

EXECUTIVE SUMMARY

TITLE OF PROJECT

The project for which this Detailed Environmental Impact Assessment (DEIA) report has been prepared is known as the **Land Reclamation and Refinery Project at Sg. Limau Hydrocarbon Hub (SULIHH), Kedah**

PROJECT COMPONENTS

The proposed project is a part of the North Corridor Economic Region (NCER). The proposed SULIHH Project consists of several components, i.e.:

- Land reclamation off the coast between Kuala Sg. Limau and Kuala Sg. Kubang Busok, Kedah covering an area of 1,700 acres;
- Construction and operation of two trains of petroleum refinery plant, each with capacity to process 200,000 Barrels/day of crude oil imported from the Middle-East and their supporting facilities on the reclaimed land;
- Construction and operation of a power generation plant on the reclaimed land with capacity to generate 150 MW of electricity for internal usage of the refinery;
- Construction and operation of a Single Buoy Mooring (SBM) facility off the coast of Kedah to receive crude oil from Very Large Crude Carrier (VLCC).
- Construction and operation of another SBM facility at another location for export of petroleum products on smaller tankers.
- Construction and operation of submarine pipelines from the refinery to the SBMs.

STATEMENT OF NEED

Demand for Petroleum Product

The national and global demand for refined petroleum products has been growing in the last two decades and is expected to grow for the next decade. Closer to home, thriving economies such as China and India are quickly becoming large oil consumers is one of the major

contribution for world growth of oil demand. Global oil reserves can still cater for future refinery feedstock. There is a demand of refinery products as economic growth in Asia-Pacific region increases. Refinery capacities are low while demand is ever on the rise. Technology has reached a level where it can cope with over specifications for the next 20 years. The oil refinery development in Kedah is an opportunity for high economic impact project which would cater the demand for petroleum product.

Local businesses in services, materials and manpower providers are expected to benefit greatly. The oil refinery is also expected to attract other petroleum related businesses i.e. LPG bottling, lube blending and distribution in the area. Petroleum coke will be produced as by-product however it can become the source of fuel for a power plant. Petroleum coke also can be supplied to other industries i.e. cement, steel mills, electrodes, etc.

Local Commercial Viability

Asian refiners have survived a period of over-expansion and low margins. Throughputs were low as refiners could not cover incremental operating costs through simple equipment making fuels for international competition. From 2003, margins have improved allowing refiners to run at far higher rates and reap benefits of investments made in the 1990s. Costs of refining have fallen over the past decade as expansion projects went hand in hand with more intensive processing. Further improvement in refining costs profiles are anticipated as the margin cycle moves into a more expansive period. When refining cost is combined with rising demand in the medium term, the proposed project is expected to be commercially viable.

SITE SELECTION

The proposed site offers the following advantages (and hence has been selected for project implementation):

- Kedah is the first point of entry from the West to Peninsular Malaysia.
- It enjoys the most comfortable span outside the world's busiest shipping route.
- It is endowed with existing natural passage way and draft for extra large vessels.

The site has been selected to be on reclaimed land between Kuala Sg Kubang Busuk and Kuala Sg Limau. This justifications for the off-shore (i.e. reclamation) option has been made base on several reason as listed below:-

- Strategic national interest for food security, which the agricultural land in District of Yan need to be remain as it is and Kedah will be remain as major producer of rice in Malaysia.
- Socioeconomic advantage of reclamation will avoid the need to acquire land and relocate established community. There will be minimal land acquisition exercise to be carried out and would not arise disruption to social structure, loss of livelihood, abandonment of physical structures, financial difficulties and psychological stress. Cost of land acquisition, compensation and relocation will not be addressed in the project.

EXISTING ENVIRONMENT

Topography and Landuse

District of Yan covers an area about 24,177.78 hectares, including the 24,028.76 hectares of land under 5 mukim and 4 islands (Pulau Bunting, Pulau Songsong, Pulau Telor and Pulau Bidan) (149.02 hectares). From this total area, 16,296.80 hectares or 67.40 percent has been classified as agricultural area, while the remaining 3,123.50 hectares or 12.91 percent cover built-up areas including residential, commercial, industrial, institutional, transportation and recreational. Commercial area in Yan are located at the major settlement such as Bandar Yan (included Yan Besar and Yan Kecil), Pekan Guar Chempedak (Mukim Sala Besar), Pekan Simpang 3 Sg. Limau and Pekan Sg. Limau Dalam (Mukim Sungai Daun).

Topographically, Yan is generally undulating with almost 86.70 percent of the land less than 100 m above the mean sea level. Only 6.02 percent of the land is between 101 – 300 m above the mean sea level. The highest peak in Yan is Gunung Jerai with a height of 3,500 m above the mean sea level.

The major existing land use in the study area (5 km radius from the proposed project site) is agriculture (67.40 percent). The forest area encompasses of 15.52 percent scattered in Mukim Yan, Mukim Singkir and the islands. Other land use such as residential area, industry, commercial area, institutions, infrastructure and transport encompasses 12.91 percent of the land in the district.

