply for the supply to be installed.

5.1.6 Site Laydown Areas

Two site laydown areas are proposed at the discharge point of pipeline alternative 2, both approximately 0.4 hectares in size (**Figure 17**). Only one of these site laydown areas would be required. These site laydown areas would be accessible from the main road, R44 and are adjacent to the Voëlvlei Dam.

The main site laydown area is proposed at the pump station and weir site for purposes of construction (**Figure 18**). This laydown site is approximately 0.85 hectares in size and is adjacent to the Berg River. The site will be accessible from the existing unnamed farm roads.



Figure 17: Location of the two proposed laydown areas adjacent to the Voëlvlei Dam



Figure 18: Proposed site laydown area at the pump station and weir site adjacent to the Berg River

6 ALTERNATIVES

6.1 Introduction

The 2014 EIA Regulations require that feasible project specific alternatives are identified (including the "do nothing" option). Alternatives are defined as following:

Different means of meeting the general purpose and requirements of the activity, which may include alternatives to:

- property on which or location where the activity is proposed to be undertaken;
- type of activity to be undertaken;
- design or layout of the activity;
- technology to be used in the activity; or
- operational aspects of the activity; and
- the option of not implementing the activity.

The sub-sections to follow discuss the project alternatives considered during the Scoping process. The EIA process will provide a detailed comparative analysis of feasible alternatives from environmental (including specialist input) and technical perspectives.

By conducting the comparative analysis, the BPEO can be selected with technical and environmental justification. Münster (2005) defines BPEO as the alternative that "provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term".

6.2 Alternatives Considered

6.2.1 Alternatives screened during the Feasibility Phase

The WCRSS has reviewed the future water requirement scenarios and the reconciliation options for meeting these water requirements within a planning horizon to 2030. The WCRSS identified various alternative implementation options which can offer flexibility in planning, such that possible changes in the projected water requirement scenarios can be accommodated. One set of those implementation options is the potential to further develop the surface water resources of the Berg and Breede WMAs.

Therefore, the WCRSS identified the need for augmentation of the WCWSS by 2019. Based on this, the DWS appointed the WCWC JV to undertake pre-feasibility level investigations into six potential surface water development options (Phase 1). These options are detailed below:

1. Mitchell's Pass Diversion Scheme

This scheme involves a low level intake structure on the left bank of the Upper Breede River at Michell's Pass, adjacent to the existing DWS streamflow gauge at which the current irrigation diversion (Artois canal) takes place (**Figure 18**). This is an inter-basin transfer from the Breede WMA into the Berg WMA.



Figure 19: The existing Artois canal irrigation diversion at Michell's Pass

Surplus winter water would be diverted via a low weir (up to 2.5 m high) into a GRP pipeline of up to 2.0 m dia. The weir dimensions and pipeline diameter would depend on the diversion capacity of the scheme. The pressure pipeline would transfer the water under gravity over approximately 7.3 km to discharge into the Boontjies River, a tributary of the Klein Berg River, from where the water would be diverted into the existing Voëlvlei Dam via the existing Klein Berg Diversion. The use of a low intake weir limits the upstream inundation impact and avoids impacting on the Witels tributary, the confluence of which lies approximately 2.3 km upstream of the proposed weir location. Provisional designs of the weir structure to enable downstream releases to be made and to ensure that sedimentation and boulder accumulation can be managed, have been undertaken.

Storage would be provided in the existing Voëlvlei Dam and the water could be used to supply Cape Town by means of the spare capacity (3.16 m³/s) in the existing pipeline from the City's WTW. This spare conveyance capacity is however only available in winter when water requirements are lower than during the dry summer months. This equates to a potential volume of 20 million m³/a. The scheme could also be used to supply water to the West Coast Regional Schemes, of which the Saldanha scheme is anticipated to experience significant growth in water requirements.

2. First Phase Augmentation of Voëlvlei Dam

This potential scheme involves the pumped abstraction of winter water from the Berg River, once the requirements of the Environmental Water Requirements (EWR) have been met. A number of diversion sites and scheme operational aspects have been previously investigated by DWS and by the CCT, at various levels of detail. Since those investigations, the water quality characteristics within the dam have changed.

For the option involving storing Berg River water in Voëlvlei Dam, the potential demand centres that could be supplied include the CCT, the growing West Coast region, and addressing any irrigation over-allocation from Voëlvlei Dam.

3. Further Phases of Voëlvlei Dam Augmentation

The Further Phases of the Voëlvlei Dam Augmentation Option would involve the abstraction of water as described in Phase 1, namely at 6 m³/s, with additional storage being made available in Voëlvlei Dam by means of a low raising of the existing dam wall.

4. Molenaars River Diversion

This inter-basin transfer scheme involves the potential transfer of surplus winter water from the Upper Molenaars River in the vicinity of the Eastern Tunnel Portal (Huguenot Tunnel) to the Berg River Dam (Berg WMA). Two potential options have been investigated, namely:

- Pumping from the Molenaars River; and
- Gravity Supply from the Elandspad tributary of the Molenaars River.

The first option involves a low level intake structure in the Molenaars River downstream of the entrance to the tunnel (from the Worcester side) and located at an existing causeway (**Figure 19**). Water would be pumped during surplus winter flow periods into a balancing tank above the tunnel entrance, from where it would gravitate into and through the existing 1.3m diameter pipeline installed in the tunnel during its construction. From the tunnel portal on the Paarl side the water would be conveyed under gravity over a distance of approximately 30 km via a new GRP pipeline (1.1m diameter.) into the Berg River Dam.



Figure 20: Molenaars River

The second option is an alternative and it involves the potential construction of a low level weir on the Elandspad River (a tributary of the Molenaars) upstream of the existing DWS flow gauging station (**Figure 20**). This would negate the need for infrastructure to be developed in the Molenaars River itself and would require no pumping.



Figure 21: Elandspad River

Water becoming available in winter from the scheme would be stored in the Berg River Dam and in this way integrated into the Western Cape Water Supply System. The option of storing the abstracted water in Wemmershoek Dam was also considered but is less favorable due to the limited capacity of the existing pipeline from Wemmershoek Dam to Cape Town. On the other hand, water delivered to the Berg River Dam could be delivered via the Dasbos Pumpstation either into Theewaterskloof Dam, or to Cape Town via the existing tunnel. The proposed Muldersvlei pipeline would enable delivery directly to Cape Town. For these reasons, use of the Berg River Dam for storage purposes offers greater flexibility.

5. Upper Wit River Diversion

This scheme involves the potential inter-basin transfer of surplus winter water from the Upper Wit River (**Figure 21**), a tributary of the Breede River, in the vicinity of Eerste Toll (Bain's Kloof), into the Berg River catchment. This would be achieved by constructing a low level weir (2m high) and intake on the left bank (looking downstream). Once the winter EWR requirements have been met, water would be diverted into a drop structure connecting to a 3m diameter tunnel, of about 350m length, under Bain's Kloof.



Figure 22: The Upper Wit River

The water could either be released into the Krom River from the dam, through an exchange with the Berg River Irrigators, for water currently allocated to them from Theewaterskloof Dam. Alternatively the water could be piped under gravity to the Welvanpas WTW in Wellington during summer, via a 7,3km GRP pipeline of 600mm dia. The existing WTW would require upgrading. The water then could be used locally to supply Wellington, as well as Paarl via reverse pumping in the existing 450mm diameter pipeline between Paarl and Wellington.

6. Further Phases of the Palmiet Transfer Scheme

The potential of raising either the Upper or the Lower Steenbras Dam has been considered. However from an environmental, financial, technical and integration perspective, it became clear during initial assessments that raising the Lower Steenbras Dam was much more feasible.

The potential areas of supply would be the CCT. Water becoming available from this scheme would be transferred to the CCT's Faure WTW. The existing raw water pipeline to Faure has adequate spare capacity to deliver the water becoming available from this option.

The six possible options detailed above were then prioritised to identify the two most viable options for further investigation at the Feasibility Study level in Phase 2. The prioritisation indicated the following two priority schemes.

- BRVAS (also known as the First Phase Augmentation of Voëlvlei Dam); and
- BBTS (also known as the Mitchell's Pass Diversion Scheme).

Both schemes rely on the utilisation of the existing storage capacity in the Voëlvlei Dam, and on the existing capacity of the CCT's pipeline, from their WTWs at the dam, to their Plattekloof reservoir in Cape Town. It was found that the BRVAS option was the more favourable surface water intervention option.

Three potential diversion sites were considered for the BRVAS scheme namely:

- Spes Bona;
- Sonquasdrift, and
- Lorelei.

The Spes Bona and Lorelei sites were considered to be best suited for the proposed options. Zonquasdrift was also considered but the former two sites proved preferable for alignment of pipelines and limiting the impacts on the Voëlvlei Conservancy. The Lorelei site was found to be the most feasible of the options for the following reasons:

- It is close to a bend on the Berg River which is favourable from a sedimentation management perspective. Geologically this is the only location of those considered at which any rock outcrop is evident for suitable founding conditions. From a hydraulic and geotechnical perspective this site was therefore recommended as the preferred location for the abstraction weir.
- Geotechnical conditions are generally favourable, and the weir design can be suitably accommodated at the proposed site. Machine excavation is expected to be possible along the pipeline route. Although there is potential for the use of excavated materials for backfilling, the final pipe type selection will influence the extent of selected fill material available insitu.

According to the Reserve for the Berg River Estuary the required stream flow into the estuary during the summer months should vary between 0.6 and 0.9 m³/s. As the present day inflows into the estuary are not gauged (although DWS has plans to install a gauge), the present day inflow of 0.3 m³/s was estimated from the gauged flows below Misverstand Dam, and from the downstream irrigation allocations which will be metered in the near future. In order to provide the required Reserve inflows to the estuary would require that additional releases of between 0.3 m³/s and 0.6 m³/s be made from Voëlvlei Dam, particularly during the four summer months from December to March. Therefore, the conservative assumption has been made in the system modelling of the proposed scheme that an additional release of 0.5 m³/s should be made from Voëlvlei Dam for the four summer months. Two scheme options have been investigated, namely:

- Option 1: a 4 m³/s pump station with a stepped-pump operating rule that works in 1 m³/s increments up to a pump station capacity of 4 m³/s and which allows a base flow of 1 m³/s to pass the site at all times.

- Option 2: a 6 m³/s pump station with variable speed drives so that the EWR requirement can be allowed to pass the site at all times, exactly, while the balance will be abstracted up to the pump station capacity of 6 m³/s.

Of the two potential abstraction approaches investigated, namely a 4 m³/s pump station with a stepped-pump operating rule, or a 6 m³/s pump station with variable speed drives, the former appears to be more easily implemented and operated, as well as offering a slightly higher resulting yield (23 versus 20 million m³/a).

Therefore, from an operational perspective, Option 1: 4m³/s abstraction via a stepped-pumping operating rule was selected as the optimal pumping scheme for the proposed pump station.

6.2.2 Alternatives to be assessed as part of EIA

Of the six alternatives previously assessed during the pre-feasibility level investigations, two priority schemes were identified as feasible:

- BRVAS (also known as the First Phase Augmentation of Voëlvlei Dam); and
- BBTS (also known as the Michell's Pass Diversion Scheme).

It was then found that the BRVAS option was the more favourable surface water intervention option of the two, primarily due to lower environmental impacts. Three alternative pipeline routes are considered as part of the BRVAS scheme (**Figure 8**). These routes are related to three potential discharge options into the dam from the diversion weir site. These alternative routes are as follows:

- Option 1: Pipeline route to Northern Discharge Point = 8 115 m;
- Option 2: Pipeline route to Central Discharge Point = 5 000 m; and
- Option 3: Pipeline route to Southern Discharge Point = 6 300 m.

6.3 No-go Alternative

The 'no-go' alternative refers to a situation where the proposed surface water development for augmentation of the WCWSS is not built. This would mean that there would not be the much needed increase in water supply to surrounding communities.

The future water requirement projections conducted in the WCWSS Reconciliation Strategy Study apply only to the CCT (including bulk water supplied by the CCT to Drakenstein and Stellenbosch Municipalities). The results of the future water requirements modelling indicate that the average growth in water demand for the high scenario is 3.09% per annum and for the low scenario is 1.43% per annum. The average of the two scenarios is approximately 2.26% per annum. In general, the average growth in water demand is lower than the economic growth rate and higher than the population growth rate.

Figure 25 shows the low water levels of the Voëlvlei Dam during the 2016 drought. If the augmentation of the WCWSS is not undertaken, these low water levels will be experienced frequently and the capacity of the dam will not be fully utilised and there would be no sufficient water to support the projected economic growth in the area. Future water requirements will not be met resulting in severe and frequent restrictions of supply. Even if the CCTs water conservation and water demand strategy remains successful, a severe limitation will be evident in terms of the ability to support the projected growth and water requirements in the water supply area of the WCWSS.



Figure 23: Images of the low water levels of the Voëlvlei Dam

7 ENVIRONMENTAL ASSESSMENT PRACTITIONER

Nemai Consulting was appointed as the independent EAP to undertake the environmental assessment for the proposed surface water developments for the augmentation of WCWSS. In accordance with Section 2(a) of Appendix 2 of GN 921 of 04 December 2014, this section provides an overview of Nemai Consulting and the company's experience with EIAs, as well as the details and experience of the EAPs that form part of the Scoping and EIA team.

Nemai Consulting is an independent, specialist environmental, social development and Occupational Health and Safety (OHS) consultancy, which was founded in December 1999. The company is directed by a team of experienced and capable environmental engineers, scientists, ecologists, sociologists, economists and analysts. The company has offices in Randburg (Gauteng), Durban (KwaZulu-Natal), and Cape Town (Western Cape).

The core members of Nemai Consulting that are involved with the Scoping and EIA process for the proposed development are provided in **Table 2**, and their respective Curricula Vitae are contained in to **Appendix C** of the EIA Report.

Table 5: Scoping and EIA Core Team Members

Name	Qualifications	Duties
Ms D. Naidoo	BSc – Eng (Chem)	Project Manager and Environmental Engineering
Mr D. Henning	MSc – Aquatic Health Ecology	Environmental Assessment Practitioner/Study Leader
Mr C. Chidley	BSc – Eng (Civil) BA – Economics, Philosophy MBA	Project Leader: Specialists and WULA
Mrs V. Stippel	BSc. (Hons) – Zoology MSc. – Ecology, Environment and Conservation	Public Participation and Quality Control

8 LEGISLATION AND GUIDELINES CONSIDERED

8.1 Overview of Legislation

Some of the pertinent environmental legislation that has bearing on the proposed development is captured below (**Table 4**).

Construction will be undertaken according to recognised best industry practices and will include measures prescribed within this EMPr. This EMPr shall form part of the contract documents, and informs the Contractor about his duties in the fulfilment of the project objectives, with particular reference to the mitigation of environmental impacts that may potentially be caused by construction activities associated with the project. The Contractor will note that obligations imposed by the EMPr are legally binding in terms of environmental legislation.

Table 6: Environmental Statutory Framework

Legislation	Relevance
Constitution of the Republic of South Africa (Act No. 108 of 1996)	Chapter 2 – Bill of Rights. Section 24 – environmental rights.
National Environmental Management Act (Act No. 107 of 1998)	Section 24 – Environmental Authorisation (control of activities which may have a detrimental effect on the environment). Section 28 – Duty of care and remediation of environmental damage. Environmental management principles. Authority – DEA.
Government Notice No. R. 982 of 04 December 2014	Purpose – regulate the procedure and criteria as contemplated in Chapter 5 of the Act relating to the preparation, evaluation, submission, processing and consideration of, and decision on, applications for environmental authorisations for the commencement of activities, subjected to EIA, in order to avoid or mitigate detrimental impacts on the environment, and to optimise

Legislation	Relevance
	positive environmental impacts, and for matters pertaining thereto.
Government Notice No. R. 983 of 04 December 2014 (Listing Notice 1)	Process for undertaking Basic Assessment / Scoping and EIA process.
Government Notice No. R. 984 of 04 December 2014 (Listing Notice 2)	Activities that need to be assessed through a Basic Assessment process.
Government Notice No. R. 985 of 04 December 2014 (Listing Notice 3)	Activities that need to be assessed through a Scoping and EIA process.
National Water Act (Act No. 36 of 1998)	Chapter 3 – Protection of water resources. Section 19 – Prevention and remedying effects of pollution. Section 20 – Control of emergency incidents. Chapter 4 – Water use. Chapter 12 – Safety of dams Authority – DWS.
National Environmental Management: Protected Areas Act (Act No. 57 of 2003)	Protection and conservation of ecologically viable areas representative of South Africa's biological diversity and natural landscapes. Authority –DEA.
National Environmental Management: Air Quality Act (Act No. 39 of 2004)	Air quality management. Section 32 – dust control. Section 34 – noise control. Authority – DEA.
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)	Management and conservation of the country's biodiversity. Protection of species and ecosystems. Authority – DEA.
National Environmental Management: Waste Act (Act No. 59 of 2008)	Chapter 5 – licensing requirements for listed waste activities (Schedule 1). Authority – Minister (DEA) or MEC (provincial authority)
Occupational Health & Safety Act (Act No. 85 of 1993)	Provisions for Occupational Health & Safety. Authority – Department of Labour.
National Heritage Resources Act (Act No. 25 of 1999)	Section 34 – protection of structure older than 60 years. Section 35 – protection of heritage resources. Section 36 – protection of graves and burial grounds. Section 38 – Heritage Impact Assessment for linear development exceeding 300m in length; development exceeding 5 000m ² in extent. Authority – Western Cape Heritage (WCH).
Conservation of Agricultural Resources Act (Act No. 43 of 1983)	Control measures for erosion. Control measures for alien and invasive plant species. Authority – Department of Forestry and Fisheries (DAFF).
National Forestry Act (Act No. 84 of 1998)	Section 15 – authorisation required for impacts to protected trees. Authority – DAFF.
Minerals and Petroleum Resources Development Act (Act No. 28 of 2002)	Permit required for borrow pits. Authority – Department of Mineral Resources (DMR).
Conservation of Agricultural Resources Act (Act No. 43 of 1983)	Control measures for erosion. Control measures for alien and invasive plant species. Authority – Department of Agriculture.
National Road Traffic Act (Act No. 93 of 1996)	Authority – Western Cape Department of Roads and Public Works.
Tourism Act of 1993	Authority – South African Tourism Board.

