KAJIAN PEMBANGUNAN DAN PENGGUNAAN TOTAL MAXIMUM DAILY LOAD

Final Report
Volume 1: Executive Summary

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EXECUTIVE SUMMARY

INTRODUCTION

1. Malaysia's Environmental Quality Report 2015 states that river water quality has declined over the last ten years based on the Water Quality Index (WQI). In general, the decline in river water quality can be attributed to human activities, primarily land use change for urban, industrial and agricultural areas, population growth and an intensification of economic activities.

2. Rivers, as natural systems, have an intrinsic capacity to reduce the impact of most pollutants either through the process of degradation, dispersion or dilution. However, this assimilative capacity is finite and when exceeded, results in the impairment of river water quality. River water quality nationwide can be expected to decline further unless the relationship between pollution discharge and the assimilative capacity of a river system is understood. This understanding will be valuable in providing information to guide necessary actions to effectively mitigate water pollution issues and improve river water quality.

3. In an effort to gain this understanding, the Department of Environment (DOE) commissioned the 'development and implementation of a Total Maximum Daily Load (TMDL) programme' using Sg. Semenyih (and Sg. Beranang) as a case study, under the project on 'Strengthening Environmental Sustainability' (Memantapkan Kelestarian Alam Sekitar) (Project Code: 23072004110000) in Thrust Four 'Pursuing Green Growth for Sustainability and Resilience' of the Eleventh Malaysia Plan (2016-2020). ERE Consulting Group Sdn. Bhd. was appointed to undertake this study, which was conducted over a 24-month period.

4. Sg. Semenyih is the largest tributary of Sg. Langat, with a catchment of approx. 62,600 ha in size. At its upper catchment, the river is impounded at the Sg. Semenyih Dam, a water supply dam. From the dam, Sg. Semenyih flows south-southwest for approx. 35 km through the towns of Semenyih and Bangi Lama (also known as Pekan Bangi) before merging into Sg. Langat. Numerous tributaries feed into Sg. Semenyih, the major of which are Sg. Batangsi, Sg. Beranang, Sg. Buah, Sg. Rinching, Sg. Saringgit, and Sg. Tekala. Sg. Beranang, the largest tributary, has catchment size of approx. 30,911 ha. It originates from the northern part of Seremban district in Negeri Sembilan, and flows westwards (from Lenggeng) for approx. 25 km before flushing into Sg. Semenyih. Sg. Beranang's major tributaries include Sg. Broga, Sg. Lenggeng, Sg. Pajam, and Sg. Batang Benar (Figure ES-1).

5. The overall objective of the Study is to develop and implement a pollution loading reduction programme (based on the TMDL framework), using Sg. Semenyih (and Sg. Beranang) as a Case Study to identify and resolve technical and institutional challenges. This Study will also form the implementation framework for a pollution loading reduction programme in Sg. Semenyih, and as a guide for replication in other river catchments in Malaysia.

RIVER WATER QUALITY MANAGEMENT

6. Malaysia's economic development has had a substantial influence on river water quality. Malaysia's post-independence growth led by the mining sector followed by the rapid expansion of agro-based industries, primarily based on raw rubber and crude palm oil production were the precursor for the development of better controls over the industrial sector to regulate the impacts of effluent on water pollution.

7. In 1974, the Environmental Quality Act was passed by parliament focusing squarely on the control of pollution from targeted industrial sectors. Priority was given to controlling the most chronic sources of pollution i.e. raw rubber and crude oil production. This resulted in the promulgation of the Environmental Quality (Prescribed Premises) (Crude Palm Oil) Regulations 1977 and Environmental Quality (Prescribed Premises) (Raw Natural Rubber) Regulations 1978. Under these regulations, all prescribed premises i.e. crude palm oil mills and raw natural rubber factories, were subject to licensing and surveillance requirements.

8. In 1979, effluent discharge from manufacturing industries such as food processing, textile, chemical and sewage are controlled with the Environmental Quality (Sewage and Industrial Effluent) Regulations 1979. In 2009, the Environmental Quality (Industrial Effluent) Regulations 2009, Environmental Quality (Sewage) Regulations 2009 and Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009 were also introduced. All of these regulations were curative in nature based on end-of-pipe control where the manner and rate of pollutants that entered the environment was limited.

9. At the same time, the National Water Quality Monitoring Programme was established by the DOE. The Interim National Water Quality Standards (INWQS) was developed in 1985 and was considered as a national "benchmark" of water quality conditions based on a per parameter basis. The INWQS defines six classes including I, IIA, IIB, III, IV and V which refers to the classification of rivers with Class I as the best and Class V as the worst condition. In 2005, the "interim" in the INWQS was dropped and the standards were published as the

National Water Quality Standards (NWQS) in the Environmental Quality Report by the Department of Environment of Malaysia (DOE).

10. River water quality in Malaysia varies throughout each State and this has constantly been a concern for various government agencies, local authorities as well as the general public. Several states across the country such as Selangor, Johor and Sabah are undergoing rapid development and as a result, rivers are subjected to pollution from point and non-point sources. The water quality of rivers tends to worsen in urban areas due to increasing population and human activities.

11. Since 2005, the largest sources of pollution were from sewage treatment plants followed by the manufacturing sector which generated 46.9% and 45.7% of pollution loads respectively. However, worst sources of pollutants were from non-point sources which include quarrying, housing development, road and land-clearing activities.

12. The implementation of environmental regulation still remains as the main approach to pollution control in Malaysia. While this will remain as a fundamental approach to control industrial effluent, there is also an urgent need to look into the regulation of other point sources that are not regulated. In addition, the carrying capacity of receiving rivers needs to be considered for pollution control to prevent further deterioration of water resources. Best management practices need to be strengthened to tackle the issue of non-point sources of pollution.

TOTAL MAXIMUM DAILY LOAD APPROACH

13. Total Maximum Daily Load (TMDL) is a pollution allocation budget that prescribes the maximum amount of pollutants that can be received by a water body without adversely affecting the beneficial uses of water or designated water quality targets. TMDL has been used as a planning tool for the restoration of water quality in impacted water bodies where pollution load limits are prescribed to individual sources of pollution and supported with targeted mitigation measures within the catchment.

14. The TMDL for any given body of water involves a combination of the factors that contribute towards pollution. TMDL considers the pollution load generated from the two major components of point and non-point sources of pollution, shown by the formula below:

$$TMDL = WLA + LA + MOS$$

where,
WLA is the waste load allocation (kg/day)
LA is the load allocation (kg/day); and
MOS represent the margin of safety

15. Point sources are pollution sources that can be identified with the "owner" of a premise, such as a wastewater treatment plant or a factory. To estimate TMDL, existing or future point sources of pollution are grouped under the category of waste load allocation (WLA). WLAs establish effluent limits for point source discharge facilities that are based on the designated water quality targets of the receiving water body.

16. Non-point sources are pollution that originates from many diffuse sources. It is usually caused by rainfall or water flow over and through the ground then deposited into nearby water bodies. Examples of non-point source pollution include runoff from logged forests, agriculture land, and urban areas. Non-point sources are grouped under the category of load allocation (LA).

17. The Margin of Safety (MOS) is a numeric estimate included in the TMDL calculation, usually between 7% to 15% of the TMDL, intended to allow a safety buffer between the calculated TMDL and the actual load that will allow the water body to meet its beneficial use (since natural processes are complex and several variables may alter future conditions).

APPLICATION OF TMDL

18. The objective of a TMDL is to estimate allowable pollution loads and to subsequently allocate these loads to existing and future pollution sources within a catchment in order to meet water quality targets. Water quality targets are usually based on the beneficial uses of the water and the desired (or minimum) conditions required so that the beneficial use is not impaired.

19. Targets may be described either as numerical values or narratives based on one or more water quality parameters. Targets may be developed for the overall river system or a particular segment based on the specific use of that segment. For example, at a segment where there is recreational use involving human body contact with water and where untreated sewage is the pollutant of concern, the levels of allowable faecal coliform may be prescribed as either a numerical value or a narrative.

20. After a target is determined, the capacity of the water body to receive and assimilate the pollutant(s) of concern is estimated. Assimilative capacity is based on a number of factors which include the capacity of the river to dilute pollutants

to an acceptable concentration and pollutant degradation as a result of natural physical, chemical or biological processes.

21. Therefore, assimilative capacity is not static but varies with the condition of the river at a particular time or season. However, during low flow conditions, the river will become more susceptible to similar pollution loads. Therefore, TMDL targets are generally allocated to low flow conditions to account for the lower limit of the assimilative capacity of a river.

APPROACH AND METHODOLOGY

22. The Sg. Semenyih Catchment was divided into 16 sub-catchments (Table ES-1, Figure ES-2) to guide data collection and characterisation of the basin.

Table ES-1 Sub-Catchments in the Sg. Semenyih Basin

Sub-Catchment	Main River (Name)	Location (State)	Area (ha)	Area (%)
SM1	Sg. Semenyih	Selangor	6,910.3	11.04
SM2	Sg. Semenyih	Selangor	2,551.3	4.08
SM3	Sg. Semenyih	Selangor	4,431.7	7.08
SM4	Sg. Semenyih	Negeri Sembilan/Selangor	4,476.2	7.15
TK1	Sg. Tekala	Selangor	1,191.6	1.90
BS1	Sg. Batangsi	Selangor	5,448.9	8.70
SR1	Sg. Saringgit	Selangor	2,270.9	3.63
RC1	Sg. Rinching	Selangor	2,639.0	4.22
BU1	Sg. Buah	Negeri Sembilan/Selangor	1,772.3	2.83
BN1	Sg. Beranang	Negeri Sembilan	5,051.5	8.07
BN2	Sg. Beranang	Selangor	1,778.8	2.84
BN3	Sg. Beranang	Negeri Sembilan/Selangor	2,686.9	4.29
BR1	Sg. Broga	Negeri Sembilan/Selangor	2,466.9	3.94
LG1	Sg. Lenggeng	Negeri Sembilan	9,582.8	15.31
PJ1	Sg. Pajam	Negeri Sembilan	6,715.0	10.73
BB1	Sg. Batang Benar	Negeri Sembilan	2,629.1	4.20
		Total	**62,603.20**	**100**

23. Data was collated from existing sources including the Department of Environment (DOE) database, published literature, technical reports and other records (Table ES-2).

