Nature Iraq / Twin Rivers Institute for Scientific Research
Laboratories Division – Sulaimani Office
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Nature Iraq Field & Lab Report

DARBANDIKHAN SAMPLING RESULTS

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Information Sheet

Samples Information

Types of Samples: Water
Number of Samples: 5
Number of Required Parameters: 8
Types of Required Parameters: pH, Temp, EC, Salinity, Turbidity, Total Dissolved Solids (TDS), Total Organic Carbon (TOC) and heavy metals in water: Fe, Zn, Cd, Pb, Ni, Cu, and Mn
Date of Collection: 7/9/2008
Place of Collection: Darbandikhan Lake
Date of Sample Arrival to the Lab: 7/9/2008
Date of Analysis: 20/9/2008

Customer Information

Name of the Customer: Sulaimani Environment Directorate
Place of Work: Sulaimani
Name of Project: Darbandikhan Lake Pollution

Lab Information

Lab Manager: Raid Abdulmehdi
Name(s) of the Analyst(s): Haider Ahmed and Ali Maher
Name(s) of the Assistant(s): Laith Anwar
The method used: Samples were collected, preserved and analyzed by Nature Iraq team with participation of Sulaimani Environment Directorate according to the APHA 2005

Parameter	Methodology	Method No. in APHA 2005
pH	pH meter	4500 H^+
EC	Electric Current	2510
Salinity	Electrical conductivity	2520B
Turbidity	Turbid meter	2130A
TDS	Total Dissolved Solid Dried at 180°C	2540C
TOC	Total Organic Carbon	5310A
Heavy Metals	FAAS	3111B

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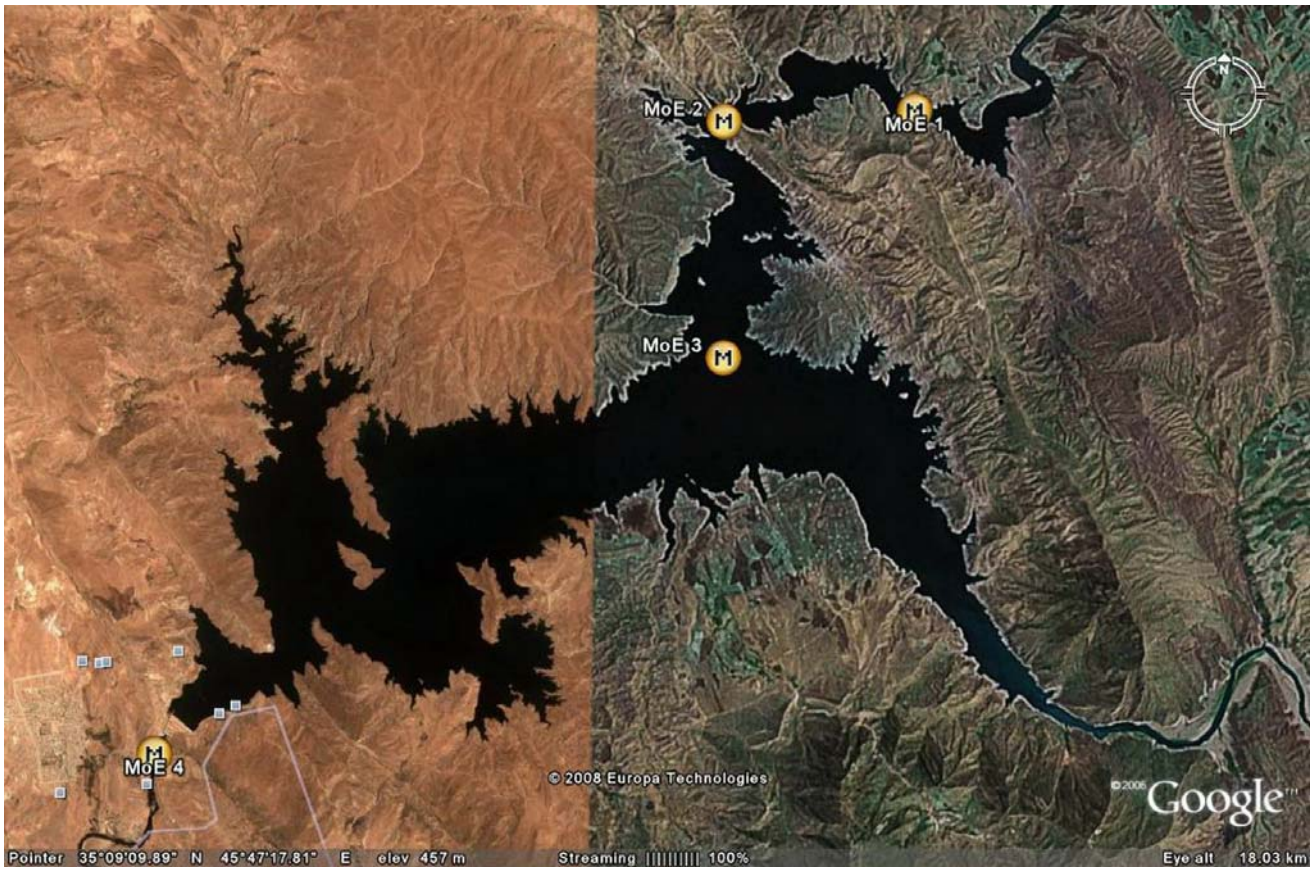
Map of the Study Area showing sampling points



