RiverWatch

Pilot Project Report
February 2013

A project of Waterkeepers Iraq sponsored by Nature Iraq with support from the German Foreign Federal Office

NATURE IRAQ طبيعة العراق سروشتی عێراق

پاریزەرانی ئاو عیراق
WATERKEEPERS IRAQ
المحافظين على المياه العراق

Federal Foreign Office

INTRODUCTION

The goal of the RiverWatch project and the Waterkeepers Iraq program in general is to improve the ecological health and quality of Iraqi Rivers. Specifically, this project focuses on the Upper Tigris Basin within particularly the Upper Diyala and Lesser Zab Rivers. It is hoped that the project will model a program that can be adapted to improve the health of other river basins within Iraq and the larger region.

Program Objectives

The program consists of the following three planned measures and activity steps:

1. **Objective 1 Activities**
    a. Continue distribution of the Waterkeeper brochure and a flyer used to promote the project and inform potential partners about how to get involved.
    b. Conduct the Monitoring Survey Trips on a monthly basis with schools and university groups. Work with school groups will occur primarily in the spring and fall (with continuation into the following year if funding is available.
    c. Conduct additional trips with other stakeholder groups (ministry staff, media, NGOs, and interested individual). These will take place throughout the year;
    d. Trips will include a combination of both on the water and riverbank surveys to monitor for physical and basic chemical water quality using a handheld YSI multi-parameter meter (Temperature, pH, TDS, Conductivity and Chlorides) and a HACH colorimeter
    e. Additionally, updating of site descriptions and threats assessments (which should at a minimum be done quarterly) will be conducted at each monitoring point.

2. **Objective 2 Activities**
    a. Action Trips. Primary actions, such as river clean up, petition campaigns, or other activities will occur in late fall/early winter and spring/early summer and will be collaboratively planned with project participants to encourage 100% engagement in the planned actions;
    b. These actions will be promoted to the public through local and regional media and the Nature Iraq & Iraq Waterkeeper website and the Waterkeeper Facebook Page.

3. **Objective 3 Activities**
    a. Data entry, validation and analysis;
    b. Scorecard development based on primary water quality indicators;
    c. Public press conference event to release the Scorecard

An additional activity was to conduct evaluation & reporting as follows:

a. Feedback from participants will be collected throughout the project through both formal (written evaluation forms) and informal (oral feedback during program activities or on the Waterkeeper Hotline) methods.
b. A final report will be produced after the release of the Score Card to summarize project achievements, present overall feedback, evaluate problems and identify next steps for future activities.

The German Foreign Federal Office provided funds to hire a River Educator to work with the Waterkeeper and purchase water quality monitoring equipment. The German funding corrected the initial 4 ½ months to get the program up and running and the following report provides the results from this initial pilot program.

ACHIEVEMENT OF THE PILOT PROJECT

Monitoring Trips

As a part of the RiverWatch project, 23 trips were conducted by the Waterkeeper, Nwenar Fatih and the River Educator, Amir Muhsen. This included twelve trips (out of the eleven trips planned) with stakeholder groups by January 21, 2013. Trips with university and high school students were organized in addition to a trip with journalists and two trips for governmental employees. In total, 212 people participated in RiverWatch trips by this date, with an average 46% of the participants being women. Also, seven volunteers were involved in assisting in the trips and visiting the sampling sites.

We had hoped to obtain data on 12 core sites/month as well as 6 or more additional sites. But there were delays in receiving equipment (The boat and some of the equipment needed to use it did not arrive in Sulaimani until late November and the colorimeter required to obtain data on nutrients was ordered but as of this report has not yet arrived in-country). Bad winter weather required the cancellation of some trips and training the staff and getting them comfortable with using the equipment took additional time away from the sampling effort. The sample effort was restricted to the following 11 sites and dates:

