



Interpretation of Groundwater Quality Data
Groundwater Samples Collected on 28 June 2022
from Sinjhara, Tharparkar

Analyzed by
Mehran University of Engineering and Technology

For
Alliance for Climate Justice And Clean Energy

By
Dr. Mark Chernaik
Environmental Law Alliance Worldwide

April 2023

Please see attached in spreadsheet form my interpretation of the water quality data obtained for water samples collected in or near the Thar Coal Block II power plant and lignite mine.

See: [Interpretation of water quality data of samples collected from Thar coal blocks on 28 June 2022.xlsx](#)

Cells shaded **RED** in the spreadsheet indicate a parameter that exceeds the Sindh Standards for Drinking Water Quality. Cells shaded **YELLOW** in the spreadsheet indicate a parameter that *does not* exceed the Sindh Standards for Drinking Water Quality but does exceed the generally more stringent World Health Organization Drinking Water Quality Guideline Values.

Please see below a Google Earth image of the locations of the nine water samples collected from in or near Thar Coal Block II on 28 June 2022:



Three aspects of the water quality data are worth highlighting

All of the drinking water samples collected are unfit for human consumption because of elevated levels of toxic metals (selenium, arsenic, mercury, chromium, and lead)

Specifically:

- Water from the Khario Ghulam Shah Village Well (Aban Jo Tar) contains unsafe levels of mercury and lead that exceed the Sindh Standards for Drinking Water Quality;
- Water from the Village Jamun Samo Well (Sengario) contains unsafe levels of mercury and lead that exceed the Sindh Standards for Drinking Water Quality, and a level of arsenic that exceeds World Health Organization Drinking Water Quality Guideline Value;

- Water from the Amra Well Bhittra (Sengario) contains unsafe levels of selenium, mercury and lead that exceed the Sindh Standards for Drinking Water Quality, and a level of arsenic that exceeds the World Health Organization Drinking Water Quality Guideline Value;
- Water from the Water Tank (Paro Jo Tar - UC Rajoro) contains unsafe levels of selenium and mercury, that exceed the Sindh Standards for Drinking Water Quality; and levels of arsenic and lead that exceeds World Health Organization Drinking Water Quality Guideline Values; and
- Water from the Water Tank (Meghe Jo Tar - UC Rajoro) contains unsafe levels of selenium, mercury, chromium and lead that exceed the Sindh Standards for Drinking Water Quality, and a level of arsenic that exceeds the World Health Organization Drinking Water Quality Guideline Value.

Please let me know if you would like additional information about the health effects caused by ingestion of excessive levels of selenium, mercury, lead, chromium and arsenic.

The highest levels of toxic contaminants are found in the Meghe Jo Tar pipeline (Sengario)

Although drinking water quality standards do not apply to this sample, the highest levels of toxic contaminants are found in the Meghe Jo Tar pipeline (Sengario). Specifically:

- The selenium level in this sample is 0.20 mg/L, compared to the next highest selenium level of 0.072 mg/L, in Water Tank (Meghe Jo Tar - UC Rajoro);
- The arsenic level in this sample is 0.09 mg/L, compared to the next highest arsenic level of 0.026 mg/L, in Village Jamun Samo Well (Sengario);
- The lead level in this sample is 0.33 mg/L, compared to the next highest lead level of 0.15 mg/L (in Water Tank (Meghe Jo Tar - UC Rajoro).

The mercury level in this sample is 0.095 mg/L, the second highest mercury level.

To the extent that water in the Meghe Jo Tar pipeline (Sengario) has a hydrological connection to groundwater, this implicates the Meghe Jo Tar pipeline (Sengario) as a source of selenium, arsenic, mercury and lead contamination of the regional aquifer.

NOTE: By this same logic, water in Wasteland (Sengario Jamun Samo 1), Wastewater land (Sengario Jamun Samo 2), and Wastewater land (Sengario Jamun Samo 3), does not appear to be sources of selenium, arsenic, mercury and lead contamination of the regional aquifer.

Toxic contaminants were generally absent in groundwater surveys included in ESIA reports for Thar coalfield projects

Levels of selenium, arsenic, mercury, chromium, and lead in the nine water samples collected from in or near Thar Coal Block II on 28 June 2022 can be compared to levels of these toxic metals found in groundwater samples included in baseline surveys in the ESIA reports for Thar coalfield projects.

The ESIA for the project “330 MW Coal-Fired Power Plant in Energy Park, Block II Thar Coalfields” dated 9 August 2016 contains the following baseline data (at page 4-51):

Exhibit 4.52: Water Quality in the Study Area⁴³

<i>Parameters</i>	<i>Unit</i>	<i>Min^a</i>	<i>Max^b</i>
pH	-	7.48	8.42
EC	µS/cm	3,280	14,500
Sodium	mg/l	500	2,460
Magnesium	mg/l	10	240
Calcium	mg/l	11	320
Potassium	mg/l	9	58
Sulfate	mg/l	150	712
Chloride	mg/l	975	5,599
Bicarbonate	mg/l	185	729
Silica Dioxide	mg/l	11.2	15.4
Hardness (as CaCO ₃)	mg/l	68	1,705
Sulfide	mg/l	<1.00	
Fluoride	mg/l	0.495	1.14
TDS	mg/l	1,996	9,584
Iron	mg/l	0.05	0.675
Aluminum	mg/l	0.075	0.28
Manganese	mg/l	0.025	0.08
Arsenic	mg/l	0.005	0.01
Copper	mg/l	0	0
Lead	mg/l	0.02	0.1
Zinc	mg/l	0.025	0.05
Cadmium	mg/l	0	0
Nickel	mg/l	0.025	0.25
Chromium	mg/l	0	0
Cobalt	mg/l	0	
Selenium	mg/l	0	0
Mercury	mg/l	0	0

a Minimum value among the 40 wells
b Maximum value among the 40 wells

Note the **absence of detectable levels of selenium, mercury and chromium**; lead levels that ranged from 0.02 to 0.1 mg/L, and arsenic levels that ranged from 0.005 to 0.01 in the 40 wells that were analyzed.

