WATER QUALITY IN THE ELANDS RIVER AND THE LINDLEYSPOORT DAM, 2001

by

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EXECUTIVE SUMMARY

Introduction

Lindleyspoort Dam is situated on the Elands River north of Swartruggens in the North West Province (Figure 1). The downstream users of the water of the Lindleyspoort Dam complained to Mr. H Jordaan (water control officer at Lindleyspoort Dam) about the water quality and the effect it may have on their irrigation and livestock farming activities. This initiated the request by Mr. H. Jordaan (from the North West Region) to the Institute for Water Quality Studies for an *ad hoc* survey in the impoundment and upstream of the impoundment.

Results and Conclusions

- The water quality in the Lindleyspoort Dam and upstream of the impoundment in the Elands River is of acceptable quality when the South African Water quality guidelines for irrigation (moderately sensitive crops) are considered.

- The highest nutrient concentrations were found in the canal water that is released from the bottom anaerobic, hypolimnetic water of the Lindleyspoort Dam. These high nutrient concentrations should not pose problems to irrigation farmers downstream of the impoundment.

- The macrophyte growth in the inflow of the Lindleyspoort Dam was identified as a water primrose species (*Ludwigia* sp.). The primrose species has the potential to spread and dominate in wetland areas.

Recommendations

- Farmers downstream of the Lindleyspoort Dam should be informed of the fact that the water quality of the Lindleyspoort Dam does not pose a hazard to moderately sensitive crops.

- Monitoring of the spreading of macrophytes should be done on a regular basis, so that management options can be considered when the macrophytes become a problem in the impoundment.

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1. OBJECTIVE

The objective of the *ad hoc* sampling was:

- to assess the water quality upstream and in the Lindleyspoort Dam River to determine the potential impact of upstream landuse activities.
- to determine the effect of the water quality on the agricultural users downstream of the impoundment, and
- to identify a macrophyte species growing in the inflow of the Lindelyspoort Dam.

2. STUDY AREA

Lindleyspoort Dam is situated on the Elands River north of Swartruggens in the North West Province (Figure 1). The downstream users of the water of the Lindleyspoort Dam complained to Mr. H Jordaan (water control officer at Lindleyspoort Dam) about the water quality and the effect it may have on their irrigation farming activities. This initiated the request by Mr. H. Jordaan (from the North West Region) to the Institute for Water Quality Studies for an *ad hoc* survey in the impoundment and upstream of the impoundment.

Mr. Jordaan assisted in the sampling site selection and expressed concerns about the growth of macrophytes in the inflow to the Lindleyspoort Dam. He subsequently requested the IWQS to identify the macrophyte in the inflow section of the dam.

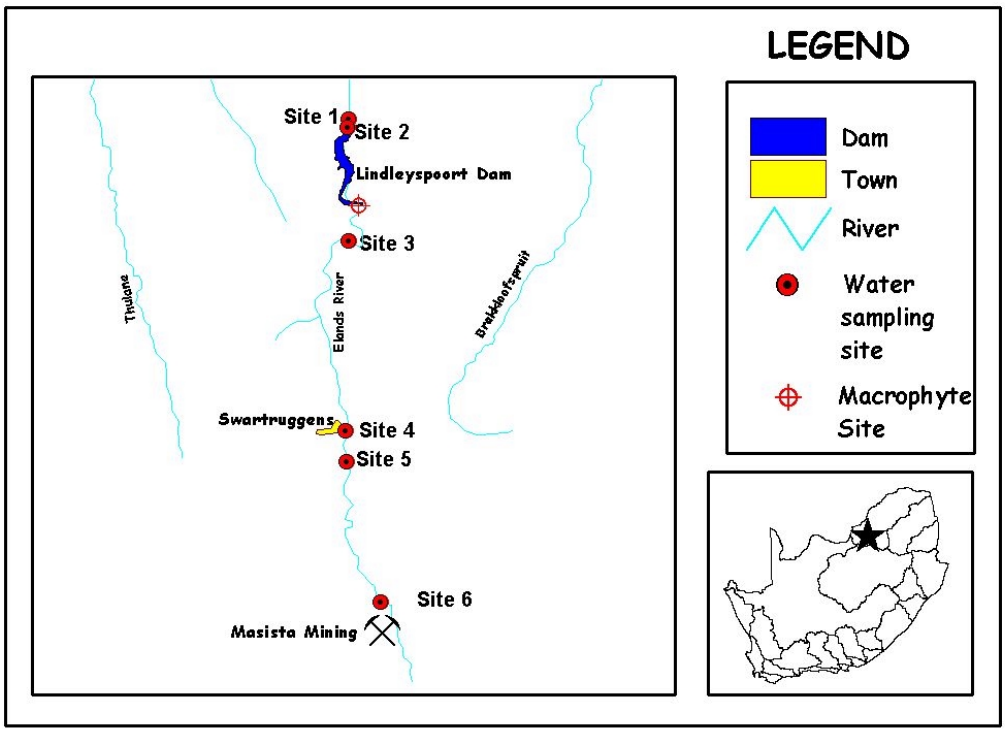

Figure 1. Sampling sites in the Elands River and the Lindleyspoort Dam.

