water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

# INKOMATI NWRCS

# APPROACHES TO DETERMINE THE CONSEQUENCES OF SCENARIOS & RECOMMEND MANAGEMENT CLASSES

- Ecology
- Water quality
- Ecosystem Services
- Economics

24 November 2014

# Inkomati WRCS Integrated Steps

1: Delineate units of analysis and describe the status quo

2: Initiation of stakeholder process and catchment visioning

3: Quantify EWRs

4: Identification and evaluation of scenarios within IWRM

5: Draft Management Classes

6: Resource Quality Objectives (EcoSpecs & water quality (user))

7: Gazette class configuration

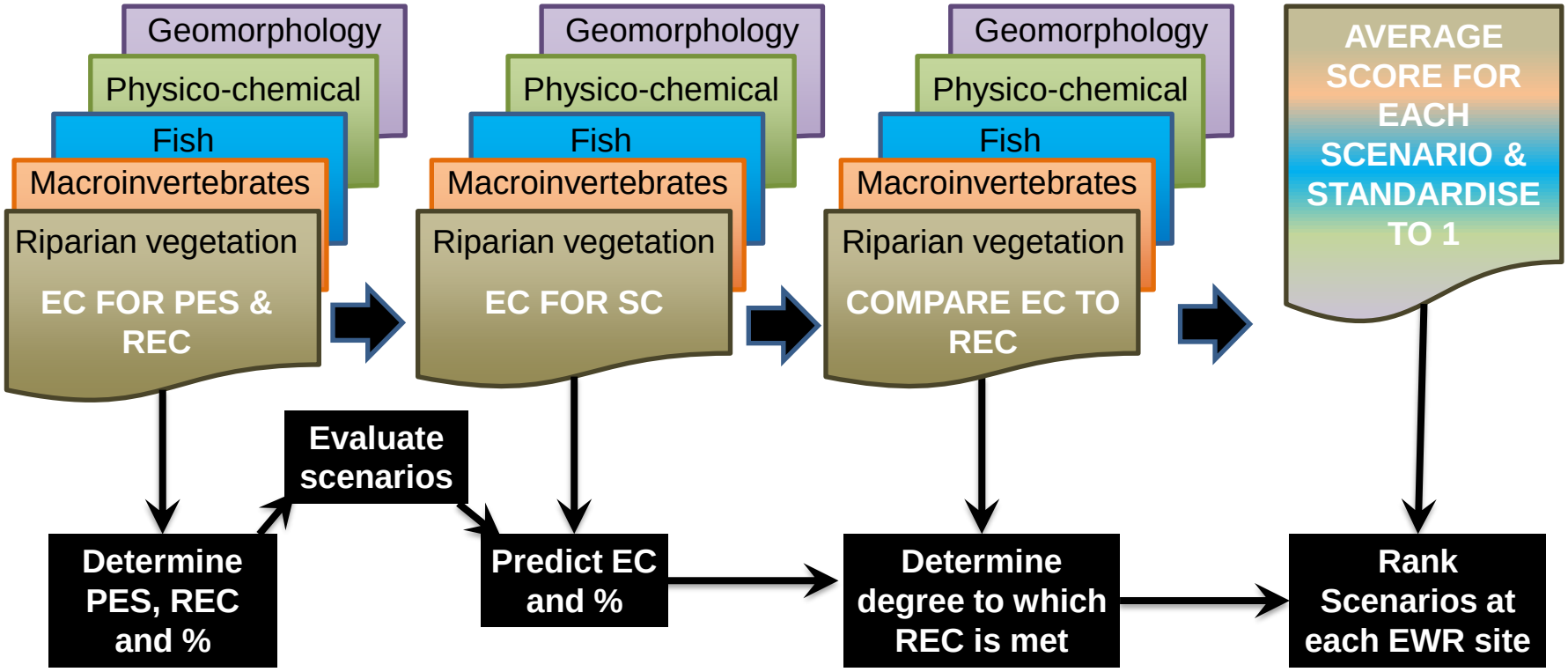
**Scenario Evaluation, MC determination**

