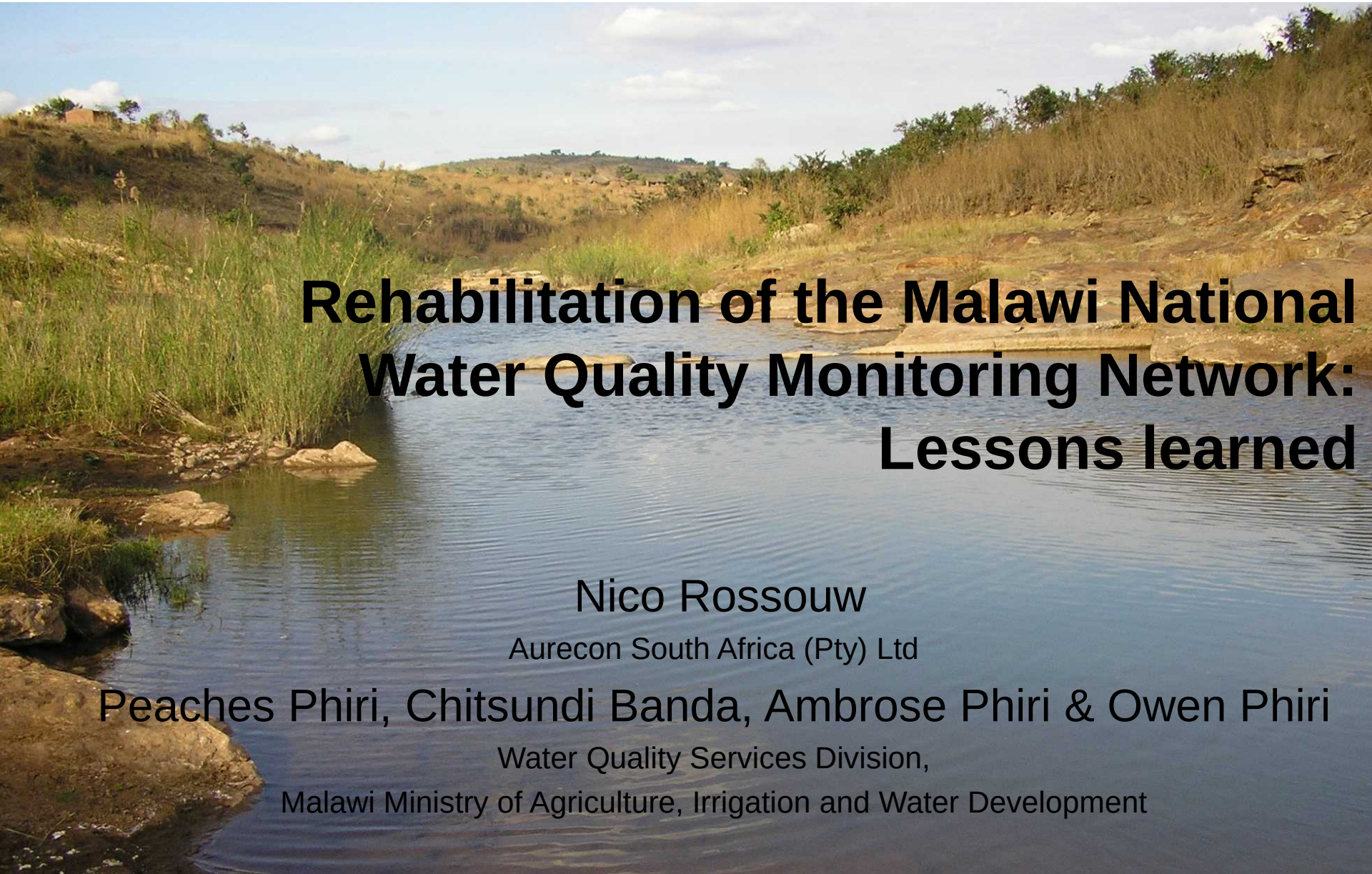

Rehabilitation of the Malawi National Water Quality Monitoring Network: Lessons learned

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Malawi Ministry of Agriculture, Irrigation and Water Development

Co-authors


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Ruvuma
Lake Malawi
Nias
Malawi
Lilongwe
Tete
Zam
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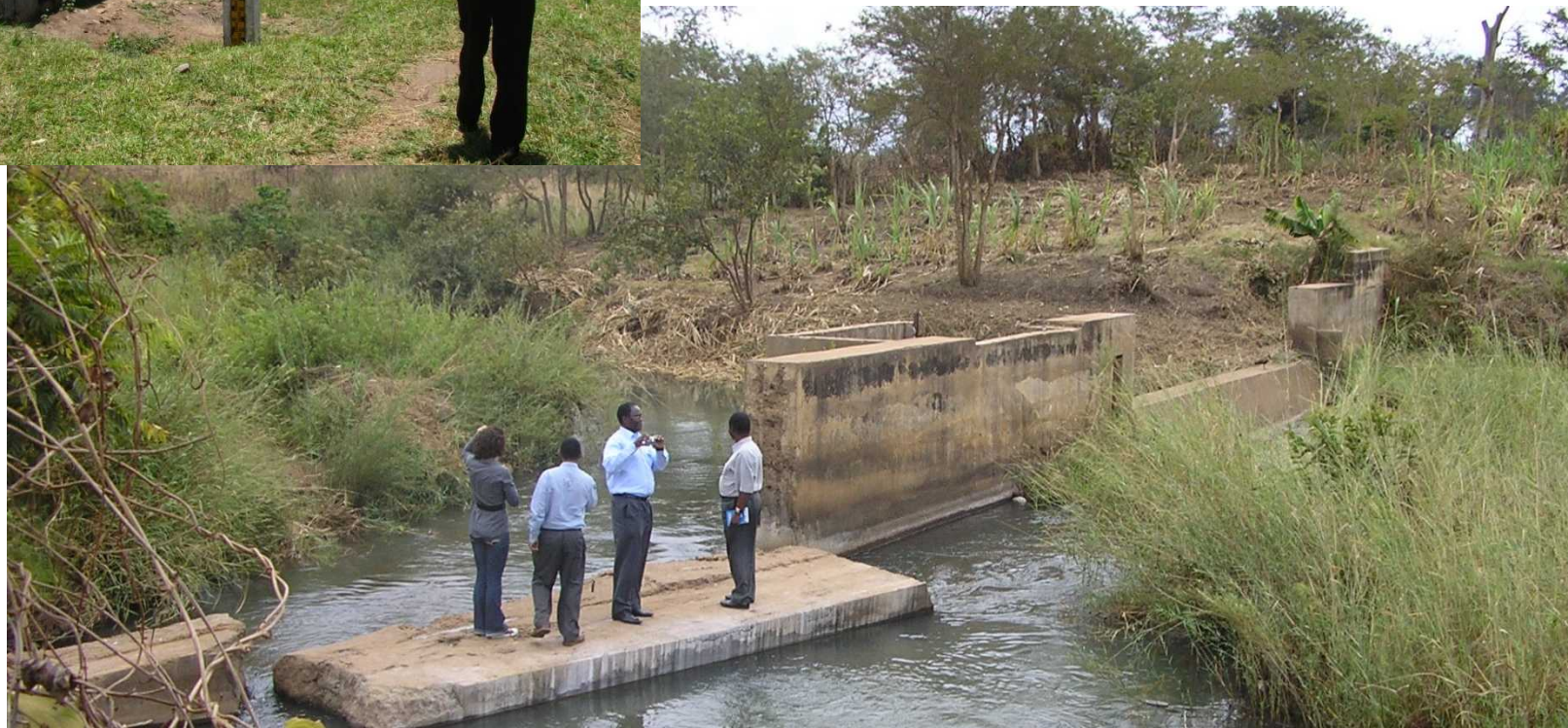
Water Resources Monitoring in Malawi

