ENVIRONMENTAL FLOWS MANAGEMENT PLAN FOR THE PUNGWE WATERCOURSE

November 2024

Pungwe Environmental Flows Policy Statement

The Republics of Zimbabwe and Mozambique are committed to:

- providing for protection of the Pungwe Watercourse from its source to Indian Ocean in Mozambique, including its estuary and marine zone, for the benefit of people and the environment;
- ensuring that Environmental Flows (hereinafter referred to as "EFlows") provisions are met at all times;
- implementing recommended eco-social management measures to ensure sustainable utilization of the natural resources of the Pungwe Watercourse and the safeguarding of the people that depend on it;
- undertaking independent/joint monitoring of EFlows provisions and river condition and to communicate results to all stakeholders;
- implementing adaptive management based on the monitoring results;
- to develop joint water resources infrastructure to enhance and meet the downstream Eflows demand
- reviewing and revising EFlows provisions, releases and procedures, as needed; and

These commitments are encapsulated in this EFMP.

The EFMP applies to the Pungwe Watercourse from its source to the head of the estuary, the Pungwe Estuary and the marine zone supported by the Pungwe Watercourse for the benefit of people and the environment. In accordance with the EFMP, EFlows and eco-social management measures are expected to maintain the Pungwe Watercourse in a C/D[1] range of the ecological category (attached herein as Appendix B); the Pungwe estuary in a D[2] category, or better. The target ecological category after implementation of restoration and protection activities is to maintain the Pungwe Watercourse in a C category and the Pungwe estuary in a CC/D category.

The monthly EFlows linked with the implementation of the Agreement between the Republic of Mozambique and the Republic of Zimbabwe on: *Co-operation on the Development, Management, and Sustainable Utilisation of The Water Resources of The Pungwe Watercourse* (hereinafter referred to as "Pungwe Agreement") are given in the Table below in million m^3. The monthly EFlows account for all baseline and planned abstractions, water resources infrastructure, hydropower production and plantations in Zimbabwe and Mozambique agreed between the two countries in the Pungwe Agreement. There may

[1] Moderately modified. Loss and change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged.

[2] Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.

be scope for small additional developments and abstractions which may be accommodated. Depending on their location and magnitude, these developments will affect the ecological health of the river, estuarine and/or marine ecosystems, with knock-on effects on the people who depend on those ecosystems. The *Pungwe Basin Configuration Tool*[3] can be used to explore the potential impacts of such developments to the Pungwe Watercourse system.

Table 1A: Recommended Environmental Flows for key sites in the Pungwe Watercourse

	EFlows (in million m^3)											
Key Eflow sites	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
E64	16.0	20.4	63.3	130.2	140.8	112.9	70.8	42.3	32.1	28.1	26.5	19.2
E73	6.5	9.6	44.0	94.1	101.1	79.8	47.3	22.4	15.6	13.7	13.3	8.6
E65	28.6	35.7	141.2	302.0	324.6	256.7	155.6	82.0	59.9	52.9	51.0	36.2
E80	4.5	8.7	21.6	69.7	174.7	147.9	47.9	11.4	6.6	8.0	6.6	7.9
Into the estuary	16.8	40.6	257.8	731.0	1150.4	1054.9	552.9	132.7	65.1	50.2	36.6	16.8

The BUPUSATEC is responsible for the implementation of the EFMP and has delegated the performance of key aspects of the implementation of this EFMP to:

- The Standing Working Group on Water, Environment and Climate is responsible for the implementation of the EFlows Monitoring Programme, and all reporting required therein. At the Member State Level, the National Directorate of Environment (DINAB), National Directorate of Water Resources (DNGRH), ARA Centro and AQUA in Mozambique, and Environmental Management Agency (EMA), and Department of Water Resources and ZINWA in Zimbabwe are responsible for meeting the EFlows, including record keeping.

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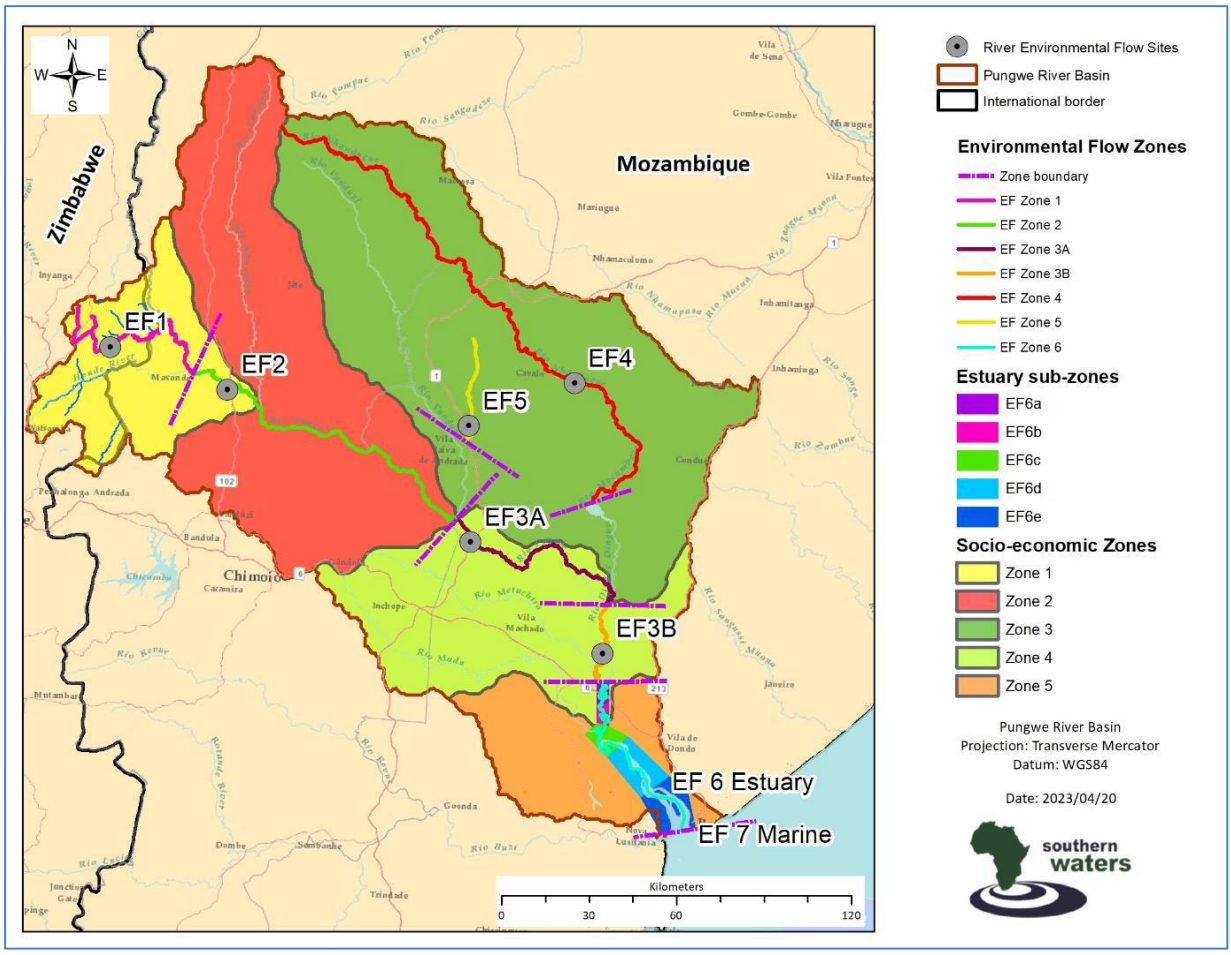

Figure 1. Socio-economic zones (Zones 1-5) of the Pungwe Watercourse and corresponding EFlows sites and zones for the river (EF1-5), estuary (EF6) and EF7, which is the nearshore coastal environment. Source: Eco-social Flows (EFlows) assessment of the Pungwe Watercourse- EFlows Scenario Assessment Report

Compliance with the EFMP shall be monitored at key points along the Pungwe Watercourse. These include relevant Republics of Zimbabwe and Mozambique flow gauging weirs, the EFlows[4] sites in the Pungwe Watercourse and the EFlows zones in the Pungwe Estuary as indicated in the Table above. The objectives of the compliance monitoring include:

- to establish whether or not the agreed EFlows are being met; and
- to determine whether the target ecological categories are being achieved in the rivers and estuary.

Adaptive management shall be used to implement the EFMP.

The BUPUSATEC shall be responsible for the final decisions relating to the adaptive management system, on the basis of recommendations made by its subcommittee, the Standing Working Group on Water, Environment and Climate, and relevant stakeholderssuch as private sector, civil society, conservancies, academia etc.

4 Environmental Flows Sites

All costs relating to the implementation of the EFMP shall be borne by the Parties. BUPUSACOM shall coordinate the implementation of the EFMP, including coordinating a Joint Basin Survey every five (5) years to update the collective understanding of the basin's water resources and ecosystems.

