

# Hydrogeological and Environmental Study of Sungai Serai, Hulu Langat

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## ABSTRACT

This study was a part of the applied field course at our department. The field work was done during the weekends for two weeks and it involves several locations including Bestari Jaya, Ulu Yam Dam, Paya Indah, Sungai (Sg.) Serai some open sand mining areas and others. The methods of sample extraction and handling were taught on site. Each group is divided into these respective locations for the study. For our group which is Group 4, the location assigned is Sg. Serai area. Equipment and item needed for this study was provided by the Geology Department. These equipment and item includes the water pump, the *Hydro lab* instrument, the cooler, and the sample bottle. The objective of this study was to study the geohydrology of the study area and to understand the environment of surrounding areas and its effect on the hydrology.

## 1. Introduction

Langat Basin is an important water catchment area providing raw water supply and other amenities to approximately 1.2 million people within the basin. Important conurbations served include towns such as Cheras, Kajang, Bangi, Government Centre of Putrajaya and others. There are two reservoirs (Semenyih and Hulu Langat) and 8 water treatment plants (4 of which operates 24 hours), which provide clean water to the users after undergoing treatment. Use of Langat River is not only limited to water supply but also for other purposes such as recreation, fishing, effluent discharge, irrigation and even sand mining, to name a few (Abdul Rahim, 1996). These multifaceted usages of the river results in conflicting interest from the perspective of the various stakeholders. Therefore, there is a need for proper resource optimization and resolution of conflict.

The Langat River has a total catchment area of approximately 1815 km<sup>2</sup>. It lies within latitudes 2° 40' M 152" N to 3° 16' M 15" and longitudes 101° 19' M 20" E to 102° 1' M 10" E. The catchment is illustrated in Fig. 1 and 2. The main river course length is about 141 km mostly situated around 40 km east of Kuala Lumpur. The Langat River has several tributaries with the principal ones being the Semenyih River, the Lui River and the Beranang River. There are two reservoirs, the Langat Reservoir and the Semenyih Reservoir respectively. The Langat Reservoir, built in 1981 has a catchment area of 54 km<sup>2</sup> while the Semenyih Reservoir, built in 1982 with the purpose to supply domestic and industrial water has a catchment area of 41 km<sup>2</sup>. For the Langat Reservoir, it is also used to generate power supply at moderate capacity for the population within the Langat Valley. Langat River Basin is drained by three major tributaries – Langat River, Semenyih River, and Labu River (Fig. 2). The main tributary, Langat River, flows about 182 km from the main range (Banjaran Titiwangsa) at the Northeast of Hulu Langat District in south-southwest direction, and draining into the Straits of Malacca. Both Langat River and Semenyih River originate from the hilly and forested areas in the western slope of Banjaran Titiwangsa, northeast of Hulu Langat (Homma & Tsukahara, 2002). The main reach of Semenyih River can be considered to start from the Semenyih Dam flowing south-southwest direction through the town of Semenyih, Bangi Lama and finally merges with Langat River at about 4 km to the east of Bangi Lama town. Semenyih River is also supplemented by Beranang River and Pajam River. Both of these rivers originate from the northern part of Seremban District, Negeri Sembilan (Territorial division Lenggang, Seremban).

