EXECUTIVE SUMMARY

1.0 Title of the Project

The title of the project is **"Projek Pembangunan Lembangan Sungai Bersepadu Sungai Kemaman, Kemaman, Terengganu"**. Hereinafter, it will be referred to as the 'Project'.

2.0 Contact Details of the Project Proponent

The proponent of the project is the Jabatan Pengairan dan Saliran (JPS) Malaysia. The principle contact address and person for the project is as follows:-

Pengarah
Bahagian Pengurusan Banjir
Jabatan Pengairan dan Saliran (JPS)
Kementerian Air, Tanah dan Sumber Asli
Jalan Sultan Salahuddin,
50626 Kuala Lumpur,
Tel. No. : 03-2616 1515
Contact Person : **Dato Ir. Sabri Bin Abdul Mulok**
Email Address : irsabri@water.gov.my

3.0 Contact Details of EIA Team Members

The Environmental Consultant for the project is Ecotone Worldwide Sdn. Bhd. The contact detail is as follows:

Ecotone Worldwide Sdn. Bhd. (291163-M)
Suite 912, Block A, Kelana Centre Point
3 Jalan SS 7/19, Kelana Jaya
47301 Petaling Jaya, Selangor Darul Ehsan.
Tel : 03-7806 4640; Fax: 03-7806 4650
Email : ecotonemalaysia@yahoo.com
Team Leader: **Dr. Nather Khan Bin Hj. Ibrahim**
Designation : **Executive Director**

4.0 Statement of Needs

For many years, the government had tried to address the persistent and damaging flood problems by constructing new drains, straightening streams and other infrastructure to solve recurring flood woes at the Chukai town. However, it did not give expected results due to inadequate capacity to keep up with rapid development. Therefore, a comprehensive long term solution is mandatory to protect the Chukai town and its residents, industrial complex, commercial enterprises, government institutions and infrastructures. There is an urgent need to implement the proposed flood mitigation project to protect the Chukai town from recurring and devastating flood to alleviate suffering of the people and economic losses to industrial and commercial sectors.

5.0 Alternatives Considered

In the Drainage Master Plan study in 1996, a floodway alignment was proposed from Sg. Kemaman to Sg. Chukai across Binjai Swamp, that was from Kg. Sawah Paya Paman to Kg. Takar. However, due to newly built Petronas gas pipeline and railway tracks which passed through the same area and would cross the proposed floodway alignment, a new alignment for floodway was proposed skirting path of the railway track and gas pipeline; and this alignment is also to avoid Paya Paman peat swamp. Later in order to prevent severe damage to Sg Chukai and firefly colonies,

the floodway was redesigned again to avoid direct discharge to Sg Chukai but through Binjai swamp and Tasik Bungkus.

The construction of bunds along the Sg. Kemaman was one of the core components of this project. The bunds to be built at both the riverbanks of Sg Kemaman that will start from the Geliga Bridge and will run upstream comprising a length of 11.4 km on southern bank and 10.5 km on the northern bank. However, in certain locations bund alignments were plan to accommodate local constraints such as to avoid interference with existing development or in other area where no development, greater berm widths are adopted at river bends so as to limit scour potential.

Approximately 12 km bund is proposed through the Binjai swamp starting from Kg. Sawah Paya Paman towards northern boundary of Chukai town at the eastern side of the floodway. Initially, bund was proposed on both sides of the Sg Chukai, however, later single bund was adopted at south of Sg Chukai in order to allow sufficient water to maintain ecology and biodiversity of Binjai swamp. Meanwhile, initially a total of 5 potential areas were identified for flood detention ponds to store floodwater during critical time within Chukai town. However, for the current project only two flood retention ponds will be constructed together with pump house and other infrastructure facilities.

6.0 Location of the Project Site

The proposed flood mitigation project is located mostly southeast of the Sg. Kemaman basin covering entire Chukai town. The project area lies between the longitude of 103^{o} 19’ 10” N to 103^{o} 29’ 10’’ N and latitude of 4^{o} 10’ 58” E to 4^{o} 18’ 20” E. It covers an area of approximately 125 km² extending from Pondok China in the south to Bukit Penghulu Daud in the north, Kg. Sg. Pinang in the west and Tanjong Gemok in the northeast. The eastern side of the study area bounded by South China Sea. As floodway is most important component of the project and therefor 5 km radius is followed for floodway corridor and for Sg Kemaman and Binjai bunds the study covered just the zone of influence for EIA study. Overall, the study boundary goes beyond and therefore 5 km radius covering entire downstream flood plain of Sg. Kemaman.

7.0 Project Description

In the latest design, the length of the floodway is approximately 8.7 km long which run across the Binjai swamp to divert floodwater from Sg. Kemaman to Binjai Swamp and Tasik Bungkus, and excessive water from Tasik Bungkus would be released into Sg. Bungkus in regulated manner to reduce the impact at the downstream of Sg. Chukai. The flood protection earth bunds, namely Sg Kemaman and Binjai bunds are another core components of this project. The Sg Kemaman bund will be built at both riverbanks that will start from the Geliga Bridge and will run upstream comprising a length of 11.4 km on southern bank and 10.5 km on the northern bank. Basically, the bunds are aligned in such a way that at least 100 m floodplain is maintained inside bunded area. Approximately 12 km bund is proposed through Binjai swamp starting from Kg. Sawah Paya Paman towards northern boundary of Chukai town at the eastern side of the floodway. This bund will mainly protect the Chukai town from flood occurring due to over spilling of the Sg. Chukai and floodway. Two flood retention ponds together with pump house and other infrastructure also included as part of the project.

8.0 Environmental Sensitive Receptors (ESR)

The proposed project boundary covers wider area with multiple land uses and involving massive land clearing and earthwork activities particularly in the forest and wetland areas affecting physical, biological and human environment significantly. There are many environmentally sensitive receptors are located within and vicinity of the project boundary which are as follows:-

1. Bukit Sai and Kuala Kemaman Forest Reserves
2. Sg Kemaman Water Intake Point upstream of the Floodway Inlet
3. Tasik Bungkus and Sg Chukai wetland complex
4. Fireflies and related eco-tourism at Sg. Yak Yah and Sg Chukai
5. Kemaman Mini Zoo & Recreational Park near Kg. Ibok
6. Critically endangered River Terrapin (tuntungs) of Sg. Kemaman
7. Socio-economy and public health issues at the impacted zones
8. Fishery and fish culture in the rivers including cage culture at Bukit Kuang
9. Coastal Mangroves including Bakau Tinggi Recreation Forest
10. TNB Transmission Line and Pylon passing through floodway corridor