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PREAMBLE

The framework of implementation of the Pungwe EFMP takes guidance from the BUPUSA Data Sharing Rules and Procedures, Article 3(2)(e) of the BUPUSA Establishment Agreement, Article 3 (6) of the Revised SADC Protocol on Shared Watercourses and Articles 9, 10,11,12,13, 14, 15, 16 and 17 of the Pungwe Agreement.

Supporting legislation for Mozambique.

The water sector in Mozambique is governed primarily by the Water Law of 1991 (Law No. 16/91 of 3 August). The Act establishes the legal basis for a river basin approach to water management, with the Ministry of Public Works, Housing and Water Resources (MOPHRH) being the line ministry responsible for water management. This law gives particular attention to the aspect of environmental sustainability. The Water Law is complemented by the National Water Policy, originally of 1995, and subsequently revised in 2007 and further updated in 2015. The Policy assigns water resources management functions to basin and provincial level organizational structures. It further focuses on promoting environmental conservation and reducing the country's vulnerability to floods and droughts, as well as on the establishment of comprehensive and coordinated management agreements for the promotion of social and economic cohesion and the regional integration of Mozambique.

Mozambique also adopted a National Strategy for Water Resources Management (2007) that highlights the principles of equity and gender balance in the development and implementation of management policies, thus promoting the strengthening of the role of women in decision-making, planning, monitoring and management of the water supply systems operation and maintenance.

The Regulation of Water Licenses and Concessions, approved by Decree No. 43/2007, of October 30, was published following the adoption of the National Strategy of Water Resources Management to effectively implement the new water management framework, especially the regulation of water resources management through the licensing or granting of water use rights to natural or legal persons. This instrument determined that the state is responsible for the water sector management through the Ministry governing the sector and assigns to local governments the responsibility of establishing priorities concerning the development of strategic projects regarding water use. The same document assigned to the regional water administrations (ARAs) the responsibility for water use licensing.

Outside the immediate water legislation, the Environmental law (Law No. 20/97, of 1 October) defines the measures and legal basis for the management and proper use of environmental resources required for the sustainable development of the country, applicable to all public or private activities which may directly or indirectly influence the environment. The Environment Law promotes the rational use and management of the environmental components, reinforcing the role of water in the country’s sustainable development. The same law also encourages equality and gender equity in the access and use of natural resources in Mozambique.

The Environment Policy of 1995 was approved by the resolution 5/95 August 3rd and responds to article 72 of the Constitution which defines the right of citizens to an equitable environment and the responsibility

to protect it. The policy establishes the foundations for sustainable development in Mozambique, which needs to be met through an acceptable and realistic compromise between socio-economic development and environmental protection. The policy includes principles such as the sustainable use of natural resources and the polluter-pays principle. The Environment Policy further stresses the need to develop sectoral policies to deal with issues related to the high rate of exploration of sub-surface natural resources that may interfere with groundwater quality, the need to establish adequate mechanisms to supervise and monitor changes in the environment, and the quality of natural resources resulting from the impact of the exploration activities as well as the need for the international cooperation with regards to environmental protection.

The Regulations on Environmental Quality Standards and Effluent Emissions, approved by Decree No. 18/2004 assign to the former Ministry for the Coordination of Environmental Action (MICOA), now the Ministry of Land and Environment (MTA) the responsibility for supervising the permissible concentration of pollutants in wastewater to be discharged into watercourses. The document established the parameters of water quality assessment, which vary according to the category of water use.

The Drinking Water Quality Regulations were established by the Ministry of Health (MISAU) through the Ministerial Decree No. 180/2004, Decreto n.º 52/2023: *Aprova o Regulamento de Padrões de Qualidade de Água Bruta e de Descarga de Efluentes Líquidos e Sólidos*, *Regulamento sobre Padrões de Qualidade Ambiental e de Emissão de Efluentes (Decreto 67/2010, de 31 de Dezembro* (Decree nr 52/2023 which approves the regulations of quality of raw water and discharge of solid and liquid effluents; regulation on environmental quality and Effluents emissions (Decree 67/2010, od 31 December) within the framework of the Ministry's responsibilities in the strategic development and implementation of policies for public hygiene in the water sector. The regulations aim to ensure the minimum level of drinking water quality by defining water quality parameters and the methods for carrying out appropriate control at different stages of the water supply system, ranging from water abstraction to distribution.

The Government of Mozambique has approved the Regulations on the environmental impact assessment procedure through Decree No 54/2015 of 31st December. This regulation specifies the conditions for carrying out environmental impact assessments, in public or private activities with potential negative influence on the environment, including projects with characteristics and specific dimensions within the infrastructure, namely transport systems, aqueducts and canals of water for human consumption or for industrial or other uses, including wastewater treatment facilities.

The Land Policy was approved by the resolution 10/95. The policy highlights important principles linked to groundwater including the sustainable use of natural resources and securing of protection zones. This policy refers to the need to harmonize the proposed review of land law with the other sectorial policies that are undergoing preparation for review including water, mining, tourism, etc. The policy indicates that the right to use the land does not entitle the beneficiary to unlimited exploration of groundwater but allows for the abstraction of sufficient quantities for human consumption and irrigation up to the established limit.

ARA Centro IP is the key regional water management agency for the Pungwe, with the responsibility of integrated water resources management, flood and drought management, infrastructure maintenance, disaster management and environmental protection. It was restructured under Decree No. 73/2020 to

enhance its operational efficiency.

The National Irrigation Policy and its Implementation Strategy were adopted in 2002, recognizing the great strategic importance vested with irrigation. The guiding principles are:

• Water resources, although renewable, are not inexhaustible and therefore it is necessary to manage, control and preserve them rigorously.
• Water is an economic resource, which deserves an appropriate economic and social value.
• Water and irrigated land are public assets whose use must depend on a licence.

Supporting legislation for Zimbabwe

The primary legislation dealing with integrated water resources and environmental management are the Constitution of Zimbabwe (section 73- environmental rights and 77 - the right to water), Water Act of 1998 *[Chapter 20:24],* Zimbabwe National Water Authority Act *[Chapter 20:25],* Environmental Management Agency (EMA) Act *[Chapter 20:27]*, and Rural District Councils Act [*Chapter 29:13]* as summarised below:

The Water Act of 1998 governs the use and management of water resources in Zimbabwe. The Water Act of 1998 is founded on economic efficiency, environmental sustainability and equity of use of water resources within Zimbabwe. The Act established stakeholder-driven institutions that have more say on water allocation and general water management on a day-to-day basis. Thus, water management has been decentralized to stakeholder-managed Catchment Councils (CCs) and Sub-Catchment Councils (SCCs).

The Zimbabwe National Water Act [Chapter 20:25] establishes the Zimbabwe National Water Authority and provides for its functions, appointment and functions of a board of the Authority, allocation and distribution of water resources, raising of charges for the provision of water and other services by the Authority

The Environmental Management Act was promulgated in the year 2000. It provides for:

- the sustainable management of natural resources and protection of the environment;
- the prevention of pollution and environmental degradation;
- the preparation of a National Environmental Plan and other plans for the management and protection of the environment;
- the establishment of an Environment Fund, and;
- the establishment of the Environmental Management Agency (EMA). EMA is a body corporate capable of suing and being sued in its own name.

Other relevant acts include the Mines and Minerals Act of 1996 *[Chapter 21:05],* the Public Health Act and the Civil Protection *[Chapter 10:06].*

EFlows Assessment

An EFlows assessment for the Pungwe Watercourse, Punqwe Estuary and Punqwe Marine Zone was undertaken in 2023 (GWPSA, 2023). The assessment focussed on five (5) river EFlows sites, five estuary zones and the near-shore marine zone.

The EFlows assessment resulted in the following EFlows provisions being set for the Pungwe Watercourse:

Table 2: Recommended Environmental Flows for key sites in the Pungwe River Basin

	EFlows (in million m^3)											
Key Eflow sites	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
E64	16.0	20.4	63.3	130.2	140.8	112.9	70.8	42.3	32.1	28.1	26.5	19.2
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E65	28.6	35.7	141.2	302.0	324.6	256.7	155.6	82.0	59.9	52.9	51.0	36.2
E80	4.5	8.7	21.6	69.7	174.7	147.9	47.9	11.4	6.6	8.0	6.6	7.9
Into the estuary[16]	16.8	40.6	257.8	731.0	1150.4	1054.9	552.9	132.7	65.1	50.2	36.6	16.8

Where the EFlows requirements above are not currently met from the natural river flows development of water resources infrastructure is needed. The Eflows shall be incorporated into the proposed design, construction and operation of the water-resource developments listed in the Pungwe Watercourse Agreement.