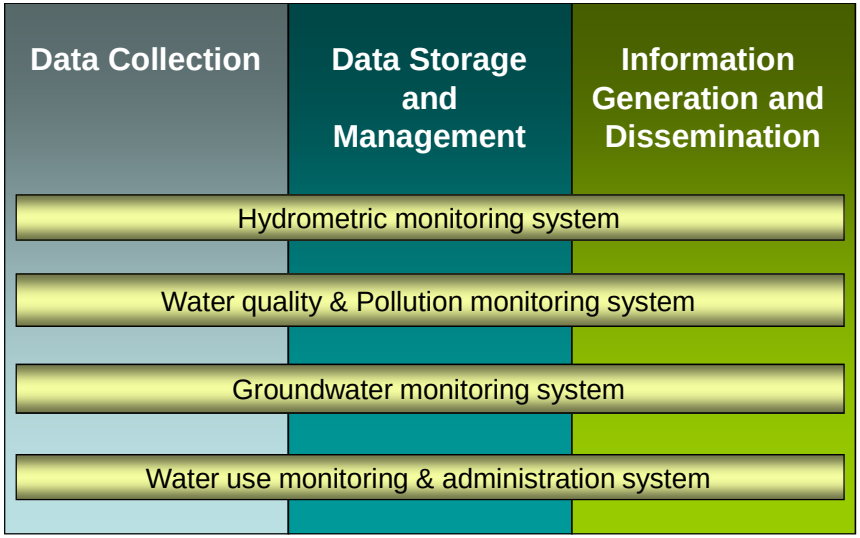


African Development Bank funded project (2010)

- **Establishment of Water Resources Monitoring System and Management Information System**
- User centric approach followed - the purpose of monitoring is defined as delivering the management information about the water resource status required by water resource managers, planners and other stakeholders.