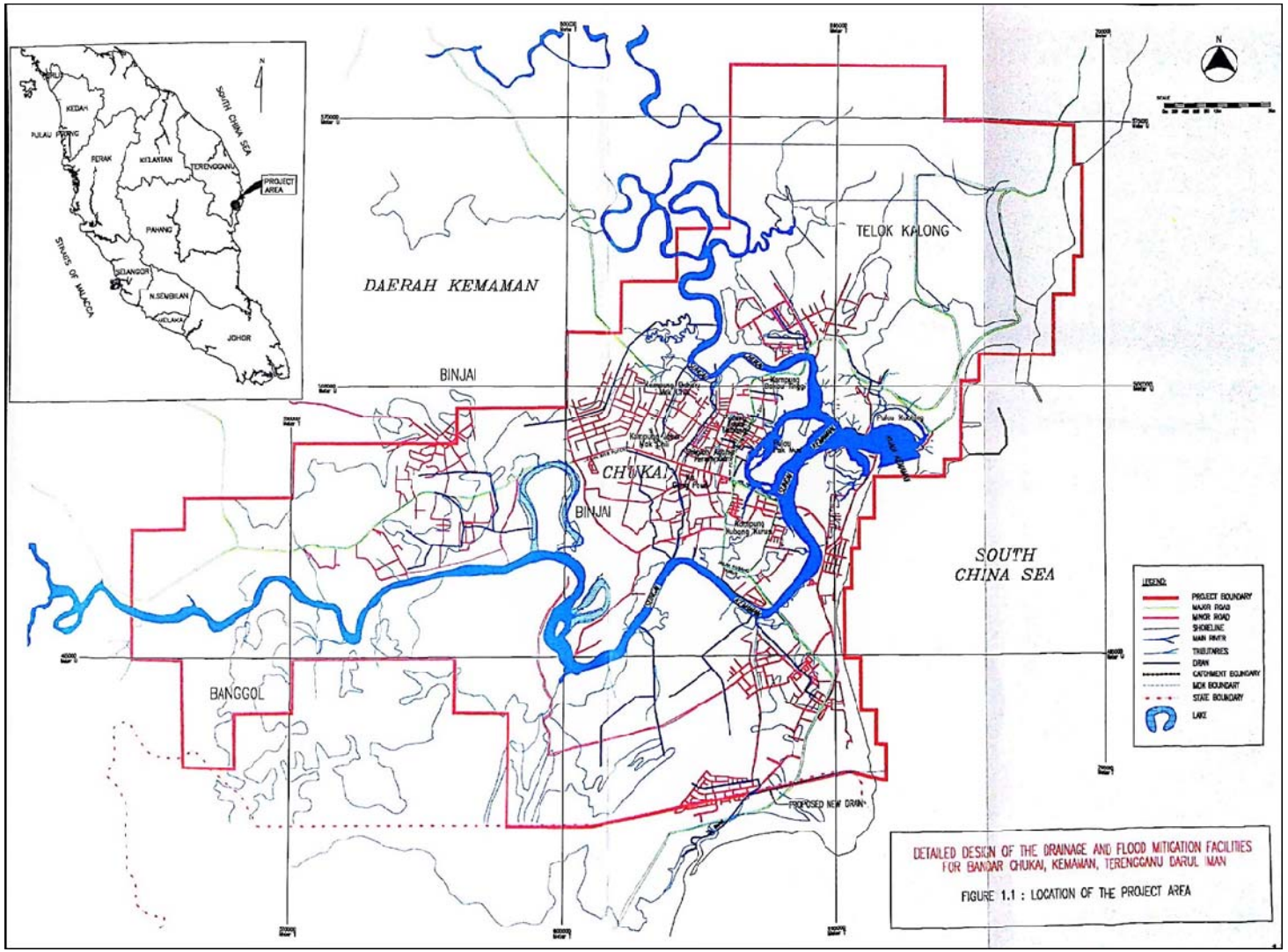


Figure ES-1: Project boundary with Chukai town *(Source: JPS, 2003).*

Figure ES-2: Project Conceptual Plan *(Source: JPS, 2018).*

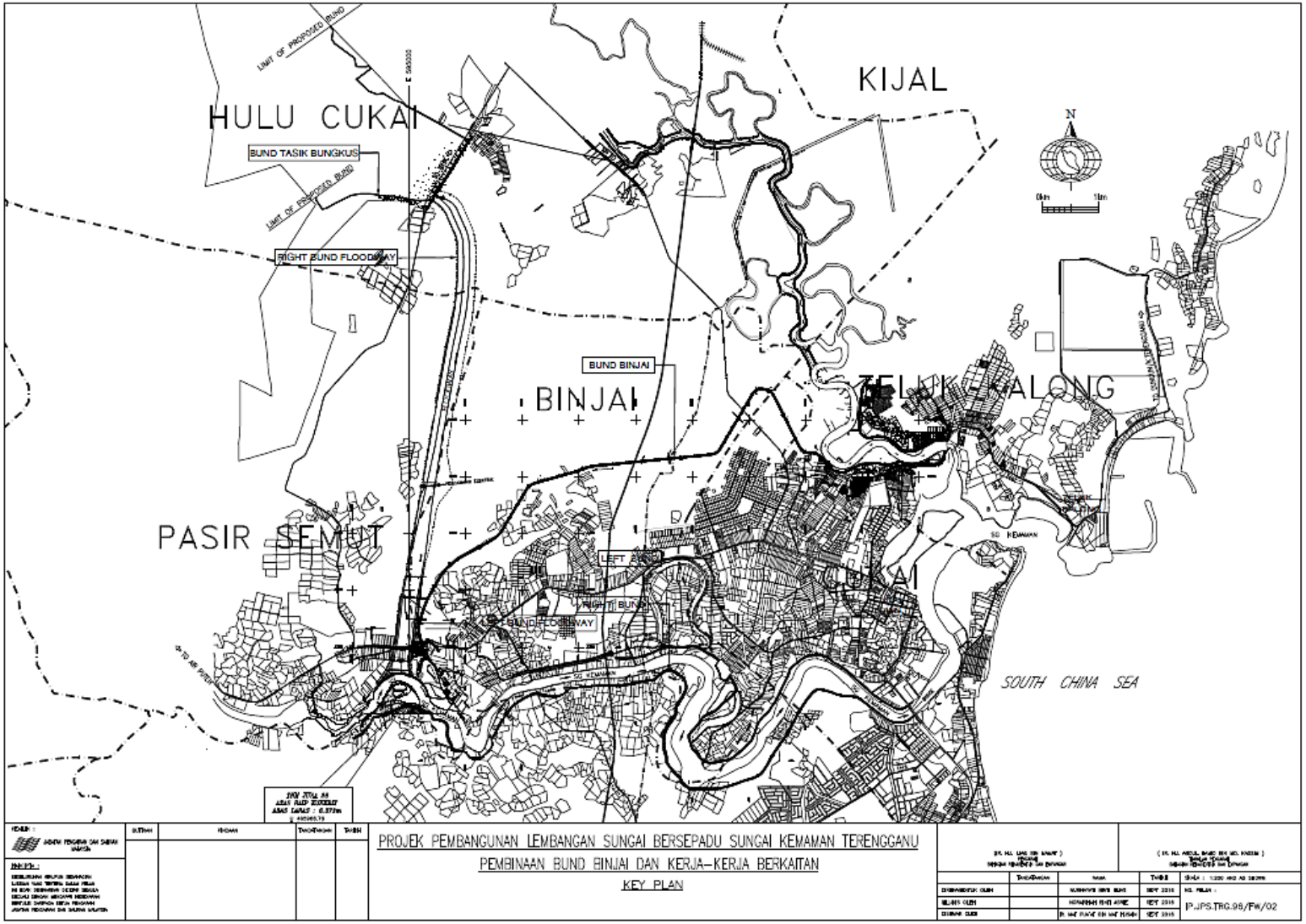


Figure ES-3: Project Key Plan. *(Source: JPS, 2018)*

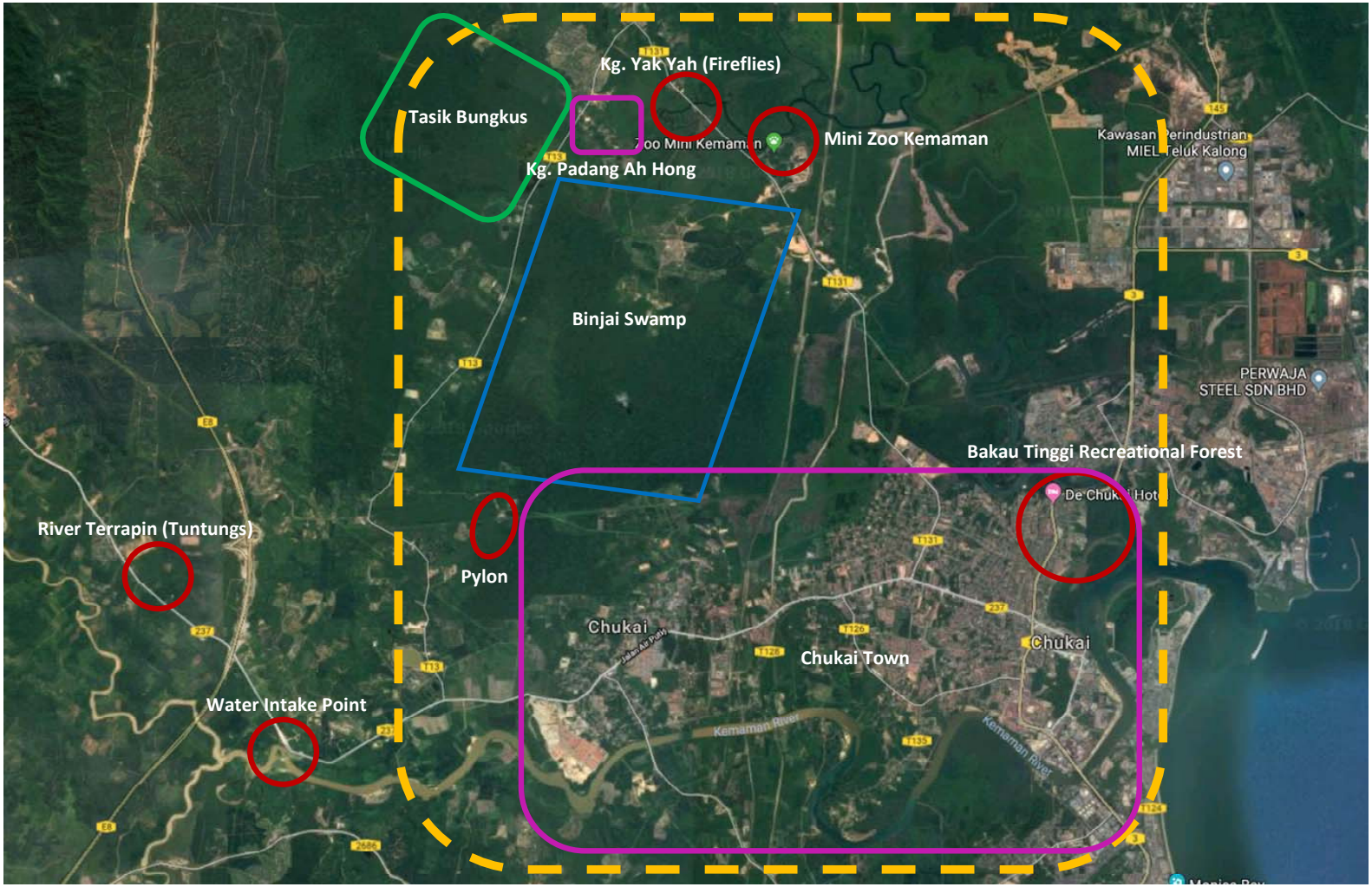


Figure ES-4: Project Location and Sensitive Receptors

9.0 Existing Environment

9.1 Topography and Geomorphology

The project area is located at the downstream of Sg. Kemaman basin which is a flat and flood prone area during the wet season. The topography of the area ranges from 0 m (on the eastern part at sea level) to 1360 m (to the North-West). The topography of the basin starts at elevation of 1360 m of Gunung Lipat Sanggol and ends at the sea after passing through low lying area of Chukai town. The Chukai town is located mostly flat area with elevation below 20 m. The length of Sg. Kemaman to the river mouth is approximately 90 km.

9.2 Geology, Soil and Hydrogeology

The Project Area is underlain completely by alluvial (riverine) sediments of Quaternary (young) age, deposited by Sg. Kemaman and its tributaries. The Quaternary alluvium, made up of peaty material, clay, silt, fine to coarse sand and gravel, overlies granitoids which had intruded into the older metasediments of phyllites and slates. Both the granite and metasediments are not exposed in the project area but granite was identified in the Borelogs 15 and 16.

9.3 Water Resources, Hydrology and Drainage

The Sg. Kemaman basin is consisting of many streams and rivers, of which Sg. Kemaman (*sensu stricto; s.s.*), Sg. Chukai, Sg. Cherul and Sg. Jabor, are the major rivers. The entire Sg. Chukai and Sg. Kemaman watersheds are important for the current project, though the project area is located downstream of the watershed. The Sg. Kemaman (*s.s*) is the larger one, which drains around 82% of the total catchment area (i.e. about 1696 sq. km). It starts at about 730 m above MSL in the Cherul Forest Reserves near the boundary of Pahang and Terengganu and travel eastward through a total length of about 90 km before reaching the sea. The main tributaries of Sg. Kemaman are Sg. Cherul, Sg. Tebak and Sg. Jabor. The Sg. Chukai, which forms the northern region of Chukai estuary, serves as smaller catchment area of 381 sq. km. It is about 33 km in length with few upstream tributaries and notable ones are Sg. Bungkus, Sg. Yak Yah and Sg. Ibok.

9.4 Water Quality

The baseline water quality study was carried out to assess the existing water quality of rivers which would possibly be affected by the development at the project boundary. The water testing and sampling for water quality analysis was carried out on 22nd July 2018 at eleven (11) sampling stations by ChemVi Laboratory Sdn. Bhd., a laboratory accredited by Skim Akreditasi Makmal Malaysia (SAMM). Elevan (11) water quality parameters were tested which consisting of temperature, pH, salinity, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Oil & Grease and Ammonical Nitrogen (AN) and the readings mostly were found within the National Quality Standards (NWQS) Class IIA limit except for turbidity, Total Suspended Solids (TSS) and E-Coli which are too high at some stations for river waters. Based on the Water Quality Index (WQI) classification, the water quality classified as slightly polluted and to highly polluted and water quality index from Class II in most stations and Class III in few stations.

9.5 Climate and Meteorology

The meteorological data pertaining to this project were obtained from the Jabatan Meteorologi Malaysia. The meteorological data thus discussed includes temperature, rainfall, rainy days, humidity and evaporation for a period of five years, from January, 2013 until December, 2017. The climatic data shows typical Malaysian weather with no adverse climatic conditions.