The hydrogeological assessment conducted for the BUPUSA Watercourses identified the Lake Urema Graben as a regional groundwater recharge area, that is the area is also a groundwater dependant ecosystem.

Supporting documentation

This EFMP is supported by the following key documents:

- Pungwe Basin EFlows Assessment of 2023;
- Pungwe Agreement of 2016;
- BUPUSACOM Rules and Procedures for Data and Information Sharing of 2024;
- BUPUSACOM Establishment Agreement of 2023;
- Revised SADC Protocol on Shared Watercourses of 2000;
- National Biodiversity Strategy and Action Plan (NBSAP) of Mozambique (2015-2030); and
- National Biodiversity Strategy and Action Plan (NBSAP) of Zimbabwe (2015-2020 - being updated to align with the post-2020 global biodiversity framework).

Together, these documents provide the details of the legal and policy framework that underlies and supports the EFMP. The EFMP is subject to review and revision in line with the principles of adaptive management (see section 7). There is need to create a database of all relevant documents.

EFMP Development Process

The involvement of stakeholders in the development of the EFMP was given high priority. Key Institutions involved include:

- *Zimbabwe: Department of Water Resources Management and Utilisation Zimbabwe, ZINWA , Environmental Management Agency (EMA),Ministry of Mines and Mining Development, Academia, Forestry, Local Government, Parks and Wildlife.*
- *Mozambique: DNGRH, Regional Water Authorities (ARA Centro, IP), Pungwe Unit, Department Lands and Environment, Department of Mining, Parks and wildlife and Academia.*

Provision for additional and on-going revision of the EFMP and/or its supporting procedures is also allowed in the EFMP.

EFMP Implementation

The BUPUSATEC shall be responsible for the implementation of the EFMP and may assign specific tasks outlined herein to its subcommittee; the Standing Working Group on Water, Environment and Climate (the National Directorate of Environment (DINAB), DNGRH, AQUA, ARA Centro in Mozambique, and Environmental Management Agency (EMA), ZINWA in Zimbabwe) and other institutions and/or service providers, as deemed appropriate.

Definitions of Key Concepts

Adaptive management is an approach to managing complex natural systems that builds on learning - based on common sense, experience, experimenting, and monitoring - by adjusting practices based on what was learned (Bornmann 1999).

EFlows describe a modified flow regime for a river that is linked to a description of the condition or health of the river that this flow regime achieves. EFs typically comprise:

- *Low flows,* which occur when the river is not in flood. They are larger and more varied in the wet season than in the dry season. They create different conditions in different seasons, dictating the occurrence and densities of aquatic species.
- *Small floods*, which occur several times within a year. They stimulate spawning in fish, flush out poor-quality water, cleanse the riverbed and sort the river stones by size, thereby creating different kinds of habitat. They trigger and synchronize activities as varied as upstream migrations of fish and germination of seedlings on riverbanks.
- *Large floods*, which occur less than once a year. They trigger the same responses as small floods, but, in addition, they provide the scouring flows that shape the river channel. They move and cleanse cobbles and boulders on the riverbed, and deposit silt, nutrients, eggs and seeds on floodplains. They inundate backwaters, secondary channels and floodplains, and trigger bursts of growth in many species. They also recharge soil moisture levels in the banks, enabling seedlings of riparian trees to grow.
- *Flow variability* on a daily, seasonal or annual basis, which acts as a form of natural disturbance. Fluctuations between low flows and small and large floods change conditions through each day and season, creating mosaics of areas inundated and exposed for different lengths of time. The more diverse the physical conditions, the higher the biodiversity and the greater the resilience of the ecosystem to disturbance.

EFlows provisions refer to the seasonal pattern and quantities of water needed to maintain the target ecological condition of the Pungwe River.

Flow regime refers to the seasonal pattern and quantities of flow in a river, whether natural or modified.

Geomorphology refers to the study of the processes and pressures operating on river systems. Changes in the independent variables of discharge, sediment load supplied to reach, and slope give rise to adjustments in the dependent variables of sediment load and particle size, hydraulic characteristics, and habitats, all of which interact with each other.

Habitat refers to the physical environment that surrounds (influences and is utilised by) a species.

Hydrology refers to the record of the volume, the timing and magnitude of flows in the river.

Impoundment means any in-channel or off-channel storage of relatively large volumes of water behind a control structure.

Macroinvertebrates are animals that have no backbone and are visible without magnification. The macroinvertebrate communities in rivers are dominated by insect larvae, many with a (non-aquatic) flying stage.

Mean annual runoff (MAR) refers to the long-term average annual water flow from a catchment; it is a measure of the average amount of water available as natural river flow.

Monitoring programme is a programme that observes, regulates, and controls or verifies the operations of a management system. In the context of the EFMP, the EF monitoring programme is designed to provide information that will allow verification of adherence to the agreement in this EFMP and assessment of the resultant condition of the receiving river system. This information will be used in the adaptive management system to regulate the EFlows activities to ensure that the target conditions for the downstream river are achieved.

Reach (as in *river reach*) is a stretch of river that has more or less homogenous characteristics throughout, in terms of geomorphology, hydrology and aquatic biota.

Riparian zone/area [*inhabiting or situated on the bank of a river*] is that part of the riverine ecosystem which occupies the banks of the river channel and areas immediately adjacent to them, where the influence of river flow/water flowing in the river is felt. It is usually distinguished by an assemblage of plant species, which is different from that in nearby terrestrial habitats, often dominated by woody plants.

River condition is described using a set of five or six qualitative descriptions of the category of the riverine ecosystem, from pristine, natural conditions through progressive (or regressive) changes until the ecosystem is so transformed as to be non-functional.

Sample analysis in the context of the EFMP refers to the analysis of sediment and water quality samples at an accredited laboratory.

Water quality refers to the chemical, physical and biological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose.

DRIFT EFlows Methodology (King et. al., 2003; King 2012 and Joubert et. al., 2022) - The EFlows Assessment for the Pungwe Basin used the Downstream Response to Imposed Flows Transformation (DRIFT) method for 10 locations in the Basin (called DRIFT-Pungwe). DRIFT is a process and Decision Support System (DSS) for managing and interrogating knowledge on the links between river flows (water, sediment and biota), ecosystem functioning and social uses. DRIFT allows for:

- Time-series based evaluation of changes to hydrology, hydraulic or sediment characteristics.
- Incorporation and evaluation of measured or modelled time-series data.
- Use of models, data, knowledge and experience to model ecosystem functioning.
- Calibration or evaluation of time-series predictions against ecological data, where available.
- Inclusion of social and management criteria.

The results from the DRIFT-Pungwe assessments, augmented with results from other studies as required, were extrapolated to a further 24 sites in the Basin using the EFlows basin configuration model in Excel.

Pungwe Eflows Basin Configuration model: The Pungwe Basin Configuration Tool (PBCT) was developed to provide a rapid desktop assessment of the likely effects that changes in flow (due to various types of water-resource development) at one location will have at locations further downstream to the estuary. Resulting impacts on flow and ecological health are given at various locations. This helps to enhance understanding of the more and less sensitive parts of the river system. *It is not intended for use in detailed basin planning or for decisions on location, design and/or operation of dams, mining or large-scale agriculture.*

The PBCT incorporates a network of 30 linked locations (nodes) that represent river reaches throughout the basin (Figure 2.1). There are two kinds of nodes:

- 6 EFlow sites which were used in the DRIFT EFlows assessment.
- 24 additional nodes distributed more widely across the basin.

ACRONYMS AND UNITS

BES	Baseline Ecological Status
DO	Dissolved oxygen
EFlows	Environmental Flows
EFMP	Environmental Flows Management Plan
EFR	Environmental Flow Requirement
SAZ	Standard Association of Zimbabwe

km^2	Square kilometre
m/hour	Meter per hour
m^3/s	Cubic meter per second
mg/L	Milligram per litre

1 Commitments

The Republics of Zimbabwe and Mozambique are committed to:

- providing for protection of the Pungwe Watercourse from its source to Indian Ocean in Mozambique, including its estuary and marine zone, for the benefit of people and the environment;
- ensuring that Environmental Flows (hereinafter referred to as "EFlows") provisions are met at all times;
- implementing recommended eco-social management measures to ensure sustainable utilization of the natural resources of the Pungwe River and the safeguarding of the people that depend on it;
- undertaking independent/joint monitoring of EFlows provisions and river condition and to communicate results to all stakeholders;
- implementing adaptive management based on the monitoring results;
- to develop joint water resources infrastructure to enhance and meet the downstream Eflows demand
- reviewing and revising EFlows provisions, releases and procedures, as needed; and

These commitments are encapsulated in this EFMP, and are to be achieved by:

- formally documenting the intentions of the Republics of Zimbabwe and Mozambique with respect to management of the rivers and estuary of the Pungwe Watercourse and the people who depend thereon;
- providing a set of principles that will govern the implementation of the agreed EFlows and river resource management measures;
- designating responsibility for implementation of the EFMP;
- providing an adaptive management plan to address any unexpected outcomes in terms of EFlows and river condition; and,
- providing for systematic and periodic auditing of performance.