24. A comparative assessment of the implementation of a TMDL (or pollution load allocation) framework in other countries was carried out. This assessment included the institutional and legal framework, the strengths and weaknesses of the mechanism, the successes, failures and lessons learnt, as well as the limitations of the mechanism. In addition to the relevant legislations of these countries, the case studies assessed included:

- United States of America: Willis River (Virginia), Deer Creek (Utah)
- Japan: Tokyo Bay, Ise Bay, Set Inland Sea
- South Korea: Han River, Nakdong River, Geum River, Yeongsan/Sumjin River
- Australia: Great Barrier Reef

Table ES-2 List of Data Compiled

No.	Type of Data	Source Agency(s)
1	Water Quality Monitoring Data (2006-2016)	Department of Environment (DOE) HQ
2	GIS data for Sg. Semenyih and Sg. Beranang - catchment and river layers	Department of Irrigation and Drainage (DID)
3	Rainfall data from 2006-2016	Department of Irrigation and Drainage (DID)
4	Recommended Raw Water Quality Criteria	Ministry of Health (MOH)
5	List of water supply shutdown incidents at Semenyih Water Treatment Plant	Pengurusan Air Selangor Sdn Bhd
6	List of Pollution Sources in E-KAS	Department of Environment (DOE) HQ
7	List of Sewage Treatment Plants (STP) and Communal Septic Tanks (CST)	Department of Environment (DOE) HQ
8	List of Sewage Treatment Plants (Public) and Individual Septic Tanks	Indah Water Konsortium Sdn Bhd
9	List of Sewage Treatment Plants (Private)	Suruhanjaya Perkhidmatan Air Negara (SPAN)
10	Information of Industrial and Sewerage premises in Langat Catchment	Department of Environment (DOE) Selangor
11	List of pollution producing premises (factories, wet markets, restaurants, food courts, car wash)	- Majlis Perbandaran Kajang - Majlis Perbandaran Nilai
12	List of fish pond operations	- Department of Fisheries (DOF) - Department of Fisheries (DOF) Negeri Sembilan
13	List of agriculture farm operations and crop land use map for Selangor 2010	Department of Agriculture (DOA) Selangor
14	List of livestock farm operations	- Department of Veterinary Services (DVS) Negeri Sembilan - Veterinary Services Office Daerah Hulu Langat
15	List of sand mining activities	Badan Kawal Selia Air (BKSA) Negeri Sembilan
16	List of earthworks activities within study area	Lembaga Urus Air Selangor (LUAS)
17	Information on landfill operations	Jabatan Pengurusan Sisa Pepejal Negara (JPSPN)

25. The first key activity in establishing TMDL within a water catchment is the identification of beneficial uses of the river stretches. 'Beneficial use' describes water necessary for a stated purpose which results in appreciable gain or benefits to the user. Within the Study Area, the beneficial uses identified were:
    - extraction for untreated domestic use
    - extraction for treated water supply for municipal and industrial use
    - recreational use with body contact
    - extraction for recreational fishing ponds and aquaculture
    - extraction for livestock watering
    - extraction for crop irrigation
    - preservation of habitat for aquatic species

The identification of beneficial uses was based on spatial survey carried out on online mapping platforms (e.g. Google Maps) paired with ground-truthing exercise on site.

26. Based on the beneficial uses identified, water quality targets were set for key parameters (main pollutant of concern) with guidance from the National Water Quality Standards (NWQS). In general, river reaches in the upper catchment are targeted to be clean at Class I levels, while water quality at the final river stretch of the raw water intake is targeted to be at Class IIA levels. In addition to this, the preservation of habitat for aquatic species represents an overarching goal for Sg. Semenyih to maintain ecosystem services obtained from the river. For river stretches where existing water quality is better than the prescribed requirements for its beneficial use, the existing water quality shall be maintained.

27. River water quality was assessed at 47 monitoring stations spanning the 16 sub-catchments (Table ES-3). Three rounds of sampling were carried out throughout the study period: March, July and October 2017, to capture a variety of flow conditions. In addition, data from 8 water quality monitoring stations maintained by DOE was analysed.

Table ES-3 Water Quality Monitoring Stations

No.	Sub-Catchment	River	Sampling Point	Latitude	Longitude
1	SM1	Sg. Semenyih	SM 01	3°03'36.1"N	101°52'25.3"E
2	SM1	Sg. Semenyih	SM 02	3°03'25.3"N	101°52'22.2"E
3	SM1	Sg. Semenyih	SM 03	3°02'02.4"N	101°52'14.8"E
4	SM2	Sg. Semenyih	SM 04	3°01'44.5"N	101°52'06.7"E
5	SM2	Sg. Semenyih	SM 05	3°00'49.0"N	101°51'58.1"E
6	SM2	Sg. Semenyih	SM 06	3°00'31.8"N	101°52'08.2"E
7	SM3	Sg. Semenyih	SM 07	2°59'55.3"N	101°52'30.4"E
8	SM3	Sg. Semenyih	SM 07a	2°59'28.4"N	101°52'20.4"E
9	SM3	Sg. Semenyih	SM 08	2°58'31.3"N	101°51'47.1"E
10	SM3	Sg. Semenyih	SM 09	2°56'45.4"N	101°50'52.0"E
11	SM3	Sg. Semenyih	SM 10	2°54'14.1"N	101°48'31.7"E
12	SM4	Sg. Semenyih	SM 11	2°53'43.9"N	101°47'33.6"E

No.	Sub-Catchment	River	Sampling Point	Latitude	Longitude
13	SM4	Sg. Semenyih	SM 12	2°53'45.0"N	101°46'32.9"E
14	SM4	Sg. Semenyih	SM 13	2°53'31.1"N	101°45'43.5"E
15	SM4	Sg. Semenyih	SM 14	2°53'31.9"N	101°45'00.5"E
16	TK1	Sg. Tekala	TK00	3°03'29.71"N	101°52'20.10"E
17	TK1	Sg. Tekala	TK 01	3°03'28.6"N	101°52'21.1"E
18	SR1	Sg. Saringgit	SR 00	2°57'37.81"N	101°53'4.65"E
19	SR1	Sg. Saringgit	SR 00a	2°57'18.4"N	101°52'44.41"E
20	SR1	Sg. Saringgit	SR 01	2°56'52.6"N	101°50'53.5"E
21	BS1	Sg. Batangsi	BS 00	3°01'48.6"N	101°54'11.5"E
22	BS1	Sg. Batangsi	BS 01	3°01'35.9"N	101°53'41.9"E
23	BS1	Sg. Batangsi	BS 02	3°01'01.0"N	101°52'05.5"E
24	RC1	Sg. Rinching	RC 01	2°56'21.8"N	101°53'26.9"E
25	RC1	Sg. Rinching	RC01a	2°55'6.20"N	101°51'45.75"E
26	RC1	Sg. Rinching	RC 02	2°54'18.7"N	101°48'41.6"E
27	BU1	Sg. Buah	BU 01	2°51'25.7"N	101°47'19.0"E
28	BU1	Sg. Buah	BU 02	2°53'32.1"N	101°45'51.7"E
29	BN1	Sg. Beranang	BN 00	2°54'21.91"N	101°57'22.67"E
30	BN1	Sg. Beranang	BN 01	2°53'45.7"N	101°55'14.0"E
31	BN2	Sg. Beranang	BN 02	2°53'25.0"N	101°52'56.0"E
32	BN2	Sg. Beranang	BN 03	2°52'17.9"N	101°51'00.7"E
33	BN3	Sg. Beranang	BN 04	2°53'17.8"N	101°49'44.6"E
34	BN3	Sg. Beranang	BN 05	2°53'35.2"N	101°47'46.3"E
35	BR1	Sg. Broga	BR 01	2°56'44.8"N	101°54'39.4"E
36	BR1	Sg. Broga	BR 02	2°53'51.4"N	101°53'30.7"E
37	LG1	Sg. Lenggeng	LG 01	2°50'23.9"N	101°58'37.8"E
38	LG1	Sg. Lenggeng	LG 02	2°52'22.0"N	101°52'15.1"E
39	PJ1	Sg. Pajam	PJ00	2°46'42.83"N	101°54'50.98"E
40	PJ1	Sg. Pajam	PJ 01	2°50'04.1"N	101°51'24.5"E
41	PJ1	Sg. Pajam	PJ 02	2°50'45.2"N	101°50'40.0"E
42	PJ1	Sg. Pajam	PJ 03	2°52'37.6"N	101°50'23.3"E
43	BB1	Sg. Batang Benar	BB 00	2°49'11.34"N	101°49'46.19"E
44	BB1	Sg. Batang Benar	BB 01	2°50'25.9"N	101°49'42.2"E
45	BB1	Sg. Batang Benar	BB 02	2°51'59.6"N	101°50'01.7"E
46	SM3	Semenyih Sentral	SS 01	2°57'24.75"N	101°50'25.60"E
47	SM3	Semenyih Sentral	SS 02	2°56'38.06"N	101°50'46.38"E

28. The cross-sectional area of the stream was measured at each water quality sampling point. The area was obtained by multiplying channel depth by channel width along a transverse section of the stream. The method of measuring a channel's width and depth is described in Hydrological Procedure No. 15 (Drainage and Irrigation Department, 1976). The channel geometry measurements for river width (m), river height (m), and the depth (m) was carried out to calculate the rivers' cross-sectional areas

29. A total of 216 premises were sampled for point sources of pollution from March to October 2017 (Table ES-4) to characterise water pollution from known point sources for pollutant loading calculations.

Table ES-4 Types of premises sampled for point sources

Type of premise		No. of samples
Industrial		43
Landfill		1
STP		81
Recreational Fish Ponds and Aquaculture Ponds		(7) + (2)
Restaurants		47
Food Courts		4
Livestock Farms		5
Wet Markets		4 + 2 (wet market profile)
Laundromats		13
Car Wash		15
	Total	**216**

30. The flow rate of the point sources discharge was measured using the 'bucket method'. The 'bucket method' involves collecting wastewater discharge in a bucket of known volume while the time to fill it up is recorded with a stopwatch. The flow rate is calculated by dividing the volume of the bucket with the average time taken to fill the bucket.

31. An inventory of point sources of pollution was established. The information collated for the pollution source inventory is as follows:
    - Type of pollution
    - Location of the pollution source (GPS coordinates)
    - Pollution load (quantity of discharge and characteristics of pollutants)
    - Effluent treatment used (if any)
    - Photographs
    - Contact details of premise owner

32. Loading for point sources of pollution were calculated by multiplying the wastewater discharge flowrate with the wastewater concentration quality. Based on the loading estimation, the pollution sources within the main catchment and sub-catchments of the river was ranked and prioritised for further action.

33. Non-point sources of pollution loading were estimated using the Event Mean Concentration (EMC) method. EMC values for various land use were gained from other studies and literature.

34. A water quality model for Sg. Semenyih was developed using the QUAL2K software utilising information on river hydrology, point and non-point sources of pollution, and water quality data. Various pollution load reduction scenarios were modelled to determine the priorities for the formulation of the strategies and interventions.

35. Two surveys, utilising questionnaires, were carried out during the course of this study to assess the attitudes and perceptions of the public with regards to the beneficial uses provided by Sg. Semenyih. The first survey was undertaken on 25 November 2017 on 40 respondents visiting Sg. Tekala Recreational Forest while a second survey of 158 samples was undertaken in November 2017 at several locations in Putrajaya.

36. The existing legal and institutional framework was thoroughly assessed to identify opportunities, gaps and weaknesses in the current system that could affect the implementation of a TMDL programme. Main and relevant legislations at both Federal and State levels were assessed.

37. The strategies, thrusts and interventions were formulated based on the results gained throughout the study. Feedback on the interventions was sourced during consultation workshops, focus group discussions and meetings with stakeholders.

CATCHMENT CONDITIONS AND WATER QUALITY

Hydrology and Land Use

38. The Study Area encompasses the Sg. Semenyih catchment (a tributary of Sg. Langat), directly above the Sg. Semenyih Raw Water Supply Intake at Jenderam Hilir, Selangor (coordinates: N2°53'29.23"; E101°44'11.28"). The Sg. Langat catchment, one of the largest river catchments along the west coast of Peninsular Malaysia, encompasses an area of approx. 242,300 ha. Sg. Semenyih is the largest tributary of Sg. Langat, with a catchment of approx. 62,600 ha in size.

39. The Sg. Semenyih catchment straddles the states of Selangor and Negeri Sembilan. The main river of Sg. Semenyih is mostly located in Selangor, while the major tributary of Sg. Beranang is mostly located in Negeri Sembilan. In addition to this, the catchment is further divided along four districts, with two districts each in Selangor (Hulu Langat & Sepang) and Negeri Sembilan (Seremban & Jelebu).

