water & sanitation

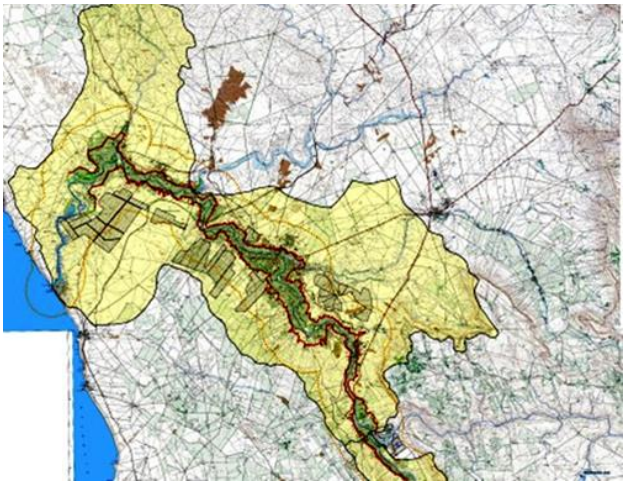
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Post Feasibility Bridging Study for the Proposed Bulk Conveyance Infrastructure from the Raised Clanwilliam Dam (WP0485)

Water Requirements Assessment Report





January 2018

Department of Water and Sanitation
Directorate: Options Analysis

POST FEASIBILITY BRIDGING STUDY FOR THE PROPOSED BULK CONVEYANCE INFRASTRUCTURE FROM THE RAISED CLANWILLIAM DAM

APPROVAL

Title	:	Water Requirements Assessment Report
DWS Report Number	:	P WMA 09/E10/00/0417/4
Consultants	:	Aurecon South Africa (Pty) Ltd
Report status	:	Final
Date	:	January 2018

STUDY TEAM

Approved for Aurecon South Africa (Pty) Ltd:

.....

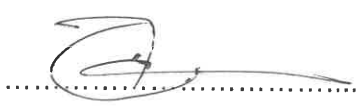
E VAN DER BERG
Technical Director

DEPARTMENT OF WATER AND SANITATION
Directorate Options Analysis

Approved for Department of Water and Sanitation:

.....

M MUGUMO
CHIEF ENGINEER: OA (South)



.....

C FOURIE
DIRECTOR: OPTIONS ANALYSIS

Document control record

Document prepared by:

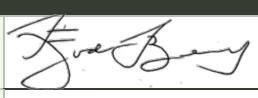
Aurecon South Africa (Pty) Ltd
1977/003711/07

Aurecon Centre
1 Century City Drive
Waterford Precinct
Century City
Cape Town
7441

PO Box 494
Cape Town
8000
South Africa

T +27 21 526 9400
F +27 21 526 9500
E capetown@aurecongroup.com
W aurecongroup.com

Document control						aurecon
Report title		Water Requirements Assessment Report				
Document ID		P WMA 09/E10/00/0417/4	**Project number**		113834	
File path		\\Aurecon.info\shares\ZACPT\Projects\Projects\113834 Bridging Study Clanwilliam Dam\03 Prj Del\13 Reports\04 Water Requirements Assessment\TASK 3 Water Requirements Assessment Report rev 1 (Final with signatures).docx1				
Client		Department of Water and Sanitation	**Client contact**		Mr M Mugumo	
Rev	**Date**	**Revision details/status**	**Prepared by**	**Author**	**Verifier**	**Approver**
0	31 October 2017	Draft 1	Aurecon	W Enright	A Chang	E v/d Berg
1	4 December 2017	Draft 2	Aurecon	W Enright	A Chang	E v/d Berg
2	22 January 2018	Final	Aurecon	W Enright	A Chang	E v/d Berg
Current Revision		**2**				

Approval			
Author signature		Approver signature	
Name	Willie Enright	Name	Erik van der Berg
Title	Project Support Engineer	Title	Technical Director

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF WATER AND SANITATION

Directorate: Options Analysis

Post Feasibility Bridging Study for the Proposed Bulk Conveyance Infrastructure from the Raised Clanwilliam Dam

WATER REQUIREMENTS ASSESSMENT

January 2018

Prepared by:

Aurecon South Africa (Pty) Ltd
P O Box 494
Cape Town, 8000
South Africa

Tel: 021 526 5790
Fax: 086 526 9500
e-mail: erik.vanderberg@aurecongroup.com

Prepared for:

Director: Options Analysis
Department of Water and Sanitation
Private Bag X313
Pretoria 0001
South Africa

Mr Menard Mugumo (CE:OA, South)
Tel: 012 336 6838
E-mail: mugumom@dws.gov.za

This report is to be referred to in bibliographies as:

Department of Water and Sanitation, South Africa. 2018. *Water Requirements Assessment Report*. Prepared by Aurecon South Africa (Pty) Ltd as part of the Post Feasibility Bridging Study for the Proposed Bulk Conveyance Infrastructure from the Raised Clanwilliam Dam. DWS Report No. P WMA 09/E10/00/0417/4.

Post Feasibility Bridging Study for the Proposed Bulk Conveyance Infrastructure from the Raised Clanwilliam Dam

Reports produced as part of this project are indicated below.

Bold type indicates this report.

Report Index	Report Number	Report Title
1		Inception Report
2	P WMA 09/E10/00/0417/2	Capacity Building & Training Year 1
3	P WMA 09/E10/00/0417/3	Capacity Building & Training Year 2
4	**P WMA 09/E10/00/0417/4**	**Water Requirements Assessment**
5	P WMA 09/E10/00/0417/5	Distribution of Additional Available Water
6		Existing Infrastructure and Current Agricultural Development Sub-Report
7	P WMA 09/E10/00/0417/6	Existing Conveyance Infrastructure and Irrigated Land
8		Suitable Agricultural Areas and Land Ownership Report
9		Evaluation of Development Options Sub-Report
10	P WMA 09/E10/00/0417/10	Suitable Areas for Agricultural Development
11		Right Bank Canal Design Sub-Report
12		Conceptual Design Sub-Report
13		Environmental Screening Sub-Report
14		Jan Dissels and Ebenhaeser Schemes Design Sub-Report
15	P WMA 09/E10/00/0417/13	Feasibility Design
16	P WMA 09/E10/00/0417/7	Topographical Surveys
17	P WMA 09/E10/00/0417/8	Geotechnical Investigations
18	P WMA 09/E10/00/0417/9	Soil Survey
19		Financial Viability of Irrigation Farming Sub-Report
20	P WMA 09/E10/00/0417/11	Agricultural Production and Farm Development
21		Right Bank Canal Cost Analysis Sub-Report
22		Socio-Economic Impact Analysis Sub-Report
23	P WMA 09/E10/00/0417/12	Socio-Economic Impact Analysis
24	P WMA 09/E10/00/0417/14	Record of Implementation Decisions Report
25	P WMA 09/E10/00/0417/1	Main Report
26	P WMA 09/E10/00/0417/15	Historically Disadvantaged Farmers Report

