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# WATER QUALITY OBSERVATION ON JOHOR RIVER ESTUARY AND EAST TEBRAU STRAIT, MALAYSIA

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**Graphical abstract**

**Abstract**

Coastal reclamation activities on the coastline of Johor, which are underway seen to be affecting the quality of coastal waters and rivers nearby. Therefore, this study was undertaken to monitor and identify the extent to which the assumptions say that the water quality will be affected by the results of the coastal reclamation activities. After a couple of water sampling locations are identified, reading the parameters of water quality were conducted. The results of the monitoring conducted found that the water qualities in that area are in good condition.

*Keywords*: Water quality, Tebrau river, Coastal reclamation



## 1.0 INTRODUCTION

Situated at south of Peninsular Malaysia, the condition of Johor is isolated from the neighboring country Singapore by Tebrau Strait (otherwise called Johor Strait). Johor Causeway was developed in 1923 and remains the most essential southern gateway of Malaysia to date. The rubble mound structure had from that point forward partitioned the strait into the east and west channels. Because of the absence of vivacious blending in the relatively calm and shielded water, water quality of the Tebrau Strait has consequently disintegrated after some time. The East Tebrau Strait (ETS), specifically, is cited as amongst the most contaminated marine water in Malaysia [1].

Johor government has dispatched a task to construct a tidal barrage across Johor River close to Kota Tinggi. The objective of the tidal barrage is to anticipate saline water in Johor River Estuary (JRE) from coming to the Johor River Waterworks (JRWW) [2][3]. JRWW is the biggest consumable water supply to Singapore, with an average output of 250 mgd (UK gallons)[4]. It will expected to decrease the need of saltiness flushing from Linggiu Dam upstream, in this way bringing down the normal riverine release into the estuary when the structure completed.

There is the work in advancement inside of the estuary is the notorious substantial scale coastal reclamation at Tekong Island, Singapore. The project site is situated at the conversion of Johor River Estuary (JRE) and East Tebrau Strait (ETS), and had started subsequent to late 1970s until present day. The plan basically combines Tekong Besar Island and Tekong Kecil Island at the upper east of Singapore into one large land mass[5].

### 1.1 Location of Study

#### *1.1.1 Johor River Estuary (JRE)*

With a total estimated length of 122.7 km, Johor River (N 1°27'–1°49', E 103°42'–104°01') with flows from central Johor southwards into JRE. In this study area, the Johor River Estuary (JRE) and the adjoining East Tebrau Strait (ETS) (Figure 1), have a combined catchment area of up to 2,636 km$^2$ on the Peninsular Malaysia. The basin landscape is characterized by primarily oil palm and rubber plantations in the south, whereas natural forest and low land swamps in the northern and central catchment[6].


**Figure 1** Johor River Estuary and East Tebrau Strait

## 2.0 EXPERIMENTAL

With seventeen (17) strategic locations, denoted by stations 1-9, were chosen along the coast of Johor River Strait (see Figure 2) to obtain the general water quality profile of the area under the present state. Meanwhile station 10-17 were chosen along the East Tebrau Strait (ETS) as shown in Figure 3. Stations 10-14 in ETS are located in the highly industrialized area. In station 14 it can be observed the oil slick and foam, this is because at station 14 is located the Tenaga Nasional Berhad (TNB) Sultan Iskandar power plant.