40. The Sg. Semenyih catchment is dominated by two major land use/land cover, namely agriculture and forests, which occupy more than 75% of the land area. However, the catchment can be considered relatively developed with residential, industrial and institutional land uses (Table ES-5, Figure ES-3).

Table ES-5 Present Land Use of the Catchment Area

No.	Land use	Area (ha)	Percentage (%)
1.	Forest	22,981.3	36.7
2.	Agriculture	24,152.6	38.6
3.	Settlements	5,338.2	8.5
4.	Industry	2,007.6	3.2
5.	Infrastructure	4,566.7	7.4
6.	Vacant Land	3,202.1	5.1
7.	Water body	323.5	0.5
	Total	**62,572**	**100**

Source: JPBD Selangor (2010) and JPBD Negeri Sembilan (2016)

River Water Quality

41. Water quality in Sg. Semenyih is generally between Class II and Class III. River quality is overall cleaner in the upper reaches of both main river and some of the tributaries (i.e. Sg. Tekala, Sg. Broga, Sg. Lenggeng). In the upper reaches of the catchment, the water quality is generally within Class II. DO levels were between 5 to 8 mg/l while Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were low. The Total Suspended Solid (TSS) was generally less than 100 mg/l at the upper reaches of Sg. Semenyih as well.

Plate ES-1 Relatively clear water in upstream Sg. Semenyih (SM01).

42. As the river flows downstream, the water quality deteriorates to generally Class III levels. This occurs as the river receives more wastewater from built-up areas, be it residential, commercial or industrial. Parameters such as BOD and NH_3-N shows deterioration compared to the upstream. TSS levels also increased.

43. Overall, TSS levels in the Sg. Beranang catchment is higher than that in the Sg. Semenyih catchment. Some of the highest concentrations of TSS were found at the downstream points of Sg. Broga, Sg. Lenggeng and in Sg. Beranang.

Plate ES-2 Rivers in the catchment are generally light brown in colour. Photo shows Sg. Beranang BN02 in Kampung Sesapan Bukit, Beranang, Selangor.

44. Fecal coliform pollution is prevalent within the whole catchment and is generally in Class III/IV at all the sampling locations. The highest result was found at the upper point of Semenyih Sentral Drain (SS01) at 32,000 count/100mL; followed by the upper point of Sg. Saringgit (SR01) at 30,000 count/100mL.

BENEFICIAL USES OF WATER

45. Sg. Semenyih provides a variety of beneficial uses along its various stretches, the major of which have been documented under the following categories:

- Extraction for treated water supply for municipal and industrial use
- Extraction for untreated domestic use
- Extraction for recreational fishing ponds and aquaculture
- Extraction for crop irrigation
- Extraction for livestock watering
- Recreational use with body contact
- Preservation of habitat for aquatic species

46. When the beneficial use of a water body is designated, it should meet minimum requirements in terms of water quality to allow users to attain benefits. For this purpose, the National Water Quality Standards (NWQS) forms the main guidance for water quality requirements for beneficial uses.

47. Sg. Semenyih is a major source of treated water supply for over 1.6 million users in the southern part of the Klang Valley. Raw water is extracted at the Sg. Semenyih Raw Water Supply Intake at Jenderam Hilir and subsequently transferred for treatment at the Sg. Semenyih Water Treatment Plant (WTP) in Precinct 19, Putrajaya. The Sg. Semenyih Raw Water Supply Intake has capacity of 600 MLD.

Plate ES-3 Sg. Semenyih Raw Water Intake at Jenderam Hilir

48. Water from the river is also used for recreational purposes. There are two Amenity Forest in the catchment - Sg. Tekala Recreational Forest and Lenggeng Recreational Forest - as well as several eco-resorts and outdoor recreational facilities where ponds have been constructed and filled with water extracted from nearby streams for activities such as swimming, rafting or kayaking.

49. Other uses of water from Sg. Semenyih and its tributaries include for agricultural activities such as aquaculture, crop irrigation and livestock watering.

Plate ES-4 Aquaculture ponds at upstream Sg. Batangsi

INVENTORY OF POINT SOURCES OF POLLUTION

50. More than 800 point sources of pollution (excluding ISTs) were documented for the pollution source inventory. These point sources have a single discharge point that flows into the river that have been identified and are marked with coordinates. There are 10 categories of pollution sources including:

- Industries
- Sewage treatment plants
- Restaurants and food courts
- Wet markets
- Municipal solid waste disposal sites or landfill
- Recreation fish ponds and aquaculture ponds
- Livestock farms
- Laundry Shops
- Car Wash
- Sand mining operations

51. There are 107 industrial premises that discharge effluent in the catchment, located in 11 industrial parks. These premises can be divided into seven major categories: aluminium manufacturing, food industry, metal products, plastic manufacturing, rubber manufacturing, steel manufacturing and others (such as O&G, fabric and pharmaceuticals manufacturing, battery distributor).

52. Within the Study Area, there are a total of 107 STPs - 60 STPs within the Sg. Semenyih catchment and 47 STPs within the Sg. Beranang catchment (where 2 are private STPs). The STP types found in the Study Area include communal septic tanks (CST), extended aeration (EA), oxidation ponds (OP), Imhoff tanks (IT), intermittent decanted extended aeration (IDEA) as well as sequence batch reactor (SBR). The STPs within the Semenyih catchment cater to a PE of 230 to 18,000 while in Beranang catchment, 55 to 35,000 PE. There are also an estimated 13,270 individual septic tanks (IST) in the catchment.

Plate ES-5 STP effluent discharge at Arab Malaysian Industrial Park.

53. There are three landfills found in the catchment - Pajam Landfill, Sungei Kembong Landfill, and the Bulk Waste Landfill in upstream Semenyih. Both Pajam and Sungei Kembong are currently closed for rehabilitation.

54. There are 219 restaurants and 6 food courts recorded in the catchment. They are mainly found in the towns of Semenyih, Kajang, Beranang and Nilai. In addition there are 6 wet markets – 4 in Selangor and 2 in Negeri Sembilan.

Plate ES-6 Wastewater with blood in drain from Mantin Wet Market in where chicken slaughtering is carried out.

55. There are at least 18 recreational fish ponds and 3 aquaculture ponds identified within the Semenyih and Beranang catchment. Recreational ponds are filled with selected fish species and patrons pay a fee to fish. While, inland aquaculture refers to intensive commercial fish farming (usually freshwater species) where fish is sold for consumption.

56. There is an estimate of 219 livestock farms located within the Semenyih and Beranang catchment. Livestock bred include cattle (meat and dairy), goat (meat), chicken (meat and eggs), buffalo, sheep and other animals such as rabbit, ostrich, deer, swiftlets and horses (leisure activities). Poultry farms have the largest total standing population with 1,670,264 for poultry meat production and 1,800,000 for poultry egg production. There are no pig farms in the catchment. There are also no abattoirs or slaughterhouses.

57. In addition to the above, there are 28 car wash and 32 laundromats identified within the catchment area. Due to their unregulated operations, car wash and laundromats are emerging as pollution sources as well.

58. There are 8 sand mining operators in the catchment – 4 in Selangor and 4 more in the Negeri Sembilan side of the catchment. However, 3 of the 4 operators in Negeri Sembilan have stopped operations during the course of this study.

Plate ES-7 Sand mining in Sg. Semenyih about 1 km upstream from the raw water intake.

WATER POLLUTION ISSUES

Industries

59. The common characteristics of industrial effluent is high concentration of BOD, COD, TSS, and O&G; especially those from the food manufacturing industries.

60. From the inventory exercise and discussions with stakeholders, the issues related to industrial premises identified are:

- Lack of regular monitoring and inspection of permits
- Lack of enforcement on the illegal industries.
- Non-compliance of some industries with respect to wastewater treatment plants and the discharge limits

Sewage Treatment Plants

61. There are three categories of STPs within the catchment which have different compliance limits. The categories are based on the Second Schedule (Regulation 7) of the Environmental Quality (Sewage) Regulations 2009, Paragraphs (i), (ii), and (iii) depending on the date each respective sewage system was approved and commissioned.

62. Of the 107 STPs, only 35 STPs are liable to comply with Standard A of Paragraph (i). Thus, approximately 68 % of the STPs in the catchment are currently not liable to comply to the Standard A limits although located in a catchment area where the Standard applies (upstream of a water intake).

63. From the inventory exercise and discussions with stakeholders, the issues related to STP identified are:

- Non-compliance or imperfect compliance are mainly caused by high concentration of oil and grease (O&G) - discharged into STP serving industrial, commercial areas and food related business premises. This may be due to the lack of use or maintenance of grease traps. Other contributing factors are excessive discharge of soaps, detergents and other cleaning agents into the sewerage system.

- The variances in STP infrastructure design across the sewerage industry. This is partly due to the process of construction by private developers which are handed over to the public operator (for operations and maintenance). This leads to difficulty in managing the infrastructure which will subsequently have impacts on the treatment processes and operations.

Individual Septic Tanks

64. The outflow/overflow from individual septic tanks (IST) is also a major contributor to BOD, NH_3-N and fecal coliform pollution. However, information on septic tank effluent quality is particularly hard to come by as:

- there is no uniformity in input quality and effluent quality from one septic tank to another because of different loading patterns and waste outputs from individual houses;
- there are a variety of different tank configurations and capacities which can lead to wide variations in effluent quality;
- maintenance frequency and variations for individual tank units can vary widely and affect the overall treatment unit performance;
- the amount of work required to effectively sample a septic tank unit is both substantial and costly (and septic tank outlets are not always accessible).

Restaurants and Food Courts

65. Wastewater from restaurants and food courts are mainly from washing water, food preparation and food waste. The sampling results indicated that COD, BOD and O&G are the major pollutants, while some restaurants recorded exceedingly high levels of TSS as well.

Plate ES-8 Food waste and liquids disposed into drains behind restaurants which eventually flow into rivers.

66. For food courts, all parameters - BOD, COD, TSS, ammoniacal nitrogen, and O&G - exceeded the NWQS Class V limits. The results from the sampling show that untreated sullage, far exceeds even the poorest water quality standards.

67. From the inventory exercise and discussions with stakeholders, the issues related to restaurants and food courts are:

- There are disputes whether the control of sullage discharges or discharge limit from restaurants or food courts are incorporated in any by-laws within the two states.
- Inadequate implementation and maintenance of grease traps among restaurants and food courts operators.
- Direct disposal of wastewater and sullage from food premises' washing and cleaning activities onto stormwater drains or roads.
- Inadequate inspection, monitoring and enforcement by local authorities at restaurants and food court operators for licensing compliance (e.g. installation and usage of grease traps).

Wet Markets

68. Wet markets generate sullage that is mostly organic in nature, originating from activities such as poultry slaughtering, fish cleaning, butchery, as well as wastewater from washing of floors and merchant stalls. The untreated wastewater is usually swept into small stormwater drains within the market area which later flow into the perimeter drains. All wet market sampled showed high concentrations of COD and BOD consistent with the nature of wastewater generated by wet markets.

69. Fecal coliform levels found in wet markets are exceedingly high ranging from 2,000 to 23,400,000 count/100mL. This is mainly due to the waste generated from meat and fish preparation such as blood, scales, chicken guts, feathers and some chicken heads were disposed into the drain.

70. The main issues related to wet market discharges have been identified as follows:

- There are uncertainties whether the control of sullage discharges or compliance of sullage discharge limit from wet market are incorporated in any by-laws within the two states.
- There is no proper treatment of the wet market discharge prior to release into the surrounding drains and rivers.