Concise Description of the Content of Study Reports

Report Index	Report Number	Report Title and Description of Content
1		Inception The report forms part of the contract and stipulates the scope of work for the study, the contract amount and the contract period. It contains a detailed description of tasks and methodology, a study programme, human resource schedule, budget and deliverables. The Capacity Building and Training Plan has been included.
2	P WMA 09/E10/00/0417/2	Capacity Building & Training Year 1 Describes the range of capacity building and training activities planned for the study, and the activities undertaken during the first year of the study, including field-based training, training workshop 1 and mentorship of DWS interns through secondment.
3	P WMA 09/E10/00/0417/3	Capacity Building & Training Year 2 Describes the range of capacity building and training activities planned for the study, and the activities undertaken during the second year of the study, including field-based training, training workshop 2 and mentorship of DWS interns through secondment.
4	P WMA 09/E10/00/0417/4	Water Requirements Assessment Provides an analysis of the existing water use and current water allocations in the study area, and addresses ecological water requirements, water use for irrigated agriculture and projections for future use, current domestic and industrial water use and projections for future use, water use for hydropower and water losses in the water supply system.
5	P WMA 09/E10/00/0417/5	Distribution of Additional Available Water Confirms the volume of additional water available for development, after water has been reserved for the current water uses, as well as making recommendations on how the additional yield should be distributed among water use sectors and water users.
6		Existing Infrastructure and Current Agricultural Development Sub-Report Provides an overview of the extent and general condition of the current bulk water storage and conveyance infrastructure. This report also provides an overview of the locality and extent of the existing agricultural areas determined by reviewing Geographic Information System (GIS) data obtained from various sources.

Report Index	Report Number	Report Title and Description of Content
7	P WMA 09/E10/00/0417/6	Existing Conveyance Infrastructure and Irrigated Land An update of the Sub-Report, providing a refinement of the current agricultural water requirements following evaluation of the current crop types, an assessment of the desirability of diverting releases for downstream irrigators via the Clanwilliam Canal and Jan Dissels River, to meet the summer ecological flows in the lower Jan Dissels River, and presents an Implementation Action Plan with costs.
8		Suitable Agricultural Areas and Land Ownership Sub-Report Description of the collection of information and the preparation undertaken for the analysis of options, which includes a summary of existing irrigated areas and water use, cadastral information, land ownership, environmental sensitivity, soils suitability, water quality considerations and constraints, and the initiation of the process to identify additional areas suitable for irrigation.
9		Evaluation of Development Options Sub-Report Describes the salient features, costs and impacts of identified potential irrigation development options for new irrigation development in the lower Olifants River. This provides the background and an introduction to the discussions at the Options Screening Workshop held in December 2018.
10	P WMA 09/E10/00/0417/10	Suitable Areas for Agricultural Development Describes the supporting information, process followed and the salient features, costs and impacts of identified potential irrigation development options for new irrigation development in the lower Olifants River. Recommends the preferred options to be evaluated at feasibility level.
11		Right Bank Canal Feasibility Design Sub-Report Describes the Design Criteria Memorandum, based on best practice in engineering and complying with recognised codes and standards. Description of route alignments and salient features of the new Right Bank canal. Feasibility-level design of bulk infrastructure, including evaluation of capacities, hydraulic conditions, canal design, surface flow considerations, canal structures, power supply and access roads. Operational considerations and recommendations.
12		Conceptual Design Sub-Report Describes the scheme layouts at a conceptual level and infrastructure components to be designed, alternatives to consider or sub-options, and affected land and infrastructure, as well as the updated recommended schemes for new irrigation development.
13		Environmental Screening Sub-Report Describes and illustrates the opportunities and constraints, and potential ecological risks/impacts and recommendations for the short-listed bulk infrastructure development options at reconnaissance level. Describes relevant legislation that applies to the proposed irrigation developments.

Report Index	Report Number	Report Title and Description of Content
14		Jan Dissels and Ebenhaeser Schemes Feasibility Design Sub-Report Describes the Design Criteria Memorandum, based on best practice in engineering and complying with recognised codes and standards. Description of route alignments and salient features of the Jan Dissels and Ebenhaeser schemes. Feasibility-level design of bulk infrastructure, including evaluation of capacities, hydraulic conditions, intake structures, balancing dams and reservoirs, rising mains and gravity pipelines and trunk mains where relevant, power supply and access roads. Operational considerations and recommendations.
15	P WMA 09/E10/00/0417/13	Feasibility Design Description of the approach to and design of selected bulk infrastructure at feasibility level, with supporting plans and implementation recommendations.
16	P WMA 09/E10/00/0417/7	Topographical Surveys Describes the contour surveys for the proposed identified bulk infrastructure conveyance routes and development areas, the surveying approach, inputs and accuracy, as well as providing the survey information.
17	P WMA 09/E10/00/0417/8	Geotechnical Investigations Presents the findings of geotechnical investigations of the various identified sites, as well as the approach followed, field investigations and testing, laboratory testing, interpretation of findings and geotechnical recommendations.
18	P WMA 09/E10/00/0417/9	Soil Survey Describes the soil types, soil suitability and amelioration measures of the additional area covering about 10 300 ha of land lying between 60 to 100 m above river level, between the upper inundation of the raised Clanwilliam Dam and Klawer.
19		Financial Viability of Irrigation Farming Sub-Report Describes the findings of an evaluation of the financial viability of pre-identified crop-mixes, within study sub-regions, and advises on the desirability of specific crops to be grown in these sub-regions. It includes an evaluation of the financial viability of existing irrigation farming or expanding irrigation farming, as well as the identification of factors that may be obstructive for new entrants from historically disadvantaged communities.
20	P WMA 09/E10/00/0417/11	Agricultural Production and Farm Development This report will focus on policy, institutional arrangements, available legal and administrative mechanisms as well as the proposed classes of water users and the needs of each. This would include identifying opportunities for emerging farmers, including grant and other types of Government and private support, and a recommendation on the various options and opportunities that exist to ensure that land reform and water allocation reform will take place through the project implementation.

