

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

DRAFT FOR CONSULTATION



Aerial Photo of Trans Sumatera Toll Road – Medan to Binjai Section (Source: BPJT, PUPR sourced from www.liputan6.com)

SIMPANG NESS TO MERLUNG SEGMENT (PHASE 1 DEVELOPMENT OF JAMBI – RENGAT TOLL ROAD PROJECT)

JAMBI PROVINCE, INDONESIA

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The draft Environmental and Social Impact Assessment (ESIA) is prepared by the Directorate General of Highways of the Ministry of Public Works, the Republic of Indonesia for the Asian Infrastructure Investment Bank (AIIB) according to the Bank's Environmental and Social Standard. The contents of this ESIA may be preliminary in nature and do not represent the views of the Bank.

DISCLAIMER

This Environmental and Social Impact Assessment (ESIA) is being disclosed in draft form to facilitate stakeholder review and feedback prior to Project approval. The document presents the findings of environmental and social assessments undertaken for the Simpang Ness-Merlung Section (67.45 km) of the Jambi-Rengat Toll Road Project based on information available at the time of preparation.

The Project will consider comments, questions, and recommendations received from affected communities, government agencies, civil society organizations, academic institutions, and other stakeholders during the disclosure and stakeholder feedback process. Where appropriate, stakeholder feedback will be incorporated into the final ESIA and related environmental and social instruments.

The final ESIA may therefore be updated to reflect stakeholder feedback, clarification of assessment findings, refinement of mitigation measures, updates to environmental and social management arrangements, and other relevant information available prior to Project implementation.

Detailed information relating to land acquisition, resettlement impacts, compensation, livelihood restoration, stakeholder engagement, and grievance management is provided in the accompanying Land Acquisition and Resettlement Plan (LARP) and Stakeholder Engagement Plan (SEP).

ABBREVIATIONS / ACRONYMS

AF	Associated Facilities
AH	Affected Household
AIIB	Asian Infrastructure Investment Bank
AMDAL	Analisis Mengenai Dampak Lingkungan (Indonesian Environmental Impact Assessment)
AoI	Area of Influence
AP	Affected Person
AQ	Air Quality
AQMP	Air Quality Management Plan
ATR/BPN	Ministry of Agrarian Affairs and Spatial Planning / National Land Agency
B3	Bahan Berbahaya dan Beracun (Hazardous and Toxic Materials)
BAT	Best Available Technology
BBKSDA	Balai Besar Konservasi Sumber Daya Alam (Regional Natural Resources Conservation Agency)
BEP	Best Environmental Practice
BIG	Badan Informasi Geospasial (Geospatial Information Agency)
BMP	Biodiversity Management Plan
BNPB	Badan Nasional Penanggulangan Bencana (National Disaster Management Agency)
BOD	Biological Oxygen Demand
BPJN	Balai Pelaksanaan Jalan Nasional (National Road Implementing Agency)
BPJT	Badan Pengatur Jalan Tol (Toll Road Regulatory Agency)
BUJT	Badan Usaha Jalan Tol (Toll Road Business Entity)
CAR	Corrective Action Request
CBP	Concrete Batching Plant
CBR	California Bearing Ratio
CBS	Capillary Barrier System
CESMP	Construction Environmental and Social Management Plan
CHA	Critical Habitat Assessment
CIA	Cumulative Impact Assessment
CLO	Community Liaison Officer
CO	Carbon Monoxide
CoC	Code of Conduct
COD	Chemical Oxygen Demand
CSC	Construction Supervision Consultant
CSO	Civil Society Organization
CTMP	Construction Traffic Management Plan
DED	Detailed Engineering Design
DGH	Directorate General of Highways
DIN	Deutsches Institut für Normung (German Institute for Standardization)
DO	Dissolved Oxygen
DPPT	Land Acquisition Planning Document
E&S	Environmental and Social

EA	Executing Agency
EC	Emergency Coordinator
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EN	Endangered (IUCN Category)
ERP	Emergency Response Plan
ESCP	Erosion and Sediment Control Plan
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESEL	Environmental and Social Exclusion List
ESMP	Environmental and Social Management Plan
ESP	Environmental and Social Policy
ESS	Environmental and Social Standard
ETC	Electronic Toll Collection
EU	European Union
FC	Fecal Coliform
FFI	Fauna & Flora International
FGD	Focus Group Discussion
FI	Financial Intermediary
FTA	Federal Transit Administration (USA)
GAP	Gender Action Plan
GBV	Gender-Based Violence
GIIP	Good International Industry Practice
GMP	Groundwater Management Plan
Gol	Government of Indonesia
GR	Government Regulation
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
HV	High Voltage
HWS	Highest Water Spring
IA	Implementing Agency
IAS	Invasive Alien Species
IBA	Important Bird Area
IFC	International Finance Corporation
IPPF	Indigenous Peoples Planning Framework
iRAP	International Road Assessment Programme
IRI	International Roughness Index
IsDB	Islamic Development Bank
IUCN	International Union for Conservation of Nature
JSA	Job Safety Analysis
KA-ANDAL	Kerangka Acuan Analisis Dampak Lingkungan (Terms of Reference for Environmental Impact Statement)
KAT	Komunitas Adat Terpencil (Remote Indigenous Community)

KKPR	Kesesuaian Kegiatan Pemanfaatan Ruang (Spatial Plan Conformance Letter)
KLHK	Kementerian Lingkungan Hidup dan Kehutanan (Ministry of Environment and Forestry)
KPI	Key Performance Indicator
L10	Basic Noise Level (exceeded 10% of measurement time)
LARF	Land Acquisition and Resettlement Framework
LARP	Land Acquisition and Resettlement Plan
LFA	Layer Flash Analysis
LMC	Lean Mix Concrete
LMAN	Lembaga Manajemen Aset Negara (State Asset Management Institution)
LMP	Labor Management Procedures
LRP	Livelihood Restoration Program
LTIFR	Lost Time Injury Frequency Rate
masl	Meters Above Sea Level
MHA	Masyarakat Hukum Adat (Customary Law Community)
MoE	Ministry of Environment
MoEF	Ministry of Environment and Forestry
MoH	Ministry of Health
MPM	Multiphase Programmatic Project
MPN	Most Probable Number
MPW	Ministry of Public Works
MPWH	Ministry of Public Works and Housing
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organization
NMP	Noise and Vibration Management Plan
NO ₂	Nitrogen Dioxide
OHS	Occupational Health and Safety
OSS	Online Single Submission
OWSCP	Operational Water Supply Contingency Plan
PAH	Project-Affected Household
PAP	Project-Affected Person
PC	Public Consultation
PCI	Pre-stressed Concrete I-girder
PDAM	Perusahaan Daerah Air Minum (Regional Water Company)
PENLOK	Penetapan Lokasi (Location Designation Permit)
PIB	Project Information Brochure
PLN	Perusahaan Listrik Negara (State Electricity Company)
PM _{2.5}	Particulate Matter less than 2.5 micrometers
PM ₁₀	Particulate Matter less than 10 micrometers
PMC	Project Management Consultant
PMU	Project Management Unit
PPE	Personal Protective Equipment
PPK	Pejabat Pembuat Komitmen (Commitment Making Officer)
PPM	Project-affected People's Mechanism

PPV	Peak Particle Velocity
PR	Presidential Regulation
PS	Performance Standard (IFC)
PT HK	PT Utama Karya (Persero)
PTHK	PT Utama Karya (Persero)
PTW	Permit to Work
Puskesmas	Pusat Kesehatan Masyarakat (Public Health Center)
Pustu	Puskesmas Pembantu (Sub-health Center)
RBI	Rupabumi Indonesia (National Topographic Map)
RCIA	Rapid Cumulative Impact Assessment
RKK	Rencana Keselamatan Konstruksi (Construction Safety Plan)
RKL-RPL	Rencana Pengelolaan Lingkungan - Rencana Pemantauan Lingkungan (Environmental Management and Monitoring Plan)
RMLLP	Rencana Manajemen Lalu Lintas Pekerjaan (Construction Traffic Management Plan)
RMPK	Rencana Mutu Pekerjaan Konstruksi (Construction Quality Plan)
ROW	Right of Way
RPJMN	Rencana Pembangunan Jangka Menengah Nasional (National Medium-Term Development Plan)
RRO	Rapid Response Officer
RSA	Rest and Service Area
RSS	Root Sum Square
SEA/SH	Sexual Exploitation and Abuse / Sexual Harassment
SEP	Stakeholder Engagement Plan
SER	Stakeholder Engagement Record
SESA	Strategic Environmental and Social Impact Assessment
SEWMP	Soil Erosion and Water Management Plan
SME	Small and Medium Enterprise
SMK3	Sistem Manajemen Keselamatan dan Kesehatan Kerja (Occupational Health and Safety Management System)
SMKK	Sistem Manajemen Keselamatan Konstruksi (Construction Safety Management System)
SO ₂	Sulfur Dioxide
SOP	Standard Operating Procedure
Sp. Ness	Simpang Ness (Junction)
SRP	Sediment Retention Pond
STA	Station (chainage point along road alignment)
STP	Sewage Treatment Plant
SWQMP	Surface Water Quality Management Plan
TCL	Tiger Conservation Landscape
TDS	Total Dissolved Solids
TIU	Technical Implementation Unit
TMP	Traffic Management Plan
TRIR	Total Recordable Incident Rate
TSP	Total Suspended Particulates
TSS	Total Suspended Solids

TSTR	Trans-Sumatera Toll Road
VEC	Valued Environmental and Social Component
VU	Vulnerable (IUCN Category)
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
WMP	Water Management Plan
WTP	Water Treatment Plant
WWF	World Wide Fund for Nature

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RINGKASAN EKSEKUTIF

Latar Belakang dan Tujuan. Sebagai Pulau dengan jumlah penduduk dan PDB terbesar kedua di Indonesia, Pulau Sumatera membutuhkan peningkatan konektivitas antarkabupaten-kota, antarpulau di Sumatera, maupun lintas pulau. Kondisi ini diperkuat oleh fakta bahwa 95% industri dan perdagangan antarkabupaten-kota di Sumatera mengandalkan infrastruktur jalan nasional dan provinsi.¹ Meskipun demikian, jaringan jalan tersebut tergolong padat, rawan kecelakaan, belum saling terhubung, dan sering mengalami kerusakan parah akibat curah hujan tinggi maupun kekeringan. Dalam mengatasi hal ini, Pemerintah Indonesia melalui Peraturan Presiden (Perpres) No. 18/2020 tanggal 20 Januari 2020 secara bertahap membangun dan mengoperasikan Jalan Tol Trans-Sumatra (JTTS) dengan total panjang ruas jalan diperkirakan mencapai 2.854 km² sebagai tulang punggung transportasi darat, yang membentang dari Provinsi Aceh di utara hingga Provinsi Lampung di selatan Pulau Sumatera. Pada bulan Juni 2024, jalan tol JTTS yang telah terbangun sekitar 955 km dan sepanjang 800 km telah beroperasi.³

Sebagai bagian dari JTTS, Pemerintah Indonesia—melalui Direktorat Jenderal Bina Marga (Ditjen Bina Marga), Kementerian Pekerjaan Umum (Kementerian PU)—berencana membangun jalan tol sepanjang 67,45 km yang terbentang dari Jambi/Simpang Ness (Sp. Ness) ke Merlung, Provinsi Jambi sebagaimana Peta 1, atau yang selanjutnya disebut dengan ‘Proyek’. Ruas ini merupakan Tahap 1 dari target pembangunan Jalan Tol Jambi–Rengat sepanjang 198,13 km. Pembiayaan Tahap 1 direncanakan berasal dari Islamic Development Bank (IsDB) dan Asian Infrastructure Investment Bank (AIIB), sementara pengoperasiannya akan dipercayakan kepada PT Hutama Karya/PTTHK (Persero) sesuai Peraturan Presiden No. 42/2024 tanggal 25 Maret 2024.

Wilayah Proyek saat ini memiliki kepadatan lalu lintas yang tinggi dan didominasi dengan berbagai fasilitas komersial, permukiman, dan fasilitas umum yang berkembang tanpa perencanaan. Jalan nasional yang ada juga rentan terhadap bencana alam, seperti banjir dan kabut asap akibat kebakaran hutan dan lahan pada saat cuaca ekstrem. Jalan tol ini diharapkan dapat mengatasi permasalahan tersebut sekaligus mendukung dua tujuan nasional: (i) meningkatkan konektivitas dan keselamatan jalan serta memangkas waktu tempuh antara Provinsi Jambi, Riau, dan wilayah lain di Sumatra; dan (ii) mendorong pertumbuhan ekonomi yang lebih merata di Sumatra sekaligus menekan biaya logistik pengangkutan barang dan jasa. Namun, pencapaian tujuan-tujuan tersebut menuntut upaya substansial dalam mengelola risiko dan dampak lingkungan serta sosial yang cukup signifikan.

Penilaian Dampak Lingkungan dan Sosial. Berdasarkan Kebijakan Pelindungan Lingkungan dan Sosial AIIB, proyek ini diklasifikasikan sebagai Kategori “A,” yang mewajibkan dilakukannya studi Penilaian Dampak Lingkungan dan Sosial (*Environmental and Social Impact Assessment* - ESIA). Ketentuan serupa juga berlaku berdasarkan peraturan perundang-undangan Indonesia, yaitu kewajiban Proyek dalam menyusun Analisis Mengenai Dampak Lingkungan (AMDAL) pada proyek yang memiliki risiko

¹ Badan Pusat Statistik. [Perdagangan antardaerah di Indonesia 2020](#). Maret 2021.

² <https://padek.jawapos.com/sumbar/2364842884/bangun-800-km-tol-trans-sumatera-hingga-juni-andre-rosiade-apresiasi-kinerja-hutama-karya>

³ [Hutamakarya.com/pmn-dukung-keberlanjutan-proyek-jalan-tol-trans-sumatera-hutama-karya-optimis-perkuat-konektivitas-dan-dorong-ekonomi-d#:~:text=Hutama%20Karya%20menjalankan%20kepercayaan%20investasi,800%20km%20di antaranya%20telah%20beroperasi.](https://hutamakarya.com/pmn-dukung-keberlanjutan-proyek-jalan-tol-trans-sumatera-hutama-karya-optimis-perkuat-konektivitas-dan-dorong-ekonomi-d#:~:text=Hutama%20Karya%20menjalankan%20kepercayaan%20investasi,800%20km%20di%20antaranya%20telah%20beroperasi.)

tinggi terhadap lingkungan dan sosial, termasuk infrastruktur berskala besar seperti jalan tol. Ketentuan ini sebagaimana diamanatkan dalam Undang-Undang Perlindungan dan Pengelolaan Lingkungan Hidup (UU No. 32/2009) beserta peraturan pelaksanaannya (UU No. 6/2023, Peraturan Pemerintah No. 22/2021, Peraturan Kementerian Lingkungan Hidup dan Kehutanan No. 22/2025, dan peraturan perundang-undangan terkait lainnya). Dalam rangka memenuhi kebijakan tersebut, studi ESIA ini disusun mengacu pada Kerangka Kerja Lingkungan dan Sosial (*Environmental and Social Framework* - ESF) AIIB serta peraturan perundang-undangan yang berlaku, baik di Tingkat nasional, provinsi, maupun daerah. ESIA ini perlu dibaca bersama dokumen lingkungan dan sosial lainnya yang turut disusun untuk Proyek ini, diantaranya Rencana Keterlibatan Pemangku Kepentingan (*Stakeholder Engagement Plan* - SEP), Kerangka Kerja/Rencana Pengadaan Tanah dan Pemukiman Kembali (*Land Acquisition and Resettlement Framework/Plan* - LARF/P), Rencana Tanggap Darurat (*Emergency Response Plan* - ERP), Rencana Pengelolaan Limbah, Prosedur Penemuan Tak Terduga, Rencana Aksi Gender, dan Rencana Aksi Lingkungan dan Sosial (*Environmental and Social Action Plan* - ESAP).

Desain Proyek dan Paket Pekerjaan

Sebagaimana persetujuan Pemerintah Indonesia dan hasil penilaian proyek, paket pekerjaan sipil jalan tol ini akan dibagi menjadi empat paket :

- Paket 1A: Pembangunan jalan tol sepanjang 15,20-km dan infrastruktur terkait dari STA 0+000 hingga STA 15+200 termasuk Jembatan Sungai Pijoan (akan didanai oleh Islamic Development Bank);
- Paket 1B: Pembangunan jalan tol sepanjang 3,55-km, infrastruktur terkait, dan Jembatan Sungai Batanghari (dengan bentang hingga 1 km) dari STA 15+200 hingga STA 18+750 (akan didanai oleh AIIB);
- Paket 2A: Pembangunan jalan tol sepanjang 24,55-km dan infrastruktur terkait dari STA 18+750 hingga STA 43+300 (akan didanai oleh AIIB); dan
- Paket 2B: Pembangunan jalan tol sepanjang 24,15-km beserta infrastruktur terkait dari STA 43+300 hingga STA 67+450 (akan didanai oleh AIIB).

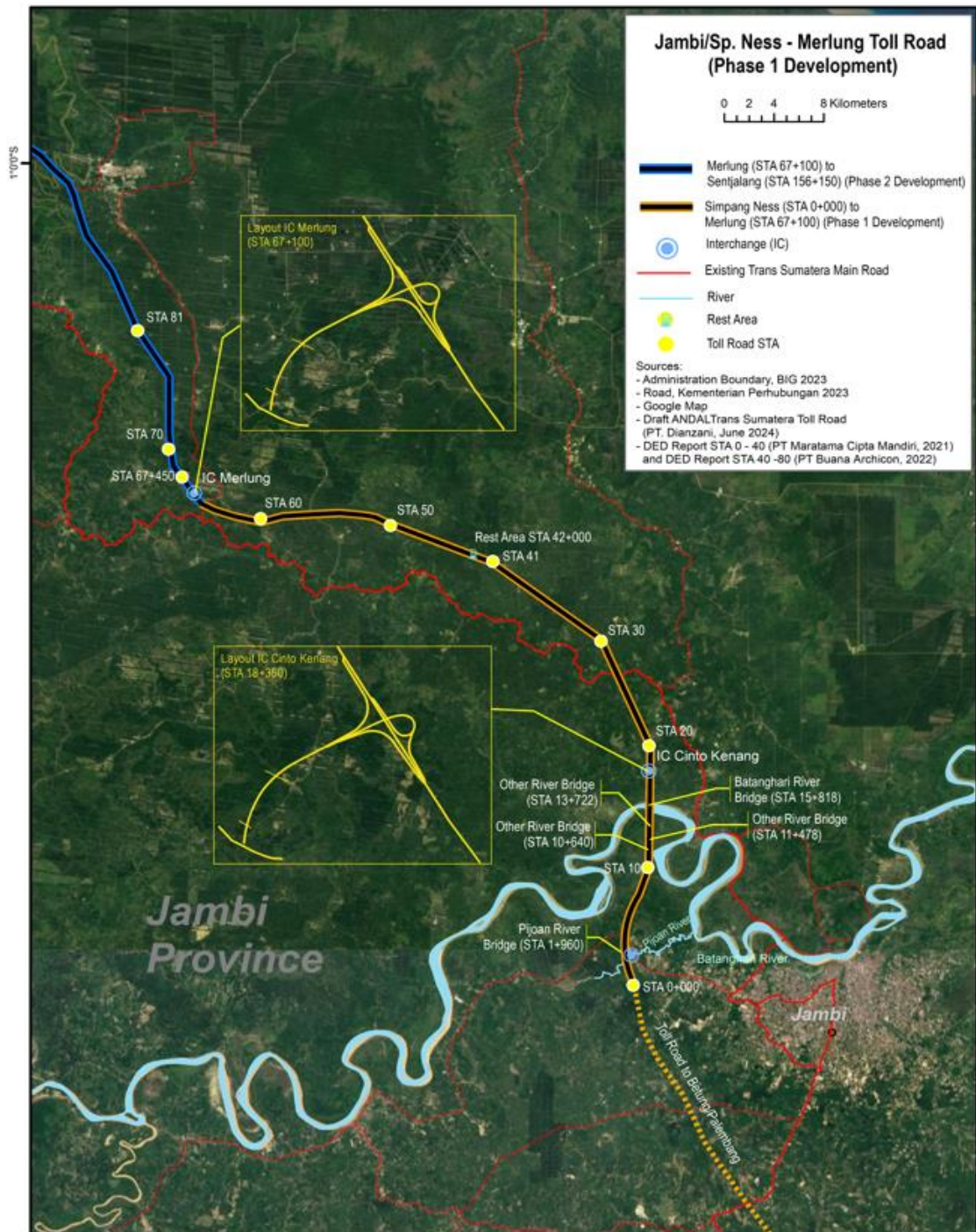
Jalan tol sepanjang 67,45 km ini dirancang dengan enam lajur kendaraan di setiap arah (total empat lajur), masing-masing selebar 4,5 m, menggunakan perkerasan beton. Jalan tol ini akan dilengkapi dengan dua simpang susun—di Cinto Kenang (STA 18+305) dan Merlung (STA 67+100)—serta gerbang tol, jalan akses dari jalan nasional yang sudah ada, dan area istirahat dan pelayanan di STA 42+000.

Jembatan akan dibangun melintasi Sungai Pijoan dan anak-anak sungainya di empat lokasi, dengan bentang 26–46 m menggunakan struktur balok beton *I-girder* prategang (*Pre-stressed Concrete I-girder/PCI girder*). Satu jembatan utama akan dibangun melintasi Sungai Batanghari, dengan bentang hingga 1,221.7 m menggunakan struktur kantilever seimbang (*balanced cantilever*). Jalan layang (*overpass*) dan jalan bawah tanah (*underpass*) turut dibangun untuk menjaga akses masyarakat dan satwa liar, serta mempertahankan drainase alami, jalur lintasan primata, dan aliran sungai di sepanjang trase jalan tol.

Kegiatan konstruksi Proyek akan didukung oleh fasilitas penunjang yang dioperasikan langsung oleh kontraktor utama, subkontraktor, atau pihak ketiga lainnya—antara lain tambang pemasok bahan bangunan seperti pasir dan kerikil, pabrik pencampuran beton untuk pengaspalan jalan tol, serta jalan

umum dan jalan milik swasta yang sudah ada, yang akan digunakan untuk mengakses dan memobilisasi peralatan, bahan bangunan, dan pekerja selama konstruksi berlangsung.

Peta 1. Proyek Jalan Tol Simpang Ness – Merlung



Sumber: Peta ini digambar ulang berdasarkan informasi yang disajikan dalam draf Andal Jambi – Rengat. (PT Dianzani Utama Konsultan, Juni 2024); dan slide DGH/PT HK yang dipresentasikan pada November 2023.

Kebijakan Utama dan Kerangka Regulasi.⁴ Berdasarkan tingkat Risiko lingkungan dan sosial, Proyek Jalan Tol Sp. Ness–Merlung diklasifikasikan sebagai Kategori A (berisiko tinggi), sehingga memerlukan Penilaian Dampak Lingkungan dan Sosial (ESIA) serta rencana pengelolaan lingkungan dan sosial sesuai dengan Kerangka Kerja Lingkungan dan Sosial AIIB (Juni 2024) serta praktik internasional terbaik. Dalam waktu bersamaan, Direktorat Jenderal Bina Marga (DJBK) sedang menyusun Analisis Dampak Lingkungan dan Rencana Pengelolaan Lingkungan (AMDAL) untuk Jalan Tol Jambi–Rengat, guna mematuhi Undang-Undang No. 6 Tahun 2023—yang meratifikasi dan mengesahkan Peraturan Pemerintah Pengganti Undang-Undang (Perppu) Nomor 2 Tahun 2022 tentang Penciptaan Lapangan Kerja—serta Peraturan Pemerintah Nomor 22 Tahun 2021 tentang Perlindungan dan Pengelolaan Lingkungan Hidup. Evaluasi AMDAL dan penerbitan Izin Lingkungan dari Kementerian Lingkungan Hidup saat ini sedang dalam proses penyiapan.

Sebagian ruas Jalan Tol Sp. Ness–Merlung, terutama menuju kawasan Merlung, berada di dalam kawasan hutan produksi yang ditetapkan oleh Kementerian Kehutanan. Karena itu, Proyek ini perlu melepaskan status kawasan hutan tersebut dan memperoleh Izin Kehutanan dari Kementerian Kehutanan, termasuk terkait penilaian dampak pengambilan air.

Pelibatan Pemangku Kepentingan dan Penyampaian Informasi. Keterlibatan Pemangku Kepentingan (*Stakeholder Engagement* - SE) tidak hanya membantu mengidentifikasi potensi risiko dan dampak, tetapi juga mendorong inklusi dan keadilan melalui langkah-langkah yang meningkatkan manfaat pembangunan bagi masyarakat, khususnya pengguna jalan dan masyarakat di sepanjang koridor jalan. Untuk itu, telah dilakukan analisis pemangku kepentingan guna mengidentifikasi berbagai kelompok pemangku kepentingan, menilai pengaruh dan dampak timbal balik mereka terhadap proyek, merancang pendekatan yang tepat untuk menjangkau setiap kelompok maupun individu, serta membagikan informasi dan menindaklanjuti masukan mengenai proyek. Kegiatan pelibatan pemangku kepentingan ini turut mendorong keterlibatan tenaga kerja lokal, sekaligus membuka peluang keterlibatan yang lebih luas dengan pemangku kepentingan lokal—seperti instansi pemerintah daerah, lembaga non-pemerintah, penyedia pelatihan, dan lembaga akademis—yang diharapkan dapat memfasilitasi pelatihan keterampilan.

Kegiatan pelibatan pemangku kepentingan telah dan akan terus dilaksanakan sejak tahap perancangan, agar kekhawatiran dan masukan yang diterima dapat ditangani secara sistematis dalam keputusan perancangan maupun mekanisme pelaksanaan.⁵ ESIA ini disusun melalui konsultasi dengan berbagai pemangku kepentingan kunci —termasuk lembaga pemerintah, pihak yang berpotensi terdampak, dan pihak berkepentingan lainnya—guna menentukan pendekatan pengelolaan serta langkah-langkah pencegahan dan mitigasi dampak yang diperlukan. ESIA ini juga dilengkapi dengan hasil Penilaian Dampak Lingkungan dan Sosial Strategis (SESA) yang baru dilakukan, dan menjadi dasar

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⁵ Sejumlah kegiatan pelibatan pemangku kepentingan, termasuk konsultasi publik dan penyampaian informasi terkait Proyek Jalan Tol Jambi–Rengat, telah dilaksanakan selama periode 2020–2025 melalui: (i) pengumuman proyek dan konsultasi publik yang dilaksanakan sebagai bagian dari penyusunan dokumen AMDAL Proyek pada tahun 2020; (ii) diskusi kelompok terarah (*Focus Group Discussions*/FGD) yang dilaksanakan pada November 2023 sebagai bagian dari proses pelibatan masyarakat untuk penyusunan dokumen perlindungan lingkungan dan sosial Proyek (yaitu LARP, SEP, IPP, GAP, dan ESIA); (iii) pelibatan instansi pemerintah yang berwenang di bidang konservasi alam di Provinsi Jambi dan Provinsi Riau serta organisasi konservasi nonpemerintah (*non-governmental organizations*/NGO) terkait yang dilaksanakan pada November 2023; dan (iv) pelaksanaan kajian SESA selama periode 2024–2025.

untuk menetapkan wilayah pengaruh proyek, memetakan pemangku kepentingan, dan menyusun matriks kepentingan/pengaruh. Pemangku kepentingan dikelompokkan menjadi pihak yang terdampak proyek, pihak berkepentingan lainnya, serta kelompok rentan dan kurang beruntung, dengan sejumlah subkelompok yang telah diidentifikasi untuk dianalisis lebih lanjut. Kelompok pemangku kepentingan utama mencakup otoritas nasional dan regional, asosiasi profesional, lembaga sektor swasta, organisasi non-pemerintah, dan kelompok masyarakat. Keterlibatan pemangku kepentingan diharapkan menjadi kegiatan berkelanjutan sepanjang siklus proyek, dan Rencana Pelibatan Pemangku Kepentingan (*Stakeholder Engagement Plan* - SEP) telah disusun, disampaikan, dan dikonsultasikan sebelum tahap penilaian proyek.

Kondisi Lingkungan dan Sosial. Topografi kawasan proyek berketinggian antara 5 hingga 130 meter di atas permukaan laut, dengan kemiringan tanah antara 5° hingga 55°. Kualitas udara ambien di kawasan ini tergolong baik, dengan tingkat kebisingan rendah (48,4–62 dB(A)), kelembapan udara umumnya tinggi, dan variasi musiman yang relatif homogen. Trase Jalan Tol Sp. Ness–Merlung yang direncanakan, beserta infrastruktur terkaitnya, sebagian besar berada di Habitat Termodifikasi—terdiri dari perkebunan kelapa sawit dan perkebunan industri lainnya, serta lahan tandus yang ditumbuhi semak belukar. Beberapa kilometer terakhir jalan tol menuju Merlung melintasi hutan produksi yang ditanami kelapa sawit, sementara trase secara keseluruhan juga melintasi Sungai Batanghari dan Sungai Pijoan beserta vegetasi tepi sungainya.

Trase jalan tol ini melintasi daerah aliran sungai (DAS) Batanghari, Tungkal, dan Mendahara dengan ruas jalan melintang pada sungai Pijoan dan Baranghari. Sungai Pijoan dan Batanghari merupakan Sungai parental dengan debit rata-rata tahunan sebesar 78.77 m³/s, dan 1,327 m³/s, secara berurutan. Debit ini berkurang sebesar 40% pada musim kemarau (Mei – September). Laju erosi pada DAS Batanghari dapat mencapai 480 ton per hektar per tahun dengan pendangkalan sungai yang diakibatkan sedimentasi, mencapai 50 cm per tahun.

Hasil tumpang susun (*overlay*) antara trase jalan tol dan peta bencana alam dalam *Rencana Penanggulangan Bencana Alam* (diterbitkan oleh Badan Nasional Penanggulangan Bencana) menunjukkan bahwa risiko gempa bumi tergolong rendah dari sekitar STA 0+000 hingga STA 109+000. Untuk risiko kebakaran hutan dan lahan, Jalan Tol Jambi–Rengat secara umum berada pada kategori sedang hingga tinggi, kecuali segmen STA 0+000–STA 30+000 yang tergolong rendah hingga sedang. Sementara itu, risiko banjir bervariasi antarwilayah—cenderung tinggi di beberapa lokasi, namun tergolong rendah pada segmen STA 21+000–STA 67+000.

Trase jalan tol sepanjang 67,45 km ini seluruhnya berada di Provinsi Jambi, mencakup sebagian wilayah administratif Kabupaten Muaro Jambi, Batanghari, dan Tanjung Jabung Barat. Sembilan desa di ketiga kabupaten tersebut berpotensi akan terkena dampak kegiatan Proyek. Pembangunan ruas Jalan Tol Jambi–Merlung beserta fasilitas permanen dan infrastruktur terkait akan memerlukan pengadaan tanah seluas 892.49 hektar, yang sebagian besar dimiliki perorangan dan, dalam porsi lebih kecil, berada di bawah hak guna lahan perkebunan kelapa sawit serta beberapa bidang tanah milik pemerintah. Total orang yang akan kehilangan lahan diperkirakan mencapai 519 rumah tangga terdampak; rinciannya tersedia dalam Laporan Uji Tuntas (*Due Diligence Report* - DDR) dan Rencana Pengadaan Tanah dan Pemukiman Kembali (LARP) yang disusun untuk Proyek ini.

Survei sosial-ekonomi dilakukan pada tahun 2023 dan memetakan 519 rumah tangga yang kemungkinan akan terdampak oleh Proyek melalui pengadaan tanah dan berhak menerima kompensasi. Selain itu, audit telah dilakukan terhadap 128 rumah tangga yang lahannya terdampak Proyek, dan kompensasi kepada rumah tangga tersebut telah disalurkan.

Sekitar 84% kepala rumah tangga terdampak (*Affected Household - AH*) bekerja di sektor pertanian dan perkebunan, seperti kelapa sawit, akasia, dan karet, sementara sisanya (16%) bekerja sebagai buruh, pemilik usaha, karyawan sektor swasta, dan lainnya. Sebanyak 247 dari 519 rumah tangga terdampak dikategorikan rentan, dengan rincian: 121 rumah tangga dikepalai perempuan dengan tanggungan, 39 rumah tangga dikepalai lansia tanpa dukungan, dan 87 rumah tangga tergolong miskin dengan pendapatan di bawah garis kemiskinan (sesuai definisi Badan Pusat Statistik Indonesia). Tidak satu pun dari 519 rumah tangga tersebut yang tergolong masyarakat adat atau rumah tangga penyandang disabilitas di wilayah Proyek.

Risiko serta Dampak Lingkungan dan Sosial. Proyek ini berpedoman pada Kerangka Lingkungan dan Sosial (*Environmental and Social Framework - ESF*) AIIIB, yang meliputi ESP, ESEL, ESS1&2, IFC *Performance Standard 6*, dan Praktik Industri Internasional yang Baik (*Good International Industry Practice - GIIP*), serta mengacu pada peraturan perundang-undangan yang berlaku. Perlu dicatat bahwa ESS3 tidak berlaku untuk Proyek ini, mengingat tidak ada masyarakat adat yang berada di wilayah yang berpotensi terkena dampak Proyek. Risiko dan dampak lingkungan dan sosial yang berhasil diidentifikasi dijelaskan pada paragraf-paragraf berikut, dengan penilaian yang didasarkan pada tingkat keparahan—ditentukan oleh sifat dampak, durasi, luas area terdampak, serta kerentanan pihak yang terkena dampak—di samping kemungkinan terjadinya, tingkat risiko, dan dampak sisa beserta signifikansinya. Berdasarkan sifat dan cakupan risikonya, Proyek ini digolongkan sebagai Kategori A menurut ESF AIIIB, mengingat potensinya memengaruhi wilayah terdampak serta menimbulkan dampak lingkungan dan sosial yang signifikan, tidak dapat dipulihkan, bersifat kumulatif, dan beragam. Mengingat Proyek dilaksanakan secara bertahap dan berpotensi melibatkan fasilitas dengan pendanaan di luar dari Proyek seperti pembebasan lahan, Lokasi pengambilan material (*borrow pits*), *quarry*, jaringan kelistrikan dan pasokan air, maka fasilitas tersebut dikategorikan sebagai *Associated Facilities* sebagaimana ESS1-AIIB.

Risiko lingkungan dan sosial utama proyek ini meliputi:

- Tenaga Kerja dan Kondisi Kerja. Pembangunan jalan diperkirakan akan mendatangkan sejumlah besar tenaga kerja dari berbagai wilayah, baik dalam maupun luar negeri. Skema pengadaan tenaga kerja baru akan diketahui setelah kontrak diberikan dan rencana kerja disampaikan oleh kontraktor pemenang. Sebagian besar pekerja proyek adalah pekerja konstruksi yang dipekerjakan oleh kontraktor beserta subkontraktornya, serta pekerja yang dipekerjakan oleh insinyur pengawas dan konsultan desain/pelaksanaan; pekerja langsung mencakup pegawai pemerintah yang diperbantukan dan konsultan yang bertugas sebagai staf proyek. Karena Keselamatan dan Kesehatan Kerja (K3) serta kondisi kerja menjadi risiko utama bagi pekerja konstruksi, disusunlah Prosedur Manajemen Tenaga Kerja (*Labor Management Procedures - LMP*) untuk memandu pengelolaan tenaga kerja. Sebagai kebijakan, proyek ini tidak akan mempekerjakan anak-anak atau tenaga kerja paksa, sehingga kontrak kerja akan diaudit, dan LMP turut mencakup mekanisme pengaduan bagi pekerja. LMP telah disusun, disampaikan, dan dikonsultasikan sebelum tahap penilaian proyek.
- Risiko arus masuk tenaga kerja (*labor influx*) muncul dari mobilisasi pekerja beserta fasilitas operasional mereka, yang dapat memengaruhi masyarakat setempat serta layanan dan sumber daya yang tersedia. Risiko Eksploitasi dan Kekerasan Seksual serta Pelecehan Seksual (*Sexual Exploitation & Abuse and Sexual Harassment - SEA/AH*)—bagian dari Kekerasan

Berbasis Gender (*Gender-Based Violence*)—diperkirakan rendah, namun proyek tetap perlu melakukan upaya terencana untuk memastikan kesetaraan gender.

- Permasalahan pada kesetaraan gender dalam proyek ini mencakup ketidaksetaraan akses terhadap manfaat, risiko pemindahan yang berdampak tidak proporsional terhadap perempuan, terbatasnya partisipasi perempuan dalam proses konsultasi, serta perlunya perspektif gender diintegrasikan dalam perencanaan infrastruktur. Meski proyek berupaya inklusif, hasil penilaian menunjukkan masih adanya kesenjangan pada aspek mata pencaharian, keselamatan, dan keterwakilan perempuan—sehingga disusunlah Rencana Aksi Gender (*Gender Action Plan - GAP*) untuk mengatasinya.
- Timbulnya polusi selama konstruksi: Pembangunan jalan tol dan fasilitas pendukung (jalan akses lokasi, tambang batu, pabrik pencampuran beton) berpotensi meningkatkan kebisingan dan getaran, serta menurunkan kualitas udara ambien akibat partikel padat dan emisi gas. Produksi limbah juga berpotensi meningkat—dari kantor cabang, *base camp* pekerja, aktivitas pekerja di wilayah proyek, hingga mobilisasi dan pemeliharaan kendaraan serta alat berat—sementara pembukaan lahan dapat meningkatkan limpasan, erosi tanah, serta sedimen dan padatan tersuspensi di perairan sekitar yang memengaruhi ekosistem perairan. Selama pembangunan jembatan, pemasangan tiang pancang menghasilkan kebisingan impulsif bawah air yang berbahaya bagi biota akuatik dan masyarakat sekitar, sementara getaran tanah berpotensi mengancam bangunan bersejarah di permukiman terdekat.
- Pencemaran selama pengoperasian jalan tol: pengoperasian Jalan Tol Jambi–Rengat berpotensi meningkatkan kebisingan dan menurunkan kualitas udara ambien, sementara pengoperasian area istirahat (*rest area*) berpotensi menghasilkan timbunan limbah.
- Hidrologi: Pembangunan jembatan melintasi Sungai Batanghari akan menimbulkan efek penyempitan hidrodinamik yang mengubah pola aliran lokal, sehingga meningkatkan erosi tepi sungai secara lateral dan berpotensi menambah sedimen di sungai. Tingginya muatan sedimen Sungai Batanghari juga menuntut estimasi kedalaman gerusan (*scour*) yang konservatif, guna menjaga keselamatan struktur jangka panjang serta stabilitas geomorfologi.
- Penggunaan sumber daya: Pengambilan air permukaan pada fase konstruksi—untuk pabrik pencampuran beton, kantor, *base camp* pekerja, mitigasi peningkatan debu, dan kegiatan konstruksi lainnya—akan memengaruhi ketersediaan air, sementara pada fase operasi, area istirahat (*rest area*), kantor/gerbang jalan tol, dan pemeliharaan jalan berpotensi meningkatkan penggunaan air.
- Pengadaan tanah: Proses pengadaan tanah dan relokasi berpotensi memengaruhi kepemilikan lahan dan mata pencaharian.
- Hilangnya jasa ekosistem: Gangguan terhadap ekosistem dapat mengurangi ketersediaan sumber daya alam untuk jasa penyediaan, regulasi, budaya, dan jasa pendukung.
- Deforestasi: Pembukaan lahan meningkatkan akses manusia terhadap sumber daya alam untuk pertanian, penambangan liar, dan migrasi.
- Hilangnya keanekaragaman hayati dan fragmentasi habitat: Pekerjaan tanah, termasuk pembukaan lahan, berpotensi menyebabkan hilangnya flora dan fauna, sehingga menurunkan populasi satwa liar dan meningkatkan risiko kepunahan.

Layanan masyarakat: risiko keselamatan dan kesehatan kerja maupun masyarakat, serta masalah sosial akibat arus masuk tenaga kerja—termasuk gangguan habitat, debu, kebisingan dan getaran dari

konstruksi, risiko pencemaran dari limbah konstruksi, tumpahan bahan bakar, pembuangan limbah yang tidak tepat, dan pengelolaan lubang galian.

Warisan budaya: potensi dampak terhadap pemakaman masyarakat adat dan situs warisan penting lainnya selama masa konstruksi.

Untuk mengatasi risiko dan dampak di atas, Proyek ini menyusun Rencana Pengelolaan Dampak Lingkungan dan Sosial (ESMP) yang komprehensif, dilengkapi dengan sejumlah laporan independen: Rencana Keterlibatan Pemangku Kepentingan (SEP), Kerangka Rencana Pengadaan Tanah dan Pemukiman Kembali (LARPF), Rencana Pengadaan Tanah dan Pemukiman Kembali (LARP), Rencana Aksi Gender (GAP), Kerangka Perencanaan Masyarakat Adat (IPPF), Rencana Tanggap Darurat (ERP), Rencana Pengelolaan Limbah, serta Rencana Pengelolaan Keanekaragaman Hayati.

Selain risiko, sejumlah manfaat dari pembangunan jalan tol ini juga telah diidentifikasi, sebagaimana diuraikan berikut:

- Konektivitas: jalan tol ini meningkatkan konektivitas antarwilayah, sehingga membuka akses yang lebih mudah dan lebih baik ke pendidikan, layanan kesehatan, dan layanan lainnya.
- Peluang kerja: tersedia peluang kerja bagi perempuan dan kelompok rentan selama masa pembangunan.
- Promosi warisan budaya: jalan tol ini membuka akses yang lebih baik ke situs-situs bersejarah dan berpotensi mendorong industri pariwisata lokal.
- Perubahan iklim: kualitas permukaan jalan yang konsisten dan lebih sedikit titik henti membuat jalan tol ini mengurangi emisi kendaraan per kilometer tempuh, sekaligus mendukung konsumsi bahan bakar yang lebih efisien dan waktu tempuh yang jauh lebih singkat dibandingkan jalan nasional/lokal yang ada.

Penilaian dampak selanjutnya menentukan risiko inheren—yaitu risiko tanpa tindakan mitigasi apa pun—serta risiko residual yang tersisa setelah mitigasi diterapkan. Tindakan mitigasi mengikuti hierarki mitigasi dengan urutan prioritas: penghindaran, minimalisasi, restorasi, dan kompensasi (*offset*). Dengan pendekatan ini, risiko dapat diklasifikasikan berdasarkan tingkat keparahan dampaknya pada setiap fase—perencanaan, konstruksi, serta operasi dan pemeliharaan.

