water & sanitation

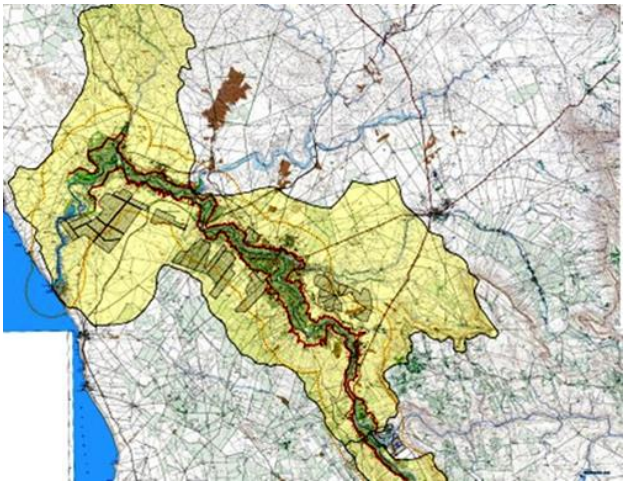
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

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

Distribution of Additional Available Water Report





July 2018

Department of Water and Sanitation
Directorate: Options Analysis

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

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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

DISTRIBUTION OF ADDITIONAL AVAILABLE WATER

Final: July 2018

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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.
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.

Report Index	Report Number	Report Title and Description of Content
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

The Clanwilliam Dam is located on the Olifants River in the Western Cape near the town of Clanwilliam. To comply with current dam safety standards applicable for extreme events, the Department of Water and Sanitation (DWS) plans to implement remedial measures on the Clanwilliam Dam in the near future. This presents an opportunity to raise the full supply level (fsl), since the marginal cost of raising, over and above the cost of the strengthening of the dam wall, proved to be economically viable.

A 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 offers a unique opportunity to make water available to augment the water supply to the existing scheduled irrigation area, towns and industrial use, as well as to provide additional water for new irrigation areas to establish emerging farmers to support water allocation reform.

The objective of the Post Feasibility Bridging Study for the Proposed Bulk Conveyance Infrastructure from the Raised Clanwilliam Dam is to provide recommendations on the bulk conveyance infrastructure required for the equitable distribution of the existing and additional water from the raised Clanwilliam Dam. A specific objective is to identify ways in which the additional yield, made available through the increased storage capacity of the Dam, can be used to meet the study objective. The resultant increase in the capacity of the dam from 122 million m^3 to 344 million m^3 will provide an additional yield of 82 million m^3 per annum. The allocation of water use must ensure that the available natural resources of the area are used to the greatest benefit to society.

The additional water will firstly be used to meet the ecological water requirements of the Olifants River below the dam. Some of the additional water will be used to provide irrigation water to existing irrigators at a higher level of assurance. There is a large need to use additional water made available through the raising of the Clanwilliam Dam to support historically disadvantaged farming projects and other broad-based black economic

empowerment opportunities. The largest portion of available additional water will be used for this purpose.

The scheme provides the option of either large-scale development for historically disadvantaged individuals (HDIs) or incremental development over time, depending on the flexibility in terms of funding of the scheme. A suite of opportunities is suggested. These include:

- Encourage black commercial farmers and investors
- Support for joint ventures between existing commercial farmers and HDIs
- Establishment of a Development Company (DEVCO) to co-ordinate the development
- Commercial farmers to provide sufficient land and water to existing farm workers

A small volume of water will also be used to improve the low assurance of supply of municipalities. This will not increase their current water entitlements but will provide better assurance to avoid the current regular restrictions experienced due to limited water availability.

The future development of HDI farmers, or for other development opportunities that may arise in the future can be phased in. This may allow for uncertainties relating to climate change, losses and improving the assurance of supply of existing users. Not all available water needs to be allocated immediately unless there is a sufficient equity demand to take up this water.

It has previously been deduced that the availability of land with suitable soil for irrigated agriculture is not a limiting factor to the expansion of irrigation in the study area, following the extensive soil survey undertaken during the Feasibility Study. Due to the advanced farming technology and management skills that exist in the intensely developed sections of the catchment, most of the inherent soil limitations do not pose any serious constraints to irrigation development.

Possibilities of the geographic distribution of potential water allocations are briefly introduced. These include:

- Area upstream of Clanwilliam Dam,
- Clanwilliam Dam catchment,
- Jan Dissels River catchment,
- Area between Clanwilliam Dam and Bulshoek Weir,
- Area downstream of Bulshoek Weir along the Olifants River,
- Area downstream of Bulshoek Weir from the System,
- Ebenhaeser community supply,
- Provision of water to non-agricultural users,
- Jackals River Area, Sandveld.

A summary of the proposed distribution of the available yield to existing users and future allocations is provided. It is proposed that water allocation be based on a recurrence interval of 1:10 years, which is typical for agricultural irrigation. This should be acceptable, as the other uses are very small compared to the current and proposed future irrigation water use.

The future requirement for industrial, domestic and mining use is 0.6 million m^3/a. In accordance with the approved DWS rule for distribution of the remaining additional available yield of 81.6 million m^3/a, 75% of the remaining available yield should be allocated to new emerging farmer dominant projects, which amounts to 61.1 million m^3/a.

At the relevant assurance of supply for respective existing water use sectors, at least 15.8 million m^3/a is needed to enable them to use their appropriate quotas on the existing allocated entitlements. For the 25% remaining additional yield of 81.4 million m^3/a (that can be allocated to existing farmers), i.e. 20.3 million m^3/a, the balance of 4.5 million m^3/a need not be immediately allocated. The unallocated portion could provisionally not be taken up, to cater for the uncertainty of climate change and available hydrology in the system, until better trends become known through monitoring and research. Such an arrangement can be reviewed as needed.

Table E1 summarises the potential take-up of the additional available yield from the raising of the Clanwilliam Dam to the respective water user groups. It is recommended that the take-up of the additional water be phased in.