Similarly, the ESIA of the Thar Coalfield Block VI 2x330MW Coal-fired Power Plant dated March 2017 contains the following baseline data (at Table 78):

Table 78: Summary of aquifer water quality results in Block VI

Parameter	Units	Aquifer			
		Deep SCE34_DTW	Middle SCE34_MTW 1	Middle SCE31_MTW 2	Shallow SCE34_ST W
Metals					
Cobalt (Co) total	mg/l	0.0585	<0.01	0.0392	<0.01
Nickel (Ni) total	mg/l	<0.01	<0.01	<0.01	<0.01
Copper (Cu) total	mg/l	0.0482	<0.01	<0.01	0.0285
Cadmium (Cd) total	mg/l	<0.01	<0.01	<0.01	<0.01
Lead (Pb) total	mg/l	<0.001	<0.001	<0.001	<0.001
Arsenic (As) total	mg/l	0.003090	0.001826	0.003057	0.004716
Chromium (Cr) total	mg/l	0.00998	0.01390	0.006	<0.001
Chromium ((Cr) VI	mg/l	0.00475	0.01250	0.00274	<0.001
Chromium (Cr) III	mg/l	0.00523	0.0014	0.00326	-
Zinc (Zn) total	mg/l	0.0082	0.5372	0.1793	0.0853
Mercury (Hg) total	mg/l	<0.00001	<0.00001	<0.00001	<0.00001
Selenium (Se) total	mg/l	<0.00001	<0.00001	<0.00001	<0.00001

The general absence, or very low levels, of selenium, arsenic, mercury, chromium and lead in the baseline surveys of groundwater in the ESIA reports for Thar coalfield projects is evidence that excessive levels of selenium, arsenic, mercury, chromium and lead in the nine water samples collected from in or near Thar Coal Block II on 28 June 2022 **is of recent origin and associated with coal activities in the Thar coalfields.**

NOTE: By this same logic, the generally high levels of **chloride and TDS** found in the baseline surveys of groundwater in the ESIA reports for Thar coalfield projects, that are generally similar to the levels of chloride and TDS in the nine water samples collected from in or near Thar Coal Block II on 28 June 2022, is evidence that these generally high levels of chloride and TDS are not of recent origin and may not be associated with coal activities in the Thar coalfields.

Sample Description	Coordinates	Contaminant, mg/L											Comment	
		Cl	Se	Sulfate	TDS	Ca	Nitrate	Mg	As	Hg	Cd	Cr		Pb
Khario Ghulam Shah Village Well (Aban Jo Tar)	24.7809626 N, 70.3578072 E	420	BDL	136	1217	47.0	13.6	27	0.004	0.060	BDL	BDL	0.071	
Wasteland (Sengario Jamun Samo 1)	24.8128544 N, 70.4042047 E	349	0.020	109	729	70.5	3.3	10.2	0.005	0.028	BDL	BDL	0.031	Drinking wat
Wastewater land (Sengario Jamun Samo 2)	24.8126524 N, 70.4039875 E	305	0.026	99	656	66.5	4.3	10.3	0.0045	0.019	BDL	BDL	0.033	Drinking wat
Wastewater land (Sengario Jamun Samo 3)	24.8125948 N, 70.4041575 E	283	0.041	65	674	9.0	4.0	17.0	0.010	0.019	BDL	BDL	0.078	Drinking wat
Village Jamun Samo Well (Sengario)	24.8320619 N, 70.4143582 E	1582	BDL	310	3110	79.0	42.6	1211.0	0.026	0.019	BDL	0.022	0.075	
Amra Well Bhittra (Sengario)	24.8282334 N, 70.394861 E	1366	0.060	337	2720	22.0	14.0	105.0	0.025	0.047	BDL	0.022	0.079	
Meghe Jo Tar pipeline (Sengario)	24.8340607 N, 70.3872398 E	3465	0.200	332	9240	BDL	BDL	420.0	0.090	0.095	BDL	BDL	0.330	
Water Tank (Paro Jo Tar - UC Rajoro)	24.9023927 N, 70.333610 E	3165	0.010	199	4850	329.0	2.6	230.0	0.010	0.190	BDL	BDL	0.390	
Water Tank (Meghe Jo Tar - UC Rajoro)	24.9032551 N, 70.3297496 E	899	0.072	241	2030	263.0	17.0	68.0	0.014	0.094	BDL	0.068	0.150	
Sindh Standards for Drinking Water Quality		250	0.01	none	1000	none	50	none	0.050	0.001	0.01	0.05	0.05	
WHO Drinking Water Quality Guideline Values		250	0.01	none	1000	none	50	none	0.010	0.001	0.003	0.05	0.01	