- ‘Signifikansi rendah’: dampak dapat dideteksi, namun tidak dianggap signifikan sehingga langkah mitigasi bersifat diskresioner.
- ‘Signifikansi sedang’: dampak dinilai sedang dan dapat/tidak dapat dipulihkan, sehingga dapat dimitigasi dengan langkah-langkah yang mudah dan lazim tersedia untuk menekan risiko ke tingkat yang dapat diterima.
- ‘Signifikansi substansial’: dampak dinilai signifikan, merugikan, dan dapat/tidak dapat dipulihkan, sehingga harus dimitigasi dengan langkah-langkah khusus untuk menekan risiko serendah mungkin secara wajar.
- ‘Signifikansi tinggi’: dampak dinilai signifikan, merugikan, meluas, dan tidak dapat dipulihkan sehingga tidak dapat dimitigasi—sehingga perlu diidentifikasi dan diterapkan alternatif kegiatan proyek yang berdampak lebih kecil.

Sebagian besar risiko residual diperkirakan berada pada tingkat rendah hingga sedang, dengan syarat mitigasi direncanakan dan dilaksanakan sesuai rencana dan kesepakatan dalam ESAP. Dengan demikian, risiko dan dampak di atas bersifat sementara, spesifik lokasi, sebagian besar reversibel, dan dapat dikelola melalui langkah-langkah mitigasi dalam ESIA ini sesuai hierarki mitigasi. Dalam jangka panjang, Proyek diharapkan memberikan hasil positif yang signifikan—mengurangi kecelakaan lalu lintas, menurunkan biaya transportasi, menciptakan peluang kerja, dan meningkatkan peluang mata pencaharian.

Rencana Pengelolaan Lingkungan dan Sosial (ESMP). ESMP telah disusun sebagai pedoman mitigasi dampak negatif dan untuk memastikan kepatuhan sepanjang siklus proyek. ESMP akan menjadi bagian dari kontrak konstruksi dan diberlakukan secara ketat selama pelaksanaan; kontraktor bertanggung jawab atas pelaksanaan dan kepatuhan terhadap seluruh langkah mitigasi dan pengaturan pemantauan dalam ESMP melalui staf ESHS yang ditugaskan khusus. Manajemen proyek akan melakukan pemantauan rutin menggunakan daftar periksa Lingkungan dan Sosial (E&S) sesuai ESMP, dengan pemantauan internal triwulanan dan pemantauan eksternal tahunan melalui pihak ketiga. Evaluasi berkala atas proses dan hasilnya memungkinkan Unit Teknis Pelaksana Proyek (TIU) mengidentifikasi kekurangan dan menerapkan langkah perbaikan guna mencapai tujuan dan sasaran ESIA. Seluruh laporan dan dokumen perlindungan lingkungan dan sosial akan dipublikasikan pada kanal web AIB dalam bahasa Inggris. Menindaklanjuti ESMP ini, Kontraktor juga harus menyusun Rencana Pengelolaan Lingkungan dan Sosial Kontraktor (*Contractors Environmental and Social Management Plan* - CESMP) yang berfokus pada aspek konstruksi, dan akan dipantau serta dilaporkan secara berkala.

Pengaturan Kelembagaan dan Implementasi ESMP. Peran dan tanggung jawab utama lembaga pelaksana dan kontraktor—dalam pelaksanaan, pengawasan, dan pelaporan ESMP Proyek, termasuk yang dipersyaratkan oleh Pemerintah Indonesia—dirangkum sebagai berikut.

Direktorat Jenderal Bina Marga (DJB) di Kementerian Pekerjaan Umum (Kementerian PU) bertindak sebagai Lembaga Pelaksana, mengawasi aspek teknis, keuangan, serta lingkungan dan sosial, termasuk ESMP Proyek secara keseluruhan.

Direktorat Manajemen Sistem dan Strategi Pembangunan Jalan dan Jembatan (DSSPJ) di bawah Ditjen Bina Marga bertindak sebagai Unit Manajemen Proyek (PMU) di tingkat Pemerintah Pusat, dan akan memantau serta mengevaluasi pelaksanaan Proyek dari aspek teknis, keuangan, lingkungan dan sosial, serta administratif, sesuai Perjanjian Pinjaman dan Manual Administrasi Proyek.

- PMU akan didukung oleh konsultan manajemen proyek (PMC) yang akan direkrut oleh DJB.
- Direktorat Jalan Tol (DJT) di bawah Ditjen Bina Marga bertindak sebagai Unit Pelaksana Proyek (PIU) di tingkat Pemerintah Pusat, dan melaksanakan komponen Proyek terkait perancangan serta pelaksanaan pekerjaan teknis dan Lingkungan dan Sosial, termasuk pelaksanaan Rencana Pengelolaan Lingkungan dan Sosial (ESMP).
- Badan Pelaksana Jalan Nasional (BPJN) Provinsi Jambi bertindak sebagai Badan Pelaksana (IA) di tingkat Pemerintah Daerah, bertanggung jawab atas pelaksanaan harian Proyek termasuk pelaksanaan, pemantauan, dan pelaporan Lingkungan dan Sosial (E&S), termasuk Rencana Pengelolaan Lingkungan dan Sosial (ESMP).
- BPJN akan didukung oleh konsultan pengawasan konstruksi (CSC) untuk melakukan pengawasan konstruksi dan evaluasi pelaksanaan Proyek, termasuk ESMP.

- Kontraktor, subkontraktor, dan pemasok wajib melaksanakan dan mematuhi seluruh persyaratan ESMP.

Pengadaan Tanah, Pemukiman Kembali, dan Pemulihan Mata Pencarian ditangani oleh departemen terpisah yang bekerja sama dengan DJBM.

Mekanisme Penanganan Keluhan (GRM). Proyek ini akan mengembangkan dan mengoperasikan mekanisme penanganan keluhan yang inklusif, akuntabel, dan bertahap, dengan aksesibilitas dalam bahasa lokal serta terintegrasi dengan mekanisme digital dan berbasis komunitas—guna memastikan penyelesaian keluhan yang tepat waktu, terutama terkait pengadaan tanah, dampak lingkungan, dan penyediaan layanan. Proyek ini mengakui bahwa pengaduan merupakan hak prerogatif individu atau kelompok yang mata pencarian, kesehatan dan keselamatan, norma budaya, maupun warisan budayanya terkena—atau berpotensi terkena—dampak negatif dari kegiatan proyek, yang jika tidak ditangani secara efektif akan menimbulkan risiko sosial, lingkungan, dan/atau reputasi serius yang membahayakan keberlanjutan Proyek.

GRM bertujuan menjaga kinerja sosial dan lingkungan Proyek dengan memastikan penyelesaian masalah dan kekhawatiran yang disampaikan Pihak yang Terkena Dampak Proyek, tanpa membebani mereka dengan biaya maupun risiko tindakan balasan. Mekanisme ini beroperasi dalam kerangka hukum dan budaya yang berlaku, sekaligus membuka kesempatan tambahan untuk menyelesaikan keluhan di tingkat proyek lokal.

Proyek ini akan memiliki dua GRM—satu khusus untuk pekerja guna menyampaikan keluhan terkait manajemen tenaga kerja dan kondisi kerja, dan yang kedua diperuntukan bagi semua pihak yang terkena dampak proyek, termasuk masalah yang berkaitan dengan pengadaan tanah, pembatasan akses, keamanan masyarakat, dan Kekerasan Berbasis Gender (GBV)/Kekerasan Seksual (SEA)/Kekerasan Seksual (SH). GRM terkait tenaga kerja merupakan bagian dari LMP, sedangkan GRM lainnya—yang mencakup proyek secara keseluruhan—akan memiliki struktur tiga tingkatan dengan komite pengaduan yang inklusif dan berimbang gender di tingkat desa, regional, dan nasional. TIU akan memberi tahu Masyarakat terdampak mengenai proses pengaduan melalui kegiatan keterlibatan pemangku kepentingan, dan sistem ini harus dirancang agar setiap masyarakat terdampak dapat menyampaikan pengaduan dalam bentuk apa pun—baik secara langsung, melalui telepon, pesan teks (SMS), surat, email, maupun situs web—termasuk secara anonim jika diperlukan. Sistem pengaduan berjenjang ini juga harus menyediakan jalur eskalasi dan banding lebih lanjut. Setiap pengaduan yang berkaitan dengan SEA/SH akan ditangani secara rahasia dan diselesaikan melalui saluran khusus. Pedoman Manajemen (GM) ini tidak menghalangi para pihak yang membuat aduan untuk mencari upaya hukum lain sesuai kerangka hukum Indonesia, termasuk mengajukan banding yudisial formal kapan pun.

Mekanisme Masyarakat yang Terkena Dampak Proyek (PPM) dari AIIB. Mekanisme ini melengkapi Mekanisme Penanganan Keluhan (GRM) Proyek dan menjadi tanggung jawab AIIB. PPM memberi kesempatan bagi masyarakat yang terkena dampak negatif untuk memperoleh tinjauan independen dan imparial atas pengaduan mereka, apabila pengaduan tersebut belum terselesaikan secara memadai melalui GRM Proyek.

Status Terkini ESIA. ESIA ini disampaikan dalam bentuk draf sebagai bagian dari proses pengungkapan informasi lingkungan dan sosial Proyek, dengan tujuan memberikan akses bagi pemangku kepentingan terhadap informasi Proyek serta kesempatan untuk meninjau temuan penilaian dan langkah-langkah mitigasi yang diusulkan. Masukan yang diterima selama proses pengungkapan akan ditinjau dan, jika sesuai, dimasukkan ke dalam ESIA final beserta rencana manajemen terkait. Setiap perubahan

material terhadap temuan penilaian, langkah-langkah mitigasi, pengaturan pengelolaan lingkungan dan sosial, atau komitmen pelaksanaan akan tercermin dalam versi final ESIA.

EXECUTIVE SUMMARY

Background and Objectives. Sumatra Island, Indonesia's second largest island in terms of population and GDP, requires significant improvements in its intra- and inter-island connectivity. Sumatra's industries highly depend on road infrastructure as 95% of the island's inter-provincial trade relies on roads.⁶ Yet, the national road network is highly congested, heavily damaged due to severe rainfalls and droughts, prone to accidents, and unconnected to one another. To address this situation, the Government of Indonesia (GoI) has been gradually developing and operating the Trans-Sumatera Toll Road (TSTR) as a road transport backbone to improve connectivity among cities in the region, spanning from Aceh Province in the north to Lampung Province in the south of Sumatra Island. The TSTR is the strategic national project mandated in the Presidential Regulation (PR) No. 18/2020 (dated 20 January 2020). The total length of the TSTR is estimated to be 2,854-km long.⁷ As of June 2024, approximately 955-km toll road has been constructed in Sumatera including 800-km toll road that is already in operation.⁸

As part of the TSTR, the GoI, through the Directorate General of Highways (DGH) of the Ministry of Public Works (MPW), plans to construct a 67.45-km long toll road from Jambi/ Simpang Ness (Sp. Ness) to Merlung in Jambi Province or designated as "the Project area" (see the map below). This toll road segment forms the Phase 1 development of a 198.13 km long Jambi to Rengat Toll Road. GoI plans to seek financial support for Phase 1 development from the Islamic Development Bank (IsDB) and Asian Infrastructure Investment Bank (AIIB). The toll road operation will be assigned to PT Hutama Karya/PTTK (Persero) (a national construction and investment company) according to Presidential Regulation No. 42/2024 (dated 25 March 2024).

The project area is currently highly congested and encroached by a mixture of unplanned commercial, residential, and public facilities. Further, the existing national road is prone to natural disaster risks such as flooding and haze due to forest- and land-fires during extreme weather conditions. This toll road shall address the current situational issues and will help in achieving the national objectives of (i) improving road connectivity and safety and reducing travel time between Jambi and Riau Provinces as well as other regions in Sumatera Island; and (ii) promoting economic growth and equal development in Sumatera and reducing logistic cost of transporting goods and services. In this context, However, accomplishing these will mean substantial efforts at managing the environmental and social risks and impacts, which are quite significant.

Environmental and Social Impact Assessment. To address the environmental and social issues, Environmental and Social Impact Assessment (ESIA) report has been prepared in compliance with AIIB's Environmental and Social Framework (ESF), relevant national laws and regulations. In accordance with AIIB's Environmental and Social Policy, the project has been classified as Category "A," requiring an ESIA study. This is also mandatory as per Indonesian legislation. Environmental Impact Assessment (EIA) — in Indonesia, formally known as AMDAL (*Analisis Mengenai Dampak*

⁶ Central Statistics Bureau. [Inter-regional trade in Indonesia 2020](#). March 2021.

⁷ <https://padek.jawapos.com/sumbar/2364842884/bangun-800-km-tol-trans-sumatera-hingga-juni-andre-rosiade-apresiasi-kinerja-hutama-karya>

⁸ [Hutamakarya.com/pmn-dukung-keberlanjutan-proyek-jalan-tol-trans-sumatera-hutama-karya-optimis-perkuat-konektivitas-dan-dorong-ekonomi-d#:~:text=Hutama%20Karya%20melaksanakan%20kepercayaan%20investasi,800%20km%20diantaranya%20telah%20beroperasi.](https://hutamakarya.com/pmn-dukung-keberlanjutan-proyek-jalan-tol-trans-sumatera-hutama-karya-optimis-perkuat-konektivitas-dan-dorong-ekonomi-d#:~:text=Hutama%20Karya%20melaksanakan%20kepercayaan%20investasi,800%20km%20diantaranya%20telah%20beroperasi.)

Lingkungan) — is compulsory under Indonesian law for high-risk projects, including large-scale infrastructure projects such as toll roads. This requirement is mandated by the Environmental Protection and Management Law (Law No. 32/2009) and its implementing regulations (i.e., Law No. 6/2023, Government Regulation No. 22/2021, MOEF Regulation No. 22/2025, and other relevant regulations across levels – Central and Sub-national Governments). This ESIA should be read together with other plans prepared for the project, including the Stakeholder Engagement Plan (SEP), Land Acquisition and Resettlement Framework/ Plan (LARF/P), Emergency Response Plan (ERP), Waste Management, Chance Find Procedure, and Gender Action Plan, and Environmental and Social Action Plan (ESAP).

Project Design and Work Packages

Subject to approval from the Indonesian Government and completion of the Project appraisal, the following civil work packages for the toll road are planned. Each package will be constructed by a single contractor and supervised by three Contractor Supervised Consultant (Packages 1A, 1B & 2A, and 2B):

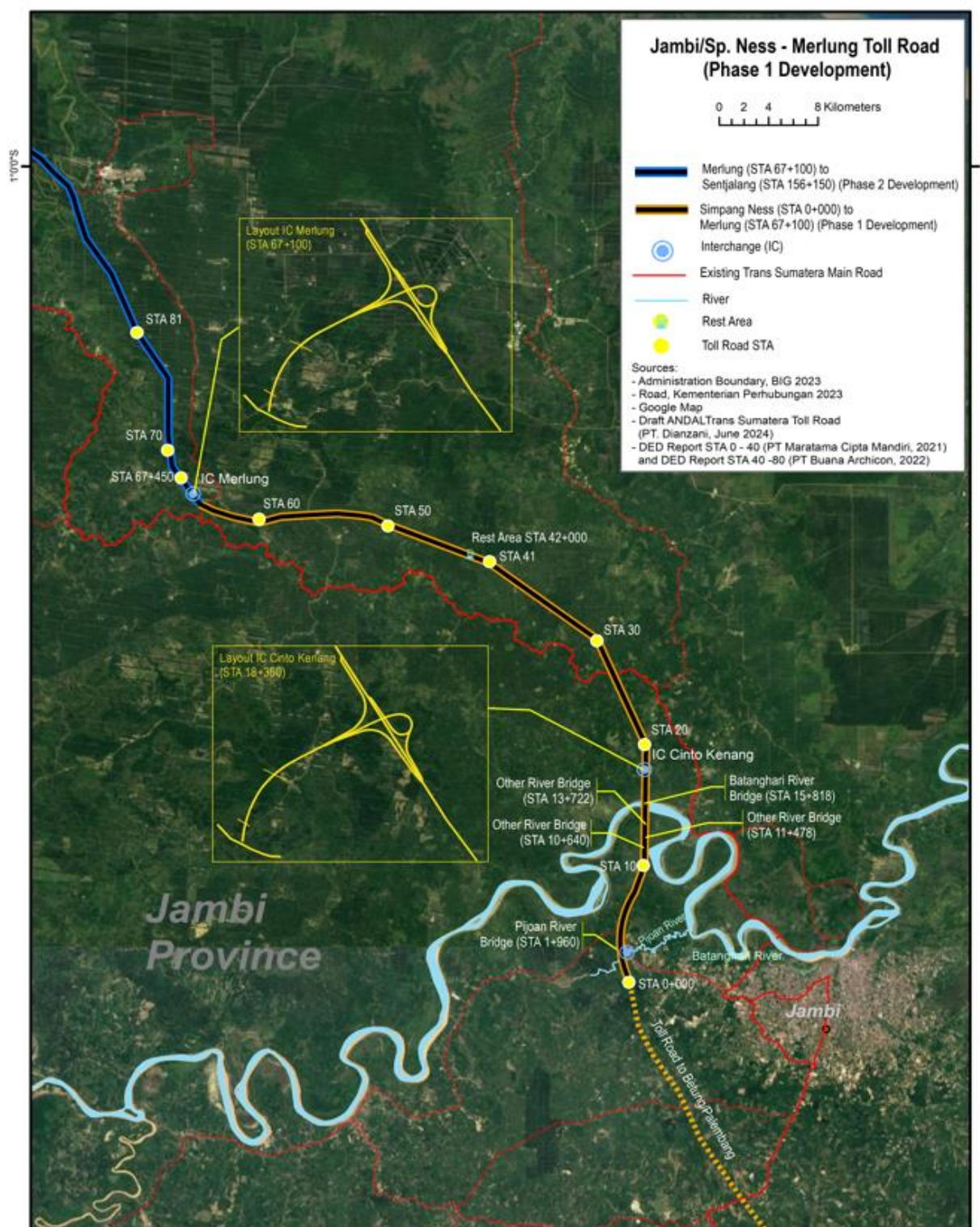
- Package 1A: Construction of 15.20-km long toll road and related infrastructure from STA 0+000 to STA 15+200 including Pijoan River Bridge (to be funded by Islamic Development Bank);
- Package 1B: Construction of 3.55-km long toll road, related infrastructure, and Batanghari River Bridge (of up to 1-km span) from STA 15+200 to STA 18+750 (to be funded by AIIB);
- Package 2A: Construction of 24.55-km long toll road and related infrastructure from STA 18+750 to STA 43+300 (to be funded by AIIB); and
- Package 2B: Construction of 24.15-km long toll road and related infrastructure from STA 43+300 to STA 67+450 (to be funded by AIIB).

The toll road is designed for a 67.45-km long dual vehicular lane in each direction with each line designed at 4.5-m wide and concrete, rigid-type pavement. There will be a total of six (6) vehicular lanes for both directions (if the traffic load warrants for this extension). The toll road will be completed with two (2) interchanges i.e., at Cinto Kenang (STA 18+305) and Merlung (STA 67+100). There will be toll gates, access roads from the existing national roads, and rest and service areas (STA 42+000).

Bridges would be constructed across the Pijoan River and its tributaries at four (4) locations with a range of 26 - 46 m span using a Pre-stressed Concrete I-girder (PCI girder) structure. A major bridge will also be constructed across the Batanghari River with a span of up to long using a balanced cantilever-type structure. In addition, overpasses and underpasses will also be constructed to facilitate community and wildlife access as well as maintain natural drainages, primate crossing, and streams within the toll road alignment.

Construction activities related to the Project will be supported by ancillary facilities directly operated by the main contractors, its subcontractors, or other third parties. These ancillary facilities would, among others, include quarries to supply construction materials such as sand and gravel, concrete batching plants supplying concrete for paving the toll road, and the use of existing public and private-owned roads to access and mobilize equipment, construction materials, and workers during construction activities.

Map 1. Simpang Ness – Merlung Toll Road Project



Source: The map is re-drawn based on the information presented in the draft Andal of Jambi – Rengat. (PT Dianzani Utama Konsultan, June 2024); and DGH/ PT HK slide presented in November 2023.

Key Policies and Regulatory Frameworks. The Sp. Ness–Merlung Toll Road project is classified as Category A (high-risk) for environmental and social aspects, requiring an Environmental and Social Impact Assessment (ESIA) and an Environmental and Social (E&S) management plan in

accordance with the AIIB's E&S Framework (June 2024) and international best practices. and international best practices. At the same time, DGH has been preparing a national Environmental Impact Assessment and Environmental Management Plan (AMDAL) for the Jambi–Rengat Toll Road to comply with Law No. 6/2023, which officially ratified and enacted the Job Creation Government Regulation in Lieu of Law (Perppu) No. 2/2022, and Government Regulation No. 22/2021 on Environmental Protection and Management. The AMDAL evaluation and subsequent issuance of the Environmental Permit from the Ministry of Environment are still pending.

A small section of the Sp. Ness – Merlung Toll Road, particularly towards the Merlung area, is located within a production forest designated by the Ministry of Forestry. Therefore, the Project is required to relinquish this forest and secure the required Forestry Permit from the M6.2.5 regarding water abstraction impact assessment.

Stakeholder Engagement and Disclosure: Stakeholder Engagement (SE) helps not only unearthing potential risks and impacts but also enables inclusion and equity as it results in measures to promote development benefits to the public, particularly, road users and communities along the corridor. Accordingly, a stakeholder analysis has been done --identifying different stakeholder groups; assessing their influence/ impact on/ by the project; devising appropriate approach and methods to reach out to each of them (individually and/ or group wise); and share and evince feedback on the project. As SE activities can promote engaging the local work force into the project as it enables promoting engagement with local stakeholders such as local government agencies, non-government agencies, training providers and academic institutions who are expected to facilitate skills training.

Stakeholder engagement activities will be/ have been carried out as early as the design stage to ensure that concerns and feedback are systematically captured and addressed as part of the design decisions and implementation modalities⁹. The ESIA was prepared in consultations with a broad range of stakeholders, including government agencies, potentially affected parties and interested stakeholders to inform the management approach and required measures to prevent and mitigate potential impacts. Further ESIA has been supplemented and complemented with the results of a Strategic Environmental and Social Impact Assessment (SESA) conducted recently. This has enabled further: defining the project area of influence; mapping the stakeholders; and drawing interest / influence matrix. categorizing stakeholders into: project affected parties, other interested parties, as well as vulnerable & disadvantaged sections, several sub-groups have been identified for analysis. Key stakeholder groups include national and regional authorities, professional associations, private sector agencies, non-governmental organizations and community groups. The SE is expected to be a

⁹Several stakeholder engagements including public consultation and information disclosure in relation to the Jambi – Rengat Toll Road project have been conducted in 2020 – 2025 period through: (i) Project announcement and Public Consultation undertaken as part of the Project's Amdal study in 2020; *Focus group discussions (FGDs)* carried out in November 2023 as part of the community engagement process to prepare the Project's E&S safeguard documents (i.e., LARP, SEP, IPP, GAP, and ESIA); (iii) The engagement with the government's nature conservation agencies in Jambi and Riau Provinces and related non-governmental conservation organizations (NGOs) was conducted in November 2023; and (iv) SESA study during 2024-2025.

continuous activity throughout the project cycle. The SEP has been prepared, disclosed, and consulted prior to project's appraisal.

Environmental and Social Settings. The topography of the Project area has an elevation range of 5 - 130 meters above sea level and land slope in a range of 5° – 55°. The area has a good ambient air quality with low noise (48.4 – 62 dB(A) and dominant high humidity and homogeneous seasonal variation. In particular, the planned Sp. Ness – Merlung Toll Road alignment and related infrastructure are primarily located in Modified Habitat, comprising of oil palm and other industrial plantations, and barren lands grown with shrubs. The last few kilometers of the toll road towards the Merlung area is in a production forest grown with oil palm. The toll road alignment also crosses Batanghari River and Pijoan River which have riparian vegetation.

The toll road alignment traverses the Batanghari, Tungkal, and Mendahara river basins, with sections crossing the Pijoan and Batanghari rivers. The Pijoan and Batanghari are perennial rivers with average annual discharge rates of 78.77 m³/s and 1,327 m³/s, respectively. These discharge rates decrease by 40% during the dry season (May–September). Erosion in the Batanghari River basin can reach 480 tons per hectare per year, resulting in river siltation of up to 50 cm annually.

An overlay of the toll road alignment with the natural disaster maps published in the *Natural Disaster Management Plan* (published by the National Agency of Natural Disaster Management) indicates that: the earthquake risk is considered low from approximately STA 0+000 to STA 109+000; the Jambi – Rengat Toll Road is within the areas of moderate to high risk to forest- and land-fires, with the exception from STA 0+000 to STA 30+000 that could be considered as area of low to moderate risk to fires; few areas appear to have high risk of flooding, but STA 21+000 – STA 67+000 seem to have low risk of flooding.

The area of the 67.45-km long toll road alignment is entirely located in Jambi Province and, in part, in the administrative areas of Muaro Jambi, Batanghari, and Tanjung Jabung Barat Regencies. Nine (9) villages in these regencies are likely to be affected by this Project. The construction of the Jambi – Merlung Toll Road section, including other associated permanent facilities and infrastructure, would require the acquisition of 892.49 hectares of land. These lands are mostly owned by individuals and, to a lesser extent, under the utilization right of the oil palm plantations and some land parcels owned by the government. The total number of persons losing land is estimated to be 519 affected households, details of which are available in the Due Diligence Report (DDR) and Land Acquisition and Resettlement Plan (LARP) prepared for the Project.

A socio-economic survey (“the survey”) was conducted in 2023, mapping 519 households likely to be affected by the Project through land acquisition and would need to be compensated. In addition, an audit was undertaken to 128 households whose lands would be affected by the Project and the payment of compensation to these households had been paid.

Approximately 84% of the heads of affected households worked in agricultural practices and plantation, such as oil palm, acacia, and rubber plantations. The remaining 16% of them were employed as labor, business owner, private sector employee, etc. About 247 out of the 519 affected households were considered as vulnerable based on the following factors: 121 females were the head of AHs with dependents; 39 AHs had elderly person as the head of family without supports; and 87 AHs were poor households with incomes under the poverty line (as defined by the Indonesian Statistics Office). None of the 519 AHs is categorized as Indigenous Peoples or disabled households within the Project area.

E&S Risks and Impacts. AIIB's Environmental and Social Framework (ESF), including ESP, ESEL and ESS1&2, IFC Performance Standard 6, and Good International Industry Practices (GIIP), as well as relevant national regulations, will apply to this Project. ESS3 is not relevant, as no indigenous people are present in the country as per ESS3 definition. The identified potential ES risks and impacts are listed below. The potential ES risks and impacts listed are assessed considering their severity — which depends on factors like impact nature, duration, extent, and sensitive receptors — along with their likelihood, risk level, and possible residual impacts, including their significance. Given the nature and extent of risks, the Project is classified as Category A under AIIB's (ESF), as this project potentially may affect the Area of Impact, generate significant ES impacts that are irreversible, cumulative and diverse . Further, given that the Project will be implemented in phases and may involve facilities funded outside the Project—such as land access, material extraction sites (borrow pits), quarries, and electrical and air supply networks—it is noted that these facilities be classified as Associated Facilities in accordance with AIIB ESS1.

Key Environmental and social risks relate to the following:

- Labor and Working Conditions. Road construction is expected to bring a substantial number of workforces from different parts of the country and abroad. How they will be sourced will only be known following contract awards and submission of workplans by winning contractors. The majority of the project's workers will consist of construction workers hired by contractors, including their sub-contractors, and workers hired by supervision engineers and design/ implementation consultants. Direct workers include government secondees and consultants hired as project staff. OHS and risks around working conditions are most pertinent to construction workers. Hence, it requires the preparation of Labor Management Procedures (LMP) for guiding the management of 'labor'. As a policy the project shall not employ any child or forced labor and accordingly employment contracts will be audited. The LMP will include a grievance mechanism for workers. LMP has been prepared, disclosed, and consulted prior to the project's appraisal.
- Labor influx risks could affect the local communities and available services and resources due to sudden presence of workers with their operating facilities. Sexual Exploitation & Abuse and Sexual Harassment (SEA/AH) (constituent of Gender Balanced Violence) risks are expected to be low. However, project will have to put in planned efforts to ensure gender equity.
- Gender equity concerns in the project center around unequal access to benefits, risks of displacement affecting women disproportionately, limited participation of women in consultation processes, and the need for mainstreaming gender in infrastructure planning. While the project shall strive to be inclusive, the assessment reveal, in general, gaps in addressing women's livelihoods, safety, and representation. To address the same, a Gender Action Plan has been prepared.
- Pollution generation during construction: The construction of a toll road and ancillary facilities such as access roads to sites, quarries, and batching plants) potentially increases noise and vibration and declines ambient air quality caused by particulate matter and gaseous emissions. Waste generation may also increase during these activities, including from satellite offices, base camps, worker activities within the

project zones, and the mobilization and maintenance of vehicles and heavy machinery. Land clearing additionally results in increased runoff, soil erosion, and higher sediment and suspended solids in nearby water bodies, which can affect aquatic ecosystems. During bridge construction, piling activities generate impulsive underwater noise that is dangerous to aquatic creatures and nearby communities. Furthermore, ground vibrations may threaten historic buildings in adjacent settlements.

- Pollution generation during operation: the operation of the Jambi – Rengat Toll Road may increase noise level and decline ambient air. In addition, the operation of rest area may generate waste

Hydrology: Bridge construction across the Batanghari River will create hydrodynamic constriction effects that alter local flow patterns. This will increase lateral bank erosion that can increase sediment in the river. During construction, pile driving will. Additionally, the Batanghari's high sediment load requires conservative scour depth estimates to maintain long-term structural safety and geomorphic stability.

- Use of resources: Extracting surface water within the construction phase to support the batching plant, office, base camp, and construction activities affects water availability. Additionally, the rest area, toll road office/gates, and road maintenance may see increased water use during operation.
- Land acquisition: Land acquisition and resettlement processes have the potential to impact land ownership and livelihoods.
- Loss of ecosystem services: Disturbance of the ecosystem resulting in a reduction of natural resources for provisions, regulation, cultural, and supporting services.
- Deforestation: Land clearing induces increases human access to natural resources for agriculture, illegal logging and human migration.
Earthwork, including land clearing, potentially causes biodiversity loss and habitat fragmentation: loss of flora and fauna, leading to wildlife population declines and endangering extinction.
- Community services: occupational and community health and safety risks, and social issues from labor influx, including habitat disturbance, dust generation, noise and vibration from construction, risks of pollution from construction wastes, fuel spills, improper waste disposal, and burrow-pit management.
- Cultural heritage: Potential to impact on indigenous peoples cemeteries and other significant heritage sites during construction.

Towards addressing the above-listed risks and impacts, the project has, apart from a Comprehensive ESMP, prepared independent reports- Stakeholder Engagement Plan (SEP), Land Acquisition and Resettlement Plan Framework (LARPF), Land Acquisition and Resettlement Plan (LARP), Gender Action Plan (GAP), Indigenous Peoples Planning Framework (IPPF), Emergency Response Plan (ERP), Waste Management Plan, and Biodiversity Management Plan.

There are also benefits identified from the development of the toll road as listed below:

- Connectivity: The toll road provides connectivity between regions, offering easier and better access to education, health care, and other services.
- Job opportunities: Job opportunities for women and vulnerable groups during construction.

- **Cultural heritage promotion:** The toll road provides better access to historical sites and could promote the local tourism industry.
- **Climate change:** The toll road reduces vehicle emissions per km traveled due to relatively consistent pavement quality and fewer stops. It enables fuel-efficient driving and significant travel-time reduction compared to the existing national/local road.

The impact assessments are further pursued by determining the inherent risk of an impact, i.e., without any mitigation measures, and the residual risk of an impact that remains after the related mitigation measures are implemented. These mitigation measures are determined by the mitigation hierarchy, which ranks avoidance, minimization, restoration, and offset in order of priority. This enabled classifying risks based on the severity of the impacts during the planning, construction and operation & maintenance phases.

- ‘Low significance’ if the impact is detectable but not considered significant and, therefore, mitigation measures are discretionary.
- ‘Moderate significance’ if the impact is evaluated as moderate, irreversible, or reversible and, therefore, can be mitigated using readily, commonly available measures to reduce the risk to an acceptable level.
- ‘Substantial significance’ if the impact is evaluated as significant, adverse, irreversible, or reversible and, therefore, should be mitigated using specialized measures to reduce the risk to as low as reasonably practicable.
- ‘High significance’ if the impact is evaluated as significant, adverse, widespread, and irreversible that cannot be mitigated and, therefore, alternatives to the project’s activities that are of less impact should be identified and adopted for the Project.

Most residual risks seem to be low to moderate subject to planning and implementing appropriate mitigation measures as planned and agreed as per ESAP. Hence, the above-stated risks and impacts are temporary, site-specific, largely reversible in nature, and manageable by adopting mitigation measures provided in this ESIA, in accordance with the mitigation hierarchy. In the longer term, the project is expected to deliver significant positive outcomes by reducing traffic accidents, lowering transport costs, creating employment opportunities, and enhancing livelihood opportunities.

Environmental and Social Management Plan (ESMP): An Environmental and Social Management Plan (ESMP) has been developed to guide the mitigation of negative impacts and ensure compliance throughout the project lifecycle. The ESMP will be a part of the construction contract agreement and will be strictly enforced during the implementation of the project. The Contractor(s) will be responsible for implementation and adherence to all the mitigation measures and monitoring arrangements outlined in the ESMP associated with their respective activities through dedicated ESHS staff. During implementation, the project management will conduct regular monitoring using an E&S checklist based on the ESMP. Internal monitoring on Quarterly Basis and external monitoring on Annual Basis (through third-party) will be carried out during project implementation. Periodic evaluation of the process and the outcomes will enable the TIU to identify deficiencies and implement corrective measures to achieve the desired goals and objectives of the ESIA. All environmental and social safeguards reports and documents shall be disclosed on the websites of AIIB in English and of Bahasa (in the local language). Following on the comprehensive ESMP, the Contractor shall also prepare a Contractors Environmental and

Social Management Plan (CESMP) chiefly related to ‘construction’ aspects and the same will be monitored and reported at regular intervals.

Institutional and Implementation Arrangements. Key roles and responsibilities of the executing/implementing agencies, and contractors that will be responsible for implementation, supervision, and reporting of the Project’s environmental and social management plan (ESMP) including those stipulated by the Indonesian Government are summarized as follows.

The Directorate General of Highways (DGH) of the Ministry of Public Works (MPW) is the Executing Agency that will oversee the overall technical, financial, E&S including ESMP of the Project.

The Directorate of System and Strategy Management for Road and Bridge Delivery (DSSPJ) of the DGH is the Project Management Unit (PMU) - Central Government Level. The PMC will provide monitoring and evaluation on the implementation of the Project from technical, financial, E&S, and administrative aspects according to the Loan Agreement, and Project Administration Manual.

- The PMU will be supported by a project management consultant (PMC) to be hired by DGH.
- The Directorate of Freeways (DJBH) of the DGH as the Technical Implementing Unit (TIU) - Central Government Level. It will implement the project components related to design and implementation of technical works and E&S including ESMP implementation.
- The National Road Implementing Agency (BPJN) in Jambi Province - Implementing Agency (IA) at the Regional Government Level. It will be responsible for day-to-day implementation of the Project including implementation, monitoring and reporting on E&S including ESMP.
- The BPJN will be supported by a construction supervision consultant (CSC) to undertake construction supervision and evaluation of the Project implementation including ESMP.
- Contractors, sub-Contractors, and Vendors. These entities are required to implement and comply with the ESMP requirements.

Land Acquisition and Resettlement as well as Livelihood Restoration are handled by separate departments but in collaboration with the DGH.

Grievance Redress Mechanism (GRM). The project shall develop and make it functional an inclusive, accountable multi-tiered grievance redress mechanism to ensure accessible in local languages and integrated with both digital and community-based mechanisms such as to ensure timely resolution of complaints, especially for land acquisition, Indigenous rights, environmental impacts, and service delivery. The project acknowledges that grievance: is the prerogative of an individual or group whose livelihood, health and safety, cultural norms and heritage are adversely affected or likely to be affected by a project activity which, if not addressed effectively, shall cause severe social/ environmental and / or reputational risks endangering sustainability.

A grievance redress mechanism (GRM) is to safeguard project’s social and environmental performance by ensuring addressal of issues and concerns aired by the PAPs with no ‘costs’ to them and without retribution works within existing legal and cultural frameworks, providing an additional opportunity to resolve grievances at the local project level.

The project will have two GRMs – one exclusively for laborers for airing grievances related to labor and working conditions management; and the other for all other project affected persons

including issues related to land acquisitions, accesses restrictions, community safety, GBV/SEA/SH. Labor related GRM forms a part of the LMP. And the other GRM, for the project as a whole, shall be a three-tier structure with broad based gender balanced grievance committees at village, regional and national levels. The TIU will inform the PAPs about the grievance process in the course of its stakeholder engagement activities, and the system shall be such that any/ all PAPs should be able to and can submit their grievances in any form- in any form, in person, by phone, text SMS, mail, e-mail or via a website. The mechanism will also allow for anonymous grievances to be aired. The multi-layer grievance system shall provide for escalation and further appeals, if need be. Any grievance related to SEA/SH shall be handled in confidence and addressed through a special window. This GM does not preclude complainants in seeking other legal remedies in accordance with the legal framework of Indonesia, including formal judicial appeal at any point of time.

AIIB's Project-affected People's Mechanism (PPM). This mechanism applies to the project in addition to the project's GRM. PPM is the responsibility of the Bank's, providing opportunities for people who are adversely affected to have an independent and impartial review of complaints in the case that it cannot be addressed satisfactorily through Project GRM.

Current Status of the ESIA. This ESIA is disclosed in draft form as part of the Project's environmental and social disclosure process. The purpose of disclosure is to provide stakeholders with access to Project information and an opportunity to review the assessment findings and proposed mitigation measures. Comments received during the disclosure and stakeholder feedback process will be reviewed and, where appropriate, incorporated into the final ESIA and associated management plans. Any material changes to assessment findings, mitigation measures, environmental and social management arrangements, or implementation commitments will be reflected in the final version of the ESIA.

1.0 INTRODUCTION

1.1 Project Background and Objectives

The Government of Indonesia (GoI) has been gradually developing and operating the Trans-Sumatera Toll Road (TSTR) as a road transport backbone connecting major cities across Sumatera Island, from Aceh Province in the north to Lampung Province in the south. The TSTR is a Strategic National Project mandated under Presidential Regulation (PR) No. 18/2020 on the 2020–2024 National Medium-Term Development Plan (RPJMN), subsequently designated as a priority project under PR No. 42/2024 on the Acceleration of Toll Road Development in Sumatera, and further affirmed through the Regulation of the Coordinating Minister for Economic Affairs No. 16/2025 on the National Strategic Projects List.¹ The total length of the TSTR is estimated at **2,800 km**¹⁰. As of January 2026, approximately **1,116 km** of toll road is already in operation in Sumatera, with an additional **265 km** currently under construction.¹¹

The GoI, through the Directorate General of Highways (DGH) of the Ministry of Public Works,³ plans to construct a **198.13-km** long toll road connecting Jambi City to Rengat City as part of the broader TSTR development. The toll road will be developed in three phases, as follows:

- **Phase 1:** The 67.45 km Simpang Ness (Sp. Ness) to Merlung (this Project) is entirely located in Jambi Province and spans Muaro Jambi, Batanghari, and Tanjung Jabung Barat Regencies.
- **Phase 2:** Merlung to Sentjulang, **88.15 km**.
- **Phase 3:** Sentjulang to Rengat, **42.53 km**.

Phase 1 has been identified as the highest-priority segment for immediate implementation, reflecting its advanced state of readiness compared to the other two (2) phases. A consensus was reached among Directorate General of Highways (DGH), Asian Infrastructure Investment Bank (AIIB), and Islamic Development Bank (IsDB) to prioritize the construction of the Sp. Ness–Merlung segment. These Banks are committed to providing loans for the Phase 1 development, subject to securing the required permits from the GoI and the completion of the project appraisal by both financing institutions. PT Hutama Karya (Persero) has been designated as the toll road operator in accordance with PR No. 42/2024.

The initial Detailed Engineering Design (DED) for this Project was completed and approved by the Directorate General of Highways (DGH) of the Ministry of Public Works and Housing in 2023, which has been renamed the Ministry of Public Works in October 2024. The DED was subsequently updated and being reviewed in February 2025 for the segment **Sta. 00+000 to Sta. 43+300**, incorporating AIIB recommendations on road safety enhancement, biodiversity protection, construction technology, and climate change mitigation and adaptation. The DED

¹⁰ <https://padek.jawapos.com/sumbar/2364842884/bangun-800-km-tol-trans-sumatera-hingga-juni-andre-rosiade-apresiasi-kinerja-hutama-karya>

¹¹ [Hutamakarya.com/pmn-dukung-keberlanjutan-proyek-jalan-tol-trans-sumatera-hutama-karya-optimis-perkuat-konektivitas-dan-dorong-ekonomi-d#:~:text=Hutama%20Karya%20melaksanakan%20kepercayaan%20investasi,800%20km%20diantaranya%20telah%20beroperasi](https://www.hutamakarya.com/pmn-dukung-keberlanjutan-proyek-jalan-tol-trans-sumatera-hutama-karya-optimis-perkuat-konektivitas-dan-dorong-ekonomi-d#:~:text=Hutama%20Karya%20melaksanakan%20kepercayaan%20investasi,800%20km%20diantaranya%20telah%20beroperasi)

review for the segment **STA. 43+300 to STA. 67+450** is currently ongoing and is expected to be completed by June 2026.

The updated DED includes design adjustments to ensure that the Sp. Ness–Merlung segment meets the **"4-star"** road safety standard under the International Road Assessment Programme (iRAP) ¹², which is recognized as Good International Industry Practice (GIIP). The climate resilience of the road design has been strengthened through consideration of flood elevation levels, earthquake return period standards, and the provision of wildlife crossing structures and corridors to facilitate the movement of mobile fauna. Innovative technologies are also recommended, including weigh-in-motion systems at toll gates, green building standards at rest areas, electric vehicle charging facilities, solar panel installations, and partial rainwater reuse systems.

The Project alignment traverses predominantly modified habitats. If future surveys verify the presence of Critical Habitat, the project could cross the Critical Habitat area (CHA) because of its proximity to internationally recognized areas, intersect riparian zones within Critical Habitat, and be near residential neighborhoods. The project is located in a largely converted area to large-scale oil palm plantations, with a small portion overlapping with production forest near Merlung. No part of the toll road alignment overlaps with protected areas or nature conservation zones, including Bukit Tigapuluh National Park, although portions overlap with internationally recognized areas. Given the project is close to Bukit Tigapuluh National Park, there is a potential presence of sensitive and protected fauna observed within the project area.