9.6 Air Quality

The baseline air quality monitoring was carried out between 21th to 25th July 2018 by ChemVi Laboratory Sdn. Bhd, at four (4) noise monitoring locations designated as Stations A1 to A4. The results obtained for the Particulate Matter PM^{10} were ranged from 40µg/m³ to 48 µg/m³ and the Particulate Matter $PM^{2.5}$ were ranged from 24µg/m^3 to 32µg/m^3. The other parameters such as Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) Carbon Monoxide (CO), Ozone (O_3) and Lead (Pb) were undetectable level. As an overall conclusion, the ambient air quality parameters were complied with the respective limits stipulated in New Malaysian Ambient Air Quality Standard (NMAAQS).

9.7 Noise Level

The baseline noise monitoring was carried out between 21th to 25th July 2018 by ChemVi Laboratory Sdn. Bhd at six (6) noise monitoring locations designated as Stations N1 to N6. The equivalent continuous sound level (LAeq) monitored for day time indicates that existing noise ranged from 53.1 to 58.6 dB(A). The highest noise was measured at N6 while the lowest was at N2. During night time, the LAeq obtained were ranged between 43.8 to 48.2 dB(A). The highest noise was measured at N3 while the lowest was at N1 with reference to the recommended DOE guidelines of Limiting Sound Level (LAeq) for Urban Residential (High Density) Areas, the existing noise recorded at all the stations within the limit of 60.0 dB(A) for day time and 50.0 dB(A) for night time within recommended limit.

9.8 Vibration Level

Vibration level measurement was carried out at four (4) sampling stations (V1-V4) on 21th until 24th July 2018. The vibration result was found to be within the recommended limit as per Schedule 2: The Planning Guidelines for Vibration Limits and Control in the Environment. The vibration levels at the Stations V1 varied from 0.148 to 0.240 mm/s p.p.v., whereas at the Stations V2 they varied from 0.138 to 0.265 mm/s p.p.v. The vibration levels at the Stations V3 varied from 0.120 to 0.336 mm/s p.p.v and Station V4 varied from 0.227 to 0.433 mm/s p.p.v. As a summary, the peak vector sum of peak particle velocity in mm/s for Stations V1, V2, V3 and V4 were found to be within the DOE limit of the peak vector sum data.

9.9 Ecology and Sensitive Habitats

The project area is consisting of several ecological habitats including dry forest, swamp forest, marsh, rivers, lakes, large plantations, small scale agricultural land including paddy fields. The ecological habitats can also be classified into terrestrial, wetland and aquatic type. The wetland and aquatic ecosystem are further classified into freshwater and brackish water components in the region. All these habitats are inter-connected in terms of their ecosystem resources, values and functions. Though the project corridor is looked swamp, jungles with secondary vegetation or disturbed forest but it has many ecological and socio-economic values and functions including unique biological diversity. All the ecological habitats and their

importance in terms of resources, uses and functions are discussed in details in the report.

9.10 Terrestrial and Wetland Flora

The overall assessment showed that the flora composition in the Sg Kemaman basin consists of 678 species from 376 genus and 131 families. There are 492 species of tree species recorded mainly from *Euphorbiaceae, Dipterocarpaceae, Annonaceae, Lauraceae* and *Moraceae*. The shrubs found in the survey area consist of 67 species mostly from *Rubiaceae.* Herbaceous plant group is consisting of 55 species mainly from the family of *Zingiberaceae*. The lianas and climber vegetation comprise of 16 species. The palms were recorded with 27 species, mainly from the genus of *Pinanga*. The fern and fern-allies were recorded with 21 species from 14 families such as *Adiantaceae, Aspleniaceae* and *Polypodiaceae*.