8.2 Project Specifications

The EMPr focuses more on performance criteria for environmental compliance, whereas the detail on how the project is to meet these performance criteria is provided in the project specification in the form of minimum standards and measures to be implemented by the Contractor. The Contractor shall provide detailed method statements on how the performance criteria will be met, through the application of the specification. These methods are to be reviewed and approved by the Project Manager to ensure that they are adequate.

The Method Statements must be project- and site specific and should explain in detail the following:

1. The manner in which the work is to be undertaken;
2. The estimated schedule for the works (timing);
3. The area where the works will be executed (location);
4. The materials and plant / equipment needed for the works;
5. The necessary mitigation measures that need to be implemented to adequately safeguard the environment, construction workers and the public (where applicable);
6. Training of employees;
7. Roles and responsibilities; and
8. Monitoring and reporting requirements;

The list of method statements required to assist in the implementation of this EMPr includes at least the following (where applicable):

- Method Statement for site clearing;
- Method Statement for establishing the construction camp;
- Method Statement with regard to waste and wastewater management;
- Method Statement to show procedures for dealing with possible emergencies that can occur, such as fire and accidental leaks and spillage of carbon fuels and oils;
- Method Statement for dust control;
- Method Statement for the storage and handling of hazardous substances;
- Method Statement for management of concrete and batching plants;
- Method Statement for river diversions;
- Method Statement for controlling alien invasive species and noxious weeds;
- Method Statement for the decommissioning of the construction works area; and
- Method Statement for rehabilitation of construction footprint.

9 ROLES AND RESPONSIBILITIES

A high-level outline of the institutional arrangements for the implementation of the EMPr during the pre-construction and construction phases of the project, as well as the conditions of the Environmental Authorisation, is provided in **Figure 5**.

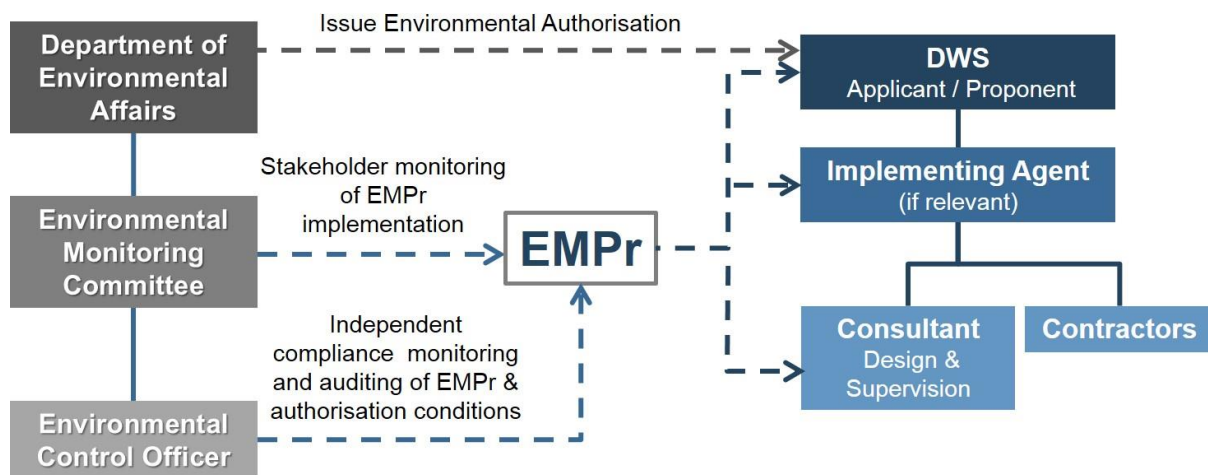


Figure 24: Institutional Arrangements: Roles and Responsibility

9.1 DEA

DEA is the mandated authority in terms of the National Environmental Management Act (No. 107 of 1998) (NEMA) that determines whether authorisation can be issued for the project, following a decision-making process conducted as part of the EIA. Conditions are included in the Environmental Authorisation, which need to be complied with by the project applicant.

DEA also fulfils a compliance and enforcement role with regards to the authorisation. The Department may perform random inspections to checks compliance. DEA will also serve as an active member of the Environmental Monitoring Committee (EMC) and will review the monitoring and auditing reports compiled by the ECO.

Amendments may be required to the EMPr or the Environmental Authorisation, based on adaptive management to the site conditions and the technical requirements of the project. These amendments will need to be approved by DEA.

9.2 DWS

DWS is the applicant in terms of NEMA. DWS is also referred to as the project proponent and is ultimately responsible for the development and implementation of the EMPr and ensuring that the conditions in the Environmental Authorisation are satisfied. The liability for non-compliance thus rests with DWS.

DWS may appoint an implementing agent for the project and arrangements for compliance need to be formalised between these parties.

9.3 Environmental Monitoring Committee

An EMC will be established before commencement of any construction activities, and will serve as an additional mechanism for monitoring the implementation of the EMPr and compliance with the Environmental Authorisation as well as for improving communication amongst key stakeholders. The committee will have an advisory, monitoring and “watch-dog” role for the duration of the construction phase of the project. This committee will report to the Director-General of DEA.

Appropriate Terms of Reference for the EMC will need to be prepared, which will include roles and responsibilities, membership and functionality (amongst others).

9.4 Project Manager

The Project Manager has over-all responsibility for managing the Contractors and for ensuring that the environmental management requirements are met. During the construction phase, the Project Manager will be the proponent’s (or implementing agent’s) construction manager. During the operations phase it is expected that this role will be fulfilled by the operations manager.

The Project Manager will be on site and the responsibilities of this party will include the following (amongst others):

- Overseeing of all environmental matters and compliance with all environmental requirements and authorisations; and
- Act as the interface between the ECO, EMC and the other project role players.

9.5 Environmental Control Officer

The Environmental Control Officer (ECO) is a competent (minimum of 3 years’ experience) and independent representative, who acts as the EMC monitoring representative for the conducting of independent audits and performing a secretariat function for the EMC.

The ECO will undertake weekly inspections of the site and at least 6 monthly full compliance auditing against the EMPr and Environmental Authorisation. The aforementioned reports will be submitted to the Project Manager, EMC and DEA for their records.

The ECO will also check the following:

- The record of environmental incidents (spills, impacts, legal transgressions, etc.) as well as corrective and preventive actions taken;
- The public complaints register in which all complaints are recorded, as well as actions taken; and
- Results from the environmental monitoring programme (air, noise, water quality).

9.6 Contractor's Environmental Officer

The primary role of the competent Environmental Officer (minimum of 3 years' experience) is to coordinate the environmental management activities of the Contractor on site.

Specific responsibilities of the Environmental Officer, who will be on site, will include the following:

- Aiding the Contractor to comply with all the project's environmental management requirements;
- Assisting the Contractor in compiling Method Statements;
- Facilitating environmental activities and environmental awareness training of all persons on site;
- Exercise an internal compliance management system on behalf of the Contractor;
- Inspect the site as required to ensure adherence to the management actions of the EMPr and the Method Statements;
- Ensuring that environmental monitoring (air, noise, water quality) is being undertaken;
- Complete Site Inspection Forms on a regular basis;
- Provide inputs to the regular environment report to be prepared by the ECO (as required);
- Liaise with the construction team on issues related to implementation of, and compliance with, the EMPr;
- Maintain a record of environmental incidents (spills, impacts, legal transgressions etc.) as well as corrective and preventive actions taken; and
- Maintain a public complaints register in which all complaints are recorded, as well as actions taken.

10 MONITORING

Monitoring is required to ensure that the receiving environment is suitably safeguarded against the identified potential impacts, and to ensure that the environmental management requirements are adequately implemented and adhered to during the execution of the project.

10.1 Baseline Monitoring

Baseline monitoring aims to determine the pre-construction state of the receiving environment, and serves as a reference to measure the residual impacts of the project by evaluating the deviation from the baseline conditions and the associated significance of the adverse effects.

The environmental parameters to be included in the baseline monitoring are shown in **Table 7**.

Table 7: Baseline Monitoring Requirements

Environmental Parameter	Monitoring Locations	Requirements
Water Quality	<ul style="list-style-type: none"> All major watercourses to be affected by the project, including the affected Berg River. Sites to be located at suitable locations up- and downstream of the construction sites and in-stream works, to be determined in consultation with the ECO. <i>In situ</i> water quality monitoring to be conducted. 	<ul style="list-style-type: none"> Comply with relevant standards - SANS 5667.
Air Quality	<ul style="list-style-type: none"> Dust fallout units to be located taking into consideration significant sources of air pollution, sensitive receptors, and dominant wind direction. Particulate matter (PM₁₀) – strategic monitoring point(s) to be selected. 	<ul style="list-style-type: none"> Dust fallout – comply with ASTM D1739; SANS 1929, SANS 69. Particulate matter (PM₁₀) – comply with the National Ambient Air Quality Standards.
Noise	<ul style="list-style-type: none"> Noise monitoring sampling sites to be located taking into consideration significant sources of noise, sensitive receptors, and dominant wind direction. Sites to coincide 	<ul style="list-style-type: none"> Comply with SANS 10103:2008.

Environmental Parameter	Monitoring Locations	Requirements
	with dust fallout sites (where relevant).	

10.2 Environmental Monitoring

Environmental monitoring entails checking, at pre-determined frequencies, whether thresholds and baseline values for certain environmental parameters are being exceeded. The parameters and sampling localities used during the baseline monitoring will form the basis of the environmental monitoring programme.

The environmental parameters to be included as part of the environmental monitoring programme, which is to be undertaken by the Contractor, includes the following:

1. Water quality;
2. Air Quality
 - a. Dust fallout;
 - b. Particulate matter (PM₁₀); and
3. Noise.

The following requirements need to be incorporated into the programme:

- Monitoring during normal operations, abnormal situations and emergency situations (e.g. unexpected spillage of hazardous substance);
- Measuring equipment must be accurately calibrated;
- Adequate quality control of the sampling must be ensured;
- Analysis is to be undertaken at a SANS 17025 certified laboratory;
- Certified methods of testing must be employed;
- Where legal specifications exist for testing and sampling methods, these must be taken into account; and
- Establish a process for identifying and implementing corrective measures.

Note that the specifications will include more detailed requirements in terms of environmental monitoring.

10.3 Compliance Monitoring and Auditing

Compliance monitoring will commence in the pre-construction phase, where those conditions in the Environmental Authorisation that need to be adhered to prior to project implementation will need to be checked and recorded, as well as to check compliance with the provisions in the EMPr. Compliance monitoring will be completed at the end of the defects liability period to check the performance of rehabilitation measures and whether the related objectives have been met.

The ECO will undertake weekly inspections of the site and at least 6 monthly full compliance auditing against the EMPr and Environmental Authorisation. The aforementioned reports will be submitted to the Project Manager, EMC and DEA for their records.

Auditing of compliance with the Environmental Authorisation, and EMPr must be conducted in accordance with Regulation 34 of GN No. R 982 (4 December 2014) in terms of the following:

1. The holder of an Environmental Authorisation must, for the period during which the Environmental Authorisation, and EMPr, remain valid -
 - a. Ensure that the compliance with the conditions of the Environmental Authorisation, and EMPr is audited; and
 - b. Submit an environmental audit report to DEA.
2. The environmental audit report must-
 - a. Be prepared by an independent person with the relevant environmental auditing expertise;
 - b. Provide verifiable findings, in a structured and systematic manner, on-
 - i. The level of performance against and compliance of an organization or project with the provisions of the requisite Environmental Authorisation or EMPr; and
 - ii. The ability of the measures contained in the EMPr, to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity;
 - c. Contain the information set out in Appendix 7 of GN No. R 982 (4 December 2014); and
 - d. Be conducted and submitted to DEA at intervals as indicated in the Environmental Authorisation.
3. The environmental audit report must determine-
 - a. The ability of the EMPr to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity on an ongoing basis and to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the closure of the facility; and
 - b. The level of compliance with the provisions of Environmental Authorisation, and EMPr.

A document handling system must be established to ensure accurate updating of EMPr documents, and availability of all documents required for the effective functioning of the EMPr. Supplementary EMPr documentation could include:

- Method Statements;
- Site instructions;
- Emergency preparedness and response procedures;
- Record of environmental incidents;

- Non-conformance register
- Training records;
- Site inspection reports;
- Monitoring reports;
- Auditing reports; and
- Public complaints register (single register for maintained for overall site).

11 ENVIRONMENTAL TRAINING AND AWARENESS CREATION

Training aims to create an understanding of environmental management obligations and prescriptive measures governing the execution of the project. It is generally geared towards project team members that require a higher-level of appreciation of the environmental management context and implementation framework for the project.

Awareness creation strives to foster a general attentiveness amongst the construction workforce to sensitive environmental features and an understanding of implementing environmental best practices. The various means of creating environmental awareness during the construction phase of the project may include:

- Induction course for all workers before commencing work on site;
- Refresher courses (as and when required);
- Daily toolbox talks, focusing on particular environmental issues (task- and area specific);
- Courses must be provided by suitably qualified persons and in a language and medium understood by the workers;
- Erect signage and barricading (where necessary) at appropriate points in the construction domain, highlighting sensitive environmental features (e.g. grave sites, protected trees); and
- Place posters containing environmental information at areas frequented by the construction workers (e.g. eating facilities).

Training and awareness creation will be tailored to the audience, based on their designated roles and responsibilities. Records will be kept of the type of training and awareness creation provided, as well as containing the details of the attendees.

12 ENVIRONMENTAL ACTIVITIES, ASPECTS AND IMPACTS

In order to establish best management practices and prescribe mitigation measures, the following project-related information needs to be adequately understood:

- **Activities** associated with the proposed project;
- **Environmental aspects** associated with the project activities;
- **Environmental impacts** resulting from the environmental aspects; and
- The nature of the surrounding **receiving environment**.

12.1 Environmental Activities

This section identifies any potential impact, either positive or negative that has/may occur as a result of any construction associated with the proposed surface water developments for augmentation of the WCWSS. All impacts identified must be then prevented, mitigated against or managed. The EMPr strives to provide a comprehensive list of mitigation measures associated with the overall project-related negative aspects and impacts for the entire project lifecycle (pre-construction, construction, and operational).

In order to understand the impacts related to the project it is necessary to unpack the activities associated with the project lifecycle.

