

# A Study on Cost-Efficiency of New Sewerage System in Terengganu

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## Abstract

Population of Kuala Terengganu city is forecast to increase until 2040. With the population increase, environmental load impact will also simultaneously increase. To cater the problem, City Council of Kuala Terengganu has proposed plans to induce new wastewater treatment system in the city. This study aims to evaluate the environmental efficiency of the plans based on the ratio of pollutant load reduction to cost needed in conducting the new system. Environmental efficiency derived by dividing the amount of pollutant reduced by the cost needed. Pollutant in this study refers to suspended solid(SS), Biochemical Oxygen Demand(BOD), Chemical Oxygen Demand(COD) and Ammonia, while the cost is capital cost in constructing the facilities, electricity cost in operating plants and fuel cost in desludging process. We will conduct cost-effectiveness analysis of three plans proposed by the authority and compare it to the current situation of sewerage in Kuala Terengganu, which is the base scenario in this study

Keywords : centralized sewerage system, environmental simulation, urban planning.

JEL classifications: Q15,Q23,Q25, Q51, Q58

## 1 Introduction

Malaysia has faced numerous environmental problems due rapid urbanization of the country. With many migrating factors in urban areas such as employment opportunities and better lifestyle, more are migrating to cities to increase the population in certain areas. Despite the growing scale of the main cities, evidences have shown that the general state of the environment as well as the quality of life in some parts of the urban areas are notably deteriorating. Heat island, greenhouse gasses emission, and air pollution are some environmental issues to be mentioned. Another serious social problem in urban area is lack of access to clean water, which is a result of the rapid declination of water quality of river in the intake area. A concentrated area with insufficient clean water supply could lead to a severe blow to the socio-economic activities of the area. A construction of 45 km long pipeline to transport 1.9 billion litre raw water from Pahang to Selangor which completed this year addresses the seriousness of the problem.

The sources of water pollution are categorized as point sources; the sources of pollution entering water body at specific locations such as household black water and discharges from industries, and non-point sources; the sources of pollution entering water bodies at no specific location such as surface run-off and storm-water. Sewerage and sanitary system in the country has no much progress until the Government privatized sewerage services in 1994 to Indah Water Konsortium (IWK). However, since the service were managed by 144 Individual Local Authorities before the privatization, operations in some regions were not taken over leading to different standards of management at some cities. Besides, due to lack of interest and investment in building centralized or regional sewerage system by the Government, proliferations of small plants with less than 5,000 PE in new development by developers are skyrocketing as the industrial and residential areas are expanding. Due to lack of efficiency in management and operation, almost 300 of the plants are handed over to IWK every year.

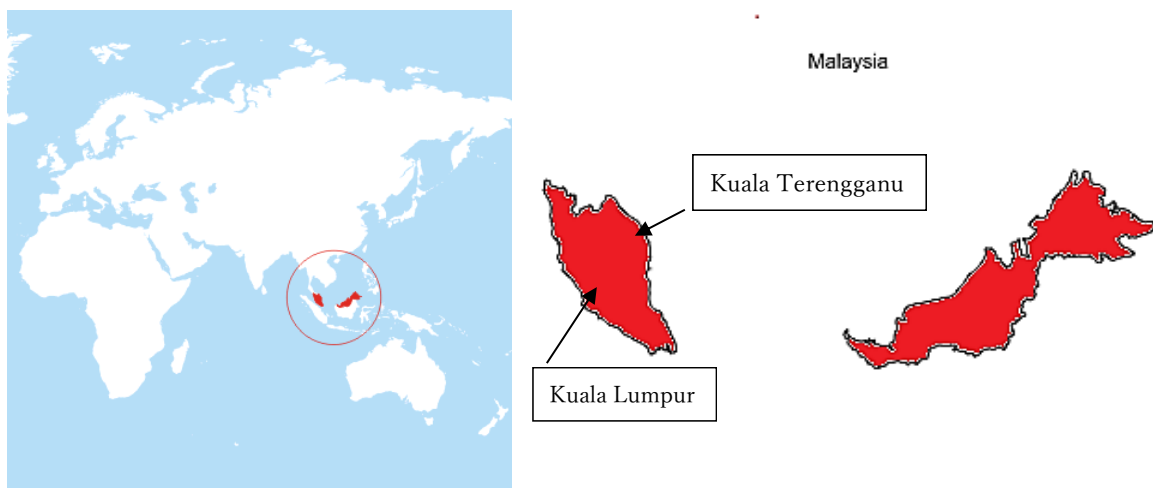
According to National Water Services Commission, there are 9,729 small STP around the country with a total of 26,313,062 PE and 2,221,101 non-connected sewerage system including communal septic tank, individual septic tank and pour flush serving 11,754,118 PE as at 2015. Realizing that a reliable and sustainable sewerage system is a vital contributing factor towards the improvement of social life standard and environmental health of the nation, the Government has proposed Sewerage Development Plan (2006-2035) to serve 80% of the population with connected sewer services by 2035. Also, in the Tenth Malaysia Plan (2011-2015), RM10.3 billion (242 million USD) were allocated to improve sewerage infrastructures and 277 small STPs were rationalized as of 2013.