Report Index	Report Number	Report Title and Description of Content
21		Right Bank Canal Cost Analysis Sub-Report Provides an economic modelling approach to quantify the risk of the failure of the existing main canal and the determination of the economic viability of the construction of the new right bank canal to reduce the risk of water supply failure.
22		Socio-Economic Impact Analysis Sub-Report Describes the socio-economic impact analysis undertaken for the implementation of the new irrigation development schemes, for both the construction and operational phases. This includes a description of the social and economic contributions, the return on capital investment, as well as the findings of a fiscal impact analysis.
23	P WMA 09/E10/00/0417/12	Socio-Economic Impact Analysis Synthesis of agricultural economic and socio-economic analyses undertaken, providing an integrated description of agricultural production and farm development and socio-economic impact analysis, as well as the analysis of the right bank canal costs and benefits.
24	P WMA 09/E10/00/0417/14	Record of Implementation Decisions Describes the scope of the project, the specific configuration of the schemes to be implemented, the required implementation timelines, required institutional arrangements and the required environmental and other approval requirements and mitigation measures, to ensure that the project is ready for implementation.
25	P WMA 09/E10/00/0417/1	Main Report Provides a synthesis of approaches, results and findings from the supporting study tasks and interpretation thereof, culminating in the study recommendations. Provides information in support of the project funding motivation to be provided to National Treasury.
26	P WMA 09/E10/00/0417/15	Historically Disadvantaged Farmers Report Describes the activities undertaken by an independent consultant to evaluate existing HDI Farmers policies and legislative context, identify, map and analyse prospective HDI farmers and potential land for new irrigation, as well as propose a mechanism for the identification and screening of HDI farmers.

Executive Summary

This report provides an analysis of the existing water use and current water allocations in the study area.

The mean annual runoff of the Olifants River in its natural state was 1 055 million m^3/a. However, developments in the Olifants River catchment have resulted in a 32% reduction in streamflow. The proposed raising of the dam could increase the dam's storage to 100% of its original inflow and increase the yield by an additional 74 million m^3/a.

In this report, the latest information on existing water use, current water allocations and all current water use from Clanwilliam Dam is confirmed. Best available information from the various sources, inclusive of abstractions below Bulshoek Weir, is assessed and summarised. The water requirements evaluation addresses the following:

- Ecological water requirements,
- Water use for irrigated agriculture and projections for future use,
- Current domestic and industrial water use and projections for future use,
- Water use for hydropower, and
- Water losses in the water supply system.

Ecological water requirements

The current flows that contribute to the ecological requirements are outlined although some of these flows are not deliberately released.

Current Water Use Entitlements

The scheduled water entitlements for irrigation purposes within the Government Water Schemes and Irrigation Boards are 12 200 m^3/ha/a, as per the terms of Section 33 of the National Water Act, 1998. Current irrigation from and downstream of Clanwilliam Dam is managed by the Clanwilliam Water User Association (WUA) and Lower Olifants River Water User Association (LORWUA). The total scheduled water entitlements below the dam is 11 500 ha.

Although an assurance of supply for agriculture is generally 91%, water users on this scheme are not able to fully utilise their water allocations due to restricted summer allowance, ranging from 5 100 m^3/ha to 8 600 m^3/ha over the past 10 years. Although restrictions were lifted after

the summer periods when winter rainfall fills the dam, the water users could not fully utilise their water allocations.

The average municipal water use over the last three years for the Cederberg and Matzikama municipalities in the study area were 1.44 million m^3/a and 4.78 million m^3/a respectively. A further 1.98 million m^3/a is used for household purposes by farms directly from the canal.

Mining and industrial requirements averages 2.41 million m^3/a.

Losses were determined as 27.8 million m^3/a (21%) in the LORWUA supply system.

A hydro power station is situated on the right bank of the river. The plant, with capacity of 1.7 MW, provides base load and helps to stabilise the current voltage variations in Clanwilliam. Water use is non-consumptive and power is only developed when water is released to the river for downstream use.

Contents

Figures

Tables

Acronyms

DWAF	Department of Water and Forestry
DWS	Department of Water and Sanitation
EWR	Ecological water requirements
fsl	full supply level
LORWUA	Lower Olifants River Water User Association
MAR	Mean annual runoff
ORGWS	Olifants River (Vanrhynsdorp) Government Water Scheme
ORSA	Olifants River System Analysis
WUA	Water User Association

1 Introduction

1.1 Background

The Clanwilliam Dam, located on the Olifants River in the Western Cape near the town of Clanwilliam, was originally built in 1935, and was raised in the 1960s.

The crest gates can potentially affect the safety of the dam wall if they are not opened in time during large floods. The dam wall would need to be strengthened if the gates were replaced by an uncontrolled concrete spillway. The feasibility study completed in 2008, considered the no raising option, which was about 40% of the cost of the 13 m raising option. The 13 m raising was found to be economically viable due to the substantial increase in yield from the dam (70 million m^3). The feasibility study concluded that the raising of Clanwilliam Dam, and further associated agricultural development, is economically viable and socially desirable. The feasibility study recommended the raising of the full supply level of the existing Clanwilliam Dam by 13 m.

The raising of Clanwilliam Dam would generate additional yield for development, with relatively low environmental impact. Planning of the dam raising focused on achieving a sustainable balance between development and protection of aquatic ecosystems, whilst simultaneously achieving water allocation reform and social upliftment. The additional water will augment the water supply to the existing scheduled irrigation area, towns and industrial use, as well as provide additional water for new irrigation areas to establish resource-poor farmers.

Detailed analysis and modeling of the existing and potential water resource availability in the Olifants River Catchment, resulting from the proposed raising of the Clanwilliam Dam, were done as part of the Clanwilliam Dam Raising Study and are presented in the System Analysis Report (DWAF, 2009). The natural mean annual runoff (MAR) of the Olifants River above the Clanwilliam Dam is 356 million m^3.

The average supply from the Olifants River (Vanrhynsdorp) Government Water Scheme (ORGWS) (Clanwilliam Dam and Bulshoek Weir) to users over the last 25 years was estimated as 174 million m^3/a.

The raising of Clanwilliam Dam by 13 m will increase its capacity from 124 million m^3 to 321 million m^3. The historical firm yield of Clanwilliam Dam and Bulshoek Weir was assessed in the Natural Resources Development report by Department of Agriculture as part of the Clanwilliam Dam Raising: Utilisation of Additional Water Study as 149 million m^3/a and the future yield will increase by 74 million m^3/a after the raising of the Clanwilliam Dam to 223 million m^3/a with a 13 m wall raising.

1.2 Study Objective

The objective of this study is to provide recommendations on the bulk conveyance infrastructure (new developments / upgrading / rehabilitation) required and investigate additional opportunities for the equitable distribution of the existing and additional water from the raised Clanwilliam Dam.