Date	Site Name	Site Code	Coordinates	
			Latitude (North)	Longitude (East)
27-12-12	Raparin	T1	35.5913	45.25735
07-01-13				
14-11-12	Bakrajo	T2	35.52001	45.36185
14-11-12				
07-01-13				
12-11-12	Serchinar (N.P.)	T5	35.58568	45.37983
12-11-12				
12-11-12				
12-11-12				
29-12-12				
27-12-12	Tanjaro	T6	35.48003	45.43512
08-01-13				
17-12-12	Dukan Output	Z6	35.94168	44.95958
17-12-12	Dukan Town	Z6-A	mobile float	mobile float
15-01-13	Eco Camp	Z7	35.81812	45.19888
24-12-12	Kani Shouq	Z8	35.82154	45.09465
13-01-13				
13-01-13				
17-12-12	Boat put-in	Z10	35.883350°	44.972695°
17-12-12	Shuqashan	Z11	35.87283	44.9395
14-01-13				
06-02-13				
18-01-13	Qadr Karam	X	-	-

In terms of developing strong contacts with participant groups, the project has been a great success. All groups contacted were enthusiastic to participate in the project and responded favourably. The following groups have participated or are planning future trips with the RiverWatch Project currently.

Institute	No. Participants	Profession
The American University of Iraq Sulaimani	47	Students
University of Sulaimani – College of Agriculture	45	Students
Graduates of College of Agriculture	14	Graduates
IMCK – Environmental Media Training	12	Journalists
Classical School of Medes – Secondary school	43	Students
Classical School of Medes – High school	17	Students
Sulaimani Environment Directorate	20	Gov't Employees
Awat Newspaper	17	Journalists
Municipality of Qadr Karam	14	Gov't Employees
ASO Folk High School	40	Students
Handren Primary School – Dukan	Planned	Students
Sara Primary School – Dukan	Planned	Students
Kanakawa Primary School	Planned	Students
Garmian Youth Group – Kalar	Planned	Employees

Some images from RiverWatch trips:

Methodology, Data Collection & Data Management

The monitoring effort is governed by a Quality Assurance Project Plan (QAPP) (Nature Iraq, 2012) that outlines all survey methods and equipment use. Data was collected using the following instruments:

1. Garmin GPS Device for verifying site coordinates and elevations.
2. YSI Professional Plus Multimeter. This instrument was calibrated within 24 hours before each field work day based on the manufacturer's instructions and standardized calibration solutions.

Sites were GPS located and the multimeter was used to obtain data on the following physical parameters: Temperature, pH, TDS, Conductivity, Dissolved Oxygen and Ammonium.

In addition, the following data sheets were filled out in the field:

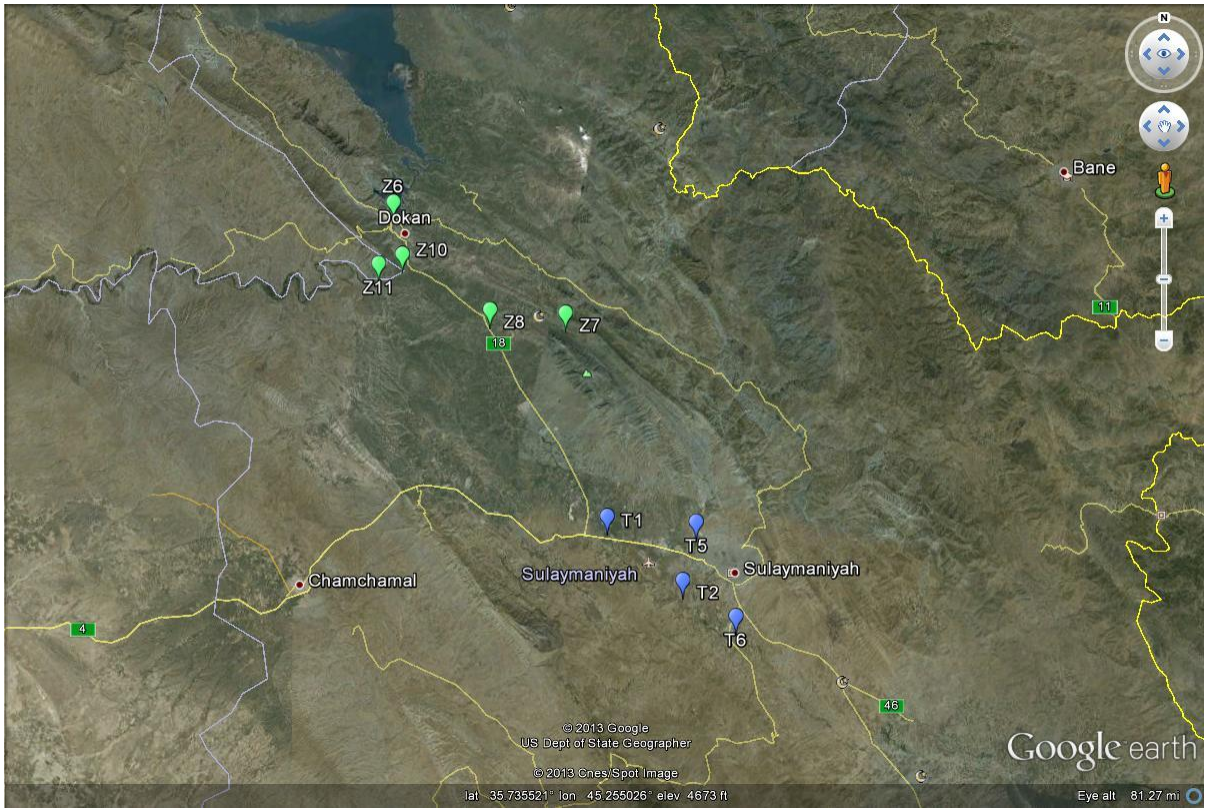
1. Basic Site Information Sheet (entering information on the site, coordinates, weather and water conditions & logistics)
2. Water Quality Data sheet for entering instrument readings
3. Threat Assessment sheets (primarily used for discussion with community groups)