Table 8: Project and environmental activities associated with the Pre-construction Phase of the proposed surface water developments for augmentation of the WCWSS

PRE-CONSTRUCTION PHASE	
Project Activities	
1.	Detailed engineering design
2.	Detailed geotechnical design
3.	Ecological Assessment Report
4.	Search, Rescue and Relocation Plan
5.	Phase 1 Heritage Impact Assessment
6.	Agricultural Impact Assessment
7.	Riparian Habitat and Wetland Delineation Impact Assessment
8.	Socio-Economic Impact Assessment
9.	Stormwater Management Plan

10. Procurement of contractors
11. Site survey
12. Survey and mark construction servitude
13. Development and approval of method statements
14. Development and approval of construction plans
15. Ongoing consultation with landowners and affected parties
16. Development of employment strategy
17. Construction site planning, access and layout
18. Determining and documenting the road conditions for all identified access roads
19. Improvements of access roads to facilitate the delivery of construction plant and materials
Environmental Activities
20. Diligent compliance monitoring of the EMPr, environmental authorisation and other relevant environmental legislation
21. Undertake a walk through survey of the project footprint by the relevant environmental specialists to identify sensitive environmental features
22. Demarcation of buffers around sensitive areas
23. Establish Environmental Monitoring Committee (EMC)
24. Ongoing consultation with landowners, affected parties, stakeholders and authorities

Table 9: Project and environmental activities associated with the Construction Phase of the proposed surface water developments for augmentation of the WCWSS

CONSTRUCTION PHASE
Project Activities
1. Site establishment (including site camp)
2. Fencing of the construction area
3. Environmental awareness training
4. Site clearing (as necessary)
5. Construction/widening of access roads

6. Stormwater control mechanisms
7. Delivery of construction material
8. Transportation of equipment, materials and personnel
9. Storage and handling of material
10. Excavation
11. Management of topsoil and spoil
12. Control of invasive plant species
13. Blasting
14. Concrete works
15. Mechanical and electrical works
16. Electrical supply
17. Cut and cover activities
18. Stockpiling (sand, crushed stone, aggregate, etc.)
19. Waste and wastewater management
20. Traffic control measures
21. Bulk earthworks
22. Site security
23. Road surface finishes
24. Temporary river diversion for weir and pipeline crossings
25. Construction of weir, pump station, and pipeline
26. Waste and wastewater management
27. Landscaping
28. Reinstatement and rehabilitation
Environmental Activities
29. Diligent compliance monitoring of the EMPr, EA and other relevant environmental legislation
30. Conduct environmental awareness training

31. Ongoing search, rescue and relocation of red data, protected and endangered species, medicinal plants, heritage resources and graves (based on area of influence of the construction activities) – permits to be in place
32. Implement EMPr
33. Reinstatement and rehabilitation of construction domain
34. Convene EMC meetings
35. Ongoing consultation with landowners, affected parties, stakeholders and authorities

Table 10: Project and environmental activities associated with the Operational Phase of the proposed surface water developments for augmentation of the WCWSS

OPERATIONAL PHASE
Project Activities
1. Maintenance and management of service infrastructure
2. Control of invasive plant species
3. Routine maintenance inspections of project infrastructure
4. Repair and maintenance works of project infrastructure
5. Operation of scheme
6. Adhere to Operating Rule
Environmental Activities
7. Ongoing consultation with landowners, affected parties, stakeholders and authorities
8. Management of sensitive areas or buffered areas
9. Satisfy EWR

12.2 Environmental Aspects

Environmental aspects are regarded as those components of an organisation's activities, products and services that are likely to interact with the environment and cause an impact. The following environmental aspects have been identified for the proposed surface water developments for augmentation of the WCWSS, which are linked to the project activities (note that only high level aspects are provided):

Table 11: Environmental aspects associated with the proposed surface water developments for augmentation of the WCWSS

ENVIRONMENTAL ASPECTS
Pre-construction Phase
1. Insufficient construction site planning and layout
2. Poor consultation with landowners, affected parties, stakeholders and authorities
3. Site-specific environmental issues not fully understood
4. Inadequate environmental and compliance monitoring
5. Absence of relevant permits
6. Lack of barricading of sensitive environmental features
7. Poor waste management
8. Absence of ablution facilities
Construction Phase
1. Poor consultation with landowners, affected parties, stakeholders and authorities
2. Inadequate environmental and compliance monitoring
3. Lack of environmental awareness creation
4. Construction starting without or inadequate search and rescue
5. Indiscriminate site clearing
6. Poor site establishment
7. Poor management of access and use of access roads
8. Poor transportation practices
9. Poor traffic management
10. Disturbance of topsoil
11. Disruptions to existing services

12. Inadequate storage and handling of material
13. Inadequate storage and handling of hazardous material
14. Erosion
15. Poor maintenance of equipment and plant
16. Poor management of labour force
17. Pollution from ablution facilities
18. Inadequate management of construction camp
19. Poor waste management practices – hazardous and general solid, liquid
20. Poor management of pollution generation potential
21. Poor management of water
22. Damage to significant fauna and flora (if encountered)
23. Environmental damage of sensitive areas
24. Disruption of archaeological and culturally significant features (if encountered)
25. Dust and emissions
26. Noise nuisance due to construction activities
27. Influence to resource quality of the affected rivers and wetlands
28. Poor reinstatement and rehabilitation
Operational Phase
1. Poor consultation with landowners, affected parties, stakeholders and authorities
2. Inadequate environmental and compliance monitoring
3. Inadequate management of access, routine maintenance and maintenance works
4. Inadequate management of vegetation
5. Not satisfying the EWR

6. Release of poor quality water

12.3 Potential Significant Environmental Impacts

Environmental impacts are the change to the environment resulting from an environmental aspect, whether desirable or undesirable. Refer to **Tables 12** and **13** for the potential significant impacts associated with the preceding activities and environmental aspects for the construction and operational phases.

Table 12: Potential significant environmental impacts associated with the Construction Phase

Feature	Impact
Geology and Soil	<ul style="list-style-type: none"> • Unsuitable geological conditions • Blasting • Soil erosion • Sourcing of construction material • Improper disposal of spoil material • Compaction and erosion of removed and stockpiled soils • Soil contamination from incorrect storage/handling/disposal of hazardous waste • Soil contamination through spillages and leakages • Soil contamination due to mismanagement and/or incorrect storage of hazardous chemicals • Poor stormwater management during construction
Surface Water	<ul style="list-style-type: none"> • Disturbance of ecological quality and ecosystems, resulting in a vulnerability to alien species • Surface contamination through spillages and leakages, and/or incorrect disposal of hazardous and non-hazardous materials or waste • Surface water contamination through runoff containing suspended solids, sediments and fuel residue • Poor stormwater management during construction
Geohydrology	<ul style="list-style-type: none"> • Contamination of groundwater resulting from incorrect storage/handling and disposal of hazardous waste materials • Contamination of groundwater through spillages from equipment, machinery and vehicle storage or from a leakage caused by a fracture/crack or rupture in the fuel storage tanks • Contamination of surface water resources through runoff containing suspended solids, sediments and fuel residue
Hydrology	<ul style="list-style-type: none"> • Alteration of flow regimes
Water Users	<ul style="list-style-type: none"> • Water quality deterioration and disturbance to flow caused by construction activities may adversely affect downstream water users • Water abstracted from watercourses for construction purposes
Water Quality	<ul style="list-style-type: none"> • Sedimentation from instream works • Water quality impacts due to spillages and poor construction practices
Aquatic Ecology	<ul style="list-style-type: none"> • Disruptions to aquatic biota community due to water contamination, alteration of flow, loss of instream habitat (dam) and disturbance to habitat during construction (watercourse crossings) • Spread of noxious / declared weeds

Feature	Impact
Riparian Habitat	<ul style="list-style-type: none"> Loss of riparian and instream vegetation within construction domain Destabilisation of channel morphology at river
Flora	<ul style="list-style-type: none"> Loss of sensitive vegetation and habitat Disturbance of natural ecosystems, making them vulnerable to invasion of alien species Soil contamination and compaction, vegetation loss and vegetation disturbance due to fuel and chemical spills Vegetation and habitat disturbance due to accidental introduction of alien species Destruction of potential red list plants during site clearing and construction Disturbance of sensitive plant species if relocated Illegal harvesting of medicinal plants during construction phase Damage to plant life outside the proposed site
Fauna	<ul style="list-style-type: none"> Loss of habitat through site clearing and construction Illegal killing or hunting of mammals Killing of snakes during construction phase due to poor environmental education procedures Potential illness and/or death of fauna due to pollution and/or littering Noise disturbance to sensitive species Faunal species harm due to poor environmental education procedures
Agricultural Potential	<ul style="list-style-type: none"> Loss of fertile soil through land clearance Loss of grazing land within construction domain
Air Quality	<ul style="list-style-type: none"> Increased dust generation Greenhouse gas emissions from construction vehicles
Access Roads	<ul style="list-style-type: none"> Construction-related traffic
Noise	<ul style="list-style-type: none"> Localised noise increase Noise nuisance
Waste Management	<ul style="list-style-type: none"> Waste generated from site preparations (e.g. plant material) Domestic waste Surplus and used building material Hazardous waste (e.g. chemicals, oils, soil contaminated by spillages, diesel rags) Disposal of excess spoil material (soil and rock) generated as part of the bulk earthworks Land, air and water pollution through poor waste management practices
Socio – Economic	<ul style="list-style-type: none"> Increased employment opportunities (positive) Increased economic opportunities in the area (positive) Increased potential for increased land invasions Loss of land within construction domain Safety and Security
Heritage Resources	<ul style="list-style-type: none"> Disturbance and/or possible destruction of heritage resources

Table 13: Potential significant environmental impacts associated with the Operational Phase

Feature	Impact
Hydrology	<ul style="list-style-type: none"> Alteration of flow regimes Changes to seasonal flow patterns Quantity of water releases

Feature	Impact
Water Users	<ul style="list-style-type: none"> • Impact to existing pumps • Loss of use of existing canal
Water Quality	<ul style="list-style-type: none"> • Impact to sediment balance • Quality of water releases
Aquatic Ecology	<ul style="list-style-type: none"> • Impacts to migration of aquatic biota • Fragmentation of affected river - interruptions to river continuum
Riparian Habitat	<ul style="list-style-type: none"> • Destabilisation of channel morphology at river
Agricultural Potential	<ul style="list-style-type: none"> • Permanent loss of potential agricultural land and natural areas

13 SENSITIVE ENVIROMENTAL FEATURES

Within the context of the project area, cognisance must be taken of the following sensitive environmental features, attributes and aspects, for which mitigation measures are included in the EIA Report and EMPr (**Figure 25**):

- The EWR of the Berg Estuary.
- The existing agricultural activities and vineyards in the area.
- The affected landowners, farmers, and the existing water users in the area.
- The existing pumps located within the Berg River.
- All existing infrastructure and structures, including the powerlines and roads in the area, are regarded as sensitive and need to be safeguarded from construction activities.
- All traffic and pedestrians on the public roads are regarded as sensitive and measures need to be implemented to safeguard these road users.
- One of the two access roads will run along the northern boundary of the farm Sonquas Drift 648/1, which has been described and graded by CK Rumboldt & Partners (2014) as part of their Swartland Rural Heritage Survey as having a grading of IIIB.
- A collection of ESA artefacts, including a single handaxe were identified on the edge of a field and close to the Berg River and the location of the pump station and weir.
- A number of watercourses are affected by the project. These systems include the Berg River floodplain, valley bottom wetlands, hillslope seeps, depressions and numerous drainage channels.
- The proposed developments encroach on the 1:100 year floodline, traverse wetlands and thus fall within 500m of a wetland.

- Both pipeline Alternatives 1 and 3 fall within the CBA and ESA: restore categories. Discharge Point 2 falls within the CBA.
- One breeding pair of Blue Crane (*Anthropoides paradiseus*) was noted on Gouklip Farm, near the proposed Pump station and Laydown Area 3.
- The Great White Pelican (*Pelecanus onocrotalus*) was observed on site and is listed as Vulnerable.
- One endemic species recorded on site was the Jackal Buzzard (*Buteo rufofuscus*).
- The proposed developments fall within two Critically Endangered vegetation units: Swartland Alluvium Fynbos and Swartland Shale Renosterveld.
- Three Terrestrial Threatened Ecosystems are affected by the proposed developments: Atlantis Sand Fynbos, Swartland Alluvium Fynbos, and Swartland Shale Renosterveld.
- No threatened species or plant species of conservation importance were noted on the proposed development areas.
- The Voëlvlei Nature Reserve is located on the Dam but is not impacted on by the proposed developments.
- Alternative 3 is situated adjacent to the Voëlvlei Nature Reserve and there is high probability of encountering and destroying the habitat of the CR Geometric Tortoise.
- Two Red Data frog species are known to occur in the region of the proposed development sites-namely Cape Rain Frog (*Breviceps gibbosus*) and Cape Caco (*Cacosternum capense*), both listed as Vulnerable, and the probability of occurrence of these species on the study area is high.

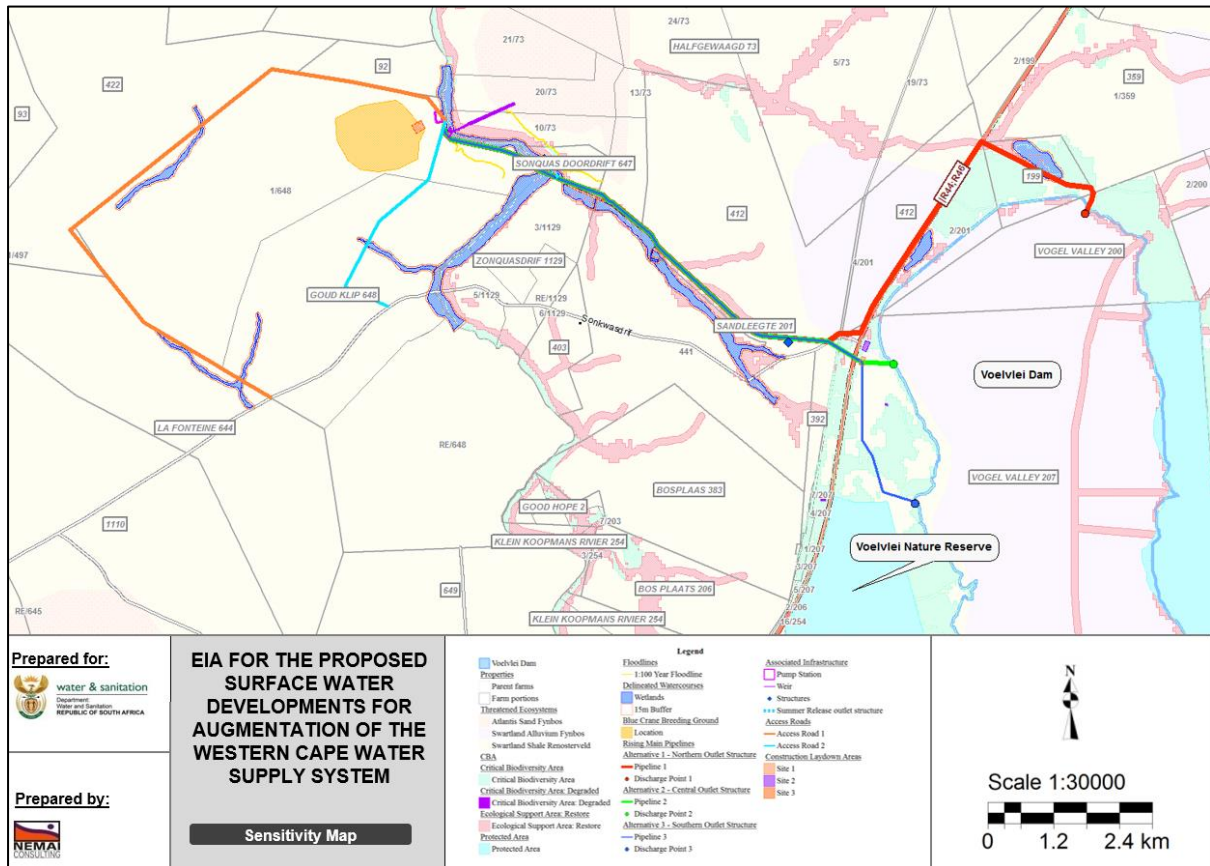


Figure 25: Sensitivity Map

The sensitivity map shown in **Figure 25** needs to be made available to the implementation team (including the Project Manager, Environmental Control Officer (ECO) and Contractor) in GIS format to allow for further consideration and adequate interpretation at an appropriate scale.

14 IMPACT MANAGEMENT

The basis for the management measures which follow below comprise of the following:

- **Management objectives** – i.e. desired outcome of management measures for mitigating negative impacts and enhancing the positive impacts related to project activities and aspects (i.e. risk sources);
- **Targets** – i.e. level of performance to accomplish management objectives; and
- **Management actions**– i.e. practical actions aimed at achieving management objectives and targets;
- **Responsibilities**; and
- **Monitoring requirements.**

14.1 Environmental Principles

The following principles should be considered at all times during the pre-construction and construction phase activities.

The environment is considered to be composed of both biophysical and social components.

- Construction is a disruptive activity and all due consideration must be given to the environment, including the social environment, during the execution of a project to minimise the impact on affected parties.
- Minimisation of areas disturbed by construction activities (i.e. the footprint of the construction area) should minimise many of the construction related environmental impacts of the project and reduce rehabilitation requirements and costs.
- As minimum requirements, all relevant standards relating to international, national, provincial and local legislation, as applicable, shall be adhered to. This includes requirements relating to waste emissions (e.g. hazardous, airborne, liquid and solid), waste disposal practices, noise regulations, road traffic ordinances, etc.
- Every effort should be made to minimise, reclaim and/or recycle “waste” material.

14.2 Pre-Construction Phase

The planning or pre-construction phase largely entailed conducting the necessary specialist studies, determining the site layout and carrying out the requisite environmental processes to obtain authorisation.

