EXECUTIVE SUMMARY

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Project Proponent

Lynas Malaysia Sdn. Bhd.
PT 17212, Jalan Gebeng 3, Kawasan Perindustrian Gebeng, 62080 Kuantan, Pahang D.M.
Contact Person:
Dato' Mashal Ahmad (Vice President/Managing Director)
Dr. Ismail Bahari (General Manager, Radiation Safety and Regulation)
E-mail:
Mashal.Ahmad@lynascorp.com
IBahari@lynascorp.com

Gading Senggara Sdn. Bhd. (Project Operator)
Noo. B-58, 1st Floor, Lorong IM 8/33, Taman Mahkota Putra, Indera Mahkota 8, 25200, Kuantan, Pahang D.M.

EIA Consultant

AGV Environment Sdn. Bhd.
100-06-035, Block J, 129 Offices, Jaya One, No 72A, Jalan Universiti, 46200 Petaling Jaya, Selangor D.E.
Contact Person:
Datin Dr. Vijayalakshmi Samuel (Director and Principal Consultant)
Ms. Tan Kim Fong (Director and Principal Consultant)
Ms. Maria Violetta Thomas (Principal Consultant)
E-mail :
vijayalakshmi@agvenvironment.com
kimfong.tan@agvenvironment.com
maria@agvenvironment.com

Overview

Project Location

Involves the establishment of a permanent disposal site for WLP and its access road.
Located within Bukit Ketam, in the District of Kuantan, Pahang

- 30 km north of Kuantan Town
- 23.5 km west of Lynas Advanced Material Plant
- 0.1 km west of the Terengganu border
- 11 km south of Cheneh Baru, Terengganu

Land Area

The Project site occupies an area of 143.95 ac (58.25 ha). Components include:

- PDF Cells - 1.29 ha (27.9 ac) or 19.4%
- Access Road - 26.11 ha (64.53 ac) or 44.8%
- Ancillary Facilities - 20.88 ha (51.52 ac) area or 35.8%

Located within an area earmarked for the development of a Multi-Category Industrial Scheduled Waste Disposal Site (MCISWDS) which occupies a land area of 500 ac (202.35 ha)

Legal Requirement

Based on the prescribed activities listed under the *Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order, 2015,* the proposed Project is captured under the:

Second Schedule:

- Activity 17, Radioactive Materials and Radioactive Waste: Any activity specified in this Schedule and the First Schedule using radioactive materials and generating radioactive wastes.

Activity 17 has been triggered through the requisition of a Class G license under Act 304 enforced by the Atomic Energy Licensing Board (AELB). A Class G license is required for the disposal or storage of radioactive materials or their waste

The Project also captures the:

First Schedule:

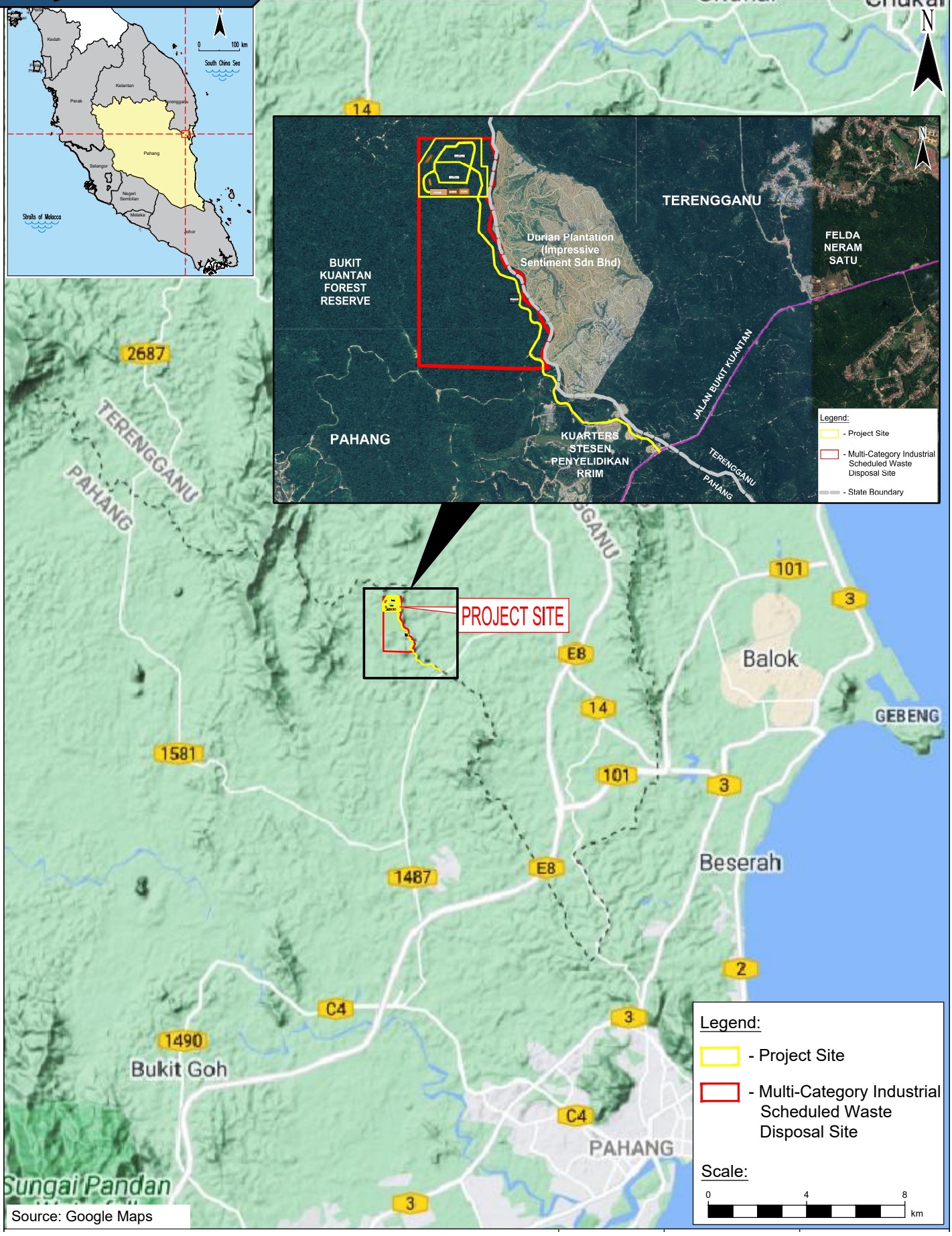
- Activity 12, Development in Slope Area: Development or land clearing less than 50 per cent of an area with slope greater than or equal to 25˚ but less than 35˚.
- Activity 20, Road (c) Construction of road, tunnel or bridge traversing or adjacent or near to environmentally sensitive areas.

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Project Location



Source: Google Maps

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Statement of Need

Management of By-products

WLP has been categorized as Very Low Level Waste (VLLW) by the Atomic Energy Licensing Board (AELB), therefore requiring its own personal disposal site

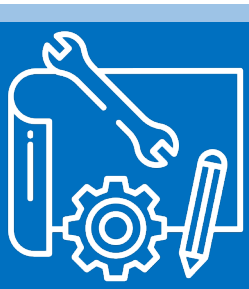
Commercialization of WLP Residue

Research indicates beneficial properties of WLP to be used for road construction, soil ameliorant & backfilling material. The Malaysian Government has instructed Lynas to dispose the WLP in a PDF

License Approval Condition

Milling of materials and associated substances are under the purview of AELB (Radioactive Waste Management Regulation 2011). The WLP is currently store in a Residue Storage Facility (RSF)

Project Background



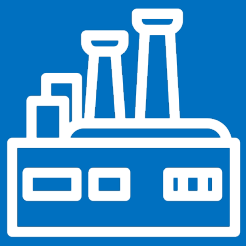
Project Background

Lynas Advanced Material Plant (LAMP) began operations in 2013, located within the Gebeng Industrial Estate (GIE)

By-products generated from the Cracking & Leaching process:

- Neutralisation Underflow (Schedule Waste – SW205)
- WLP (VLLW)

WLP is non-toxic, non-corrosive and non-ignitable. The WLP has very low radioactivity (shielded by 1 cm of clay) and very low permeability (5.6 X 10^{-9} m/s)



LAMP Production

Input	95,000 tonnes /year of lanthanide concentrate
Output	22,500 tonnes/year of high purity lanthanide compound: • SEG-HRE Oxide • Lanthanum (La) Oxide • Cerium (Ce) Carbonate • LaCe Carbonate • Didymium Oxide