Solid Waste Disposal Sites and Landfill

71. The main impact of landfills on water bodies is leachate entering the environment, either through groundwater or runoff. Leachate is generated from liquids in the waste deposited or from rainwater penetrating the landfill surface, percolating and entraining environmentally harmful products from waste.

72. The landfill result sampling shows that a few parameters do not comply with standard limit as stipulated in the Environmental Quality (Control of Pollution From Solid Waste Transfer Station and Landfill) Regulations 2009. The landfill discharges exceeded the standard limit for the parameter BOD, manganese, and colour with the concentration of 41 mg/l, 0.407 mg/l and 420 ADMI.

Plate ES-9 Foaming at aeration ponds in Pajam Landfill treatment process.

73. In addition, illegal dump sites also pose a serious environmental issue due to undocumented and unmonitored leachate runoff. Leachate runoff may enter nearby waterways and cause water pollution. Illegally disposed items may contain hazardous substances and chemicals that could cause damage to the soil, air and the surrounding groundwater. The contaminated water then enters water sources that are used for consumption. Moreover, rubbish in illegal dump sites can be consumed by animals, affecting its health and bioaccumulating across the food chain.

Plate ES-10 A solid waste dumpsite found within the catchment. This is common especially at road sides and more secluded roads.

74. ***Recreational fish ponds and aquaculture ponds***

75. The main source of pollution from both types of fish ponds is effluent from the ponds. For recreational ponds, effluent is generated from overflow during heavy rainfall. Meanwhile, effluent from aquaculture ponds is mainly from the harvesting activities.

Plate ES-11 Visible discharge from aquaculture ponds into Sg. Batangsi

76. For recreational fish ponds, concentrations of additives such as fertiliser and feed are lower. However as relatively closed systems, nutrients, plankton, and suspended solids can accumulate over time. Effluent quality from aquaculture ponds differ based on species being cultivated, feed used and intensity of the activity. Effluent characteristically high levels of suspended solids and organic content. This becomes sludge and sediments accumulate at the bottom of ponds are also released as wastewater.

77. At least two recreational fishing ponds in Semenyih stock marine fish by adding salt to the ponds. Hence if effluent is discharge from these ponds, they will show elevated saline levels. However, according to the salt water fish ponds operators, no effluent is being discharged from the saltwater fish ponds except overflow during heavy rainfall.

78. Sampling results from fish pond effluent found that BOD levels are typically high, mostly exceeding Class III limits. However, they are all within the limits set by LUAS for this prescribed activity. Most parameters concentrations are also on the lower side.
    - Inland aquaculture operators with ponds less than 50 ha are not regulated and are not required to comply with effluent discharge limits, nor carry out any monitoring of effluent quality.
    - Recreational fish ponds are not regulated, however their expected discharge impacts are expected to be minimal.
    - Discharges from saltwater recreational fish ponds are expected to cause salinization of freshwater environments during excessive rainfall, and if there is discharge to the river.

Livestock Farms

79. The main pollution issue from livestock farms are that they generate wastewater containing animal faeces and by-products contains nutrients such as phosphorous and nitrogen, which in high concentrations can lead to eutrophication of water bodies. Untreated livestock farm effluent is characteristically similar to untreated sewage. When these wastes contaminate the water bodies, it increases the risk of waterborne diseases and reduces the quality for safe consumption.

Plate ES-12 Wastewater from a livestock farm in the catchment flows into a pond behind the farm. The pond shows signs of eutrophication.

80. Results from wastewater samples obtained from livestock farms showed that they contain exceedingly high concentrations of BOD, COD, TSS, and NH_3-N .

81. Some of the issues related to livestock farms are:

- Inadequate capacity of wastewater treatment facilities within farms.
- Inadequate storage facilities for unused and excess livestock manure within farms.
- Cumulative effects of untreated wastewater and inadequate storage of livestock manure from smallholder farms may be detrimental to soil and waterways.
- Inadequate implementation of Good Animal Husbandry Practices (GAHP) among smallholders.

Car Wash and Laundromats

82. The most common contaminants in car wash water include: metals, polycyclic aromatic hydrocarbons (PAHs), and detergents/surfactants. The dominant metal contaminants from car wash are copper (Cu), lead (Pb) and zinc (Zn). PAHs in car wash are usually from (incompletely combusted) exhaust emissions deposited on car exteriors, while detergents and surfactants are ingredients in car washing products.

Plate ES-13 Soapy runoff from car wash operations flowing into drains.

83. Wastewater collected from car wash premises showed the presence of phosphate, nitrate, copper, zinc. TSS is also found with the highest concentration recorded at 1,420 mg/l).

84. The main pollution issue with laundromats is the discharge of laundry wastewater containing detergent into the drains. Detergents that are used for laundry activities, including biodegradable detergents, can have detrimental effects on all types of aquatic life such as destroying the external mucus layers that protect fish from bacteria and parasites. In addition, detergents can also cause severe damage to the gills. Most fish kills occur when detergent concentrations approach 15 parts per million. Detergent concentrations of as low as 5 ppm can kill fish eggs. Surfactant detergents are known to decrease fertility of aquatic organisms.

Plate ES-14 Wastewater from laundromats discharged into drains

85. Results show wastewater discharged from laundry shops is generally alkaline (pH 6.4 to 12.9) and notably warmer (28 to 36˚C) than ambient temperature. In addition, COD and TSS levels were found to be exceedingly high, with the highest at 2,560 mg/l and 146 mg/l respectively. Methylene blue active substances (MBAS) – anionic surfactants – were also detected indicating the presence of detergents, thus causing high levels of nitrates and phosphates as well.

Non-Point Sources of Pollution

86. Surface runoff from various land uses during storm events is a major source of suspended solids pollution in the catchment. It is extra prevalent in areas where land use conversion activities are occurring such as forests to agriculture and agriculture land to construction areas (for residential, commercial and cemeteries). The removal/reduction of vegetation cover and extensive earthwork cause increased soil erosion and sedimentation of streams and rivers.

Plate ES-15 Land clearing on hillslopes for cemetery in the upper reaches of Sg. Semenyih.

87. In addition to that, sand mining activities are also another source of increased suspended solids in the rivers. Apart from the discharge from the sand washing pond, sand mining operations also contribute to runoff from the exposed sites and stockpiles, as well as stirring up sediments on riverbeds during excavation.

Plate ES-16 Sand mining operation along Sg. Beranang

88. Other potential causes for non-point sources of pollution include degraded river banks and encroachment of the river reserves by other activities such as agriculture and industries.

Plate ES-17 Degraded riparian vegetation may lead to stream bank erosion

POLLUTION LOADING

Point Sources of Pollution

89. Overall, the total loading in Sg. Semenyih is marginally higher than Sg. Beranang for the parameters COD, BOD, NH_3-N, TSS and O&G (Table ES-6).

Table ES-6 Total Load for COD, BOD, NH_3-N, TSS and O&G in Sg. Semenyih and Sg. Beranang Catchments

Sg Semenyih Catchment	**Loading (kg/day)**				
Point Source	**BOD**	**COD**	**NH_3-N**	**TSS**	**Oil & Grease**
Industrial	2.86	16	0.633	8.28	1.52
Sewage Treatment Plant	475	1,940	487	639	110
Restaurant	80.2	225	0.142	47.4	26.5
Food Court	3.68	13.8	0.0278	2.69	139
Wet Market	6.01	16.3	0.0544	2.18	0.259
Fish Pond	1.5	7.33	0.0588	3.78	-
Livestock	0.509	1.82	0.0313	1.55	-
Carwash	6.04	20.7	-	28.7	0.512
Laundry Shops	6.44	24.1	0.0323	2.82	-
Total	**582**	**2,270**	**488**	**736**	**278**

Sg. Beranang Catchment	**Loading (kg/day)**				
Point Source	**BOD**	**COD**	**NH_3-N**	**TSS**	**Oil & Grease**
Industrial	14.9	66.6	3.84	29.4	0.794
Sewage Treatment Plant	279	16,40	275	619	82.2
Restaurant	117	327	0.386	70.4	41.1
Food Court	3.33	14.3	0.0252	2.35	120
Wet Market	8.42	15.8	0.175	4.77	0.516
Fish Pond	0.384	1.94	0.0134	1.18	-
Livestock	0.571	2.17	0.0349	1.45	-
Carwash	1.81	6.15	-	9.68	0.219
Laundry Shops	17.1	69.3	0.0462	7.13	-
Landfill	12.3	74.4	0.51	3.9	0.3
Total	**455**	**2,220**	**280**	**749**	**245**

90. STPs are found to be the largest pollution load contributor of NH_3-N, BOD, COD, and TSS among all of the point sources identified in this project. This is true in both Sg Semenyih and Sg. Beranang Catchments. It is also evident that the total load contributed from STPs far exceeds all other identified point sources mainly due to the large volume of effluent discharged by the STPs.

91. Conversely, livestock and fish ponds generally have the lowest load for COD, BOD and TSS, and amongst the lowest values for NH_3-N.

92. The lowest detectable O&G is found in Sg. Semenyih comes from Wet Markets (0.259 kg/day), while in Sg. Beranang it is from Car Wash (0.219 kg/day).

93. Industries in Sg. Beranang sub-catchment contribute higher pollution load than those in Sg. Semenyih. Industries in Sg Beranang catchment contribute loads of COD (four times), BOD (five times), NH_3-N (six times) and TSS (three times) higher than values calculated in Sg. Semenyih. However, the pollution load from industries in this catchment is relatively low compared to that of STP and restaurants.

94. The pollution loading from each category of point source pollution based on their spatial locations (sub-catchments) are tabulated in Table ES-7 to ES-15 below:

Table ES-7 Sub-Catchment Loading from Industries.

Sub-catchment	River	Loading (kg/day)				
		COD	**BOD**	**NH_3-N**	**TSS**	**O&G**
SM1	Sg. Semenyih	-	-	-	-	-
TK1	Sg. Tekala	-	-	-	-	-
SM2	Sg. Semenyih	-	-	-	-	-
BS1	Sg. Batangsi	-	-	-	-	-
SM3	Sg. Semenyih	2.02	0.466	0.141	0.616	0.03
SR1	Sg. Saringgit	-	-	-	-	-
RC1	Sg. Rinching	2.86	0.38	0.0387	0.659	0.403
BN2	Sg. Beranang	38.9	9.04	3.49	23.6	0.447
BN1	Sg. Beranang	-	-	-	-	-
LG1	Sg. Lenggeng	0.12	0.03	0.015	0.075	0.0015
PJ1	Sg. Pajam	0.381	0.0711	0.0353	0.0793	0.00712
BB1	Sg. Batang Benar	26.2	5.58	0.205	5.14	0.318
BR1	Sg. Broga	-	-	-	-	-
BN3	Sg. Beranang	0.956	0.202	0.0906	0.456	0.02
BU1	Sg. Buah	10.4	1.87	0.403	6.79	1.02
SM4	Sg. Semenyih	0.677	0.14	0.0502	0.218	0.064
	Total	**82.5**	**17.8**	**4.47**	**37.6**	**2.31**

Table ES-8 Sub-Catchment Loading from Sewage Treatment Plant.