In addition, data from the EFMP Monitoring Programme shall be uploaded into a live web-based database in a timely fashion, in conformance with the different access in accordance with the Rules and Procedures for Data and Information Sharing.

The EFMP is aligned with, and takes guidance from, the Pungwe Watercourse Agreement and the BUPUSA Rules and Procedures for Data and Information Sharing.

2 Institutional framework

2.1 EFMP implementation

The Republics of Zimbabwe and Mozambique are responsible for implementation of the EFMP. In keeping with this, as per Article 8, 9 And 10 of the BUPUSA Establishment Agreement (2023), and in accordance with the Terms of Reference of the BUPUSACOM Technical Committee, the Standing Working Group on Water, Environment and Climate will have delegated responsibility to:

- be custodian of the baseline dataset;
- be custodian of monitoring data collected under the EFlows Monitoring Programme;
- be responsible for making such information available to interested and affected parties; and
- delegate performance of key aspects of the implementation of the EFMP to relevant organisations.

The Riparian States agree to share all data and information relevant for the planning, implementation and reporting of the Pungwe EFMP, in accordance with the BUPUSA Rules and Procedures for Data and Information Sharing.

2.2 Delegation of responsibilities

The Republics of Zimbabwe and Mozambique have delegated performance of key aspects of the implementation of the EFMP as follows:

- ARA Centro in Mozambique, and ZINWA in Zimbabwe will be responsible for the release of EFlows;
- National Directorate of Environment (DINAB), DNGRH, AQUA, ARA Centro IP in Mozambique, and Environmental Management Agency (EMA), ZINWA in Zimbabwe will be responsible for monitoring and record keeping;
- Standing Working Group on Water, Environment and Climate will be responsible for the implementation of the EFlows Monitoring; and,
- The BUPUSATEC will be responsible for implementation oversight and of the EFMP to the Council of Ministers.

In each case, overall responsibility for performance is to be assigned to a staff member chosen for these duties. Duties include handling the relevant organisational requirements, such as: ensuring required activities are conducted timeously and correctly; keeping detailed records; quality control for data collection and data archiving; annual reporting as per the required format; reporting issues or problems to the Standing Working Group on Water, Environment and Climate; and the participation of the relevant staff in the Periodic Inspection Program (Section 6.3).

3 SCOPE OF THE EFMP

3.1 Ambit

The EFMP focuses on the implementation of EFlows and a suite of agreed management measures in the Pungwe Watercourse. It also identifies groundwater dependant ecosystems and the accompanying management interventions.

3.2 Temporal scope

The EFMP shall take effect from 29 November 2024.

The EFMP shall apply for a maximum of 5 years, or until the review and update of the Environmental Flows requirements of the Basin, whichever comes earlier.

The implementation of the EFMP will be subject to an independent audit in accordance with the BUPUSACOM Manuals, Policies and Procedures.

The EFMP may be amended only after independent audit, review and consultation with the relevant authorities i.e. the BUPUSACOM.

The provisions in the EFMP shall not be changed within five (5) years of approval, unless compelling reasons for change emerge from review.

3.3 Spatial scope

The EFMP shall apply to the Pungwe Watercourse as a whole, including the estuary and the near-shore marine zone.

4 THE EFLOWS PROVISIONS

4.1 Base hydrology

The initial calculation of EFlows is determined relative to the baseline hydrology available at the time of the assessment. Thus, any changes in the baseline hydrology should be reflected proportionately in the EFlows provisions. The base hydrology used to calculate the EFlows in this EFMP was developed by Consultec (2013) and updated for use in the EFlows by Southern Waters (2023). The recommended flows were approved by the Parties. The hydrogeological assessment by SADC-GMI (2023) provided insights into groundwater/surface water interactions and baseflow.

Table 3: Naturalised Flows at key gauging stations of the Pungwe Watercourse

Gauging station	Naturalised flows (in million m^3)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E64	34.8	37.3	80.4	149.9	157.2	126.8	82.6	62.4	55.5	61.2	60.1	49.1
E73	*19.9*	*19.8*	*54.1*	*111.0*	*118.4*	*94.6*	*57.9*	*35.6*	*29.9*	*34.0*	*34.6*	*29.0*
E65	62.2	63.7	163.8	328.0	346.8	276.4	173.0	115.8	99.6	110.9	110.1	90.4
EF4	91.7	91.2	257.7	568.5	721.8	611.5	342.2	189.2	154.9	172.3	170.8	139.5
E80	5.4	9.1	21.9	69.9	174.8	148.2	48.4	12.2	9.1	10.8	11.0	9.0
Into the Estuary	85.7	95.3	340.7	810.2	1212.5	1110.0	607.2	197.2	148.9	145.7	141.9	116.1

Table 4: Baseline Flows (2023) at key gauging stations of the Pungwe Watercourse

Gauging station	Baseline flows (in million m^3)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E64	25.8	29.1	71.2	143	152.2	121.9	77.5	54.3	44.8	46.8	44.7	36.2
E73	17.3	18	52.9	109.9	117.2	93.5	56.7	34	27.7	31	31.1	25.4
E65	48.7	52.3	151.4	318.5	339.3	269.1	165.5	104.2	84.5	90.5	87.7	70.9
EF4	74.7	78.7	244.8	558.6	714	603.3	333.7	176.4	138.1	149.3	144.2	114.7
E80	3.4	8.5	21.6	69.7	174.7	147.8	47.9	11.6	8.2	9.3	8.6	6
Into the estuary	85.7	80.2	323.6	793.3	1195.5	1094.3	594.7	180.9	126.6	117.5	105	76

4.2 Water quantity

The Table below shows the recommended monthly water volumes at key gauging stations, in million cubic metres, covering both wet and dry season flows.

Table 5: Recommended monthly Eflow volumes at key gauging stations

Gauging station	Eflows (in million m^3)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E64	16.0	20.4	63.3	130.2	140.8	112.9	70.8	42.3	32.1	28.1	26.5	19.2
E73	6.5	9.6	44.0	94.1	101.1	79.8	47.3	22.4	15.6	13.7	13.3	8.6
E65	28.6	35.7	141.2	302.0	324.6	256.7	155.6	82.0	59.9	52.9	51.0	36.2
E80	4.5	8.7	21.6	69.7	174.7	147.9	47.9	11.4	6.6	8.0	6.6	7.9
Into the estuary	16.8	40.6	257.8	731.0	1150.4	1054.9	552.9	132.7	65.1	50.2	36.6	16.8

*Table 6: **EFlows linked to the Eflows sites***

Gauging station	Eflows (in million m^3)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E64	16.0	20.4	63.3	130.2	140.8	112.9	70.8	42.3	32.1	28.1	26.5	19.2
E73	*8.2*	*11.3*	*50.1*	*106.9*	*114.7*	*90.7*	*53.8*	*25.8*	*18.1*	*16.1*	*15.8*	*10.6*
E65	28.6	35.7	141.2	302.0	324.6	256.7	155.6	82.0	59.9	52.9	51.0	36.2
EF4	56.0	55.0	198.8	511.2	681.5	578.6	314.4	135.65	91.9	81.0	74.0	59.1
E80	4.5	8.7	21.6	69.7	174.7	148.0	48.0	11.4	6.6	8.0	6.6	7.9
Into the estuary	**16.8**	40.6	257.8	731.0	1150.0	1054.9	552.9	132.7	65.1	50.2	36.6	**16.8**

4.2.1 Minimum eflows into Mozambique

Table 7: Minimum Eflows volumes into Mozambique

Key Eflow sites	EFlows (in million m^3)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
E64	16.0	20.4	63.3	130.2	140.8	112.9	70.8	42.3	32.1	28.1	26.5	19.2

4.2.2 Minimum eflow volumes into the estuary

River flows into the estuary shall not fall below 6.5 m^3/s as discharges of 6.0 m^3/s or lower significantly increase the risk of eutrophication.

Table 8: Minimum eflow volumes into the estuary

Key Eflow sites	EFlows (in million m^3)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
Into the estuary[16]	16.8	40.6	257.8	731.0	1150.4	1054.9	552.9	132.7	65.1	50.2	36.6	16.8

4.2.3 Criteria for construction, testing, commissioning and operation of proposed impoundments

The agreed limits on inter- and intra-daily fluctuations in the releases from impoundments are given in Table 9, viz.: <10% intra- and inter-daily flow variations (excluding flood events). These criteria apply to construction, testing, commissioning and operational phases.