Current and Future Storage of WLP

RSF	Volume (m^3)
RSF 1	68,349
RSF 2	53,742
RSF 3	99,729
RSF 4	14,8000
RSF 5 (till September 2023))	99,826
Balance storage within WLP RSF 5	211,390
Future WLP RSF (up to March 2023)	35,6719
TOTAL	1,037,756

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Project Concept

Project Components

Development Component	Unit	Hectares (ha)	Acres (ac)	%
Administrative Building				
Administrative Building	4	0.03	0.07	0.08
Shed	1	0.002	0.005	
Roofed Courtyard	1	0.01	0.02	
Compact Substation	1	0.003	0.007	
Guard House	1	0.0005	0.001	
Permanent Disposal Facility				
PDF Cell A	1	5.21	12.87	8.9
PDF Cell B	1	5.75	14.20	9.9
Leachate Treatment Plant (LTP)	1	1.02	2.52	1.8
WLP Lagoon	1	0.90	2.22	1.5
Detention Pond	3	0.92		1.6
Green Area				
Green Area		18.51	45.74	31.78
Access Road				
Access Road	4 km	4.58	11.32	2.26
Buffer	-	21.33	52.71	36.61
TOTAL				
		58.25	143.95	100

PDF Cells and WLP Lagoon Design

Details	Cell A	Cell B	WLP Lagoon
Embankment Fill Height	10.5m–22m	5m–24.5m	5.5m-11m
Outer Slopes Protection	1(V) : 2(H) Rip-Rap Stones		
Inner Slopes	1(V) : 1.5(H)	1(V) : 1.5(H)	1(V) : 2(H)
Berm Height	5m		
Berm Width	1.5m		
Fill Type	Compacted Earth Fills		
Thickness of WLP Emplacement	12.5m – 16.5m	10m – 19.5m	-
Total Capacity	600,000 m^3	750,000 m^3	40,818 m^3

Access Road Design

Description	Value
Length	4.0 km
Lanes	Single Carriageway
Minimum Lane Width	3.5 m
Shoulder width	3.0m
Slope Gradient	7% (maximum)
Cross Section	1st Layer: 40mm Asphaltic Concrete Wearing Course 2nd Layer: 60mm Asphaltic Concrete Binder Course 3rd Layer: 250mm Crushed Aggregate 4th Layer: 200mm Sand Sub-Base (California Bearing Ratio > 30%)

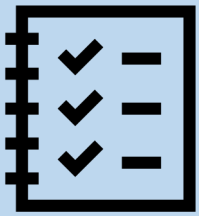
Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Project Characteristics and Development

Pre-Construction Phase



- Soil investigation
- Topographical survey, existing and proposed land use survey
- Agencies approval
- Environmental baseline monitoring

Construction Phase

Site Clearing

- Removal of existing flora and stripping of topsoil
- The estimated area to be cleared is 490,000m^2

Earthworks, Slope Cutting and Filling

- Includes excavation, backfilling, compaction, embankment placement and slope stabilization.
- Construction of water courses and silt traps

Installation of Drainage, Liners and Temporary Facilities

- Liners will be installed for the WLP cells and lagoon
- Subsoil drainages will be connected to a collection sump

Construction of Temporary Facilities

- WLP Transfer Station (WTS)
- PDF site security, access control station and fencing
- Drop-off zone and parking area
- Assembly area , site cabin and canteen
- Workshop

Operational Phase

Lorries will be used to transport the WLP from LAMP to the PDF, and subsequently into the PDF cells. Emplacement of PDF will be conducted in phases. Loading and unloading of WLP will be conducted following strict SOP.

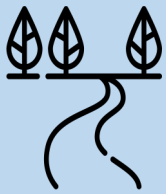
Closure and Post-Closure Phase

The PDF will be capped once capacity has been reached. Secure capping liners will be used and topped with earthfill and landscaped

PDF Liner and Leachate Management

1. The WLP will sit on a raised platform which Provides a 5 m separation between the WLP residue and groundwater
2. Platform and dual liner material will have low permeability and/or high adsorption coefficient
3. Top internal subsoil drainage will consist of 450 mm aggregate with 200 mm diameter collection pipes for leachate collection
4. An HDPE geomembrane liner 2 mm thick is placed below the top subsoil drainage to prevent migration of active surface runoff
5. A 5 mm geosynthetic clay liner with bentonite is an effective shear-resistance hydraulic barrier
6. A bottom subsoil drainage system consisting of a 300 mm thick sand layer and a subsoil drainage aggregate installed at intervals to intercept any possible leakages

Inactive Surface Runoff



Inactive (surface runoff that does not come in contact with WLP) will be directed into detention ponds and will be gradually released into Sg. Ara tributaries.

Active Surface Runoff

Active contaminated runoff includes the following:

- Supernatant liquors in contact of WLP residue
- Surface runoff within the PDF Cells of the emplaced WLP residue

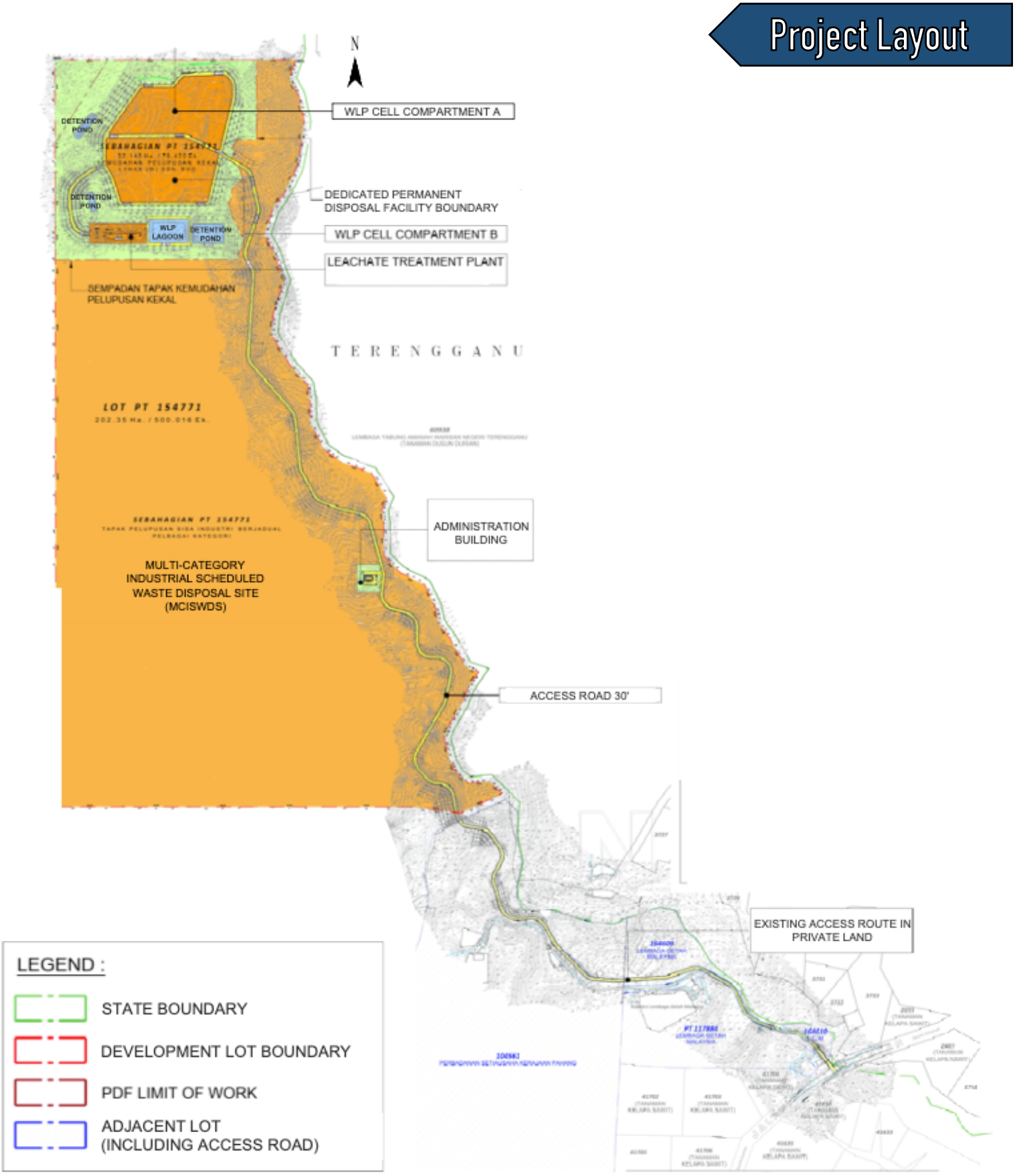
The WLP lagoon will provide preliminary water treatment (oxidation) before conveyed into the LTP. Leachate collected within the PDF will be the transferred to a central collection sump prior to treatment in the LTP. The LTP will operate throughout the operational, closure and post-closure phases. The influent will be treated to a more stringent level than Standard A (Industrial Effluent)