# ECOLOGY

# Determining ecological consequences of scenarios

- Need to answer the 'what if' questions
- Express in terms of change in Ecological Category AND degree in which the REC is met
- Detailed process to predict changes in all the biophysical components per site and per scenario.
- Then to integrate and demonstrate in systems context
- Include in MC DSS process

# Determining ecological consequences of scenarios



# Determining ecological consequences of scenarios

**RELATIVE ECOLOGICAL IMPORTANCE OF SITES**

- PES
- EIS
- Locality in conservation areas
- Confidence
- Length of river

↓

**WEIGHT**

**APPLY WEIGHT TO**

**Ecological ranking of scenarios per EWR site**

**OUTPUT**

**Ecological ranking of scenarios for the system**

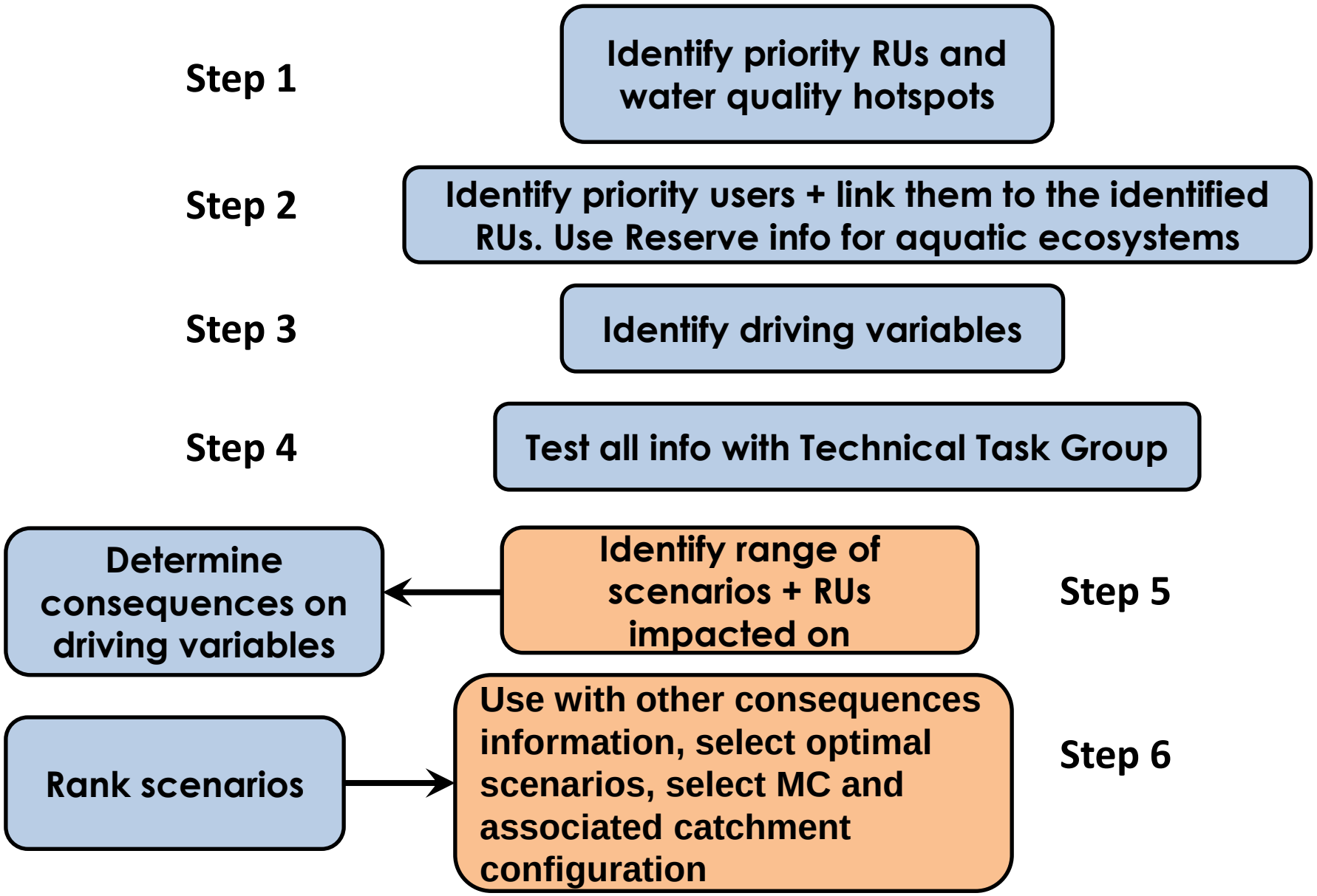
# WATER QUALITY

# STEPS 4 + 6 of CLASSIFICATION: WATER QUALITY

- **Water quality = two broad components**
  - **Ecological, i.e. as part of the EWR or Reserve process. Output = EcoSpecs.**
  - **Non-ecological or Users, i.e. UserSpecs (excl. aquatic ecosystems).**

- **UserSpecs and consequences of scenarios (Step 4)**
  - **Wq included as a service identified in ECOSYSTEM SERVICES**
  - **Wq included indirectly in the ECONOMICS in terms of water treatment costs**
  - **USER WQ: Evaluate Impact of scenarios on users by (1) identifying primary users, (2) identifying driving wq variables + (3) use of model (quantitative) or alternative qualitative approach to assess consequences**

# USER WATER QUALITY STEPS



TO SUMMARIZE, USER WATER QUALITY STATE PER SCENARIO AND PER RELEVANT RU AND IUA WAS SCORED USING THE DRIVING WATER QUALITY VARIABLES LINKED TO THE PRIMARY WATER QUALITY USER(S). NOTE THAT ALTHOUGH THE AQUATIC ECOSYSTEM IS THE RESOURCE BASE RATHER THAN A "USER", IT WAS GROUPED AND EVALUATED WITH OTHER USERS FOR PURPOSES OF THIS STEP OF THE CLASSIFICATION PROCESS.

# RESULTS – USER CONSEQUENCES

- No scale is shown on the bars as the process undertaken was qualitative and in relation to Current State (CS)
- CS relates to the water quality state
- CS per river reach can therefore be assessed comparatively, that is, if CS is lower on one bar than the other, then water quality is assumed to be poorer at that site