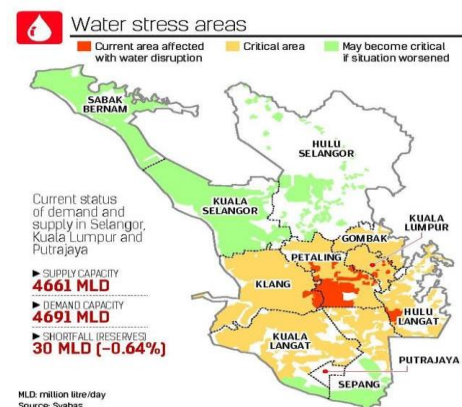


Fig. 1 Selangor State: The Study Area

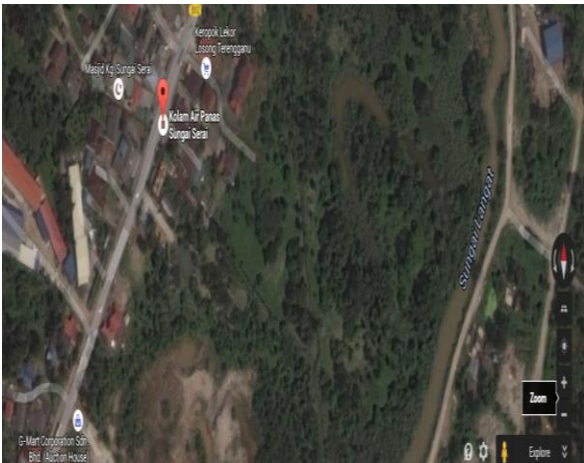


Fig. 2 Langat Drainage Basin

Langat River basin can be divided into 3 distinct zones. The first can be referred to as the mountainous zone of the northeast corner of Hulu Langat district. The average height of the highland ranges is about 960 meter above mean sea level. Most of the mountainous region is below 500 m from the mean sea level. The second zone is the hilly area characterized by gentle slopes spreading widely from north to the east in the middle part of Langat basin. The area is generally below 100 m and the lower part of the hills extends to Putrajaya, Cyberjaya, and Dengkil in Sepang. Langat River flows gently in the hilly area. The river sediment changes composition gradually from boulder/gravel in the mountainous zone, to sand, and then silt in the hilly areas. The third zone is a relatively flat alluvial plane located in the southwest of Langat Basin. This zone is bounded by the hilly area to the north and east, and by the Straits of Malacca to the west. Most of this area is characterized by peat with clay and silt soil. Bedrock in the mountain area near the source of the river is granite that forms the mountain bone of the peninsula and it extends around hilly areas near Kg. Cheras. Layers of the hilly areas are called Kenny Hill Formation and Kajang Formation, consisting of metamorphosed sandstone, shale, mudstone, and schist (Razali, 1998). The upper part of the bedrock including those of granite is weathered. Some parts are heavily weathered with depths of several meters. In the low flatlands, thick quaternary layers are deposited on the bedrock. The quaternary layer, from the top to the bottom, consists of 0.5 to 5.5m deep Beruas Formation with peat layer at the top, clayey Gula Formation and Kempadang Formation starting in the hilly areas and having a 40 to 50 m depth near the seacoast. Lying underneath is the Simpang Formation of sand and gravel with thickness of several meters in the hilly area and about 50 m to more than 100 m in the low flatlands.

## 2. Study Area

The location for Group 4 is Sg Serai Hot-spring area or known as the infamous *Kolam Air Panas Sg Serai*. In this study area, there is the hot spring and the well. Samples were taken from both the pool and the well itself. The latitude and longitude of the study area is  $3^{\circ}5'27.712''$  and  $101^{\circ}47'39.055''$  respectively. This location is also a public hot spring bath especially for the people living nearby the area (Samsudin *et al.*, 1997). The spring is located near an abandoned Ox Bow Lake (U shaped) which is believed to be a break-off from the main river which is Sungai Langat. Plus, there are actually more hot spring spread around the Hulu Langat areas reported Fig. 3a & b.



**Fig. 3:** 1(a)The Sg Serai Hotspring (marked yellow) located nearby Sg.Langat (map scale 2cm:50m) and 1(b) The pool of the hot spring of Sg Serai

## 3. Material & Methods

This section will be divided into more sub-sections according to the process.

### 3.1. Sampling

During the fieldwork, the sample were extracted and stored in the sample bottle. This bottle is first rinsed with the very water that is going to be taken as sample and then labeled as (Location/ Date/ Group/ Type of Sample; cation or anion). So, for each location (that is the pool and well) two sample bottle is filled up till the neck of the bottle. The sample from the well is extracted using the water pump because the water is significantly deep.

Next step is to run the *Hydro lab* instrument in these two areas. This

instrument can measure its pH, temperature, conductivity, and dissolved oxygen; with options for turbidity 1, depth and redox.

### 3.2. Analysis



As mentioned before, the sample is kept in the cooler for preservation purposes. Besides storing in the cold, the acid is also added to the sample within the given time. The acid with pH about 2-4 is added to the cation sample. As for the anion sample, only cooling is sufficient. The sample holding time (where by the sample is at its best to process) is also differ for both type of sample. The cation sample can hold up about two weeks to one month period of time while the anion can hold up to a very shorter period compared to cation. The sample is then filtered and placed into the sampling tube before placing in the ICP and IC machine to analyze its contents. This task was divided into parts and done based on discussions. Previous studies of the area are also taken into account. Overall, the report is the documentation of the overall results and progress during this study.