Sub-catchment	River	Loading (kg/day)					
		COD	BOD	NH_3-N	TSS	O&G	Nitrate
SM1	Sg. Semenyih	-	-	-	-	-	-
TK1	Sg. Tekala	-	-	-	-	-	-
SM2	Sg. Semenyih	-	-	-	-	-	-
BS1	Sg. Batangsi	-	-	-	-	-	-
SM3	Sg. Semenyih	462	96.5	129	155	26.3	182
SR1	Sg. Saringgit	237	51	56	92.7	11.9	67.9
RC1	Sg. Rinching	127	46.1	41.5	36.8	3.98	42.1
BN2	Sg. Beranang	242	28.6	86.4	65.5	10.6	169
BN1	Sg. Beranang	13	4.5	6.26	5.57	0.619	2.44
LG1	Sg. Lenggeng	111	15.7	12.8	26.5	9.36	62.1
PJ1	Sg. Pajam	411	87.5	59.6	161	20.9	99.1
BB1	Sg. Batang Benar	568	101	54.4	233	22.5	93.2
BR1	Sg. Broga	5.98	1.22	1.37	1.87	0.216	1.44
BN3	Sg. Beranang	293	40.5	54.1	126	18	31.5
BU1	Sg. Buah	303	72.1	53.1	93	20.6	63.6
SM4	Sg. Semenyih	814	209	208	261	47.6	162
	Total	**3,587**	**754**	**763**	**1,260**	**193**	**976**

Table ES-9 Sub-Catchment Loading from Restaurants.

Sub-Catchment	River	Loading (kg/day)				
		COD	BOD	NH3-N	SS	O&G
SM1	Sg. Semenyih	0.328	0.0653	0.00019	0.177	0.0384
TK1	Sg. Tekala	-	-	-	-	-
SM2	Sg. Semenyih	2.94	1.06	0.00175	0.521	0.331
BS1	Sg. Batangsi	-	-	-	-	-
SM3	Sg. Semenyih	62.6	23	0.0404	12.8	8.22
SR1	Sg. Saringgit	9.17	3.06	0.00639	1.99	1.22
RC1	Sg. Rinching	65.4	23.9	0.049	16.9	9.47
BN2	Sg. Beranang	20	8.76	0.0268	4.71	2.91
BN1	Sg. Beranang	-	-	-	-	-
LG1	Sg. Lenggeng	2.94	1.06	0.00175	0.521	0.331
PJ1	Sg. Pajam	96.6	29.9	0.227	24.7	11.2
BB1	Sg. Batang Benar	127	49.6	0.0815	23.7	14.5
BR1	Sg. Broga	20	6.62	0.0131	4.12	2.98
BN3	Sg. Beranang	60.5	21.5	0.0362	12.6	9.14
BU1	Sg. Buah	18.8	6.57	0.0121	3.67	2.29
SM4	Sg. Semenyih	65.3	22.5	0.0325	11.3	4.92
	Total	**551.57**	**197.595**	**0.5286**	**117.70**	**67.55**

Table ES-10 Sub-Catchment Loading from Food Courts

Sub-catchment	River	Loading (kg/day)				
		COD	BOD	NH_3-N	TSS	O&G
SM1	Sg. Semenyih	-	-	-	-	-
TK1	Sg. Tekala	-	-	-	-	-
SM2	Sg. Semenyih	-	-	-	-	-
BS1	Sg. Batangsi	-	-	-	-	-
SM3	Sg. Semenyih	5.43	1.9	0.0244	0.988	0.102
SR1	Sg. Saringgit	-	-	-	-	-
RC1	Sg. Rinching	-	-	-	-	-
BN2	Sg. Beranang	-	-	-	-	-
BN1	Sg. Beranang	-	-	-	-	-
LG1	Sg. Lenggeng	3.17	1.58	0.00634	0.634	0.0634
PJ1	Sg. Pajam	12.6	6.84	0.169	4.14	0.453
BB1	Sg. Batang Benar	-	-	-	-	-
BR1	Sg. Broga	-	-	-	-	-
BN3	Sg. Beranang	-	-	-	-	-
BU1	Sg. Buah	10.2	3.76	0.00979	0.979	0.137
SM4	Sg. Semenyih	0.673	0.35	0.0202	0.209	0.0202
	Total	**28.1**	**7.01**	**0.053**	**5.04**	**259**

Table ES-11 Sub-Catchment Loading from Wet Market

Sub-catchment	River	Loading (kg/day)			
		COD	BOD	NH3-N	TSS
SM1	Sg. Semenyih	-	-	-	-
TK1	Sg. Tekala	-	-	-	-
SM2	Sg. Semenyih	-	-	-	-
BS1	Sg. Batangsi	-	-	-	-
SM3	Sg. Semenyih	5.43	1.9	0.0244	0.988
SR1	Sg. Saringgit	-	-	-	-
RC1	Sg. Rinching	-	-	-	-
BN2	Sg. Beranang	-	-	-	-
BN1	Sg. Beranang	-	-	-	-
LG1	Sg. Lenggeng	3.17	1.58	0.00634	0.634
PJ1	Sg. Pajam	12.6	6.84	0.169	4.14
BB1	Sg. Batang Benar	-	-	-	-
BR1	Sg. Broga	-	-	-	-
BN3	Sg. Beranang	-	-	-	-
BU1	Sg. Buah	10.2	3.76	0.00979	0.979
SM4	Sg. Semenyih	0.673	0.35	0.0202	0.209
	Total	**32.073**	**14.43**	**0.22973**	**6.95**

Table ES-12 Sub-Catchment Loading from Fish Pond

Sub-catchment	River	Loading (kg/day)			
		COD	BOD	NH_3-N	SS
SM1	Sg. Semenyih	1.32	0.25	0.0226	0.813
TK1	Sg. Tekala	-	-	-	-
SM2	Sg. Semenyih	0.33	0.066	0.0024	0.174
BS1	Sg. Batangsi	3.42	0.683	0.0083	1.74
SM3	Sg. Semenyih	1.93	0.439	0.0231	0.875
SR1	Sg. Saringgit	-	-	-	-
RC1	Sg. Rinching	0.33	0.066	0.0024	0.174
BN2	Sg. Beranang	-	-	-	-
BN1	Sg. Beranang	-	-	-	-
LG1	Sg. Lenggeng	-	-	-	-
PJ1	Sg. Pajam	1.28	0.252	0.00864	0.834
BB1	Sg. Batang Benar	-	-	-	-
BR1	Sg. Broga	-	-	-	-
BN3	Sg. Beranang	0.66	0.132	0.0048	0.348
BU1	Sg. Buah	-	-	-	-
SM4	Sg. Semenyih	-	-	-	-
	Total	**9.27**	**1.89**	**0.0722**	**4.96**

Table ES-13 Sub-Catchment Loading from Livestock Farms.

Sub-catchment	River	Loading (kg/day)			
		COD	BOD	TSS	NH_3-N
SM1	Sg. Semenyih	-	-	-	-
TK1	Sg. Tekala	-	-	-	-
SM2	Sg. Semenyih	0.252	0.0699	0.205	0.00511
BS1	Sg. Batangsi	0.0577	0.0136	0.014	0.000239
SM3	Sg. Semenyih	0.876	0.25	0.816	0.0132
SR1	Sg. Saringgit	-	-	-	-
RC1	Sg. Rinching	0.631	0.175	0.512	0.0128
BN2	Sg. Beranang	0.252	0.0699	0.205	0.00508
BN1	Sg. Beranang	0.466	0.0992	0.0702	0.000412
LG1	Sg. Lenggeng	0.883	0.245	0.716	0.0179
PJ1	Sg. Pajam	-	-	-	-
BB1	Sg. Batang Benar	-	-	-	-
BR1	Sg. Broga	-	-	-	-
BN3	Sg. Beranang	0.252	0.0699	0.205	0.00511
BU1	Sg.Buah	-	-	-	-
SM4	Sg. Semenyih	-	-	-	-
	Total	**3.67**	**1.08**	**3.0**	**0.0662**

Table ES-14 Sub-Catchment Loading from Car Wash.

Sub-catchment	River	Loading (kg/day)			
		COD	BOD	TSS	O&G
SM1	Sg. Semenyih	-	-	-	-
TK1	Sg. Tekala	-	-	-	-
SM2	Sg. Semenyih	-	-	-	-
BS1	Sg. Batangsi	-	-	-	-
SM3	Sg. Semenyih	4.73	1.39	6.04	0.146
SR1	Sg. Saringgit	-	-	-	-
RC1	Sg. Rinching	11.5	3.33	12	0.21
BN2	Sg. Beranang	-	-	-	-
BN1	Sg. Beranang	-	-	-	-
LG1	Sg. Lenggeng	-	-	-	-
PJ1	Sg. Pajam	3.32	0.966	4.3	0.0889
BB1	Sg. Batang Benar	1.18	0.348	1.51	0.0475
BR1	Sg. Broga	-	-	-	-
BN3	Sg. Beranang	1.65	0.493	3.87	0.0821
BU1	Sg. Buah	1.29	0.385	6.52	0.0648
SM4	Sg. Semenyih	3.21	0.939	4.18	0.0914
	Total	**26.9**	**7.85**	**38.42**	**0.731**

Table ES-15 Sub-Catchment Loading from Laundry Shops.

Sub-catchment	River	Loading (kg/day)			
		COD	BOD	NH_3-N	TSS
SM1	Sg. Semenyih	-	-	-	-
TK1	Sg. Tekala	-	-	-	-
SM2	Sg. Semenyih	-	-	-	-
BS1	Sg. Batangsi	-	-	-	-
SM3	Sg. Semenyih	3.16	0.734	0.00134	0.342
SR1	Sg. Saringgit	0.15	0.0608	0.000239	0.0564
RC1	Sg. Rinching	11.4	3.23	0.0018	1.07
BN2	Sg. Beranang	14.6	3.83	0.00569	1.23
BN1	Sg. Beranang	-	-	-	-
LG1	Sg. Lenggeng	-	-	-	-
PJ1	Sg. Pajam	6.63	1.54	0.00281	0.719
BB1	Sg. Batang Benar	34.4	8.5	0.0317	3.6
BR1	Sg. Broga	-	-	-	-
BN3	Sg. Beranang	13.7	3.21	0.00602	1.58
BU1	Sg. Buah	1.14	0.468	0.011	0.144
SM4	Sg. Semenyih	8.24	1.95	0.0179	1.21
	Total	**93.4**	**23.5**	**0.0785**	**9.95**

Non-Point Sources of Pollution

95. Generally, based on the land use in the catchment, agriculture land is the major contributor of non-point sources of pollution load compared to all other land use types. At the catchment scale under existing land use, Sg. Semenyih Catchment contributes greater NPS load of COD, BOD and NH_3-N compared to Sg. Semenyih Catchment. Whereas, Sg. Beranang still contributes for more TSS. The NPS loads are given in **Table ES-16**.

Table ES-16 Table of pollution load (tonnes/year) by land use type, between Sg Semenyih and Sg Beranang

Land Use	Existing Load (tonnes/year)				Future Load (tonnes/year)			
	COD	BOD	NH3-N	TSS	COD	BOD	NH3-N	TSS
Semenyih Catchment								
Forest	754	168	2.78	202	725	162	2.67	194
Industry	2,430	334	17.3	2,880	3890	537	27.8	4,610
Residential	2,230	411	16.8	2,940	11,400	2,110	86.0	15,100
Infrastructure and Utilities	241	44.6	1.82	318	295	55	2.13	363
Commercial	320	54.7	2.03	291	753	129	4.77	686
Institution and Public Amenities	3,310	564	21	3,010	3,680	629	5.79	3,350
Transportation	1,410	665	-	-	1,490	702	-	9,240
Agriculture	3,540	549	21.2	45,800	1,590	246	9.50	20,500
Open Space, Recreation or Vacant Land	781	171	2.17	2,740	396	87	1.10	1,390
Total	**15,000**	**2960**	**85.1**	**66,900**	**24,200**	**4,660**	**140**	**55,500**
Beranang Catchment								
Forest	456	102	1.68	122	459	102	1.69	123
Industry	2,030	288	14.5	2,410	2,090	288	14.9	2,480
Residential	2,820	520	21.1	3,730	9860	1,820	74.1	13,000
Infrastructure and Utilities	867	160	6.53	1,150	705	131	5.23	972
Commercial	510	87	3.23	464	868	148	5.51	790
Institution and Public Amenities	739	126	4.69	672	680	116	4.98	620
Transportation	1,600	755	-	9,920	1,590	753	-	9,910
Agriculture	4,270	661	25.6	55,200	2,780	431	16.6	35,900
Open Space, Recreation or Vacant Land	338	74.2	0.939	1,190	120	26.4	0.334	422
Total	**13,600**	**2,770**	**78.4**	**74,900**	**19,200**	**3,820**	**123**	**64,200**

96. The largest difference is in net TSS load, whereby Sg. Beranang Catchment (74,900 tonnes/year) contributes approximately 10% greater load than Sg. Semenyih (66,900 tonnes/year). For both catchments, the largest proportion of COD, NH_3-N and TSS load is contributed by agriculture land since that particular land use occupies approximately 40 percent of both catchments combined.