Geology and Soils

The subsurface layering can be subdivided into three main components. The topmost layer is composed of very soft to soft silty CLAY. The Standard Penetration Test (SPT) n value of this layer is zero, with only a minimal value at its boundary to the layer below it. The thickness of this layer is 30.0 m at the coastline and increases progressively to 37.0 m offshore, approximately 1.48 km from the coastline. The second layer is composed of very stiff to hard clayey SILT. The SPT n values range from n = 20 up to a maximum value of n = 50. The thickness of this layer is between 9.0 m to 12.0 m. The third and lowermost layer is the bedrock at the proposed refinery site and has been logged as SHALE. The depth to this bedrock ranged between 40 – 50 m, increasing from the coastline towards offshore.

Climate

The study area lies entirely in the equatorial zone. The climate is governed by the regime of the south-west monsoon which blows from approximately between May and September. Being in the tropics, the average temperature throughout the year is constantly high (26° C). The diurnal temperature range is about 7° C. The humidity is high (about 80%) due to the high temperature and a high rate of evaporation, and the rainfall is heavy (more than 2500 mm).

Hydrology

The topography of the surrounding area is paddy field. Therefore, the land is generally flat. There is no extensive development within and around the study area. This situation influenced the surface flow which is regulated by Sg Sala and the other two main canals, namely Sg Daun and Sg Limau. Both canals are regulated whereby the waters come from Sungai Muda as part of the Rancangan Kemajuan Pengairan Sungai Muda, Phase 2 (CA = 4210 km²). There are three control (tidal) gates constructed, one at the river mouth of Sg Sala and the other two are at the river mouth of Sg Kubang Busuk and Sg Limau respectively. The function of these gates are to control water level fluctuation and salt water intrusion.

Water Quality

Recorded temperatures on site for water quality are between 26.9 to 29.0°C for August 2008 and 29.5 to 31.1°C for September 2008. This may be regarded as normal daytime

temperatures for tropical waters, indicating no presence of unusual heat discharges whether in the rivers or the coastal areas.

Salinity values of 33 to 34 ppt are normal values for Malaysian coastal marine waters, with the corresponding conductivity values of 54 -57 mS. The almost zero salinity and conductivity values for fresh river waters are normal for rivers not polluted by any industrial discharges.

Recorded marine water pH values of 7.8 to 8.1 indicate normal pH values for marine waters, which are expected to be slightly alkaline. The recorded river water pH values of 6.1-7.6 are also within normal pH range for river waters, which are slightly more acidic. All pH values may be regarded as within normal water pH range and are within the range for the Interim National Water Quality Standard for Malaysia (INWQSM) (Class IIB) pH range of 6.5 to 9.0.

Turbidity values of less than 10 NTU for most of the coastal water measurements indicate very clear waters. Higher values of several hundred were recorded in river waters at low tides indicating moderately turbid waters, although not seriously polluted as indicated by the moderate DO values.

Marine water DO values of 5.4-7.8 mg/L indicate well aerated coastal waters, while the lower values of 2.2 to 4.2 mg/L for river waters at low tides are on the low side, although the waters would still be aerobic. The low values may be due to natural organics in the river waters and are at present not harmful as the values are elevated during high tides. The higher values are normal for cleaner waters of Malaysia, for which the INWQSM Class IIB DO range is 5 to 7 mg/L.

Noise

In general, most of the existing day-time and night-time baseline noise levels measured at the selected noise sampling stations at the nearest residential and sensitive areas already exceed the permissible sound level. The ambient existing noise levels recorded at the noise sampling stations vary within the range 50.8-59.3 dBA during day-time (7.00 am to 10.00 pm) and 47.9-53.4 dBA during night-time(10.00 pm to 7.00 am), which is already higher than the maximum permissible level for lowly populated and noise sensitive areas (50 dBA day-time and 40 dBA night-time). At most stations, the dominant noise sources are due to human activities, traffics and tidal waves.

Air Quality

The ambient air monitoring results in the vicinity of project area at Yan are summarised as below:

- TSP at all monitoring locations ranged between 27.78 $\mu\text{g}/\text{m}^3$ to 97.22 $\mu\text{g}/\text{m}^3$. The lower value is due to the monitoring area covered with shrubs and grasses that can filter off the suspended particulates. The higher value is due to the monitoring area being exposed and uncovered road near junctions to the villages.
- The concentration of PM_{10} was detected at all monitoring locations that ranged between 13.89 $\mu\text{g}/\text{m}^3$ to 69.44 $\mu\text{g}/\text{m}^3$.
- Hazardous pollutants (NO_2 , SO_2 , CO and VOC) concentrations at all monitoring locations were considered as not detected, with values for NO_2 and SO_2 at less than 0.0042 mg/m^3 respectively, CO at less than 0.1 mg/m^3 and VOC at less than 0.333 mg/m^3 .

Marine Traffic and Navigation

The study area is the waterfront along the coast from the northern extremity of Kuala Kedah Port Limits, in the north, and up to the estuary of Sungai Merbok, between Tanjung Dawai and Tanjung Perpat in the south; and for a distance of about 15 nautical miles (27.8 kilometres) offshore. Based on information from the latest nautical chart of the area, the 20 metre ACD depth contour lies a minimum distance of 6.5 nautical miles (12 kilometres) from the shoreline, whilst the 30 metre ACD depth contour lies a minimum of 10.8 nautical miles (20 kilometres) from the shoreline. There is a submarine communication cable from Langkawi to Kuala Muda that passes along the coastline of the study area at a minimum distance of 11.5 nautical miles (21.3 kilometres) from the existing shoreline.

