

Note: This is Online Appendix 2 of McLoughlin, C.A., Riddell, E.S., Petersen, R.M. & Venter, J., 2021, ‘Adaptive and transformative learning in environmental water management: Implementing the Crocodile River’s Ecological Reserve in Kruger National Park, South Africa’, *Koedoe* 63(1), a1663. <https://doi.org/10.4102/koedoe.v63i1.1663>

Appendix 2

TABLE 1-A2: Example elements selected from Crocodile River Ecological Reserve management, used in the strategic adaptive management (SAM) cycle framework.

SAM cycle phase	SAM cycle component	Summary: Example Ecological Reserve related elements in Crocodile River SAM
Adaptive Planning	Vision and objectives breakdown (increased focus/rigor).	Kruger National Park (KNP) vision: maintaining biodiversity in all its natural facets and fluxes. Freshwater related Objectives Hierarchy culminating from KNP vision (see McLoughlin et al. 2011b). Summary Crocodile River sub-objectives: - To give effect to Ecological Reserve implementation. - To oversee Ecological Reserve study outputs. - To maintain the “C” Ecological Category river for reaches traversing KNP.
	Explicit and measurable end-points, known as Thresholds of potential concern (TPCs).	Development of indicators and thresholds of indicators, associated with the “C” Ecological Category river and related KNP biodiversity objectives. Collaborative construction of Crocodile River TPCs (see McLoughlin et al. 2011b): - River flows, water quality, sedimentation. - Fish, macro-invertebrates (e.g., see Todd and Thirion, 2011), riparian vegetation.
Adaptive Implementation	Intervention options. Actions for meeting the TPCs and ultimately the interlinked subobjectives, objectives and vision.	Developed strategies for implementation of the Ecological Reserve. Hydrological models (e.g., Mike FLOOD WATCH and Water Resource Modelling Platform). Crocodile River Operations Committee (CROCOC) – stakeholder participation and collaboration for management of the Crocodile River including Ecological Reserve.
	Planning inputs	Ecological Reserve: Strategies for progressive realization of Ecological Reserve. Stakeholder involvement and responsibilities. Hydrological modelling scenarios - river flow manipulation, dam operating rules.

River flow monitoring - gauging weirs with telemetry capability (near real-time).

Operational planning (monitoring Ecological Reserve flows):

- Rapid Response System (RRS, see McLoughlin et al., 2011a).
- Judicious initiation of feedbacks as and when required.

Strategic planning (monitoring against list of running TPCs):

- Ecological Water Resource Monitoring System (EWRM; see McLoughlin et al. 2011b).
- TPC documentation.
- TPC protocols, to guide and prioritize monitoring activities.
- Running list of all TPCs deployed, indicating whether exceeded or not, management actions etc.

Governance arrangements:

- SAM cycle conceptual plan.
- CROCOC stakeholders, involvement, connections, roles.
- Information types, requirements, responsibilities.

Implementation of
plans

Operational:

- Deploy RRS: monitoring, feedbacks, communications, management log (see McLoughlin et al. 2011b).
- Maintain required river flows as per Ecological Reserve benchmarks calculated each week.
- Release water from Kwena Dam as required.
- Implement water user restrictions as required.
- Generate awareness of current water situation.

Operational monitoring:

- Observe river flows (near real-time) at TenBosch Gauging Weir.
- Initiate timely feedbacks as required.

Strategic monitoring:

- Implement TPC monitoring plan, fieldwork, data collection and use.
- Compile all relevant data and information for TPC audit report input.

Checking
Operational
Outputs

Check required Ecological Reserve flows against the benchmarks of the RRS.

As needed implement operations, e.g., dam operating rules, water user restrictions.

Auditing of
Strategic Outcomes

Deploy TPC maintenance system:

- Collate monitoring data.
 - Audit TPCs.
 - Report TPC status (see McLoughlin et al., 2011b).
 - Red-flag when TPCs exceeded (or close to being exceeded).
 - Integrate with EWRM operations (see McLoughlin et al. 2011b).
 - Resources directed to priority KNP river reaches as needed (actions, monitoring, research).
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McLoughlin, C.A., MacKenzie, J., Rountree, M. & Grant, R., 2011a, *Implementation of Strategic Adaptive Management for freshwater protection under the South African national water policy*, Research Report Number 1797/1/11, Water Research Commission, Pretoria, South Africa.

McLoughlin, C. A., Deacon, A., Sithole, H. & Gyedu-Ababio, T., 2011b, 'History, rationale, and lessons learned: Thresholds of Potential Concern in Kruger National Park river adaptive management', *Koedoe* 53(2), Art. #996, 27 pages. DOI: 10.4102/koedoe.v53i2.996.

Todd, C. & Thirion, C., 2011, *Macroinvertebrate Thresholds of Potential Concern (TPCs) and Ecological Specifications (EcoSpecs) in the Sabie and Crocodile Rivers, Kruger National Park*, Unpublished Report.