Table 9 Limits on downstream releases from impoundments

Aspect	Requirement	Location
Releases	≤10% fluctuations over a rolling 12-hour period	1 km downstream
Water level fluctuations	≤0.05 m/hour	1 km downstream

4.2.4 Criteria for filling of proposed impoundments

The percentage of inflow released shall depend on the month(s) in which filling occurs, and on the storage ratio of the proposed impoundment. The releases shall be implemented gradually and result in water level changes on the downstream river of no more than 0.05 m/hour. The downstream river ecosystems shall be closely monitored during reservoir filling, and releases increased if there are any signs of distress related to the sudden reduction in discharge.

4.2.5 Operationalising of environmental flows

To be able to monitor the recommended environmental flows, the volumes in the tables above need to be converted to discharge, both for the dry months, when the bulk of the volumes are contained in low flows, and for the wet months, when part of the volume is made up of low flows and part is flood events.

To convert to the required discharges to facilitate monitoring, a baseflow separation technique was applied which resulted in mean estimated volumes for the low-flows and the floods in each month. These are provided in the table below, together with the (original) total volumes. The low flow volumes were then converted to discharge to provide a minimum target discharge for monitoring. Whether the minimum low flow targets have been achieved is monitored at each location by:

- Measuring daily discharges at each location and comparing against the Target Minimum Discharge (m^3/s); minimum low flows in each month should not drop below the target. Low flows are only part of the EFlows requirements, as it is important for river health that the floods are also provided. Whether the flood targets are being achieved is monitored at each location by:
  - ✓ Recording the daily flows (m^3/s) for the duration (days) of each flood event
  - ✓ Converting these to daily volumes (m^3/s x 60 x 60 x 24 x 30/1000000)
  - ✓ Adding the volumes for the number of days that a flood lasted
  - ✓ Repeating this for all floods in a month
  - ✓ Adding volumes for the month and comparing against the Flood Target Volume (m^3x10^6).

- Whether the Total EFlows are being achieved is monitored at each location by:
  - ✓ Adding lowflow and highflow volumes for the month, and comparing against the Total Target Volume (m^3x10^6) for each month
- EFlows volumes should not drop below the target.

Table 10: Measurement targets for EFlows linked with the implementation of the Pungwe Watercourse Agreement water resource developments, augmented to ensure a minimum discharge of >6.5 m^3/s into the estuary (red numbers)

Location	Portion of flow regime	Type	Months											
			O	N	D	J	F	M	A	M	J	J	A	S
E64	Total flows	Target Volume (m^3x10^6)	16.0	20.4	63.3	130.2	140.8	112.9	70.8	42.3	32.1	28.1	26.5	19.2
	Lowflows	Target Volume (m^3x10^6)	14.7	15.2	26.5	48.8	64.4	66.6	55.9	40.5	31.5	27.9	26.2	19.1
		Target Minimum Discharge (m^3/s)	6.2	7.9	24.4	50.2	54.3	43.6	27.3	16.3	12.4	10.8	10.2	7.4
	Floods	Target Volume (m^3x10^6)	7.9	25.7	58.1	62.5	54.3	41.0	21.0	4.3	2.0	0.7	1.2	0.3
E73	Total flows	Target Volume (m^3x10^6)	6.5	9.6	44.0	94.1	101.1	79.8	47.3	22.4	15.6	13.7	13.3	8.6
	Lowflows	Target Volume (m^3x10^6)	5.8	6.4	15.3	32.2	43.1	43.3	34.4	21.4	15.3	13.7	13.1	8.5
		Target Minimum Discharge (m^3/s)	2.5	3.7	17.0	36.3	39.0	30.8	18.2	8.7	6.0	5.3	5.1	3.3
	Floods	Target Volume (m^3x10^6)	9.7	33.6	65.2	65.8	57.4	45.8	27.2	4.8	1.8	0.6	1.6	0.3
E65	Total flows	Target Volume (m^3x10^6)	28.6	35.7	141.2	302.0	324.6	256.7	155.6	82.0	59.9	52.9	51.0	36.2
	Lowflows	Target Volume (m^3x10^6)	26.5	26.6	53.8	107.3	142.2	143.8	116.7	78.1	58.8	52.5	50.3	36.1
		Target Minimum Discharge (m^3/s)	11.0	13.8	54.5	116.5	125.2	99.0	60.0	31.6	23.1	20.4	19.7	14.0
	Floods	Target Volume (m^3x10^6)	7.2	25.6	61.9	64.5	56.2	44.0	25.0	4.7	1.9	0.7	1.4	0.2
E80	Total flows	Target Volume (m^3x10^6)	4.5	8.7	21.6	69.7	174.7	147.9	47.9	11.4	6.6	8.0	6.6	7.9
	Lowflows	Target Volume (m^3x10^6)	4.4	4.2	7.8	21.8	54.9	66.6	41.1	10.7	6.5	6.6	6.4	6.7
		Target Minimum Discharge (m^3/s)	1.7	3.4	8.3	26.9	67.4	57.0	18.5	4.4	2.6	3.1	2.6	3.0
	Floods	Target Volume (m^3x10^6)	1.9	51.5	63.9	68.7	68.6	55.0	14.1	6.0	2.8	16.8	4.3	15.2
Into the estuary[3]	Total flows	Target Volume (m^3x10^6)	16.8	40.6	257.8	731.0	1150.4	1054.9	552.9	132.7	65.1	50.2	36.6	16.8
	Lowflows	Target Volume (m^3x10^6)	16.8	15.4	72.7	218.6	396.7	475.5	363.4	128.3	64.4	50.2	36.5	16.8
		Target Minimum Discharge (m^3/s)	6.5	15.7	99.5	282.0	443.8	407.0	213.3	51.2	25.1	19.4	14.1	6.5
	Floods	Target Volume (m^3x10^6)	0	62.2	71.8	70.1	65.5	54.9	34.3	3.3	1.0	0.2	0.2	0

[3] i.e., downstream of the Route 24 Offtake

4.3 Ecosystem integrity

The estimated baseline (2022) integrity (ecological condition) of the individual ecosystem disciplines in the EFlows zones in the Pungwe Watercourse

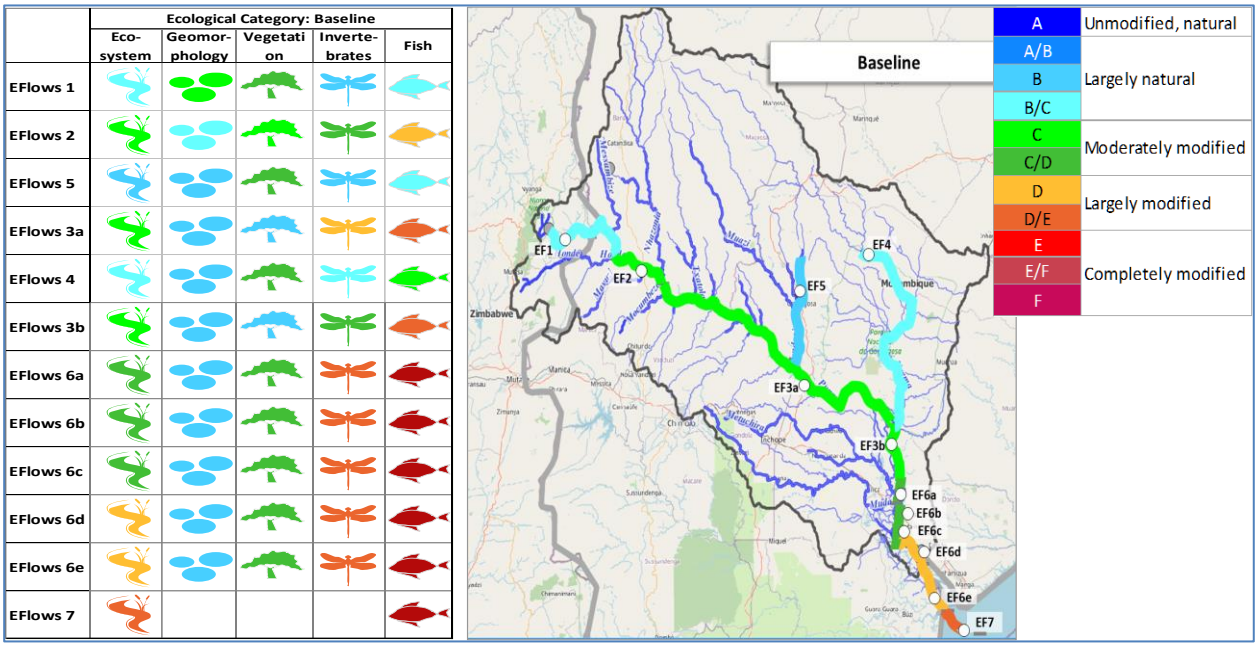

Figure 1: Baseline (2022) ecological integrity of the Pungwe Watercourse

The target ecological conditions for the Pungwe Watercourse and estuary are provided in Interventions will focus on enhancing the knowledge baseline on groundwater-surface water interactions: developing guidelines for groundwater protection zoning and model regulations to manage groundwater use; groundwater monitoring network design and implementation; and sharing groundwater level, abstraction and quality data for the area.