Kuala Kedah to the north is the major fishing port, being the home port for hundreds of fishing boats of various types. There are numerous estuaries of rivers that are havens for local fishing boats of various sizes which engage in various types of fishing in the near coastal as well as off shore waters. Those nearest to the proposed reclamation project are Kuala Sg. Kubang Busok and Kuala Sg. Sala to the north and Kuala Sungai Limau and Kuala Sungai Sedaka to the south. Fishing vessels of various sizes and types, ranging from small sampans up to large powerful fishing boats work offshore the coastline of the proposed reclamation site. During calm weather, the wide coastal mud flat is the fishing ground for fishermen using nets ('Pukat Sering Belachan') pushed by small boats to catch tiny prawns used to make

belachan. There are large boats which work to catch ikan bilis, as well as trawlers. These large vessels may sometimes work in pairs, they fish between 5 and 20 nautical miles offshore. Drift net fishing boats fish up to five nautical miles from the shore, whilst others fish at greater distance. It should be noted that off parts of the Kedah coast, certain types of fishing is prohibited within 12 nautical miles of the shoreline, however such fishing is still often carried out within this prohibited zone.

Kuala Kedah is the base for ferries which serve the route: Kuala Kedah to the Port of Kuah on Pulau Langkawi. Regular scheduled passenger ferries connect Kuala Kedah port with the Port of Kuah on Pulau Langkawi. However, the ferry route from Kuah, Pulau Langkawi to Kuala Kedah, is well away to the north and does not cross the study area.

There are regular line towed barges connecting Kuala Kedah and Kuah; these carry vehicles and general cargo. There are some small cargo vessels which link Kuala Kedah to Penang and ports in Indonesia (Belawan and Aceh) and south western Thailand, (Satun Port).

Dredgers work at Kuala Kedah, usually during daylight hours only. The channel in the Sungai Kedah estuary has to be dredged every two years, the type of dredgers used are both the clam shell type and Trailer Hopper Suction Dredgers (TSHD). These dredgers will only transit the Kedah coast when being deployed and when leaving the area.

The Port Operations and Port Control Station Centre, call sign “Kuala Kedah Port Control” is operated by the Marine Department, Kuala Kedah, and is in operation around the clock. A continuous radio watch is maintained on VHF Radio Hague Plan Safety and Calling Channel 16.

Land Traffic

Basically, the K1 state road is in good condition and a traffic study surroundings the proposed project site was carried out. The traffic study was done on a typical weekend and on two typical weekdays at three junctions namely junction A (K144), B (K142) and C (K366). From the analysis, it is found that all the junctions are in good condition within the LOS of A to B range with the maximum delay at junction C of 10.8 seconds which in a tolerable one. Travel time study was also carried on these junctions and found to also in good condition.

Marine Plankton Community

A total of 24 genera of phytoplankton including 18 genera of diatoms (Bacillariophyta), 5 genera of dinoflagellates (Pyrrophyta) and one genus of blue-green algae (Cyanophyta) have been identified. Diatom cells are the most dominant in all samples collected. Among the most common genera of diatoms are *Chaetocerus*, *Ditylum*, *Skeletonema*, *Thalasionema*, *Thalassiosira* and *Thalassiothrix* while *Ceratium*, *Gonyaulax* and *Prorocentrum* are most common dinoflagellates. The blue-green algae, *Trichodesmium* sp. is commonly found at all sampling stations. In terms of diversity, the coastal areas recorded higher number of genera with 19-22 genera per station as compared to the offshore stations close to the proposed SBM locations that recorded the lowest number with 17 genera.

Marine Macrobenthos

The abundance of macrobenthos ranged between 820-4800 individuals/m². Apparently, sampling stations which are located at the edge of intertidal area recorded the highest abundance as compared to the other stations. The density gradually decreases in the deeper waters and the lowest abundance is recorded at proposed SBM locations with only 820 and 927 individuals/m². The Shannon Weiner and Evenness indices range between 2.42-2.74 and 0.37-0.41 respectively.

Intertidal Community

The coastline and intertidal areas of Yan district are characterized by mudflats. Remnants of mangrove species are found along the intertidal areas as well as the river mouth. The shore fauna that inhabited this area are represented by several groups of epi- and in-faunal invertebrates. Among the most abundant are small fiddler crabs such as *Ocypode ceratophthalma* and *Uca* sp. There were some species of mudskippers, bivalves, gastropods and hermit crabs. These species are common in mudflats, muddy sandy beaches and intertidal areas of the West Coast of Peninsular Malaysia. At Pulau Bunting, most intertidal area is covered by rocky shore and some patch of narrow sandy beaches. As expected, the common inhabitants are isopods *Ligia* sp., barnacle (*Chythamalus* sp.), Oysters (*Saccostrea* sp.) and limpets (*Siphonaria javanica* and *Cellana* sp.) and gastropods (*Nodilittorina* sp.).

Coral Reef and Sea Grass

There are no coral reefs and sea grass habitats in the proposed reclamation area and the SBM locations due to very muddy seabed characteristics. The shallow waters of Yan coastline is

also very turbid and this seawater profile do not permit the hermatypic corals and sea grasses to grow due to lack of light penetration that needed for photosynthesis.

However, at a small cove at Pulau Bunting called Teluk Nipah, a small coral reef do exist. The reef is found in a very shallow (about 2-5m) water and about 20 m from the beach. The size of the reef is about 30 m wide and about 10 m in length.