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Project Layout

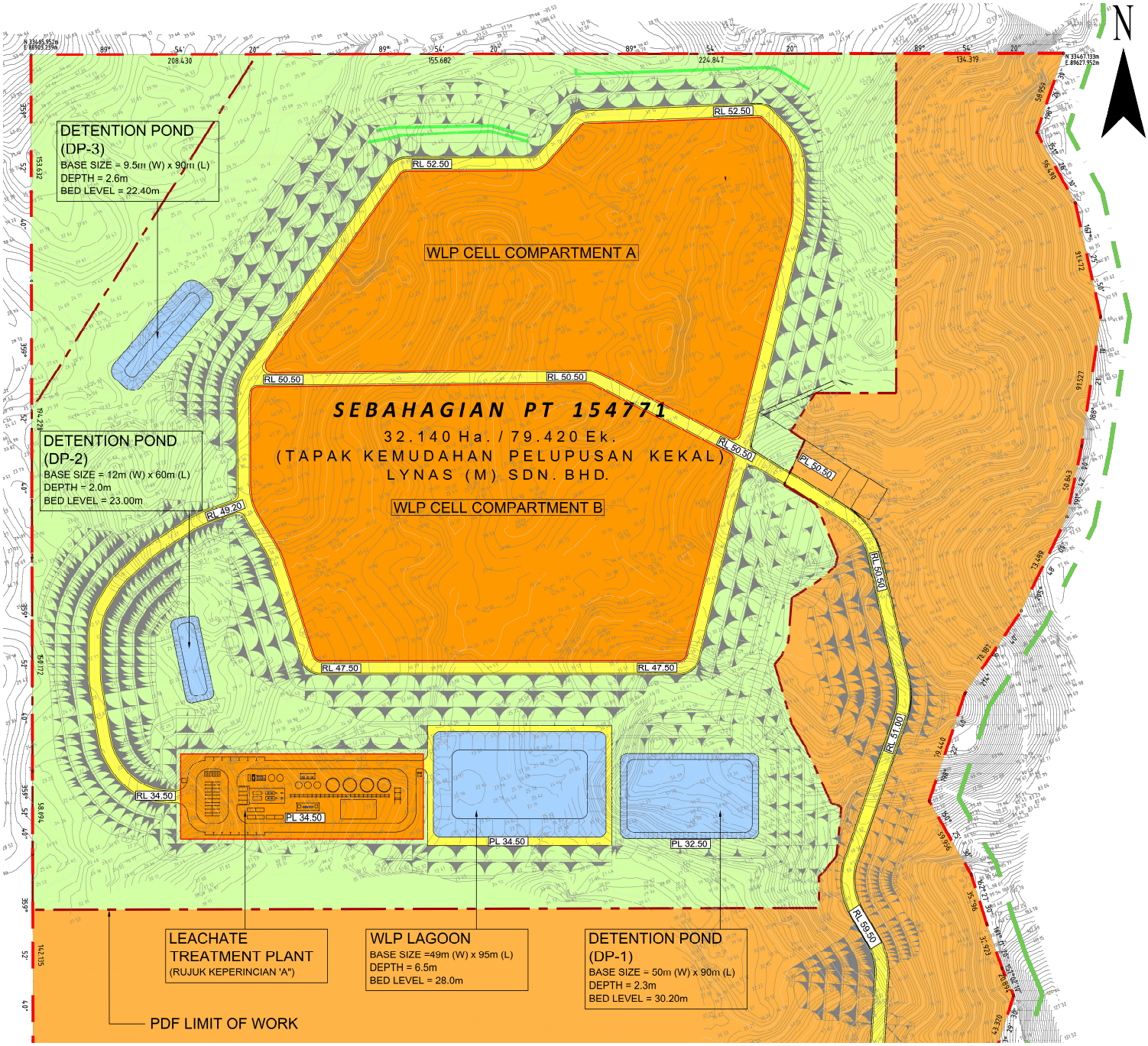


Executive Summary

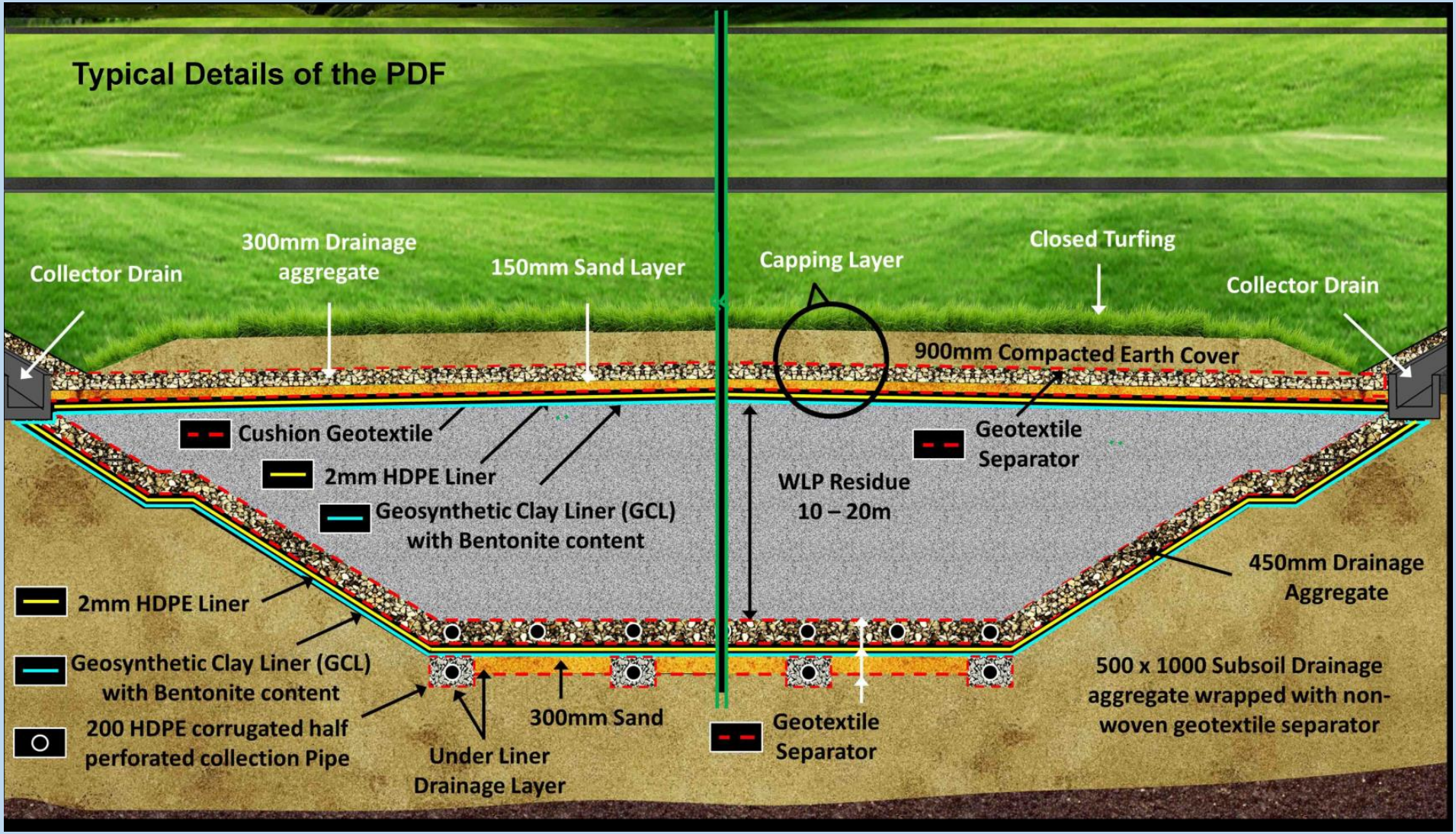
Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

PDF Layout



PDF Cross-Section



Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Existing Environment

Topography

Undulating hills and depressions consisting mostly of slopes < 25°. Elevation ranging between RL 20m – RL 126 m

Soil

Low permeability fine grained residual soil weathered from argillaceous phyllite, slate with interbeds of fine-grained sandstone

Geology

Quaternary alluvial deposits with interlayering of silt, sandy silt and sand or soft clay of Beruas and Simpang Formation with intrusions of Permian – Jurassic granite.

