water & sanitation

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Water and Sanitation
REPUBLIC OF SOUTH AFRICA

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P WMA 19/G10/00/2516/6



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

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Draft

February 2017

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Authors:	***S Gerber, V Stippel, D Henning and N Naidoo***
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CONSULTANTS: NEMAI CONSULTING

Approved for Consultants by:

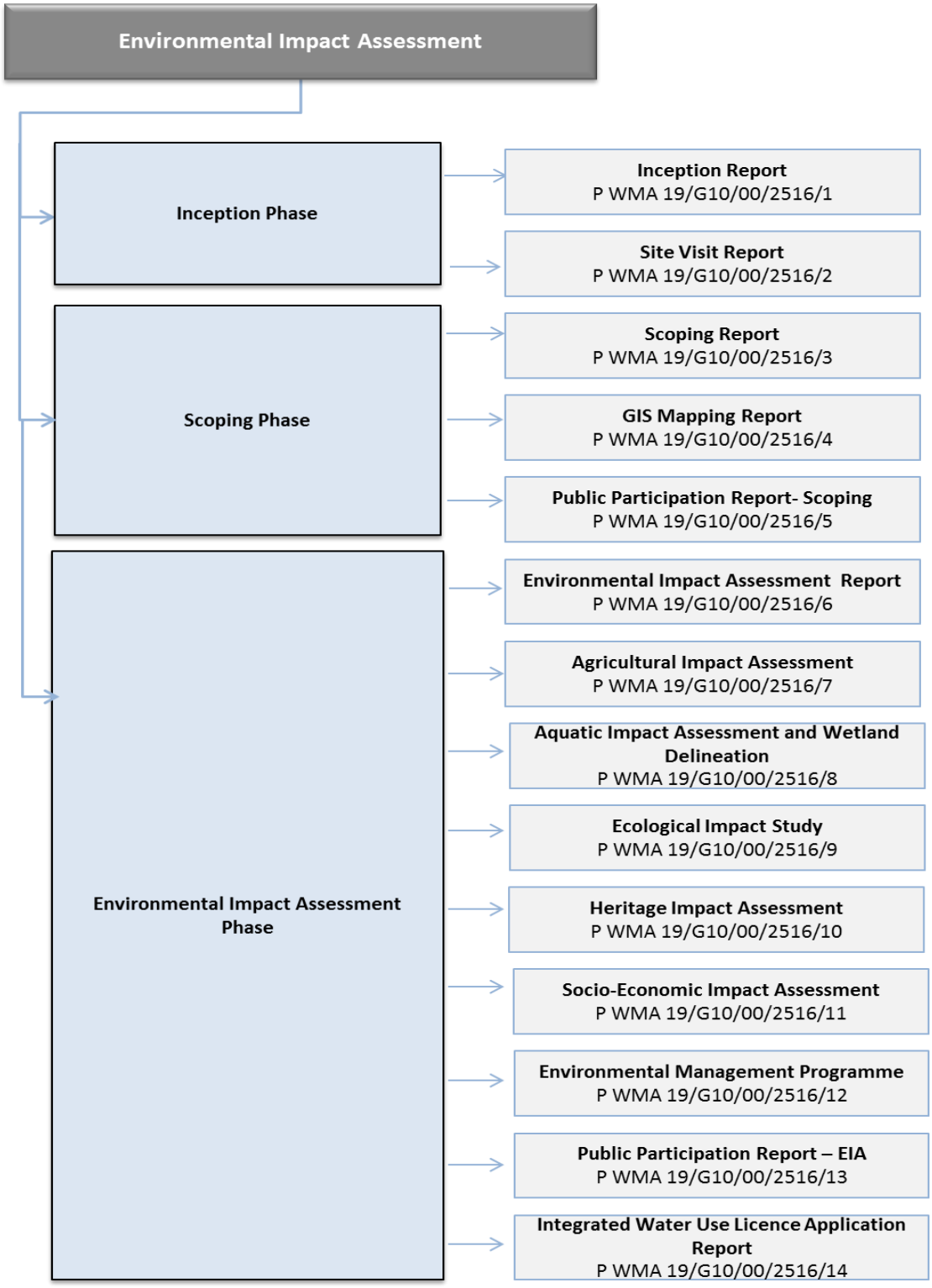
……	……
D Henning	*N Naidoo*
Project Leader	*Project Manager*

DEPARTMENT OF WATER AND SANITATION (DWS)

Approved for Directorate: Options Analysis by:

……	……
M. Mugumo	*O van den Berg*
Chief Engineer: Options Analysis (South)	*Acting Director: Options Analysis*

List of Study Reports



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Prepared for:	DWS - Directorate: Options Analysis

Prepared By: Nemai Consulting

NEMAI CONSULTING

☎ +27 11 781 1730
🖷 +27 11 781 1730
✉ info@nemai.co.za
🌍 www.nemai.co.za

147 Bram Fischer Drive, FERNDALE, 2194

PO Box 1673, SUNNINGHILL, 2157

Amendments Page

Date:	Nature of Amendment	Amendment Number:
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Executive Summary

Nemai Consulting was appointed by the Department of Water and Sanitation as the Environmental Assessment Practitioner to undertake the Environmental Impact Assessment for the proposed surface water developments for augmentation of the Western Cape Water Supply System.

The proposed augmentation triggers activities contained in the 2014 Environmental Impact Assessment Regulations (Government Notice 983, Government Notice 984 and Government Notice 985 of 4 December 2014) and thus a Scoping and Environmental Impact Assessment Process is required. Further, as the project occurs within a regulated area of a watercourse and involves abstraction of water, it triggers activities that are listed under Section 21 (a), (c) and (i) of the National Water Act (Act No. 36 of 1998). As such an Integrated Water Use Licence Application process will also be undertaken.

The Western Cape Water Supply System serves the City of Cape Town, surrounding urban centres and irrigators. It consists of infrastructure components owned and operated by both the City of Cape Town and the Department of Water and Sanitation. In 2007, the Western Cape Reconciliation Strategy Study was commissioned by the Department of Water and Sanitation to determine future water requirements for a 25 year planning horizon. The Study investigated a number of options and found that whilst 556 million m^3 per annum would be available from 2007, the estimated water requirement in 2011 would be 560 million m^3/a, with the implication that the system supply will then be fully utilised and thus additional interventions will thus be required.

Based on the above, Department of Water and Sanitation identified the need for augmentation of the Western Cape Water Supply System by 2019 and proceeded with pre-feasibility and feasibility studies into potential surface water development options. Initially six options were assessed at a pre-feasibility level of detail. These options were then prioritized to identify the two most viable options. These were:

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

Ultimately, the Feasibility Study found that the Berg River-Voëlvlei Augmentation Scheme option was the most favourable surface water intervention and as such the Department of Water and Sanitation proposes to implement this scheme which involves the transfer of approximately 23 million m^3 per annum from the Berg River to the existing Voëlvlei Dam (i.e. the yield of the dam would be 23 million m^3 per annum more than it is currently).

The proposed project is situated in Western Cape in the Drakenstein Local Municipality of the Cape Winelands District as well as the Swartland Local Municipality of the West Coast District.

The proposed developments fall within the Berg River Catchment of the Berg–Olifants Water Management Area. Both Voëlvlei Dam and the Lorelei abstraction site are located in quaternary catchment G10F of the Berg River Catchment.

The project components include the following:

- A low level weir, abstraction works and 4 m^3/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 Water Treatment Works 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 Environmental Impact Assessment. 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; and
- Construction camp (footprint).

Three pipeline route alternatives and associated discharge points are assessed in the report. The feasible options were taken forward in the impact assessment phase, where the potential positive and adverse effects to the environmental features and attributes are examined further. The Environmental Impact Assessment phase includes a detailed comparative analysis of the project's feasible alternatives that emanate from the Scoping exercise, which includes environmental (with specialist input) and technical evaluations. This ultimately resulted in the selection of a Best Practicable Environmental Option.

The proposed surface water developments for augmentation of the Western Cape Water Supply System requires authorisation in terms of the National Environmental Management Act (Act No. 107 of 1998), and the Environmental Impact Assessment is undertaken in accordance with the Environmental Impact Assessment Regulations (Government Notice No. R. 982, R. 983, R. 984 and R. 985 of 04 December 2014), promulgated in terms of Chapter 5 of National Environmental Management Act. Based on the types of activities involved which include activities listed in Government Notice No. R. 983; R. 984 and R. 985 of 04 December 2014; the requisite environmental assessment for the project is a Scoping and Environmental Impact

Assessment process. In terms of the Regulations, the lead decision-making authority for the environmental assessment is the Department of Environmental Affairs.

Key objectives for the Environmental Impact Assessment phase include the following:

- Carry out relevant specialist studies;
- Conduct public participation;
- Assess receiving environment;
- Undertake quantitative assessment of significant environmental impacts and identify concomitant mitigation measures;
- Evaluate project alternative through a comparative analysis; and
- Compile Environmental Impact Assessment Report in accordance with the requirements stipulated in Appendix 3 of Government Notice No. R. 982 (04 December 2014) for review by Interested and Affected Parties.

The EIA Report provides a general description of the status quo of the receiving environment in the project area, and also provides local and site-specific discussions on those environmental features investigated by the respective specialists. This allows for an appreciation of sensitive environmental features and possible receptors of the effects of the proposed project.

The study area includes the entire footprint of all the project components, which includes the construction domain and surrounding receiving environment.

The receiving environment is assessed and discussed in terms of the following:

- Climate;
- Geology and Soils;
- Geohydrology;
- Topography;
- Surface Water;
- Flora;
- Fauna;
- Land Capability;
- Land Use;
- Heritage;
- Socio-Economic Environment;
- Planning;
- Existing Infrastructure;
- Air Quality;
- Noise;

- Visual; and
- Access Roads.

The following specialist studies were undertaken during the Environmental Impact Assessment to inform the best alternative for the project:

- Ecological Impact Study;
- Aquatic Assessment and Wetland Delineation;
- Socio-Economic Assessment;
- Phase 1 Heritage Impact Assessment; and
- Agricultural Impact Assessment.

The information obtained from the respective specialist studies was incorporated into the Environmental Impact Assessment report in the following manner:

1. The information was used to complete the description of the receiving environment in a more detailed and site-specific manner;
2. A summary of each specialist study is provided, focusing on the approach to the study, key findings and conclusions drawn;
3. The specialists' impacts assessment, and the identified mitigation measures, were included in the overall project impact assessment;
4. The evaluations performed by the specialists on the alternatives of the project components were included in the comparative analysis to identify the most favourable option;
5. Specialist input was obtained to address comments made by Interested and Affected Parties that related to specific environmental features pertaining to each specialist discipline;
6. Salient recommendations made by the specialists were taken forward to the final Environmental Impact Assessment Conclusions and Recommendations; and
7. The assumptions and limitations identified in each study were noted.

The Environmental Impact Assessment Report assessed the pertinent environmental impacts that could potentially be caused by the proposed project during the pre-construction, construction and operational phases of the project.

Impacts were identified as follows:

- An appraisal of the project activities and components;
- Impacts associated with listed activities contained in Government Notice No. R. 983, R. 984 and R. 985 of 04 December 2014, for which authorisation has been applied for;
- An assessment of the receiving biophysical, social, economic and built environment;
- Findings from specialist studies;

- Issues highlighted by environmental authorities; and
- Comments received during public participation.

The impacts and the proposed management measures are discussed on a qualitative level and thereafter quantitatively assessed by evaluating the nature, extent, magnitude, duration, probability and ultimately the significance of the impacts. The assessment considered impacts before and after mitigation, where in the latter instance the residual impact following the application of the mitigation measures is evaluated.

The proposed mitigation of the impacts associated with the project includes specific measures identified by the technical team (including engineering solutions) and environmental specialists, stipulations of environmental authorities and environmental best practices. The Environmental Management Programme provides a comprehensive list of mitigation measures for specific elements of the project, which extends beyond the impacts evaluated in the body of the Environmental Impact Assessment Report.

The Environmental Impact Assessment Report provides an appraisal of all the environmental and technical considerations associated with the various alternatives through a comparative analysis to eventually distil the Best Practicable Environmental Option.

The Environmental Impact Assessment Report provides a full account of the Public Participation Process that was followed for the Scoping and Environmental Impact Assessment Phases for the proposed surface water developments for augmentation of the Western Cape Water Supply System.

A summary of the Public Participation process conducted is provided below.

Scoping and EIA Phase		**Timeframes**
Scoping Phase	Project Notification / Announcement	24 and 25 May 2016
	IAP Registration Period	26 May to 27 June 2016
	Submission of Application Form to DEA	22 September 2016
	Submission of Draft Scoping Report to DEA	23 September 2016
	Public Meeting to Present the Draft Scoping Report	04 October 2016
	Authority and Registered IAPs Review Period of Draft Scoping Report – 30 Days	23 September to 25 October 2016
	Submission of Final Scoping Report to DEA	28 October 2016
	DEA Review and Decision Making	01 November 2016 to 06 January 2017
	Acceptance of Scoping Report	09 December 2016
EIA Phase	Notification of Draft EIA Review	13 to 14 February 2017
	Authority and Registered IAPs Review Period of Draft EIA Report – 30 Days	15 February to 17 March 2017
	Public Meeting to Present the Draft EIA Report	22 February 2017
	Submission of Final EIA Report to DEA	04 April 2017

All comments received during the public participation process will be assessed in the Final Environmental Impact Assessment Report and will also be noted in the Comments and Response Report. Comments received from Interested and Affected Parties will help shape

the Environmental Impact Assessment Phase. The Final Environmental Impact Assessment Report will then submitted to the Department of Environmental Affairs, who is the Competent Authority in respect to this proposed development.

Attention is drawn to specific sensitive environmental features (with an accompanying sensitivity map) for which mitigation measures are included in the Environmental Impact Assessment Report, and Environmental Management Programme.

An Environmental Impact Statement is provided and critical environmental activities that need to be executed during the project life-cycle are also presented.

With the selection of the Best Practicable Environmental Option, the adoption of the mitigation measures include in the Environmental Impact Assessment Report and the dedicated implementation of the suite of Environmental Management Programme, it is believed that the significant environmental aspects and impacts associated with this project can be suitably mitigated. With the aforementioned in mind, it can be concluded that there are no fatal flaws associated with the project and that authorisation can be issued, based on the findings of the specialists and the impact assessment, through the compliance with the identified environmental management provisions.

The Environmental Impact Assessment Report is concluded with key recommendations, which may also influence the conditions of the Environmental Authorisation (where relevant).

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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
FAII	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 document serves as the Draft EIA Report for the proposed surface water developments for augmentation of the WCWSS. The proposed project consists of the following:

- A low level weir, abstraction works and 4 m^3/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 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).

According to GN No. R. 982 (4 December 2014), the objective of the EIA process is to undertake the following, through a consultative process:

- Determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
- Describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
- Identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking

process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;

- Determine the--
    - Nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
    - Degree to which these impacts-
        - Can be reversed;
        - May cause irreplaceable loss of resources, and
        - Can be avoided, managed or mitigated;
- Identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
- Identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;
- Identify suitable measures to avoid, manage or mitigate identified impacts; and
- Identify residual risks that need to be managed and monitored.

The Scoping Phase of the project has been completed. The Final Scoping Report and Plan of Study for the EIA was submitted to the Department of Environmental Affairs (DEA) on 28 October 2016 and approved on 09 December 2016 (**Appendix A**). The Scoping Phase allowed Registered Interested and Affected Parties (IAPs) the opportunity to comment on the overall environmental assessment approach and environmental issues. These comments helped to focus the efforts from technical specialists during the subsequent EIA Phase.

The Draft EIA Report will be made available to IAPs for a 30 day review period from **15 February 2017 to 17 March 2017**. All comments that are received will be assessed in the Final EIA Report and will also be noted in the Comments and Response Report. The Final EIA Report will then be made available for further public review at the same time as it is submitted to DEA, the Competent Authority in respect to this proposed development.

2 DOCUMENT ROADMAP

The EIA Report is intended to meet all requirements as stipulated in Appendix 3 of Government Notice (GN) No. R. 982 (04 December 2014). In order to provide clarity to the reader, a document roadmap is provided in terms of the aforementioned regulatory requirements (**Table 1**).

Table 1: Document Roadmap

Chapter	Title	Correlation with Appendix 3 of GN No. R. 982	
1	Purpose of the Document	N/A	
2	Document Roadmap	N/A	
3	Environmental Assessment Practitioner	3 (a)	Details of – (i) the EAP who prepared the report; and (ii) the expertise of the EAP, including a curriculum vitae.
4	Project Background and Motivation	3 (f)	A motivation for the need and desirability for the proposed development including the need and desirability of the activity within the context of the preferred location.
5	Project Location and Catchment Context	3 (b)	The location of the activity including – (i) The 21 digit Surveyor General code of each Cadastral land parcel; (ii) Where available, the physical address and farm name; and (iii) Where the required information in terms of (i) and (ii) is not available, the coordinates of the boundary of the property or properties
		3 (c)	A plan which locates the proposed activity or activities applied for at an appropriate scale, or if it is – (i) A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is undertaken; and (ii) On land where the property has not yet been defined, the coordinates within which the activity is to be undertaken.
6	Legislation and Guidelines Considered	3 (e)	A description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process.
7	Scoping and EIA Process	N/A	
8	Assumptions and Limitations	3 (p)	A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed.
9	Need and Desirability	3 (f)	A motivation for the need and desirability for the proposed development including the need and desirability of the activity within the context of the preferred location.

Chapter	Title	Correlation with Appendix 3 of GN No. R. 982	
10	Project Description	3 (d)	A description of the scope of the proposed activity, including – (i) All listed and specified activities triggered; and (ii) A description of the activities to be undertaken, including associated structures and infrastructure.
		3 (g)	A motivation for the preferred development footprint within the approved site.
11	Alternatives	3 (h)	A full description of the process followed to reach the proposed preferred activity, site and location within the site, including: (i) Details of all alternatives considered; (ix) The outcome of the site selection matrix; (x) If no alternatives including alternative locations for the activity were investigated, the motivation for not considering such.
12	Profile of the Receiving Environment	3 (h)	A full description of the process followed to reach the proposed preferred activity, site and location within the site, including: (iv) The environment attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;
13	Public Participation	2 (h)	A full description of the process followed to reach the proposed preferred activity, site and location within the site, including: (ii) Details of the public participation process undertaken in terms of regulation 41 of the Regulations including copies of supporting documents and inputs; and (iii) A summary of the issues raised by IAPS and an indication of the manner in which the issues were incorporated or the reasons for not including them.
14	Summary of Specialist Studies	3 (k)	Where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report.
15	Impact Assessment	3 (h)	A full description of the process followed to reach the proposed development footprint within the approved site, including: (v) The impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts – a. can be reversed;

Chapter	Title	Correlation with Appendix 3 of GN No. R. 982	
			b. may cause irreplaceable loss of resources; and c. can be avoided, managed or mitigated. (vi) The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks. (vii) Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects. (viii) The possible mitigation measures that could be applied and level of residual risk.
		3 (i)	A full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred location through the life of the activity, including – (i) A description of all environmental issues and risks that were identified during the environmental impact assessment process; and (ii) An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.
		3 (j)	An assessment of each identified potentially significant impact and risk, including- (i) Cumulative impacts; (ii) The nature, significance and consequences of the impact and risk; (iii) The extent and duration of the impact and risk; (iv) The probability of the impact and risk occurring; (v) The degree to which the impact and risk can be reversed; (vi) The degree to which the impact and risk may cause irreplaceable loss of resources; and (vii) The degree to which the impact and risk can be mitigated.
16	EAP Conclusions and Recommendations	3 (l)	An environmental impact statement which contains – (i) A summary of the key findings of the environmental impact assessment: (ii) A map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site

Chapter	Title	Correlation with Appendix 3 of GN No. R. 982	
			indicating any areas that should be avoided, including buffers; and (iii) A summary of the positive and negative impacts and risks of the proposed activity and identified alternatives.
		3 (m)	Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation.
		3 (o)	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation.
		3 (q)	A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.
17	Oath of EAP	3 (s)	An undertaking under oath or affirmation by the EAP in relation to: (i) The correctness of the information provided in the reports; (ii) The inclusion of comments and inputs from stakeholders and IAPs; (iii) The inclusion of inputs and recommendations from the specialist reports where relevant; and (iv) Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties.
18	References	-	-
N/A		3 (r)	Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised.
N/A		3 (u)	An indication of any deviation from the approved scoping report, including the plan of study, including – (i) any deviation from the methodology used in determining the significance of potential environmental impacts and risks (ii) a motivation for the deviation
N/A		3 (v)	Any specific information that may be required by the competent authority.
N/A		3 (w)	Any other matters required in terms of section 24(4)(a) and (b) of the Act.

3 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**.

Table 2: 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
Ms. S. Gerber	BSc (Hons) – Ecology, Environment and Conservation	Public Participation and Report Writing

4 PROJECT BACKGROUND AND MOTIVATION

4.1 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 m^3/a with the existing sources yielding only about 475 million m^3/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 m^3/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).

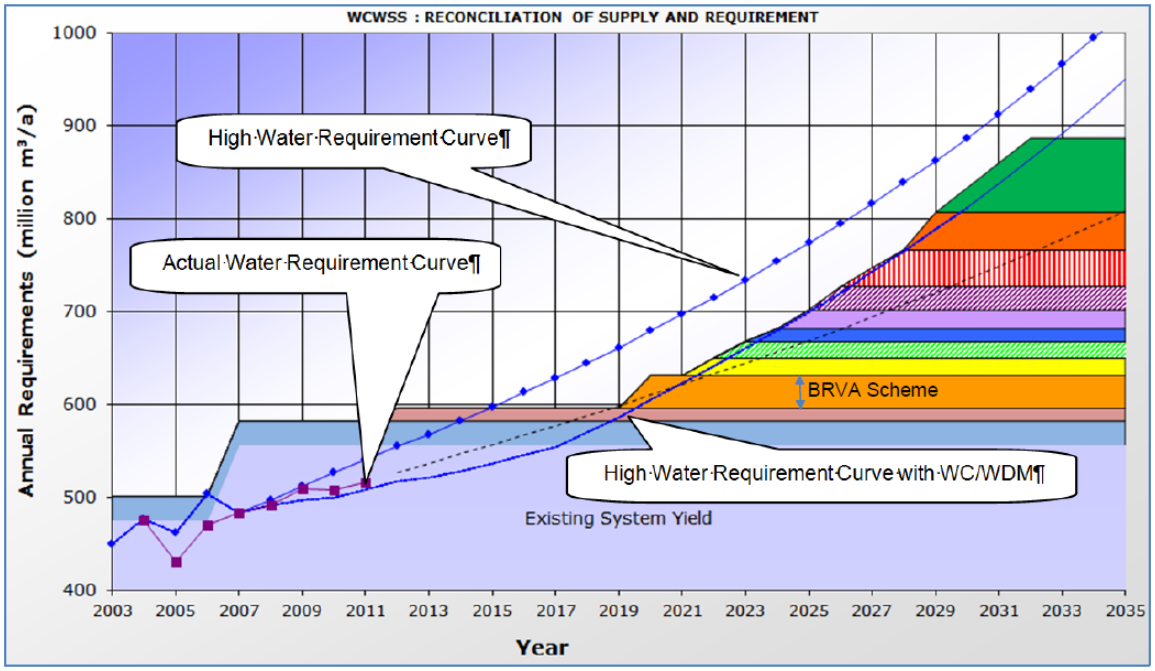


Figure 1: WCWSS Reconciliation of Supply and Requirements (DWA, 2012a)

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**.

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 undertaken in order to timeously identify the next most feasible option for further augmentation of the system in the future.

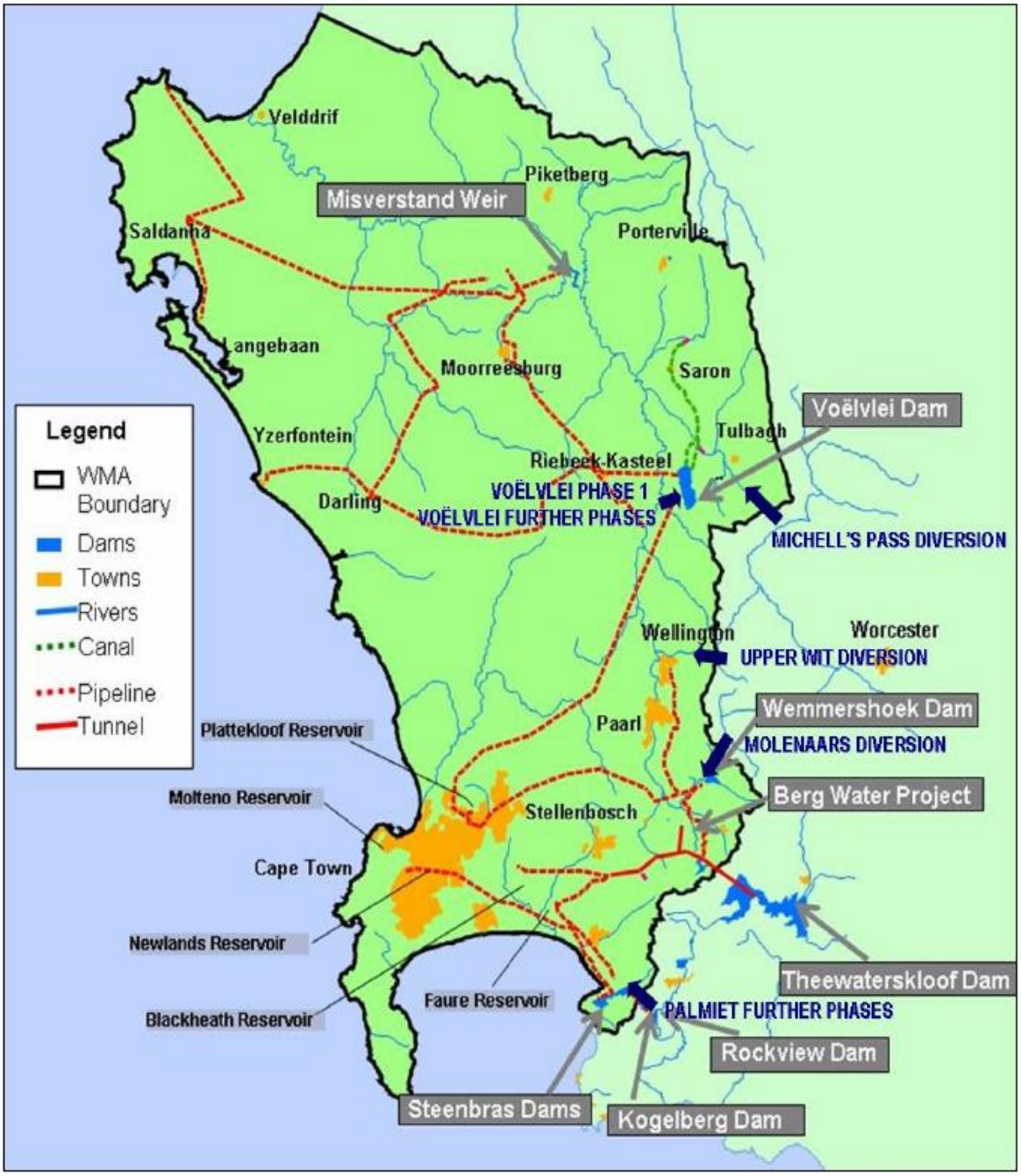


Figure 2: The WCWSS and the Location of the Options Investigated (DWA, 2010)

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 Plattekloof 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.

4.2 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 km^2) 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 Riebeek-Kasteel, Riebeek-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 m^3/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 (31km^2) 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 m^3/s whilst the canal from the Leeu River and Twenty Four River is 29 km long with a capacity of 34 m^3/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).

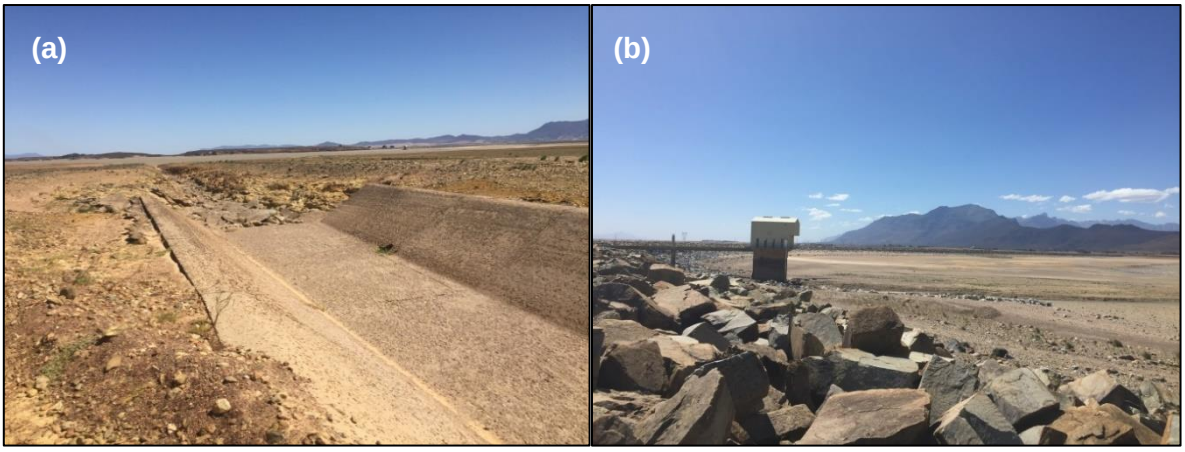


Figure 3: Canal feeding Voëlvlei Dam (a) and a dry Intake tower at Voëlvlei Dam (during the summer of 2016 (b)

5 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 km^2 in the Western Cape Province, and is subdivided into 12 quaternary catchments ranging in size from 125 km^2 near the headwaters to 2000 km^2 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 Mm^3 (C.A.P.E., 2008).

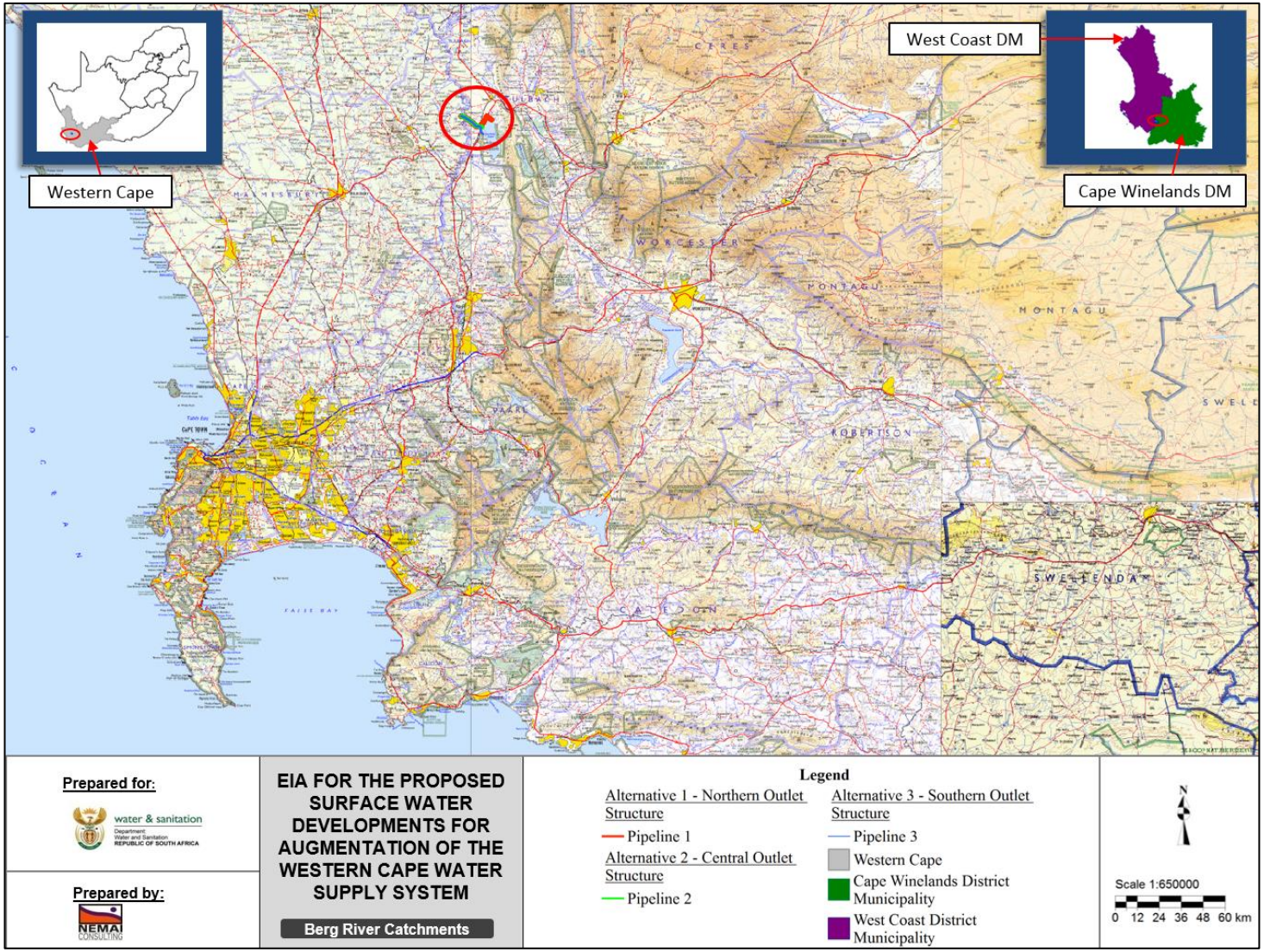


Figure 4: Locality Map

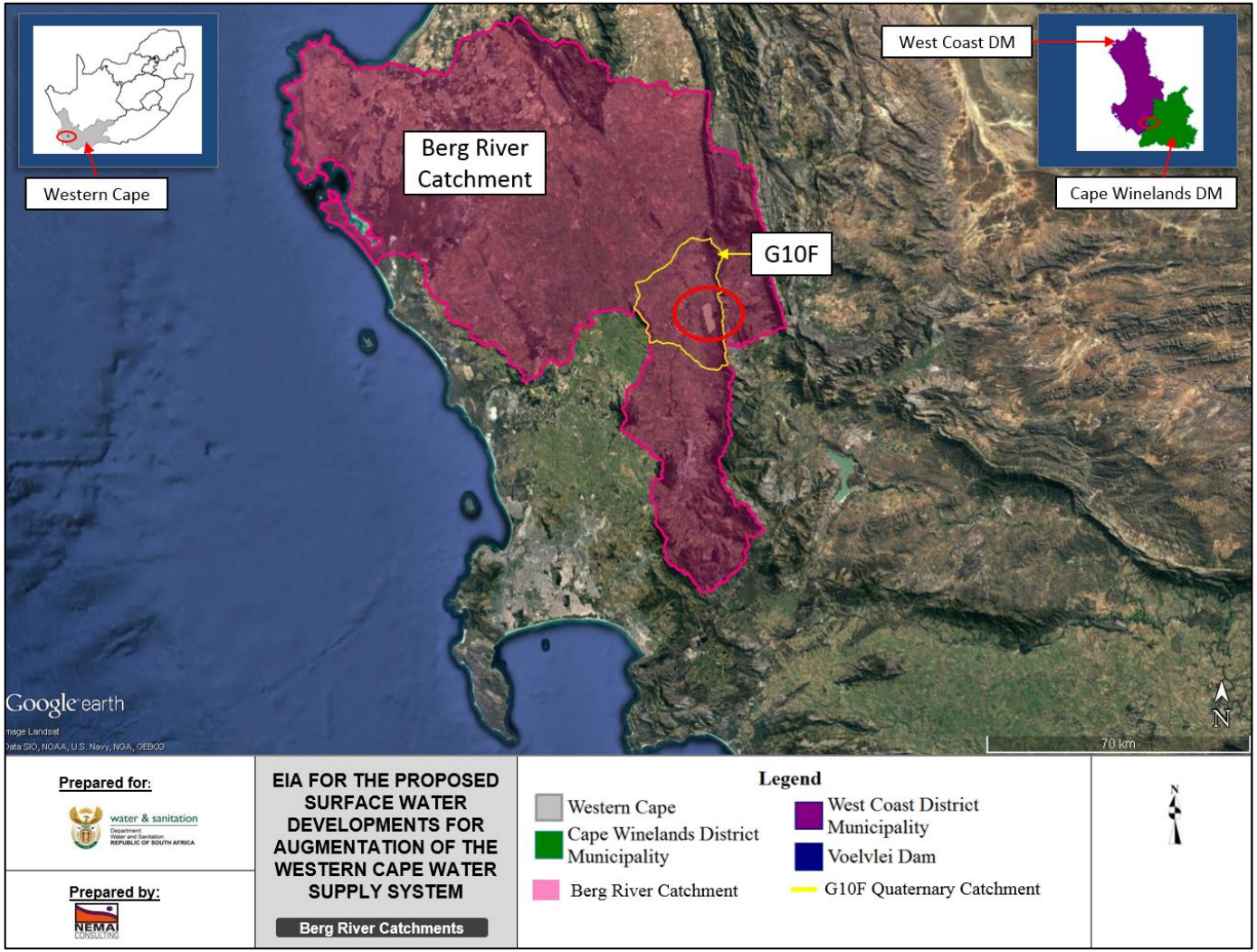


Figure 5: Berg WMA and Berg River Catchment

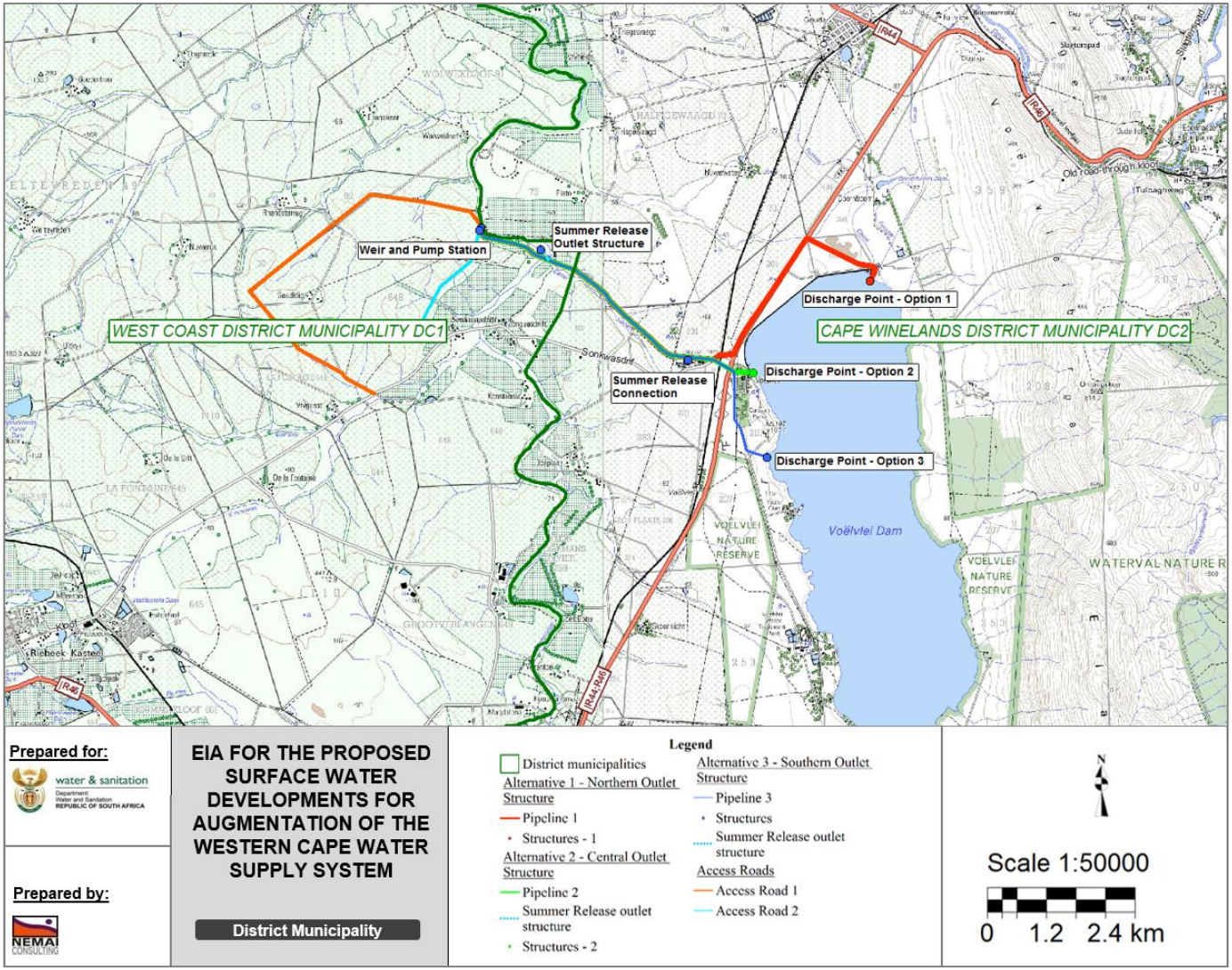


Figure 6: District Municipalities Map

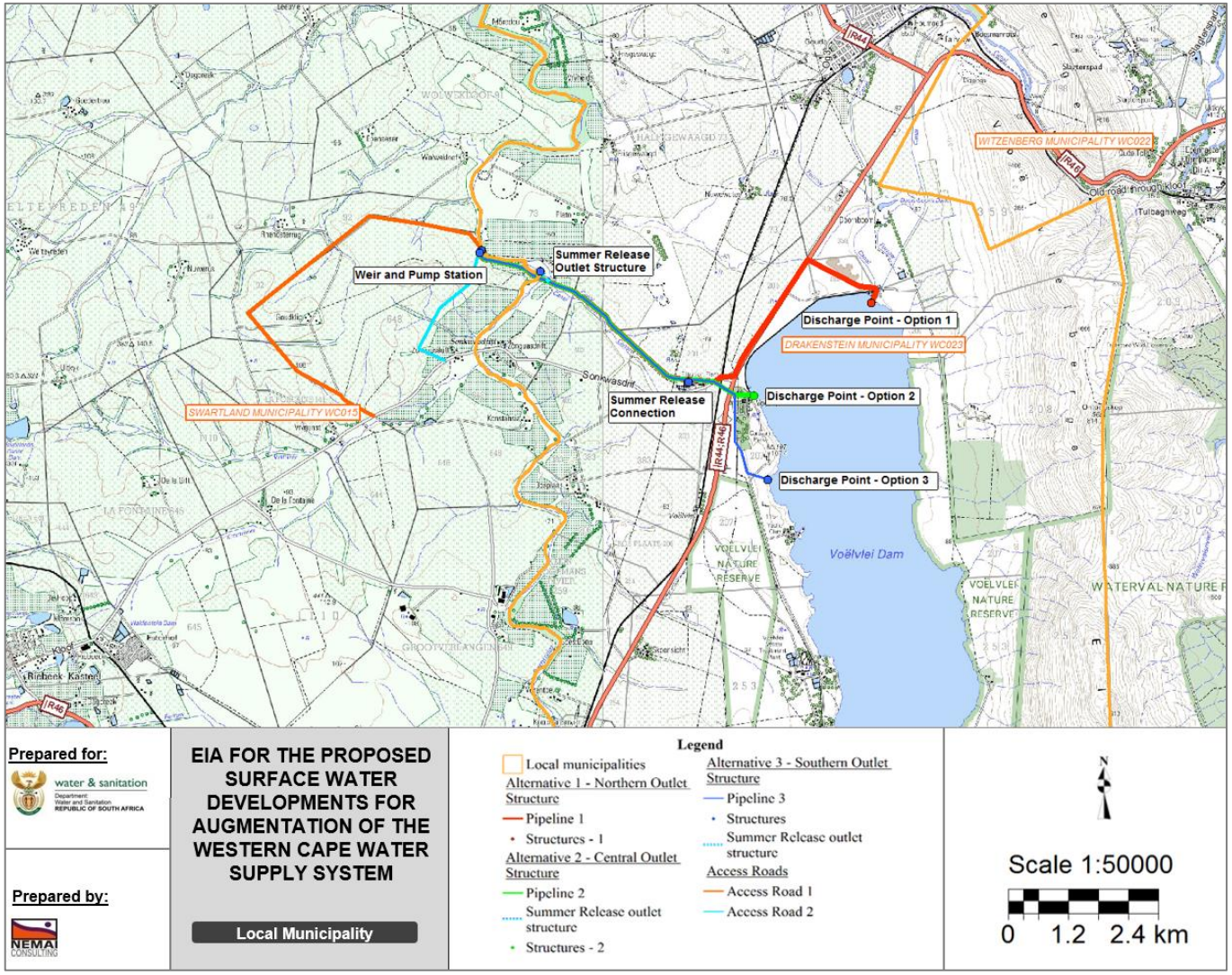


Figure 7: Local Municipalities Map

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 8** and listed in **Table 3**.

Table 3: Directly affected properties

Project Component	Farm Name	Portion	SG Code
Pipeline and associated Discharge Points	Half Gewaagd 73	21	C07500000000007300021
	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	C07500000000007300025
	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 Tulbugh 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

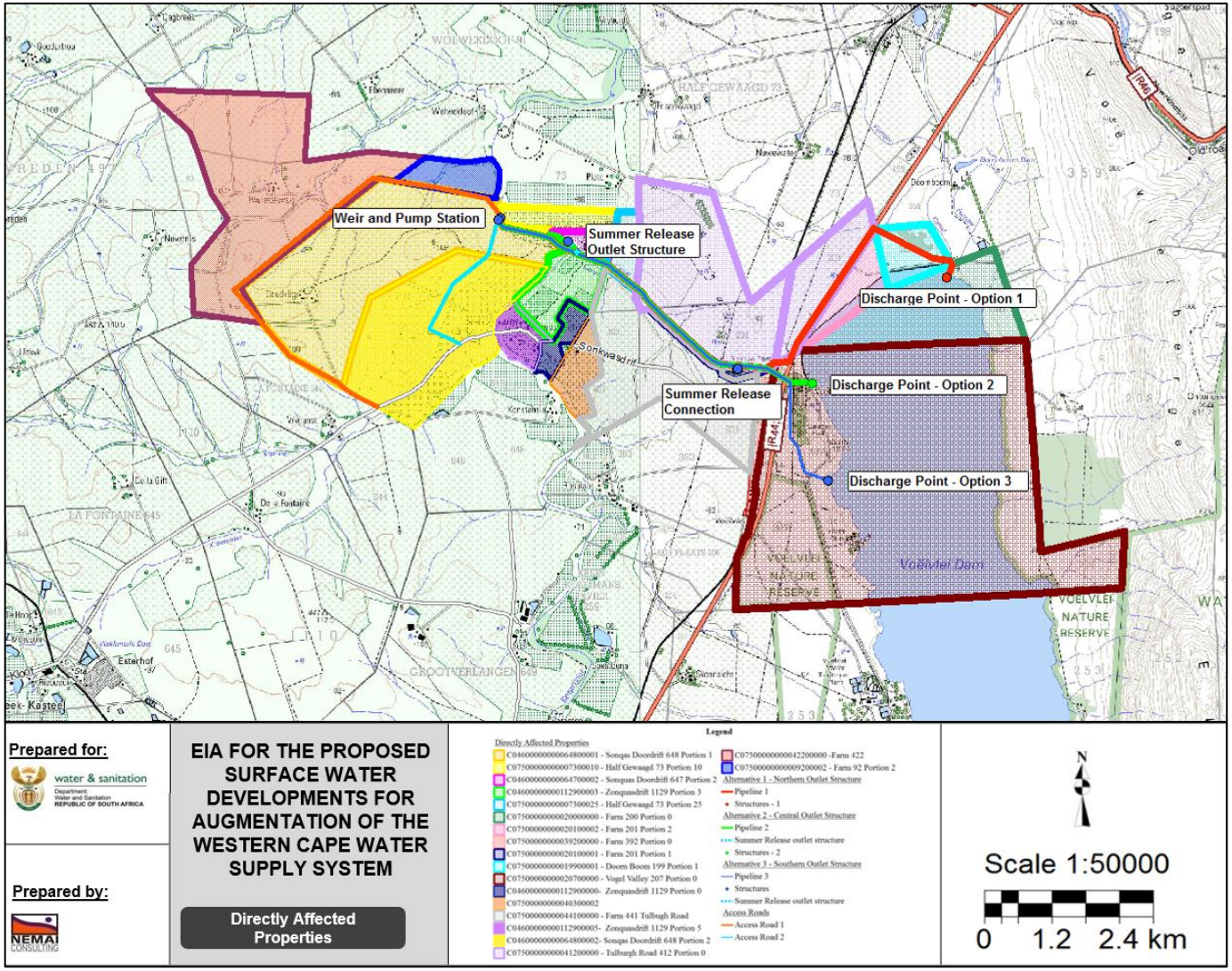


Figure 8: Directly affected properties

6 LEGISLATION AND GUIDELINES CONSIDERED

6.1 Overview of Legislation

Some of the pertinent environmental legislation that has bearing on the proposed development is captured below (**Table 4**). More detailed information is provided in **Section 6.2.** to **6.14**. This Section aims to satisfy 2(e) of Appendix 2 of GN No. R. 921 of 04 December 2014 (A description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process).