Fisheries

In term of fishery activities in District of Yan there are 216 registered fishing vessels and 460 fishermen with 16 fishing bases. Only 10 fishing bases in Yan are actively used. The majority of the fishing activities (about 75 %) are in Zone A (areas within 5 km from the coastline) and the other 25% are in Zone B (areas more than 5 km from the coastline). Kuala Sungai Limau is the closest active fishing base to the proposed project area. At Sungai Kubang Busuk fishing base, there are no fishing vessel registered according to Kedah Fishery Department (unpublished), suggesting no or minimal fishery activities.

Cultured brackish water fishery production in Kedah fluctuated between 500 and 1300 tons/yr. Shrimps (e.g. tiger prawn) and fishes (e.g. sea bass and snappers) are the major components that are cultured. In the District of Yan, there are no registered brackish cage culture practice. However, there are 17 brackish water ponds found with the production of 35.5 ton/yr; that is about 6% from the total brackish water production in Kedah.

Terrestrial Flora

The species composition identified in and around the project site indicates a flora of mixed vegetation type, whereby the front most zone just behind the marine beaches is made up of strand vegetation with characteristic species such as *Exocaria agollocha* (buta-buta), *Avicennia alba* (api-api) and *Hibiscus tiliaceus* (bebaru). Right behind this zone is the lowland scrub vegetation, whereby a mosaic of herbaceous species are found such as *Euphatorium odoratum*, *Morinda citrifolia* and *Mimosa pigra*. The last zone is the paddy cultivation area found in the flat zone up to foot of Gunung Jerai.

Terrestrial Fauna

Generally vertebrate life recorded is poor. Large wildlife of conservation interest is largely non existent, apart from the occasional civets (*Paradoxurus hermaphroditus*, *Veverra zibentha* and

Viverra zibetha), otters (*Amblyonyx cinerea* and *Lutragale perspicillata*), Malayan flying fox (*Pteropus vampyrus*) and water lizards (*Varanus nebulosus* and *Varanus salvator*). A number of snake species are reported from or encountered in the project area. Among the species encountered are the king cobras (ular tedung selar, *Ophiophagus Hannah*).

Socio-economy

A survey was conducted among 200 household heads who reside within 5 km radius from the proposed project as respondents. It was found out that 96.5 percent are within the economically active population and majority of the respondents finished secondary school. In terms of employment, 66.5 percent work as farmers, 20.5 percent are fishermen and the rest work as civil servants, in the private sector and traders, and about 3.0 percent have no stable jobs. Earned income of the majority of the respondents is in the range between RM500 to RM999 per month and the monthly expenditure are also between RM500 to RM999 per month. With regards to awareness, 82.5 percent are aware of the proposed project and for overall evaluation, 83.5 percent of the respondents agreed the proposed project would be very beneficial and bring advantages as well as creating more job opportunities to the surrounding areas.

Public Health

The morbidity rate for dengue fever/dengue hemorrhagic fever in the District of Yan is 38 cases per 100,000 population which is low when compared with incidence rate for the state of Kedah (103 per 100,000 population) for 2005. However, the rate increased in year 2006 and 2007, to 85 and 116 per 100,000 population, respectively. Both rates are higher compared to the national rate of 64 cases per 100,000 in 2006. Possibility of outbreak of dengue fever in this area is at a high potential of occurrence. The study also found that the disease of respiratory system and skin problem is the commonest illness treated at health clinics from 2005 to 2007 which might due to open burning of household wastes by the locals.

The community survey found that hypertension is the commonest disease being diagnosed among respondents followed by heart problem and upper respiratory tract infection. There are cases of patients admitted in hospital in Yan due to uncontrolled hypertension and heart attack. There was one case of a patient being admitted due to chronic obstructive pulmonary disease (COPD) which usually occurs among smokers and those who are exposed chronically to air pollutants either in environment or in workplace.

POTENTIAL IMPACT AND MITIGATING MEASURES FOR RECLAMATION ACTIVITY

Topography and Landuse

The reclamation project does not propose any changes in land use category of the mainland area. The paddy area will remain as it is. The Project Proponents planned to allocate a 500 m buffer zone within their project area that delineates between the hazardous facilities of the proposed refinery and the paddy field. The buffer zone shall be used to locate the administrative building, workshops, warehouse, car parks, fire station building, electrical sub-station, open spaces and other facilities that are non-hazardous.

Influx of workers from outside the area, either permanent staff of the proposed refinery or short term contract workers will require living accommodations, either permanent or temporary. Local authorities such as “Majlis Daerah Yan” or “Jabatan Perancangan Bandar dan Desa” therefore should plan for new residential areas with supporting amenities and commercial facilities to accommodate such new population.

Geology and Soil

The top layer of the seabed is relatively weak for infrastructure development, especially the construction of heavy structures, without the introduction of soil improvement and stabilization measures. Vertical wick drains will be used for the process of dewatering and soil compaction while monitoring for ground settlement will implemented until 95% consolidation is achieved. Surcharging on the fill material will ensure decent compaction.

Surface Hydrology

The main impacts to the marine environment during reclamation are related to the sediment plume dispersion from the site. Sediment sources might be due to winning of reclamation material or transfer of this material from the temporary dump site. Hence, contractor need to ensure that the sand source has a low content of fines (the assumed percentage silt/mud was 10% in the simulations). Laying of the silt curtain around the reclamation prior to infilling, will minimise dispersion of sediment. Hydrodynamic modeling results on sediment plume dispersion shows that the extent of suspended sediments are controlled and localized and the concentration is less than 10 g/m³.