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Table 11 Target Ecological State categories

	Pungwe River					Estuary				
	1	2	3	4	5	6a	6b	6c	6d	6e
BES (2021)	B/C	C	C	B/C	B	C/D	C/D	C/D	D	D
Target	B/C	C	C	B/C	B	C	C	C	C/D	C/D

The definitions of the Ecological State categories are provided in Appendix 1.

4.4 Groundwater depletion of interconnected surface water, wetlands and GDEs

The Lake-Urema area was identified as a regional groundwater recharge zone: a mixed surface water–groundwater flow system, receiving surface runoff during the rainy season and groundwater during the dry season. The rivers coming off Mount Gorongosa and Cheringoma Plateau are perennial, becoming seasonal upon entering Urema Graben. The runoff infiltrates the subsurface, indicating that the Urema Graben

flanks behave as regional groundwater recharge area. Establishing any large-scale groundwater use activities on the Urema Graben flanks has the potential to impact connected surface water resources.

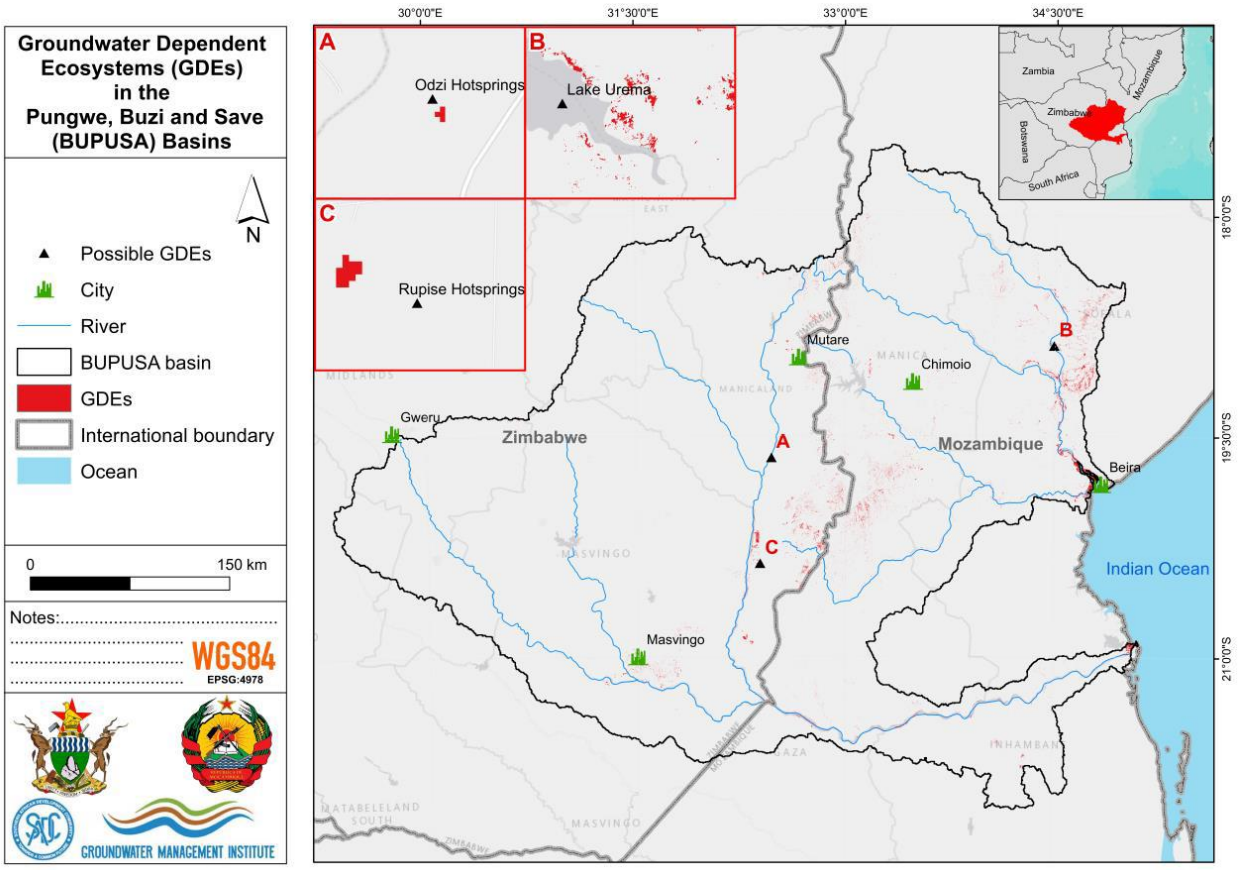

Figure 2: Groundwater dependent ecosystems in the Buzi, Pungwe and Save basins

Interventions will focus on enhancing the knowledge baseline on groundwater-surface water interactions: developing guidelines for groundwater protection zoning and model regulations to manage groundwater use; groundwater monitoring network design and implementation; and sharing groundwater level, abstraction and quality data for the area.

4.5 Agreed management measures

Combine waterresource development in Pungwe Water Sharing Agreement with investments in environmental protection and sustainable utilization of natural resources, comprising:

- maintain the Nhandugue River, the Nhandare River and the Urema catchment in near-natural condition, including cross-sectoral engagements to faciliate a cessation of deforestation activities to support migratory species and other ecosystem processes
- ensure dry season river inflows to estuary >6.5 m^3/s to offset risk of eutrophication, and other risks
- maintain flood flows in the river and estuary to support fishery
- Ensure protection for the *Lake Urema graben*

Facilitating cross-sectoral engagements and resource mobilisation for the development of sustainable management plans, linked with:

- employment-intensive investments
- rural health, quality education, rural infrastructure and services

5 The EFlows monitoring programme

The successful implementation of Eflows must demonstrate to stakeholders clear improvements in key hydrological, ecological, livelihood, and broader economic conditions, at specific sites of concern and for the basin as a whole.

The specific objectives of the EFlows monitoring are to:

- establish whether or not the agreed EFlows provisions are being adhered to;
- establish whether the overall environmental objective of achieving target river conditions is met;
- establish whether the overall socioeconomic objectives of achieving target river conditions are met;
- establish whether or not there is any change in baseline water quality;
- establish whether there is any change in the baseline biodiversity of key groups; and,
- use the information gathered to guide necessary management interventions and adaptive management.

5.1 Data collection and responsible institutions

The following data shall be collected as part of the EFlows monitoring plan. These are, however, subject to adjustment, refinement and expansion in accordance with the adaptive management principles in Section 7 of this plan. Full implementation of the monitoring and adaptive management system for the Pungwe Water over the long-term requires carefully defined roles and responsibilities for BUPUSATEC, and for identified strategic partners, coupled with a strategy for sustainable financial support.

Table 12: Monitoring Parameters and Responsibilities

Category	Monitoring Parameter	Responsible partner
River hydrology, hydraulics and hydrogeology:	Discharge data and gauging weir rating curve review and refinement of rating relationships where required	ZINWA Save, ARA Centro, IP
	Stage/water level data from key EFlows sites and gauging stations	ARA Centro, IP,
	Channel dimensions at gauging and EFlows monitoring sites	National Agency for Environmental Quality Control National Directorate of Water Resources Management
	Bed sediment composition at gauging stations and EFlows monitoring sites	
	Aquatic habitat mapping and fixed-point photography at gauging stations and EFlows monitoring sites	Eduardo Mondlane University, National Directorate of Environment University of Zimbabwe
Hydrology of water resource developments	Inflows into reservoirs	ZINWA, ARA Centro IP
	releases from reservoirs	ZINWA Save, ARA Centro,IP CC & SCCs

	abstractions from the river	
Water quality	in-situ physical water quality;	EMA, ZINWA Save, ARA Centro,IP CC & SCCs, Local Authorities, SAZ
	chemical water quality;	
	Biological water quality	
	Continuous electrical conductivity and temperature monitoring at flow gauges.	
Vegetation:	abundance, condition and community composition.	EMA, Forestry Commission, Allied Timbers, CC & SCCs,
	Invasive/encroaching species	Eduardo Mondlane University; National Directorate of Environment
	Fire	National Directorate of Environment
Macroinvertebrates:	abundance and community composition.	Eduardo Mondlane University; Aquaculture and Fishery Institute
Fish:	abundance and community composition	Eduardo Mondlane University; Aquaculture and Fishery Institute
Livelihood parameters/river-affected people:	health	National Directorate of Environmental Healthy
	fish-catch data.	Aquaculture and Fishery Institute
	agriculture	Department Responsible for Water Resources in Zimbabwe (MLAFWRD), National Directorate of Agriculture
	water supply	ZINWA Save, National Directorate for Water Supply and Sanitation
	livestock	Department Responsible for Water Resources in Zimbabwe (MLAFWRD), National Service of Veterinary
	Freshwater and estuarine fisheries	Department Responsible for Water Resources in Zimbabwe (MLAFWRD), Aquaculture and Fishery Institute
	Tourism	MoTHI, National Directorate of Tourism
	Natural resource utilization (e.g. reeds)	EMA, Forestry Commission, Allied Timbers, National Directorate of Environment

5.2 Monitoring locations

5.2.1 EFlows river monitoring sites

The key Eflow River Monitoring Sites are: **E64, E73, E65, E80** and **into the estuary.**

The applicable EFlows zones on the Pungwe Watercourse are:

1. EFlows Zone 1: The Pungwe River in Zimbabwe E-
2. EFlows Zone 2: The Pungwe River in Mozambique, from downstream of the confluence with the Honde River to upstream of the confluence with the Vunduzi River
3. EFlows Zone 3: The Pungwe River in Mozambique, from the Vunduzi confluence to the head of the estuary
4. EFlows Zone 4: The Nhandugue River upstream of Lake Urema EFlows Zone 5: The Nhandare River
5. EFlows Zone 6: The Pungwe Estuary
6. EFlows Zone 7: Near-shore marine environment.