Table 4: 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 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.

Legislation	Relevance
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.

6.2 The Constitution (Act No. 108 of 1996)

The Constitution of the Republic of South Africa, Act No. 108 of 1996, is the supreme law of the land and provides amongst others the legal framework for legislation regulating coastal management in general. It also emphasises the need for co-operative governance. In addition, the Environmental clause in Section 24 of the Constitution provides that:

"Everyone has the right –

a) To an environment which is not harmful to their health or wellbeing;

b) To have the environment protected for the benefit of present and future generations through reasonable legislation and other measures that:

I. Prevent pollution and ecological degradation;

II. Promotes conservation;

III. Secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development".

The Constitution provides the overarching framework for sustainable development.

6.3 The National Environmental Management Act (Act No. 107 of 1998)

The proposed surface water developments for augmentation of WCWSS requires authorisation in terms of the National Environmental Management Act (NEMA) (Act No. 107 of 1998), and the EIA was undertaken in accordance with the EIA Regulations (04 December 2014).

The 2014 EIA Regulations consist of the following:

- EIA procedures - Government Notice No. R. 982;
- Listing Notice 1 - Government Notice No. R. 983;
- Listing Notice 2 - Government Notice No. R. 984; and
- Listing Notice 3 - Government Notice No. R. 985.

The proposed developments triggered activities under Listing Notices 1, 2, and 3 and thus a Scoping and EIA process needs to be undertaken. The listed activities are fully explained in context of the project in **Table 5**.

Table 5: Listed Activities triggered by the proposed project

Listed Activity	Listed Activity Description per project
GN No. R 983 – Activity 9 (i) (a) The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water or storm water- (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where- (a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve; or (b) where such development will occur within an urban area.	A new rising main pipeline will be constructed in order to transfer water from the Berg River to the existing Voëlvlei Dam. The pipeline will be between 5000 and 8115m in length and will have a diameter of 1.7m. The servitude for the pipeline will be 25m on either side.

Listed Activity	Listed Activity Description per project
GN No. R 983 – Activity 12 (iii) (v) (x) (xii) (a) The development of- (i) canals exceeding 100 square metres in size; (ii) channels exceeding 100 square metres in size; (iii) bridges exceeding 100 square metres in size; (iv) dams, where the dam, including infrastructure and water surface area, exceeds 100 square metres in size; (v) weirs, where the weir, including infrastructure and water surface area, exceeds 100 square metres in size; (vi) bulk storm water outlet structures exceeding 100 square metres in size; (vii) marinas exceeding 100 square metres in size; (viii) jetties exceeding 100 square metres in size; (ix) slipways exceeding 100 square metres in size; (x) buildings exceeding 100 square metres in size; (xi) boardwalks exceeding 100 square metres in size; or (xii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; - excluding- (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies;	New weir, pump station building and infrastructure more than 100m^2 in size within 32m of the Berg River will be constructed. The footprint of the pump station alone will be in the order of 80 x 30m (~2400m^2) on the left bank (looking downstream). The weir footprint extends well onto the right bank and will also exceed 100m^2. The scheme could be operated in one of two ways. Either a possible 4m^3/s abstraction via a stepped pumping rule into a 1.7m dia pipe, or via a variable speed abstraction of up to 6m^3/s into a 1.9m dia pipe. The recommended is the former one (i.e. 1.7m dia pipe with a stepped pumping rule up to 4m^3/s), which is more easily operated.

Listed Activity	Listed Activity Description per project
(cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; or (ee) where such development occurs within existing roads or road reserves.	
GN No. R. 983 – Activity 19 (i) The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from- (i) a watercourse; (ii) the seashore; or (iii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater but excluding where such infilling, depositing, dredging, excavation, removal or moving- (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.	The proposed development will include the construction of various infrastructure within the Berg River, including: • Low level weir; • Pipeline; and • Pump station. This will result in the excavating, dredging and infilling within a watercourse of more than $5m^3$. One of the access roads proposed is to be via the existing Sonquasdrift Road which currently crosses the Berg River in the direction of Riebeeck Kasteel. That road is wide enough (6m surface and 15-20m servitude). From the existing Sonquasdrift Road to the abstraction / pump station site, there may be small watercourses to cross (depending on which of the two possible access routes are selected).
GN No. R. 983 – Activity 27 (i) The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	The footprint of the pump station alone will be in the order of 80 x 30m (~$2400m^2$) on the left bank (looking downstream). The weir footprint extends well onto the right bank and will also exceed $100m^2$.
GN No. R. 983 – Activity 30	The proposed developments fall within the Swartland Shale Renosterveld, and the Swartland Alluvium Fynbos, both of which are categorised as Critically Endangered, according to data sourced from SANBI.

Listed Activity	Listed Activity Description per project
Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).	The proposed developments also fall within both Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) regions.
GN No. R. 984 – Activity 11 (i) (ii) The development of facilities or infrastructure for the transfer of 50 000 cubic metres or more water per day, from and to or between any combination of the following - (i) water catchments; (ii) water treatment works; or (iii) impoundments; excluding treatment works where water is to be treated for drinking purposes.	The proposed development involves the transfer of approximately 23 million cubic metres per annum between the Berg River and the existing Voëlvlei Dam. Water from the Dam is abstracted by West Coast District Municipality and City of Cape Town.
GN No. R. 985 – Activity 12 (a) (i) (ii) The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. (i) Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (ii) Within critical biodiversity areas identified in bioregional plans; (iii) Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuarine functional zone, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; or (iv) On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.	The proposed development will result in more than 300 square metres of indigenous vegetation being cleared. Part of the pipeline route occurs within a CBA area as well as an area indicated in the National Spatial Biodiversity Assessment (2004) as CE.
GN No. R. 985 – Activity 18 (f) (i) (aa)	The existing Sonquasdrift Road is proposed as the one of the main access route, from where access would then be via existing farm roads (the farm roads would need

Listed Activity	Listed Activity Description per project
The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. (f) In Western Cape: i. All areas outside urban areas: (aa) Areas containing indigenous vegetation; (bb) Areas on the estuary side of the development setback line or in an estuarine functional zone where no such setback line has been determined.; or ii. In urban areas: (aa) Areas zoned for conservation use; or (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority	widening). The Sonquasdrift Road itself has a current surface width of 6m and a minimum servitude of 15m and is wide enough.

6.4 The National Environmental Management: Waste Act (Act No. 59 of 2008)

The National Environmental Management Waste Act (NEM: WA) (Act No. 56 of 2008) regulates waste management in order to protect the health and environment of South African citizens. This is achieved through pollution prevention, institutional arrangements and planning matters, national norms and standards and the licensing and control of waste management activities.

The list of waste management activities that have or are likely to have a detrimental effect (GN No. 921 of 29 November 2013) contains activities listed in Categories A and B that would require licensing from the provincial or national authorities and activities contained in Category C which would require meeting the requirements of various Norms and Standards.

The purpose of the Norms and Standards for the Storage of Waste is to provide a uniform approach to the management of waste storage facilities, ensure best practice is the management of waste storage facilities and provide minimum standards for the design and operation of new and existing waste storage facilities.

The Norms and Standards require registration of new storage facilities. They also provide details on the management of all storage facilities in terms of access control and notices, operation, general requirements of waste storage containers, minimum requirements for above ground storage facilities and minimum requirements for below ground storage facilities.

The Norms and Standards also require that training be undertaken and an emergency preparedness plan be compiled. In addition, specific monitoring and inspections need to be undertaken as well as internal and external audits.

As part of the operation of the facility, waste will be stored temporarily on site prior to disposal. These storage facilities will be managed in line with the Norms and Standards for Storage.

No authorisation will be required in terms of the NEM: WA (Act No. 59 of 2008), as the project will not include any listed waste management activities.

The following should be noted with regards to waste management during the Construction Phase:

- Temporary waste storage facilities will remain below the thresholds contained in the listed activities under Schedule 1 of NEM: WA; and
- The Environmental Management Programme (EMPr) will make suitable provisions for waste management, including the storage, handling and disposal of waste.

6.5 The Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)

The purpose of the Mineral and Petroleum Resources Development Act (MPRDA) (Act No. 28 of 2002) is to make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources and to provide for matters related thereto. This act defines mining as "any operation or activity for the purposes of winning any mineral on, in or under the earth, water or any residue deposit, whether by underground or open working or otherwise and includes any operation or activity incidental thereto".

Under Section 106(1) of the Mineral and Petroleum Resources Development Act (MPRDA) (Act No. 28 of 2002), DWS is exempt from the provisions of Sections 16, 20, 22 and 27 "*in respect of any activity to remove any mineral for road construction, building of dams or other purpose which may be identified in such notice*".

No Mining Permits are required for the proposed developments as borrow pit material (e.g. soil, gravel or sand) will be sourced from a commercial source.

6.6 The National Water Act (Act No. 36 of 1998)

The National Water Act (NWA) (Act No. 36 of 1998) regulates the water resource of South Africa and aims to achieve the sustainable use water for the benefit of all users. Water is considered a scarce commodity and should therefore be adequately protected. Amongst others, the act deals with the protection of water sources, water uses, water management strategies and catchment management, dam safety and general powers and functions, as well as water quality.

The purpose of the act is to ensure that South Africa's water resources are protected, used, developed, conserved, managed and controlled, and for achieving this purpose, to establish

suitable institutions and to ensure that they have appropriate community, racial and gender representation.

The NWA definition for a Water Resource includes:

1. A Watercourse;
2. Surface Water;
3. An Estuary; and
4. An Aquifer.

The NWA defines a watercourse as follows:

a) A river or spring;
b) A natural channel in which water flows regularly or intermittently;
c) A wetland, lake or dam into which, or from which, water flows; and
d) Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse include, where relevant, its bed and banks.

Section 21 of the NWA provides information on what water uses require approval. These include:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in a stream flow reduction activity;
e) Engaging in a controlled activity;
f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a watercourse;
j) Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

The project entails the following activities that constitute water uses in terms of Section 21 of NWA:

(a) Taking water from a water resource (water abstraction from the Berg River);

(c) Impeding or diverting the flow of water in a watercourse (instream works for the weir, pipeline, and access roads); and

(i) Altering the bed, banks, course or characteristics of a watercourse (instream works for the weir, pipeline, and access roads).

The NWA specifies that for a S21(i) water use the applicant must delineate the watercourse and riparian habitat using the DWAF guideline: "*A practical field procedure for identification and delineation of wetlands and riparian areas*" and indicate the proposed activity location in relation to the riparian area, the 1:50 and 1:100 year floodlines on a map of appropriate scale.

Any development within the riparian habitat or 1:100 year floodline whichever is the greatest distance from the watercourse, will require an authorisation from the Department.

As the proposed developments occur within a regulated area of a watercourse and involves abstraction of water, an IWULA is required in terms of Sections 21 (a), (c) and (i). In addition, an Aquatic and Wetland Delineation Report has been prepared as part of the EIA Phase and can be referred to in **Appendix G** of the EIA Report.

6.7 National Environmental Management: Biodiversity Act (Act 10 of 2004)

The National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004) was promulgated for the management and conservation of South Africa's biodiversity through the protection of species and ecosystems and the sustainable use of indigenous biological resources.

The main implication of this act is the protection of biodiversity.

6.8 The National Environmental Management: Protected Areas Act (Act No. 57 of 2003)

The aim of the National Environmental Management: Protected Areas Act (NEMPA) (Act No. 57 of 2003) is to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and natural seascapes. The purpose of a Protected Environment is amongst others to protect a specific ecosystem outside a special nature reserve world heritage site or nature reserve and also to ensure the use of the natural resources in the area is sustainable.

The proposed developments do occur near a Protected Areas, namely the Voëlvlei Nature Reserve managed by Cape Nature. However, the proposed developments do not encroach on the Reserve.

6.9 The Conservation of Agricultural Resources Act (Act No. 43 of 1983)

The Conservation of Agricultural Resources Act (CARA) (Act No. 43 of 1983) requires the maintenance of riparian vegetation and provides a list of invasive alien vegetation that must be controlled or eradicated.

Agricultural land is impacted on by the proposed developments. The impacts of the proposed developments have been assessed in the EIA phase as agricultural land may be lost as a

result of the project. In addition, an Agricultural Impact Assessment has been conducted as part of the EIA Phase and can be referred to in **Appendix G** of the EIA Report.

6.10 National Forest Act (Act 84 of 1998)

In terms of the National Forests Act (Act 84, 1998), trees in natural forests or protected tree species (as listed in Government Gazette Notice 1012 of 27 August 2004) may not be cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold - except under licence granted by the DAFF.

This Act has considered in the Terrestrial Ecological Impact Assessment (**Appendix F1**) in terms of the occurrence of any Protected Trees on the proposed study area.

6.11 National Heritage Resources Act (Act No. 25 of 1999)

The National Heritage Resources Act (Act No. 25 of 1999) was promulgated for the protection of National Heritage Resources and the empowerment of civil society to conserve their heritage resources.

The proposed developments will trigger certain categories as listed below that require a heritage impact assessment (HIA) in terms of Section 38 of the National Heritage Resources Act. These categories are:

- Any development or other activity which will change the character of a site
    - Exceeding 5 000 m^2 in extent; or
    - Involving three or more existing erven or subdivisions thereof; or
    - Involving three or more erven or divisions thereof which have been consolidated within the past five years;
    - The costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority; or
    - Any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority.

The Act also makes provision for General Protections, which apply automatically to certain categories of heritage resources such as archaeological and paleontological sites, cemeteries and graves, and structures older than 60 years.

A Notice of Intent to Develop was submitted to Heritage Western Cape (HWC). In their response, dated 30 September 2016 (but only received by Nemai Consulting on 27 October 2016), HWC stated:

"You are hereby notified that since there is no reason to believe that the proposed water distribution lines and associated infrastructure will impact on heritage resources, no further action under Section 38 of the National Heritage Resources Act (Act 25 of 1999) is required". However, a Phase 1 HIA was still compiled.

6.12 The National Environmental Management: Air Quality Act (Act No. 39 of 2004)

The National Environmental Management: Air Quality Act (Act No. 39 of 2004) provides for the setting of national norms and standards for regulating air quality monitoring, management and control and describes specific air quality measures so as to protect the environment and human health or well-being by:

- Preventing pollution and ecological degradation; and
- Promoting sustainable development through reasonable resource use.

It also includes the establishment of national ambient dust fall out levels that may be relevant to the construction.

6.13 The Occupational Health and Safety Act (Act No. 85 of 1993)

The Occupational Health and Safety Act (Act No. 85 of 1993) provides for the health and safety of people at work as well as the health and safety of persons using plant and machinery.

This act will need to be taken into account should the proposed development be approved.

6.14 Policy, Programmes, Guidelines and Plans

6.14.1 Guidelines

The following guidelines were used in the preparation of this report.

- Integrated Environmental Management Information Series, in particular Series 2 – Scoping (DEAT, 2002);
- Guideline on Alternatives: NEMA Environmental Impact Assessment Regulations (prepared by the Western Cape Department of Environmental Affairs and Development Planning, 2006);
- Guideline 3: General Guide to the Environmental Impact Assessment Regulations, 2005. Integrated Environmental Management Guideline Series (DEAT, 2005a);
- Guideline 4: Public Participation, in support of the EIA Regulations. Integrated Environmental Management Guideline Series (DEAT, 2005);

- Guideline on Need and Desirability, NEMA Environmental Impact Assessment Regulations Guideline and Information Document Series. Department of Environmental Affairs and Development Planning (DEADP, 2009); and
- Assessment of alternatives and impacts (Guideline 5) in support of the EIA Regulations, Department of Environmental Affairs and Tourism, Pretoria (DEAT, 2006).

6.14.2 Regional Plans

The following regional plans were considered during the execution of the EIA:

- National Development Plan;
- Western Cape Provincial Spatial Development Framework (SDF);
- West Coast District Integrated Development Plan (IDP);
- Cape Winelands SDF;
- Voëlvlei Resource Management Plan (RMP); and
- Relevant provincial, district and local policies and strategies.

The need for the proposed development may be linked to these existing policies and strategies.

7 SCOPING AND EIA PROCESS

7.1 Environmental Assessment Triggers

The proposed surface water developments for augmentation of the WCWSS entails certain activities that require authorisation in terms of NEMA. Refer to Section 6 for further discussion on the legal framework.

The process for seeking authorisation is undertaken in accordance with the EIA Regulations (GN No. R. 982, R. 983, R. 984 and R. 985 of 04 December 2014), promulgated in terms of Chapter 5 of NEMA.

Based on the types of activities involved which include activities listed in GN No. R. 983, R. 984, and R. 985 of 04 December 2014 (**Table 5**), the requisite environmental assessment for the project is a Scoping and EIA process.

7.2 Environmental Assessment Authorities

In terms of the EIA Regulations, the lead decision-making authority for the environmental assessment is the DEA.

7.3 EIA Process

7.3.1 Formal Process

Key objectives for the EIA phase include the following:

- Carry out relevant specialist studies;
- Conduct public participation;
- Assess receiving environment;
- Undertake quantitative assessment of significant environmental impacts and identify concomitant mitigation measures;
- Evaluate project alternative through a comparative analysis; and
- Compile EIA Report in accordance with the requirements stipulated in Appendix 3 of GN No. R. 982 (04 December 2014) for review by IAPs. Refer to **Chapter 2** for the document's composition, in terms of the regulatory requirements.

An outline if the Scoping and EIA process is provided in **Figure 9**.

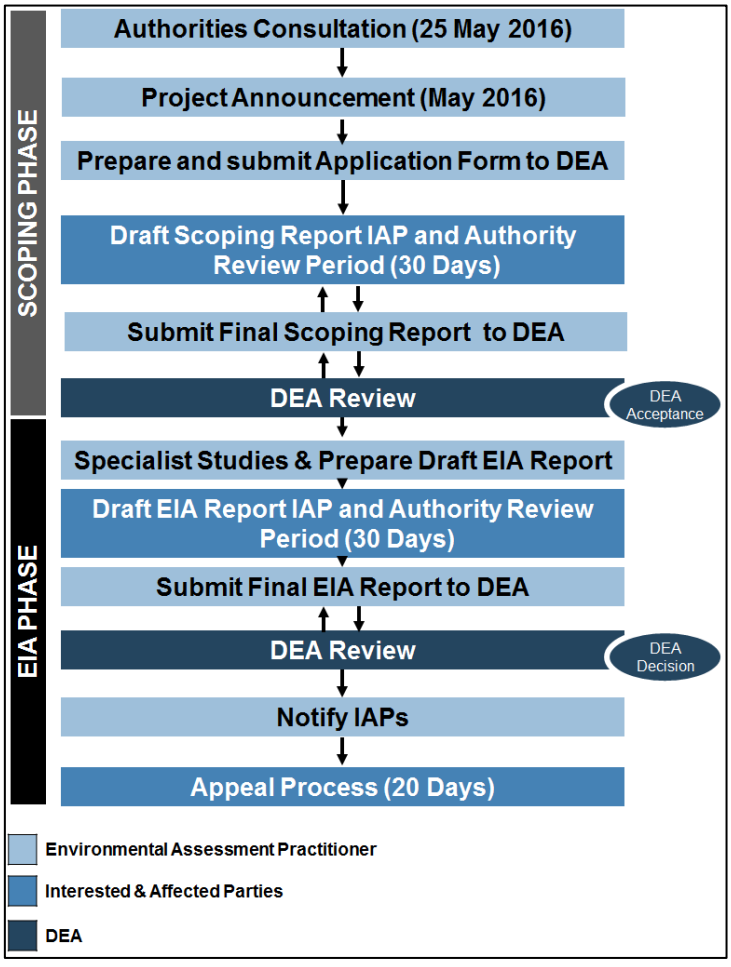


Figure 9: Scoping and EIA Process

7.3.2 Landowner Notification

Table 3 lists the various farms affected by the project (refer to cadastral map contained in **Figure 8**). The details of the affected landowners are included in the Interested and Affected Party (IAP) database contained in **Appendix F3**.

The landowners, farm managers and occupiers were notified of the project. The landowners of the properties possibly traversed by the access roads were also notified.

Proof of written notification to the landowners / persons in control of the land is included in **Appendix F2**.

7.3.3 Application Form

An Application Form for the Scoping and EIA, in terms of Regulation 10 of GN No. R. 982 of 04 December 2014, was submitted to DEA on 22 September 2016.

The activities triggered in terms of GN No. R. 983, R. 984 and R. 985 of 4 December 2014 have been confirmed based on the following:

- Current understanding of the project;
- Available technical information;
- Feedback received from the technical team; and
- Feedback received from DEA and Western Cape Department of Environmental Affairs and Development Planning (WC DEA&DP).

Initially, the Application Form included Activity 14 of GN No R985 of 04 December 2014, however, WC DEA&DP stated that Activity 14 would not be applicable as the site is not located in a protected area in terms of NEMA; no environmental management framework and/or systematic biodiversity plans have been adopted by the competent authority; and the site is not located in a core area in a biosphere reserve. Therefore, an Amended Application Form was submitted to DEA on 28 October 2016 along with the Final Scoping Report.

A copy of the Application Form that was submitted on 22 September 2016.

However, based on comments received from DEA which requested more detailed indication of which Listed Activities are being applied for, as well as the electrical supply no longer being included in the scope of work for the proposed project, a second Amended Application Form is submitted with the Draft EIA.

A copy of the second Amended Application Form is provided in **Appendix B**.

7.3.4 Screening of Alternatives

Various options to meeting the project's objectives were considered during previous studies (including the Pre-Feasibility Study), which eventually lead to the identification of alternatives. This includes the assessment of these options as part of the Scoping exercise, which forms

part of the Scoping and EIA phase. The “no go” option is also evaluated to understand the implications of the project not proceeding.

The feasible options are taken forward in the impact prediction, where the potential positive and adverse effects to the environmental features and attributes are examined further. The EIA phase includes a detailed comparative analysis of the project’s feasible alternatives that emanate from the Scoping exercise, which includes environmental (with specialist input) and technical evaluations. This ultimately resulted in the selection of a Best Practicable Environmental Option (BPEO).

See **Section 11** for further discussions on alternatives.

7.3.5 Public Participation and Review of Scoping Report

Scoping is the first phase of the formal EIA process and as such the Scoping process to be followed for the proposed surface water developments aimed to:

- Identify and engage with IAPs and allow for adequate participation in the process;
- Duly consider alternatives for achieving the project’s objectives;
- Identify significant issues to be investigated further during the execution of the EIA phase;
- Clarify the roles and responsibilities of various stakeholders in the process;
- Determine the scope of the ensuing EIA phase, in terms of specialist studies, public participation, assessment of impacts and appraisal of alternatives; and
- Allow for informed decision-making with regard to the EIA process.

In order to meet the aforementioned aims, the Scoping Report provided the following:

- Information on the Need and Desirability of the proposed development;
- Information on how the proposed development will be undertaken (if approved);
- Information on Alternatives which are being considered;
- Information on the Specialist Studies required in the pending EIA Phase;
- Information on the receiving environment that could be affected by the proposed project;
- Information on the Scoping and EIA processes as well as the Public Participation Process;
- Information on the legislation that has been considered; and
- Information on the Plan of Study for the pending EIA Phase of the project.

Scoping was the first phase of the formal EIA process. The following milestones were reached during the Public Participation and Scoping Report Review:

- The public were given the opportunity to register as IAPs from 26 May 2016 to 27 June 2016;

- Newspaper advertisements were placed in the Paarl Post and the Daily Voice, both published on 26 May 2016;
- Onsite notices were placed at all specific points around the project area; and
- Background Information Documents (BIDs) were emailed to IAPs on this database. IAPs were requested to register as IAPs during this period.
- A hardcopy of the Draft Scoping Report was placed at Gouda Library to provide IAPs the opportunity to review and comment on 22 September 2016. A 30 day public review period was given from 23 September 2016 to 25 October 2016.
- Hardcopies of the Draft Scoping Report were sent to commenting authorities for a 30 day review period from 23 September 2016 to 25 October 2016.
- The Application Form was submitted to DEA on 22 September 2016.
- The Draft Scoping Report was submitted to DEA on 23 September 2016.
- A Public Meeting was held on 04 October 2016.
- The Final Scoping Report was submitted to the DEA on 28 October 2016.
- The Approval of the Final Scoping Report was received, dated 09 December 2016.

8 ASSUMPTIONS AND LIMITATIONS

The following assumptions were made during the EIA process:

- The detailed engineering design will be finalised at a later stage. The conditions of the environmental authorisation, if issued, must be factored into the final design.
- The findings of the Impact Assessment is informed by the Specialist reports which are assumed to be accurate.
- The mitigation measures provided in the EMPr will be implemented and it assumed that the measures are adequate and will successfully enhance positive impacts while limit the negative impacts.
- The Ecological Specialist Study noted the following assumptions and limitations (Nemai Consulting, 2017):
    - The field survey was conducted outside of the peak spring-flowering period (August to October) when most geophytes in the region are in flower. This restricts the assessment in terms of the noticeable botanical attributes. Assumptions with regard to the botanical value of the site were therefore made

on the basis of habitat condition and knowledge of species most likely to occur in the area.

- Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage and Nemai Consulting can thus not accept responsibility for conclusions and mitigation measures made in good faith based information gathered or databases consulted at the time of the investigation.

- The Aquatic and Wetland Specialist noted the following assumptions and limitations (The Biodiversity Company, 2016):
  - According to the DWAF (2005) wetland and riparian area delineation guidelines, key indicators are required for the demarcation of these systems. Due to the fact that the local land uses include commercial agricultural activities and the establishment of infrastructure which includes roads, railways and settlements, the implementation of the required indicators was somewhat inhibited. In an attempt to address this, desktop data and imagery were considered to supplement the study findings.
  - Due to the extent of the study area, only areas (or systems) expected to be directly impacted on because of the project alternatives were ground truthed. These areas formed the focus and basis for the baseline study, and impact assessment. The adjacent and extending watercourses were identified, delineated and assessed at a desktop level only.
- The HIA noted the following assumptions and limitations (ACO Associates, 2016):
  - We did not cover all the proposed pipeline alternatives but assume that impacts will not differ significantly across the study area.
  - It is further assumed, that archaeological material in ploughed fields has been extensively disturbed, and are no longer in their original context. They have lost much of their heritage significance.
  - Collections of ESA material have been made in the Gouda area by Orton & Fleur (2013) and these adequately inform on the ESA history of the area.
  - We were unable to access alternative pipeline discharge Option 1, which enters the Voëlvlei Dam to the north. This is not considered a significant limitation as no heritage resources were identified along Options 2 and 3.
- The Socio-Economic Specialist noted the following assumptions and limitations (Nemai Consulting, 2016):

- It is assumed that information obtained during the interviews provide an honest account of the community and community relationship to the dam. It must be noted, however, that meetings are not statistically representative.
- It must be assumed that all the interview reports are based on reflections provided by those present and may or may not necessarily be a reflection of future conditions.
- The study was done with the information available to the specialist at the time of executing the study, within the available time frames and budget. The sources consulted are not exhaustive, and additional information which might strengthen arguments, contradict information in this report and/or identify additional information might exist. However, the specialist did endeavour to take an evidence-based approach in the compilation of this report and did not intentionally exclude information relevant to the assessment.

9 NEED AND DESIRABILITY

In terms of Regulation 2(f) of Appendix 2 of GN No. R. 921 of 04 December 2014, this section discusses the need and desirability of the project. The format contained in the Guideline on Need and Desirability (DEA&DP, 2009) has been used in **Table 6**.

Table 6: Need and Desirability of the project

No.	Question	Response
NEED ('timing')		
1.	Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved Spatial Development Framework (SDF) agreed to by the relevant environmental authority? (i.e. is the proposed development in line with the projects and programmes identified as priorities within the IDP).	Water from the Voëlvlei Dam is supplied to the WTW and farms in the surrounding areas. The WCDM SDF states that agriculture is considered the primary economic growth sector in the majority of towns in the West Coast District. As the West Coast District is confronted by an increased demand for water, it becomes more difficult to address these demands efficiently due to capacity constraints in the existing distribution schemes and water sources. Therefore, the proposed developments are considered part of the mandate to provide water to communities and industries within the Western Cape.

2.	Should development, or if applicable, expansion of the town/area concerned in terms of this land use (associated with the activity being applied for) occur here at this point in time?	The proposed development is in line with surrounding land use as the dam and associated pipeline will supply irrigation to surrounding agricultural farms, as well as supply water to the WTW which in turn supplies treated water to towns and municipalities.
3.	Does the community/area need the activity and the associated land use concerned (is it a societal priority)? This refers to the strategic as well as local level (e.g. development is a national priority, but within a specific local context it could be inappropriate)	The surrounding agricultural areas, WTWs, and the two District Municipalities receive water from the dam and there is currently an increased demand for water that becomes more difficult to address due to water shortages, therefore an increase in the amount of water supplied is needed in the area.
4.	Are the necessary services with appropriate capacity currently available (at the time of application), or must additional capacity be created to cater for the development?	This project is an augmentation to an existing scheme so appropriate capacity is available to take up the water. 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. 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.	Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services)?	The proposed developments are categorised as water service provision and therefore is planned for under both municipalities due to the need for increased water supply to the region although the project is not mentioned by the municipalities due it being driven by DWS.
6.	Is this project part of a national programme to address an issue of national concern or importance?	There is an urgent need to provide water services to communities within South Africa.
DESIRABILITY ('placing')		
7.	Is the development the best practicable environmental option (BPEO) for this land/site?	Six site options were investigated during the Feasibility Studies. From these six options, the following two priority schemes were determined as the most feasible: • BRVAS (also known as the First Phase Augmentation of Voëlvlei Dam); and

		• BBTS (also known as the Michell'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.
8.	Would the approval of this application compromise the integrity of the existing approved municipal IDP and Spatial Development Framework (SDF) as agreed to by the relevant authorities?	It is not anticipated that the proposed developments will contradict or be in conflict with the IDP and SDF for the area.
9.	Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in EMFs), and if so, can it be justified in terms of sustainability considerations?	Currently, there is no existing EMF for the region. Therefore, this application will not compromise the integrity of the environmental priorities for the area. A number of mitigation measures have also been provided by all specialists and these have been incorporated into the EMPr contained in Appendix I.
10.	Do location factors favour this land use (associated with the activity applied for) at this place? (this relates to the contextualisation of the proposed land use on this site within its broader context).	The proposed developments are situated in close proximity to existing WTWs and the Voëlvlei Dam is currently an existing dam and therefore the land use is favoured.
11.	How will the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas (built and rural/natural environment)?	The impact of the proposed activity on sensitive features is discussed in Section 15. In summary, the environmental specialists recommended that the proposed development could go ahead as planned as long as certain mitigation measures are implemented such as a Search, Rescue and Relocation Plan being developed and an aquatic monitoring survey needs to be conducted after the construction activities have been completed.
12.	How will the development impact on people's health and wellbeing (e.g. i.t.o. noise, odours, visual character and sense of place, etc)?	The impact of the proposed development on sensitive features and people's health and wellbeing is discussed in Section 15. The only possible negative impact on health is noise and dust during the construction phase. The positive impact would be the better water security for domestic use.

13	Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?	There will be no change in land use as the weir will be located within the Berg River and the pump station does not require a change in land use. In addition, the pipeline will be an underground pipeline and the land use will not be impacted. Therefore, there will be no unacceptable opportunity costs.
14	Will the proposed land use result in unacceptable cumulative impacts?	As there will be no change in land use for the proposed developments. However, a servitude may be registered for the pipeline route which may have a cumulative impact. Cumulative impacts can be identified by combining the potential environmental implications of the proposed project with the impacts of projects and activities that have occurred in the past, are currently occurring, or are proposed in the future within the project area. The following cumulative impacts are anticipated: • Loss of sensitive vegetation types; and • Encroachment of alien vegetation. One of the main cumulative impacts is the loss of sensitive habitat. The proposed developments fall within the Swartland Shale Renosterveld, and the Swartland Alluvium Fynbos, both of which are categorised as CR, according to data sourced from SANBI. The Swartland Shale Renosterveld originally covered 495 000 hectares and now approximately 8% of natural area remains. Less than 1% of its original area is protected. At least 35 endemic plant species and 151 Red Data List plant species occur in the ecosystem. The Swartland Alluvium Fynbos originally covered 47 000 hectares and now approximately 27% of natural area remains. Approximately 2% of the ecosystem is protected in the Waterval Nature Reserve, Winterhoek (mountain catchment area) with a further 7% is found in private reserves such as Elandskloof, Langerug and Wiesenhof Wildpark. At least 13 endemic plant species and 57 Red Data List plant species occur in the ecosystem. During construction, there will be traffic-related impacts to the local road network. The construction period for the WCWSS developments will possibly place a significant burden on the roads in the project area. The associated impacts may include traffic disruptions and deterioration of road conditions. Large-scale land clearing activities and other construction-related disturbances could lead to the proliferation of exotic vegetation. The watercourses that will be affected may already be disturbed by anthropogenic influences, such as water quality deterioration by farming practices (e.g. nutrient-rich runoff) and erosion caused by grazing cattle. The project's

		construction activities may exacerbate impacts to the water quality and channel stability of the affected watercourses. There are a number of positive cumulative impacts including the increase in water provision and employment in the area. The project was initiated to meet the water demands in the Drakenstein, Swartland and CCT municipalities. The proposed WSWSS developments will cater for the water demands within these areas on a sustained basis. In turn, this will have a positive impact on the macro socio-economic environment.

10 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

10.1 Project Components

The project components are illustrated in **Figure 10** and include the following:

- A low level weir, abstraction works and 4 m^3/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; and
- Construction camp (footprint).

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

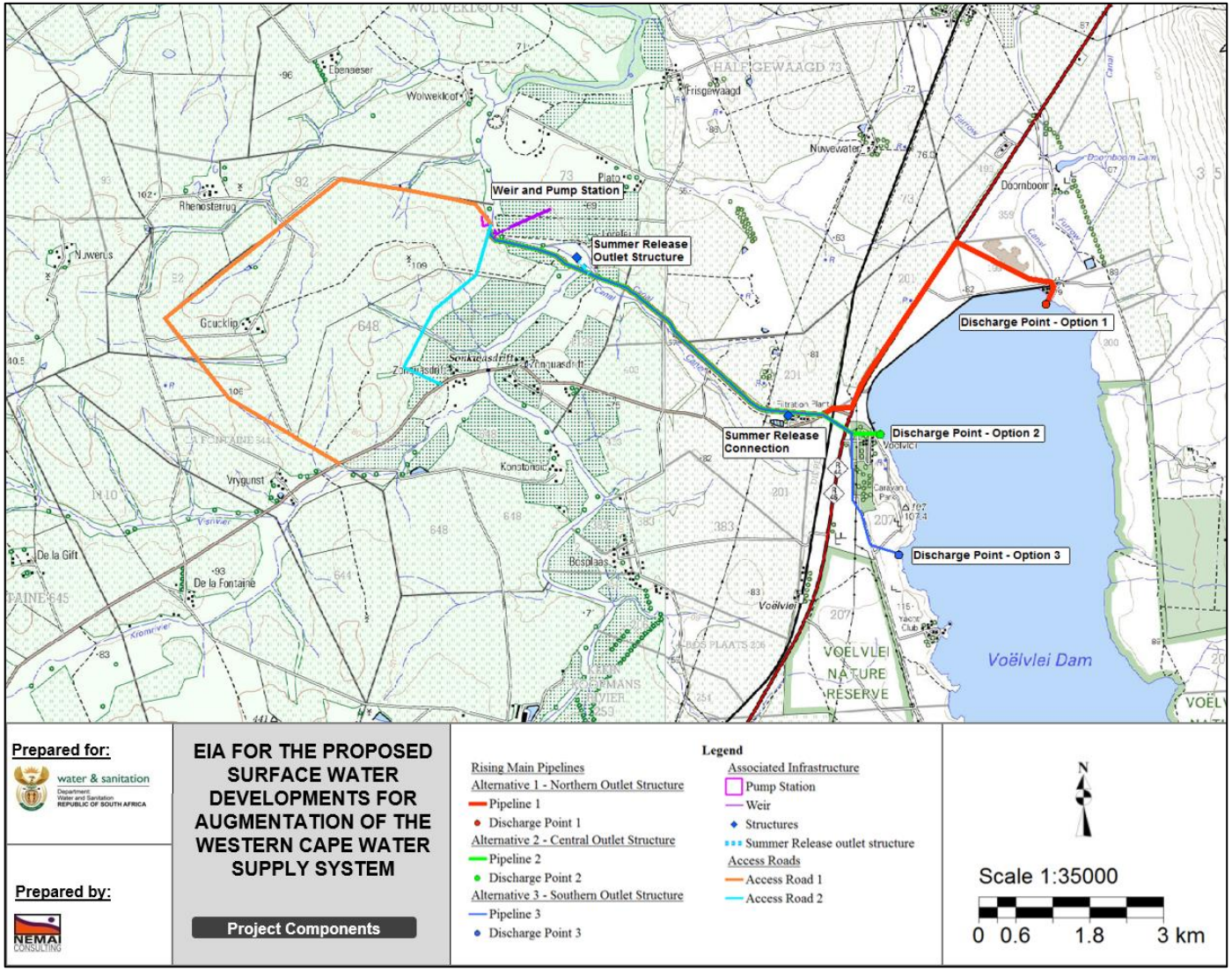


Figure 10: Project components

10.1.1 Diversion Weir and Abstraction Works

The proposed diversion weir will be located on the outer (western) bank of the Berg River (**Figures 11** and **12**).

Figure 11: Google Earth image of the weir location

Figure 12: 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 13** and **14**.

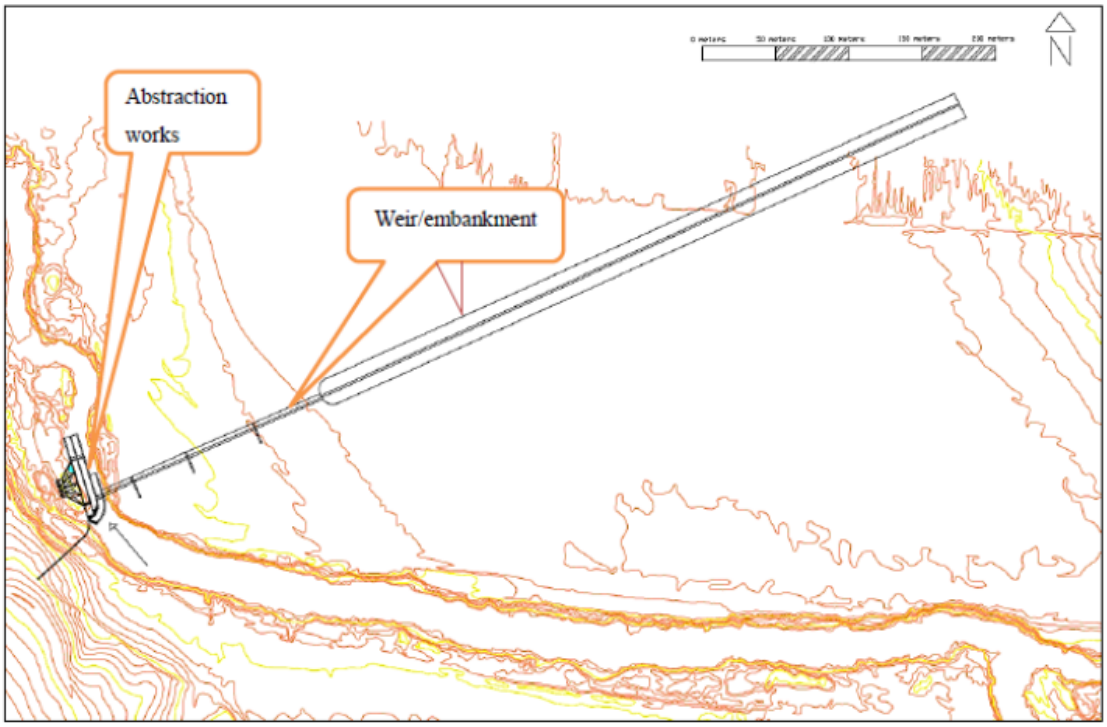


Figure 13: Layout of Abstraction Works, Weir and Embankment (DWA, 2012)

Figure 13 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 3 m 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 14**). The weir will be founded on solid rock, and therefore no energy dissipation structure has been added.

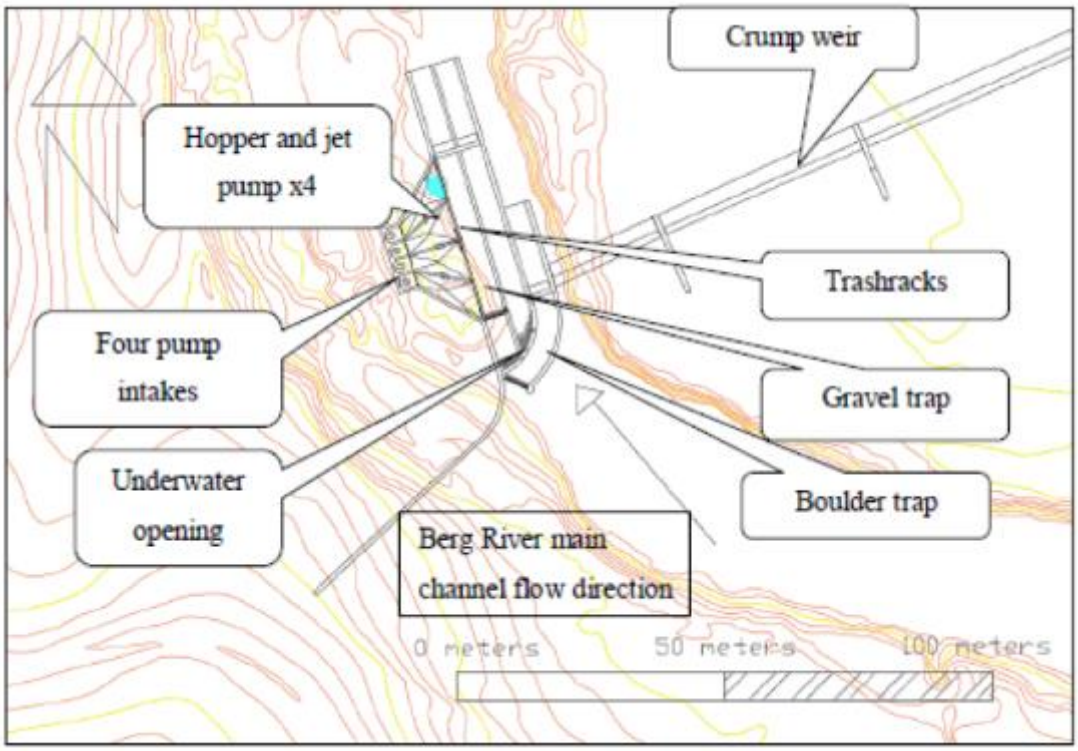


Figure 14: Components of the Proposed Abstraction Works (DWA, 2012)

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 15** 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).

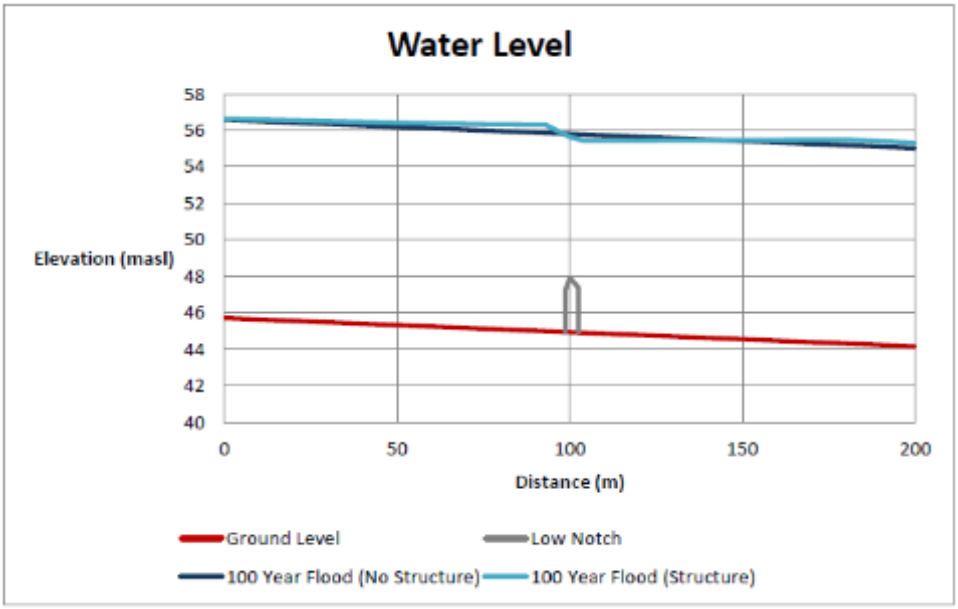


Figure 15: 100 year flood levels with the Weir in place (blue) and without the Weir in place (black)

10.1.2 Rising Main

As shown in **Figure 10,** three pipeline routes were investigated during the Technical Feasibility Study and was 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, while the pipeline itself is 1.7m wide. The servitude conditions are as follows:

- Permanent access to the pipeline servitude will be required after construction.
- Pipeline markers (concrete posts) will be installed at changes in direction and at regular intervals along the route
- Farming activities (stock and crop farming) can continue within the servitude area after construction, taking cognisance of the need for permanent access to the pipeline servitude.
- No encroachment of infrastructure (buildings) or the establishment of trees will be allowed as roots compromise the stability of the pipeline.

Whilst design flows of 4 and 6 m^3/s were considered for the rising main during the Technical Feasibility Study, the EIA only assesses the 4 m^3/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 7: 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

10.1.3 Pump Station

The design parameters adopted for the 4m^3/s Pump Station are provided in **Table 8**.

Table 8: Design Parameters for the 4m^3/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 m^3/s abstraction will be based on a step-pumping operating rule, allowing a minimum flow (spill) of 1 m^3/s past the abstraction point down the Berg River at all times, after abstraction. The pumps are in sets each with a 1 m^3/s capacity. Each pump starts up when the river inflow to the site exceeds the sum of the required environmental base flow of 1 m^3/s and the abstraction, in 1 m^3/s steps (DWA, 2012a).

A schematic diagram indicating the section through the abstraction point at the proposed pump station is shown in **Figure 16**.

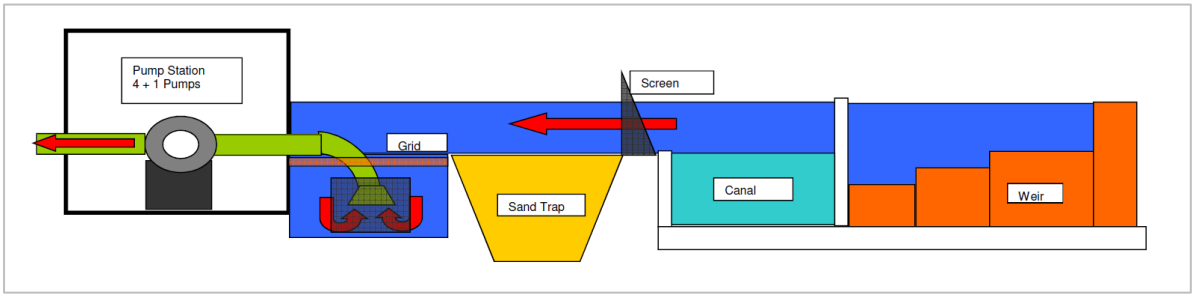


Figure 16: Abstraction point at the proposed pump station

The proposed location of the Pump Station is provided in **Figure 17**.