Table E1 | Summary table for distribution of additional yield (million m^3/a)

Proposed Allocation	Volume (million m^3/a) 97% assurance of supply	Volume (million m^3/a) 91% assurance of supply
1. Increase reliability to existing water users		15.2
2. New domestic, industrial and mining use	0.6	
3. New emerging farmer irrigation development		61.1
4. Unallocated portion of increased assurance of supply to existing users		5.1
Proposed Allocation Totals	**0.6**	**81.4**

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Acronyms

BH	Bulshoek
CW	Clanwilliam
CWD	Clanwilliam Dam
DEVCO	Development company
DWAF	Department of Water and Forestry
DWS	Department of Water and Sanitation
EWR	Ecological water requirements
fsl	full supply level
HFY	Historical firm yield
IRR	Internal Rate of Return
JV	Joint Venture
LORWUA	Lower Olifants River Water User Association
MAR	Mean annual runoff
ORGWS	Olifants River (Vanrhynsdorp) Government Water Scheme
ORSA	Olifants River System Analysis
VSB	Vredendal Saamwerk Boerdery
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. In order to comply with current dam safety standards applicable for extreme events, the Department of Water and Sanitation (DWS) plans to implement remedial measures on the Clanwilliam Dam in the near future. This presents an opportunity to raise the full supply level (fsl), since the marginal cost of raising, over and above the cost of the strengthening, is economically viable.

A feasibility study was completed in 2008, which 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, to augment the water supply to the existing scheduled irrigation areas, towns and industrial use, as well as to provide additional water for new irrigation areas to establish emerging farmers.

The Olifants River Valley, like much of South Africa, is characterised by significant income and social disparities and fluctuating seasonal unemployment. The potential raising of Clanwilliam Dam offers a unique opportunity to make water available to address some of these issues by supporting water allocation reform. The objective of the Post Feasibility Bridging Study for the Proposed Bulk Conveyance Infrastructure from the Raised Clanwilliam Dam is to provide recommendations on the bulk conveyance infrastructure required for the equitable distribution of the existing and additional water from the Dam. An overview is provided of the ways in which the additional yield, made available through the increased storage capacity of the Dam, can be used to meet the study objective, whilst more detail will be provided in later reports. It must ensure that the available natural resources of the area are used to the greatest benefit to society.

The potential for water to be used as a tool for addressing some of these development issues has been identified and is articulated in the purpose of the National Water Act, which, among other things is intended to:

- Promote the equitable access to water (Section 2.b);
- Redress the results of past racial and gender discrimination (Section 2.c);
- Promote the efficient, sustainable and beneficial use of water in the public interest (Section 2.d); and
- Facilitate social and economic development (Section 2.e).

1.2 Purpose and Structure of this Report

It is important to determine the volume of additional water available for development, after water has been reserved for the current water uses listed in the Current Water Use and Allocation Report undertaken for this study. The capacity of the dam will increase from approximately 122 million m^3 to 321 million m^3 to be approximately equal to the mean annual runoff (MAR) of the Olifants River, which will result in an additional yield of 82.1 million m^3 per annum.

The additional yield (of the available water resource) should be distributed among the current and future water uses in the Clanwilliam Dam supply area and be divided between the various users, namely for:

a) Ecological water requirements (EWR), also referred to as the ecological Reserve;
b) Agricultural irrigated areas (improve the assurance of supply to existing allocations);
c) Agricultural water supply to new emerging farmers;
d) Domestic water uses in towns and other communities;
e) Industrial water use; and
f) Provision for system losses.

The determination process of the EWR recommended that the status quo should be maintained for releases made from Clanwilliam Dam. The EWR further stipulated that the development of large in-stream dams in the Doring River should be restricted to compensate for the ecological flow deficit in the Olifants River up to the Doring River confluence. The base flows entering the estuary should be maintained at approximately 1.5 m^3/s throughout the year. This base flow will have to be met by return flows or by releases from Bulshoek Weir only when needed. The measuring station at Lutzville will have to be upgraded to measure these low flows.

The current policy of the DWS regarding water allocation reform and access to water by emerging farmers will be considered for the allocation of water from the raised Clanwilliam Dam. There is a need to use additional water made available to support emerging farming projects and other

broad-based black economic empowerment opportunities. Various options to effect this are detailed for further investigation and implementation.

Estimates are made in this report of the volumes of water required to improve the assurance of supply for current users, as well as the volumes that can be allocated for new water uses from the additional yield that will be available from a raised Clanwilliam Dam. Improving the assurance of supply to existing users would not involve an actual change in water allocations, but only an improvement in the reliability of the supply.

The availability of land with suitable soil for irrigated agriculture is not a limiting factor to the expansion of irrigation in the study area (Feasibility Study for the Raising of the Clanwilliam Dam). Infrastructural and other limitations however influence the delivery of water. An overview of the geographic distribution of potential future development options is provided in this report, with respective associated potential. The potential for agricultural development will be revisited later in the study.

Summaries of the additional yield available from a raised Clanwilliam Dam are provided, and volumes for an improved assurance of supply for current users and for new use by the various water use sectors are recommended.

1.3 Study Area

The study area mainly comprises the Clanwilliam Dam supply area, which is located within the Cederberg and Matzikama Local Municipalities, and includes the towns of Clanwilliam, Klawer, Lutzville and Vredendal. The study area may potentially include portions of the Olifants River valley upstream of Clanwilliam Dam. Some activities may even extend the study area to the larger catchment area, such as the Jackals River. **Figure 1.1** shows a map of the larger Olifants-Doorn Catchment 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 Water Resource Availability and Yield

2.1 Introduction

Detailed analysis and modelling of the existing and potential water resource availability in the Olifants River Catchment resulting from the proposed raising of the Clanwilliam Dam was done as part of the Feasibility Study for the Raising of the Clanwilliam Dam and is presented in the System Analysis Report (DWA, 2007) of that study. A summary of these results, as interpreted for the anticipated raising of the dam by 13 m, is provided in Table 6.1 and Figure 6.1 of that report.

2.2 Modelling of the Historical System

Inflows to Clanwilliam Dam were inferred using the 'reverse mass balance' method. Inflows were then compared with historical inflow determined in the Olifants River System Analysis (ORSA). For the system analysis, the streamflows generated during the original ORSA were retained because they were deemed to be acceptable following evaluation. The natural MAR of the Olifants River above the Clanwilliam Dam is 356 million m^3/a.