3. SAMPLING METHODS AND ANALYSES

The water quality of the Elands River upstream, and inclusive of the Lindleyspoort Dam, was monitored on 14 February 2001 at six selected sites (Figure 1 & Table 1). The sites were selected according to potential impacts in the catchment.

A wet sample of one macrophyte species was taken at the inflow of the Elands River into the Lindleyspoort Dam.

Table 1. The description of the sampling sites in the Elands River catchment.

Site No.	Site description
Site 1	Sampling site in the canal directly downstream of the Lindleyspoort Dam wall
Site 2	Sampling site at the Lindleyspoort Dam wall
Site 3	Bridge 2049 on the road from the Lindleyspoort Dam to Swartruggens
Site 4	Bridge across the Elands River in Swartruggens downstream of a feedlot.
Site 5	Swartruggens Dam near the dam wall
Site 6	Bridge across the Elands River downstream of the Masista Mining Area

3.1 Sampling methods

The water of the *ad hoc* grab sample was transferred into the major inorganic chemical (macro) sampling bottles of the IWQS, preserved with mercury (II)-chloride and transported to the IWQS.

The physical measurements, temperature and dissolved oxygen, were measured *in situ* at the Lindleyspoort Dam with a YSI 95 oxygen and temperature meter. The pH reading was determined in the Macro Elements Laboratory at the IWQS.

3.2 Analysis methods

3.2.1 Macro chemical samples including Kjeldahl nitrogen (KN) and total phosphorus (TP) analysis were taken at the six sites as shown in Figure 1. The analyses included pH, ammonium (NH_4-N), nitrate and nitrite (NO_3 + NO_2 as N), fluoride (F), alkalinity as calcium carbonate (ALK), sodium (Na), magnesium (Mg), silicon (Si), ortho-phosphorus (PO_4-P), sulphate (SO_4), chloride (Cl), potassium (K), calcium (Ca), electrical conductivity (EC), and total dissolved salts (TDS). The methods used to determine these variables are discussed in detail in the IWQS (1999) document.

3.2.2 Biological samples were analysed by the biological laboratory of the IWQS. Samples were tested for chlorophyll-*a*, phaeophytin-*a*, total suspended solids (TSS) and algal identifications. The methods used to determine the results are discussed in detail in the IWQS (2000a) document.

3.2.3 The macrophyte sample was identified by using the Aquatic Plant identification Deck of the University of Florida (Ramey, 1995).

4. RESULTS AND DISCUSSION

4.1 Water quality

The water quality of the survey was assessed in terms of the South African Water Quality Guideline for irrigation (DWAF 1996). Using specifically the moderately sensitive irrigation uses. The results are shown in Table 2. According to the results none of the variables measured, except for total dissolved salts (TDS) indicated any major impacts, of landuse activities in the catchment, on the water quality of the Elands River or the Lindleyspoort Dam.

Table 2 Results of the *ad hoc* chemical, biological and physical sampling in the Lindleyspoort Dam and upstream in the Elands River.