Figure 17: 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.

10.1.4 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 (**Figure 18**). 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 (the access road width is approximately 6m).

Figure 18: Proposed access to weir and pump station

10.1.5 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.

10.1.6 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 19**). 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 20**). 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.

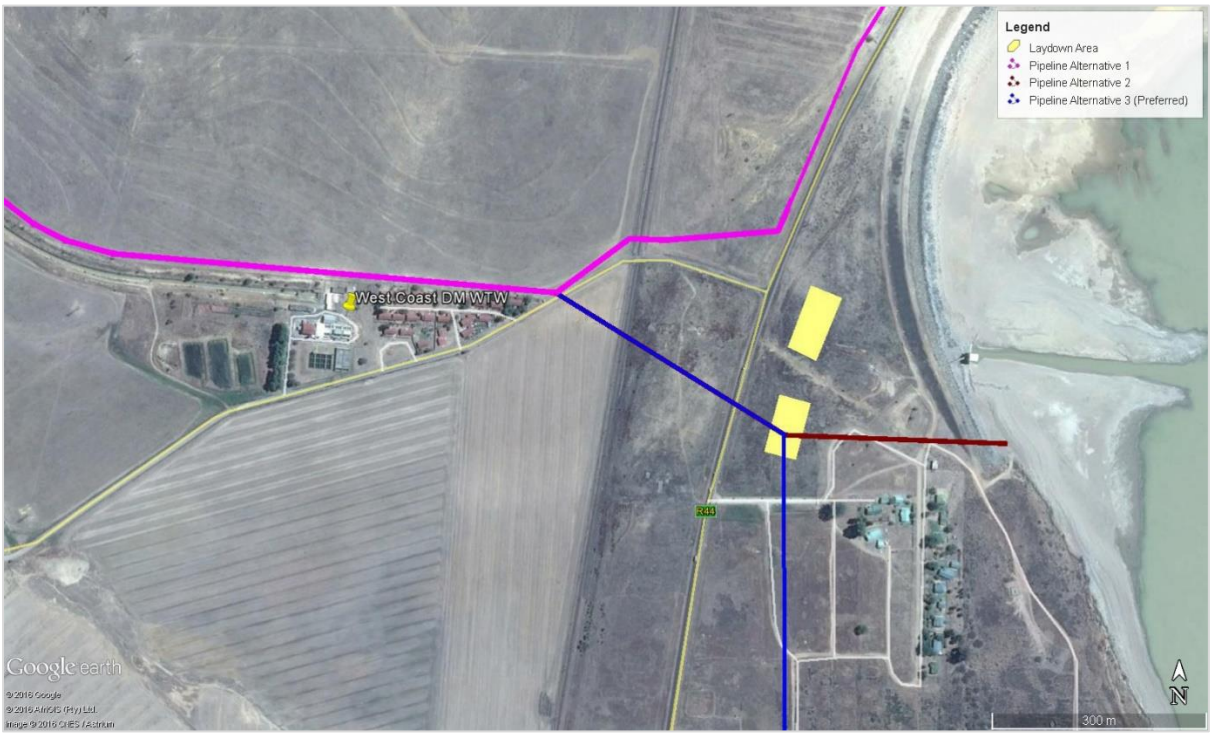


Figure 19: Location of the two proposed laydown areas adjacent to the Voëlvlei Dam

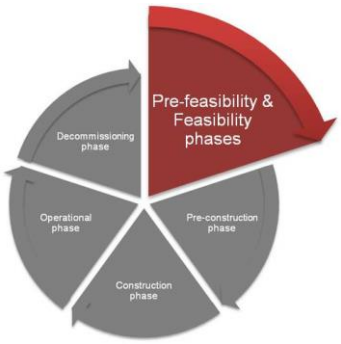
Figure 20: Proposed site laydown area at the pump station and weir site adjacent to the Berg River

10.2 Project Lifecycle

To adequately consider the impacts associated with the proposed surface water developments for the augmentation of the WCWSS, the major activities during each phase of the project lifecycle are listed in the sub-sections to follow.

10.2.1 Feasibility Studies

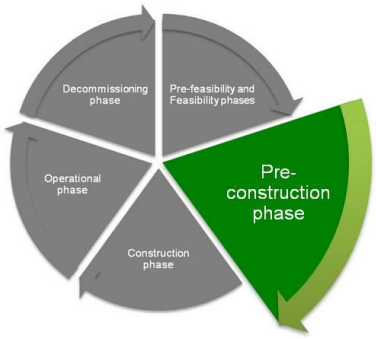
Major activities during the Feasibility Phase of the project included the following:



- Environmental screening of alternatives;
- Geotechnical investigations to confirm soil conditions (where needed);
- Technical and economic analysis; and
- Preliminary design.

10.2.2 Pre-Construction Phase

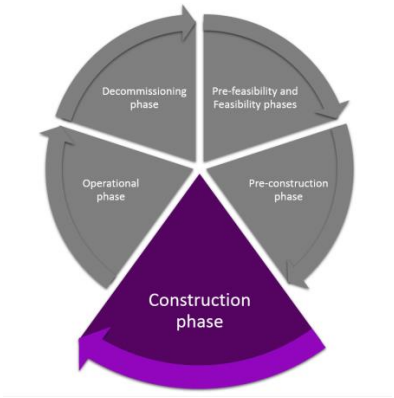
Major activities during the Pre-construction Phase of the project include the following:



- Detailed layouts and services designs;
- Detailed geotechnical investigations;
- Obtain Environmental Authorisation and IWULA;
- Tender for various construction works;
- Agreements with landowners regarding access; and
- Procurement of necessary materials.

10.2.3 Construction Phase

Major activities during the Construction Phase are as follows:



Appointments and site camp set up:

- Appoint Environmental Control Officer (ECO);
- Set up site camp with temporary offices and administrative facilities;
- Set up ablutions;
- Set up access control, security; signage and lighting;
- General materials storage and laydown areas
- Construction of chemicals storage facilities (oil, grease, solvents etc.) and associated infrastructure (bunds, secured / roofed areas etc.);
- Above ground fuel storage (e.g. gasoil/ petrol);
- Employment of construction labour;
- Workshops / areas (e.g. welding, mechanical repair, electrical etc.);
- Change-houses, chemical toilets and showering facilities (linked to conservancy tanks – removal of contents by exhauster vehicle and disposal at permitted facility); and
- Temporary waste storage areas; these shall be established and managed in accordance with EMPr requirements to be developed in the EIA phase.

Sourcing of construction materials and equipment:

- All bulk materials (aggregate, cement, steel etc.) will be sourced from existing lawful commercial sources; there will be no direct mining, harvesting or extraction of natural resources;

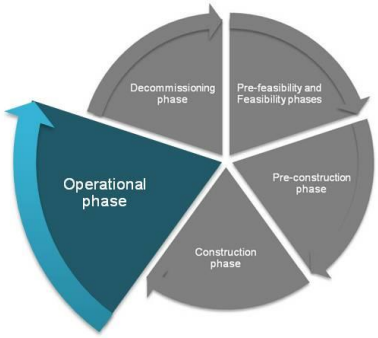
Excavation, earthworks and concreting

- Clearing of vegetation;
- Levelling and compaction using heavy machinery / earthmoving equipment;
- Potential for excavations and trenching in order to prepare foundations and laying of below ground level equipment (cables, pipes, sumps, drainage etc.);
- Potential for excavation dewatering in the event of water-table interception;
- Piling / drilling depending on the identified construction / founding technique;
- Use of general mechanical equipment within construction areas (generators, cutting and welding equipment, compressors etc.);
- Site establishment;
- Relocation of infrastructure;
- Prepare access roads;
- Establish construction laydown areas;
- Bulk fuel storage;
- Storage and handling of material;
- Employment of construction labour;
- Excavation;
- Blasting;
- Waste and wastewater management;
- Temporary river diversion for gauging weir and river crossings;
- Construction of embankment, outlet, and spillway;
- Concrete Works;
- Steel works;
- Mechanical and Electrical Works;
- Cut and cover activities;
- Stockpiling (sand, crushed stone, aggregate, etc.);
- Construction of gauging weir;

- Construction of pump station; and
- Construction of pipeline.

10.2.4 Operation Phase

Major activities during the Operation Phase of the project include the following:



- Operation of pump station and pipeline;
- Maintenance of infrastructure; and
- Ongoing consultation with directly affected parties.

10.2.5 Decommissioning Phase

Decommissioning of the proposed developments is not envisioned. However, should decommissioning be required the activity will need to comply with the appropriate environmental legislation and best practices at that time.

11 ALTERNATIVES

11.1 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 provides 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".

11.2 Alternatives Considered

11.2.1 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. Michell'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 21**). This is an inter-basin transfer from the Breede WMA into the Berg WMA.

Figure 21: 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 m^3/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 m^3/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 m^3/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 22**). 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 22: 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 23**). This would negate the need for infrastructure to be developed in the Molenaars River itself and would require no pumping.

Figure 23: 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 24**), 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 24: 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 Michell'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 m^3/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 m^3/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 m^3/s and 0.6 m^3/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 m^3/s should be made from Voëlvlei Dam for the four summer months. Two scheme options have been investigated, namely:

- Option 1: a 4 m^3/s pump station with a stepped-pump operating rule that works in 1 m^3/s increments up to a pump station capacity of 4 m^3/s and which allows a base flow of 1 m^3/s to pass the site at all times.

- Option 2: a 6 m^3/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 m^3/s.

Of the two potential abstraction approaches investigated, namely a 4 m^3/s pump station with a stepped-pump operating rule, or a 6 m^3/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 m^3/a).

Therefore, from an operational perspective, Option 1: 4m^3/s abstraction via a stepped-pumping operating rule was selected as the optimal pumping scheme for the proposed pump station.

11.2.2 Alternatives 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 (**Figure 25**): Pipeline route to Northern Discharge Point = 8 115 m;
- Option 2 (**Figure 26**): Pipeline route to Central Discharge Point = 5 000 m; and
- Option 3 (**Figure 27**): Pipeline route to Southern Discharge Point = 6 300 m.

From a technical perspective, Option 3 is the preferred option of the three route and discharge points:

- 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 is 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.

- It has the shortest conveyance length of all abstraction site options considered and enables the rising main to the Voëlvlei Dam to be aligned such that the least possible impact is made on the Renosterveld within the Voëlvlei Conservancy.
- A large portion of the servitude occurs on state owned land.

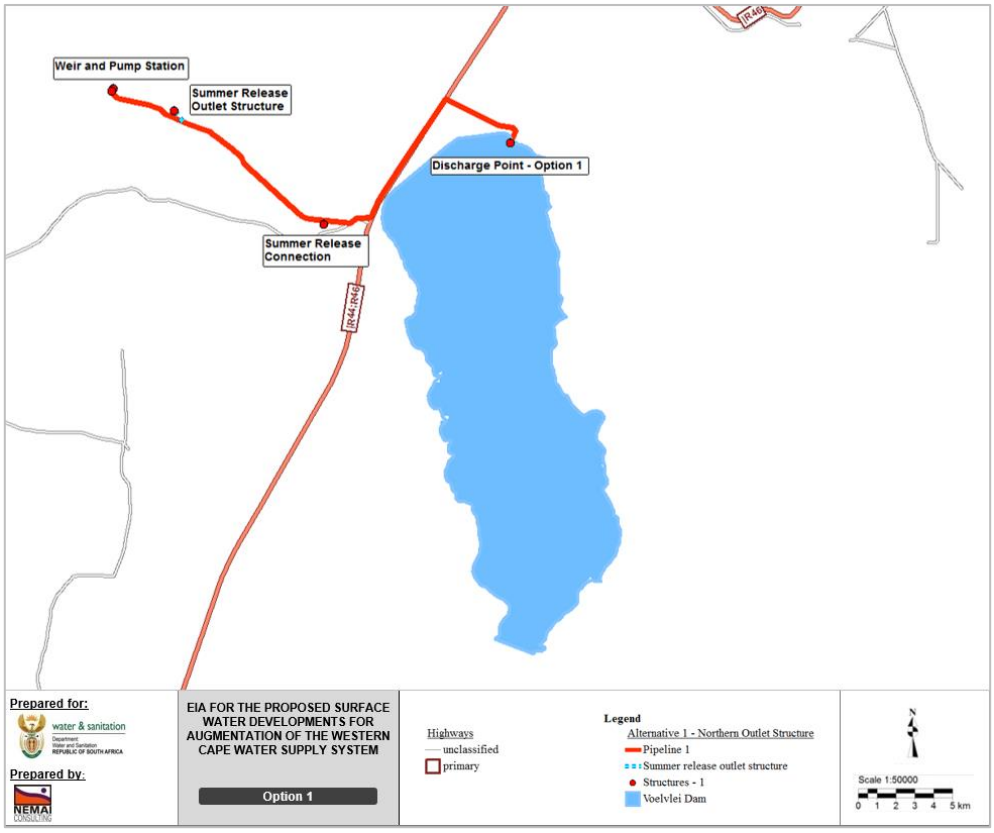


Figure 25: Option 1

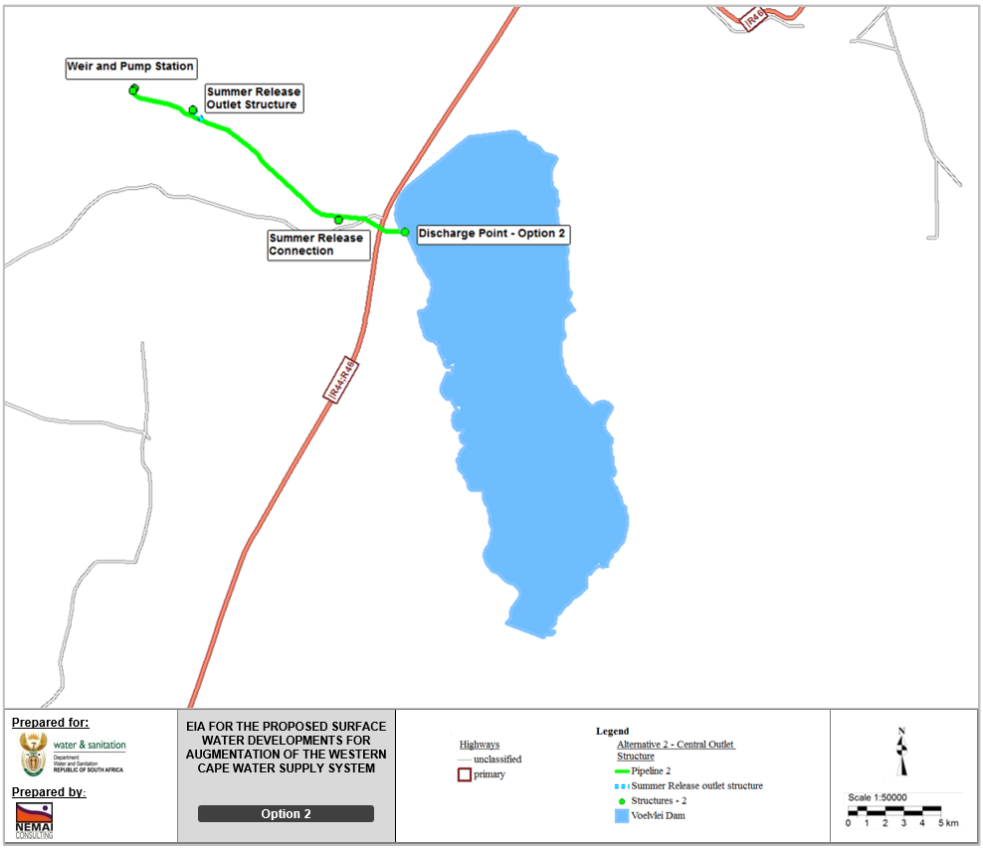


Figure 26: Option 2

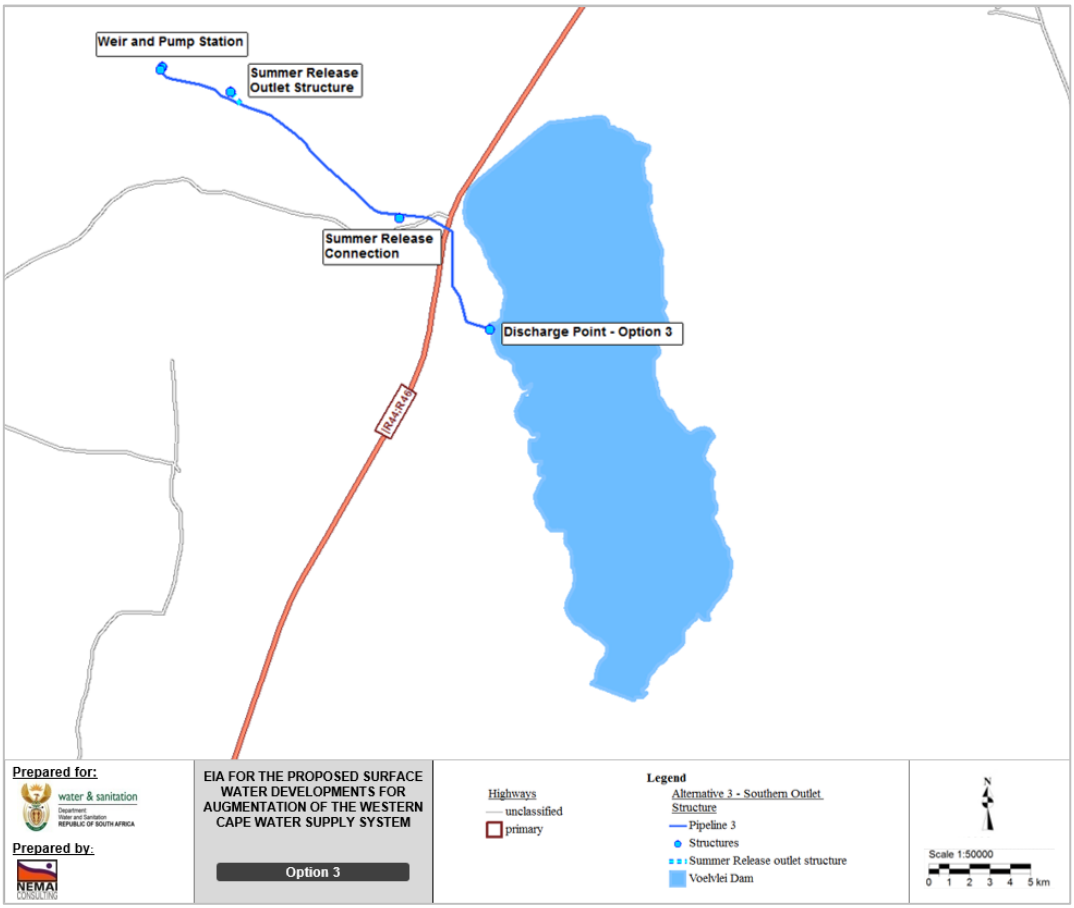


Figure 27: Option 3

11.3 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 28 shows the low water levels of the Voëlvlei Dam during the 2016 drought. If the augmentation of the WCWSS is not undertaken, these ow water levels will 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 28: Images of the low water levels of the Voëlvlei Dam

12 PROFILE OF THE RECEIVING ENVIRONMENT

This section provides a general description of the status quo of the receiving environment in the project area. This serves to provide the context within which the EIA was conducted. It also allows for an appreciation of sensitive environmental features and possible receptors of the effects of the proposed project.

Where necessary, the regional context of the environmental features is also explained, with an ensuing focus on the local surrounding environment. Refer to Section 14 for more elaborate explanations of the Specialist Studies and their findings for specific environmental features.

The potential impacts to the receiving environment are discussed further in Section 15.

As previously mentioned, Pre-Feasibility and Technical Feasibility Study reports were compiled by WCWC-JV in 2012 and these reports were used to assess the profile of the receiving environment for the augmentation of the Voëlvlei Dam.

12.1 Climate

According to the Department of Environmental Affairs and Development Planning (DEA&DP) the key climate change considerations for the Western Cape relates specifically to the following trends:

- Warmer temperatures (max and min) everywhere, but more so in the interior;
- Drier conditions in the shoulder seasons, especially away from mountains, weaker cold fronts, longer fire season, decreased crop yield, reduced economic activity;

- Increased humidity and greater persistence of stronger southerly winds;
- Increased rainfall intensity and extreme events (flooding), which leads to increased soil erosion, coastal and riverine erosion as well as damage to infrastructure;
- Rising sea levels that will lead to increased salt water intrusion into aquifers and wetlands as well as increased coastal floodings.

12.1.1.1 Temperature and Precipitation

As the nearest meteorological station is located in Paarl, Western Cape, the information to follow was obtained from the South African Weather Services (SAWS) for this station.

The climate of the Berg River catchment differs extensively with the season. The winters are typically wet and cold (17°C average) with occasional frost and snow, while the summers are very hot and dry (37°C average daily maximum) (**Figures 29** and **30**).

Rainfall patterns also differ markedly from up to 3000 mm/a in the western mountains, to as low as 150 mm/a in the southern-central valleys. Average annual rainfall the Gouda/Hermon Farming Area decreases rapidly from moderate along the slopes of the mountains forming the eastern boundary to poor in the west.

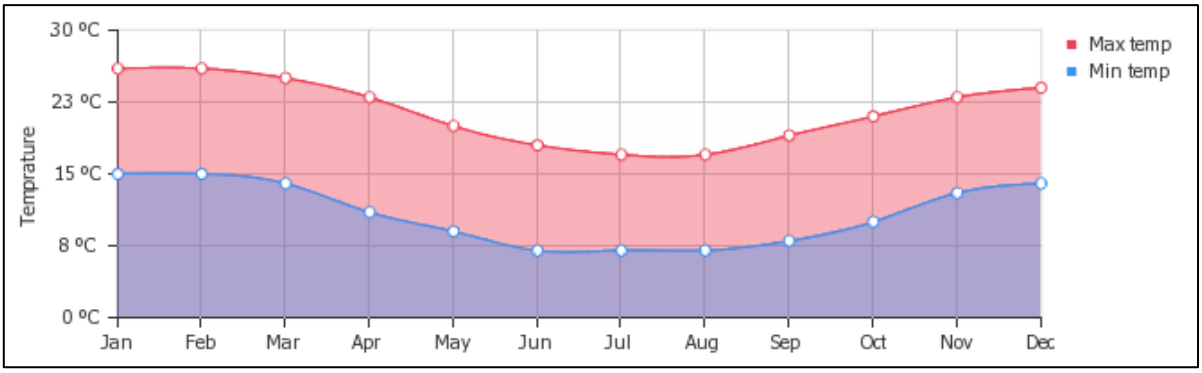


Figure 29: Average minimum and maximum temperatures in Paarl (Copyright© 2015 www.weather-and-climate.com)

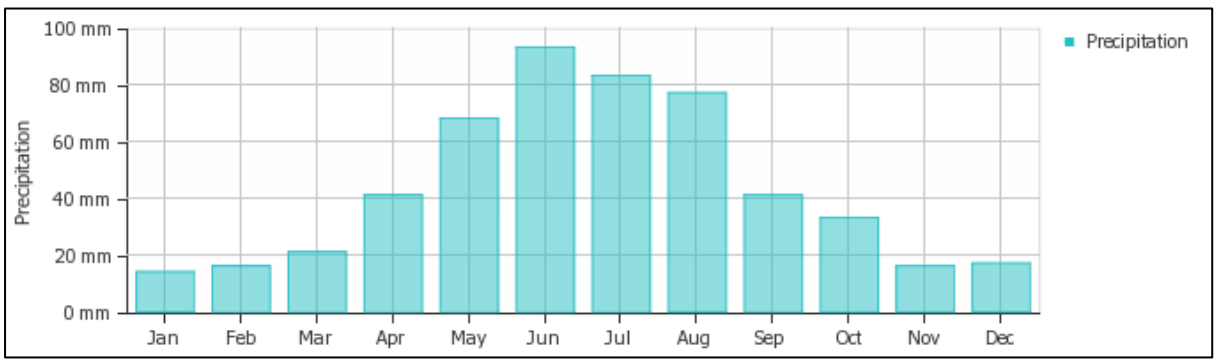


Figure 30: Average precipitation in Paarl (Copyright© 2015 www.weather-and-climate.com)

12.1.1.2 Wind

Voëlvlei Dam is located to the north west of Voëlvlei Nature Reserve and Waterval Nature Reserve which includes the DuToitskloof Mountains. This mountain range channels winds across the Dam. This results strong winds spraying water across the Dam wall and onto the R44. The wind also sprays across the WCDM WTWs which is located to the north west of the Dam. Lastly, the strong winds can create large waves on the Dam. The wind rose from Porterville (which is about 30-40km from the Dam) shows there are also strong northerly and southerly winds (**Figure 31**).

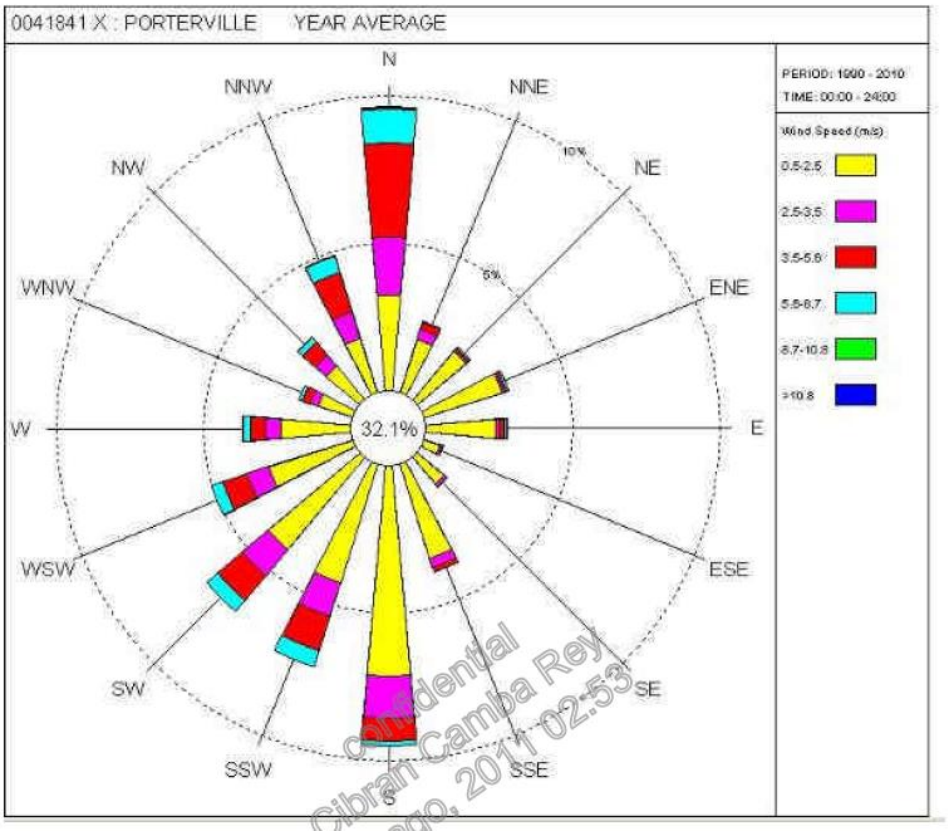


Figure 31: Porterville wind

12.2 Geology and Soils

Geotechnical investigations were carried out as part of the Technical Feasibility Study to determine if there were any fatal flaws with the proposed developments. The investigations were generally conceptualised by the WCWC-JV and undertaken under contract by Fairbrother Geotechnical Engineering cc with R.A. Bradshaw & Associates cc, Consulting Engineering Geologists, acting as the independent Professional Service Provider.

The feasibility level investigations were conducted in May, June and July 2011. They comprised mapping of the bedrock and the exploratory drilling of eight boreholes at the Berg River weir site, and the excavation of nine trial pits along the proposed pipeline route from the

Lorelei abstraction site to the Voëlvlei Dam. Laboratory testing of soils and groundwater from the trial pits supplemented the field investigations.

Some of the key findings were as follows:

12.2.1.1 Geology and Geomorphology

The area investigated is underlain by the shales and siltstones of the Porterville Formation of the Malmesbury Group that are masked by alluvial deposits of Quaternary Age.

The Berg River has strongly influenced the geomorphological development of the area. The river has meandered over a wide swath which extends as far west as the weir site and possibly as far east as Voëlvlei Dam. This process has been accompanied by erosion and, in some areas, peneplanation of the bedrock and deposition of alluvium.

A combination of higher ground to the west of the left bank at the weir site and the occurrence of more extensive outcrop indicates that the river is probably at the westward limit of its meandering at the weir site.

Several possible phases of erosion and their position have probably occurred across the broad alluvial plane between the site and Voëlvlei Dam. The possibility therefore exists that buried river channels also occur locally. However no such channel has been discovered at the weir site, but a step occurs in the bedrock at the eastern edge of outcrop.

12.2.1.2 Assessment of weir site

The weir would be partly located directly on bedrock, which would provide good founding. However, the founding level steps approximately 4 m at the eastern edge of the existing outcrop, which will probably require a subsidiary embankment structure on the right flank.

The bedrock geology at the weir site comprises the regionally metamorphosed rocks of the Porterville Formation of the Malmesbury Group which are entirely masked on the right bank and right (eastern) part of the river channel. Scattered areas of outcrop and alluvium occur in the western part of the river channel and weathered outcrop generally occurs on the lower left flank.

Geotechnical conditions at the site are generally favourable, particularly if an adequate length of spillway can be provided in the general area of the rock exposures on the west side of the river channel.

12.2.1.3 Assessment of pipeline route

The significant geotechnical factors to consider when assessing construction conditions and costs for the pipeline include:

- Excavation conditions,
- Stability of the sidewalls of the pipe trenches,
- Groundwater conditions,
- Use of excavated material for pipe bedding and backfill, and

- Engineering properties of the backfill.

The pipeline route was sub-divided into eight regions or sections of similar soil profile, and therefore similar geotechnical conditions (**Figure 32**). The anticipated soil and rock profiles along the route can be summarised as follows:

- Section 1 (pump station to 0.05km): Thin transported soils mask relatively unweathered Malmesbury bedrock.
- Section 2 (0.05km to 0.1km): Clayey soils overlying weathered Malmesbury rock.
- Section 3 (0.1km to 1km): The alluvial plain of the Berg River extends into a broad strip along the left bank and the soil profile comprises mainly alluvial, slightly silty sands and minor clayey sands and local gravel lenses or layers. Bedrock generally occurs below 3m depth except possible in the extreme western end of this section.
- Section 4 (1km to 1.15km - the Berg River crossing): The soil profile and depth to bedrock where the pipeline passes below the Berg River are unknown. Sandy alluvium is expected, but the depth of bedrock is critical because it would affect excavation conditions and program.
- Section 5 (1.15km to 1.8km): Aluvium associated with the Berg River and alluvial wash associated with the drainage course/seasonal stream, which extends from southwest of TP VV 5 to near the crossing point, extends to the east of the river. The existing canal and the seasonal stream must be crossed. Bedrock might be encountered at depths where the stream has eroded the alluvium and locally lowered ground levels.
- Section 6 (1.8km to 2.6km): The weathered bedrock apparently occurs at shallow depth and the route re-crosses the seasonal stream and an associated seepage area in the vicinity of 1.9km and 2.5km.
- Section 7 (2.6km to 4.2km): Clay and gravelly alluvium occurs with highly to moderately weathered Malmesbury bedrock towards 3m depth. Rapid transition to less weathered, more massive bedrock might occur, in places.
- Section 8 (4.2km to Voëlvlei dam): The final section of the route apparently traverses deeply developed alluvial clayey silty sand with more clayey and locally gravelly soils at depth. Bedrock might occur at shallow depth in close vicinity to the Voëlvlei Dam wall.

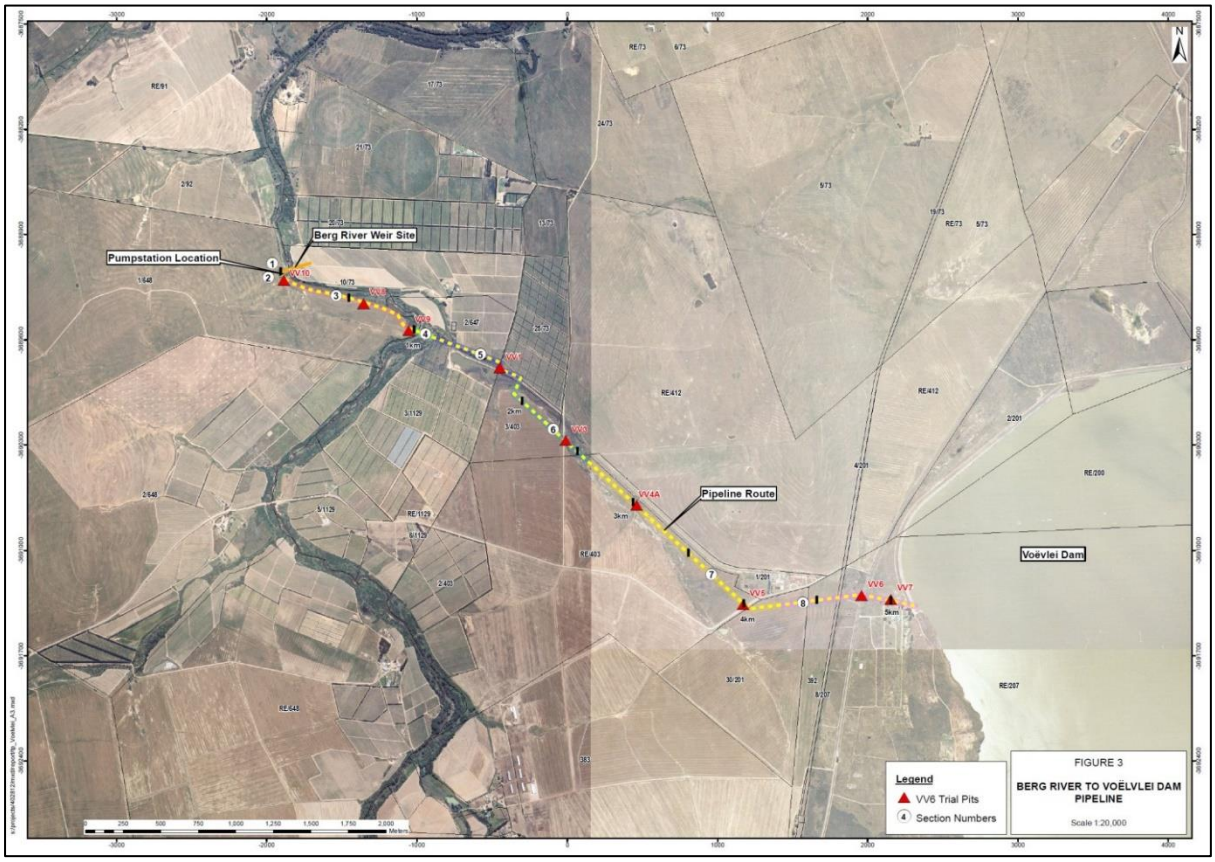


Figure 32: Pipeline sections

12.3 Geohydrology

Groundwater in the Berg River catchment is stored mainly in the Table Mountain Group and Malmesbury Group aquifers. The Table Mountain Group Aquifer is the dominant aquifer in the upper catchment and along the eastern and northern fringes of the catchment, while the Malmesbury Group Aquifer underlies most of the central and lower catchment. This groundwater does not exist in isolation and plays a vital role in ensuring the baseflow of rivers during the dry season. The total harvest potential for the Berg River basin is about 325 million cubic metres per annum. High yielding aquifers are the Table Mountain Group Aquifer and one near Langebaan. Aquifers associated with the Malmesbury Group, Cape Granite Suite and Klipheuwel Group are considered to be of low harvesting potential. Total groundwater use in the catchment is about 8.5% of the harvest potential, with agriculture being the largest user. Most of the groundwater in the catchment is used in the western and southern parts, with little being used in the central region where dryland crops predominate. Poor groundwater quality, particularly in the Malmesbury Group Aquifer, and the availability of surface water supplies have limited the use of groundwater as a resource. It is essential that groundwater use does not result in the ecological collapse of surface waters, such as wetlands and rivers. The Table Mountain Group Aquifer contains substantial supplies of groundwater. The CCT is

investigating this groundwater resource for additional water supply in certain areas, for example the Watervalsberge near Voëlvlei Dam.

From the Technical Feasibility Study conducted, seasonal or local occurrences of groundwater might occur throughout the sections of pipeline east of the river. Groundwater will adversely affect excavation conditions, stability of the excavated slopes in the trenches, and pumping and possibly local de-watering will be required.

12.4 Topography

The terrain morphology of the project area slopes upwards towards the dam and is dominated by undulating terrain with moderate relief. The elevation ranges from 54m to 76m above sea level (**Figures 33** and **34**).

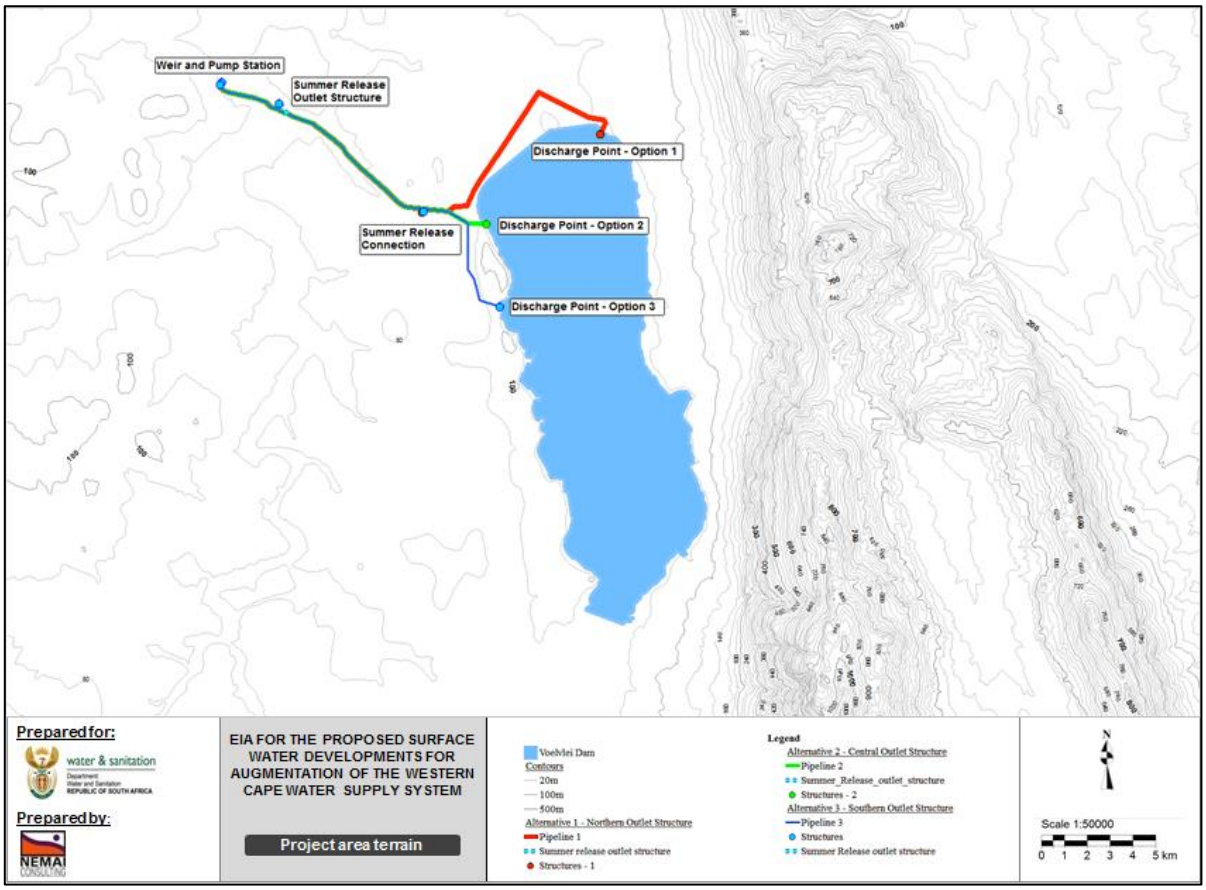


Figure 33: 20m contour map (An A3 copy of this map is contained in Appendix B)

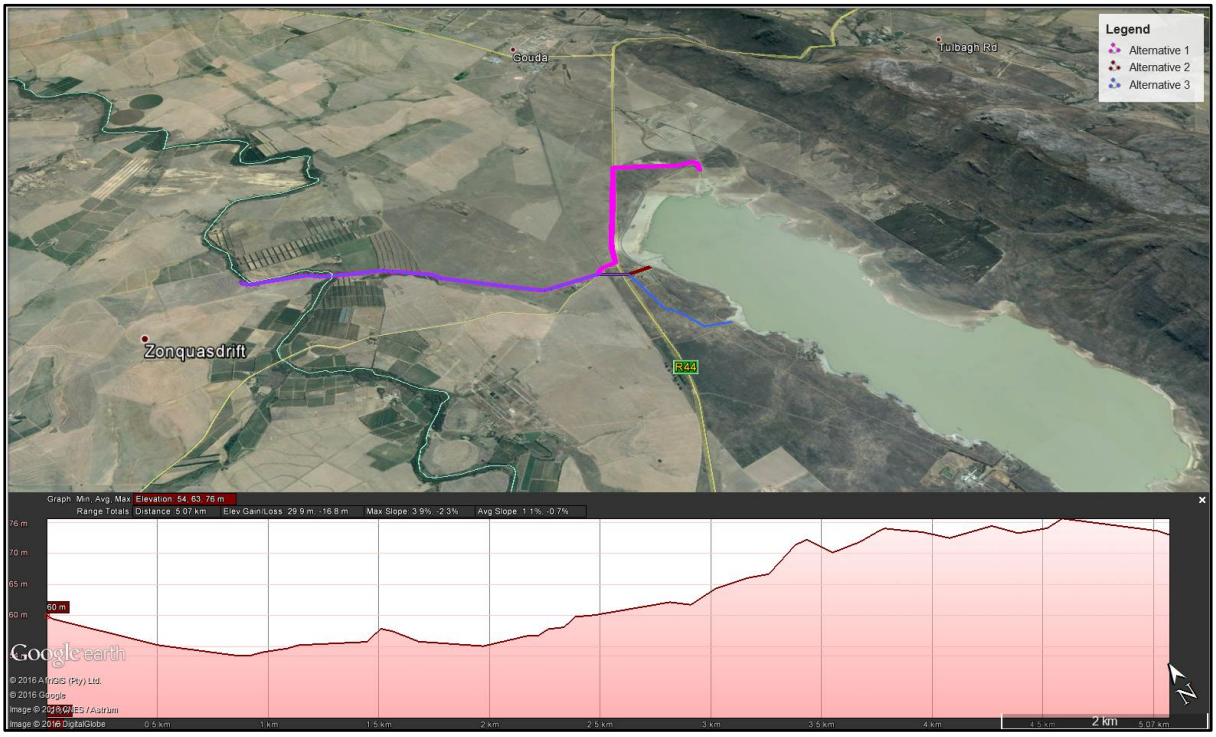


Figure 34: Elevation and topography of the project area

12.5 Surface Water

12.5.1 Hydrology

Voëlvlei Dam falls within the Berg River Catchment which is approximately 9 000 km^2 in size (DWAF, 2007). The catchment also falls within the Berg WMA within the Quaternary Catchment G10F (**Figure 35**).

The Berg River is a naturally perennial system, which rises near Dwarsberg in the Franschoek and Drakenstein mountains at an altitude of 1 500 m. It drains an area of approximately 8 980 km² (DWAF 2004), before passing into the Atlantic Ocean via the Berg River Estuary, near Veldrif, some 285 km away, on the West Coast (RHP, 2004) (DLM, 2009). The Berg River has 19 major tributaries, with a total natural runoff from its catchment amounting to ca. 931 Mm^3/a (DWA, 2007).

The major perennial tributaries of the Berg River include the Franschoek, Wemmershoek, Dwars, Matjies, Klein Berg and Twenty Four Rivers/Leeu Rivers (DLM, 2009). Total natural runoff from the Berg River Catchment amounts to 931 million m^3/a, 45% of which is generated in quaternary catchments G10A, G10B and G10C (DWAF, 2007).

Three major dams have been built in the catchment (DLM, 2009). The Wemmershoek Dam south east of Paarl has a surface area of 3 km^2 and a storage capacity of 66 Mm^3. The Berg River Dam in close proximity to the Wemmershoek Dam covers an area of 5 km^2 and has a storage capacity of 130 Mm^3. The Vöelvlei Dam west of Tulbagh covers an area of 15 km^2

and has a storage capacity of 170 Mm^3. Numerous smaller farm dams are found throughout the eastern part of the catchment. Despite all the dams, which have controlled natural flood regimes in the downstream catchment, the Berg River in the Drakenstein region has a very high energy potential and regularly overflows its banks. In certain areas the banks are eroded causing damage to farmlands (DLM, 2009).

DWAF (1993) estimated present-day annual runoff of the Berg River amounted to 682 million m^3/a, with the modified flow attributed to direct abstraction from the river for irrigation, storage and abstraction for urban water supply, development of forestry within the basin, irrigation return flow, and releases from the Voëlvlei, Wemmershoek and Theewaterskloof Dams (the latter via the Berg River Syphon).

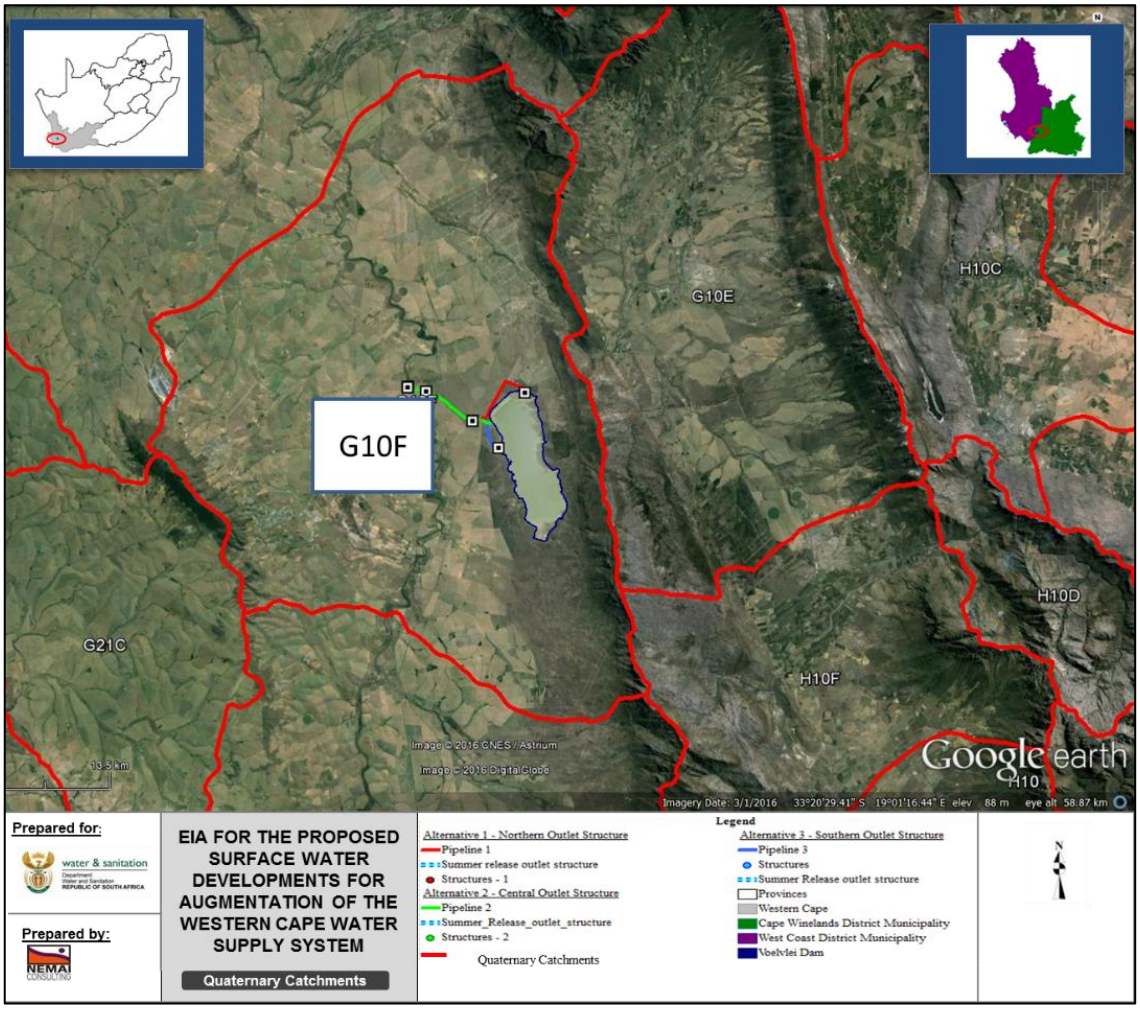


Figure 35: Quaternary Catchment (An A3 copy of this map is contained in Appendix B)

As discussed in **Section 10**, a number of Pre-Feasibility and Technical Feasibility studies were conducted for the augmentation of the Voëlvlei Dam. The hydrology of the Berg River system and Berg WMA was assessed in these studies and it was found that the proposed developments would not have an impact on the hydrology in the study area. Flooding may

have occurred at the proposed weir location, however, the weir has been designed to be notched in order to prevent flooding of the Berg River at the weir location.