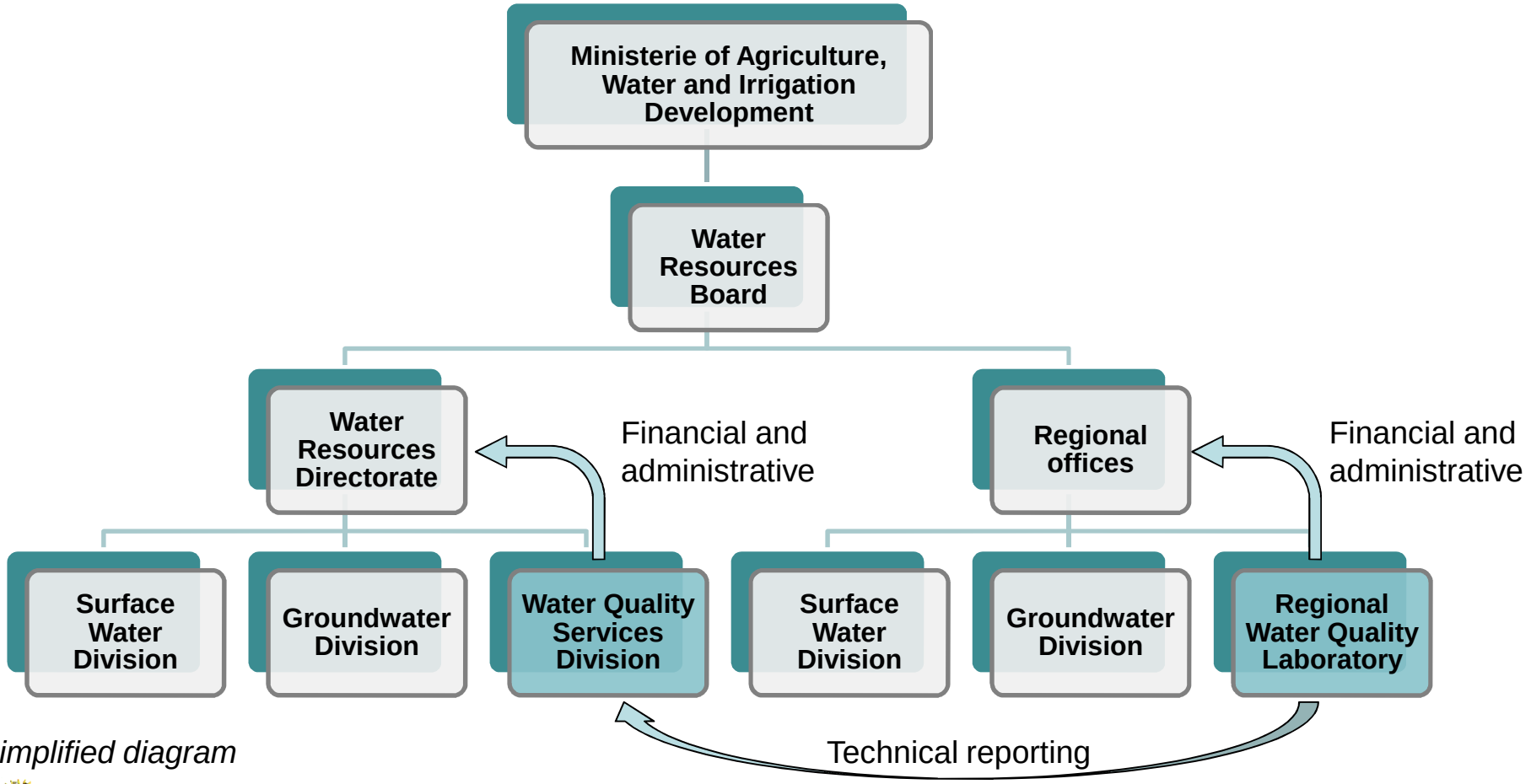
Design focused on three core functions

- Data collection
- Data storage & management
- Information generation & dissemination



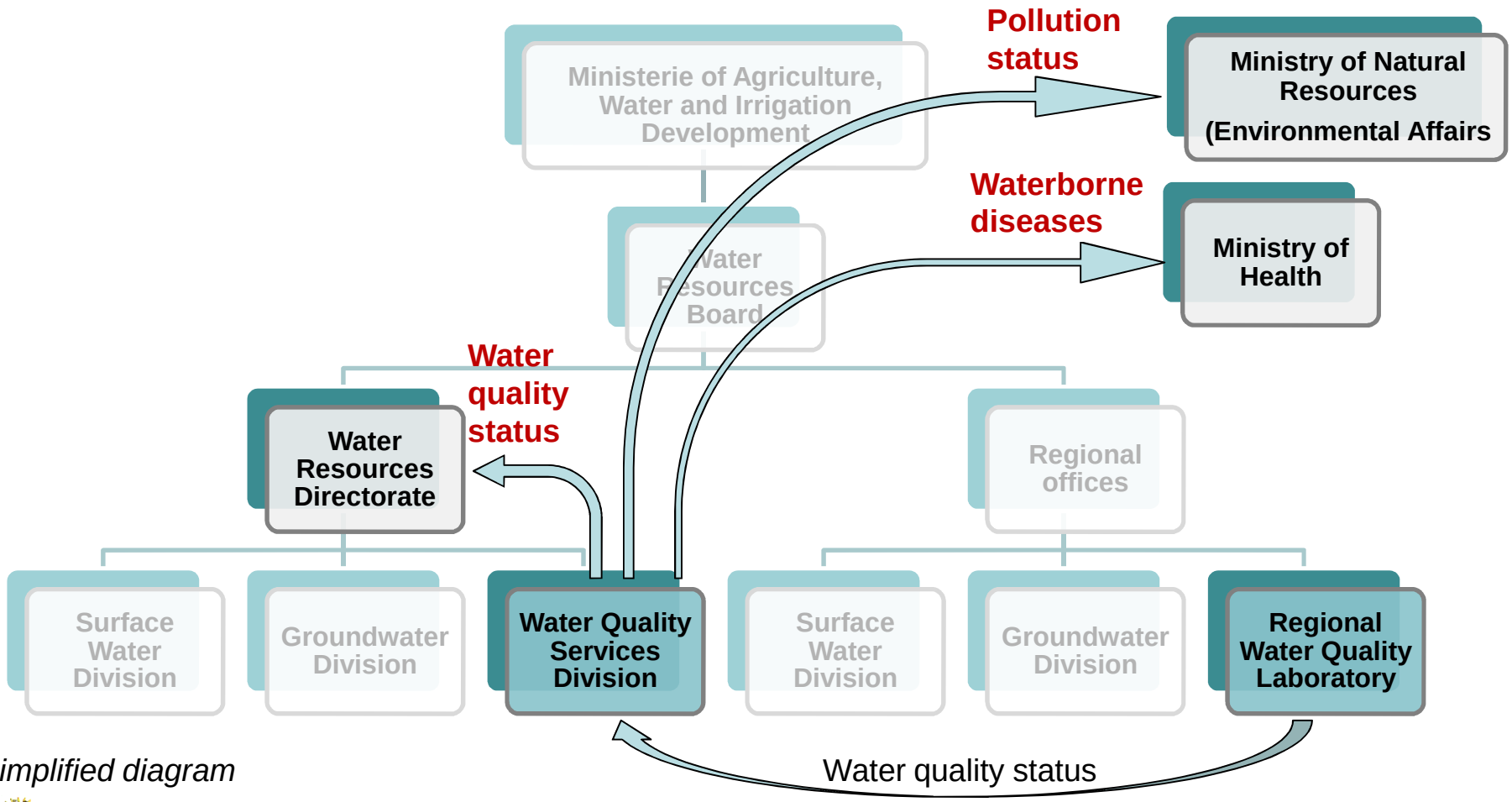
Information users

Who is responsible for monitoring water quality?