In addition, it may be necessary to collect some information from the tributaries entering the Pungwe River, e.g., sediments. Additional sites of interest for monitoring include **Nhandare E42, Nhandugue E677, Mafambisse E67, Nhacangale E70, Nhazonia E72, Metuchira E74, Gorongosa E651.**

5.3 Establishment of a baseline data set

The EFlows Monitoring programme shall commence no later than June 2025, and the first four years shall be used to generate a baseline data set against which future data can be compared.

5.4 Monitoring schedule

The monitoring schedule for one calendar year is given in Table 13. The frequency of data collection varies from continuous logging of data by loggers installed in the river stream, to regular and less frequent data collection to take place monthly (water quality), bi-annually (macroinvertebrates and fish), annually (geomorphology). Geomorphology monitoring is to take place during low flows (October).

Table 13 EFlows Monitoring schedule

Data	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Hydrology	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬
Hydraulics and geomorphology	**X**						**X**		X			
Water quality	**X**	X	X	**X**	X	X	**X**	X	X	**X**	X	X
Fixed point photographs	X						X					
Vegetation	**X**						**X**					
Macroinvertebrates							X					
Fish							X					
Livelihoods							X					

5.5 Staffing and skills requirements

Monitoring personnel shall be qualified, with sufficient experience to perform the diverse functions

required in the EFMP, including data collection, data analysis, report writing, presentation of results, input to adaptive management decisions and participation in periodic inspection programs. Data collection, management and analysis activities should also be fully resourced with sufficient support personnel and equipment to perform the necessary functions and provide the required level of data analysis. Ideally, institutional or partners' staff that are already collecting similar datasets should contribute to implementation of the EFMP.

The EFMP recognise that continuity of technical positions is essential to maintaining consistent high standards of practice.

6 Reporting, record keeping and auditing

6.1 Record keeping

The BUPUSATEC shall store all data collected in the Eflows reporting system developed for the Pungwe Watercourse in BUPUSAWIS, the standard data management system that shall be adopted by the BUPUSACOM for data storage and management. Until its development, the Technical Committee will make use of a live web-based data base.

6.2 Reporting

The Standing Working Group on Water, Environment and Climate shall produce two reports per annum. The BUPUSATEC shall consolidate the annual Pungwe Watercourse EFlows Monitoring Report in December of each year for submission to the Council of Ministers and shared with stakeholders.

The Annual EFlows Reports shall include, but not necessarily be limited to:

- implementation of EFlows Procedures Analysis and Compliance, including:
    - documentation of issues or problems related to implementation, if any, and suggested solutions.
- Hydrological Analysis and Compliance, including (at the appropriate time step – but no greater than daily):
    - a statistical summary of the releases from impoundments, including percent compliance with the 10% rule, annual and seasonal flow duration curves, and duration curves of rates of water flow change;
    - a breakdown of the calculated flows at E64, E73, E65, E80 and into the estuary, Mafambisse E67, Nhacangale E70, Nhazonia E72, Metuchira E74, Gorongosa E651
- Measured River Condition Targets Analysis and Compliance, including:
    - comparative analysis of baseline and monitoring data;
    - trend analysis of monitoring data.

6.3 Periodic Inspection Program

The implementation of the EFMP shall be subject to an annual auditing and review by external auditors.

6.4 Public disclosure of monitoring information

6.4.1 Annual EFlows Monitoring Reports

Once they have been approved by the Republics of Zimbabwe and Mozambique, BUPUSATEC shall make the Annual EFlows Monitoring Reports available for download on their website.

This shall occur no later than 1st June of the following year.

6.4.2 Audit Reports

Once they have been approved by the Republics of Zimbabwe and Mozambique, BUPUSATEC shall make the Audit Reports available for download on their website.

This shall occur no later than six months following audit.

7 Adaptive management system

7.1 Adaptive management activities

Adaptive management actions shall be informed by evaluation of whether implementation of EFlows is giving the desired results. This can be achieved by evaluating performance of the river system against some hypothetical questions that explicitly test the relationship between the flow regime and potential ecological and socio-economic responses (Cottingham et al. 2005).

The following questions (adapted from Beilfuss, 2012) serve as hypothesis statements to test whether key outcomes desired by stakeholders are being met through EFMP implementation, and thus serve as the basis for the EFR monitoring system. Additional statements may be defined during implementation

- *Hydrological questions*
    - ✓ Do EFlows result in more natural (pre-impact) hydrological conditions, with respect to the timing, depth, extent, duration, and/or frequency of water flows and levels?
    - ✓ Do EFlows improve water quality (such as temperature, salinity, dissolved oxygen, pH, nutrient cycling and availability, chlorophyll a, heavy metals)?
    - ✓ Do EFlows restore or maintain geomorphic stability (i.e., reduce dam-induced down- cutting and/or riverbank erosion) and sedimentation (transport and deposition) processes?

- *Ecological questions*
    - ✓ Do EFlows support fundamental food chain dynamics (phytoplankton, macroalgae, zoobenthos, macroinvertebrates)?
    - ✓ Do EFlows improve the diversity, status, distribution, and condition of key species (mammal, bird, amphibian, reptile, or other species of conservation concern)?
    - ✓ Do EElows improve the diversity, status, distribution, and condition of key wetland vegetation?
    - ✓ Do EFlows reduce the extent and density of problem invasive species?
    - ✓ Do EFlows reduce the intensity or extent of dry season fires?

- Livelihood questions
    - ✓ Do EFlows increase water availability for domestic use (as surface or groundwater)?
    - ✓ Do EFlows increase subsistence or cash crop agriculture productivity and/or income (flood recession, riverbank, small-scale irrigated)?
    - ✓ Do EFlows improve livelihoods from livestock?
    - ✓ Do EFlows improve livelihoods from freshwater and/or estuarine fisheries?
    - ✓ Do EFlows increase the availability or quality of natural resources valued by river basin communities (e.g., reeds, mangroves, riparian forests)?
    - ✓ Do EFlows maintain or improve public health status with respect to water borne disease outbreaks?
    - ✓ Do EFlows maintain or reduce current levels of flood vulnerability or emergency relief (risk to people, property, or local infrastructure)?
    - ✓ Do EFlows improve commercial livestock condition (against disease), productivity and/or income?

- ✓ Do EFlows increase commercial freshwater and/or estuarine fisheries productivity, catch rates, and/or income?
- ✓ Do EFlows contribute to regional tourism and/or safari hunting revenue or employment?
- ✓ Do EFlows maintain or improve commercial agriculture productivity and/or income?

Adaptive management activities shall include:

- Quarterly meetings aimed at reviewing objectives, goals and progress; and,
- Producing quarterly reports on the status of the basin.

7.2 Decision-making and the adaptive management system

The BUPUSATEC shall be responsible for the final decisions relating to the adaptive management system.

7.3 Stakeholder involvement

All relevant major stakeholders for each of the EFlow sites (dam operators, irrigators, wildlife reserve authorities, downstream communities, fishers, national environmental authorities, etc.) shall be involved in discussions if the agreed target condition of the rivers is not being met and may have to be changed.

- There shall be public disclosure and involvement for the full period of implementation of the EFMP.
- There shall be an annual external and independent audit of implementation of the EFMP.
- The audit shall make provision for stakeholder inspection and involvement.