12.5.2 Water Users

The following was extracted from the Socio-Economic Impact Assessment conducted by Nemai Consulting, 2016:

"Water uses of the Voëlvlei Dam include the following:

- *Domestic Use*

The primary purpose of Voëlvlei Dam is to provide domestic water to West Coast DM and City of Cape Town. There is a planned augmentation scheme to increase the capacity of the Dam.

- *Irrigation*

The Dam also provides some water for irrigation to farmers in the Lower Berg River. Water is released for irrigation up to the Estuary. Many of the directly affected landowners are farms who obtain water from the dam.

- *Land use at the dam*

DWS have a staff quarters on the dam where there currently is a discharge point.

- *Recreational Use*

The main recreational clubs that make use of the Dam are the Vogelvlei Yacht Club (VYC), Western Province Artificial Lure Angling Society (WPALAS), Western Province Freshwater Angler's Association (WPFAA), Tulbagh Angling Club (TAC); Witzenberg Angling Club (WAC) and the Cape Piscatorial Society (CPS).

The following recreational activities commonly take place at the Voëlvlei Dam:

- *Bird-watching;*
- *Fishing from shore;*
- *Boardsailing/windsurfing;*
- *Fishing from boats;*
- *Swimming;*
- *Yachting; and*
- *Picnicking and sunbathing.*

A number of events are held at the dam including various angling competitions (for Bass and Carp) as well as a number of Regattas. VYC has also organised a triathlon at the Dam in recent years. The Stanford Bird Club has also visited the dam for their bird fairs in the past.

A water treatment works and staff residents are located at the proposed summer release structure 2. Additional DWS staff houses are located at the alternative 2 discharge point. The staff manage the dam."

More information is provided in a summary of the Socio-Economic Impact Assessment in **Section 14.5**.

12.5.3 Affected Watercourses

The proposed developments will be located along the Berg River (**Figure 36**) and associated tributaries, as well as be discharging into the Voëlvlei Dam (**Figure 37**). There are also a number of National Freshwater Ecosystem Priority Areas (NFEPA) wetlands identified within the vicinity of the Voëlvlei Dam.

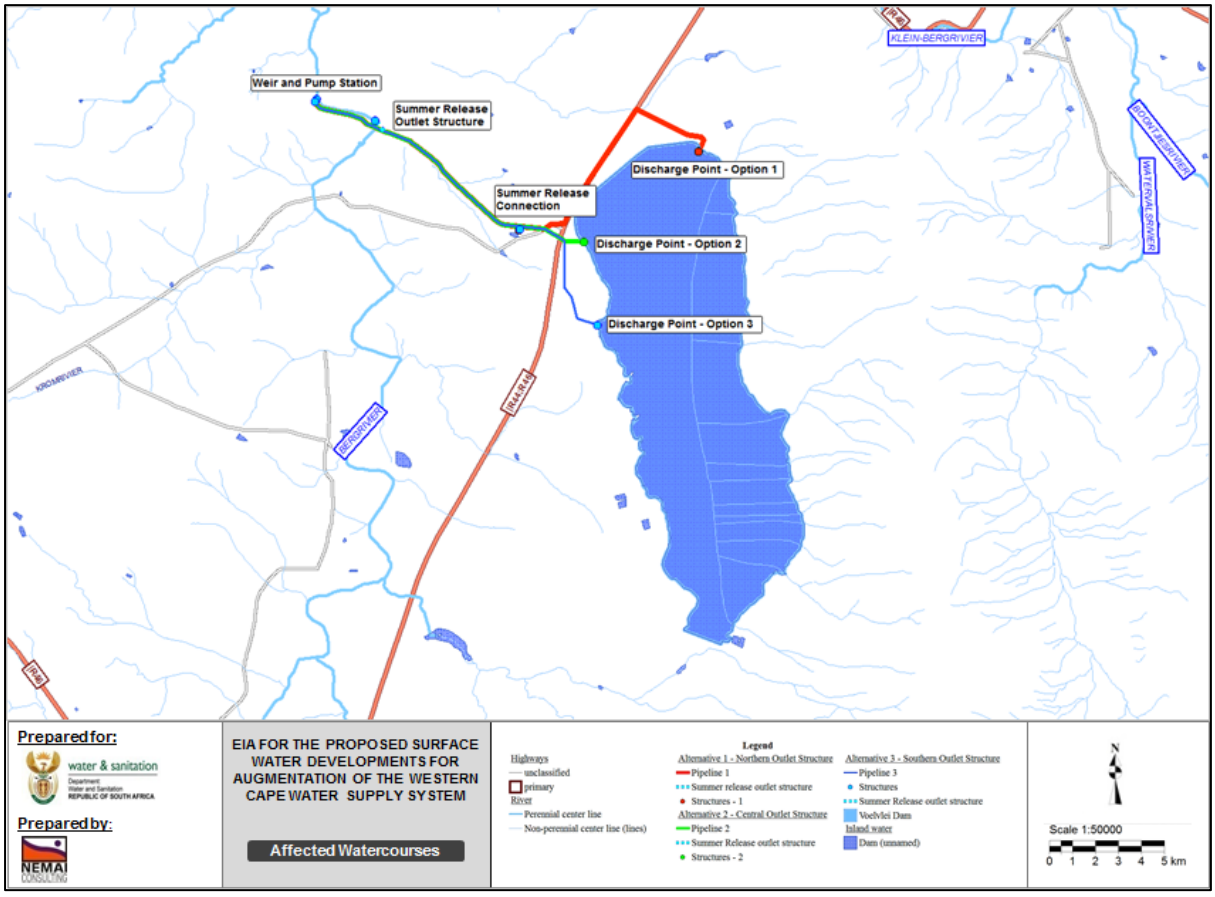


Figure 36: Affected Watercourses according to the NFEPA database (An A3 copy of this map is contained in Appendix B)

Figure 37: Berg River

The NFEPA data does not identify any wetlands occurring along the pipeline route. However, during a site assessment, a wetland was identified along the route that may be affected by the proposed developments (**Figure 38**).

Figure 38: Wetland identified along the pipeline route

12.5.4 Water Quality

The water quality at Voëlvlei Dam has been monitored by DWS since 1969. However sampling has not occurred since 2011. The average values during the period between 1969 and 2011 are provided in **Table 9**. It should also be noted that both City of Cape Town Metropolitan Municipality (CCTMM) and WCDM undertake water quality monitoring at the Dam as part of their water treatment process.

In general, poor quality effluent discharged from the Tulbagh Waste Water Treatment Works (WWTW), winery effluent discharged into the Klein Berg River, and pollution from informal settlements contributes to the poor water quality in the river and therefore at the Dam. The

extent of the direct discharge from the wineries into the river is not well established but may have a considerable cumulative effect. Similarly, the impact on water quality of the return flows arising from over-irrigation (with winery effluent) in close proximity to the river, is also of concern. The Tulbagh WWTW is designed for domestic effluent, however traces of fruit waste are common. Vandalism and pipe blockages in the reticulation system cause spills from manholes into the stormwater system. In addition, the water quality problem in the Klein Berg River is exacerbated at the start of winter due to diffuse pollution being washed into the river from adjacent informal settlements. As a result it is desirable that the runoff from the first winter rains is not diverted into Voëlvlei Dam (DWAF, 2004).

Turbidity is also an issue at the Dam and may be due to a number of issues including the proliferation of the illegally introduced alien sharptooth catfish (*Clarias gariepinus*). In addition, carp are known to increase turbidity as they are bottom feeders and stir up the sediment.

Table 9: Water Quality at Voëlvlei Dam

Variable	Average (1976-2013)
Calcium (Ca)	3.71
Chloride (Cl)	20.19
Dimethyl sulphide (DMS)	63.93
Electrical Conductivity (EC)	11.72
Fluoride (F)	0.12
Potassium (K)	1.02
KJEL_N_Tot_Water	0.38
Magnesium (Mg)	2.94
Sodium (Na)	11.51
Amonia (NH4_N)	0.05
Nitrates (NO3_NO2)	0.07
Phosphorous (P)	0.32
pH	7.21
Phosphates (PO4_P)	0.17
Silicon (Si)	0.79
Sulphates (SO4)	6.41
Total Alkalinity (TAL)	14.64

De Villiers (2007) investigated the long term trends of the nutrient status of the Berg River and found that inorganic nitrogen and phosphorus levels increase downstream by a factor of more than 10, in response to anthropogenic inputs. Similarly, nutrient levels fluctuate seasonally by more than an order of magnitude, in response to input from diffuse and point sources of pollution. These changes of more than 1 000% far exceed the 15% maximum change stipulated by the South African water quality guidelines for aquatic ecosystems.

Further, total phosphorus levels indicate that hypertrophic conditions prevail at least episodically at all of the Berg River monitoring stations and most of the time at some of them. Additionally, river water phosphate levels show a dramatic increase over the past 20 years. There is also strong evidence that the trophic status of the Berg River is very sensitive to

reduced river runoff and thus the construction of Dams such as the Berg River Dam can act to exacerbate the trophic status (De Villiers, 2007).

Evidence for increased NOx levels during low runoff conditions suggests an increased number of point-sources of pollution. It is also suggested that overloading of water treatment plants during high runoff conditions or flooding of informal human settlements during winter storm events may result in nutrient enrichment during high runoff, related to these 'point sources'.

The two most likely anthropogenic sources of nutrients along the Berg River are agricultural runoff and effluent from overloaded municipal sewage works and un-serviced communities. Both sources are expected to peak in magnitude along the middle section of the Berg River, between Paarl and Hermon, the most heavily cultivated and most populated area along the river. This includes informal human settlements that have developed along the banks of the river.

Diffuse nutrient sources, such as agricultural runoff, produce seasonal concentration profiles coincident with river runoff, i.e. concentrations that peak during high runoff conditions. In contrast, point sources such as sewage effluent from municipal WWTW generally result in seasonal concentration profiles that have no relation to runoff, i.e. relatively constant input throughout the year, or an inverse relation to river runoff (De Villiers, 2007).

Further, according to the Western Cape Integrated Water Resource Management (IWRM) Action Plan (DEA&DP, 2011), the following water quality issues occur in the Berg WMA:

- A significant water quality problem in the Berg River catchment is salinization in the middle and lower reaches. This is caused by leaching from the natural geology, which extends from the north of Paarl to the Berg River mouth, consists of Malmesbury shale, as well as agricultural practices and the wash-off of salts from irrigated and dryland agricultural lands. The problem is exacerbated during the first winter rains, when accumulated salts are washed into the river resulting in elevated salinity in Misverstand Dam;
- A further concern in the Berg River is nutrient enrichment as a result of the discharge of treated sewage effluent from WWTWs, irrigation with winery effluent, and the discharge of some winery effluent that may not have been adequately pre-treated. Diffuse pollution which includes runoff from informal settlements, for example in the Klein Berg catchment (Tulbagh) impacts on the quality of water diverted into Voëlvlei Dam. This has led to increasing problems with nuisance algae in the middle and lower Berg River reaches and in Voëlvlei Dam. This has led to higher domestic water treatment costs;
- Concerns have been expressed about the microbial quality of rivers affected by treated wastewater effluent discharges and runoff from informal settlements. Rivers such as the Plankenberg and Eerste River near Stellenbosch, Stiebeul River near Franschhoek, and the Kuils River in Bellville are affected by poor quality effluents and runoff from informal

settlements and high density settlements with poor sanitation services. Aging sewerage infrastructure and pump station breakdowns contribute to these problems. Some improvements in microbial water quality have in recent times been achieved in areas such as Stellenbosch and Paarl and Wellington due to interventions by the relevant Local Municipalities. Concerns have also been expressed about the management and impacts of many small package plants that fall outside local authorities such as on golf estates and wineries;

- Many of the urban river systems in the Berg WMA serve as conduits for treated effluent discharged to the sea. The Bellville, Scottsdene, Kraaifontein, Zandvliet, Stellenbosch, and Macassar WWTWs discharge treated effluent into the Kuils/Eerste River system. Borcherds Quarry and Athlone WWTWs discharge into the Black/Salt River and the Potsdam WWTW discharges into the Diep River, which feeds into the ecologically sensitive Rietvlei wetland system. The Cape Flats WWTW discharges into the canal downstream of the Zeekoevlei outlet control weir. These rivers no longer display seasonal flow patterns, and some, notably the Black/Salt and Kuils Rivers have become severely modified. High residual nutrients can lead to eutrophication related problems such as nuisance algal growth and excessive growth of aquatic weeds. Other problems associated with urban rivers include leaking sewers, contaminated storm water runoff, litter, oil, and toxic spills. The constant and high base flows in these rivers also impact on the estuaries and many have lost their tidal variation;
- There are concerns about the accumulation of pesticide and herbicide residues in the surface waters, biota and sediments downstream of intensive irrigation areas. Concerns have also been expressed about the presence of Endocrine Disrupting Compounds (EDCs) in surface waters near intensive irrigation systems. Persistent Organic Pollutants (POPs) and EDCs are not monitored routinely in the Berg River WMA.
- Concerns have been expressed about the impacts of many piggeries in the WMA on the organic loads to rivers. Organic compounds consume oxygen when they decompose in rivers thereby reducing the dissolved oxygen concentrations and negatively impacting aquatic organisms. Discharges not complying with Chemical Oxygen Demand standards and irrigated effluents high in organic content that are washed into rivers have similar impacts on aquatic ecosystems (DEA&DP, 2011).

The water quality in the Berg River has changed considerably over time, with the major impactors being agricultural return flows, irrigation releases, urban and industrial runoff and wastewater discharges.

A Baseline Water Quality Study was conducted at the Berg River as part of the Feasibility Studies conducted for the project. The study explored two aspects of the behaviour of water quality in the Berg River during the rainfall season:

- Change in quality during a flood to determine if there was a peak in pollution that should be avoided when transferring water to Voëlvlei Dam; and
- Changes in quality over the winter rainfall season to determine if the early season runoff should be avoided because the quality may be poorer than later in the season.

Conservative substances (constituents such as sodium and chloride) were found to increase from low concentrations early in the rainfall season to higher concentrations later in the rainfall season. This is a well-known phenomenon in the middle and lower Berg River. The reason for this is that Malmesbury shales dominate in the catchment downstream from about Wellington. These soils leach salts during the rainfall season resulting in an increase in concentrations as the rainfall season progresses. The same trend is true for nitrogen. Non-conservative substances and nitrogen concentrations are controlled by non-point source, catchment processes during the winter rainfall season.

Phosphates concentrations and E.coli counts on the other hand decrease during the rainfall season, following a pattern that is typically associated with point source processes. Phosphates from upstream WWTW's are high at the end of the dry season when there is little dilution of the wastewater effluent. The same true for E.coli from dry-weather storm water inflows into the Berg River. An increase in flow dilutes the phosphate concentrations and E.coli counts, resulting in lower concentrations as the rainy season progresses.

It is not clear whether there is a first flush effect that should be avoided. It is clear that phosphates and bacterial are high early in the season due to point source inputs but the concentrations are quickly halved during a flood event. At this stage there is probably not sufficient evidence of a particular period during which water transfers should be avoided.

12.5.5 Aquatic Biota

The following was extracted from the Riparian Habitat and Wetland Delineation Impact Assessment conducted by the Biodiversity Company, 2016:

"An elevated pH value of 10.37 was measured in the Berg River. This exceeded the recommended guideline range having a limiting effect on local aquatic biota at the time of the survey. This high pH value may be a concern to the Berg River biota and potentially the Voëlvlei Dam and aquatic biota if it persists at elevated levels once the water pipeline is operational.

The EC value measured in the Berg River (365 µS/cm) was below the recommended guideline value and would not be a limiting factor of aquatic biota at the time of the survey.

During the survey DO levels in the Berg River were above the maximum prescribed limits with a measurement of 178% recorded. This high reading is in excess of saturation (super-saturation of oxygen) which usually indicates eutrophication in a water body (DWAF, 1996). The conditions in the Berg River at the time of sampling were in agreement that the river was eutrophic (green in colour) which may stem from nutrient input from both WTW discharges and agricultural input in the catchment. Elevated oxygen concentrations (super saturation) may cause gas bubble disease in fish. Supersaturated conditions also tend to inhibit photosynthesis in green algae, favouring instead bluegreen algae, which are more tolerant of supersaturation, but which may become a nuisance to other water users (DWAF, 1996). Therefore, DO would have been a limiting factor of aquatic biota at the time of the survey if these high DO levels persist for extended periods.

During the survey, a water temperature of 27.9°C was measured. The water temperature was considered to be within recommended guideline levels and was not expected to have a negative effect on the aquatic ecosystem.

If the elevated pH and DO values persist for extended periods of time in the Berg River together with strong sunlight and vigorous photosynthetic activity, they may give rise to gas bubbles disease, fish kills and algal blooms (Alabaster and Llyod, 1982). These algal blooms may produce toxic by-products which may be an issue once water is pumped into the Voëlvlei Dam."

More information is contained in **Section 14.3** where a summary of the Riparian Habitat and Wetland Delineation Impact Assessment is provided.

12.5.6 Riparian Habitat

The riparian area provides habitat for aquatic and terrestrial species, contributes towards maintaining the form of the river channel and serves as filters for sediment, nutrients and light.

As shown in **Figure 41**, the riparian habitat of the Berg River is relatively intact, but has however been disturbed and reduced due to adjacent agricultural activities.

Figure 39: Riparian habitat of the Berg River

12.5.7 Estuary

By definition, an estuary constitutes a partly enclosed coastal body of water with one or more rivers or streams flowing into it, and with a free connection to the open sea. These systems form a transition zone between river and ocean environments and are subject to both marine influences (e.g. tides, waves, and the influx of saline water) and riverine influences (e.g. flows of fresh water and sediment). The high productivity in estuaries stems from the inflow of both seawater and freshwater, which provide high levels of nutrients in both the water column and sediment.

The Berg River Estuary is located approximately 130 km north of Cape Town on the West Coast of South Africa (**Figure 42**). The main channel of the estuary is about 100-200 m wide near the mouth, becoming progressively narrower and shallower upstream. Depth is about 3-5 m on average, but extends up to 9 m in places. The total volume of the estuary is estimated to be about 12 Mm^3. The catchment lies entirely within the Western Cape Province, which receives most precipitation during the winter rainfall season. Four major dams have been built in the catchment, including the Voëlvlei Dam (surface area = 15 km^2, storage capacity = 170 Mm^3/a).

The estuary reflects strong seasonal patterns. River inflow during winter creates more turbid, freshwater dominated conditions, with limited saline intrusion near the mouth. During summer,

the estuary becomes marine-dominated with less turbid saline waters penetrating up to about 40 km from the mouth. Upwelling during these summer months is a typical feature along the West Coast when colder, nutrient-rich seawater is introduced into the estuary. This seasonal variability drives the ecology of the estuary.

Figure 40: Geographical boundaries of the Berg River Estuary

The Present Ecological Status (PES) of the estuary is a C. Major drivers of change in the system were a significant reduction in river inflow (floods and baseflows), but it is likely that the estuary is on a negative trajectory of change, because of the extremely low lowflows under the present state (< 1 m^3s-1), particularly during the summer months. Maintaining the status quo would therefore likely result in a decline in condition. The estuary is considered highly important. The Estuarine Health Index scores allocated to the Berg River Estuary were:

Table 10: PES of the Berg River Estuary

VARIABLE	WEIGHT	Score	WEIGHTED score
Hydrology	25	72	18
Hydrodynamics and mouth condition	25	90	23
Water quality	25	40	10
Physical habitat alteration	25	59	15

VARIABLE	WEIGHT	Score	WEIGHTED score
Habitat health score			**65**
Microalgae	20	75	15
Macrophytes	20	54	11
Invertebrates	20	50	10
Fish	20	56	11
Birds	20	78	16
Biotic health score			**63**
ESTUARINE HEALTH SCORE			**64**

Storage and abstraction of water in the catchment have reduced freshwater inflow to the Berg River Estuary by 30%. This results in:

- extensive upstream intrusion of seawater into the estuary, particularly during summer;
- reduction in frequency and extent of floodplain inundation; and
- a decrease in the scouring of sediment within the estuary.

The extensive upstream intrusion is also exacerbated by the stabilisation of the mouth which keeps it permanently open via a constructed channel.

Livestock grazing and the construction of salt works and Port Owen Marina have resulted in extensive loss of natural habitat, mainly saltmarsh. Although the salt works has destroyed this habitat, the area now provides rich feeding grounds for flamingos and waders. Power boating activities, as well as the stabilisation and regular dredging of the mouth have resulted in increased bank erosion in the estuary, with the associated loss of saltmarsh habitat and a decline in floodplain vegetation.

Potential threats to water quality include wastewater discharges from a fish processing plant, seepage from the salt works, harbour activities (e.g. dumping of fish offal and petroleum oils). Agricultural return flow is another potential source of pollutants (nutrients and pesticides) to the system.

12.6 Flora

12.6.1 Biome and Vegetation

The proposed developments fall within the Fynbos Biome. The Fynbos Biome extends across the southern corner of South Africa in a 100-200km wide coastal belt in the Western Cape

Province. Fynbos is characterised as schlerophyllous shrub-land and this biome is comprised of two major vegetation types, the Fynbos and the Renosterveld. The Fynbos Biome forms the main part of the Cape Floristic Region (CFR), which is recognised globally as a biodiversity hotspot, due to the high numbers of endemic plant and invertebrate taxa.

The CFR covers approximately 87 892 km^2 within the Western Cape and slightly into the Eastern Cape Province of South Africa. This region is extremely rich in plant species, with approximately 9 600 different species of plants having been documented with at least 70% of these endemic to this region. The diversity of plant taxa arises from the diversity of soil types, topography and climatic conditions across the region.

The chain of large mountain ranges within the region are viewed as essential water catchment areas, and as such have historically received the focus of conservation action in the region. This has unfortunately neglected the low lying Fynbos areas which hold high levels of biodiversity. Much of the vegetation types of the lowlands have been converted into agricultural fields or rangelands, or succumbed to the expansion of infrastructure development. The disruption of the natural fire regimes has impacted negatively on many of the Fynbos plant species as these species utilise specific fire frequencies to set seed and germinate. Infestation by alien invasive plant species, such as certain Australian Acacia and Eucalyptus species, has also converted much of the natural habitat areas into alien "forests", devoid of the natural biodiversity of the region. The Fynbos Biome is predicted to be severely impacted upon by climate change, with estimates of as high as a 50% loss of the Fynbos Biome. The drastic climatic changes predicted could alter the conditions required for the persistence of the biome, such as changes in rainfall patterns and temperature, which in turn lead to changes in the plant communities which are able to persist in the area.

12.6.2 Western Cape Biodiversity Framework

The Western Cape Biodiversity Framework is a type of conservation plan aimed at a broader range of sectors than just conservation authorities and institutions. It is a tool for supporting and streamlining land-use planning and environmental decision-making across all sectors and tiers of government, with an emphasis on the spatial implications for development and conservation.

The 2010 Western Cape Biodiversity Framework (WCBF2010; Kirkwood *et al.,* 2010) was the first integration of biodiversity planning products into a common, user-friendly framework to guide land-use decision making in the Western Cape. Importantly, it provided a clear indication of all Critical Biodiversity Areas (CBAs) identified across the province. These are the areas crucial for conserving a representative sample of biodiversity and maintaining ecosystem functioning.

Approximately 28 200 hectares of CBAs have been added to the provincial conservation estate since the WCBF2010 was completed. This equates to 37% of total protected area gains (77 500ha), up from 21% for the period going back to 2007. CBAs from 64 different vegetation

types are represented. In terms of habitat loss to agricultural expansion (between 2006 and 2011), about 53 600ha have been converted across the province (over 10 700ha per year) and, surprisingly given the degree to which CBAs have been promoted in environmental decision-making, 31% of that expansion was into CBAs (16 800ha). On the other hand, areas known to have been under agriculture but which were intentionally selected as CBAs total about 78 000ha, or 2% of the total CBA network.

In cases where a CBA has been converted to field agriculture subsequent to having been identified as a CBA, the management objective is to either maintain natural land or rehabilitate degraded land and manage for no further degradation. However, this has not been met and must be reassessed. For Ecological Support Areas (ESA), the management objective is to maintain ecological processes.

The proposed developments fall within both CBA and ESA regions (**Figure 41**).

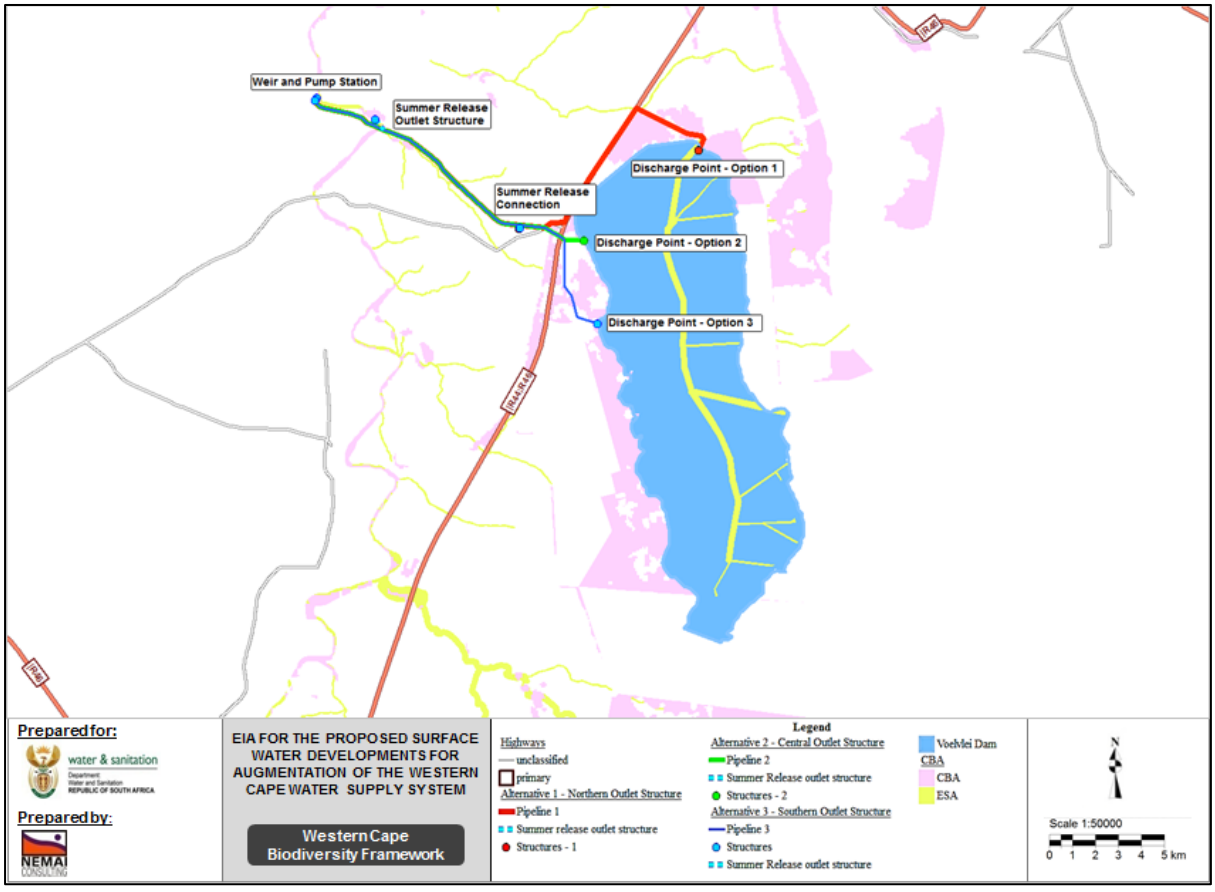


Figure 41: CBA and ESA regions (An A3 copy of this map is contained in Appendix B)

12.6.3 Terrestrial Threatened Ecosystems

The South African National Biodiversity Institute (SANBI), in conjunction with the Department of Environmental Affairs and Tourism (DEAT), released a draft report in 2009 entitled "Threatened Ecosystems in South Africa: Descriptions and Maps" to provide background

information on the abovementioned List of Threatened Ecosystems (SANBI, 2009). The purpose of this report was to present a detailed description of each of South Africa¡¦s ecosystems and to determine their status using a credible and practical set of criteria. The following criteria were used in determining the status of threatened ecosystems:

- Irreversible loss of natural habitat;
- Ecosystem degradation and loss of integrity;
- Limited extent and imminent threat;
- Threatened plant species associations;
- Threatened animal species associations; and
- Priority areas for meeting explicit biodiversity targets as defined in a systematic conservation plan.

In terms of section 52(1) (a), of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004), a national list of ecosystems that are threatened and in need of protection was gazetted on 9 December 2011 (GN 1002 (http://bgis.sanbi.org/ecosystems/project.asp). The list classified all threatened or protected ecosystems in South Africa in terms of four categories; *Critically Endangered* (CR), *Endangered* (EN), *Vulnerable* (VU) or *Protected*. The purpose of categorising these ecosystems is to prioritise conservation areas in order to reduce the rates of ecosystem and species extinction, as well as preventing further degradation and loss of structure, function, and composition of these ecosystems. It is estimated that threatened ecosystems make up 9.5% of the land in South Africa, with critically endangered and endangered ecosystems accounting for 2.7%, and vulnerable ecosystems 6.8% of the land area. It is therefore vital that Threatened Terrestrial Ecosystems inform proactive and reactive conservation and planning tools, such as Environmental Impact Assessments and other environmental applications (Mucina *et al.*, 2006*)*.

The proposed developments fall within the Swartland Shale Renosterveld, and the Swartland Alluvium Fynbos, both of which are categorised as CR, according to data sourced from SANBI (**Figure 42**).

More information is contained in the Summary of the Terrestrial Ecological Impact Assessment in **Section 14.2**.

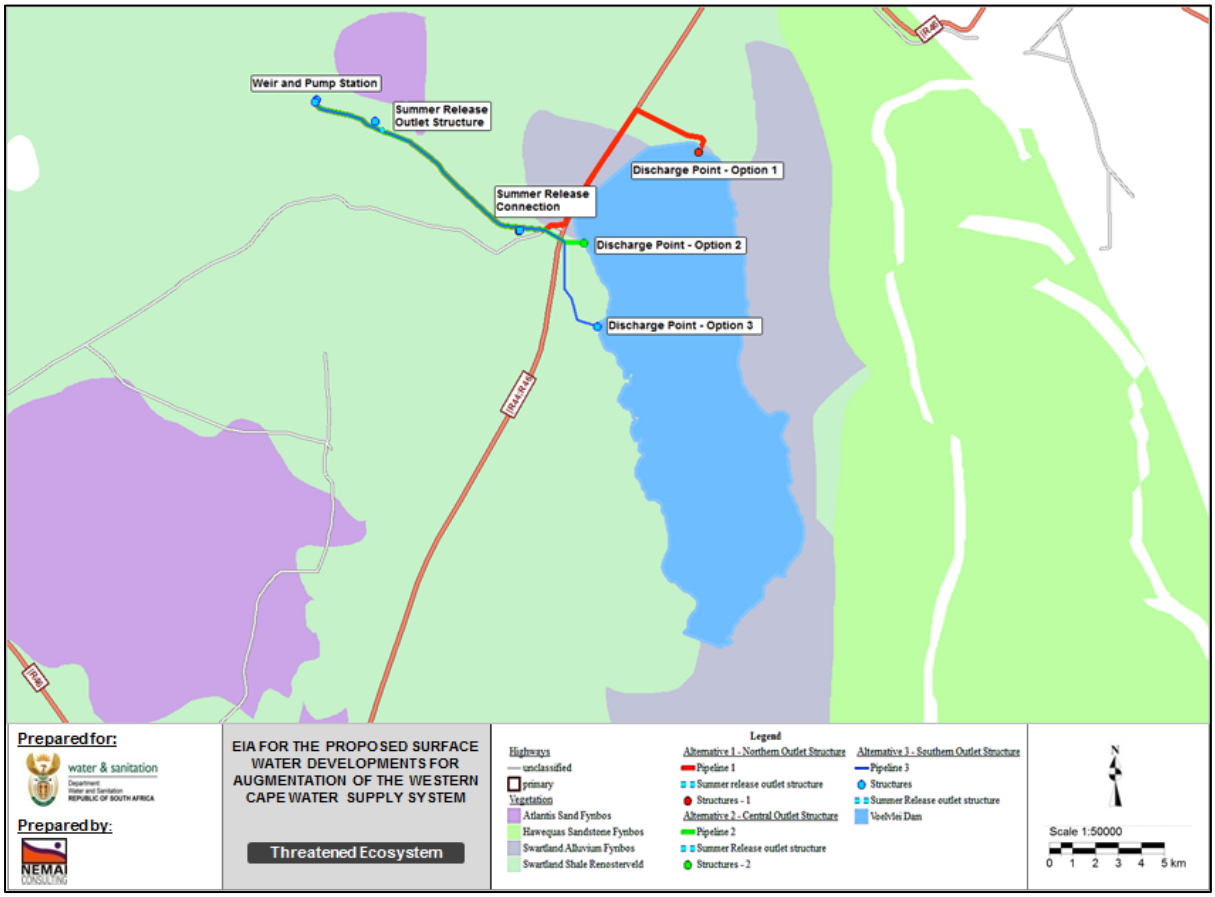


Figure 42: Threatened Ecosystem (An A3 copy of this map is contained in Appendix B)

Although the proposed developments fall within two threatened ecosystems, the area is quite disturbed and transformed as a result of farming activities (**Figure 43**).

Figure 43: Transformed land next to the Berg River

12.6.4 Plant Species

The proposed developments is located within the 3319AC and 3318BD Quarter Degree Squares (QDS) in terms of the 1:50 000 grid of South Africa. The Pretoria Computerised Information System (PRECIS) list of Red Data plants was obtained from SANBI (http://posa.sanbi.org/searchspp.php).

The list was consulted to verify the record of occurrence of the plant species seen in the vicinity of the proposed development. The site sampled is also only a very small portion of the whole grid and so habitats suitable for certain species in the PRECIS list may not be present at the areas sampled.

A list of threatened plant species that occur in the grid is provided in **Table 11**. Conservation status and definitions of each status is listed in **Table 12**.

Table 11: Red Data Plant species recorded in grid cell 3319AC and 3318BD which could potentially occur in the study area (SANBI data)

Family	Species	Threat Status	SA Endemic
AMARYLLIDACEAE	Brunsvigia elandsmontana	CR	No
APONOGETONACEAE	Aponogeton angustifolius	VU	No
AQUIFOLIACEAE	Ilex mitis	Declining	No
ASPHODELACEAE	Bulbine monophylla	CR	No
ASPHODELACEAE	Trachyandra chlamydophylla	VU	No
ASPHODELACEAE	Trachyandra filiformis	NT	No
ASPHODELACEAE	Trachyandra paniculata	Threatened	No
ASTERACEAE	Arctotis angustifolia	CR	No
ASTERACEAE	Athanasia adenantha	EN	No
ASTERACEAE	Athanasia crenata	EN	No
ASTERACEAE	Cotula filifolia	CR	No
ASTERACEAE	Cotula pusilla	NT	No
ASTERACEAE	Marasmodes oligocephala	CR	No
ASTERACEAE	Marasmodes spinosa	EN	No
ASTERACEAE	Marasmodes undulata	CR	No
ASTERACEAE	Metalasia octoflora	VU	No
ASTERACEAE	Oedera viscosa	NT	No
ASTERACEAE	Othonna ciliata	VU	No
ASTERACEAE	Relhania fruticosa	NT	No
ASTERACEAE	Steirodiscus gamolepis	EN	No
BORAGINACEAE	*Echiostachys ecklonianus*	EN	No
BORAGINACEAE	*Lobostemon capitatus*	VU	No
CAMPANULACEAE	*Merciera tetraloba*	EN	No
COLCHICACEAE	*Wurmbea inusta*	VU	No
CRASSULACEAE	*Crassula bergioides*	NT	No
ERICACEAE	*Erica capitata*	NT	No
ERICACEAE	*Erica oxysepala*	VU	No
ERICACEAE	*Erica rehmii*	VU	No
FABACEAE	*Indigofera psoraloides*	EN	No
FABACEAE	*Lebeckia plukenetiana*	EN	No
FABACEAE	*Lotononis complanata*	EN	No
FABACEAE	*Lotononis prostrata*	NT	No
FABACEAE	*Lotononis rigida*	VU	No
FABACEAE	*Otholobium bolusii*	NT	No
FABACEAE	*Otholobium uncinatum*	NT	No

Family	Species	Threat Status	SA Endemic
FABACEAE	*Podalyria cordata*	VU	No
FABACEAE	*Podalyria sericea*	VU	No
FABACEAE	*Rafnia crispa*	CR	No
FABACEAE	*Rafnia lancea*	EN	No
FABACEAE	*Wiborgia tenuifolia*	NT	No
GERANIACEAE	*Monsonia speciosa*	EN	No
GERANIACEAE	*Pelargonium asarifolium*	VU	No
GERANIACEAE	*Pelargonium chelidonium*	EN	No
GERANIACEAE	*Pelargonium reflexum*	EN	No
GUNNERACEAE	*Gunnera perpensa*	Declining	No
HAEMODORACEAE	*Wachendorfia brachyandra*	VU	No
HYACINTHACEAE	*Albuca albucoides*	EN	No
HYACINTHACEAE	*Lachenalia contaminata*	NT	No
HYACINTHACEAE	*Lachenalia longibracteata*	Declining	No
HYACINTHACEAE	*Lachenalia mediana*	EN	No
HYACINTHACEAE	*Lachenalia pallida*	Declining	No
HYACINTHACEAE	*Lachenalia polyphylla*	EN	No
HYACINTHACEAE	*Lachenalia purpureo-caerulea*	CR	No
HYACINTHACEAE	*Lachenalia pustulata*	NT	No
HYPOXIDACEAE	*Pauridia minuta*	NT	No
HYPOXIDACEAE	*Spiloxene alba*	VU	No
HYPOXIDACEAE	*Spiloxene minuta*	EN	No
IRIDACEAE	*Aristea lugens*	EN	No
IRIDACEAE	*Aristea nigrescens*	EN	No
IRIDACEAE	*Babiana angustifolia*	NT	No
IRIDACEAE	*Babiana melanops*	VU	No
IRIDACEAE	*Babiana odorata*	EN	No
IRIDACEAE	*Babiana patula*	Declining	No
IRIDACEAE	*Babiana rubrocyanea*	VU	No
IRIDACEAE	*Babiana secunda*	CR	No
IRIDACEAE	*Babiana stricta*	NT	No
IRIDACEAE	*Babiana villosa*	NT	No
IRIDACEAE	*Babiana villosula*	EN	No
IRIDACEAE	*Bobartia fasciculata*	NT	No
IRIDACEAE	*Geissorhiza erosa*	EN	No
IRIDACEAE	*Geissorhiza furva*	EN	No
IRIDACEAE	*Geissorhiza imbricata*	NT	No
IRIDACEAE	*Geissorhiza imbricata*	NT	No
IRIDACEAE	*Geissorhiza purpureolutea*	NT	No
IRIDACEAE	*Geissorhiza setacea*	EN	No
IRIDACEAE	*Geissorhiza tulbaghensis*	EN	No
IRIDACEAE	*Gladiolus exilis*	NT	No
IRIDACEAE	*Gladiolus recurvus*	VU	No
IRIDACEAE	*Gladiolus watsonius*	NT	No
IRIDACEAE	*Gladiolus meliusculus*	NT	No
IRIDACEAE	*Hesperantha spicata*	VU	No
IRIDACEAE	*Ixia abbreviata*	NT	No
IRIDACEAE	*Ixia campanulata*	EN	No
IRIDACEAE	*Ixia dubia*	Declining	No
IRIDACEAE	*Ixia monadelpha*	EN	No
IRIDACEAE	*Ixia mostertii*	EN	No
IRIDACEAE	*Ixia polystachya*	EN	No
IRIDACEAE	*Ixia rouxii*	CR	No
IRIDACEAE	*Ixia vinacea*	EN	No
IRIDACEAE	*Ixia viridiflora*	CR	No
IRIDACEAE	*Ixia viridiflora*	EN	No
IRIDACEAE	*Lapeirousia azurea*	EN	No
IRIDACEAE	*Lapeirousia corymbosa*	Declining	No

Family	Species	Threat Status	SA Endemic
IRIDACEAE	*Moraea angulata*	CR	No
IRIDACEAE	*Moraea cooperi*	VU	No
IRIDACEAE	*Moraea punctata*	EN	No
IRIDACEAE	*Moraea tricolor*	EN	No
IRIDACEAE	*Moraea tulbaghensis*	EN	No
IRIDACEAE	*Moraea versicolor*	VU	No
IRIDACEAE	*Moraea villosa*	VU	No
IRIDACEAE	*Moraea villosa*	VU	No
IRIDACEAE	*Sparaxis grandiflora*	EN	No
IRIDACEAE	*Sparaxis tricolor*	VU	No
IRIDACEAE	*Tritoniopsis elongata*	EN	No
IRIDACEAE	*Watsonia dubia*	EN	No
IRIDACEAE	*Watsonia humilis*	CR	No
ISOETACEAE	*Isoetes capensis*	EN	No
ISOETACEAE	*Isoetes stellenbossiensis*	NT	No
ISOETACEAE	*Isoetes stephansenii*	CR	No
LOBELIACEAE	*Monopsis variifolia*	EN	No
MESEMBRYANTHEMACEAE	*Antimima mucronata*	VU	No
MESEMBRYANTHEMACEAE	*Drosanthemum calycinum*	NT	No
MESEMBRYANTHEMACEAE	*Drosanthemum hispifolium*	VU	No
MESEMBRYANTHEMACEAE	*Drosanthemum worcesterense*	Threatened	No
MESEMBRYANTHEMACEAE	*Erepsia ramosa*	VU	No
MESEMBRYANTHEMACEAE	*Lampranthus coccineus*	CR	No
MESEMBRYANTHEMACEAE	*Lampranthus dilutus*	EN	No
MESEMBRYANTHEMACEAE	*Lampranthus filicaulis*	VU	No
MESEMBRYANTHEMACEAE	*Lampranthus leptaleon*	EN	No
MESEMBRYANTHEMACEAE	*Lampranthus peacockiae*	VU	No
MESEMBRYANTHEMACEAE	*Lampranthus reptans*	NT	No
MESEMBRYANTHEMACEAE	*Lampranthus scaber*	EN	No
MESEMBRYANTHEMACEAE	*Phyllobolus suffruticosus*	EN	No
ORCHIDACEAE	*Ceratandra venosa*	NT	No
ORCHIDACEAE	*Disa atrorubens*	NT	No
ORCHIDACEAE	*Disa flexuosa*	NT	No
ORCHIDACEAE	*Disa physodes*	CR	No
ORCHIDACEAE	*Disa tenella*	EN	No
ORCHIDACEAE	*Pterygodium inversum*	EN	No
OXALIDACEAE	*Oxalis droseroides*	EN	No
OXALIDACEAE	*Oxalis meisneri*	VU	No
OXALIDACEAE	*Oxalis natans*	CR	No
POLYGALACEAE	*Muraltia spicata*	VU	No
POLYGALACEAE	*Muraltia trinervia*	NT	No
PRIONIACEAE	*Prionium serratum*	Declining	No
PROTEACEAE	*Aulax pallasia*	NT	No
PROTEACEAE	*Diastella myrtifolia*	CR	No
PROTEACEAE	*Diastella parilis*	CR	No
PROTEACEAE	*Diastella thymelaeoides*	VU	No
PROTEACEAE	*Leucadendron argenteum*	EN	No
PROTEACEAE	*Leucadendron chamelaea*	CR	No
PROTEACEAE	*Leucadendron corymbosum*	VU	No
PROTEACEAE	*Leucadendron daphnoides*	EN	No
PROTEACEAE	*Leucadendron gydoense*	EN	No
PROTEACEAE	*Leucadendron lanigerum*	EN	No
PROTEACEAE	*Leucadendron sessile*	NT	No
PROTEACEAE	*Leucadendron stellare*	CR	No
PROTEACEAE	*Leucospermum cordifolium*	NT	No
PROTEACEAE	*Leucospermum hypophyllocarpodendron*	VU	No
PROTEACEAE	*Leucospermum innovans*	EN	No

Family	Species	Threat Status	SA Endemic
PROTEACEAE	*Leucospermum lineare*	VU	No
PROTEACEAE	*Leucospermum tomentosum*	VU	No
PROTEACEAE	*Leucospermum tottum*	NT	No
PROTEACEAE	*Leucospermum vestitum*	NT	No
PROTEACEAE	*Protea angustata*	EN	No
PROTEACEAE	*Protea burchellii*	VU	No
PROTEACEAE	*Protea coronata*	NT	No
PROTEACEAE	*Protea effusa*	NT	No
PROTEACEAE	*Protea grandiceps*	NT	No
PROTEACEAE	*Protea lorea*	NT	No
PROTEACEAE	*Protea mucronifolia*	CR	No
PROTEACEAE	*Protea recondita*	NT	No
PROTEACEAE	*Protea scabra*	NT	No
PROTEACEAE	*Protea scolymocephala*	VU	No
PROTEACEAE	*Protea scorzonerifolia*	VU	No
PROTEACEAE	*Serruria candicans*	EN	No
PROTEACEAE	*Serruria fasciflora*	NT	No
PROTEACEAE	*Serruria furcellata*	CR	No
PROTEACEAE	*Serruria rosea*	NT	No
PROTEACEAE	*Serruria roxburghii*	EN	No
PROTEACEAE	*Serruria rubricaulis*	NT	No
PROTEACEAE	*Serruria triternata*	NT	No
PROTEACEAE	*Sorocephalus imbricatus*	CR	No
PROTEACEAE	*Spatalla caudata*	EN	No
RESTIONACEAE	*Elegia extensa*	EN	No
RESTIONACEAE	*Elegia recta*	NT	No
RESTIONACEAE	*Restio coactilis*	VU	No
RHAMNACEAE	*Phylica plumosa*	VU	No
RHAMNACEAE	*Phylica plumosa*	Declining	No
RHAMNACEAE	*Phylica stenopetala*	VU	No
RHAMNACEAE	*Phylica strigulosa*	VU	No
RHAMNACEAE	*Phylica thunbergiana*	EN	No
RUTACEAE	*Acmadenia macradenia*	NT	No
RUTACEAE	*Agathosma betulina*	Declining	No
RUTACEAE	*Agathosma corymbosa*	EN	No
RUTACEAE	*Agathosma crenulata*	Declining	No
RUTACEAE	*Agathosma marifolia*	NT	No
RUTACEAE	*Agathosma pulchella*	VU	No
RUTACEAE	*Diosma aspalathoides*	NT	No
RUTACEAE	*Diosma pedicellata*	NT	No
RUTACEAE	*Euchaetis pungens*	VU	No
SCROPHULARIACEAE	*Polycarena capensis*	NT	No
THYMELAEACEAE	*Gnidia humilis*	EN	No
THYMELAEACEAE	*Lachnaea grandiflora*	VU	No
THYMELAEACEAE	*Lachnaea pusilla*	VU	No
THYMELAEACEAE	*Lachnaea uniflora*	VU	No

Note: VU=Vulnerable; NT=Near Threatened; EN=Endangered; CR=Critically Endangered

Table 12: Definitions of Red Data plant status (Raimondo et al., 1999)

Symbol	Status	Description
CR	Critically Endangered	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the five International Union for Conservation of Nature (IUCN) criteria for Endangered, and is therefore facing a very high risk of extinction in the wild.