97. In Sg. Beranang Catchment, agriculture land contributes the most load of COD (4,270 mg/l), NH_3-N (25.6 mg/l) and TSS (55,200 mg/l). Other land use contributions include open spaces, recreation or vacant land (1,100 ha) contribute the least COD (338 tonnes/year), BOD (74.2 tonnes/year) and NH_3-N (1.0 tonnes/year) but forests contribute the least TSS load (1,190 tonnes/year).

98. In the future, it is expected that the large proportion of Agriculture will be converted into Residential land, as planned in the Selangor Structure Plan 2035.

In Sg Semenyih,

- Residential COD (11,400 tonnes/year), BOD (2,110 tonnes/year) and NH_3-N (86.0 tonnes/year) load is the greatest amongst all land uses.
- Infrastructure contributes the least COD and BOD, while Open Spaces, Recreation or Vacant Land contributes the least NH_3-N; and Forest contributes the least TSS (194 tonnes/year).

In. Sg. Beranang

- Residential load of COD (9,860 tonnes/year), BOD (1,820 tonnes/year) and NH_3-N (74.1 tonnes/year) will be the greatest amongst the land uses.
- Open Spaces, Recreation or Vacant Land will contribute the least NPS load for COD (120 tonnes/year), BOD (26.4 tonnes/year) and NH_3-N (0.33 tonnes/year), followed by Forests which also contribute the least TSS (123 tonnes/year).

99. Agriculture will still contribute the largest proportion of TSS load, in Sg Semenyih (20,500 tonnes/year) and in Sg Beranang (35,900 tonnes/year).

POLLUTION LOAD REDUCTIONS AND ALLOCATIONS

Waste Load Allocation

100. The waste load allocation (WLA) was derived from the water quality model developed for this study. The derivation of WLA involves a substantial amount of judgement From this exercise, it was found that generally within the Sg. Semenyih catchment, the main pollution loads are as follow:

- NH_3-N from sewage treatment plants (STP);
- BOD from sullage, especially restaurants, as well as wet markets, laundromats and car wash;
- Suspended solids from sand mining operations;
- Faecal coliform from STP (*and ISTs)*

101. The most critical period of water pollution occurs during low flow periods, where the river's ability for dilution is reduced. Hence, the water quality simulation was carried out for a 7Q10 low-flow event. The general understanding is that if the river's water quality targets can be met during low-flow events, the water quality targets will not be breached during times of normal flow.

102. Generally for point sources, the pollution loads for BOD can be reduced significantly by eliminating direct discharge of untreated sullage into the waterways. The cumulative BOD loads from restaurants, food courts, laundromats, car wash and wet markets contributes to the river's pollution substantially. The elimination of sullage discharge includes ensuring all wastewater generated from these premises are directed into the sewerage system or into a treatment system prior to discharge.

103. For NH_3-N, the main load contributors are from the STPs. Although many are in compliance with the Environmental Quality (Sewage) Regulations 2009 Standard A limits, it is not sufficient to prevent water pollution in the receiving rivers. A decrease of loading (such as reducing the NH_3-N concentration limit from 10 mg/l to 2 mg/l without altering the discharge flowrate) is necessary to reduce NH_3-N loads extensively. Approximately 45% to 80% of NH_3-N load reduction is needed at STPs overall.

104. In addition to the WLAs, there needs to be a reduction of loads from existing "non-point" sources of pollution e.g. groundwater seepage, overland discharge and unknown sources. This is because even with load reduction implemented at the existing point sources, there is still an excess of loads at some river reaches making it difficult to achieve the water quality targets set.

Load Allocation

105. The respective LAs for NPS pollution within the Semenyih catchment are summarised in Tables ES-17 to ES-19. To meet Class IIA, a mean of about 980 kg/day of BOD, and 9 kg/day of NH_3-N load reduction is needed from agriculture areas.

106. For TSS, contribution for agriculture land is very high at around 134,000 kg/day. This high TSS load was incurred due to agriculture land being the second most featured land use in the catchment as well as a high EMC value of 545.6 mg/l. There is a need to implement and improve upon BMPs for agriculture to enable the EMC reduction to about 100 mg/l to achieve the water quality target.

Table ES-17 TSS Load Allocation for NPS pollution within the Semenyih catchment

Land Use	Current load during high flow (kg/day)	LA to meet Class IIA NWQS during high flow (kg/day)	LA to meet Class IIA NWQS during high flow (with 15% MOS) (kg/day)
Forest	422.46	-	-
Industrial Areas	7,310.77	2,202.04	1,871.73
Developed Areas	28,277.38	11,310.95	9,614.31
Agriculture	134,185.37	24,594.09	20,904.98

Table ES-18 BOD Load Allocation for NPS pollution within the Semenyih catchment

Land Use	Current load during high flow (kg/day)	LA to meet Class IIA NWQS during high flow (kg/day)	LA to meet Class IIA NWQS during high flow (with 15% MOS) (kg/day)
Forest	351.23	-	-
Industrial Areas	849.99	440.41	374.35
Developed Areas	4,614.87	2,262.19	1,922.86
Agriculture	1,608.45	737.82	627.15

Table ES-19 NH_3-N Load Allocation for NPS pollution within the Semenyih catchment

Land Use	Current load during high flow (kg/day)	LA to meet Class IIA NWQS during high flow (kg/day)	LA to meet Class IIA NWQS during high flow (with 15% MOS) (kg/day)
Forest	5.80	5.80	4.93
Industrial Areas	44.04	22.02	18.72
Developed Areas	178.71	113.11	96.14
Agriculture	62.22	62.22	52.89

STRATEGIES AND ACTION PLANS

107. Six strategies have been formulated to provide direction in implementing TMDL or pollution loading control in the Semenyih Catchment Area. The strategies cover action plans to be implemented at the federal, state and district levels with short term (1-2 years), mid-term (2-5 years) and long terms (5-10 years). In formulating the action plans, the following time horizons have been adopted.

Duration	Starting in	Completed by	Targeted Load Reductions
Short Term	2020	2022	10 %
Medium Term	2022	2023	15%
	2023	2025	20%
Long Term	2025	2027	30 %
	2027	2030	50 %

Strategy 1: Major Point Source Pollution

108. Point sources of pollution refer to single identifiable sources of pollution. In the Semenyih catchment, the key point source pollution comes from sewage treatment plants, industrial effluent, wet markets, restaurants and food courts, residential areas, aquaculture and recreational fish ponds, livestock farming, laundry shops, and car wash shops.

109. The key action for point sources is to regulate pollution loading from all these sources by establishing a registration system as well as licensing effluent/wastewater discharges.

110. In Strategy 1, 33 Action Plans under 9 thrusts were developed. They are summarized in Table ES-20 below:

Table ES-20 Summary of Action Plans in Strategy 1

No.	Action Plan	Lead Agency
Thrust 1.1: Sewage Treatment Plants		
1.1.1	Establish Registration System for Operators of Sewage Treatment Plants	SPAN
1.1.2	Implement Effluent Discharge Licenses for Sewage Treatment Plants	SPAN
1.1.3	Implement Upgrading Programme for Under-Performing Sewage Treatment Plants	SPAN
1.1.4	Implement Connection Programme for Small Sewage Treatment Plants	SPAN
1.1.5	Implement Septic Tanks Desludging Programme	SPAN

No.	Action Plan	Lead Agency
1.1.6.	Review of Environmental Quality (Sewage) Regulation 2009 to include fecal coliform as a parameter of concern in sewage discharge	DOE
Thrust 1.2: Industrial Effluent		
1.2.1	Establish Registration System for All Industrial Effluent Treatment System (IETS)	DOE
1.2.2	Implement TMDL Limit for Effluent Discharge	DOE
1.2.3	Implement Connection Programme for Small IETS to Existing Centralized STP	SPAN
1.2.4	To construct centralized IETS at New Industrial Park	DOE
Thrust 1.3: Wet Markets		
1.3.1	Establish Registration System for Operators of Wet Markets	Local Councils
1.3.2	Implement Installation of Pre-Treatment Systems for Wet Markets	Local Councils
1.3.3	Implement TMDL Discharge Limit for Wet Markets	Local Councils
1.3.4	Implement Best Management Practices for Wet Markets	Local Councils
Thrust 1.4: Restaurants and Food Courts		
1.4.1	Implementing Registration System for Restaurants and Food Court	Local Councils
1.4.2	Upgrading Pollution Control and Treatment Systems	Local Councils
1.4.3	Implement Best Management Practices for Restaurants/Food Courts	Local Councils
Thrust 1.5: Sullage From Residential Area		
1.5.1	Implement Premise Pipe Reconnection Programme (Residential and Urban Areas)	Local Councils
1.5.2	Enhance Enforcement of Regulations of New / Renovation Works (Residential and Urban Areas)	Local Councils
Thrust 1.6: Aquaculture and Recreational Fish pond		
1.6.1	Establish Centralised Registration System for Operators of Recreational Fish Ponds and Aquaculture Ponds	DOF
1.6.2	Implement Effluent Discharge Licenses for Aquaculture Operators	LUAS
1.6.3	Install Treatment Systems/RAS system for Aquaculture Pond	MOA
1.6.4	Implement Best Management Practices for Fish Ponds/Aquaculture Ponds	MOA
Thrust 1.7: Livestock Farming		
1.7.1	Establish Registration System for Operators of Livestock Farms	DVS
1.7.2	Implement Discharge Licenses for Selected Livestock Farms	LUAS
1.7.3	Implement Pre-Treatment Systems/ Pond System Programme	MOA

No.	Action Plan	Lead Agency
1.7.4	Implement Best Management Practices for Livestock Farms	MOA
Thrust 1.8: Laundry Shop		
1.8.1	Establish Registration System for Operators of Laundry Shops	Local Councils
1.8.2	Implement Sump/ Continuous Batch Washers Systems Programme	Local Councils
1.8.3	Implement Best Management Practices for Laundry Shops	Local Councils
Thrust 1.9: Car Wash		
1.9.1	Establish Registration System for Operators of Car Wash	Local Councils
1.9.2	Implement Sump / Sediment Pits / Filtration Treatment Systems Programme	Local Councils
1.9.3	Implement Best Management Practices for Car Wash	Local Councils

Strategy 2: Major Non-Point Source Pollution

111. Non-point source pollution is considered to be most significant in areas undergoing development, such as urbanisation, particularly where land clearing activities are occurring. The pollution load in the catchment, particularly TSS, is identified as being NPS-driven. Therefore, it is pertinent to consider the following actions in controlling or minimising the effects of NPS. The key non-point sources pollution in include earthwork and development sites, agricultural areas, sand mining, riparian zones.