To achieve this objective, the following aspects need to be investigated:

- The existing water allocation and projections for the supply area.
- New areas for agricultural development.
- Options for the required conveyance infrastructure, and
- Appropriate farming models and cost of irrigation water.

1.3 Purpose and Structure of this Report

In this report, the latest information on existing water use, current water allocations and all current water use from Clanwilliam Dam is confirmed. Best available information from the various sources, inclusive of abstractions below Bulshoek Weir, is assessed and summarised. The water requirements evaluation addresses the following:

- Ecological water requirements.
- Water use for irrigated agriculture and projections for future use.
- Current domestic and industrial water use and projections for future use.
- Water use for hydropower, and
- Water losses in the water supply system.

1.4 Study Area

The study area mainly comprises the Olifants River valley, but some activities may extend to the larger catchment area. **Figure 1.1** shows a map of the study area, which includes the Cederberg and Matzikama Local Municipalities, and shows the location of key bulk water infrastructure.

Figure 1.1 | The Study area

2 Ecological Water Requirements

2.1 Meeting Ecological Water Requirements

In its natural state, the MAR of the Olifants River was 1 055 million m^3/a. During winter, about half the streamflow was provided by the Doring River tributary; while during summer, the Doring River mostly dries up and the perennial Olifants River provides the estuarine base flow.

Developments in the Olifants River catchment as a whole have reduced the streamflow by 32%.

The proposed dam raising could potentially increase the dam's storage to 100% of the original inflow and increase the additional yield with 74 million m^3/a. If Clanwilliam Dam is raised, then it will absorb more of the winter streamflow before it spills and, as a result, the spillage over the dam will be reduced and delayed.

To meet estuarine summer Reserve flow requirements, releases need to be made from Bulshoek Weir to supplement the streamflow at Lutzville, to increase the streamflow to about 1.5 m^3/s. However, proper management is required to ensure that irrigators located downstream do not intercept these ecological releases.

In addition to the need for base flows from the Olifants River, the estuary also requires flood flows during winter. During early winter, the Doring River provides these high flows, as the Clanwilliam Dam currently impounds the streamflow in the upper Olifants River until it starts to spill.

2.2 River Reach upstream of Clanwilliam Dam

The raising of the Clanwilliam Dam will obviously not impact the flows in the reach upstream of the Clanwilliam Dam, but the management of this reach could affect the yield of the Clanwilliam Dam. This river reach is in a D Ecological Category, as determined for the ecological water requirement (EWR) Site 1 at Citrusdal.

During the summer months, the naturally perennial Olifants River upstream of the dam can be pumped dry, sometimes for up to several weeks. The historical pumping from boreholes located alongside the river has aggravated the situation. One option to reduce the pumping from the river is to increase the storage of winter water for use in summer. Unless proper controls are in place to manage summer abstraction, the summer pumping will only further reduce the streamflow

entering the Clanwilliam Dam, and lead to conflict with water users downstream of Clanwilliam Dam.

2.3 River Reach between Clanwilliam Dam and Bulshoek Weir

The dam intercepts winter high flows and releases water for irrigators downstream, primarily during the dry summer months. The flow regime is therefore already highly modified, and it cannot be reversed to better replicate the natural flow regime.

During summer, up to 8 m^3/s are released from the Clanwilliam Dam down to Bulshoek Weir, for diversion into the Lower Olifants River Water User Association (LORWUA) canal. This is significantly more than the natural summer base flow. In winter, releases of about 0.5 m^3/s are made from the dam to irrigators located just downstream of the dam, who do not receive accruals from the Jan Dissels River.

The release of water from the dam also impacts the temperature and water quality characteristics (e.g. dissolved oxygen concentration) of the water released downstream. This can, however, be partially mitigated through the construction of a multilevel outlet, which has been planned as part of the raising of the dam.

The multilevel outlet works will be able to provide the necessary flow and temperature triggers to encourage the spawning of the Clanwilliam Yellow Fish during spring. Freshets released from the Dam for fish spawning could be captured in Bulshoek Weir, and could potentially be released in combination with releases for irrigation.

It has also been proposed that some of the water released from the Clanwilliam Dam during summer can be diverted via the existing Clanwilliam Canal, to provide the required summer base flows for the lower reach of the Jan Dissels River. This may allow additional allocations to be made to users from the Jan Dissels River.

2.4 River Reach between Bulshoek Weir and the Doring River Confluence

The environmental flow requirement for the 18 km long river reach between the Bulshoek Weir and the confluence of the Olifants River with the Doring River is critical to the operation and available yield from the Clanwilliam Dam.

There was unanimous agreement from the ecologists undertaking the Reserve determination, that the attainment of a D-category at EWR Site 2 in this river reach was unrealistic, and a ‘residual flow’ was instead recommended to maintain this river reach in a category E, provided that the Doring River remained undammed and thus remained able to provide the bulk of the required ecological flows at the Olifants estuary.

The principle adopted was that no releases for high flow requirements would be made from Bulshoek Weir for the downstream reach. The option of meeting Drought EWR requirements for the downstream reach was adopted for the analysis of the available yield from the proposed raising.

2.5 Olifants River from the Doring River to the Estuary

The raising of the Clanwilliam Dam will reduce the floods entering the estuary and it is assumed that further development in the Doring River will be restricted so that floods from the Doring River continue to serve the estuary.

2.6 Olifants Estuary

In its natural state, the Olifants River estuary would receive half of its winter flows from each of the Doring River and the Olifants River respectively and summer base flows from the naturally perennial Olifants River. Though the current Clanwilliam Dam is only about 30% of the MAR at its site, it traps the early winter flows and the developments along the Olifants River below the dam modify the summer base flow.

The present ecological state of the estuary was assessed as a Category C but is worsening. Improved management, aimed at reducing the impact of the non-anthropogenic activities, could help to maintain the estuary as a Category C. The base flows entering the estuary should be maintained at approximately 1.5 m^3/s. This base flow will have to be met by return flows or releases from Bulshoek Dam when needed.

A critical requirement for the maintenance of the ecological state of the estuary is the requirement that no significant developments be done on the main stem of the Doring River, thereby allowing as much of the natural winter flood volumes as possible to flow through to the estuary and to compensate for the additional winter flows stored in the raised Clanwilliam Dam.

3 Current Water Requirements

3.1 Overview

Besides the ecological Reserve, the other water requirements are for the irrigation of crops, municipal water supply, and for mines, industries and power generation.