General requirements during the pre-construction phase include the following:

- Design to consider and incorporate environmental requirements.
- Define and communicate roles and responsibilities for the implementation of the EMPr.
- Develop and implement an environmental awareness programme.
- Compile and implement an employment strategy construction labour.

14.2.1 Specialist Environmental Investigations

Management Objective:

- Identify sensitive and protected environmental features in addition to those that have been identified as part of the BA process.

Target:

- All sensitive and protected environmental features to be identified in the construction domain (all the components of the project).

- All relevant approvals to be obtained prior to relocation of red data, protected and endangered flora and fauna species, medicinal plants, heritage resources and graves.

Management Actions:

- Suitable specialist(s) to identify sensitive environmental features (including watercourses, fauna, and flora) where special care needs to be taken and implement suitable mitigation measures to safeguard these features (e.g. barricading, signage and awareness creation).
- Baseline studies should be undertaken to be completed as soon as possible before implementation commences in order to provide a benchmark against which impacts resulting from the construction and operation of the project can be measured. Aspects to be included are water quality, terrestrial ecology, air quality and noise.
- Given that construction activities will expose workers and landowners to excessive noise rating levels, it is recommended that a baseline noise survey also be conducted as soon as possible following commencement of site activities – in accordance with the requirements of the Noise Induced Hearing Loss Regulations (OHS Act 85 of 1993) and SANS 10083:2004.
- A Search, Rescue and Relocation Plan needs to be developed that takes into consideration Red data, protected and endangered flora and fauna species (amongst others). In this regard, attention will be given to the red data reptile species, namely Geometric Tortoise. All relocations will need to comply with the requirements of Cape Nature and Nature Conservation Ordinance of the Western Cape Province.
- It is recommended that a Maintenance Management Plan (MMP) be developed to ensure that future maintenance activities associated with the proposed development are assessed and taken into consideration.

Responsibilities:

- DWS / implementing agent to appoint suitably qualified specialists.
- Specialists to execute the management actions.

Monitoring Requirements:

- Approval by relevant environmental authorities.

14.2.2 Construction Site Planning and Layout

Management Objective:

- Appropriate planning and layout of construction site to ensure environmental protection.

Target:

- No negative impacts to sensitive environmental features as a result of construction site planning and layout.

Management Actions:

- Conduct a pre-construction survey of the area to be affected by the development. This must include site investigations with photographic records.
- Suitable specialist(s) are to identify sensitive environmental features (including fauna, flora and heritage sites) where special care needs to be taken, and implement the required suitable mitigation measures to safeguard these features (e.g. barricading, signage and awareness creation).
- Before construction commences, all sensitive habitats must be clearly demarcated with fencing or orange mesh netting. These sensitive areas are to be defined in accordance with recommendations from the appointed specialists including a botanist, zoologist and an archaeologist. Barricading measures to be utilised should not restrict the movement of the fauna in the area.
- No access to no-go areas without the permission of the Project Manager.
- The Contractor to develop method statements to be approved by the Project Manager prior to construction taking place. The plan must show the following (as relevant), as a minimum:
 - Buildings and structures;
 - Contractors' camp and lay down areas;
 - Site offices;
 - Roads and access routes;
 - Gates and fences;
 - Essential services (permanent and temporary water, electricity and sewage);
 - Rubble and waste rock storage and disposal sites;
 - Solid waste storage and disposal sites;
 - Site toilets and ablutions;
 - Topsoil stockpiles;
 - Construction materials stores;
 - Workshops;
 - Wash bays;
 - Vehicle and equipment stores;
 - Sensitive environmental features; and
 - Any other activities, facilities and structures deemed relevant.

Responsibilities:

- Proponent – acquire permits.
- Project Manager/engineer and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Photographic record as part of the pre-construction survey of areas to be affected by construction activities.
- Approved site plan.
- Barricading and signage.
- Records of awareness creation.

14.2.3 Environmental Awareness Creation

Management Objective:

- Ensure that the Contractor, construction workers and site personnel are aware of the relevant provisions of the EMPr.

Target:

- All construction workers and employees to have completed appropriate environmental training.
- A record of environmental training undertaken to be kept on site.

Management Actions:

- The Contractor must arrange that all of his employees and those of his sub-contractor go through the project specific environmental awareness training courses before the commencement of construction and as and when new staff or sub-contractors are brought on site.
- The environmental training is compulsory for all employees and structured in accordance with their relevant rank, level and responsibility, as well as the Environmental Specification as they apply to the works and site.

Responsibilities:

- Project Manager/engineer and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Public complaints register.
- Records of environmental training and awareness creation.

14.2.4 Ongoing Consultation with Community and Affected Parties

Management Objective:

- Establish and maintain a record of all complaints and claims against the project and ensure that these are timeously and effectively verified and responded to.

- Adhere to agreements made with landowners and community members regarding communication.

Target:

- All complaints and claims are to be acknowledged within five (5) working days and are to be responded to within 10 working days of receipt, unless additional information and / or clarification are required.
- No deviations from agreements made with landowners and community members.

Management Actions:

- Establish lines of communications with affected parties, landowners, and community members.
- Establish processes and procedures to effectively verify and address complaints and claims received.
- Complaints or liaison with affected parties, landowners, and community members with regard to environmental aspects, compensation or disturbance to activities or animals, must be recorded, reported to the correct person and a record of the response is to be entered in the complaints register.
- Provide the relevant contact details to affected parties, landowners, and community members for queries / raising of issues or complaints.
- Continued liaison with authorities with regards to compliance with the EA.

Responsibilities:

- Project Manager/engineer and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Public complaints register.

14.3 Construction Phase

14.3.1 Site Clearing

Management Objective:

- Manage environmental impacts associated with site clearing.
- Ensure that only areas that are specifically required for the construction purposes are cleared.

Target:

- No damage is caused to sensitive environmental features outside of the demarcated construction areas, including marked and barricaded heritage resources, protected trees, watercourses, agricultural areas, structures and infrastructure.

Management Actions:

- Restrict site clearing activities to construction area / domain.
- Clearing of vegetation to be conducted in a phased manner (where possible), with due consideration of the search and rescue activities. Vegetative cover for sensitive areas such as riparian zones is to remain for as long as possible.
- A Method Statement is to be developed, which will provide the details of how site clearing will be executed. Where possible, clearing by hand is recommended in order to create employment opportunities.
- Maintain barricading around sensitive environmental features.
- Avoid any disturbance to demarcated sensitive environmental features.
- Suitably experienced personnel (relevant to the potentially affected environmental features) to monitor the clearing activities, with particular focus on heritage resources, as well as protected fauna and flora species.

Responsibilities:

- Project Manager/engineer and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- No clearing outside of construction domain.
- Intact barricading.
- Public complaints register.
- Contractor's method statement.

14.3.2 Site Establishment

Management Objective:

- Minimise environmental impacts associated with site establishment.

Target:

- No damage to the environment outside construction area during site establishment.
- No access or encroachment into no-go areas.
- No justifiable complaints regarding general disturbance and nuisance received from the affected parties and community members.

Management Actions:

- The Contractor is to produce a site plan for the approval by the Project Manager/Engineer prior to the establishment of the site, which aims to identify construction activities, facilities and structures in relation to sensitive environmental features. This plan will serve as a spatial tool that facilitates the execution of the construction phase with due consideration of sensitive environmental features.
- Locate construction and labour camps in areas where sensitive environmental features will not be impacted on.
- Facilities and structures shall be located with due cognisance of the terrain and geographical features of the project site.
- Positioning of the storage and laydown areas should aim to minimise visual impacts.
- Control the movement of all vehicles and plant (including suppliers), such that they remain on designated routes and comply with relevant agreements.
- Maintain barricading around sensitive environmental features until the cessation of construction works.
- Ensure noise levels of construction activities and equipment are within their lawfully acceptable limits as per SANS 10103.
- Minimise public disturbance from lighting of the construction camp and site. For example, proper design of the placing (zones), height, type, direction (inward rather than outward) and intensity of floodlights, without compromising safety.
- The extent of the site should by all means be limited, to avoid any additional clearance of vegetation.
- The Contractor shall comply with all safety requirements enforced; these include emergency evacuation procedures, fire preventative measures, etc.
- The Contractor shall supply firefighting equipment in proportion to the fire risk presented by the type of construction and other on-site activities and materials used on site. This equipment shall be kept in good operating order. This particularly applies to welding activities, etc.
- No smoking allowed on the site. The contractor is to provide designated safe smoking areas.
- Every precaution should be taken, to prevent pollution of air, soil, ground and surface water as a result of construction or associated activities at the construction site.

Responsibilities:

- Project Manager/engineer and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Intact barricading.
- Contractor's method statement.
- Public complaints register.

14.3.3 Management of Construction Camp and Eating Areas

Management Objective:

- Minimise environmental impacts associated with the construction camp and eating areas.

Target:

- No environmental contamination associated with the construction camp.
- Minimise visual impact associated with the construction camp.
- No complaints regarding the construction camp.

Management Actions:

- Construction/labour camp to be screened to minimise the visual impact, where practicable.
- The Contractor shall provide eating areas for all staff. Eating areas be cleaned on a daily basis and shall provide adequate temporary shade.
- Open uncontrolled fires will be forbidden at the site camp. Rather, 'contained' cooking mechanisms will be used (e.g. gas stoves or an enclosed braai facility).
- Eating areas will be designated and demarcated.
- Refuse bins must be placed at all eating areas.
- The feeding, or leaving of food for animals, is strictly prohibited.
- Sufficient vermin / weatherproof bins will be present in this area for all waste material.
- Dishwashing facilities will be provided to ensure that wastewater is disposed of appropriately.
- Failure to comply with the general code of conduct, or the rules and procedures implemented at the construction camp will result in disciplinary actions.
- Provide safe potable water for food preparation, drinking and bathing.
- Prohibit the felling of trees for firewood.
- Provide medical and first aid facilities at the camp area.

Responsibilities:

- Project Manager/engineer and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Public complaints register.
- Contractor's method statement.
- Disposal certificates.

14.3.4 Management of Ablution Facilities

Management Objective:

- Minimise environmental impacts associated with ablution facilities.

Target:

- No environmental contamination associated with ablution facilities.
- Minimise visual impact associated with ablution facilities.

Management Actions:

- Provide sufficient ablution facilities (e.g. mobile / portable / VIP toilets) at the construction camp and along construction sites, which conform to all relevant health and safety standards and codes.
- No pit latrines, trench drain systems or soak away systems shall be allowed. Install and maintain conservancy tanks for any residential labour camp and site offices. The location of conservancy tanks is to be approved by the Project Manager/Engineer.
- Toilets may not be situated within 100m of any water body or within the 1:100 year flood line.
- A sufficient number of toilets shall be provided to accommodate the number of personnel working in any given area. Toilets may not be further than 100 m from any working area. Toilet facilities supplied by the Contractor for the workers shall occur at a maximum ratio of 1 toilet per 15 workers.
- All staff to use the provided toilets at all times.
- All temporary / portable / mobile toilets shall be secured to the ground to prevent them from toppling over due to wind or any other cause.
- Some form of screened off changing facility must be provided separately for each sex.
- All sanitary fees that may be payable to any local authority shall be paid by the Contractor.
- Ablutions are to be cleaned/emptied on a regular basis, before they are full and contaminate the environment.
- Informal ablutions within riparian areas must be prohibited.
- The entrances to the toilets will be adequately screened from public view.
- Sanitary hygiene bins will be provided for female staff.
- Toilet paper shall be provided.
- The Contractor will ensure that no spillage occurs when the toilets are cleaned or emptied and that a licensed service provider removes the contents from site. Disposal of such waste is only acceptable at a licensed waste disposal facility.
- Should shower facilities be provided for use by staff staying on site, the following controls must be imposed:

- Positioning of the shower, and specifically its discharge point, will be carried out to ensure that erosion and build-up of detergents does not occur.
- All discharge from the shower and other washing facilities must be managed to prevent environmental contamination.
- Use of the shower facilities must be limited to staff or authorised persons only.

Responsibilities:

- Project Manager/engineer and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Public complaints register.
- Maintenance register for ablution facilities.
- Disposal certificates.
- Contractor's method statement.

14.3.5 Management of Workshop and Equipment

Management Objective:

- Minimise environmental impacts associated with workshops and equipment use.

Target:

- No environmental contamination associated with workshops and equipment use.

Management Actions:

- Maintenance of equipment and vehicles will be performed in such a manner so as to avoid any environmental contamination (e.g. use of drip trays).
- All vehicles and equipment will be kept in good working order and serviced regularly. Leaking equipment will be repaired immediately or removed from the site.
- Suitable storage and disposal of hydraulic fluids and other vehicle oils.
- All diesel powered equipment and vehicles used in construction activities must be suitably serviced, maintained and repaired in order to minimise the emission of diesel particulate matter and reduce subsequent worker exposure to this carcinogenic substance.
- All vehicles and equipment will be kept in good working order and serviced regularly. Leaking equipment will be repaired immediately or removed from the site.
- Emergency on-site maintenance should be done over appropriate drip trays and all oil or fuel must be disposed of according to waste regulations. Drip-trays must be placed under vehicles and equipment when not in use.

- No washing of plant may occur on the construction site. Plant to be washed in dedicated areas.
- Drip trays will be provided for the stationary plant and for the "parked" plant.

Responsibilities:

- Project Manager/engineer and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Recorded evidence of spillages.
- Vehicle and equipment checklists
- Training register.
- Contractor's method statement.

14.3.6 Fencing and Barricades

Management Objective:

- To ensure and assist with controlled fencing and barricades in the working environment.
- Minimise disturbance to animals.

Target:

- Provide a clearly demarcated and safe working area.
- No direct harm to fauna due to inadequate fencing arrangements.

Management Actions:

- No pedestrian or vehicular access shall be allowed to such fenced areas.
- In places where temporary fencing is required, the Contractor shall erect such fencing when and where required and re-erect and maintain temporary fencing as necessary. Temporary fencing shall remain in position either until it is replaced by permanent fencing or until completion of the works.
- On farms or in areas where livestock / game occur, erect fences according to appropriate specifications (depending on the type on animals that occur on the farms) for the construction camps and construction servitude to protect animals from construction-related activities.
- Any fences damaged by the Contractor shall be repaired as soon as possible at his/her cost, and shall be of the standard of the original fence.
- Fences should be constructed to meet the following requirements:
 - The fence should be straight and vertical;
 - All the straining posts should be firmly and vertically anchored;

- All the posts should extend to the same height above ground level by corresponding to the terrain form;
- The straining posts and droppers should not be too far apart – the closer they are, the firmer the fence;
- Each wire strand should be firmly attached to the standards or line posts at a specific height above ground level and should be a certain distance apart from each other;
- The droppers should be neatly and evenly spaced between the standards. The wire strands should be firmly attached to maintain the proper space between the strands and to prevent vertical movement;
- Fences should never be constructed of inferior quality material. Therefore, fencing material with the SABS mark should be used; and
- Comply with Nature and Environmental Conservation Ordinance (Act No. 19 of 1974) with regards to the accommodation of relevant large mammal species.
- All fences erected for construction purposes (e.g. fences around camp sites, fencing around trenches, etc.) should be inspected on a daily basis to detect whether any damage has occurred. Damaged fences / barricading to be repaired immediately.

Responsibilities:

- Project Manager/Engineer and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Public complaints register.
- Agreements with landowners.
- Fencing register.

14.3.7 Management of Labour Force

Management Objective:

- Ensure suitable management of labour force to prevent security-related issues.
- Optimise the use of local labour.
- Provide a work environment that is conducive to effective labour relations.

Target:

- No complaints from landowners, affected parties, and community members regarding trespassing or misconduct by construction workers.
- All unskilled labour to be sourced from local communities.

Management Actions:

- Prevent trespassing of construction workers onto private property.
- Workers should be provided with identity cards and should wear identifiable clothing.
- Make suitable provision for transport and/or accommodation of workforce.
- Creating nuisances and disturbances in or near communities shall be prohibited.
- Machine / vehicle operators shall receive clear instructions to remain within demarcated access routes and construction areas.
- Designated and demarcated smoking areas should be provided, with special bins for discarding of cigarette butts.
- Create opportunities for the employment of women.
- Use local labour as far as possible, where necessary (e.g. unskilled labour).
- Develop a community labour agreement with targets for employment and for progression.
- Training of labour to benefit individuals beyond completion of the project.
- Local people should be employed to increase support for the project and reduce the potential for criminal activities.

Responsibilities:

- Proponent – employment targets.
- Project Manager and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Public complaints register.
- Labour-related targets.

14.3.8 Management of Health and Safety

Management Objective:

- Provide a safe and healthy working environment to construction workers and the public.

Target:

- Approved Health and Safety Plan.
- No incidents.
- Compliance with the Occupational Health and Safety Act (Act No. 85 of 1993), Construction Regulations (2003) and other relevant regulations.

