Management of Environmental Flows in the Nile Basin: NBI Experience
**What/Why are Environmental Flows?**

Environmental flows describe the quantity, quality and timing of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and wellbeing that depend on these ecosystems.

Environmental flows are important for the maintenance of biodiversity and ecosystems services provided by the river to sustain the human livelihoods that depend on these services.
Nile E-Flows Management Strategy

**Vision**
A Nile Basin in which water resources are developed and managed while sustaining the river flows required for healthy freshwater and estuarine ecosystems supporting human livelihoods and wellbeing that depend on them.

**Goal**
To facilitate and develop a culture of incorporation of collaborative, best practice E-flow management into the water resource planning, management and policies of the countries who share the Nile Basin (short term) to ultimately result in the establishment of an integrated, basin scale E-flows management system (long term).

**Objective**
To achieve sustainable water resources development through management of the Nile Basin’s flows required to sustain the freshwater and estuarine ecosystems and the human livelihoods and wellbeing that depend on these ecosystems; build body of knowledge on e-flow processes.
Strategic Objectives and Strategic Action Areas

A. Develop an Environmental Flows management framework appropriate for the Nile Basin.

B. Build capacity and awareness amongst national technical staff and policy makers.

C. Support establishment of enabling national policy environments for E-flow management.

D. Develop a regional e-flow knowledge management, quality assurance and support function at NBI.

E. Support the NBI Countries to increase the number of E-Flows application with the Nile Basin; at different scales and scopes.
A Nile Basin Environmental flows management Framework

The NBI e-flow management framework adapted from international best practices.

Environmental flow management frameworks: Environmental flow management frameworks are structured approaches designed to help consistent evaluation of environmental flow requirements across multiple ecosystems and scales and to guide stakeholders in the development and implementation of e-flow standards.

The e-flow management framework: A seven-phase approach

**Phase 1:** Scoping the assessment and alignment to regional management requirements.

**Phase 2:** Setting the Resource Quality Objective.

**Phase 3:** Establishing the hydrological foundation.

**Phase 4:** Classifying ecosystem types.

**Phase 5:** Describing flow alterations.

**Phase 6:** Establishing flow-ecosystem services linkages; *mutual influences and interactions*.

**Phase 7:** E-flow Setting and monitoring
Managing Environmental Flows in the Nile Basin: Guiding Principles

1. Recognise the challenge
2. Strive for appropriate simplicity
3. Learn while doing
4. Learn from each other and share experiences
5. Consider resource availabilities
6. Prepare to manage environmental flows at multiple scales
7. Embrace subsidiarity
E-Flows: LOG FRAME

THE VISION DESCRIBES SOCIETY'S ASPIRATION FOR ITS INTERACTION WITH THE RESOURCES PROVIDED BY THE NILE RIVER

RQOS - RESOURCE QUALITY OBJECTIVES DESCRIBE THE RESOURCES OF THE NILE RIVER AS THEY SHOULD BE.

TARGETS DESCRIBE THE RQOS IN RELATION TO THE COMPONENTS OF THE ECO시스템 THAT NEED TO BE MANAGED I.E. QUANTITY, QUALITY, HABITAT AND BIOTA

INDICATOR QUANTIFY THE TARGETS AND PROVIDE VALUES NEEDED TO BE ACHIEVED I.E. E-FLows MEASURED IN XXXM3/S

VISION

RQO e.g. GOOD WATER QUALITY TO PROVIDE SAFE WATER FOR DOMESTIC USE

TARGET e.g. GOOD WATER QUALITY IN TERMS OF PATHOGENS

INDICATOR e.g. E.COLI IN COUNTS COUNTS PER 100ML

RQO e.g. QUANTITY OF WATER TO KEEP THE ECOSYSTEM IN A GOOD CONDITION AND PROVIDES FOOD FOR FISH

TARGET e.g. SUSTAINABLE SOURCE OF FOOD FOR FISH IS PROVIDED

INDICATOR e.g. STOCKS OF FISH IN TONNES PER ANNUM

TARGET e.g. ENVIRONMENTAL FLOWS KEEP ECOSYSTEM IN GOOD CONDITION ACCORDING TO MONTH OF THE YEAR

INDICATORS e.g. E-Flows in m3/s PER MONTH
Rationale of Selected EFA Approach

ENVIRONMENTAL FLOW ASSESSMENT METHODS

HYDROLOGICAL

HYDRAULIC RATING

HABITAT SIMULATION

HOLISTIC METHODS

RECONNAISSANCE/DESKTOP/RAPID LEVEL OF IMPLEMENTATION – MODELS ONLY

OR

COMPREHENSIVE LEVEL OF IMPLEMENTATION – HABITAT/SITE ASSESSMENT BASED
NILE E-FLOWS FRAMEWORK

PHASE 1: SITUATION ASSESSMENT AND ALIGNMENT PROCESS

PHASE 2: GOVERNANCE MANAGEMENT SYSTEM & RESOURCE QUALITY OBJECTIVE SETTING

PHASE 3: HYDROLOGIC FOUNDATION

PHASE 4: ECOSYSTEM TYPE CLASSIFICATION

PHASE 5: FLOW ALTERATIONS

PHASE 6: FLOW-ECOLOGICAL-ECOSYSTEM SERVICES LINKAGES
Stakeholders Consultations

SITE-REGIONAL SCALE CONSIDERATION
- SOCIETAL NEEDS & VALUES
- LEGISLATION & POLICY CONSIDERATIONS

DESIRED ECOSYSTEM WELLBEING
- TRADE-OFF ANALYSES & NEGOTIATION
- DESIRED ECOSYSTEM SERVICES

PHASE 2: GOVERNANCE MANAGEMENT
SYSTEM & RESOURCE QUALITY OBJECTIVE SETTING
- VISION FOR THE RESOURCE
- RESOURCE QUALITY OBJECTIVES
Stakeholders’ Matrix

**TRSB**
- Upstream – downstream interest and impacts; alignment & compatibility.
- Legal framework and international customary laws & conventions.