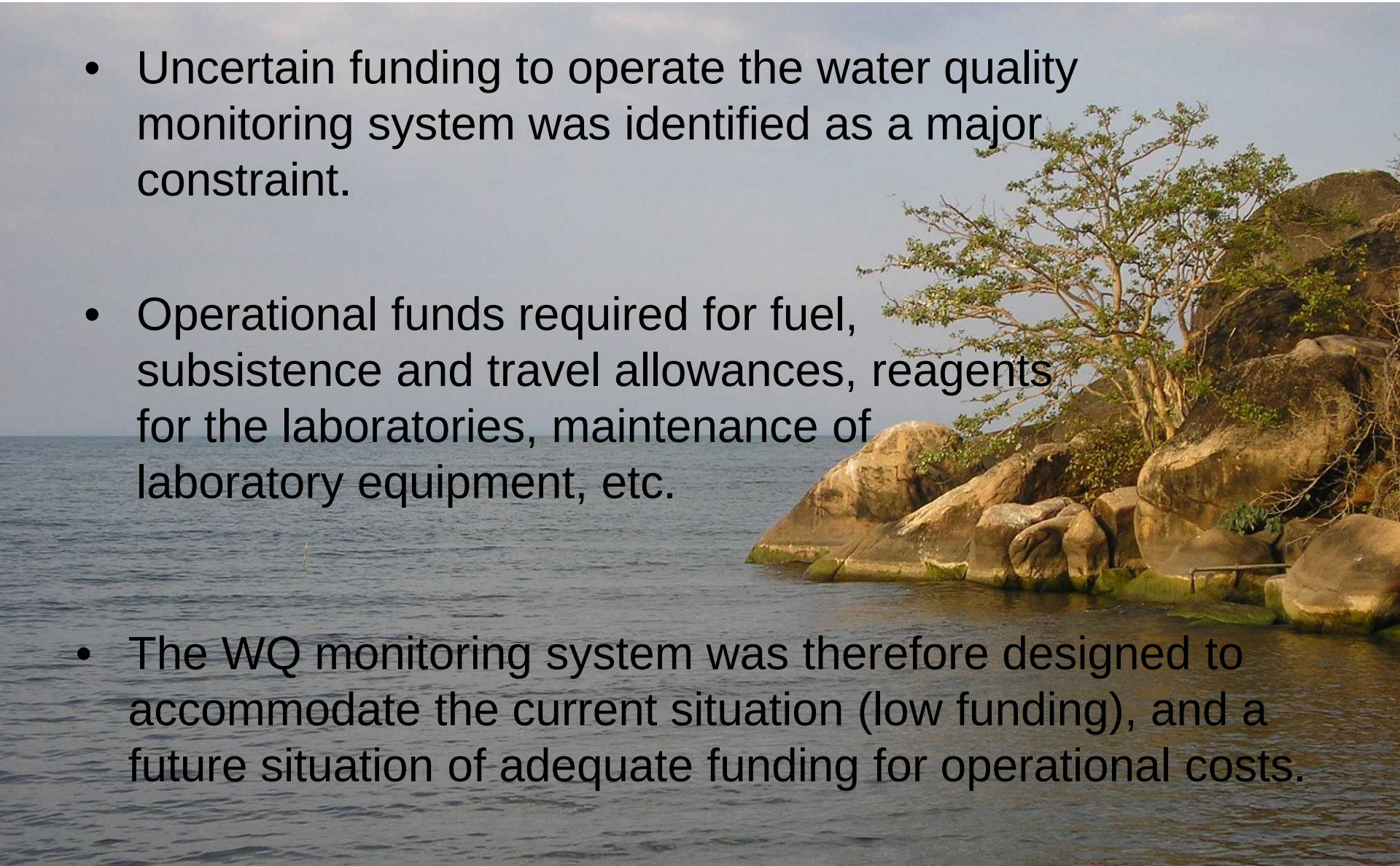
Simplified diagram

Information requirements



Simplified diagram

Water Quality Monitoring Constraints

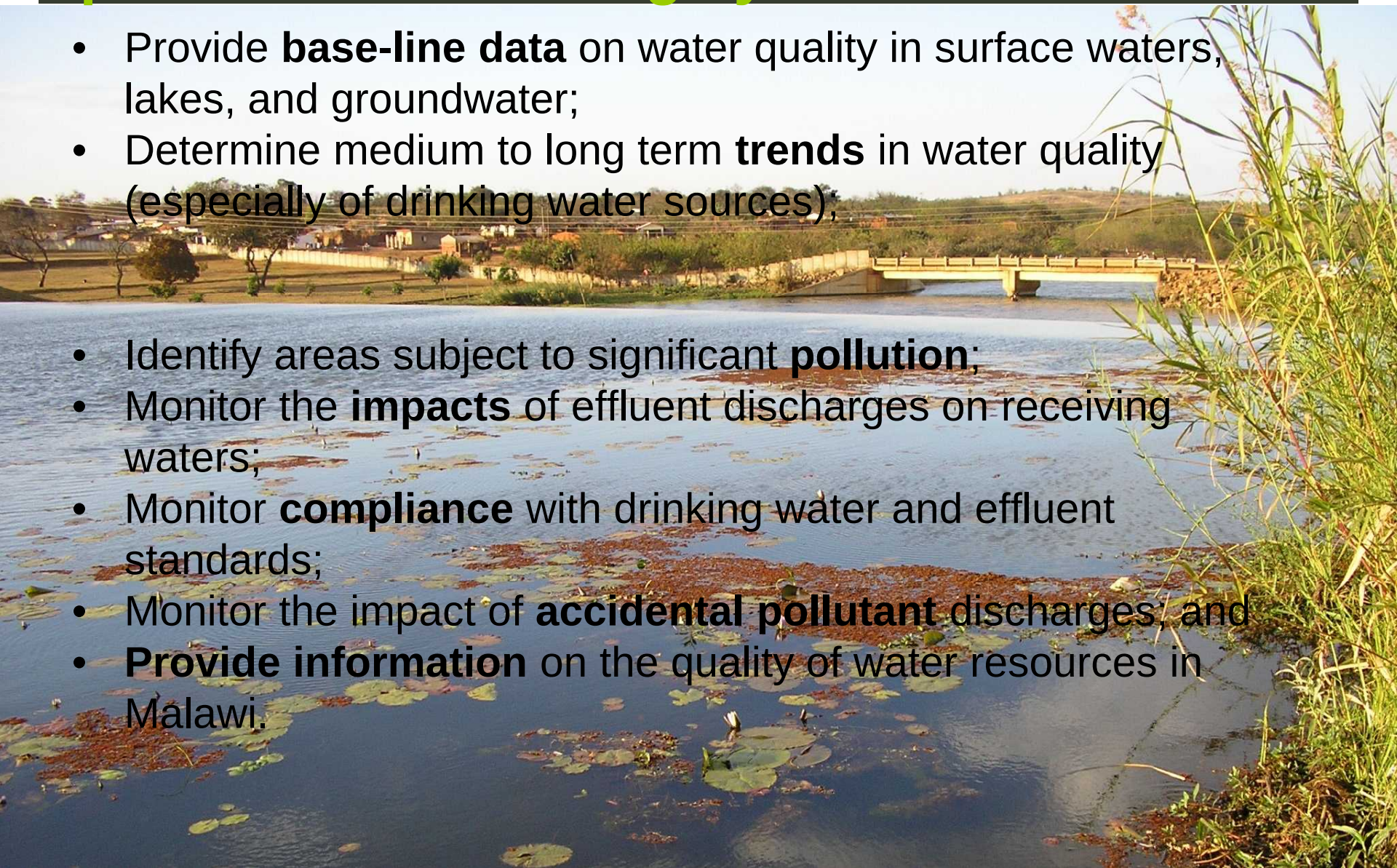


- Uncertain funding to operate the water quality monitoring system was identified as a major constraint.