The historical inflow sequence derived was checked to see how accurately it simulated the historical behaviour of the system. The simulated historical sequence generally compares very favourably with the actual sequence. The average supply from the Olifants River (Vanrhynsdorp) Government Water Scheme (ORGWS) (Clanwilliam Dam and Bulshoek Weir) to users over the 25 years before 2008 was estimated as 174 million m^3/a, although during droughts the supply would have been curtailed.

2.3 Scenarios Analysed

Various scenarios were analysed, using the Water Resources Yield Model (WRYM), to determine the historical yields of the system for the existing (unraised) dam and for three different dam raisings of 5 m, 10 m and 15 m. The scenarios also determined the influence on yield of making

releases from Clanwilliam Dam to meet the ecological water requirements (EWRs) downstream of the Bulshoek Weir and at the estuary.

The yield for a 13 m dam raising was determined by interpolating the results for the 10 m and 15 m raising.

Flows from the Doring River were assumed to supply the winter flood requirements at the estuary. A minimum summer base flow of 1.5 m^3/s was maintained as part of the simulations at the causeway at Lutzville. During the peak summer irrigation months, up to 1.2 m^3/s is supplied by return flows from irrigation along the Lower Olifants River Canal. The shortfall in the base flow was augmented by modelled releases from Clanwilliam Dam.

2.4 Yield

The Historical Firm Yield (HFY) that was derived in the feasibility study from historical streamflow sequences is given in **Table 2.1**. The provisional allocation/distribution of the available yield to various components of the system is also given. These include the average annual diversions to the Clanwilliam Canal and the Lower Olifants River Water User Association (LORWUA) Canal, abstractions between Clanwilliam Dam and Bulshoek Weir, and losses to evaporation and evapo-transpiration between Clanwilliam Dam and Bulshoek Weir. **Table 2.1** shows the anticipated yield and allocation thereof as was determined during the Feasibility Study for the raising of Clanwilliam Dam in 2008 and is quoted here without changes for information and comparison only. These yields have now been revised as detailed in Table 5.1. The proposed distribution of available additional water is also detailed further in the report and tabled in Table 5.1.

Table 2.1 | Anticipated yield from the raising of the Clanwilliam Dam in million m^3/a
(As per Feasibility Study for the Raising of Clanwilliam Dam)

Yield breakdown		Historical	Future
		HFY	Feasibility Study
Scenario	Raising (m)	0	13
	Clanwilliam Dam (CWD) Capacity (million m^3)	122	321
Breakdown of Yield by use / demand components	Clanwilliam (CW) Canal	10	10
	Bulshoek (BH) canal - LORWUA	98	98
	CWD evaporation (already deducted from yield)	n/a	n/a
	BH Weir evaporation	2	2
	Evapotranspiration between CWD and BH	1.6	1.6
	Pumps from CWD to Irrigation and CW Town	3.1	3.1
	Pump d/s CWD (allocation)	16	16

Yield breakdown		Historical	Future
		HFY	Feasibility Study
	Pumps d/s CWD (above allocation)	2.3	2.3
	Increase reliability to existing users (provisional)		18
	Additional distribution		51
	BH releases (incorporated)		
	River and canal losses (incorporated)		
Breakdown of Yield by EWR components		**133**	**202**
EWR	Drought EWR	16	16
	Extra for Class E EWR base flow		5
	Extra for high flow EWR		0
Total		**149**	**223**

If the Clanwilliam Dam is raised, it will no longer spill almost annually as is currently the case. This reduction in spillage will have a negative impact on the environmental conditions downstream. To compensate for this, the EWR base flow releases from the Bulshoek Weir were increased from the (present) 'drought' level to class E. The HFY for a scenario making class E base flow releases for 10 m and 15 m raisings was 192 million m^3/a and 206 million m^3/a respectively. By interpolating, using a fitted curve (as opposed to a straight line), a HFY for a 13 m raising was estimated as 202 million m^3/a.

If no EWR releases are made, then the yield from Clanwilliam Dam for a 13 m dam raising would be 223 million m^3/a, obtained from interpolating between the yields of 213 million m^3/a for a 10 m raising and 227 million m^3/a for a 15 m raising.

The anticipated total additional yield resulting from a 13 m raising of the dam wall is approximately 74 million m^3/a.

2.5 Impact of Upstream Development Options

Modelling of the impacts of storage upstream of Clanwilliam Dam indicated that additional upstream storage (farm dams) leads to a reduction of the available yield from Clanwilliam Dam of approximately 75% of the additional storage provided upstream of the dam. In other words, if a new farm dam of 1 million m^3 storage capacity is developed upstream of the Clanwilliam Dam, then the impact of this dam will be to reduce the available yield from the Clanwilliam Dam by approximately 0.75 million m^3/a. For the system analysis undertaken for the Dam Raising Feasibility Study, the combined volume of the farm dams upstream of Clanwilliam Dam taken into

account was 34.3 million m^3. This corresponds very well with the results of the recently completed Validation and Verification study undertaken by DWS, of 34.17 million m^3, during the qualifying period.

3 Options for Distribution of Additional Water

The raising of Clanwilliam Dam is a favourable option because it introduces a limited suite of associated environmental and social impacts. There is a need to use the additional water made available through the raising of the Clanwilliam Dam to support emerging farming projects and other broad-based black economic empowerment opportunities. This development provides flexibility in terms of supplying potential beneficiaries and creating opportunities and development options for emerging farmers, also in terms of the location of new irrigation developments and crop varieties.

This scheme provides the option of either large-scale development for emerging farmers or incremental development over time, depending on the flexibility in terms of funding of the scheme. There is no single solution to address all the issues concerned, and it is proposed that a suite of opportunities be explored. It is also not possible at this stage to exactly quantify how much water needs to be set aside to support these individual initiatives. To achieve the desired objectives, the proposed way forward is described in this chapter.

3.1 Ecological Water Requirements

The ecological Reserve determination process recommended that the status quo should be maintained and that no additional releases be made from Clanwilliam Dam. However, a multi-level outlet structure will be constructed to also make targeted releases for the immediately downstream endemic yellow fish community. Agricultural development and associated large in-stream dams in the Doring River must be restricted to compensate for the ecological flow deficit in the Olifants River up to the Doring River confluence, to limit the downstream effect on the river and the estuary due to the raised Clanwilliam Dam.