Management Actions:

Health –

- The Construction Regulations (OHS Act 85 of 1993) require that all contractors conduct an initial health risk assessment of their workers activities prior to initiating any work on site.
- All construction workers should be subject to baseline (pre-employment) medical examinations. In addition, members of the community should be encouraged to undergo voluntary examination/testing. The structure of these examinations should be at the discretion of a registered Occupational Medical Practitioner but should include appropriate testing for:
 - Tuberculosis.
 - HIV (voluntary consent but strongly encouraged).
 - Syphilis.
 - Other STI.
- Workers must be made familiar with the routes of exposure to STI and TB as well as ways to reduce the risks and/or prevent infection.
- Ensure all workers are medically fit to conduct their activities, with priority being given to those workers required to engage in manual physical labour activities – pre-employment medical examinations are recommended.
- Ensure that all workers are suitably informed and trained in the signs and symptoms of heat stress which they may be exposed in the course of their work.
- Ensure that all workers are trained in appropriate measures to prevent heat stress related injuries or illnesses. Informing workers of the need to drink regular quantities of water should be prioritised. Ready access to drinking water must be provided at all work locations.
- Issuing of appropriate protective wear (jackets, hats and gloves) should suffice in preventing workers from developing any adverse health effects following exposure to cold working conditions.
- Drafting of a formal malaria control plan for the construction sites is recommended. Consideration could be given to initiating an appropriate chemical control programme at worker accommodation sites. Spraying of effective insecticides to control mosquito populations is an effective way of reducing the risk of malaria and advice on residual spray methods should be obtained from the relevant authority.
- Educating workers in ways and means of preventing malaria is also recommended.
- The incidence of Schistosomiasis should be confirmed in the study area by appropriate specialists, preferably before construction begins. Education and training of workers in ways and means of reducing their risks of infection.

Safety –

- First aid officers should be trained on site (levels 1 to 3) to deal with construction related injuries.

- When working in the area of encroachment is prevalent all open excavated trenches and foundations should be clearly marked and secured to keep people and fauna from falling in.
- Storage areas, assembling areas where construction material is stored on site should similarly be secured. No stacking and storing of material will be allowed underneath any operational power lines.
- The Principal Contractor must establish site access rules and implement and maintain these throughout the construction period. Access control must, amongst other, include the rule that non-employees will not be allowed on site unaccompanied.
- Access by non - construction staff into any construction related sites should be restricted and clearly indicated as such by signposts.
- Maintain access control to prevent access of the public to the construction areas.
- The requirements of the Occupational Health and Safety Act (Act 85 of 1993) and related regulations shall be adhered to.
- Speed limits shall be enforced in all areas, including public roads and private properties. All drivers of the construction teams shall be sensitised to this effect and courteous behaviour is expected from everybody in this regard.
- Fencing and barriers will be in place in accordance with the Occupational Health and Safety Act (Act No. 85 of 1993).
- Comply with the provisions of the Fencing Act (Act No. 31 of 1963).
- Applicable notice boards and hazard warning notices will be put in place and secured. Night hazards will be indicated suitably (e.g. reflectors, lighting, and traffic signage).
- Emergency contact details will be prominently displayed.
- All construction personnel must be clearly identifiable. All employees must also be issued with employee cards for identification purposes.
- All workers will be supplied with the required Personal Protective Equipment as per the Occupational Health and Safety Act (Act No. 85 of 1993).
- Appropriate signage must be posted to this effect and all employees on site must be instructed to ensure that non-employees are protected at all times. All non-employees entering the site must receive induction into the hazards and risks of the site and the control measures to be observed.
- The integrity of property fences must be maintained.
- No telephone lines must be dropped during the construction operations, except where prior agreement by relevant parties is obtained. All crossings must be protected, raised or relocated as necessary.
- All complaints and/or problems related to impacts on man-made facilities and activities must be promptly addressed by the Contractor and documented.

Responsibilities:

- Project Manager and ECO – to check.
- Dedicated Occupational Health and Safety system to be implemented by Contractor's Safety Officer. To be monitored and audited by the Client's Safety Agent, in terms of the Construction Regulations (2003).
- Contractor to implement management actions.

Monitoring Requirements:

- Occupational Health and Safety system – checked by Safety Agent.

14.3.9 Management of Emergency Procedures

Management Objective:

- Minimise environmental impacts associated with emergency procedures.

Target:

- No site fires to be caused by construction activities and workers.
- Approved emergency response procedures, where relevant.

Management Actions:

Fire –

- Comply with the National Veld and Forest Fire Act (No. 101 of 1998).
- Proper emergency response procedure to be in place for dealing with fires.
- Burning of waste is not permitted.
- Suitable precautions will be taken (e.g. suitable fire extinguishers, water bowsers, welding curtains) when working with welding or grinding equipment.
- All fire control mechanisms (firefighting equipment) will be routinely inspected by a qualified investigator for efficacy thereof and be approved by local fire services.
- All staff on site will be made aware of general fire prevention and control methods, and the name of the responsible person to alert to the presence of a fire.
- No fires are allowed on site, unless in dedicated areas approved by the Project Manager.
- Dedicated smoking areas to be provided. Cigarette butts may not be disposed of onsite.

Accidental Leaks and Spillages –

- Proper emergency response procedure to be in place for dealing with spills and leaks.
- Ensure that the necessary materials and equipment for dealing with spills and leaks are available on site, where practicable.
- Remediation of the spill areas will be undertaken to the satisfaction of the Project Manager and ECO.

- In the event of a hydrocarbon spill, the source of the spillage will be isolated and contained. The area will be cordoned off and secured. The Contractor will ensure that there is always a supply of an appropriate absorbent material readily available to absorb, breakdown and where possible, encapsulate a minor hydrocarbon spillage.
- All staff on site will be made aware of actions to be taken in case of a spillage.
- Provide contact details of person to be notified in a case of spillages – signage to be displayed at strategic points within the construction domain (e.g. workshop, fuel storage area, hazardous material containers).

Responsibilities:

- Project Manager and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Approved Emergency Response Plan.
- Training and awareness creation records.
- Signage displayed.
- Contractor's method statement.

14.3.10 Management of Access and Traffic

Management Objective:

- Ensure that all construction vehicles use only dedicated access routes to construction sites.
- Ensure that landowners and community members have reasonable access to the land during construction.
- Ensure proper access control.
- Prevent unlawful access to construction domain.
- Adhere to agreements made with individual landowners and community members regarding access.
- Ensure the safety of all road users by implementing proper signage and traffic control measures.
- Limit construction-related nuisance to service nodes.

Target:

- No reports of construction vehicles using other unauthorised routes.
- No transporting of unsafe loads. Permits are to be obtained for abnormal loads.
- No speeding.
- No accidents.

Management Actions:

- Signs must be placed along construction roads to identify speed limits, travel restrictions, and other standard traffic control information.
- Undertake negotiations and confirm arrangements with landowners and community members regarding the use of traffic arrangements.
- Site access should be controlled and no unauthorised persons should be allowed onto the site.
- Any clearing for access or haul roads outside the demarcated works area shall only be undertaken after approval from the Project Manager/ Engineer.
- Ensure appropriate traffic safety measures are implemented.
- The Contractor must comply with all driving, vehicle, licensing and driver ability requirements.
- Permission required from the Project Manager for the movement of any vehicles and/or personnel outside of designated working areas.
- Existing roads shall be used as far as possible for construction purposes.
- Contractor to ensure safe access for adjacent landowners on all roads.
- Wet suppression of unpaved areas should be applied during dry windy periods, using a water cart and/or fixed sprinklers.
- Chemical suppression can also be used in conjunction with wet suppression. This involves the use of chemical additives in the water, which help to form a crust on the surface and bind the dust particles together. Chemical stabilisation reduces watering requirements, but any savings can be offset by the cost of the additives. Repeat treatments are usually required at intervals of 1-4 weeks. The method is best suited to permanent site roads and usually not cost-effective on temporary roads, which are common in construction sites.
- Provide hard-standing areas for vehicles and regularly inspect and clean these areas.
- The Principal Contractor shall organise the site in such a manner that pedestrians and vehicles can move safely and without risks to health, including sufficient and suitable traffic routes and safe walkways with relevant signage.
- Access roads to be maintained in a suitable condition.
- Suitable erosion protective measures to be implemented for access roads during the construction phase.
- Traffic safety measures (e.g. traffic warning signs, flagmen) to be implemented.
- Consult with landowners, local authorities and communities to ensure that all affected parties are informed of the timing and extent of any disruptions.
- An access control plan should be developed.

Responsibilities:

- Project Manager and ECO – to check.

- Contractor to implement management actions.

Monitoring Requirements:

- Signage displayed and maintained.
- Public complaints register.
- Contractor's method statement.

14.3.11 Management of Waste

Management Objective:

- Minimise environmental impacts associated with waste.
- Apply waste management principles of prevent, minimise, recycle or re-use, with disposal as a last option.

Target:

- No littering on construction site.
- Maintain a clean and tidy construction site.
- 100% record of all waste generated and disposed at waste disposal facilities.
- Valid disposal certificates for all waste disposed.
- Provision of adequate waste containers that are easily accessible and maintained.
- Waste bins to be removed and cleaned weekly.

Management Actions:

- Waste management activities must comply with the National Environmental Management: Waste Act (Act No. 59 of 2008).
- Vermin / weatherproof bins will be provided in sufficient numbers and capacity to store domestic waste. These bins must be kept closed to reduce odour build-up and emptied regularly to avoid overflowing and other associated nuisances.
- Where possible, waste must be separated at source (e.g. containers for glass, paper, metals, plastics, organic waste and hazardous wastes).
- Provide waste skips at the construction areas. These skips should be sufficient in number, the skip storage area should be kept clean, skips should be emptied and replaced before overflowing or spillage occurs.
- Ensure daily site clean-ups to prevent the build-up of litter
- The Contractor will ensure that no burying, dumping or burning of waste materials, vegetation, litter or refuse occurs. All waste will be disposed of at suitable licensed disposal sites, based on the waste type (general versus hazardous).
- Ensure that solid waste is transported so as to avoid waste spills en-route.
- The following requirements shall be incorporated into the waste management programme:

- Solid Waste:
 - Littering on site and the surrounding areas is prohibited.
 - Clearly marked litterbins must be provided on site. The Contractor must monitor the presence of litter on the work sites as well as the construction campsite.
 - All bins must be cleaned of litter regularly.
 - All waste removed from site must be disposed of at a municipal/permitted waste disposal site.
 - Excess concrete, building rubble or other material must be disposed of in areas designated specifically for this purpose and not indiscriminately over the construction site.
 - The entire works area and all construction sites must be swept of all pieces of wire, metal, wood or other material foreign to the natural environment.
 - Contaminated soil must be treated and disposed of at a permitted waste disposal site, or be removed and the area rehabilitated immediately.
 - Waste must be recycled wherever possible.
- Liquid Waste
 - The Principal Contractor must install and maintain mobile toilets at work sites.
 - The Principal Contractor must provide adequate and approved facilities for the storage and recycling of used oil and contaminated hydrocarbons. Such facilities must be designed and sited with the intention of preventing pollution of the surrounding area and environment.
 - All vehicles must be regularly serviced in designated area within the Contractors camp such that they do not drip oil. Where required, vehicles will be serviced in bunded areas and drip trays will be provided.
 - All chemical spills must be contained and cleaned up by the supplier or professional pollution control personnel. Run-off from wash bays must be intercepted.
- Hazardous Waste:
 - No hazardous materials must be disposed of in the veld or anyplace other than a registered landfill for hazardous material. Hazardous waste must be stored in containers with tight lids that must be sealed and must be disposed at an appropriately permitted hazardous waste disposal site. Such containers must not be used for purposes other than those originally designed for.

- The Principal Contractor must maintain a hazardous material register.

Responsibilities:

- Project Manager and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Public complaints register.
- Waste register.
- Recycling targets.
- Disposal certificates.
- Contractor's method statement.

14.3.12 Management of Storage and Handling of Non-Hazardous Material

Management Objective:

- Effective and safe management of materials on site, in order to minimise the impact of non-hazardous materials on the environment.

Target:

- No pollution due to handling, use and storage of non-hazardous material.

Management Actions:

- Materials to be suitably stored to prevent environmental contamination and visual impacts. Storage requirements to be determined based on chemical qualities of material and Material Safety Data Sheets (MSDS).
- Where required, stored material to be protected from rain and run-off to avoid environmental contamination.
- Materials to be appropriately transported to avoid environmental contamination. Loose loads (e.g. sand, stone chip, refuse, paper and cement) to be covered.
- Suitable remedial measures, depending on the nature of the contaminant and the receiving environment, to be instituted for spillages.
- Materials to be suitably used to prevent environmental contamination.

Responsibilities:

- Project Manager/Engineer and ECO – checking.
- Contractor to implement management actions.

Monitoring Requirements:

- Evidence of spillages.

- MSDS register.
- Contractor's method statement.

14.3.13 Management of Storage and Handling of Hazardous Material

Management Objective:

- Ensure the protection of the natural environment and the safety of personnel on site, by the correct management and handling of hazardous substances.

Target:

- No pollution due to handling, use and storage of hazardous material.
- In the event of a spill, appropriate containment, clean up and disposal of contaminated material. Spills to be cleaned within 24 hours.

Management Actions:

- Hazardous substances must be stored and handled in accordance with the appropriate legislation and standards, which include the Hazardous Substances Act (Act No. 15 of 1973), the Occupational Health and Safety Act (Act No. 85 of 1993), relevant associated Regulations, and applicable SANS and international standards.
- Storage and use of hazardous materials will be strictly controlled to prevent environmental contamination, and must adhere to the requirements stipulated on the MSDS.
- Where flammable liquids are being used, applied or stored the workplace must be effectively ventilated.
- No person may smoke in any place in which flammable liquid is used or stored.
- Install an adequate number of fire-fighting equipment in suitable locations around the flammable liquids store.
- Where flammable liquids are decanted, the metal containers must be bonded or earthed.
- No flammable material (e.g. paper, cleaning rags or similar material) may be stored together with flammable liquids.
- Staff that will be handling hazardous materials must be trained to do so.
- Any hazardous materials (apart from fuel) must be stored within a lockable store with a sealed floor. Suitable ventilation to be provided.
- All storage tanks containing hazardous materials must be placed in bunded containment areas with impermeable surfaces. The bunded area must be able to contain 110% of the total volume of the stored hazardous material.
- MSDSs, which contain the necessary information pertaining to a specific hazardous substance, must be present for all hazardous materials stored on the site.
- Spill kits must be available for the clean-up of hazardous material spillages.
- Provide secondary containment where a risk of spillage exists.

- Drip trays to be placed under parked heavy vehicles, equipment and other receptacles of hazardous material to prevent spillages.
- In the event of spillages of hazardous substances, the appropriate clean up and disposal measures are to be implemented.
- Spill reporting procedures to be displayed at all locations where hazardous substances are being stored.
- Hazardous materials will be disposed of at registered sites or handed to registered hazardous waste disposal facilities for disposal / recycling.
- Proper and timeous notification of any pollution incidents associated with hazardous materials.
- Hazardous chemical substances containers be clearly marked with the contents and main hazardous category e.g. “Flammable” or “Corrosive”.

Responsibilities:

- Project Manager/Engineer and ECO – checking.
- Contractor to implement management actions.

Monitoring Requirements:

- Evidence of spillages.
- MSDS register.
- Training register.
- Disposal certificates.
- Contractor’s method statement.

14.3.14 Management of Pollution Generation Potential

Management Objective:

- Ensure that all possible causes of pollution are mitigated as far as possible to minimise impacts to the surrounding environment.

Target:

- No complaints regarding pollution.
- No measurable signs of pollution.
- Noise – Comply with SANS 10103:2008.

Management Actions:

General –

- No waste of a solid, liquid or gaseous nature shall be emitted from the site without approval by the Engineer.

- Accidental pollution incidents shall be reported to the ECO immediately they occur and shall be cleaned-up (to the satisfaction of the Co-ordinator Environmental Rehabilitation or ECO) by the Contractor or a nominated clean-up organization at the expense of the Contractor.

Soil –

The following requirements for soil pollution management shall apply:

- Soil must not be stockpiled on drainage lines or near watercourses without prior consent from the Project Manager.
- Soil should be exposed for the minimum time possible once cleared of invasive vegetation, that is the timing of clearing and grubbing should be co-ordinated as much as possible to avoid prolonged exposure of soils to wind and water erosion. Stockpiled topsoil must be either vegetated with indigenous grasses or covered with a suitable fabric to prevent erosion and invasion by weeds.
- All cut and fill surfaces need to be stabilized with appropriate material or measures when major civil works are complete.
- All equipment must be inspected regularly for oil or fuel leaks before it is operated. Leakages must be repaired on mobile equipment or containment trays placed underneath immobile equipment until such leakage has been repaired.
- Soil contaminated with oil must be appropriately treated and disposed of at a permitted landfill site or the soil can be regenerated using bio-remediation methods.
- Appropriate measures should be implemented in order to prevent potential soil pollution through fuel and oil leaks and spills and then compliance monitored by an appropriate person.