Water Quality

Material filling activity during reclamation would lead to temporary increase in turbidity and suspended solids of the sea water. A temporary increase in turbidity would also be expected due to dirt on rock and bottom layer disturbance during placing of rock material for revetment. Waste minimization should be implemented by proper placing of rock material and proper calculation of rock sizes for each layer.

The sea wall will only be constructed at the parameter which is facing the sea. A potential impact which can be attributed to this activity is the dispersion of deposited material if the sea wall is not sufficiently long to prevent waves impacting on fill materials. The construction involves transportation of the concrete blocks to the perimeter of the proposed reclaimed area and placing the blocks into the water. The impact of this activity would be temporary increase in water turbidity due to stirring up of bottom sediments. This impact is limited to the section of the wall undergoing construction only. A shorter time would be taken for the water turbidity to return to the existing condition since the sea water in the area is rather shallow. Oil and grease in the water is also expected to increase due to oily spillage from machinery and sea vehicles used during the construction works. In minimizing the impacts, the project proponent has to ensure proper design of the sea wall and the quality of construction work is up to specifications to avoid leakage of fill material. In general, careful operation and supervision, good selection of equipment, and proper maintenance of equipment could minimize the turbidity and oil and grease during construction work of the bund.

Soil compaction is necessary in the reclamation process as this activity improves soil stability and hastens consolidation of soil. Once the land filling and soil compaction are completed, surface erosion due to water run-off from the reclaimed land could pose a temporary impact on water quality. The run-off can carry suspended solids that would eventually increase the suspended solids contents of the receiving sea water in the Straits of Malacca. Silt traps need to be erected near the end of water flow sections before the run-off enter the sea.

Air Quality

Dust from soils stuck to the tyres of the lorries leaving the construction site for the access road and the reclamation area and then travelling onto the metalled road would be churned up and deteriorate the air quality along the travelling route. Actions by the wind will increase the suspended dust and can affect the visibility of the area. The situation will be worse during

very hot and dry days. The lorries may emit dark smoke from the diesel engine exhaust. A temporary water trough should be constructed to wash the tires of the lorries before travelling onto the main roads. The water from the washing should be channeled into a silt trap to reduce the suspended solid content before discharging to the drainage system. Exposed ground surface and access road should be sprayed with water in order to minimize the impact of fugitive dust.

Noise

Construction of access road will involve the use of many noisy vehicles around the proposed alignment. The impact of overall noise level emitted from this construction can be minimised by restricting noisy construction activities to between 7:00 am and 8:00 pm only when working close to residential areas. It is also recommended that noisy construction works should be minimised during weekend and public holidays when working close to those areas.

The frequent flow of heavy vehicles and long trailers for carrying construction materials to the construction site will inevitably increase the existing noise level in the surrounding area. Residents and villagers living nearby the access roads to the proposed SULIHH site used by such vehicles will be affected by these activities. Noise level emitted from the transportation of fill material activities can be controlled by scheduling the movement of the heavy vehicles during day-time only, when travelling close to residential areas. To minimise traffic disruption, transportation involving slow moving vehicles may have to be done at night or during other off-peak period. It is also recommended that all heavy vehicles be checked for proper installation of engine silencer to reduce the emitted noise level.

Pumping and leveling activities within the reclamation area will involve the use of many noisy vehicles including bulldozer and back-pushers. Since occupants at nearby residents and villagers are more than 200 m away, they will not be affected during such activities. The impact of overall noise level emitted from the sand pumping and leveling activities can still be further minimised by constructing a temporary hoarding at the boundary of the reclamation area with the mainland.

Land Traffic

It is expected that there will be traffic obstruction along the K1 public road during the construction of the access road. When the access road is ready to be used, transportation of heavy equipment such as cranes, construction vehicles and materials to the reclaimed land for refinery construction may cause localised traffic congestion to the surrounding area and may cause difficulties to road users at and along the road especially at the junction with the access road. An increase of traffic volume especially lorries has a tremendous strain on the present traffic condition. Occasional breakdowns of construction vehicles to and from the construction site may also affect the smooth flow of traffic.

To mitigate this public inconvenience, proper signage are to be erected to alert road users within 500 meters before the junction of the access road with K1 road. There must be a traffic controller to manually manage the traffic flow at the junction to avoid serious accidents. Road warning lights and dummies need to be erected according to standards and requirement of Local Authorities and Public Works Department.

Marine Traffic and Navigational Safety

The marine craft that may be used during the reclamation phase include tug boats and line towed barges; dredgers (clam shell) and/or Trailer Hopper Suction Dredgers (TSHD); work boats and crew boats. The expected impact arising from these movements of the marine craft is marine traffic congestion and safety. To mitigate such impact, all rules and regulations, both local and international, appertaining to the manning, registration, licensing, operation, routing, equipping and management of marine craft shall be strictly complied with. All vessels involved with the project may need be vetted by inspectors from the Marine Department and must comply with all the safety and other requirements of the Marine Department. All marine traffic arrivals, movements and departures should be fully reported to the Kuala Kedah Port Control by VHF radio, and the instructions and advice of the Port Control should be closely followed. A restricted area will need to be established to encompass each and every working area, and all work areas should be clearly marked by day and by night with lighted markers buoys. All fixed and movable structures, such as piling barges, construction frames and platforms, floating pipelines, etc., must be well illuminated by night and be clearly visible by day. The additional marine traffic generated by the construction work will need to be closely monitored by the authorities. There may be a need to implement local rules so as to minimise any potential accidents which may occur.