The implementation of the EWR will provide socio-economic benefits associated with a healthy aquatic ecosystem. Benefits could come through tourism ventures, such as the Vleiland Project, or through direct dependence such as the Ebenhaeser fishermen and other communities, both

inside and outside of the study area, that are dependent on the fish that use the estuary for breeding. Meeting the EWR therefore has an important equity component.

Increasing the EWR to a 'drought' EWR reduces the available yields by about 14 million m^3/a. Further increasing the EWR to a class 'E' base flow reduces the available yield by an additional 7 million m^3/a. These releases from Bulshoek Weir are about 21 million m^3/a.

The modelled impact of meeting the 1.5 m^3/s base flow at Lutzville is minor, as it is covered by the assumed 20% return flow from irrigation, even if no explicit EWR releases are made from Bulshoek Weir. However, in practice, the return flows may not reach Lutzville. The System Analysis Report of the Feasibility Study (DWS Report No. P WMA 17/E10/00/0607) shows that in some drought years the streamflow at Lutzville reduces to about 0.5 m^3/s. If this reduction is due to unauthorised abstraction then the abstraction should be stopped, or alternatively, additional releases of 1.0 m^3/s would be required from Bulshoek Weir for say 6 months of the year. This would equate to releases of 16 million m^3/a.

If no EWR releases are made, the yield from Clanwilliam Dam for a 13 m dam raising would be 223 million m^3/a. The EWR releases, described above, reduce the available yield with 21 million m^3/a of which 16 million m^3/a is needed to meet the drought EWR and an additional 5 million m^3/a is required to raise the EWR from the drought requirement to class E. No extra high flow releases are considered other than potential spillages (which will be significantly reduced as a result of the dam raising) as these higher flows must be provided from the Doring River.

3.2 Improving the Assurance of Supply for Existing Users

Farmers currently receive, and in the past received, water at an unacceptably low assurance of supply (**Figure 3.1**). The yield analysis previously undertaken estimates the current assurance of supply at around the 1:10 year level, although it may be lower in practice. The need has been expressed to improve the overall assurance of supply for the ORGWS. Improving the assurance of supply to existing users would not involve actual changes in water allocations, but only an improvement of the reliability at which the water is supplied. This would benefit current irrigators during periods of drought and provide for more assured agricultural planning, so that they can be more certain of obtaining preferably their full quota, but at least an increased percentage of their quota in very dry years. This could have a significant socio-economic benefit for the area, which had not been quantified when this report was being compiled.

The current low assurance of supply is evident in the restricted quotas applied during the last 10 years, ranging from only 5 100 $m^3/ha/a$ to 8 600 $m^3/ha/a$ over the summer season.

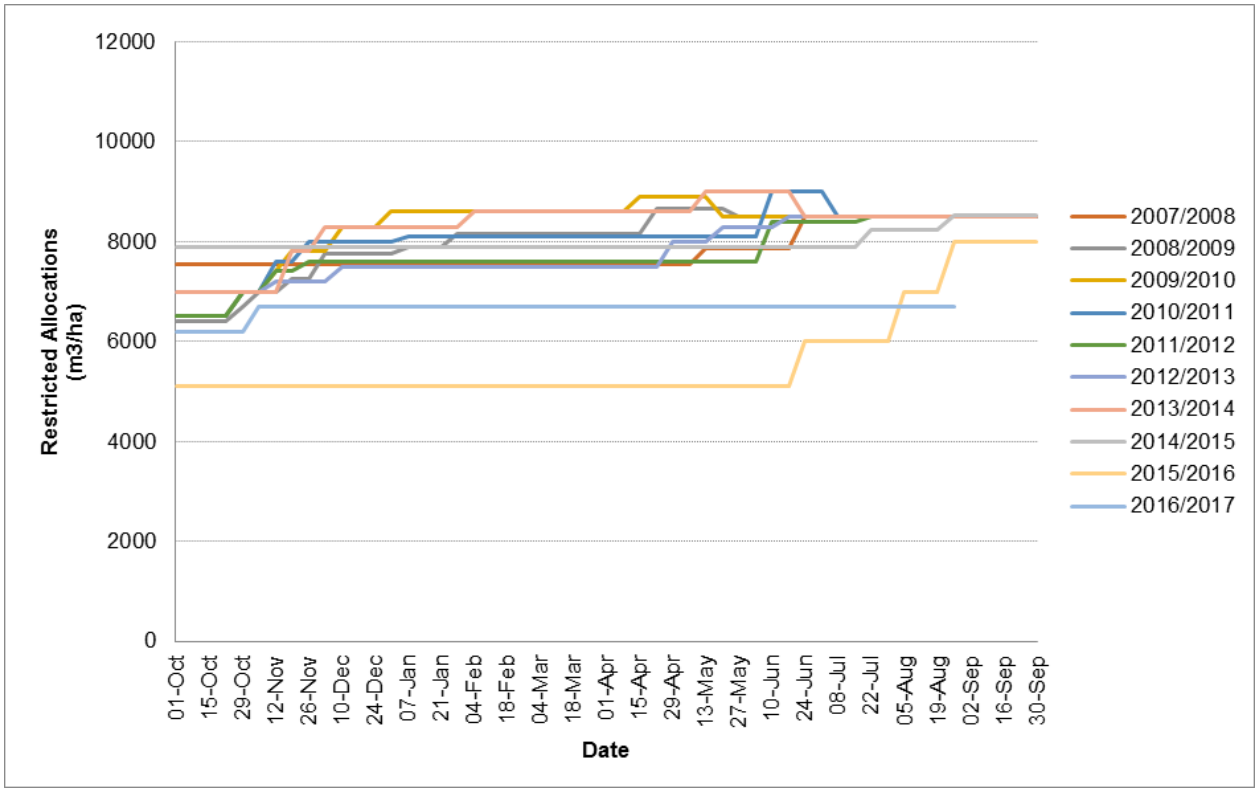

Figure 3.1 | **Quota restrictions during specific periods of the year for the period 2007-2017**

Due to the restrictions during the critical summer months of October to April, farmers cannot use the full water allocation of 12 200 m^3/ha/a from the scheme. **Table 3.1** indicates the volumes and equivalent use per hectare that was used from the LORWUA canal over the period 2010 to 2017.