112. There are 6 Thrusts with 12 Action Plans in Strategy 2 which are summarized in Table ES-21 below:

Table ES-21 Summary of Action Plans in Strategy 2

No.	Action Plan	Lead Agency
Thrust 2.1: Improve Earthwork and Development Sites		
2.1.1	Improving accessibility to information regarding earthwork and development sites' registration	DOE
2.1.2	Operationalise 'Ops Lumpur' Integrated Enforcement Team	DID
2.1.3	Impose a Discharge License for Earthworks and Development Sites	DOE
2.1.4	Implement Best Management Practices (BMP) as an Approval Condition for Earthwork and Development Sites	Local Councils
2.1.5	Strengthen Public Complaint Mechanism for Earthwork and Development Sites	TMDL Taskforce, MSAN

No.	Action Plan	Lead Agency
Thrust 2.2: New Development Areas		
2.2.1	Enforce Water Sensitive Urban Design (WSUD) as an approval requirement of new development projects	Local Councils
Thrust 2.3: Agriculture		
2.3.1	Integrate Pollution Loading Controls into MyGAP certification	MOA, MPOB, MRB, DID
Thrust 2.4: Sand Mining		
2.4.1	Develop an Integrated Taskforce for Enforcement of Sand Mining Regulations	DOE
Thrust 2.5: Riparian Zones		
2.5.1	Identifying and gazetting key river reserves	Local Councils
2.5.2	Assessment of riparian rehabilitation measures	DOE
2.5.3	Rehabilitate Riparian Zones	Local Councils
Thrust 2.6: Land Use Planning		
2.6.1	Using Integrated Land Use Planning to Promote Concordance between Beneficial Uses and River or Riparian Conservation	Local Councils

Strategy 3: Monitoring and Assessment Framework

113. Given that TMDL is a relatively new method of measuring pollution levels, it is expected that the monitoring and assessment framework will differ to current standard practices. In particular, is the need of monitoring non-point source pollution which is diffuse and difficult to define.

114. In these early stages development of a database or inventory of land uses is crucial to future planning and estimation of pollutant loading. A strong focus is also required to promote inter-agency data-sharing so that redundancy can be reduced and the effectiveness of monitoring and enforcement activities can be improved.

115. There are 3 Thrusts with 11 Action Plans in Strategy 3 which are summarized in Table ES-22 below:

Table ES-22 Summary of Action Plans in Strategy 3

No.	Action Plan	Lead Agency
Thrust 3.1: Monitoring		
3.1.1	Establish new river water quality monitoring stations	DOE
3.1.2	Incorporate flow measurements in water quality monitoring	DOE
3.1.3	Establish new pollution monitoring stations	DOE
3.1.4	Increase frequency of water quality monitoring	DOE
3.1.5	Establish long-term monitoring stations for non-point sources of pollution	DOE
3.1.6	Use remote sensing to monitor land use change in the catchment area	DOE
Thrust 3.2 Database Management		
3.2.1	Establish comprehensive database of pollution sources and water quality data	DOE
3.2.2	Systemic updating of the Sg. Semenyih Database	DOE
3.2.3	Data sharing to support inter-agency monitoring of pollution	DOE
Thrust 3.3 Institutional Support		
3.3.1	Establish Interim TMDL Taskforce on TMDL Implementation in Sg. Semenyih Basin	DOE
3.3.2	Establish Training and Development Programme for Technical Staff from Regulating Agencies on TMDL	DOE

Strategy 4: Capacity Building and Public Awareness

116. For TMDL to be successful in maintaining and improving water conditions requires the cooperation of various industries and the general public.

117. As mentioned earlier, NPS is diffused and difficult to define, therefore every potential source needs to be adequately managed. The best way to instigate this is to encourage various industries and the general public to take precautionary measures and be pro-active in managing pollution and discharge.

118. There are 8 Action Plans for Public Awareness and 3 Action Plans for Capacity Building under Strategy 4 which are summarized in Table ES-23 below:

Table ES-23 Summary of Action Plans in Strategy 4

No.	Action Plan	Lead Agency
Thrust 4.1 Public Awareness		
4.1.1	Install River Information Boards (RIB)	DID
4.1.2	Conduct Awareness Programme on Desludging of Individual Septic Tanks	IWK
4.1.3	Conduct Awareness Program on Discharges from Wet Market	DID
4.1.4	Conduct Awareness Program on Discharges from Commercial Areas (Restaurants, Food Courts, Car Wash and Laundry Shops)	Local Councils
4.1.5	Implement "Storm Drain Inlet Marker" Programme at Urban Area	DID
4.1.6	Establish Sg. Semenyih Environmental Education Centre (SSEEC)	DOE/DID
4.1.7	Conduct River Clean-Up and Beautification of Sg. Semenyih and Sg. Beranang	DID
4.1.8	Introduce a 'used cooking oil in exchange for voucher' programme	Local Councils
Thrust 4.2 Capacity Building		
4.2.1	Conduct River Biodiversity Education Programme	MOE
4.2.2	Initiate Community-Based Water Quality Monitoring Programme	DID
4.2.3	Provide Additional Training on Pollution Control Scope to Livestock Farms/Agriculture Operators and Aquaculture/Recreational Fish Ponds	MOA, DOF

Strategy 5: Financial Mechanism and Incentives

119. The TMDL in general encourages greater accountability on the part of the polluter and therefore, there is need to reconsider current financial mechanisms such as penalties, compliance fees and environmental conservation.

120. In this strategy, there is a strong narrative for using the "polluter-pays" principle or known as the conservation fee below. In this context, the polluting party pays a fee to continue discharging wastewater and the collected fees may be allocated to conservation or rehabilitation of the river catchment.

121. There are 6 Action Plans in Strategy 5 which are summarized in Table ES-24 below:

Table ES-24 Summary of Action Plans in Strategy 5

No.	Action Plan	Lead Agency
Thrust 5.1 Financial Mechanism and Incentives		
5.1.1	Establish Conservation Trust Fund for Sg. Semenyih Catchment	TMDL Taskforce, Local Councils
5.1.2	Introduce Conservation Fee to water users of Precinct 19 Putrajaya Water Treatment Plant	TMDL Taskforce, Local Councils
5.1.3	Introduce Conservation Fee into Sand Mining Royalties	PTG, KSSB
5.1.4	Introduce pollution tax through discharge licensing program	DOE, LUAS, BKSA
5.1.5	Revise Entrance Fees for Sg. Tekala Recreational Forest	JPSM
5.1.6	Promoting Corporate Social Responsibility (CSR) Programmes for Companies Operating in the Semenyih River Catchment	TMDL Taskforce, Local Councils

Strategy 6: Institutional and Legal Actions

122. Currently, there is shared jurisdiction over waters, rivers and pollution between the state and federal governments of Malaysia. As it currently stands, Selangor's LUAS enactment 1999 has provisions for the implementation of TMDL, while Negeri Sembilan's Water Act 1920 has limited power to enact it. Hence, ensuring a wholistic TMDL implementation will require creating concordance between state and federal jurisdiction; which the following action plans aim to do.

123. There are 5 Action Plans in Strategy 6 which are summarized in Table ES-25 below:

Table ES-25 Summary of Action Plans in Strategy 6

No.	Action Plan	Lead Agency
Thrust 6.1 Legal Actions		
6.1.1	Develop policy document on TMDL	KATS, MESTECC, DOE
6.1.2	Amend the Environmental Quality Act 1974	KATS, MESTECC, DOE

No.	Action Plan	Lead Agency
6.1.3	Use Proposed Regulations (EQ) to Govern Discharge Limits from Point Sources	KATS, MESTECC, DOE
6.1.4	Use of State Legislation for TMDL (Selangor)	LUAS
6.1.5	Rationalisation exercise in the TMDL Context	BKSA

LEGAL RECOMMENDATIONS TOWARDS ENABLING TMDL

124. From a legal perspective, there are two recommendations towards enabling TMDL which are either from the Federal approach or from the State approach:

Option I : Using the Environmental Quality Act 1974 to enable the development of a TMDL Plan. This will require certain key amendments to the Act to be made. This can be construed as being a Federal approach where the TMDL is led by the Federal department with participation from the States.

Option II : Using State laws specific to water such as Selangor Waters Management Authority Enactment 1999 (hereinafter "LUAS") for Selangor and the Waters Act 1920 for Negeri Sembilan to enable development and implementation of a TMDL as solely state programmes; albeit with some level of Federal support. This view is projected in light of one State (Selangor) having strong water resources legislation and institutional powers that can accommodate TMDL more effectively. This position is somewhat weaker for Negeri Sembilan as it does not have a LUAS equivalent.

125. For Option I, several amendments and subsidiary legislation (such as regulations) are required to create a complete enabling structure for TMDL. The most feasible aspect and key to implementing any WLA (in so far as Point Source pollution is concerned) is through Regulations that will license the discharge of effluents according to the derived waste load allocation under the TMDL in question.

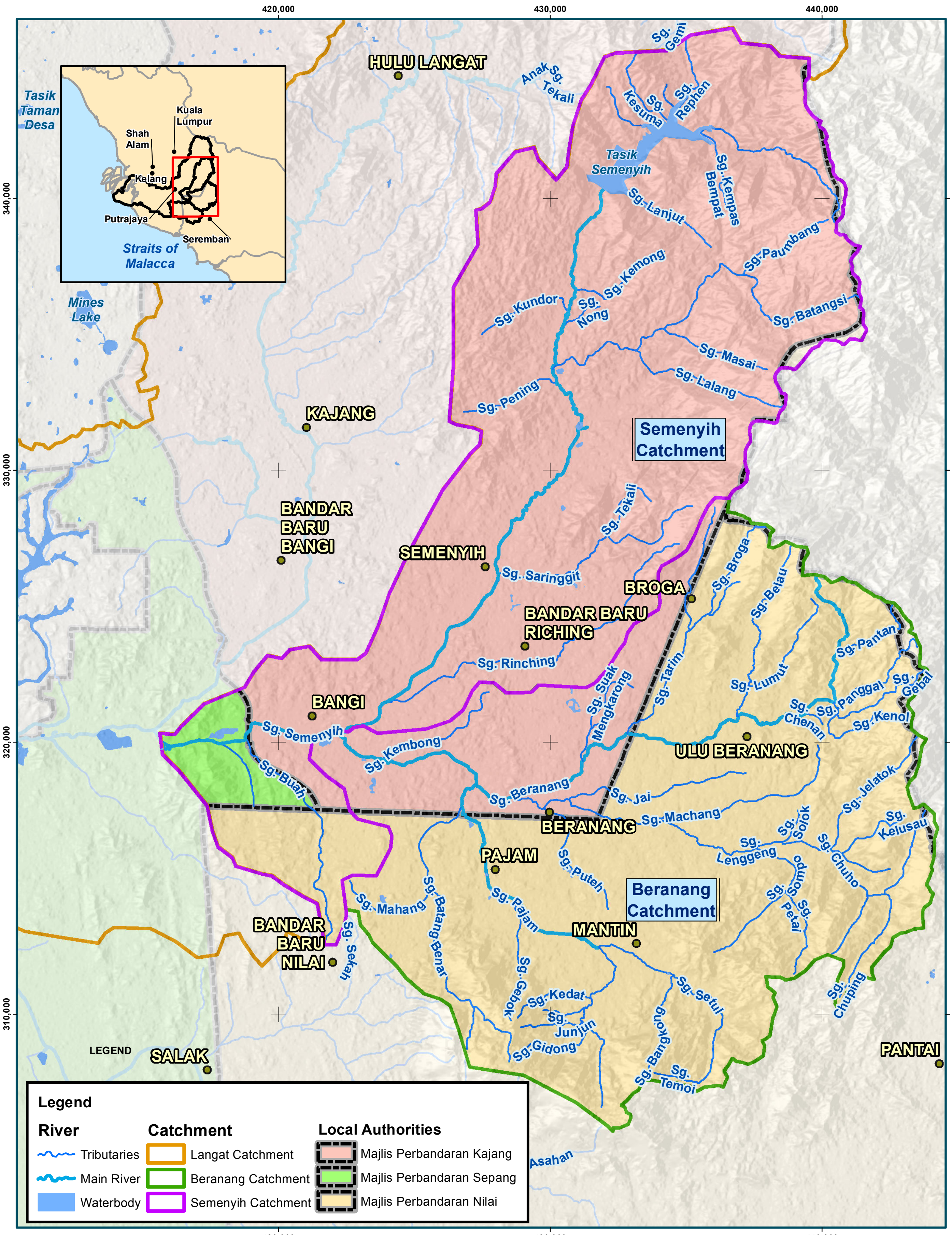
CONCLUSIONS

126. Implementing the six strategies and its numerous action plans is a major task that will require concerted and substantial effort from all stakeholders. A 12-month kick-off programme is proposed to focus on all necessary actions required to facilitate the implementation of the full TMDL programme as well as other actions that can be immediately implemented.