- The impact of scenarios (denoted as Sc x) have been considered in relation to CS
- It is expected that if a scenario has little impact on ecological water quality, it is unlikely to have a large impact on the water quality linked to any user

# ECOSYSTEM SERVICES

# Ecological Goods & Services Attributes (EGSA)

- EGSA are the goods and services provided by the river (and associated ecological systems) that result in a value being produced for consumers. EGSA are now referred to as **Ecosystem Services**.
- **Provisioning services** are the most familiar category of benefit, often referred to as ecosystem 'goods', such as foods, fuels, fibres, medicine, etc., that are in many cases directly consumed.
- Other services include
  - **cultural services** (ritual use of rivers, aesthetic or historical importance)
  - **regulating services** (e.g. water quality inputs), and
  - **supporting services** (e.g. nutrient formation)

# Socio Economics and EGSA

- Brief in this study is to look at two separate components (packages)of the overall "Socio-Economics" but to integrate in final analysis.
- Package 1- Economics linked to market and broader economic parameters
- Package 2 – Ecosystem Goods and Services/Ecological Goods and Services Attributes (EGSA), Ecological Infrastructure = Ecosystem Services

# Socio Economics and EGSA

- Our approach:
  - Water abstracted from the river and utilised/value added falls within the ambit of "economics"
  - Water that remains in the river but provides goods/services that generate value falls within the ambit of "Ecosystem Services"

# SCENARIO CONSEQUENCES: ASSESSMENT STEPS

## STEP 1

- Analyse the site – status quo.
- Identify the communities likely to derive benefits from ESS
- List the range of ESS available

## STEP 2

- Populate Ecosystem list and generate spreadsheet

# SCENARIO CONSEQUENCES: ASSESSMENT STEPS

## STEP 3: EVALUATE CHANGE PER SC

- ID the potential change that each of the key ESS may undergo in each of the scenarios.
- Change is measured against a base score of 1 –represents the current situation.
- The potential change will be noted as a factor, EG, no change = 1, a 50% increase = 1.5, and a 20% decrease = 0.8.