Table 3.1 | Water use volumes and equivalent use per hectare over the period 2010-2017

Period	Irrigation use (million m^3/a)	Equivalent use per hectare (m^3/ha/a)	Percentage of full allocation quota
2010/2011	80.6	8 395	69%
2011/2012	80.7	8 408	69%
2012/2013	75.5	7 869	65%
2013/2014	77.7	8 095	66%
2014/2015	72.6	7 562	62%
2015/2016	62.4	6 501	53%
2016/2017	58.1	6 055	50%

An improvement in the assurance of supply to existing irrigation farmers is economically sound as it was shown in the Dam Raising Feasibility study to be the most economically viable option for increasing the irrigation potential of the study area. An important decision that needs to be made is whether this should be considered as additional allocation or whether a certain volume should be allocated to increase the assurance of supply, based on existing allocations.

One of the recommendations in the Main Report of the Feasibility Study for the Raising of Clanwilliam Dam was that: '*The LORWUA should indicate to what extent they wish to take up a portion of the increased yield of the ORGWS, to improve the assurance of supply of the scheme'*. Neither the LORWUA not the Clanwilliam Water Association had to date provided their requirements in this regard.

According to Section 4.2.3 of the System Analysis Report of the Feasibility Study, the irrigators at the time in 2007 received 80% of their theoretical allocation. In the period 2010 to 2017, irrigators received less than 70%, and even as low as 53%, of their formal allocation of the scheduled water use entitlements.

Large restrictions are experienced in the current 2017/18 season, with the dam level being less than 40%. With a severely restricted quota of 1 700 m^3 for the summer months, farmers investigated the possibility of pumping groundwater into the canal to improve the water supply.

3.3 Encourage Black Commercial Farmers and Investors

It is the perception among prospective black farmers that sole ownership is the most desirable business model for commercial farmers, although severe challenges are encountered with the sustainability thereof. In an effort to support emerging farmers, opportunities to support private black commercial farmers or investors must be encouraged. These could either be individuals or groups of individuals who have proven themselves by successfully farming on commonage land, such as the Vredendal Saamwerk Boerdery (VSB), or new farmers and investors looking for commercial opportunities in the area. Support for these farmers can be provided by providing water allocations, grants for developing infrastructure, and training by farmer organisations and commercial farmers.

3.4 Providing Additional Water to the Municipalities

The provision of additional water to the municipalities will support the growing domestic water requirements and the increase in industrial water requirements, particularly of the Matzikama Municipality. Most of this water would be used to directly support socio-economic development

needs through the provision of domestic needs, employment and support for broad-based black economic empowerment (BBBEE) industrial projects.

There are currently several successful commonage schemes in both municipalities. The potential allocation of additional water to these schemes should be focused on providing basic livelihood support and food security, while those farmers who have proved to be successful at this scale, such as the VSB, should be given the opportunity to expand into fully commercial agriculture as mentioned in the paragraph above.

Provision will be made for water to be provided to emerging farmers. Several possibilities exist for the distribution and use of such additional allocations to be made, that will be outlined in following reports.

3.5 Household use provided from Bulshoek Canal

Water for household purposes and for limited irrigation is currently supplied from the Bulshoek canal to farms by means of separate household connections. Although the design of these off-takes are standardised, the volume taken per farm is potentially excessive for Schedule 1 water use and this will be investigated with the aim of reducing such use, as done in other schemes. At present an average annual volume of 1.98 million m^3/a is supplied over the whole scheme.

3.6 Hydropower Operation

The only power station in the area is a small privately-owned hydro-electric installation 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 and connected to the national grid and augment electricity supplies to the town of Clanwilliam and also supply electricity to some farmers.

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

The contractual agreements need to be renegotiated with the developer. A possible opportunity exists to make some power available for a scheme to pump water over the ridge to the Jan Dissels River valley at an affordable cost where land is available for irrigation development projects by emerging farmers.

3.7 Phasing the uptake of additional water

Water for the future development of emerging farmers, or for other development opportunities that may arise in the future, or for improved assurance of supply can be phased in. This may allow for uncertainties relating to the hydrology, climate change and losses. Not all available water need to be allocated immediately, even if there is a sufficient equity demand to take up this water. If some surplus remains, it could be held over until equity users come to the fore or uncertainties have been resolved. Where appropriate, this water could be leased out temporarily to existing commercial farmers until such future development opportunities are established and more certainty obtained on climate change influences.

4 Geographic Distribution of New Water Development

4.1 Availability of Land, Crops and Requirements for Irrigation

It can be deduced that the availability of land with suitable soil for irrigated agriculture is not a limiting factor to the expansion of irrigation in the study area, following the extensive soil survey undertaken during the Feasibility Study. Due to the advanced farming technology and management skills that exist in the intensely developed sections of the catchment, most of the inherent soil limitations do not pose any serious constraints to irrigation development.

Permanent crops make up 80% of the planted area and cash crops (20%) are mainly grown in the winter along the river below Clanwilliam Dam. There are a variety of cash crops, with vegetables and wheat being the significant ones. Wine grapes as well as citrus are the main permanent crops. The irrigation systems used in the area comprise of centre pivots, drip systems, micro sprinklers and flood irrigation, with drip irrigation being the most common method of irrigation for permanent crops.

Potential areas for the distribution and use of additional water are briefly introduced here and will be further described in following reports.

4.2 Area Upstream of Clanwilliam Dam

The expansion of citrus farming (the main crop) within the Olifants River catchment in the area upstream of the Clanwilliam Dam (i.e. the expansion of existing irrigation development), or the development of new irrigation farms is not envisaged to be economical in most cases, mainly due to the expected relatively high cost of irrigation infrastructure, specifically the need for off-channel farm dams, as farmers are relying on run-of-river flow.

