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Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments

ECOSYSTEM SERVICES CONSEQUENCES REPORT

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Department of Water and Sanitation

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PROJECT NUMBER**:** WP 11387

Ecosystem Services Consequences Report

CLASSIFICATION OF SIGNIFICANT WATER RESOURCES AND DETERMINATION OF RESOURCE QUALITY OBJECTIVES FOR WATER RESOURCES IN THE USUTU TO MHLATHUZE CATCHMENTS

JULY 2023

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2	WEM/WMA3/4/00/CON/CLA/0222	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Status Quo and Delineation of Integrated Units of Analysis and Resource Unit Report**
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	WEM/WMA3/4/00/CON/CLA/0123, volume 2	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Ecological Consequences Report, Volume 2: Estuaries**
15	WEM/WMA3/4/00/CON/CLA/0323	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Ecosystem Services Consequences Report**
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Shaded Grey indicates this report.

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EXECUTIVE SUMMARY

BACKGROUND

Chapter 3 of the National Water Act, 1998 (NWA) (Act 36 of 1998), deals with the protection of water resources. Section 12 of the NWA requires the Minister to develop a system to classify water resources. In response to this, the Water Resource Classification System (WRCS) was gazetted on 17 September 2010 and published in the Government Gazette no. 33541 as Regulation 810. The WRCS is a step-wise process, whereby water resources are categorised according to specific classes that represent a management vision of a particular catchment. This vision takes into account, the current state of the water resource, the ecological, social, and economic aspects that are dependent on the resource. Once significant water resources have been classified through the WRCS, Resource Quality Objectives (RQOs) have to be determined to give effect to the class.

The Chief Directorate: Water Ecosystems Management (CD: WEM) of the Department of Water and Sanitation (DWS), initiated a study to determine the Water Resource Classes and RQOs for all significant water resources in the Usutu to Mhlathuze Catchment. The Usutu to Mhlathuze Catchments are amongst many water-stressed catchments in South Africa. These catchment areas are important for conservation, and contain a number of protected areas such as natural heritage sites, cultural and historic sites, as well as other conservation areas that need protection.

STUDY AREA

The study area is the Usutu to Mhlathuze Catchment, which has been divided into six drainage areas, as well as secondary catchment areas:

- W1 catchment (main river: Mhlathuze).
- W2 catchment (main river: Umfolozi).
- W3 catchment (main river: Mkuze).
- W4 catchment (main river: Pongola) - part of this catchment area falls within Eswatini.
- W5 catchment (main river: Usutu) - much of this catchment falls within Eswatini.
- W7 catchment (Kosi Bay and Lake Sibaya).

PURPOSE OF THIS REPORT

The purpose of this report is to describe and document the Ecological Goods and Services Attributes (EGSA) responses to the scenarios.

METHOD

An EGSA analysis of multiple sites within the study area was undertaken. This included a profile of EGSA associated with each site, keeping in mind they represent a wider area, and thereafter assessed against the planning scenarios applicable to the site.

Specifically an analysis of the sites on the Amatigulu River, Nseleni, Black Mfolozi, White Mfolozi, Mkuze, Pongola, Assegai and Ngwempisi was undertaken. For the Estuaries, the aMatigulu/Nyoni, iSiyaya, uMLalalzi, uMhlathuze and iNhlabane were examined.

EGSA associated with the sites, bearing in mind that they represent a wider area, were listed and where they were deemed to generate value they were evaluated against the scenarios applicable

to the site. A list of the relevant EGSA that were found in the various reaches examined, and deemed to be significant, was generated as a table. These were cross checked with the biophysical experts that formed part of the project team at a specialist (remote) workshop held during 2023.

The biophysical specialists then identified the potential change that each of the key Ecosystems Services (ESS) may undergo in each of the scenario clusters. The potential change was noted as a factor and used in later calculations. For example, no change = 1, a 50% increase = 1.5, and a 20% decrease = 0.8.

The scenario impact on various ESS (including botanical or fish species) were then amalgamated into overall categorisation of provisioning, regulating, cultural, and supporting services. The scenarios are also weighted with respect to the importance of the services at each EWR site. As such the score given to each of the services when the sub quaternary (SQ) catchments are evaluated is examined against the nature of the particular Ecological Water Requirement (EWR) site and associated area. In an instance where regulating services, for example are deemed to be important, then these services are given a higher weight. The same goes for the other services. All weightings are normalised against a base score of 1. Where all four services are deemed to be of equal importance then a score of 0.25 would be allocated to each. In this instance, given the relatively homogenous nature of the sites and the socio-economic dependant the weightings given remained constant across sites.

The process to determine an integrated ranking of the different scenarios required determining the relative importance of the different EWR sites was undertaken. The perceived vulnerability of households dependent on the provisioning aspect of ESS played a major role. Again all scores were normalised against a base score of 1.

RESULTS

Given the relatively high abundance of natural resources within the Water Management Area (WMA) and the moderate and high utilisation of these resources, the provisioning services are given the highest weighting of 0.4. Regulating and cultural services are provided an equal weighting of 0.2 and 0.3 respectively. Supporting services are given the lowest weighting of 0.1.

In the main, and for the River analysis, the scenarios that were examined showed only marginal to moderate envisaged changes from the baseline. The Estuary results were more marked. Some of the estuaries, notable the iNhlabane, are in a very poor state and scenarios that examined a programme of restoration interventions showed a dramatic potential for recovery of Ecological Goods and Services. Climate change scenarios, and those that were linked to developmental inputs that require reduced flows to the estuaries, had notable significant negative impacts on Ecological Goods and Services.

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TERMINOLOGY AND ACRONYMS

CD: WEM	Chief Directorate: Water Ecosystems Management
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EGSA	Ecological Goods and Services Attributes
ESS	Ecosystems Services
EWR	Ecological Water Requirement
GIS	Geographic Information System
HFY	High Flow Yield
IUA	Integrated Unit of Analysis
IWRM	Integrated Water Resource Management
MAR	Mean Annual Runoff
MEA	Millennium Ecosystems Assessment
MWAAS	Mhlathuze Water Availability Assessment Study
NWA	National Water Act
PSP	Professional Service Provider
REC	Recommended Ecological Category
RQO	Resource Quality Objective
Sc	Scenario
SCI	Socio Cultural Importance
SQ	Sub Quaternary
WMA	Water Management Area
WRCS	Water Resource Classification System
WTW	Water Treatment Works
WWTW	Waste Water Treatment Works

SPELLING

There are multiple references to the spelling of various Rivers, Lakes, Dams and Estuaries, depending on the source of information. For the purposes of this report, the following Table presents the selected spelling of indicated water resources and places.

Selected Spelling for this Study	Alternate spellings
Usutu River	Usuthu River
Mhlathuze River	Mhlatuze, uMhlatuze River
Pongola (river, Town & Pongolapoort Dam)	Phongola, Phongolo
Lake Sibaya	Lake Sibiya, Lake Sibhayi, Lake Sibhaya
Eswatini	eSwatini
Umfolozi River	Mfolozi River
Amatigulu River	Amatikulu, Matigulu River
Goedertrouw Dam	Lake Phobane
Mfuli River	Mefule River
aMatigulu/iNyoni Estuary	
Sibiya Estuary	
Mlalazi Estuary	
uMhlathuze /Richards Bay Estuary	
iNhlabane Estuary	
uMfolozi/uMsunduze Estuary	
St Lucia Estuary	
uMgobezeleni Estuary	
Kosi Estuary	
Hluhluwe Game Reserve	
iMfolozi Game Reserve	
Ithala Game Reserve	
Ndumo Game Reserve	
Tembe Elephant Reserve	
iSimangaliso Wetland Park	
Kosi Bay and Coastal Forest Area	
uMkhuze Game Reserve	

GLOSSARY

Ecological Water Requirements (EWR)	The flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition. This term is used to refer to both the quantity and quality components.
Integrated Unit of Analysis (IUAs)	An IUA is a homogeneous area that can be managed as an entity. It is the basic unit of assessment for the Classification of water resources, and is defined by areas that can be managed together in terms of water resource operations, quality, socio-economics and ecosystem services.
Resource Quality Objectives (RQOs)	RQOs are numeric or descriptive goals or objectives that can be monitored for compliance to the Water Resource Classification, for each part of each water resource. “The purpose of setting RQOs is to establish clear goals relating to the quality of the relevant water resources” (NWA, 1998).
Scenario	Scenarios, in the context of water resource management and planning, are plausible definitions (settings) of factors (variables) that influence the water balance and water quality in a catchment and the system as a whole. Each scenario represents an alternative future condition, generally reflecting a change to the present condition.
Sub-quaternary (SQ) reaches	A finer subdivision of the quaternary catchments (the catchment areas of tributaries of main stem rivers in quaternary catchments), to a sub-quaternary reach.
Target Ecological Category (TEC)	This is the ecological category toward which a water resource will be managed once the Classification process has been completed and the Reserve has been finalised. The draft TECs are therefore related to the draft Classes and selected scenario.
Water Resource Class	The Water Resource Class (hereafter referred to as Class) is representative of those attributes that the DWS (as the custodian) and society require of different water resources. The decision-making toward a Class requires a wide range of trade-offs to be assessed and evaluated at a number of scales. Final outcome of the process is a set of desired characteristics for use and ecological condition of the water resources in a given catchment. The WRCS defines three management classes, Class I, II, and III, based on extent of use and alteration of ecological condition from the predevelopment condition.

1 INTRODUCTION

1.1 BACKGROUND

Chapter 3 of the National Water Act, 1998 (NWA) (Act 36 of 1998), deals with the protection of water resources. Section 12 of the NWA requires the Minister develop a system to classify water resources. In response to this, the Water Resource Classification System (WRCS) was gazetted on 17 September 2010 and published in Government Gazette 33541 as Regulation 810. The WRCS is a stepwise process whereby water resources are categorised according to specific classes that represent a management vision of a particular catchment. This vision takes into account the current state of the water resource, the ecological, social and economic aspects that are dependent on the resource. Once significant water resources have been classified through the WRCS, Resource Quality Objectives (RQOs) must be determined to give effect to the class. The implementation of the WRCS therefore assesses the costs and benefits associated with utilisation versus protection of a water resource. Section 13 of the NWA requires that Water Resource Classes and RQOs be determined for all significant water resources.

Thus, the Chief Directorate: Water Ecosystems Management (CD: WEM) of the Department of Water and Sanitation (DWS) initiated a study for determining the Water Resource Classes and RQOs for all significant water resources in the Usutu to Mhlathuze Catchment. The Usutu to Mhlathuze Catchments are amongst many water-stressed catchments in South Africa. These catchment areas are important for conservation and contain a number of protected areas, natural heritage sites, cultural and historic sites as well as other conservation areas that need protection. There are five RAMSAR[1] sites within the catchment, which includes the world heritage site, St Lucia. The others are Sibaya, Kosi Bay, Ndumo Game Reserve and Turtle Beaches.