9.11 Terrestrial and Wetland Fauna

A total of 12 mammal species were recorded in the project area. Of the 12 recorded mammal species, four are totally protected five protected and the remaining three are not listed under WCA 2010. Meanwhile, under IUCN's Red List, one species is endangered, two are vulnerable, two near threatened and the remaining seven least concern. Five species of primates recorded which is quite high, with White-handed Gibbon being the most critical since it's not only totally protected but also endangered. At least another 29-mammal species comprised largely of bats and rodents are expected to be present. The most diverse terrestrial vertebrate fauna group recorded as expected was bird with 84 species in total. More than 400 species of reptiles and amphibians are recorded in Peninsular Malaysia with many of them are being elusive and active mostly at night. For reptiles and amphibians, 30 species were recorded in total, among them the river terrapin is critically endangered and totally protected species of the region.

9.12 Aquatic Flora and Fauna

A total of 22 phytoplankton species are identified during the present study at five locations. Sg Jabor recorded the high number of phytoplankton with 16 species followed by, paddy fields with 15 species, Sg Yak Yah with 12 species, Sg Ibok

with 11 species and lastly Tasik Bungkus of blackwater swamp with 10 species. Chloropytha become the dominant phytoplankton groups that represent 10 species followed by Bacillariophyta with 8 species and Cynophyta with 4 species. A total of 22 species of zooplankton have been identified during the present study. Again Sg Jabor recorded the highest number of zooplankton species with 14 species followed by Sg Ibok with 13 species, paddy fields with 11 species, Tasik Bungkus blackwater swamp with 10 species and Sg Yak Yah with 9 species. Rotifers become the dominant group which represent 14 species followed by cladocerans with 6 species and copepods with 1 species.

The total number of fish species recorded during the present study is 19 species not including one species of crabs such as *Scylla serrata* (ketam bakau) and one species of giant freshwater prawn *Macrobrachium rosenbergii* (udang galah). Blackwater swamp areas recorded the lowest fish species with only 1 species by observation. None of the protected fish species under Terengganu Fisheries Act such as kelisa (*Scleopages formosus*) and temoleh (*Probarbus jullieni*) were caught during the study period. On the other hand, Sg. Yak Yah recorded the highest fish species number with eleven species followed by paddy fields and Sg. Ibok with 5 species each and Sg. Jabor with 4 species.

The Sg. Chukai is well known for its firefly ecotourism, though not as popular as the Sg. Selangor in Selangor D.E. It is one of the 14 firefly sanctuaries in Malaysia. The fireflies in Sg. Chukai are specifically concentrated at Sg. Yak Yah and Sg. Bungkus. According to report, the Sg. Yak Yah, a small tributary of Sg. Bungkus has the highest clusters of fireflies in Malaysia. The Sg. Yak Yah recorded up to 28 clusters while in other places up to 14 clusters only. This was attributed due to few species of fireflies with verities of host plants and not exclusively at the Berembang trees only.

9.13 Land Use

The Kemaman is well planned developed area as the planning development can be referred in Kemaman Local Plan 2003 – 2015. The current development of Kemaman is focused at the coastal area along main road from Chukai town in the south towards Kertih at the north of Kemaman. In national context, Kemaman district is serving as the main producer of oil and gas for the country. Meanwhile for

regional context, Kemaman Local Plan areas together with Paka jointly play the role as the main support center for East Coast National Region, where Kuantan is the main center of the region. From macro perspective in development planning, Kemaman plays a big role in contributing the growth in agricultural, farming and fishery. By referring to the Kemaman Local Plan under development concept, local authority had already proposed floodway and bund construction along Kemaman river to overcome flood and river overflow.

9.14 Socio-Economy and Public Perception

To evaluate socio-economy, and potential social risks/impacts, the zone of influence which likely to be affected by the project is identified, including all of its ancillary aspects, such as power transmission corridors, pipelines, residential clusters, village settlements, existing access roads, waste disposal areas, and construction sites, as well as unplanned development induced by the project (e.g.small agricultural activity along the access roads, fishing by the recreational areas and food stalls). Areas involved in the influence of this study includes 5km from the study area. The majority of the respondents did not oppose the proposed project, with 96.0% of the respondents having no objection. Among those who disagreed (2.0%) stated that the reasons for their disagreement are mainly due to their perception on other past experiences or they have already witnessed the negative impacts from other projects within the vicinity.

9.15 Public Health

The public health survey was carried out together with socio-economic survey in the end of August 2018. The health survey was aimed at local community in determining their current health status who are potentially at risk of exposure to environmental health hazards from the Project. This cross-sectional survey shows that the local community need to have adequate basic amenities which include safe water supply, appropriate sewage and solid waste management system. The period prevalence rates of the chronic diseases in this local community were lower than those reported in the National Health and Morbidity Survey Information System (NHMS) V, 2015 and NHMS III, 2006). There were no obvious problems on the breeding of vector.

9.16 Infrastructure and Utility

The residential, commercial and institutional establishment around project site are well connected with electricity supply. Tenaga Nasional Berhad (TNB) is providing required electricity supply for most areas including around Chukai-Kemaman area. The Syarikat Air Terengganu Sdn. Bhd. (SATU) plays an important role for water supply services for the Terengganu including services related water management and responsible for abstracting, treating and distributing water for Kemaman District. The communication network in the project area is good including for mobile phone system. The District of Kemaman area has excellent roads and road network within and vicinity of the project boundary.