Completed field sheets are archived in the Nature Iraq Library.

The process of data collection is still going and the results of each sampling site from each visit to a site are being discussed with university students, professors and the local Blue Horizons Water quality Lab to develop local standards for the local streams' parameters. The raw data are published on the Waterkeepers Iraq website as soon as possible after returning from the field in order to make it easier for all the people who are interested to access and work with the data (See: www.iraqwaterkeeper.org).

Survey Area

The survey area focuses on key portions of the Lesser Zab River and the Tanjero/Diyala River basins. Both tributaries to the Tigris River, these rivers receive a portion of their waters from Iran before receiving additional waters as they travel through Kurdistan, northern Iraq before they eventually meet the Tigris north of the town of Baiji and in Baghdad respectively. Six core monitoring points and six elective monitoring points have been selected in each basin. Though this was not fully achieved in the pilot project as yet, the goal will be to visit core monitoring points a monthly basis during the sampling seasons and elective monitoring points on a quarterly basis. A map below shows the sample points that were visited during the initial pilot project. "Z" Site codes are in the Lesser Zab basin. "T" site codes are in the Tanjero/Diyala Basin.



Map 1: Sample Site Map

The following site descriptions provide information on conditions and threats at the sample sites that were visited in the first four months of the survey:

Site Name	Site Code	Site Description
Raparin	T1	Small stream (<2 meters wide) in Raparin area, close to a residential area and agricultural, no vegetation cover; high impacts from garbage dumping, agriculture, grazing animals and sewage
Bakrajo	T2	Small stream (<4 meters wide), Close to College of Agriculture and near a power station (power lines hang over the site), Surrounded by agricultural fields, near the airport; Little vegetation cover at sample sites but narrow riparian area of willows and shrubs up and downstream, Sample point is below the bridge to Hazarmerd. Irrigation ditch above on left bank; high impact from garbage dumping, burning, sewage, grazing animals and agriculture.
Serchinar	T5	Serchinar spring stream approx. 500-750 meters downstream from Serchinar Spring; sample point upstream of the bridge entrance to Nawruz Park, which is on the right bank and a restaurant (on the left bank), downstream of another recreational area that has armed the stream bed and banks; Moderate riparian vegetation. Stream is approx. 3 meters wide; high impacts from garbage dumping.
Tanjero	T6	Tanjero mainstem downstream of the Sulaimani City Dump and gravel mines, wide stream (< 10 meters), downstream of Tanjero industrial area; high impacts from the dump, gravel mining, garbage, sewage, and agriculture.
Dukan Output	Z6	Lesser Zab mainsteam downstream from the Dukan Dam and immediately upstream of the Dukan residential area; River approx. 15 to 25 meters wide; rocky; high impacts are water management regime, some car washing, picnicking occurs near sample point. Transect difficult due to fast flow and rocky substrate.
Dukan Town	Z6-A	Dukan river or Qashqoli (Lesser Zab mainstem) downstream of main Dukan Bridge; banks developed for tourist cabins and residential areas; high impacts from sewage, garbage dumping, urban development, water management regime of the dam.
Ecocamp	Z7	Small stream (Chami Mergapan) in Mergapan Area (by NI Eco-camp), Approx. 5 meters wide, with overhanging shrubs and trees; past earthen dams (now broken) upstream of the sample point, agro-forestry and orchards nearby; high impacts from agriculture, grazing animals, urban expansion in the valley, and water management upstream.