1.2 STUDY AREA

The study area is the Usutu to Mhlathuze Catchment that has been divided into six drainage areas and secondary catchment areas as follows (refer to the locality map provided as **Figure 1.1**):

- W1 catchment (main river: Mhlathuze).
- W2 catchment (main river: Umfolozi).
- W3 catchment (main river: Mkuze).
- W4 catchment (main river: Pongola) - part of this catchment area falls within Eswatini.
- W5 catchment (main river: Usutu) - much of this catchment falls within Eswatini.
- W7 catchment (Kosi Bay estuary and Lake Sibaya).

Note that all assessments within Eswatini are excluded apart from the hydrological modelling required to assess any downstream rivers in South Africa that either run through Eswatini or originate (source) in Eswatini.

River Ecological Water Requirements (EWR) sites are shown on **Figure 1.1**.

[1] A Ramsar site is a wetland site designated to be of international importance under the Ramsar Convention, also known as "The Convention on Wetlands", an intergovernmental environmental treaty established in 1971 by UNESCO in the Iranian city of Ramsar, which came into force in 1975.

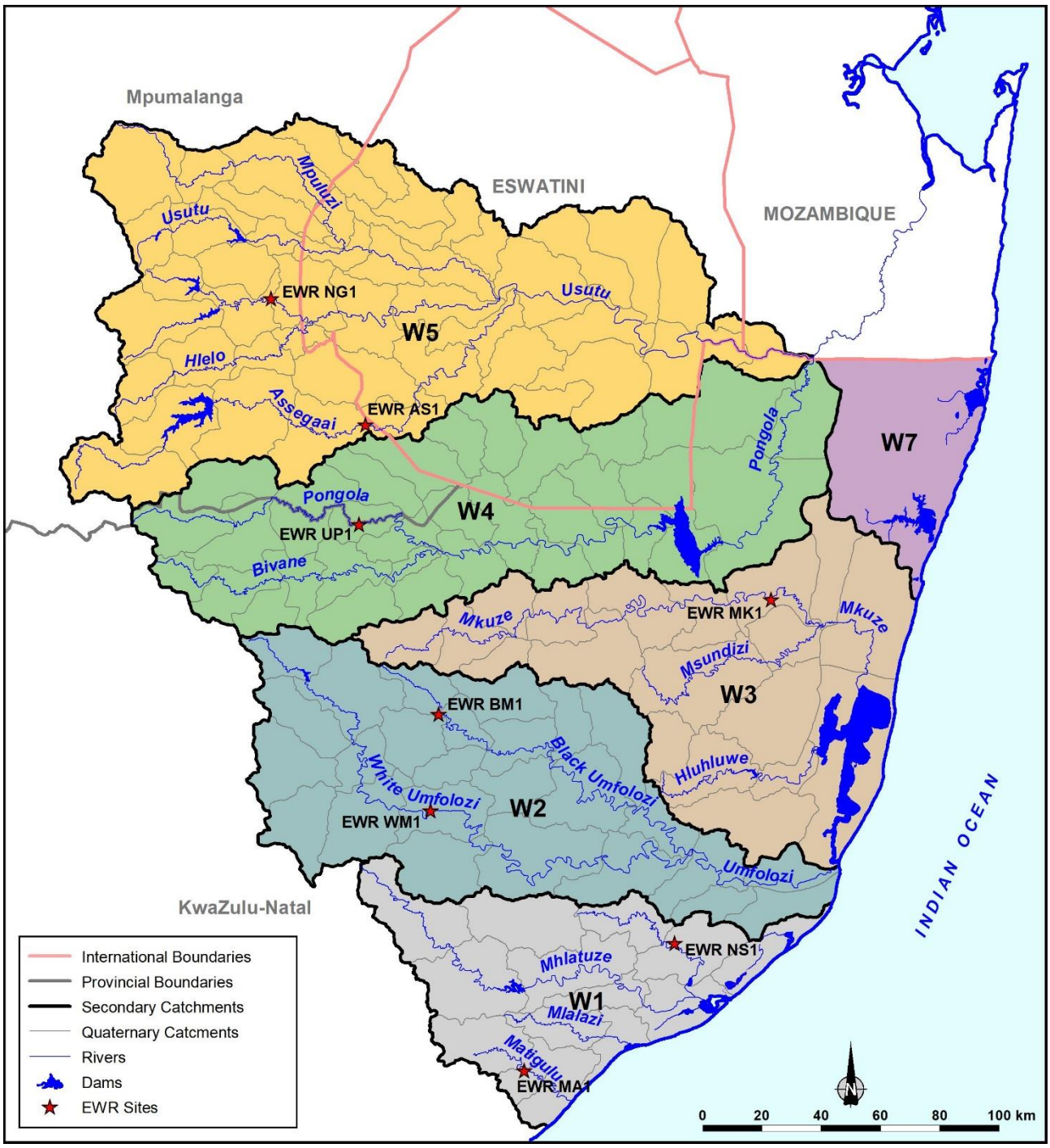

Figure 1.1 Locality Map of the Study Area showing EWR sites

1.3 PURPOSE OF THIS REPORT

The purpose of this report is to describe and document the consequences of the operational scenarios on Ecosystem Services (ESS) in the applicable catchments within the Water Management Area (WMA). This report presents the approach and methodology used to evaluate the different operational scenarios as well as the results obtained in terms of economic variables.

The results form part of Task 4: Identify and Evaluate scenarios within Integrated Water Resource Management (IWRM) (**Figure 1.2**).

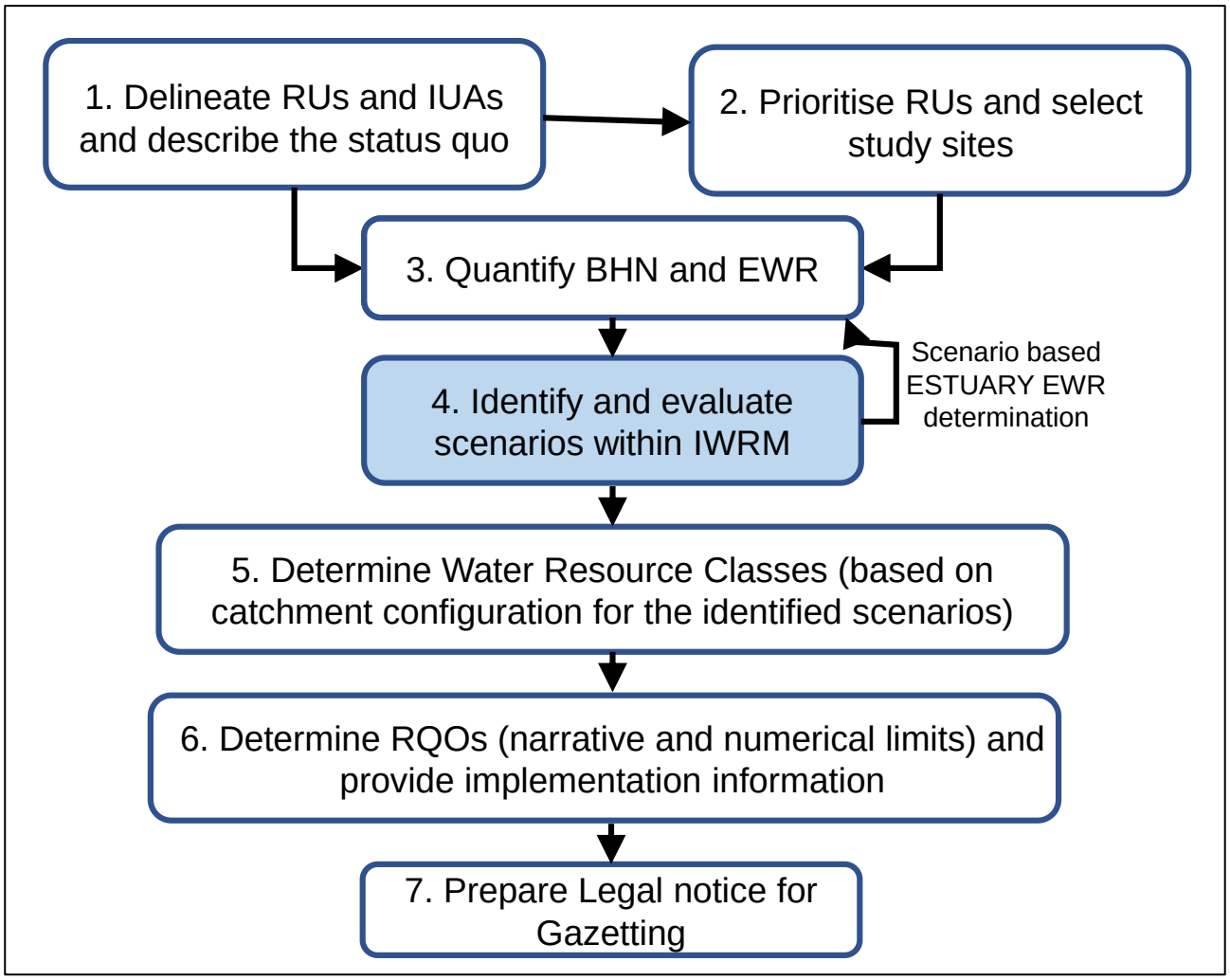

Figure 1.2 Project Plan for the Usutu-Mhlathuze Classification study

1.4 REPORT OUTLINE

The report outline is as follows:

- **Chapter 1** This Chapter provides general background to the project Task.
- **Chapter 2** provides a summary of the different scenarios assessed.
- **Chapter 3** outlines the approach used during this study to determine the ESS consequences of the operational scenarios.
- **Chapter 4** The results of the different operational scenarios for each of the catchments are presented in terms of the ESS values as assessed.
- **Chapter 5** lists the references used in the report.

2 SCENARIO DESCRIPTION

Scenarios, in the context of water resource management and planning are plausible definitions (settings) of all the factors (variables) that influence the water balance and water quality in a catchment and the system as a whole. The scale (resolution) of the analysis requires the aggregation of land-use effects, and therefore individual and localised small-scale developments will not significantly influence the classification of a water resource. However significant small-scale impacts on priority water resources should be managed by setting the RQOs at the specific point to protect the said water resource, especially in the case of sensitive aquatic resources.

Possible variables that make up scenarios have been identified for the Usutu-Mhlathuze Catchments. These variables have been combined into different scenarios which are described in (DWS, 2022). The variables and scenarios are illustrated in matrices that show scenario naming and which variables are applicable to each scenario. The operational scenarios are based on flow related aspects and not on non-flow related aspects. Mitigation measures to address non-flow related aspects will be identified and will be addressed as part of the RQO identification process.