There may be opportunities for some farmers who wish to fully utilise existing infrastructure. The building of off-channel storage dams will reduce the effective storage in Clanwilliam Dam by about 75% of the capacity of such off-channel dams. The viability of this and the contribution such farmers can make must be further investigated.

4.3 Direct Supply from Clanwilliam Dam

There are 407 ha of scheduled water use entitlements for irrigation from the Clanwilliam Dam.

Clanwilliam town takes most of its water from the Jan Dissels River and some from the Clanwilliam Dam. The compulsory licensing process restricted the taking of water between the months of December to February from the Jan Dissels River, but not from the Clanwilliam Dam. Due to the lack of funds to implement the required infrastructure to take water from the dam, this abstraction option has not yet been implemented. The quantity of water to be taken from the Clanwilliam Dam has been assumed in the available yield calculations.

4.4 Jan Dissels River Catchment

The confluence of the Jan Dissels River with the Olifants River is just below Clanwilliam town, with the catchment stretching past the town from a south-western direction, parallel to the Olifants River. Potential for additional irrigable land for use by emerging farmer groups has been identified higher up in the catchment on municipal land.

4.5 Area between Clanwilliam Dam and Bulshoek Weir

The area between Clanwilliam Dam and Bulshoek Weir has the advantage that users are not reliant on bulk distribution infrastructure only. The canal does have some additional capacity that can be utilised. The DWS is the owner of the canal, but the operation and maintenance of the scheme is delegated to the Clanwilliam Water User Association. The operation and maintenance of the canal can be improved to ensure a better utilisation of water.

Water can also be pumped directly from the river for irrigation because the river in that stretch is used for the conveyance of irrigation water.

Some areas are irrigated from the Bulshoek Weir, although fluctuating water levels cause operational challenges.

4.6 Area Downstream of Bulshoek Weir along the Olifants River

Some farmers downstream of Bulshoek Weir are pumping water from the Olifants River under a concession allowed in 1963. This irrigation was possible due to leakages and run-off from Bulshoek Weir and not due to specific releases. Water availability is therefore not guaranteed.

A possible location for new development would be on the right bank of the river just downstream of Bulshoek Weir, up to the confluence of the Doring River.

4.7 Area Downstream of Bulshoek Weir along the Canal System

Bulshoek Weir diverts water into the canals managed by LORWUA. The weir was built in 1914 and has 16 sluice gates. During the summer season from 1 October to 30 April, the available water released to the LORWUA Canal is accordingly capped at a maximum of 8 400 m^3/ha/a. The design capacity of the canal was 290 m^3/ha/week but with improvements in capacity it can supply up to 325 m^3/ha/week for the scheduled area at an equivalent of 9 600 ha (taking into account the industrial and municipal uses). The canal has a maximum capacity of 26 000 m^3/h (7.22 m^3/s).

If the canal can carry 325 m^3/ha for 30 weeks and 200 m^3/ha for 12 weeks (the remaining 10 weeks are dry periods for maintenance work), it can theoretically deliver 12 150 m^3/ha to all properties, provided there are no restrictions of available water. Balancing dams would be needed but are not available for each user due to limited space and other factors. The peak requirements of the crops in summer therefore limit the water availability in the rest of the year. This limits the ability to effectively use a high percentage of the annual quota should there be no restriction of water availability.

The canal starts on the left bank of the river from Bulshoek Weir up to the N7 road crossing over the Olifants River. Here the canal splits with one part continuing on the left bank to Vredendal and Ebenhaeser, and the other part crossing the river through a pipe on a bridge. On the right bank, the canal splits again into the Doring River canal flowing in an upstream direction towards the Doring River, whilst the larger part is flowing along the right bank of the river towards Lutzville and Koekenaap. **Figure 1.1** provides a map of the area and key infrastructure.

If the canal had a larger carrying capacity, more water could be made available for irrigation downstream of Bulshoek Weir.

4.8 Ebenhaeser Community Supply

Ebenhaeser is a community located at the end of the left bank of the LORWUA canal system. There are 156 plots with 1.65 ha of water each. The total scheduled water use entitlements to Ebenhaeser is 257 ha at 12 200 m^3/ha/a. Available suitable land and bulk water supply for irrigation is, for now, adequate at Ebenhaeser. A balancing dam was built just upstream of Ebenhaeser that regulates the flow to the community very well. The problems with erratic water supply in past years have now to a large degree been resolved.

The current water supply system for irrigation is under-utilised. Internal distribution of irrigation water through unlined canals that are not properly maintained, is deemed unacceptable, and requires attention. There is a need to investigate the potential to supply each of the plots with a reliable supply of water. Better agricultural and community management is also needed.

Domestic water is supplied by the Matzikama municipality.

4.9 Provision of Water to Non-Agricultural Users

There is currently an increase in the growth of other small industrial water requirements in the Vredendal area. Increasing the allocation of water to these emerging Small, Micro and Medium Enterprises, mainly through increasing the allocation to the Municipality, should be considered in the light of promoting local economic development in the area, and provision must be made for this.

Planning must allow for possible growth trends. Having said this, urban and light industries are not large individual users of water in the area. It is unlikely that such use will compete significantly with agriculture for any additional water made available by the raising of the Clanwilliam Dam wall.

Applications from non-agricultural users would have to be evaluated on merit, but some allowance should be made for the future uptake of non-agricultural use. The estimated additional future requirement for urban and industrial water use and for mines is 1.9 million m^3/a. The uptake on non-agricultural use that can benefit the poor would need special attention to ensure that it does not fall through the cracks.

4.10 Jackals River Area

Good potential irrigable soils exist along the Jackals River in the Sandveld Area. The Jackals River is a seasonal river that originate on the mountain slopes west of Clanwilliam, flows westwards towards the Atlantic Ocean and terminates in Jackalsvlei pan at Lamberts Bay. This rural area is extensively farmed. Most of the current irrigation development, for mainly potato crops, in the region are supported by groundwater. It is technically possible to transfer water over the watershed from the Clanwilliam Dam to this area.

5 Summary of Recommended Allocations

A summary of the proposed distribution and later allocation of the available yield from the raised Clanwilliam Dam to existing and future users' allocations is provided in **Table 5.1**. The values in this table were updated from those determined previously in the Feasibility Study for the Raising of the Clanwilliam Dam.