Marine Ecology

The total loss of benthic community of the reclaimed area is expected. During the reclamation works, turbidity levels of the sea water would increase that reduce light penetration and dissolve oxygen around the area where filling activity is taking place. Since there will be silt curtains around the reclamation area, dispersion of sediments and hence increase in turbidity of the sea water will be localized. Marine life outside the reclamation area would not be affected.

Terrestrial Flora and Fauna

An access roads will be built connecting the existing Yan-Sala coastal (K1) road to the project site. There will be a loss of insignificant amount of terrestrial flora and fauna due to the construction of the access road. However care is to be taken to avoid dispersion of sediment to the adjacent paddy fields especially during rainy days so as not to affect the growth and yield of the planted paddy.

River Ecology

The river system and the MADA irrigation canals will not be disturbed. Thus there will be no impact on to the freshwater aquatic life.

Agriculture

During the construction of the access road and a stream crossing, there will be an obstruction for movement of paddy field machinery (e.g. harvesters and ploughs) near the project area, especially the area crossing the access road. The flow of drainage water distribution in the irrigation system will be disturbed and thus, it will affect the harvesting period, yield per hectare and eventually the income of farmers.

The Project Proponents should consider short term rental for the whole affected paddy fields during this construction period for the loss of crops on the top of payment for the land acquired or leased.

Socio-economy

The local fishermen will have to find other fishing grounds to make their catch since their traditional fishing area at the reclamation site is lost. This may incur extra operating cost in terms of fuel to be used in their boats to travel to other fishing areas further away. The

Project Proponents should consider negotiating with representatives of fishermen or the Fishermen Association together with representative from the Department of Fisheries on how best to deal with the lost of the fishing ground due to the reclamation project. The fishermen may be provided with jobs with the Project Proponents or be paid compensation due to incurrence of extra cost to continue with their trade.

Public Health

Dengue fever and dengue hemorrhagic fever have been identified to be the main environmental health issues at the project area during the reclamation process coupled with the problem of high dispersion of dust due to land transportation of fill materials for the on land fill activities. Mitigating measures are very important to prevent dengue fever and dust exposure to workers and vicinity communities. Drainage alteration for all small rivers should always be monitor according to zones with regular inspection. All water retainers should be dispose, cover or fill with earth. Water storage should be cover to keep out mosquitoes. For personal prevention, a mosquito repellent can be applied during daytime. For dust, workers should wear face mask to protect them from particles inhalation. Frequent watering of the temporary road should be carried out to reduce the dispersion of dust. Workers should be screened regularly for their health status. For communities, active reporting of any health problem particularly related to dust exposure and dengue fever should be encouraged. Public education regarding the communicable diseases and vector should be conducted regularly together with local authority agencies.

POTENTIAL IMPACT AND MITIGATING MEASURES FOR REFINERY AND ASSOCIATE FACILITIES

Impacts and mitigating measures for the construction of the refinery and associate facilities including the power plant and the tank farm on the reclaimed land, placement of the Single Buoy Moorings (SBMs) and the laying of the submarine pipelines are presented. However, the impact assessment and recommendations on mitigating measures relating to operation and maintenance of such facilities are not done when this DEIA report was prepared. Impact assessment during operation of the facilities such as Atmospheric Emission Dispersion Modelling, Noise Modelling, Water Quality Modelling, Thermal Plume Modelling, Oil Spill Modelling, Quantitative Accidental Hazard Risk Assessment and Environmental Health Risk Assessment cannot be done because preliminary design data required as inputs to the relevant

models have not been made available yet to the EIA consultants. These assessments shall be included in a supplementary report to be reviewed at a later stage.

Construction of Refinery and Associate Facilities on the Reclaimed Land

Geology and Geotechnics

In terms of geotechnical aspects of the reclaimed land, the effects arising from the construction activities would be minimal since the facilities will be built after the soil has achieved 95 % consolidation. The proposed cement treated base (CTB) access road would not be damaged during transportation of construction materials and equipment by lorries and trailers. The strength of the CTB access road would be enough to support heavy vehicles. To prevent damage to the existing public roads and the new access road, only construction vehicles with their loads that weigh less than the designated axle loads of the existing roads be used.

Water Quality

The temporary base camp will only affect water quality if sewage and sullage are improperly discharged which can lead to increase in BOD level of the receiving water bodies. The presence of workers at the site would generate sewage, sludge and garbage. Potential pollution of surroundings and downstream water bodies by sanitary wastewater can be minimized by providing sufficient number of mobile toilets and treating the effluent from the toilet and the sullage in self contained septic tank system to be approved by the Ministry of Health and/or the Ministry of Housing and Local Government. Covered garbage bins should be provided and garbage should be collected everyday and disposed in a Majlis Daerah Yan municipal waste landfill.