The range of scenarios and associated variables were presented and discussed with the DWS and stakeholders, and a final (representative) range selected for the purposes of modelling and scenario assessment. The detailed descriptions of the scenarios and their resulting flows are included in the Scenario description report produced as part of this study (DWS, 2022). A summary table of the final scenarios that were assessed from a rivers, estuary or both (rivers and estuary) perspective is included in **Table 2.1**. EWR sites are indicated where present in the Integrated Unit of Analysis (IUA).

Table 2.1 Description of river flow related scenarios (DWS, 2022)

IUA[1]	Scenario			Type
	#	Abbrev.	Description	
W11	1	CC	Climate Change.	Both, including MA1
	2	-20%MAR[2]	Reduction of present day MAR by 20%.	Matigulu Estuary
	3	-30%MAR	Reduction of present day MAR by 30%.	Matigulu Estuary
	4	+15%MAR	Increase of present day MAR by 15%.	Matigulu Estuary
	5		Present with non-flow restoration interventions including active restoration of the riparian area undertaken in conjunction with a reduction in harvesting and grazing pressures on the macrophytes. Fishing pressure (especially illegal gill netting) is reduced and recreational activities such as boating are controlled. Recreational activities in the lower reaches are curbed through zonation and improved compliance.	Matigulu Estuary
W12-a	1	CC	Climate Change.	Rivers
W12-b	1	CC	Climate Change.	Rivers, including NS1
W12-c	1	CC	Climate Change.	Both
	2	+15%MAR	Increase of present day MAR by 15%.	uMhlathuze Estuary
	3	2030	2030 year projected water requirements on the system (including increased transfer from Thukela to Goedertrouw).	uMhlathuze Estuary
	4	2040	2040 year projected water requirements on the system (including increased transfer from Thukela to Goedertrouw).	uMhlathuze Estuary
W12-d	1	CC	Climate Change.	Both
	2	EWR	Present Day including EWR releases from Lake Nhlabane as obtained from Mhlathuze Water Availability Assessment Study (MWAAS - DWAF, 2009).	iNhlabane Estuary
	3	Rest	Restoration Scenario 1 to allow for mouth breaching each year.	iNhlabane Estuary
	4	Rest/Int	Restoration and interventions Scenario 2.	iNhlabane Estuary
W12-e	1	CC	Climate Change.	Rivers and Lake Msingazi
W13	1	CC	Climate Change.	Both
	2	-15%MAR	Reduction of present day MAR by 15% (SIYAYA).	Mlalazi and Siyaya estuaries
	3	+15%MAR	Increase of present day MAR by 15% (SIYAYA).	Mlalazi and Siyaya estuaries
	4	WWTW	Present day including the upgrade of the Mtunzini Waste Water Treatment Works (WWTW) increased to a 1.5 Ml/d plant (Mlalazi).	Mlalazi and Siyaya estuaries

IUA[1]	Scenario			Type
	#	Abbrev.	Description	
	5	Sc1	Present day including additional demand of 10% on present day MAR supplied by Eshowe Dam with an increased capacity of 15 million m^3 (Mlalazi).	Mlalazi and Siyaya estuaries
	6	Sc2	Present day reduced by 10% through abstraction from lower reaches of river (Mlalazi).	Mlalazi and Siyaya estuaries
	7	Sc3	Present day reduced by 20% through abstraction from lower reaches of river (Mlalazi).	Mlalazi and Siyaya estuaries
	8	Sc4	Scenario 3 including additional demand of 10% on present day MAR supplied by Eshowe Dam with an increased capacity of 20 million m^3 (Mlalazi).	Mlalazi and Siyaya estuaries
	9	Sc5	Restoration/Intervention Scenario 1: Mlalazi Estuary= REC; Siyaya Estuary= PES.	Mlalazi and Siyaya estuaries
	10	Sc6	Restoration/Intervention Scenario 2: Mlalazi Estuary= REC; Siyaya Estuary= REC.	Mlalazi and Siyaya estuaries
W21	1	CC	Climate Change.	Rivers, including. WM1
	2	HFY-noEWR	Historic Firm Yield (HFY) abstracted from upstream dams, no EWR.	Rivers, including. WM1
	3	HFYEWR	HFY abstracted from upstream dams, with EWR.	Rivers, including. WM1
	4	KLPEWR	Raised Klipfontein HFY abstracted from upstream dams, with EWR.	Rivers, including. WM1
W22	1	CC	Climate Change.	Rivers, including BM1
W23	1	CC	Climate Change.	Rivers
W31-a	1	CC	Climate Change.	Rivers
W31-b	1	CC	Climate Change.	Rivers, including MK1
	2	2040	Present Day with increased upstream domestic use.	Rivers, including MK1
	3	IRR	Present Day with increased return flows due to increased irrigation supplied from Pongolapoort Dam.	Rivers, including MK1
W32-a	1	CC	Climate Change.	Rivers
W32-b	1	CC	Climate Change.	Rivers
W41	1	CC	Climate Change.	Rivers
W42-a	1	CC	Climate Change.	Rivers, including UP1
	2	2040	Present Day with increased upstream domestic use (upgraded Frischgewaad Water Treatment Works - WTW).	Rivers, including UP1
W42-b	1	CC	Climate Change.	Rivers
W44	1	CC	Climate Change.	Rivers

IUA[1]	Scenario			Type
	#	Abbrev.	Description	
W45	1	CC	Climate Change.	Rivers and Pongola Floodplain
W51-a	1	CC	Climate Change.	Rivers
W51-b	1	CC	Climate Change.	Rivers
W52	1	CC	Climate Change.	Both, including AS1 and NG1
	2	2040	Present Day with increased upstream domestic use.	Rivers, including AS1 and NG1
	3	EWR	Present Day with EWR included.	Rivers, including AS1 and NG1
	4	noEWR	Present Day with no EWR.	Rivers, including AS1 and NG1
W55	1	CC	Climate Change.	Rivers, including Pans and Chrissiesmeer
W57	1	CC	Climate Change.	Rivers, including Ndumo Pans
W70-a	1	CC	Climate Change.	Both, including Kosi Lakes and Estuary
W70-Muzi Swamps	1	CC	Climate Change.	Muzi Swamps
W-70b	1	CC	Climate Change.	Both, including Lake Sibaya, uMgobezeleni Estuary
St Lucia	1	CC	Climate Change.	St Lucia, W2 and W3 feeder streams. W32-Mkuze Floodplain/Swamp

1 Mean Annual Runoff

3 APPROACH AND METHODOLOGY

The main aim of the scenario (Sc) evaluation process is to determine the appropriate balance between the level of environmental protection and the use of the water to sustain the status quo of socio-economic activities. Once the preferred scenario has been selected the Water Resource Class is defined by the level of environmental protection embedded in that scenario.

There are three main variables to consider in this integration process, namely the Ecology, Ecosystem Services and the Economic benefits obtained from the use of a portion of the water resource. The scenario evaluation process therefore estimates the consequences each scenario from a plausible set of scenarios will have on these variables. The evaluation process uses the quantification of selected metrics to compare the scenarios on a relative basis with one another.

3.1 OVERVIEW OF ECOLOGICAL GOODS AND SERVICES ATTRIBUTES AND THEIR VALUES

The Usutu-Mhlathuze Water Management Area, because of the nature of the communities that it intersects, plays an important role in maintaining important Ecological Goods, Services and Attributes (EGSA) on-site as well as other users. An EGSA is a product that emerges from processes or features within largely natural environments, which enhances human wellbeing and is directly used by people. Natural capital and associated ecosystem services are now becoming scarce and the Millennium Ecosystems Assessment (MEA) partitions ecosystems services into four broad categories:

- Provisioning services are the most familiar category of benefit, often referred to as ecosystem ‘goods’, such as foods, fuels, fibres, bio-chemicals, medicine, and genetic material, that are in many cases: directly consumed; subject to reasonably well-defined property rights (even in the case of genetic or biochemical material where patent rights protect novel products drawn from ecosystems); and are priced in the market.
- Cultural services are the less familiar services such as religious, spiritual, inspirational and aesthetic well-being derived from ecosystems, recreation, and traditional and scientific knowledge that are: mainly passive or non-use values of ecological resources (non-consumptive uses); that have poorly-developed markets (with the exception of ecotourism); and poorly-defined property rights (most cultural services are regulated by traditional customs, rights and obligations); but are still used directly by people and are therefore open to valuation.
- Regulating services are services, such as water purification, air quality regulation, climate regulation, disease regulation, or natural hazard regulation, that affect the impact of shocks and stresses to socio-ecological systems and are: public goods (globally in the case of disease or climate regulation) meaning that they “offer non-exclusive and non-rival benefits to particular communities” (Perrings, 2006); and are thus frequently undervalued in economic markets; many of these are indirectly used being intermediate in the provision of cultural or provisioning services.
- Supporting services are an additional set of ecosystem services referred to in the MEA, such as nutrient and water cycling, soil formation and primary production, that capture the basic ecosystem functions and processes that underpin all other services and thus: are embedded in those other services (indirectly used); and are not evaluated separately (Mander *et al*., 2007).

3.2 APPROACH

In terms of generating data for this report the most important step was to provide an integrated assessment of the current population of all areas. Analysis was undertaken using primary tools that were:

- Geographic Information System (GIS) overlays of quaternary catchments. Data was analysed to select areas in which populations likely to be dependent on riverine goods and services were possibly or probably present.
- Cross check of the GIS data sets with available mapping to determine likely livelihood styles and profiles.

A second level of analysis based on the typology of settlements in the area and their likely associated dependence on goods and services for livelihoods was undertaken for this report. This was sourced from information available and cross referenced with an examination of aerial photography, largely that provided by Google Earth. This allowed for an analysis of land use types associated with the settlement typology.

3.3 METHOD

An EGSA analysis of multiple sites within the study area was undertaken. This included a profile of EGSA associated with each site, keeping in mind they represent a wider area, and thereafter assessed against the planning scenarios applicable to the site.

Specifically an analysis of the sites on the Amatigulu River, Nseleni, Black Mfolozi, White Mfolozi, Mkuze, Pongola, Assegai and Ngwempisi was undertaken. For the Estuaries, the aMatigulu/Nyoni, iSiyaya, uMLalalzi, uMhlathuze and iNhlabane were examined (Refer to **Appendix A**)

EGSA associated with the sites, bearing in mind that they represent a wider area, were listed and where they were deemed to generate value they were evaluated against the scenarios applicable to the site. A list of the relevant EGSA that were found in the various reaches examined, and deemed to be significant, was generated as a table (**Appendix A**). These were cross checked with the biophysical experts that formed part of the project team at a specialist (remote) workshop held during 2023.