(Goggle Earth Map, 2008)

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Sample Results

Results Sheet for MoE Site 1

Site Coordination: N 35° 11' 53.1" E 45° 49' 55.7"
Site Code: MoE 1
Sampling Depth: 0.5 m
Time of Collection: 1:52 pm
Site Description: The site has been selected where the Tanjero river water enters and become part of Darbandikhan Lake. On the sampling date and time the water of the Tanjero River was characterized as low discharge with a brown color, on the right bank of the river dead fish were observed, which caused a smell of decay over the area. The major activities around the selected site were fishing using nets. Also use motorboats and the release of fuel was observed.

1- Field Measurements :

Parameters	Results
Salinity ppt	ND*
Conductivity µs/cm	368
PH (pH unites)	8.74
Water Temperature °C	27
Air Temperature °C	40
Turbidity NTU	91.5

*Not Detected

2- Lab Measurements:

Heavy Metals	
Parameters	Results
Fe (mg/L)	ND*
Cu (mg/L)	ND
Mn (mg/L)	0.048
Cd (mg/L)	ND
Pb (mg/L)	0.101
Zn (mg/L)	ND
Ni (mg/L)	0.021
TOC %	4.62
TDS mg/L	245
DO mg/L	7.3

*Not Detected

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Results Sheet for MoE Site 2 - Surface

Site Coordination: N 35° 11' 47.9" E 45° 47' 58.5"
Site Code: MoE 2-S
Sampling Depth: 0.5 m
Time of Collection: 2:26 pm
Site Description: The site lies approximately five kilometers south of the first site. The site has been in a clear water state. No local activities were observed except fishing using nets.

1- Field Measurements :

Parameters	Results
Salinity ppt	ND*
Conductivity µs/cm	306
pH (pH unites)	8.39
Water Temperature °C	29.6
Air Temperature °C	40
Turbidity NTU	5.61

*Not Detected

2- Lab Measurements:

Heavy Metals	
Parameters	Results
Fe (mg/L)	0.129
Cu (mg/L)	ND*
Mn (mg/L)	0.02
Cd (mg/L)	ND
Pb (mg/L)	0.066
Zn (mg/L)	ND
Ni (mg/L)	ND
TOC %	66.43
TDS mg/L	206
DO mg/L	7.9

*Not Detected

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Results Sheet for MoE Site 2 - Bottom

Site Coordination: N 35° 11' 47.9" E 45° 47' 58.5"
Site Code: MoE 2-B
Sampling Depth: 2 m
Time of Collection: 2:26 pm
Site description: See Site 2 - Surface

1- Field Measurements :

Parameters	Results
Salinity ppt	ND*
Conductivity µs/cm	300
pH (pH unites)	8.4
Water Temperature °C	30
Air Temperature °C	40
Turbidity NTU	4.94

*Not Detected

2- Lab Measurements:

Heavy Metals	
Parameters	Results
Fe (mg/L)	0.203
Cu (mg/L)	ND*
Mn (mg/L)	0.128
Cd (mg/L)	ND
Pb (mg/L)	0.11
Zn (mg/L)	ND
Ni (mg/L)	ND
TOC %	9.48
TDS mg/L	204
DO mg/L	7.9

*Not detected

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Results Sheet for MoE Site 3

Site Coordination: N 35° 09' 49.4" E 45° 47' 58.0"
Site Code: MoE 3
Sampling Depth: 0.5 m
Time of Collection: 2:57 pm
Site Description: This site is located on the main part of the lake after both the Tanjero and the Sirwan River have entered into the Lake. Clear water was observed with flow rates appearing to be higher than at the other sites. No local activities were notice.