Construction materials will be brought in by lorries and deposited at depots or directly to the project site. Improper storage of construction materials such as cements, lime, granite stones, crusher run, sand, etc. and fuel/lubricants for the equipment may lead to spillage and can contaminate surface and groundwater. Uncovered sand and aggregates at the stockpile area may easily get washed away by running water and eventually end up accumulating in nearby streams and coastal sea water. Transportation of the construction materials can cause spills if the lorries are overloaded. Overloading could also cause road damage, thus exposing the road to erosion. All the impacts would increase water turbidity in nearby water bodies. However such impacts are short term during the construction period. The lorries carrying the

construction materials should not be overloaded and should be properly covered. It is recommended that specification clauses be included in contracts to ensure that contractors make a reasonable effort to minimize such impacts.

Air Quality

Vehicles threading on exposed ground will churn out the dust into the atmosphere. Any strong wind will increase the suspended dust and can affect the visibility in the nearby areas. The mud from the wheels of the lorries can also increase the dust level along the access roads and the public roads and can affect the safety of the road users. Spillage from lorry loads can also increase the dust levels in the air. Air pollution can also be caused by the exhaust emissions of moving vehicles going to and from the construction site. Hoarding which can serve as a wind screen should be erected along the boundary of the project site and along the access roads near the residential areas. Water trough should be installed at the exits of the construction site to prevent mud from being carried to the public roads. Any dirt or mud carried to the main roads should be immediately cleared as required under Section 47 of Street, Drainage and Building Act 1974 (Act 133).

Noise

During construction stage, it is expected that activities will involve the use of noisy equipment including cranes, bulldozers, excavators, graders, piling machines, trucks and other heavy machinery. The noise are due to the diesel engines that drive these equipment which can effect nearby village residents. The impact of overall noise level emitted from the construction equipment stage can be minimized by restricting noisy construction activities to between 07:00 am and 8:00 pm only. It is also recommended that all heavy vehicles be checked for proper installation of engine silencer to reduce the emitted noise level in compliance with the Emission Standards, Environmental (Motor Vehicles Noise) Regulations 1987 (Environmental Quality Act 1974).

Land Transportation Traffic

There will be an increase of heavy vehicles carrying construction materials and equipment travelling to and from the construction site, leading to increase in traffic volume of slow moving heavy vehicles. Traffic near the junction to the project site can become congested that could lead to serious accidents if there are no precaution to the road user in relation to the heavy vehicles movement. Slow moving vehicles to and from the construction site should be

restricted to off peak time only. Signage to warn road users of slow and heavy vehicles coming out and going into the access road at the junction with the public road need to be put up at least within 500 m distance. Signage and temporary traffic lights need to be endorsed and approved by local authority or the Public Works Department (JKR).

Waste Management

A large volume of construction wastes comprising wood wastes, chemicals and their containers, metal and plastic wastes, waste oils, etc, will be generated. Improper management of these can lead to ground, water and air pollution. As far as possible, the waste resources should be recovered, whether for reuse, such as wood wastes, or sale, such as metal parts and plastic containers. Reuse should be designed for, so that materials such as forming wood may be reused at another point, within or outside the site. Designated collection bins or areas for different wastes to be recycled or reused should be provided so that while the construction is on-going, workers may segregate wastes by depositing them into designated collection bins or areas.

It is estimated that there will be about 1,500 workers employed during the construction phase. These workers will generate about 1,500 kg/day of solid municipal wastes (garbage) that need to be managed properly. Improper management of these wastes would lead to odour, flies and pollution of the Straits of Malacca waters. Regular garbage collection should be carried out and be properly transported in garbage trucks to prevent spillage of garbage and leachate. Garbage should be disposed at an approved facility or municipal waste landfill of Majlis Daerah Yan.

There will be sewage and sullage generated by the workers, estimated to be about 300 m³/day. The sewage treatment plant (STP) should be ready before construction starts. If the STP is not yet ready, the facilities provided during construction should include sufficient number of mobile toilets and centralised kitchen and bathing facilities with sullage collection and onsite treatment. Sullage on-site treatment facility may be a simple screening followed by ponding-cum-filtration sand bed.

Socio-economy

Construction labour force will either be among the locals or from other parts of Kedah or from other states or by recruiting foreign labour. They will be residing on-site at temporary base camp. This would lead to increase in demand for various amenities, facilities, goods and services, food, etc. However, the construction works may require that food stalls and shops be located at some distance from the construction site for health and safety reasons. Existing food stalls and shops that are very near to the project site will be affected by this requirement and thus would affect the livelihood. Measures must be taken to provide alternative sites for the existing food stalls and other affected business concerns in order to minimize impact on income and livelihood.

Public Health

There is a risk of outbreak of dengue fever in this proposed project area. The biohazard identified is the vector for dengue fever which need clean water for their breeding activity. Clearing of the area during construction phase might cause mobilization of the *Aedes* vector into the inner and bigger inland area. All parties must ensure that all containers like food polystyrene, packages and other water potential containers should be properly disposed, covered or filled with earth accordingly. Water storage containers in workers camp such as tanks, drums, and others should always be covered to keep out mosquitoes and Abate (temophos) is to be added into the water to kill larvae. Workers should be screened regularly for their health status especially if they develop fever and skin rash. They must practice clean and healthy living lifestyles and be able to take preventive actions.

Laying of Submarine Pipeline

Water Quality

With the use of the floating crane and excavator to dig up a trench in the seabed, there will be a possibility of oil and grease that might be released into the sea. Pipeline laying activities would increase the turbidity of sea water, which would also lead to degradation of the surrounding water quality. Silt curtain may need to be installed on a temporary basis, where the trenching and laying activities are to be carried out to minimize the impact of water turbidity.