The biophysical specialists then identified the potential change that each of the key ESS may undergo in each of the scenario clusters. The potential change will be noted as a factor and used in later calculations. For example, no change = 1, a 50% increase = 1.5, and a 20% decrease = 0.8.

The scenario impact on various ESS (including botanical or fish species) were then amalgamated into overall categorisation of provisioning, regulating, cultural, and supporting services. The scenarios are also weighted with respect to the importance of the services at each EWR site. As such the score given to each of the services when the sub quaternary (SQ) catchments are evaluated is examined against the nature of the particular EWR site and associated area. Critical, to note is that the nature of the area and the impact on the resources is then examined against the receiving socio-economic environment and particularly the vulnerability of populations dependent on resources. In an instance where regulating services, for example are deemed to be important, then these services are given a higher weight. The same goes for the other services. All

weightings are normalised against a base score of 1. Where all four services are deemed to be of equal importance then a score of 0.25 would be allocated to each. In this instance, given the relatively homogenous nature of the sites and the socio-economic dependant the weightings given remained constant across sites.

4 RESULTS

4.1 RIVERS

4.1.1 Amatigulu River system

Given the relatively high abundance of natural resources and the moderate to high utilisation of these resources, the provisioning services are given the highest weighting of 0.4. Again it should be noted that giving a higher rating to provisioning services is largely driven by the nature of the impact on the receiving socio-economic environment. The key driving resources supplied by provisioning services in this instance were fish consumed for food, as well as nursery aspects of the prawn population.

Regulating and cultural services are provided weightings of 0.2 and 0.3 respectively. Supporting services are given the lowest weighting of 0.1.

Scenario 1 (MA1_CC) - Natural inflow scaled for climate change (**Table 2.1**), was assessed and resulted in a relatively static state in terms of ecosystem service functions (**Table 4.1**). Provisioning services (largely increase in abundance of utilised floral species) resulted in a positive reaction to the scenario, but this was balanced against the negative trajectory associated with the regulating services. The general deterioration of the of bio-physical riparian and catchment environment is having a key negative impact on regulating services, notably the ability of the river to assimilate and dilute waste and attenuate floods. This is caused by increased erosion in the catchment as well as the reoccur pressure that the reiver is under and increased levels of overall effluent and pollution. Cultural and supporting services, given the nature of their utilisation and the marginal changes associated are not impacted.

Table 4.1 Amatigulu River scenario rating

Service	Sc MA1_CC	Weight
Provisioning Services (P)	1.023	0.4
Regulating Services (R)	0.950	0.2
Cultural Services (C)	1.000	0.3
Supporting Services (S)	1.000	0.1
Weighted Score	**0.999**	**1**

4.1.2 Nseleni River system

This site has a moderate abundance of provisioning resources and moderate utilisation by local people, thus provisioning services are given the highest weighting of 0.4. Cultural service is weighted as 0.3 due to the utilisation of the river for recreational and subsistence fishing. Regulating and supporting services is given a weighting of 0.2 and 0.1 respectively.

Scenario 1 (NS1_CC) - Natural inflow scaled for climate change (**Table 2.1**), was assessed and resulted in a relatively static/marginally positive state in terms of ecosystem service functions (**Table 4.2**). Provisioning services (largely increase in sand winning) resulted in a positive reaction to the scenario, but this was balanced against the negative trajectory associated with the regulating services. Services examined included waste assimilation and dilution and flood attenuation.

Disservices including increases in bilharzia were also looked at. Cultural and supporting services, given the nature of their utilisation and the marginal changes associated are not impacted.

Table 4.2 Nseleni River scenario rating

Service	Sc NS1_CC	Weight
Provisioning Services (P)	1.0917	0.4
Regulating Services (R)	0.9550	0.2
Cultural Services (C)	1.0000	0.3
Supporting Services (S)	1.0000	0.1
Weighted Score	**1.0277**	**1**

4.1.3 Black Mfolozi River system

The EWR site provides provisioning services with respect to fish and a moderate abundance of riparian vegetation. Given the relatively high abundance of natural resources and the moderate to high utilisation of these resources in the proximate area by the receiving socio-economic environment, the provisioning services are given the highest weighting of 0.4. Regulating and cultural services are provided weightings of 0.2 and 0.3 respectively. Supporting services are given the lowest weighting of 0.1.

Again, a single scenario, Scenario 1 (Sc BM1_CC) - Natural inflow scaled for climate change (**Table 2.1**) was assessed and resulted in a relatively static/marginally negative state in terms of ecosystem service functions (**Table 4.3**). Provisioning services (largely increase in botanical use) resulted in a positive reaction to the scenario, but this was balanced against the negative trajectory associated with the regulating services. Cultural and supporting services, given the nature of their utilisation and the marginal changes associated are not impacted.

Table 4.3 Black Mfolozi River scenario rating

Service	Sc BM1_CC	Weight
Provisioning Services (P)	1.008	0.4
Regulating Services (R)	0.756	0.2
Cultural Services (C)	1.000	0.3
Supporting Services (S)	1.000	0.1
Weighted Score	**0.954**	**1**

4.1.4 White Mfolozi River system

The site provides a relatively moderate to high abundance of provisioning resources (specifically fish and natural riparian vegetation) which is utilised by people at a moderate to high degree. Hence provisioning services are provided the highest weighting of 0.4, while cultural services are given a weighting of 0.3. Regulating and supporting services are weighted as 0.2 and 0.1 respectively.

Scenarios that were assessed generally resulted in moderate increases in ecosystem provision, and some overall improvements (**Table 4.4**). Scenarios assessed were the following (**Table 2.1**):

- Sc 1: WM1_CC: Natural inflow scaled for climate change.
- Sc 2: WM1_HFYnoEWR: HFY abstracted from upstream dams, no EWR.

- Sc 3: WM1_HFYEWR: HFY abstracted from upstream dams, with EWR (yield is not affected by EWR).
- Sc 4: WM1_KLPEWR: Raised Klipfontein HFY (14.3 m) abstracted from upstream dams, with EWR (yield is not affected by EWR).

The major reason for the improvement in the scenarios, from the base, can be attributed to increases in the provisioning services under all scenarios considered. These were largely due to altered riparian conditions favouring willows (*Salix mucronata*), sedges, and grasses.

Table 4.4 White Mfolozi River scenario ratings

Service	WM1_CC	WM1_HFYnoEWR	WM1_HFYEWR	WM1_KLPEWR	Weight
Provisioning Services (P)	1.015	1.023	1.023	1.023	0.4
Regulating Services (R)	0.980	0.980	0.980	0.980	0.2
Cultural Services (C)	1.000	1.000	1.000	1.000	0.3
Supporting Services (S)	1.000	1.000	1.000	1.000	0.1
Weighted Score	**1.002**	**1.005**	**1.005**	**1.005**	**1**

4.1.5 Mkuze River system

The site provides a relatively moderate to high abundance of provisioning resources (specifically fish and natural riparian vegetation) which is utilised by people at a moderate to high degree. Hence provisioning services are provided the highest weighting of 0.4, while cultural services are given a weighting of 0.3. Regulating and supporting services are weighted as 0.2 and 0.1 respectively.

Scenarios that were assessed generally resulted in very slight increases in ecosystem provision, and some overall improvements (**Table 4.5**). Scenarios assessed were the following (**Table 2.1**):

- Sc 1: MK1_CC: Natural inflow scaled for climate change.
- Sc 2: MK1_2040: Present Day scenario with increased upstream domestic use.
- Sc 3: MK1_IRR: Present Day scenario with increased return flows due to increased irrigation supplied from Pongolapoort Dam.

The major reason for the very marginal improvement in the scenarios, from the base, can be attributed to increases in the provisioning services under all scenarios considered. These were largely due to conditions favouring sand winning becoming more accessible.

Table 4.5 Mkuze River scenario ratings

Service	MK1_CC	MK1_2040	MK1_IRR	Weight
Provisioning Services (P)	1.007	1.007	1.007	0.4
Regulating Services (R)	0.992	0.992	0.992	0.2
Cultural Services (C)	1.000	1.000	1.000	0.3
Supporting Services (S)	1.000	1.000	1.000	0.1
Weighted Score	**1.001**	**1.001**	**1.001**	**1**

4.1.6 Pongola River system

The site provides a relatively high abundance of provisioning resources (specifically fish and natural riparian vegetation) which is utilised by people to a moderate to high degree. Hence provisioning services are provided the highest weighting of 0.4, while cultural services are given a weighting of 0.3. Regulating and supporting services are weighted as 0.2 and 0.1 respectively.

Scenarios that were assessed generally result in moderate increases in ecosystem provision, and some overall improvements (**Table 4.6**). Scenarios assessed were the following (**Table 2.1**):

- Sc 1: UP1_CC: Natural inflow scaled for climate change.
- Sc 2: UP1_2040: Present Day scenario with increased upstream domestic use (upgraded Fritz WTW).

The major reason for the improvement in the scenarios, from the base, can be attributed to increases in the provisioning services under both scenarios considered. These were largely due to conditions favouring willows, sedges, and grasses as well as sand winning.

Table 4.6 Pongola River scenario ratings

Service	UP1_CC	UP1_2040	Weight
Provisioning Services (P)	1.108	1.125	0.4
Regulating Services (R)	0.965	0.965	0.2
Cultural Services (C)	1.000	1.000	0.3
Supporting Services (S)	1.000	1.000	0.1
Weighted Score	**1.036**	**1.043**	**1**

4.1.7 Assegaai River system

The site provides a relatively moderate to high abundance of provisioning resources (specifically fish and natural riparian vegetation) which is utilised by people to a moderate to high degree. Hence provisioning services are provided the highest weighting of 0.4, while cultural services are given a weighting of 0.3. Regulating and supporting services are weighted as 0.2 and 0.1 respectively.

Scenarios that were assessed generally result in moderate increases in ecosystem provision notably provisioning and regulating services, and some overall improvements (**Table 4.7**). Scenarios assessed were the following (**Table 2.1**):

- Sc 1: AS1_CC: Natural inflow scaled for climate change.
- Sc 2: AS1_2040: Present Day scenario with increased upstream domestic use.
- Sc 3: AS1_EWR: Present Day scenario with EWR as provided included (no impact on yield of Heyshope Dam).
- Sc 4: AS1_noEWR: Present Day scenario with no EWR.

In these cases both the positive trajectory in provisioning services (largely botanical species) as well as regulating services (increases in the marginal riparian vegetation zone) contributed to the overall improvement in EGSA under the scenarios examined.