Hydrology

Located within Sg. Kuantan Basin

Major sub-catchments include Sg. Ara and Sg, Riau eventually flowing into Sg. Kuantan. Water from the region does not flow into the state of Terengganu. Kg. Kobat Raw water intake is located 30.5 km downstream along Sg. Kuantan, supplying water to Bukit Ubi Water Treatment Plant (WTP) and Semambu WTP. No prior flood events have been noted.

Aquatic Ecology

- 5 phyla of phytoplankton
- 3 phyla of zooplankton
- 3 phyla of macrobenthos
- 13 species of fish
- Active shore and boat based angling

Hydrogeology

Medium aquifer level. Groundwater flows towards the south. Pahang-Terengganu border ridge forms a groundwater divide. Deep groundwater flows east towards the Pahang coastline

Climate & Meteorology

Wind Speed

Fluctuates between 1.0 - 2.4 m/s
Highest average in February (2.1 m/s)
Lowest average in October (1.4 m/s)

Rainfall

Highest average in December (701.5 mm)
Lowest average in March (110.1 mm)

Rain days

Highest average in November (22.4 days)
Lowest average in March (10.0 days)

Temperature

Highest average in May (28.1°C)
Lowest average in January (25.8°C)

Relative Humidity

Highest average in January (86.9%)
Lowest average in March (82.4%)

Terrestrial Ecology

Recorded species include:

- 31 plant species
- 6 bird species
- 9 species of mammals

Wildlife is considered scarce due to past human activities. The primary forest has been logged over

Most recorded species were classified as 'Least concern' under the IUCN classification barring a few including:

- Pig-Tailed Macaque
- Malay Tapir
- Binturong

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Existing Environment

Community Health

- The National Cancer Registry recorded 821 breast cancer notifications in Kuantan (2007-2016)
- 194 breast cancer notifications in Kuantan (2007-2016)
- According to the Department of Statistic Malaysia 2020, Vector borne diseases , communicable diseases, vaccine preventable diseases and sexually transmitted diseases were within the acceptable range for Kemaman and Kuantan

Traffic

Study was emphasized on the unsignalised T-junction at Jalan Bukit Kuantan, Federal Route 1487 to the RRIM Quarters. The junction provides a very good level of service (LoS A).

Socio-Economy

Located within the Pahang state, bordering Terengganu. Kuantan is the most populous district in Pahang, whereas Kemaman is the second most populous district in Terengganu

Seismic and Tsunami Risk

Major earthquakes are rare due to the distance of Malaysia with plate boundaries. Faults (Bukit Tinggi fault zone) are classified as inactive. Hence, earthquake and tsunami risk is considered insignificant

Land Use, Landscape and Visual

Located 32 km north of Kuantan Town. Nearest sensitive receptor is the RRIM complex, located 2.1 km south. A durian plantation is located 100 m east of the Project site. The closest dense residential development (FELDA Neram 1) is located 3.0 km east of the Project site. Locality within a water catchment area indicates a Rank 2 classification for Environmentally Sensitive Area (ESA)

Air Quality

All measured parameters comply with MAAQS limits except for $PM_{2.5}$

Groundwater

Exceedance was recorded for BOD, COD, iron and manganese

Water Quality

Exceedance was recorded for pH, DO, BOD, COD, TSS, turbidity, fecal coliform and total coliform

Noise

All noise results were within the Schedule 1 Limit (Recommended Permissible Sound Level (LA_{eq}) by Receiving Land Use for New Development)

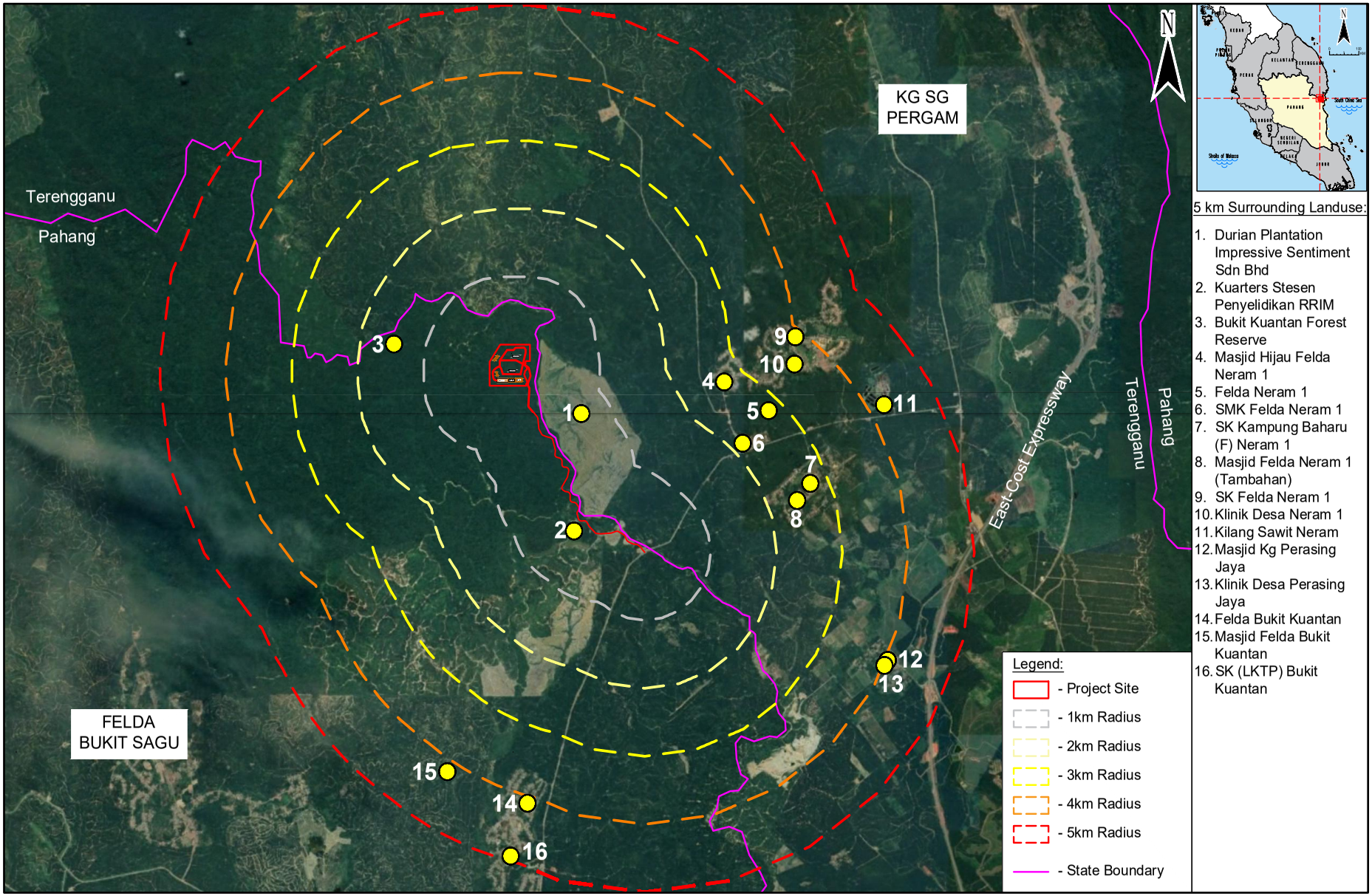
Vibration

Recorded vibration levels were generally below the caution level (Recommended Limits for Human Responses and Annoyance from Steady State Vibrations)

Existing Radiation Level

The radiological assessment is based on results obtained from the Baseline Radiological Monitoring Program (BRMP). Parameters include external radiation levels, soil samples, airborne dust and water for ^{238}U, ^{232}Th, ^{226}Ra, ^{228}Ra, gross alpha and beta. Monitoring was conducted within the expected zone of impact. All monitoring results were within the expected ambient range.