3.2 Current Irrigation Areas

Current irrigation from and downstream of Clanwilliam Dam is managed by the Clanwilliam Water User Association (WUA) and LORWUA.

The Clanwilliam WUA manages abstractions from the Clanwilliam Dam catchment, the Clanwilliam Canal and the Olifants River up to the Bulshoek Weir. The Jan Dissels River Catchment also forms part of the Clanwilliam WUA. All water users between the Clanwilliam Dam and Bulshoek Weir are members of the Clanwilliam WUA. Water users abstract their water either from farm dams filled by pumping from the Clanwilliam Canal, or by pumping directly out of the Olifants River.

The Clanwilliam Canal system, currently operated by the Clanwilliam WUA, starts at the Dam wall and supplies water to 564 ha of irrigation. This canal was built in 1940. Irrigators using the canal operate on a request basis and the current canal losses are estimated at 30%.

LORWUA manages water supply from the canal system starting at the Bulshoek Weir up to the Ebenhaeser community on the left bank and up to the Koekenaap area on the right bank of the Olifants River. The Olifants River below the Bulshoek Weir is also part of the LORWUA area of jurisdiction.

A recent study on the Status of Agricultural Economy Lower Olifants River, done by the Western Cape Department of Agriculture, provides important information on current activities. Crops cultivated in this area with water supplied from the Clanwilliam Dam are indicated in **Table 3.1**.

Table 3.1 | Crops cultivated in the Lower Olifants River valley with water supplied from the Clanwilliam Dam

Crops	Subcategory	Area (hectares)
Grapes	Export	713
	Wine	8610
	Raisins	832
Tomatoes	Tunnels	20
	Factory	350
	Market	166
Vegetables	Hothouse	70
	Open	615
Peaches		50
Pecan Nuts		50
Other		920

3.3 Current Water Use Entitlements

Scheduled water entitlements within Government Water Schemes and within Irrigation Boards that existed in 1999 were declared by the then Minister of Water Affairs as Existing Lawful Water Use, in terms of Section 33 of the National Water Act, 1998, whether it was fully used or not but payments for water use charges are made to the Government Water Scheme and/or the Irrigation Boards. A water application rate of 12 200 m^3 per hectare per year has been determined in determination notices in the Government Gazette.

Section 33 provides for the formal approval of water use entitlements that were in the process of being exercised when the National Water Act was promulgated:

33. Declaration of water use as existing lawful water use

(1) A person may apply to a responsible authority to have a water use which is not one contemplated in section 32(1)(b)(i), (ii) or (iii), declared to be an existing lawful water use.

(2) A responsible authority may, on its own initiative, declare a water use which is not one contemplated in section 32(1)(b)(i), (ii) or (iii), to be an existing lawful water use.

(3) A responsible authority may only make a declaration under subsections (1) and (2) if it is satisfied that the water use –

(a) took place more than two years before the date of commencement of this Act and was discontinued for good reason; or

(b) had not yet taken place at any time before the date of commencement of this Act but

(i) would have been lawful had it so taken place; and

(ii) steps towards effecting the use had been taken in good faith before the date of commencement of this Act.

The members of the Clanwilliam WUA have an allocation of water from the Clanwilliam Dam of 20 million m^3/a (1 637 hectares each receiving 12 200 m^3/ha). The LORWUA irrigators currently have an allocation of water from the Clanwilliam Dam/Bulshoek Weir of 120.3 million m^3/a (9 862 hectares each receiving 12 200 m^3/ha).

These scheduled water allocations are in terms of Section 63 of the previous Water Act, 1956. These scheduled water use entitlements, declared as existing lawful water use, can be used even if it was not fully exercised in 1998.

Some irrigation also takes place below the Bulshoek Weir. In 1963, the then Minister of Water Affairs granted an option of a concession to all farmers who were riparian in June 1963. This concession, which was issued subject to a number of conditions, would allow each farmer/land owner to pump 8.6 ha (10 morgen) from the river. Water availability and quality were not guaranteed, but was supplied because of leakages from Bulshoek Weir. Several studies were done to determine the extent of the lawful uses and unauthorised abstractions, as some water users exceeded their concession volumes. The extent of farming via concessions below the Bulshoek Weir is currently estimated as 345.19 ha totalling some 4.21 million m^3/a.

3.4 Current Irrigation Requirements and Assurance of Supply

During the summer season from 1 October to 30 April, the water allocation released to the LORWUA canal is capped at 8 400 m^3/ha/a, due to the capacity constraint of the canal. This is equivalent to 325 m^3/ha/week and the canal is designed for 290 m^3/ha/week. The current water supply system is thus 'over committed'. The rest of the allocation is released during the remaining months of the year, if water is available. The maximum release into the canal is 26 000 m^3/h (7.22 m^3/s).

Figure 3.1 illustrates the extent of restrictions applied for specific periods during the respective years from 2007/2008 to 2016/17. An analysis of the state of the Clanwilliam Dam is made by end September of each year. Calculations are made to ensure that the dam will end above 10% by middle of May in the next year. The summer part of the quota is then determined and applied to all users. These restricted summer allowance ranged from 5 100 m^3/ha to 8 600 m^3/ha over the past 10 years. Although restrictions were lifted after the summer periods when winter rainfall fills the dam, the water users could not fully utilise their water allocations. For the years 2014/2015, 2015/2016 and 2016/17 restrictions were not lifted in full after the summer. The current year (2016/2017) is the third successive year with higher and longer restrictions on the allocated quota.