There are many studies have been conducted on development of sewage treatment technologies and pollution controls in Malaysia, however, there are few studies on the quantitative evaluation of sewerage systems and the effectiveness of the system especially the optimization and selection of appropriate operation management in a long term. Hence, the goal of this study is to propose

optimal sewerage system management in designated scenarios using cost-efficiency analysis. Target area in this study is Kuala Terengganu city, which is located in basin of Kuala Terengganu river and Kuala Ibai river. This study will evaluate the effectiveness of the new centralized sewerage system proposed in the area.

## 2 Background of study area

Kuala Terengganu, located in the eastern coastal region of peninsular Malaysia, is the administrative capital, royal capital and economic centre of Terengganu State. It is in the basin of Terengganu river which flows from the Kenyir Lake to the South China Sea. Kuala Terengganu is the smallest yet most populated district in the state with a population of 186,100 in an area of 20,776 hectares (density: 892/km<sup>2</sup>). The annual mean air temperature varies between 27-29°C and the annual rainfall is about 3300 mm. Monsoon season that takes place between November to March brings heavy rains to this area. Distance of Terengganu from Kuala Lumpur, capital city of Malaysia, is about 400 km.



Kuala Terengganu was among areas declared as “Terengganu Special Economic Zone” (TSEZ) on September 2015. TSEZ is a region in Terengganu that adapts laws and procedures intended to function in the zone of rapid economic growth, using tax business incentives to attract local and foreign investment and technology. It is believed to be a strategic tool for speeding up industrialization. To boost the development in the area furthermore, construction of a railway system connecting Terengganu and western of Peninsular Malaysia was approved. Terengganu is the only state in Malaysia without railways network system as public transportation up to present. With the construction of the rail line is expected to be completed by 2022, the area will experience an escalated socio-economic growth more than before. Terengganu shows a 5% GDP growth with 6.4 billion USD in 2015 and is expected to achieve 8.0% GDP growth with a value of 9.7 billion USD by 2020. According to authorities, an additional 1.5% GDP growth is estimated on completion of the rail line.

Above mentioned projects are among high-impact development plans in the study area that is expected to bring increase the urbanization of Kuala Terengganu to another level. Thus, Terengganu was selected as study area as preparation of the concentrated population in the region in future which undeniably will also increase the pollutant load. In order to improve the sewerage system in the target area and its vicinity together with the common goal to improve water quality of Terengganu river and Ibai river, the Government of Malaysia through its agency, Sewerage Services Department (SSD) (or Jabatan Perkhidmatan Pembentungan(JPP) in Malaysian Language), plans to construct Regional Sewerage Treatment Plant(RSTP) in selected catchment areas. This will increase the coverage of sewerage service and enhance the river beautification at the same time aims to boost local tourism industry and promote business opportunity in the area.

### 3 Problem Statement

Like in many other states in Malaysia, the domestic water supply in Terengganu fully comes from surface water. In 2015, Malaysian Department of Environment reported that the major sources of pollution come from sewage, agro-based industry, animal farm, manufacturing industry and wet market. Wastewater from domestic and commercial premises in urban or semi-urban areas is channeled into septic tanks before being discharged to the public sewer or perimeter drains. However, desludging of the septic tanks is often not carried out lead to overflowing sewage from septic tanks, polluting waterways. As it is shown in Table 1, sewage gives the highest fraction in polluting rivers in Malaysia.