In Phase 1 at Segment Sp. Ness - Merlung, the project line crosses two rivers with riparian vegetation classified as Critical Habitat under IFC Performance Standard 6 (PS6) Criterion 1d: the Pijoan River, a tributary of the Batanghari River near STA 2+000, and the Batanghari River itself near STA 16. The Batanghari is the largest and longest river in Jambi Province, crucial for providing freshwater, supporting aquatic life, and sustaining local livelihoods. The riparian zones along these rivers, varying from a few meters to about 100 meters wide, are vital habitats for endangered and nationally protected species of regional conservation importance.

During the ESIA study, no adat communities or indigenous peoples classified under ESS 3 were found within or near the project areas. However, the project area encompasses residential area and communities in Muaro Jambi, Batanghari, and West Tanjung Jabung regencies, many of whom are directly dependent on land and water resources that fall within or are adjacent to the project footprint, including smallholder farmers, fisherfolk, and vulnerable groups such as female-headed households and the elderly.

The primary objectives of the toll road are: (i) to enhance road connectivity and safety between Jambi and Riau Provinces, as well as other parts of Sumatra; and (ii) to foster economic growth and fair development across Sumatra by lowering logistics costs. Achieving these aims cannot rely solely on widening the existing Trans-Sumatera national road, as it is already heavily congested and affected by unplanned residential and commercial encroachments. Additionally, it is vulnerable to natural hazards like flooding and haze caused by forest and land fires during extreme weather events.

¹² the umbrella program for Road Assessment Programmes worldwide that are working to save lives.

1.2 The Need for ESIA and Securing Key Permits

The need for Indonesian Amdal and the ESIA and ESMP required by the Banks. An Environmental Impact Assessment (¹³AMDAL study) for the entire Jambi–Rengat Toll Road Project has been carried out to comply with the provisions of Law No. 32/2009 on Environmental Protection and Management¹⁴, as amended by Law No. 6/2023 on Job Creation, and Government Regulation (GR) No. 22/2021 on the Implementation of Environmental Protection and Management.⁵

The AMDAL process comprises the following sequential steps: (i) public announcement of the planned activity; (ii) public consultation; (iii) submission of the Terms of Reference for the Environmental Impact Statement (KA-Andal) to the competent authority for evaluation; (iv) submission of the Environmental Impact Statement (Andal) and Environmental Management and Monitoring Plan (RKL-RPL) for evaluation; and (v) issuance of the Environmental Approval. As of 2026, the KA-Andal has been approved by the Ministry of Environment and Forestry (MOEF)⁶ in 2021, while the approval of the Andal and RKL-RPL documents remains under processing and is planned to be completed through the provincial government in accordance with Law No. 6/2023, GR No. 22/2021, and the Regulation of the Minister of Environment No. 22/2025 on the Authority to Issue Environmental Approvals.

Considering the readiness for the implementation of Sp. Ness to Merlung section (Phase 1 development) of the toll road project, this ESIA and Environmental and Social Management Plan (ESMP) for the Sp. Ness–Merlung segment is prepared in accordance with the provisions of the AIB's Environmental and Social Framework (ESF), including ESP, SEL, and ESSs, and relevant national regulations. These documents aim to minimize the adverse impacts of the Project, identify mitigation measures that are technically and financially feasible, and ensure significant benefits for affected communities and other relevant receptors. Further details on the applicable policy and regulatory frameworks are presented in Section 3.0.

A small portion of the Phase 1 alignment, particularly in the areas approaching Merlung Toll Road, is located within production forest zones, as established in the Governor of Jambi's Letter No. S.4466/2020 dated 14 December 2022. Accordingly, DGH is required to submit an application for a forest area borrowing and use permit (*Izin Pinjam Pakai Kawasan*) to the Ministry of Forestry for the section of the alignment that overlaps with the production forest.

Phase 1 construction requires the acquisition of approximately 892.49 hectares of land, encompassing privately owned land, public facilities, and other assets. Primary construction activities include earthworks comprising:

- land clearing, cut-and-fill, and grading operations;
- the operation of ancillary facilities, including access roads to construction sites, quarries, and concrete batching plants; and

⁵ GR No. 22/2021 serves as the implementing regulation of Law No. 32/2009 as amended by Law No. 6/2023, governing all technical aspects of environmental protection and management, including the AMDAL process.

⁶ The Ministry of Environment and Forestry (MOEF) was reorganized into two separate ministries, namely the Ministry of Environment and the Ministry of Forestry, following the inauguration of the new Cabinet on 20 October 2024.

¹⁴ The Amdal study includes the sequential steps as follows: (i) Project notification to the public; (ii) Public consultation; (iii) Submission of KA-Andal (terms of reference for impact assessment) for evaluation by the authority; (iv) Submission of Andal (environmental impact statement) and RKL-RPL (environmental management plan and environmental monitoring plan) for evaluation by the authority; and (v) Issuance of the Environmental Permit.

- the mobilization and demobilization of construction materials, heavy equipment, and workers.

During the operational phase, toll road traffic, road maintenance, toll gate office operations, and rest area activities may generate impacts on sensitive receptors, including ambient air quality, noise levels, community safety, terrestrial biodiversity, the local economy, traffic conditions, and issues related to gender-based violence and discrimination against vulnerable groups. A summary of key environmental and social issues associated with each project phase are summarized in Table 1.

Table 1 Key Environmental and Social Issues

Phase	Key Activities	Key environmental and social issues
Pre-construction	▪ Land acquisition	▪ Physical and economic displacement & loss of livelihoods ▪ Local economy ▪ Gender ▪ Vulnerable groups discrimination ▪ Access restrictions to land use, natural resources & assets
Construction	▪ Primarily earthworks (i.e., land clearing, cut/fill, and levelling) ▪ Mobilization of construction materials truck & heavy equipment ▪ Unpaved access roads used for construction ▪ Quarry & batching plant operations	▪ Ambient air quality ▪ Increase of noise level and vibration ▪ Occupational and community health and safety ▪ Biodiversity and ecosystem services ▪ Surface water and groundwater ▪ Riparian ecosystem ▪ Road traffic & condition ▪ Labor influx (incl. Local infrastructure & public services) ▪ Vulnerable groups discrimination ▪ Gender-based violence ▪ Access restrictions to land use, natural resources & assets ▪ Inadequate labor and working conditions ▪ Risks an impacts from use of security personee ▪ Impact on cultural resources & heritage
Construction	▪ Recruitment and retrenchment of construction workers, including manpower mobilization and demobilization	▪ Physical and economic displacement & loss of livelihoods ▪ Local economy ▪ Labor influx (incl. Local infrastructure & public services) ▪ Vulnerable groups discrimination ▪ Gender ▪ Gender-based violence ▪ Inadequate labor and working conditions ▪ Risks an impacts from use of security personnel
Construction	▪ Construction/ operation of	▪ Local economy

Phase	Key Activities	Key environmental and social issues
	contractor basecamps and accommodation	▪ Labor influx (incl. Local infrastructure & public services) ▪ Vulnerable groups discrimination ▪ Gender-based violence ▪ Inadequate labor and working conditions ▪ Risks an impacts from use of security personnel
Operation	▪ Toll road traffic	▪ Air quality ▪ Noise ▪ Biodiversity
Operation	▪ Toll road repair and maintenance	▪ Inadequate labor and working conditions ▪ Biodiversity
Operation	▪ Toll road office and rest area operation	▪ Local economy ▪ Gender ▪ Vulnerable groups discrimination ▪ Gender-based violence ▪ Inadequate labor and working conditions ▪ Soil and groundwater

The Contents of this ESIA. This ESIA report presents a comprehensive assessment of the environmental and social risks and impacts associated with the Project. The report is structured as follows:

Executive Summary

Section 1. Introduction

Section 2. Project Description

Section 3. Applicable Policy and Regulatory

Section 4. ESIA Methodology

Section 5. Environmental Baseline

Section 6. Socio-Economic Baseline

Section 7. Environmental Impact Assessment

Section 8. Cumulative Impact Assessment

Section 9. Mitigation Measures

Section 10. Emergency Response Plan

Section 11. Stakeholder Engagement and Information Disclosure

Section 12. Grievance Redress Mechanism

Section 13. Environmental and Social Mitigation Measures and Monitoring Efforts

Section 14. Project Implementation Arrangement

Section 15. Monitoring, Reporting, and Review Arrangement

1.3 ESIA Limitations

This draft of ESIA has been prepared primarily based on data and information sourced from the final Detailed Engineering Design (DED) reports of the Jambi–Rengat Toll Road (2023); the draft Environmental Impact Statement (ANDAL) and Environmental Management and Monitoring Plan (RKL-RPL) documents of the Jambi–Rengat Toll Road (dated June 2024); and relevant information provided by DGH as the executing agency and PT Hutama Karya (PT HK) as the future toll road operator. In addition, supplementary environmental sampling and analysis, site-specific biodiversity surveys and Critical Habitat Assessment, as well as targeted social surveys and consultations were conducted to support the preparation of this ESIA and ESMP.

This ESIA report has been prepared in accordance with generally accepted industry practices, with the understanding that the DED data and information used herein are relevant at the time of report preparation and disclosure. Accordingly, independent verification of such data and information has not been undertaken within the scope of this report. This ESIA should be read in its entirety together with other environmental and social safeguard documents and instruments prepared for the Project, including the Environmental and Social Management Plan (ESMP), Biodiversity Management Plan (BMP), Emergency Response Plan (ERP), Land Acquisition and Resettlement Plan (LARP), Stakeholder Engagement Plan (SEP), and and Gender Action Plan.

2.0 PROJECT DESCRIPTION

This section presents key design and information for Sp. Ness - Merlung Toll Road (“the Project”) as the basis for identifying and assessing potential E&S risks and impacts that would be generated during the construction and operation phases, as well as for developing the related ESMP. Any design changes likely to generate material E&S impacts will require an update to the ESIA, including the ESMP, as the ‘adaptive measure.’

2.1 Civil Work Packages

Subject to securing the Indonesian Government's approval and completing the Project appraisal, IsDB is committed to providing a loan for the construction of Package 1A (15.2 km long), and AIIB is committed to providing a loan for the construction of Packages 1B, 2A, and 2B for the Sp. Ness – Merlung Toll Road (52.25 km long). These packages will be constructed by four different contractors, with three Construction Supervised Consultants (CSCs) as follows:

- **Package 1A:** Construction of a **15.20-km** long toll road and related infrastructure from Sta. 0+000 to Sta. 15+200, including Pijoan River Bridge (funded by IsDB), will be constructed by Contractor 1A and supervised by CSC 1A;
- **Package 1B:** Construction of a **3.55-km** long toll road, related infrastructure, and Batanghari River Bridge with a span of up to **1,221.7 m** from Sta. 15+200 to Sta. 18+750 (funded by AIIB) will be constructed by Contractor 1B and supervised by CSC 1B – 2A;
- **Package 2A:** Construction of a **24.55-km** long toll road and related infrastructure from Sta. 18+750 to Sta. 43+300 (funded by AIIB) will be constructed by Contractor 2A and supervised by CSC 1B – 2A; and
- **Package 2B:** Construction of a **24.15-km** long toll road and related infrastructure from Sta. 43+300 to Sta. 67+450 (funded by AIIB), will be constructed by Contractor 2A and supervised by CSC 2B.

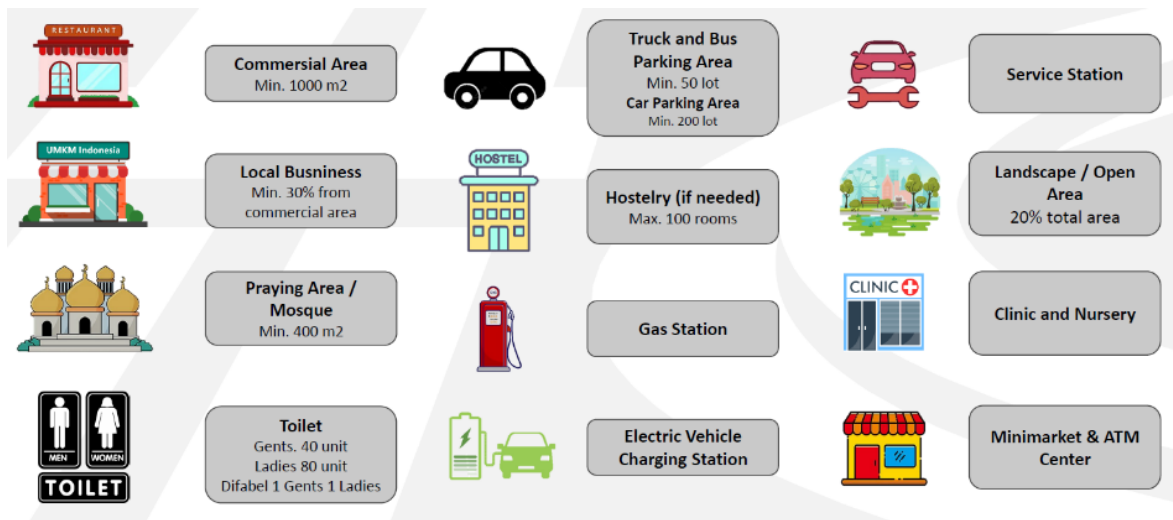
Implementation of the construction activities above will be supervised by the DGH of the Ministry of Public Works at the Central Government level and the National Road Implementing Agency (BPJN) based in Jambi.

2.2 Project Facilities

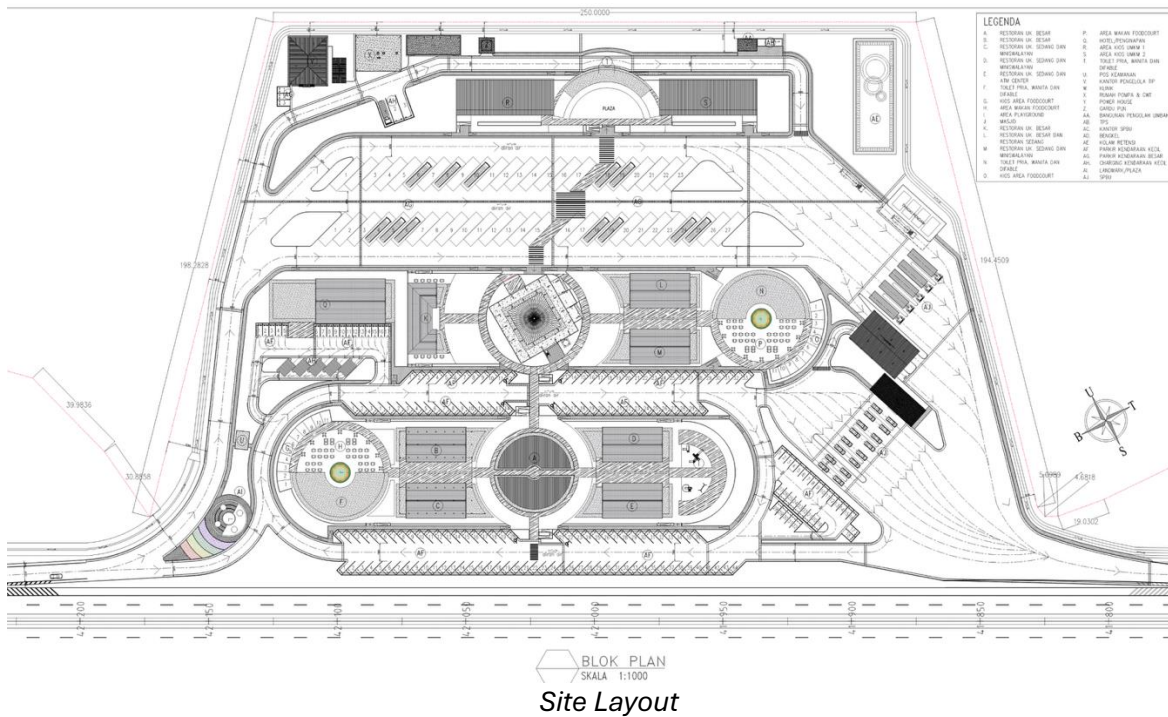
2.2.1 Permanent Facilities

Rest and Service Area (RSA). The RSA of type A will be constructed on each side of the toll road; hence, a total of two RSAs will be constructed. Typical services and facilities provided at Typed-A RSA are illustrated in Figure 1. Each RSA would require approximately 6 ha of land. The construction and operation of the RSA will be undertaken through a business-to-business agreement between PT Hutama Karya (PT HK), as the designated toll road operator by the Indonesian Government, and an interested business partner. The STA 42+000 is identified as the potential site for the RSA.

Figure 1 Rest and Service Area Type A-Facilities and Layout



Facilities

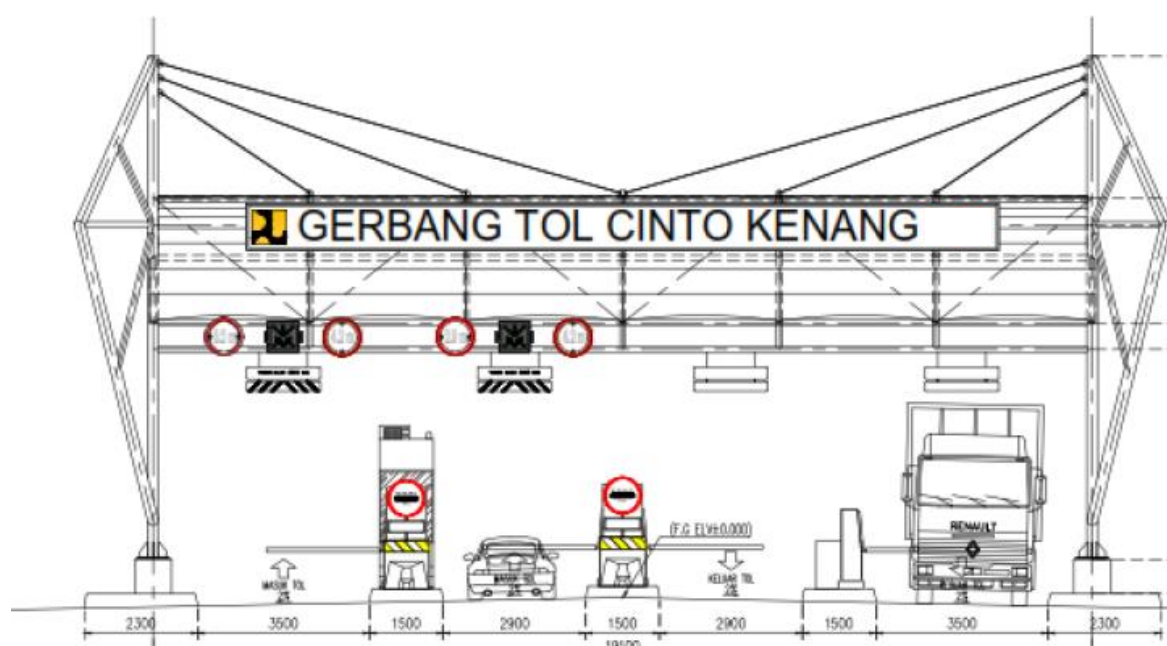


Site Layout

Source: DGH slides, Comparison of Existing DED (2023) and DED Review (2025) - E. ARCHITECTURE, 2026.

Toll Gates and Offices. Toll gates will be constructed near the Cinto Kenang (STA 18+305) and Merlung (STA 67+100) Interchanges and will be designed not only as entry/exit points to/from the toll road, but also as barriers between the toll and non-toll roads. Toll road service fees are collected at the toll gate. The design of the toll gates is shown in Figure 2.

Figure 2 Toll Gate Cross Design



Source: PT. Hutama Karya Archive (2023)

The office compound will also be constructed within the proximity of the toll gates to make it accessible for visitors who need to use, among others, toilet (separate for men and women) and prayer facilities available. The office compound comprises buildings for office, utilities, car park, and other structures,, including areas required, as presented in Table 2.

Table 2 Toll Gate Office Compound

Structure / Utilities	Approximate (m ²)
Toll gate office	400
Generator building	40
Fire extinguisher building	6
Temporary waste storage	4
Prayer room, public toilet, other sanitary facilities	50
Parking lot for 10 cars	150

Source: DED Report of Jambi-Rengat Toll Road STA 40+000 – 80+000 (PT. Buana Archicon, 2022)

Figure 3. Layout of Toll Gate Office Compound



Source: DED Report (Supporting Facilities and Accessories) of Jambi-Rengat Toll Road STA 0+000 – 15+200 (PT. Maratama Cipta Mandiri, 2022)

2.2.2 Ancillary Facilities

Construction activities for the Project will be supported by ancillary facilities operated directly by main contractors, their sub-contractors, or third parties. These facilities include quarries supplying materials like sand and gravel, concrete batching plants for toll road paving, and the use of existing public and private roads for access, mobilizing equipment, construction materials, and workers. The location of ancillary facilities will be determined by the contractor.

2.2.3 Associated Facilities

The project covers the entire 67.5 km toll road package and includes co-financing mechanisms from multilateral development banks and the state budget. Under the financing arrangement, the associated facilities of this project include land acquisition, the resettlement process, and compensation payments, as well as potential quarries, borrow pits, power and water grids. Although these facilities are not included in the project description outlined in the Legal Agreements between the Government of Indonesia and financiers, it has been identified as facilities that:⁷

- are directly and materially related to the Project;
- are carried out, or planned to be carried out, contemporaneously with the Project; and
- are necessary for the Project to be viable and would not be carried out if the Project did not exist.

Given the close interdependence between the AF and the main Project, all environmental and social risks and impacts arising from the operation of these facilities – to support the Project – are assessed and managed in accordance with the applicable AIB E&S standards, as detailed in this ESIA and ESMP.

2.2.4 Pre-construction Phase

Detailed Engineering Design (DEDs). The preparation of DEDs for the Jambi – Rengat Toll Road commenced in 2020 and was completed in 2023 following the approval of DGH. Relevant data and information design included in the DEDs are presented in this ESIA. However, the DED review for the segment Sta. 43+300 – Sta. 67+450 is currently ongoing and is expected to be completed by December 2026.

Key E&S Permits Required. The construction of Jambi – Merlung Toll Road project requires the key permits to proceed into construction:

- The Spatial Plan Confirmation Letter confirms that the entire Jambi – Rengat Toll Road project are in conformity with the national and local spatial plans. This is based on the Spatial Plan Conformance Letter (RKKPR) No. PF.01/788-200/2024, issued by the Ministry of Agrarian and Spatial Planning/National Land Agency (ATR/BPN) on 20 March 2024. Additionally, it is consistent with the Jambi Province Spatial Plan for 2023–2043, as outlined in Province Regulation No. 7/2023 dated 27 June 2023;
- Environmental Permit – The draft Andal and RKL-RPL (Indonesian EIA and EMP, respectively) of the Jambi – Rengat Toll Road project has been drafted and submitted for MoE evaluation. Upon completion of the evaluation of these documents, the MoE will issue an Environmental Permit. As noted, during the preparation of ESIA, environmental permit of this project is still on progress (as of May 2026);
- Forestry Permit - A relatively small segment of the Phase 1 development project overlaps with production forest areas. The DGH has reportedly applied for the required permit of the forest area concerned. The forestry permit is still awaiting for approval (as of October 2024);
- Designation Location Permit – A substantial land acquisition process will be required for the construction of the toll road project in Jambi Province as its alignment traverses privately-owned lands, oil palm plantations, and lands planted with crops by the community. For this purpose, the DGH has obtained an updated location designated location permit (known as *penetapan lokasi* or abbreviated "Penlok") based on the Governor of Jambi Decree Number 550/KEP.GUB/SETDA.PEM.OTDA-1.1/2024, which supersedes the earlier Penlok issued under Governor of Jambi letter No. 1448/X/2020 (dated 20 October 2020). The 2024 Penlok is valid until 2027 and may be extended for one additional year.
- Forest Area Borrowing and Use Permit — A small section of the Phase 1 alignment overlaps with production forest areas. The Governor of Jambi reportedly submitted the required permit application to the Ministry of Forestry in 2022. However, the forestry permit remains pending. Therefore, the recommendation for changes to the designation and function of the production forest area will be resubmitted to the Ministry of Forestry; and
- Technical approval for the Traffic Impact Analysis (Andalalin) of the High-Impact Traffic Generation from the Jambi-Rengat Toll Road Development in Jambi and Riau Provinces was issued through the Decree of the Director General of Land Transportation No. KP.251/LT.408/DJPD-ANDALALIN/2022 dated 13 May 2022, as a prerequisite for the preparation of the Environmental Impact Assessment (AMDAL).

Land Acquisition. Land acquisition activities have been initiated along the project corridor to secure land required for the Jambi–Rengat Phase 1 Toll Road (Sp. Ness–Merlung). Based on the 2026 LARP, the project requires approximately 892.49 ha of land, comprising 447.73 ha of private land owned by 519 affected households (1,703 persons), 433.95 ha of plantation land owned by one company, and 10.81 ha of government land. The LARP identifies 344 severely affected households and 247

vulnerable households based on socio-economic criteria. The project will also affect several community assets, including schools and a mosque. Compensation payments have been partially completed for affected households in Selat and Gerunggung Villages. As of 2021, compensation had been paid for covering approximately 86.32 ha (863,239 m²) of land associated with 186 parcels owned by 128 project-affected persons, as well as 23 parcels of local government land used for public infrastructure. Detailed information on land acquisition impacts and mitigation measures is provided in the project LARP, which also includes a resettlement audit of compensation payments already completed.

Land acquisition will be undertaken based on the Location Determination (Penlok) issued by the Provincial Government. The process will be implemented by the Land Offices (BPN) of Muaro Jambi and Batanghari Regencies, while overall coordination on behalf of DGH will be carried out by the Provincial Jambi Land Acquisition Commitment Making Officer (PPK Pengadaan Tanah Provinsi Jambi) under the Regional II Land Acquisition Working Unit (Satker Pengadaan Tanah Wilayah II), Directorate of Freeway.

2.2.5 Construction Phase

2.2.5.1 Workforce and Basecamp

Worker Recruitment. The toll road project will be divided into several civil work packages, each carried out by qualified contractors selected through a competitive bidding process. Recruitment will depend on available opportunities and meeting skill and qualification criteria. Most workers can be recruited from Sumatra, with some skilled and semi-skilled workers sourced from other parts of Indonesia. It is estimated that up to 500 workers, including skilled, semi-skilled, and unskilled labor, may be involved in construction activities, as shown in Table 3. However, this number could vary based on workload and qualification needs.

Table 3 Project Worker Requirements

Job Titles	Academic Qualifications	Number of Workers (indicative)
General superintendent	Bachelor's degree	2
Site engineer	Bachelor's degree	3
Main engineer	Bachelor's degree	4
Structural bridge engineer	Bachelor's degree	3
Assistant to Structural bridge engineer	3-years diploma degree	8
Road engineer	Bachelor's degree	4
Assistant to Road engineer	3-years diploma degree	4
Geodetic/surveyor engineer	Bachelor's degree	4
Assistant to Geodetic/surveyor engineer	3-years diploma degree	8
Engineer (general and supports)	3-years diploma degree/ Bachelor's degree	8
Drafter	3-years diploma degree/ Senior high school	6

Job Titles	Academic Qualifications	Number of Workers (indicative)
Estimator/Quantity engineer	Bachelor's degree	6
Engineering administration & Laboratory technicians	3-years diploma degree	5
Finance and Administration	Bachelor's degree	10
Logistics/warehouse	3-years diploma degree	10
Heavy equipment maintenance	3-years diploma degree	10
Security personnel	Junior/senior high school	40
Environment, health, and safety (various roles)	Senior high school/ 3-years diploma degree / Bachelor's degree	11
Mammals Expert	Bachelor's degree with 3-years experience	1
Primate Expert	Bachelor's degree with 3-years experience	1
Herpetofauna Expert	Bachelor's degree with 3-years experience	1
Social and Community Development Expert	Bachelor's degree with 3-years experience	2
Heavy equipment operator and vehicles' driver	Senior high school/ 3-years diploma degree	50
Unskilled and semi-skilled labor	Primary school, junior/senior high school	300
Total		500

Source: The draft Andal of Jambi – Rengat Toll Road (PT Dianzani Utama Konsultan, Juni 2024)

The Contractor Base camps and Worker Accommodation. To support construction activities, the selected contractors will either construct a base camp or use any available existing buildings in the project area to function as an office, materials stockpile, small workshop, and on-site temporary accommodation for workers. The base camp will be equipped with basic, functional sanitation facilities for employees, including bathrooms, toilets (separate for men and women), clean water supplies, and trash bins, as well as other supporting utilities¹⁵. The contractors may also rent houses owned by the local community as temporary accommodation for their workers. The locations of these base camps and accommodation facilities have not been determined, as the civil work contractors have not been selected at the time of ESIA preparation.

2.2.5.2 Mobilization of the Project's Vehicles and Heavy Equipment

The selected contractors will be responsible for mobilizing their own construction fleet through existing roads and/or jetties located within Batanghari River. A total of approximately 335 units of

¹⁵<https://www.ifc.org/en/insights-reports/2000/publications-gpn-workersaccommodation>

trucks and heavy equipment will be shown in Table 4. The type and number of vehicles and equipment listed in the following table are indicative only and may vary from one contractor to another depending on their contracted scope of work.

Table 4 Vehicles and Heavy Equipment to be Used

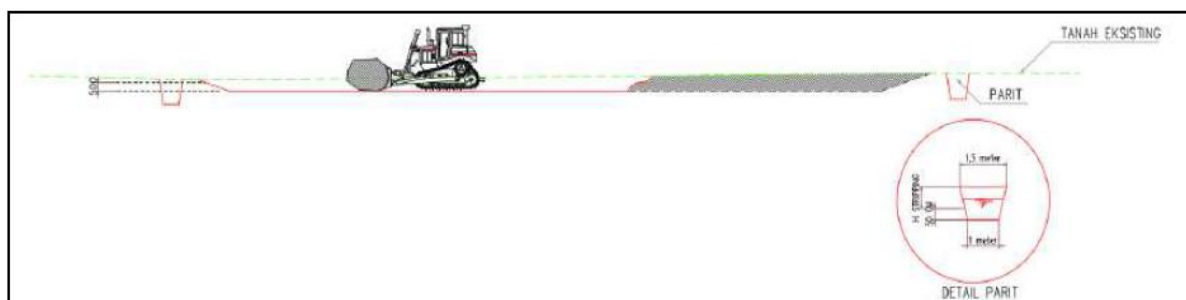
Type of Vehicles and Equipment	Number of Equipment (Indicative only)
Stone crusher	3
Concrete batching plant	3
Dump truck	200
Vibratory roller	10
Tandem roller	10
Motor grader	15
Excavator	15
Pneumatic tire roller	3
Wheel loader	4
Water tanker	5
Asphalt finisher	3
Asphalt sprayer	3
Concrete mixer	5
Air compressor	5
Diesel-fueled generator	6
Bulldozer	15
Pile hammer	10
Bored pile	12
Mobile crane	8
Total	335

Source: The draft Andal of Jambi – Rengat Toll Road (PT Dianzani Utama Konsultan, June 2024)

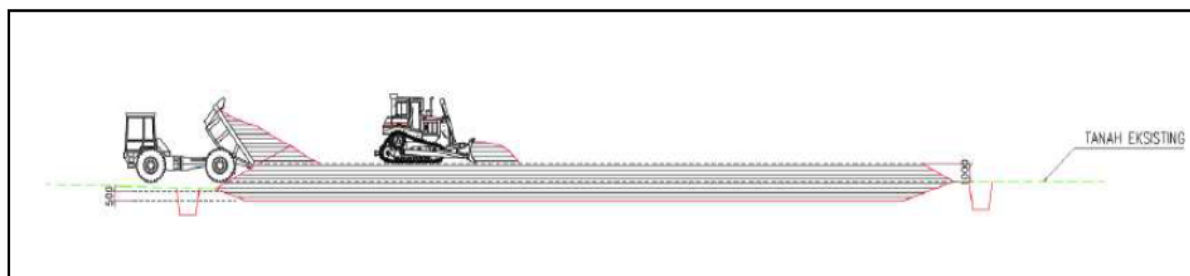
2.2.5.3 Earthworks and Construction Activities

Large-scale earthworks, including land clearing, cut and fill, bore piling, and road paving, will be carried out to create a stable foundation for the toll road. Land clearing and excavation remove topsoil, vegetation, boulders, and debris that may be unsuitable for construction. After removing the topsoil, the subgrade should be checked and stabilized if necessary to support the concrete pavement. Excavation and grading involve moving, building up, sloping, and leveling the ground for road construction. The accompanying figures illustrate these earthwork activities. During construction, soil erosion and surface runoff will be managed using appropriate methods such as land clearing, cut and fill, levelling, and the construction of temporary drainage channels and settling ponds, based on a hydrology study of the area.

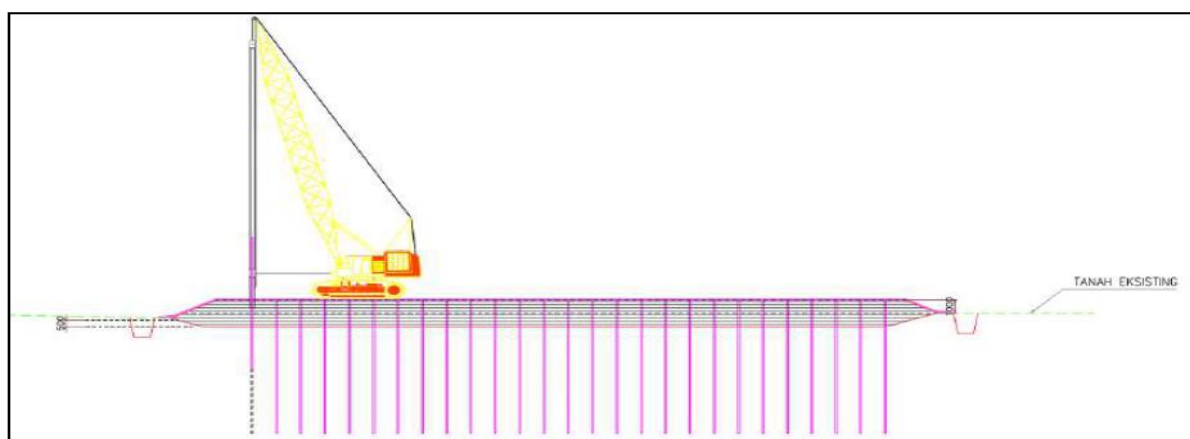
Figure 4 Earthworks Activities



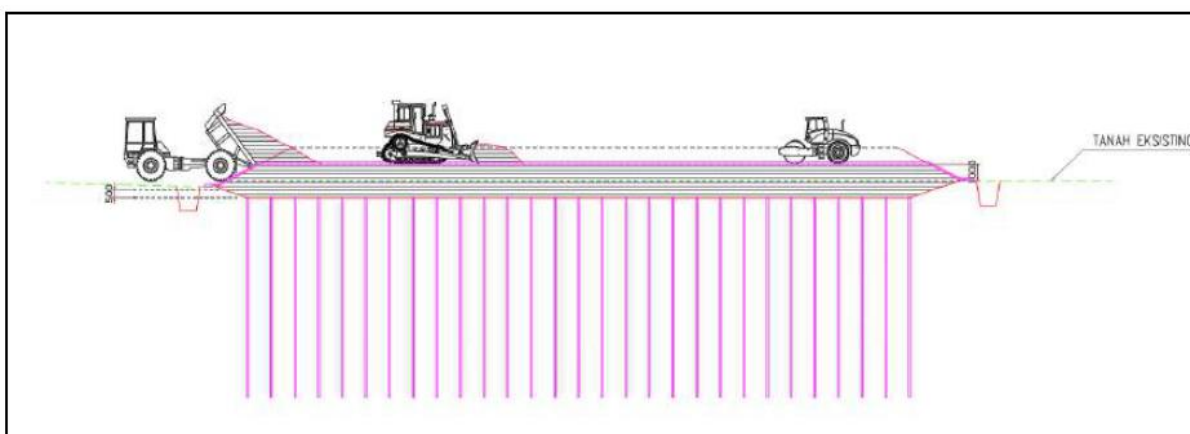
Land clearing and soil stripping



Excavation and grading as a working base



Putting bore piles as the road foundation



Backfilling and grading ready for putting concrete pavement

Source: DED Report of Jambi – Rengat Toll Road of STA 0+000 – 40+000 (PT Maratama Cipta Mandiri, 2022)

Toll Road Design. The toll road features three lanes per direction, totaling six lanes to increase traffic volume. It will include interchanges, toll gates, and access roads linked to the existing national

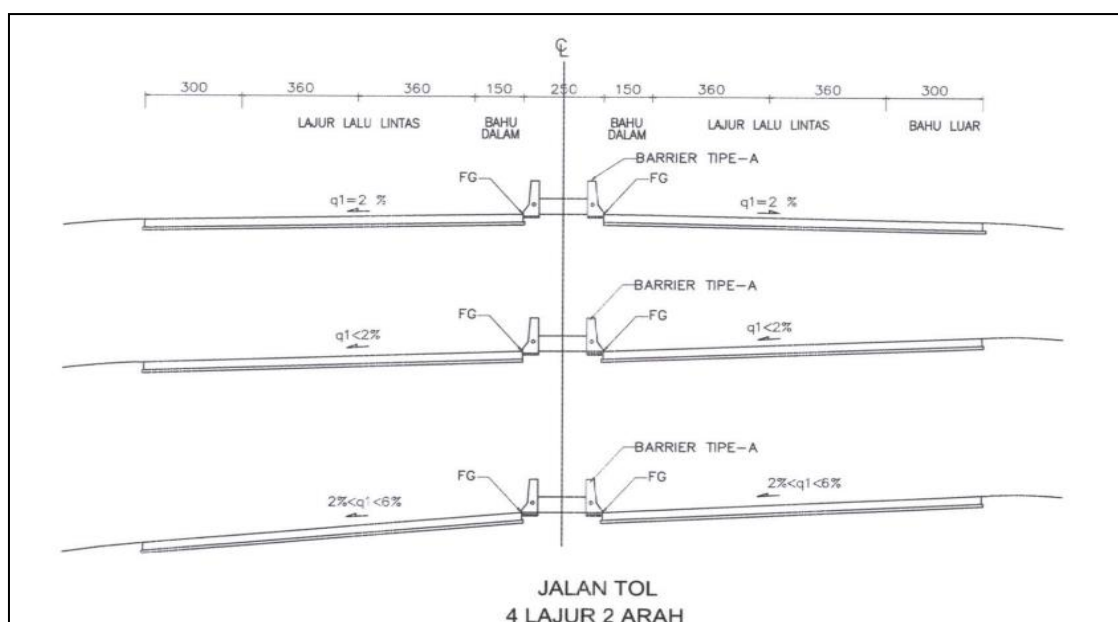
network. Key design standards are listed in Table 5, while the final DED reports depict the toll road's cross-section in Figure 5.

Table 5 Key Design Criteria of Toll Road

Road Parameter	Value
Total length of Jambi – Merlung segment	67.45 km
Vehicle speed	Up to 100 km/h
Overall toll road right of way	60 - 100 m
The width of each lane	3.6 m
The width of outer road shoulder	3.0 m
The width of inner road shoulder	1.5 m
The width of the road median	2.5 m
Number of vehicles lanes	2 x 2 lanes (initially) and 2 x 3 lanes (later on if the traffic load warrants for this extension)
Slope of road cross section	2%
Median type	Concrete-typed barrier
Pavement	Rigid-typed pavement

Source: Final DED – Drawings (general section) STA 18+750–67+450 (PT Maratama Cipta Mandiri and PT Buana Archicon, 2022)

Figure 5 Toll Road Cross Section



Source: Final DED – Drawings (general section) of STA 18+750 to 67+450 (PT Maratama Cipta Mandiri and PT Buana Archicon, 2022). Note: The dimensions are in centimeters.

Access Road Design. The design criteria of the access road to the toll road with one lane in each direction, and hence a total of two lanes for both directions, are shown in the following table.

Interchange Design. Two interchanges will be constructed at Cinto Kenang and Merlung to connect the toll road with the existing national road, using the same design criteria as the access road (see Table 6). The location and length of each interchange are presented in Table 7.

Table 6 Access Road Design

Road Parameter	Dimension
Vehicle speed	40 km/h
Road width, each lane	4.0 m
Outer shoulder width	3.0 m
Inner shoulder width	1.0 m
Median width	0.8 m
Slope of road cross section	2%
Pavement type	Rigid-typed

Source: DED – Drawings (general section) STA 18+750–67+450
(PT Maratama Cipta Mandiri and PT Buana Archicon, 2022)

Table 7 Interchange Location and Length

Interchange	Location	Length of Interchange
Cinto Kenang	STA 18+305	4.31 km
Merlung	STA 67+100	2.89 km

Source: Slides of DGH/PT HK presented in November 2023.

Pavement Design: For the project, a rigid pavement will be implemented, comprising cement concrete plates as the foundation and a sub-base layer over the subgrade. This type of pavement, often called a concrete road due to its raw material, uses concrete as its main component. The toll road's pavement structure includes:

- *Subgrade preparation* – This work includes levelling the roadbed and repairing the subgrade if the existing subgrade does not meet the road's technical requirements. If the California Bearing Ratio (CBR) of the subgrade is about 6%, then repairing the subgrade is undertaken by spreading the selected soil.
- *Road foundation* – This work includes forming the road foundation by spreading road construction materials and mixing them with a binder for subsequent leveling and compaction. Pavement structure work includes sub-base work with an aggregate layer and a hardened road shoulder surface.
- *Lower foundation layer (sub-base course)* – The lower foundation layer is the pavement layer that is located above the subgrade layer and below the upper foundation layer. This lower foundation layer functions as:
 - Part of pavement construction to spread the wheel load to the subgrade.
 - Impregnation layer so that groundwater does not accumulate in the foundation.
 - Layer to prevent fine particles from the subgrade from rising to the upper foundation layer.
 - Protective layer of subgrade from the load of heavy equipment wheels (due to the weak bearing capacity of the subgrade) at the beginning of the work.
 - Protective layer of base soil from the effects of weather especially rain.
- *Upper foundation layer (base course)* – The top foundation layer is the pavement layer that is located between the bottom foundation layer and the surface layer that functions as:
 - The part of the pavement that resists the transverse force of the wheel load and spreads the load to the layers beneath it.

- Cushioning against the surface layer.
- The materials for the top foundation layer must be strong and durable enough so that they can withstand the wheel loads.
- *Surface course* – The surface layer is the layer that is in direct contact with the vehicle wheel load and functions as:
 - A layer that directly supports the load of vehicle wheels.
 - Layer that directly resists friction due to vehicle brakes (wear layer)
 - A layer that prevents rainwater that falls on it from seeping into the bottom layer and weakening the layer.
 - A layer that spreads the load to the bottom layer, so that it can be borne by the layer beneath it.

If necessary, a covering layer/wearing course can also be installed on top of the surface layer. The function of this cover layer is as a protective layer for the surface layer to prevent water from entering the road surface while providing skid resistance. The wear layer is not considered to carry the traffic load. The design criteria of the pavement structure for both the main toll road and access road/interchange are shown in Table 8.