Noise –

- Construction site yards, concrete batching plants, asphalt batching plants, construction worker camps and other noisy fixed facilities should be located well away from noise sensitive areas. Once the proposed final layouts are made available by the contractor(s), the sites must be evaluated in detail and specific measures designed in to the system.
- Noisy fixed facilities should be located well away from noise sensitive areas. Once the proposed final layouts are made available by the Contractor(s), the sites must be evaluated in detail and specific measures designed in to the system.
- The provisions of SANS 10103:2008 will apply to all areas at the perimeter of the site, within audible distance of residents.
- Working hours to be agreed upon with Project Manager, so as to minimise disturbance to landowners and community members.
- No unnecessary noise disruption or disturbance during school hours is to be allowed.

- No amplified music will be allowed on the site. The use of radios, tape recorders, compact disc players, television sets etc. will not be permitted unless at a level that does not serve as an intrusion to adjacent land-owners.
- Construction activities generating output levels of 85 dB or more will be confined to the hours during normal working hours.
- The Contractor will take preventative measures (e.g. screening, muffling, timing, pre-notification of affected parties) to minimise complaints regarding noise and vibration nuisances from sources such as power tools.
- With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents on how best to minimise impact, and the local population should be kept informed of the nature and duration of intended activities.

Dust –

- Dust impacts are to be minimised in order to protect the local orchards, crops and farm activities in the area.
- Appropriate dust suppression measures or temporary stabilising mechanisms to be used when dust generation is unavoidable (e.g. dampening with water, chemical soil binders, straw, brush packs, chipping), particularly during prolonged periods of dry weather. Dust suppression to be undertaken for all bare areas, including construction area, access roads, site yard, etc.
- Fine materials must be covered during transportation.
- Set speed limits of 35 km/hr or less for site traffic on paved roads and 10-15 km/hr on unpaved surfaces. Speed controls on vehicles have an approximately linear effect on dust emissions. Thus by reducing the speed from 30 km/hr to 15 km/hr dust emissions can be reduced by 50%.
- Speed limits to be strictly adhered to.
- The Contractor will take preventative measures to minimise complaints regarding dust nuisances (e.g. screening, dust control, timing, and pre-notification of affected parties).

Lights –

- Prior to construction the position and type of lighting will be planned to ensure unnecessary light pollution will be eliminated.
- All lighting installed on site must not lead to unacceptable light pollution to the surrounding community and natural environment (e.g. use of down-lighters).

Erosion –

- Protect areas of the construction site that are susceptible to erosion through suitable measures (e.g. watering, planting, retaining structures, commercial anti-erosion compounds).

- Particular care must be taken to prevent carrying of sediment onto roadways.
- Any erosion channels caused by construction activities to be suitably stabilised and rehabilitated.
- All efforts to prohibit ponding on surface and ensure stormwater runoff is channelled from the site must be made. The method used will be appropriate to the expected stormwater flows and the topography and geology of the site.
- Erosion and donga crossings must be dealt with as river crossings. Appropriate soil erosion and control procedures must be applied to all embankments that are disturbed and destabilized.

Cement and Concrete Batching –

- Cement mixing to take place on an impervious surface (e.g. cement mixing pit).
- Batching operations to take place in a designated area, which will be kept clean at all times.
- Location of batching plant to be approved by the Project Manager, with due consideration of the relevant management measures.
- Ensure separation of clean and dirty water from batching plant.
- Wastewater from batching operations to be suitably disposed of.
- Waste concrete and cement sludge to be removed on a regular basis (to prevent overflowing) and to be disposed of at a suitable facility.
- Unused cement bags will be stored in an area not exposed to the weather and packed neatly to prevent hardening or leakage of cement.
- Used cement bags will be stored so as to prevent windblown dust and potential water contamination. Used bags will be disposed of adequately at a licenced waste disposal facility.
- Limit concrete batching to single sites where possible.
- Concrete transportation will not result in spillage.
- Cleaning of equipment and flushing of mixers will not result in pollution, with all contaminated wash water entering the waste water collection system.
- To prevent spillage onto roads, ready mix trucks will rinse off the delivery shoot into a suitable sump prior to leaving the site.
- Suitable screening and containment will be in place to prevent windblown contamination from cement storage, mixing, loading and batching operations.
- All contaminated water and fines from exposed aggregate finishes will be collected and stored in sumps and will be adequately disposed of.
- All visible remains of excess concrete will be physically removed on completion of the plastering or concrete pouring and disposed of in an acceptable manner.
- Any spilled concrete to be cleaned up immediately.

Responsibilities:

- Project Manager and ECO – to check.
- Contractor to implement management actions.
- Contractor to conduct environmental monitoring for air quality (dust), noise and water quality.

Monitoring Requirements:

- Public complaints register.
- Evidence of pollution.
- Contractor's method statement.

14.3.15 Management of Topsoil

Management Objective:

- Ensure suitable removal, storage, transportation of topsoil for reuse during rehabilitation.

Target:

- >95% of recovered topsoil from disturbed areas to be stored for future use.
- No visual evidence of erosion from topsoil stockpiles.
- No visual evidence of erosion from areas where topsoil has been reinstated.

Management Actions:

- Topsoil from the construction camp should be stored for post-construction rehabilitation work and should not be disturbed more than is absolutely necessary.
- Topsoil should also be stored in such a way that does not compromise its plant-support capacity.
- Determine the average depth of the topsoil prior to excavations.
- Identify suitable areas to store topsoil.
- Stockpiled topsoil should not be compacted and should be replaced as the final soil layer. No vehicles are allowed access onto the stockpiles after they have been placed.
- Stockpiled soil should be protected by erosion-control berms if exposed for a period of greater than 14 days during the wet season. The need for such measures will be indicated in the site-specific report.
- Topsoil stripped from different sites must be stockpiled separately and clearly identified as such. Topsoil obtained from sites with different soil types must not be mixed.
- Remove topsoil from areas to be affected by construction activities.
- Topsoil to be adequately protected from contamination from construction activities and by aggregate, cement, concrete, fuels, litter, oils, domestic and industrial waste.
- Protect stored topsoil from compaction.
- Wind and water erosion-control measures to be implemented to prevent loss of topsoil.

- Do not store topsoil in drainage lines or areas exposed to strong winds or heavy rain.
- Following the construction phase, the topsoil should be used in rehabilitation of affected areas and landscaping around the development.

Responsibilities:

- Project Manager and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Topsoil stockpiles.
- Dust monitoring.
- Rehabilitated areas.
- Contractor's method statement.

14.3.16 Management of Excavations

Management Objective:

- Minimise environmental impacts associated with excavations.

Target:

- No damage to sensitive environmental features outside construction area during excavations.

Management Actions:

- Construction activities to remain within the designated construction areas.
- Subsoil and overburden should be stockpiled separately to be returned for backfilling in the correct soil horizon order.
- Suitable barricading to be erected around open excavations/trenches, as per the Construction Regulations (2003). Provide signage as a warning of open excavations.
- Divert runoff away from excavations, where necessary.
- Trench lengths will be kept as short as practically possible.
- Trench walls are to be stabilised using battering, shoring and bracing or similar techniques depending on the stability of the trench sides (where relevant).
- Inspect open trenches at least daily basis to ensure that animals have not become trapped. Such animals will be safely removed and released, where possible. Special equipment for handling of venomous snakes should be available on site to ensure safe removal.
- Filing of trenches to make provision for subsidence.

Responsibilities:

- Project Manager and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Barricading of excavations.
- Excavation register.
- Contractor's method statement.

14.3.17 Management of Blasting

Management Objective:

- Minimise environmental impacts associated with blasting.

Target:

- Compliance with blasting-related legislation and standards.
- No blasting-related impacts to private property, livestock or human health.

Management Actions:

- Prior to commencing with blasting activities, the blasting Contractor should submit a Method Statement which should comply with the Explosives Regulations (2003) and all relevant SANS standards and health and safety standards for mitigating blasting.
- The Contractor shall employ industry standard methods to control the impact of blasting and limit the risk of damage to buildings and structures by reducing blast vibrations induced in the rock mass, eliminating fly rock and limiting air-blast and noise to acceptable levels.
- Blast mats should be used wherever fly-rock may result in damage to any infrastructure or where it could result in death or injury of animals, or where damage could be caused to sensitive environmental features.
- Blasting operations should be controlled to ensure sound pressure levels are kept below the generally accepted 'no damage' level of 140 decibels.
- All explosives shall be transported, stored and handled in accordance with applicable laws and good design engineering and constructions practices.
- Blasting operations are to be strictly controlled with regard to the size of explosive charge in order to minimise noise and air blast, and timings of explosions. The number of blasts per day should be limited, blasting should be undertaken at the same times each day and no blasting should be allowed at night.

Responsibilities:

- Project Manager/Engineer and ECO - checking.
- Contractor to implement management actions.

Monitoring Requirements:

- Noise and vibration levels.
- Public complaints register.
- Contractor's method statement.

14.3.18 Management of Visual Aspects

Management Objective:

- Minimise impacts to the aesthetics / visual quality.
- Ensure that the visual appearance of the construction site is not an eyesore the adjacent areas.

Target:

- No complaints regarding impacts to visual quality.

Management Actions:

- The design of the new road and pump station should be designed positively contribute to the sensitive visual environment in both form and materiality.
- Advertising and lighting will be in accordance with relevant standards.
- Lighting must not constitute an eyesore / hazard to users of the road and the surrounding community.
- Lighting will be sufficient to ensure security but will not constitute 'light pollution' to the surrounding areas.
- The site will be shielded / screened to minimise the visual impact, where practicable.
- Where practicable, development designs to compliment the natural surroundings in order to preserve a sense of place.
- On-going housekeeping to maintain a tidy construction area.
- Discourage the unnecessary usage of high voltage lights during through-night construction. Lighting should be kept to an acceptable minimum and designed in position and height to minimise negative impact on surrounding inhabitants.
- The extent of unnecessary damage to natural surrounds must be kept to a minimum.

Responsibilities:

- Project Manager/Engineer and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Public complaints register.
- Contractor's method statement.

14.3.19 Management of Flora

Management Objective:

- Preserve protected flora species outside of construction areas.
- Control alien plants and noxious weeds.

Target:

- No unpermitted disturbance to protected flora species.
- Ongoing eradication of alien plants and noxious weeds.

Management Actions:

- Comply with the requirements of the National Environmental Management: Biodiversity Act (No. 10 of 2004), National Forests Act (No. 84 of 1998) and National Veld and Forest Fire Act (No. 101 of 1998).
- Photographs of protected and sensitive flora species must be displayed in the construction camp to heighten awareness.
- Construction activities should be restricted to the development footprint area and then the compliance in terms of footprint can be monitored by ECO.
- As much vegetation growth as possible should be promoted within the proposed development site in order to protect soils and to reduce the percentage of the surface area which is left as bare ground. In this regard special mention is made of the need to use indigenous vegetation species as the first choice during landscaping. The plant material to be used for rehabilitation should be similar to what is found in the surrounding area.
- As much vegetation growth as possible should be promoted within the wetland areas in order to protect soils, using indigenous vegetation species.
- During site preparation, topsoil and subsoil are to be stripped separately from each other and must be stored separately from spoil material for use in the rehabilitation phase. It should be protected from wind and rain, as well as contamination from diesel, concrete or wastewater.
- Larger exotic species that are not included in the Category 1b list of invasive species could also be allowed to remain for aesthetic purposes.
- Construction activities should be restricted to the development footprint area and then the compliance in terms of footprint can be monitored by ECO.
- No tree or shrub outside of the works area shall be felled, lopped, cut or pruned or burnt without the prior written approval of the ECO.
- ECO will ensure awareness of the Nature Reserve to the workers during the toolbox meetings
- The removal of plant material for medicinal purposes is prohibited.

- All flora species of conservation importance, bulbs and aloes that are found during the search and rescue action or construction should be removed and placed in the nursery and should be utilised during rehabilitation.
- The removal of any plant material from site, including flowers or bulbs is strictly prohibited unless unavoidable and essential for the purposes of construction.
- Appropriate measures should be implemented in order to prevent potential soil pollution through fuel and oil leaks and spills and then compliance monitored by an appropriate person.
- Make sure construction vehicles are maintained and serviced to prevent oil and fuel leaks.
- Emergency on-site maintenance should be done over appropriate drip trays and all oil or fuel must be disposed of according to waste regulations. Drip-trays must be placed under vehicles and equipment when not in use.
- Implement suitable erosion control measures.
- Promote awareness of all personnel.
- The establishment of pioneer species should be considered with the natural cycle of rehabilitation of disturbed areas, which assists with erosion control, dust and establishment of more permanent species. This can be controlled during construction phase and thereafter more stringent measures should be implemented during the rehabilitation and post rehabilitation.
- Larger exotic species that are not included in the Category 1b list of invasive species could also be allowed to remain for aesthetic purposes.
- The Contractor should employ personnel on site responsible for preventing and controlling of litter. Promote good housekeeping with daily clean-ups on site.
- During construction, refresher training can be conducted to construction workers with regards to littering, ad hoc veld fires, and dumping.
- No fires are allowed on site.
- Construction activities should be restricted to the development footprint area and then the compliance in terms of footprint can be monitored by ECO.
- Areas which could be deemed as no go should be clearly marked.
- Newly cleared soils will have to be re-vegetated and stabilised as soon as construction has been completed and there should be an on-going monitoring program to control and/or eradicate newly emerging invasives.
- All areas to be affected by the proposed project will be rehabilitated after construction and all waste generated by the construction activities will be stored in a temporary demarcated storage area, prior to disposal thereof at a licensed registered landfill site.
- As much vegetation growth as possible should be promoted within the proposed development areas in order to protect soils and to reduce the percentage of the surface area which is left as bare ground. In this regard special mention is made of the need to use indigenous vegetation species as the first choice during landscaping. The plant

material to be used for rehabilitation should be similar to what is found in the surrounding area.

Responsibilities:

- Proponent – acquire permits
- Project Manager and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Permits.
- Encroachment of alien invasive plants and noxious weeds.
- Successful rehabilitation.
- Contractor's method statement.

14.3.20 Management of Fauna

Management Objective:

- Ensure the protection of animals

Target:

- No direct / indirect harm to animals from construction activities.

Management Actions:

- Comply with the requirements of the National Environmental Management: Biodiversity Act (No. 10 of 2004), Natal Nature Conservation Ordinance 15 of 1974 and Animal Protection Act (No. 71 of 1962).
- Stringent and dedicated control of poaching.
- No wilful harm to any animals, unless a direct threat is posed to a worker's health or safety.
- Animals residing within the designated area shall not be unnecessarily disturbed.
- Any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person.
- Before construction starts, construction workers must be educated with regards to littering and poaching.
- During construction, refresher training can be conducted to construction workers with regards to littering and poaching.
- The Contractor and his/her employees shall not bring any domestic animals onto site.
- Toolbox talks should be provided to contractors regarding disturbance to animals. Particular emphasis should be placed on talks regarding snakes.

- Construction areas must be demarcated but should allow for the migration of small faunal species out of the construction zone. Fencing types must be selected for minimal disturbance to animal movement corridors (e.g. palisade fencing is preferable to diamond-mesh fencing).
- Open trenches inspected regularly ensure that animals have not become trapped. Such animals will be safely removed and released, where possible.
- With regards to other areas which may need to be fenced temporarily during construction, i.e. aloe area where moles were found, a normal stock fence can be utilised, either diamond or rectangular fencing.
- Prior to construction, animal species of conservation importance (such as Geometric Tortoise and Blue Crane) must be rescued and relocated. An experienced person who knows the animals in the region well will identify any possible Red Data fauna on site and acquire the necessary permits to relocate fauna will be obtained if avoidance is not possible.
- Training of construction workers to recognise threatened animal species will reduce the probability of fauna being harmed unnecessarily.
- During site preparation special care must be taken during the clearing of the works area to minimise damage or disturbance of roosting and nesting sites, especially the pair of breeding pair recorded in Gouklip farms.
- The contact details for animal rescue such as snakes' removal shall be made available at the construction site, so as to rescue them should they be found on the construction site.
- Trenches shall be inspected regularly for fauna that may have fallen into them and become trapped. All fauna found in trenches must be rescued.
- Any incidents of poaching, wilful disturbance or damage to wild animals as well as accidental damage to or death of wild animals should be reported to the ECO and recorded.
- Photographs of sensitive animals (Greater White pelican, Jackal Buzzard, Geometric Tortoise, and Blue Crane) must be displayed in the construction camp to heighten awareness of the creatures.
- Animals residing within the designated area shall not be unnecessarily disturbed.
- During construction, refresher training can be conducted to construction workers with regards to littering and poaching.
- The Contractor and his/her employees shall not bring any domestic animals onto site.
- Toolbox talks should be provided to contractors regarding disturbance to animals. Particular emphasis should be placed on talks regarding snakes.
- Allow for safe animal passage through and specifically out of the construction site.
- The disturbance of fauna should be minimized.
- Animals residing within the designated area shall not be unnecessarily disturbed.
- Poaching and illegal hunting are strictly prohibited.