Symbol	Status	Description
EN	Endangered	A taxon is Endangered when the best available evidence indicates that it meets any of the five International Union for Conservation of Nature (IUCN) criteria for Endangered, and is therefore facing a very high risk of extinction in the wild.
VU	Vulnerable	A taxon is Vulnerable when the best available evidence indicates that it meets any of the five) an IUCN criterion for Vulnerable and it is therefore considered to be facing a high risk of extinction in the wild.
NT	Near Threatened	A taxon is Near Threatened when available evidence indicates that it is close to meeting any of the five IUCN criteria for Vulnerable, and is therefore likely to qualify for a threatened category in the near future.
	Declining	A taxon is Declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population.

12.6.5 Terrestrial Invasive Plant Species

Invasive alien plants are widely regarded as the single greatest threat to South Africa's biological diversity. The water taken up by alien plants affects not only the water supply, but can also have negative impacts on water quality.

A large number of alien species occur in the 3318BD and 3319AC QDS surrounding the Voëlvlei Dam. This has potential negative implications for the management of the Dam as terrestrial invasive plant species are known to result:

- Loss of indigenous species as a result of competition for space and resources with alien species;
- Disruption of aquatic and riparian ecosystems;
- Erosion of river banks and riparian areas;
- Alterations in environmental flows as a result of water use by invasive alien plants; and
- An increased fire risk, which destroys indigenous habitats.

12.6.6 Aquatic Invasive Plant Species

Another key biophysical encumbrance is the presence of aquatic invasive species. Currently 14 alien aquatic and wetland plant species are declared weeds or invader plants in South Africa and their control is subject to the Conservation of Agricultural Resources Act (CARA), Act 43 of 1983, and amended in 2001. Another 13 species have been proposed for listing under CARA and the NEMBA. There are also a number of indigenous or cosmopolitan (worldwide) species that can flourish and become troublesome in disturbed aquatic habitats.

No aquatic invasive plant species have been noted as a problem at the Dam, however, according to the Agricultural Geographic Information System (AGIS) Weeds and Invasive Plants (WIP) Database, there are three known aquatic invasive species in the 3319AC QDS around the Dam. These include:

- *Arundo donax*;
- *Eichhornia crassipes*; and
- *Myriophyllum aquaticum.*

Water Hyacinth is known to cause major ecological and socio-economic impacts. According to Villamagna and Murphy (2010), these impacts include:

- Altering of water clarity and decrease in phytoplankton production, dissolved oxygen, nitrogen, phosphorous, heavy metals and concentrations of other contaminants;
- Decreasing abundance and diversity of aquatic invertebrates through decreased phytoplankton (food) availability;
- Decreased dissolved oxygen concentrations and decreased phytoplankton negatively impact fish species.
- Increasing of sedimentation rates within the plant's complex root structure; and
- Increased evapotranspiration rates from water hyacinth leaves when compared to evaporation rates from open water.

Myriophyllum aquaticum is a spirally leafed, aquatic plant capable of forming dense infestations in waterways with pale green, finely divided, feather-like leaves arranged in whorls. Tiny, solitary, inconspicuous cream flowers forming in the axils of the leaves from May-September. It invades still or slow-moving water on the banks of rivers, lakes and ponds. The species is known to be a problem in the Western Cape.

The species forms dense rooted mats which disrupt recreational activities, threaten aquatic ecosystems and irrigation schemes. Dense mats clog waterways, reduce water flow and block irrigation equipment. The mats provide ideal breeding conditions for mosquitoes and bilharzia-carrying snails.

Further, invasive aquatic plants are known to disrupt navigation, fishing and other recreational activities, adversely affect waterflow, increase the loss of water from storage dams and pose a threat to hydro-electric installations. High densities of the plants degrade aquatic ecosystems and are a threat to biodiversity. They can also result in the deaths of cattle and livestock, walking on 'beds' of aquatic weeds often results in drowning.

12.7 Fauna

12.7.1 Freshwater Fish

Voëlvlei Dam, from its establishment until around 2005, was one of the prime smallmouth bass Dams in South Africa. The Dam mainly contained bass, but also other alien species such as some rainbow trout (*Oncorhynchus mykiss*), bluegill (*Lepomis macrochirus*) and very large carp (*Cyprinus carpio*). The Dam used to contain small numbers of Endangered Berg-Breede

whitefish (*Barbus andrewi)*, which never became abundant due to bass predation in the Dam. Rivers which feed the dam contain Endangered Berg River redfin (*Pseudobarbus burgi)*, Cape kurper (*Sandelia capensis*) and Cape Galaxias (*Galaxias zebratus*) in river areas which lack alien fish. The last 15 years has seen the proliferation of the illegally introduced alien sharptooth catfish (*Clarias gariepinus*), and collapse of bass numbers, which has also resulted in carp numbers exploding, and contributing to water quality problems. Recent fish surveys show that alien Mozambique tilapia (*Oreochromis mossambicus*) is also now present in the Dam. Large numbers of carp and catfish present subsistence fishing opportunities to poor communities using legal angling methods, and harvesting of these problem fishes should be encouraged.

12.7.2 Mammals

According to the Animal Demography Unit (http://vmus.adu.org.za/vm_sp_list.php), three sensitive mammal species are known to occur in the grid 3319AC and 3318BD around the site (**Table 13**).

Table 13: Mammal species recorded in grid cell 3319AC and 3318BD which could occur in the area

Species	Common Name	Threat Status	No. Records
Damaliscus pygargus pygargus	Bontebok	VU	6
Equus zebra zebra	Cape Mountain Zebra	VU	3
Mellivora capensis	Honey Badger	NT	17
Mystromys albicaudatus	African White-tailed Rat	EN	3

Note: NT=Near Threatened; VU=Vulnerable

12.7.3 Avifauna

Important Bird and Biodiversity Areas (IBAs) form a network of sites, at a bio-geographic scale, which are crucial for the long-term viability of naturally occurring bird populations (Barnes, 2000). IBAs are classified on the basis of the following criteria:

- The site regularly holds significant numbers of a globally threatened species;
- The site is thought to hold, a significant component of a group of species whose breeding distributions define an Endemic Bird Area (EBA) or Secondary Area; and
- The site is known or thought to hold a significant component of a group of species whose distributions are largely or wholly confined to one biome.

Conservation and planning tools were consulted for relevancy for this project, and found that one IBA falls within the study area. The proposed developments fall within the Boland Mountains IBA (**Figure 44**).

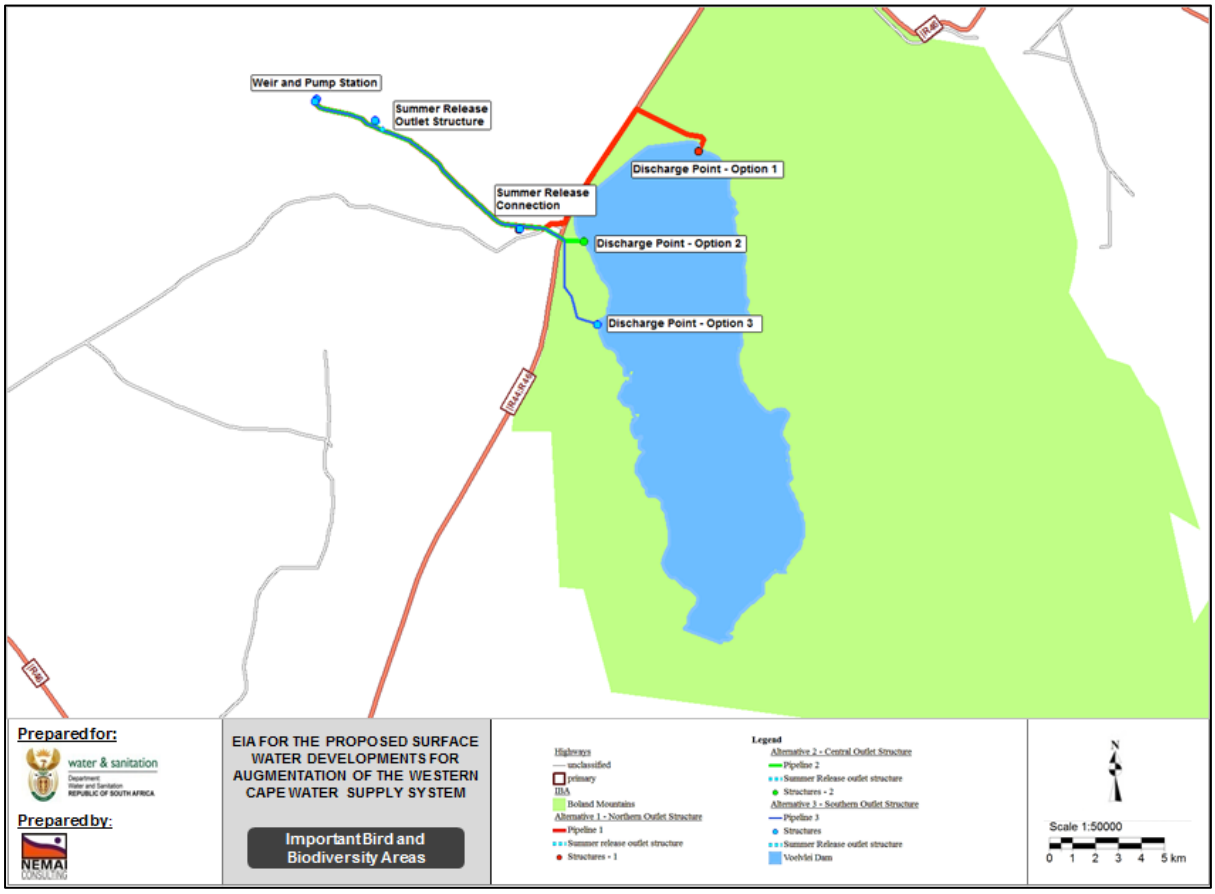


Figure 44: IBA (An A3 copy of this map is contained in Appendix B)

According to the Southern African Bird Atlas Project (SABAP) 2, a number of sensitive bird species have been noted in grid cell 3319AC and 3318BD which might occur on site (**Table 14**).

Table 14: Bird species recorded in cell 3319AC and 3318BD which could occur in the area

Species	Common Name	Threat Status
Pelecanus onocrotalus	Great White Pelican	NT
Ciconia nigra	Black Stork	NT
Phoenicopterus roseus	Greater Flamingo	NT
Phoeniconaias minor	Lesser Flamingo	NT
Sagittarius serpentarius	Secretary bird	NT
Polemaetus bellicosus	Martial Eagle	VU
Circus ranivorus	African Marsh-Harrier	VU
Circus maurus	Black Harrier	NT
Falco biarmicus	Lanner Falcon	NT
Falco naumanni	Lesser Kestrel	VU
Anthropoides paradiseus	Blue Crane	VU
Gyps coprotheres	Cape Vulture (Griffon)	VU
Falco peregrinus	Peregrine Falcon	NT
Sterna caspia	Caspian Tern	NT
Alcedo semitorquata	Half-collared Kingfisher	NT

Note: NT=Near Threatened; VU=Vulnerable

Species such as the Blue Crane is also of concern and is listed as vulnerable in the Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Barnes, 2000). The species has declined in much of its former stronghold mostly due to habitat loss, but has adapted well to the artificial habitat of the wheat producing areas of the WCP (Shaw, 2003) to such a degree that it is estimated that about 50% of the total population now occurs in the WCP (McCann, 2001) (Shaw and Waller, 2012).

12.7.4 Reptiles

According to the Reptile Atlas of Southern African (http://vmus.adu.org.za/vm_sp_list.php), the reptile species that were recorded in grid cell 3319AC and 3318BD are shown in **Table 15**.

Table 15: Amphibian species recorded in grid cell 3319AC and 3318BD which could occur in the area

Species	Common name	Red List Category	No. Records
Cordylus oelofseni	Oelofsen's Girdled Lizard	NT	9
Psammobates geometricus	Geometric Tortoise	CR	3

Note: NT=Near Threatened; CR=Critically Endangered

The Geometric Tortoise, which is listed as Critically Endangered, is protected under the Nature Conservation Ordinance of the Western Cape Province and Schedule I of the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) (**Figure 45**). It is also listed as one of the top 25 most endangered tortoises and turtles in the world. One of the main conservation priorities of the Voëlvlei Nature Reserve is the conservation and protection of this species. According to Cape Nature the following conservation actions are required in the area:

- The establishment of additional statutory conservation areas; private landowners with geometric tortoise populations on their properties can establish conservation stewardship sites and conservancies;
- A Biodiversity Management Plan for this species must be developed; and
- Funding for further conservation actions and awareness programmes must be sourced.

Figure 45: Example of a road sign warning of the geometric tortoises

The geometric tortoise occurs only in the low-lying renosterveld shrublands of the Swartland, Upper Breede River Valley and Ceres Valley, where wheat and wine farming, as well as urban development have led to the destruction of more than 90% of its habitat. The main threats to the species include:

- Urban and agricultural expansion (wheat, other crop farming and vineyards) threatens remaining habitats;
- Severe fragmentation of remaining habitat puts pressure on small and isolated populations;
- Invasive alien vegetation and animals, such as feral pigs, lead to further habitat degradation;
- Too frequent fires in small, isolated habitats will destroy these populations, however, the absence of fire may also negatively affect the quality of these isolated habitat patches; and
- The poaching of specimens from the wild remains a significant potential threat.

12.7.5 Amphibians

Amphibians are an important component of South Africa's exceptional biodiversity and are such worthy of both research and conservation effort.

Frogs are useful environmental bio-monitors (bio-indicators) and may acts as an early warning system for the quality of the environment. Frogs and tadpoles are good species indicator on

water quality, because they have permeable, exposed skins that readily absorb toxic substances. The presence of amphibians is also generally regarded as an indication of intact ecological functionality and therefore construction activities within these habitat units should be undertaken in an ecologically-sensitive manner.

According to the Frog Atlas of Southern African (http://vmus.adu.org.za/vm_sp_list.php), the frog species that were recorded in grid cell 3319AC and 3318BD are shown in **Table 16**.

Table 16: Amphibian species recorded in grid cell 3319AC and 3318BD which could occur in the area

Species	Common name	Red List Category	No. Records
Breviceps gibbosus	Cape Rain Frog	VU	2
Cacosternum capense	Cape Caco	VU	3

Note: VU=Vulnerable

12.8 Land Capability

According to the Agricultural Geo-Referenced Information System (AGIS), the site is located on an area that is considered to have moderate potential arable land and non-arable, moderate potential in terms of grazing land.

12.9 Land Use

The following extract was taken from the Socio-Economic Impact Assessment conducted by Nemai Consulting, 2016:

"Land use within the Berg River catchment comprises mainly of dryland wheat farming, livestock farming, plantation forestry, commercial industry, fruit farming, urban areas and nature conservation. The major industries are agriculturally based (grapes and deciduous fruits) and includes wineries, canneries and other food processing factories (DWAF, 2007). Grain farming is also a dominant land use in the Catchment. The Voëlvlei Nature Reserve is located on the dam and in close proximity to the site.

The town of Gouda, located in Ward 31 is predominantly a rural town established in support of the agricultural activities in the surrounding area (Drakenstein Local Municipality, 2013). Commercial activities in the town include fruit storage and packaging facility (Karsten Fruit Packers), five shopping facilities and a hotel located in the western portion of town.

Surrounding small towns to Gouda include Saron, located 10km north-east of the study area, Riebeek West is a hill side town approximately 14 km west of Gouda and Riebeek Kasteel, located 14 km west of Gouda. In Ward 12, Riebeek Kastaal is the main town. The town is one

of the oldest in South Africa and houses the first South African hotel. The aesthetical appeal of Riebeek Kastaal attracts artists to the area.

Agriculture is the largest industry and main commercial use of land in the region. Each of the small towns listed above are surrounded by agricultural activity and in support the industry."

More information is provided in a summary of the Socio-Economic Impact Assessment in **Section 14.5**.

Figures 47 and **48** show examples of the types of farming found within the vicinity of the proposed developments. The major industries are agriculturally based (grapes and deciduous fruits) and includes wineries, canneries and other food processing factories (DWAF, 2007). Grain farming is also a dominant land use in the Catchment. The Voëlvlei Nature Reserve is located on the Dam but is not impacted on by the proposed developments.

Land use in the catchment, especially agricultural use has impact on the water quality of the Dam. This is further impacted by WWTWs in the catchment which are sources of pollution.

Figure 46: Image of crop farming and surrounding mountainous area

Figure 47: Example of livestock farming

12.10 Heritage

The Voëlvlei Dam is a very large earth walled structure built in the late 20th century. It does not occupy any particular river valley; however it is fed through a system of canals and diversions. Augmentation will involve increasing the capacity of these facilities to optimise water resources that can be obtained from winter flooding. Since the Voëlvlei Dam is a recent structure (less than 60 years of age), it and its associated infrastructure are not protected by heritage legislation, however some of the proposed augmentation measures involve land and areas that could be sensitive in heritage terms.

The archaeological heritage of the Berg River has been described by a number of researchers; however formal publications on the built environment of the area are rather scarce.

The Berg River runs mainly through the Swartland – an area of high agricultural potential was likely to have been frequented by Khoekhoen pastoral communities since 2000 years ago. The soils of the Swartland have a far better carrying capacity than those of the Cape Fold Belt Mountains which means that early stock farmers would have enjoyed better success raising herd of domestic cattle and fat tailed sheep (Hart 1987, Smith *et al.* 1991). The first formal archaeological surveys of the Berg River Valley in the Gouda-Porterville area were carried out in 1983 and found that the ploughed fields contained numerous archaeological sites relating to the Early and Middle Stone Age, but found very few sites that could relate to the Khoekhoen herders who were historically known to frequent the area. It was concluded to be likely that herder sites were very ephemeral as these groups of people were highly mobile and that sheet erosion and deep ploughing had destroyed much of the evidence. Various archaeologists have found evidence of large but highly ephemeral archaeological sites on the Vredenberg Pensinsula and Swartland.

In terms of Pre-colonial Archaeology, only two archaeological research projects have been carried out in the nearby vicinity. One involved a survey of the Swartland area around Porterville (Hart 1984, 1987), while the second saw two small rock shelters being excavated near Voëlvlei Dam (Smith *et al.* 1991) with a view to exploring the relationship between hunter-gatherers and herders in the south-western Cape. A few impact assessments have also been conducted (Orton, 2008a, 2008b, 2010; Webley & Hart, 2010). These studies inform the following archaeological review:

- The earliest period of pre-colonial archaeology present in the region is the Early Stone Age (ESAge) which occurred until about 200 000 years ago. Artefacts pertaining to this period of prehistory are commonly encountered all along the western edge of the Cape Fold Belt Mountains. Most often they are associated with river terraces where the cobbles served as a source of stone material for making artefacts. Such artefacts have been recorded in the vicinity of the study area where Hart (1984, 1987) found ESAge artefacts to be closely associated with rivers and focused on stony hills and ridges. Orton (2008b,

2010) found ESAge artefacts scattered in farmland on the lower mountain slopes north of Saron as well as on the farm immediately east of the present study area. Webley and Hart (2010) found no archaeology in an area to the southwest of Gouda;

- After 200 000 years ago and extending up until some 40 000 to 20 000 years ago is the Middle Stone Age (MSA). Hart (1984, 1987) records the occurrence of MSA artefacts in similar contexts to ESAge ones throughout his study area. No other reports of MSA artefacts are known in the vicinity;
- The Later Stone Age (LSA) extends from the end of the MSA until the arrival of European colonists some 350 years ago. The two small rock shelter excavations conducted by Smith et al. (1991) yielded material demonstrating that the area was certainly used by the San and the Khoekhoen. The Voëlvlei rock shelter had three radiocarbon dates conducted with the upper two being in the 15th and 16th centuries and the oldest one, from the base of the site, falling within the 2nd century AD. The Driebos deposits were never dated but the finds suggest material of a similar age (Smith et al. 1991);
- The rock shelter excavations were conducted as part of Smith's wider interest in the origins of the herding economy in the Western Cape. He proposed that the Khoekhoen moved between winter pastures at the coast (specifically the Vredenburg Peninsula) to summer pastures inland (Smith 1983, 1984). The latter would have been on the Malmesbury shales where the nutritious Renosterveld vegetation grew. His cycle of transhumance passed through the Gouda area, following the course of the Great Berg River; and
- Rock art is present in the area with both the shelters documented by Smith *et al.* (1991) containing art. Several rock art sites are reported to occur in the region around Porterville (SA-Venues 2012) with the famous European galleon being a notable inclusion (Parkington 2003). The precise age of rock paintings is unknown but those with European content, such as the galleon, clearly indicate that the tradition of painting on the walls of rock shelters and boulders continued into the colonial period.

Therefore, the possibility of finding intact heritage resources in the study area is high due to the history of the surrounding towns and structures.

12.11 Socio-Economic Environment

Voëlvlei Dam occurs in Drakenstein Local Municipality, a Category B municipality which forms part of the larger Cape Winelands District. The proposed developments occur in the Drakenstein Local Municipality of the Cape Winelands District as well as the Swartland Local Municipality of the WCDM.

Unless otherwise indicated, all information in the section was obtained from the Census 2011 (Statistics South Africa, 2011) data.

12.11.1 Drakenstein Local Municipality

The Drakenstein Local Municipality has a total population size of approximately 251 262 people with an average population growth rate of 2.56%.

The population of 15–34 age groups and the 35-64 age group account for 36% and 33% of the population respectively. This means that 69% of the population are of working age.

Youth in total account for 35% of the population indicating that youth are expected to contribute towards the households bearing more responsibility than what is normal. Only 5% of the population are over 65 years of age.

There are 59 774 households in the municipality, with an average household size of 3.9 persons per household. Almost 93.8% of households have access to piped water either in their dwelling or in the yard. Only 0.6% of households do not have access to piped water and 95.0% of households have access to electricity for lighting.

Of those aged 20 years and older, 6.5% have completed primary school, 37.7% have some secondary education, 27.9% have completed matric and 11.9% have some form of higher education. Approximately 3.3% of those aged 20 years and older have no form of schooling (**Figure 49**).

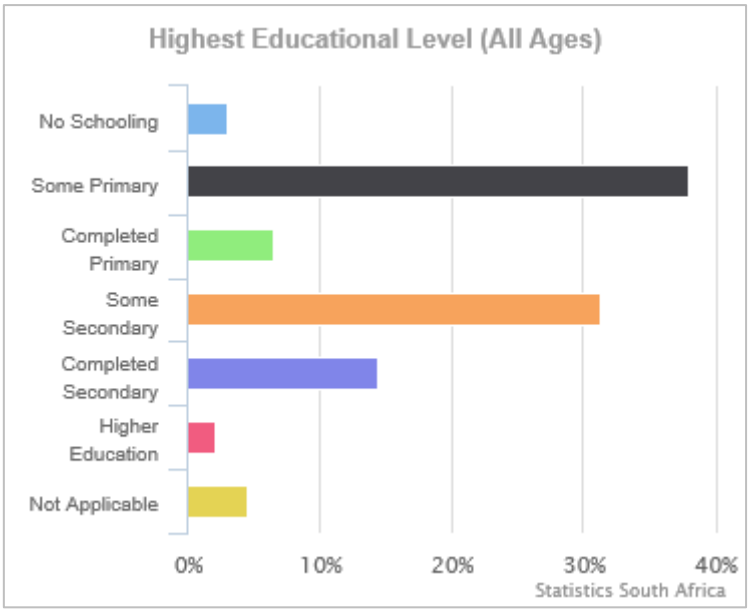


Figure 48: Education Level

There are 106 030 economically active (employed or unemployed but looking for work) people in the municipality, and of these 17.6% are unemployed (**Figure 50**). Of the 50 279 economically active youth (aged 15–34) in the municipality, 24.6% are unemployed.

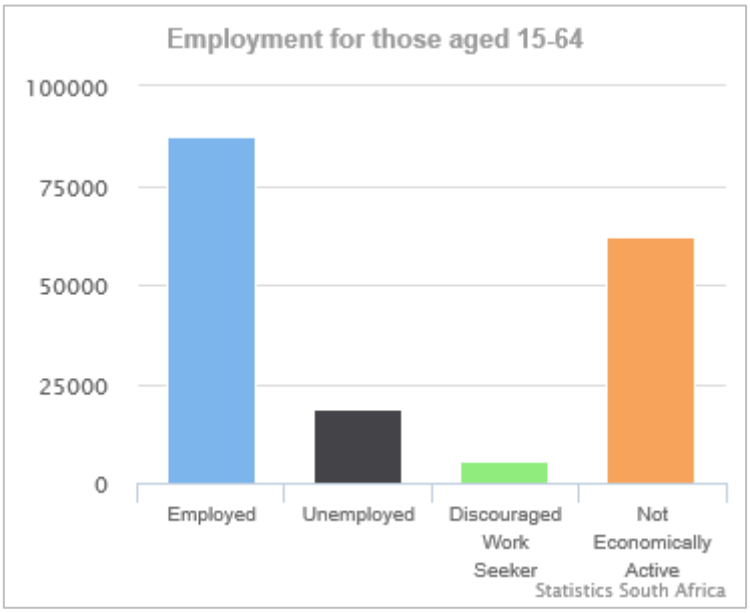


Figure 49: Employment status

Table 17 shows the average household income.13% of households earn no income at all.

Table 17: Average Household Income for Drakenstein (Census 2011)

Income	Percentage
No income	13%
R1 - R4,800	1,7%
R4,801 - R9,600	3,1%
R9,601 - R19,600	10,7%
R19,601 - R38,200	17,2%
R38,201 - R76,4000	18,4%
R76,401 - R153,800	13,9%
R153,801 - R307,600	11%
R307,601 - R614,400	7,4%
R614,001 - R1,228,800	2,5%
R1,228,801 - R2,457,600	0,7%
R2,457,601+	0,4%

12.11.2 Swartland Local Municipality

The Swartland Local Municipality has a total population size of approximately 113 762 people with an average population growth rate of 4.56%.

Youth in total account for 25% of the population indicating that youth are expected to contribute towards the households bearing more responsibility than what is normal. Only 6% of the population are over 65 years of age.

There are 29 324 households in the municipality with an average household size of 3.5 persons per household. Of these households, 80.6% have access to piped water inside their dwelling, and 16.9% have access to water in their yard. Only 0.5% of households do not have access to piped water, and 97.8% of households have access to electricity.

Of those aged 20 years and older, 7.8% have completed primary school, 35.4% have some secondary education, 24.2% have completed matric, and 9.6% have some form of higher education (**Figure 51**).

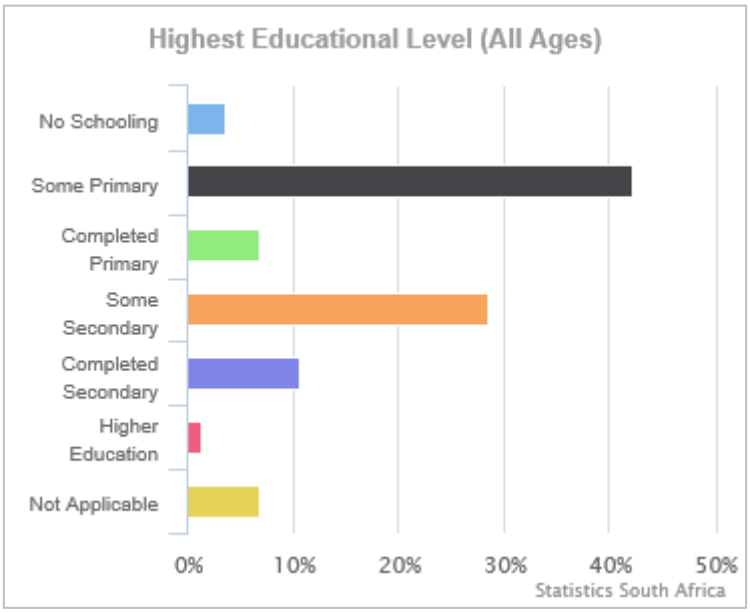


Figure 50: Education level

A total of 40 651 people are economically active (employed or unemployed but looking for work), and of these, 12.7% are unemployed (**Figure 52**). The economically active youth (15–34 years) in the area total 18 248, of which 17.9% are unemployed.

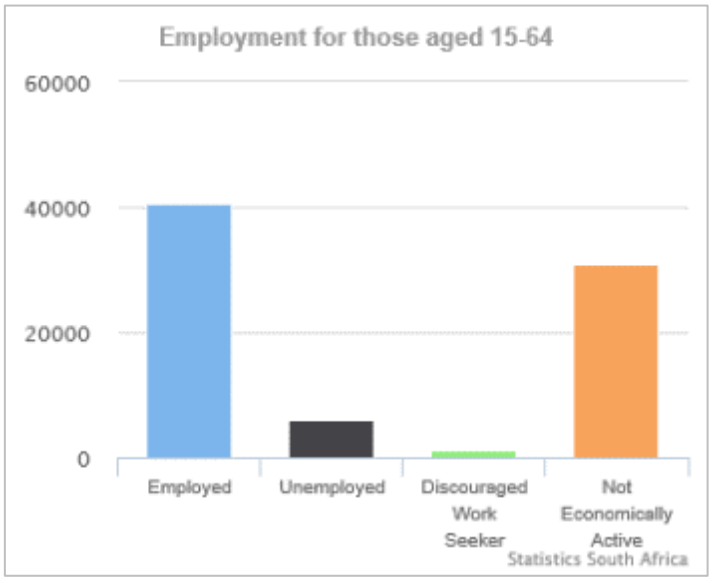


Figure 51: Employment status

Table 18 shows the average household income.10.5% of households earn no income at all.

Table 18: Average Household Income for Swartland (Census 2011)

Income	Percentage
No income	10,5%
R1 - R4,800	1,7%
R4,801 - R9,600	2,6%
R9,601 - R19,600	13,4%
R19,601 - R38,200	21,7%
R38,201 - R76,4000	20,1%
R76,401 - R153,800	13%
R153,801 - R307,600	9,5%
R307,601 - R614,400	5,5%
R614,001 - R1,228,800	1,5%
R1,228,801 - R2,457,600	0,4%
R2,457,601+	0,2%

12.11.3 Social Environment

In 1997 2.5% of the National Gross Domestic Product (GDP) originated from the Berg WMA with the main drivers of local economy including:

- Agriculture;
- Trade;
- Manufacturing;
- Finance; and

- Government.

Agriculture is the only sector in which the economy of the Berg WMA is competitive in the South African interior. This is largely due to the Mediterranean climate. Most of the economic production is from the areas where irrigation is practised and where processing and packaging plants are located (DWA, 2004).

12.11.4 Wards 12 and 31

The following was extracted from the Socio-Economic Impact Assessment conducted by Nemai Consulting, 2016 with regards to the Ward in which the proposed project will take place:

12.11.4.1 Population, Age and Gender

The total population for the two wards is 18 729 persons. Ward 31 has a population of 8 301 persons while Ward 12 has a larger population of 10 428. Majority of the people live in the towns of Gouda (Ward 31) and Riebeek Kastaal (Ward 12).

The age group 15 – 64 is defined as the working age population. In total, this group accounts for sixty-nine percent of the population in the study area. The population is fairly young, with over sixty percent below the age of 35.

There are more males than females in the Ward 12, and of working age population which differs to South Africa in general, where there are more females than males. In Ward 31 there is no overall difference in the gender ratio.

12.11.4.2 Education

Education levels in the area quite low with less than 15 percent of the population over age 20 having received a matric or higher qualification.

Approximately a forty percent of the population have no education or have not completed primary education and are considered to be functionally illiterate. Functional illiteracy is defined as a person who has received skills to read and write that are inadequate to manage daily living and employment tasks that require reading skills beyond a basic level. Usually persons who have a low level of education, up to primary education, are classified as functionally illiterate.

Economic theory proves that education improves the level and quality of human capital, in turn increasing the productivity of individuals. Thus increasing the output generated per worker. Education facilitates long term growth and is critical to escape the poverty trap.

Economic theory is proven in practice in a study conducted by Altbeker and Storme (2013). The study shows that while the number of graduates in South Africa has more than doubled in the past fifteen years; the unemployment rate amongst graduates has declined to around five percent.

The Altbeker and Storme study, in conjunction with the data shown above, reveal that education levels in the study area are so low that the communities in these two wards are structurally geared towards unemployment and thus poverty. The community is economically dependent on the less than fifteen percent of the population who have completed high school or higher education. It is only this group that is likely to earn an income in the middle or high income bracket, resulting in a perpetuating cycle of low education and low income levels.

12.11.4.3 Employment

The labour force comprises all persons who are employed plus all persons who are unemployed. Ward 31 has a labour force of 4 407 and Ward 12 has a labour force of 3 093.

There are 106 030 economically active (employed or unemployed but looking for work) people in the municipality, and of these 17.6% are unemployed. Of the 50 279 economically active youth (aged 15–34) in the municipality, 24.6% are unemployed.

According to the municipal IDP, the unemployment rate for the Drakenstien LM twenty-three percent. In Swartland LM at twenty-five percent in 2010 with thirty-two percent of the population living in poverty.

12.12 Planning

The following provides a literature overview of the planning with regards to water supply infrastructure in the study area:

12.12.1 Western Cape Provincial SDF

Water will be the key determinant of future Provincial economic growth and development. Key agricultural water users are located in the Breede agricultural valley areas and Oliphants - Doorn agricultural corridor. Key industrial water users are located in the Cape metro, greater Saldanha and Southern Cape regions. Key urban and industrial water users are located in the Cape Town functional region.

Competition for water derived from the Berg River WMA exists between the Cape Town and Saldanha functional regions. There is a present and growing competing tension between the agricultural and industrial sectors and settlements in accessing water, and therefore water demand management efficiency measures must be put in place in these strategic water use sectors.

An overarching approach to water demand management to be adopted – firstly efficiencies must be maximised, storage capacity sustainably optimised and ground water extraction sustainably optimised, with the last resort option of desalination being explored, if necessary.

12.12.2 West Coast District IDP

The provision of potable water within the West Coast District is becoming more challenging as the population growth, urbanisation and migration lead to higher demand for water, especially in the Saldanha Bay – Vredenburg areas. The West Coast District Municipality is the supplier of bulk water in the Swartland and Saldanha Bay Municipalities, which include water resources such as the Misverstand Dam, Voëlvlei Dam and the Langebaan Aquifer. To the north of the district, in the Matzikama and Cederberg Municipalities, the Olifantsriver Water Scheme is the primary water distribution network. The anticipated upgrading/ extension of the Clanwilliam Dam, by the Department of Water Affairs and Forestry, will in future increase the capacity of water supply in these municipalities for domestic use and also for agricultural irrigation purposes.

The key spatial challenges identified are as follows:

- Growing demand for potable water supply;
- Limited availability of additional water allocation from the Voëlvlei Dam, as the Cape Town Metropole is the primary beneficiary of the Voëlvlei Dam water supply;
- Identification and implementation of new bulk water sources; and
- Pollution of the Berg River, which affects water quality downstream and limits the potential use of water from the river.

One of the proposals within the West Coast SDF involves the improvement of the water quality of the Berg River. According to the Western Cape Provincial Government, three primary issues have been identified as having the biggest impact on the health of the Berg River system:

1. Pollution from existing wastewater treatment plants;
2. Pollution from informal settlements. Grey and black wastewater that bypass the formal system directly into streams, as well as domestic household pollution (papers, plastic, etc.);
3. The loss of indigenous vegetation along the river, which would act as a buffer to naturally filter certain excess pollutants.

In this regard, it is proposed that the improvement and preservation of the water quality of the Berg River be prioritised by:

- ensuring well-managed and operationally sound waste water treatment works along feeder streams and the Berg River,
- minimising pollution from informal areas; and
- protecting natural vegetation in river corridors and along river embankments.

12.12.3 Cape Winelands SDF

Priority should be given to the supply of irrigation water to as yet undeveloped, medium and high potential areas. This would require the construction of reservoirs and dams and water supply schemes. It is not suggested that the already stressed rivers be put under further pressure. The existing dams in the area, especially those not beneficially used for irrigation purposes, should be considered for use.

12.12.4 Voëlvlei RMP

The Voëlvlei RMP was compiled based on detailed stakeholder input and engagement. This formed the cornerstone of the RMP through the establishment of a Vision for the Dam with a number of Key Objectives. The RMP lays the foundation required to consolidate objectives for the resource, within the framework of existing policy priorities. The key recommendations of the Voëlvlei Dam Resource Management Plan are as follows:

- Implementation of the Institutional Plan including the formation of a Dam Management Committee, Operations Management Committee and RMP Steering Committee. As part of this Institutional Plan, it is vital that all agreements are updated to take into account the findings of the RMP;
- Implementation of standardised and harmonised Aids to Navigation and Demarcation Markers and Unique Positioning Number System and the Wash Bay System at the Dam;
- Resolution of all land matters including putting in place new agreements;
- Public day visitors and fishing area to be created and the feasibility of a community access card to be assessed. Further, information brochures to be developed to inform communities about the potential uses of the Dam and how to join recreational clubs;
- Land matters to be resolved and new agreements with adjacent landowners to be drawn up;
- The potential for nature sensitive overnight facilities to be assessed. Dark sky principles should be incorporated into all development planning;
- Potential of creating an overall “Back to Basics” hiking trail which includes astronomy, Rock Art, plant and animal biodiversity. This could be linked to skills development and job creation initiatives in the area. Dark sky principles should be incorporated into all development planning;
- Potential cycling trails to be assessed.
- Containment Plan for invasive fish species;
- Expansion of the Working for Water Programme to remove alien plant species in the area;

- Potential for commercial fishing or small scale fisheries programme to be assessed;
- Heritage assessment/study of the state of the Rock Art site and to determine methods of preservation;
- Wash bay system to be implemented to prevent alien invasive species infestations;
- Coordination between Yacht Club, local schools and South African Sailing to introduce youth sailing programme at the Dam.;
- The potential for School science education programmes including elements of botany, zoology, geology, meteorology, astronomy to be assessed; and
- Skills training programmes including life guard training, first aid training, astronomy, rock art, and biodiversity to be developed as part of eco-tourism development and community skills training.

12.12.5 Conclusion

Based on the literature review of the documents mentioned above for the study area, there is a strategic need for the provision of increased basic water services to the surrounding communities and agricultural holdings within the municipalities. As one of the main aims is to use existing dams rather than construct new ones, the augmentation of the existing Voëlvlei Dam is supported. In addition, there is a need to improve the water quality of the Berg River which is a component of the proposed project.

12.13 Existing Infrastructure

The main infrastructure at the Dam includes (**Figures 53** and **54**):

- The intake tower;
- The CCTMM WTW and intake tower;
- Housing and offices for DWS, CCTMM and WCDM;
- VYC club house and camping facilities;
- WPALAS facilities including accommodation; and
- Two Dam walls.

Figure 52: One of the intake towers located on the Dam

Figure 53: DWS site houses

12.14 Air Quality

Due to the predominantly agricultural nature of the study area, as well as the presence of the Voëlvlei Nature Reserve, the air quality is regarded to be good. Localised impacts to air quality include burning of emissions from vehicles travelling on the surrounding road network, dust from un-vegetated areas and dirt roads, smoke (veld fires), agricultural activities, and methane release from cattle. Dust generated along the access roads may potentially damage existing crops grown in the area (**Figure 55**).

Figure 54: Warning sign located along the potential access roads

Anthropogenic activities such as the recreational activities on the Dam, the Swartland WTW, WCDM WTW, and CCTMM WTW contribute to the air quality in the area.

Sensitive receptors to dust and other air quality impacts in the study area include farm dwellings, and the recreational clubs on the Dam.

12.15 Noise

The natural state of the study area affords it tranquillity. Large open agricultural holdings are situated within the study area. Recreational activities on the Dam, the Swartland WTW, WCDM WTW, and CCTMM WTW add to the noise levels within the area but the noise increases are minimal.

Noise in the region emanates primarily from households, farming operations (e.g. use of farming equipment), vehicles on the road network, activities on the Dam and operational activities of the Swartland WTW, WCDM WTW, and CCTMM WTW. The undulating hills and lowlands serves as noise attenuation features, although the ambient noise levels are regarded as insignificant.

The following were identified as sensitive noise receptors in the study area:

- Dwellings on surrounding farms may be exposed to construction-related noise;
- Recreational clubs located on the Dam;
- Gouda is located approximately 5km from the dam wall; and

- The Voëlvlei Nature Reserve is located on the Dam.

12.16 Visual

The study area is afforded aesthetic appeal through topographical features such as undulating hills, mountains, valleys, and watercourses (**Figures 56** and **57**). The openness of the area and the presence of the Voëlvlei Dam and Berg River, as well as the Voëlvlei Nature Reserve on the banks of the Dam, contribute to the visual qualities.

Figure 55: View of Berg River and surrounding open farmlands

Figure 56: View of mountains surrounding the Voëlvlei Dam

12.17 Access Roads

There is no formal access area at Voëlvlei Dam. For safety and security reasons, the whole Dam is fenced so without prior arrangement there is no way to access the Dam. During construction and operation, access roads to the weir and pump station site will be via existing farm roads in the study area (**Figure 58**). There is access to the proposed pump station and weir site via existing access roads, however, sections of new roads routing off the existing roads will need to be developed (**Figure 59**). Refer to **Section 10.1** for an overview of the proposed access roads to be used for the project.

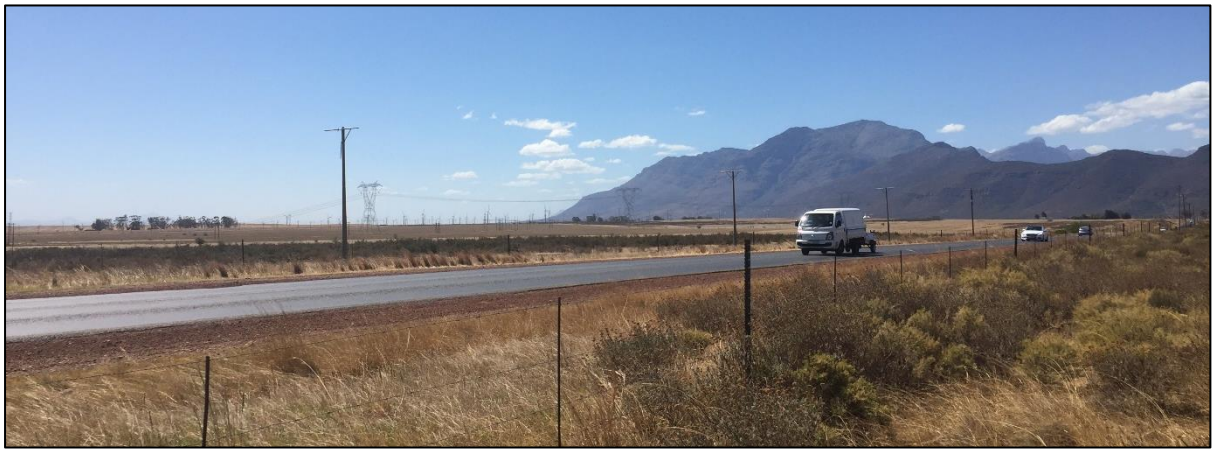


Figure 57: Existing main roads in the study area

Figure 58: Proposed access options to weir and pump station

13 PUBLIC PARTICIPATION

The purpose of the public participation process for the proposed development includes:

- Providing IAPs with an opportunity to obtain information about the project;
- Allowing IAPs to express their views, issues and concerns with regard to the project;
- Granting IAPs an opportunity to recommend measures to avoid or reduce adverse impacts and enhance positive impacts associated with the project; and
- Enabling the project team to incorporate the needs, concerns and recommendations of IAPs into the project, where feasible.

The public participation process that was followed for the proposed surface water developments is governed by NEMA and GN No. R. 982 (4 December 2014).

13.1 Announcement Phase

13.1.1 Landowner Notification

The properties that are directly affected by the proposed development are shown in **Figure 6** and listed in **Table 3**. The details of the affected landowners are included in the IAP database which is contained in **Appendix F3**.

Proof of written notification to the landowners / persons in control of the land is included in **Appendix F2**.

13.1.2 Identification of IAPs and Compilation of IAP Database

IAPs were identified based on regulatory requirements and the specific site/project requirements. In summary, the database includes the following:

- Landowners, adjacent landowners/occupiers;
- Relevant Organs of State / Authorities including the following;
    - DEA;
    - DWS;
    - CCT;
    - West Coast District Municipality;
    - Drakenstein Local Municipality;
    - Cape Winelands District Municipality;
    - Swartland Local Municipality;
    - Western Cape DEA&DP;
    - Western Cape Department of Agriculture;
    - Department of Mineral Resources (DMR);

- South African Heritage Resource Authority (SAHRA);
- Western Cape Heritage;
- Cape Nature;
- Berg Water Use Association;
- Western Cape Department of Roads;
- Drakenstein Local Municipality Ward Councillor 31; and
- Swartland Local Municipality Ward Councillor 12.

- General IAPs that may have an interest in the project.

Please note that a copy of the IAP database will be updated in the Final EIA Report to be submitted to DEA; however, a copy is available in **Appendix F3**.

13.1.3 IAP Registration Period

A 30 day registration period was conducted from 26 May 2016 to 27 June 2016 which provided the public with the chance to register as an IAP in order to review and provide comments on the draft reports, as well as be invited to the public meetings. The 30 day registration period was advertised in the Daily Voice (published 26 May 2016) and the Paarl Post (published 26 May 2016).

13.1.4 Notification Process

The notification process undertaken is detailed in the sections to follow:

13.1.4.1 Background Information Document

Background Information Documents (BIDs) (**Appendix F1**) and Reply Forms were distributed by email or hand delivered to IAPs contained in the IAP Database. In addition, BIDs were placed at the Gouda Library (**Figure 60**). BIDs contained a brief background and description of the project, as well as the EIA process, and listed the details for submitting comments regarding the proposed developments. The BID was compiled in both English and Afrikaans, the two predominant languages of the study area. The BID served to notify IAPs of the project and the details on how to register as an IAP.

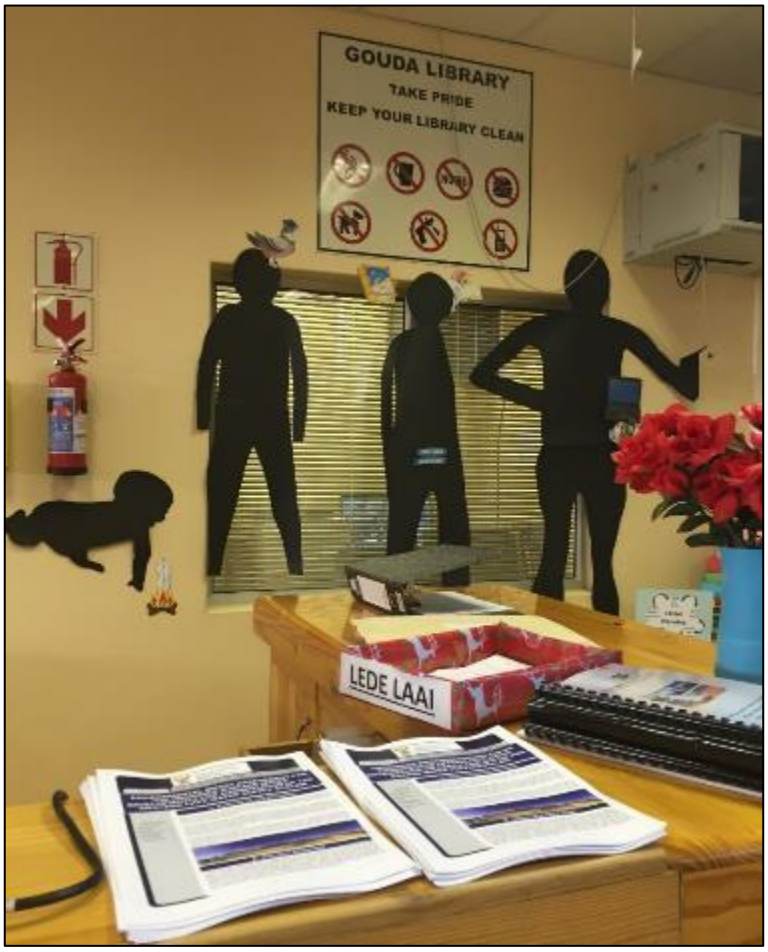


Figure 59: BIDs placed at the Gouda Library for the public

Notification of the proposed WCWSS developments took place on 24 May 2016. Proof of initial notification is provided in **Appendix F1**. All reply forms from registered IAPs and landowners to date are included in **Appendix F4**.