## STEP 4: AGGREGATE THE STEP

- Each category rated out of 1
- Sum the numbers of each service, divide by number of services, and rate each service out of 1

# SCENARIO CONSEQUENCES: ASSESSMENT STEPS

## STEP 5 WEIGHTING

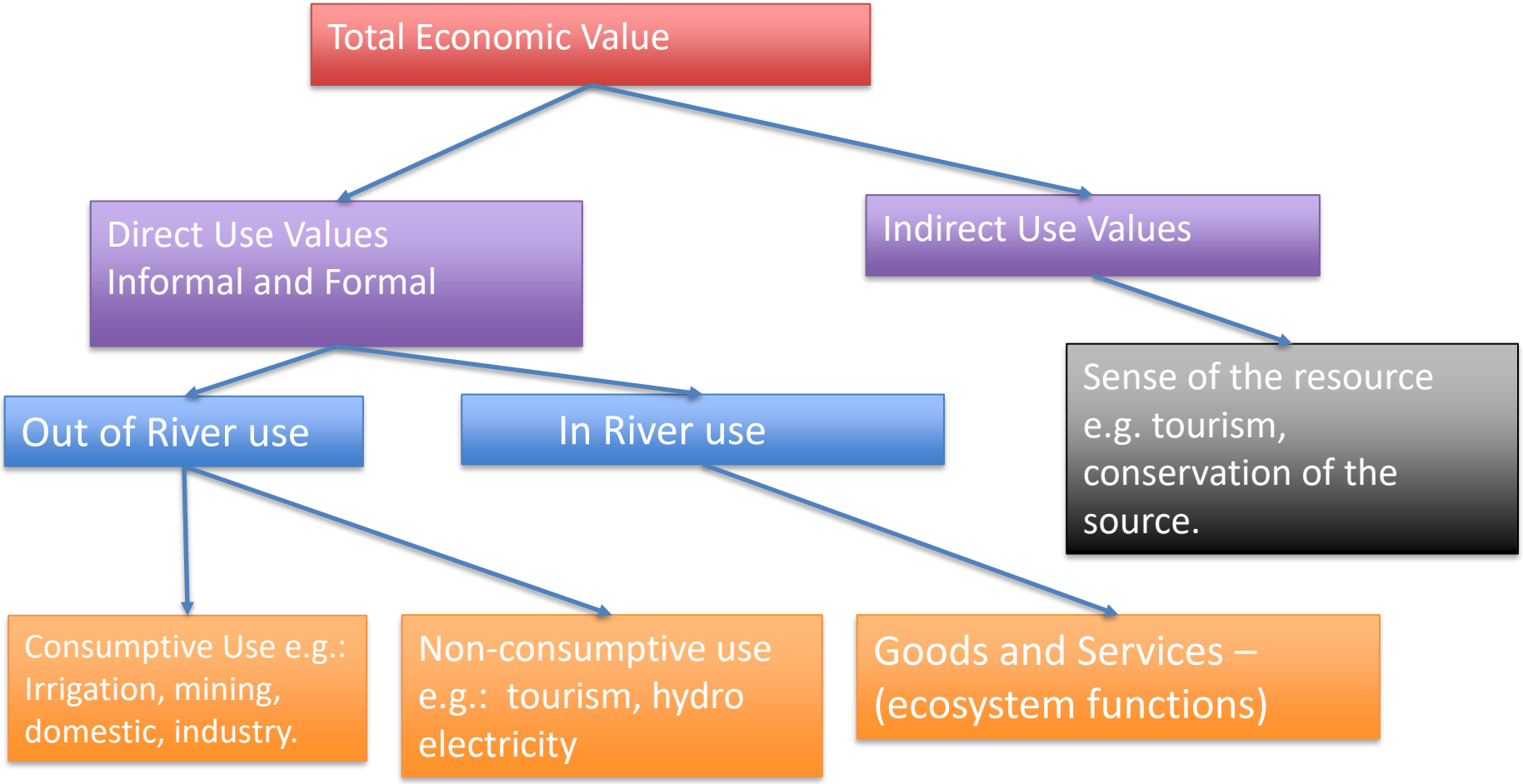
- Weigh each category
- Category weight is normalised to 1
- E.g. all services equal weight then Provisioning = 0.25, Regulating = 0.25, Cultural = 0.25, Supporting = 0.25.