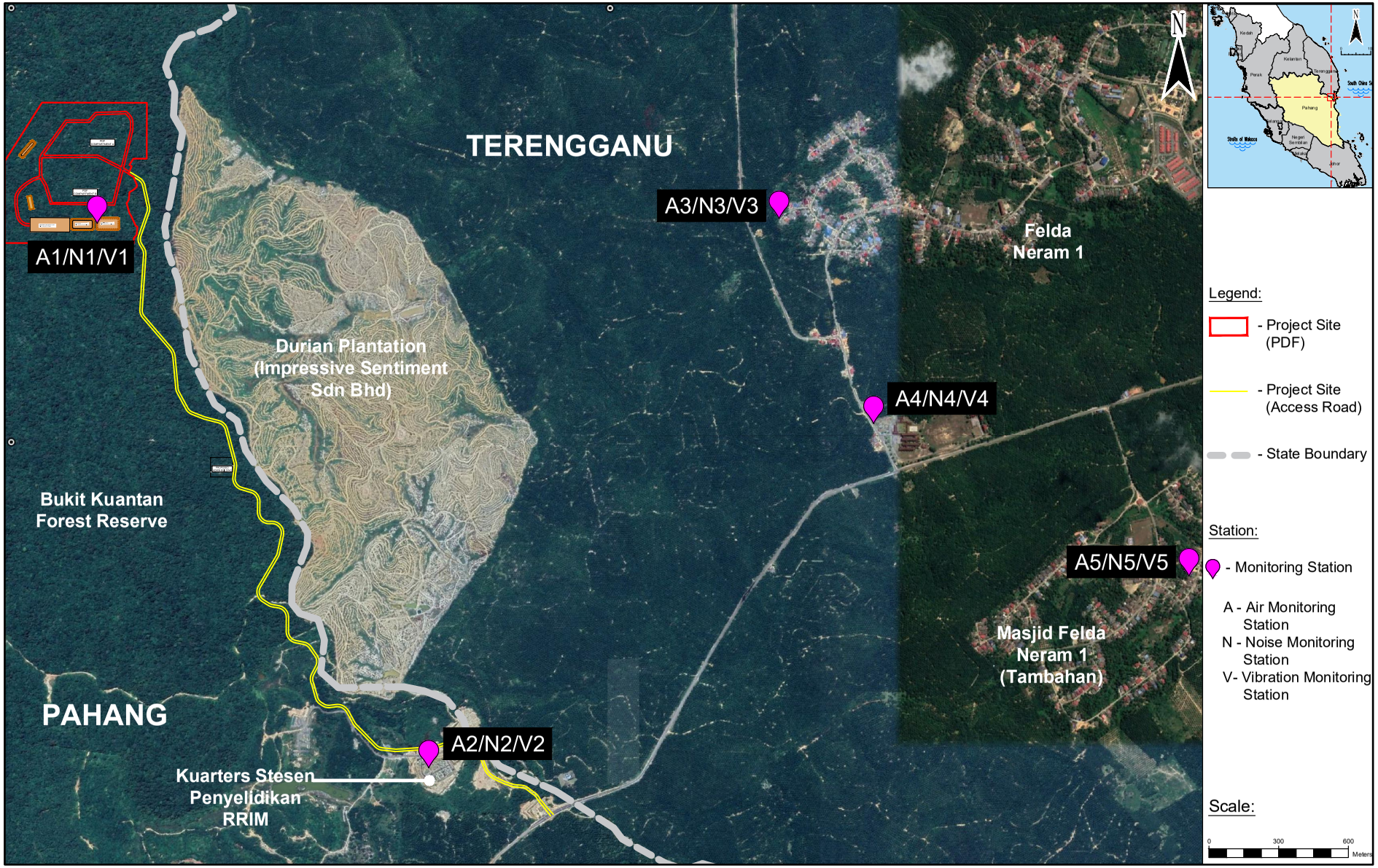
5-km Land Use



5 km Surrounding Landuse:

1. Durian Plantation Impressive Sentiment Sdn Bhd
2. Kuarters Stesen Penyelidikan RRIM
3. Bukit Kuantan Forest Reserve
4. Masjid Hijau Felda Neram 1
5. Felda Neram 1
6. SMK Felda Neram 1
7. SK Kampung Baharu (F) Neram 1
8. Masjid Felda Neram 1 (Tambahan)
9. SK Felda Neram 1
10. Klinik Desa Neram 1
11. Kilang Sawit Neram
12. Masjid Kg Perasing Jaya
13. Klinik Desa Perasing Jaya
14. Felda Bukit Kuantan
15. Masjid Felda Bukit Kuantan
16. SK (LKTP) Bukit Kuantan

Air, Noise and Vibration Monitoring Station



Executive Summary

Environmental Impact Assessment (2nd Schedule)

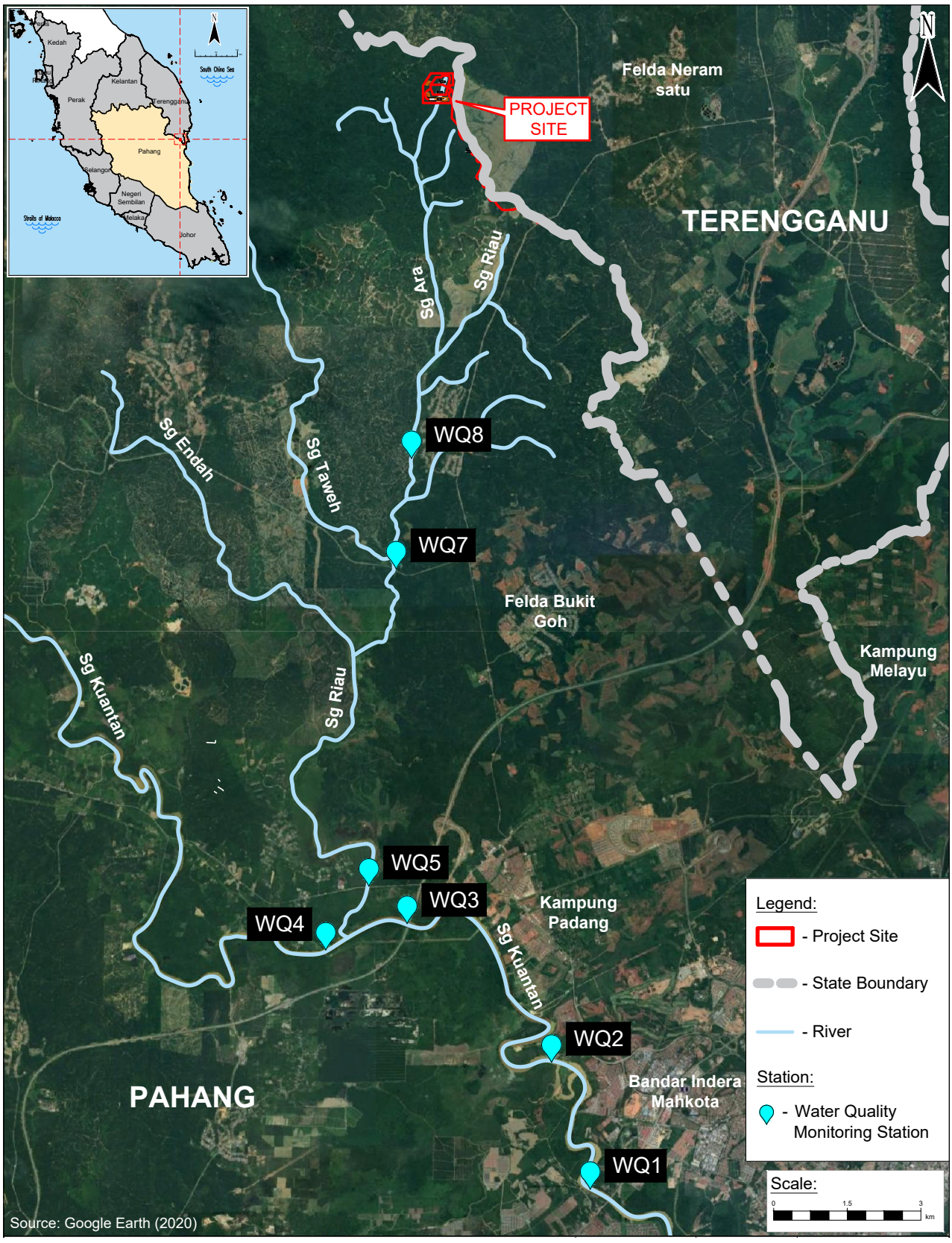
Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Water Quality Monitoring Station