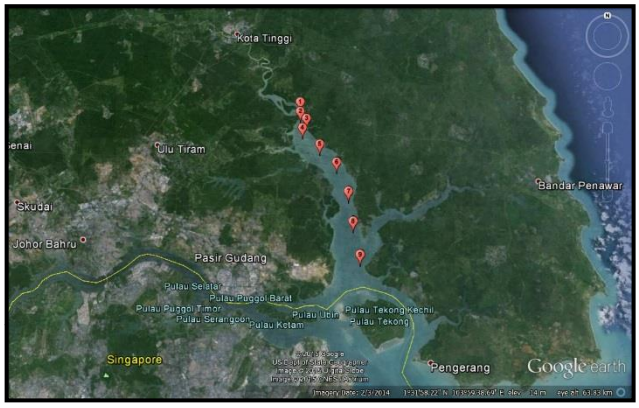


**Figure 2** Station 1 to 9 located along JRE

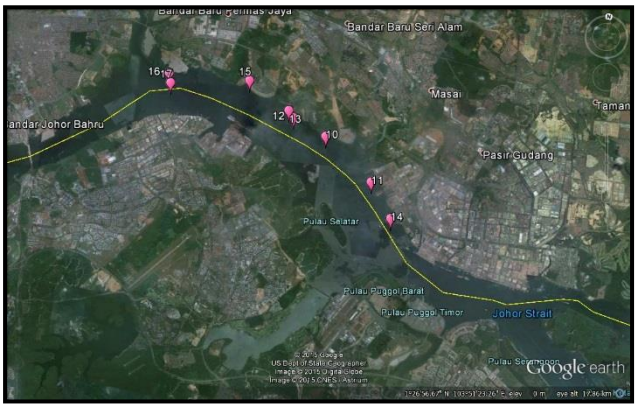


**Figure 3** Station 10 to 17 located at ETS

## 3.0 RESULTS AND DISCUSSION

Table I and 2 gives the in-situ water quality measured using *Horiba U-50 Series* water quality meter with multiple-sensors and automatic calibration function. The data represent the average readings taken for two (2) time during day time (9am-5pm) with temperature ranging between 28°C to just above 31°C, and water depth of up to 1.5 m. Humidity and sunlight exposure are the factors that affected temperature readings [7].

Specific gravity (SG), salinity, total dissolved solids are measured using the principle of conductivity conversions. Given $\sigma t = (SG - 1)\times 1000$, the SG obtained is observed to range from 13.9 to 16.5, which station 8 and 9 give the high value of SG of 16.5 . Both the values of salinity, total dissolved solids (TDS) and turbidity follow the trend of the $\sigma t$ (or SG) value of the station. Station 2 has the lowest values for both salinity and TDS, followed by station 1.

*Horiba U-50 Series* measures in-situ turbidity using light scattering method. From the data obtained, obviously shown station 14 give the highest value in turbidity among station located along ETS with value of 6.6 NTU. During the visit, the TNB Sultan Iskandar power plant release the yellowish of water discharge which expected effluent from the process of cooling tower. Meanwhile, station 10, 11, 13 and 15 gives the lowest turbidity value with 0 NTU. The water at these station are very clear. The similarity can be seen in this four stations are mussel farming strive activities. The exitance of mussel can reduce pollutant and improve water quality. The effect of mussel farming on nitrogen cycling was modeled for the Gullmar Fjord on the Swedish west coast and it is shown that the net transport of nitrogen (sum of dissolved and particulate) at the fjord mouth was reduced by 20% [8].

The values of conductivity, pH and oxidation reduction potential (ORP) are measured using electrode methods. Conductivity in ETS is generally >40 mS/cm, meanwhile in JRS ranging between 37.5

to 42.8 with higest conductivity value is located at station 14. In JRS, the conductivity value shows the increasing trend from upstream until river mouth (Station 9).