**NATIONAL**
- National legislations, policies, strategies and development plans & priorities.
- Trade-offs (inter-sectoral, geographical, etc.) and decision making processes.

**NGOS**
- Attached to grass roots and target groups (credibility, trust, understanding).
- Key actor in supporting implementation (awareness, advisory, organization).

**ADMIN**
- Accountability to residents for the socio-economic development.
- Key player in supporting, monitoring and enforcement of interventions.

**LOCALS**
- Direct interest in natural systems’ performance and alterations (services).
- Key to successful implementation of the recommended measures.
Demonstration of the Nile E-flows Framework in the Dinder River, Blue Nile Basin

- Largest seasonal Blue Nile tributary
- Data scarce environment
- The Dinder National Park (Ethiopia)
- Potential development & local needs
- Annual flooding of floodplain habitats

Rapid E-flows assessment of a site on the Dinder River using a combination of the Desktop Reserve Model and a hydraulic rating procedures with flow-ecological considerations derived from historical evidence and data collected during a survey to the Dinder River.

Current fish communities and their flow-habitat related attributes of the Dinder River from the survey site was considered. Additional historical data was also considered.

Objective: To characterize the habitat diversity, model the physical template of the river and link flows to this template so that habitat conditions can be modeled, evaluate water quality, identify diversity and state of local and regional habitats as well as flow-dependent human and habitat requirements; within the reach of the study area in the Nile Basin.
Demonstration of the Nile E-flows Framework in the Dinder River, Blue Nile Basin

The Dinder forms part of the Blue Nile Sub-basin where E-flows management is limited. To date no regional alignment processes have been established for the region.

In Sudan river flow alterations are governed through historical treaties and irrigation legislation primarily. No formal water resource visioning and objective setting policies etc. are available in Sudan or the Blue Nile Region.

The Dinder Basin is a major source of river discharge for the Blue Nile. The flows of the Dinder River have been monitored historically downstream of the Dinder Reserve which has been suitable to generate a baseline for flows in the study area and have been used in EFA assessments with moderate confidence.

There are no national classification systems for Sudan and no regional attempt to classify ecosystems in detail has been undertaken. This does not allow for any comparisons between similar ecosystems or the description of the range of variability across ecosystems.

In this case study included a rapid analyses of the flows required to maintain ecological components in a suitable state. These altered flows are low confidence and need to be updated with better information.

Preliminary data has been obtained from a survey undertaken to the study during the high flow period of 2015. Although some relationships have now been defined, many important relationships still need to be described.

From this assessment low confidence EFRs for the Dinder River were proposed. The low confidence of the EFR for the Dinder River and inability to relate the EFRs to regional EFRs affects the suitability of these requirement. No mechanisms are available for implementation.

No adaptive management processes have been developed or initiated to test hypotheses to improve E-flow management.
DINDER RIVER E-FLOWS
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DINDER RIVER E-FLOWS

Percentiles Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
0.1 167.21 87.54 12.41 0.43 0.00 0.00 0.00 0.00 14.22 78.71
1 166.30 87.21 12.33 0.43 0.00 0.00 0.00 0.00 14.09 77.99
5 161.88 71.84 12.04 0.00 0.00 0.00 0.00 0.00 13.31 74.60
10 145.24 65.05 10.88 0.00 0.00 0.00 0.00 0.00 12.30 69.03
15 120.16 37.42 7.24 0.00 0.00 0.00 0.00 0.00 10.86 56.42
20 99.32 26.60 5.80 0.00 0.00 0.00 0.00 0.00 8.10 46.53
30 54.29 23.31 3.43 0.00 0.00 0.00 0.00 0.00 1.93 28.31
50 34.71 19.17 1.87 0.00 0.00 0.00 0.00 0.00 0.00 15.91
80 21.80 11.42 0.97 0.00 0.00 0.00 0.00 0.00 0.00 9.02
90 20.51 7.74 0.47 0.00 0.00 0.00 0.00 0.00 0.00 5.07
95 20.51 5.88 0.00 0.00 0.00 0.00 0.00 0.00 0.00 2.78
99 20.51 2.99 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.95
99.9 18.40 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 1.71

Mean Monthly (Mm3/day)
DINDER RIVER E-FLOWS

Dinder River: Monthly hydrograph

Legend
- Nile River
- Allocable flows
- Ecological Flow Requirements
- Supply exceeds demand
- Supply conflicts

SITE
REACH
RIVER SUB-BASIN
RIVER BASIN
NILE SUB-BASIN
NILE BASIN
E-Flows Specifications

ENDPOINTS
- WATER FOR PEOPLE
- HEALTHY FAMILIES
- ECO-TOURISM
- NO DANGEROUS SUBSTANCES
- HEALTHY ECOSYSTEMS
- HEALTHY BUGS
- ACCESS FOR FISH
- HEALTHY PLANTS

MARA EFR

RR1 Monthly hydrograph

RR10 Monthly hydrograph
The Nile E-flows framework:

- E-flows frameworks direct the collaborative (TRS) management of E-flows on regional spatial scales.
- Allows for the integration of multiple EFAs/EFMs, multiple case studies from diverse ecosystem types to meet social and ecological multiple objectives.
- Based on best practice E-flows principles with local (African) relevance.