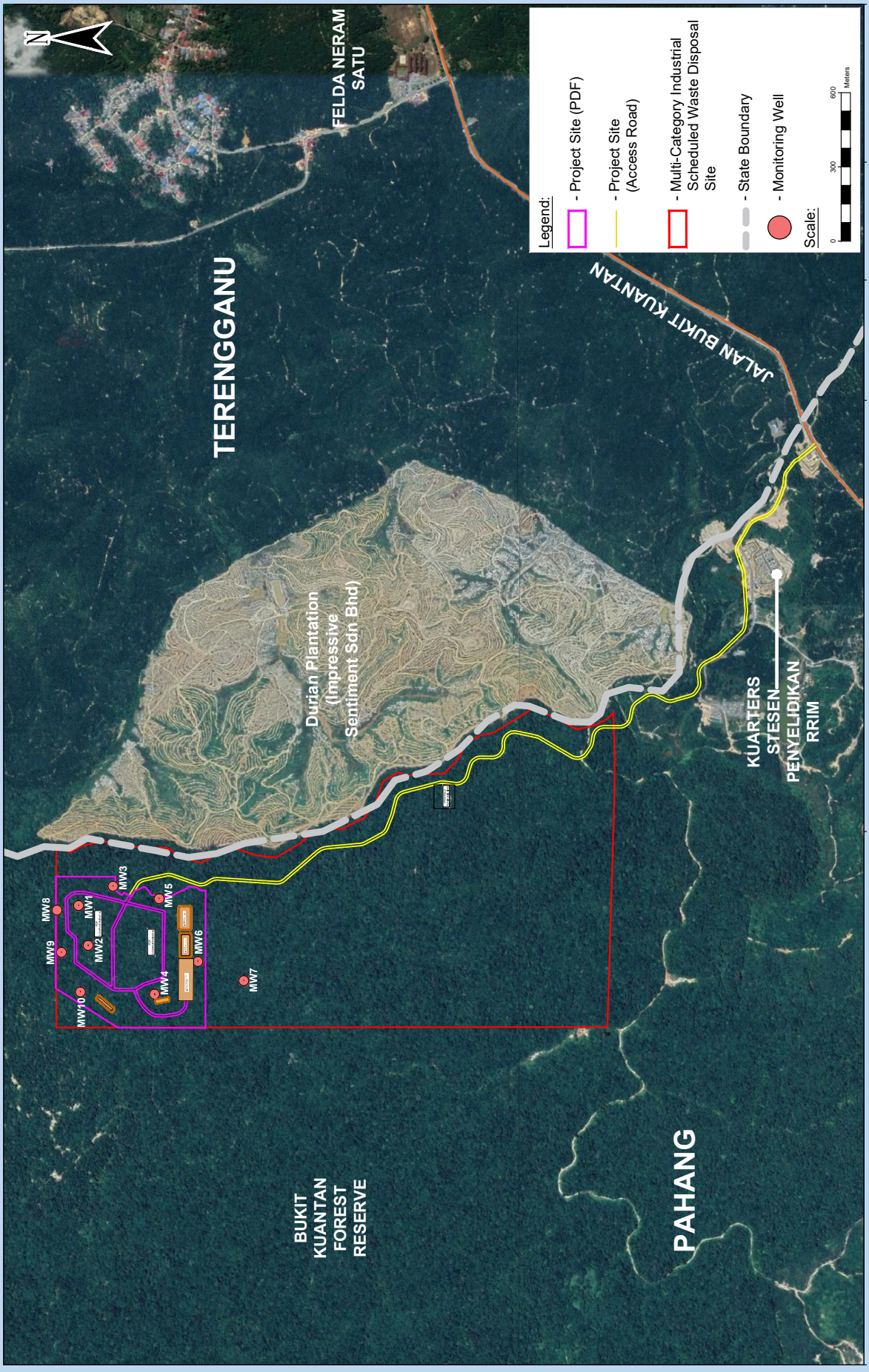


Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Monitoring Wells Location



Impact Assessment

Hydrology & Water Quality

Modeling Impacts

- Modelling was conducted using the MIKE11 HD module for temperature, DO, pH, TSS, Ba, Cr, Pb, Hg and radionuclides (^{232}Th and ^{228}Radium). The modelled scenarios are shown below:

Scenario	Description
1: Baseline	To establish the existing WQ condition without the Project during normal flow condition
2: Construction	Simulation during construction phase which mainly concerns the TSS during design storm
3: Operational	Simulation during operation period, which includes treated effluent discharge from LTP and radionuclides during low flow
4: Worst-case	Simulation for 8 hours of LTP failure resulting untreated raw influent entering the river during low flow. Simulation includes radionuclides

Scenario 1: Baseline Condition

- DO is generally lower in Sg Riau compared to Sg Kuantan
- Low pH was reported in Sg Riau, whereas pH in Sg Kuantan is closer to neutral levels. All pH levels were within the Recommended Raw Water Quality Criteria (RWQC) by the Ministry of Health (MOH)
- Pb, Ba, Cr and Hg were below the laboratory detection limit. Hg models for all scenarios were below the detection limit

Scenario 2: Construction Phase

- Temperature in scenario 2 was lower then scenario 1 due to the larger inflow of Sg. Riau caused by rainfall
- An increase in TSS and stagnant water at the confluence reduces DO required for photosynthesis, therefore reducing the growth of sensitive aquatic life in the long run. The DO deficit recovers upon entering Sg. Kuantan
- pH increase is still within the RWQC limit and the National Water Quality Standard (NWQS)
- Despite the increase in TSS, Ba, Cr and Pb concentrations remain low

Scenario 3: Operational Condition

- The increase in temperature is due to high temperature effluent released from the LTP
- Drop in DO prior to entering Sg. Kuantan is due to stagnant water at the confluence of Sg. Riau and Sg. Kuantan. The low baseline DO combined with the LTP effluent resulted in further reduction in DO levels. Despite of this, the DO deficit seems to slowly recover upon entering Sg Kuantan
- Increase in pH is still within the RWQC and NWQS limit
- TSS showed a significant increase in concentration, showing accumulation as it approaches the confluence where the water is slow-moving
- Modelled Ba, Cr and Pb concentrations are low
- ^{232}Th mass concentration was significantly reduced upon entering Sg. Kuantan. ^{228}Radium was already at a low concentration, becoming negligible as it enters Sg. Kuantan.

Scenario 4: Worse-Case Scenario

- Temperature, pH and DO showered similar trends to scenario 3
- TSS peaks higher compared to scenario 3 due to higher input concentration. However, the overall trend remains similar.
- Ba, Cr and Pb remains low
- The mass concentration of radionuclides (^{232}Th and ^{228}Radium) are higher then in scenario 3. However, the concentration was significantly reduced upon entering Sg. Kuantan

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

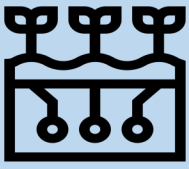
Impact Assessment

Geotechnical Assessment

- Geotechnical consideration focuses on the stability of the perimeter, embankments, divider embankments and basin as well phasing of the PDF in impact prevention. Basal reinforcements and retaining structures are incorporated into the PDF design to the desired Factor of Safety (FOS)
- For the access road impact assessment is focused on the stability of the fill embankment, cut slopes and high risk existing slopes. Existing slope stability and soil nails at required for best management of slopes at the access road
- The estimated total settlement is in the order of 25 – 103 mm for the road and embankments within the PDF site and less than 250 mm along the access road.

Soil Erosion

- Existing condition soil loss rate is 4.207 t/ha/yr for the PDF and 3.08 t/ha/yr for the access road
- For the worst case condition, a soil loss rate of 185.29 t/ha/yr for the PDF and 4.33 t/ha/y for the access road is expected . This is considered a substantial increase in soil loss compared to existing conditions
- With mitigation measures, soil loss rate is reduced to 74.05 t/ha/yr for the PDF and 1.37 t/ha/yr for the access road



Hydrogeology

Impact Modelling

- The Visual MODFLOW Flex was used for groundwater modelling
- Modelled parameters include SO_4, Ba, Pb, Cr, Hg and Zn. Ni and radionuclides ^{232}Th and ^{228}Ra were also monitored for scenario 2

Scenario 1: Simulation Result of Present Level of Topography

- SO_4, Ba, Pb, Cr, Hg and Zn contamination plume would be transported through the top layer of the model to downstream over a 10,950-day (30-year) simulation period. The lack of contaminant movement is likely due to the very low hydraulic conductivity of the top layer (stiff sandy silt)

Scenario 2: Simulation Result of Elevated Ground Surface with Compacted Fill Material

- The model was conducted as per the elevation of the PDF design in which compacted material was added to the existing topography. The northern part of the proposed disposal site (Cell A) was raised to 35 m while the southern part of the disposal site (Cell B) was raised to 30 m
- SO_4, Ba, Pb, Cr, Hg and Zn do not show significant downstream movement. Compacted material used for the elevation of the PDF is able to retard the plume movement more significantly.
- Ni, ^{232}Th and ^{228}Ra are exceptionally low and insignificant in contributing to contamination of the Project site