## 4. Limitations & Accessibility

The location is overall quite accessible since it is an open public hot spring bath. During the fieldwork, a number of civilian were in the area especially in the pool itself. The limitation during the fieldwork is one or two of group members had to go in the hot spring to obtain the *Hydro lab* instrument reading at different spots of the pool and preventing the samples from containing air bubbles.

## 5. Results & Discussion

### Hydro lab Measurement

**Table 1** Sungai Serai Hot spring 1(pool)

MEASUREMENT	Pool 1	Pool 2	Pool 3
TEMPERATURE	46.09	41.15	41.46
SALINITY	0.14	0.14	0.13
TDS	0.1807	0.1802	0.1792
DEPTH	0.3m	0.1m	0.3
Ph	7.61	7.90	7.96
AMMONIUM	7.36	7.66	6.91
NITRATE	25.96	30.32	34.60
CHLORITE	0.00	0.00	0.00
ORP	164	246	241

### Ion Chromatography

## Sungai Serai Pool

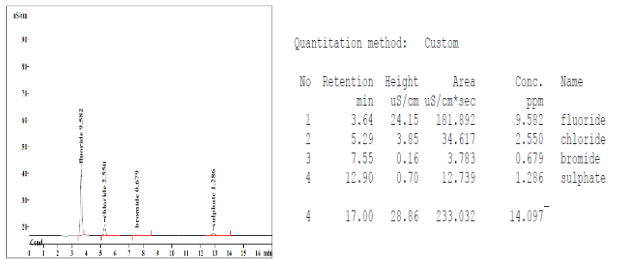


Fig. 4 Ion Chromatography Sungai Serai Pool

## Sungai Serai Well

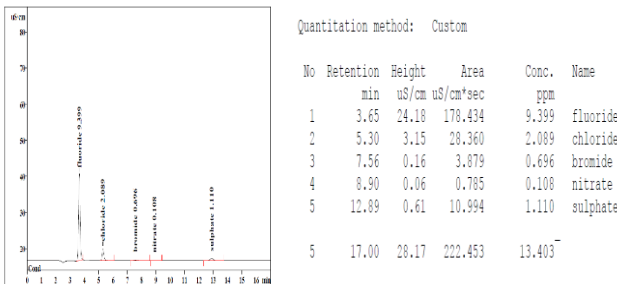


Fig. 5 Ion Chromatography Sungai Serai Well

Table 2 Inductively Coupled Plasma Mass Spectrometry

Analyte	concentration(mg/L)	
	pool	Well
Y	4.25	4.13
K	1.94	1.83
Ca	11.47	12.57
Mg	0.01	0.06
Pb	-0.01	-0.02
Cd	0.00	0.00
Se	0.01	0.00
Al	0.22	0.01
Mn	0.01	0.03
Cu	0.01	0.01
Zn	0.03	0.05
Fe	0.17	0.29
As	-0.01	-0.01
Na	51.24	49.62
Ni	0.00	0.00
Cr	0.00	0.00
Ag	0.01	0.01
Si	68.86	65.59

For the first sample, ssp 2, the constituent of trace chemistry compound is shown as below:

Minor constituent	Concentration (ppm)
Fluoride	9.582
Chloride	2.550
Bromide	0.679
Sulphate	1.286

Table 3: Concentration of minor constituent for Sample ssp 2.

The concentration of fluoride is 9.852 ppm, far more than the consuming level made by World Health Organization (WHO), which is range from 0.6 to 1.1 ppm in drinking water (State Water Resources Control Board, 2002). The high concentration of fluoride in ssp 2 is probably results from alkaline volcanic, hydrothermal, sedimentary, and other rocks derived from highly evolved magmas and hydrothermal solutions, and this fluorine dissolves into nearby water as fluoride. Excessive consume of fluoride will cause an adverse effect on neurodevelopment of human brain, especially for those whom are underage. Besides, weakening of bones (skeletal fluorosis), kidney failure and also damage towards thyroid would also occur. As for aquatic organisms, fluoride accumulates in the bone tissues of fish and in the exoskeleton of aquatic invertebrates, causing fluoride toxicity. If a daily water consumption of 2 litres and an average chloride level in drinking-water of 10 ppm are assumed, the average daily intake of chloride from drinking-water would be approximately 20 mg per person, but a figure of approximately 100 mg/day has also been suggested. Thus, based on WHO, the chloride level in sample ssp 2 falls in safe level for human consume. However, excessive chloride intake will results chloride toxicity and has serious damage to heart, for example congestive heart failure. As for bromide, the concentration in water sample still falls in safe level. Based on WHO, concentrations of bromide in fresh water typically range from trace amounts to about 0.5 mg/l whereas concentrations of bromide in desalinated waters may approach 1 mg/l. Bromide ion has a low degree of toxicity, thus bromide is not of toxicological concern in nutrition.

