Risk and Sustainability

Eskom

Routine Biomonitoring Programme

Factsheet

1. Why is biomonitoring important?

A surface water quality monitoring network is imperative for effective water quality and impact management at Eskom. Biomonitoring is utilised as an important tool in assessing the condition of aquatic ecosystems over time. The biomonitoring network includes the use of biological indicators, in addition and complementary to traditional chemical and physical water quality monitoring techniques. The biomonitoring protocols applied in this project give a good reflection of the possible impacts on Eskom's surrounding water resources (Figure 1).

Figure 1: Biomonitoring undertaken by a biomonitoring specialist.

2. How was Eskom's Biomonitoring Plan developed and where is it implemented?

The Routine Water Quality Monitoring Programme for Eskom (Durgapersad, 2012), was proposed in 2012. The report was reviewed, assessed supported by independent aquatic specialists in 2012 (Niehaus *et al.,* 2013). The Biomonitoring sites were selected:

- To be accessible;
- Representative of as many biotopes available;
- To be as closely comparable as possible;
- To take in to consideration surrounding land use activities and catchment boundaries;
- In relation to dominant wind direction and position of power station.

Sites were identified on topographical maps of 1:50000 and final positions of the sites were selected during site visits.

Biomonitoring surveys are conducted bi-annually in summer and winter every year. Chemistry analysis, macro-invertebrate, habitat, fish and toxicity assessments were performed on 39 sites around the Arnot, Camden, Duvha, Grootvlei, Hendrina, Kendal, Komati, Kriel, Kusile, Lethabo, Majuba, Matimba, Matla, Medupi and Tutuka power stations and the Underground Coal Gasification (UCG) site (Figure 2).

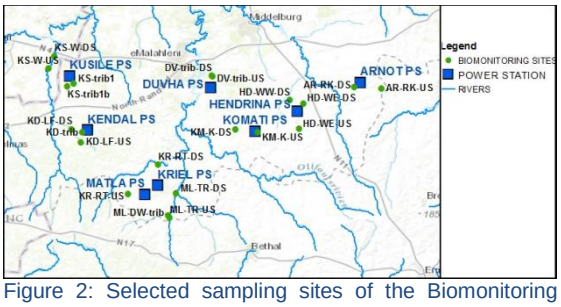

Figure 2: Selected sampling sites of the Biomonitoring Routine Network.

3. What are our legislative requirements?

The majority of Eskom's Power Station Water Use Licences (WUL) as per the National Water Act No 36 of 1998 requires biomonitoring assessments around power stations to be undertaken routinely. The assessment of Eskom's operational influence on the aquatic ecosystems surrounding the power stations will enable Eskom to comply with legislation; individual WUL requirements, and to take a proactive step towards water quality management by identifying water quality trends of Eskom surrounding water resources.

4. What are the different analyses undertaken in the programme?

- Chemistry Analysis
- Invertebrate Analysis
- Fish Analysis
- Toxicity Analysis

5. What chemistry analysis is required?

A comprehensive list of chemistry analyses carried out by an accredited laboratory at all selected sites is required.

6. How do we undertake and interpret the invertebrate assessment?

Benthic macro-invertebrate communities of the selected sites are investigated according to the South African Scoring System, version 5 (SASS5) approach. The SASS method is a rapid, simple and cost effective method, which takes into consideration resistant and sensitive invertebrate presence and abundance in difference available biotopes, i.e. stone/vegetation/gravel, sand and mud. The results provide an indication of the change in biotic integrity (Figure 3).

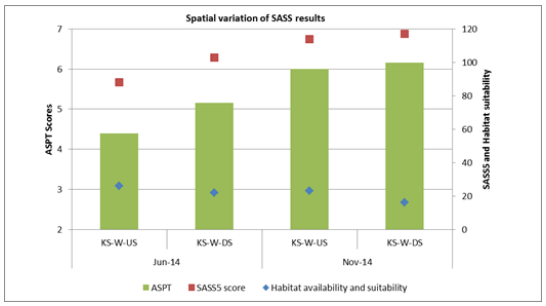

Figure 3: Spatial variation of SASS5, ASPT and Habitat Score.

Aquatic taxa identified and enumerated have varying water quality requirements. The presence/absence of the aquatic taxa provide an indication of the long term water quality changes of the sampling site assessed (Table 1). Figure 4 shows examples of invertebrates found during sampling surveys.

Table 1: Abundance and varying water quality requirement of selected aquatic taxa.