Variable	Agriculture: Irrigation (DWAF, 1996)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Date		2001-2-14	2001-2-14	2001-2-14	2001-2-14	2001-2-14	2001-2-14
Time		10:00	9:30	10:35	10:47	10:57	11:22
Surface Temperature (°C)	NA	-	25.3	-	-	-	-
Surface O_2 (mg/ℓ)	NA	-	7.48 (91.3%)	-	-	-	-
Chlorophyll-*a* (µg/ℓ)	NA	-		-	-	-	-
Phaeophytin-*a* (µg/ℓ)	NA	-		-	-	-	-
Suspended solids (mg/ℓ)	0 – 50	-		-	-	-	-
Secchi depth (m)	NA	-	1.0	-	-	-	-
pH	6.5 – 8.4	7.8	8.0	8.0	7.9	7.9	7.7
Kjeldahl nitrogen (mg/ℓ)	NA	0.82	0.46	0.45	0.51	0.57	0.48
Ammonium (mg/ℓ)	NA	0.26	<0.04	<0.04	<0.04	<0.04	<0.04
Nitrate & nitrite (mg/ℓ) as N	2.5	<0.04	0.06	0.09	0.06	0.04	0.14
Fluoride (mg/ℓ)	0 – 2	0.2	0.2	0.2	0.2	0.2	0.2
Alkalinity as $CaCO_3$ (mg/ℓ)	NA	60	58	115	75	67	44
Sodium (mg/ℓ)	≤70	6	8	11	8	8	5
Magnesium (mg/ℓ)	NA	8	8	15	8	8	5
Silica (mg/ℓ)	NA	4.9	3.9	5.6	4.2	4.1	4.3
Total phosphorus (mg/ℓ) as P	NA	0.065	0.030	0.025	0.034	0.030	0.031
Ortho-phosphorus (mg/ℓ) as P	NA	0.033	0.019	0.014	0.024	0.016	0.015
TN:TP ratio	NA	13.1	17.3	21.6	16.8	20.3	20.0
PO_4:TP ratio	NA	0.51	0.63	0.56	0.71	0.53	0.48
Sulphate (mg/ℓ)	NA	9	11	14	11	6	6
Chloride (mg/ℓ)	0 – 100	<10	<10	<10	<10	<10	<10
Potassium (mg/ℓ)	NA	2.4	2.6	2.4	2.2	2.1	1.4
Calcium (mg/ℓ)	NA	11	11	22	11	10	7
Electrical Conductivity (mS/m)	NA	16.3	16.2	28.9	17.9	16.4	11.1
Total dissolved salts (mg/ℓ)	< 40	117	116	214	139	121	83

The Lindleyspoort Dam was previously classified as being between mesotrophic and eutrophic by Van Ginkel *et al.* (2001) and the system had not experienced major algal blooms during the last ten-year period. The algal population is often dominated by cyanobacteria, although the chlorophyll *a* concentration seldom exceeds 10 µg/ℓ.

There was however a period that problems were experienced in the Elands River that led to an *ad hoc survey* in 1999 by Van Ginkel (1999). The problem of smells of the outlet water from the Lindleyspoort Dam was found to be due to the draw-off at 20 m in the anaerobic hypolimnion water that is rich in manganese and H_2S (Van Ginkel, 1999). During the sampling on 14 February 2001 the dissolved oxygen concentration profile at the wall of Lindleyspoort Dam showed again a distinct anaerobic hypolimnion in the water column (Figure 2) from 7 m down.

When the nutrient concentrations of the different sites are compared, higher nutrient (nitrogen and phosphorus) concentrations were found at Site 1, the draw-off from the anaerobic hypolimnion. This is a natural phenomenon during the summer period and leads to the release of especially phosphorus from the bottom sediments (Wetzel, 1983).

In the Elands River upstream of the Lindleyspoort Dam the water quality was acceptable in terms of the South African Water Quality Guideline for irrigation (moderately sensitive crops) (DWAF, 1996). However salinity does seem to be slightly higher tan acceptable.