13.1.4.2 Onsite Notices

Eleven site notices were placed at strategic points along the proposed pipeline route and around the pump station and Dam locations (**Figure 61**). Notification of the proposed developments and how to register as an IAP were provided on the site notice. Onsite notices were primarily placed in proximity to the project components, based on the availability of public access.

Figure 62 provides the locations of each site notice in relation to the proposed developments. Details of the locations of the onsite notices and accompanying photographs are contained in **Appendix F1**.

Figure 60: Example of a site notice placed in the study area

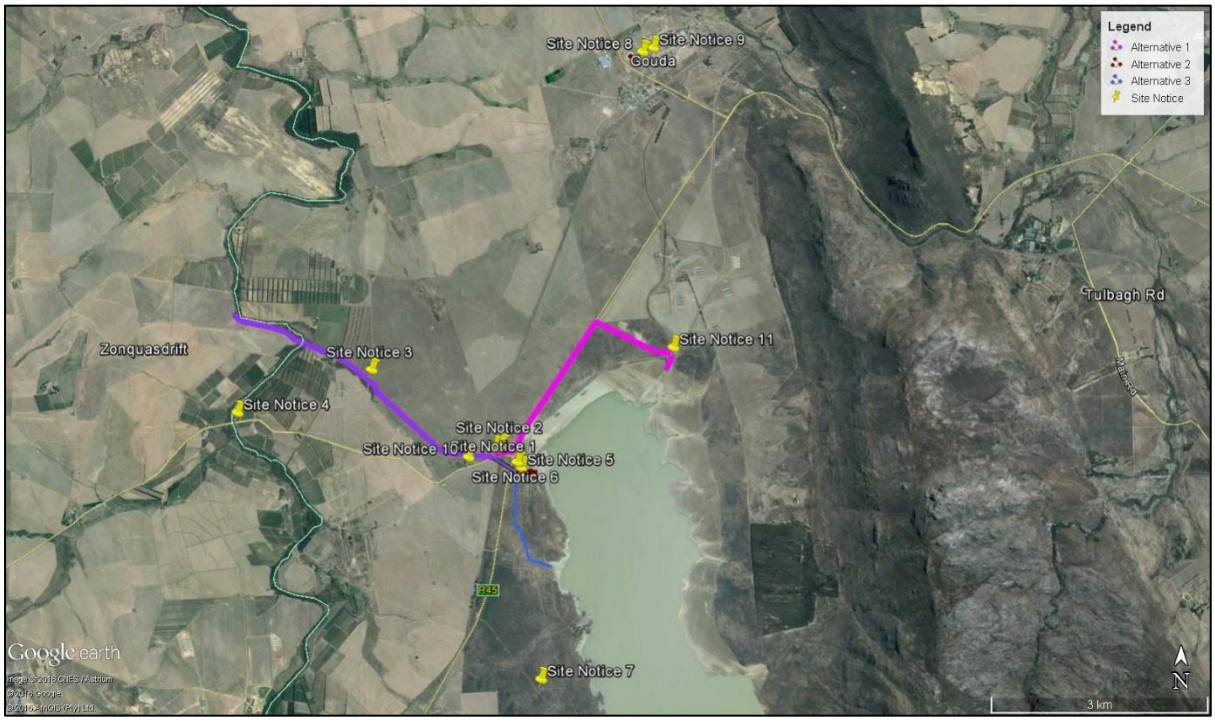


Figure 61: Locations of site notices within the project area

13.1.4.3 Newspaper Notices

Advertisements were placed in the following newspapers as notification of the project and how to register as an IAP (refer to copies of the newspaper advertisements contained in **Appendix F1**):

- The Daily Voice, published 26 May 2016; and
- The Paarl Post, published 26 May 2016.

13.2 Review Process for Draft Scoping Report

The Application Form was submitted to DEA on **22 September 2016** and the reference number was provided: 14/12/16/3/3/2/973.

Initially, the Application Form included Activity 14 of GN No R985 of 04 December 2014, however, WC DEA&DP stated that Activity 14 would not be applicable as the site is not located in a protected area in terms of NEMA; no environmental management framework and/or systematic biodiversity plans have been adopted by the competent authority; and the site is not located in a core area in a biosphere reserve. Therefore, an Amended Application Form will be submitted to DEA on 28 October 2016 along with the Final Scoping Report.

13.2.1 Public Review

In accordance with G.N. No. R. 982 of 04 December 2014, IAPs were granted an opportunity to review and comment on the Draft Scoping Report. Hardcopies of the document were placed at Gouda Library (**Figure 63**). Emails and SMSes will be sent to all registered IAPs to notify them of the review of the Draft Scoping Report. Proof of the notification of the public review period was included in the Final Scoping Report.

Figure 62: Draft Scoping Report at Gouda Library

13.2.2 Authority Review

Hardcopies of the document were also provided to the following key regulatory and commenting authorities for a 30 day review period.

13.2.3 Meetings

13.2.3.1 Authority Meeting and Site Visit

An authority meeting and site visit was conducted on 25 May 2016 (**Figure 64**). Three locations along the proposed pipeline route were visited, being the weir location, a site near the wetland and the Discharge Point, and the Dam.

Details of the site visit are contained in the Comments and Responses Report in **Appendix F7** and the attendance register, meeting agenda, and minutes of the meeting are contained in **Appendix F6**.

Figure 63: Photos from the authority site visit

The Draft Scoping Report was presented to the authorities on 16 August 2016.

13.2.3.2 Focus Group Meetings – Landowners

Meetings were arranged with most of the affected landowners on 27 September 2016 to discuss the potential impacts of the project components on their properties. The minutes and attendance registers of the focus group meetings are provided in **Appendix F6**.

13.2.3.3 Public Meeting

A public meeting was held at the Gouda Library (**Table 19**). The aim of the meeting was to present the Draft Scoping Report and to provide IAPs with a platform for project related discussions. The minutes and attendance registers of the meeting are provided in **Appendix F6**. All registered IAPs were notified of the public meeting via email or SMS.

Table 19: Public Meeting Details

Date	Time	Venue
04/10/2016	16:00 – 18:00	Gouda Library (Malva Street, Gouda)

13.2.4 Comments and Responses Report

The Comments and Response Report, which summarises the salient issues raised by IAPs and the project team's response to these matters, is contained in **Appendix F7**. The issues listed in the Comments and Response Report were identified from minutes of meetings, completed Reply Forms and other correspondence received to date.

The Scoping phase served to identify and prioritise issues for further assessment during the EIA phase. Accordingly, the comments received from IAPs during public participation as part of Scoping will be afforded due consideration and further investigation during the pending EIA stage.

The main concerns raised by IAPs to date are as follows:

- The impacts of the proposed developments on the water quality of the Dam and the Berg River;
- The monitoring of overflow from the Dam;
- The impact of the project on flooding in the area;
- The redundancy of the existing canal and the potential loss of the wetland fed by the canal;
- The impact to the project on landowners existing pumps; and
- The impact of access roads on existing properties.

13.3 Review Process of the Draft EIA Report

13.3.1 Public Review of Draft EIA and IWULA

In accordance with GN. No. R. 982 of 04 December 2014, IAPs are granted an opportunity to review and comment on the Draft Reports. Hardcopies of the Draft Reports will be placed at the venue listed below (**Table 20**). An electronic copy of the reports will also be available. Emails or SMSes were sent to all registered IAPs which will include the details of the review period of the Draft EIA and IWULA.

Table 20: Location of Draft EIA and IWULA Report for Review

Venue	Address	Contact Details
Gouda Library	Malva Street, Gouda	023 232 0841

The public review of the Draft EIA and IWULA will take place for a 30 day review period **from 15 February 2017 to 17 March 2017**.

13.3.2 Authority Review Period of Draft EIA and IWULA

Hardcopies of the Draft IWULA will be delivered to the key regulatory and commenting authorities for review. The authority review of the Draft EIA and IWULA will take place from **from 15 February 2017 to 17 March 2017**.

13.3.3 EIA Public Meeting

A public meeting will be held at the Gouda Library on **22 February 2017**. The aim of the meeting is to present the Draft EIA Report and to provide IAPs with a platform for project related discussions. All registered IAPs were invited to attend the public meeting.

In addition, an Authority Meeting and site visit will take place at the Gouda Library on **23 February 2017** to present the findings of the Draft EIA Report.

13.3.4 Comments and Responses Report

A Comments and Response Report has been compiled and included in the EIA Report, which records the date that issues were raised, a summary of each issue, and the response of the team to address the issue. In addition, any unattended comments from the Scoping Phase or where the status of the responses has changed, have also been addressed in the Comments and Response Report for the EIA Phase.

13.3.5 Review of the Final EIA (including the IWULA)

Registered IAPs and authorities will be granted an opportunity to review and comment on the Final EIA and IWULA. A link containing the electronic Final Reports will be sent to Authorities and Registered IAPs only. Any further comments from Registered IAPs will be forwarded to the Competent Authority.

13.3.6 Notification of DEA's Decision

All authorities and registered IAPs will be notified via email or SMS after having received written notice from DEA on the final decision for the EIA. Advertisements will also be placed as notification of the Department's decision. These notifications will include the appeal procedure to the decision and key reasons for the decision. A copy of the decision will also be provided to IAPs on request.

14 SUMMARY OF SPECIALIST STUDIES

14.1 Specialist Studies undertaken as part of the EIA

A crucial element of the Plan of Study for the EIA prepared during the Scoping phase was to provide the Terms of Reference for the requisite specialist studies triggered during Scoping. According to Münster (2005), a 'trigger' is "*a particular characteristic of either the receiving environment or the proposed project which indicates that there is likely to be an issue and/or potentially significant impact associated with that proposed development that may require specialist input*". The requisite specialist studies 'triggered' by the findings of the Scoping process, aimed at addressing the key issues and compliance with legal obligations, included:

- Ecological Impact Assessment;
- Aquatic Assessment and Wetland Delineation;
- Socio-Economic Assessment;
- Phase 1 Heritage Impact Assessment; and
- Agricultural Impact Assessment.

In addition, a number of technical studies were required including:

- Geotechnical Investigation;
- Stormwater Management Plan; and
- Technical Drawings.

These technical studies have not been summarised below, but are included in **Appendix H**.
For the inclusion of the findings of the specialist studies into the EIA report, the following guideline was used: *Guideline for the review of specialist input in EIA processes* (Keatimilwe & Ashton, 2005). Key considerations included:

- Ensuring that the specialists have adequately addressed IAPs' issues;
- Ensuring that the specialists' input is relevant, appropriate and unambiguous; and
- Verifying that information regarding the receiving ecological, social and economic environment has been accurately reflected and considered.

14.2 Ecological Impact Assessment

14.2.1 Details of the Specialist

Specialist	
Organisation:	Nemai Consulting
Name:	Mr. Ronald Phamphe
Qualifications:	MSc (Botany)
Affiliation (if applicable):	• Professional Natural Scientist-Ecological Science (Reg number: 400349/12) with South African council for Natural Scientific Professions (SACNASP) • Professional member of South African Institute of Ecologists and Environmental Scientists (SAIEES) • Professional member of South African Association of Botanists (SAAB)

14.2.2 Main Findings

14.2.2.1 Objectives of Study

The objectives of the Terrestrial Ecological Study were as follows:

- To apply relevant literature to determine the diversity and eco-status of the plants, mammals, birds, reptiles and amphibians on the proposed development areas;
- To carry out a field surveys to gain an understanding of the diversity and eco-status of taxa which inhabit the proposed study area, as well as the presence of unique habitats that might require further investigation or protection;
- To assess the current habitat and conservation status of plant and animal species on the study sites;
- To comment on ecological sensitive species/areas;
- To assess the possible impact of the proposed project on these taxa and/or habitats;
- To list the species on sites and to recommend necessary actions in case of occurrence of endangered, vulnerable or rare species or any species of conservation importance;
- To provide management recommendations to mitigate negative and enhance positive impacts of the proposed development areas; and
- To recommended the preferred alternative from a terrestrial ecological perspective.

14.2.2.2 Regional Vegetation

The proposed developments fall within the Fynbos Biome (SANBI, 2012). The Fynbos Biome extends across the southern corner of South Africa in a 100-200km wide coastal belt in the Western Cape Province. Fynbos is characterised as schlerophyllous shrub-land and this biome is comprised of two major vegetation types, the Fynbos and the Renosterveld. The

Fynbos Biome forms the main part of the CFR, which is recognised globally as a biodiversity hotspot, due to the high numbers of endemic plant and invertebrate taxa.

The CFR covers approximately 87 892 km^2 within the Western Cape and slightly into the Eastern Cape Province of South Africa. This region is extremely rich in plant species, with approximately 9 600 different species of plants having been documented with at least 70% of these endemic to this region. The diversity of plant taxa arises from the diversity of soil types, topography and climatic conditions across the region.

According to SANBI (2012), the project area falls within three Vegetation types, namely Atlantis Sand Fynbos, Swartland Alluvium Fynbos and Swartland Shale Renosterveld (**Figure 65**). Although the proposed developments fall within two Critically Endangered vegetation units (Swartland Alluvium Fynbos and Swartland Shale Renosterveld), the area is quite disturbed and transformed as a result of farming activities.

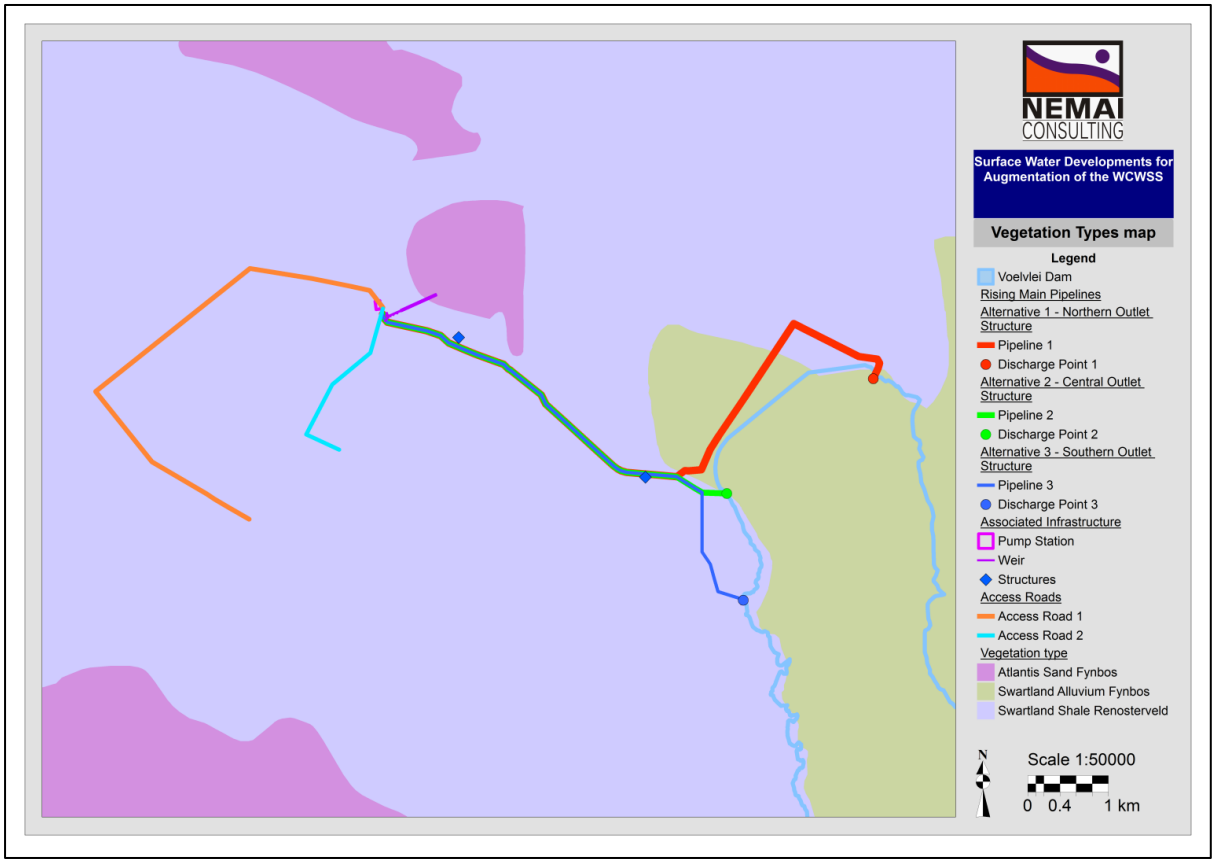


Figure 64: Vegetation Types in the project area

14.2.2.3 Terrestrial Threatened Ecosystems

The threatened ecosystems Atlantis Sand Fynbos, Swartland Alluviam Fynbos and Swartland Shale Renosterveld are affected by the project (**Figure 66**). Much of the original natural habitats in the Drakenstein and Swartland Local Municipalities have been converted for agricultural, residential or urban use. In addition, invasion by alien plants has led (and is

continuing to lead) to significant loss of biodiversity and transformation of ecosystems. Poor fire management of the fire-dependent vegetation types has also led to loss of biodiversity.

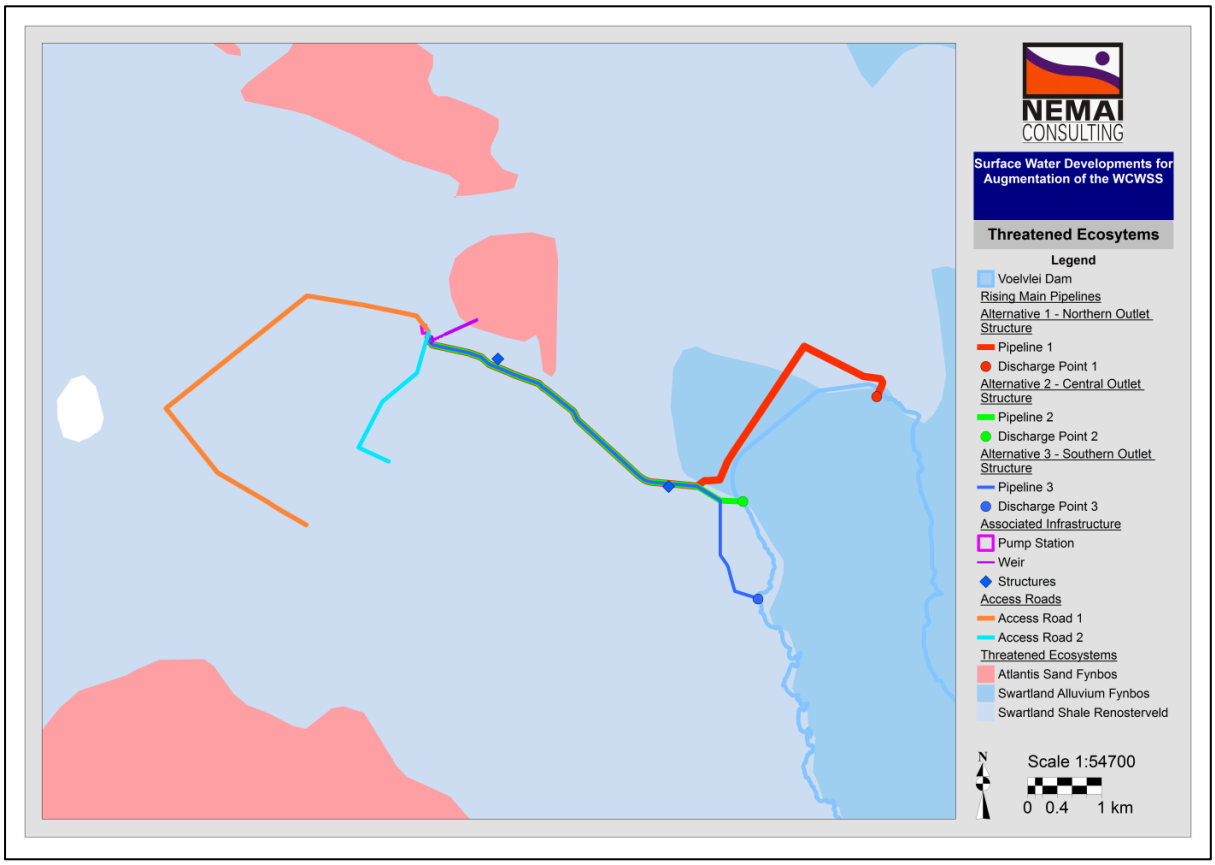


Figure 65: Terrestrial Threatened Ecosystems occurring in the project area

14.2.2.4 Protected Areas

The Voëlvlei Nature Reserve is located adjacent to the Dam but is not impacted on by the proposed developments. The following flora species are known to be found in the Reserve: Silky Needlebush (*Hakea sericea*), Swartveld Conebush (*Leucadendron corymbosum*), Common Shale Conebush (*Leucadendron lanigerum lanigerum*), Common Sunshine Conebush (*Leucadendron salignum*), Star Conebush (*Leucadendron stellare*), Arid Pincushion (*Leucospermum calligerum*), Grey-leaf Sugarbush (*Protea laurifolia*) and Common (Cape) Sugarbush (Protea repens). The studies conducted by Baard (1993) and van Bloemestein (2005) indicate that six reserves where established in order to protect the Geometric tortoise, and those being the largest reserve was the Elandsberg Private Nature Reserve (EPNR) and the second largest reserve was Voëlvlei Nature Reserve.

14.2.2.5 Flora

During the field surveys, no threatened species or plant species of conservation importance were noted on the proposed development areas and this could be attributed to the farming activities in the area and also habitat fragmentation due to initial construction of the canal activities and also the fact that almost the proposed pipeline routes follow the existing roads.

14.2.2.6 Fauna

The proposed development footprint consisted of suitable habitats for mammalian species such as rivers, riparian vegetation and grasslands. During the field assessments, some small rodent species were observed on the study area but the identity of these species could not be verified and only nine (9) species recorded on sites and none of the species recorded were of conservation concern. The traps set did not yield any positive results as no mammals were captured.

The Important Bird and biodiversity Areas Programme identifies and works to conserve a network of sites critical for the long-term survival of bird species that are globally threatened, have a restricted range and are restricted to specific biomes/vegetation types. Several Conservation and planning tools were consulted for relevancy for the project and these included IBAs. The proposed developments fall within the Boland Mountains IBA. The IBA encompasses a continuous chain of mountains and includes several State forests, mountain catchment areas and provincial nature reserves. The Boland Mountains IBA also includes the Voëlvlei Dam, which provides habitat for a range of waterbirds, which congregate in high numbers at this site. It is particularly important for the near-endemic South African Shelduck (*Tadorna cana)*, large flocks of which use the site as a safe refuge for their annual post-breeding moult. A total of 1 400 Shelduck has been recorded in a single count, which represents c. 3% of the species' global population. These birds probably move in from the Swartland farmland to the west and north and from the Karoo to the east to undergo their moult at the dam. Voëlvlei also provides habitat for large numbers of non-threatened waterbirds such as Egyptian Goose (*Alopochen aegyptiaca)*, Spur-winged Goose (*Plectropterus gambensis)* and Red-knobbed Coot (*Fulica cristata)*.

One of the two Red Data bird species found on site was the Blue Crane (*Anthropoides paradiseus),* which is now listed as Near Threatened. This species is endemic to southern Africa. It is a national bird of South Africa and has declined mostly due to loss of habitat (human population growth), direct and indirect poisoning and also powerline collisions. It is a bird of open grasslands and other upland habitats and is mostly found in natural vegetation in the eastern parts of their distribution (e.g. Mpumalanga and KwaZulu-Natal), but also utilises cultivated pastures and crop lands. One breeding pair was noted on Gouklip Farm, near the proposed Pump Station and Laydown Area 3 (**Figure 67**).

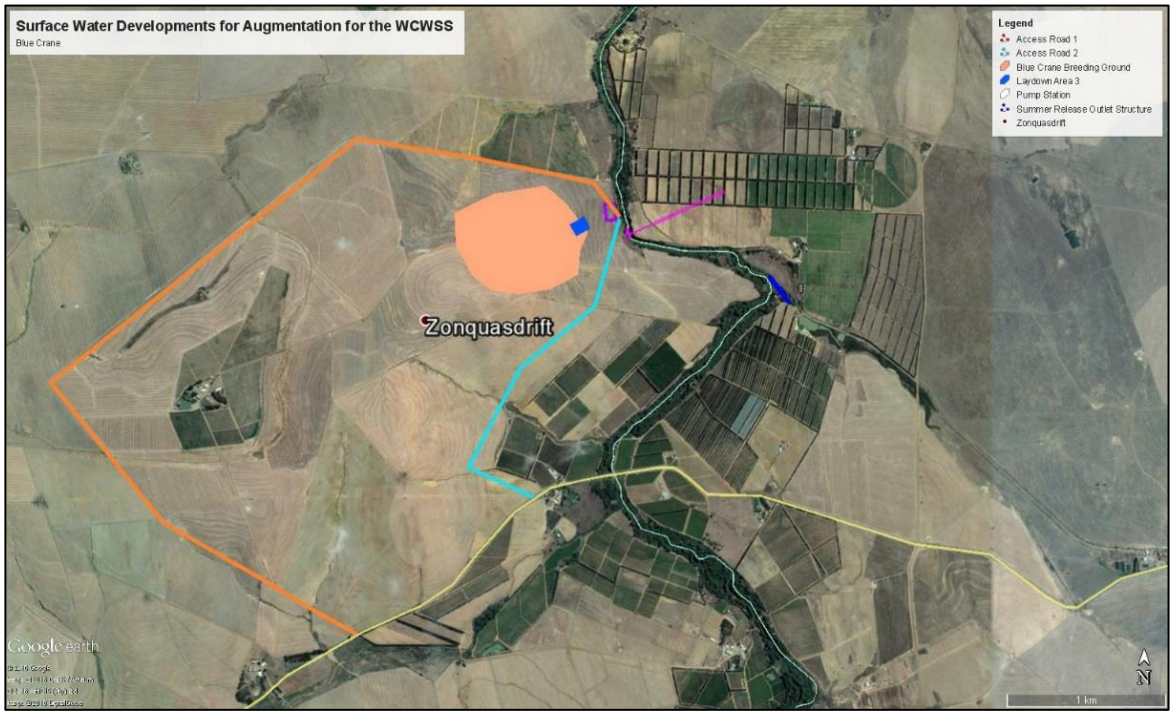


Figure 66: A breeding pair of Blue crane noted near the proposed Pump station and Laydown Area 3

Much of the fynbos in the Swartland has been transformed due to agriculture. Though this obviously resulted in considerable natural habitat being destroyed, numerous species have adapted well to this transformation. One such species, which is highly relevant to this study, is the Blue Crane. This species has thrived on the grain lands and pastures in the southern and western Cape. The Blue Crane has relatively recently expanded its range into the Swartland, where it feeds on *inter alia* fallen grain and recently germinated crops. They also feed on supplementary food put out for small stock, and can congregate in huge numbers around these feed lots.

It is important to note that during construction phase, any breeding pairs and/or nest sites located during this survey must be plotted and should be treated as focal sites for subsequent monitoring.

Another Red data bird species found on site was the Great White Pelican (*Pelecanus onocrotalus*). This species is generally known to be found on large inland waters, and on the coast and is listed as Vulnerable (D2). This species was recorded in the Voëlvlei Dam.

One endemic species recorded on site was the Jackal Buzzard (*Buteo rufofuscus*). Bird species endemic to southern Africa are important as they do not occur anywhere else in the world. A marginal of the World's bird species have small, restricted ranges, being confined to a particular area, and they are thus endemic to that area. Typically a bird is termed endemic if it is constricted to a range of 50,000 km^2 or smaller. Regionally endemic species pose special conservation responsibilities to the region’s conservation authorities, government and land owners. The constricted range makes these species vulnerable to population reduction. This

species is known to be found in cliffs and ridges, and also on open grasslands. South Africa is known to boast a number of endemic restricted to fynbos biome. The proposed development is not likely to be associated with large-scale loss of habitat, thus it is highly unlikely that the proposed development would exert an impact of any significance on this endemic bird species.

The Berg River, Voëlvlei Dam and Canal hold water on a permanent basis and are probably important breeding habitat for most of the frog species which occur at the sites. Only two frog species were recorded on site (Cape River Frog and Clicking Stream Frog) and none of these species recorded were of conservation importance. 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.

14.2.2.7 Sensitivity Analysis of the Area

As mentioned, 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.

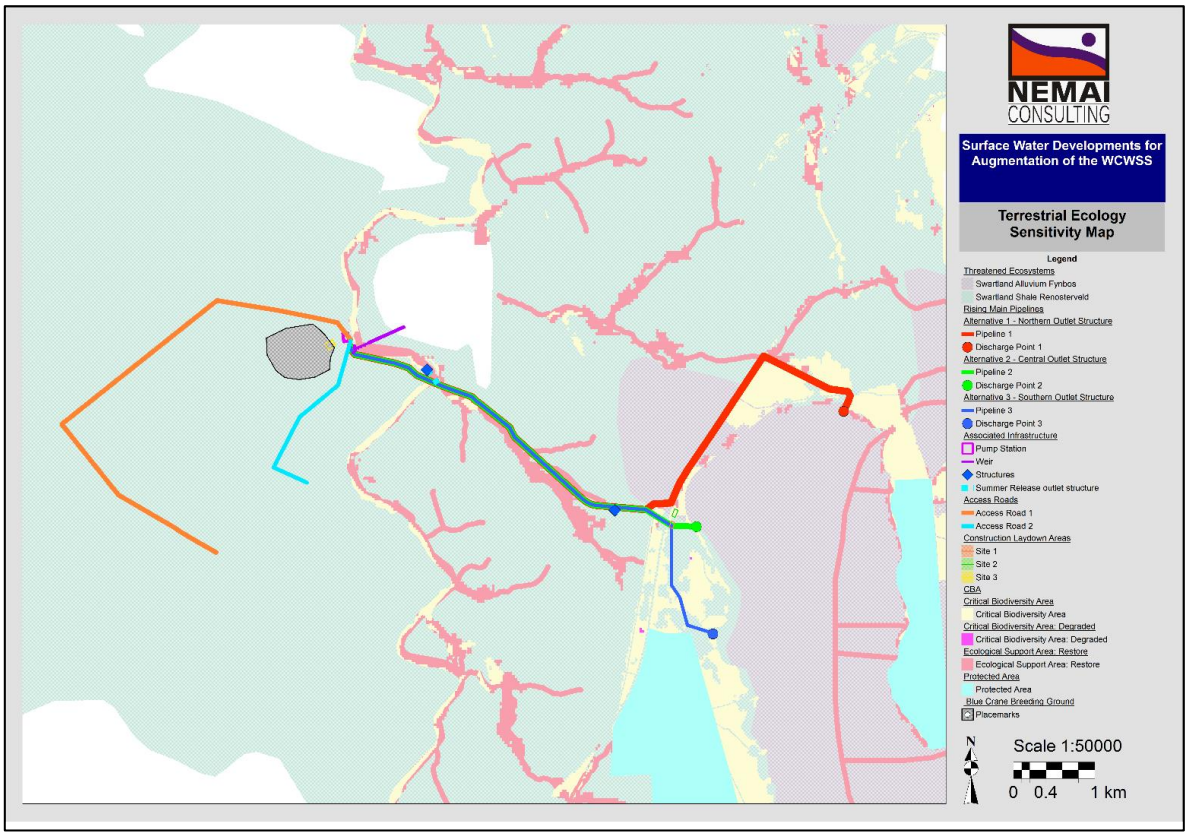


Figure 67: Terrestrial Ecological Sensitivity of the proposed development areas

14.2.3 Conclusions and Recommendations

According to the literature review, Voëlvlei Nature Reserve was established to preserve the Critically Endangered reptile species, the Geometric Tortoise. No activities are supposed to take place inside this reserve as to preserve this species and its habitat. The proposed pipeline 3 and its discharge points are situated near the reserve and should this be preferred option, a Search, rescue and relocation plan needs to be developed for this species and Cape Nature is to be consulted to ensure that the Plan incorporates all the authority's requirements.

Exotic vegetation is encountered in the project area and is mostly associated with over-grazing and disturbances linked to farming activities. Areas will be cleared during the construction phase of the project and all disturbed areas will need to be appropriately rehabilitated to ensure that a cumulative impact is not caused in this regard. Through the Search, Rescue and Relocation Plans, a concerted effort will be made to prevent the loss of red data, protected and endangered fauna and flora species that will be affected by the project.

14.3 Riparian Habitat and Wetland Delineation Impact Assessment

14.3.1 Details of the Specialist

Specialist	
Organisation:	The Biodiversity Company
Name:	Mr. Andrew Husted
Qualifications:	MSc (Aquatic Health)
Affiliation (if applicable):	• Professional Natural Scientist- Ecological Science, Environmental Science and Aquatic Science (Reg number: 400213/11) with South African council for Natural Scientific Professions (SACNASP)

14.3.2 Main Findings

The Biodiversity Company was appointed to conduct a Riparian Habitat and Wetland Delineation Impact Assessment for the project. A single survey was conducted on from 25 – 27 October 2016, which is considered to be the onset of the dry season period. This specialist study aimed to assess the local watercourses and wetland (including riparian) systems associated with the proposed project infrastructure alternatives.

14.3.2.1 Aquatic Ecology

The focus of the assessment is one study reach on the Berg River which feeds into the Atlantic Ocean and three points on the Voëlvlei Dam. The area surrounding the proposed project site consists of agricultural and livestock activities. The activities in the area and local land uses have had impacts to the aquatic system and visible disturbances were moderate. Due to these

activities, the Berg River system and Voëlvlei Dam are regarded as largely modified at a desktop level.

Desktop Data for Sub-Quaternary Catchment G10F-8604 and G10F-8658, respectively

NFEPA's	**No NFEPAs listed**	**No NFEPAs listed**
Present Ecological Status	**Largely modified (Class D)**	**Largely modified (Class D)**
Ecological Importance	**Low**	**Moderate**
Ecological Sensitivity	**High**	**High**

In situ water quality analyses was conducted at in the Berg River (**Table 21**). These results are important to assist in the interpretation of biological results due to the direct influence water quality has on aquatic life forms.

Table 21: In situ water quality results for the site with reference to the Target Water Quality Requirements (TWQR)

Site	pH	Conductivity (µS/cm)	DO (mg/l)	DO Saturation (%)	Temperature (°C)
TWQR	**6.5-9.0**	**<700**	**>5.00**	**80-120**	**5-30**
BR1	**10.37**	365	**10.2**	**178**	27.9

According to the 2016 low flow season assessment, the state of the Berg River was in a largely modified state, which has led to modified macroinvertebrate and fish community assemblages. Furthermore, impacts to instream and riparian habitat and more notable water quality were evident.

Aquatic Assessment Results for the October 2016 survey

Site	**Berg River**	**Voëlvlei Dam**
In Situ Water Quality Parameters	**Poor**	**N/A**
Integrated Habitat Assessment System	**Good**	**N/A**
Flow	**0.2 - 0.4 m/s**	**Dam (75% full)**
Clarity	**35 cm (Eutrophic)**	**20cm (Turbid)**
Biotic Integrity Based on SASS5 Results	**C (Moderately modified)**	**N/A**
Fish	**Seriously modified**	**Seriously modified**
Current Ecological Status	**Seriously modified (E)**	**Largely modified (D)**

14.3.2.2 Wetland Assessment

The desktop study concluded with reasonable confidence that due to the distance of the Berg River estuary and floodplain from the project area, and also considering the nature of this project, no risks to the Berg River floodplain are expected.

The project area is associated with numerous NFEPA wetland types. These are largely associated with the Berg River and the Voelvlei Dam. None of the local NFEPA wetlands are classified as ecological priority areas.

Numerous wetland types were identified and delineated for the study. These include valley bottom systems, hillslope seeps, depressions and the Berg River floodplain. The extent of the delineated wetland (and riparian) areas for the project, and the corresponding HGM types is presented in **Figure 69** and listed in **Table 22**.

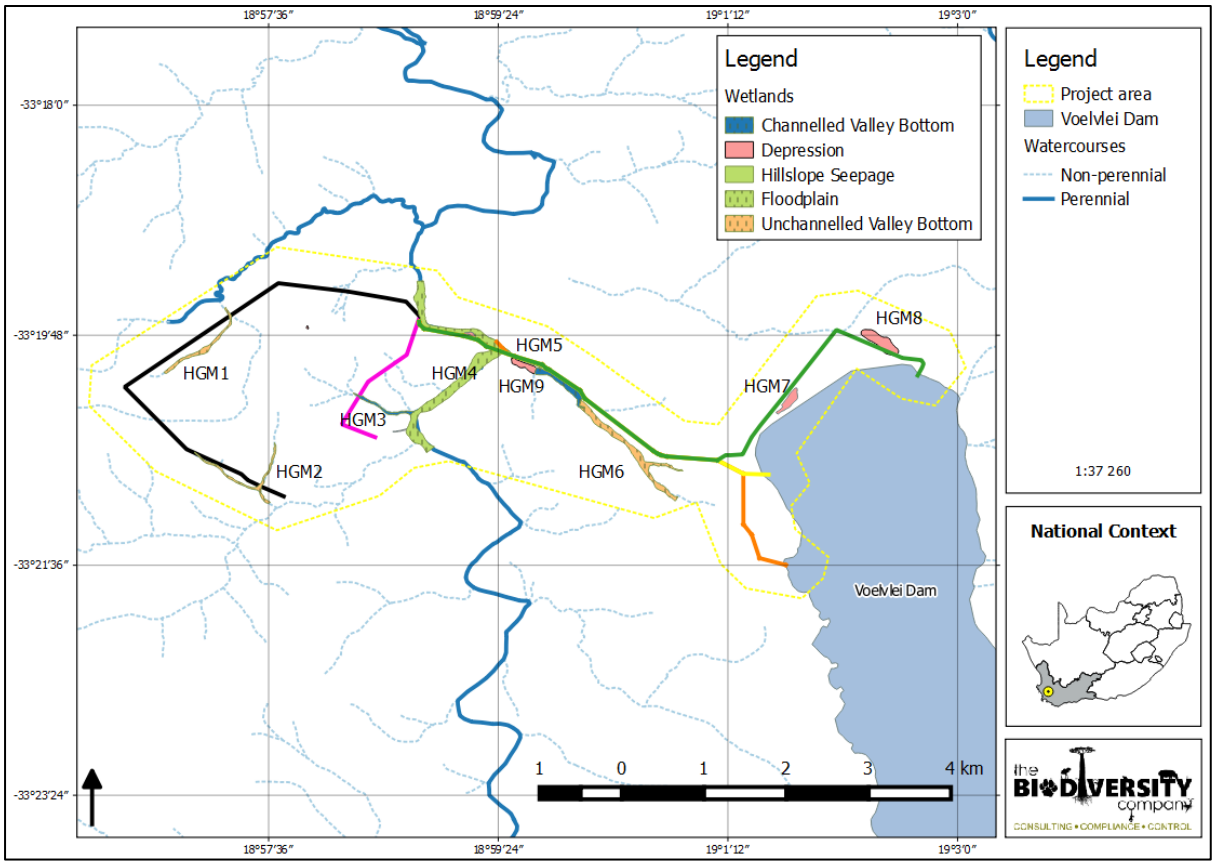


Figure 68: The delineated wetland HGM units for the study

Table 22: An indication of the identified wetland types for each HGM unit

System	HGM Type
HGM1	Unchannelled valley bottom wetland
HGM2	Unchannelled valley bottom wetland
HGM3	Channelled valley bottom wetland

System	HGM Type
HGM4	Floodplain
HGM5	Hillslope Seepage
HGM6	Unchannelled valley bottom wetland
HGM7	Depression
HGM8	Depression
HGM9	Depression

The riparian habitat associated with the Berg River was determined to be largely modified (PES category D) indicating a system that has experienced a large loss of natural habitat, biota and basic ecosystem function. Some of the noted impacts and disturbances to the riparian habitat include:

- Clearing of vegetation to accommodate large-scale agricultural activities on either side of the river, resulting in the narrowing and the loss of riparian habitat;
- Alien vegetation encroachment within the riparian zone. These species are outcompeting endemic species and becoming well established in the habitat; and
- The flooding regime of the Berg River has been altered as a result of surrounding land-uses, local water schemes and the development of the catchment. This has had an impact on the structuring and support of the riparian area.

A total of nine (9) HGM units were identified and delineated for the study. The PES for the assessed wetland systems is presented in **Table 23**.

Table 23: Summary of the scores for the wetland PES

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	**Description**	**Rating**	**Description**	**Rating**	**Description**
HGM1	C	Moderately Modified	B	Largely Natural	B	Largely Natural
Overall PES Class					C: Moderately Modified	
HGM2	C	Moderately Modified	C	Moderately Modified	D	Largely Modified
Overall PES Class					C: Moderately Modified	
HGM3	D	Largely Modified	C	Moderately Modified	D	Largely Modified
Overall PES Class					D: Largely Modified	
HGM4	C	Moderately Modified	C	Moderately Modified	D	Largely Modified
Overall PES Class					C: Moderately Modified	

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Description	Rating	Description	Rating	Description
HGM5	C	Moderately Modified	C	Moderately Modified	E	Seriously Modified
Overall PES Class					D: Largely Modified	
HGM6	B	Largely Natural	C	Moderately Modified	D	Largely Modified
Overall PES Class					C: Moderately Modified	
HGM7	C	Moderately Modified	C	Moderately Modified	C	Moderately Modified
Overall PES Class					C: Moderately Modified	
HGM8	C	Moderately Modified	C	Moderately Modified	C	Moderately Modified
Overall PES Class					C: Moderately Modified	
HGM9	C	Moderately Modified	C	Moderately Modified	C	Moderately Modified
Overall PES Class					C: Moderately Modified	

The PES of the wetland systems varied from largely moderately modified (Class C) to largely modified (Class D), with none of the systems considered to be natural or largely modified. The local commercial agricultural activities and developments have contributed to the modifications of these systems.

14.3.2.3 Impacts

The proposed project will have both direct and indirect impacts on the local watercourses. The most significant risks are associated with the weir and fishway structures, with the level of risk determined to be moderate. The risks associated with the supporting activities and linear structures was determined to be low. Some of the potential impacts (or risks) that have been identified for the study and that will be considered for the risk assessment include the following:

- Erosion and scouring at the discharge area in the dam.
- The construction of a weir will result in modified flows across the Berg River system. This will include modifications to the flooding regime of the system.
- The weir may also create a migratory barrier for the movement of fish across the system.
- Inadequate measures to allow fish movement upstream of the weir, especially smaller species that cannot navigate strong flows (*Galaxias zebratus* and *Sandelia capensis* – if present).
- Inadequate measures to protect river bed material from flows immediately downstream of the weir resulting in scouring and erosion of substrates from below the structure.

- Exotic vegetation encroachment into the marginal and riparian zones may occur in cleared areas, resulting in competition and loss of indigenous vegetation.
- The placement of infrastructure within wetlands which will result in the loss of wetland resources.
- The traversing of wetlands by linear structures which may impact on these systems, potentially resulting in the partial loss of these systems. However, there is also the opportunity to improve upon existing crossings which will in turn improve the status and functioning of traversed wetlands.

Several concerns regarding the fishway design have been highlighted and need to be addressed for the fishway to be successful.

The existing canal is concrete and does not sustain any of the adjacent wetland systems. Seepage and interflow is not facilitated by the current canal, and the proposed project does not pose a risk to the wetlands, due to the loss of these water movements.

14.3.3 Conclusions and Recommendations

Results showed that the sampled reach of the Berg River is in a largely to seriously modified state. This was predominantly due to the modified state of the local aquatic biota and instream and riparian habitats. The Berg River showed great habitat availability, however poor water quality has resulted in modified macroinvertebrate and fish community assemblages.

A number of watercourses were identified and assessed for the project. These systems include the Berg River floodplain, valley bottom wetlands, hillslope seeps, depressions and numerous drainage channels. The ecological integrity of these systems varied from moderately to largely modified, with no systems determined to be in a natural or largely natural state.

The proposed project will have both direct and indirect impacts on the local watercourses. The most significant risks are associated with the weir and fishway structures, with the level of risk determined to be moderate. These moderate risks are expected for the construction and operation of the project. The risks associated with the supporting activities and linear structures was determined to be low.

It is recommended that an aquatic monitoring programme be implemented after construction activities should the proposed project commence. A buffer zone for the delineated wetlands of 15m and 21m has been prescribed for the construction and operational phase respectively.

14.4 Phase 1 Heritage Impact Assessment

14.4.1 Details of the Specialist

Specialist	
Organisation:	ACO Associates
Name:	Mr. Tim Hart
Qualifications:	MA in Archaeology
Affiliation (if applicable):	• Professional member (no 50) Association of Southern African Professional Archaeologists (ASAPA) • Principal Investigator, cultural resources management section (ASAPA) • Professional member in specialist and generalist categories Association of Heritage Professionals (APHP) • Committee Member Heritage Western Cape, Committee Member SAHRA

14.4.2 Main Findings

The area was surveyed by Lita Webley and David Halkett on 14 October 2016. Tracks were recorded by means of Garmin GPS devices and all sites were digitally recorded.

14.4.2.1 Archaeology

The majority of the study area is under wheat fields and there are no visible archaeological traces. A single heap of rocks, on the edge of a field and close to the Berg River and the location of the pump station and weir, produced a collection of ESA artefacts, including a single handaxe (**Figure 70**).

Figure 69: The collection of ESA stone tools and a handaxe found in a heap of stones at the edge of a wheat field on the farm Sonquas Drift 648/1 in proximity to the proposed pump station and weir.

14.4.2.2 Built Environment

One of the two access roads to the proposed pump station and weir on the Berg River, will run along the northern boundary of the farm Sonquas Drift 648/1 (**Figure 71**).The property

has been described and graded by CK Rumboldt & Partners (2014) as part of their Swartland Rural Heritage Survey as having a grading of IIIB. Although not officially endorsed by HWC, the grading of the buildings on the farm is an indication of their significance. However, the access road will run at least 600m to the north-west and south-west of the farm house and no impacts will occur.

Figure 70: The derelict house and adjoining barn, on the werf Sonquas Drift 648/1 which are described as having Grade IIIB significance.

14.4.2.3 Impacts to Palaeontology

The pipeline route, through the wheatlands underlain by Malmesbury shales, is considered to have low palaeontological sensitivity and no impacts are expected. A protocol (i.e. EMPr) for dealing with fossil finds is required.

14.4.2.4 Impacts to Archaeology

Since heritage sites, such as archaeological sites, are non-renewable, it is important that they are identified and their significance assessed prior to development.

The main cause of impacts to archaeological sites is direct, physical disturbance of the material itself and its context. The significance of an archaeological site is highly dependent on its geological and spatial context. Generally, impacts to archaeological sites are most severe during the construction period although indirect impacts may occur during the operational phase of the project.

With respect to the ESA artefacts found on the edge of the wheatfields, these are of low significance (ungraded) and impacts are likely to be very low.

14.4.2.5 Impacts to Built Environment

The two alternative access roads through Sonquas Drift 648/1 and 648/2 will be used during construction of the pump station and weir on the Berg River, and more infrequently during the maintenance of these buildings.