## STEP 6 REACH WEIGHTING

- The SCI score generated as first steps in determine reach importance revisited.
- Score out of 5 - acts as weighting - normalised back to a score of "1"

# ECONOMICS

# Economics - Value



# Approach in Evaluating the Scenarios

The following sectors were used in evaluating the scenarios:

A. Irrigation Agriculture
   - ✓ Formal
   - ✓ Informal – Gardens - very often "formal" produced crops are marketed informally.

B. Household Sector
   - ✓ Partly to accommodate the informal sector.
   - ✓ Urbanisation supports the service sector – formal and informal

C. Industry
   - ✓ Formal
   - ✓ Not all water driven, but water supply helps creates the basis for development

** The irrigation, household and industry sectors will only be impacted by scenarios which results in available volumes increasing or decreasing*

# Tourism Sector

- In the case of the KNP all the proposed scenarios will improve the instream water flow in the river part that is in the National Park.
- The current unit occupation rate of the all the Kruger camps during the 2012/2013 was 78%, with a peak during the winter months
- The question, whether there is actually scope for increased occupancy of tourist facilities should the volume of the water in the rivers increase, then arises.
- Our deduction was that the “experience” of the visitors will improve but not necessarily the number of visitors.
- We came to the same conclusion for the other tourist facilities in the catchment and therefore did not estimate the possible economic impact on tourism for any of the facilities.

# Forestry Sector

- The commercial forestry sector is regulated by streamflow reduction licencing, and no reduction in the commercial plantation area was considered for the scenario evaluation. For this reason it was accepted that on the medium term the forestry sector will not be impacted on by any operational scenario.
- With the exception of a small section in the Sand River system, which was considered.

# MULTI CRITERIA ANALYSIS

## Method of comparing and ranking scenarios

# What needs to be evaluated?

- Degree of the ecological health defined by Ecological Categories of biophysical nodes (none-monetary)
- Ecosystem Services (none-monetary)
- Socio-Economic implications
  - Monetary (GDP) and non-monetary (job count)

# HOW IS THE COMPONENTS RATED?

- Ecological consequences are rated according to the degree that the Recommended Ecological Category is met. (REC is the top of the scale.)
- Ecosystem Services, current state is "1.0" with relative rating for scenarios.
- Economic Indicator, in general GDP or other relevant comparative monitory indicator.
- Employment, number of jobs as affected by scenario.
- Integrated rank, weighted scores of above 4 variables – two methods of ranking.