Table 4.7 Assegaai River scenario ratings

Service	AS1_CC	AS1_2040	AS1_EWR	AS1_noEWR	Weight
Provisioning Services (P)	1.117	1.117	1.117	1.117	0.4
Regulating Services (R)	1.011	1.011	1.011	1.011	0.2
Cultural Services (C)	1.000	1.000	1.000	1.000	0.3
Supporting Services (S)	1.000	1.000	1.000	1.000	0.1
Weighted Score	**1.049**	**1.049**	**1.049**	**1.049**	**1**

4.1.8 Ngwempisi River system

The site provides a relatively moderate to high abundance of provisioning resources (specifically fish and natural riparian vegetation) which is utilised by people to a moderate to high degree. Hence provisioning services are provided the highest weighting of 0.4, while cultural services are given a weighting of 0.3. Regulating and supporting services are weighted as 0.2 and 0.1 respectively.

Scenarios that were assessed generally result in moderate decreases in ecosystem provision, notable regulating services, and some overall declines (**Table 4.8**). Scenarios assessed were the following (**Table 2.1**):

- Sc 1: NG1_CC: Natural inflow files scaled for climate change.
- Sc 2: NG1_2040: Present Day scenario with increased upstream domestic use.
- Sc 3: NG1_EWR: Present Day scenario with EWR as provided included (Yield of Jericho Dam drops).

In this instance the expected negative trajectory for scenarios examined is attributed to the provisioning services and the regulating services being potentially impacted.

Table 4.8 Ngwempisi River scenario ratings

Service	NG1_CC	NG1_2040	NG1_EWR	Weight
Provisioning Services (P)	0.992	0.988	0.992	0.4
Regulating Services (R)	0.991	0.991	0.991	0.2
Cultural Services (C)	1.000	1.000	1.000	0.3
Supporting Services (S)	1.000	1.000	1.000	0.1
Weighted Score	**0.995**	**0.994**	**0.995**	**1**

4.2 ESTUARIES

4.2.1 uMhlathuze Estuary

The site provides a relatively high abundance of provisioning resources (specifically fish and natural riparian vegetation) which is utilised by people to a moderate to High degree. Hence provisioning services are provided the highest weighting of 0.4, while cultural services are given a weighting of 0.3. Regulating and supporting services are weighted as 0.2 and 0.1 respectively.

Scenarios that were assessed generally result in a varying set of projected reactions (**Table 4.9**). Scenarios assessed were the following (**Table 2.1**):

- Sc 1: Climate change.

- Sc 2: Increase of present day MAR by 15%.
- Sc 3: 2030 year projected water requirements on the system (including increased transfer from Thukela to Goedertrouw Dam).
- Sc 4: 2040 year projected water requirements on the system (including increased transfer from Thukela to Goedertrouw Dam).

For the estuaries in general, and specifically the uMhlathuze Estuary, the scenarios examined had a greater range of projected outcomes. This is in part due to the greater degree of impact potentially experienced in the estuaries given the geographical locality and sensitivities to change. However, it is also due to the range of scenarios developed for the estuaries.

For the uMhlathuze Estuary, Sc 1 (Climate change) was moderately negative. This is largely due to the potential decline in provisioning services, notably fish species that are used for subsistence fishing purposes. Cultural services, linked to aesthetic value as well as supporting services were also deemed to be negatively impacted under this scenario. Scenario 2 (Increase of present day MAR by 15%) is positive, mostly for the inverse reasons to the negative impact of Sc 1. Scenarios 3 and 4 are slightly negatively scored with flood attenuation as a regulating service being the main reason for Sc 4.

Table 4.9 uMhlathuze Estuary scenario ratings

Service	Sc 1	Sc 2	Sc 3	Sc 4	Weight
Provisioning Services (P)	0.83	1.18	1.00	1.00	0.4
Regulating Services (R)	1.02	1.00	1.01	0.88	0.2
Cultural Services (C)	0.80	1.10	0.94	0.94	0.3
Supporting Services (S)	0.86	1.08	0.98	0.99	0.1
Weighted Score	**0.86**	**1.11**	**0.98**	**0.96**	**1**

4.2.2 iNhlabane Estuary

The site provides a relatively high abundance of provisioning resources (specifically fish and natural riparian vegetation) which is utilised by people to a moderate to High degree. Hence provisioning services are provided the highest weighting of 0.4, while cultural services are given a weighting of 0.3. Regulating and supporting services are weighted as 0.2 and 0.1 respectively.

Scenarios that were assessed generally result in a varying set of projected reactions (**Table 4.10**). Scenarios assessed were the following:

- Sc 1: Climate Change.
- Sc 2: Present Day including EWR releases from Lake Nhlabane.
- Sc 3: Increase MAR + 15%.
- Sc 4: Restoration Scenario to allow for mouth breaching each year. Increase of flows with interventions.

The iNhlabane estuary is currently assessed as being in a very poor state. Scenario 1 would see a negative trajectory with invertebrates and prawn species potentially declining greatly. Scenario 2 would largely replicate current conditions and Sc 3 would be a marginal improvement. Scenario 4, which includes restoration measures, would have a dramatic impact in terms of positive trajectory related to EGSA and the abundance of fish species would potentially improve greatly.

Table 4.10 iNhlabane Estuary scenario rankings

Service	Sc 1	Sc 2	Sc 3	Sc 4	Weight
Provisioning Services (P)	0.78	1.00	1.02	3.84	0.4
Regulating Services (R)	1.01	1.00	1.00	0.70	0.2
Cultural Services (C)	0.88	1.00	1.14	3.22	0.3
Supporting Services (S)	0.88	0.99	1.17	1.40	0.1
Weighted Score	**0.86**	**1.00**	**1.07**	**2.78**	**1**

4.2.3 iSiyaya Estuary

The site provides a relatively high abundance of provisioning resources (specifically fish and natural riparian vegetation) which is utilised by people to a moderate to High degree. Hence provisioning services are provided the highest weighting of 0.4, while cultural services are given a weighting of 0.3. Regulating and supporting services are weighted as 0.2 and 0.1 respectively.

Scenarios that were assessed generally result in a varying set of projected reactions (**Table 4.11**). Scenarios assessed were the following:

- Sc 1: Climate change.
- Sc 2: Reduction of present day MAR by 15% - increased abstraction.
- Sc 3: Restoration of baseflow

Scenario 1 would see a negative trajectory with fish and prawn species potentially declining greatly and negative impacting provisioning services. Recreational fishing as well as loss of aesthetic value would also impact cultural services negatively. Scenario 2 would also see these services declining, albeit in not as dramatic a fashion. Scenario 3, with improved flows, would see the inverse results with an improvement in all services.

Table 4.11 iSiyaya Estuary scenario rankings

Service	Sc 1	Sc 2	Sc 3	Weight
Provisioning Services (P)	0.50	0.67	1.33	0.4
Regulating Services (R)	0.93	0.94	1.04	0.2
Cultural Services (C)	0.73	0.80	1.16	0.3
Supporting Services (S)	0.64	0.74	1.19	0.1
Weighted Score	0.67	0.77	1.21	1

4.2.4 uMlalazi Estuary

The site provides a relatively high abundance of provisioning resources (specifically fish and natural riparian vegetation) which is utilised by people to a moderate to High degree. Hence provisioning services are provided the highest weighting of 0.4, while cultural services are given a weighting of 0.3. Regulating and supporting services are weighted as 0.2 and 0.1 respectively.

Scenarios that were assessed generally result in a varying set of projected reactions (**Table 4.12**). Scenarios assessed were the following:

- Sc 1: Climate change
- Sc 4: Present day including the upgrade of the Mtunzini WWTW.

- Sc 5: Present day – additional 10% demand on MAR supplied by Eshowe Dam with an increased capacity of 15 million m^3.
- Sc 6: Similar to above – with 10% increase abstraction from lower reaches.
- Sc 7: Present day reduced by 20% through abstraction from lower reaches of river
- Sc 8: Present day reduced by including additional demand of 10% on present day MAR supplied by Eshowe Dam. Maximum Development.
- Sc 9: Present day with non-flow related restoration interventions, including riparian buffer zones

All of the above scenarios result in a potentially negative trajectory bar Scenario 9. Scenario 8 followed by Scenario 7, 6, 4 and 1 are rated as having the most negative impact. All services are potentially negatively impacted with provision and supporting services particularly so. Fish, invertebrates and presence of refugia (supporting service) are the aspects deemed most negatively vulnerable to scenario change.

Table 4.12 uMlalazi Estuary scenario rankings

Service	Sc 1	Sc 4	Sc 5	Sc 6	Sc 7	Sc 8	Sc 9	Weight
Provisioning Services (P)	0.68	0.60	0.96	0.89	0.71	0.68	1.10	0.4
Regulating Services (R)	0.76	0.82	0.98	0.90	0.84	0.81	1.00	0.2
Cultural Services (C)	0.76	0.71	0.96	0.93	0.81	0.78	1.13	0.3
Supporting Services (S)	0.68	0.74	0.97	0.86	0.72	0.68	1.10	0.1
Weighted Score	**0.72**	**0.69**	**0.96**	**0.90**	**0.77**	**0.74**	**1.09**	**1**

4.2.5 aMatigulu/Nyoni Estuary

The site provides a relatively high abundance of provisioning resources (specifically fish and natural riparian vegetation) which is utilised by people to a moderate to High degree. Hence provisioning services are provided the highest weighting of 0.4, while cultural services are given a weighting of 0.3. Regulating and supporting services are weighted as 0.2 and 0.1 respectively.

Scenarios that were assessed generally result in a varying set of projected reactions (**Table 4.13**). Scenarios assessed were the following:

- Sc 1: Climate change.
- Sc 2: Reduction of present day MAR by 20%.
- Sc 3: Reduction of present day MAR by 30%.
- Sc 4: Increase of present day MAR by 15%.
- Sc 5. Present day with non-flow related restoration interventions.

Three of the four result in a negative impact on the ecological goods and services. Scenario 3 is particularly negative. Other than the impacts associated with regulating services, all other services are considerably negatively impacted. Fish, invertebrates and presence of refugia (supporting service) are the aspects deemed most negatively vulnerable to this scenario change. Scenario 4, linked to increased MAR is positive across all services. Scenario 5 (Present day with non-flow related restoration interventions, including active restoration of the riparian) is marginally positive.

Table 4.13 aMatigulu/Nyoni Estuary scenario rankings

Service	Sc 1	Sc 2	Sc 3	Sc 4	Sc 5	Weight
Provisioning Services (P)	0.95	0.80	0.66	1.11	0.92	0.4
Regulating Services (R)	0.93	1.00	1.01	1.01	1.00	0.2
Cultural Services (C)	0.95	0.87	0.77	1.06	1.10	0.3
Supporting Services (S)	0.87	0.74	0.62	1.09	1.20	0.1
Weighted Score	**0.94**	**0.86**	**0.76**	**1.07**	**1.02**	**1**

4.3 CONCLUSION

The various operational scenarios present a mixed set of results. The final preferable options will depend on the interaction between the economic values, the EGSA and the environmental impacts.