It is not anticipated that there will be any impacts to the farmstead of Sonquas Drift 648/1.

14.4.2.6 Impacts to Cultural Landscape and Scenic Routes

The pipelines will be placed underground and once reburied and revegetated will not have lasting impacts on the landscape. Similarly, the access roads which are required for the construction of the pump station and weir (Sonquas Drift 648/1) and the summer release outlet connection (Sonquas Doordrift 647/2) are gravel roads which run through farmlands and will not be visible.

The pump station and weir on Sonquas Drift 648/1 and the summer release outlet connection on Sonquas Doordrift 647/2 are positioned on the banks of the Berg River, on private lands. They will not be visible and will have no impact on the Cultural Landscape.

14.4.3 Conclusions and Recommendations

It is concluded that the proposed development will have low impacts on the heritage resources of the area.

With respect to the three alternative potential discharge options for the pipeline into the dam, all three options are acceptable from a heritage perspective, but Option 2, which follows existing infrastructure will have the least impact on below ground resources. With regard the two road alternatives, both alternatives are acceptable.

It is recommended that the development may proceed.

If any heritage resources (particularly graves) are uncovered during construction, then work must stop, and Heritage Western Cape (Tel: 021 483 9685) must be notified.

14.5 Socio-Economic Impact Assessment

14.5.1 Details of the Specialist

Specialist	
Organisation:	Nemai Consulting
Name:	Ms. Sameera Munshi
Qualifications:	BA (Econ) Honours

14.5.2 Main Findings

14.5.2.1 Public Participation

Overall, the public engagements were encouraging as affected parties understood the need for the project and its desirability. Farmers encouraged the supply of water in the summer months. Currently the area is undergoing a draught. At such a time, it is expected that little resistance to any project that will increase water security would be objected to.

There was one strong objection to the project raised from one farmer who was concerned that the project affect the water supply on his land. Currently the farmer abstracts waster from a wetland located on his property. The farmer is of the opinion that the wetland will no longer be fed through the canal as this project diverts the water away from the canal. Thus, the runoff from the canal system would not deed to the dam located on his property and he will not be able to abstract water from the wetland, leaving him with less water than required for irrigation. Hence, he is concerned of the impact on his farm where principle activities include the export of fruits and farming of 35hs of citrus.

Furthermore, a new pump station and associated infrastructure will be required to abstract water from the Berg River.

It is noted that an aquatic and wetland study was commissioned as part of the EIA. The results of the wetland study indicate that the wetland, which is largely manmade, will not dry up as a result of this project.

On the main, other feedback from the farmers related to the technical aspects of the project such as not abstractive polluted water from the first floods, the monitoring of overflow from the Dam; the redundancy of the existing canal etc.

14.5.2.2 Identification of Impacts

14.5.2.2.1 Physical Infrastructure

The purpose of the physical infrastructure is to ensure that the capacity of the Voëlvlei Dam, which never reaches full capacity, is maintained. The physical infrastructure of this project has both social and economic implications on both a local and regional scale.

The project will ensure water security for all users of the Voëlvlei Dam and the Berg River. On a regional scale, this will allow continued domestic, agricultural and commercial use of water without disruption.

Locally, directly affected farmers and downstream users of the Berg River will have water security, allowing for the continued abstraction of water during the summer months. Water security allows for sustained agricultural activities to take place. In an area where agriculture is the dominant sector, it is critical that the industry is supported. The West Coast DM SDF states that agriculture is considered the primary economic growth sector in majority of the town in the district. This project therefore is directly part of the districts mandate to provide water to communities and industries for continued support of agricultural activity.

The infrastructure does however bear some burden on farmers, though the impact may be small. The access roads will alter the land use as arable land will be lost to create access. Additionally, structures such as pump stations cannot be erected within the infrastructure servitude area. Thus, there will be alteration of land use and a loss of arable land to lay down the required infrastructure.

14.5.2.2.2 Sense of Place

The sense of place in these areas can be said to have the following components:

- The location of the surrounding communities
  The study area is situated in Drakenstien LM and and Swartland LM. It falls outside the urban edge. The dominant land use agriculture and tourism. The Voëlvlei dam, the Bergriver and Limietberg mountains has attracted a tourism industry.
- The physical environment; including the natural environment
  The proposed area is used for residential and commercial farming. There is both economic and social value placed on the land, thus the ecological value to the land is important. The area is not built up and is rural in nature.
- The layout of the streets; locations; and infrastructure in relation to the residential areas
  The area is formalised with a road rural network. The R44 and R46 serve as the main roads that traverses through the area connecting the site to the City of Cape Town, Paarl and other towns within the Western Cape Province.
  Internal road networks are gravel based on the rural – like nature of the area. The internal roads are primarily used by residents of the area and connect farms.
- The socio-economic characteristics of the inhabitants
  The site area is dominated by commercial farming activity. These farms are aesthetically pleasing and have a high reliance on Berg River for water supply. The community are long term residents with a shared history of the area. There is an aging population. While living in largely formalised areas, the communities in the study area are rural, live in poverty and remain unskilled
- The sense of instability in the various facets of the study area
  The area is isolated and rural in nature. It is characterised by high levels of poverty and low education levels. Unemployment is high and there are limited economic opportunities available given the rural environment.

14.5.2.2.3 Job Creation and Skills Development

It is anticipated that there will be a positive impact on job creation during the construction phase. The construction itself will generate temporary employment as workers will be required. Potential secondary employment impacts can result as small business employs more persons to sell goods to labourers during the construction phase.

It is anticipated that the operation phase will not give rise to employment or skills development opportunities. DWS have staff quarters on the dam and it is assumed that the current staff base will maintain the project infrastructure as it is not extensive.

DWS must monitor the employment process at all times. Employment audits should be conducted and there should be full transparency of the process. It is important that women are also provided employment opportunities. Audits should pay attention to the employment process of women to ensure that exploitation does not take place.

Given the concerns by stakeholders that the CLO process is disruptive and inefficient to the project, DWS should manage the employment process in an alternative manner. However, it must be ensuring that the new method of employment does not disturb the implementation of the project or conflict with the law.

14.5.2.2.4 Construction Activity

Where possible, DWS should support and encourage the development of SMMEs and local or regional suppliers. Where possible, procurement should come from local or regional business so that the profits stay in the area, increasing economic activity.

Heavy duty trucks and construction vehicles will cause damage to the current road conditions as well as contribute to congestion on the roads.

The greater the number of trucks on the road, the greater the risk of road accidents occurring. It is important that the contractors are sensitive to the road conditions and ensure that throughout the construction process that these roads are maintained and suitable for small vehicles.

Care should be taken to ensure that construction vehicles do not disturb sensitive crops. The EMPr must have a traffic plan to ensure vehicles avoid these areas.

The construction phase will likely result in a restriction of access across the length of the pipeline corridor. This impact will be temporary in nature and may impact farmers and arable land. Mitigation measures recommended should ensure limited disruption to the landowners as well as ensure strict access control on private property.

An increase in the risk of criminal activity due to additional traffic along the route as well a potential increase of job seekers in the area may arise during the construction phase. This risk is likely to decrease during the operation phase again.

During the construction phase, dust and various air born pollutants will be emitted from the use of machinery and equipment. During the operational phase vehicle traffic is also likely to contribute to the general overall exhaust emissions.

Dust not only impacts human and livestock health through inhalation, but it also bears on impact on the growth of crops. It is important that that dust suppression methods apply in consultation with landowners and best practice to minimise the impact on humans, livestock and crops.

An influx of workers is often characterised by higher health risks and social issues, particularly if the influx is male dominated. These include a higher disease burden and rise in HIV/AIDS rates, pressures on food and water security.

14.5.3 Conclusions and Recommendations

The project will improve access to cleaner water for the users of the Berg River, allowing for sustained provision of domestic and commercial water. In this light, the project should continue.

The Socio-Economic Specialist recommended either Alternative 2 or Alternative.

14.6 Agricultural Impact Assessment

14.6.1 Details of the Specialist

Specialist		
Organisation:	Private	
Name:	Mr. Johann Laubscher	Mr. Freddie Ellis
Qualifications:	PhD Agriculture	PhD Agriculture (Soil Science)

14.6.2 Main Findings

14.6.2.1 Soil Suitability for Dry-Land and Irrigated Crop Production

Soils described during the soil surveys were evaluated by the surveyors in terms of its suitability for the commercial production of annual (e.g. grain crops) and perennial irrigated crops (e.g. table grapes). The suitability rating ranges from 1 to 10, with 1 the lowest and 10 equal to the highest or best suitability. The suitability rating refers to vigour and potential production potential without considering product quality.

The majority of soils in the study area are (<10 % clay) sandy in the topsoil and upper subsoil. The inherent nutrient status and potential to retain nutrients will therefore be low.

14.6.2.2 Agricultural Economic Assessment

The focus of this component is to investigate the impact for agricultural production along the footprint of the scheme structures on agricultural land.

The region is characterised by a fairly unreliable winter rainfall. This factor, when seen together with the relatively medium-low suitable soils, limits crop production. The site is situated in the winter-grain production region, but the production thereof is risky due to:

- medium-low potential soils and thus, lower output
- relatively variable (unreliable) winter-rain volumes

The farms are currently used for agricultural purposes and production possibilities are winter grain and winter grazing crops for animal feedstuff. Both cattle and sheep are possible livestock enterprises to be practised in combination with winter grain production systems in rotation with grazing crops, mainly medic types. Irrigated vineyards exist on certain soils near

the Berg River. An 'average' suitability is assumed for the soils that are utilized for both winter cropping and the vineyards (**Table 24**).

Table 24: Perspective of the agricultural land to be affected by the alternative lay-outs for the pipeline and access roads

Name*	Pipe or road	Distance (m)	Soil suitability	Present Use	Area (ha)**
A	Pipeline	845.3	Medium-low	Table grapes	4.4
B1	Pipeline	306.0	*Not applicable*	River	1.6
B2	Pipeline	1008.8	Medium	Winter grain	5.2
C	Pipeline	2144.4	Low	Grazing crops	11.1
D	Pipeline	2471.3	Low	Grazing crops	12.8
E	Pipeline	1374.7	*Not applicable*	Reserve	7.1
F	Pipeline	1599.1	*Not applicable*	Reserve	8.3
G	Pipeline	697.5	*Not applicable*	Reserve	3.6
	Summer release pipeline	80.0		Table grapes	0.4
I	Proposed Road near river	336.8	Medium	Citrus	0.9
J	Proposed Road near river	1999.0	Medium	Grazing crops	5.2
L	Proposed Road West	6789.0	Medium-low	Grazing crops	17.7
K	Weir	675.0	Medium	Table grapes	3.5
	Construction camp (footprint)		Medium	Winter grain	1.0
* Refer to soil suitability map (Annexure 1)					
** Pipeline area: 51.7m wide and access road area: 26m wide					
Affected areas: Agricultural perspective					
Pipeline					
A	4.8ha table grapes plus 5.2ha, 11.1ha, and 12.8 ha winter grain/grazing crops (rotation)				
B	4.8 ha table grapes plus 5.2ha and 11.1 ha winter grain/grazing crops (rotation)				
C	4.8 ha table grapes plus 5.2ha and 11.1ha winter grain/grazing crops (rotation)				
Road					
1	17.7ha winter grain/grazing crop rotation **(i.e. proposed road west)**				
2	0.9 ha citrus + 5.2 ha winter grain/grazing crops rotation **(i.e. proposed road near river)**				
Construction camp (footprint): 1ha winter grain/grazing crops (rotation)					

The estimated yearly loss (i.e. the negative impact, should the pipeline/service road impede with agricultural production practices of this kind) is estimated at **R130 256 per hectare**.

It is obvious that it will be the least harmful to agricultural production when existing roads are to be used as an access road (i.e. Access road, Alternative 1).

As far as the pipeline alternatives are concerned, the harm to agricultural production is more severe, especially when it crosses land with perennial crops (i.e. vineyards). It seems that Alternatives B or C of the pipeline alternatives will be marginally less harm full than Alternative A.

It is thus foreseen that the access roads will be used as farm roads and/or firebreaks, while as much as possible of the existing farm roads will also be used in the layout.

The expropriation of the farmland is expected to be costly and should be calculated in detail by an expert in this regard. It is further assumed that appropriate mitigation measures, like the conservation of the top-soil, the proper rehabilitation of the construction sites and the proper construction of service roads will be implemented.

This yearly loss in agricultural production value of between **R1 253 000** and **R1 133 000**, (depending on the alternative chosen for the pipe line and access road) must, however, be weighed against, *inter alia*, the contribution of the project to the regional water system that is under continuous pressure due to the rising water demand from a rapidly increasing population in the Cape Metropolitan area.

14.6.2.3 Impact of Project: Agricultural Perspective

This section describes the potential impacts of the envisaged water scheme on the future agricultural production potential of farming in the region. The impacts can either be positive or negative on the existence (i.e. existing role, contribution or function) of an entity (i.e. the farms impacted). For example, the construction of the proposed water scheme would impact negatively on the natural resource base of the relevant farms in the Gouda region should it take up a large portion of the farmland that can be used for the production of winter grain/grazing crops and vineyards. On the other hand, the additional water from the Berg River-Voëlvlei Augmentation Scheme will contribute to the water volume in the dam to be utilized by the Cape metropolitan area.

The impact of the project is expected to be as follows:

- It can be seen as a permanent substitution of some agricultural land for the construction of the water scheme (i.e. footprint of access roads and pipelines).
- The possible decrease in winter water from the Berg River for irrigation utilization downstream of Gouda.
- The magnitude of the impact of the water scheme at the provincial level is expected to be more positive than negative (i.e. the positive contribution towards meeting the water needs of the increasing population of the Cape metropolitan area is expected to be more than the negative impact of the loss in agricultural output value).
- The duration of the project can be seen as long term (i.e. permanent).

The expected loss in farmland (20 to 50ha) comprises a relative small percentage of the farm land even if it applies to only one farm unit. The impact can, however, significantly be decreased (only 20ha) should existing roads be used as access roads to the project infra structure.

The ‘’no-go’’ option will obviously be advantageous for the farms that are to be impacted by the water scheme development (local farming perspective), but it will at the same time be disadvantageous for the community of the Cape Metropolitan area (i.e. provincial level) as far as the provision of scarce household water sources is concerned.

The construction of the water scheme will, however have a small negative impact from an agricultural production point of view. A placing strategy for the footprint of the pipe lines and access roads that ensures that the minimum area of soils with relative better agricultural production potential will be utilized, should further minimize the small negative impact of the proposed water scheme developments on farming activities.

The project should, however, contribute by a larger magnitude to the national water supply network (i.e. provincial level) than the negative impact of the loss in agricultural output value on the farms. Cognition should be taken of appropriate mitigation measures during construction.

14.6.3 Conclusions and Recommendations

The most important mitigation measures with regard to the conservation of the natural resource base should form an integral part of the planning process. The proper execution of relevant planning principles, as far as the conservation of existing farming activities is concerned, should thus lead to the minor disturbance, if any, of agricultural production practices on the farms. The most important mitigation measures include:

- Proper planning of new 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.

15 IMPACT ASSESSMENT

15.1 Overview

This section focuses on the pertinent environmental impacts that could potentially be caused by the proposed surface water developments for augmentation of the WCWSS during the pre-construction, construction and operational phases of the project.

Please note that an “impact” refers to the change to the environment resulting from an environmental aspect (or activity), whether desirable or undesirable. An impact may be the direct or indirect consequence of an activity.

The impacts to the environmental features are linked to the project activities, which in broad terms relate to the proposed development and its associated services and infrastructure.

Impacts were identified as follows:

- Impacts associated with listed activities contained in GN No. R. 983, R. 984 and R. 985, for which authorisation has been applied for;
- Issues highlighted by environmental authorities;
- Comments received during public participation;
- An appraisal of the project description and the receiving environment; and
- Findings from specialist studies.

The following sections provide an overview of the potential impacts raised by Authorities (no concerns were raised by IAPs), as well as those relating to the relevant listed activities contained in GN No. R. 983, R. 984 and R. 985 of 04 December 2014.

This summary is then followed by the impact assessment overview based on the specialist studies. Please note that special attention was placed on the findings of the Specialist studies as they incorporated information on the receiving environment (or baseline conditions), comments from IAPs as well as specialist knowledge. The assessment of impacts was based on the professional judgment of the specialists, fieldwork and desktop analysis.

15.1.1 Impacts associated with Listed Activities

As mentioned, the project requires authorisation for certain activities listed in the EIA Regulations (2014), which serve as triggers for the environmental assessment process. The potential impacts associated with the key listed activities are broadly stated in **Table 25** below.

Please note that the potential impact overview does not take into account mitigation measures as this will be discussed in further detail in relation to each environmental feature.

Table 25: Potential Impacts related to GN. R. 983, 984 and 985 of 04 December 2014

Listed Activity	Potential Impact Overview
GN No. R 983 – Activity 9 (i) (a) The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water or storm water- (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where-	• Impacts associated with the footprint of the physical infrastructure (proposed water pipeline). • Effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with traversing the watercourses. • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Visual impact during construction.

Listed Activity	Potential Impact Overview
(a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve; or (b) where such development will occur within an urban area.	
GN No. R 983 – Activity 11 (i) The development of facilities or infrastructure for the transmission and distribution of electricity- (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or (ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.	• Potential loss of sensitive environmental features (e.g. sensitive fauna and flora species).
GN No. R 983 – Activity 12 (iii) (v) (x) (xii) (a) The development of- (i) canals exceeding 100 square metres in size; (ii) channels exceeding 100 square metres in size; (iii) bridges exceeding 100 square metres in size; (iv) dams, where the dam, including infrastructure and water surface area, exceeds 100 square metres in size; (v) weirs, where the weir, including infrastructure and water surface area, exceeds 100 square metres in size; (vi) bulk storm water outlet structures exceeding 100 square metres in size; (vii) marinas exceeding 100 square metres in size; (viii) jetties exceeding 100 square metres in size; (ix) slipways exceeding 100 square metres in size; (x) buildings exceeding 100 square metres in size; (xi) boardwalks exceeding 100 square metres in size; or (xii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse;	• Impacts associated with the footprint of the physical infrastructure - weir, pump station, water pipeline, access road, and associated infrastructure (mixing and concrete batching plant, site camp and site office) within 32m of a watercourse and within a watercourse. • Adverse effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside watercourses. • Destabilisation of affected watercourses. • Potential loss of sensitive environmental features (e.g. sensitive fauna and flora species). • Potential loss of sensitive vegetation and habitat.

Listed Activity	Potential Impact Overview
(b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; - excluding- (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; or (ee) where such development occurs within existing roads or road reserves.	
GN No. R. 983 – Activity 19 (i) The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from- (i) a watercourse; (ii) the seashore; or (iii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater but excluding where such infilling, depositing, dredging, excavation, removal or moving- (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.	• Construction activities (including bulk earthworks) to be undertaken within a watercourse for physical infrastructure –weir and embankment, access roads, pump station, and water pipeline. • Adverse effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside the watercourses. • Destabilisation of affected watercourses.

Listed Activity	Potential Impact Overview
GN No. R. 983 – Activity 27 (i) The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	• Clearance of large areas of indigenous vegetation associated with the construction footprint, including weir and embankment, pump station, construction laydown areas, powerlines, and water pipeline. • Potential loss of sensitive fauna and flora species. • Potential loss of sensitive vegetation and habitat.
GN No. R. 983 – Activity 30 Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).	• Potential loss of sensitive fauna and flora species. • Potential loss of sensitive vegetation and habitat.
GN No. R. 984 – Activity 11 (i) (ii) The development of facilities or infrastructure for the transfer of 50 000 cubic metres or more water per day, from and to or between any combination of the following - (i) water catchments; (ii) water treatment works; or (iii) impoundments; excluding treatment works where water is to be treated for drinking purposes.	• Adverse effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside the watercourses. • Destabilisation of affected watercourses.
GN No. R. 985 – Activity 12 (a) (i) (ii) The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. (i) Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (ii) Within critical biodiversity areas identified in bioregional plans; (iii) Within the littoral active zone or 100 metres inland from high water mark of the sea or an	• Clearance of large areas of indigenous vegetation associated with the construction footprint, including weir and embankment, pump station, construction laydown areas, powerlines, and water pipeline. • Potential loss of sensitive fauna and flora species. • Potential loss of sensitive vegetation and habitat.

Listed Activity	Potential Impact Overview
estuarine functional zone, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; or (iv) On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.	
GN No. R. 985 – Activity 18 (f) (i) (aa) The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. (f) In Western Cape: i. All areas outside urban areas: (aa) Areas containing indigenous vegetation; (bb) Areas on the estuary side of the development setback line or in an estuarine functional zone where no such setback line has been determined.; or ii. In urban areas: (aa) Areas zoned for conservation use; or (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority	• Impacts associated with widening existing roads to the various sites (construction and operational phases). • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Traffic disruptions.

15.1.2 Impacts raised by IAPs

During the public review of the Scoping Report, a number of concerns were raised and are summarised in the Comments and Responses Report (**Appendix F7**). A summary of general concerns raised by IAPs include:

- The impact of transferring water of lower quality from the Berg River into Voëlvlei Dam;
- The impacts of the proposed developments on the water quality of the Dam and the Berg River;
- The monitoring of overflow from the Dam;
- The impact of the project on flooding in the area;
- The impact of the project on landowners existing pumps in the Berg River;
- The impact the project may have on exacerbating flooding events in the area;
- Dust impacts to the crops in the area;

- The redundancy of the existing canal and the potential loss of the wetland possibly fed by the canal; and
- The use of existing roads during construction which may impact the surrounding properties.

15.1.3 Project Activities and Environmental Aspects

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 26: 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. Search, Rescue and Relocation Plan
4. Procurement of contractors
5. Site survey
6. Survey and mark construction servitude
7. Development and approval of method statements
8. Development and approval of construction plans
9. Ongoing consultation with landowners and affected parties
10. Development of employment strategy
11. Construction site planning, access and layout
12. Determining and documenting the road conditions for all identified access roads
13. Improvements of access roads to facilitate the delivery of construction plant and materials
Environmental Activities
1. Diligent compliance monitoring of the EMPr, environmental authorisation and other relevant environmental legislation
2. Undertake a walk through survey of the project footprint by the relevant environmental specialists to identify sensitive environmental features
3. Demarcation of buffers around sensitive areas
4. Establish Environmental Monitoring Committee (EMC)
5. Ongoing consultation with landowners, affected parties, stakeholders and authorities

Table 27: 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
1. Diligent compliance monitoring of the EMPr, EA and other relevant environmental legislation
2. Conduct environmental awareness training
3. 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
4. Implement EMPr
5. Reinstatement and rehabilitation of construction domain
6. Convene EMC meetings
7. Ongoing consultation with landowners, affected parties, stakeholders and authorities

Table 28: 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
1. Ongoing consultation with landowners, affected parties, stakeholders and authorities
2. Management of sensitive areas or buffered areas
3. Satisfy EWR

15.1.4 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 29: 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

15.1.5 Potential Significant Environmental Impacts

Note that it is not the intention of the impact assessment to evaluate all potential environmental impacts associated by the project's environmental aspects, but rather to focus on the potentially significant direct and indirect impacts identified during the Scoping phase and any additional issues uncovered during the EIA stage.

The potential significant environmental impacts associated with the project, as listed in **Table 30** (construction phase) and **Table 31** (operational phase), were identified through an appraisal of the following:

- Project-related components and infrastructure (**Section 10.1**);
- Activities associated with the project life-cycle (i.e. pre-construction, construction, operational and decommissioning) (**Section 10.2**);
- Proposed alternatives to project components (**Section 11**);
- Nature and profile of the receiving environment and potential sensitive environmental features and attributes (**Section 12**), which included a desktop evaluation (via literature review, specialist input, GIS, topographical maps and aerial photography) and site investigations;
- Findings from Specialist Studies (**Section 14**);
- Understanding of direct and indirect effects of the project as a whole (**Section 15**);
- Input received during public participation from authorities and IAPs (**Section 13**); and
- Legal and policy context (**Section 6**).

Table 30: Potential significant environmental impacts associated with the Construction Phase

Feature	Impact
Geology and Soil	• 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	• 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	• 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	• Alteration of flow regimes
Water Users	• Water quality deterioration and disturbance to flow caused by construction activities may adversely affect downstream water users • Water abstracted from watercourses for construction purposes • Potential loss of wetland as a result of redundancy of canal
Water Quality	• Sedimentation from instream works • Water quality impacts due to spillages and poor construction practices
Aquatic Ecology	• 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
Riparian Habitat	• Loss of riparian and instream vegetation within construction domain • Destabilisation of channel morphology at river
Flora	• 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

Feature	Impact
Fauna	• 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	• Loss of fertile soil through land clearance • Loss of grazing land within construction domain
Air Quality	• Dust impacts to crops and vineyards in the area • Increased dust generation • Greenhouse gas emissions from construction vehicles
Access Roads	• Construction-related traffic
Noise	• Localised noise increase • Noise nuisance
Waste Management	• 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	• 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	• Disturbance and/or possible destruction of heritage resources

Table 31: Potential significant environmental impacts associated with the Operational Phase

Feature	Impact
Hydrology	• Alteration of flow regimes • Changes to seasonal flow patterns • Quantity of water releases
Water Users	• Potential flooding of existing structures • Impact to existing pumps and pump houses • Loss of use of existing canal • Potential loss of wetland as a result of redundancy of canal
Water Quality	• Impact to sediment balance • Quality of water releases
Aquatic Ecology	• Impacts to migration of aquatic biota • Fragmentation of affected river - interruptions to river continuum
Riparian Habitat	• Destabilisation of channel morphology at river
Agricultural Potential	• Permanent loss of potential agricultural land and natural areas

15.1.6 Impact Mitigation

Impacts are to be managed by assigning suitable mitigation measures. According to DEAT (2006), the objectives of mitigation are to:

- Find more environmentally sound ways of executing an activity;
- Enhance the environmental benefits of a proposed activity;
- Avoid, minimise or remedy negative impacts; and
- Ensure that residual negative impacts are within acceptable levels.

Mitigation should strive to abide by the following hierarchy – (1) prevent; (2) reduce; (3) rehabilitate (/remediate); and/or (4) compensate (offset) for the environmental impacts.

Figure 71: Mitigation Hierarchy

The proposed mitigation of the impacts associated with the proposed surface water developments for augmentation of the WCWSS includes specific measures identified by the technical team (including engineering solutions) and environmental specialists, stipulations of environmental authorities and environmental best practices.

Note that the mitigation measures in the subsequent sections are not intended to be exhaustive, but rather focus on the potentially significant impacts identified.

An EMPr (contained in **Appendix I**) provide a comprehensive list of mitigation measures for specific elements of the project, which extends beyond the impacts evaluated in the body of the EIA Report.

An EMPr represents a detailed plan of action prepared to ensure that recommendations for enhancing positive impacts and/or limiting or preventing negative environmental impacts are implemented during the life-cycle of a project.

Table 32: Overview of the EMPr

Overview of the EMPr
The EMPr aims to satisfy the requirements stipulated in Section 24N of NEMA and Appendix 4 of GN No. R. 982 (04 December 2014). The scope of the proposed surface water developments for augmentation of the WCWSS are as follows: • Establish management objectives during the project life-cycle in order to enhance benefits and minimise adverse environmental impacts; • Provide targets for management objectives, in terms of desired performance; • Describe actions required to achieve management objectives; • Outline institutional structures and roles required to implement the EMPr; • Provide legislative framework; and • Description of requirements for record keeping, reporting, review, auditing and updating of the EMPr. All liability for the implementation of the EMPr (as well as the EIA findings and environmental authorisation) lies with the project proponent (i.e. DWS).

The following considerations and assumptions accompany the compilation of the EMPrs:

- The EMPrs are guided by the following principles (based on Lochner, 2005) –
    - **Continuous improvement** – The project proponent (or implementing organisation) should be committed to review and to continually improve environmental management, with the objective of improving overall environmental performance;
    - **Broad level of commitment** – A broad level of commitment is required from all levels of management as well as the workforce in order for the implementation of the EMPrs to be successful and effective;
    - **Flexible and responsive** – The implementation of the EMPr needs to be responsive to new and changing circumstances. The EMPr report is a dynamic "living" document that will need to be updated regularly throughout the duration of the project life-cycle.
- Any changes to the EMPr must be submitted to DEA for acceptance. In accordance with Appendix 4 of GN No. R. 982 (04 December 2014), the Environmental Authorisation (if granted) will specify the requirements for amending or updating the EMPr.
- The EMPr for the proposed surface water developments for augmentation of the WCWSS provide the framework for the overarching environmental management requirements for the project life-cycle. Following detailed design and planning, the EMPr may need to be revised to render the management actions more explicit and accurate to the final project specifications.
- Although every effort has been made to ensure that the scope and level of detail of the EMPr are tailored to the level of environmental risk (i.e. type and scale of activity and the

sensitivity of the affected environment) and the project- and site-specific conditions, certain of the environmental management requirements within the EMPr may be regarded as generic to make provision for activities that may take place as part of the overall project.

15.1.7 Impact Assessment Methodology

Information provided by specialists was used to calculate an overall impact score by multiplying the product of the nature, magnitude and the significance of the impact by the sum of the extent, duration and probability based on the following equation:

Overall Score = (NxMxS)x(E+D+P)

Where: N = Nature;
E = Extent
M = Magnitude
D = Duration
P = Probability
S = Significance

Table 33: Impact Methodology Table

Nature				
Negative		Neutral		Positive
-1		0		+1
Extent				
Local	Regional		National	International
1	2		3	4
Magnitude				
Low		Medium		High
1		2		3
Duration				
Short Term (0-5yrs)	Medium Term (5-11yrs)		Long Term	Permanent
1	2		3	4
Probability				
Rare/Remote	Unlikely	Moderate	Likely	Almost Certain
1	2	3	4	5
Significance				
No Impact/None	No Impact After Mitigation/Low		Residual Impact After Mitigation/Medium	Impact Cannot be Mitigated/High
0	1		2	3

The following definitions apply:

For the methodology of the impact assessment, the analysis is conducted on a quantitative basis with regard to the nature, extent, magnitude, duration, probability and significance of the impacts. The following definitions and scoring system apply:

Nature (/Status)

The project could have a positive, negative or neutral impact on the environment.

Extent

- Local – extend to the site and its immediate surroundings.
- Regional – impact on the region but within the province.
- National – impact on an interprovincial scale.
- International – impact outside of South Africa.

Magnitude

Degree to which impact may cause irreplaceable loss of resources.

- Low – natural and social functions and processes are not affected or minimally affected.
- Medium – affected environment is notably altered; natural and social functions and processes continue albeit in a modified way.
- High – natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.

Duration

- Short term – 0-5 years.
- Medium term – 5-11 years.
- Long term – impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention.
- Permanent – mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Probability

- Almost certain – the event is expected to occur in most circumstances.
- Likely – the event will probably occur in most circumstances.
- Moderate – the event should occur at some time.
- Unlikely – the event could occur at some time.
- Rare/Remote – the event may occur only in exceptional circumstances.

Significance

Provides an overall impression of an impact's importance, and the degree to which it can be mitigated. The range for significance ratings is as follows- 0 – Impact will not affect the environment. No mitigation necessary. 1 – No impact after mitigation. 2 – Residual impact after mitigation. 3 – Impact cannot be mitigated.

For example, the worst possible impact score of -117 would be achieved based on the following ratings:

N = Nature = -1
M = Magnitude = 3
S = Significance = 3
E = Extent = 4
D = Duration = 4
P= Probability = 5

Worst impact score = (-1 x 3 x 3) x (4+4+5) = -117

On the other hand, if the nature of an impact is 0 (neutral or no change) or the significance is 0 (no impact), then the impact will be 0.

Impact Scores will therefore be ranked in the following way:

Table 34: Ranking of Overall Impact Score

Impact Rating	Low/Acceptable impact	Medium	High	Very High
Score	0 to -30	-31 to -60	-61 to -90	-91 to -117

15.2 Geology and Soil

15.2.1 Potential Impacts

The proposed developments of the weir, pump station, and water pipeline will require suitable geological foundation conditions, which were confirmed through the geotechnical investigations as part of the Technical Feasibility Study. The results of the investigations are included in **Section 12.2**.

During the construction phase, large areas will be cleared of vegetation, which may lead to soil erosion. The EMPr will include suitable erosion and stormwater management measures to prevent the occurrence of erosion.

Soil may be polluted by poor storage of construction material, spillages and inadequate housekeeping practices. Specific mitigation measures are contained in the EMPr, where the primary objective is the effective and safe management of materials on site, in order to minimise the impact of these materials on the biophysical environment. The same objective applies to the correct management and handling of hazardous substances (e.g. fuel).

15.2.2 Impact Assessment

Geology and Soil							
Project Lifecycle:	Construction and Operational Phases						
Potential Impact:	Soil Erosion						
Proposed Mitigation:	Erosion Control: • Suitable erosion protective measures to be implemented for access roads. • Stabilisation of cleared areas to prevent and control erosion. The method chosen (e.g. watering, planting, retaining structures, commercial anti-erosion compounds) will be selected according to the site specific conditions. • Monitoring to be conducted to detect erosion. • Rehabilitate all areas disturbed during construction. • The Contractor shall take measures to the approval of the Engineer to ensure that there is no undue stormwater damage and soil erosion resulting from the construction activities outside the construction camp and works areas. • During construction, water diversion soil berms will be constructed to divert surface and stormwater from traversing the disturbed areas. • Cross and side stormwater drainage measures shall be constructed on access roads to the site.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Medium	Likely	2	-28
With Mitigation	-	Local	Low	Short	Unlikely	1	-4
Project Lifecycle:	Construction Phase						
Potential Impact:	Loss of topsoil						
Proposed Mitigation:	• Wind and water erosion-control measures to be implemented to prevent loss of topsoil. • After excavation, all soils must be replaced in the same order as they were removed. • Remove, stockpile and preserve topsoil for re-use during rehabilitation. • Topsoil should be temporarily stockpiled, separately from (clay) subsoil and rocky material, when areas are cleared. If mixed with clay sub-soil the usefulness of the topsoil for rehabilitation of the site will be lost. • 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. • Topsoil stockpiles must not be contaminated with oil, diesel, petrol, waste or any other foreign matter, which may inhibit the later growth of vegetation and microorganisms in the soil. • 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 coordinated 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.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Medium	Likely	2	-28
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

15.3 Geohydrology

15.3.1 Potential Impacts

From the Technical Feasibility Study conducted, seasonal or local occurrences of groundwater might occur throughout the sections of pipeline east of the river. Groundwater will adversely affect excavation conditions, stability of the excavated slopes in the trenches, and pumping and possibly local de-watering will be required.

The project is unlikely to have an impact on groundwater as raw water is transported in the pipeline. However, groundwater may be impacted on as follows during construction phase:

- 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 the batching plant.

15.3.2 Impact Assessment

Geohydrology							
Project Lifecycle:	Construction and Operational Phases						
Potential Impact:	Contamination through spillage of fuel, hazardous chemicals, leaking vehicles, etc.						
Proposed Mitigation:	• All construction activities to comply with NWA. • Ensure that all hazardous storage containers and storage areas comply with the relevant SANS standards to prevent leakage. • Regularly inspect all vehicles for leaks. • Re-fuelling of vehicles must take place off-site; if this is not possible then re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil. • Littering must be prohibited by providing adequate number of rubbish bins during the construction and operational phases to ensure proper disposal of rubbish. • Staff must be trained to deal with fuel/chemical spills and spill kits must be easily available at all times. • Mixing of cement must be done on impermeable surface and all spills must be cleaned up immediately. • Ensure that all activities impacting on groundwater resources are managed according to the relevant DWS licensing requirements.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Moderate	2	-24
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

15.4 Surface Water

For the discussion to follow “watercourses” are considered as rivers, streams, natural channels (perennial and seasonal), wetlands and dams.

Activities linked with the construction and operational phases can cause significant adverse impacts to the “resource quality” of the affected watercourses, which is defined by NWA as the following:

- Quantity, pattern, timing, water level and assurance of in-stream **flow**;

- **Water quality**, including physical, chemical and biological characteristics of the water;
- Character and condition of the in-stream and riparian **habitat**; and
- Characteristics, condition and distribution of the **aquatic biota**.

15.4.1 Potential Impacts

15.4.1.1 Hydrology

The proposed project will affect the Berg River system within the Berg WMA. A number of Pre-Feasibility and Technical Feasibility studies were conducted for the augmentation of the Voëlvlei Dam. The hydrology of the Berg River system and Berg WMA was assessed in these studies and it was found that the proposed developments would not have an impact on the hydrology in the study area. Flooding may have occurred at the proposed weir location, however, the weir has been designed to be notched in order to prevent flooding of the Berg River at the weir location. There is potential for flooding of pump houses and other structures within the area of the Berg River, however, this impact is not expected to be high due to the design of the weir.

The Contractor will prepare detailed method statements on how the river diversions will be undertaken to accommodate the construction of the proposed project infrastructure. Best practices to manage the flow of the rivers to be affected by the diversions are included in the EMPr.

15.4.1.2 Riparian Habitat

Sections of the riparian zone on the Berg River will be lost due to the construction of the pump station.

During construction, the riparian habitat will be damaged at the proposed developments sites for the pipeline and pump station. The earth moving activities and the establishment of the construction laydown area will result in the temporary loss of riparian habitat. Instream habitat will also be affected as machines will be working within the active channel. Once construction is complete, the direct disturbance associated with the construction activities will cease, however revegetation will be required to prevent long term degradation.

During operational phase, flooding may occur as a result of the weir which may result in the loss of riparian habitat. However, this impact is not expected to be significant due to the weir being designed to prevent flooding at the weir location.

15.4.1.3 Aquatic Biota

Based on the Feasibility studies conducted, a 4m^3/s abstraction via a stepped-pumping operating rule was selected as the optimal pumping scheme for the proposed pump station. 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. The EWR will ultimately feed into the licensing process of DWS and the operating rules of the proposed project.

The flow patterns resulting from the weir structure in the Berg River may influence the current biophysical functioning of the watercourse. The influence to the natural cycles in the river (e.g. elimination of natural flooding) will also impact on the downstream ecosystem.

The potential changes to flow patterns may influence the current biophysical functioning of the watercourse.

Most indigenous fish species in this country undertake annual migrations within river systems for a number of reasons, such as feeding, dispersal, refuge areas during unfavourable conditions and reproductive success. The proposed weir structure will act as barriers that will prevent the up- and downstream movement of aquatic biota.

The harmful effect of barriers to migration is particularly severe in coastal rivers, where catadromous species, which need to migrate from their marine or estuarine spawning grounds into freshwater reaches of rivers for feeding purposes. As these fish migrate upstream as small juveniles, even low barriers of less than a metre can be impassable.

During construction, the instream works (i.e. at the gauging weir, river crossings) will increase the turbidity in the affected watercourses, which could lead to the clogging of gills of aquatic fauna from increased silt loads and the alteration of micro-habitats.

15.4.1.4 Water Quality

During the construction phase, potential contamination of surface water could occur through:

- Sedimentation from working within and alongside the watercourse;
- Diffuse pollution from spillages, silt-laden runoff from disturbed areas, and improper practices (e.g. poor management of waste water, inadequate storage and housekeeping practices, and inadequate disposal of solid waste); and
- Dewatering without filtering of sediments.

The water quality impacts during the construction phase will be managed by employing environmental best practises that will be contained in the EMPr.

During storm flow conditions, the Berg River water will be more turbid than during normal flows. Algal blooms is a possibility, but considered unlikely due to the lack of commercial farming activities in the catchment. Moderate algal counts are unlikely to cause major water treatment problems.

However, the outcomes of the water quality assessment conducted during the Feasibility Phase indicate that the extent of the impact is not yet significant enough to foreclose storing Berg River water in the dam and therefore the water quality should not be impacted.

15.4.1.5 Water Users

Positive impacts associated with the proposed developments is the increase of water supply and services to the area.

The Feasibility Studies have shown that there will be no flooding at the weir, hence there is limited impact on the water users either upstream or downstream.

Downstream water users may have been impacted on by the abstraction of water, however, the amount of water abstracted will remain constant in order for there to be water available in the Berg River for abstraction by users. The operating rule for Voëlvlei Dam will ensure that the existing water use entitlements are not affected.

If it is found that pumps in the Berg River will be impacted on by the proposed developments, the affected pumps are to be relocated.

The existing canal is concrete and does not sustain any of the adjacent wetland systems. Seepage and interflow is not facilitated by the current canal, and the proposed project does not pose a risk to the wetlands, due to the loss of these water movements.

There may have been a negative impact on the water quality of the Berg River, however, water quality modelling was conducted as part of the Feasibility Studies and it was determined that there would be no impact of the Berg River on the Dam.

The following impacts were identified by the Aquatic and Wetland Specialist:

Some of the potential impacts (or risks) that have been identified for the study and that will be considered for the risk assessment include the following:

- Erosion and scouring at the discharge area in the dam.
- The construction of a weir will result in modified flows across the Berg River system. This will include modifications to the flooding regime of the system.
- The weir may also create a migratory barrier for the movement of fish across the system.
- Inadequate measures to allow fish movement upstream of the weir, especially smaller species that cannot navigate strong flows (*Galaxias zebratus* and *Sandelia capensis* – if present).
- Inadequate measures to protect river bed material from flows immediately downstream of the weir resulting in scouring and erosion of substrates from below the structure.
- Exotic vegetation encroachment into the marginal and riparian zones may occur in cleared areas, resulting in competition and loss of indigenous vegetation.
- The placement of infrastructure within wetlands which will result in the loss of wetland resources.
- The traversing of wetlands by linear structures which may impact on these systems, potentially resulting in the partial loss of these systems. However, there is also the opportunity to improve upon existing crossings which will in turn improve the status and functioning of traversed wetlands.

15.4.1.6 Impact Assessment

Surface Water – Hydrology							
Project Lifecycle:	Construction Phase						
Potential Impact:	Impacts to watercourses from temporary diversions						
Proposed Mitigation:	• Minimise influence to downstream flow regime when diverting and impeding flow (cofferdams, temporary river crossings etc.). • Prevent erosion caused by temporary in-stream diversion. Install suitable buttressing / stabilisation structures to prevent future erosion, if required. • Select appropriate crossing points (geotechnical conditions, sensitivity of riparian habitat and in-stream habitat), depending on technical feasibility.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Likely	2	-24
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

Surface Water – Hydrology							
Project Lifecycle:	Operational Phase						
Potential Impact:	Impacts to flow regime in the Berg River during the operation of Voëlvlei Scheme						
Proposed Mitigation:	• Compliance with DWS operating rules. • Water abstracted from the Berg River must not impact the EWR of the Berg River and Berg Estuary, i.e. the EWR must be satisfied and over abstraction must not take place. • Water quality and quantity released from Voëlvlei Dam will need to satisfy the EWR of the Berg River and Berg Estuary.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Moderate	2	-12
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

Surface Water – Water Quality							
Project Lifecycle:	Construction Phase						
Potential Impact:	• Contamination of surface water through sedimentation from instream works and silt-laden runoff from disturbed areas. • Water quality impacts due to spillages and poor construction practices.						
Proposed Mitigation:	• Conduct water quality monitoring (baseline and during construction) at suitable up- and downstream sites on the Berg River. • All diffuse pollution sources to be managed to prevent pollution of the watercourses in the project area. • Storage area and ablution facilities to be located 50m from edge of riparian habitat. • Where necessary, install in-stream silt traps during construction within the watercourse channel and along the riparian habitat. The style of silt trap will depend on materials used and the water movement patterns. • Implement suitable stormwater measures during construction to manage ingress of runoff into watercourses. • 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. • Reduce sediment loads in water from dewatering operations. All dewatering should be done through temporary sediment traps (e.g. constructed out of geo-textiles and hay bales).						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	High	Short	Likely	3	-54
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

Surface Water – Water Users							
Project Lifecycle:	Construction and Operational Phases						
Potential Impact:	• Impacts to lawfully entitled water users						
Proposed Mitigation:	• Manage water quality during construction. • Existing water use entitlements not to be affected. • Compliance with DWS operating rules. • Relocation of landowner pumps, if impacted on by the proposed developments. • Water quality and quantity released from Voëlvlei Dam will need to satisfy the EWR of the Berg River and Berg Estuary.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Regional	High	Long Term	Likely	3	-81
With Mitigation	-	-	-	-	-	0	0

The methodology used by the aquatic and wetland specialist differs slightly from that described in Section 15.1.7. All impacts were analysed with regard to their nature, extent, magnitude, duration, probability and significance. The assessments below were extracted from the Riparian Habitat and Wetland Delineation Impact Assessment (The Biodiversity Company, 2016) (**Tables 35**, **36** and **37**).

Table 35: Potential risks associated with the project

Phase	Activity	Aspect	Impact
Construction	Construction of low level weir	Damming and diversion of the Berg River for the weir	Impeding the flow of water Fish migration barrier Loss of aquatic habitat Siltation of watercourse Erosion of watercourse Flow sediment equilibrium change Altered flow dynamics Loss of wetland (seepage) areas Damage to wetlands (or loss) Impaired water quality
	Construction of pump station	Cutting/reshaping of river banks	
		Construction and upgrade of access routes	
	Digging of trenches	Construction (and upgrade) of crossings / causeways	
		Clearing of areas for infrastructure	
	Laying of pipelines	Interception of interflow by trenches	
		Additional associated infrastructure for staff	
	Upgrade of roads	Operation of equipment and machinery	
	Construction of roads	Excavations in and across watercourses	
		Use of temporary structures for river crossings	
	Upgrade of watercourse crossings	Construction of fishway in the system	
Operation	Weir and fishway	Weir structure	Impeding the flow of water Fish migration barrier Loss of aquatic habitat Siltation of watercourse Erosion of watercourse Flow sediment equilibrium change Altered flow dynamics Loss of wetland (seepage) areas Impaired water quality
		Drainage patterns change due to road extent and levels	
		Drainage patterns change due to crossing upgrades	
	Pumping of water	Increased extent of hardened surfaces	
		Loss of infiltration and seepage areas	
	Discharge of water	Operation of equipment and machinery	
	Vehicle access	Increased developed footprint area for the catchment	
		Water abstraction from the Berg River	
		Discharge of water into Voelvlei Dam	

Table 36: Risk rating assessment

Aspect	Severity							
	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase								
Damming and diversion of the Berg River for the weir	4	2	4	3	**3.25**	**3**	**3**	**9.25**
Cutting/reshaping of river banks	2	2	3	2	**2.25**	2	2	**6.25**
Construction and upgrade of access routes	2	1	1	2	**1.5**	1	2	**4.5**
Construction (and upgrade) of crossings / causeways	3	3	2	2	**2.5**	2	2	**6.5**
Clearing of areas for infrastructure	1	1	2	2	**1.5**	1	2	**4.5**
Interception of interflow by trenches	3	1	1	1	**1.5**	1	2	**4.5**
Additional Associated Infrastructure for staff	1	1	2	1	**1.25**	1	1	**3.25**
Operation of equipment and machinery	1	3	1	2	**1.75**	1	2	**4.75**
Excavations in and across watercourses	3	4	3	3	**3.25**	2	2	**7.25**
Use of temporary structures for river crossings	3	2	2	2	**2.25**	2	2	**6.25**
Construction of fishway in the system	4	4	2	3	**3.25**	2	2	**7.25**
Operation Phase								
Weir structure	5	2	3	3	**3.25**	3	5	**11.25**
Drainage patterns change due to road extent and levels	2	1	1	1	**1.25**	1	5	**7.25**
Drainage patterns change due to crossing upgrades	2	2	1	2	**1.75**	2	5	**8.75**
Increased extent of hardened surfaces	2	1	1	1	**1.25**	2	4	**7.25**
Loss of infiltration and seepage areas	1	1	1	1	**1**	1	5	**7**
Operation of equipment and machinery	1	1	1	1	**1**	1	3	**5**
Increased developed footprint area for the catchment	2	1	1	1	**1.25**	2	5	**8.25**
Water abstraction from the Berg River	3	1	1	2	**1.75**	2	3	**6.75**
Discharge of water into Voelvlei Dam	1	2	1	2	**1.5**	1	3	**5.5**

Table 37: Risk rating assessment continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Risk Rating
Construction Phase							
Damming and diversion of the Berg River for the weir	**3**	**3**	**5**	**1**	**12**	**111**	**Moderate**
Cutting/reshaping of river banks	2	2	5	2	**11**	**68.75**	**Moderate***
Construction and upgrade of access routes	2	2	1	2	**7**	**31.5**	**Low**
Construction (and upgrade) of crossings / causeways	2	2	5	2	**11**	**71.5**	**Moderate***
Clearing of areas for infrastructure	2	2	1	2	**7**	**31.5**	**Low**
Interception of interflow by trenches	3	1	1	3	**8**	**36**	**Low**
Additional associated infrastructure for staff	1	1	1	1	**4**	**13**	**Low**
Operation of equipment and machinery	2	2	1	2	**7**	**33.25**	**Low**
Excavations in and across watercourses	2	2	5	2	**11**	**79.75**	**Moderate***
Use of temporary structures for river crossings	2	2	1	2	**7**	**43.75**	**Low**
Construction of fishway in the system	3	3	5	3	**14**	**101.5**	**Moderate**
Operation Phase							
Weir structure	4	4	1	3	**12**	**135**	**Moderate**
Drainage patterns change due to road extent and levels	3	1	1	2	**7**	**50.75**	**Low**
Drainage patterns change due to crossing upgrades	3	2	1	2	**8**	**70**	**Moderate***
Increased extent of hardened surfaces	3	2	1	1	**7**	**50.75**	**Low**
Loss of infiltration and seepage areas	3	1	1	3	**8**	**56**	**Moderate***
Operation of equipment and machinery	2	1	1	2	**6**	**30**	**Low**
Increased developed footprint area for the catchment	3	2	1	1	**7**	**57.75**	**Moderate***

Water abstraction from the Berg River	2	2	5	2	**11**	**74.25**	**Moderate***
Discharge of water into Voelvlei Dam	2	2	5	2	**11**	**60.5**	**Moderate***

The risk assessments indicated that the largest risks are associated with the weir structure specifically, and not the supporting activities and structures. The most significant risks were determined to be moderate, with the remaining risks determined to be low. The two moderate risks for the construction phase are associated with the damming and diversion of the Berg River, and also the construction of the fishway structure. The most significant risk (moderate) considered for the operational phase of the project is the weir structure itself.