Conclusion

- Potential contaminants from the breach of the PDF liners will only travel a few meters at low concentrations
- Under worst-case scenario, contaminants moving following the groundwater flow will leave the Project site in approximately 50 years and will be captured in monitoring well MW6 and MW7
- Migration of contaminants including radionuclides are slow due to the low permeability of the soil

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Impact Assessment

Geology and Seismicity

Construction Phase

- Existing soil conditions provide good bearing capacity as the foundation for construction
- Low Peak Ground Acceleration (PGA), therefore, no seismic impacts are expected

Operational Phase

- Geological conditions will not affect PDF operations
- Pahang is far from known seismic epicenters, therefore no impacts are predicted

Ambient Air Quality

Construction Phase

- AERMOD air quality modelling was used to predict the Maximum Incremental Average Concentration (MAIC) for PM_{10}, 24 hours averaging time and annual average for 3 scenarios and compared to the Malaysian Ambient Air Quality Standard (MAAQS) 2020

Scenario 1: Construction Works Without Any Form of Mitigation or Control Measures

- The predicted 24-hours MAIC and annual MAIC at all sensitive receptors for PM_{10} were below the MAAQS 2020 prescribed limit of 100 µg/m³ and 40 µg/m³ respectively except at the RRIM complex and SMK FELDA Neram 1
- The 24-hours averaging time Ground Level Concentration (GLC) i.e. with the addition of Background Level (BL) exceed the prescribed limit of 100 µg/m³ of the MAAQS 2020 for all sensitive receptors
- The predicted annual MAICs for all off-site receptors were all below the MAAQS 2020 prescribed limits

Scenario 2: Construction Works with Emission Control Efficiency of 35% Through Periodical Water Spraying for the Project Site and Unpaved Access Road

- The predicted 24-hours MAICs and annual MAICs for all off-site receptors were all below the MAAQS 2020 limit except for the RRIM complex
- The 24-hours averaging time GLC exceeded the limit especially at the RRIM complex and FELDA Neram 1
- The predicted annual MAICs for all off-site receptors were below the MAAQS 2020 prescribed limits

Scenario 3: Construction Works with Emission Control Efficiency of 90% Through Revegetation of the Project Site and Control Efficiency of 84% Reduction with the Application of Gravel for the Unpaved Access Road

- The predicted 24-hours MAICs, GLCs and annual MAICs for all off-site sensitive receptors were all below the MAAQS 2020 prescribed limits.

Operational Phase

- CALINE4 was used for air modeling with emphasis on the transportation route. Modelled parameters include particulate matter with size less than 2.5 micron ($PM_{2.5}$), CO and NO_2
- Calculated 24-hours average derived from the calculated maximum 24-hours averaging time concentration for $PM_{2.5}$ are below the MAAQS 2020 prescribed limit of 35 µg/m³ for all sensitive receptors.
- Maximum averaging time concentration for CO and NO_2 due to vehicular emissions were below the MAAQS 2020 standards.

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Impact Assessment

Noise & Vibration

Construction Phase

- Sound pressure levels were modelled using procedures from ISO ISO 9613-2: Acoustic – Attenuation of sound during propagation outdoors
- Predicted noise source includes on-road lorries, off-road lorries, excavators, back pushers, bulldozers, roller compactors, cranes and water bowser lorries
- The predicted cumulative L_{max} levels were within the recommended limit of 90 dB(A) with the predicted levels ranging from 54.6 dB(A) to 65.3 dB(A)
- Vibration impacts are not expected as there no residential buildings within the Cosmetic Damage range of 25 m as well as the Human Response range of 100 m

Operational Phase

- Modelling was conducted along road segments, using traffic density to predict the estimated noise volume at each segment
- The predicted cumulative LAeq levels at the sensitive receptors ranged from 54.3 dB(A) to 58.6 dB(A). The anticipated community response to noise is expected to be nought
- Vibration impacts are expected only in extreme circumstances such as traffic induced ground-borne vibrations

Aquatic Ecology

Construction Phase

- Water quality deterioration along Sg. Riau, mainly the increase of TSS and pH as well as decrease in DO reduces the habitability of the river
- Impacts of macrobenthonic and aquatic life includes disturbances of respiratory and digestive systems
- Since water quality deterioration only occurs primarily upstream of the Sg. Riau-Sg. Kuantan confluence and is predicted to be short-termed, impacts of inland and recreational fisheries are anticipated to be minor.

Operational Phase

- Solubility of radionuclides differ based on environmental characteristics
- In determining aquatic life quality, simulated DO and TSS were at acceptable levels
- Simulated metal concentrations showed no significant changes
- The accumulation of radionuclides from the water into the tissue of organisms would depend on environmental conditions i.e., pH, hardness, feeding habits, etc
- Inland and recreational fisheries can be impacted by accidental discharge of LTP
- Degradation of water quality will potentially affect the downstream fish population

Terrestrial Ecology

- Impacts on avifauna is considered low priority and non-significant due to the
- The relatively small area, despite the loss of forest covers, food source and security will not cause significant impacts to mammals in the region
- Land clearing includes removal vegetation. Therefore , impacts on terrestrial flora are localized and non-significant due to the low quality of existing vegetation.

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Impact Assessment

Socio Economy

Perception Survey

Receptors Along the Transportation Route
- Concern include pollution , poor WLP management, safety risk, noise and traffic

Taman Sri Perasing and Taman Aspa
- Complains on the existing Jabor-Jeranggau landfill, namely odor and nuisance flies
- Traffic accidents caused by transportation trucks from the nearby bauxite quarry

Orang Asli Kampung Sungai Pergam
- Located 6 km west and not affected by the development
- Hiring priority should be given to Orang Asli and local workers

Focus Group Discussion (FGD)

Rubber Research Institute Malaysia (RRIM)
- Concerns were raised regarding the shared usage of the first 500 m off the access road due to the potential damages caused by the ingress and egress of WLP transport trucks. RRIM proposed the construction of a separate access road for the Project.
- RRIM is willing to negotiate on the matter provided that GSSB, as the operator, presents their proposed road alignment to their parent organisation, the Malaysian Rubber Board (MRB) for their deliberation
- Concerns on radioactive exposure

Impressive Sentiments Sdn. Bhd. (Durian Platation)
- Reduction of commercial value and production, and public perception of the durian

Jawatankuasa Kemajuan dan Keselmatan Kampung (JKKK), FELDA Bukit Kuantan and FELDA Neram 1
- Concerns of proximity to residential developments and oil palm plantations and radiological impacts
- Previously unpleasant experience with nearby bauxite quarry

Socio Economic Impact Assessment
- Estimated 100 new employment opportunities for a 5 year period

Traffic

- Estimate generation of 0.11 pcu/h and 0.10 pcu/h for Peak AM and PM respectively
- Increase in traffic due WLP transportation trucks is not expected to affect the operations of Jalan Bukit Kuantan and the junction into the RRIM complex
- The road maintains its LOS A operating capacity with or without the implementation of the Project

Health Impact Assessment

Construction Phase
- Health impacts due to dust and noise exposure are predicted to be minimal

Operational Phase
- Cumulative radiation dose is expected to be 0.3 mSv/year with the protective lining and cover of the PDF cells .
- Health impacts due to air emissions, water leachate and food and air borne disease are considered non-significant
- No additional health concerns are expected to be introduced in the region, however hazards such as dengue outbreaks and leptospirosis are a potential threat

Impact Assessment

Radiological Impact Assessment

Exposure Rates

- External Radioation: 1.57 μSv/hour for 2,000 hours/year
- ^{222}Rn and ^{220}Rn Progenies: 0.454 mSv/year for 2,000 hours/year
- Airbourne Dusts: 3.22 mSv/year for 2,000 hours/year
- Radiation Exposure due to Accident during WLP Transportation: 0.0108 mSv/year for 6 hours

Modelling

- RESRAD was used for the radiological assessment

5th Year Exposure Rates (Operation)

- PDF: 5.44 mSv/year
- Durian Plantation: 0.03 mSv/year
- RRIM complex: 0.01 mSv/year
- FELDA Neram 1: 0.0089 mSv/year

1000th Year Exposure Rates (Hydrological Sources)

- PDF: $1.0X10^{-1}$ mSv/year
- Durian Plantation: 0 mSv/year
- RRIM complex: 0 mSv/year
- FELDA Neram 1: 0 mSv/year

1000th Year Exposure Rates (Post Closure)