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6 APPENDIX A: EGSA SPREADSHEETS

6.1 RIVERS

6.1.1 Amatigulu River system

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	MA 1 CC
Fish							
Recreation	1 Yellowfish, tilapia, catfish & eels	*L. natalensis, O. mossambicus, C. garienpinus* and *Anguillids.*	3	2	1	*L. natalens*is preferred fly fishing spp.	0.9
Subsistence	All 21 indigenous fish species expected.	n/a	3	3	1	Esp. in many rural areas/settlements.	0.9
Riparian Veg							
Plant part collection							
Food / fruits	Waterpear	*Syzygium guineense*	2	2	1		1
Wood (indigenous)	River Bushwillow	*Combretum erythrphyllum*	1	1	1		1
Wood (alien)	Black Wattle	*Acacia mearnsii*	3	3	1		1
Crafts			0	0	1		1
Construction	Reeds	*Phragmites mauritianus*	3	1	1	Slight increase in abundance expected so use should also increase.	1.05
Grazing							
Riverine	Hippo Grass	*Ishaemum fasciculatum*	2	3	1	Slight increase in abundance expected so use should also increase.	1.1
Riverine	River Grass	*Arundinella napalensis*	4	2	1	Slight increase in abundance expected so use should also increase.	1.1
Water Quality			*1-5*	1-5	1		
Waste assimilation			1-5	1-5	1		0.9
Waste dilution			1-5	1-5	1		0.9
Bilharzia treatment			1-5	1-5	1		1
Bilharzia productivity loss			1-5	1-5	1		1
Pathogens treatments			1-5	1-5	1		0.9
Pathogens			1-5	1-5	1		1

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	MA 1 CC
productivity loss							
Geomorph			1-5	1-5	1		
Flood Attenuation			1	1	1	Confined valley lacks FA structures.	1
Bank Protection			4	2	1	small increase in marginal veg possible; minimal evidence of bank instability at PD.	0.95
Streamflow regulation			4	4	1	Increased catchment degradation under CC.	0.95
Groundwater recharge			1	1	1	Limited GWR given terrain.	0.9
Sand Winning			4	2	1	Sand supply increases downstream of site and is heavily worked in places; some increase in and supply with CC.	1.2
Other Social							
Recreational Use			1-5	1-5	1		1
Stock Watering			1-5	1-5	1		1
Ritual Use			1-5	1-5	1		1

6.1.2 Nseleni River system

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	NS1 CC
Fish							
Recreation	1 Yellowfish, tilapia, catfish & eels	*L. natalensis*, *O. mossambicus*, *C. garienpinus* and *Anguillids.*	2	1	1	*L. natalensis* preferred fly fishing spp.	0.95
Subsistence	All 21 indigenous fish species expected.	*n/a*	2	3	1	Esp. in many rural areas/settlements.	0.95
Riparian Veg							
Plant part collection							
Food / fruits			0	0	1		1
Wood (indigenous)			0	0	1		1
Wood (alien)			0	0	1		1
Crafts			0	0	1		1

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	NS1 CC
Construction			0	0	1		1
Medicinal			0	0	1		1
Grazing							
Riverine	Hippo Grass	*Ishaemum fasciculatum*	2	1	1		1
Riverine	Swamp Counch	*Hemarthria altissima*	2	1	1		1
Water Quality							
Waste assimilation			1-5	1-5	1		0.9
Waste dilution			1-5	1-5	1		0.9
Bilharzia treatment			1-5	1-5	1		1
Bilharzia productivity loss			1-5	1-5	1		1
Pathogens treatments			1-5	1-5	1		1
Pathogens productivity loss			1-5	1-5	1		1
Geomorph			1-5	1-5	1		
Flood Attenuation			1	1	1	Confined river.	1
Bank Protection			2	2	1	Limited erosion potential.	1
Streamflow regulation			3	3	1	Increased catchment degradation under CC.	0.85
Groundwater recharge			1	1	1	Confined river.	0.9
Sand Winning			2	1	1	Sand resource limited to upper catchment, Some evidence of resource extraction. Resource could increase with CC induced erosion.	1.2
Other Social							
Other recreational river use			1-5	1-5	1		1
Stock Watering			1-5	1-5	1		1
Ritual Use			1-5	1-5	1		1

6.1.3 Black Mfolozi River system

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	BM1 CC
Fish							
Recreation	1 Yellowfish, tilapia, catfish & eels	*L. natalensis, O. mossambicus, C. garienpinus* and *Anguillids.*	2	2	1	*L. natalensis* preferred fly fishing spp.	0.6
Subsistence	All 18 indigenous fish species expected.	*n/a*	2	2	1	Esp. in many rural areas/settlements.	0.7
Riparian Veg							
Plant part collection							
Food / fruits	Waterpear	*Syzygium guineense*	1	1	1	Slight increase in abundance expected so use should also increase.	1.1
Wood (indigenous)	Sweet Thorn	*Vachellia karroo*	3	3	1	Slight increase in abundance expected so use should also increase.	1.2
Wood (alien)	Syringa	*Melia azedarach*	1	2	1	Slight increase in abundance expected so use should also increase.	1.2
Crafts	Giant Sedge	*Cyperus dives*	1	2	1		1
Construction	Reeds	*Phragmites mauritianus*	4	2	1	Slight increase in abundance expected so use should also increase.	1.1
Medicinal			0	0	1		1
Grazing							
Riverine	Hippo Grass	*Ishaemum fasciculatum*	3	4	1	Slight increase in abundance expected so use should also increase.	1.1
Riverine	Tough Love Grass	*Eragrostis plana*	4	4	1		1
Water Quality			*1-5*	1-5	1		
Waste assimilation			1-5	1-5	1		0.5
Waste dilution			1-5	1-5	1		0.4
Bilharzia treatment			1-5	1-5	1		0.6
Bilharzia productivity loss			1-5	1-5	1	Primarily infects children.	0.8
Pathogens treatments			1-5	1-5	1		0.7
Pathogens productivity loss			1-5	1-5	1		0.9
Geomorph			1-5	1-5	1		

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	BM1 CC
Bank Protection			4	2	1	Bank protection is relevant throughout the section but limited riparian zone means protection of land alongside river is not especially important. CC may result in increased marginal zone and associated bank vegetation, providing increased protection.	1.2
Streamflow regulation			4	4	1	No regulating structures.	0.95
Groundwater recharge			1	1	1	could be some percolation from river bed & storage in flood benches; limited storage potential; flows significantly reduced under CC.	0.75
Sand Winning			2	1	1	Not evident at site but probably occurs locally downstream; sand supply could increase due to increased erosion under CC scenario.	1.1
Other Social							
Other recreational river use			1-5	1-5	1		1
Stock Watering			1-5	1-5	1		1
Ritual Use			1-5	1-5	1		1

6.1.4 White Mfolozi River system

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	WM1 CC	HFY_No EWR	HFY_With EWR	Raise Klip
Fish										
Recreation	1 Yellowfish, tilapia, catfish & eels	*L. natalensis, O. mossambicus, C. garienpinus* and *Anguillids.*	3	2	1	*L. natalensis* preferred fly fishing spp.	0.95	1	1	1
Subsistence	All 26 indigenous fish species expected.	*n/a*	2	3	1	Esp. in many rural areas/settlements	0.95	1	1	1
Riparian Veg										
Plant part collection										
Food / fruits			0	0	1		1	1	1	1
Wood (indigenous)	Sweet Thorn	*Vachellia karroo*	1	0	1		1	1	1	1
Wood (alien)	Syringa	*Melia azedarach*	1	0	1		1	1	1	1
Crafts			0	0	1		1	1	1	1
Construction	Cape Willow	*Salix mucronata*	2	1	1	Slight increase in abundance expected so use should also increase.	1.1	1.1	1.1	1.1
Medicinal			0	0	1		1	1	1	1
Grazing										
Riverine	Hippo Grass	*Ishaemum fasciculatum*	2	4	1	Slight increase in abundance expected so use should also increase.	1.1	1.1	1.1	1.1
Riverine	Sedges	various *Cyperus*	2	2	1	Slight increase in abundance expected so use should also increase.	1.1	1.1	1.1	1.1
Water Quality			*1-5*	1-5	1					
Waste assimilation			1-5	1-5	1		1	1	1	1
Waste dilution			1-5	1-5	1		1	1	1	1
Bilharzia treatment			1-5	1-5	1		1	1	1	1
Bilharzia productivity loss			1-5	1-5	1		1	1	1	1

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	WM1 CC	HFY_No EWR	HFY_With EWR	Raise Klip
Pathogens treatments			1-5	1-5	1		0.9	0.9	0.9	0.9
Pathogens productivity loss			1-5	1-5	1		1	1	1	1
Geomorph			1-5	1-5	1					
Flood Attenuation			0.5	0.5	1	Confined valley.	1	1	1	1
Bank Protection			1	1	1	Limited potential for channel migration.	1	1	1	1
Streamflow regulation			3	3	1	increased catchment degradation under CC.	0.9	0.9	0.9	0.9
Groundwater recharge			1	1	1	Confined valley.	1	1	1	1
Sand Winning			3	1	1	Sand deposits widespread in lower WRU but largely inaccessible.	1	1	1	1
Other Social										
Other recreational river use			1-5	1-5	1		1	1	1	1
Stock Watering			1-5	1-5	1		1	1	1	1
Ritual Use			1-5	1-5	1		1	1	1	1

6.1.5 Mkuze River system

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	MK1 CC	MK1 2040	MK1 IRR
Fish									
Recreation	1 Yellowfish, tilapia, catfish & eels	*L. natalensis, O. mossambicus, C. garienpinus* and *Anguillids.*	1	1	1	*L. natalensis* preferred fly fishing spp.	1	1	1
Subsistence	All 27 indigenous fish species expected.	*n/a*	3	3	1	Esp. in many rural areas/settlements.	1	1	1
Riparian Veg									
Plant part collection									
Food / fruits	Waterpear	*Syzygium guineense*	1	1	1		1	1	1
Wood (indigenous)	Fever Tree	*Vachellia xanthophloea*	4	3	1		1	1	1
Wood (alien)	Syringa	*Melia azedarach*	2	3	1		1	1	1
Crafts			0	0	1		1	1	1
Construction	Reeds	*Phragmites mauritianus*	3	2	1		1	1	1
Medicinal			0	0	1		1	1	1
Grazing									
Riverine	Hippo Grass	*Ishaemum fasciculatum*	3	4	1		1	1	1
Riverine	River Grass	*Arundinella napalensis*	2	3	1		1	1	1
Floodplain		*Sporobolus fimbriatus*	3	4	1		1	1	1
Water Quality			*1-5*	1-5	1				
Waste assimilation			1-5	1-5	1		1	1	1
Waste dilution			1-5	1-5	1		1	1	1
Bilharzia treatment			1-5	1-5	1		1	1	1
Bilharzia productivity loss			1-5	1-5	1		1	1	1
Pathogens treatments			1-5	1-5	1		1	1	1
Pathogens productivity loss			1-5	1-5	1		1	1	1
Geomorph			1-5	1-5	1				
Cultivated floodplains			3	3	1		1	1	1
Wetland			1	1	1	No wetlands identified in	1	1	1