**Table 1** In-situ water quality measurement along JRE (Station 1-9)

| Station | Coordinate | Temperature | pH | ORP | COND | Turbidity | DO | TDS | Salinity | SG |
|---|---|---|---|---|---|---|---|---|---|---|
| | | °C | | mV | mS/cm | NTU | (mg/L) | g/L | ppt | σt |
| 1 | 1° 38' 05" N 103° 58' 20" E | 28.95 | 9.56 | 189 | 37.5 | 12.7 | 5.61 | 22.9 | 23.8 | 13.9 |
| 2 | 1° 37' 25" N 103° 58' 20" E | 29.01 | 9.51 | 219 | 36 | 12.4 | 7.29 | 21.9 | 22.7 | 13 |
| 3 | 1° 36' 56" N 103° 58' 45" E | 29.01 | 9.49 | 227 | 38.9 | 18.6 | 7.32 | 23.7 | 24.7 | 14.5 |
| 4 | 1° 36' 17" N 103° 58' 29" E | 29.08 | 9.47 | 226 | 39.9 | 11.5 | 6.98 | 24.3 | 25.5 | 15.1 |
| 5 | 1° 35' 09" N 103° 59' 38" E | 29.05 | 9.44 | 228 | 39.7 | 6.4 | 6.54 | 24.2 | 25.3 | 15 |
| 6 | 1° 33' 56" N 104° 0' 44" E | 29.11 | 9.43 | 228 | 42.2 | 9.2 | 6.02 | 25.8 | 27.1 | 16.3 |
| 7 | 1° 31' 59" N 104° 01' 29" E | 29.16 | 9.42 | 250 | 42.5 | 10.9 | 5.76 | 25.9 | 27.3 | 16.4 |
| 8 | 1° 30' 01" N 104° 01' 46" E | 29.3 | 9.41 | 253 | 42.8 | 23.4 | 5.65 | 26.1 | 27.5 | 16.5 |
| 9 | 1° 27' 53" N 104° 02' 11" E | 29.38 | 9.41 | 240 | 42.8 | 23.4 | 5.65 | 26.1 | 27.5 | 16.5 |

**Table 2** In-situ water quality measurement along ETS (Station 10-17)

| Station | Coordinate | Temperature | pH | ORP | COND | Turbidity | DO | TDS | Salinity | SG |
|---|---|---|---|---|---|---|---|---|---|---|
| | | °C | | ORPmV | mS/cm | NTU | (mg/L) | g/L | ppt | σt |
| 10 | 1° 27' 57" N 103° 51' 23" E | 29.66 | 7.8 | 222 | 42.8 | 0 | 3.42 | 26.1 | 27.5 | 16.4 |
| 11 | 1° 27' 15" N 103° 52' 17" E | 29.41 | 7.69 | 198 | 42.2 | 0 | 3.24 | 25.7 | 27.1 | 16.2 |
| 12 | 1° 28' 13" N 103° 50' 46"E | 29.54 | 7.87 | 234 | 42.5 | 0.4 | 3.69 | 25.9 | 27.3 | 16.3 |
| 13 | 1° 28' 20" N 103° 50' 40"E | 29.37 | 7.8 | 242 | 40.2 | 0 | 3.28 | 24.5 | 25.6 | 15.1 |
| 14 | 1°26'39" N 103°52'43" E | 31.8 | 7.96 | 266 | 43.1 | 6.6 | 3.49 | 26.3 | 27.7 | 15.9 |
| 15 | 1° 28' 47" N 103° 49' 54"E | 29.87 | 7.85 | 238 | 42.9 | 0 | 4.43 | 26.1 | 27.6 | 16.4 |
| 16 | 1° 28' 44" N 103° 48' 27" E | 29.6 | 7.81 | 246 | 42.7 | 1.4 | 3.32 | 26 | 27.4 | 16.4 |
| 17 | 1° 28' 34" N 103° 48' 30" E | 29.85 | 7.9 | 252 | 42.6 | 1.1 | 3.44 | 26 | 27.3 | 16.2 |

The water is generally alkaline in both ETS and JRE, but with difference range. In ETS the pH value ranging from 7.6 to 7.9 meanwhile in JRE the pH value indicate higher pH value between 9.4 to 9.6. According to National Water Quality Standard [9], the acceptable pH value is 5.0 – 9.0. It shows that pH value in JRE are exceeded the permissible limit.

Oxidation reduction potential (ORP) is a measurement that indicates the degree to which a substance is capable of oxidizing or reducing another substance. Large, positive ORP readings are obtained for all stations (highest at station 14, at 266 mV), indicating that the water in ETS and JRE is a strong oxidizing agent. The dissolved oxygen (DO) measured using polarographic method shows that in ETS have lower DO value than in JRE with range 3.2 to 4.4 and 5.6 to 7.3 respectively. Low of DO value may lead to anaerobic reaction [10].

## 4.0 CONCLUSION

We presented the field measurement of water quality profile for JRE and ETS. From the result obtained shows that water quality at JRE more polluted than ETS, this is perhaps due to the construction of tidal barrage across Johor River near to Kota Tinggi. Besides, mussel farming strive have ability to reduce the turbidity of water as data obtain along the ETS.

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