The relatively low risk rating for the project may be attributed to the modified statuses of the assessed watercourses. In addition to this, the extent of the impacts, except for the formal weir structure, are generally expected to be both site and area specific.

Mitigations measures have been prescribed for the assessed risks, with due consideration for the moderate risks associated with the project.

The following weir construction specific mitigation measures are provided:

- 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; 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.

The following fishway construction specific mitigation measures are provided:

- 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.

The following pipeline mitigation measures are provided:

- 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 bunded 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.

The following general mitigation measures are provided:

- 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.

15.5 Terrestrial Ecology – Flora

15.5.1 Potential Impacts

Vegetation will be lost within areas that are to be cleared for the project infrastructure such as the pump station. The potential loss of significant flora species may occur, which needs to be investigated further.

Clearing of vegetation for construction purposes may result in the proliferation of exotic vegetation, which could spread beyond the construction domain. This potential impact will need to be managed.

The potential establishment of alien vegetation in the Dam from the Berg River may occur due to the transfer of water between the Dam and the River.

The establishment of trees within the pipeline servitude will not be allowed as roots may compromise the stability of the pipeline.

15.5.2 Impact Assessment

The impact assessment below was extracted from the Terrestrial Ecology Study (Nemai Consulting, 2017):

FLORA PRE – CONSTRUCTION PHASE						
Potential Impact			Mitigation			
Site clearing			• 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.			
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact				Mitigation		
Soil contamination, vegetation loss and vegetation disturbance due to fuel and chemical spills.				• 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		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact				Mitigation		
Vegetation and habitat disturbance due to the accidental introduction of alien species.				• 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		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact				Mitigation		
Vegetation and habitat disturbance due to pollution and littering during construction phase.				• 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.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA CONSTRUCTION PHASE						
Potential Impact				Mitigation		
Damage to plant life outside of the proposed development area.				• 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.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA OPERATIONAL PHASE	
Potential Impact	Mitigation
The proposed construction activities may affect biodiversity through the encroachment of exotic vegetation following soil disturbance, in addition the maintenance of the area would disturb naturalised species within the 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.

FLORA OPERATIONAL PHASE						
Potential Impact				Mitigation		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FLORA OPERATIONAL PHASE						
Potential Impact				Mitigation		
Rehabilitation of the site				• 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.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

15.6 Terrestrial Ecology – Fauna

15.6.1 Potential Impacts

Vulnerable species could occur within the study area and the construction of the proposed dam will have a negative impact on the habitats of such species. Fauna could be adversely affected through construction-related activities (noise, illegal poaching, and habitat loss).

Potential impacts which could occur during the operational phase include:

- The loss of habitat for various species of fauna due to increased levels at the weir; and
- The transfer and release of water may have an impact the faunal species.

15.6.2 Impact Assessment

The impact assessment below was extracted from the Terrestrial Ecology Study (Nemai Consulting, 2017):

FAUNA PRE – CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Search and Rescue of animals on site.	• 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.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

FAUNA PRE – CONSTRUCTION PHASE						
Potential Impact	Mitigation					
Site clearing	• 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.					
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA CONSTRUCTION PHASE						
Potential Impact				Mitigation		
Disturbance to animals				• 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.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA CONSTRUCTION PHASE						
Potential Impact				Mitigation		
Animal passage out of construction site				• Allow for safe animal passage through and specifically out of the construction site.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Negative	Local	Low	Short-term	Likely	1

FAUNA OPERATIONAL PHASE	
Potential Impact	Mitigation
Disturbance of faunal species	• The disturbance of fauna should be minimized. • Animals residing within the designated area shall not be unnecessarily disturbed.

FAUNA OPERATIONAL PHASE						
Potential Impact				Mitigation		
				• Poaching and illegal hunting are strictly prohibited.		
Without Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Medium	Medium-term	Almost certain	2
With Mitigation	Nature	Extent	Magnitude	Duration	Probability	Significance
	Positive	Local	Low	Short-term	Likely	1

15.7 Agricultural Potential

15.7.1 Potential Impacts

The construction of the pump station may result in the loss of arable land for grazing and agriculture. In addition, the construction of the pipeline may disturb the surrounding agricultural land which may decrease its arability.

Based on the Agricultural Economic Considerations compiled as part of the Feasibility Studies for the project, the construction of a new pipeline to Voëlvlei Dam may impact on farming activities on the pipeline route. In addition, if the abstraction of surplus winter water from the Berg River does not impede irrigation activities downstream, the project would be acceptable due to its low-cost nature. If the additional water to Voëlvlei Dam is transferred from other areas (i.e Breede River system), it may impede irrigation activities in those areas.

The following impacts were identified by the Agricultural Impact Assessment:

- It can be seen as a permanent substitution of some agricultural land for the construction of the water scheme (i.e. footprint of access roads and pipelines).
- The possible decrease in winter water from the Berg River for irrigation utilization downstream of Gouda.
- The magnitude of the impact of the water scheme at the provincial level is expected to be more positive than negative (i.e. the positive contribution towards meeting the water needs of the increasing population of the Cape metropolitan area is expected to be more than the negative impact of the loss in agricultural output value).
- The duration of the project can be seen as long term (i.e. permanent).

15.7.2 Impact Assessment

The impact assessment below was extracted from the Agricultural Impact Assessment (Laubscher and Ellis, 2016).

The impacts associated with the proposed development for the water scheme and the “no-go” option were analysed and assessed with the emphases on *agricultural production potential*. The significance rating of the unmitigated and mitigated scenarios for each impact-group was calculated and rated as indicated in **Table 39** below.

Table 38: Impact Matrix: Berg River-Voëlvlei Augmentation Scheme: Agricultural perspective

PROJECT ALTERNATIVE	POTENTIAL ENVIRONMENTAL IMPACT / NATURE OF IMPACT	ENVIRONMENTAL SIGNIFICANCE																		MITIGATION
		BEFORE MITIGATION									AFTER MITIGATION									
		MAGNITUDE	DURATION	EXTENT	IRREPLACEABLE	REVERSIBILITY	PROBABILITY	TOTAL (SP)	SIGNIFICANCE	CUMULATIVE	MAGNITUDE	DURATION	EXTENT	IRREPLACEABLE	REVERSIBILITY	PROBABILITY	TOTAL (SP)	SIGNIFICANCE	CUMULATIVE	
Project activity:	**Site clearance and construction**																			
Development of water scheme for the augmentation of Voëlvlei dam	On-farm impacts [1]	2	4	1	4	4	4	60	**M (-)**	**M (-)**	2	4	1	4	4	4	60	**L (-)**	**None**	Directives have been included in the EMP for the Construction Phase management and protection of soil and ground and surface water resources.
"No-go" alternative	The non-realization of the loss of scarce agricultural resources.	0	4	1	0	4	5	45	**M (-)**	**M (-)**	-	-	-	-	-	-	-	-	-	No mitigation would be applicable without the development.

1. Loss of agricultural land and thus by implication future agricultural production potential

Appropriate mitigation measures with regard to the conservation of the natural resource base should form an important part of the planning process, *inter alia* regarding the following aspects:

- 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.

It must be noted that the servitude conditions for 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. Therefore, there will not be a complete loss of agricultural land.

15.8 Heritage Resources

15.8.1 Potential Impacts

Heritage resources such as archaeological and cultural-historical sites or artefacts may be found in or near the dam sites that could be destroyed during construction. Such heritage resources will need to be identified (if any) and protected (if required).

The Heritage Specialist concluded that the proposed development will have low impacts on the heritage resources of the area.

15.8.2 Impact Assessment

The impact assessment below was extracted from the HIA (ACO Associates, 2016):

Nature of Impact: Destruction of archaeological material, both above and below ground during the construction of the proposed project.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	1
Duration	Permanent (5)	5
Magnitude	Minor (2)	1

Probability	Improbable (2)	1
Significance	Low (16)	7
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	N/A	N/A
Mitigation: If any heritage resources (particularly graves) are uncovered during construction, then work must stop, and HWC (Tel: 021 483 9685) must be notified.		
Cumulative Impacts: Negligible		
Residual Impacts: None		

Nature of Impact: Damage to historic buildings		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	1
Duration	Permanent (5)	5
Magnitude	Minor (2)	1
Probability	Improbable (2)	1
Significance	Low (16)	7
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	N/A	N/A
Mitigation: None		
Cumulative Impacts: Negligible		
Residual Impacts: None		

15.9 Socio-Economic Environment

15.9.1 Potential Impacts

A positive impact could be the creation of short-term work opportunities for local residents during construction, as well as long-term work during the operation of the pump station and maintenance of the pipeline.

There could be an influx of job seekers during the construction phase that could lead to tensions between local residents wanting to find employment and those coming from outside the area to do the same.

The influx of construction workers could also have a similar effect especially if the workers are not respectful of local customs and traditions.

Given the quiet pristine nature of the project area, construction activity is likely to cause a number of social nuisances as well as economic implications on the communities and farming activities.

The following impacts were identified by the Socio-Economic Impact Assessment:

- SMME development;
- Induced migration;
- Impact on road conditions;
- Safety and access control;

- Crime and security;
- Disturbance of Cultural, Spiritual and Religious Sites;
- Dust and pollutants; and
- Impact on health.

In addition, there was one strong objection to the project raised from one farmer who was concerned that the project will affect the water supply on his land. Currently the farmer abstracts water from a wetland located on his property. The farmer is of the opinion that the wetland will no longer be fed through the canal as this project diverts the water away from the canal. Thus, the runoff from the canal system would not deed to the dam located on his property and he will not be able to abstract water from the wetland, leaving him with less water than required for irrigation. Hence, he is concerned of the impact on his farm where principle activities include the export of fruits and farming of 35hs of citrus.

Furthermore, a new pump station and associated infrastructure will be required to abstract water from the Berg River.

It is noted that an aquatic and wetland study was commissioned as part of the EIA. The results of the wetland study indicate that the wetland, which is largely manmade, will not dry up as a result of this project.

On the main, other feedback from the farmers related to the technical aspects of the project such as not abstractive polluted water from the first floods, the monitoring of overflow from the Dam; the redundancy of the existing canal etc.

15.9.2 Impact Assessment

The impact assessment below was extracted from the Socio-Economic Impact Assessment (Nemai Consulting, 2016).

15.9.2.1 Impact on the Economy

Environmental Feature		Impact on the Economy				
Project life-cycle		Pre-Construction phase, Construction Phase, Operational Phase				
Potential Impact		Proposed Management Objectives / Mitigation Measures				
Water Security		• 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.				
	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Positive	Regional	High	Permanent	Likely	3
After Mitigation	Positive	Regional	High	Permanent	Likely	3
Agricultural impact		• 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.				

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Positive	Local	Low	Short Term	Likely	1
After Mitigation	Positive	Regional	High	Permanent	Likely	3

15.9.2.2 Impact on Infrastructure

Environmental Feature	Impact on Infrastructure
Project life-cycle	Pre-Construction Phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
Access	• 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. • The EMPr must enforce strict access control measures.
Land use	• 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.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	Medium	Long term	Almost Certain	3
After Mitigation	Negative	Local	Low	Long term	Almost Certain	2

15.9.2.3 Construction Impacts

Environmental Feature	Construction Impacts
Project life-cycle	Construction Phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
Skills transfer	• 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 phase.
Increased employment	• 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.

Environmental Feature	Construction Impacts
Project life-cycle	Construction Phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
	• In order to increase the size of local employment, women should also be employed in the construction phase.
Impact on SMMEs	• 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.
Impact on Traffic	• 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.
Impact on Access	• Access to the farmer's private land during construction must be controlled. An access control plan should be developed and must form part of the EMPr. 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.
Increase in Dust	• 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. • 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.
Induced Migration	• 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.

Environmental Feature	Construction Impacts
Project life-cycle	Construction Phase
Potential Impact	Proposed Management Objectives / Mitigation Measures
Safety and security	• 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.
Impact on Cultural Beliefs	• Mitigation as per the relevant specialist studies apply.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	Medium	Short Term	Almost Certain	3
After Mitigation	Negative	Local	Low	Short Term	Almost Certain	2

15.10 Air Quality

15.10.1 Potential Impacts

Potential impacts during the construction phase include:

- Dust will be generated during the construction period from various sources, including blasting, earthworks, stockpiles, use of access roads, transportation of spoil material and general construction activities on site; and
- Exhaust emissions from vehicles and equipment.

Mitigation measures are included in the EMPr to ensure that the air quality impacts during the construction phase are suitably monitored (dust fallout and particulate matter) and managed and that regulated thresholds are not exceeded.

15.10.2 Impact Assessment

Air Quality							
Project Lifecycle:	Construction Phase						
Potential Impact:	• Excessive dust levels as a result of construction activities						
Proposed Mitigation:	• 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 and access roads. Note that all dust suppression requirements should be based on the results from the dust monitoring and the proximity of sensitive receptors. • 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, pre-notification of affected parties). • Air quality to be monitored (baseline and during construction) for dust fallout and particulate matter. Sampling locations to consider major sources of dust and sensitive receptors.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Likely	2	-24
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

15.11 Noise

15.11.1 Potential Impacts

During construction, localised increases in noise will be caused by blasting, earthworks, vehicles on access roads, and general construction activities on site. Vibration would be felt close to construction equipment.

The operation of the pump station may increase the noise levels in the study area but minimally.

Noise that emanates from construction activities will be addressed through targeted best practices for noise monitoring and management in the EMPr. It is assumed that the pump station will comply with best practices to limit any noise impacts.

15.11.2 Impact Assessment

Noise							
Project Lifecycle:	Construction Phase						
Potential Impact:	• Excessive noise levels as a result of construction activities						
Proposed Mitigation:	• The provisions of SABS 1200A will apply to all areas within audible distance of residents. • Working hours to be agreed upon with Project Manager, so as to minimise disturbance to landowners/occupiers and community members. • Construction activities generating output levels of 85 dB or more will be confined to normal working hours. • Noise preventative measures (e.g. screening, muffling, timing, pre-notification of affected parties) to be employed. • Blasting operations to be controlled to ensure sound pressure levels are kept below the generally accepted 'no damage' level of 140 decibels. • Noise to be monitored (baseline and during construction). Sampling locations to consider major noise sources and sensitive receptors.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Likely	2	-24
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

15.12 Access Roads

15.12.1 Potential Impacts

- During the construction period, there will be an increase in traffic on the local road networks due to the delivery of plant and material, transportation of staff and normal construction-related traffic. Haul roads and access roads will also be created on site, within the construction domain.
- As part of the construction phase, measures will be implemented for the selective upgrade of the roads (if necessary) and to render these roads safe for other users (amongst others).
- After the construction phase, the local roads will only need to be used for operation and maintenance purposes.

Any disruptions to the transportation network must be mitigated, and will be discussed in the EMPr.

15.12.2 Impact Assessment

Access Roads							
Project Lifecycle:	Construction Phase						
Potential Impact:	• Inadequate road conditions • Disruptions to existing road users • Safety risks • Increase in dust levels						
Proposed Mitigation:	• Make provision for landowners and affected parties to access their properties. • Speed limit of 40km/h on public and other roads within the project area to be adhered to. • 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. • Clearly demarcate all access roads. Clearly mark pedestrian-safe access routes.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Likely	3	-36
With Mitigation	-	Local	Low	Short	Moderate	1	-5

15.13 Waste Management

15.13.1 Potential Impacts

Waste management aims to avoid waste pollution of both land and water resources during and as a consequence of the proposed project. The following describes the impacts during the construction phase:

- 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);
- Wastewater (sanitation facilities, washing of plant, operations at the batching plant, etc.); and
- Disposal of excess spoil material (soil and rock) generated as part of the bulk earthworks.

15.13.2 Impact Assessment

Waste Management	
Project Lifecycle:	Construction Phase
Potential Impact:	• Land, air and water pollution through poor waste management practices
Proposed Mitigation:	• No ablution facilities to be positioned within riparian or wetland area. • Sufficient ablution facilities to be provided at the Construction Camp and along construction servitude. • Suitable litter receptacles to be positioned strategically across the site at all working areas.

	• Waste must be separated at source (e.g. containers for glass, paper, metals, plastics, organic waste and hazardous wastes). • The Contractor shall dispose of all refuse generated on site or from the activities of construction or its related activities. The contractor shall on a weekly basis dispose of all refuse at an approved refuse disposal site. Proof of disposal must be kept on record. • Littering by the workers is prohibited. Clearly marked litterbins must be provided on site. • Monitor the presence of litter on site. All staff shall be sensitised to this effect. • The entire site will be cleared of construction material, metal, tins, glass bottles, and food packaging or any other type of empty container or waste material or waste equipment used by the construction team on a daily basis. • Waste material that may harm man or animals should be removed immediately. • No hazardous materials, e.g. oil, diesel and fuel should be disposed of in the veldt. Any diesel, oil or petrol spillages are to be collected and stored in specially marked containers and disposed of at a permitted waste disposal site and must be treated as hazardous waste. • No refuse or litter is allowed to be burnt on site. • The recycling of all waste is to be encouraged of both the contractor and staff. • All vehicle parking areas and vehicle servicing areas are to be inspected carefully for diesel, oil and other spillages weekly.						
	Nature +/-	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**	**Score**
Without Mitigation	-	Local	Medium	Short	Likely	3	-36
With Mitigation	-	Local	Low	Short	Unlikely	1	-4

15.14 No-Go Impacts

The proposed surface water developments for augmentation of the WCWSS will ensure that the much needed increase in water supply to surrounding communities and agricultural areas is implemented.

If the proposed surface water development for augmentation of the WCWSS is not built, there would not be the increase in water supply to surrounding communities and agricultural areas.

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.

If the augmentation of the WCWSS is not undertaken, the low water levels will 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.

In contrast, should the proposed development of the surface water developments for augmentation of the WCWSS does not go ahead, any potentially significant environmental issues associated with the project would be irrelevant and the status quo of the local receiving

environment would not be affected by the project-related activities. The objectives of the project and the economic benefits discussed above would however not materialise.

15.15 Cumulative Impacts

According to GN No. R. 982 (04 December 2014), a ***"cumulative impact"***, in relation to an activity, means the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Cumulative impacts can be identified by combining the potential environmental implications of the proposed project with the impacts of projects and activities that have occurred in the past, are currently occurring, or are proposed in the future within the project area.

One of the main cumulative impacts is the loss of sensitive habitat. The proposed developments fall within the Swartland Shale Renosterveld, and the Swartland Alluvium Fynbos, both of which are categorised as CR, according to data sourced from SANBI.

The Swartland Shale Renosterveld originally covered 495 000 hectares and now approximately 8% of natural area remains. Less than 1% of its original area is protected. At least 35 endemic plant species and 151 Red Data List plant species occur in the ecosystem.

The Swartland Alluvium Fynbos originally covered 47 000 hectares and now approximately 27% of natural area remains. Approximately 2% of the ecosystem is protected in the Waterval Nature Reserve, Winterhoek (mountain catchment area) with a further 7% is found in private reserves such as Elandskloof, Langerug and Wiesenhof Wildpark. At least 13 endemic plant species and 57 Red Data List plant species occur in the ecosystem.

During construction there will be traffic-related impacts to the local road network. The construction period for the WCWSS developments will possibly place a significant burden on the roads in the project area. The associated impacts may include traffic disruptions and deterioration of road conditions.

Large-scale land clearing activities and other construction-related disturbances could lead to the proliferation of exotic vegetation.

The watercourses that will be affected may already be disturbed by anthropogenic influences, such as water quality deterioration by farming practices (e.g. nutrient-rich runoff) and erosion caused by grazing cattle. The project's construction activities may exacerbate impacts to the water quality and channel stability of the affected watercourses.

The proposed weir will be a cumulative impact as it will further the instream activities within the Berg River. However, this impact has been mitigated for through the design of the weir, as well as the inclusion of a fishway in the river.

The project was initiated to meet the water demands in the Drakenstein, Swartland and CCT municipalities. The proposed WSWSS developments will cater for the water demands within these areas on a sustained basis. In turn, this will have a positive impact on the macro socio-economic environment.

16 ANALYSIS OF ALTERNATIVES

Alternatives are the different ways in which the project can be executed to ultimately achieve its objectives. Examples could include carrying out a different type of action, choosing an alternative location or adopting a different technology or design for the project. By conducting the comparative analysis, the BPEOs 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".

16.1 No-Go Alternative

As standard practice and to satisfy regulatory requirements, the option of not proceeding with the project is included in the evaluation of the alternatives. The implications of the 'no-go' option are discussed in Section 15.14.

The 'no-go' alternative is not supported due to the need for increased water provision within the area and the need to reduce water losses which are currently occurring. The socio-economic benefits, including additional economic activity in the region, and employment opportunities which are associated with the proposed scheme, will not be realised.

The ultimate economic benefits of the project are in favour of the project being implemented based on the prime objectives of socio-economic upliftment through the provision of water.

16.2 Comparative Analysis of Alternatives Based on Impact Assessment

Table 39 summarises and compares the findings of the various relevant specialists in terms of their respective preferences for the project alternatives based on the outcome of the specialist studies and impact assessment.

Table 39: Summary of the Specialists' Preferred Options

Environmental Feature/Attribute		Pipeline Route and Associated Discharge Point			Access Roads	
		Alternative 1	Alternative 2	Alternative 3	Alternative 1	Alternative 2
Terrestrial Ecology			X		X	
Riparian Habitat and Wetland	**Aquatics**	No Preference		X	No Preference	
	Wetland		X	X	X	
Heritage			X		No Preference	
Agricultural			X	X	X	
Socio-Economic			X	X	X	
Technical				X	X	

With respect to the three alternative potential discharge options for the pipeline into the dam, all three options are acceptable from a heritage perspective, but Option 2, which follows existing infrastructure will have the least impact on below ground resources.

From an aquatics and wetland perspective, the following applies:

- In terms of the road options, there is no preference for any of the proposed road options in terms of the aquatic assessment;
- With regards to local wetlands, Option 1 is the most preferred option, due to the route being predominantly aligned with existing access routes. It is likely that four (4) crossings may have to be upgraded for this option, which includes one wetland system;
- The second preferred road option is Option 2 for the roads, which is expected to require the crossing of three (3) watercourses, with one wetland system being traversed;
- Alternative 3 has a discharge area with existing excavation scars with a gentle gradient which is expected to mitigate any likely scouring (desirable). Owing to this, this alternative is the preferred alternative for the aquatic assessment;
- Alternative 2 has the shortest route path (desirable) and the discharge point enters the dam at a steep gradient that would result in large scale scouring with subsequent increase in turbidity (not desirable), and due to this risk, this alternative is the second preference for the aquatic assessment;
- Alternative 1 has the longest route path (not desirable) and will discharge into an area of the dam that received clean water from surrounding systems. Owing to the length of this pipeline, and the potential mixing of clean water, this is the least preferred option for the aquatic assessment;
- With regards to the wetland study, Alternative 1 for the pipelines is not recommended owing to the fact that the structure will transect a depression system, resulting in impacts to the system; and
- Further to the wetland study, there is no preference for either Alternative 2 or Alternative 3 as no risks to wetlands are posed by either alternative.

From an agricultural perspective, it is obvious that it will be the least harmful to agricultural production when existing roads are to be used as an access road (i.e. Access Road 1).

As far as the pipeline alternatives are concerned, the harm to agricultural production is more severe, especially when it crosses land with perennial crops (i.e. vineyards). It seems that Alternatives 2 or 3 of the pipeline alternatives will be marginally less harmful than Alternative 1.

The Socio-Economic Specialist recommended either Alternative 2 or Alternative 3:

- Alternative 2 is the shortest, requiring less loss of arable land and disturbance to current activities surrounding the dam. It is therefore also the least costly option. However, the discharge point is located in close proximity to the staff houses and therefore there will be anticipated nuisance impact during construction and potentially during the operation of the scheme.
- Alternative 3 is slightly longer than alternative 2 and therefore costing more. However, as it is further away from the DWS staff houses, the route will have less of an impact on the community.

In addition, the 6.7km access road 1 route follows an existing unnamed farm route and therefore the construction of only 300 meters of road is required.

From a terrestrial ecological perspective, Access Road 1 is more preferred as it runs along the gravel road on the farms. With regards to proposed pipelines, both pipeline Alternatives 1 and 3 fall within the CBA and ESA: restore categories and only the Discharge Point 2 falls within the CBA and therefore Alternative 2 is the preferred option. The proposed Alternative 3 is situated adjacent to the Voëlvlei Nature Reserve and there is higher probability of encountering and destroying the habitat of Geometric Tortoise and therefore this route is recommended as the least preferred one. Should Alternative 3 be the preferred option, a Search, rescue and relocation plan needs to be developed for this species and Cape Nature is to be consulted to ensure that the Plan incorporates all the authority's requirements.

16.3 Best Practicable Environmental Option (BPEO)

Based on the recommendations of the specialists, technical considerations and the comparison of the impacts associated with the three pipeline route and associated discharge point alternatives, Alternative 3 was selected.

Alternative 3 was selected due to the following reasons:

- The discharge area has existing excavation scars with a gentle gradient which is expected to mitigate any likely scouring (desirable);
- There are no risks to wetlands posed by this alternative;
- This alternative will be marginally less harmful to agricultural resources;
- The discharge point is further away from the DWS staff houses, therefore the route will have less of an impact on the community; and
- Although this alternative is not the preferred option from an ecological perspective due to the higher probability of encountering and destroying the habitat of Geometric Tortoise, the Ecological Specialist stated that if this alternative is selected, a Search, rescue and relocation plan needs to be developed for this species.

The BPEO therefore includes the following:

- Pipeline and Discharge Point Alternative 3;
- Access Road Alternative 1,
- Mitigation measures recommended by the Specialists; and
- The measures proposed by the Stormwater Management Plan, and the Geotechnical Investigation.

17 EIA CONCLUSIONS AND RECOMMENDATIONS

17.1 Sensitive Environmental 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 76**):

- The EWR of the Berg Estuary and River.
- 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.

The sensitivity map shown in **Figure 73** 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.

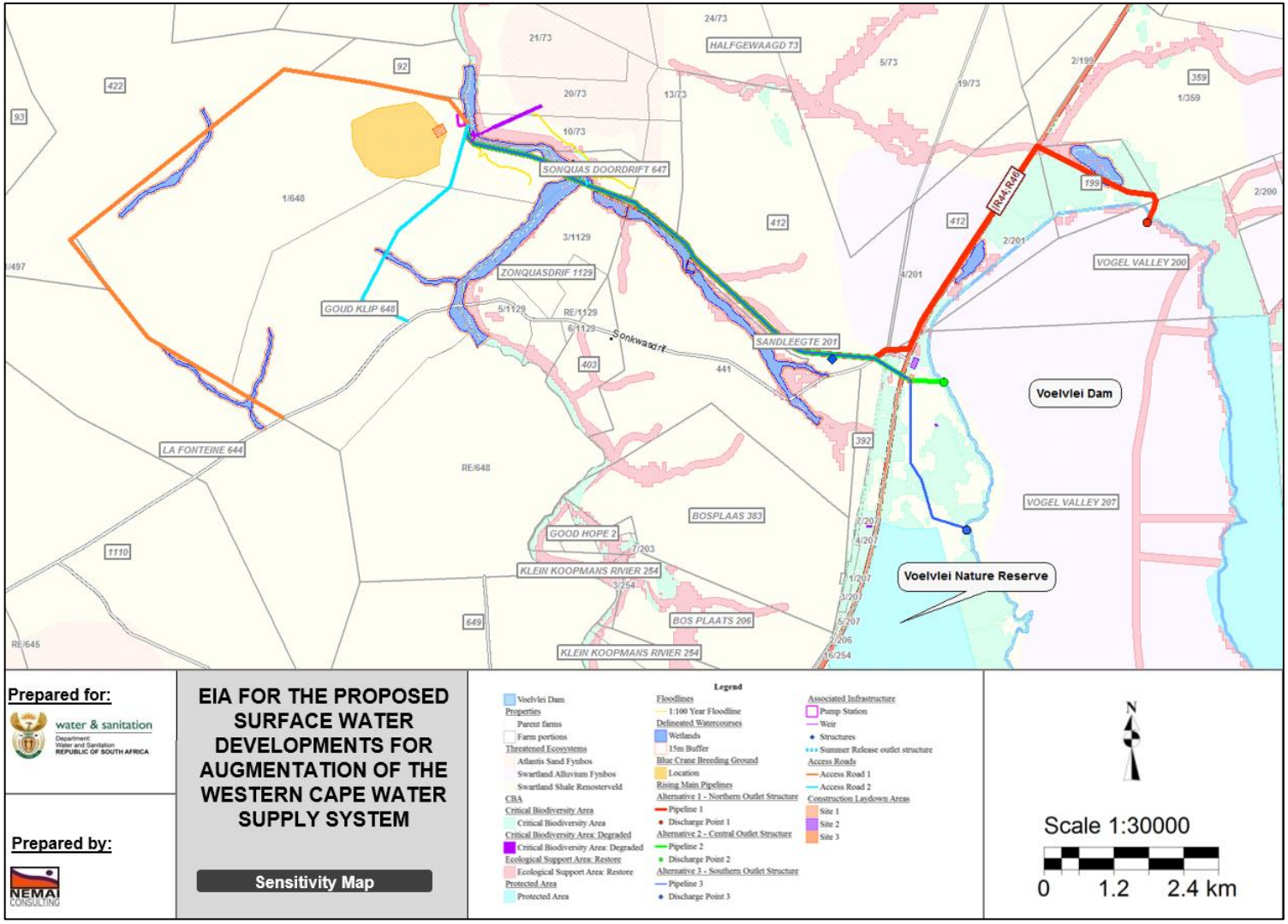


Figure 72: Sensitivity Map

17.2 Environmental Impact Statement

The Western Cape Water Supply System serves the City of Cape Town, surrounding urban centres and irrigators. It consists of infrastructure components owned and operated by both the City of Cape Town and the Department of Water and Sanitation. In 2007, the Western Cape Reconciliation Strategy Study was commissioned by the Department of Water and Sanitation to determine future water requirements for a 25 year planning horizon. The Study investigated a number of options and found that whilst 556 million m^3 per annum would be available from 2007, the estimated water requirement in 2011 would be 560 million m^3/a, with the implication that the system supply will then be fully utilised and thus additional interventions will thus be required.

Based on the above, Department of Water and Sanitation identified the need for augmentation of the Western Cape Water Supply System by 2019 and proceeded with pre-feasibility and feasibility studies into potential surface water development options. Initially six options were assessed at a pre-feasibility level of detail. These options were then prioritized to identify the two most viable options. These were:

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

Ultimately, the Feasibility Study found that the Berg River-Voëlvlei Augmentation Scheme option was the most favourable surface water intervention and as such the Department of Water and Sanitation proposes to implement this scheme which involves the transfer of approximately 23 million m^3 per annum from the Berg River to the existing Voëlvlei Dam i.e. the yield of the dam would be 23 million m^3 per annum more than it is currently.

Based on the location and nature of the proposed development, the following environmental specialist studies were conducted:

- Terrestrial Ecological Assessment Report;
- Riparian Habitat and Wetland Delineation Impact Assessment;
- Agricultural Impact Assessment;
- Phase 1 HIA; and
- Socio-Economic Impact Assessment.

In addition, a number of technical studies were required including:

- Stormwater Management Plan;
- Geotechnical Investigation; and
- Technical Drawings.

The Heritage Specialist concluded that the proposed development will have low impacts on the heritage resources of the area. Some ESA artefacts were found in a pile of rocks on the edge of a wheatfield. They are not of significance and no further mitigation is required. Similarly, one of the two access roads along the northern boundary of the farm Goudklip 648/1 but no impacts are expected. With respect to the three alternative potential discharge options for the pipeline into the dam, all three options are acceptable from a heritage perspective, but Option 2, which follows existing infrastructure will have the least impact on below ground resources. With regard the two road alternatives, both alternatives are acceptable. The Specialist therefore recommended that the development may proceed.

The Aquatic and Wetland Specialist stated that according to the 2016 low flow season assessment, the state of the Berg River was in a largely modified state, which has led to modified macroinvertebrate and fish community assemblages. Furthermore, impacts to instream and riparian habitat and more notable water quality were evident. Numerous wetland types were identified and delineated for the study. These include valley bottom systems, hillslope seeps, depressions and the Berg River floodplain. The ecological status of the riparian area within the floodplain was determined to be largely modified. The integrity of the assessed wetland systems was determined to vary from moderately to largely modified. The local commercial agricultural activities and developments have contributed to the modifications of these systems.

The proposed project will have both direct and indirect impacts on the local watercourses. The most significant risks are associated with the weir and fishway structures, with the level of risk determined to be moderate. These moderate risks are expected for the construction and operation of the project. The risks associated with the supporting activities and linear structures was determined to be low. Several concerns regarding the fishway design have been highlighted and need to be addressed for the fishway to be successful.

In terms of the road options, Option 1 is the most preferred for the study from an aquatic and wetland perspective. The least preferred road option is Option 2. With regards to the pipeline alternatives, Alternative 1 is not recommended, and the preferred alternative is Alternative 3.

The Agricultural Specialist stated that the impact of the project is expected to be as follows:

- It can be seen as a permanent substitution of some agricultural land for the construction of the water scheme (i.e. footprint of access roads and pipelines).
- The possible decrease in winter water from the Berg River for irrigation utilization downstream of Gouda.
- The magnitude of the impact of the water scheme at the provincial level is expected to be more positive than negative (i.e. the positive contribution towards meeting the water needs of the increasing population of the Cape metropolitan area is expected to be more than the negative impact of the loss in agricultural output value).

- The duration of the project can be seen as long term (i.e. permanent).

The expected loss in farmland (20 to 50ha) comprises a relative small percentage of the farm land even if it applies to only one farm unit. The impact can, however, significantly be decreased (only 20ha) should existing roads be used as access roads to the project infra structure.

It is obvious that it will be the least harmful to agricultural production when existing roads are to be used as an access road (i.e. Access road, Alternative 1).

As far as the pipeline alternatives are concerned, the harm to agricultural production is more severe, especially when it crosses land with perennial crops (i.e. vineyards). It seems that Alternatives B or C of the pipeline alternatives will be marginally less harm full than Alternative A.

It is thus foreseen that the access roads will be used as farm roads and/or firebreaks, while as much as possible of the existing farm roads will also be used in the layout.

The Socio-Economic Specialist highlighted that the socio-economic conditions of the surrounding town to the project are characteristic of rural communities in South Africa. There communities are poor, largely unskilled and have limited access to economic opportunities. Rather, migration to urban centres is required.

The project will improve access to cleaner water for the users of the Berg River, allowing for sustained provision of domestic and commercial water. In this light, the project should continue.

The Socio-Economic Specialist recommended either Alternative 2 or Alternative 3:

- Alternative 2 is the shortest, requiring less loss of arable land and disturbance to current activities surrounding the dam. It is therefore also the least costly option. However, the discharge point is located in close proximity to the staff houses and therefore there will be anticipated nuisance impact during construction and potentially during the operation of the scheme.
- Alternative 3 is slightly longer than alternative 2 and therefore costing more. However, as it is further away from the DWS staff houses, the route will have less of an impact on the community.

In addition, the 6.7km access road 1 route follows an existing unnamed farm route and therefore the construction of only 300 meters of road is required.

The Ecological Specialist noted that the proposed developments fall within three Vegetation types, namely Atlantis Sand Fynbos, Swartland Alluvium Fynbos and Swartland Shale Renosterveld. Although the proposed developments fall within two Critically Endangered vegetation units (Swartland Alluvium Fynbos and Swartland Shale Renosterveld), the area is

quite disturbed and transformed as a result of farming activities. Three Terrestrial Threatened Ecosystems are affected by the proposed developments: Atlantis Sand Fynbos, Swartland Alluvium Fynbos, and Swartland Shale Renosterveld.

One of the two Red Data bird species found on site was the Blue Crane (*Anthropoides paradiseus),* which is now listed as Near Threatened. One breeding pair was noted on Gouklip Farm, near the proposed Pump Station and Laydown Area 3. It is important to note that during construction phase, any breeding pairs and/or nest sites located during this survey must be plotted and should be treated as focal sites for subsequent monitoring. Another Red data bird species found on site was the Great White Pelican (*Pelecanus onocrotalus*). This species is listed as Vulnerable (D2). One endemic species recorded on site was the Jackal Buzzard (*Buteo rufofuscus*). The proposed development is not likely to be associated with large-scale loss of habitat, thus it is highly unlikely that the proposed development would exert an impact of any significance on this endemic bird species.

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.

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.

The proposed pipeline 3 and its discharge points are situated near the reserve and should this be preferred option, a Search, rescue and relocation plan needs to be developed for this species and Cape Nature is to be consulted to ensure that the Plan incorporates all the authority's requirements.

Through the Search, Rescue and Relocation Plans, a concerted effort will be made to prevent the loss of red data, protected and endangered fauna and flora species that will be affected by the project. In terms of the alternatives provided for this project, Access Road 1 is more preferred as it runs along the gravel road on the farms. A breeding pair of Red data bird species Blue Crane were observed near the Pump station and during construction, this species should not be unnecessarily disturbed. With regards to proposed pipelines, both pipeline Alternatives 1 and 3 fall within the CBA and ESA: restore categories and only the Discharge Point 2 falls within the CBA and therefore Alternative 2 is the preferred option. The proposed Alternative 3 is situated adjacent to the Voëlvlei Nature Reserve and there is higher probability of encountering and destroying the habitat of Geometric Tortoise and therefore this route is recommended as the least preferred one.

Critical environmental activities that need to be executed during the project life-cycle include the following:

- Pre-construction Phase
- Construction Phase
- Operational Phase
    - Satisfy EWR; and
    - Ongoing consultation with landowners, water users, and affected parties.

Based on the recommendations of the specialists, technical considerations and the comparison of the impacts, the following was identified as the BPEO for the related project components:

With the selection of the BPEO (Alternative 3), the adoption of the mitigation measures include in the EIA Report and the dedicated implementation of the EMPr, it is believed that the significant environmental aspects and impacts associated with this project can be suitably mitigated. With the aforementioned in mind, it can be concluded that there are no fatal flaws associated with the project and that authorisation can be issued, based on the findings of the specialists and the impact assessment, through the compliance with the identified environmental management provisions.

17.3 Recommendations

Based on the information contained in this report, and taking into account the outcome of the impact assessment, opinions and recommendations included in the specialist studies as well as all supporting documentation, it is the recommendation of the practitioner that EA be granted by the DEA for the proposed surface water developments for the augmentation of the WCWSS.

The following key recommendations, which may also influence the conditions of the Environmental Authorisation (where relevant), accompany the EIA for the proposed surface water developments for augmentation of the WCWSS:

1. Alternative 3 Pipeline and Discharge Point Alternative 3 and Access Road Alternative 1 are recommended.
2. Appointment of an ECO to monitor compliance with the EA and the approved EMPr.
3. 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.
4. As discussed in the EMPr, various forms of monitoring are 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. The types of monitoring to be undertaken include:

a. Baseline Monitoring needs to be undertaken to determine to 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;
b. Environmental Monitoring entails checking, at pre-determined frequencies, whether thresholds and baseline values for certain environmental parameters are being exceeded; and
c. Compliance Monitoring and Auditing for the independent Environmental Control Officer (ECO) to monitor and audit compliance against the EMPr and Environmental Authorisation.

5. Pertinent recommendations from the Terrestrial Ecological Impact Assessment (Nemai Consulting, 2017) include:
    a. 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).
    b. Should Alternative 3 be the preferred option, a Search, rescue and relocation plan needs to be developed for the Geometric Tortoise and Cape Nature is to be consulted to ensure that the Plan incorporates all the authority's requirements.
    c. 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.
    d. 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.
    e. 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.
    f. 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.

6. Pertinent recommendations from the Riparian Habitat and Wetland Delineation Impact Assessment (The Biodiversity Company, 2016) include:
    a. 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.
    b. It is imperative that the new low level weir cater for fish migration, especially during very low flows.
    c. 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
    d. Pipelines crossing watercourses should preferably span the systems above ground. This prevents disruptions to sub surface flow dynamics.
    e. The delineated aquatic and wetland areas outside of the specific project site area must be avoided where possible.
    f. The construction vehicles and machinery must make use of existing access routes as much as possible, before adjacent areas are considered for access.
    g. Laydown yards, camps and storage areas must be beyond the aquatic and wetland areas.
    h. It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces.
7. Pertinent recommendations from the HIA (ACO Associates, 2016) include:
    a. If any heritage resources (particularly graves) are uncovered during construction, then work must stop, and HWC (Tel: 021 483 9685) must be notified.
8. Pertinent recommendations from the Agricultural Impact Assessment (Laubsher and Ellis, 2016) include:
    a. Proper planning of new 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.

b. Conservation of the topsoil during construction and the proper rehabilitation of the construction sites after construction.

9. Pertinent recommendations from the Socio-Economic Impact Assessment (Nemai Consulting, 2016b) include:
    a. Farmers and landowners must be consulted in the design of the road to ensure that there is minimal impact on landowners.
    b. Farms may choose to negotiated mitigation measures such as access gates to mitigate against the loss the livestock, damage to property and safety.
    c. DWS must develop a skills development program for the duration of the construction activity.
    d. 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.
    e. Access to the farmer's private land during construction must be controlled. An access control plan should be developed and must form part of the EMPr. Landowners must be afforded the opportunity to comment on the plan. Contractors and sub-contractors must be forced to comply with the plan.
    f. Where sensitive crops are affected by dust, DWS should conduct a feasibility study to tar the roads.

18 OATH OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

I (name and surname) _____

Of (address) _____

ID No. _____ *Contact No.* _____

I hereby make an oath and state that:

In accordance with Appendix 2 of Government Notice No. R. 982 (4 December 2014), this serves as an affirmation by the Environmental Assessment Practitioner (EAP) in relation to:

Section 2(j) -

1. *The correctness of the information provided in this report;*
2. *The inclusion of comments and inputs from stakeholders and interested and affected parties; and*
3. *Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties.*

Section 2(k) -

The level of agreement between the EAP and interested and affected parties on the plan of study for undertaking the environmental impact assessment.

1. I know and understand the contents of this declaration.

2. I do not have any objection in taking prescribed oath.

3. I consider the prescribed oath to be binding on my conscience.

Signature _____*Date:* _____

I certify that the deponent has acknowledged that he/she knows and understands the contents of the statement and the deponent signature was placed there on in my presence.

COMMISSIONER OF OATH	FULL NAME	DESIGNATION

19 REFERENCES

Cape Action for People and the Environment. 2008. Berg Estuary Situation Assessment. C.A.P.E. Estuaries Management Programme. Produced by Anchor Environmental. – Downloaded from: http://www.fewlbnexus.uct.ac.za/sites/default/files/image_tool/images/91/Berg%20Estuary%20Management%20Plan%20-%20Situation%20Assessment.pdf

Cape Winelands District Municipality. 2007. Spatial Development Framework: District Management Area. Prepared by Envro Dinamik.

DEAT, 2002. Scoping, Integrated Environmental Management, Information Series 2, Department of Environmental Affairs and Tourism (DEAT), Pretoria.

DEAT. 2002. "Integrated Environmental Management Information Series: Ecological Risk Assessment." Department of Environmental Affairs and Tourism (DEAT), Pretoria.

DEAT. 2005a. Guideline 3: General Guide to the Environmental Impact Assessment Regulations, 2005. Integrated Environmental Management Guideline Series. Department of Environmental Affairs and Tourism (DEAT), Pretoria.

DEAT. 2005b. Guideline 4: Public Participation, in terms of the EIA Regulations. Integrated Environmental Management Guideline Series. Department of Environmental Affairs and Tourism (DEAT), Pretoria.

DEAT. 2006. "Integrated Environmental Management Information Series 23: Risk Management." Department of Environmental Affairs and Tourism (DEAT), Pretoria.

DEA&DP. 2009. Guideline on Need and Desirability, NEMA EIA Regulations Guideline and Information Document Series. Western Cape Department of Environmental Affairs & Development Planning (DEA&DP), Cape Town.

DEA&DP. 2011. Western Cape Integrated Water Resource Management Action Plan. Western Cape Department of Environmental Affairs & Development Planning (DEA&DP), Cape Town.

Department of Water Affairs, South Africa. 2010. Report No.2 : Preliminary Assessment of Options. Prepared by Western Cape Water Consultants Joint Venture, as part of the Pre-feasibility and Feasibility Studies for Augmentation of the Western Cape Water Supply System by Means of Further Surface Water Developments

Department of Water Affairs, South Africa. 2012a. Report No.3 : Feasibility Studies, Volume 1 – First Phase Augmentation of Voëlvlei Dam, Berg River-Voëlvlei Augmentation Scheme. Prepared

by Western Cape Water Consultants Joint Venture, as part of the Pre-feasibility and Feasibility Studies for Augmentation of the Western Cape Water Supply System by Means of Further Surface Water Developments.

Department of Water Affairs, South Africa. 2012b. Report No.4 : Record of Implementation Decisions Regarding the First Phase Augmentation of Voëlvlei Dam. Prepared by Western Cape Water Consultants Joint Venture, as part of the Pre-feasibility and Feasibility Studies for Augmentation of the Western Cape Water Supply System by Means of Further Surface Water Developments.

Department of Water and Forestry, 2004. State of the rivers report.

Department of Water and Forestry, South Africa. 2007. Western Cape Water Supply System Reconciliation Strategy Study. Prepared by Ninham Shand (Pty) Ltd and UWP Consulting (Pty) Ltd.

Department of Water and Sanitation, South Africa. 2015. Final Resource Management Plan Voëlvlei Dam. Prepared by Nemai Consulting.

Mucinia, L., & Rutherford, M. (2006). The vegetation of South Africa, Lesotho and Swaziland. Strelizia 19.

Statistics South Africa. (2011). Census 2011.

Western Cape Government, South Africa. 2013. Western Cape Provincial Spatial Development Framework.

West Coast District Municipality, South Africa. 2012. West Coast District Municipality Integrated Development Plan.

APPENDICES