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	MK1 CC	MK1 2040	MK1 IRR
Cultivation						downstream channel but may be present locally.			
Flood Attenuation			3	3	1		1	1	1
Bank Protection			3	3	1	Some vegetation loss related to rural settlement.	1	1	1
Streamflow regulation			3	3	1	Catchment degradation will increase under CC but some amelioration doe to extensive flood plains especially in middle catchment.	0.9	0.9	0.9
Groundwater recharge			4	4	1		1	1	1
Sand Winning			5	3	1	Possible increase in catchment erosion increases sediment supply.	1.1	1.1	1.1
Other Social									
Other recreational river use			1-5	1-5	1		1	1	1
Stock Watering			1-5	1-5	1		1	1	1
Ritual Use			1-5	1-5	1		1	1	1

6.1.6 Pongola River system

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	UP1 CC	UP1 2040
Fish								
Recreation	3 Yellowfish spp & catfish	*L. marequensis, L. polylepis, L. nelspruitensis & C. gariepinus*	3	1	1		0.9	1
Subsistence	All 26 indigenous fish species expected.	*n/a*	3	3	1	Esp. in many rural areas/settlements.	0.9	1
Riparian Veg								
Plant part collection								
Food / fruits			0	0	1		1	1
Wood (indigenous)	Sweet Thorn	*Vachellia karroo*	3	2	1		1	1
Wood (alien)	Black Wattle	*Acacia mearnsii*	3	3	1		1	1
Crafts			0	0	1		1	1
Construction	Cape Willow, Reeds	*Salix mucronata, Phragmites australis*	4	2	1	Slight increase in abundance expected so use should also increase.	1.1	1.1
Medicinal			0	0	1		1	1
Grazing								
Riverine	Hippo Grass	*Ishaemum fasciculatum*	4	4	1	Slight increase in abundance expected so use should also increase.	1.2	1.2
Riverine	Guinea Grass	*Panicum maximum*	3	4	1		1	1
Water Quality			*1-5*	1-5	1			
Waste assimilation			1-5	1-5	1		0.9	0.9
Waste dilution			1-5	1-5	1		0.9	0.9
Bilharzia treatment			1-5	1-5	1		1	1
Bilharzia productivity loss			1-5	1-5	1		1	1
Pathogens treatments			1-5	1-5	1		0.9	0.9
Pathogens productivity loss			1-5	1-5	1		1	1
Geomorph			1-5	1-5	1			
Wetland Cultivation			2	0.3	1	Confined valley; wetlands abundant in upper catchment tributaries but largely intact.	1	1
Flood Attenuation			1	1	1	Confined valley.	1	1

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	UP1 CC	UP1 2040
Bank Protection			2	2	1		1	1
Streamflow regulation			4	4	1	Catchment generally in good to moderate condition.	0.95	0.95
Sand Winning			2	1	1	Increased erosion increases sand supply but channel largely bedrock controlled.	1.1	1.1
Other Social								
Other recreational river use			1-5	1-5	1		1	1
Stock Watering			1-5	1-5	1		1	1
Ritual Use			1-5	1-5	1		1	1

6.1.7 Assegaai River system

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	As1 CC	AS1_2040	EWR	No EWR
Fish										
Recreation	3 Yellowfish spp & catfish	*L. marequensis, L. polylepis, L. nelspruitensis & C. gariepinus*	3	1	1		0.95	0.95	0.95	0.95
Subsistence	All 19 indigenous fish species expected.	*n/a*	3	1	1		0.95	0.95	0.95	0.95
Riparian Veg										
Plant part collection										
Food / fruits			0	0	1		1	1	1	1
Wood (indigenous)	Sweet Thorn	*Vachellia karroo*	3	2	1		1	1	1	1
Wood (alien)	Black Wattle	*Acacia mearnsii*	4	3	1		1	1	1	1
Crafts			0	0	1		1	1	1	1
Construction	Cape Willow, Reeds	*Salix mucronata, Phragmites australis*	5	2	1	Slight increase in abundance expected so use should also increase.	1.2	1.2	1.2	1.2
Medicinal			0	0	1		1	1	1	1
Grazing										
Riverine	Hippo Grass	*Ishaemum fasciculatum*	4	3	1	Slight increase in abundance expected so use should also increase.	1.2	1.2	1.2	1.2
Riverine	River Grass	*Arundinella napalensis*	3	3	1	Slight increase in abundance expected so use should also increase.	1.1	1.1	1.1	1.1
Water Quality			*1-5*	1-5	1					
Waste assimilation			1-5	1-5	1		1	1	1	1
Waste dilution			1-5	1-5	1		1	1	1	1
Bilharzia treatment			1-5	1-5	1		1	1	1	1
Bilharzia productivity loss			1-5	1-5	1		1	1	1	1
Pathogens treatments			1-5	1-5	1		1	1	1	1
Pathogens			1-5	1-5	1		1	1	1	1

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	As1 CC	AS1_2040	EWR	No EWR
productivity loss										
Geomorph			1-5	1-5	1					
Flood Attenuation			1.5	1.5	1	Confined valley.				
Bank Protection			2	2	1	increase in marginal zone veg.	1.15	1.15	1.15	1.15
Streamflow regulation			4	4	1	Catchment generally in good condition.	0.95	0.95	0.95	0.95
Groundwater recharge			2	1	1	Low potential.	1	1	1	1
Sand Winning			2	1	1	Very localised.	1	1	1	1
Other Social										
Other recreational river use			1-5	1-5	1		1	1	1	1
Stock Watering			1-5	1-5	1		1	1	1	1
Ritual Use			1-5	1-5	1		1	1	1	1

6.1.8 Ngwempisi River system

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	NG1 CC	NG1 2040	EWR
Fish									
Recreation	2 Yellowfish spp & catfish	*L. marequensis, L. polylepis & C. gariepinus.*	3	1	1	Especially in dams, some river fishing.	0.95	0.9	0.95
Subsistence	All 14 indigenous fish species expected.	*n/a*	4	2	1	Especially around towns and on farms.	0.95	0.95	0.95
Riparian Veg									
Plant part collection									
Food / fruits			0	0	1		1	1	1
Wood (indigenous)	Sweet Thorn	*Vachellia karroo*	2	2	1		1	1	1
Wood (alien)	Black Wattle	*Acacia mearnsii*	3	2	1		1	1	1
Crafts			0	0	1		1	1	1
Construction	Reeds	*Phragmites australis*	4	1	1		1	1	1
Medicinal			0	0	1		1	1	1
Grazing	Hippo Grass	*Ishaemum fasciculatum*	3	3	1		1	1	1
Riverine	River Grass	*Arundinella napalensis*	2	2	1		1	1	1
Riverine			*1-5*	1-5	1				
Waste assimilation			1-5	1-5	1		1	1	1
Waste dilution			1-5	1-5	1		1	1	1
Bilharzia treatment			1-5	1-5	1		1	1	1
Bilharzia productivity loss			1-5	1-5	1		1	1	1
Pathogens treatments			1-5	1-5	1		1	1	1
Pathogens productivity loss			1-5	1-5	1		1	1	1
Geomorph			**1-5**	**1-5**	**1**				
Cultivated floodplains			3	2	1	Above the site only.	1	1	1
Flood Attenuation			3	3	1	Important only in upper reaches.	1	1	1
Bank Protection			3	3	1	Important only in upper	1	1	1

Resources	Common Name	Scientific	Abundance 1-5	Utilisation	Current Utilisation Status	Comments	NG1 CC	NG1 2040	EWR
						reaches.			
Streamflow regulation			3	2	1	Catchment in moderate to good condition, much forestry, some degradation due to climate change.	0.95	0.95	0.95
Groundwater recharge			2	2	1	Important only in upper reaches.	0.95	0.95	0.95
Sand Winning			1	1	1	Negligible sand deposits.	1	1	1
Other Social									
Other recreational river use			1-5	1-5	1		1	1	1
Stock Watering			1-5	1-5	1		1	1	1
Ritual Use			1-5	1-5	1		1	1	1

6.2 ESTUARIES

6.2.1 uMhlathuze Estuary

Resources	Common Name	Abundant	Utilisation	Current Utilisation Status	Comments	1:CC	2: +15%	3: 2030	4: 2040
Provisioning Services				1					
Subsistence Fishing	Fish	5	5	5		0.88	1.13	1.00	1.00
	Invertebrates	3	3	3		0.75	1.25	1.00	1.00
Nursery Fish		5	5	5		0.88	1.13	1.00	1.00
Nursery - Prawns		5	3	3		0.75	1.25	1.00	1.00
Building Materials		1	1	1		0.88	1.13	1.00	1.00
Cultural Services									
Aesthetic Value		5	2	2		0.86	1.08	0.98	0.99
Ritual Utilisation									
Recreational Fishing		5	1	1	Safety issues	0.88	1.13	1.00	1.00
Birding		2	2	2		0.67	1.08	0.83	0.83
Regulating Services									
Waste Assimilation/Dilution-physical		**3**	**3**	**3**		**1.04**	**0.98**	**1.01**	**1.01**
Flood Attenuation-physical		**5**	**5**	**5**		**1.01**	**1.01**	**1.01**	**0.76**
Dis-Services -biological	*Bilharzia*								
	Cholera								
	Human Health Impacts								
Supporting Services									
Refugia		5	5	5		0.9	1.1	1.0	1.0