Kani Shouq	Z8	The stream (Tabbin) is appox. 8-10 meters wide and flowing through agricultural land at the sampling point; Upstream of the Dukan Road Bridge (near Chami Rezan Turnoff), downstream from the village of Kani Shouq, high impacts from agriculture, some garbage dumping and sewage, grazing animals.
Boat Put-In	Z10	Lesser Zab mainstem, approx. 15-25 meters wide and fairly deep., General location for starting boating trips on the river; located across from an old gravel mine (possibly inactive) and downstream of the town of Dukan, Oil refinery (built only a few years ago but possibly inactive) located downstream; high impacts from garbage and sewage of Dukan, water management from the Dukan Dam, gravel mines, agriculture and grazing animals.
Shuqashan	Z11	Chami Rezan (Tabbin) stream near its mouth on the Lesser Zab; Area turned into a gravel mine in 2012, most of the wide riparian area in the area damaged. Braided stream (two branches) and pools created by gravel mining operation for the Shuqashan Dam under construction upstream. Entire stream basin width approx 8 to 10 meters wide; high impact from gravel mine, garbage dumping; dam construction upstream, some grazing animals.
Qadr Karam	X	Relatively wide, approx. 10 meters and very shallow stream surrounded by open, unvegetated lands. Note: This is not a core site for the RiverWatch monitoring effort.

Data Discussion

The sampling effort occurred primarily from November to January, with sites visited based on logistical needs of the groups participating in the project. The following table presents the raw data obtained in the first months of the RiverWatch:

Date	Time	Site Code	Last Rain	Water State	Depth	Water Temperature	pH	Salinity	NH4	TDS	DO	DO	Conductivity
					m	˚C		ppt	mg/L	mg/L	mg/L	%	µS/cm
12-11-12	2:30	**T5**	12-11-12	Med	0.15	17	7.50	0.2	0.2	256.0	6.00	68.0	398
12-11-12	8:45	**T5**	12-11-12	Med	0.15	17	7.50	0.2	0.3	269.0	6.00	68.0	415
12-11-12	11:15	**T5**	12-11-12	Med	0.15	18	7.70	0.2	0.07	265.5	7.20	83.0	407
12-11-12	12:45	**T5**	12-11-12	Med	0.15	17	7.50	0.2	0.2	256.0	5.90	68.0	398
14-11-12	8:45	**T2**	14-11-12	Slow	0.2	18	7.60	0.3	3.3	406.0	5.60	59.0	624
14-11-12	11:45	**T2**	14-11-12	Slow	0.2	19	7.65	0.3	3.3	406.0	5.90	61.0	626
17-12-12	1:30	**Z6**	14-12-12	Med	2	15	8.30	0.1	0.09	201.0	8.30	85.0	310
17-12-12	3:00	**Z6-A**	14-12-12	Med	1.8	14.4	7.70	0.1	0.08	190.0	8.30	85.0	292
17-12-12	4:20	**Z10**	14-12-12	Med	2	15	7.80	0.1	0.89	184.0	8.20	82.0	299
17-12-12	11:22	**Z11**	14-12-12	Med	0.5	11.5	8.40	0.3	0.09	354.9	10.30	98.0	405.4
24-12-12	11:15	**Z8**	18-12-12	Slow	0.3	12	7.40	0.2	0.02	298.0	8.30	81.0	412
27-12-12	12:15	**T1**	18-12-12	Slow	0.2	12	7.45	0.2	8.1	489.0	17.00	27.0	794
27-12-12	11:00	**T6**	18-12-12	Med	0.7	12.4	8.00	0.2	2.22	301.0	8.40	82.0	470
29-12-12	1:00	**T5**	18-12-12	Med	0.15	13	7.40	0.2	0.1	257.0	6.70	70.0	411
07-01-13	10:00	**T1**	07-01-13	Med	0.25	9.5	7.68	0.4	9.72	533.0	20.00	19.0	820
07-01-13	11:00	**T2**	07-01-13	Med	0.2	9.5	7.76	0.3	6.3	447.0	3.00	29.0	688
08-01-13	10:50	**T6**	08-01-13	Fast	0.8	10.6	8.20	0.2	2.17	295.8	8.70	84.0	454.9
13-01-13	1:30	**Z8**	08-01-13	Slow	0.3	11	7.80	0.2	0.04	325.6	8.10	78.0	484
13-01-13	11:45	**Z8**	08-01-13	Slow	0.3	10.8	7.80	0.2	0.04	340.0	8.30	81.0	484
14-01-13	12:15	**Z11**	08-01-13	Slow	0.6	8.5	7.30	0.3	0.12	347.0	10.50	92.0	530
15-01-13	10:30	**Z7**	08-01-13	Slow	0.15	8	7.20	0.1	0.02	290.0	7.70	73.0	427
06-02-13	10:30	**Z11**		Fast	0.8	10	-	0.2	0.08	325.0	10.00	96.0	355
18-01-13	11:00	**X**	08-01-13	Slow	0.2	8.6	-	0.4	1.53	579.0	11.30	100.0	889