Taxon	June 2014 KS-W-US			
	Stones	Veg	GSM	Total
PORIFERA	A	-	-	A
COELENTERATA	A	-	A	A
TURBELLARIA	A	-	A	A
Oligochaeta	-	-	-	-
Leeches	-	-	-	-
Potamonautidae*	-	-	-	-
Atyidae	-	-	-	-
Baetidae	B	B	B	C
Caenidae	A	-	B	B
Heptageniidae	A	-	-	A
Leptophlebiidae	A	-	-	A
Key				
High requirement for unmodified water quality				
Moderate requirement for unmodified water quality				
Low requirement for unmodified water quality				
Very low requirement for unmodified water quality				
A = 1-10 individuals; B = 11-100 individuals;				
C = 101-1000 individuals				

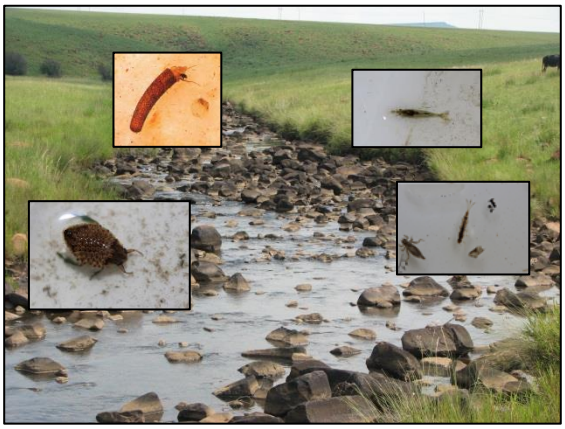

Figure 4: Example of invertebrates found during sampling surveys.

Important Indices

SASS5 Score: Is used to determine the change in biotic conditions both spatially and temporally.
Number of Taxa: Total number of taxa identified per site.
Average Score per Taxon (ASPT): The average resistance or sensitivity score to water pollution per taxa.
Habitat Score: An evaluation of habitat quality and availability to biota is critical to any assessment of ecological integrity. On site habitat assessments were conducted by using existing habitat evaluation indices.

7. How is the fish analysis carried out?

Fish Assemblage Integrity Index (FAII) developed by Kleynhans (1999), has been used to determine the status of the fish

assemblage in relation to human-induced factors. FAII was used to account for both anthropogenic and environmental factors. Water abstraction; flow modification; bed modification; channel modification; inundation; presence of exotic macrophytes; solid waste disposal; indigenous vegetation removal; and bank erosion cause for fish habitat integrity degradation. Figure 5 show an example of fish species found during certain sampling surveys.

Figure 5: Southern Mouthbrooder (*Pseudocrenilabrus philander*)

8. Why do we do toxicity analysis?

Toxicity testing of complex effluents has been shown worldwide to be an effective management option in preventing deteriorating water quality in aquatic ecosystem. The Department of Water and Sanitation (DWS) has implemented the Direct Estimation of Ecological Effect Potential (DEEEP), which uses representative organisms from different trophic levels of the food chain (fish, invertebrate, algae and bacteria) to reflect the overall impact of toxicants. The DEEEP analysis is undertaken at selected sites in order to determine additional information on water resources under stress.

9. What are the benefits of having a Biomonitoring Programme at Eskom?

If undertaken on a routine, consistent and well-coordinated manner, it will result in:

- Compliance with biomonitoring requirements in the WULs;
- Development of In-house skills within Eskom;
- Eskom will be the owner and authority of all data and a single database will house all chemical and biomonitoring data;
- The data can be used to identify and manage point and diffuse inputs on Eskom source waters, and examine trends over time;
- The information obtained would assist Eskom management in making decisions regarding water quality management;
- In-house technical reports, as well as research reports on trends in specific areas, can be issued when required;
- Eskom being acknowledged as having a corporate social and environmental accountability and responsibility thereby enhancing Eskom's reputation.

10. Way forward…

The design, review and implementation of the integrated biomonitoring network (invertebrate; habitat; fish and toxicity) has laid the foundation for the functional routine network at Eskom that will allow for effective monitoring and management of our surrounding water resources and compliance with existing WUL requirements. Routine and efficient monitoring is essential for early identification of impacts to the aquatic environment, which will allow for triggering of prompt mitigation actions, thereby preventing costly remediation measures.

For more information:

1. *Dr Kaajial Durgapersad (Air Quality, Climate change and Ecosystem Management Senior Environmental Advisor)*
Research, Testing and Development
Work: +27 11 629 5168
E-mail: DurgapK@eskom.co.za

2. *Bheki Maliba (Air Quality, Climate change and Ecosystem Management Environmental Advisor)*
Research, Testing and Development
Work: +27 11 629 5422
E-mail: MalibaB@eskom.co.za