- Operational funds required for fuel, subsistence and travel allowances, reagents for the laboratories, maintenance of laboratory equipment, etc.

- The WQ monitoring system was therefore designed to accommodate the current situation (low funding), and a future situation of adequate funding for operational costs.

Objectives of the water quality and pollution monitoring system

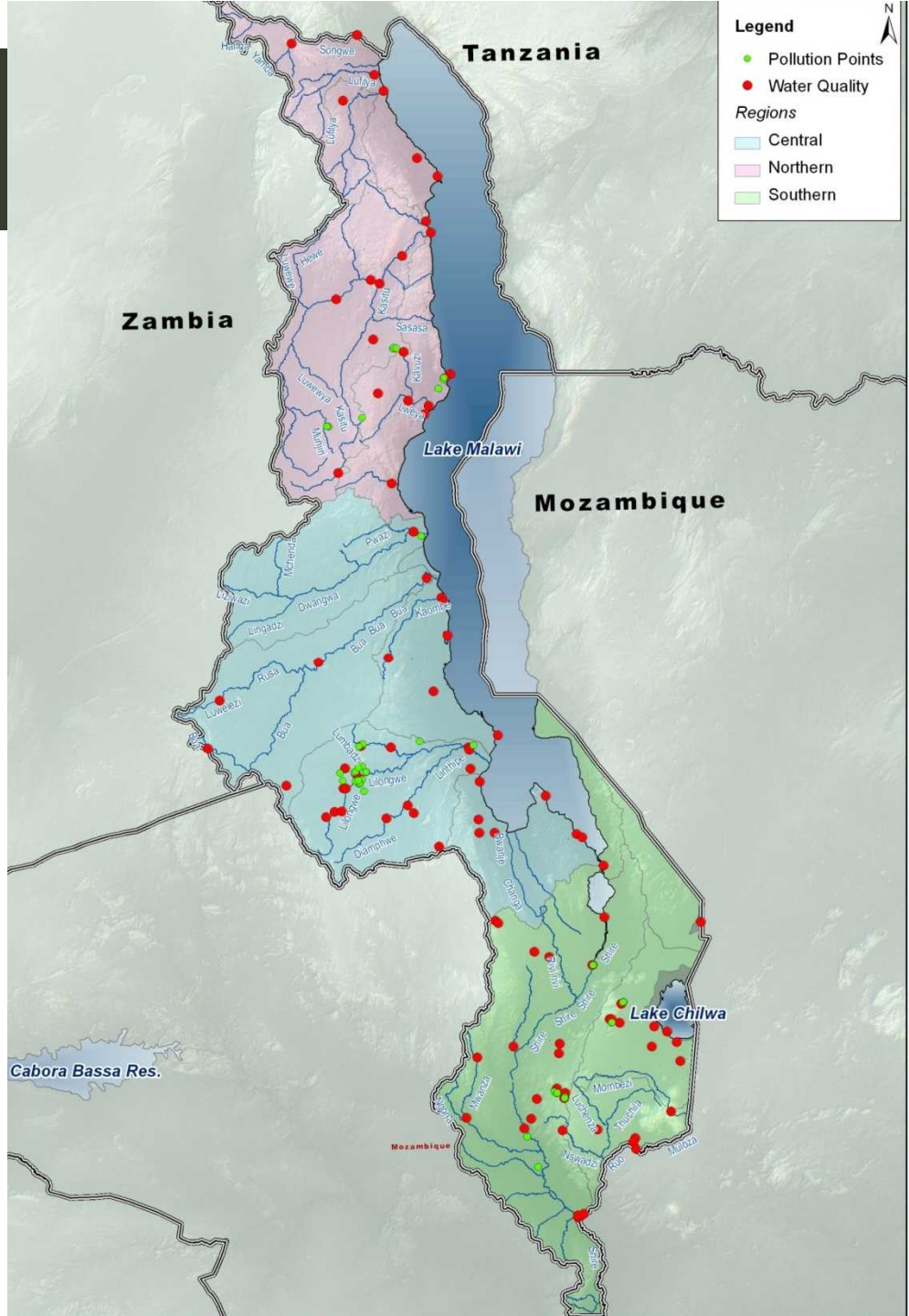


- Provide **base-line data** on water quality in surface waters, lakes, and groundwater;
- Determine medium to long term **trends** in water quality (especially of drinking water sources);

- Identify areas subject to significant **pollution**;
- Monitor the **impacts** of effluent discharges on receiving waters;
- Monitor **compliance** with drinking water and effluent standards;
- Monitor the impact of **accidental pollutant** discharges; and
- **Provide information** on the quality of water resources in Malawi.

Monitoring network

- Location of sampling points
  - No consistent numbering system or coordinates
  - Spatial coverage reviewed
  - Added unimpacted headwaters & transboundary rivers
  - Removed duplicate points
  - Downscale – focus on pollution hot spots and end-of-catchment points



Monitoring constituents

Routine chemical analyses

- pH.
- Electrical conductivity.
- Total dissolved salts.
- Carbonate.
- Bicarbonate.
- Chloride.
- Sulphate.
- Nitrate.
- Fluoride.
- Sodium.
- Potassium.
- Calcium.
- Magnesium.
- Iron.
- Manganese.
- Silica.
- Turbidity.
- Suspended sediment.
- Hardness ($CaCO_3$).
- Alkalinity ($CaCO_3$).