Data Ranges

The following table provides a general idea of the range of data obtained in the field work for each parameter.

Parameter	Range
Water Temperature (˚C)	8˚C at Eco-camp on 1/15/2013 to 19˚C at Bakrajo on 11/14/2012
pH	7.2 at Eco-camp and Dukan Float to 8.4 at Shuqashan
Salinity (ppt)	0.1 ppt at Dukan output, Dukan Float, Boat Put-in, & Eco-camp to 0.4 ppt at Raparin
NH4 (mg/L)	0.02 mg/L at the Eco-camp and Kani Shouq to 9.72 mg/L at Raparin
TDS (mg/L)	184 mg/L at the Boat Put-In to 533 mg/L in Raparin
DO (mg/L)	3 mg/L at Bakrajo to 20 mg/l at Raparin
DO (%)	19% at Raparin to 98% at Shuqashan
Conductivity (µS/cm)	292 µS/cm at Dukan Float to 889 µS/cm at Qadr Karam

Though this data represents only information from the late fall and early winter of 2012/2013, some hotspots are already being noticed based on the water quality data obtain.

Three sites have exceeded Iraqi standards for Ammonium (NH4) in surface waters and at least on one occasion one of these sites also fell below the Iraqi dissolved oxygen standard. See the table below:

Parameter	Ammonium (standard is ≤1 mg/L*)		
Date	**Site Name**	**Site Code**	**Results**
14-11-12	Bakrajo	T2	3.3 mg/L
14-11-12	Bakrajo	T2	3.3 mg/L
27-12-12	Raparin	T1	8.1 mg/L
27-12-12	Tanjero	T6	2.22 mg/L
07-01-13	Raparin	T1	9.72 mg/L
08-01-13	Tanjero	T6	2.17 mg/L
18-01-13	Qadr Karam	X	1.53 mg/L
Parameter	**Dissolved Oxygen (standard is > 5 mg/L*)**		
Date	**Site Name**	**Site Code**	**Results**
07-01-13	Bakrajo	T2	3.0 mg/L

**Limitations of Iraqi Regulation 25 for 1967: Preserving Rivers and Public Waters from Pollution*

The ammonium ion, NH4+, is an important member of the group of nitrogen-containing compounds that act as nutrients for aquatic plants and algae. In surface water, most of the ammonia, NH3, is found in the form of the ammonium ion, NH4+. Because of this we can roughly determine the concentration of most of the nitrogen (occurring as both ammonia and ammonium, usually called ammonia nitrogen), simply by measuring the ammonium concentrations. High levels of ammonium nitrogen can be toxic to some aquatic fauna; they can also enhance the growth of algae and aquatic plants. Bacteria can also convert high levels of ammonium into nitrate (NO3) through nitrification, which lowers the dissolved oxygen level. Thus there can be ripple effects on other attributes of water quality. Common sources of ammonia are sewage and animal waste, agricultural runoff, decaying plants and animals, industrial waste, and atmospheric nitrogen.