8 Funding

8.1 Provision for the financing of the implementation of the EFMP shall be included in the budget for BUPUSACOM annual activities, specifically the Standing Working Group on Water, Environment and Climate. Where there is a shortfall ICPs shall be approached for support and Member states are expected to co-finance. The EFMP budget includes provision for:

- Time and costs associated with the implementation of the technical aspects of the EFMP, including:
    - personnel and disbursement costs associated with data collection;
    - procurement and maintenance of monitoring equipment;
    - costs of sample analyses (sediments, water quality, plants, macroinvertebrates, fish, etc.);
    - personnel and disbursement costs associated with data management, analysis and reporting;
    - independent review of monitoring reports and data; and
    - any other costs that may be relevant to the EFMP.

8.2 Provision of funding for the design, maintenance and updating of a webpage to make EFlows information available to the public. This webpage can be accessed from the BUPUSACOM website and eventually link to the Decision Support and Information Systems BUBUPUSAWIS, once developed.

- *Ad hoc* meetings with interested and affected Parties;
- Appointment of an external reviewer;
- Periodic meetings, including those as may be necessitated by the Adaptive Management System(AMS);
- Time and costs associated with technical adjustment of targets as may be necessitated by the Adaptive Management System; and,
- Training and networking.

APPENDIX A: MAPS SHOWING MONITORING LOCATION

The EFlows assessment focused on seven EFlows zones, as follows (Figure 1):
EFlows Zone 1: The Pungwe River in Zimbabwe
EFlows Zone 2: The Pungwe River in Mozambique, from downstream of the confluence with the Honde River to upstream of the confluence with the Vunduzi River
EFlows Zone 3: The Pungwe River in Mozambique, from the Vunduzi confluence to the head of the estuary
EFlows Zone 4: The Nhandugue River upstream of Lake Urema
EFlows Zone 5: The Nhandare River
EFlows Zone 6: The Pungwe Estuary
EFlows Zone 7: Near-shore marine environment.

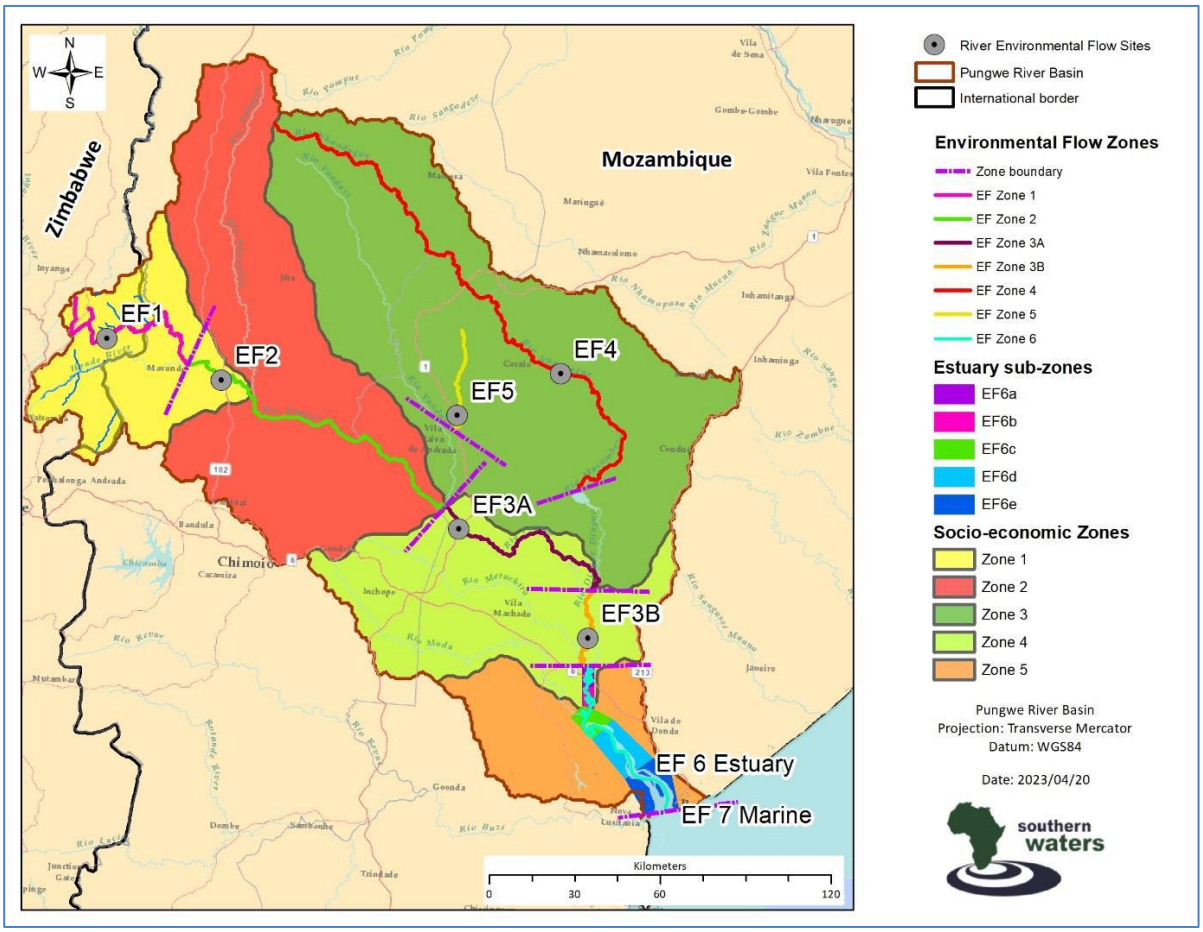

Figure 3: Socio-economic zones (Zones 1-5) of the Pungwe Watercourse and corresponding EFlows sites and zones for the river (EF1-5), estuary (EF6) and EF7, which is the nearshore coastal environment. Source: Eco-social Flows (EFlows) assessment of the Pungwe Watercourse - EFlows Scenario Assessment Report

The corresponding socio-economic zones are shown in Figure 2, which also shows the position of the river EFlows sites.

The process of delineation of the zones is presented the *Eco-social Flows (EFlows) assessment of the Pungwe River basin - Delineation and Preliminary Status and Trends Interim Report*, and the supporting specialists' reports.

The river zones are represented at six river sites, EFlows sites 1, 2, 3a and 3b on the Pungwe River, numbered downstream from the source, and one each on the Nhandugue (EF5) and Nhandare (EF4) tributaries, as shown on Figure A1, Figure A.2 and in Table A.1.

The estuary zone is represented by five sub-zones (EFlows zones 6a-e; Figure A.1 and Figure A.2), numbered downstream to the river mouth.

- EFlows Zone 6a (EF6a) - 0 to 20 km upstream of the estuary mouth.
- EFlows Zone 6b (EF6b) - 20 km to 40 km upstream of the estuary mouth.
- EFlows Zone 6c (EF6c) - 40 km to 60 km upstream of the estuary mouth.
- EFlows Zone 6d (EF6d) - 60 km to 80 km upstream of the estuary mouth.
- EFlows Zone 6e (EF6e) - 80 km to 100 km upstream of the estuary mouth.

Figure 4: Estuary zonation into five sub-zones that respond similarly to modification of river inflows

The marine zone is represented by one zone (EFlows Zone 7).

Table 14: Location and co-ordinates of the six river EFlows sites. River EFlows Site/Zones

	Location	Coordinates
1	Mukupe Village, Honde Valley Road, Pungwe River, gauge F24	-18 o 26’ 00’’S; 32o 53’ 49’’E
2	Pungwasul Village, N7 road bridge crossing, Pungwe River, gauge E65	-18 o 33’ 10’’S; 33o 16’ 49’’E
3a	N1 bridge crossing Pungwe River, Matenga-Pungwe Village, gauge E651	-18 o 59’ 43’’S; 34o 05’ 05’’E
3b	Floodplain and wetland area upstream of the Estuary Zone 6a2	-19°13'35.75"S; 34°30'52.17"E
4	Casa Banana Village, Nhandugue River	-18o 29’ 33’’S; 34 o 23’ 59’’E
5	South of Gorongosa Village, Nhandare River	-18o 38’ 12.9’’S; 34 o 03’ 49.4’’E
6a	80 to 100 km upstream of the estuary mouth	
6b	60 to 80 km upstream of the estuary mouth	
6c	40 to 60 km upstream of the estuary mouth	
6d	20 to 40 km upstream of the estuary mouth	
6e	0 to 20 km upstream of the estuary mouth	
7	Off-shore marine zone	

APPENDIX B: *ECOLOGICAL CATEGORY*

Ecological condition categories describe the general condition of the river ecosystem (after Kleynhans 1996) as follows:

Table 15: Ecological category description

Ecological category	Description
A	Unmodified. Still in a natural condition.
B	Degrees of: Near natural. A small change in natural habitats and biota has taken place but the ecosystem functions are essentially unchanged.
BB/C	
B/C	
B/CC	Degrees of: Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
C	
CC/D	
C/D	
C/DD	Degrees of: Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
D	
DD/E	
D/E	
D/EE	Degrees of: Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
E	

APPENDIX D: REFERENCES

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