In-situ measurements

- Water temperature.
- pH.
- Electrical conductivity.
- Total dissolved solids.
- Dissolved oxygen.
- Turbidity.
- Free chlorine (drinking water only)

Microbiological analyses

- Faecal coliforms.
- Faecal streptococci.

Other

- Radioactivity.
- Chlorophyll a.
- Pesticides and herbicides.
- Oil and grease.

Monitoring constituents

Routine chemical analyses

- pH.
- Electrical conductivity.
- Total dissolved salts.
- Carbonate.
- Bicarbonate.
- Chloride.
- Sulphate.
- Nitrate. **Add PO_4-P**
- Fluoride.
- Sodium.
- Potassium.
- Calcium.
- Magnesium.
- Iron.
- Manganese.
- Silica.
- Turbidity.
- Suspended sediment.
- Hardness ($CaCO_3$).
- Alkalinity ($CaCO_3$).

In-situ measurements

- Water temperature.
- pH.
- Electrical conductivity.
- Total dissolved solids.
- Dissolved oxygen.
- Turbidity. **Add Secchi disk depth**
- Free chlorine.

Microbiological analyses

- Faecal coliforms.
- ~~Faecal streptococci.~~
- Total bacterial count
- Escherichia coli

Other

- ~~Radioactivity.~~ **Send to specialist laboratory**
- Chlorophyll a. **Reservoir monitoring**
- Pesticides and herbicides. **Collaborate**
- Oil and grease. **Pollution monitoring**

Analytical procedures and downscaling

- Analytical procedures – recommended a move to test kits rather than wet chemistry

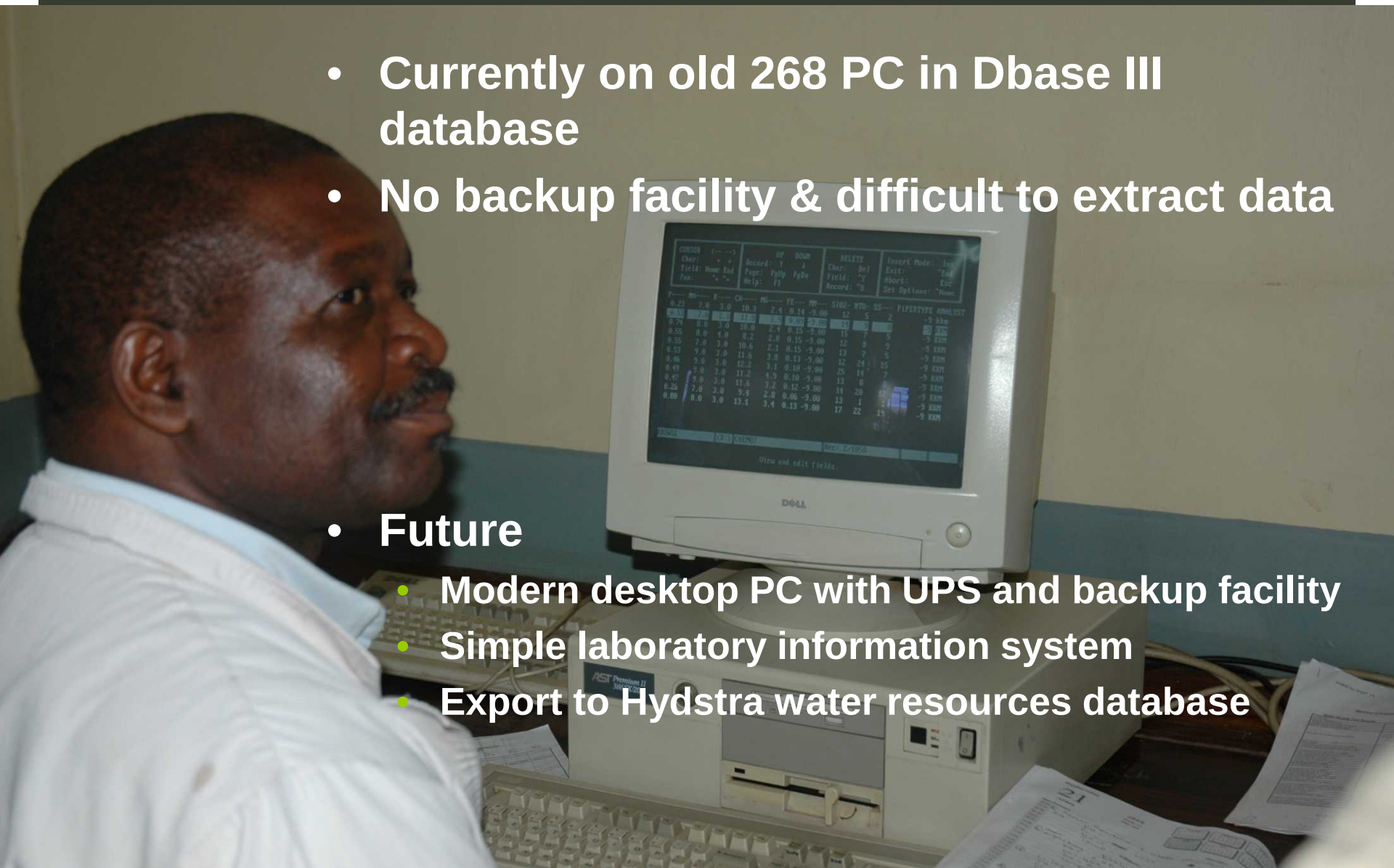


- To downscale – focus on in-situ measurements, human health concerns and pollution control

Operational plans and procedures

- Manual for
  - Uniform sample collection procedures
  - Uniform field measurement procedures
  - Quality control/quality assurance procedures
- Update laboratory procedures manual
- Primary data storage and retrieval procedures