Respective yields were determined for the 1:10 and 1:20 recurrence periods. It is proposed that water allocation be based on a recurrence interval of 1:10 years, which is the generally accepted assurance of supply for irrigated agriculture in South Africa. This should be acceptable, as the other uses, who require a higher assurance of supply, are very small compared to the current and prospective irrigation water use.

5.1 Yields

Yields determined for the current status and the raising of the dam by 13 m are shown in **Table 5.1** in Section A – Yields. The yield, before consideration of the EWR, will increase from 175 to 263 million m^3 per annum, thus with 88 million m^3/a, based on a 1:10 year return period.

5.2 Ecological Water Requirements

The Feasibility Study for the Raising of the Clanwilliam Dam concluded that the estuary could be maintained in its present ecological category C, even if the Clanwilliam Dam was raised by up to 15 m, and if only the summer base flow EWR was released for the reach between Bulshoek Weir and the confluence with the Doring River, taking into account that the summer return flows from irrigation below Bulshoek Weir to the estuary would increase with increased usage.

As indicated in **Table 5.1** in Section B – EWR, increasing the EWR to a 'drought' EWR reduces the yields by about 14 million m^3/a. Further increasing the EWR to a class 'E' base flow reduces the yield by an additional 7 million m^3/a. The EWR has the highest priority, after the small domestic use, and is shown in **Table 5.1** to be adhered to first.

The total available yield after supplying the EWR requirements first in a 1:10 year return period is 242 million m^3/a after the raising of the dam.

5.3 Losses

Losses through canal and river distribution were determined and indicated in **Table 5.1** in Section C – Losses. Average percentages for losses of 27% for Bulshoek (LORWUA) canals and 30% for Clanwilliam Canal have been accepted for the determination of available yield. The assured assurance of supply was accepted as 91% of the original allocation and losses were calculated based thereon. A weighted quota of 11 100 m^3/ha/a is 91% of the original entitlements, to adjust for appropriate assurance of supply. Evapotranspiration between Clanwilliam Dam and Bulshoek Weir has been assumed to be constant after the Clanwilliam Dam is raised and flows in this river section increase. The total additional losses catered for after the raising of the dam and the improvement of assurance of supply for current users is 24.6 – 15.8 = 5.8 million m^3/a. The percentage losses can increase when severe restrictions are in place.

The total available water for distribution after accounting for losses and EWR is 206.6 million m^3/a. for a 1:10 return period after raising the dam. This leaves an additional available yield after raising of the dam of 82.0 million m^3/a.

5.4 Proposed allocations

Proposed allocations are set out in **Table 5.1** in Section D – Allocations.

The requirements of the Clanwilliam town have been assumed as 50% of current usage. During the compulsory licensing process of the Jan Dissels River it was decided that only winter water should be abstracted from the Jan Dissels River and water use in summer must be drawn from the Clanwilliam Dam. Only limited water was historically drawn from the dam due to lack of infrastructure and funding. It has been assumed that future water to be taken from the raised dam would require a new allocation.

Allocations of current irrigation water users have been reassessed and adjusted to the actual hectares of scheduled entitlements as per the Lists of Rateable Areas of the water user associations. These entitlements were declared as existing lawful uses and may be used in future. The effective quotas have been interpolated to match the respective yields available.

Actual use of water has been calculated as the crop/water requirement quota times the relevant assurance of supply percentage. According to policy of the DWS, the assurance of supply for irrigation water use is deemed to be 91% (70% of the time at full quota and 30% of the time at

70% of the quota). For municipalities and industries, the assurance is deemed to be 97% (70% of the time at full quota and 30% of the time at 90% of the allocation).

This 91% assurance of supply is not met at present. The additional volume to reach this level of assurance has been allowed and indicated for each WUA area at a 1:10 assurance of supply, following an evaluation of the system analysis previously undertaken. The water uses above the current status without raising the dam is thus to increase the assurance of supply. This is in line with national policy guidelines and no additional water use entitlements are made to existing agricultural users. The net increases are indicated in the last column of **Table 5.1**.

The total increase in yield at a 1:10 year assurance of supply, with the raising of the Clanwilliam Dam is 82.0 million m^3/a. Allowing a total of 0.6 million m^3/a for domestic, industrial and mining use (at a 97% assurance of supply), this leaves 81.4 million m^3/a to allocate for irrigation.

There is an approved DWS rule for the Clanwilliam Dam Raising that 75% of the additional available water should be allocated to emerging farmer projects, and 25% can be utilised to improve the assurance of supply for current irrigators. Since other identified future uses besides irrigation is very small (only 0.6 million m^3/a), this rule is applied to the amount of water left after other uses have been supplied, i.e. to 82.0 – 0.6 = 81.4 million m^3/a.

The required increase in assurance of supply for the existing users at the relevant assurance of supply and full use of scheduled allocations is 15.2 million m^3/a. This leaves an allocable yield of 66.2 million m^3/a.

5.5 Allocable water

In accordance with the rule for distribution of the additional available yield, 75% of the available remaining additional yield of 81.4 million m^3/a should be allocated to new emerging farmer dominant projects, which amounts to 61.1 million m^3/a. At the relevant assurance of supply for respective existing water users, at least 15.2 million m^3/a is needed to enable them to use their appropriate quotas on the existing allocated entitlements. In addition, the future requirement for industrial, domestic and mining use is 0.6 million m^3/a. From the remaining 25% of the remaining additional yield of 81.4 million m^3/a, i.e. 20.3 million m^3/a, a balance of 5.1 million m^3/a need not immediately be allocated. The yield and additional available water shown in Table 5.1, used for further calculations, are based on 1:10 year return periods and 91% assurance of supply for agricultural irrigation water uses and 97% assurance of supply for urban and industrial water uses, according to the standard policy of the DWS. The HFY and 1:20 year return period values are only provided for comparison purposes.