The mean sulphate level is 12.5 ppm in untreated water but 22.5 mg/litre in treated water based on GEMS/Water, a global network of water monitoring stations. Fortunately, the ssp 2 water sample is under normal range. Excessive consume of sulphate will results catharsis in adult males. Besides, Children, transients and the elderly are such populations because of the potentially high risk of dehydration from diarrhoea that may be caused by high levels of sulphate in drinking water too.

Table 4: Concentration of minor constituent for Sample ssw 2.

Minor constituent	Concentration (ppm)
Fluoride	9.399
Chloride	2.089
Bromide	0.696
Nitrate	0.108
Sulphate	1.110

Compared to sample ssp 2, ssw 2 contain 0.108 ppm of nitrate, which is normal under the water sanitation made by WHO. Under aerobic conditions, nitrate can percolate in relatively large quantities into the aquifer when there is no growing plant material to take up the nitrate and when the net movement of soil water is downward to the aquifer. As for other trace, chemical component in ssw 2, the concentration in ppm of fluoride, chloride, bromide and sulphate are almost identical.

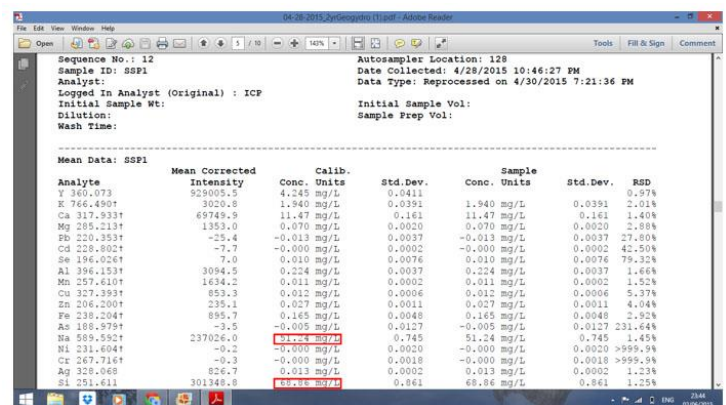


Fig. 6: ICP Result of ssp 1



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Fig. 7: ICP Result of ssw 1

Sample ssp 1 and ssw 1, both shows high concentration of sodium and silicon abnormally. Although sodium ion is ubiquitous in water, but most water supplies only contain less than 20 mg of sodium per litre. Saline intrusion, mineral deposits, seawater spray, sewage effluents, and salt used in road de-icing can all contribute significant quantities of sodium to water. In addition, water-treatment chemicals, such as sodium fluoride, sodium bicarbonate, and sodium hypochlorite, can together result in sodium levels as high as 30 mg/litre. In fact, acute effects and death have been reported following accidental overdoses of sodium chloride. Acute effects may include nausea, vomiting, convulsions, muscular twitching and rigidity, and cerebral and pulmonary oedema. Excessive salt intake seriously aggravates chronic congestive heart failure, and ill effects due to high levels of sodium in drinking-water have been documented. Next, silicon rarely occurs naturally in real life, it usually exists in the form of silica ( $\text{SiO}_2$ ). Although a lot of experiments were still undergone to look for potential influence of silica towards human body, it has been shown that the performances to a cognitive test were positively correlated to the consumption of silica and that the risk of Alzheimer's disease (AD) was reduced in subjects who had the higher daily silica intake compared to the others. The silica is probably the natural antidote of the aluminium and could play a benefit role by decreasing the biodisponibility of aluminium, whose neurotoxicity is now clearly established. However, one should never intake more than 2 mg/l, as severe effects on respiratory and digestive system will likely to happen.

## Conclusion

Both samples, ssp 2 and ssw 2 are polluted, with an anomalously high reading of fluoride. Fluorosis has been described as an endemic disease of tropical climates, but this is not entirely the case. Waters with high fluoride concentrations occur in large and extensive geographical belts associated with a) sediments of marine origin in mountainous areas, b) volcanic rocks and c) granitic and gneissic rocks; resulting the high concentration of fluoride in water samples.

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