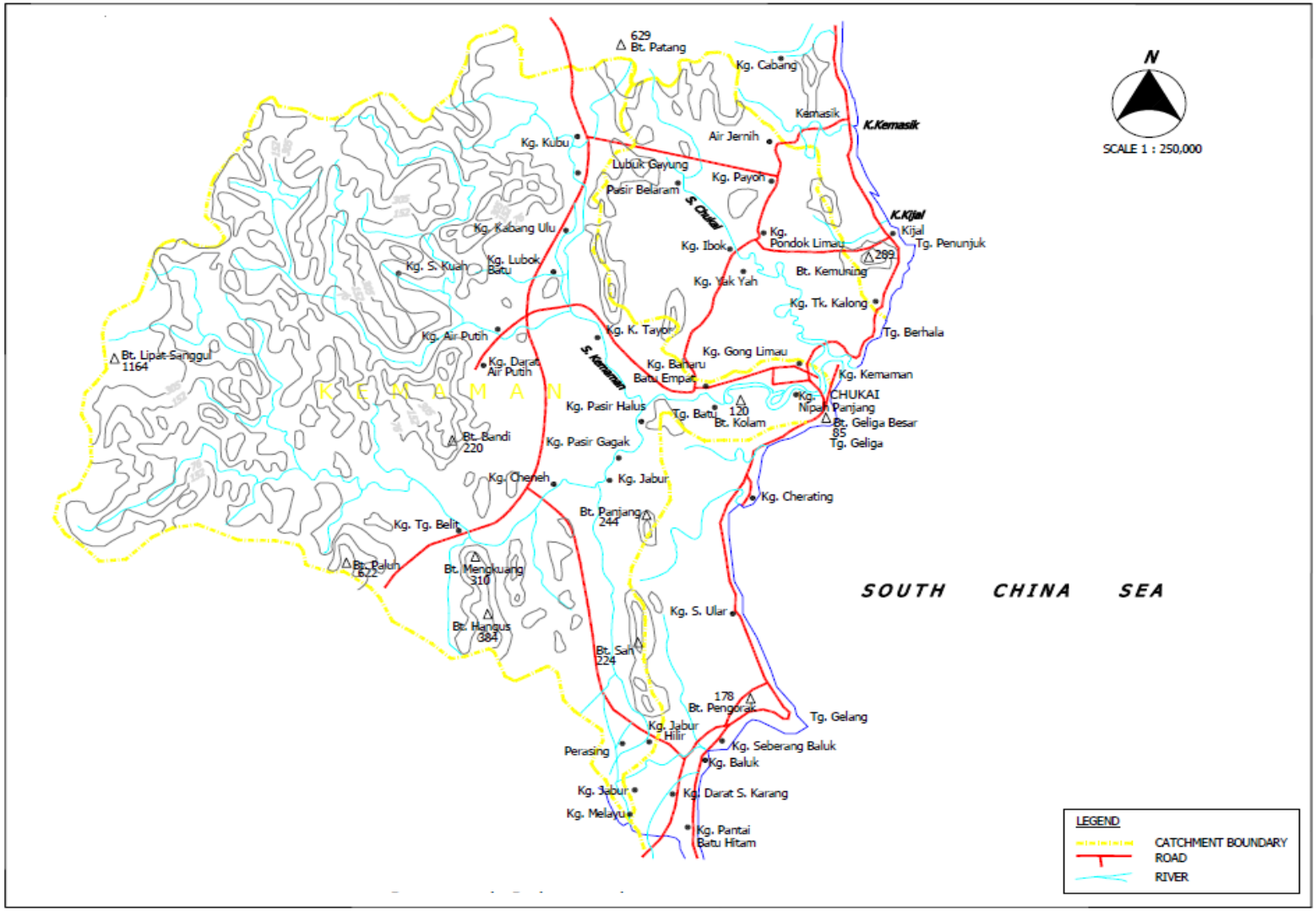


Figure ES-5: Topography of the project area *(Source: JPS, 2003).*

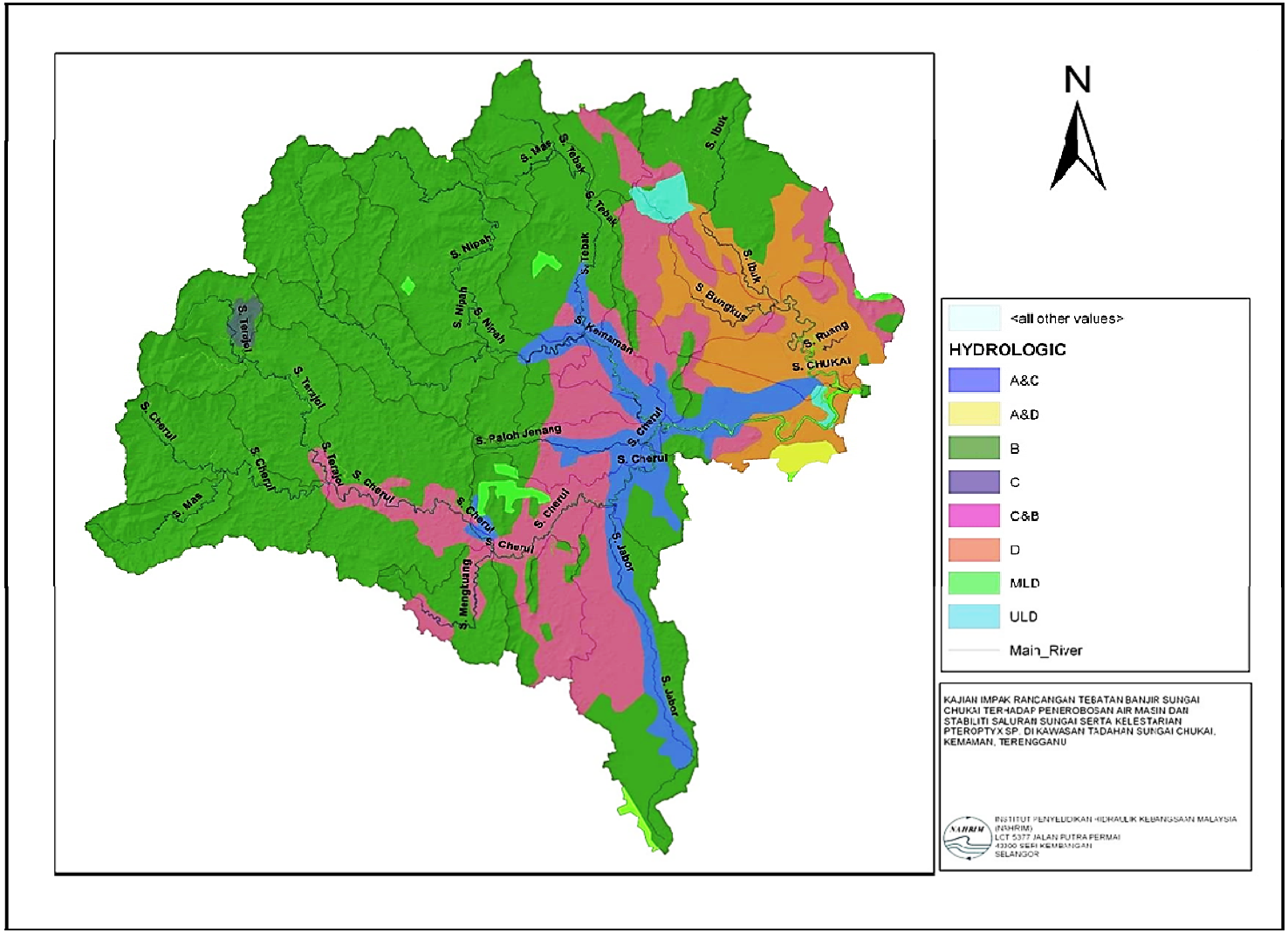


Figure ES-6: Hydrologic soil group of Sg. Kemaman basin *(Source: NAHRIM, 2014)*

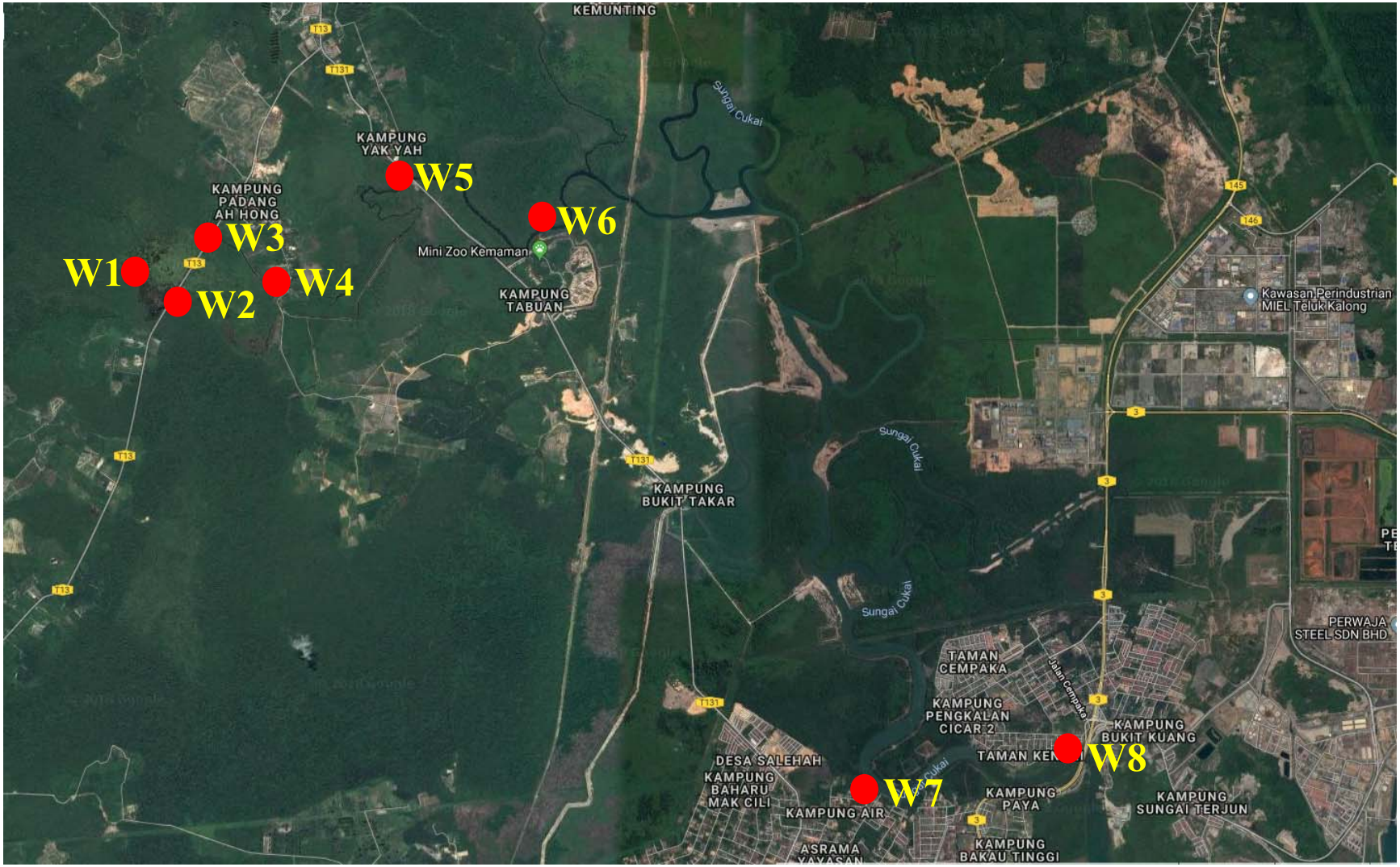


Figure ES-8: Water quality monitoring stations at Tasik Bungkus and Sg. Chukai.