**Table 1** Pollution load into rivers in Malaysia from point sources

Load Source	BOD (%)	SS (%)	AMN (%)
Animal farm	41	49	11.3
Sewage	51	41	83.7
Manufacturing Ind.	5	6	1.5
Agro-based Ind.	2	3	3.4
Wet Market	1	1	0.1
Total	100	100	100

Government and housing developers have cooperated to avoid this issue becoming severe by building small scale Sewage Treatment for each newly developed residential area. Yet, this leads to proliferation of small scale sewage treatment plant in the area. Upon completion, all STPs are handed over to Indah Water Konsortium(IWK), a national company which in charge of developing and maintaining sewerage system in Malaysia, for maintenance and handling. This burdens IWK as they need to watch over more STPs year by year. Even though constructing a regional sewage treatment plant facility is costly and the benefits often ambiguous, the State government of

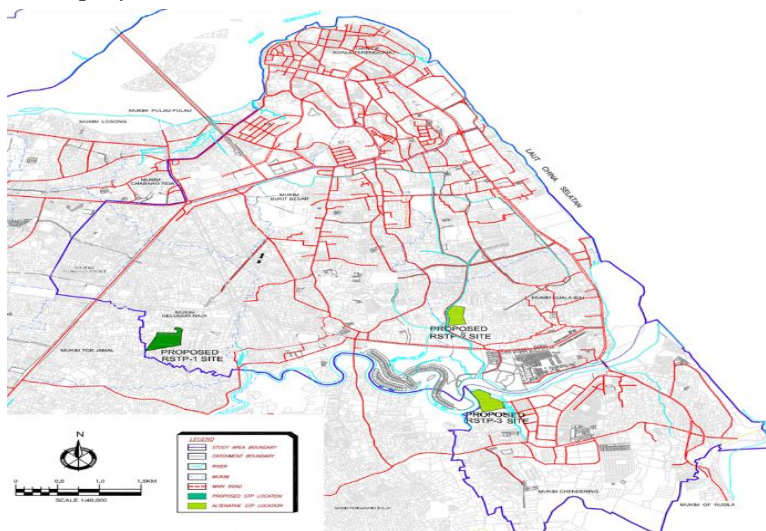
Terengganu has emphasized the importance of wastewater management development and proposed to the federal Government to build a regional sewage treatment plant in Terengganu city by integrating the multipoint STPs in the region to cope with the population increase in near future.

Besides that, sewage charge in Malaysia is flat and separated from water charge. Users basically pay USD 0.5 to USD 2 monthly depending their housing category. This makes IWK financially not able to invest more in capital development by solely depending on the collection of sewage charge. IWK stated that the federal government pumped over USD 250 million from 2000-2010 and another USD 8.25 billion is needed for capital expenditure in next 30 years.

#### 4 Materials and Methodology

In this study, a macroeconomic-based evaluation methodology is adopted by estimating the gross environmental pollution and cost to obtain net zero pollution<sup>1)</sup>. A method of converting any addition of pollutant load in the discharged sewage water into “water quality cost”<sup>2)</sup> in term of monetary value. The pollutant here refers to suspended solid(SS), Biochemical Oxygen Demand(BOD), Chemical Oxygen Demand(COD) and ammonia. We will also assess the volume of sewerage sludge and effluent generated, and the water quality index in the area, in regard of water balance calculation. From the data supplied by IWK, there are 30 multipoint public STPs in Kuala Terengganu, serving 80,000 PE while 320,000 PE depend on septic tanks and pour flush.

Terengganu state government has proposed three plans for the new regional Sewage Treatment plant in fast developing Kuala Terengganu city area, which covers an area of 34.5 km<sup>2</sup>. The proposal targets to cater sewage from 330,000 PE in either a single RSTP, double RSTPs or triple RSTPs. This study will also calculate the maintenance cost of the existing STPs and STs, which is planned to be integrated into the new RSTP according each plan and compare the cost-efficiency of the project.



**Figure 1** Proposed locations for RSTP in Kuala Terengganu (green areas)

**Table 2** Proposed scenarios in this study.

PE= 330K	Regional STP	New Technology
BAU	No	No
S1	3 RSTPs	No
S2	2 RSTPs	No
S3	1 RSTP	No
S4	3 RSTPs	Yes
S5	2 RSTPs	Yes
S6	1 RSTP	Yes

## 5 Conclusion

This study is expected to propose an optimal management of the sewerage system in the study area based on evaluation of some simulated scenarios of the sewerage system. By taking Kuala Terengganu city as target area in making simulation, a more precise result is anticipated. By end of this study we should be able to suggest which scenario is the optimal scenario in Terengganu, and how policy regarding sewerage charge should be improvised for a financially sustainable management.

## 6 References

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