Responsibilities:

- Proponent – acquire permits (if applicable)
- Project Manager and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Permits (if applicable).
- Contractor's method statement.

14.3.21 Management of Socio-Economic Impacts

Management Objective:

- To have no adverse impact on private properties in the area.
- The protection of existing farming activities.
- To maintain a good relationship and communications with the private landowners and farmers.

Management Target:

- No private property or infrastructure are damaged during construction.
- Interruption of farming activities during construction is minimised.

Management Actions:

- The augmentation of water will ensure water security for all water users. Maintenance of the project infrastructure is critical to ensure that there is no disruption of water supply as this will have economic implications on the project.
- Directly affected farmers may experience a loss of agricultural land due to the construction of access roads. Farmers and landowners must be consulted in the design of the road to ensure that there is minimal impact on landowners.
- Internal access routes expose the farmers to safety and security risks.
- Farms may choose to negotiated mitigation measures such as access gates to mitigate against the loss the livestock, damage to property and safety.
- DWS must develop a skills development program for the duration of the construction activity.
- Beneficiaries of educational programs should be residents who live close to the project area.
- The selection process should be transparent.
- In order to increase the size of local employment, women should also be employed in the construction of the proposed developments.
- Preferential treatment to local job seekers before employing labour from outside.

- One hundred percent of unskilled employment during the construction phase should come from local labourers who live in the study area.
- In order to increase the size of local employment, women should also be employed in the construction of the dam.
- The selection process should be transparent.
- Where possible, labour intensive methods should be used.
- In order to increase the size of local employment, women should also be employed in the construction phase.
- Construction and other materials to be sourced from local suppliers to boost the regional economic and drive the creation of more sustainable jobs.
- SMME opportunities should be provided to everyone on an equal basis. Where possible, DWS should support and encourage the development of SMMEs and local or regional suppliers.
- Where possible, procurement should come from local and regional business so that the profits stay in the area, increasing economic activity.
- DWS should make use of existing council structures to identify beneficiaries of the program.
- Ensure that the necessary signage and traffic measures are implemented for safe and convenient access to the site.
- Measures must also be put in place to ensure that these roads and any access points do not get built up with mud or sand.
- Construction machinery drivers are to travel at appropriate speeds and have flashing lights attached to the roofs of the vehicles.
- Applicable speed limits as set on regional roads must be observed at all times.
- The number of vehicles present on site must be limited to the minimum.
- Access to the farmer's private land during construction must be controlled. Landowners must be afforded the opportunity to comment on the plan. Contractors and sub-contractors must be forced to comply with the plan.
- Where necessary crossing points should be designed and sufficiently distributed for use of farmers and livestock if necessary. Crossing pointed should be planned with local authorities and landowners.
- Dust and disturbance can be mitigated through the use of appropriate dust suppression mechanisms.
- Where sensitive crops are affected by dust, DWS should conduct a feasibility study to tar the roads, particularly during the operational phase where roads will be used for maintenance of the pipeline.
- Mitigation measures management should be adhered to according the relevant specialist studies.
- The contractor must maintain the roads on an on-going basis to ensure that there is minimal dust from construction vehicles.

- DWS must make a public announcement that imported labour will not take place on the project.
- Contractors and sub-contractors must have strict conditions that prevent the importing of semi and unskilled labour without prior justification and approval
- Unless absolutely necessary, accommodation facilities should be avoided. Rather, facilities in Gouda should be made use of.
- Employment of females and youth is encouraged to ensure the empowerment of the most vulnerable to unemployment and poverty.
- Erect signage and fences to deter theft.
- EMPr must have a safety plan to ensure the protection of humans and livestock. Farmers must be provided an opportunity to proposed mitigation measures.
- It is noted that the aquatic study stated that flooding and loss of water infrastructure on farms, caused as a result of the project infrastructure is not likely, however is of great concern to landowners. In order to mitigate against this a survey should be undertaken to document all pump stations and infrastructure that may be lost during the event of a flood. The survey should account for directly affected properties as well as downstream users. In the event of flooding, the survey should be used a basis for compensation claims against the project proponent.
- Relocation of landowner pumps, if impacted on by the proposed developments.

Responsibilities:

- Proponent.
- Project Manager and ECO - to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Permits (if applicable).
- Contractor's method statement.
- Public Complaints Register.

14.3.22 Management of Agricultural Resources

Management Objective:

- To have no adverse impact on agricultural potential of the area.
- The protection of existing agricultural and farming activities.

Management Target:

- No agricultural resources are damaged during construction.
- Interruption of farming activities during construction is minimised.

Management Actions:

- Avoiding of sensitive areas, if applicable (i.e. wetlands, slopes and existing soil conservation works such as contours), in order to prevent the degradation thereof.
- Proper planning of road layout so that roads follow the contours as far as possible or where contours are crossed, proper structures be developed and implemented that will ensure proper functioning of the existing contours
- Conservation of the topsoil during construction and the proper rehabilitation of the construction sites after construction.
- Protection of the vegetation and veld by means of the construction of proper service roads and the proper maintenance thereof over time.
- The construction of the project infrastructure should be synchronised, as far as possible with the seasonal pattern of farming activities in order to minimize the possible disturbance of the latter.
- The servitude conditions of the pipeline will allow for farming activities to continue within the servitude area after construction taking cognisance of the need for permanent access to the pipeline servitude.

Responsibilities:

- Proponent – acquire permits.
- Project Manager and ECO - to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Permits (if applicable).
- Contractor's method statement.

14.3.23 Management of Archaeological and Cultural Features

Management Objective:

- To have no adverse impact on the historical inheritance of the area.
- The protection of land considered to be of traditional cultural value.
- The protection of known archaeological sites against vandalism, destruction and theft during the construction phase.
- To avoid damage to or destruction of previously unknown or excavated archaeological artefacts during construction.
- The preservation and appropriate management of new findings should these be discovered during construction.
- If any heritage resources (particularly graves) are uncovered during construction, then work must stop, and HWC (Tel: 021 483 9685) must be notified.

Management Target:

- No archaeological and cultural resources or graves to be damaged during construction.

Management Actions:

- All staff involved in the construction phase should be advised of the nature of cultural heritage resource material that may be found and informed of their obligation to report any items found that they may happen upon during the construction process.
- For any chance finds, all work will cease in the area affected and the Contractor will immediately inform the Project Manager. A registered heritage specialist must be called to site for inspection. The relevant heritage resource agency (i.e. HWC) must be informed about the finding.
- Permits to be obtained in terms of the National Heritage Resources Act (No. 25 of 1999) if heritage resources are to be impacted on and for the removal of graves.
- Should any remains be found on site that is potentially human remains, the South African Police Service and archaeologist should also be contacted.
- All archaeological, palaeontological and historical sites older than 50 years are protected in terms of the National Heritage Resources Act No 25 of 1999. In terms of this Act it is an offence to disturb any part of such site or material without a permit, should an archaeological or other such discovery be made during any excavations.
- Under no circumstances shall archaeological artefacts be removed, destroyed or interfered with by the Contractor, his employees, his sub-contractors or his sub-contractors' employees. Any person who causes intentional damage to archaeological or historical sites and artefacts could be penalised or legally prosecuted in terms on the Act.

Responsibilities:

- Proponent – acquire permits.
- Project Manager and ECO - to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Permits (if applicable).
- Contractor's method statement.

14.3.24 Management of Water

Management Objective:

- Minimise environmental impacts associated with storm water as well as water services for construction workers.
- Minimise stormwater runoff from the site onto neighbouring roads.
- Minimise water use through recycling and water efficient practices.

Target:

- No visual evidence of erosion caused by wastewater or stormwater practices.

- No environmental contamination associated with wastewater or stormwater practices.

Management Actions:

- All construction activities to comply with the National Water Act (Act No. 36 of 1998).
- During the construction stage, water will be required for various purposes, such as concrete batching, washing of plant and equipment in dedicated areas, dust suppression, potable use by construction workers, etc. Water tankers will supply water to the site.
- Manage stormwater from construction site to avoid environmental contamination and erosion.
- Establish a dedicated vehicle maintenance area and wash-bay, where suitable storm water management measures are in place to prevent pollution.
- Manage stormwater from construction site to avoid environmental contamination and erosion.
- Stormwater runoff from workshops, vehicle maintenance area, wash-bays and other potential pollution sources shall be collected and treated in hydrocarbon separation pits/tanks before discharged to drains and waterways.
- Measures must be taken to divert unpolluted water and runoff away from the site.
- All discharges to comply with legal requirements associated with the National Water Act (Act No. 36 of 1998).
- All wastewater discharges to comply with legal requirements associated with the National Water Act (Act No. 36 of 1998), including the General Authorisation that specifically deals with S21 (f) and (g) water uses.
- Ensure proper storage of material (including fuel, paint) that could cause water pollution. Ensure proper storage and careful handling of hazardous substances with spill prevention materials at hand.
- Wastewater discharges to form part of water monitoring programme.
- Visual inspections for the occurrence of erosion should be undertaken on a weekly basis.

Responsibilities:

- Project Manager and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Public complaints register.
- Water monitoring programme – discharges.
- Disposal certificates
- Contractor's method statement.

14.3.25 Management of Watercourses

Management Objective:

- Ensure that the watercourses (including affected rivers, natural channels, and drainage lines) are protected and incur minimal negative impact to resource quality (i.e. flow, water quality, riparian habitat, morphology, and aquatic biota).
- Existing water use entitlements not to be affected.

Target:

- Minimise the habitat unit destruction and potential loss of wetland/aquatic-dependent biodiversity.
- Unaltered downstream flow regime.
- Downstream water quality to remain within acceptable ranges, as determined through baseline monitoring.
- Ecological category not to be influenced by construction activities.

Management Actions:

- General –
 - Establish and maintain buffer zones.
 - Limit the amount of disturbances to local construction site only and confine most major construction to the dry season.
 - Implement an adequate water, sediment and biological monitoring programme together in the form of a management action plan.
 - Comply with the 2006 RDS requirements.
 - The delineated aquatic and wetland areas outside of the specific project site area must be avoided where possible;
 - The construction vehicles and machinery must make use of existing access routes as much as possible, before adjacent areas are considered for access;
 - Laydown yards, camps and storage areas must be beyond the aquatic and wetland areas;
 - The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
 - It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces;
 - Temporary storm water channels and preferential flow paths should be filled with aggregate and logs (branches included) to dissipate and slow flows limiting erosion;
 - Contamination of the Berg River system with unset cement or cement powder should be negated as it is detrimental to aquatic biota. Pre-cast structures should be made use of (where possible) to avoid the mixing of these materials on site, reducing the likelihood of cement in the river system;

- All chemicals and toxicants to be used for the Augmentation Scheme construction must be stored outside the channel system and in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;
- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems;
- All removed soil and material must not be stockpiled within the system. Stockpiling should take place outside of the riparian and wetland areas. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Erosion and sedimentation into the channel must be minimised through the effective stabilisation (gabions and Reno mattresses) and the re-vegetation of any disturbed banks;
- Temporary and permanent erosion control methods may include silt fences, flotation silt curtains, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed embankments, erosion mats, and mulching;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- No dumping of construction material on-site may take place;
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported; and
- An alien invasive plant management plan needs to be compiled and implemented post construction to prevent the growth of invasives on cleared areas.
- The operating rule for Voëlvlei Dam must ensure that the existing water use entitlements are not affected and that the EWR for the Berg River and Estuary are satisfied.
- Monitoring –
 - An aquatic ecologist with fishway experience should monitor the construction phase of the project, in order to assess compliance and to also provide guidance for riparian and fishway related matters that arise.
- Low level weir –

- The footprint area of the weir should be kept a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas;
- Exposed river banks / soils must be stabilised to prevent the erosion of these surfaces. Signs of erosion must be addressed immediately to prevent further erosion of the area;
- The weir should not concentrate flows at the overspill area. It is important to spread flows across the river system by having a wider overspill area, avoiding concentrated flows. Care must be taken not to spread flows outside of the existing channel path;
- It is imperative that the new low level weir cater for fish migration, especially during very low flows;
- A V-shaped centre positioned spillway is recommended for the weir design. This will allow for fish migration over the weir under different flow levels (see **Figure 23** and **Figure 24**); and
- Large aggregate outsourced or from the project area (if available) can be used for energy dissipation in the channel downstream of the weir to reduce the likelihood of scouring the river bed and sedimentation of the catchment. It is preferable that larger aggregate be used to avoid flows removing aggregate material from the site.
- Fishway (**Figures 23** and **24**) –
 - A rock-ramp type of fishway is preferred over the vertical slotted fishway;
 - The fishway should have water passing through it during both high flows and low flows to encourage fish to make use of the fishway no matter the flow levels. It may be required that an Instream Flow assessment be conducted for the project in order to prescribe water allowances for the system;
 - The fishway should cater for both rheophilic (fast moving water) and anti-rheophilic (slow moving water) fish species. This can be achieved through having several different flow velocity areas across the fishway;
 - It is recommended that a rough stone surface be cast into the fishway channel floor to cater for climbing and crawling species;
 - Rocks used for the fishway should have flat sides with rounded edges (typical of quarried rock) rather than rounded rocks, as they provide a variety of water velocity and depths that easy for fish to navigate;
 - Rock material needs to be concreted in place to prevent them from washing away during high flows;
 - Rock should be placed with a cascade pattern creating numerous step-like riffles, but should also incorporate a large variety of rock sizes placed at random to create a diversity of hydraulic conditions (microhabitats) within the fishway;
 - Pools or depressions of varying sizes and depths should be created at random throughout the length and width of the fishway and should be placed behind large

rocks to create lower velocity resting areas (eddies) for fish. The more pools incorporated in the design, the more successful the fishway will be;

- Guidelines for fishway design:
 - Channel slope – between 1/8 and 1/10 is recommended for South African fish;
 - Fishway entrance – furthest point upstream that the fish can penetrate, usually in a suitable pool (low turbulence with sufficient depth) located at the base of the low level weir;
 - Fishway exit – located in a quiet area, sheltered, low velocity to prevent fish from being swept downstream and to afford protection from predators:
 - - The invert level of the exit (i.e. water inflow) should be lower than that of the weir overflow to ensure the low flows are directed down the fishway;
 - Depth of pool – small fish (20 to 200 mm in length): at least 300 mm to reduce predation and limit turbulence;
 - - Larger fish (>200 mm): at least 500 mm can be deeper to reduce turbulence, if necessary;
 - Length of pool – at least 2.5 times the length of the largest fish catered for;
 - Drop height between pools/rock levels – maximum of 100 mm to cater for small fish;
- The fishway should take into consideration the jumping and swimming abilities of the different species, allowing the smallest and weakest swimmers passage through the fishway without undue stress;
- The fishway should take into consideration that the migratory *Barbus andrewi* may be present in the Berg River while further introduction by Cape Nature will commence;
- Cape Nature are in the process of reintroducing Whitefish to the Berg River and recommend the introduction of the natural type rock ramp fishway on the proposed weir to aid in migration of the Whitefish across the proposed barrier; and
- An aquatic biomonitoring programme should be conducted after the construction phase has been completed in order to determine the effect, if any, on the local biota and migration of the fish species.