Table 8 Pavement Design

Description	Thickness
Design live	40-years
Rigid pavement	300 mm
Lean concrete	100 mm
Class A aggregate	200 mm
Coarse-grained selected fill	200 mm
Subgrade	6%
Transverse Connection Distance	5 m

Source: DED Review of Trans Sumatera Toll Road STA 0+000–STA 43+000 (PT Maratama Cipta Mandiri, 2024)

2.2.5.4 Bridge, Overpass/Underpass, and Culvert

River Crossing/Bridge. The main elements of a river crossing or bridge include sub-structure and super-structure. The bridge sub-structure includes foundations, footings, abutments, and pillar columns. The bridge superstructure includes the main beam and bridge floor. A pile-type foundation will be used to support the river bridge. A pre-tensioned concrete girder beam will be used to construct the river bridge. The girder materials consist of concrete and stands with pre-determined specifications. The girders are usually made at pre-determined locations prior to being transported by road, ship, or crane as appropriate to their intended locations.

The bridges that would be constructed across Pijoan River and its tributaries at four locations as shown in the following table, with a range of 25.8 to 45.8 meters. Furthermore, a major bridge will be constructed across the Batanghari River with a total span of up to **1,221.7 meters** using a balanced cantilever structure. The locations and specifications of all river-crossing structures are presented in Table 9. Illustrations of the bridge types to be used are shown in Figure 7.

Table 9 River Crossings (Bridges)

STA	River	Bridge Type	Bridge Span (m)
1+961	Pijoan River	Simple Span PCI Girder	45.8
10+640	Pijoan's tributary	Simple Span PCI Girder	25.8
11+478	Pijoan's tributary	Simple Span PCI Girder	30.8
13+722	Pijoan's tributary	Simple Span PCI Girder	25.8
15+818	Batanghari River	Balance Cantilever	1,221.7

Source: DED Reports of STA 0+000 to 40+000 of Jambi – Rengat Toll Road (PT. Maratama Cipta Mandiri, 2021); STA 40+000 to 80+000 of Jambi – Rengat Toll Road (PT. Buana Archicon, 2022); and updated information from PTHK/DGH (July 2024)

The project alignment between STA 15+000 and STA 18+000 encompasses the most critical structural engineering works of the toll road, dominated by the Batanghari River crossing and its extensive approach viaducts. Based on the 2025 Detailed Engineering Design (DED) Review, the vertical alignment in this section has been optimized to balance structural safety, earthwork volumes, and environmental footprint.

- **Main River Crossing (STA 15+818):** The crossing of the Batanghari River utilizes a long-span balanced cantilever bridge design. This structural choice is specifically selected to minimize the number of piers required within the active river channel. The bridge provides a substantial

vertical clearance of 18.62 meters above the water level. This high clearance is designed to safely accommodate the highest flood levels (Highest Water Spring/HWS) and ensure unhindered river navigation or passage of large floating debris during extreme weather events.

- **In-River Foundations:** The main piers supporting the cantilever spans rely on massive, deep pile foundations (e.g., bored piles) driven directly into the riverbed. The construction of these in-river piers will involve significant temporary works, including cofferdam installation and extensive underwater drilling, which are identified as the primary sources of potential hydrological and aquatic biodiversity impacts during the construction phase.
- **Floodplain Connectivity and Approach Viaducts:** To traverse the riparian zones and adjacent floodplains without acting as a physical barrier (dam), the design prominently features elevated viaduct structures (approach spans) rather than solid earth embankments. By elevating the carriageway—with clearances ranging from 12.53 meters near STA 15+000 up to 21.64 meters—the design successfully preserves the hydrological connectivity of the Batanghari River floodplain. This ensures that seasonal floodwaters can pass freely beneath the toll road, significantly mitigating the risk of induced flooding (backwater effect) in the surrounding areas.
- **Intersections with Local Infrastructure:** The elevated nature of the toll road in this segment allows for the integration of multiple crossing structures to maintain community connectivity and avoid severing local access (see Figure 7). These include:
 - **STA 15+038:** Box Underpass for Jl. Desa (Village Road).
 - **STA 16+742:** Jembatan Utama Jl. Desa (Main Village Road Bridge) crossing beneath the toll alignment.
 - **STA 17+488:** Overpass for Jl. Kabupaten (Regency Road). The 2025 DED Review indicates an adjustment in the vertical alignment (finish grade) in this specific area, lowering the highway profile compared to the 2023 DED (from a 2.500% slope to a 1.200% slope). This optimizes the clearance heights (5.58 meters and 7.01 meters) while reducing the visual impact and required earthworks for the overpass approaches.

The following sequence outlines the anticipated methodology for establishing the main pier foundations within the Batanghari River channel:

- **Mobilization and Temporary Structures:** Construction will commence with the mobilization of heavy equipment using flat-top barges and the potential installation of temporary steel trestles (working platforms). These temporary structures will facilitate access to equipment but will introduce localized, short-term flow obstructions.
- **Cofferdam Installation:** To create a dry and secure working environment for the pile caps, the project may use temporary steel sheet pile cofferdams that will be driven into the riverbed, enclosing the main pier locations. The installation of these cofferdams marks the peak period of flow blockage, temporarily narrowing the effective river cross-section and is anticipated to cause a localized increase in flow velocity and a temporary upstream afflux (backwater effect).
- **Bored Piling and Slurry Management:** Once the cofferdam is secured, deep foundation works may utilize the bored-pile method. This process involves extracting significant volumes of riverbed material (spoil) and utilizing drilling slurry (e.g., bentonite) to stabilize the boreholes. The management, containment, and disposal of these drilling fluids and spoils are critical operations; any accidental release or improper discharge during this stage is identified as the

primary risk for extreme spikes in Total Suspended Solids (TSS) and downstream sedimentation.

- **Pile Cap and Pier Construction:** Following piling, the water inside the cofferdam will be pumped out (dewatering). The dewatering effluent must be treated via settling tanks before being discharged back into the river to ensure compliance with water quality standards. Subsequently, the concrete pile cap and pier shafts will be cast in situ.
- **Decommissioning and Riverbed Restoration:** Upon completion of the pier columns above the high-water level, the steel sheet pile cofferdams will be extracted. The removal process will cause a brief, secondary phase of riverbed disturbance. Following extraction, the localized riverbed will be restored, and permanent scour protection measures (e.g., riprap or concrete mattresses) will be installed around the pile caps to mitigate long-term vortex-induced local scouring during the bridge's operational phase.

Figure 6 Type of Bridges to be Constructed



Source: (left) <https://konstruksimedia.com>; (right) DGH/PT Hutama Karya, November 2024

Overpass and Underpass. The toll road would intersect with the national, provincial, and local roads, as well as other land uses, requiring the construction of approximately 28 overpasses and 57

underpasses. The design criteria for the overpasses and underpasses to be used in the construction are presented Table 10.

Table 10 Overpass and Underpass Design Criteria

Item	Overpass	Underpass
Materials	Concrete	Concrete
Soil handling/treatment	-	Mini pile square 25 and prefabricated vertical drain PVD)
Foundation type	Bore pile 1	Square 25 Class B
Pile length	18 – 39 meters	4 – 20 meters
Width	6.5 – 17 meters	6.5 – 20 meters
Vertical clearance	5.1 meters	4.6 – 5.1 meters

Source: DED Report of Jambi-Rengat Toll Road STA 40+000 – 80+000 (PT. Buana Archicon, 2022)

Figure 7 Detailed Engineering Design of Batanghari River Bridge

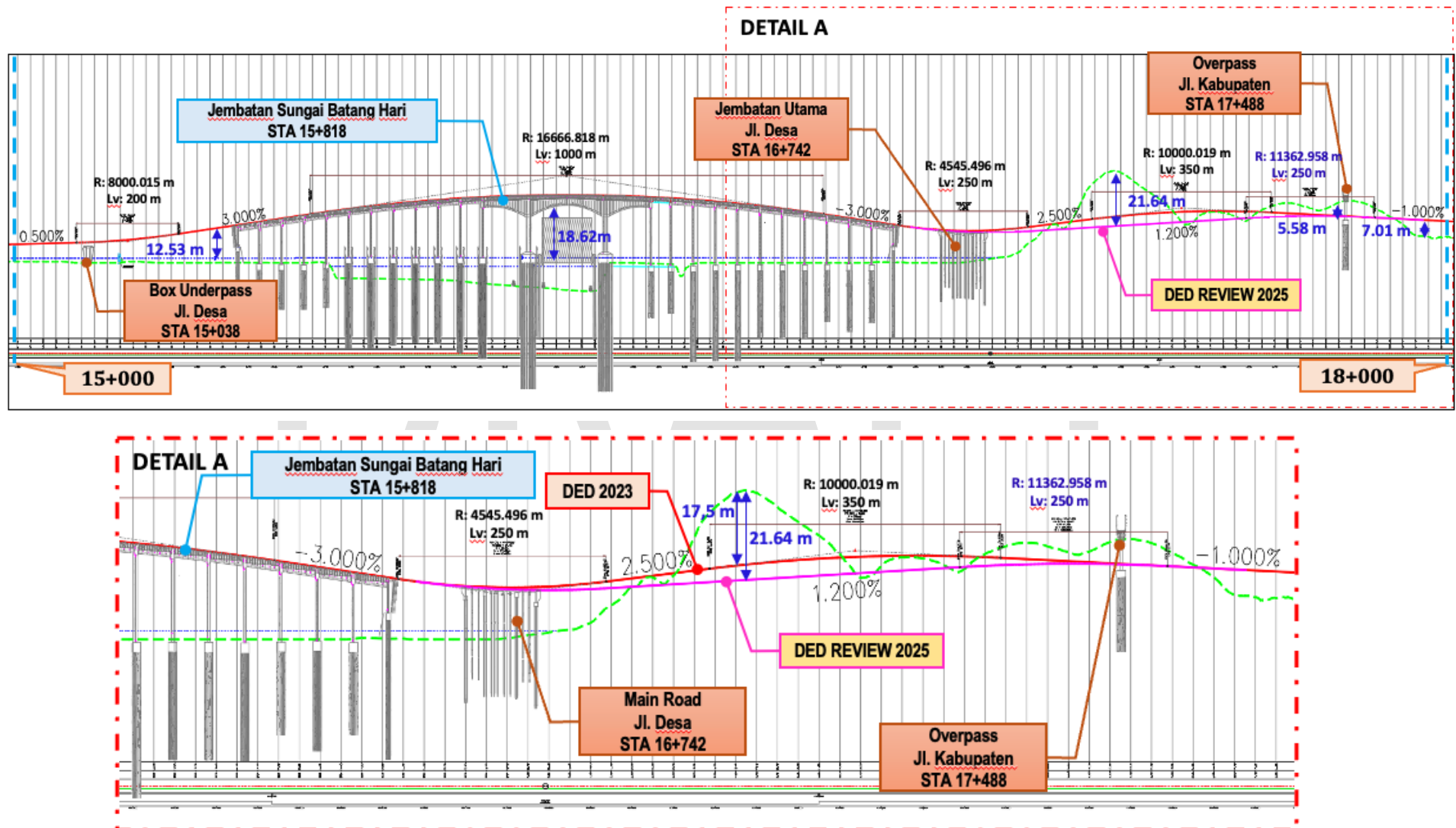
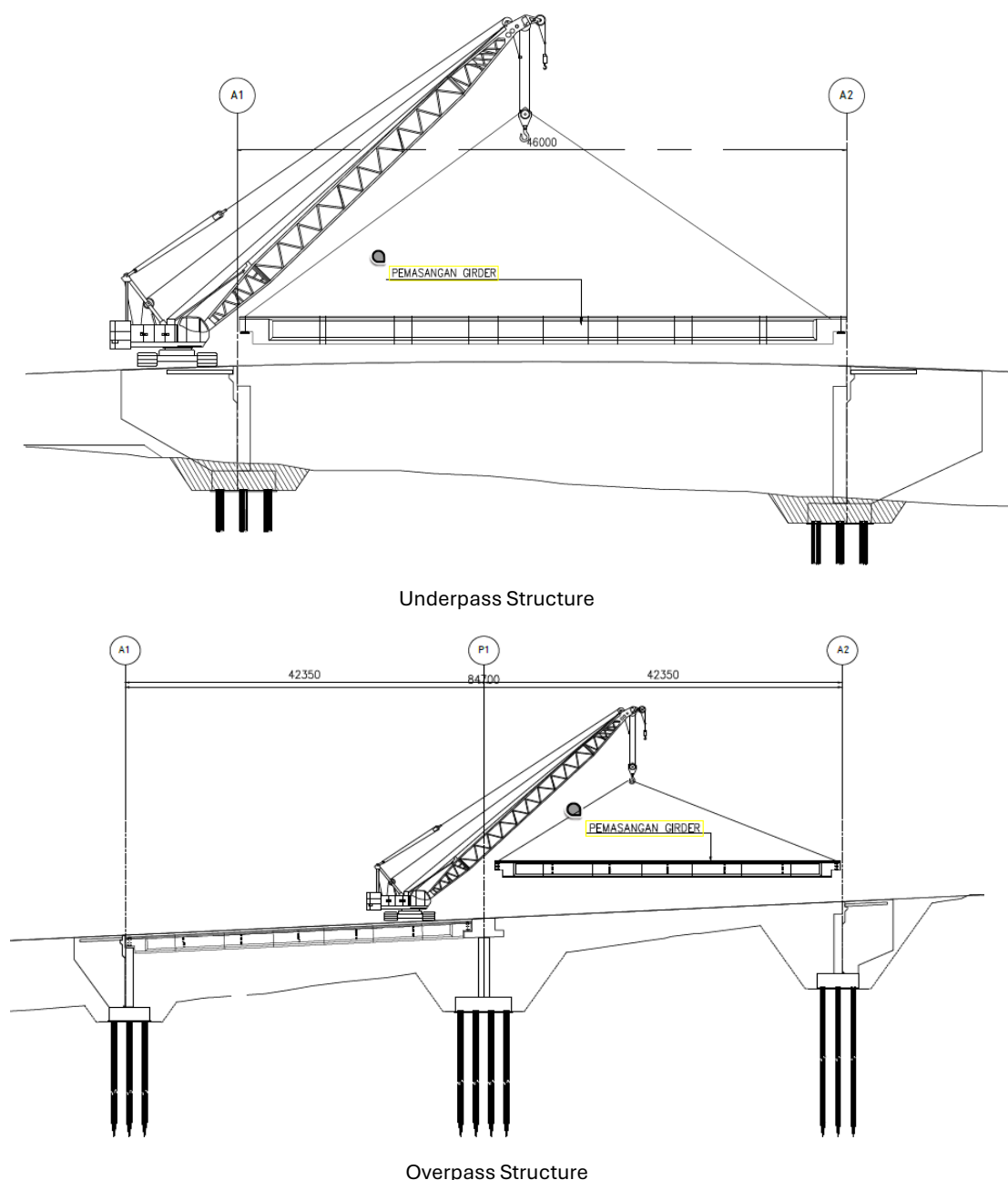


Figure 8 Overpass and Underpass Designs



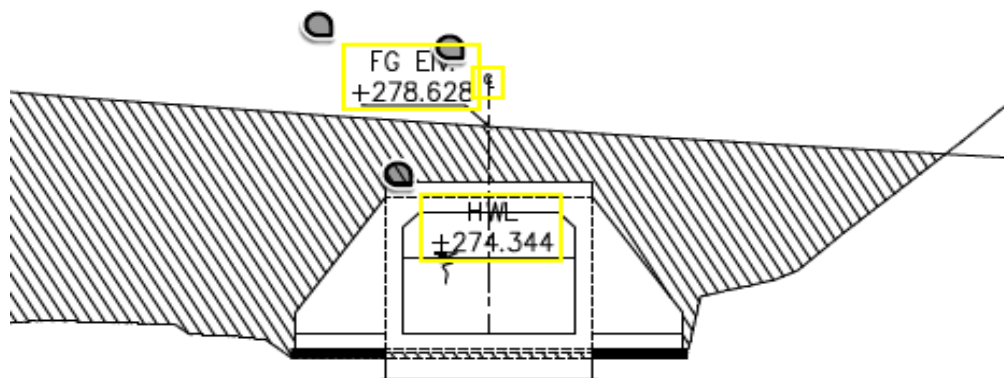
Source: DED Report (Construction Method) of Jambi-Rengat Toll Road STA 0+000 to 40+000 (PT. Maratama Cipta Mandiri, 2021)

Culvert and Drainage Channel. Natural drainage systems follow the toll road alignment. To ensure proper surface water flow and prevent accumulation—which could compromise the embankment and foundation stability—pre-cast U-shaped channels, box culverts, or similar structures will be installed. Precast concrete blocks, measuring 2 x 2 meters (or other sizes and cross-sections), will be positioned at appropriate locations along the toll road, as shown in Figure 9.

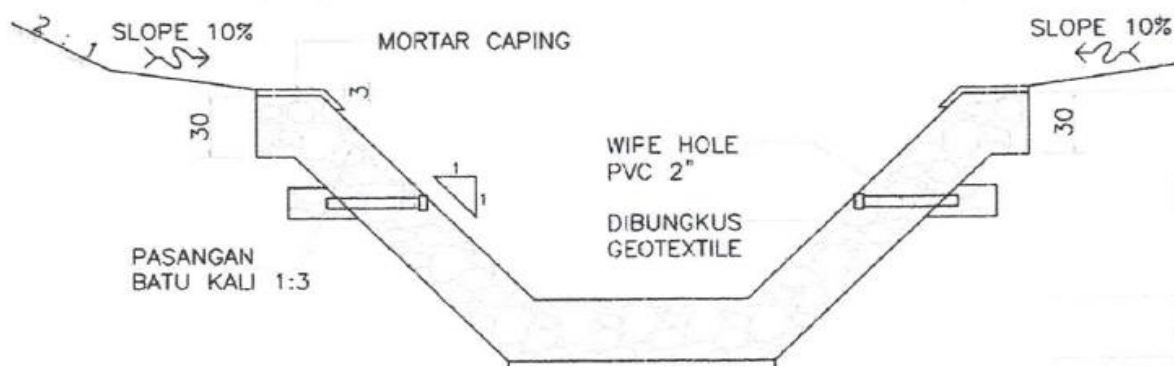
Due to a basin blocked by the planned main road embankment, a total of 105 culverts will be installed, with a design based on a 50-year return period. Because there are two potential flood areas along the toll road, a 4x3-meter culvert will be installed at STA 40+014, and a slab-on-pile will be installed over

approximately 210 meters from STA 39+700 to STA 40+350. To prepare for floods, flood detection and early warning systems are planned at the Batanghari River crossing (Figure 11).

Figure 9 Box Culvert and Drainage Channel (Example)

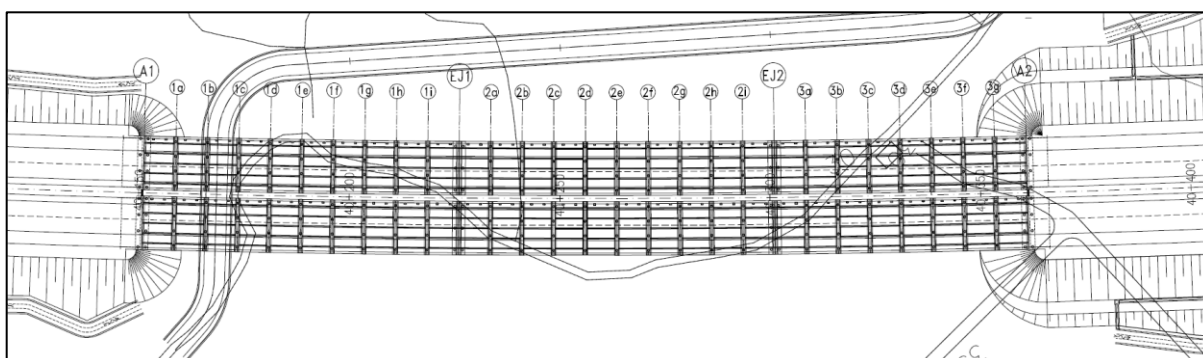


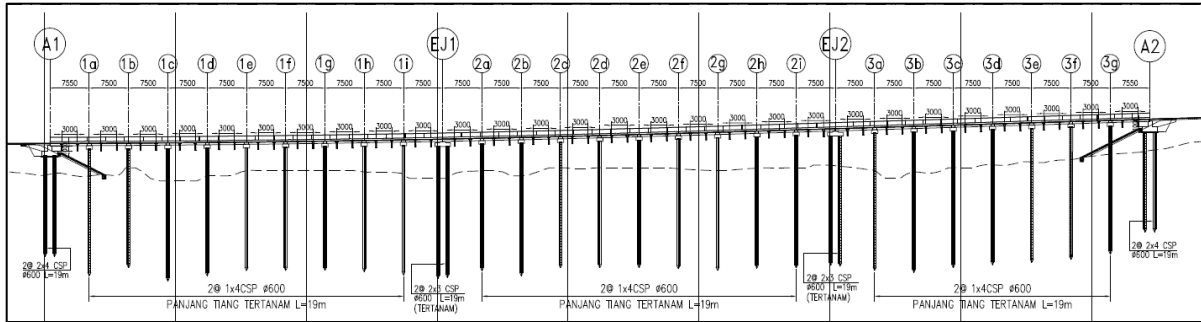
Source: DED Report (Construction Method) of Jambi-Rengat Toll Road STA 40+000 – 80+000 (PT. Buana Archicon, 2022)



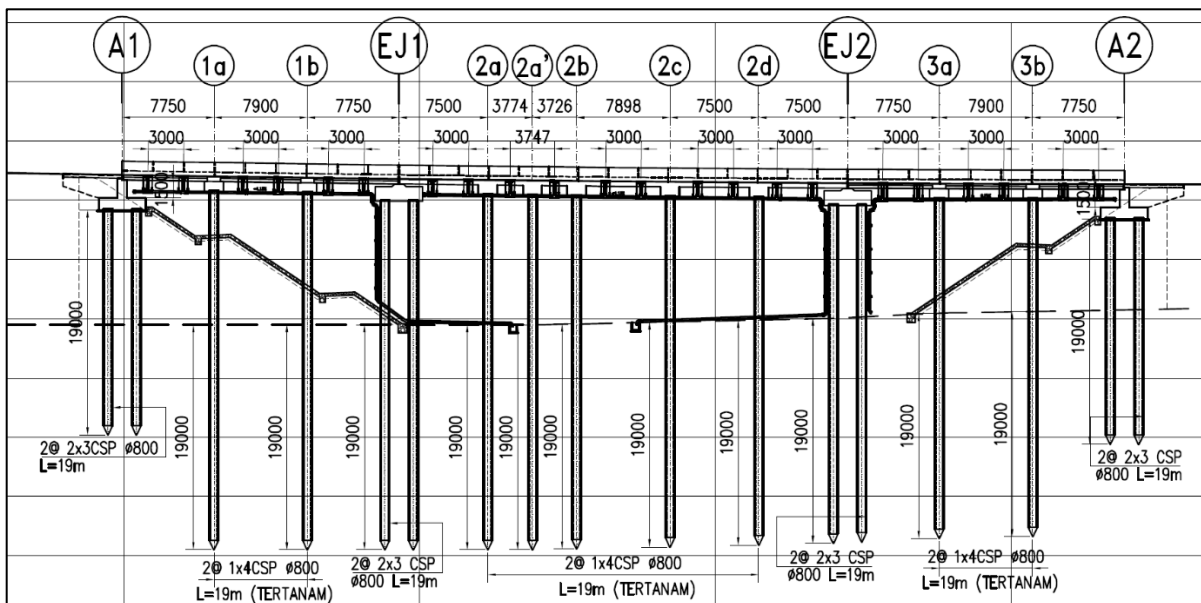
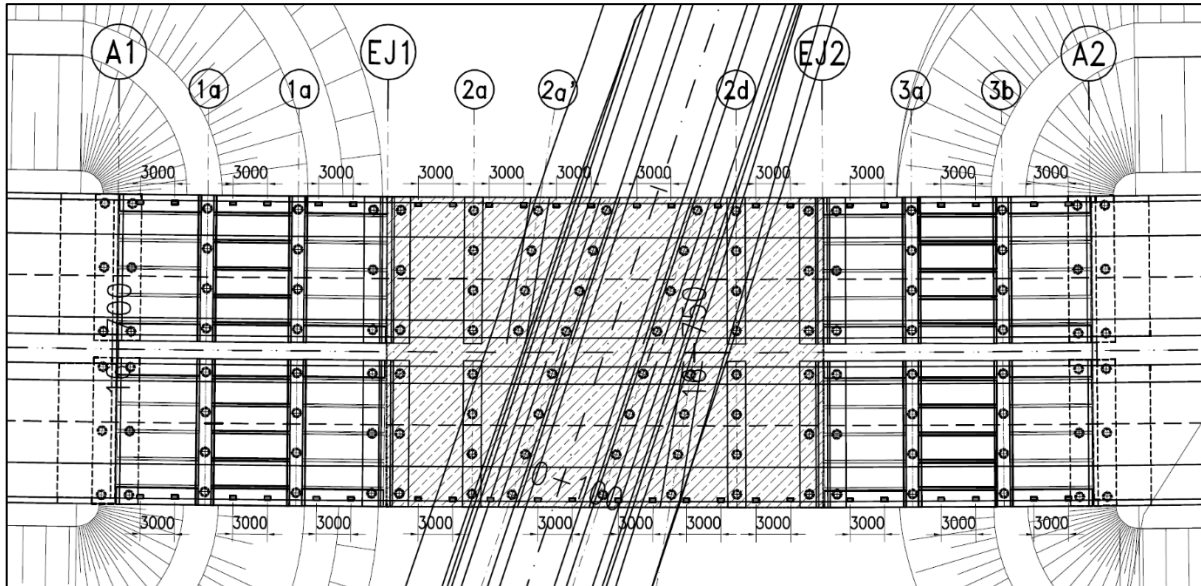
Source: DED Report (Construction Method) of Jambi-Rengat Toll Road
STA 15+200 – 18+750 (PT. Maratama Cipta Mandiri, 2022)

Figure 10 Slab on Pile Structure



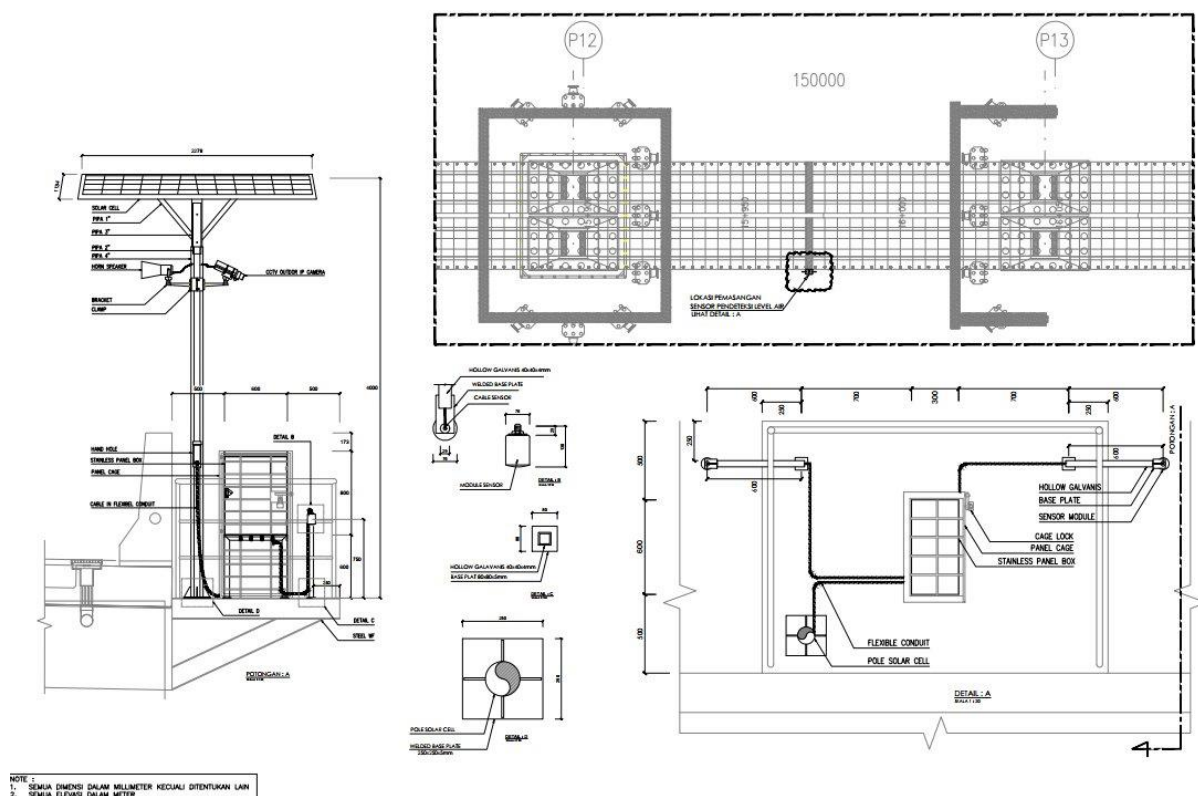


Slab on Pile Structure at STA 40+200



Design Enhancement of Slab on Pile STA 16+750

Figure 11 Flood Detection and Warning System

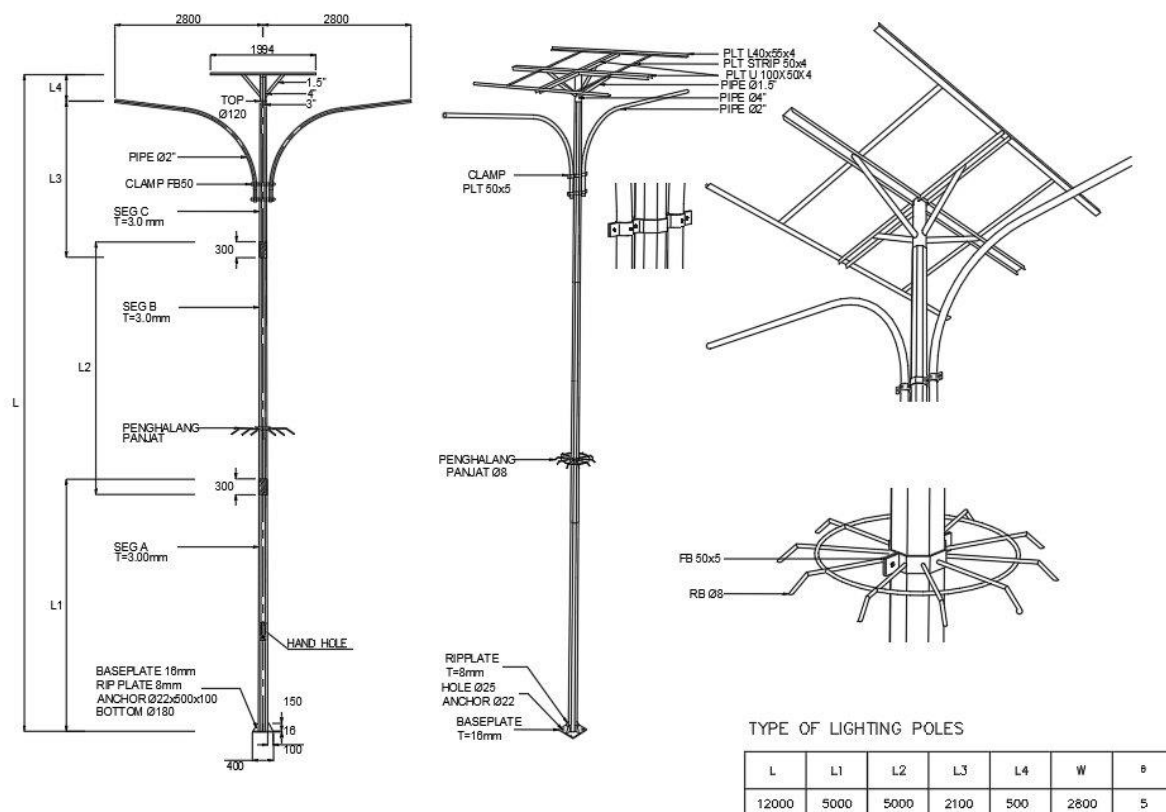


2.2.5.5 Lighting and Landscaping

Solar photovoltaic cell-powered lighting and/or the lighting powered by electricity from the power would be installed at the median of the toll road (Figure 12a), at the interchanges, and at underpass (Figure 12b). Potential specifications of the photovoltaic cell-powered lighting have not been identified at the time of ESIA preparation. In addition, cat eye reflectors will be used at the toll road sections where the lighting system is not available.

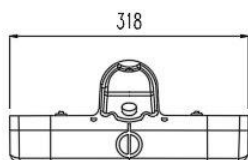
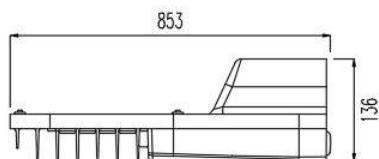
Additionally, trees will be planted beyond the pavement edge and outside the clear zone. Landscaping will serve as a form of compensatory tree planting to offset the loss of forest resources. Native tree species that are well-suited to local soil conditions and require minimal maintenance and irrigation for landscaping. This approach helps prevent the introduction of potentially invasive non-native species, in accordance with the Biodiversity Management Plan for the Jambi-Rengat Toll Road, Sumatera — Phase 1: Sp. Ness to Merlung Segment (YAPEKA, 2024).

Figure 12 Lighting Towers of Toll Road



DETAIL TIANG SOLAR CELL TIPE – B, H = 12m
SKALA NTS

*DRAWING ONLY
FOR REFERENCE



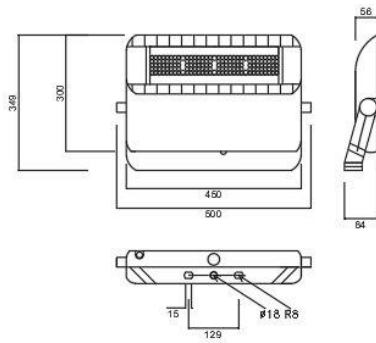
DETAIL LAMPU PJU 100W
SKALA NTS

STREET LIGHT 100W (SOLAR CELL)

NO	SPECIFICATION	DESCRIPTION / VALUE / UNIT
1	POWER	100 W
2	VOLTAGE INPUT	24 W
3	LAMP TYPE	LED
4	LUMEN	20000 lm ($\pm 5\%$)
5	EFFICACY	200 lm/w
6	COLOR RENDERING INDEX	≥ 70
7	COLOR TEMPERATURE, CCT	5000 K s/d 6500 K
8	INGRESS PROTECTION	IP-66 (DUST PENETRATION-PROTECTED, JET-PROOF)
9	IMPACT PROTECTION	IK-08 (5J VANDAL-PROTECTED)
10	MEDIAN USEFUL LIFE	50000 HOURS
11	AMBIENT TEMPERATURE RANGE	-25°C ~ 65°C
12	POWER FACTOR (COS Ø)	90%
13	DIMMABLE	YES, SMART DIMMING
14	HOUSING MATERIAL	ALUMINIUM DIE CAST

a. Solar Panel Design On The Main Road Of The Toll Road

*DRAWING ONLY
FOR REFERENCE



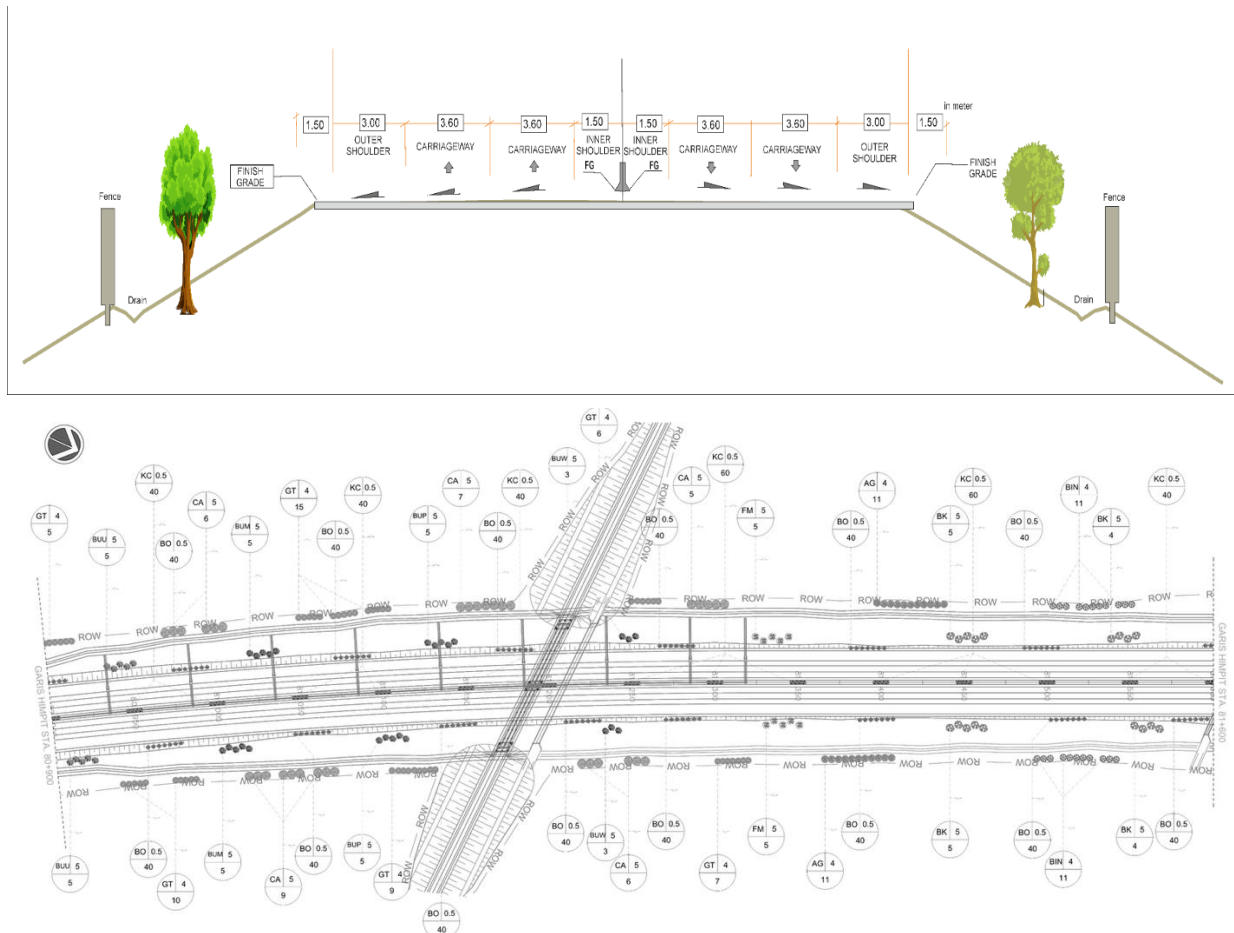
FLOOD LIGHT 30W

NO	SPECIFICATION	DESCRIPTION / VALUE / UNIT
1	POWER	30 W
2	VOLTAGE INPUT	220-240W
3	LAMP TYPE	LED
4	LUMEN	24000 lm (±5 %)
5	EFFICACY	200 lm/w
6	COLOR RENDERING INDEX	≥70
7	COLOR TEMPERATURE, CCT	4000 K s/d 5700 K
8	INGRESS PROTECTION	IP-66 (DUST PENETRATION-PROTECTED, JET-PROOF)
9	IMPACT PROTECTION	IK-08 (5J VANDAL-PROTECTED)
10	MEDIAN USEFUL LIFE	50000 HOURS
11	AMBIENT TEMPERATURE RANGE	-40°C ~ 50°C
12	POWER FACTOR (COS Ø)	90%
13	DIMMABLE	NO
14	HOUSING MATERIAL	ALUMINIUM DIE CAST

DETAIL LAMPU FLOOD LIGHT 30W
SKALA NTS

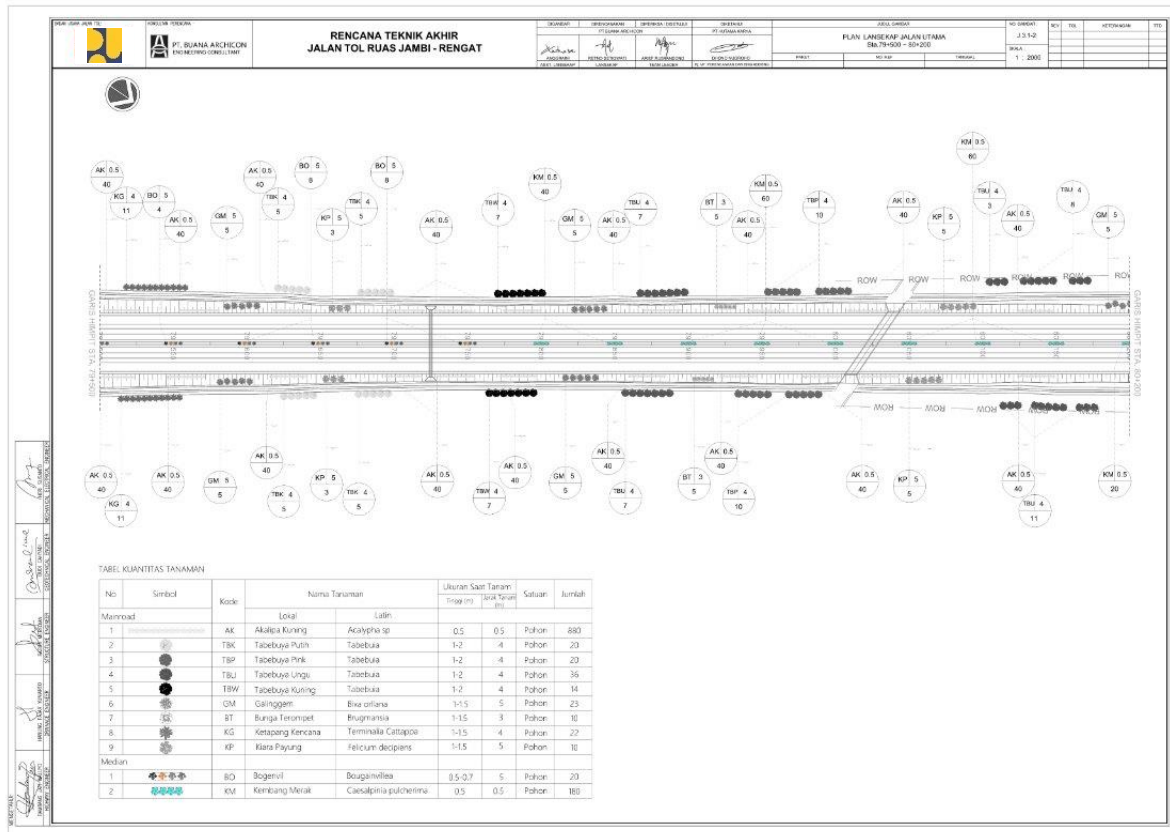
b. Underpass Light Design

Figure 13 Landscape Design of Toll Road

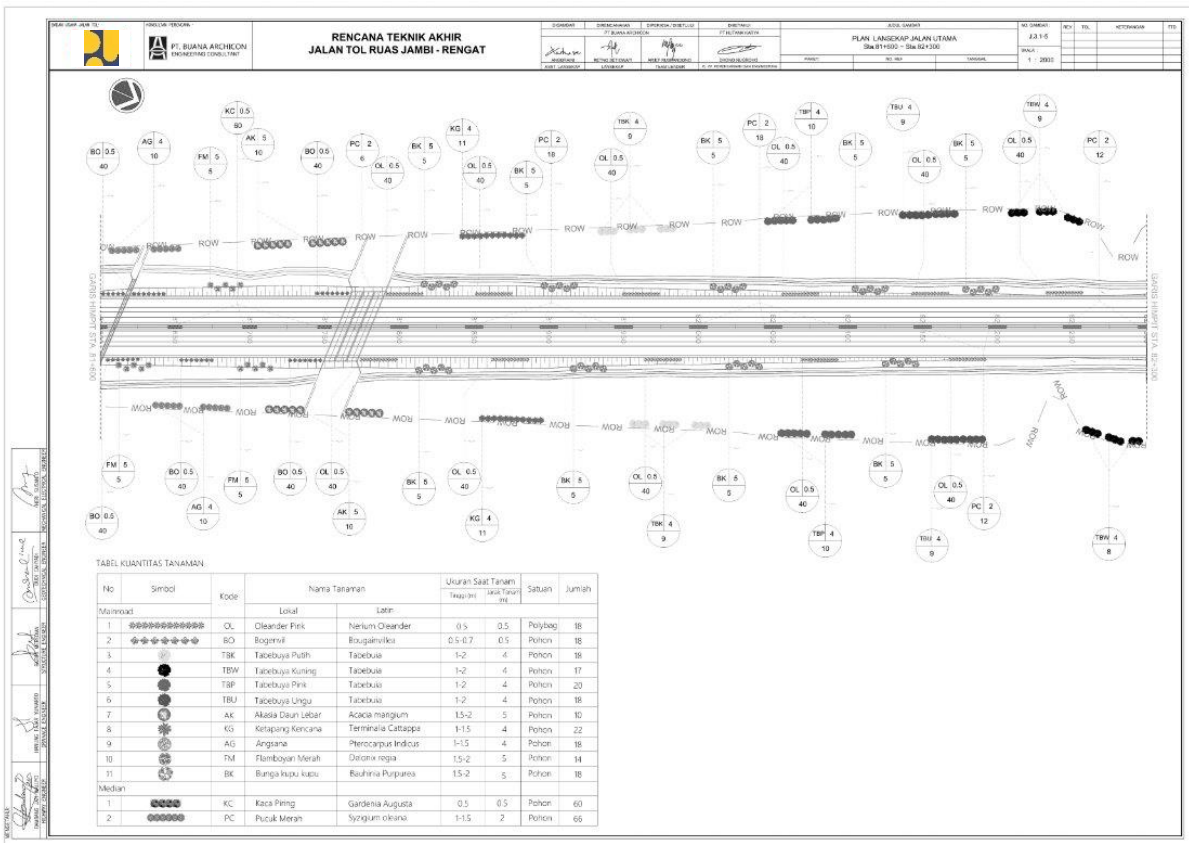


Landscaping and greenery options outside the clear zone

Simpang Ness to Merlung Segment
(Phase 1 Development of Jambi – Rengat Toll Road Project)



Compensatory Tree Planting To Offset The Loss Of Forest Resources



Planting Trees after The Pavement Edge

Source: DED Report (Landscaping) of Jambi-Rengat Toll Road STA 40+000 – 80+000 (PT. Buana Archicon, 2025)

2.2.5.6 Site Utilities

Water supplies. During construction, freshwater mainly supports dust suppression, vehicle cleaning, and general washing. It will likely be sourced from nearby streams, water bodies, or groundwater wells, depending on availability. The water will be pumped to a point where it can be filled into trucks for dust control at sites, access roads, and areas with high dust levels that disturb local communities. For personal hygiene and bathing, some water treatment will be necessary to meet standards outlined in the Ministry of Health Regulation No. 2/2023 and similar regulations. Bottled water will usually be provided at contractor base camps for drinking and cooking. The estimated freshwater requirement for dust suppression and washing is about 10 m³/day per contractor, while the base camp—including site office and worker accommodations—will need around 20 m³/day for up to 200 workers. In total, the daily water need is estimated at 30 m³ per contractor.