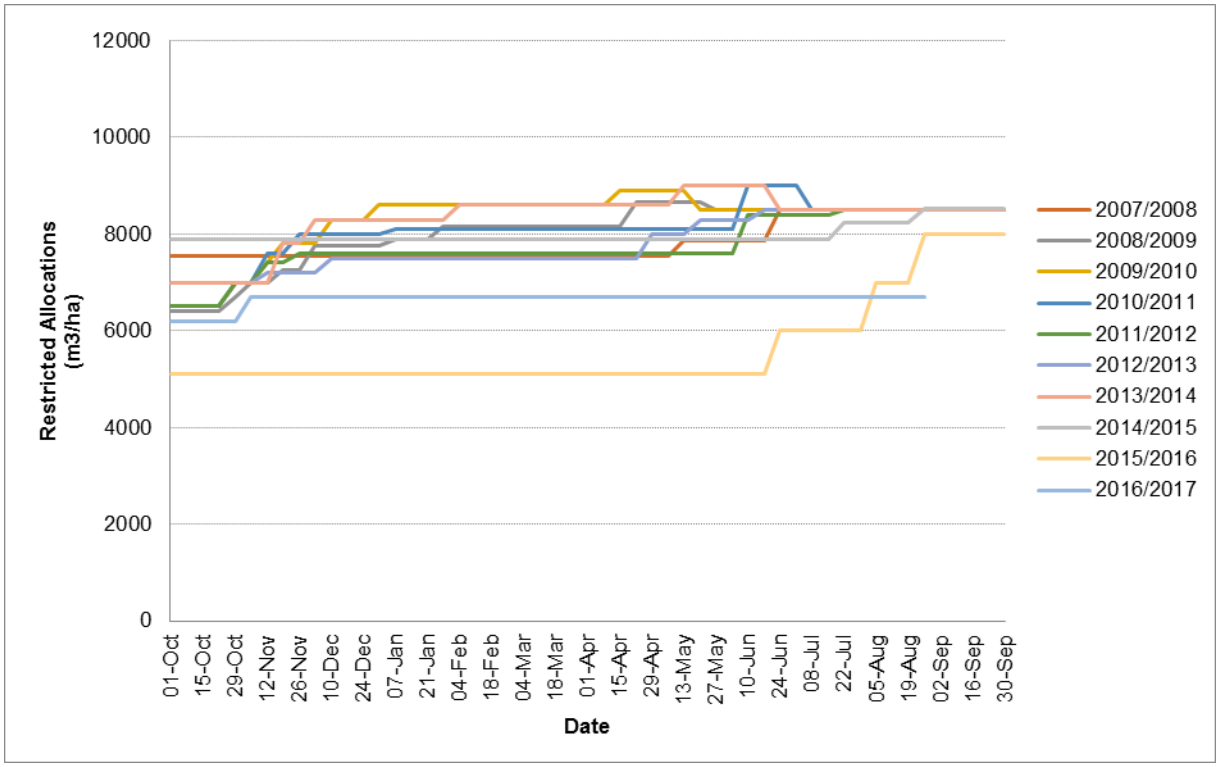


Figure 3.1 | Quota restrictions during specific periods of the year

The average inflow to the LORWUA canal for the period from 1990 to 2006 was 139 million m^3/a, but after deducting losses of 37 million m^3/a (27%) and non-irrigation consumption of about 9.6 million m^3/a, the remainder left for irrigation is about 92 million m^3/a. This equates to 9 670 m^3/ha or 80% of the theoretical allocation.

Figure 3.2 indicates the volume stored in Clanwilliam Dam over the period from 2010 to 2017. The dam levels dropped every year, even with harsh restrictions of 60% to 80% of the normal summer requirement of the 8 400 m^3/ha portion of the allocated entitlements. This clearly indicates the lack of infrastructure capacity to supply the allocated water entitlements, resulting in a lower than acceptable assurance of supply.

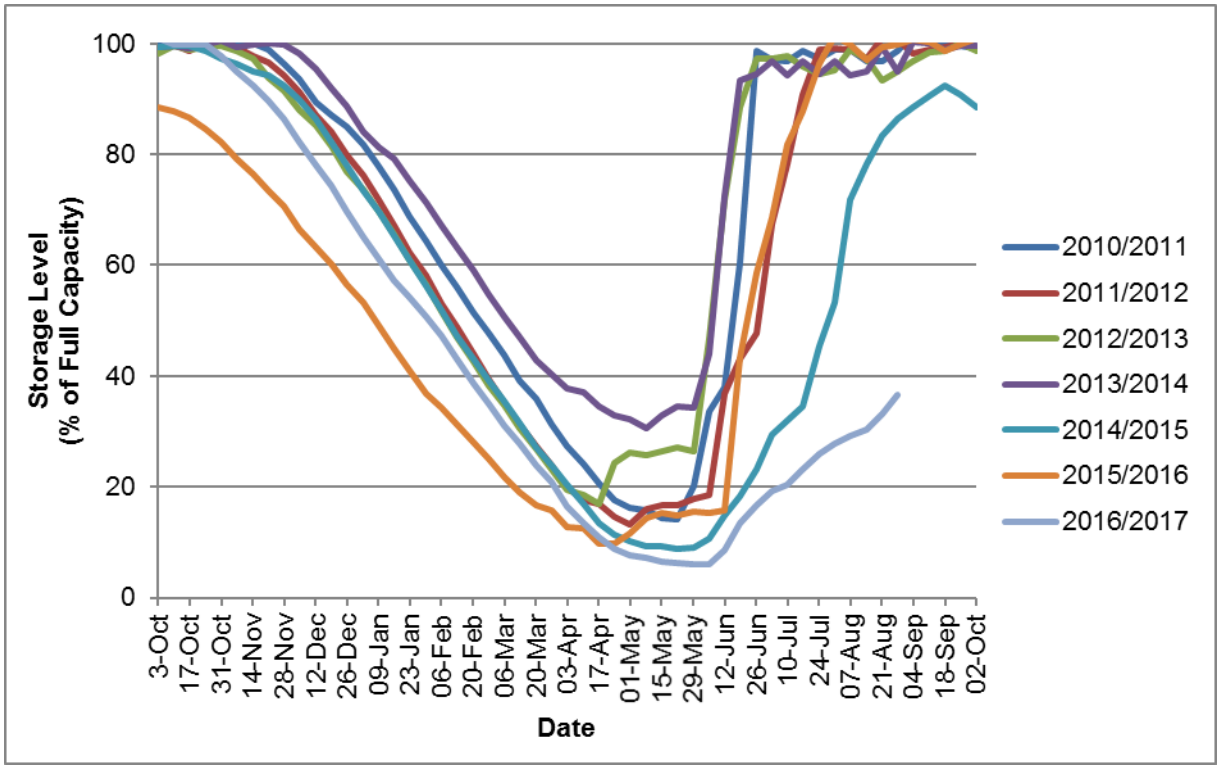


Figure 3.2 | Water storage level in Clanwilliam Dam for the period 2010 to 2017

The geographical distribution of the scheduled water allocations receiving water from the Clanwilliam Dam is indicated in **Table 3.2**.

Table 3.2 | Scheduled water allocations for irrigation from the Clanwilliam Dam

WUA	Area	Scheduled Allocations	
		ha	million m^3/a
Clanwilliam WUA	Clanwilliam Dam catchment	408	4.97
	Clanwilliam Canal	564	6.88
	Olifants River between Clanwilliam Dam up to and including Bulshoek Weir	665	8.12
LORWUA	Left Bank Canal Bulshoek to Kranz syphon	567	6.92
	Left Bank Canal Kranz syphon to Ebenhaeser	4 602	56.14
	Doring River Canal	447	5.45
	Right Bank Canal – Krans Syphon to Koekenaap	2 455	29.95
	Koekenaap Canal	1 446	17.64
	Olifants River below Bulshoek Weir	346	4.21
Total		**11 500**	**140.28**

3.5 Urban, Mining and Industrial Requirements

3.5.1 Urban Requirements

Two local municipalities obtain water from the Olifants River from and downstream of Clanwilliam Dam. The Cederberg Municipality is using water for the town of Clanwilliam from the Clanwilliam Dam as well as from the Jan Dissels River.