Data storage



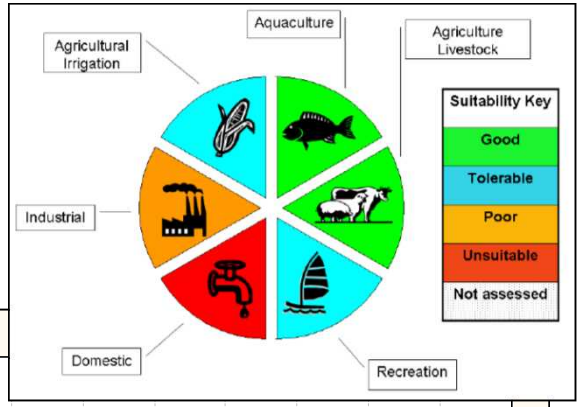
- Currently on old 268 PC in Dbase III database
- No backup facility & difficult to extract data

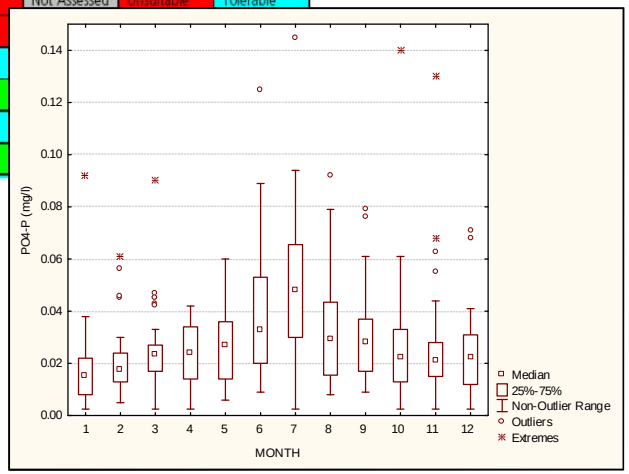
- Future
  - Modern desktop PC with UPS and backup facility
  - Simple laboratory information system
  - Export to Hydstra water resources database

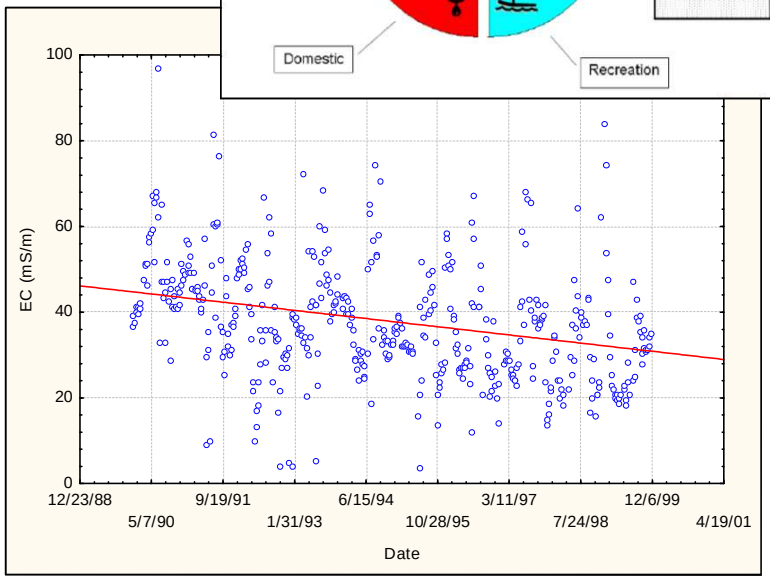
Information products

- Four main types of water quality reports required for water resources management
  - Current water quality status of surface and groundwater
  - Compliance with drinking water standards
  - Compliance with effluent standards
  - Water pollution incidents

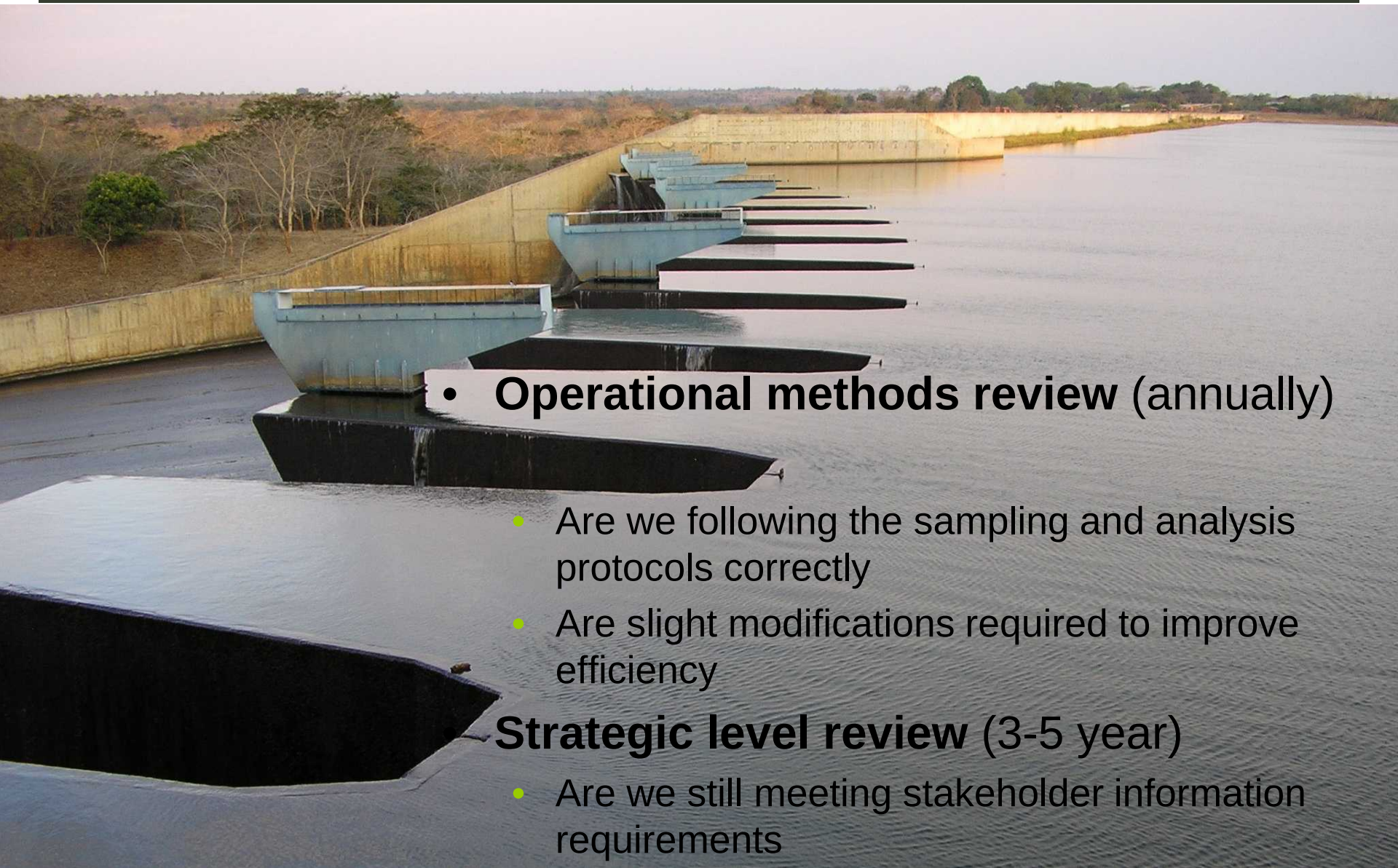
Ground Water WRA	Faecal coliforms	Fluoride	Iron*	Nitrate*	Phosphate	SAR	TDS
1	Not Assessed	Good	Good	Tolerable	Not Assessed	Unsuitable	Tolerable
2	Not Assessed	Tolerable	Good	Unsuitable	Not Assessed	Poor	Tolerable
3	Not Assessed	Good	Good	Unsuitable	Not Assessed	Unsuitable	Tolerable
4	Not Assessed	Tolerable	Good	Unsuitable			
5	Not Assessed	Good	Good	Tolerable			
6	Not Assessed	Good	Good	Good			
7	Not Assessed	Good	Good	Tolerable			
8	Not Assessed	Tolerable	Good	Good			