Wastewater Treatment and Disposal. A modular wastewater treatment system, such as a bio-filter or bio-septic tank with a seepage system, will be installed to manage sewage and latrine waste from the men's and women's toilets at the contractor's base camps during construction. Wash water from bathrooms and cleaning facilities will flow into temporary retention ponds for sediment and effluent separation before being discharged into nearby water bodies. It is generally estimated that 80% of water used becomes wastewater, so the sizes of septic tanks, retention ponds, and similar treatment units should be based on this estimate. Portable toilets for men and women at remote sites will also be provided, each equipped with a bio-septic tank and seepage system to reduce on-site soil contamination.

Waste (Hazardous and non-hazardous) generation and management. The main waste generated from construction includes spoil, concrete, steel rods that don't meet specifications, used planks, and packaging. Additionally, household-type wastes such as food leftovers, plastic bottles, and paper boxes will be produced. While not hazardous, these wastes require safe, temporary storage on-site before being used as backfill or disposed of at a designated waste facility, chosen by the contractor and approved by the relevant authorities and local governments.

A potential disposal site has been identified within Batang Asam District, West Tanjung Jabung Regency, Jambi Province. However, its final approval depends on environmental and social (E&S) evaluation and endorsement by the authorities and local government. Disposal sites should preferably be located away from communities, water sources, forests, and floodplains. A government permit may be necessary.

During construction, household waste from the contractor's base camp is estimated at up to 2.0 liters per person daily (about 0.30 kg). For 200 workers or residents, this totals roughly 400 liters (or 60 kg) daily. The waste — including leftover food, packaging, paper, and plastics — is temporarily stored in 20- to 40-liter containers at the basecamp before being transported to government-approved disposal sites. Ideally, waste should reach a locally managed final disposal site. If such options are unavailable or inaccessible at remote locations, the contractor must transport the waste using their own or contracted vehicles. Burning waste at remote sites or basecamps is strictly forbidden.

Hazardous Waste Management. The selected contractors would generate a relatively small amount of hazardous waste, such as used lubricants, off-specification fuels, and oily contaminated rags and spill kits already used. This type of waste typically arises from the operation and maintenance of the project fleet at construction sites or contractor basecamps. Additionally, the contractors will operate

a small medical clinic to provide first aid and stabilize patients before referring them to nearby government health centers (Puskemas) or hospitals. The clinic will be staffed by trained healthcare personnel or nurses equipped to handle such situations.

The infectious waste from such a clinic mainly includes used medicine packaging and bandages. As per Government Regulation No. 22/2021 on Environmental Protection and Management, these are classified as hazardous waste and must be managed and disposed of separately from non-hazardous waste. The hazardous waste will be stored in 200-liter steel drums or similar containers in a designated, roofed area with clear signage. Licensed third-party services will then transport these wastes to approved disposal facilities.

2.2.5.7 Auxiliary Facilities to Support Construction

Access Roads. Existing access roads and crossings providing links to different segments of the project area have been identified as part of the DED. Prior to their use, a road condition survey will be conducted to document baseline conditions and identify improvements and maintenance requirements. Typical conditions of access roads within the project area are shown in Figure 14.

Figure 14 Typical Access Roads within the Project Area



Access road of asphalt pavement from Trans Sumatera National Road to ~STA 17+000

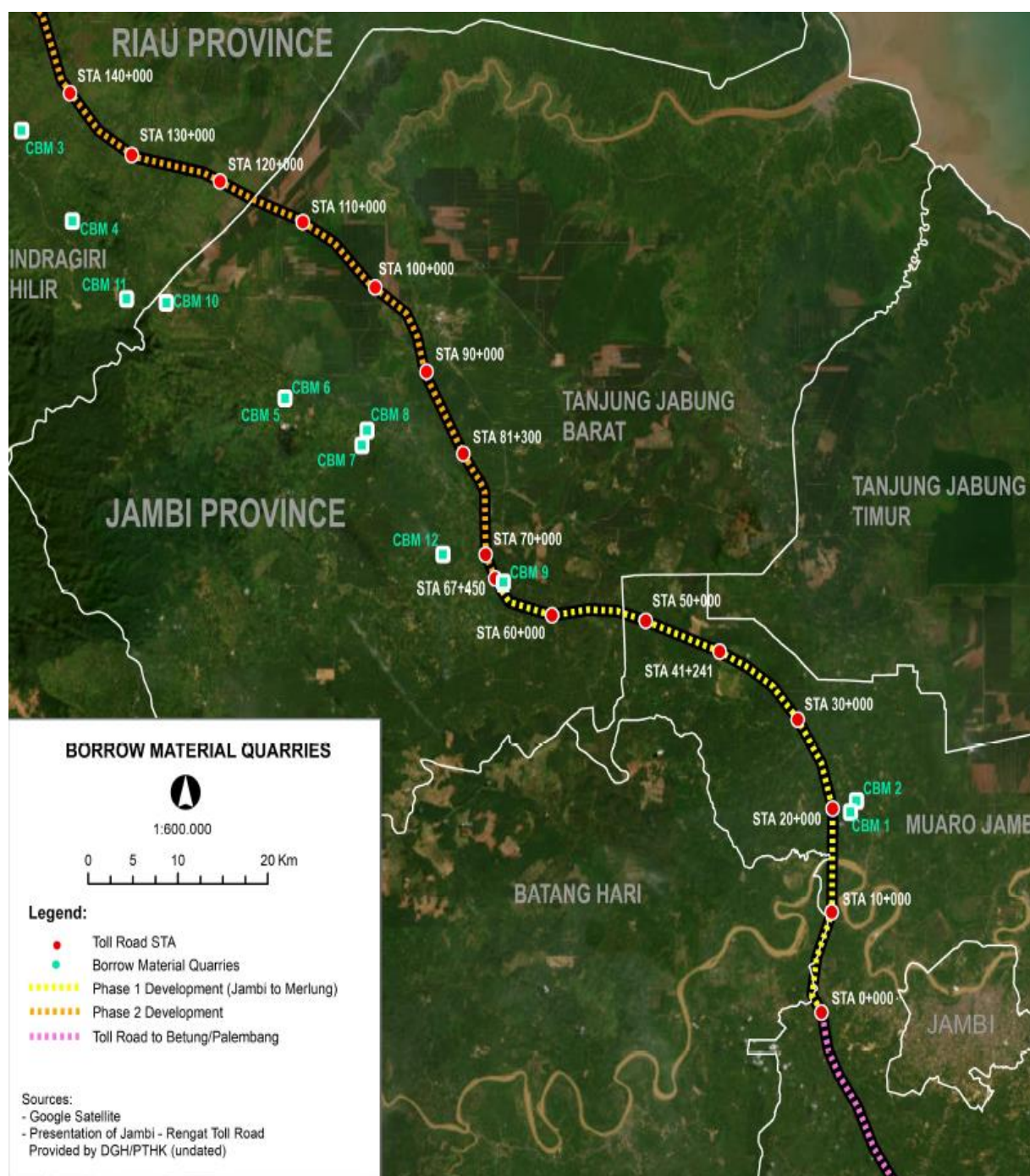


Part of unpaved access road from Trans Sumatera National Road to ~STA 50+000

Source: The presentation slides of Jambi - Rengat Toll Road provided by DGH/PT HK in November 2023.

Quarries. Approximately 18 common quarries within the project area in Jambi Province have been identified as part of the DED to supply sand, rock, and aggregates required for construction (Map 2). Quarries selected to supply project materials will be subject to meeting the applicable technical, environmental, and social criteria and holding the required government permits. Quarry areas range from 10 to 50 hectares, with material volumes ranging from 250,000 to 2,150,000 m³. Typical conditions of quarries within the project area are shown in Figure 15.

Map 2. Indicative Quarries



CBM = quarry

Source: This map is redrawn based on the presentation slides of Jambi Rengat Toll Road provided by DGH/PT HK in November 2023.

Figure 15 Typical Conditions of Quarries



Source: The presentation slides of Jambi - Rengat Toll Road provided by DGH/PT HK in November 2023.

Concrete Batching Plants (CBPs). Approximately **4 concrete batching plants** and asphalt plants have been identified as operating in the vicinity of the project area, with a capacity of 40–60 m³/hour, as presented in Table 11. CBPs to be used for the Project will be determined through a tender process. Typical conditions of concrete batching plants within the project area are shown in Figure 16.

Table 11 Concrete and Asphalt Plants in the Project Area

Name of Entities	Plant Types	Approximate Distance to ~STA 34+000 of Jambi – Merlung Toll Road (km)	Capacity
Atlas Citra Gemilang	Concrete batching	54 km	40 – 60 m ³ /hour
Pili and Trinusa	Concrete batching	56 km	40 – 60 m ³ /hour
Muria Beton	Concrete batching	56 km	40 – 60 m ³ /hour
Jambi Beton	Concrete batching	75 km	40 – 60 m ³ /hour
Gentala Jambi Jaya	Asphalt plant	68 km	1 ton/batch

Source: The presentation slides of Jambi - Rengat Toll Road provided by DGH/PT HK in November 2023.

Figure 16 Concrete Batching Plants



Source: The presentation slides of Jambi - Rengat Toll Road provided by DGH/PT HK in November 2023.

Jetties at Batanghari River, including its Tributaries. Several jetties operating along the Batanghari River within proximity of the project area have been identified through the DED survey, accessible by

barges with a capacity of up to 8,000 tons. A number of these jetties may serve as logistical hubs for the supply of construction materials, equipment, and other goods. Definitive jetties supporting the Project have not been determined at the time of ESIA preparation. Information on the identified jetties is presented in Table 12. Typical jetty conditions at Batanghari River are shown in Figure 17.

Table 12 Existing Jetties in the Project Area

Name of Entity Operating the Jetty	Approximate Distance between the Jetty to ~STA 34+000 of the Future Toll Road (km)
Naga Cipta Central 1	61 km
Naga Cipta Central 2	57 km
Muria Beton	56 km
Kumala Bahari	61 km

Source: The presentation of Jambi Rengat Toll Road provided by DGH/PT HK (undated).

Figure 17 Typical Jetties at Batanghari River



Source: The presentation slides of Jambi - Rengat Toll Road provided by DGH/PT HK in November 2023.

2.2.6 Operation Phase

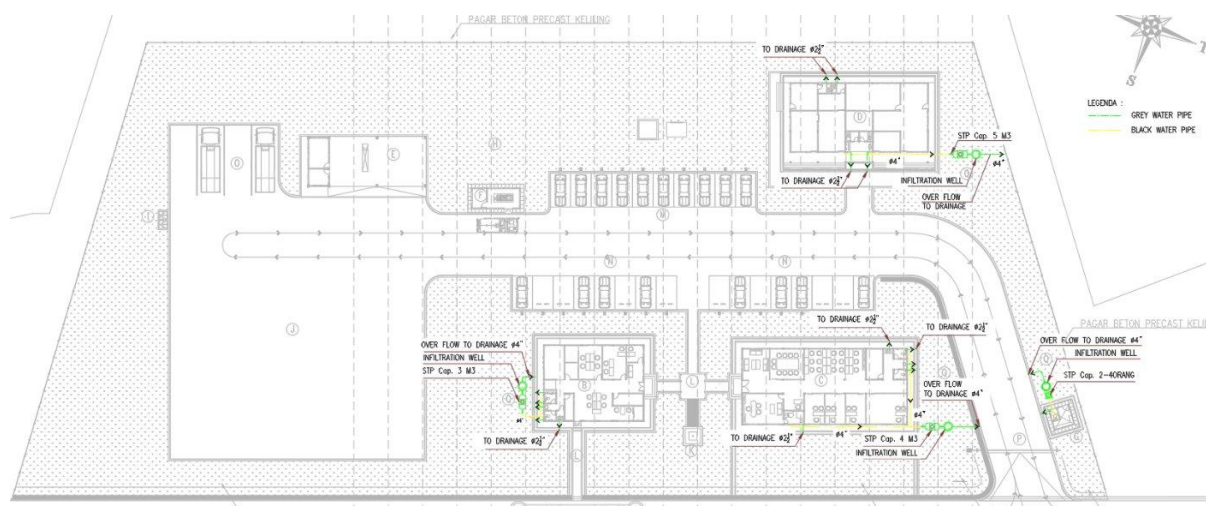
Toll Road Operation and Maintenance. Upon commissioning of the Sp. Ness–Merlung Toll Road, four-wheel and larger vehicles will be permitted to use the toll road without the traffic disruptions experienced on the existing Trans-Sumatera national road and other local roads. Periodic inspections of the toll road, bridges, overpasses, and underpasses for signs of defects, corrosion, and other deterioration will be conducted regularly as part of toll road operations. Vegetation trimming within the median, road shoulders, and right-of-way will be carried out to maintain good visibility and road user safety.

Road repairs may involve removing deteriorated or faulty concrete, filling potholes and cracks on the roadway, overpasses, and underpasses, then compacting the base and adding new material. Grinding might be necessary to smooth out bumps and dips in the surface. If spot repairs are not enough, full resurfacing could be needed, which includes breaking and removing the existing concrete, compacting and updating the base, and laying down a new concrete layer. Removed concrete is usually crushed for reuse as sub-base material or disposed of at a designated site. If the existing bridge paint is in good condition, it can be overcoated; otherwise, it must be stripped before applying new, lead-free paint. Some toll road sections will be illuminated at night with solar-powered or PLN grid lighting systems.

Offices and Rest and Service Area

The toll gate office near Cinto Kenang and Merlung interchanges, along with the Rest and Service Area at STA 42+000, will involve human activities. These activities will produce mainly household-type solid wastes and sewage, which could pose environmental concerns if not properly managed. Waste management will follow the procedures outlined in the ESMP section of the ESIA. Burning waste at these sites is strictly prohibited. Design of Sewage Treatment Plan and Water Treatment Plan (STP-WTP) design at toll gate is presented in Figure 18.

Figure 18 Sewage Treatment Plant and Wastewater Treatment Plant (STP-WTP) Design at Toll Gate



During operation and maintenance, clean water for the toll gate offices and rest areas is usually sourced from a deep well with a pumping system and a water reservoir. Freshwater for personal hygiene and bathing may require treatment, such as sedimentation, filtration, and disinfection, to meet the Ministry of Health's standards by reducing turbidity and fecal coliform levels. Alternatively, if available, the local government water company (PDAM) can supply clean water, especially in remote project areas. Bottled or packaged water is typically provided at the contractor's camp for drinking and cooking needs.

Clean water for each toll gate office employing up to 20 people (on a roster basis) for 24-hour operation is estimated at 2 m³/day. Meanwhile, clean water needs for the rest area will vary from time to time depending upon the toll road traffic and visitor loads (e.g., typical holiday or peak season and normal toll road condition) and are estimated below:

- *High season:* High number of visitors, estimated at up to 300 visitors/hour using clean water of up to 50 liters/person, hence requiring a total of 15,000 liters/hour.¹⁶ This estimated water needs equal to 15 m³/hour or 360 m³/day.
- *Medium season:* Moderate number of visitors, the volume of clean water need is estimated at 40 – 70% of that of the peak season or 144 – 252 m³/day.
- *Low season:* Minimal number of visitors, the volume of clean water need is estimated at less than 40% of that of the peak season or less than 144 m³/day. The number of employees

¹⁶ AIIB E&S Policy (May 2021).

working on the rest area is already included under the number of visitors mentioned under high, medium, and low scenarios.

Power supplies for toll interchanges and toll gate offices will be provided by PT PLN, with an estimated capacity of 100 to 150 kVA per office, assuming the existing power distribution network is accessible in the area. Likewise, each rest area requires an estimated power capacity of 850 to 1,000 kVA. Initially, diesel-powered generators may be necessary to supply power to toll gate offices and rest areas, especially if PT PLN's distribution network is not yet operational in those areas.

The diesel fuel for the generators at the toll gate office and rest area will be procured from government-authorized companies. The generators will be used initially while waiting for PT PLN to connect the power distribution lines.

Used lubricant and other hazardous wastes that may be generated from the above facilities will be temporarily stored in steel drums or appropriate materials at designated areas of the toll gate offices and rest and service areas. The disposal of these hazardous wastes will be conducted by licensed parties according to the *Gol Regulation No. 22/2021 on Environmental Protection and Management*.

2.3 The Project Area of Influence

According to the provisions of the Bank's ESS 1: E&S Assessment and Management, both direct and indirect impacts on environmental and social (E&S) aspects should be identified not only limited within the Project's footprint, but also a wider area likely to be indirectly affected by the Project, including its ancillary facilities, such as the project basecamp and accommodation, quarries, concrete batching plants, and unplanned development induced by the Project (e.g., spontaneous settlement, logging or shifting agriculture along the access roads that may be used for future construction). This is collectively termed as "the area of influence" of the Project (the Project's Aol), covering:

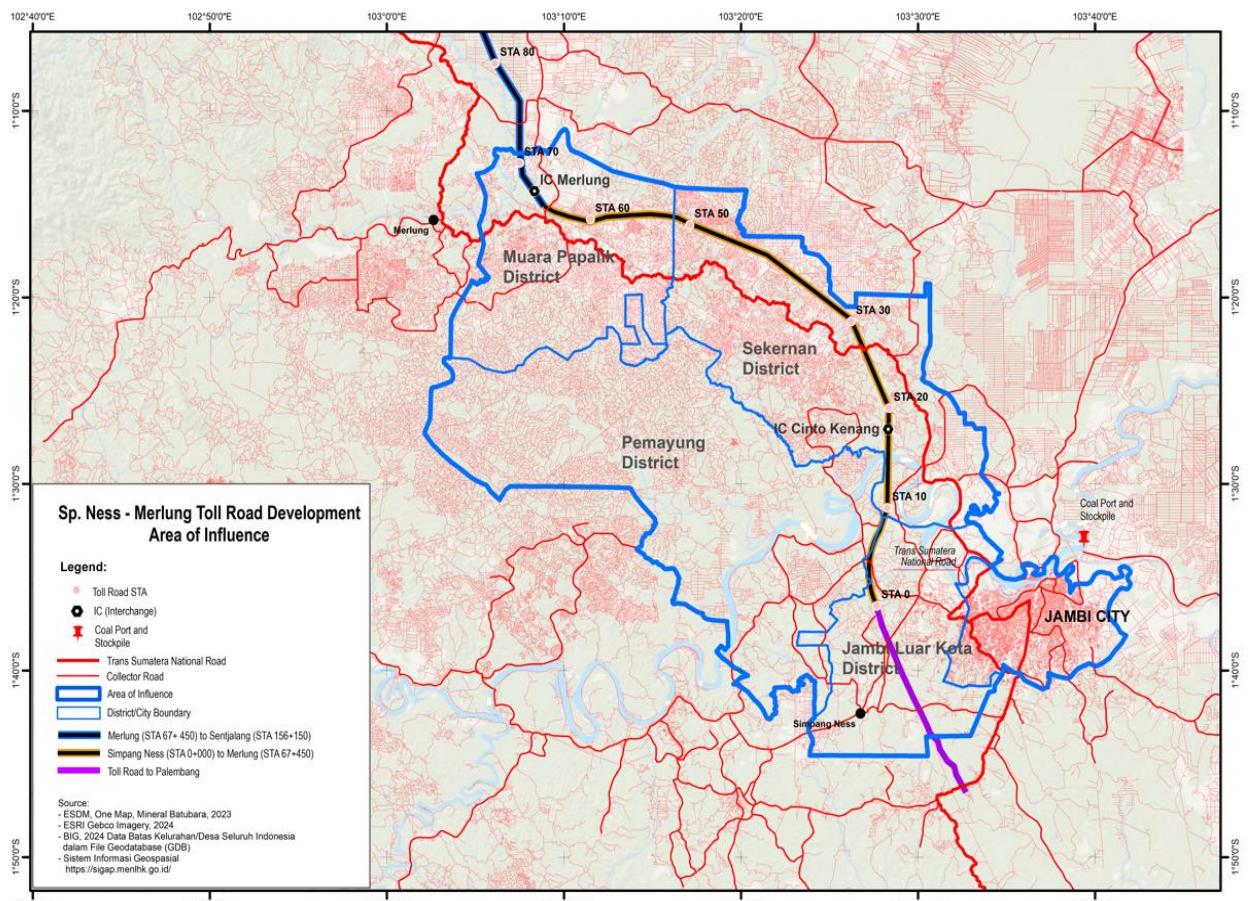
- **The Project footprint** – includes the project area and associated facilities covering 67.45-km long toll road from Jambi to Merlung with a total right-of way/corridor in a range of 60 to 100-m wide; 4.31-km long interchange at Cinto Kenang (STA 18+305) and 2.89-km long interchange at Merlung (STA 67+100); toll gates and offices at these interchanges; and one pair of rest areas (STA 42+000) with a total area of approximately 12 hectares. These project footprints are considered as the Aol.
- **The ancillary facilities** – these include the areas where existing and/or future borrow material quarries, concrete batching plants, access roads (e.g., current Trans Sumatera national roads and other public roads, and private roads for company use), and jetties (at Batanghari River) that will be used to support the Project. Therefore, the areas within the proximity of these facilities are considered as the Aol.
- **Airshed** – this includes the atmosphere anticipated to receive dispersion of air pollutants, including dust, within and beyond due to local topography and meteorological conditions. Therefore, the airshed likely to be impacted by the Project is considered as the Aol.
- **River catchment area (watershed)** – this includes water bodies and lands where water may be contained due to natural terrain and river flow. Parts of the watershed likely to be impacted by the Project (e.g., the construction of bridge and river crossings) are
- **Legally protected areas and internationally recognized areas** – these are the areas nearby and some overlapping as well as those beyond the Project footprint that are considered ecologically important for the existence, migratory, and lifecycle of protected and endangered species in Sumatera. These areas are determined as area of analysis of the critical habitat

assessment of the entire Jambi – Rengat Toll Road project (Yapeka, 2023), and part of this area is considered as AoI of the Jambi/Simpang Ness – Merlung Toll Road project.

- **Settlement areas and other areas used for livelihood, economic and cultural/customary activities** – some of these areas may be located within the proximity of the Project footprint and access roads used for construction. Therefore, these areas are considered as the AoI as it is likely impacted by the Project.

Delineation of the Project's AoI is key as the basis to conduct an adequate assessment of both direct, indirect, and cumulative E&S impacts likely impacted due to the Project construction and operation as shown in the following map.

Map 3. The Project's Area of Influence



2.4 The Project Alternatives

No Development of the Toll Road. The existing Trans-Sumatera national road is inadequate to serve as an efficient transport corridor connecting major cities across the southern, central, and northern parts of Sumatra, and is insufficient to facilitate equitable distribution of economic development across the region. The national road currently provides only one vehicle lane per direction, resulting in a total road width of approximately 7 meters, and is heavily encroached upon by a mix of residential settlements, commercial activities, government offices, and oil palm plantations on both sides of the road.

The road is used by a diverse combination of traffic, including trucks, buses, passenger cars, motorcycles, and pedestrians. The cumulative effect of these conditions results in low vehicle speeds, congestion, and elevated road safety risks that impede mobility and increase transportation costs. The

national road is also exposed to ongoing climate and natural disaster risks including extreme rainfall and drought, landslides, and forest and land fires, any of which could cause substantial disruption to people's mobility and economic activities across Sumatera.

A no-development scenario would forgo the key benefits expected from the Jambi–Merlung Toll Road, including improved connectivity between major cities in Sumatera — most notably between Jambi and Pekanbaru, which in turn provides a link from Jambi to Palembang in the south and from Pekanbaru to Medan in the north. The absence of the toll road would also hinder the realization of equitable economic development and improved inter-city connectivity across the region. Several toll road sections in South Sumatera and North Sumatera Provinces have already been constructed and have been in operation since approximately 2022. Widening the existing national road alone would be unlikely to resolve the issues described above, and could instead necessitate mass resettlement of residents living in its immediate vicinity. The no-development scenario is therefore not considered a feasible option.

Alternatives Considered in Toll Road Design. Three alignment options were evaluated for the Jambi–Rengat Toll Road, comprising the Basic Design and two alternatives (Alternative 1 and Alternative 2), taking into account technical, topographical, environmental and social, land acquisition, and financial considerations. A weighted scoring system was applied to enable comparison across the three options. The results of this scoring exercise indicate that Alternative 2 achieved the highest overall score of approximately **89%**, compared to approximately **87%** for the Basic Design and approximately **84%** for Alternative 1. The scoring results for each aspect are described as follows:

- **Technical aspect** — Alternative 2 achieved the highest score of 18.90% for this aspect, compared to 16.07% for the Basic Design and 16.97% for Alternative 1. Alternative 2 features the shortest toll road alignment and access road length among the three options.
- **Land topography** — The Basic Design achieved the highest score of 15.00% for land topography, compared to 11.59% for Alternative 1 and 12.19% for Alternative 2. The Basic Design proposes a longer toll road alignment traversing relatively flat terrain compared to the other options.
- **Environmental and Social aspects** — Alternative 2 achieved the highest score of 25.51% for these aspects, compared to 23.72% for the Basic Design and 25.30% for Alternative 1.
- **Ease of land acquisition** — The land acquisition process for Alternative 2 is anticipated to be relatively less complex, given that the length of the toll road alignment overlapping with community settlements and oil palm plantations is generally shorter than that of the Basic Design and Alternative 1.
- **Financial aspect** — Alternative 2 achieved the highest score of 31.96% for this aspect, compared to 31.78% for the Basic Design and 30.17% for Alternative 1. Alternative 2 presents the lowest estimated cost for toll road structures among the three options, although its earthworks cost is slightly higher than that of Alternative 1.

The scoring results for all aspects are presented in Table 13.

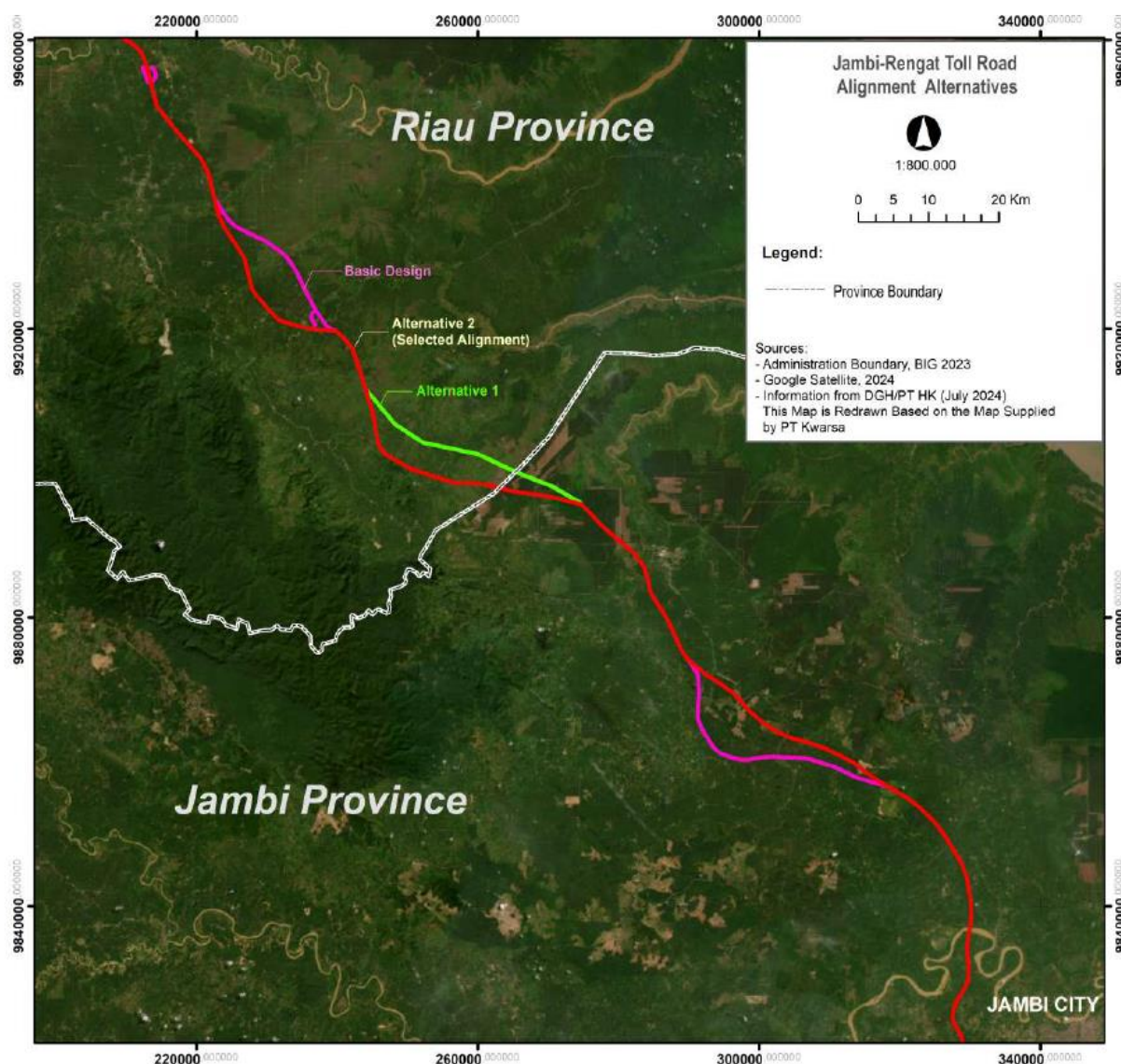
Table 13 Criteria of Jambi – Rengat Toll Road Alignment Alternatives

Criteria	Unit	Max Score per Item (%)	Basic Design		Alternative 1		Alternative 2	
			Value	Score (%)	Value	Score (%)	Value	Score (%)
A. Technical aspects								
Road length	km	4.00	199.4	3.97	201.5	3.96	198,1	4.00
Number of road interchange	unit	1.00	6	0.67	4	1.00	4	1,00
Length of access road	km	3.00	12,85	2.83	24,34	1.50	12,14	3.00
Number of river bridge	unit	3.00	11	2.18	8	3.00	8	3.00
Number of overpasses excluding pedestrians	unit	3.00	77	2.18	56	3.00	58	2.90
Number of underpasses excluding pedestrians	unit	3.00	63	2.24	56	2.52	47	3.00
Soil improvement	-	3.00	0	2.00	0	2.00	0	2.00
Sub-total			-	16.07	-	16.97	-	18.90
Land topography								
Flat terrain	km	7.00	145	7.00	123.5	5.96	120	5.79
Undulating terrain	km	5.00	53	5.00	73	3.63	78	3.40
Mountainous terrain	km	3.00	0	3.00	5	2.00	0	3.00
Sub-total				15.00		11.59		12.19
▪ Environmental & Social aspects								
Ease of land acquisition	-	10.00	-	6.11	-	9.87	-	9.94
Length of settlements overlap with the toll roads	km	10.00	2.80	7.74	2.18	9.93	2.17	10.00
Length of rice fields overlap with the toll road	km	6.00	2.08	1.57	7.94	6.00	7.94	6.00
Length of plantations overlap with the toll road	km	4.00	194.5 2	4.00	191.3 8	3.94	187.9 9	3.87
Sub-total				23.72		25.30		25.51
▪ Financial aspect								
Estimated cost for excavation, embankment, pavement, etc.)	IDR trillion	20.00	13.81	20.00	17.87	15.46	16.28	16.96
Estimated cost for structure	IDR trillion	15.00	1.98	11.78	1.58	14.71	1.55	15.00
Total cost estimate			15.79	-	19.45	-	17.83	-
Sub-total				31.78		30.17		31.96
GRAND TOTAL (A+B+C+D)				86.57	-	84.03	-	88.56

Source: Excel spreadsheet provided by DGH/PT HK (July 2024)

Selected Toll Road Options. Based on the comparison of three (3) options of the Jambi – Rengat Toll Road alignment, the Project team concludes that the Alternative 2 (i.e., the red line in the following map is the preferred option and considered to have some advantages on E&S aspects compared to the other options. The alternatives of the toll road alignments considered in the design phase are shown in the following map.

Map 4. Alternatives of Toll Road Alignment



Source: Redrawn from the map provided by DGH/PT HK (in July 2024)

3.0 APPLICABLE POLICY AND REGULATORY FRAMEWORK

This section describes the key policy and regulatory frameworks governing environmental, health and safety, and social aspects stipulated by the Government of Indonesia (GoI) that are applicable to the Project. The AIIB's Environmental and Social Framework (ESF), including applicable Environmental and Social Standards (ESS), is also described herein. Where gaps exist between Indonesian regulations and the Bank's ESS requirements, bridging measures adopted for the Project are presented in Section 3.3. The GoI stipulates E&S laws and regulations according to the nature of the subjects covered, and those applicable to the Project are summarized in the sub-sections below. With regard to the AMDAL process, the KA-Andal for the entire Jambi–Rengat Toll Road has been approved by the Ministry of Environment and Forestry (MOEF)⁸ in August 2021. The Andal and RKL-RPL documents have since been finalized and are pending Environmental Approval, which is planned to be processed through the provincial government in accordance with Law No. 6/2023, GR No. 22/2021, and the Regulation of the Minister of Environment No. 22/2025 on the Authority to Issue Environmental Approvals. The laws and regulations listed in the tables below are not intended to constitute an exhaustive list, but primarily present the main legislation applicable to the Project.¹⁷

3.1 Indonesian Policy and Regulatory Framework

The Government of Indonesia stipulates E&S laws and regulations according to the nature and scope of each subject matter covered. Regulations applicable to the Project are summarized in the following sub-sections by thematic grouping.

3.2 Environment, Health, and Occupational Safety

Key laws and regulations related to environmental management, public health, and occupational health and safety applicable to the Project are presented in Table 14.

Table 14 Laws and Regulations on Environment, Health, and Occupational Safety

Laws and Regulations	Key Provisions and Relevance to the Project
Laws passed by the Indonesian House of Representatives and the Government of Indonesia	
Law No. 6/2023 on Job Creation (amending Law No. 11/2020)	This Law introduces a risk-based business licensing system and transfers the majority of permitting authority previously held by local governments to the central government, including the authority to evaluate environmental approval applications. It also amends Law No. 32/2009 on Environmental Protection and Management and Law No. 41/1999 on Forestry, and serves as the legal foundation for the Online Single Submission (OSS) system and environmental approval processes.
Law No. 17/2023 on Health	This Law constitutes the most recent overarching health legislation in Indonesia, covering disease prevention and environmental health aspects relevant to the Project, including occupational health management for workers and community health in the vicinity of the construction area.

⁸ The Ministry of Environment and Forestry (MOEF/KLHK) was reorganized into two separate ministries — the Ministry of Environment (KLH) and the Ministry of Forestry — following the inauguration of the new Cabinet on 20 October 2024. References to MOEF/KLHK in this report relate to actions taken prior to this reorganization.

Laws and Regulations	Key Provisions and Relevance to the Project
Law No. 2/2017 on Construction Services	This Law stipulates that in every construction undertaking, users and providers of construction services are required to meet security, safety, health, and sustainability standards. A project is therefore required to establish and implement a Construction Safety Management System (<i>Sistem Manajemen Keselamatan Konstruksi/SMKK</i>), which serves as the legal basis for the Ministerial Regulation on SMKK issued by the Ministry of Public Works.
Law No. 13/2023 jo. Law No. 6/2023	This Law stipulates fundamental provisions on labor rights, employment contracts, working hours, fair wages, and social security. It mandates the implementation of an Occupational Health and Safety Management System (SMK3) for high-risk construction activities, ensures equal opportunities, and strictly prohibits child or forced labor within the project workforce.
Law No. 1/1970 on Occupational Safety	This Law stipulates general occupational safety provisions that must be adhered to by activities requiring the control of safety risks, including toll road construction activities.
Government Regulations promulgated by the Indonesian Government	
Government Regulation (GR) No. 22/2021 on the Implementation of Environmental Protection and Management	This GR was issued as the implementing regulation of Law No. 32/2009 as amended by Law No. 6/2023. It requires all planned business and/or activities to undergo a screening process to determine the type of environmental assessment instrument required, namely AMDAL for activities likely to generate significant environmental impacts, UKL-UPL for activities with non-significant impacts, or SPPL for micro- and small-scale activities. This GR also stipulates environmental quality standards for ambient air quality, surface water quality, and seawater quality.
GR No. 5/2021 on Risk-Based Business Licensing	This GR implements the risk-based business licensing system established under Law No. 6/2023 and determines the AMDAL or UKL-UPL compliance requirements for business activities according to their risk level.
GR No. 50/2012 on the Implementation of the Occupational Health and Safety Management System (SMK3)	This GR requires the implementation of an SMK3 by companies employing 100 or more workers and/or operating in high-risk sectors. All contractors engaged in the construction of the Project are required to implement SMK3.
GR No. 88/2019 on Occupational Health	This GR governs the occupational health system that employers are obliged to implement, covering occupational health services, worker health examinations, and occupational risk factor management at the workplace.
GR No. 81/2012 on Household-type Waste and Similar Waste Management	This GR stipulates general provisions for the management of household-type waste and similar waste, which is relevant to the management of solid waste generated at contractor basecamps and Project operational facilities.
Presidential Instructions	
Presidential Instruction No. 1/2023 on Mainstreaming Biodiversity Conservation in Sustainable Development	This Presidential Instruction specifically requests technical ministries under the Coordinating Minister for Maritime Affairs and Investment, including the Ministry of Public Works, to: (i) develop technical policies and infrastructure plans taking into account the distribution of biodiversity areas; (ii) support the sustainability of

Laws and Regulations	Key Provisions and Relevance to the Project
	wildlife habitats and/or areas of high biodiversity value; and (iii) implement green infrastructure or nature-based solutions for wildlife crossings and fencing in the aforementioned habitats and areas.
Ministerial and Institutional Regulations	
Regulation of the Minister of Environment and Forestry (MoEF) No. 4/2021 on Business and/or Activities Requiring AMDAL, UKL-UPL, or SPPL	This regulation determines the types and scales of business and/or activities requiring AMDAL, UKL-UPL, or SPPL, and serves as a self-screening tool to determine the required environmental instrument and the level of authority responsible for its evaluation, namely the central government, provincial, or regency/municipality level.
Regulation of the Minister of Environment (MoE) No. 6/2021 on Procedures and Requirements for Hazardous Waste Management	This regulation governs the management of hazardous waste including used lubricants, batteries, oil filters, and other hazardous wastes generated from the operation and maintenance of the Project's construction fleet.
Regulation of the Minister of Environment/Head of the Environmental Control Agency (MoE/BPLH) No. 11/2025 on Domestic Wastewater Quality Standards and Treatment Technology	This regulation establishes domestic wastewater quality standards and treatment technology requirements applicable to wastewater management at contractor basecamps and Project operational facilities. This regulation supersedes the former MoEF Regulation No. P.68/2016 on Domestic Wastewater Quality Standards.
Regulation of the Minister of Environment/Head of the Environmental Control Agency (MoE/BPLH) No. 1/2026 on the One Environmental Data System	This regulation governs the integration and standardization of environmental data relevant to Project environmental reporting and monitoring.
Regulation of the Minister of Environment (MoE) No. 22/2025 on the Authority to Issue Environmental Approvals	This regulation establishes the authority to issue environmental approvals primarily based on the location of the business activity, with primary authority vested in the Regent/Mayor. Central government authority is retained for complex activities, those with cross-provincial or cross-border impacts, National Strategic Projects, and activities with high pollution potential. Implementation is carried out through the Amdalnet system integrated with the OSS platform.
Regulation of the Minister of Public Works (MPW) No. 10/2021 on the Construction Safety Management System (SMKK)	This regulation requires all users and providers of construction services to meet security, safety, health, and sustainability standards. Each project is required to establish and implement an SMKK comprising: (i) conceptual SMKK; (ii) Construction Safety Plan (RKK); (iii) Construction Quality Plan (RMPK); (iv) Quality Assurance/Quality Control Plan; (v) Environmental Management and Monitoring Work Plan (RKPPL); and (vi) Construction Traffic Management Plan (RMLLP).
Circular Letter of the Directorate General of Highways No. 20/2023 on Guidelines for Road Construction and Mitigation Structures in Forest Areas	This circular letter provides guidelines for road construction and development of mitigation structures in forest areas, addressing the Ministry of Public Works mandates defined in Presidential Instruction No. 1/2023. It does not, however, include provisions for construction activities in non-forest areas that may hold biodiversity conservation values or overlap with internationally recognized areas.