Figure ES-9: Water quality monitoring stations at Sg. Kemaman.

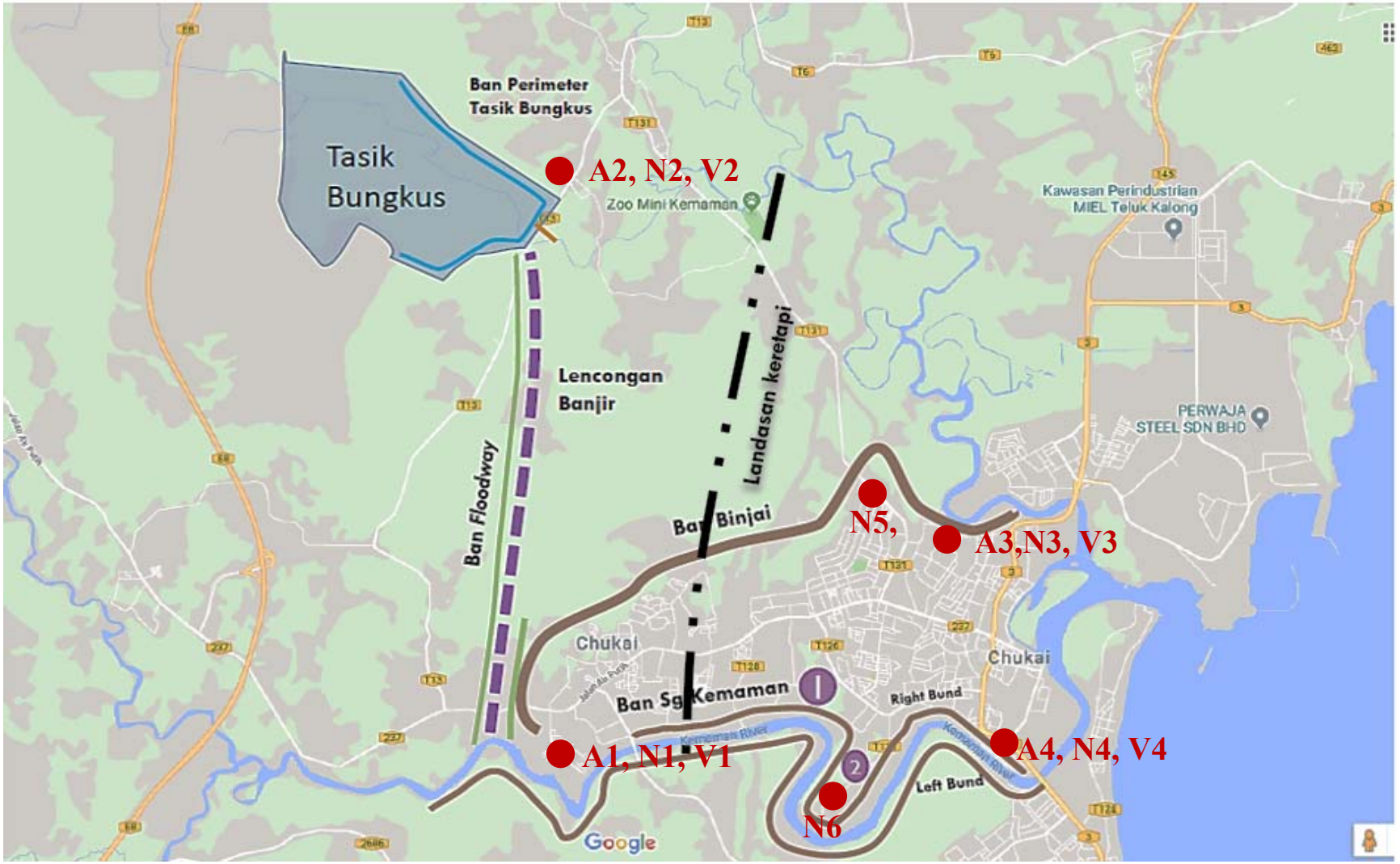


Figure ES-7: Air, Noise and Vibration monitoring stations within the project boundary.

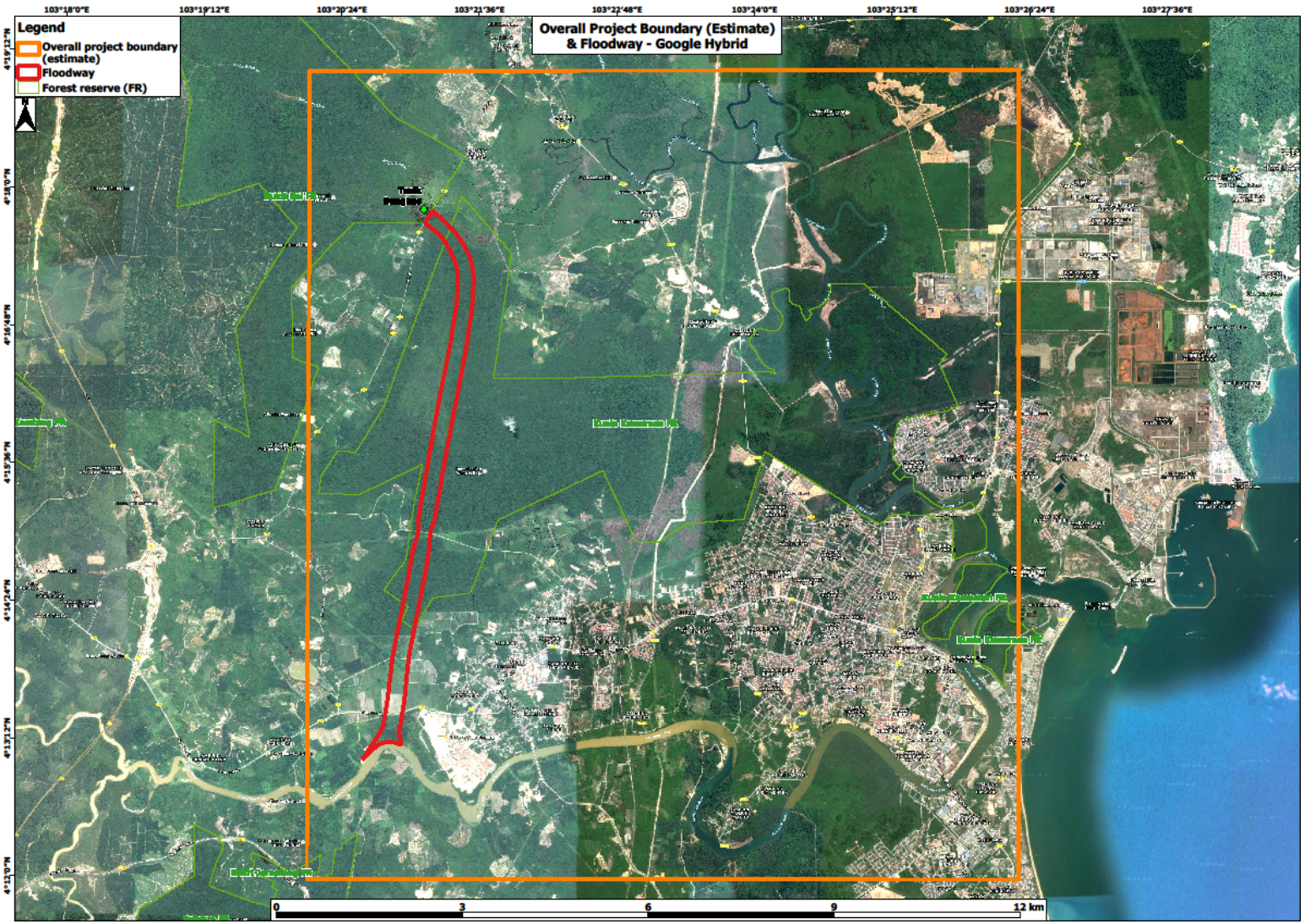


Figure ES-10: Ecological habitats within the project boundary

Figure ES-11: Tasik Bungkus and its habitats

Figure ES-12: Sg. Chukai and its riparian zones from upstream to estuary

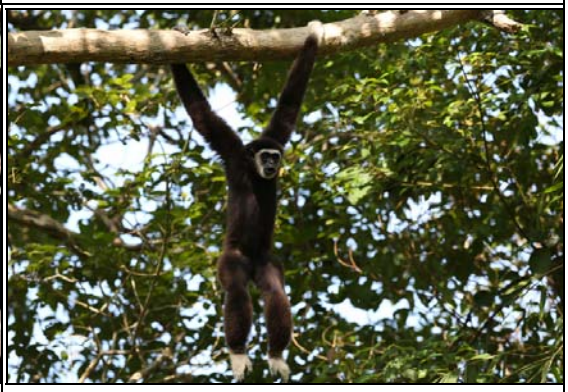
	
Sunda Slow Loris	**Spectacled Leaf Monkeys**
	
Plantain Squirrel	**White-thighed Langur**
	
Small-toothed Palm Civet	**White-handed Gibbon**

Figure ES-13.: Mammals photographed in the project area.