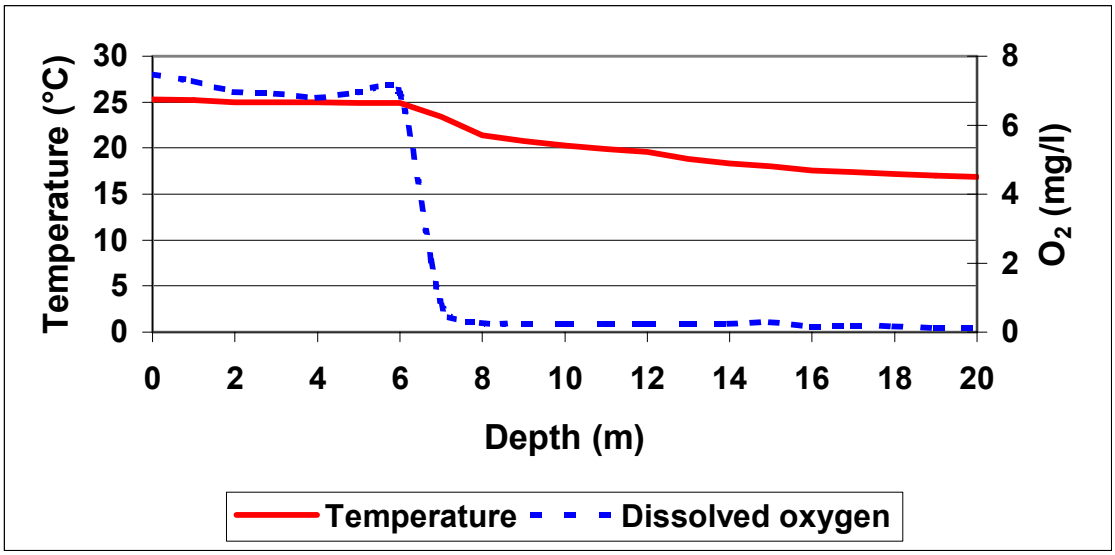

Figure 2. The temperature and dissolved oxygen concentration at Site 2 in the Lindleyspoort Dam at the dam wall on 14/02/2001.

4.2 Macrophyte growth

The macrophyte growth sample taken at the inflow of the Lindleyspoort Dam was identified as water primrose (*Ludwigia* species) (Figure 3). There are many shrubby species, some large and some small. They commonly grow in shallow marshy areas, borrow pits and ditches. They flower in all seasons except winter.

Water primroses grow to five or six feet tall. Stems are branched and sometimes have long hairs. The leaves are ovate to lance-shaped, and up to six inches long. Leaves are covered on both sides by minute soft hairs. Most water primroses have conspicuous yellow flowers. The flowers have four or five petals.

Macrophyte growth in an impoundment has limiting effects on the recreational use of an impoundment and excessive growth may have a effect on the water loss due to evaporation.

Figure 3. A water primrose (*Ludwigia peruviana*) (Photo from WWW1, 2001)

5. CONCLUSIONS

5.1 The water quality in the Lindleyspoort Dam is not of any immediate concern for irrigation of moderatly sensitive crops.

5.2 The highest nutrient concentrations were found in the canal water downstream of the impoundment. These high nutrient concentrations are released from the anaerobic hypolimnion in the Lindleyspoort Dam during the summer period but do not pose any problem for downstream users.

5.3 The macrophyte growth in the inflow of the Lindleyspoort Dam was identified as a water primrose species (*Ludwigia* sp.). The primrose species has the potential to spread and dominate wetland areas.

6. RECOMMENDATIONS

6.1 Farmers downstream of the Lindleyspoort Dam should be informed of the fact that the water quality of the Lindleyspoort Dam does not pose a hazard to moderately sensitive crops.

6.2 The monitoring of the macrophytes should be done on a regular basis, so that management options (e.g. chemical control, available biological control or integrated control) can be considered when the macrophytes become a problem in the impoundment.

7. ACKNOWLEDGEMENTS

The author wants to thank:

6.1 The IWQS Laboratories for analysis of samples without which this report would not have been possible.

6.2 Mr. Hennie Jordaan for his assistance during sampling.

6. REFERENCES

DWAF (1996). *South African Water Quality Guidelines Volume 4 Agricultural use: Irrigation*. Department of Water Affairs and Forestry. PRETORIA, South Africa.

IWQS (1999). *Macro Elements Laboratory Test Methods and SOP Manual*. Revised edition. Institute for Water Quality Studies. Department of Water Affairs and Forestry. PRETORIA. South Africa.

IWQS (2000a). *Biology Laboratory Test Methods and SOP Manual*. Revised edition. Institute for Water Quality Studies. Department of Water Affairs and Forestry. PRETORIA. South Africa.

IWQS (2000b). *Trace Metal Laboratory Test Methods and SOP Manual*. Revised edition. Institute for Water Quality Studies. Department of Water Affairs and Forestry. PRETORIA. South Africa.

RAMEY, V. (1995) *Aquatic plant identification deck*. Elf Atochem North America, Inc.

VAN GINKEL, C.E. (1999) *Lindleyspoort Dam Ad Hoc Survey – 1999.* Internal Report No. N/A220/05/DEQ/1499. Institute for Water Qulaity Studies. Department of Water Affairs and Forestry. Pretoria.

VAN GINKEL, C.E., B.C. HOHLS, A. BELCHER, E. VERMAAK & A. GERBER. (2001) *Assessment of the Trophic Status Project.* Internal Report No. N/0000/00/DEQ/1799. Institute for Water Qulaity Studies. Department of Water Affairs and Forestry. Pretoria.

WETZEL, R.G. 1983. *Limnology* 2nd Edition. Saunders College Publishing, Philadelphia. USA.

WWW1. (2001) http://aquat1.ifas.ufl.edu/ludper4.jpg