Laws and Regulations	Key Provisions and Relevance to the Project
Regulation of the Minister of Health No. 2/2023 on the Implementing Regulation of GR No. 66/2014 on Environmental Health	This regulation establishes environmental quality standards for water, air, sanitation, food, and buildings, serving as the benchmark for groundwater quality, drinking water standards, and sanitation management at contractor basecamps and Project facilities.
Regulation of the Minister of Environment and Forestry No. P.68/2016 on Domestic Wastewater Quality Standards	This Regulation sets the maximum allowable effluent quality standards for domestic wastewater discharges. It is highly relevant to the project's workers' basecamp, temporary offices, and toll operation facilities, mandating that all greywater and blackwater generated on-site must be treated using properly designed sewage treatment systems (such as septic tanks or portable STP) to meet strict parameters (including BOD, COD, TSS, oil & grease, and total coliform) prior to discharge into local water bodies.
Regulation of the Minister of Health No. 10/2023 on Healthcare Facility Standards	This regulation stipulates the standards for healthcare facilities relevant to the project medical clinics to be operated by contractors within the construction area.
Regulation of the Minister of Health No. 82/2014 on Communicable Disease Control	This regulation governs communicable disease control, which is relevant in the context of labor influx, given that the arrival of a large number of migrant workers may increase the risk of disease transmission in communities surrounding the Project.
Regulation of the Minister of Manpower No. 5/2018 on Occupational Health and Safety in the Work Environment	This regulation stipulates threshold limit values (NAB) for physical, chemical, and biological parameters in the work environment, including noise, vibration, dust, and other occupational exposure factors relevant to Project construction activities.
WHO Global Air Quality Guidelines (2021)	These guidelines constitute the international benchmark for ambient air quality established by WHO as the Good International Industry Practice (GIIP) reference for the assessment and management of air quality impacts associated with Project activities.

3.3 Social, Land Acquisition, and Indigenous Peoples

Key laws and regulations related to social aspects, land acquisition, involuntary resettlement, labor, and Indigenous Peoples applicable to the Project are presented in Table 15.

Table 15 Laws and Regulations on Social, Land Acquisition, and Indigenous Peoples

Laws and Regulations	Key Provisions and Relevance to the Project
The Constitution of the Government of Indonesia (UUD 1945) and its subsequent amendments	
The Constitution of Indonesia (UUD 1945) and its subsequent amendments	The Constitution acknowledges and respects customary law communities (masyarakat hukum adat) and their rights, where these exist and are consistent with the principles of national development. In this context, the People's Consultative Assembly issued Decree No. IX/MPR/2001 on Agrarian Reform and Natural Resource Management.
Laws passed by the Indonesian House of Representatives and the Government of Indonesia	
Law No. 6/2023 on Job Creation (amending Law No. 11/2020)	This Law introduces procedural changes in land acquisition for public interest and development, including provisions on compensation and the expedited land acquisition process.

Laws and Regulations	Key Provisions and Relevance to the Project
Law No. 2/2022 on the Second Amendment to Law No. 38/2004 on Roads	This Law provides the legal framework for road and toll road development in Indonesia. The Law regulates the planning, development, operation, and management of roads and toll roads, including provisions on road classification, toll road business entities, and the roles of the central government and regional governments in road administration. With respect to land, the Law affirms that land acquisition for road development in the public interest shall be carried out in accordance with the prevailing laws and regulations governing land acquisition, including land acquisition for indigenous people land (tanah ulayat).
Law No. 2/2012 on Land Acquisition for Development in the Public Interest	This Law regulates the procedures for land acquisition for public interest, including in terms of compensation and land acquisition. This law also regulates the rights of communities in acquiring land for public interest, recognizes that customary law communities (masyarakat hukum adat) are entitled to compensation if their lands are affected by a project. The determination of project location by the provincial/regency/city government is subject to agreement with entitled parties and affected communities.
Law No. 6/2014 on Village Affairs	This Law stipulates that customary village governance shall be implemented based on origin and traditional rights at the village level, including the management of customary land, village land, village forest, water springs, and other assets. The Talang Mamak Indigenous Territory has been identified in Riau Province, but not in Jambi Province where the Sp. Ness–Merlung Toll Road (Phase 1) is located.
Law No. 39/1999 on Human Rights	This Law provides implicit recognition of the rights of customary law communities, terminology that has been adopted in the social forestry policy under the Ministry of Forestry, the customary village policy under the Ministry of Home Affairs, and the communal land certificate scheme under the Ministry of ATR/BPN.
Law No. 13/2003 on Manpower as amended by Law No. 6/2023	This Law governs workers' rights, minimum wages, working hours, and the prohibition of child labor, all of which must be adhered to by all contractors engaged in Project construction activities.
Government Regulations promulgated by the Indonesian Government	
GR No. 19/2021 on the Implementation of Land Acquisition for Development in the Public Interest	This GR replaces the provisions stipulated in Presidential Regulation No. 71/2012 and its subsequent amendments on land acquisition for development in the public interest. Key provisions include: (i) the addition of six types of development for public interest; (ii) the requirement to secure permits for land with special characteristics prior to the issuance of a Location Designation permit; (iii) the involvement of the relevant ATR/BPN office from the land acquisition planning stage; and (iv) the provision of appropriate and fair compensation as determined by an appointed independent appraiser through negotiation with affected landowners.
GR No. 39/2023 on the Amendment to GR No. 19/2021	This GR amends several provisions of GR No. 19/2021, including: (i) the acquisition of destroyed land (tanah musnah) shall follow

Laws and Regulations	Key Provisions and Relevance to the Project
	the provisions of land acquisition law; (ii) a government appraiser may conduct compensation valuation in addition to an independent public appraiser; (iii) Indigenous Peoples are parties entitled to compensation; and (iv) the consent of affected Indigenous Peoples is required for the acquisition of indigenous land (tanah ulayat).
GR No. 35/2021 on Fixed-Term Employment Agreements, Outsourcing, Working Hours and Rest Periods, and Employment Termination	This GR governs fixed-term employment agreements (PKWT), outsourcing, working hours, and employment termination, all of which are relevant to employment contracts for Project construction workers.
Presidential Regulations	
Presidential Regulation No. 110/2025 on the Implementation of Carbon Economic Value Instruments and National Greenhouse Gas Emission Control	This PR stipulates provisions for compensation in the form of cash payment or relocation to non-titled land. It requires that compensation account for mobilization costs, housing rental during the transition period, and compensation for loss of income. It also requires the project proponent to prepare a Social Impact Management Plan where government land that has been physically occupied by communities for at least 10 consecutive years is affected by the Project.
PR No. 78/2023 on the Amendment to PR No. 62/2018	This PR amends several provisions of PR No. 62/2018 to accelerate the implementation of national development by ensuring that social impacts are duly accounted for in the land acquisition process.
PR No. 186/2014 and Regulation of the Minister of Social Affairs No. 12/2015 on Social Empowerment of Remote Indigenous Communities	This PR defines Remote Indigenous Communities (<i>Komunitas Adat Terpencil/KAT</i>) as groups of people bound by geographical, economic, and/or socio-cultural unity who are poor, remote, and/or socio-economically vulnerable. Through this PR, the Government seeks to empower KAT by granting authority and trust to local KAT to address their needs and resolve their problems based on their own strengths and capacity.
Ministerial and Institutional Regulations	
Regulation of the Minister of Finance No. 139/PMK.06/2020 and its amendment No. 95/2023 on the Procedures for Funding Land Acquisition for National Strategic Projects by the State Asset Management Institution (LMAN)	This regulation governs the mechanism for funding land acquisition for National Strategic Projects through LMAN, including administrative verification, compensation assessment, and payment of compensation via bank transfer to the accounts of entitled parties, both individuals and legal entities.

3.4 Climate Change, Biodiversity, Forestry, and Cultural Heritage

Key laws and regulations related to climate change, biodiversity conservation, forestry, and the protection of cultural heritage applicable to the Project are presented in Table 16.

Table 16 Laws and Regulations on Climate Change, Biodiversity, Forestry, and Cultural Heritage

Laws and Regulations	Key Provisions and Relevance to the Project
Laws passed by the Indonesian House of Representatives and the Government of Indonesia	
Law No. 32/2004 on the Amendment to Law No. 5/1990 on the Conservation of Biological Natural Resources and Ecosystems	This Law updates biodiversity protection provisions and strengthens corporate responsibility in conservation. Conservation areas defined under this Law include: (i) sanctuary reserves (kawasan suaka alam/KSA) comprising strict nature reserves and wildlife sanctuaries; and (ii) nature conservation areas (kawasan pelestarian alam/KPA) comprising national parks, grand forest parks, nature recreation parks, and hunting grounds. The Law also covers aquatic ecosystem conservation encompassing freshwater, coastal, and small island ecosystems, as well as other designated protected areas.
Law No. 5/1994 on the Ratification of the United Nations Convention on Biological Diversity	This Law establishes the Government of Indonesia as a signatory party to the United Nations Convention on Biological Diversity (CBD), providing the legal basis for Indonesia's international commitments on biodiversity conservation.
Law No. 11/2010 on Cultural Heritage	This Law governs the protection and management of cultural heritage in Indonesia, including the mandatory application of the Chance Find Procedure, which must be incorporated into the ESIA documentation and implemented throughout Project construction activities.
Government Regulations	
GR No. 23/2021 on Forestry Affairs	This GR was issued following the promulgation of Law No. 6/2023 and provides a legal basis for forestry matters related to forest use planning, status and function determination, and forest inventory and supervision. This GR is relevant to the Project as it requires the submission of a forest area borrowing and use permit application to the Ministry of Forestry for the section of the alignment overlapping with production forest.
GR No. 1/2022 on the National Registration and Conservation of Cultural Heritage	This GR governs the national registration mechanism and conservation of cultural heritage, which is relevant in the event of cultural heritage findings during Project construction activities.
Presidential Regulations	
Presidential Regulation No. 110/2025 on the Implementation of Carbon Economic Value Instruments and National Greenhouse Gas Emission Control	This PR governs the carbon economic value and greenhouse gas (GHG) emission control as an instrument of Indonesia's climate change policy, relevant to the reporting of GHG emissions from Project construction and operational activities.
Ministerial and Institutional Regulations	
Regulation of the Minister of Environment and Forestry (MoEF) No. 106/2018 on Protected Flora and Fauna Species	This regulation stipulates the list of flora and fauna species protected by the Government of Indonesia, serving as the primary reference for the Project's biodiversity assessment and critical habitat evaluation.
Regulation of the Minister of Environment and Forestry (MoEF) No.	This regulation governs the procedures for using forest areas, including production and protection forests, for non-forestry

Laws and Regulations	Key Provisions and Relevance to the Project
7/2021 on Forest Planning, Changes in Forest Designation and Function, and Forest Use	development such as infrastructure construction, including the procedures for applying for a forest area borrowing and use permit or for changing the status of a forest area to non-forest area (forest relinquishment).
Regulation of the Minister of Environment and Forestry (MoEF) No. 21/2022 on the Implementation of Carbon Economic Value	This regulation governs the implementation of Indonesia's NDC targets in the context of GHG emission reductions, relevant to the management of climate change impacts associated with the Project.
OJK Regulation No. 51/POJK.03/2017 on the Implementation of Sustainable Finance	This Regulation mandates the implementation of Sustainable Finance principles for financial institutions, issuers, and publicly listed companies in Indonesia. It is highly relevant to the project as it requires the integration of Environmental, Social, and Governance (ESG) risk management into project financing, alignment with national sustainable development goals, and the mandatory disclosure of sustainability performances (Sustainability Report), which complements the corporate and lender safeguard requirements of international financial institutions like AIIB.
Regulation of the Minister of Environment and Forestry (MoEF) No. P.23/MENLHK/SETJEN/KUM.1/5/2019 on Strategic Roads in Forest Areas	This regulation stipulates guidelines for road authorities in the development of unavoidable strategic roads within forest areas, with the objective of minimizing the negative impacts of such development on forest integrity, wildlife movement, biodiversity, hydrological functions, and other important ecological functions.
Circular Letter of Director General of Highways, Ministry of Public Works No. 20/SE/Db/2023 on Guidelines for the Development of Roads and Mitigation Structures Within Forest Areas	This regulation stipulates the requirements and procedures for the development of strategic roads within forest areas, including conservation forests, protection forests, and production forests. It also sets out the requirements for wildlife mitigation structures for roads passing through these forest areas, as well as for complementary structures and road facilities, such as rest areas.

3.5 Transport and Traffic

Key laws and regulations related to transportation and road traffic safety applicable to the Project are presented in Table 17.

Table 17 Laws and Regulations on Transport and Traffic

Laws and Regulations	Key Provisions and Relevance to the Project
Laws passed by the Indonesian House of Representatives and the Government of Indonesia	
Law No. 22/2009 on Road Traffic and Transportation	This Law governs road traffic safety, including vehicle safety requirements, driver qualifications, and road infrastructure standards relevant to the mobilization of heavy equipment and construction vehicles, as well as the future operation of the toll road.
Law No. 2/2022 on the Second Amendment to Law No. 38/2004 on Roads	This Law stipulates technical standards for the construction and operation of toll roads, including the obligation to provide safe facilities for road users and communities in the vicinity of the project area.
Ministerial and Institutional Regulations	
Ministerial Regulation on Traffic Impact Assessment (Andalalin)	This regulation requires the conduct of a traffic impact assessment for development activities likely to cause disruption to traffic flow, including toll road construction activities that utilize existing public roads for the mobilization of equipment and construction materials.

Laws and Regulations	Key Provisions and Relevance to the Project
Law No. 22/2009 on Traffic and Road Transport	This primary Law mandates that any major infrastructure development generating significant traffic volume must undergo a Traffic Impact Assessment (Andalalin) to ensure road safety and network capacity.
Government Regulation No. 30/2021 on Traffic and Road Transport Implementation	This Regulation defines the criteria, scale, and classification of traffic impacts for developments, integrating the Andalalin approval directly into the national business licensing framework.
Minister of Transportation Regulation No. PM 17/2021 on Traffic Impact Assessments	This Regulation provides the strict technical guidelines for Andalalin studies, detailing traffic survey methodologies, capacity analyses, and the mandatory formulation of construction traffic management plans.
IPPKH Guideline	

By Law, the Indonesian Government stipulates E&S laws and regulations depending upon the nature of the subjects, and those applicable for the Project are summarized in the following tables.

The requirements of the Indonesian Government. According to the provisions of the *GR No. 22/2021*, the Project is required to undertake an Amdal process, comprising notification to the public about the project, public consultation through to preparation of ‘ANDAL’ (Impact Statement) and ‘RKL-RPL’ (Environmental Management and Monitoring Plan) as a requirement to obtain Environmental Permit/Approval from the Ministry of Environment at the Central Government level and from the local governments at regional and local levels.

The terms of reference for conducting the Andal (KA-ANDAL) of the entire Jambi – Rengat Toll Road (198.13 km long) have been prepared and approved by the MoEF in August 2021. However, the approval of EIA/AMDAL by the Ministry of Environment is still under processing (planned to be processed through local (Provincial) government considering updated regulation Minister of Environment (MOE) Regulation No. 22 Year 2025 concerning Authority to Issue Environmental Approvals)

Environment, Health and Safety (EHS). Key laws and regulations related to EHS governance in Indonesia, including their provisions applicable to the Project, are presented in Table 18.¹⁸ The regulations stipulating environmental standards on ambient air quality, noise level, surface water quality, groundwater quality, and drinking water quality applicable to the Project are listed in the following table, and those standards are presented in the Appendix and quoted at relevant sections of this ESIA.

Table 18 EHS Laws and Regulations

Laws and Regulations	Key Provisions
The Law passed on by the Indonesian House of Representatives and the Indonesian Government	
The Job Creation Law (JCL) No. 11/2020 and its amendment No. 6/2023	The JCL No. 11/2020 or known as ‘Omnibus Bill’ is stipulated in October 2020 as a breakthrough by the GoI to streamline business licensing processes much needed to facilitate economic development in Indonesia. This Law introduces a risk-based business licensing system and transfers a majority of permitting and supervising authority previously under the

¹⁸ The laws and regulations listed in the table are not intended to be an exhaustive list, but primarily to present the main legislation applicable for the Project.

Laws and Regulations	Key Provisions
	authority of local governments back to the central government including the authority to review environmental approval applications. The stipulation of JCL results in the amendment of the Environmental Management and Protection Law No. 32/2009 and the Forestry Law No. 41/1999.
Law No. 32/2024 on the Amendment of Law 5/1990 on Conservation of Bio-natural Resources and Ecosystem	This Law provides definition of conservation areas and stipulates provisions as well as restrictions for conducting activities herein. The conservation areas defined in this Law include: ▪ Sanctuary reserve (<i>kawasan suaka alam</i> or KSA), comprising strict nature reserve (<i>cagar alam</i>) and wildlife sanctuary (<i>suaka margasatwa</i>); and ▪ Nature conservation area (<i>kawasan pelestarian alam</i> or KPA), comprising national park (<i>taman nasional</i>), grand forest park (<i>taman hutan raya</i>), nature recreation park (<i>taman wisata alam</i>) and hunting ground (<i>taman berburu</i>). ▪ Aquatic ecosystem conservation includes freshwater, coastal area, and small islands as well as other preserved areas.
Law No. 2/2017 on Construction Services	This Law stipulates that in every construction undertaking, the user and provider of construction services are required to meet the security, safety, health and sustainable standards. Therefore, a project is required to establish and implement a management system on construction safety (<i>Sistem Manajemen Keselamatan Konstruksi</i> or SMKK). The SMKK is provided in a project-specific document, containing: ▪ Conceptual SMKK; ▪ Construction Safety Plan (<i>Rencana Keselamatan Konstruksi</i> or RKK); ▪ Construction Quality Plan (<i>Rencana Mutu Pekerjaan Konstruksi</i> or RMPK); ▪ Quality Assurance/Quality Control Plan (<i>Program Mutu</i>); ▪ Environmental Management and Monitoring Plan (<i>Rencana Kerja Pengelolaan dan Pemantauan Lingkungan Hidup</i> or RKPPPL); and ▪ Project Traffic Management (<i>Rencana Manajemen Lalu Lintas Pekerjaan</i> or RMLLP).
Law No. 5/1994 concerning Ratification of the International Convention on Biodiversity	This Law states Indonesian Government as the signatory party to the International Convention on Biodiversity declared by the United Nations.
Law No. 1/1970 on Occupational Safety Provisions	This Law stipulates the general provisions related to occupational safety that should be adhered to by activities requiring mitigation of safety risks.
Government Regulations promulgated by the Indonesian Government	
Government Regulation (GR) No. 22/2021 on Environmental Protection and Management	This GR was issued following the promulgation of JCL No. 11/2020, requiring that the proposed business and/or activity should be screened to determine the type of environmental assessment and instruments required. These are Amdal (Indonesian EIA and EMP) for those are likely to generate significant E&S impacts, UKL-UPL (a simplified EMP) for those are having non-significant E&S impacts and can be managed using common mitigation measures or SPPL, which is a commitment letter to conduct environmental management and monitoring for micro- and small-scale activities or industries.

Laws and Regulations	Key Provisions
	The GR also stipulates standards/threshold values for (i) ambient air quality; (ii) surface water quality; and (iii) sea water quality
Government Regulation No. 23/2021 on Forestry Affairs	This GR was issued by the GoI following the promulgation of JCL No. 11/2020 providing a legal basis to forestry matters in Indonesia in relation to the forest use planning, status, functions, and inventory as well as supervision. This GR is relevant for the Project, requiring that the forest area overlap with the Project area should be applied for relinquishment of its forest status to MoEF.
Government Regulation No. 81/2012 on Management of Household-typed Wastes and Similar Wastes	This GR stipulates general provisions for managing including disposal of household-typed wastes and similar wastes without impairing the environment and the community.
Presidential Regulation and Instruction	
Presidential Instruction (PI) No. 1/2023 on Mainstreaming Biodiversity Conservation in Sustainable Development	This PI particularly request the technical ministries under the Coordinating Minister of Maritime and Investment and, among other, the Ministry of Public Works and Housing (MPWH) to undertake the following: ▪ Develop a technical policy and infrastructure planning taking into account the distribution of biodiversity area; ▪ Support the sustainability of wildlife habitats and/or areas of high-biodiversity values; and ▪ Implement a 'green infrastructure development' or nature-based solution for wildlife crossing and fence in the habitat and areas mentioned earlier.
Regulations issued by the Ministries	
Ministry of Health Regulation No. 2/2023 on Implementing Regulation No. 66/2014 on Environmental Hygiene	This ministerial regulation includes, among others, standards for environmental hygiene related to air quality, water quality, soil, food and buildings. Relevant water quality standards stipulated in this ministerial regulation are typically used as a benchmark of groundwater quality and drinking water standards.
MoEF Regulation No. 4/2021 on Business and/or Activity Requiring AMDAL, UKL-UPL or SPPL	This ministerial regulation stipulates the types and scale of business and/or activities that should be completed with Amdal, UKL-UPL or SPPL. It serves as the self-screening tool to determine the type of environmental instrument required for a particular business and/or activity and the level of authority in charge for evaluating the contents of the environmental instruments/document. This authority includes the Central Government, provincial or regency/municipality.
Ministry of Public Works and Housing (MPWH) Regulation 10/2021 on Construction Safety Management System	This ministerial regulation stipulates that in every construction undertaking, the user and provider of construction services are required to meet the security, safety, health and sustainable standards. ▪ A project is required to establish and implement a management system on construction safety (<i>Sistem Manajemen Keselamatan Konstruksi</i> or SMKK). The SMKK is provided in a project-specific document, containing: ▪ Conceptual SMKK; ▪ Construction Safety Plan (<i>Rencana Keselamatan Konstruksi</i> or RKK); ▪ Construction Quality Plan (<i>Rencana Mutu Pekerjaan Konstruksi</i> or RMPK);

Laws and Regulations	Key Provisions
	- Quality Assurance/Quality Control Plan (Program Mutu); - Environmental Management and Monitoring Plan (Rencana Kerja Pengelolaan dan Pemantauan Lingkungan Hidup or RKPPL); and - Project Traffic Management (Rencana Manajemen Lalu Lintas Pekerjaan or RMLLP).
MoEF Regulation No. 7/2021 on Procedures for Forestry Planning, Changes in Forest Designation and Function, and Forest Use	This ministerial regulation stipulates the procedures to use forest areas (i.e., production forest and protection forest) for non-forestry development, such as infrastructure development, to apply for the required forestry approval or to apply for to change the status of forest area to become non-forest area (known as forest relinquishment). The application to use the mentioned forest areas should be submitted by the entity/business to the MoEF.
Minister of Environment/Head of the Environmental Control Agency of the Republic of Indonesia Number 22 Year 2025 regarding Authority for the Issuance of Environmental Approval	- Location-Based Authority: Environmental Approval is now predominantly vested in the Regent/Mayor (city/district) based on the location of the business activity (in line with GR No. 28 of 2025 Art. 12 (2)). - Central Government (Minister/Head) Authority: Remains for complex activities, those with cross-province/cross-country impact, National Strategic Projects, and activities with high pollution or non-renewable energy resource use (as detailed in Article 4 and Appendix I). - Special Areas: The IKN/KBPB Authority handles all activities within their strategic delineation. - Mechanism: Implementation is through the Amdalnet system integrated with the OSS (Online Single Submission).
MoEF Regulation No. 106/2018 on Protected Flora and Fauna Species	This ministerial regulation stipulates the list of flora and fauna species that are protected by the Indonesian Government.
Ministry of Manpower Regulation No. 5 year 2018 on Occupational Health and Safety Standards	This ministerial regulation stipulates the threshold values of physical, chemical, and biological parameters for the working areas. It includes the standard on ergonomics and physiological factors, indoor air quality and hygiene.
Circular Letter issued by MPWH	
The Circular Letter of the Directorate General of Highway No. 20 year 2023 on Guidelines for Construction of Road and Mitigation Structure in Forest Areas	This circular letter (<i>surat edaran</i>) issued by the DGH provides guidelines for road construction and development of mitigation structures in forest areas. The provisions included in this circular letter generally address the MPWH mandates defined in the Presidential Instruction No. 1/2023 on Mainstreaming Biodiversity Conservation in Implementing Sustainable Development. However, it does not include provisions for construction activities that may be undertaken in non-forest areas (that may have biodiversity conservation value) or internationally recognized areas at large.

3.6 The Bank's Environmental and Social Framework

The Bank has conducted E&S screening for the entire three development phases of the Jambi–Rengat Toll Road to determine the nature and extent of potential E&S risks and impacts, as well as the sensitivity of the E&S baseline conditions. Based on the screening results and the provisions of the

Bank's Environmental and Social Framework (ESF), the Bank, IsDB, and DGH/BPJN Jambi as the Executing/Implementing Agency (EA/IA) agreed on the following:

- An E&S Management Planning Framework (ESMPF) is required for the Jambi–Rengat Toll Road at 67.5 km from Sp Ness to Merlung.
- A stand-alone ESIA, in accordance with the provisions of the Bank's ESS 1 on Environmental and Social Assessment and Management, is required for the construction of the Jambi–Merlung segment (Phase 1 development), which meets the criteria of a Category A project as described below. The ESIA is required given that the construction of Phase 1 is anticipated to commence prior to the other two development phases.
- A project-specific Land Acquisition and Resettlement Plan (LARP) has been prepared to meet the provisions of the Bank's ESS 2.
- An Indigenous Peoples Planning Framework (IPPF) has been prepared to meet the provisions of the Bank's ESS 3 on Indigenous Peoples.

The Project must also exclude activities and items listed in the Environmental and Social Exclusion List (ESEL) from the scope of activities to be financed by the Bank.

Environmental Screening and Project Categorization. The Bank screens each project including its development phases as early as feasible to determine the nature and extent of its potential E&S social risks and impacts as well as sensitivity of the E&S baseline conditions. The Bank assigns each proposed Project to one of these categories i.e., Category A, B, C or Financial Intermediary (FI) and determines the type of E&S assessment and instruments as described in Table 19.

Table 19 The Bank's Categorization for the Project

Project Categorization	E&S Assessment and Instrument
Category A project - If it is likely to have significant, adverse E&S impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works may be temporary or permanent in nature.	The Banks require the Client to conduct an E&S impact assessment (ESIA) or equivalent assessment and to prepare an E&S management plan (ESMP) for the Project
Category B project – If it has a limited number of potentially adverse E&S impacts and these impacts are not unprecedented. Few impacts, if any of them, are irreversible or cumulative, and these are limited to the Project area; and can be successfully managed using good practice in an operational setting.	The Banks require the Client to conduct an initial review of the E&S risks and impacts of the Project. Based on this review, the Banks, in consultation with the Client, determine the appropriate instrument i.e., typically an ESMP or ESMPF to assess the Project's E&S risks and impacts. However, an ESIA might be required but the scope is narrower than that of the ESIA required for Category A project.
Category C project if it is likely to have minimal or no adverse E&S risks and impacts.	The Banks do not require an E&S assessment, but it require the Client to prepare an analysis of the E&S aspects of the Project.
Category Financial Intermediary (FI) if the financing structure involves the provision of funds to or through a FI for the Project. The Banks delegate to the FI the decision-making on the use of the Bank funds, including the selection, assessment, approval and monitoring of Bank-	The ESMS adopted by the FI is typically the instrument used for this project category.

Project Categorization	E&S Assessment and Instrument
supported activities, based on a sound E&S management system (ESMS) adopted by the FI.	

Source: AIIB Environmental and Social Framework (amended in May 2021)

The Environmental and Social Standards (ESS). Both AIIB and IsDB agree to use the ESS required by the AIIB's E&S Framework (amended in May 2021) to which the Project should comply. These ESS include:

- *ESS1: Environmental and Social Assessment and Management* – The Client requires to undertake an environmental and social impact assessment (ESIA) when the Bank, in consultation with the Client, has determined that the Project is likely to have adverse environmental and/or social risks and impacts. Further, the Client is required to design appropriate measures to avoid, minimize, mitigate, offset or compensate for them and document this in an environmental and social management plan (ESMP). The aspects covered in the ESIA and ESMP are detailed in the ESS 1 of the AIIB's ESF.
- *ESS 2: Land Acquisition and Involuntary Resettlement* - if the *Project* is likely to involve involuntary resettlement/social impacts. Therefore, these aspects should be assessed in the social section of the ESIA or similar assessment report. In addition, a land acquisition and resettlement plan (LARP) should be prepared to detail, among others, the lands to be acquired by the Project, entitlement of the landowners or displaced persons, income and livelihood restoration strategy and associated implementation schedule.
- *ESS 3: Indigenous Peoples* – If this is triggered due to, among others, their likely presence in the Project area, have collective attachment to geographically distinctive habitats, ancestral territories, and have customary characteristics that are distinct from the dominant society or culture in parts of the Project area, the Client is required to address these aspects in the social section of the ESIA. Further, the Client is required to prepare a stand-alone IPP to define, among others, a consultative framework with IP during project implementation and measures to mitigate adverse impacts that may be resulted from the project and established a functional grievance procedure.

3.7 Key Gaps between Indonesian Regulation and the Bank's ESS

This section presents a comparison of the key gaps between the requirements of Indonesian regulations and the provisions of the Bank's ESS 1 on Environmental and Social Assessment and Management; ESS 2 on Land Acquisition and Involuntary Resettlement; and ESS 3 on Indigenous Peoples. The results of the gap analysis and the proposed measures to bridge the identified gaps are presented in Table, Table 21, and Table 22 .

Table 20 Key Gaps between Indonesian Legislation and the ESS 1

Key Provisions of ESS 1	Key Provisions of Indonesian Legislation	Mitigation Measures to Bridge the Gaps
Environmental and Social Risk and Impact Assessment (ESIA). Conduct an E&S assessment to identify direct, indirect, cumulative, and induced Project-related risks and impacts on physical, biological, socioeconomic, and cultural resources within the Project's area of influence. These include risks and impacts on: (a) environmental health; (b) natural resources including land, water, and biodiversity on critical and natural habitats, protected areas, and ecosystems; (c) greenhouse gases and climate change; (d) livelihoods; (e) vulnerable groups; (f) access to land use and natural resources; (g) cultural resources; (h) gender; (i) worker and community health and safety; and (j) labor and working conditions, and security personnel. Apply a mitigation hierarchy approach in the E&S assessment by: (a) anticipating and avoiding risks and impacts; (b) where avoidance is not feasible, minimizing or reducing risks and impacts to acceptable levels; and (c) where residual risks and impacts remain, compensating for or offsetting them where technically and financially feasible.	GR No. 22/2021 stipulates that any planned business and/or activity likely to generate significant environmental impacts is required to undertake an AMDAL process, with the impact assessment results documented in the Andal. To this extent, the obligations of this GR generally align with the provisions of ESS 1. The Andal includes assessment of potential impacts on: (a) the physical environment; (b) flora and fauna including ecosystems; (c) socioeconomic conditions; (d) socio-cultural aspects; and (e) public health. However, the provisions for E&S aspects to be assessed are generic and not as specific as those defined in ESS 1. Aspects such as impacts on critical and natural habitats, vulnerable groups, access to land and natural resources, greenhouse gases, occupational health and safety, labor and working conditions, and security personnel are not explicitly addressed in the Andal. Furthermore, the Andal applies seven significance assessment criteria that differ from the significance-based risk and impact assessment approach as defined in ESS 1. The Andal also does not differentiate the impact assessment of Associated Facilities from the main Project activities.	Taking into account the gaps identified herein, the Project is required to undertake an ESIA in accordance with the provisions of ESS 1, including assessing the risks and impacts of Associated Facilities and the relative risks and impacts of Project alternatives.
Associated Facilities (AF). As part of the above assessment, evaluate Associated Facilities, i.e., activities not included in the description of the Project as set out in the Legal Agreements governing the Project, but which, following consultation with the Client, the Bank determines are: (a) directly and materially related to the Project; (b) carried out, or planned to be carried out, contemporaneously with the Project; and (c) necessary for the Project to be viable and would not be carried out if the Project did not exist.	The Andal does not differentiate the impact assessment of AF from the main Project activities.	The Project is required to undertake an ESIA in accordance with the provisions of ESS 1, including assessing the risks and impacts of Associated Facilities.

Key Provisions of ESS 1	Key Provisions of Indonesian Legislation	Mitigation Measures to Bridge the Gaps
Examination of Project Alternatives. Examine all alternatives to the proposed Project that are relevant to its development and assess their potential E&S risks and impacts; and document the rationale for selecting the particular alternative.	Evaluation of Project alternatives to compare their relative E&S impacts is seldom undertaken or included in the Andal, although a general provision on this matter exists.	The Project is required to undertake an ESIA in accordance with the provisions of ESS 1, including assessing the relative risks and impacts of Project alternatives.
Environmental and Social Management Plan (ESMP). Based on the E&S assessment, measures to manage and mitigate risks and impacts, including offsetting and enhancing positive impacts of the Project during implementation and operation, must be reflected in an ESMP. The ESMP includes E&S monitoring and reporting requirements (performance indicators), organizational arrangements, and cost estimates for its implementation. The Bank requires the Project to include activities to conduct capacity development and training, including engagement of E&S experts required for this purpose.	GR No. 22/2021 stipulates that activities requiring AMDAL must be complemented by an RKL-RPL (the Indonesian equivalent of an ESMP). The contents of the RKL-RPL are generally aligned with ESMP good international industry practice, except that the RKL-RPL does not include provisions for: (a) cost items and estimated budget for ESMP implementation, monitoring, and reporting; and (b) capacity development and training required to implement the ESMP.	Taking into account the gaps identified herein, the Project is required to develop an ESMP in accordance with the provisions of ESS 1, including provisions for: (a) cost items and estimated budget for ESMP implementation, monitoring, and reporting; and (b) capacity development and training required to implement the ESMP.
Disclosure of E&S Information. Make available E&S documents and/or information in relation to the Project during preparation and implementation to affected people and interested stakeholders. Disclose E&S documents and/or information in English, together with summaries in languages understandable to affected communities, on the websites of the Client and the Bank.	GR No. 22/2021 does not include provisions requiring the Project to disclose the Andal, RKL-RPL, or other environmental assessment documents on the Project's website or elsewhere.	Taking into account the gaps identified herein, the Project is required to disclose the ESIA, ESMP, and other E&S documents in accordance with the provisions of ESS 1.
Meaningful Consultation. Carry out meaningful consultation with Project-affected people and other stakeholders. Meaningful consultation is an interactive process to provide information and facilitate informed decision-making that: (a) begins early in the preparation stage of the Project and obtains initial views on the Project; (b) is carried out on an ongoing basis throughout the implementation and life cycle of the Project; and (c) is designed so that all relevant parties have a voice in	As per GR No. 22/2021, the AMDAL requires project announcement through print and electronic media and a one-time Public Consultation (PC) as part of the AMDAL process at the early stage of the Project to solicit inputs and concerns as the basis for preparing the KA-Andal. However, the provisions for PC under this GR are not defined in sufficient detail to meet the meaningful consultation requirements of ESS 1.	Meaningful consultation in accordance with the provisions of ESS 1 must be conducted by the Project, including at the preparation stage of the Project and on an ongoing basis throughout the implementation and life cycle of the Project.

Key Provisions of ESS 1	Key Provisions of Indonesian Legislation	Mitigation Measures to Bridge the Gaps
consultation, including governments, the private sector, NGOs, communities, and vulnerable groups affected by the Project.		
Grievance Redress Mechanism (GRM). Establish a suitable Project-level GRM as early as feasible to receive and facilitate the resolution of concerns from people who believe they have been adversely affected by the Project's E&S impacts. Disseminate information on the GRM to Project-affected people through a transparent process that is gender-sensitive and culturally appropriate. Include provisions to protect complainants from retaliation, ensure confidentiality, and enable them to remain anonymous if requested. The Project-level GRM must be operational at the latest by the time Project activities commence, and remain so for the duration of the Project.	Although Law No. 32/2009 as amended by Law No. 6/2023 stipulates that every person has the right to file a complaint due to alleged environmental pollution and/or damage, this Law does not regulate the procedures for filing complaints and does not require a project and/or activity to establish a GRM.	A GRM in accordance with the provisions of ESS 1 must be established and implemented by the Project, including at the preparation and implementation phases of the Project.

Table 21 Key Gaps between Indonesian Legislation and the AIIB - ESS 2

Key Provisions of ESS 2	Key Provisions of Indonesian Legislation	Mitigation Measures to Bridge the Gaps
Land Acquisition and Resettlement Plan (LARP). Prepare a LARP elaborating on the entitlements of displaced persons, income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, time-bound implementation schedule, and provisions for grievance redress. Conduct a land survey and census as early as feasible during Project preparation to establish clear cut-off dates for eligibility and to prevent encroachment.	GR No. 39/2023 requires the Implementing Agency to prepare a Land Acquisition Planning Document (DPPT). The DPPT must contain at minimum: (i) purposes and objectives of the development plan; (ii) conformity with the spatial plan; (iii) national/regional development priorities; (iv) location of the land; (v) required land area; (vi) description of land status; (vii) estimated period for land acquisition; (viii) estimated land value; (ix) budgeting plan; and (x) preferred form of compensation. The DPPT does not require the Project to develop an income and livelihood restoration strategy, monitoring and evaluation framework, or institutional arrangements in relation to land acquisition and affected peoples. Disclosure of the DPPT is not required by the legislation.	A LARP has been prepared in accordance with the provisions of the Bank's ESS 2 (amended in May 2021) to complement the DPPT, particularly for the gaps outlined herein.
The calculation of full replacement cost will be based on the following: elements: (i) fair market value; (ii) transaction costs; (iii) interest accrued, (iv) transitional and restoration costs; and (v) other applicable payments, if any. Depreciation of structures and assets should not be taken into account The replacement cost shall be determined by an independent appraiser experienced in assessing acquired assets.	Under Government Regulation No. 19/2021, Government Regulation No. 39/2023, MASP Regulation No. 19/2021, and Presidential Regulation No. 62/2018, compensation is required to be fair and reasonable and is assessed by an independent licensed appraiser. Compensation may cover land, structures, plants, land-related assets, other assessable losses, and, where applicable, assistance for affected land users. Asset valuation is based on the value at the time of the location determination announcement, taking into account the period until compensation payment.	Compensation at full replacement cost will be applied. Depreciation of structures and assets shall not be taken into account; An independent and qualified appraiser will be mobilized to appraise the replacement cost of affected lands and non-land assets; In case of involuntary resettlement, capital gains tax and the costs of transferring ownership, including the cost of new land certificates, will not be deducted from the compensation of those who will lose lands;
Ensure DPs without titles or any recognizable legal rights to land are eligible for resettlement assistance and compensation at replacement cost for loss of non-land assets	The legal framework provides limited entitlements for informal land users and persons without legal title, particularly regarding compensation at replacement cost and livelihood assistance.	Compensation for non-land assets of APs without title or any recognizable legal rights at replacement cost will be applied. However, the eligibility of the APs will be defined by the cut-off date. Any informal settlers who encroach on the subproject area after the cut-off date will not be eligible for any compensation and assistance under the subproject.

Key Provisions of ESS 2	Key Provisions of Indonesian Legislation	Mitigation Measures to Bridge the Gaps
Ensure DPs without titles or any recognizable legal rights to land are eligible for resettlement assistance and compensation at replacement cost for loss of non-land assets	The legal framework provides limited entitlements for informal land users and persons without legal title, particularly regarding compensation at replacement cost and livelihood assistance.	Compensation for non-land assets of APs without title or any recognizable legal rights at replacement cost will be applied. However, the eligibility of the APs will be defined by the cut-off date. Any informal settlers who encroach on the subproject area after the cut-off date will not be eligible for any compensation and assistance under the subproject.
AIIB requires that physically and economically displaced persons be provided with adequate assistance to restore or improve their livelihoods and living standards. This includes transitional support, development assistance (such as training, employment opportunities, or access to credit), and, where relocation is required, secure tenure and access to adequate housing and community services. Particular attention must be given to vulnerable and severely affected households, including the poor, landless, elderly, women, children, Indigenous Peoples, and persons without legal title to land, with measures to improve their living standards to at least pre-project levels and, where possible, to national minimum standards.	GOI regulations do not explicitly require livelihood restoration, transitional assistance, or targeted measures to improve the living standards of vulnerable and severely affected households following land acquisition.	Livelihood restoration and transitional support will be provided to physically displaced, severely affected, and vulnerable households. Eligible households will participate in the Livelihood Restoration Program (LRP), which includes measures to restore incomes and support vulnerable groups identified during LARAP preparation.
Meaningful Consultations. Key provisions related to meaningful consultations shall refer to the relevant aspects described in the above table on ESS 1.	GR No. 39/2023 and Ministry of Agrarian Affairs and Spatial Planning/Head of National Land Agency (ATR/BPN) Regulation No. 19/2021 describe the requirements for public consultation in the land acquisition process. The consultation involves entitled parties, property managers and/or users, and/or affected communities during land acquisition, particularly to determine the form and value of compensation. These regulations are silent on the consultation monitoring requirement following land acquisition and payment of compensation, and do not address the inclusion of vulnerable groups, Indigenous Peoples, and those without legal title to land who may be affected.	The Project must undertake meaningful consultation and establish a Project-level GRM in accordance with the provisions of ESS 1 to bridge the gaps outlined herein, including the need for continued consultation and monitoring of affected persons and stakeholders during land acquisition and Project implementation, and the inclusion of vulnerable groups in the consultation process.