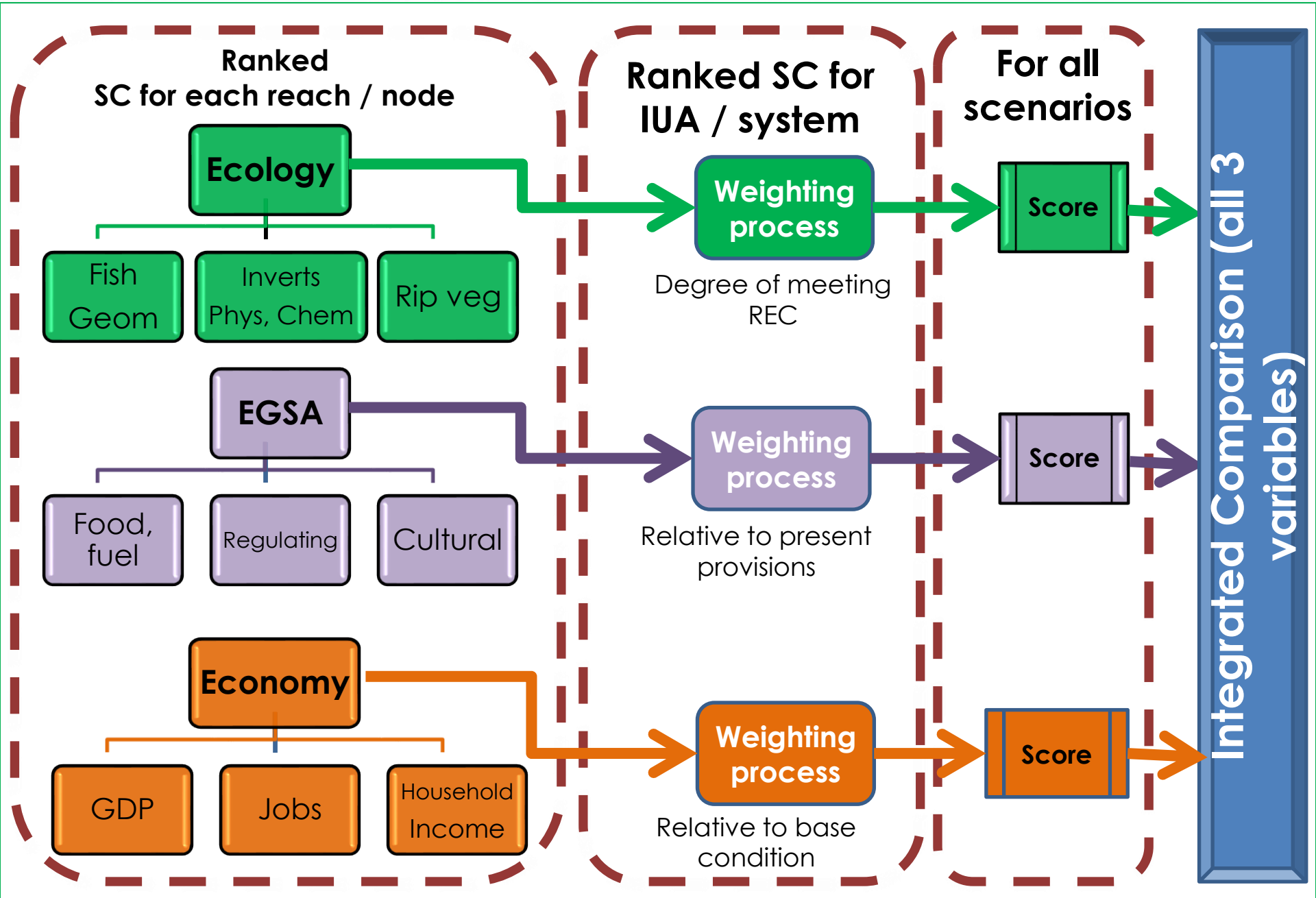
# Why Multi-Criteria Analysis?

- Method to compare alternatives where the outcomes (consequences) are in different numerical terms.
- Ecological consequences is a relative rating while economy is in monetary terms and employment in numbers.
- Multi-Criteria Analysis is appropriate in these circumstances.