127. The kick-off will require the establishment of an interim committee or task force chaired by the Department of Environment (DOE) to lead the coordination of the kick-off programme. A core group of technical personnel comprising of staff from DOE and other technical agencies will be trained to support the full implementation of the pollution load control programme. The kick-off will also involve the planning and sourcing of funding required for the implementation of the full programme of which the task force shall be responsible.

128. The kick-off phase will also be used to engage with other stakeholders to develop support and buy-in of the full programme. The private sector, NGOs and local communities shall be engaged to leverage on their respective strengths to undertake various complimentary initiatives to implement TMDL.

129. Although the efforts to implement TMDL in Sg. Semenyih would entail substantial costs and time, the long-term benefits are immense. The benefits ranging from reduced pressure on water supply, reduced cost of water treatment, increase in fish stock, and the overall increase in the river's beneficial uses is more than justify the investment needed.



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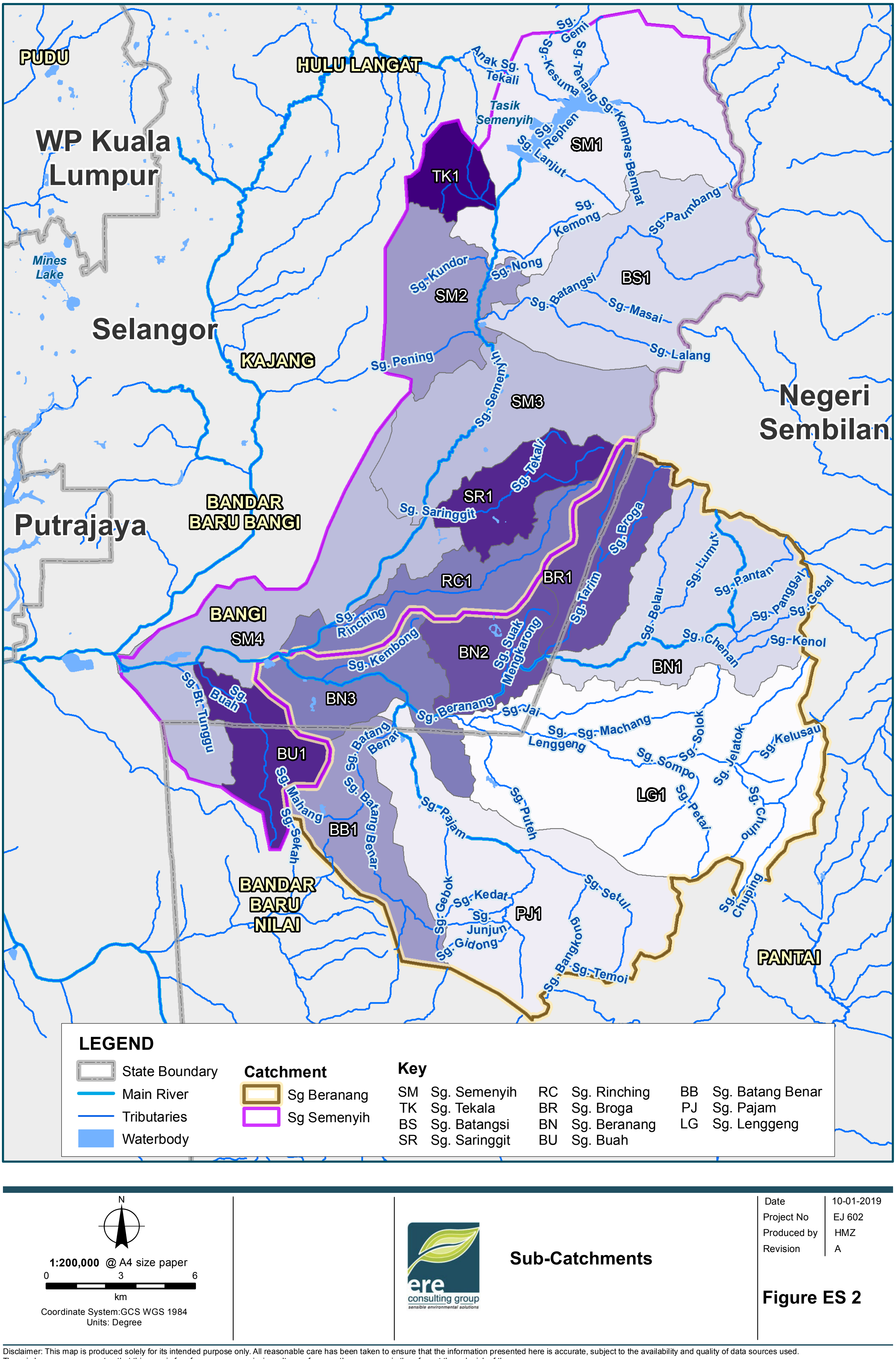
Sg. Semenyih Catchment

Date	05-04-2017
Project No	EJ 602
Produced by	ZAB
Revision	A

Figure ES 1

Source: ERE Consulting Group (2016). Hydrography data- Department of Irrigation and Drainage (2014) C:\Users\GIS01\Documents\ArcGIS\Packages\district_4A595293-193E-4EE9-852A-9984157A3EF3\v104\District.mxd



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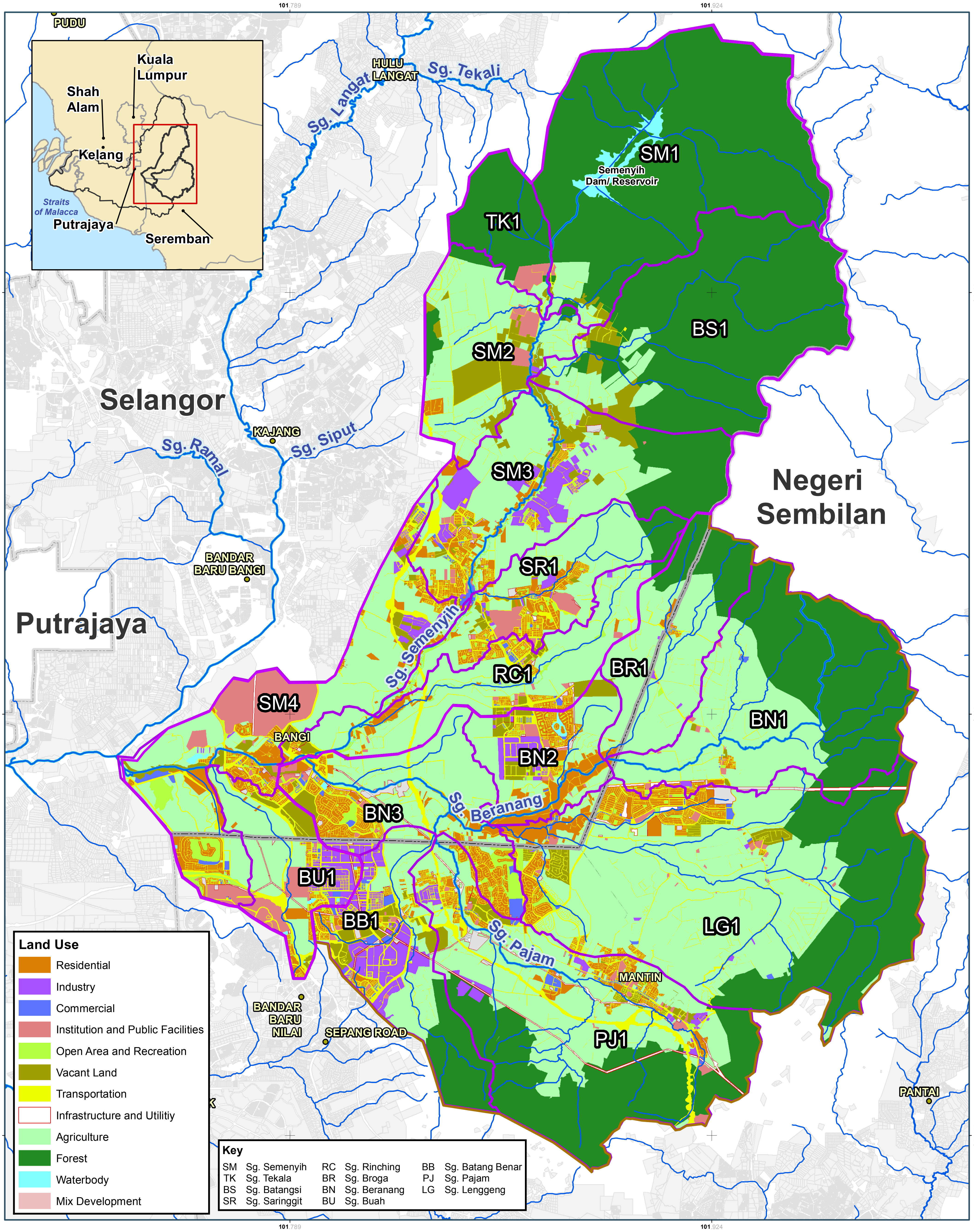
Sub-Catchments

Date	10-01-2019
Project No	EJ 602
Produced by	HMZ
Revision	A

Figure ES 2

Source: ERE Consulting Group (2017). Department of Irrigation and Drainage (2016) D:\Projects\EJ 602 TMDL\Maps\MXD\Fig 5-3 Sub-Catchment.mxd



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0 2 4 km

Coordinate System:GCS WGS 1984
Units: Degree

LEGEND

State Boundary
Main River
Tributaries

Catchment

Beranang Catchment
Semenyih Catchment

Towns

ere consulting group
sensible environmental solutions

Existing Land Use

Date	28-09-2018
Project No	EJ 602
Produced by	HMZ
Revision	A

Figure ES-3

Source: ERE Consulting Group (2016). Road/ Locality- OpenStreetMap and its contributors, Land Use- Jabatan Perancang Bandar dan Desa Negeri Sembilan (2016), Jabatan Perancang Bandar dan Desa Selangor (2010) D:\Projects\EJ 602 TMDL\Maps\MXD\Fig 8-7 Existing LU SubC.mxd