Key Provisions of ESS 2	Key Provisions of Indonesian Legislation	Mitigation Measures to Bridge the Gaps
Project-level Grievance Redress Mechanism (GRM). Key provisions related to the GRM in the context of land acquisition and involuntary resettlement shall refer to the GRM provisions described in the above table on ESS 1.	GR No. 19/2021 stipulates that where reports and/or complaints are submitted by the community to the heads of ministries/agencies, the Attorney General, the Police, or local governments regarding deviations or abuse of authority in the implementation of land acquisition for public interest and National Strategic Projects, the resolution shall prioritize the administrative process in accordance with prevailing laws and regulations. This GR also stipulates provisions regarding the resolution of objections raised by displaced persons on the project location, results of land inventory, and the form and amount of compensation.	A GRM in accordance with the provisions of ESS 1 must be established and implemented by the Project, including at the preparation and implementation phases of the Project.
Information Disclosure. Disclose the draft LARP including documentation of the consultation process in the Project area in a timely manner in accordance with the provisions of ESS 1.	GR No. 39/2023 and ATR/BPN Regulation No. 19/2021 stipulate that a Land Acquisition Plan must be explained during public consultation. Law No. 2/2012 and GR No. 19/2021 stipulate that disclosure of the development plan and project location determination is conducted through print and electronic media. Information disclosure to affected persons without legal title to land is regulated under ATR/BPN Regulation No. 6/2020.	The draft and final LARP endorsed by the EA/IAs, or its subsequent updates, will be cleared and disclosed on the websites of the Bank and the Project. Affected persons, including those without legal title to land, will be involved in the planning, implementation, and evaluation of the LARP and consulted on their compensation and entitlements.
Monitoring of Resettlement Outcomes. Monitor and assess resettlement outcomes and their impacts on the living standards of displaced persons compared to baseline conditions. The monitoring report must be disclosed on the websites of the Bank and the Project.	GR No. 19/2021 and ATR/BPN Regulation No. 19/2021 stipulate that monitoring and evaluation of the land acquisition process is conducted by the Ministry of ATR/BPN. Indonesian legislation does not require the Project to monitor resettlement outcomes against the living standards of displaced persons or to disclose the monitoring reports.	Resettlement monitoring and LARP implementation will be carried out by an independent and qualified monitoring party. Resettlement monitoring reports will be disclosed on the websites of the Bank and the Project.

Table 22 Key Gaps between Indonesian Legislation and the ESS 3

Key Provisions of ESS 3	Key Provisions of Indonesian Legislation	Mitigation Measures to Bridge the Gaps
Social Impact Assessment (SIA). Undertake a culturally appropriate and gender-sensitive social impact assessment to assess Project impacts, both positive and adverse, on affected Indigenous Peoples (IPs). Give full consideration to options for affected IPs in relation to the provision of Project benefits and the design of mitigation measures. Identify socially and economically appropriate benefits for affected IPs that are culturally suitable and gender- and inter-generationally inclusive, and develop measures to avoid adverse impacts on them, or where avoidance is not possible, to minimize or mitigate such impacts.	Several regulations at the national, provincial, and regency levels stipulate requirements to undertake SIA for affected IPs. Law No. 6/2014 on Village Affairs places government responsibility to facilitate assessment in identifying the category of customary law communities (MHA) in proposed customary villages. Regulation of the Minister of Home Affairs No. 52/2014 on the Guidance for the Recognition and Protection of Indigenous Legal Communities stipulates requirements to assess the existence of Indigenous Peoples focusing on: (i) the history of the indigenous legal community; (ii) customary law; (iii) indigenous territories; (iv) customary property and objects; and (v) indigenous institutions or governance systems. Nevertheless, the Indonesian AMDAL process under GR No. 22/2021 does not specifically stipulate that affected IPs must be included in the impact assessment.	The EA/IAs are required to conduct the ESIA in accordance with ESS 1 to include a comprehensive assessment of social impacts on IPs likely to be affected by the Project, taking into account culturally appropriate social and economic benefits as well as gender perspectives. In addition, measures to avoid, minimize, and/or mitigate identified adverse impacts and to enhance positive impacts on affected IPs will be developed and presented in the IPPF prepared for the Project.
Indigenous Peoples Planning Framework (IPPF). Prepare an IPPF if: (i) the Project is likely to involve Indigenous Peoples and consists of a program or series of activities whose details are not yet identified at the time the Project is approved by the Bank; or (ii) in exceptional circumstances duly justified by the Client, the Bank determines that the E&S assessment of the Project activities may be conducted using a phased approach. Develop the IPPF in accordance with the Bank's ESS 3, including a detailed assessment of social impacts on affected IPs.	Regulation of the Minister of Home Affairs No. 52/2014 stipulates a legal recognition mechanism to ensure IPs' rights to their lands and territories. Based on the verification and validation process conducted by a legal committee on indigenous legal communities under the supervision of the regional government, the recognition of IPs will be legalized through a Decree of the Head of Regency or Municipality Government if the IP groups exist within one administrative area, or through a joint decree of local government heads if the IPs' territories cover two or more administrative areas.	The EA/IAs are required to develop the IPPF in accordance with the provisions of the Bank's ESS 3 and to incorporate relevant sections of this document, particularly in relation to the social impact assessment on IPs likely to be affected by the Project.
Project-level Grievance Redress Mechanism (GRM). Key provisions related to the GRM involving IPs shall refer to the relevant aspects described in the above table on ESS 1.	GR No. 19/2021 stipulates that where reports and/or complaints are submitted by the community to the heads of ministries/agencies, the Attorney General, the Police, or local governments regarding deviations or abuse of	A GRM in accordance with the provisions of ESS 1 must be established and implemented by the Project, including at the preparation and implementation phases of the Project.

Key Provisions of ESS 3	Key Provisions of Indonesian Legislation	Mitigation Measures to Bridge the Gaps
	authority in the implementation of land acquisition for public interest and National Strategic Projects, the resolution shall prioritize the administrative process in accordance with prevailing laws and regulations. This GR also stipulates provisions regarding the resolution of objections raised by displaced persons on the project location, results of land inventory, and the form and amount of compensation.	
Information Disclosure. Disclose the draft IPPF including documentation of the consultation process in the Project area in a timely manner in accordance with the provisions of ESS 1.	GR No. 19/2021 stipulates that the consent of affected IPs (customary communities) is required for the acquisition of customary land (tanah ulayat). It further stipulates that where customary land exists within the area subject to acquisition, the land acquisition process is coordinated with the regional government by involving the IPs to obtain agreement and resolution on associated issues. This agreement and resolution are documented in Minutes of Meeting signed by all parties involved.	The draft and final IPPF endorsed by the EA/IAs, or its subsequent updates, will be cleared and disclosed on the websites of the Bank and the Project.

4.0 ESIA METHODOLOGY

This section describes the methodologies adopted to undertake the ESIA of the Project, including desktop study and literature review, collecting E&S baseline data and information through to conducting E&S risk and impact assessments, and developing an environmental and social management plan (ESMP) to mitigate these risks and impacts.

4.1 Desktop Studies

A desk-top study and literature review, including Project-related documents, such as the DED reports, and relevant data and information already available was conducted. The following data and information were collated and presented in the ESIA, including but not limited to the following:

- Data and information related to the design of the toll road and supporting infrastructure (e.g., road, bridge, underpass and overpass designs, interchange, toll gate offices, and rest areas);
- Auxiliary facilities (e.g., borrow material quarries, concrete batching plants) required to support the construction of the toll road;
- Typical skills and qualifications for the workers;
- Typical types and capacity of trucks and heavy equipment;
- Key E&S policy, legal, and administrative frameworks (e.g., national laws and regulations, required permits, the AIB's E&S Policy, and good international industry practices (GIIP);
- E&S baseline data and information collected from the draft Andal of Jambi – Rengat Toll Road and related published information;
- Biodiversity baseline data and information (e.g., protected, endangered, threatened flora and fauna species, habitat types, legally protected areas and internationally recognized areas, key biodiversity areas, and ecosystem services); and
- Presentation slides in relation to Jambi-Rengat Toll Road development made by DGH/PTTH in 2023 and 2024.

4.2 Scoping Process

The scoping process was conducted to define the Project's area of influence (Project's Aol) and to identify interactions between the Project's key activities/components and the E&S resources and receptors requiring detailed assessment, as well as those of minor and negligible importance. It also helps identify key gaps in the existing E&S data and in the data required for the Project's ESIA, providing the basis for proposing additional sampling and studies to bridge these gaps. The methodology for determining the Project's Aol is described in the relevant section of the ESIA.

4.3 Stakeholder Identification and Analysis

The identification of stakeholders related to the Project has been undertaken and documented in the project-specific Stakeholder Engagement Plan (SEP). A formal and informal consultations have been conducted as part of the Indonesian Amdal study, the ESIA, and the land acquisition and resettlement plan (LARP) document. This stakeholder engagement is imperative to understand their views,

concerns, and expectations on the Project as the basis to conduct the impact assessment and hence benefiting the ESIA process.

Stakeholder identification and analysis were an essential part of the ESIA process, ensuring that the perspectives, concerns, and expectations of all potentially affected or interested parties were properly considered in the impact assessment and mitigation planning. The process involved both desktop review and field verification, covering government agencies at national, provincial, and regency levels; local communities and households within the Project's Area of Influence (AoI); civil society organizations and NGOs active in the area; academic and research institutions; private sector entities such as plantation and land concession holders; and other stakeholders with direct or indirect interests in the Project. Stakeholders were further classified based on their influence over and impact by the Project, allowing the team to prioritize engagement efforts and customize communication strategies.

Formal and informal consultations have been carried out during this ESIA and the development of the Land Acquisition and Resettlement Plan (LARP). These consultations aimed to gather stakeholder input on potential environmental and social impacts, identify local concerns not captured through desktop data, and provide affected communities with accessible information about the Project. The outcomes of stakeholder identification, categorization, engagement methods, and consultation results are documented in the project-specific Stakeholder Engagement Plan (SEP). Key insights from stakeholder engagement relevant to the impact assessment are referenced throughout this ESIA. Vulnerable groups within the Project's AoI—such as women-headed households, the elderly, persons with disabilities, and economically marginalized communities—were specifically identified and given special attention to ensure their concerns were included in the assessment. The identification of these groups and the suggested measures to address their needs are detailed further in the social baseline and social impact assessment sections of this ESIA.

4.4 Baseline Studies

The E&S baseline data and information as well as related study results presented in the Project's ESIA are primarily extracted from the *draft Andal of Jambi – Rengat toll—roadToll Road* (PT Dianzani Utama Konsultan, 2024) and the results of additional E&S surveys and studies commissioned by the Bank in 2023 to obtain more comprehensive, project-specific data and information in accordance with the Bank's ESS 1: Environmental and Social Assessment and Management. These additional E&S surveys and studies included:

- Baseline noise levels were measured every 5 seconds over 10-minute intervals each hour, following the methodology outlined in the Ministry of Environment decree No. 48/1996 on Ambient Noise Level Standards, at the same locations as the air quality sampling points;
- Measurement of vibration levels adopted the methodology defined in the *Ministry of Environment decree No. 49/1996 on Vibration Level Standards*, at the same locations as those of the air quality sampling points;
- Surface water sampling at 10 points and groundwater samples at 7 representative points along the Jambi-Rengat Toll Road alignment. These samples analysed by an Indonesian accredited laboratory using the analytical methods defined in the applicable Indonesian National Standards;
- A detailed, site-specific biodiversity baseline survey and Critical Habitat Assessment (CHA) for the Jambi-Rengat Toll Road alignment;

- Due diligence of affected households that have received compensation from the Project as part of the land acquisition process; and
- Socio-economic surveys of affected households whose lands are likely to be acquired for the Project.

The results of the above surveys and data collection, together with the baseline information presented in the E&S baseline sections of this ESIA, are supported by relevant laboratory analytical reports included in the Appendices.

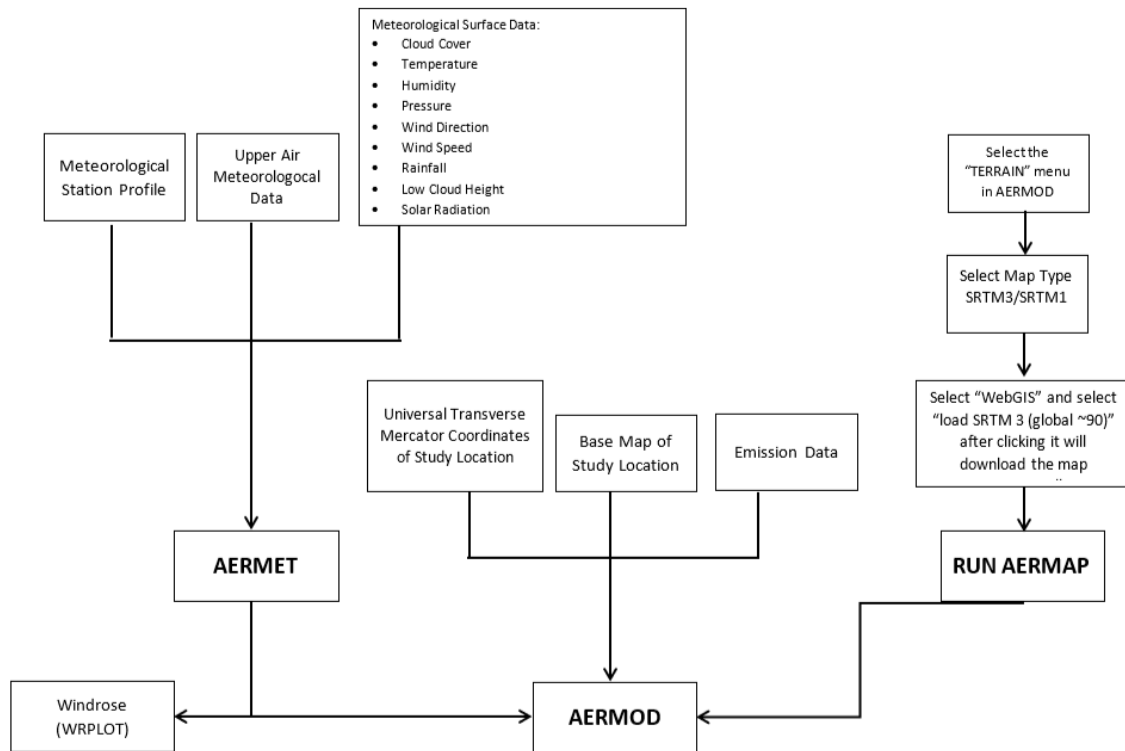
4.5 Air Pollutant Dispersion Modelling

Air pollutant dispersion modelling using the ISC AERMOD View Software was undertaken for the Project to evaluate the dispersion of air pollutants during the Toll Road construction and operation phases. This software comprises three main data processors, namely the AERMOD Meteorological Processor (AERMET), the AERMOD Terrain Preprocessor (AERMAP), and the AERMIC Dispersion Model (AERMOD), as shown in Figure 19.

AERMET. It is designed to calculate specific boundary layer parameters used to estimate wind profiles, turbulence, and temperature. The meteorological data required for the modeling include cloud cover, air temperature, air pressure, wind direction, wind speed, lowest cloud ceiling height, precipitation, and solar radiation. The meteorological data used for the modeling were sourced from the NASA POWER Project (<https://power.larc.nasa.gov/data-access-viewer/> that was accessed in October 2024) and ERA5 (<https://cds.climate.copernicus.eu/datasets/reanalysis-era5-single-levels?tab=overview> that was accessed in October 2024). The coordinates of Sultan Thaha Saifuddin Airport in Jambi City were used because they can generate accurate meteorological data from NASA and ERA5 and, therefore, are more reliable for the modeling purpose mentioned earlier.

The meteorological data used for the modelling is hourly data from January 2023 to September 2024. Once the meteorological data is consolidated, the wind rose generated from the WRPLOT, which is one of the supporting software for AERMOD is shown in the figure below. The wind rose indicates that most of the wind in the project area is blowing to the east to north-easterly direction and wind speed in a range of 0.5 – 3.6 m/s.

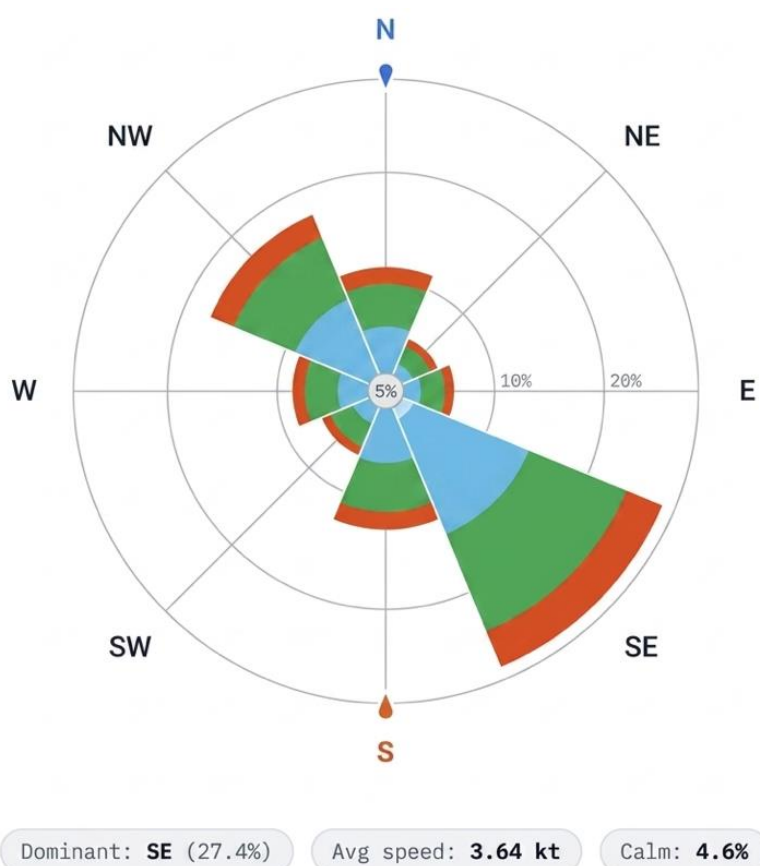
Figure 19 Inputs for Air Pollutant Dispersion Modelling



AERMAP. It uses terrain data divided into grids to calculate the representative terrain height for each receptor with the AERMOD calculating the specific terrain height value. Using this approach, the AERMOD enables calculating the effects of air pollutants on both flat and elevated surfaces within the same modeling framework. Two types of data are required to run AERMAP, and these include a run stream file that directs AERMAP to a set of options and specifies the locations of the source and receptors, and contour data in a standardized format. The contour data used in the modelling is Shuttle Radar Topography Mission Version 3.0 (SRTM3) which has been included in the AERMAP (www.webgis.com). The AERMAP uses the Universal Transverse Mercator (UTM) coordinate system to identify the locations of the source and receptors.

The AERMOD (version 8.9.0). It is released by www.weblakes.com in 2020 and used for the modelling in this ESIA. This software is developed by American Meteorological Society (AERMIC) and the United States Environmental Protection Agency (US EPA). It employs both Gaussian and bi-Gaussian approaches in its dispersion modeling, providing pollutant concentration estimates in the ambient air over daily, monthly, or annual periods that can be applied to both urban and rural areas, flat or elevated terrains, emissions from the ground or at height, and emissions from multiple sources (including point, area, or volume sources). The AERMOD estimates meteorological profiles through several equations and interpolation of nearby measurements. To calculate the concentrations of air pollutant distribution, it considers various parameters, such as vertical wind effects, temperature, and turbulence.

Figure 20 Windrose Generated for the Project Area



Modeling Domain and Receptor Grid. The modelling domain of the air pollutant dispersion, encompassing the toll road alignment, receptors, pollutant emission sources, and elevation information was created. The modelling domain is divided into approximately 440 grids to facilitate the reading of pollutant concentrations at various receptor locations. The grids created is adjusted to assist in the mapping of the air pollutant concentrations resulted from the AERMOD modeling.

Emission Sources. Key data required to estimate air pollutant emissions for the toll road project includes fuel density (in kg/m³), the number of vehicles categorized based on their types, and the assumption of the average annual distance traveled (in km/year/unit). The air pollutant emissions are then calculated using the *Atmospheric Brown Cloud Emission Inventory Workbook* (version 1.0) published by the United Nations Environment Programme (2012). Key vehicle and equipment data used as inputs for modelling the construction phase are presented in Table 23, and those for the operation phase in Table 24.

Table 23 Vehicles and Equipment Used for the Modelling (Construction Phase)

Vehicle Type	Number of vehicles (Units)	Fuel Type	Assumed travel distance (km/day/unit)
Dump truck (4 – 8-m ³ capacity)	200	Diesel	35
Vibratory roller (9 – 20-tons capacity)	10		
Tandem rollers	10		
Motor graders	15		

Vehicle Type	Number of vehicles (Units)	Fuel Type	Assumed travel distance (km/day/unit)
Excavator	15		
Pneumatic tire roller	3		
Wheel loaders	4		
Asphalt finisher and sprayer	3		
Bulldozer	15		
Hummer pile	10		
Bore pile	12		
Mobile crane	8		

Source: Draft Andal document of Jambi – Rengat Toll Road Project (PT Dianzani Utama Konsultan, Juni 2024)

Table 24 Vehicle and Equipment Used for the Modelling (Operation Phase)

Category	Number of vehicles (Units)	Fuel Type	Assumed travel distance (km/day/unit)
Passenger cars	1,948	Diesel dan gasoline	40
Light-duty vehicles (bus)	613	Diesel	166
Heavy-duty vehicles (truck)	1,032	Diesel	35

Source: Traffic Impact Assessment Report (Andalalin) of Jambi – Rengat Toll Road Project (PT Kwarsa Hexagon, 2022)
The transportation emissions rates for CO, NO₂, SO₂, PM_{2.5}, and TSP were calculated using the Atmospheric Brown Cloud Emission Inventory Manual (ABC-EIM). These emission rates (see Table 25) were used for air dispersion modelling using AERMOD.

Table 25 Air Pollutant Emissions

Source	Parameters (tons/year)				
	CO	NO ₂	SO ₂	PM _{2.5}	TSP
Construction Phase	18.45	28.63	34.38	6.51	31,177.01
Operational Phase	731.17	209.35	266.34	43.13	396,12

Note: TSP: Total suspended particulates include PM10 and particulates <100 µm.

4.6 Noise Level Modelling

Noise modeling was conducted to estimate potential noise generation during the construction and operation phases. For construction noise modeling, the ISO 9613-2-2024: Acoustics — Attenuation of sound during propagation outdoors — Part 2: Engineering method for the prediction of sound pressure levels outdoors. During operation, noise propagation was estimated using the Predicted Noise Level due to Traffic Generation No. Pd T-10-2004-8, published by the Department of Settlements and Regional Infrastructure of the Indonesian Government. A detailed approach to noise modeling for these two phases is described below.

4.6.1 Construction Phase

Methodology. Noise propagation from construction activities was estimated using distance attenuation, following the methodology defined in ISO 9613-2-2024: Acoustics — Attenuation of sound during propagation outdoors — Part 2: Engineering method for the prediction of sound

pressure levels outdoors. The noise level was also calculated using the 'iNoise' software. This method is commonly applied, according to the Roadway Construction Noise Model User Guide published by the U.S. Department of Transportation – Federal Highway Administration.¹⁹

Noise Sources and Level. The primary noise sources during the construction phase are generated by the Project's trucks, heavy equipment, and machinery handling construction materials and waste, as listed in Table 26.

Table 26 Noise Sources from Construction Phase*

Noise Sources	Sound Level [in dB(A)]
Vibratory pile driver	95
Dump truck	84
Vibratory concrete mixer	80
Backhoe	80
Front end loader	80
Motor graders	81
Excavator	85
Pneumatic tire roller	85
Generator sets	82
Concrete mixer truck	85

Note: * At 50 feet (~15 meter) from the source

Noise Propagation. To determine construction noise levels (point source) at a specific distance, the following equation is used:

$$L_{\max} = \text{Total } L_{\text{eq}} \text{ at 50 feet} - 20 \times \log(D/50) - S \dots \dots \dots (i)$$

Where $L_{\max}$ is the sound level recorded at the time of measurement, 50 feet is the reference for measurement distance, 'D' is the distance from the noise source, and 'S' is a shielding factor assumed to be zero (0) for the modeling.

Noise Level at the Receptor. The noise level received at the receptor level is calculated using formulae:

$$\text{Total } L_{\text{eq}} = 10 \log (\sum 10^{0.1 L_i}) \dots \dots \dots (ii)$$

Where 'Total L_{eq} ' is the total sound level for each activity in dB(A); and ' L_i ' is the noise level from each noise source listed in the above table in dB(A).

Assumptions Used in the Noise Modelling. For the modeling purposes, noise sources are assumed to be generated simultaneously from nine (9) locations (see Table 27). These nine locations are considered representative of the entire alignment of Sp. Ness – Merlung Toll Road project.

Table 27 Assumed Construction Area

Construction Area (as a Point)	X Coordinate (meter- East)	Y Coordinate (meter- South)	Nearest Residential (m)
Point 1	328111	9823232	80 m
Point 2	329824	9829480	120 m
Point 3	325896	9850551	250 m
Point 4	318015	9856657	280 m

¹⁹ https://www.fhwa.dot.gov/ENVIRONMENT/noise/construction_noise/rcnm/rcnm09.cfm

Construction Area (as a Point)	X Coordinate (meter- East)	Y Coordinate (meter- South)	Nearest Residential (m)
Point 5	308959	9859830	180 m
Point 6	299609	9860429	140 m
Point 7	292866	9860282	100 m
Point 8	328289	9837231	280 m
Point 9	327038	9842118	200 m



4.6.2 Operation Phase

Methodology. The methodology adopted for noise level modeling of the toll road for the operation phase refers to the guideline on *Predicted Noise Level due to Traffic Generation No. Pd T-10-2004-8* published by the Department of Settlements and Regional Infrastructure of the Indonesian Government. The noise level prediction is processed using the ‘iNoise’ software.

The estimated noise level is determined by traffic flow (number of vehicles/hour); average speed (km/h); percentage of heavy or large vehicles (%); road gradient; road surface condition, and measured at a distance of 10 meter (L_{10}) away from the edge of the toll road. These data generates the following formula, where Q is the hourly traffic volume; V, P and G represent the average vehicle speed, the percentage of heavy vehicles and the road gradient, respectively.

$$L_{10} = 10 \log Q + 33 \log \left(V + 40 + \frac{500}{V} \right) + 10 \log \left(1 + \frac{5P}{V} \right) + 0.3G - 26.6 \quad \text{.....(iii)}$$

Assumptions. The number of vehicles by class is based on the data used in the toll road traffic impact assessment (see Table 28), atmospheric attenuation (i.e., atmospheric, vegetation/foilage, and ground effects) is assumed to be negligible, and the maximum noise propagation is calculated using equation (i) at Section 4.2.2.1.

Table 28 Vehicle Data Used for Noise Modelling (Operation Phase)

Vehicle Classification in Indonesia*	Number of Vehicle/Day**	Number of Vehicles/Hour	Percentage of Vehicles based on Hourly Traffic
Class I: Passenger car, Utility vehicle, Light truck, Bus	3,651	152	58%
Class II: 2-axles truck	1,912	80	31%
Class III: 3-axles truck	659	27	10%
Class IV: 4-axles truck	10	0	0%
Class V: 5-axles truck	21	1	<1%
Total	6,523	261	100%

Note: * <https://bpjt.pu.go.id/konten/golongan-kendaraan>

**The traffic impact assessment (Andalalin) of Jambi – Rengat Toll Road (PT Kwarsa Hexagon, 2022).

In accordance with Law No. 22 of 2009 on Road Traffic, the maximum vehicle speed on the toll road is set at 100 km/hour. The percentage value of heavy vehicles (P) is calculated based on the vehicle data above as $108/261 \times 100\%$, approximately 41% of the total number of vehicles and the road gradient (G) is assumed to be 0 (zero). The calculation results show that the L_{10} value (basic noise level) is approximately 70 dB(A).

Noise Propagation. The noise level received at the receptor level at numerous distances from the noise sources is calculated using the following formula:

$$d' = [(d + 3,5)^2 + h^2]^{0,5} \dots\dots\dots(v)$$

Where 'P' is propagation value; d is correction factor; d' is the distance of the noise receptor from the toll road; 'h' is the height at which level the noise is received, assumed 1.5 m; and 'S' is the type of road surface, i.e., asphalt set at -2 dB(A).

Noise Modeling Results. The L_{eq} which is the day- and night-time noise level equivalent from numerous noises such as vehicles, trucks, heavy equipment, and machinery are calculated using equation (ii) at Section 4.4.2.1. The projected operation traffic noise values L_{eq} at various distances along the toll alignment²⁰ are visualized in the map using ArcGIS Software and then are compared with the national and international threshold standards.

4.6.3 Vibration

Ground-borne vibration from construction activities was estimated using empirical distance attenuation, following the methodology defined in the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (FTA-VA-90-1003-06, 2006). This method characterises Peak Particle Velocity (PPV) — the standard metric for assessing construction vibration impacts on structures and human receptors — as a function of distance from the vibration source, using equipment-specific reference levels derived from field measurements. The method is also consistent with ISO 2631-1:1997 on human exposure to whole-body vibration⁹ and provides a basis

⁹ NASA: National Aeronautics and Space Administration, United States. POWER: The Prediction of Worldwide Energy Resources.

¹⁰ ERA5: The European Centre for Medium-Range Weather Forecast Re-analysis 5th Generation.

¹¹ https://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/rcnm09.cfm

for comparison against applicable standards, including MoE Decree No. 49/1996² and DIN 4150-3:2016.

Vibration Sources and Reference Level. The primary vibration sources during the construction phase are generated by the Project's trucks, heavy equipment, and machinery handling construction materials, as listed in Table 29. Reference Peak Particle Velocity (PPV) values are derived from FTA (2006), which compiles empirical field measurements for common construction equipment types. These reference values represent the 50th-percentile (median) PPV recorded at a standard reference distance of 25 feet (7.62 metres) from the source.

Table 29 Vibration Sources from Construction Phase

Equipment Type	Total Units	Units/Point (÷ 9)	*PPV_ref at 7.62 m (mm/s)	SRSS contribution $\sqrt{n \times PPV^2}$
Pile hammer (impact)	10	1.1	16.360	17.159
Vibratory roller	10	1.1	5.330	5.590
Bulldozer	15	1.7	2.260	2.947
Excavator	15	1.7	2.260	2.947
Dump truck	200	22.2*	1.930	9.094
Motor grader	15	1.7	1.930	2.516
Wheel loader	4	0.4	1.930	1.221
Water tanker	5	0.6	1.930	1.495
Stone crusher	3	0.3	1.270	0.696
Tandem roller	10	1.1	1.270	1.332
Pneumatic tire roller	3	0.3*	1.270	0.696
Asphalt finisher	3	0.3*	1.270	0.696
Mobile crane	8	0.9	0.430	0.408
Bored pile rig	12	1.3	0.430	0.490
Asphalt sprayer	3	0.3	0.250	0.137
Concrete mixer	5	0.6	0.025	0.019
Air compressor	5	0.6	0.025	0.019
Diesel generator	6	0.7	0.025	0.021
Concrete batching plant	3	0.3*	0.025	0.014

Note: PPV reference values at 25 feet (~7.62 metres) from the source. Source: FTA (2006), Transit Noise and Vibration Impact Assessment, Table 12-2. The vibratory pile driver and impact piling represent the dominant vibration sources and govern the assessment at all construction points. *Shared across points or limited to specific construction zones.

Vibration Propagation. To determine construction vibration levels at a specific distance from the source, the following empirical attenuation equation is used (FTA, 2006):

$$PPV(D) = PPV_{ref} \times (D_{ref} / D)^n \dots\dots\dots(iii)$$

Where: PPV(D) is the Peak Particle Velocity at distance D from the vibration source (mm/s); PPV_{ref} is the reference PPV at the reference distance D_{ref} = 25 feet (7.62 m) from the source, as listed in Table 29 (mm/s); D is the distance from the vibration source to the receptor (metres); D_{ref} = 7.62 m (25 feet), the standard FTA reference distance; and n is the vibration propagation exponent, taken as **n = 1.5** for soft alluvial soil conditions, which is representative of the Batanghari River valley lowland

terrain traversed by the Project alignment. This exponent reflects greater energy dissipation in soft, poorly consolidated soils and is the conservative value recommended by FTA (2006) for typical construction conditions. For hard rock, $n = 1.1$ would apply.

Vibration Level at the Receptor. Where multiple vibration-generating equipment types operate simultaneously at the same construction point, the combined Peak Particle Velocity at a receptor is estimated using a Root Sum Square (RSS) approach, as follows:

$$PPV_{total} = \sqrt{(\sum [PPV_i(D)]^2)} \dots\dots\dots(iv)$$

Where: PPV_{total} is the total PPV at the receptor, combining contributions from all simultaneous vibration sources (mm/s). $PPV_i(D)$ represents the individual contribution of each piece of equipment i at the receptor distance D , calculated using Equation (iii).

Applicable Vibration Standards. The predicted PPV values are evaluated against the following

- MOE Decree No. 49/1996 concerning Vibration Standards. Residential areas: **$PPV \leq 2 \text{ mm/s}$** ; commercial areas: $PPV \leq 5 \text{ mm/s}$; industrial areas: $PPV \leq 10 \text{ mm/s}$
- DIN 4150-3:2016: Structural vibration — Effects of vibration on structures. Provides guidance values for building damage assessment: **residential structures (daytime, 4–80 Hz) = 5 mm/s**; sensitive or heritage structures = 3 mm/s; industrial structures = 10–40 mm/s (frequency-dependent).
- **FTA (2006) Human Annoyance Thresholds:** Barely perceptible = 0.35 mm/s; distinctly perceptible = 0.71 mm/s; **strongly perceptible = 1.41 mm/s**; severe = 2.83 mm/s (at 16 Hz dominant frequency). These thresholds inform the assessment of human comfort impacts on occupants of project-adjacent structures.
- **AIIB Environmental and Social Framework (ESF) — ESS 1 (Environmental and Social Assessment and Management).** Requires identification and assessment of all significant environmental and social impacts, including construction vibration affecting community health, safety, and physical infrastructure. Mitigation measures and monitoring programmes must be commensurate with the level of identified risk.
- **AIIB ESF — ESS 3 (Pollution Prevention and Abatement).** Requires application of pollution prevention measures to avoid or minimise adverse impacts. Construction vibration is treated as a physical pollutant under this standard; BAT/BEP principles apply to source control and mitigation.
- **IFC Performance Standard 4 (PS 4) — Community Health, Safety, and Security.** Requires identification of hazards to communities from construction activities, including ground-borne vibration that could cause structural damage, and implementation of measures to avoid, minimise, or mitigate such risks

Assumptions Used in the Vibration Modelling. For modeling purposes, vibration sources are assumed to operate simultaneously from nine construction sites (see Table 4). These sites are representative of the entire Sp. Ness – Merlung Toll Road project alignment and match those used in the construction noise assessment (Table 27). Additional assumptions for vibration modeling include the following:

- All equipment listed in Table 29 is assumed to operate simultaneously at each construction point during the peak construction phase. Three scenarios are considered: (i) the worst-case scenario involving construction activities with a hammer pile; (ii) operation of all equipment and heavy vehicles without using a pile hammer; and (iii) operations limited to earthmoving only with equipment and heavy vehicles..

- The propagation exponent $n = 1.5$ (soft alluvial soil) is applied uniformly across all nine construction points, consistent with the predominantly flat, riverine, and alluvial terrain of the Batanghari River valley.
- No topographic screening, structural barriers, or trench-type vibration isolation measures are assumed in the baseline model (i.e., shielding factor $S = 0$). Any such mitigation, if implemented, would reduce predicted PPV values.
- PPV_ref values represent the FTA (2006) 50th-percentile (median) empirical levels. Where conservative assessment is required, the 95th-percentile values (approximately 2× the median) may be applied, particularly for vibratory pile driver operations in the vicinity of sensitive structures.
- Human receptors are evaluated at the nearest residential dwelling, school, or healthcare facility from each construction point, as identified from satellite imagery and field verification. Structural (building-damage) receptors are evaluated at the same distances.
- The assessment covers the construction phase only. Operational-phase vibration from toll road traffic is assessed separately using the FTA (2006) ground-borne vibration model for vehicular sources.
- For wildlife receptors, the assessment considers the potential for ground-borne vibration to disturb protected mammal species identified in the biodiversity baseline (Section 5.1.x). Given the generally low predicted PPV at receptor distances ≥ 80 m (< 0.56 mm/s), significant disturbance impacts on wildlife are not anticipated; however, this should be cross-referenced against species-specific vibration sensitivity data in the biodiversity chapter (Section 5.3).

4.7 Risk and Impact Assessment Method

The E&S risk and impact assessment in this ESIA is conducted using a **significance-based approach** in accordance with the provisions of ESS 1. Under this approach, the significance of each identified impact is evaluated based on defined criteria prior to and following the application of mitigation measures, enabling a systematic comparison of pre-mitigation (inherent) and post-mitigation (residual) impact significance. The assessment follows the sequential steps described below.

All potentially significant impacts are identified based on the main activities described in the Project description and the environmental and social baseline conditions described in the relevant sections of this ESIA. Identified impacts include:

- Direct impacts — potentially resulting from a direct interaction between the Project's activities and the receiving environment and/or receptors (e.g., land clearing resulting in soil erosion and changes in surface water runoff patterns);
- Indirect impacts — potentially resulting from subsequent interactions between the Project's direct impacts and other related receiving environments and/or receptors (e.g., soil erosion increasing turbidity in receiving water bodies, or changes in runoff patterns leading to inundation or flooding in low-lying areas downstream of the Project); and
- Induced impacts — potentially resulting from other activities not forming part of the Project but occurring as a consequence of the Project (e.g., increased pressure on existing roads and public facilities due to the mobilization of a large workforce).

The significance of each identified impact is evaluated based on two primary criteria: (i) the severity or consequence of the impact on the receiving environment or receptor; and (ii) the likelihood of the impact occurring. These two criteria are combined using the impact risk matrix to generate an overall

risk score, which is then classified into an impact significance level of Minor, Moderate, or Major, as described further below. The evaluation is conducted first without any mitigation measures (inherent significance) and subsequently after the application of proposed mitigation measures (residual significance), enabling a clear demonstration of the effectiveness of the proposed mitigation hierarchy.

Relevant mitigation measures are proposed to address identified significant impacts, applied in accordance with the following hierarchy:

- Avoid — eliminate the risk or impact by not undertaking the activity or by adopting an alternative approach;
- Minimize/Reduce — reduce the probability or severity of the impact where avoidance is not feasible;
- Mitigate — implement corrective measures to restore affected environmental or social conditions; and
- Offset/Compensate — compensate for residual significant impacts where the above measures have been applied to the fullest extent technically and financially feasible.

Residual Significance. The residual significance is defined as the impact significance remaining after all proposed mitigation measures have been implemented. Where residual impacts remain significant, additional or enhanced measures are required to further reduce the significance to an acceptable level.

Monitoring. Monitoring and audit requirements are defined to verify actual impacts on receptors during Project implementation and to provide the basis for adaptive management, including the modification or supplementation of mitigation measures where monitoring results indicate this is necessary.

The impact magnitude and severity or consequence of each environmental, social, or health and safety impact is determined using the criteria presented in Table 30 and

Table 31, respectively.

Table 30 E&S Impact Magnitude

Score	Level	Environmental (incl. Biodiversity)	Socio-Economic / Physical Cultural Resources	Health & Safety (Occupational & Community)
1	Negligible	No measurable change from baseline; within natural variation; no effect on ecosystem function or quality.	No discernible effect on community livelihoods, resources, or cultural heritage; concerns are isolated and informal.	Near miss only; no physical harm; within normal occupational health parameters; no medical intervention required.
2	Low	Minor, localized change; reversible without intervention; receptor function not impaired; within applicable regulatory limits.	Minor, short-term concern affecting a small number of individuals; reversible without formal intervention or compensation.	Minor incident requiring first-aid treatment; no lost time; short-term, reversible health effect.
3	Medium	Measurable change affecting receptor function	Moderate adverse effect on a defined segment of	Incident requiring medical treatment and possible

Score	Level	Environmental (incl. Biodiversity)	Socio-Economic / Physical Cultural Resources	Health & Safety (Occupational & Community)
		over the medium term; reversible with standard mitigation; may approach but not exceed regulatory thresholds.	the affected community; reversible with targeted mitigation; some livelihood disruption.	hospitalization; moderate functional impairment; reversible health effect.
4	High	Significant change causing major impairment of receptor function; large-scale; reversible only with intensive management; likely to exceed applicable standards.	Widespread adverse effect on the majority of the affected community; significant livelihood loss or displacement; may exceed legal thresholds.	Serious incident causing permanent impairment or long-term illness; high level of medical management required; does not result in fatality.
5	Very High	Severe, largely irreversible loss of critical environmental or biodiversity values at a landscape scale; regulatory prosecution likely; project suspension possible.	Severe, irreversible impact on livelihoods or displacement of large populations; destruction of irreplaceable physical cultural resources; legal prosecution likely.	Fatal incident or severe, irreversible illness; significant community health crisis; regulatory prosecution and project suspension likely.

Table 31 E&S Impact Severity/Consequence

Impact Severity	1	2	3	4	5
	Incidental	Minor	Moderate	Major	Severe
Environmental including biodiversity	Localized, brief concerns and issues.	Minor scale, short-term, and reversible impacts.	Medium-scale, medium-term, adverse but reversible impacts.	Large-scale, medium-term, adverse, beyond the subproject area, but reversible impacts. These impacts may result in penalties and/or legal prosecution.	Large-scale, long-term, adverse, beyond the subproject area, but reversible impacts. These impacts results in penalties, legal prosecution, and/or the project is suspended.
Socio-economic; Physical cultural resources	Localized, brief concerns raised by some individuals of affected community.	Minor scale, short-term concerns raised by minority of affected community.	Medium-scale, medium-term, adverse, but reversible impacts on moderate number of affected populations.	Widespread, ongoing impact affecting majority of the affected population and other stakeholders.	Widespread, ongoing impact affecting majority of the affected population and other stakeholders.

Impact Severity	1	2	3	4	5
	Incidental	Minor	Moderate	Major	Severe
				These impacts may result in penalties and/or legal prosecution.	These impacts results in penalties, legal prosecution, and/or the project is suspended.
Health & Safety - Occupational & Community aspects	Near miss or incidents requiring first aid treatments. Minor, brief-term health impacts, no medical intervention required.	Minor incidents requiring one-time medical treatment. Short-term health impacts requiring one-time medical treatment.	Moderate incidents causing functional impairment requiring multiple medical treatments. Moderate illness requiring multiple medical treatments and hospitalization.	Major incidents causing permanent impairment requiring a high level of medical treatment. Serious illness with reversible effect requiring a high level of medical treatments or management.	Serious incidents resulting in fatality. Serious and irreversible illness requiring a high level and ongoing medical treatments or management.