6.2.2 iNhlabane Estuary

Resources	Common Name	Abundant	Utilisation	Current Utilisation Status	Comments	1:CC	2: Historical EWR	3: + 15% (Restoration)	4: Sc 3 (+15% + Interventions)
Provisioning Services				1					
Subsistence Fishing	Fish	1	3	1		1.0	1.0	1.0	6.0
	Invertebrates	1	1	1		0.5	1.0	1.0	3.0
Nursery Fish		1	2	1		1.0	1.0	1.0	6.0
Nursery - Prawns		1	2	1		0.5	1.0	1.0	3.0
Botanical Species									
Building Materials		1	1	1		0.9	1.0	1.1	1.2
Cultural Services									
Aesthetic Value		3	2	1		0.9	1.0	1.2	1.4
Ritual Utilisation				1	Mining area no access	0.0	0.0	0.0	0.0
Recreational Fishing		1	1	1		1.0	1.0	1.0	6.0
Birding		2	2	1		0.8	1.0	1.3	2.3
Regulating Services									
Waste Assimilation/Dilution-physical		**2**	**3**	**1**		**1.1**	**1.0**	**1.0**	**1.0**
Flood Attenuation-physical		**2**	**3**	**1**		**1.0**	**1.0**	**1.0**	**1.0**
Dis-Services -biological	*Bilharzia*	**5**	**5**		**Present**	**1.0**	**1.0**	**1.0**	**0.1**
	Cholera				**?**				
	Human Health Impacts				**?**				
Supporting Services				1					
Refugia		5	5	1		0.9	1.0	1.2	1.4

6.2.3 iSiyaya Estuary

Resources	Common Name	Abundant	Utilisation	Current Utilisation Status	Comments	1: CC	2: -15%	3:+15% Restoration
Provisioning Services				1				
Subsistence Fishing	Fish	2	3	1		0.7	0.7	1.3
	Invertebrates	2	1	1		0.3	0.7	1.3
Nursery Fish		2	2	1		0.7	0.7	1.3
Nursery - Prawns		2	2	1		0.3	0.7	1.3
Botanical Species								
Building Materials		3	1	1		0.5	0.7	1.3
Cultural Services								
Aesthetic Value		5	3	1		0.6	0.7	1.2
Ritual Utilisation				1		1.0	1.0	1.0
Recreational Fishing		1	1	1		0.7	0.7	1.3
Birding		5	2	1		0.6	0.8	1.1
Regulating Services								
Waste Assimilation/Dilution-physical		**2**	**2**	**3**		**1.2**	**0.9**	**1.1**
Flood Attenuation-physical		**2**	**2**	**1**		**0.7**	**1.0**	**1.0**
Dis-Services -biological	*Bilharzia*				N/A			
	Cholera				N/A			
	Human Health Impacts				N/A			
Supporting Services				1				
Refugia		5	2	1		0.6	0.7	1.2

6.2.4 uMlalazi Estuary

Resources	Common Name	Abundant	Utilisation	Current Utilisation Status	Comments	1: CC	4: WWTW	5: (Old 1: -10)	6: (Old 2 : -10%)	7: (Old 3:-20%)	8 (Old 4: Max development)	9: Present + Restoration Interventions
Provisioning Services												
Subsistence Fishing	Fish	5	5	5		0.63	0.69	0.94	0.94	0.69	0.69	1.1
	Invertebrates	5	5	5		0.80	0.53	1.00	0.87	0.73	0.67	1.1
Nursery Fish		5	5	5		0.63	0.69	0.94	0.94	0.69	0.69	1.1
Nursery - Prawns		5	5	5		0.80	0.53	1.00	0.87	0.73	0.67	1.1
Botanical Species												
Building Materials		5	1	1		0.57	0.57	0.93	0.86	0.71	0.71	1.1
Cultural Services												
Aesthetic Value		5	5	5		0.68	0.74	0.97	0.86	0.72	0.68	1.1
Ritual Utilisation						1.00	0.50	1.00	1.00	1.00	1.00	1
Recreational Fishing		5	5	5		0.63	0.69	0.94	0.94	0.69	0.69	1.1
Birding		5	5	5		0.75	0.92	0.92	0.92	0.83	0.75	1.3
Regulating Services												
Waste Assimilation/Dilution-physical		**3**	**3**	**3**		0.73	0.63	1.00	0.81	0.69	0.68	1
Flood Attenuation-physical		**4**	**4**	**3**		0.79	1.00	0.96	0.99	0.98	0.94	1
Dis-Services -biological	*Bilharzia*				N/A							
	Cholera				N/A							
	Human Health Impacts				N/A							
Supporting Services												
Refugia		5	5	5		0.68	0.74	0.97	0.86	0.72	0.68	1.1

6.2.5 aMatigulu/Nyoni Estuary

Resources	Common Name	Abundant	Utilisation	Current Utilisation Status	Comments	1: CC	2: -20% red	3: -30%	4: +15% Restoration	5: Present + Restoration Interventions
Provisioning Services				1						
Subsistence Fishing	Fish	5	5	1		1.0	0.8	0.7	1.1	1.2
	Invertebrates	3	1	1		0.9	0.8	0.6	1.1	1.1
Nursery Fish		5	5	5		1.0	0.8	0.7	1.1	1.2
Nursery - Prawns		5	5	5		0.9	0.8	0.6	1.1	1.1
Botanical Species										
Building Materials		5	1	1		0.9	0.7	0.6	1.1	
										1.1
Cultural Services										
Aesthetic Value		5	5	5		0.9	0.8	0.7	1.1	1.1
Ritual Utilisation						1.0	1.0	1.0	1.0	1
Recreational Fishing		5	5	5		1.0	0.8	0.7	1.1	1.2
Birding		5	5	5		0.9	0.9	0.7	1.1	1.1
Regulating Services										
Waste Assimilation/Dilution-physical		**3**	**3**	**3**		**1.0**	**1.0**	**1.0**	**1.0**	1
Flood Attenuation-physical		**4**	**4**	**3**		**0.9**	**1.0**	**1.0**	**1.0**	1
Dis-Services -biological	*Bilharzia*				N/A					
	Cholera				N/A					
	Human Health Impacts				N/A					
Supporting Services				1						
Refugia		5	5	5		0.9	0.7	0.6	1.1	1.2

7 APPENDIX B: COMMENTS AND RESPONSE REGISTER

No.	Section	Comment	From	Addressed?
1.	General	What's most clear to me is that our communities were never interviewed or consulted, it's all about GIS/Remote sensing, and therefore their voice continues to be left out, very bad! Secondly, the researchers navigated away from the St Lucia estuary completely, yet acknowledge how threatened is this Ramsar and Heritage site! Why so? I copy the classification tool produced at the request of Ms Shane Naidoo (before she departed) and RDM (now WEM). Have you seen this guide and is it being used, I did not see it quoted? The full report is available from website.	B. Madikizela	Noted. The budget precluded detailed fieldwork with stakeholder interviews. Ground truthing at key areas was conducted. To undertake a fieldwork exercise of this nature across the breadth of the study area is a worthwhile exercise but to do with any degree of reliability would be very resource intensive. Comment on St Lucia noted and as explained in Estuary reports.
2.	Exec sum Pg vi	How about St Lucia Ramsar and Heritage site? Conservation Park with the largest estuary in SA?	B. Madikizela	As above. See estuary report.
3.	Exec sum Pg vi	Which method was followed here, did you see K5/2465?	B. Madikizela	The broad nature of the site conditions and key risk that were largely associated with immediate dependence on the provisioning services (poverty and vulnerabilities) largely drove the weighting criteria determination.
4.	Sec 3.2 Pg 3-2	Not verified by site visits, only by desktop	B. Madikizela	Correct – see above.
5.	Sec 3.3 Pg 3-2	Except the Ramsar/Heritage site!		Noted. See estuaries report
6.	Table 3.2 Pg 2-2	Let us not forget that this table, scenarios, and the associated consequences would need to change once the estuaries scenario amendments have been concluded.		Amended.
7.	Sec 3.2 Pg 3-2	Which 3 areas?	N. Jafta	Text amended.
8.	Sec 3.3 Pg 3-2	Methods references missing	N. Jafta	Inserted as overall approach. The approach used is standardized as per recent classification studies. First used on Thukela integrated study.
9.		May this table/list please be added, even as an appendix	N. Jafta	Included.
10.		Was Sub-quat or quat level used?	N. Jafta	Sub- quat and area proximate provided the cues for assessment.
11.	Sec 3.3 Pg 3-3	It's a bit difficult to accept that the weightings were exactly the same for all river sites and estuaries. Some areas are rural, while others are more urban and coastal, and others industrial.	N. Jafta	It's the nature of the receiving environment (at risk population) that drove the weighting as per comment 3. Critical, to note is that the nature of the area and the impact on the resources is then examined against the receiving socio-economic environment and particularly the vulnerability of populations dependent on resources.
12.	Sec 4	The discussion or explanation of the results is too generic. If most of the relevant	N. Jafta	Agree- the model is added as an appendix. Most of the

No.	Section	Comment	From	Addressed?
	Pg 4-1	narrative to support the result is in the models/tools then maybe there should be a way to add it in the report or for it to form part of the Appendices.		discussion happened in a workshop format where the nature of the scenario was discussed and the impacts against those assessed by the experts. This has been added.
13.	Sec 4.1.1 Pg 4-1	Examples of resources.	N. Jafta	Provisioning services and associated resources added in text.
14.		What is causing the negative trajectory?	N. Jafta	Text added. The general deterioration of the of bio-physical riparian and catchment environment is having a key negative impact on regulating services, notably the ability of the river to assimilate and dilute waste and attenuate floods. This is caused by increased erosion in the catchment as well as the reoccur pressure that the river is under and increased levels of overall effluent and pollution.
15.	Sec 4.1.2 Pg 4-1	Examples of utilisation and regulating services.	N. Jafta	Resource examined included waste assimilation and dilution and flood attenuation. Disservices including increases in bilharzia were also looked at.
16.	Sec 4.1.3 Pg 4-2	Examples of resources.	N. Jafta	Added text.
17.	Sec 4.1.3 Pg 4-1	Which conditions and are the willows exotic species?	N. Jafta	These were largely due to minor altered riparian conditions favouring willows (*Salix mucronata*), sedges, and grasses.
18.	Sec 4.1.6 Pg 4-4	Are the willows exotic species?	N. Jafta	Cape Willow *Salix mucronata* is indigenous to South Africa and has multiple medicinal uses.
19.	Sec 4.1.7 Pg 4-4	Regulating services?	N. Jafta	Notably provisioning and regulating services.
20.	Sec 4.1.8 Pg 4-5	Regulating services?	N. Jafta	Added text.
21.	Sec 4.2 Pg 4-5	No analysis of the St Lucia.	N. Jafta	See estuary report.
22.	Sec 4.2.1 Pg 4-5	Check scenario description.	N. Jafta	Noted, altered text.
23.	Sec 4.2.2 Pg 4-6	Check scenario description.	N. Jafta	I have changed the scenario number for this Estuary as per the Estuary report.
24.	Sec 4.2.3 Pg 4-7	Check scenario description.	N. Jafta	Updated as per the Estuary report.
25.	Sec 4.2.4 Pg 4-7	Check discussion and use of scenario as well as applicable Table.	N. Jafta	Addressed.
26.	Sec 4.2.5 Pg 4-8	Check scenario description.	N. Jafta	Added Sc 5 - Present day with non-flow related restoration interventions.