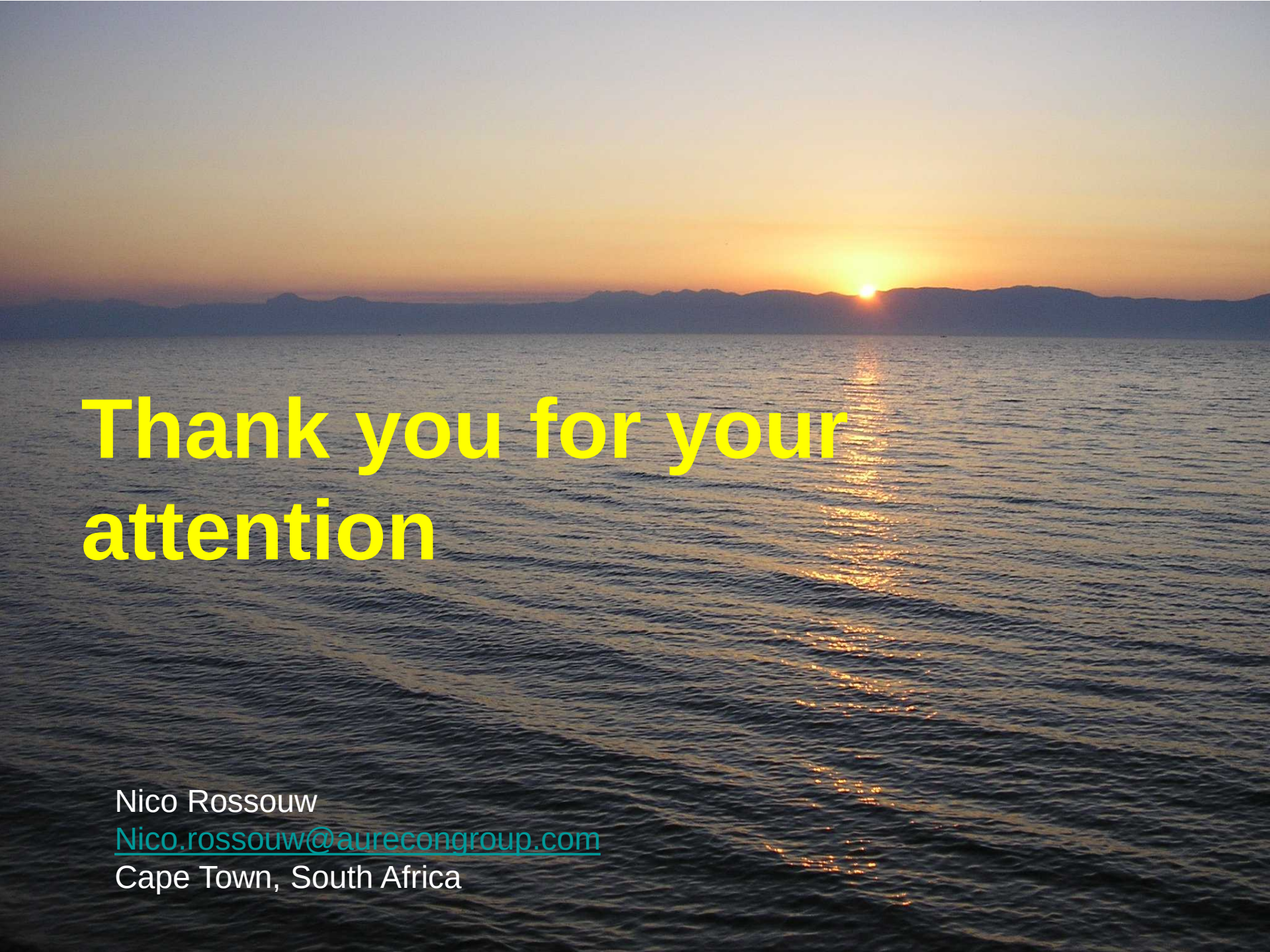
Auditing and monitoring programme evaluation



- **Operational methods review** (annually)
  - Are we following the sampling and analysis protocols correctly
  - Are slight modifications required to improve efficiency
- **Strategic level review** (3-5 year)
  - Are we still meeting stakeholder information requirements

Concluding remarks

- Current project gives the Water Quality Services Division the opportunity to:
  - Properly document monitoring system design and operational manuals
  - Upgrade equipment and refresh reagents
- Low levels of operational funding will continue to inhibit monitoring
- The current institutional setup and competition for funding will continue to hinder collaboration



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