The Matzikama Local Municipality obtains water from the LORWUA canal for the towns of Vredendal, Vanrhynsdorp, Klawer, Lutzville, Koekenaap and Ebenhaeser. Vredendal is the larger water user with the small towns using rather low volumes of water.

Water is also supplied for household purposes to farmers and their workers on the scheme.

About 480 farms receive untreated water for domestic use or irrigation of gardens on farms, via 20 mm off-takes from the canal, which could amount to 2.0 million m^3/a.

Table 3.3 provides the water uses as obtained from LORWUA of the individual towns within the local municipalities, including water supplied for household use to individual farms along the canal.

Table 3.3 | Water use by the individual towns

Municipality	Town	Water Use (million m^3/a)			
		2014/15	2015/16	2016/17	Average
Cederberg	Clanwilliam	1.45	1.44	1.44	1.44
Matzikama	Vredendal, Vanrhynsdorp	3.23	2.48	3.20	2.97
	Klawer	0.44	0.75	0.52	0.57
	Lutzville	0.64	0.58	0.52	0.58
	Koekenaap	0.12	0.11	0.10	0.11
	Ebenhaeser	0.61	0.50	0.55	0.55
	Household use - LORWUA canal	1.98	1.97	1.98	1.98
Total		**8.47**	**7.83**	**8.31**	**8.20**

3.5.2 Mining and Industrial Water Requirements

Mining operations in this area mainly consist of the Cape Lime plant and the Namakwa Sands heavy mineral mining.

The Vredendal operation of Cape Lime came into existence in 1981, when the dolomitic aggregate operation was expanded to include the Mineral Filler Plant. Further expansion included the erection of the high-grade dolomite blending plant for the glass industry in 1983 and the processing of high grade limestone in 1993. A fluid bed calciner was commissioned in 2004 producing quality white lime.

Namakwa Sands mines heavy minerals and makes it more suitable for smelting to produce titanium dioxide feedstock (chloride and sulphate grades), zircon, rutile and high purity iron products. The products are used as feedstock in a wide range of applications including pigments, metals, ceramics and foundries.

The open-pit mine and concentration plants are situated at Brand-se-Baai, where the ore is mined and processed at the primary concentration plants to produce a mineral concentrate. Water for these operations is obtained from the LORWUA canal. The canal was upgraded a few years ago to enable the additional water supply.

Industries in the Study area consist mainly of wine cellars as well as a tomato processing industry. There are a number of wine cellars in the Lower Olifants River valley (e.g. Stellar Wines) and cellars in Vredendal, Klawer, Spruitdrift, Trawal and Lutzville. The wine cellars of Vredendal, Lutzville and Spruitdrift are the three largest wine cellars in the country, with Lutzville Vineyards being the country's most westerly vineyards. The normal annual production for the three largest wineries is approximately 200 000 tons. The wine industry in the Lower Olifants area contributes approximately 15% of the total South African wine industry production.

Stellar winery was previously a grape-juice concentrate and distilling wine plant owned by KWV, but is now the largest producer of organic wines in South Africa. The grapes are sourced from farms in the lower Olifants River Valley and part of Namaqualand.

Tiger Brands Foods, otherwise known as 'All Gold', is located between Lutzville and Koekenaap. This company locally uses some 45 000 tons of tomatoes per year. Farming operations are relatively sophisticated with virtually all processing tomatoes being contracted prior to the beginning of the season. The whole production is irrigated. This company cultivates tomatoes to produce the primary product of tomato paste, which is eventually distributed throughout South Africa.

The water use for mining and industrial users, as obtained from LORWUA, from 2014 to 2016 is indicated in Table 3.4.

Table 3.4 | Mining and industrial requirements (Source: LORWUA)

Sector	Sub-sector	Water use (million m^3/a)			
		2014	2015	2016	Average
Mining	Namakwa Sands	2.10	1.79	1.54	1.81
	Cape Lime	0.01	0.05	0.06	0.07
Industries	Wine Cellars	0.43	0.43	0.44	0.43
	Tiger Brand	0.09	0.10	0.09	0.09
Total		**2.72**	**2.38**	**2.13**	**2.41**

3.6 Water Supplied by LORWUA

Figure 3.3 indicates the use of water by the respective water users in the LORWUA area.