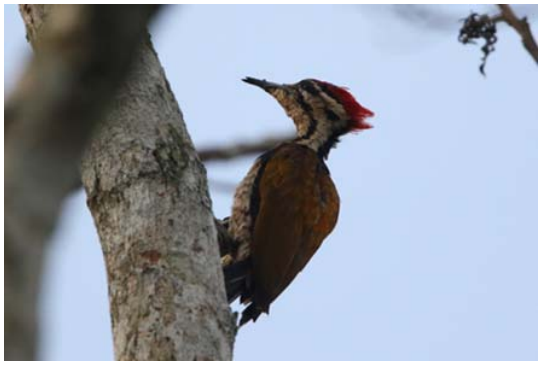
	
Baya Weaver (female in nest)	**Black-bellied Malkoha**
	
Yellow-bellied Prinia (adult)	**Blue-eared Kingfisher (juvenile)**
	
Brown-throated Sunbird (male)	**Common Flameback (male)**
	
Dark-necked Tailorbird (male breeding)	**Emerald Dove (juveniles)**

Figure ES-14: Birds photographed in the project area.

10.0 Evaluation of Impacts

The most significant activities during construction and operation phases of the project are vegetation clearance, excavation for floodway, earthworks to construct floodway and bunds, transportation of large amount of biomass and unsuitable excavated materials to disposal sites, and diversion of flood water from Sg. Kemaman to Binjai swamp, Tasik Bungkus and Sg. Bungkus. The most significant impacts arise due to the above activities are fragmentation of the forest reserve; loss of forest reserve land at the floodway corridor together with its flora and some fauna; traffic impact due to transportation of biomass and excavated materials to the dump sites and bund construction sites; erosion, sediment and nutrient runoff to waterways within the project boundary; and socio-economic issues related to all the impacts including public/ workers' health and safety. Some moderate significant impacts are arise due to the project activities are air quality, noise, vibration, waste management, public health and visual impacts, etc.

There are minimum project related activities expected during the operation phase of the project, which include maintaining the floodway and bunds in good condition, monitoring of the Tasik Bungkus, Binjai swamp and Sg. Chukai from siltation, sedimentation and other pollutants. During operation phase, the diversion of flood water would cause most significant impact on hydrology, water quality and ecology of Binjai swamp, Tasik Bungkus and Sg. Bungkus due to excessive water, and also due to siltation and sedimentation. Such impact would also affect fishery, fireflies colonies, biodiversity including at riparian zones. The most significant environmental impacts during construction and operation phases of the project are evaluated quantitatively wherever necessary and feasible.

11.0 Pollution Prevention and Mitigation Measures (P2M2)

As pointed out earlier, the most of the significant impacts can be mitigated using appropriate methods, management strategies and construction practices. However, there are certain impacts are permanent which cannot be mitigated, which include fragmentation of the forest reserve, permanent loss of forest reserve at floodway corridor and loss of associated forest flora, and to some extend loss of fauna along the floodway corridor. The remaining forest reserve would also be under threat due

to possible lose its functional values due fragmentation and also human perturbation in course of time.

Meanwhile, the sudden surge of floodwater would bring along suspended solids, sediments and nutrients to the receiving system, which in turn would affect hydrology, water quality, ecology and biodiversity. There is a possibility that due to slow sedimentation, the Tasik Bungkus wetland could possibly turn into dry land, which in turn alter ecological balance and species composition. More importantly, it may lose its flood mitigation function due to sedimentation and changes in water quality and ecology. Similar situation would possibly occur at Binjai swamp and Sg. Bungkus as well. Though additional water from Tasik Bungkus would possibly reduce any increase in salinity at Sg. Chukai which presumably happened due to river bypasses and channelization of Sg Chukai presumably affecting fishery and fireflies colonies, the problem would possibly remain same due to increase in suspended solids, siltation and sedimentation due to flood diversion in long run.

The most significant impact which cannot be mitigated required serious consideration and monitoring mechanism including to protect Binjai swamp, Tasik Bungkus, Sg. Bungkus and finally to Sg. Chukai. Though the system is already facing floodwater in large quantity during the season but the proposed floodway and Binjai Bund would redirect excessive flood water more towards north of Chukai town. There is a possibility of more wider and intensive flood expected outside the bunds during the flood season, though it is designed for 50 ARI.

Based on the summary of impact assessment findings, pollution prevention and mitigation measures (P2M2) for the construction and operation phases of the proposed project are prepared. Based on the potential impacts identified the P2M2 are proposed including for residual impacts during construction and operation phases of the project. In addition, a comprehensive EMP and LDP2M2 for the construction and operation phases would help further strengthen the mitigation measures and to monitor its compliances within the acceptable levels during the implementation of the project.

Table ES-1: Significant Impacts and Proposed P2M2 during Construction Phase

Impact Significant (IS): *Not Significant, **Medium, ***Significant; T-Temporary, L-Long Term, B-Beneficial				
Major Project Activities	**Potential Significant Impacts**	**Magnitude Of Significant Potential Impacts**	**LDP2M2 Mitigation Measures**	**Reference Page**
Access Roads and Tracks	• The existing tracks and access roads are incomplete and narrow. New access roads may be required before permanent roads are established.	**T	• Minimum land and vegetation clearance. Necessary mitigation measures provided in P2M2 including erosion and sediment control to be implemented.	8-8
Labour Force, Temporary Site Office and Workers Camps.	• Improper management of solid and sanitary wastes will result in littering, odor and vector problems which may affect health of workers. Leachate from these would contaminate streams and river affecting water quality and aquatic ecology.	***T	• Temporary sanitary facilities must be provided and maintained in a hygienic manner during entire construction phase. • Discharge from temporary septic tanks must comply with Standard B of the Environmental Quality (Sewage) Regulation 2009. • Solid wastes must be of disposed in approved landfill in compliance standards and requirements.	8-23
	• Possibility of public health problems including infectious and water borne diseases among the workers.	**T	• Pits or any temporary dump sites must not be allowed near the base camps. • Monitoring of infectious diseases and provision of health care facilities needed.	8-40

Land and Vegetation Clearing	• Land clearing activities will remove the soil cover and leave it unprotected to the effect of rainfall and subsequent surface runoff and soil erosion resulting nutrient and sediment to rivers.	***T	• Clearing should be done in phases so that exposed lands are kept to a minimum and remain for a shorter duration. • Maintenance and replanting of grass cover should be carried out as soon as possible after site clearing, trees and shrubs are established immediately after construction.	8-4
	• Hydrological characteristics will be disturbed or altered due to vegetation clearance, surface runoff, soil erosion and sedimentation.	***T	• Install sediment curtain, sediment fence, silt traps and screens to control run-off and sedimentation as in P2M2/ESCP.	8-8
	• The vegetation clearing activities will generate large amounts of biomass/solid wastes.	***T	• Removed biomass should be disposed using suitable methods at designated and approved sites.	8-6
Excavation/ Earthworks	• Earthwork activities will leave soil uncovered for a period of time and prone to erosion and sedimentation, especially during rainy seasons and more so on slope areas.	***T	• Minimize earthworks activities during the rainy season. Earthworks shall be carried out in the dry season as far as possible. • Establish grass coverage on exposed areas as soon as possible. • Plastic and nettings may be used to cover steep slopes to give temporary stability until vegetation cover established.	8-4