Air Quality

Use of diesel engine for the floating crane and excavator, may emit black smoke into the atmosphere and thus degrade the air quality. However, due to the far distance of the submarine pipe laying site to any populated area, the impact is expected to be insignificant.

Marine Ecology

Transportation of pipes, fittings and welding consumables within the alignment of the submarine pipeline would adversely affect fishery by the consequential physical disturbance of shoals of fishes and the possible migration of fish to other quieter areas. The impact would be in temporary basis and the ground will be back to normal after this activity is finished.

Marine Navigation and Traffic Safety

The vicinity of the proposed alignment of the submarine pipeline are fishing grounds for many local fishermen, who carry out fishing by both traditional and modern methods and derive their income from fishing. Shoals of fish may be temporarily dissipated arising from vessel movement for laying the submarine pipelines. Drift net used by the fishermen may be damaged by getting caught up at vessels and work boats used for laying the submarine pipelines. Vessels involved with the laying of the submarine pipeline will have to pass the offshore shipping routes when arriving at or departing from the work site, thus there is a chance of some marine traffic impacts at these times. All relevant authorities, including the Fisheries Department, etc., must be informed well in advance of any operation starting, and any required approval should be obtained, in addition this will enable local notices to fishermen, in addition to Notices to Mariners and Port Circulars issued by the Marine Department, if this is deemed necessary. Good vessel management and good seamanship practices, as well as close cooperation with the local fishermen will help to prevent, or will at least minimise, any damage to fishing gear.

Socio-economy

The major impact to socio-economic condition of local people will be a loss of fishing ground, which means a reduction of fish landing rate and subsequently less income of local fisherman. The impact would be permanent when the pipeline alignment is gazetted as no anchor zone which prohibit any fishing activities. The Project Proponents should consider negotiating with representatives of fishermen or the Fishermen Association together with representative from the Department of Fisheries on how best to deal with the lost of the fishing ground due

to the laying of the submarine pipelines. The fishermen may be provided with jobs with the Project Proponents or be paid compensation due to incurrence of extra cost to continue with their fishing activity but at other areas.

Construction of SBMs and PLEM

Marine Traffic and Navigational Safety

The installation of the SBMs and placement of PLEMs will require specialised vessels and their attendant tugboats, barges and work boats. Other marine traffic, in the immediate vicinity of the site of the proposed SBMs may consist of small work boats, survey boats, diving boats, buoy-laying vessel, piling barges, etc. Work within the confines of the area where the SBMs and PLEMs are to be installed will not directly impact upon most commercial marine traffic, as the areas are in waters which are currently not along, or very close any major navigation route. No SBM should be sited to seaward of the Pulau Langkawi to Kuala Muda submarine telecommunication cable so as to ensure that the submarine pipelines will not cross the submarine cable.

IMPACTS AND MITIGATIONS DURING OPERATION OF REFINERY AND POWER PLANT

Waste Management

Scheduled wastes can be in the form of waste lubrication oils, chemicals, solvents, etc. Improper management and storage of scheduled wastes could lead to spillages and input of toxic materials into the sewage treatment plant (STP). This may adversely affect the operation of the STP, leading to under performance. When discharged to drains, the Straits of Malacca water quality will be affected. Scheduled wastes should be managed according to the Environmental Quality (Scheduled Wastes) Regulation 2005 (EQ(SW)R 2005). Practice of waste minimization would minimize scheduled wastes generation.

There will be generation of solid wastes comprising plastics, paper, cloth, cardboards, packings and other non-scheduled wastes. Improper management of such garbage will lead to littering, odour, flies and pollution of surrounding water bodies. As much of the waste resources should be recovered for sale as possible, such as plastic materials, paper, cardboards, cloth, etc. These should be baled and sold to recyclers.

Water Quality

The wastewater stream that will be generated during the operation of the refinery could be quite significant. The proposed effluent treatment plant should be properly setup and commissioned to ensure that it is operating well at all time and could handle the loads which could arise during normal and abnormal operation of the proposed refinery complex. The effluent treatment plant should be designed such that discharges would comply with Standard B of EQ(SIE)R, 1979, so as to maintain the water quality of the water bodies.

Marine Ecology

Oil spill may occur directly from tankers or pipelines. The oil spillage is known to be harmful to marine biodiversity, its habitats and possibly fisheries. The highest risk will be at SBMs, and along the submarine pipelines. Oil spill contingency plan should be prepared with acquisition of all necessary equipment (sorbent material, oil boom, dispersants, etc) to combat any accidental spills.

Socio-economy

Employees of the refinery will require a suitable and decent residential environment furnished with educational facilities, utilities, amenities and consumer services which are already provided in Yan District. The increase in the number of people will enhance the economic and commercial activity in the region also and it is beneficial to the local community. At the same time, there could also be a rise in the cost of living, which in turn will create difficulty for the local communities. There will also be foreign employees who may get involved in conflicts due to different social background and if this remains unchecked, it may affect the sense of community and community structure. In order maintain and enhance the beneficial impact to the local community, job opportunities and business activities within the refinery plant as far as possible be offered to the local population. Foreign employees should be educated about the local culture and sensitivities in order to keep and maintain harmonies in the society. Project proponent should embark on programs to integrate their foreign employees with the local community.