# What are scenarios used for?

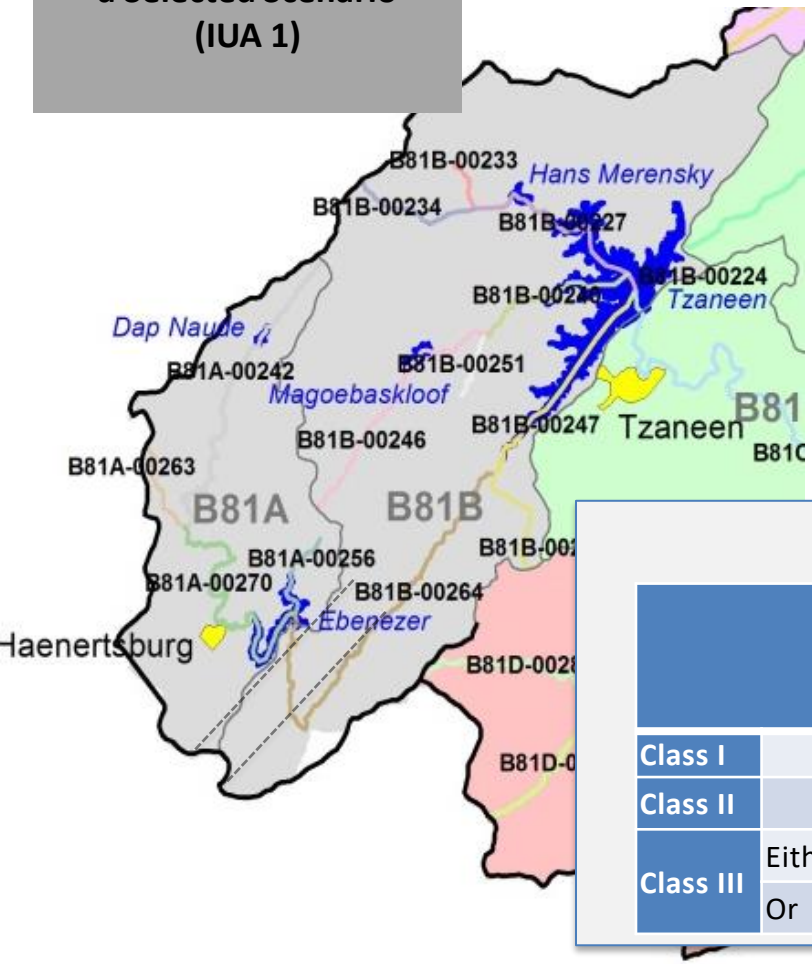
- Different levels of water use and protection are evaluated with the aim to find a preferred balanced scenario.
- Water Resource Classification is the process to evaluate and recommend what that balance scenario entails.

# Scenario evaluation method



# Deriving the Management Class

**Ecological Categories for a Selected Scenario (IUA 1)**




| River Reach | Length (km) | EC |
|---|---|---|
| B81A-00242 | 21.9 | C |
| B81A-00256 | 5.3 | D |
| B81A-00263 | 5.1 | D |
| B81A-00270 | 20.2 | C |
| B81B-00233 | 3.2 | C |
| B81B-00234 | 7.1 | C |
| B81B-00246 | 14.7 | C |
| B81B-00251 | 3.7 | D |
| B81B-00269 | 6.5 | B |
| B81B-00227 | 11.0 | D |
| B81B-00240 | 10.2 | C |
| B81B-00247 | 12.5 | C/D |
| EWR1 | 25.7 | C |
| **Total length** | **147.1** | |

$$Pd = \frac{\sum Dl}{\text{Total length}}$$

$$Pc = \frac{\sum Cl}{\text{Total length}}$$

$$Pb = \frac{\sum Bl}{\text{Total length}}$$

$$Pa/b = \frac{\sum A/Bl}{\text{Total length}}$$

## Management Class Criteria

| | | % EC representation at units represented by biophysical nodes in an IUA | | | | | Prominent EC |
|---|---|---|---|---|---|---|---|
| | | ≥ A/B | ≥ B | ≥C | ≥ D | < D | |
| Class I | | 0 | 60 | 80 | 95 | 5 | A & B EC |
| Class II | | | 0 | 70 | 90 | 10 | C EC |
| Class III | Either | | | 0 | 80 | 20 | D EC |
| | Or | | | | 100 | | |

EC - Ecological Category

**Management Class: I, II or III**