	• Eroded materials will be transported by surface runoff and increase sediment loads in the streams and river that may cause floods.	***T	• Implement LDP2M2 and BMP to control Erosion and Sediment to water ways. Sediment / silts traps should be provided by means of retention basins with dykes, straw bales and filter fabric to trap sediments in the runoff from the exposed or loosen ground. Silt traps are required to have sufficient hydraulic retention capacities and energy dissipaters ahead to dampen surge flows.	8-13
	• Earthworks activities by loaders and excavators will further churn up dust and pollute the surrounding area and degrade air quality and visibility.	***T	• Exposed soil surfaces should be regularly dampened to reduce emission of fugitive dusts.	8-41
	• Emission of dark smoke by construction vehicles and machinery will pollute the air.	***T	• All heavy vehicles or machinery used in the construction sites should be properly and regularly maintained to prevent excessive emission of air pollutants, particularly dark smoke.	8-41
Transportation Activities	• Lorries transporting biomass and earth materials may aggravate fugitive dust problems.	***T	• Soil and construction materials transported to and out of the project area over a long distance should be covered with plastic sheets. • Lorries carrying earth material should not be overloaded; load should not be higher than the side and tail boards. • Lorries carrying earth material should also travel at low speeds.	8-41

	• Vehicles leaving construction site collect dust, debris and dirt on their tires which are later dislodged when they travel out of the construction sites.	***T	• Tires of construction site lorries and other vehicles should be hosed with water to reduce carried over of mud and soil.	8-41
	• Movement of heavy vehicles over existing roads, particularly village road would cause surface damages.	***T	• Heavy vehicles should not be allowed in village roads. Transportation vehicles should not be overloaded and frequent road maintenance is required.	8-38
	• Noise is expected from movement of heavy vehicles.	***T	• All heavy vehicles must be properly maintained. • Movement of vehicles to be restricted to 0700 to 1900 hours, especially near populated or residential areas.	8-38
	• Movement of a large number of vehicles daily at a high frequency may increase the risk of accidents with people currently using the dirt track roads in and around the project sites.	***T	• The speed of all heavy vehicles must be controlled. • Proper signage should be placed at the entrance and exit of construction sites for safety purposes. • Major haul road should be wide enough to allow passing vehicles.	8-38

Construction of Drainage System	• Earthwork activities and excavation to construct the drains and place the pipes will lay bare the land causing erosion and sedimentation.	***T	• Minimize earthworks during the rainy season. Earthworks shall be carried in the dry season as far as possible. • Establish grass coverage on exposed areas as soon as possible. • Plastic and nettings may be used to cover steep slopes to give temporary stability until construction is completed.	8-10
Other Infrastructure and Utilities	• Impacts from the use of generators include air quality degradation from the exhaust fumes.	**T	• Generator sets should be properly and regularly maintained to prevent excessive emission of air pollutants.	8-41

Table ES-2: Significant Impacts and proposed P2M2 during Operation Phase

Impact Significant (IS): *Not Significant, **Medium, ***Significant; T-Temporary, L-Long Term, B-Beneficial				
Major Project Activities	**Potential Significant Impacts**	**Magnitude Of Significant Potential Impacts**	**LDP2M2 Mitigation Measures**	**Reference Page**
Maintenance of Floodway	• Efficiency of floodway would be affected due to vegetation growth, debris including vegetation and wood materials • Sedimentation due to incoming flood water and soil erosion from the surroundings.	**L	• Routine vegetation and debris removal may be required. Occasional dredging also needed.	8-50
River bund maintenance	• Effectiveness of river bunds may be affected due to overgrown vegetation, erosion and other human disturbance.	**L	• Routine monitoring of bunds required and necessary repair need to be carried out at appropriate locations. Overgrown vegetation need to be removed.	8-46
Waste Management	• Unsanitary disposal of wastes particularly solid waste would affect flow of rivers and floodway and also can pose health problems and rodent infestation, as well as present unsightly aesthetics	**L	• Any solid wastes shall be stored, handled and transferred in a manner that reduces wastes and prevents pollution. Bins allocated for domestic wastes shall be durable and not prone to spillage or leakage.	8-43

12.0 Environmental Management Plan (EMP) and LDP2M2

A comprehensive Environmental Management Plan (EMP) has been prepared for this project to manage all the potential significant impacts identified in this report and monitor the project activities, and implementation of mitigation measures at the site both during construction and operational phases of the project. The EMP document will provide specific guidelines on steps that need to be taken by the project proponent to ensure that mitigation measures recommended in this report, the EIA approval conditions and any other requirements imposed by the DOE are implemented. Even though the mitigation measures suggested in the EIA report are expected to reduce the impacts to an acceptable level, monitoring of the impacts has to be carried out at certain critical areas and times, in order to ensure that these measures are working effectively.

12.1 Environmental Monitoring and Reporting

An integral part of the Environmental Management Plan (EMP) is the formulation of various monitoring programmes to determine the effectiveness of the mitigating measures adopted, and to monitor changes (adverse or otherwise) to the surrounding physical, chemical, biological and human environments. The monitoring programmes outlined in the EMP should cover all stages of the project; from site investigation, site clearing, excavation, earthworks, construction, and operation of the project. Monitoring is necessary and important not only to ensure compliance with regulations, but also to provide the management with information for control project activities and processes to ensure that environmental management targets / quality objectives both within and immediately outside of the project area are achieved. The project management should utilise the monitoring data to check for compliance and also as an indicator of the effectiveness of pollution control measures. Remedial measures should be taken in the event of non-compliance. There are three types Environmental monitoring are promulgated in the DOE guidelines.

12.1.1 Impact Monitoring (IM)

Impact Monitoring is the monitoring activities will be conducted after the proposed project is approved for implementation. This monitoring activities will be conducted to verify that the findings of the EIA study of the potential impacts identified during EIA scoping process are correct, appropriate mitigation and prevention measures are

properly implemented and the measures are effective in mitigating the adverse impacts to the environment.

12.1.2 Compliance Monitoring (CM)

Compliance monitoring is the monitoring activities that will be conducted to ensure that the EIA Conditions of Approval (COAs) are complied with. Environmental audit may also be carried out to assess the overall project compliance and opportunity for optimization and further improvement in environmental management of the project.

12.1.3 Performance Monitoring (PM)

Performance monitoring involve the monitoring the performance of pollution control systems and other mitigation measures.

13.0 STUDY FINDINGS

Though the project would benefit the residents, commercial and industrial sectors in the Chukai town, the project would also cause some significant impacts. The most significant impacts arise due to the project activities during the construction phase of the project are fragmentation of the forest reserve, loss of significant portion of forest reserve, flora and fauna including their ecological values and functions. During the operation phase of the project, large amount of floodwater will be diverted from one hydrological system to another system including to Binjai swamp, Tasik Bungkus and Sg. Bungkus, though such flood surge and dispersion is already occurring without floodway but in different scale. Flood diversion would intensify the surge significantly affecting hydrology, water quality and ecology of the receiving system though it is designed 50 ARI.

Some of the most significant impact which cannot be mitigated which required serious consideration and monitoring mechanism to minimize or nullify the impacts in course of time. This include loss of forest reserve, loss of biodiversity, possible sedimentation of Binjai swamp, Tasik Bungkus and Sg. Bungkus, impact on Sg. Yak Yah and Sg. Chukai riparian zones and fireflies colonies, impact on river terrapin (tuntung) and also socio-economic issues due to project development.

One of the important mitigations proposed for the project include permanent protection and gazettement of catchments of Sg. Bungkus and Sg. Chukai peat swamp forest or wetland as part of Kuala Kemaman Forest Reserve. Such protection would possibly and permanently protect entire Tasik Bungkus and Sg. Bungkus catchment areas including the fireflies colonies, their feeding grounds and host plants; fishery productivity including udang galah; and social economic benefit to the locals from ecotourism and fishery activities. Even if the current project is implemented effectively with sufficient mitigations measures, there is no guarantee that forest reserves, Tasik Bungkus and Binjai swamp would remain intact, upon noticing the ongoing disturbances and destruction to the area. Unless entire Sg. Bungkus and Sg. Chukai catchments are gazetted as part of Kuala Kemaman forest reserve, even the survival of Tasik Bungkus and Kuala Kemaman forest reserve are questionable.

It is important that the state government should implement any new housing and industrial development project at the high grounds and far from flood prone areas. The current flood issues are mainly due to initial settlement at the flood prone areas first by local residence which later expanded drastically into industrial and commercial town closer to estuary without proper planning and consideration for the seasonal floods. Subsequently, the flood woes is exacerbated due to human intervention and perturbation in the watershed. If the settlement was planned on high grounds the current hardship and economic losses could have avoided. Another important conclusion of the current study is, though possibly the Chukai town will be protected from the flood, the flood problems may shift from Chukai town to Binjai swamp area north and west of Chukai town outside the proposed bunds. Therefore, a comprehensive flood mitigation measures are needed somewhat simultaneously to resolve the flood problem at the entire Sg. Kemaman basin.