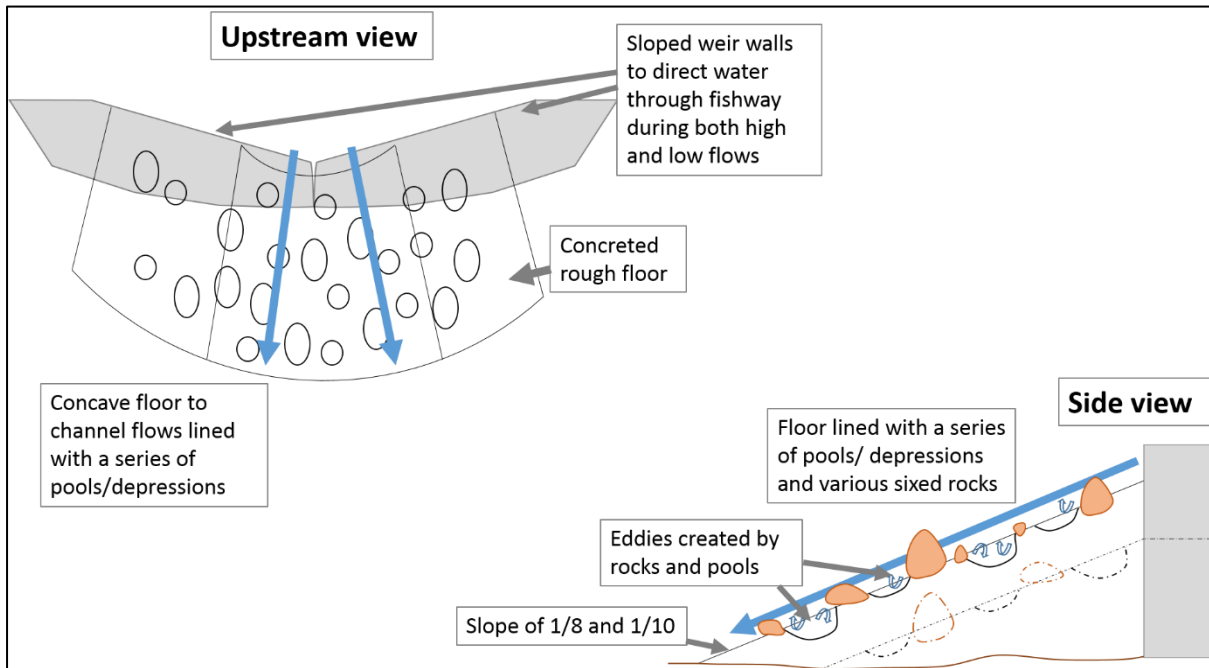


Figure 26: Different views of the rock ramp type of fishway

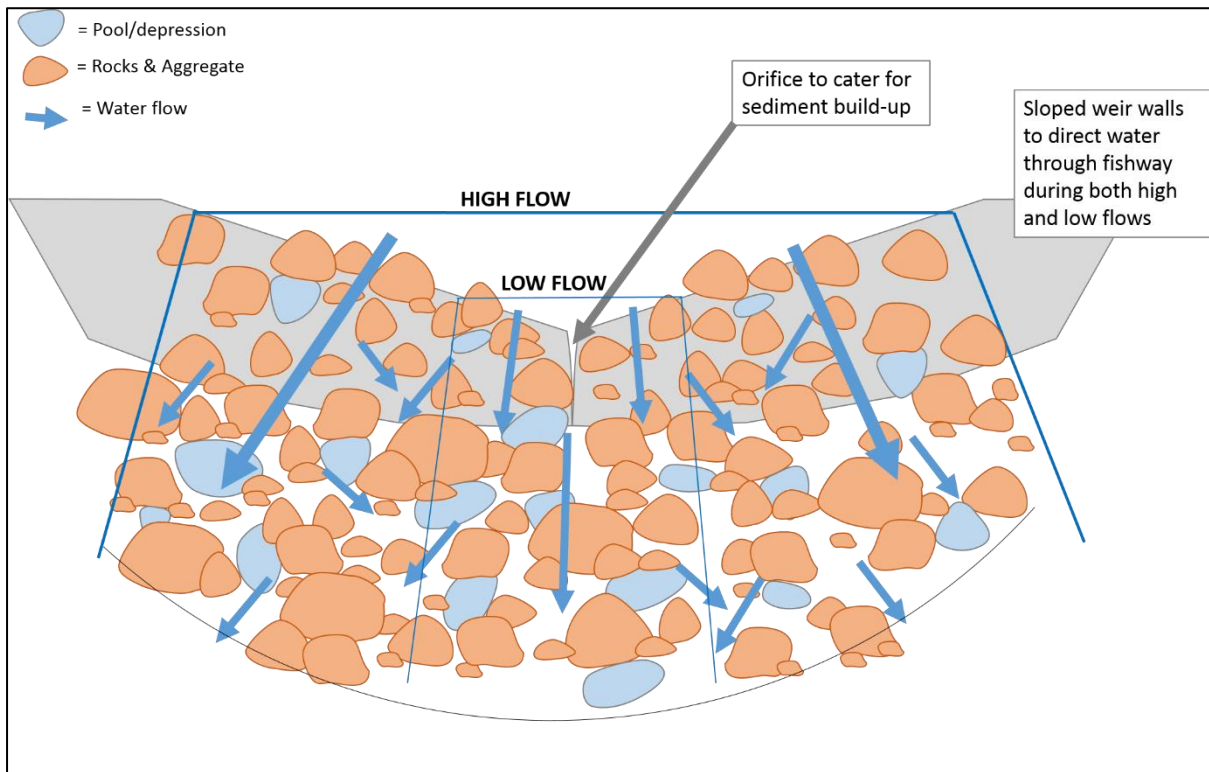


Figure 27: Diagram of rock ramp type fishway

- Fishway specifics to be changed –

The following fishway construction designs stemming from the supplied document titled “Pages from Berg River Abstraction Works Report May 2012 – rev01” need to be addressed due to a number of concerns:

- The proposed “u” shaped fishway has a main channel width of 0.9 meters;
 - This channel width is inadequate for the protection of fish traversing the fishway. This narrow channel width concentrates fish making them vulnerable to predation (between fish species, birds and local people);
 - Local people were seen at Voëlvlei Dam during the site visit, successfully stabbing fish for food with a pitchfork;
 - A wider channel width is proposed. A wider fishway will ensure sufficient flow through the fishway to attract fish to the fishway entrance while preventing overcrowding in the fishway;
 - A wider channel should lower flow velocities, offering a greater variety of flow dynamics due to the spreading of flows in each pool step;
 - A wider channel will cater for the largest fish species such as *C. gariepinus* which usually reach a length in excess of a meter. A channel width of 0.9 meters may cramp these fish once in the fishway.
- There is no mention of the depth of the fishway design;
 - A minimum depth of 500mm is recommended.
- The entrance to the fishway should not be a barrier during the lowest of flows. Rather the entrance opening should be at the same level as the lowest water level to cater for fish migration.
- A fatal flaw in many fishway designs is insufficient flow discharge from the fishway entrance. Without sufficient discharge, fish are not attracted to the fishway entrance.
- In order for the fishway to be successful, the raised issues need to be addressed. Raised issues and recommendations are based on fishway guidelines and South African case studies (Bok *et al.*, 2007).
- Pipeline –
 - It is not advisable to only set a mesh on the pipeline at the abstraction point, due to the mesh becoming clogged with debris. It is recommended that an abstraction sump be considered for the design, in addition to the mesh. The sump will ensure no blockages of the pipeline, and the mesh will prevent the transfer of fish which may result in fish fatalities;
 - Pipeline trenches and sandy bedding material may produce preferential flow paths for water across the project area perpendicular to the general direction of flow instead of angle. This risk can be reduced by installing clay plugs at intervals down

the length of the trench to force water out of the trench and down the natural topographical gradient;

- Pipelines crossing watercourses should preferably span the systems above ground. This prevents disruptions to sub surface flow dynamics;
- When a pipeline spans a river, it should be attached to any existing crossing or bridge structures (if present). If pier support structures are needed for the pipeline to span a system, then piers should be placed outside of preferential flow paths with the least number of pier structures used as possible;
- Trenches and foundations should be side dug (where possible) from the existing access routes. In the absence of access routes, temporary routes may be considered;
- Trenches should be dug on-line (where applicable) creating narrower trenches;
- Where trench breakers are required, these must be imported appropriately and installed by the backfill crew, ahead of backfilling;
- Ensure careful separation of soil types/ strata as identified for the removal of soil. The soils must be removed in such a way that they can be easily reinstated in the reverse order for backfilling;
- To ensure correct backfilling, the soil that is removed from the trench at its deepest point must be laid closest to the trench. The first layer of topsoil must be laid furthest away from the trench;
- It may be necessary to import small amounts of padding material upon which the pipe safely rests in the trench prior to backfilling. This material must be stored outside the wetland areas until it is required to be placed within the trench, and banded with sandbags;
- Any large boulders encountered during trenching operations must not be returned to the trench, but removed off site; and
- If any spoil is generated this can be transported to another location and re-used if it is required, removed correctly to a licensed facility, or offered to the landowner.

Responsibilities:

- Project Manager and ECO – to check.
- Contractor to implement management actions.

Monitoring Requirements:

- Public complaints register.
- Aquatic monitoring survey
- Water monitoring programme – discharges.
- Disposal certificates
- Contractor's method statement.

14.3.26 Management of Rehabilitation and Operation

Management Objective:

- Adequate reinstatement and rehabilitation of construction areas
- Conduct concurrent or progressive rehabilitation of areas affected by construction activities that are situated outside of the construction footprint.

Target:

- Complete site clean-up.
- Reinstatement and rehabilitate areas disturbed by construction activities that are located outside of the construction area.
- Landscaping of the finished development to complement the surrounding area.

Management Actions:

Removal of structures and infrastructure

- After the construction phase, the area disturbed outside of the pipeline servitude must be rehabilitated by appropriate landscaping, levelling, topsoil dressing, land preparation, alien plant eradication and vegetation establishment.
- Clear and completely remove from site all construction plant, equipment, storage containers, temporary fencing, temporary services, and fixtures.
- Ensure that all access roads utilised during construction which are outside of the pipeline servitude and not earmarked for use during the operational phase, are returned to a state no worse than prior to construction.

Inert waste and rubble

- Clear the site of all inert waste and rubble, including surplus rock, foundations and batching plant aggregates. After the material has been removed, the site shall be reinstated and rehabilitated.
- Load and haul excess spoil and inert rubble to fill in borrow pits/dongas or to dump sites indicated/approved by the Project Manager.
- Remove from site all domestic waste and dispose of in the approved manner at a registered waste disposal site.

Hazardous waste and pollution control

- Remove from site all pollution containment structures.
- Remove from site all temporary sanitary infrastructure and wastewater disposal systems. Take care to avoid leaks, overflows and spills and dispose of any waste in the approved manner.

- Comply with relevant provisions under the following EMPr sections: Management of Storage and Handling of Hazardous Material, Management of Water, Management of Waste, Management of Pollution Generation Potential.

Landscaping

- The landscape profile should be restored, matching as closely as possible to the original land form prior to the distribution of the topsoil.
- In general, no slopes steeper than 1(V):3(H) are permitted in cut-and-fill areas, unless otherwise specified by the Project Manager.
- Programme the backfill of excavations so that subsoil is deposited first, followed by the topsoil. Compact in layers for best results.
- Monitor backfilled areas for subsidence (as the backfill settles) and fill depressions using available material.
- Ensure that no excavated material or stockpiles are left on site and that all material remaining after backfill is landscaped to blend in with the surrounding landscape.
- Rehabilitate construction camp according to DWAF's Integrated Environmental Management Series No.6: Environmental Best Practice Specifications (Construction).

Topsoil replacement and soil amelioration

- Execute top soiling activity prior to the rainy season or any expected wet weather conditions.
- Execute topsoil placement only after all construction work has ceased.
- Replace and redistribute stockpiled topsoil together with herbaceous vegetation, overlying grass and other fine organic matter in all disturbed areas of the construction site, including temporary access routes. Replace topsoil to the original depth.
- Place topsoil in the same area from where it was stripped. If there is insufficient topsoil available from a particular soil zone to produce the minimum specified depth, topsoil of similar quality may be brought from other areas of similar quality.
- The suitability of substitute material will be determined by means of a soil analysis addressing soil fraction, fertility, pH and drainage.
- Do not use topsoil suspected to be contaminated with the seed of alien vegetation (e.g. black wattle). Alternatively, the soil is to be appropriately treated.
- Ensure that stormwater run-off is not channelled alongside the gentle mounding, but that it is taken diagonally across it.
- Shape remaining stockpiled topsoil not utilised elsewhere in an acceptable manner so as to blend in with the local surrounding area.
- After topsoil placement is complete, spread available stripped vegetation randomly by hand over the top-soiled area.

- Newly cleared soils will have to be re-vegetated and stabilised as soon as construction has been completed and there should be an on-going monitoring program to control and/or eradicate newly emerging invasives.
- Machines should remove the stone material and transported to another location and re-used if it is required, removed correctly to a licensed facility, or offered to the landowner.
- The geotextile base material, and other foreign material should also then removed during rehabilitation.

Ripping and scarifying

- Rip and/or scarify all areas following the application of topsoil to facilitate mixing of the upper most layers. Whether ripping and/or scarifying is necessary will be determined based on the site conditions immediately before these works begin.
- Rip and/or scarify all disturbed (and other specified) areas of the construction site, including temporary access routes and roads, compacted during the execution of the works.
- Rip and/or scarify along the contour to prevent the creation of down-slope channels.
- Do not rip and/or scarify areas under wet conditions, as the soil will not break up.
- The area should be ripped to an appropriate depth (at least 300 mm) to remove any minor compaction.

Planting

- The areas that have been denuded and disturbed as a result of the construction on site must be vegetated with indigenous vegetation as soon as possible.
- No exotic plants may be used for rehabilitation purpose, only indigenous plants of the area may be utilised.
- Plants should be located from other undisturbed areas, and this along with the original seed-bank within the replaced topsoil will assist with stabilising soils and re-vegetation of the area.
- All planting work is to be undertaken by suitably experienced personnel, making use of the appropriate equipment.
- Transplanting entails the removal of plant material and replanting the same plants in another designated position.
- Transplant trees and shrubs into designated positions.
- Establish further specifications for transplanted plants.
- Plant all trees, shrubs and individual plants in designated positions.
- Planting should preferably be done during the rainy season.
- After planting, each plant must be well watered, adding more soil upon settlement if necessary.
- Establish further specifications for nursery plants.

- Tree seedling material should be fresh and of local origin. Resist using plants from far afield as they may not be best suited to local climatic or soil conditions.
- Small seedlings are likely to transplant more successfully than will large ones. These should be potted and kept under nursery conditions until they are large enough to plant out.
- Establish further specifications for seeds and seedlings.

Grassing

- Suitably trained personnel must undertake grassing by making use of the appropriate equipment and grass species as specified by the terrestrial ecologist.
- Sodding may be done at any time of the year, but seeding must be done during the summer when the germination rate is better.
- Hydroseeding with a winter mix will only be specified where regrassing is urgent, and cannot wait for the summer.
- Establish further specifications for sods, runners and hand seeding.

Maintenance

- Monitor the re-growth of invasive vegetative material.
- Cordon off areas that are under rehabilitation as no-go areas.
- Revegetation must match the vegetation type, which previously existed, unless otherwise indicated by a suitable specialist.
- Control invasive plant species and noxious weeds by means of extraction, cutting or other approved methods.
- For planted areas that have failed to establish, replace plants with the same species as originally specified.
- Establish further specifications for maintenance.

14.4 Operational Phase

14.4.1 General Environmental Management

Note that where any activity and aspect associated with the operational phase of the project coincides with the receiving environment and activities of the construction phase (see **Section 14.3**), the same management requirements will apply.

14.4.2 Vegetation

- All areas to be affected by the proposed project will be rehabilitated after construction activities.

- As much vegetation growth as possible should be promoted within the proposed development site in order to protect soils and to reduce the percentage of the surface area which is left as bare ground. In this regard special mention is made of the need to use indigenous vegetation species as the first choice during landscaping. The plant material to be used for rehabilitation should be similar to what is found in the surrounding area.
- Monitor the re-growth of invasive vegetative material.
- Cordon off areas that are under rehabilitation as no-go areas.
- Control invasive plant species and noxious weeds by means of extraction, cutting or other approved methods.
- For planted areas that have failed to establish, replace plants with the same species as originally specified.
- Establish further specifications for maintenance.

14.4.3 Fauna

- The disturbance of fauna should be minimized.
- Animals residing within the designated area shall not be unnecessarily disturbed.

14.4.4 Waste Management

- Develop and implement a waste management system, based on the waste management hierarchy of reduce, re-use, recycle, treatment and disposal.
- All residents must be encouraged to apply best practice in terms of waste management.
- Recycling opportunities to be provided at the centre (e.g. bins).

14.4.5 Water Conservation

- A watercourse monitoring program will be implemented to ensure that all affected watercourses are adequately rehabilitated.
- Measures will be implemented to minimise the loss of water at any point.

14.4.6 Spillages

- Spillages of hazardous material (e.g. hydrocarbons) to be appropriately cleaned.

- Large spillages of hazardous material (>15litres depending on the nature of the material and the receiving environment), to be cleaned and remediated by a competent service provider.
- Hazardous waste to be appropriately disposed of.

14.4.7 Stormwater Management

- Implement stormwater management plan for the development.
- Prevent water quality deterioration of the receiving watercourses from stormwater discharges.
- Prevent erosion associated with stormwater runoff.
- No illegal discharges into the stormwater system to be allowed.

14.4.8 Watercourses

- The dam water level is to be monitored to ensure that there is no overflow.
- An aquatic monitoring survey needs to be conducted after the construction activities have been completed, in the operation phase of the project so that impacts can be assessed and adaptive management practices implemented if necessary. A number of sensitive aquatic biota should be specifically monitored to identify fluctuation in abundances and diversity, including fish and macroinvertebrates. The frequency of the monitoring programme should be as follows:
 - Shortly after construction of the weir, pipelines and fishway.
 - Bi-annually for at least one year after the first monitoring survey.

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