Three of these same sites also had the highest levels of total dissolved solids (over 400 mg/L) and, as would be expected, these same three had the highest conductivity readings along with one additional site from the Lesser Zab Basin (all over 500 µS/cm). See the table below:

Parameter	Total Dissolved Solids (mg/L) and Conductivity (µS/cm)			
Date	**Site Name**	**Site Code**	**TDS Results**	**Conductivity Results**
14-11-12	Bakrajo	T2	406.0	624
14-11-12	Bakrajo	T2	406.0	626
27-12-12	Raparin	T1	489.0	794
07-01-13	Raparin	T1	533.0	820
07-01-13	Bakrajo	T2	447.0	688
14-01-13	Shuqashan	Z11	347	530
18-01-13	Qadr Karam	X	579.0	889

Studies in fresh waters systems indicate that streams with a conductivity range of between 150 and 500 µhos/cm (equivalent to µS/cm) support diverse fisheries. Conductivity outside this range may indicate that the water is not suitable for certain species of fish or aquatic organisms (EPA, 2013). Raparin and Bakrajo are on the same tributary stream to the Tanjero main stem, they travel through agricultural and grazing land as well as near residential and some industrial areas. The riparian areas along the stream are heavily impacted and garbage dumping is a common practice along this stream. This preliminary data seems to indicate that

this stream is a particular hotspot within the basin with high sediment, sewage/nutrient inputs.

It is likely that the one Lesser Zab site that had high conductivity results, Shuqashan (Z11), is the result of its location downstream of a dam construction site and in the midst of a gravel mining operation dedicated to providing gravel for the dam construction. Nothing has been done to control sediment inputs to this stream and ultimately to the Lesser Zab River in flows into immediately downstream.

It is not possible to definitively state where in the two basins the best water quality can be found as there are many parameters that simply cannot be evaluated. Areas with the lowest levels of ammonium (all mostly under 0.1 mg/L) included Serchinar (T5), Dukan Output (Z6), Dukan Town (Z6A), Ecocamp (Z7), Kani Shouq (Z8) & Shuqashan (Z11).

Action Planning

Under action planning, a meeting of local supporters and activists was organized in January of 2013 to discuss the activities of the RiverWatch Project and the Waterkeepers Iraq Program overall and develop the Action Plan, which will define the future work and activities of the project. The action plan outlines 13 key threats seen in the local river basin and outlines Objectives, Strategic Actions and Action Steps required to address these threats. The following strategic action and action steps have been identified in this Action Plan for Objective 2.1 (addressing municipal sewage and wastewater issues) and Objectives 6.1 and 6.2 (address pollution from industrial wastes)

By 2014, local communities and government stakeholders are informed of threats from municipal sewage, wastewater problems, and pollution from industrial wastes		
	Strategic action	*Fully implement the RiverWatch Project and promote its Citizen Science/Activism methodology*
	Action Step #1	Run at least 72 Water Quality monitoring trips per year, with a minimum of 25 different stakeholder groups involved in these trips
	Action Step #2	Develop at least 4 RiverWatch actions/activities per year to increase community involvement and awareness
	Action Step #3	Release the annual scorecard at a public press conference and event to build pressure to promote better wastewater handling

Discussions were also made with the students who participated in the RiverWatch trips to develop an "Adopt-A-Stream" program in which a group of students adopts one of the streams that are being visited and perform a regular clean-up campaign to restore the stream.

Also, a presentation that discussed the RiverWatch project and how the environment relates to human rights was given at the University of Human Development in Qaradagh, Sulaimani, Iraq. Lastly, an educational "Outreach Sticker" (see below) was developed and printed, utilizing funds partially from the project and is now being provided to all RiverWatch participants that addresses solid waste pollution to local waterways and provides information on how long different types of solid waste take to degrade in the environment.

Scorecard

Though the raw data has been released, it was deemed pre-mature to release a Scorecard after only a few months of data collection because at least a full 6 months of data are needed to identify trends in the data and a full year of data collection is much preferred. Continued RiverWatch trips will lead at the end of the year to develop a Scorecard that grades each section of the river (each sampling point), which will be published and released in a press conference. Currently a template for the Scorecard is being developed.