Table 5.1 | Summary of the proposed allocation of available yield

Component		Loss (%) scheduled areas (ha)	Current		Future (after 13 m raising)			Improved Assurance of Supply (1:10 yr)
			HFY	1 in 10	HFY	1 in 20	1 in 10	
A. Yield	Raising (m)		0	0	13	13	13	
	Clanwilliam Dam Capacity (million m^3)		122	122	321	321	321	
	Reported gross yield (including losses) (million m^3/a)		**149**	**175**	**221**	**251**	**263**	
B. EWR	Drought EWR		16	14	14	14	14	
	Extra for Class E EWR base flow		0	7	7	7	7	
	Extra for high flow EWR		0	0	0	0	0	
	Total EWR		*16*	*21*	*21*	*21*	*21*	
Available	**Total Available water after supplying EWR (million m^3/a)**		**133**	**154**	**200**	**230**	**242**	
C. Proposed Allocations for Domestic and Industrial	Clanwilliam town and urban and industrial use (assuming partial supply from the dam in summer with the remainder supplied from the Jan Dissels River) (1) **To be supplied at 97% assurance of supply. Additional Domestic and Industrial water demands for Matzikama LM is included in part E of this table.**	50%	0	0	0.6	0.6	0.6	
Available	**Total Available water for distribution after accounting for EWR and domestic, industrial and mining use (million m^3/a)**			**154**	**199.4**	**229.4**	**241.4**	
D. Losses	Clanwilliam Dam evaporation (already deducted from yield)		n/a	n/a	n/a	n/a	n/a	
	Bulshoek Weir evaporation (already deducted from yield)		2	n/a	n/a	n/a	n/a	
	Evapotranspiration between CWD and Bulshoek (2)		1.6	1.6	1.6	1.6	1.6	

Component		Loss (%) scheduled areas (ha)	Current		Future (after 13 m raising)			Improved Assurance of Supply (1:10 yr)
			HFY	1 in 10	HFY	1 in 20	1 in 10	
	Clanwilliam Canal losses (30%)	30%		1.7	2.1	2.1	2.0	
	Bulshoek Canal losses (27%)	27%		26.3	32.5	32.5	31.8	
	Bulshoek Weir leakage			0.0	0.0	0.0	0.0	
	Total Losses			*29.6*	*36.2*	*36.2*	*35.4*	
Available	**Total Available water for distribution after accounting for EWR, domestic, industrial and mining use and losses (million m^3/a)**			**124.4**	**163.2**	**193.2**	**206.0**	
E. Proposed Allocations for Current Users	Effective irrigation allocation m^3/ha/a (3)			9 900	11 100[1]	11 100[1]	11 100[1]	91% assurance
	Irrigators abstracting from Clanwilliam Dam (3)	408 ha	3.1	4.0	4.5	4.5	4.5	4.5 - 4.0 = 0.5
	Clanwilliam Canal (3)	564 ha	10	5.6	6.3	6.3	6.3	6.3 - 5.6 = 0.7
	Irrigators between Clanwilliam Dam and Bulshoek Weir (3)	665 ha	6.0	6.6	7.4	7.4	7.4	7.4 - 6.6 = 0.8
	Bulshoek Canal – Irrigation (3)	9 862 ha	98	97.6	109.5	109.5	109.5	109.5-97.6 = 11.9
	Bulshoek Canal – urban, industrial and mines (4)			10.7	12.0	12.0	12.0	12.0 - 10.7 = 1.3
	Total Allocations at effective irrigation allocation assurance			*124.5*	*139.8*	*139.8*	*139.8*	
F. Available for Distribution to Emerging Farmers and unallocated	**Total Available water for Distribution to Emerging Farmers after accounting for current allocations and increased assurance of supply to existing irrigators(5) and unallocated (million m^3/a)**			0	23.4	53.4	**66.2**	
							Total for improved assurance of supply (million m^3/a)	**15.2**

Notes:

1) *An allowance has been included under section C to provide for the additional distribution of domestic, industrial and mining use of 0.6 million m^3/a in the Clanwilliam area.*

2) *The evapotranspiration loss allowed for under section D is only a small component of the losses and has been calculated by evapotranspiration area x evapotranspiration rate. Additional losses would occur if the water supply system was allowed to run dry and pools needed to be filled or if irrigators intercepted the releases, and possibly also should irrigators switch their abstraction from the Jan Dissels River to the Olifants River.*

3) *Effective irrigation allocations for the proportioning of yield, as detailed in section E, has been determined at 91% assurance of supply, thus 11 100 m^3/ha/a. The water uses for respective scheduled areas for the irrigators abstracting from the Clanwilliam Dam, Clanwilliam canal, between Clanwilliam Dam and Bulshoek Weir and the Bulshoek canal have been calculated at a 91% assurance of supply.*

4) *Additional industrial, urban and mining uses from the Bulshoek canal are provided at 1.3 m^3/a, as indicated in section E. Additional needs will have to be met through a reduction in losses or by upgrading of the Bulshoek canal.*

5) *For the calculation in Section F it has been assumed that the effective irrigation allocation for additional allocations will also be 12 200 m^3/ha/a at a 91% assurance of supply**,** thus 11 100 m^3/ha/a, although this will be revisited later in the study.*

5.6 Proposed Allocation of Additional Yield

Table 5.2 summarises the potential allocation of the additional available yield from the raising of the Clanwilliam Dam to the respective water user groups.

Table 5.2 | Summary table for distribution of additional yield (million m^3/a)

Proposed Allocation	Volume (million m^3/a) 97% assurance of supply	Volume (million m^3/a) 91% assurance of supply
1. Increase reliability to existing water users		15.2
2. New domestic, industrial and mining use	0.6	
3. New emerging farmer irrigation development		61.1
4. Unallocated portion of increased assurance of supply to existing users		5.1
Proposed Allocation Totals	**0.6**	**81.4**

5.7 Phasing of development

It is recommended that the take-up of additional available water be prioritised and phased, to *inter-alia* cater for the uncertainty of climate change and changing hydrology in the system, available funding, and prospective new irrigators, until better trends becomes known through monitoring and research. Should confidence in the information be improved, the system will be supplied at a slightly higher reliability, until such time as hydrological uncertainties can be resolved, such as e.g. incorporating the influence of the recent drought in the hydrology.

Some water can provisionally not be allocated. If the unallocated portion is set aside this amounts to 4.5 million m^3/a. This arrangement can be reviewed as needed.

6 References

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