1- Field Measurements :

Parameters	Results
Salinity ppt	ND*
Conductivity µs/cm	309
pH (pH unites)	8.3
Water Temperature °C	30.2
Air Temperature °C	38
Turbidity NTU	3.6

*Not Detected

2- Lab Measurements:

Heavy Metals	
Parameters	Results
Fe (mg/L)	0.212
Cu (mg/L)	ND*
Mn (mg/L)	0.022
Cd (mg/L)	ND
Pb (mg/L)	0.133
Zn (mg/L)	ND
Ni (mg/L)	ND
TOC %	68.26
TDS mg/L	208
Do mg/L	9.0

*Not Detected

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Results Sheet for MoE Site 4

Site Coordination: N 35° 06' 26.06" E 45° 42' 9.13"
Site Code: MoE 4
Sampling Depth: 0.5 m
Time of Collection: 3:56 pm
Site Description: This site is locates below Darbandikhan dam. No fishing activity was noticed. An abandon water treatment plant was located here. Local water tanker trucks are filling their tanks here to supply water to the Darbandikhan area.

1- Field Measurements :

Parameters	Results
Salinity ppt	ND*
Conductivity µs/cm	379
pH (pH unites)	7.9
Water Temperature °C	17.6
Air Temperature °C	38
Turbidity NTU	4.2

2- Lab Measurements:

Heavy Metals	
Parameters	Results
Fe (mg/L)	0.136
Cu (mg/L)	ND*
Mn (mg/L)	0.08
Cd (mg/L)	ND
Pb (mg/L)	0.122
Zn (mg/L)	ND
Ni (mg/L)	0.095
TOC %	33.22
TDS mg/L	250
DO mg/L	8.5

*Not Detected

Results Discussion:

High TDS and turbidity were reported at the site MoE No.1 (downstream Tangero) where the dead fish have been observed. While lower values of TDS and Turbidity have been exhibited at the site MoE No.2 and MoE No.3 may be related to the dilution effects of the Sirwan River.

It should be noticed that the increases of TDS at site MoE No.4 (after the dam) may be related to the decrease of the water discharge from the dam and the high evaporation during the period of the sampling.

The highest percentage of TOC has been exhibited near the Darbandikhan Lake Center (Site MoE No. 3) probably due to the accumulation of organic compounds in the center of the Lake.

The results of all the sites show that the dissolved lead values in water were very high compared with the maximum levels and standards of water quality (WHO 2006, IQS 1996, Canada 2005, EU 2005 and the EPA) indicating a serious pollution problem in Darbandikhan Lake.

It is useful to mention that Nature Iraq has done previous work on the Tangero River and the Lake in the summer of 2008 and the followings have been found:

1- The lead results of sediments samples showed higher concentrations than the EPA and the Swedish standards values. Considering that pollutants such as heavy metals precipitate in the center (deeper) parts of the lake, therefore, the sediment may be itself a major source of increase the concentrations of the heavy metals in the subsurface samples.

2- The polluted waters of the Tanjero River that enter the lake (near MoE 1) are of grave concern to human and environmental health. Comparatively this site had a higher density of the phytoplankton *Peridinium cinctum*, at levels known to be toxic to fish and the humans who eat these fish. The centric diatom seen in these waters, *Aulacoseira granulate* also indicates polluted conditions. Given the extensive fisheries that exist in the lake itself, the pollution of the Tanjero River, likely caused primarily by the sewage inputs from the city of Sulaimani, needs to be cleaned up. Additionally most of the diatoms recorded for Darbandikhan Lake are indicators of poor water quality.

3- The presence of the pollution-tolerant benthic organisms, *Physa* sp. 1 and *Gyraulus* sp., in the Diyala River below the Darbandikhan dam generally indicates that nutrient-enriched conditions and poor water quality can also be found in the waters leaving the reservoir and these waters are additionally affected by downstream pollution sources (sewage from the town of Darbandikhan).

Also, Nature Iraq collected water samples – just after the time of the reported fish kill in the area- and the results of the dissolved metals content in the water samples showed higher concentrations of lead and nickel comparing with the maximum levels and standards of water quality (WHO 2006, IQS 1996, Canada 2005, EU 2005 and the EPA).

Nature Iraq recommends the following:

1- Collecting more samples from different locations of the area and test them for other heavy metals and parameters.

2- Starting an ongoing environmental monitoring project on the entire area.

3- Consider creating a committee to discuss the following:

A- Conduct environmental impact assessments (EIAs) of the fishing industry on the lake (included the use and effects of fuel and oil for motorboat engine and fishing methods used), city industries that release wastes to the basin and lake and any other local activities that could have a significant effect on the quality of water in the basin.

B- Development of an action plan including water treatment and addressing industrial inputs of pollutants to the basin as well as other impacts on the basin.