The Scorecard will have six water quality indicators, two enforcement indicators, and one or two descriptive indicators which are not scored.

The water quality scores are calculated statistically for each numeric indicator, from water quality data obtained in accordance Quality Assurance Program Plan. The scores will be based on the percentage passing the criteria. For example, if 10% passed, the score would be a 1 out of 10, and if 100% passed the criteria the score would be 10. Problem hotspots will also be highlighted in the Scorecard. The table below shows the indicators and standards that will be used in the Scorecard at the end of the first year.

Scorecard Indicators	Standards
Water Quality Indicators	***Water Quality Standards***
Water clarity	Based on Secchi Disk Depth
Dissolved oxygen	>5 mg/L*
Nutrients	
Nitrate (NO3)	≤15 mg/L*
Nitrite (NO2)	(used to adjust NO3 concentration)
Phosphate	≤0.4 mg/L (≤0.1 mg/L for Lakes and basins)*
Ammonium (NH4)	≤1 mg/L*
Chlorides	Trace*

Scorecard Indicators	Standards
Enforcement Indicators	***Enforcement Standards***
Enforcement activities taken by the Kurdistan Environmental Protection & Improvement Board	# of Inspections # of Inspection staff # of fines Level of training
Enforcement activities taken by the Kurdistan Environmental Police	# of Inspections # of environmental police staff # of fines Level of training
Potential Descriptive Indicators	***Descriptive characteristics***
Types and characteristics of community-based engagement activities	Number and type of activities Number of people involved
8 out of 11 IUCN Threat Categories	Low, Medium, High, Very High based on scores for timing, scope and severity

**Limitations of Iraqi Regulation 25 for 1967: Preserving Rivers and Public Waters from Pollution*

Every year the Scorecard will be updated so that any trends (upward, downward or unchanging) from year to year can be determined.

Evaluation

An additional activity was to obtain evaluations from the people who attend the trips or are involved in the project in other ways (i.e. volunteers).

Five questions were asked of participants, which allowed a rating of 1 (Poor) to 5 (Excellent) and included space for comments, and left room at the bottom for additional input:

Questions	Average response
1. **How do you evaluate the trip in general?**	4.4
2. **How do you evaluate the topics of the trip and their importance?**	4.5
3. **How interested are you in participating/attending future activities?**	4.3
4. **How do you evaluate the trip's facilitator?**	4.6
5. **How do you evaluate the change in your information about water quality?**	4.5
Total Mean	4.5

Some comments received included:

- *"I never thought our water is that polluted" – Secondary School Student, Classical School of the Medes*
- *"I will try to use this information to do awareness sessions"- High school student, Classical School of the Medes.*
- *"You guys are doing an amazing job" – Student, University of Sulaimani, College of Agriculture.*
- *"I wish we have more people like you who work on these issues with such a big heart" – Employee, Sulaimani Environment Directorate.*
- *"Keep up the great work, I'm very excited about attending future activities" – Student, The American University of Iraq, Sulaimani.*

RECOMMENDATIONS FOR FUTURE RIVERWATCH PROGRAM ACTIVITIES

The following are recommendations for future RiverWatch activities:

- The monitoring effort should be concentrated into spring and fall to avoid poor weather conditions (rain and cold weather in winter and hot weather in summer). Thus the primary sampling season should be from March thru June and September thru December.
- For consistency in the data collection and to ensure that all sites are visited an adequate number of times throughout the year, efforts should be made to visit all sample sites on a regular basis and arrange community participation around the existing, scheduled trips.
- Safety training for on-the-water sampling and for transect sampling on wide rivers needs adequate time and preparation. It is recommended to have a safety orientation/re-fresher at the start of each sampling season. This is particularly important in the spring due to higher flow conditions on local rivers.
- Pursue an Adopt-A-Stream program on the Sarchinar spring and/or stream in Raparin/Bakrajo with nearby schools, businesses and community organizations and the local municipalities.
- Strengthen the relationship between the Waterkeepers Iraq/RiverWatch Program and Blue Horizons Laboratories by signing an MOU, which will allow for proper long-term maintenance of the sampling equipment.

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