- PDF: $1.6 X10^{-4}$ mSv/year
- Proposed recreational park: $3.8X10^{-5}$ mSv/year
- Durian Plantation: $1.0X10^{-5}$ mSv/year
- RRIM complex: $8.4X10^{-5}$ mSv/year
- FELDA Neram 1: $6.2X10^{-7}$ mSv/year

Executive Summary

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Mitigation Measures

Hydrology & Water Quality

- Conduct regular water quality monitoring at Sg. Riau
- Ensure proposed geotechnical and soil erosion mitigations measures are implemented and monitored
- Establish a lower TSS limit for effluent discharge during 7Q10 low flow
- The LTP will employ a robust contingency plan in case of operational failure
- The LTP will adhere to the minimum limit for DO concentration in effluent

Geotechnical Consideration

Proposed mitigation measures include the following:

- Protective vegetation for erosion control
- Hydroseeding (requires extensive soil conditioning, organics and application)
- Turfing
- Consistent maintenance of protected hydroseeding and turfed surfaces
- Soil nailing where normal soil cutting is unable to be performed
- Rip-rap stone pitching and placement

Soil Erosion

Erosion and Sediment Control Plan (ESCP)

- An ESCP will be implemented to mitigate the effects erosion by implementing specific engineering designs such as temporary drainage, sediment basin, silt fence, wash trough and stabilized construction access.
- Similarly, two Land Disturbing-Pollution Prevention and Mitigating Measures (LD-P2M2) has been prepared for the PDF and access road, focusing on prevention, mitigation and control of possible discharge from the PDF.

Hydrogeology

Construction Phase

- Installation of monitoring wells and periodic monitoring to be conducted during the construction phase
- Installation of watertight sheets to prevent flooding of shallow groundwater

Operational Phase

- Detection monitoring will be conducted and compared against DOE's Threshold Value, semi-annually
- Assessment monitoring will be conducted 90 days of detecting statically significant increase in constituents. Samples will be taken from all monitoring wells within reason to establish a groundwater protection standard (GWP).
- Corrective action will be taken if sources of contamination are identified

Mitigation Measures

Geology and Seismicity

Construction Phase

- Soft material will be removed in stages with geological characterisation analysis to design the necessary strengthening or protection measures
- Borrow materials will be tested for suitability according to their geological and geotechnical properties to ensure compaction is achievable and permeability of the materials are within the designed standards
- Mitigation measures will have to be carried out to minimize impacts to groundwater regime during excavation works
- No seismic mitigation will be implemented as no impacts are expected

Operational Phase

- No significant impacts are expected for geology and seismicity during the operational phase

Ambient Air Quality

Construction Phase

- Using water trucks to suppress dust on roads
- Compaction of construction roads to minimize dust emissions
- Limit vehicular access and speed of vehicles accessing the site to 25 km/h
- Ambient air quality monitoring to be conducted periodically during the construction
- To maintain road cleanliness and minimize potential dust emission, vehicle wash bays will be implemented. The facility will allow trucks to be washed clean before entering public roads while the sullied runoff will be contained within the bay by the provision of a drain, sump and pumping system.
- Construction of perimeter hoarding where construction is active
- Implementation of other Best Management Practices (BMP)s

Operational Phase

- To ensure WLP meet the required moisture range (30 – 40%) before being transported from LAMP. This is to minimize the possibility of the soil-like WLP from being blown away
- All transported WLP to be properly secured, compacted and covered prior to transport and only to be transported using AELB-approved carriers/trucks
- To ensure all WLP transports are properly labelled and secured as per AELB requirement

Executive Summary

Mitigation Measures

Noise & Vibration

Construction Phase

- Construction activities involving heavy machineries with high noise to only be carried out during daytime
- Erection of temporary hoarding to reduce noise emissions
- All the equipment and machineries to be well-maintained to avoid excessive noise
- Operations to comply with the Occupational Safety and Health (Noise Exposure) Regulations 2019 and the Environmental Quality (Motor Vehicle Noise) Regulation, 1987
- To supply proper personal protective equipment to onsite personnel
- Imposing speed limits for the incoming and outgoing construction vehicles.

Operational Phase

- Ensure all equipment and machineries (compactors, bulldozers, tipper trucks, etc.,) are regularly maintained and serviced for optimized performance
- To supply proper personal protective equipment to personnel likely to be exposed to high noise level such as ear plugs and/or earmuffs
- Imposing speed limits for the incoming and outgoing vehicles

Aquatic Ecology

Construction Phase

- Land clearing to be done in stages, preferably during the dry season
- Soil control measures i.e. silt traps, sediments basins, drainage etc. will be enforced and their efficiency maintained to prevent TSS increase
- Small plants to be removed first prior to bigger trees to minimize destruction of soil
- Appropriate waste and sewage disposal procedures and facilities will be provided
- Construction work will stop during heavy rain or immediately after due to the potential dislodgement of soil from the bare earth by the tire or tracks of heavy machineries

Operational Phase

- All leachate will be treated at the onsite LTP
- Transport and disposal of all radioactive materials must follow the standard operating procedure setup by the Atomic Energy Licensing Act 1984.
- In the event of a spillage, the WLP will be collected and contained in appropriate containers with strict measures to be put in place to prevent the residue's entry into any waterway or drainage system

Terrestrial Ecology

Construction Phase

- Erection of appropriate signage and perimeter fencing for wildlife protection
- Adherence to the Wildlife Conservation Act 2010 for all workers to educate them on the appropriate mitigations measures when encountering local wildlife

Operational Phase

- Keeping records on all wildlife encounters
- Implementation and maintenance of perimeter fencing and warning measures and signages to prevent unauthorized entry and trapping, capturing and hunting of wildlife
- Relevant instruction by PERHILITAN Pahang will be implemented

Executive Summary

Environmental Impact Assessment (2nd Schedule)

Proposed Development of a Permanent Disposal Facility (PDF) for the Water Leach Purification (WLP) Residue at Bukit Ketam Mukim Kuala Kuantan, Daerah Kuantan, Pahang Darul Makmur

Mitigation Measures

Socio-Economic Assessment

Construction Phase

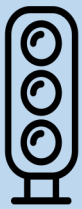
- All employed foreign workers will be legally registered with the Department of Immigration to ensure medical and health certificates are verified
- Regular health check-ups will be conducted for onsite workers
- Strict adherence to the COVID-19 Standard Operating Procedures will be maintained
- Any complaints received from the surrounding residents will be logged and addressed during the weekly Project Meetings and appropriate action will be taken.

Operational Phase

- Regular maintenance of the access road will be conducted to ensure safety of road users
- Regular interaction through organized social functions involving local communities will be conducted to build a good relationship and avoid social conflicts
- Residents will be kept notified on all construction progress and operations

Health Impact Assessment

- Encouragement of good personal hygiene of all workers and visitors.
- Cooked food are not left at room temperature for extended periods of time to avoid food poisoning and contamination
- All workers will be immunized against communicable diseases
- Workers who are unwell will be given immediate medical attention by a verified medical professional
- Workers exhibiting symptoms will be restricted from residences and the workplace
- The housekeeping and cleanliness of the whole development area including the construction site, canteen, base camp (if any), stores and workshops, will need to be prioritised by all personnel as well as visitors
- Strictly no open burnings are allowed.



Traffic

Construction Phase

- Introduction of a storage and deceleration lane for transportation effectiveness and safety

Operational Phase

- Access road will be constructed based on the R5 design standards
- Ghost islands will be used to separate the acceleration and deceleration lanes
- Installation of street lights to increase visibility of road users
- A Traffic Management Plan (TMP) will be established and implemented for increased traffic safety and avoidance of congestion

Radiological Impact Assessment

- Establishment of contingency plans containing safety hazards, implication of equipment failure and precautions
- Usage of protective attire will be enforced in helping to achieve the concept of 'As Low As Reasonably Achievable' (ALARA) when working with radioactive materials
- Implementation of adequate protective linings as practiced at the WLP RSF
- Leachate will be treated based on the LTP design standards

Executive Summary

Proposed Environmental Monitoring Program

- 8 water quality monitoring stations
  - Compliance against Class II limits of the National Water Quality Standards

- 5 air quality monitoring stations
  - Compliance against Malaysian Ambient Air Quality Standards 2020

- 5 noise monitoring stations
  - Compliance against baseline results and Schedule 1 of the Planning Guidelines for Environmental Noise Limits and Control 2019

- 10 groundwater monitoring stations
  - Compliance against the National Groundwater Standard for Drinking Water (2019)

- Compliance monitoring
  - 1 station for LTP: Compliance against Standard A, EQR (Industrial Effluent) 2009
  - 1 silt trap monitoring: Compliance against EIA approval conditions