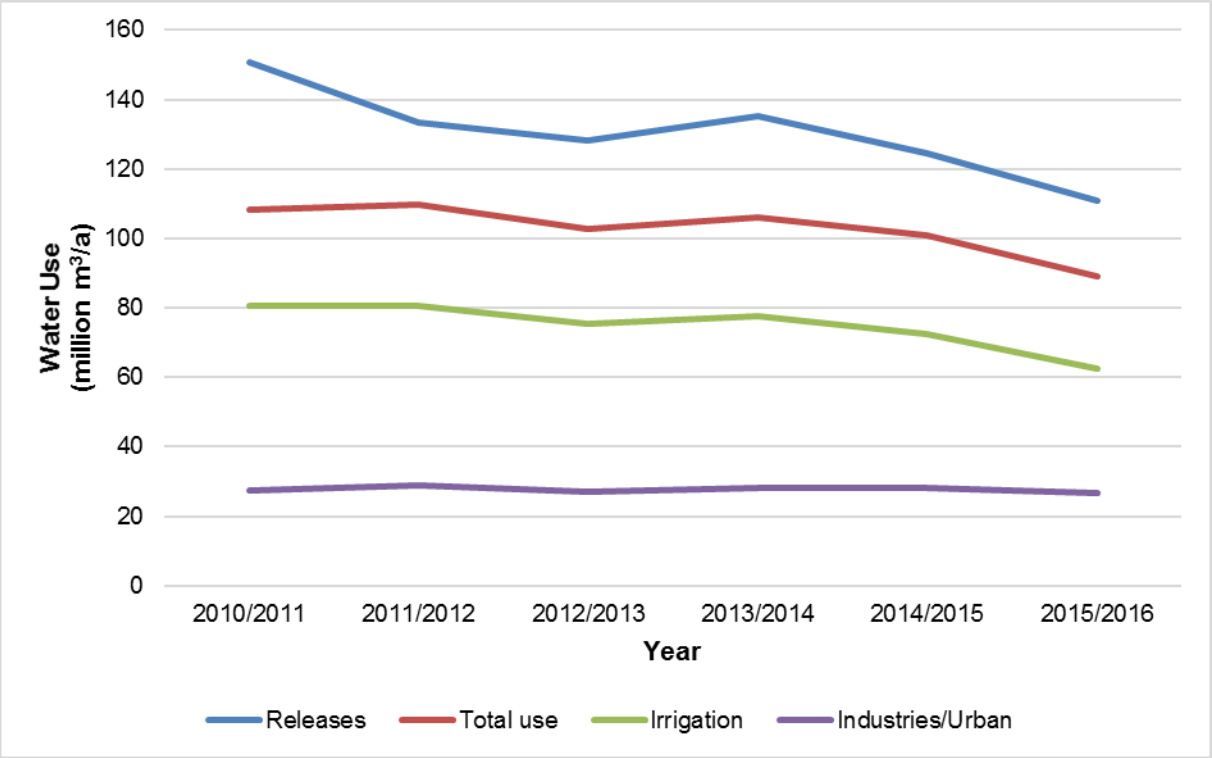


Figure 3.3 | Water use within the LORWUA area for respective sectors

The average inflow to the LORWUA canal for the period from 2010 to 2016 was 130 million m^3/a. Water supplied for irrigation for this period was about 75 million m^3/a. This equates to 7 873 m^3/ha or 64.5% of the theoretical allocation. Non-irrigation consumption for urban, industries and household water use were 27.8 million m^3/a.

Water losses can be a relative amount, as losses depend on where water flows and where it is used in a system, as well as on the operating rules. In the absence of water resources modelling,

simple empirical rules were developed to assess losses for further assessments of water allocation. Losses was determined as 27.8 million m^3/a (21%) in the LORWUA supply system.

3.7 Hydropower

The only power station in the area is a small privately-owned hydro-electric installation (non-consumptive water user) on the right bank at Clanwilliam Dam. Water use is non-consumptive and power is only developed when water is released to the river for downstream use. This plant was upgraded by the private operator during 2006/07 and supplies electricity to the town of Clanwilliam.

The plant provides base load and helps to stabilise the current voltage variations in Clanwilliam. Turbines of 1.7 MW capacity have been installed, but only 1.1 MW is currently generated. There is therefore capacity for expansion, as well as significant demand for additional power generation (as the cost of power generation is lower than Eskom's).

Provision has been made in the proposed new outlet works on the left bank to supply the hydropower plant. The plant has to move to the left bank. The flow to the hydro power plant will increase due to larger volumes of water allocated to downstream uses. All normal flows released to the river passes through the plant.

The renewal of the contract for the hydropower plant and potential increase in power development capacity open the opportunity to secure a portion of the additional power capacity to be able to pump some water from the dam to the top of the divide between the Olifants River and the Jan Dissels River. With a balancing dam at this location, water can gravitate to a large irrigable area along the Jan Dissels River that could enable new viable irrigation developments by HDIs on municipal land.

4 Summary

This report provides an analysis of the existing water use and current water allocations in the study area.

The MAR of the Olifants River in its natural state was 1 055 million m^3/a, but developments in the Olifants River catchment have resulted in a 32% streamflow reduction. The proposed raising of the dam could increase the dam's storage to about 100% of the MAR.

The various water requirements in the area consist of the ecological Reserve, irrigation of crops, municipal water supply, and mining and industrial water use.

The scheduled water entitlements for irrigation purposes within the Government Water Schemes and Irrigation Boards are 12 200 m^3/ha/a, as per the terms of Section 33 of the National Water Act, 1998. The scheduled water allocations for irrigation from the Clanwilliam Dam amount to a total of approximately 139 million m^3/a. However, water users are not able to fully utilise their water allocations due to restricted summer allowance ranging from 5 100 m^3/ha to 8 600 m^3/ha over the past 10 years.

The average municipal water use over the past three years for the Cederberg and Matzikama municipalities in the study area were 1.44 million m^3/a and 4.78 million m^3/a respectively.

Mining and industrial water use make up a smaller portion of the total water use, with an average consumption over the last three years of 1.88 million m^3/a and 0.52 million m^3/a respectively.

A summary of the current water allocations and requirements in the study area is provided in **Table 4.1**.

Table 4.1 | Summary of current water allocation and requirements in the study area

Sector	Sub-sector	Volume (million m^3/a)
Water User Associations	Clanwilliam WUA	20.00
	LORWUA	120.31
Municipalities	Cederberg	1.44
	Matzikama	4.78
Mines	Heavy minerals, Lime	1.88
Industries	Cellars, food processing	0.52
Hydro power	Power generation	0
Water losses	Distribution, evaporation	30.00
Total		**178.93**

5 References

Department of Agriculture, Western Cape, South Africa. 2013. Natural Resources Development Report. Prepared by James Cullis of Aurecon South Africa (Pty) Ltd as part of the Clanwilliam Dam Raising: Utilisation of Additional Water Study.

Department of Water Affairs and Forestry, South Africa. 2009. *System Analysis*. Prepared by A Sparks and J Cullis of Ninham Shand (Pty) Ltd and A Brown and Z Sulieman of DWAF as part of the Feasibility Study for the Raising of Clanwilliam Dam. DWAF Report No. P WMA 17/E10/00/0609.

Department of Water Affairs and Forestry, South Africa. 2008. *Main Report*. Prepared by E van der Berg of Ninham Shand (Pty) Ltd as part of the Feasibility Study for the Raising of Clanwilliam Dam. DWAF Report No. P WMA 17/E10/00/1907.

Department of Water Affairs and Forestry, South Africa. 2007. *Water Management Plan for the Olifants-Doorn Catchment Management Area*. Prepared by S J de Wet of S J de Wet Consulting Services as part of the Feasibility Study for the Raising of Clanwilliam Dam. DWAF Report No. P WMA 17/E10/00/1207.

Western Cape Department of Agriculture - Status of Agricultural Economy Lower Olifants River, 2017

Johan Matthee, LORWUA CEO, – Personal Communication, October 2017

Aurecon South Africa (Pty) Ltd
1977/003711/07

Aurecon Centre
1 Century City Drive
Waterford Precinct
Century City
Cape Town
7441

PO Box 494
Cape Town
8000
South Africa

T +27 21 526 9400
F +27 21 526 9500
E capetown@aurecongroup.com
W aurecongroup.com