Source: This matrix is a consensus of the ESIA authors by considering the risk assessment methods commonly used for ESIA.

The likelihood of each environmental, social of health and safety impact to occur is determined based on the criteria presented in the following table.

Table 32 Likelihood of the Impact

Likelihood	Descriptions	Level
Certain	The impact will occur even though the project proceeds as planned e.g., soil erosion when conducting land clearing	5
Likely	The impact will occur under normal operating conditions e.g., minor spills during handling and storage of lubricants	4
Possible	The impact would occur in certain circumstances although it is not intended to be the case e.g., reduced fauna due to increased access to forest areas	3
Unlikely	The impact may occur only in exceptional circumstances e.g., oil spills due to absence of secondary containment in the storage area	2
Rare	The impact is not expected to occur under normal circumstances but still represent a risk in the event of an incident or unforeseen condition happening e.g., fire incident due to the operation of heavy equipment.	1

Source: This matrix is a consensus of the ESIA authors by considering the risk assessment methods commonly used for ESIA.

The risk level derived from the matrix above is subsequently mapped to an **impact significance level** consistent with the significance-based approach required by the Bank's ESS 1, as follows:

- **Low risk** (risk score 1–3) — **Minor significance**: the impact is detectable but not considered significant. Mitigation measures are discretionary and generally constitute standard operational practice.
- **Medium risk** (risk score 4–9) — **Moderate significance**: the impact is evaluated as moderate, reversible or irreversible, and can be mitigated using readily available measures to reduce the risk to an acceptable level.
- **Substantial risk** (risk score 10–12) — **Major significance**: the impact is evaluated as significant, adverse, reversible or irreversible, and must be mitigated using specialized measures to reduce the risk to As Low As Reasonably Practicable (ALARP).
- **High risk** (risk score 15–25) — **Major significance**: the impact is evaluated as significant, adverse, widespread, and irreversible such that it cannot be adequately mitigated. Alternatives to the Project activity with lesser impacts must be identified and adopted.

This mapping ensures consistency between the risk assessment framework applied in this ESIA and the significance-based terminology required under the Bank's ESS 1. The impact significance level — Minor, Moderate, or Major — is reported for both the inherent significance (before mitigation) and residual significance (after mitigation) of each identified impact throughout Sections 6 and 7 of this ESIA.

Table 33 Risk Level of Impact

Likelihood/Level	Consequence/Severity Level				
	5 Severe	4 Major	3 Moderate	2 Minor	1 Incidental
5 Certain	25 High	20 High	15 High	10 Substantial	5 Moderate
4 Likely	20 High	16 High	12 Substantial	8 Moderate	4 Moderate
3 Possible	15 High	13 Substantial	9 Moderate	6 Moderate	3 Low
2 Unlikely	10 Substantial	8 Moderate	6 Moderate	4 Moderate	2 Low
1 Rare	5 Medium	4 Medium	3 Low	2 Low	1 Low

Source: This matrix is a consensus of the ESIA authors by considering the risk assessment methods commonly used and found in the following references: <https://www.riskpal.com/risk-assessment-matrices/>

<https://www.safeworkpro.com.au/an-example-of-risk-assessment-matrix/>

4.8 Rapid Cumulative Impact Assessment

The cumulative impact assessment (CIA) of the Project is conducted using the Rapid Cumulative Impact Assessment (RCIA) approach recommended in the *Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets (IFC, August 2013)*. The CIA is undertaken to assess how the Project may contribute to cumulative E&S impacts on valued environmental and social components arising from existing or planned developments within the project's area of influence. Based on this assessment, measures to enhance

the cumulative positive impacts and mitigate adverse cumulative to an acceptable level are defined. The step-by-step CIA process and its corresponding results are described in relevant sections of the ESIA.

5.0 ENVIRONMENTAL BASELINE

This section describes the physical environment, including biodiversity, and social baseline conditions within the Project area of Sp. Ness – Merlung Toll Road (Phase 1 development) likely to be directly, indirectly or cumulatively impacted by the Project during construction and operation phases.

5.1 Geophysical Environment

5.1.1 Landform and Terrain

The Project area is situated at an elevation ranging from approximately **5 to 130 meters above sea level (masl)**, with land slopes ranging from **5° to 55°**. The area is characterized by a combination of lowland areas and undulating hills, as shown in Figure 21. Certain sections of the alignment also traverse floodplains at elevations of 5 to 20 masl, with moderate slopes ranging from 0° to 16°, including the Batanghari River floodplain, where the Project's main bridge will be constructed.

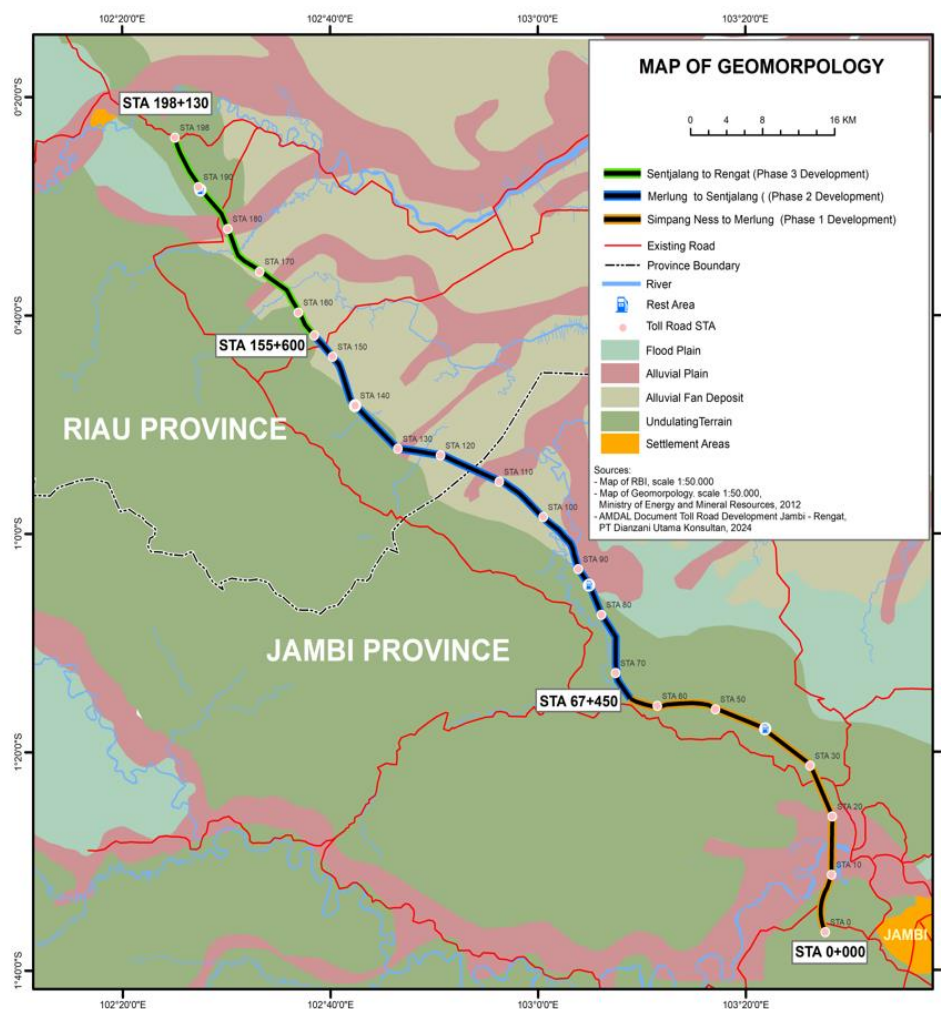
Figure 21 Landform and Terrain within Jambi – Merlung Toll Road



Source: Final DED Report of Jambi – Rengat Toll Road (STA 0+000 – 40+000), PT Maratama Cipta Mandiri (2021)

According to the *Geomorphological Map of Sumatra (Ministry of Energy and Mineral Resources, 2012)*, the alignment of Jambi – Rengat Toll Road is generally underlain by swamp sediments, flow sediment, alluvial fan, and alluvial plain deposits as shown in the following map.

Map 5. Geomorphological Map of Jambi and Riau



Source: Redrawn and improved from the map presented in the draft Andal (PT Dianzani, 2024)

5.1.2 Geological Formation

The Project area is underlain by surface sedimentary, sedimentary, malihan, volcanic, and breakthrough rocks. The surface sedimentary rocks comprise alluvium, swamp, and ‘undak’ sediments. These deposits consist of boulders, gravel, sand, silt, mud, and clay containing plant remnants. The Jambi region experiences tectonic activities from the late Palaeozoic to Resen age. The main structural elements of the rocks in this area are folds and faults. The regional structure of fault in this Jambi region is part of the Great Sumatran Fault trending in northwest-southeast direction in addition to secondary faults traversing the regional fault.

According to the *Geological Map of Sumatra (Ministry of Energy and Mineral Resources, 2012)*, the geological formation within the Jambi – Rengat Toll Road project area is presented in the following table. Further, the map indicates that no thrust, reverse or shear faults are identified within the alignment of Jambi – Rengat Toll Road.

Table 34 Geological Formation within Jambi-Rengat Toll Road

Toll Road STA	Geological Formation
STA 0 – STA 16	Alluvium deposits
STA 16 – STA 38	Muara Enim formation
STA 42 – STA 74	Gumai formation
STA 74 – STA 100	Alluvium (Qa) deposit
STA 100 – STA 174	Rawa deposits (Qas)
STA 142 – STA 146	Kasai formation (Qtk)
STA 174 – STA 198	Muara Enim formation (Tmpm 1)

Source: Revised Draft Andal Jambi – Rengat Toll Road (PT Dianzani Utama Konsultan, June 2022)

5.1.3 Climate and Meteorological Conditions

Air Temperature. The climate in the Jambi – Rengat Toll Road area is considered tropical, with temperatures ranging from 23 – 34 °C.

Rainfall rate. Based on Oldeman’s climate classification, which assesses the number of wet months per year, the project area has a wet climate with annual rainfall between 2,000 and 3,000 mm. Rainfall data for the Jambi area were collected from rain gauge stations at two meteorological stations (i.e., Muara Jambi and Sultan), covering 21 years (2000 – 2020), see Table 35. The annual maximum daily rainfall recorded ranged from 63.3 to 159 mm.

Table 35 Maximum Daily Rainfall Rate.

No	Year	Annual Maximum Daily Rainfall (mm)		
		Sta. Muaro Jambi	Sta. Sultan Thaha	Area Avg. (mm)
1	2000	150.3	103.4	126.85
2	2001	136.5	140.4	138.45
3	2002	148.5	120.4	134.45
4	2003	97	126.6	111.8
5	2004	103	107	105
6	2005	98.7	75.7	87.2
7	2006	76	106.4	91.2
8	2007	92	76.7	84.35
9	2008	99.8	103.5	101.65
10	2009	99.6	81.5	90.55
11	2010	115.8	118.7	117.25
12	2011	66	134.1	100.05
13	2012	159	125.9	142.45
14	2013	85.3	95.4	90.35
15	2014	72.5	67.6	70.05
16	2015	104.5	111.8	108.15
17	2016	99.4	63.3	81.35
18	2017	105	81.2	93.1
19	2018	85	96.2	90.6
20	2019	115.3	69.8	92.55
21	2020	137.9	97.5	117.7

Source: DED Report of STA 0+000 to STA 40+000 (PT Maratama Cipta Mandiri, 2021)

Using the Log Pearson III and Polygon Thiessen approaches, the 24-hour accumulated rainfall for a 2 to 100-years return period within the Jambi – Rengat Toll Road was calculated in a range of 98 – 213 mm/day as shown in the following table.

Table 36 Rain Intensity for 24-hour Period

Return Time (year)	R24 (mm/day)
2	93
5	141
10	176
25	227
50	268
100	313**

Source: Laporan Akhir Perencanaan Hidrologi dan Drainase (2021), DED Jalan Tol Ruas Jambi – Rengat Seksi 1 STA 0+000 s/d STA 40+000 (PT Maratama Cipta Mandiri, February 2022). Log Pearson III was adopted for the Batanghari watershed to account for the influence of climate change and skewness in the weighted rainfall series. ** Used for bridge design on Batanghari River.

Jambi Province. According to the statistical data of Jambi Province (2023), the average air temperature in this region was in a range of 27.4 °C – 28.2°C, air humidity of 83 - 87%, air pressure of 1,010 – 1,012 millibar, wind speed of 5 - 7 knots, and solar radiation 1.8 - 4.7%.

Table 37 Meteorological Data of Jambi Province (2023)

Month	Air Temperature (°C)			Humidity (%)			Air pressure (mb)	Wind Speed (knot)	Solar Irradiation (%)
	Min	Max	Average	Min	Max	Average			
January	22.4	33.6	28.0	54	98	85	1,010	7.00	2.8
February	22.6	32.2	27.4	52	98	86	1,012	7.00	1.8
March	22.8	32.6	27.7	53	98	86	1,009	6.00	3.5
April	23.0	32.4	27.7	54	98	87	1,011	5.00	3.4
May	22.4	33.6	28.0	58	98	86	1,011	5.00	4.7
June	23.2	32.8	28.0	54	98	85	1,012	5.00	4.3
July	22.0	33.2	27.6	51	98	83	1,012	6.00	4.3
August	22.8	33.0	27.9	54	98	83	1,012	5.00	3.8
September	23.1	33.2	28.2	55	98	85	1,012	6.00	3.9
October	22.6	33.6	28.1	53	98	86	1,012	5.00	3.7
November	22.0	33.0	27.5	57	98	86	1,010	5.00	2.7
December	23.3	32.4	27.8	53	98	86	1,011	6.00	3.5

Source: The 2023 Statistics of Jambi Province (The Statistics Agency of Jambi Province, 2023).

The following table presents the 2023 data on wind speed and direction in Jambi region recorded by the Meteorology, Climatology and Geophysics Agency of Jambi Province. The minimum wind speed was recorded at 0.97 knots, and the maximum was 11.08 knots, with wind direction dominantly recorded in the northwest and southeast directions.

Table 38 Wind Speed and Direction of Jambi Province

Month	Wind Speed Range (knot)		Dominant Wind Direction	Description
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	Minimum	Maximum	Average (knot)		
January	0.97 - 4.08	7.00 - 11.08	4.16	Northwest - North	Breeze
February	0.97 - 4.08	7.00 - 11.08	3.74	Northwest - North	Breeze
March	0.97 - 4.08	7.00 - 11.08	3.43	Northwest - Northeast	Breeze
April	0.97 - 4.08	7.00 - 11.08	3.04	Southeast -Southwest	Gentle wind
May	0.97 - 4.08	7.00 - 11.08	3.20	Southeast	Gentle wind
June	0.97 - 4.08	7.00 - 11.08	3.61	Southeast	Weak wind
July	0.97 - 4.08	7.00 - 11.08	3.80	Southeast	Breeze
August	0.97 - 4.08	11.08 - 17.11	4.26	Southeast	Breeze
September	0.97 - 4.08	11.08 - 17.11	3.81	Southeast	Breeze
October	0.97 - 4.08	7.00 - 11.08	3.35	Southeast - South	Gentle wind
November	0.97 - 4.08	7.00 - 11.08	3.31	West - Northwest	Gentle wind
December	0.97 - 4.08	11.08 - 17.11	3.97	Northwest	Breeze

Source: The Meteorology, Climatology and Geophysics Agency of Jambi Province (2023)

Muaro Jambi Regency. According to the statistics al data of Muaro Jambi Regency (2023), the average air temperature in this regency was in a range of 26.2 - 27.3°C, air humidity of 83 - 87%, air pressure of 1,009 – 1,012 millibar, wind speed of 2 - 3 knots, and solar radiation of 23 - 59%.

Table 39 Meteorological Data of Muaro Jambi Regency

Month	Air Temperature (°C)			Humidity (%)			Air pressure (mb)	Wind Speed (knot)	Solar Irradiation (%)
	Min	Max	Average	Min	Max	Average			
January	24.1	31.7	26.9	97	71	86	1011	2.00	35
February	23.7	31.2	26.2	97	72	86	1012	3.00	23
March	24.2	32.9	26.7	96	74	87	1009	2.00	44
April	24.3	33.8	26.9	96	67	87	1012	2.00	43
May	24.7	33.1	27.3	95	69	86	1011	2.00	59
June	24.0	32.5	27.2	96	67	85	1012	2.00	55
July	23.6	32.9	26.5	95	64	84	1012	2.00	44
August	23.7	33.4	27.1	94	61	83	1012	2.00	48
September	23.5	32.4	27.9	96	64	85	1012	2.00	49
October	23.7	32.0	27.1	96	69	86	1012	2.00	47
November	23.7	31.3	27.1	97	73	87	1009	2.00	34
December	24.0	31.3	26.8	96	72	86	1011	2.00	44

Source: The 2023 statistics of Muaro Jambi Regency (The Statistics Agency of Muaro Jambi, 2023)

5.1.4 Ambient Air Quality

Ambient air quality samples were collected at five sites across the Jambi – Rengat Toll Road project area (see Table 40). Noise and vibration levels were also measured at these locations, which represent the existing settlement area, oil palm plantations, and access roads planned for future toll road construction (see Map 6). These sampling activities, including laboratory analysis, were conducted by an accredited party in November – December 2023 to update the baseline data from 2020. The locations of the sampling/measurement sites in relation to the Jambi – Rengat Toll Road are shown in Map 6.

Table 40 Air Quality Sampling, Noise and Vibration Measurement Sites

Sampling Site Code	Existing Land Use	Approximate Location	Coordinates	
			South	East
UKG-1: Pijoan Village (Muaro Jambi Regency)	Community settlement areas	STA 2+000 to 6+000 (Phase 1 development)	1°30'32"	103°52'46"
UKG-2: Kuala Dasai Village (Tanjung Jabung Barat Regency)	Community settlement areas	STA 66+000 to 67+100 (Phases 1 development)	1°17'37"	103°15'50"

Source: Laboratory analytical results (PT RND Teknologi Indonesia, November 2023)

Figure 22 Air Quality Sampling for 24-hour

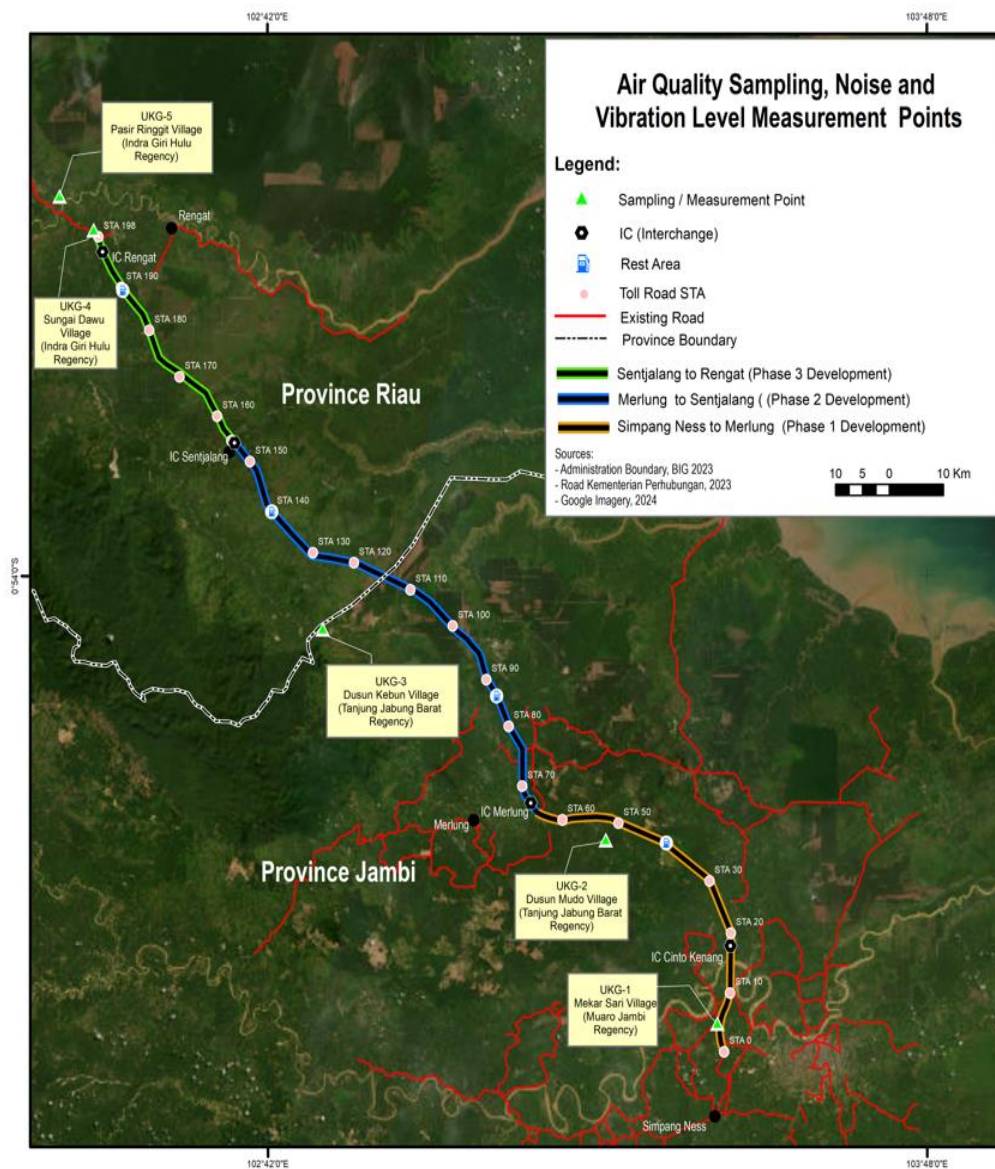


Air quality sampling at UKG-1 site



Air quality sampling at UKG-2 site

Map 6. Air Quality Sampling, Noise and Vibration Measurement Sites



Source: Redrawn from the baseline sampling map produced by PT Kwarsa Hexagon (2024)

Ambient air samples were collected by the technicians of the accredited laboratory in November 2023 following the method described in the *Indonesian Standard SNI 19-7119.6-20050* using high-volume gas sampler for 24-hours as shown in the following figure. The air samples are then analyzed for parameters listed in the *Government Regulation No. 22/2021 on Environmental Protection and Management, Appendix VII: Ambient Air Quality Standards*.

Ambient Air Quality within Sp. Ness – Merlung Toll Road (Phase 1 Development Area). The air samples were collected at Pijoan Village (UKG-1) and Kuala Dasai Village (UKG-2), representing community settlements within this toll road section. The sampling results (see Table 41) demonstrate that road traffic at the sampling sites was minimal at the time of sampling and generally indicate a good ambient air conditions (relatively unpolluted with undegraded airshed) at the time of sampling with no parameters were analysed exceeding the project-adopted standards (GR No. 22/2021, Appendix VII: Ambient Air Quality Standard, and IFC General EHS Guideline).

Table 41 Ambient Air Quality – Sp. Ness to Merlung Toll Road (all units are in $\mu\text{g}/\text{m}^3$ unless stated otherwise)

Parameters	GR No. 22/2021 Threshold Value (Measurement Period) $\mu\text{g}/\text{m}^3$	IFC General EHS Guidelines (2007)/WHO Guidelines (2021) $\mu\text{g}/\text{m}^3$	UKG-1: Pijoan $\mu\text{g}/\text{m}^3$	UKG-2: Kuala Dasai $\mu\text{g}/\text{m}^3$
Sulfur dioxide (SO_2)	75 /24-hour	20 /24-hours	<29.2	29.9
Carbon monoxide (CO)	10,000/1-hour	4,000/24-hours	<1,145	<1,145
Nitrogen dioxide (NO_2)	65/24-hour	200 $\mu\text{g}/\text{m}^3$ /1-hour	20.4	18.5
Oxidant (O_3)	150/1-hour	100/8-hours	<23.2	<23.2
Non-methane hydrocarbon	160/3-hours	-	1.18	1.04
Total suspended particulates (TSP) $\leq 100 \mu\text{m}$	230/24-hours	-	45	52
Particulates $\leq 10 \mu\text{m}$ (PM_{10})	75/24-hours	50/24-hours	30	34
Particulates $\leq 2.5 \mu\text{m}$ ($\text{PM}_{2.5}$)	55/24-hours	25/24-hours	10	15
Lead (Pb)	2/24-hours	-	<0.005	<0.005

Source: Laboratory analytical report of PT RND Teknologi Indonesia (December 2023)

The interpretation of the air quality analytical results (see Table 41) in correlation with the atmospheric conditions and compared to the project-adopted standards was as follows:

- The ambient air quality, both gaseous and particulate, is relatively consistent between the two sampling locations. The levels are within a similar range, being 20% to 53% below both national and international standards (i.e., the IFC General EHS Guideline and WHO Air Quality Guidelines, 2021), respectively.
- According to the meteorological data (see Section 5.3.1), there are no significant seasonal variations in air temperature, humidity, and solar radiation. However, daily fluctuations are more pronounced under inversion conditions, which can suppress vertical mixing and increase near-surface pollutant concentrations. This is most likely to occur in the early morning hours during the northwest monsoon season (November–March, see wind speed and direction data in Table 38), when radiative cooling is stronger..

- The relative humidity in this area is relatively high, reaching up to 90%. This condition potentially enhances the hygroscopic growth of fine particles, which increases PM_{2.5} effective diameters and deposition rates. Additionally, it facilitates the wet deposition of SO₂ and NO₂ generated from construction activities.

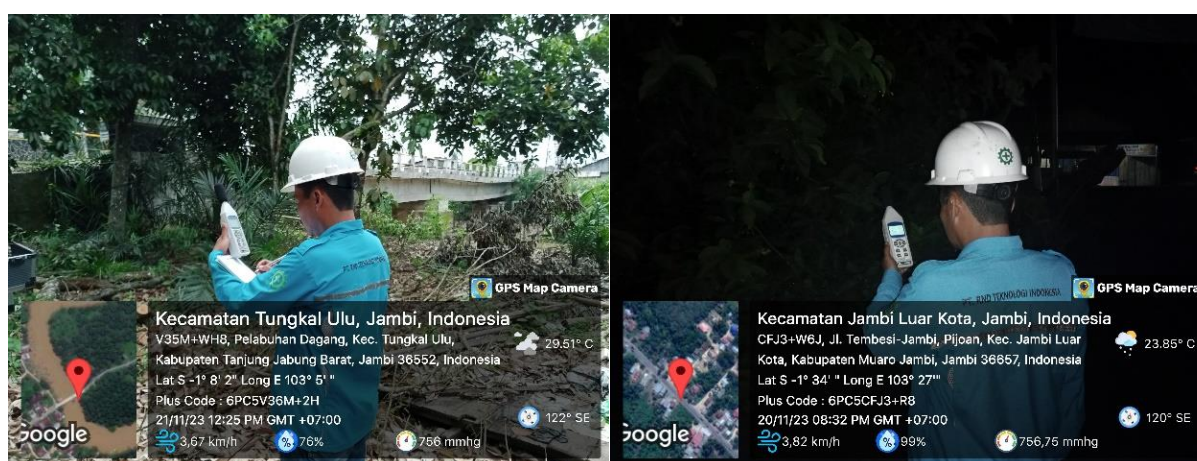
5.1.5 Noise and Vibration Level

Noise Level within Sp. Ness to Merlung Toll Road (Phase 1 Development Area). Ambient noise level measurements representing the Phase 1 development area were conducted at Pijoan Village (UKG-1) and Kuala Dasai Village (UKG-2), the same sites used for ambient air quality sampling. Noise measurement was conducted over a 24-hours period using a sound level meter following the methodology defined in the Indonesian Minister of Environment (MoE) Decree No. 48/1996 on Noise Level Standards, as shown in Figure 23.

The noise measurement results from both sites are presented in Table 42 and interpreted as follows:

- Noise levels at Pijoan Village measured 62.0 dB(A) during the day and 48.4 dB(A) at night, resulting in a day-night equivalent noise level of 60.5 dB(A). This exceeds the residential threshold of 55 dB(A) set by MoE Decree No. 48/1996. According to IFC's EHS General Guidelines (2007), thresholds are 55 dB(A) for daytime and 45 dB(A) for nighttime; the village's baseline noise already surpasses both limits. The main noise source is road traffic from village residents..
- The noise level at Kuala Dasai Village measured 52.3 dB(A) during the day and 48.7 dB(A) at night. This results in a day-night equivalent noise level of 52.8 dB(A), which remains below the residential area threshold stipulated in MoE Decree No. 48/1996. While the daytime noise was within the IFC's EHS General Guidelines (2007) threshold, the nighttime noise surpassed the guideline of 45 dB(A). The main source of noise at this location was road traffic from the village residents.

Figure 23 Noise Level Measurements



Air quality sampling at Pijoan Village

Air quality sampling at Kuala Dasai Village

Table 42 Noise Level – Jambi to Merlung Toll Road [all units are in dB(A) unless stated otherwise]

Parameters	Pijoan (UKG-1)	Kuala Dasai (UKG-2)	Indonesian MoE No. 48/1996 Standard	IFC EHS General Guidelines (2007)
Day-time noise level	62.0	52.3	-	55
Night-time noise level	48.4	48.7	-	45
Calculated day- and night-time noise level equivalent	60.5	52.8	55 (for residential area) 60 (for public area) 70 (for residential area)	-

Source: Laboratory analytical results (PT RND Teknologi Indonesia, November 2023)

Vibration Level. Ambient vibration levels within the Jambi–Rengat Toll Road project area were recorded at the same five sites used for ambient air quality and noise measurements. The results (see Table 43) indicate vibration levels ranging from less than 0.1 to 0.3 mm/s at all sites. These levels are well below the threshold values of 2 to 10 mm/s, which vary based on building conditions and structural features, as specified by the Indonesian MoE Decree No. 49/1996 on Vibration Level Standards.

Table 43 Vibration Measurement Results

Measurement Site	Results (mm/s)	Threshold Values (mm/s)			
		Category A	Category B	Category C	Category D
UKG-1: Pijoan Village	<0.1	2	5	10	10 - 40
UKG-2: Kuala Dasai Village	<0.1				
UKG-3: Tawang Kempas Village	<0.1				
UKG-4: Sakra Village	0.2				
UKG-5: Sungai Sawu Village	0.3				

Source: Laboratory analytical report of PT RND Teknologi Indonesia (December 2023)

Note: Category A: Heritage buildings of high historical value. Category B: Building with existing damage on its wall.
Category C: Building with reasonably good technical conditions, minor crack on the wall plaster. Category D:
Building with concrete or steel structure

5.1.6 Soil Characteristics

The soil layers within the Jambi – Rengat Toll Road development area is generally dominated by clayed soil with smaller proportions of silt and clay sand. Most sections of the toll road are underlined by tectonic and volcanic sedimentary-typed soils. Alluvium-type soils are primarily encountered in the vicinity of the Batanghari River and Pangabuan River crossings where the bridges will be constructed. The soil types encountered within the Sp. Ness – Merlung Toll Road project area is presented in the following table.

Table 44 Soil Types within Jambi – Merlung Toll Road

Project Area	Soil Types	Depth of Hard Soil Layer (meter below ground surface level)
STA 2+100 – STA 2+500	Sandy clay	24
STA 4+400 – STA 4+800	Stiff clay and Silt	26
STA 6+300 – STA 6+700	Soft clay soil, sandy silt	20
STA 9+000 – STA 9+400	Silty organic clay	22
STA 11+800 – STA 12+200	Organic clay, silt sand	26
STA 14+900 – STA 15+300	Sandy clay	16
STA 15+600 – STA 16+000	Sandy clay	12
STA 17+000 – STA 17+400	Sandy clay	28
STA 17+000 – STA 18+200	Sandy silt loam	28
STA 18+900 – STA 19+300	Pebbly sandy loam	24
STA 26+500 – STA 26+900	Silty clay and rocky sand	18
STA 66+300 – STA 66+700	Rocky silty clay	32

Source: Basic Design Report of Jambi – Rengat Toll Road (PT Yodya Karya, March 2020)

5.1.7 Hydrology and Surface Water Quality

Hydrological Characteristics. Information on the watersheds within the Jambi - Rengat Toll Road area is presented in the Table 45. The project is located within three watersheds: Batanghari, Tungkal, and Mendahara. The Pijoan River and Batanghari River watersheds also partially overlap with the Sp. Ness–Merlung Toll Road segment.

The Batanghari River is the largest river in the project footprint, with an estimated catchment area of 44,154 km², a river length of 1,293 km, and an average flow rate of 1,327 m³/s. A major bridge crossing, with a span of up to 1,221.7 meters, will be constructed across the river.

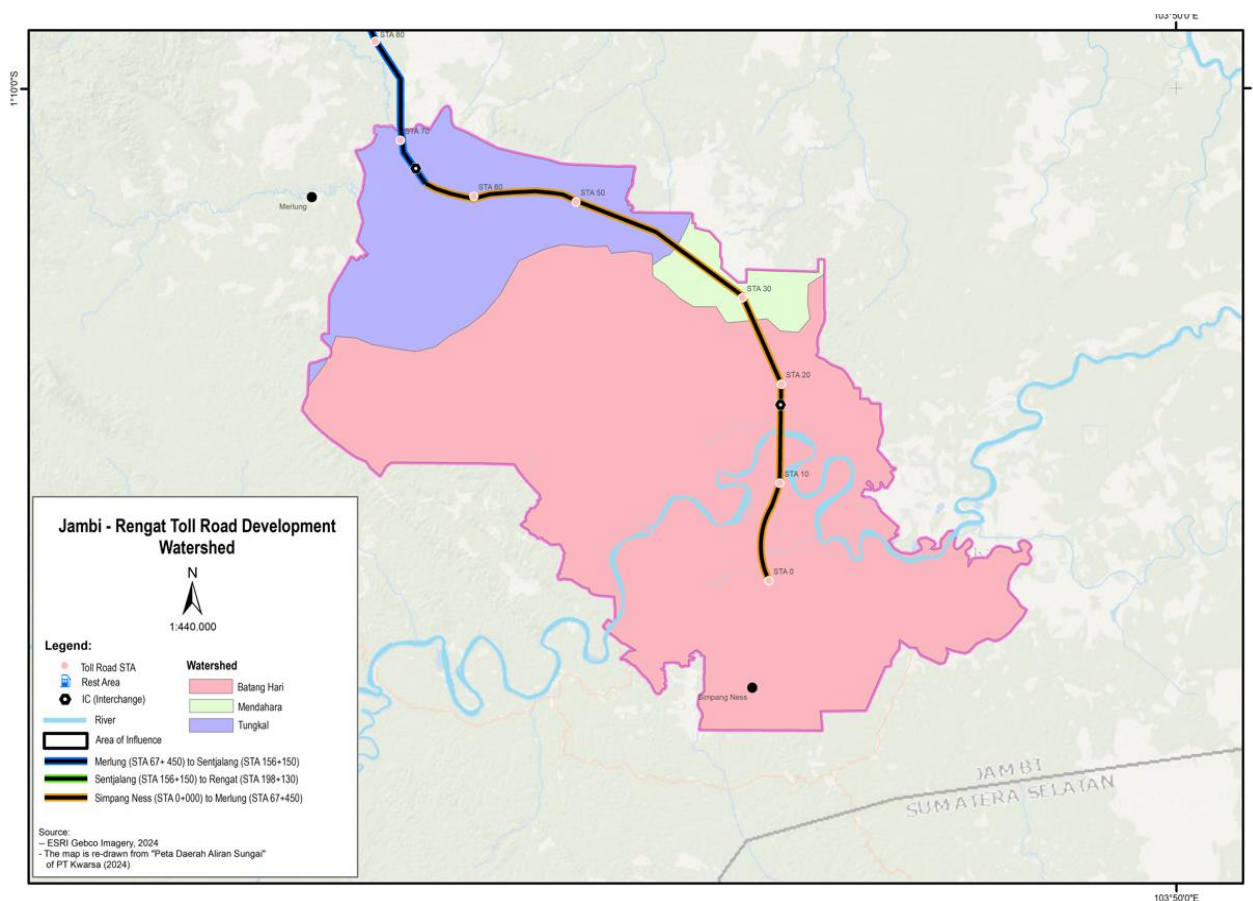
The Batanghari River originates in the middle reaches of Tebo Regency and flows downstream through Jambi City, Muaro Jambi Regency, and Tanjung Jabung Timur Regency, passing through floodplains with numerous meanders. Although it is classified as a perennial river, like the Pijoan River, its discharge declines by 40% during the dry season. The erosion rate can reach 480 tons per hectare per year, with siltation of 50 cm per year.

Table 45 Watershed within Jambi – Rengat Toll Road Project Area

Toll Road/River Crossing STA	River/Watershed	Watershed Area (km ²)	River Length (km)	River Discharge (m ³ /sec)
Phase 1 Development				
1+984	Pijoan River	116.16	21.22	78.77
15+780	Batanghari River	44,154.40	1,293.35	1,327.00

Source: Hydrological Basic Design Report (PT Yodya Karya, 2020) and Identification of Amdal Team (PT Dianzani Utama Konsultan).

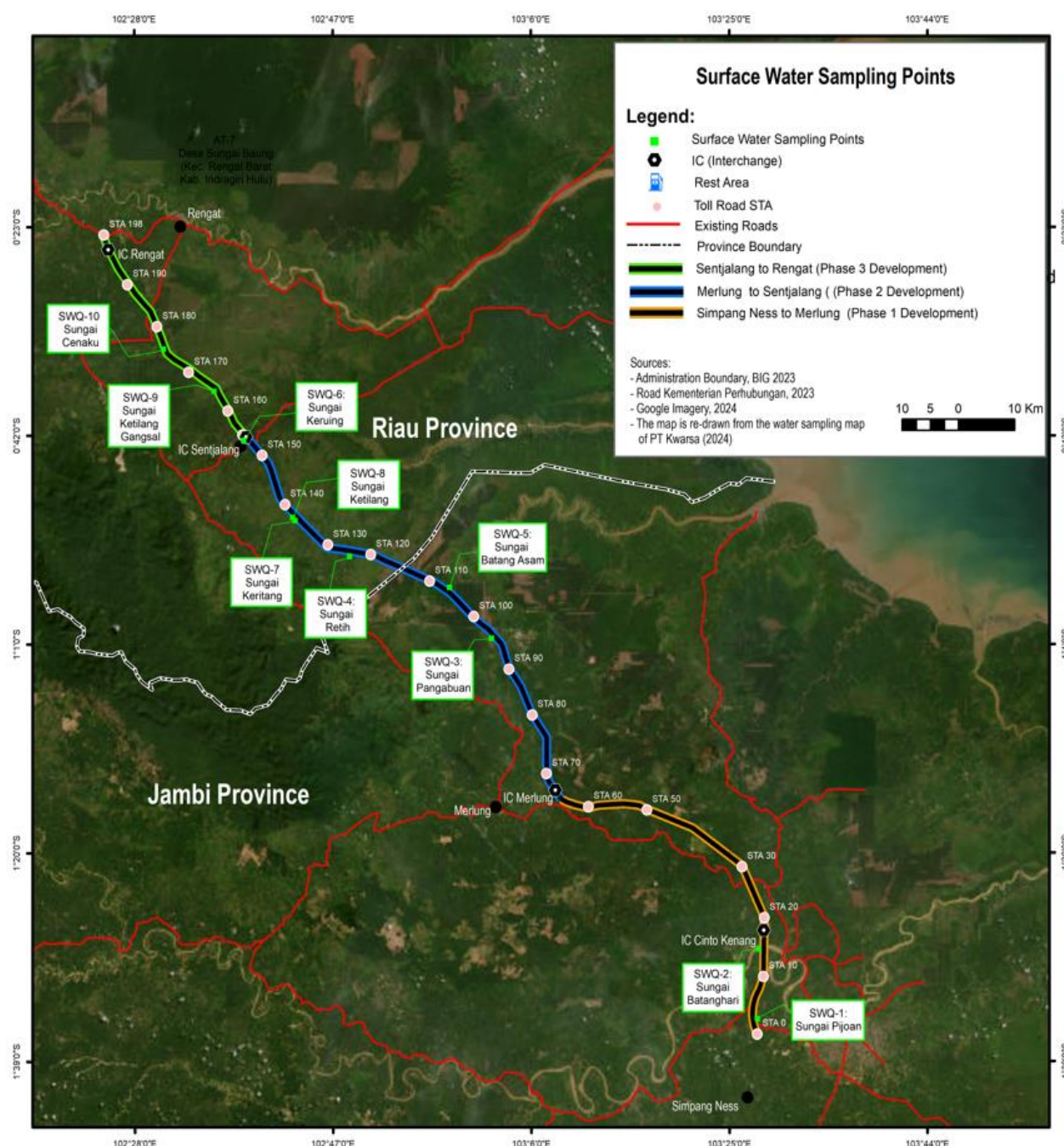
Map 7. Watersheds within the Project's Area



Source: The map is redrawn from the draft Andal of Jambi – Rengat Toll Road (PT Dianzani Utama Konsultan, 2024) and adjusted.

Surface Water Sampling. Surface water samples were collected from ten (10) sampling sites considered representative of the watersheds overlapping with the Jambi – Rengat Toll Road project area, as shown in the Map 8. Water samples were analyzed by an accredited laboratory, and the results were interpreted against Government Regulation No. 22/2021, Attachment VI: National Surface Water Quality Standards – Class 3, which covers water quality intended for aquaculture, farming, irrigation, and similar uses to characterize baseline surface water quality at the sampling points.

Map 8. Surface Water Sampling Points



Source: Redrawn from the sampling map produced by PT Karsa Hexagon (2024)

Surface Water Quality within Sp. Ness - Merlung Toll Road (Phase 1 Development Area). Two grab water samples were collected from Pijoan River (SWQ-1) and Batanghari River (SWQ-2), representing the main watersheds that partially overlap with this toll road segment, as shown in Figure 24.

The analytical result of the water samples collected at Pijoan River (SWQ-1) and Batanghari River (SWQ-2) are presented Table 46. The river water quality at both sampling points was considered to be of relatively good quality despite their turbid appearance. None of the water quality parameters was measured above the threshold values stipulated by the GoI standards surface water quality, described:

- *Physical parameters* – pH was measured between 6.5 and 7.5, classified as neutral. Despite the turbid appearance, concentrations of TDS and TSS were measured below their respective thresholds of 1,000 mg/L and 100 mg/L.
- *Chemical parameters* – The concentrations of BOD and COD were below the threshold values of 6 mg/L and 40 mg/L respectively. DO was above the minimum level of 3 mg/L. None of nutrient-related parameters (nitrogen and phosphorus) exceeded their threshold values. Sulfate and cyanide were below their respective threshold values of 300 mg/L and 0.02 mg/L.
- *Heavy metals* – Eleven parameters were analyzed, including mercury, cadmium, and hexavalent chrome in both samples, measured at 0.0005 mg/L, 0.003 mg/L, and less than 0.003 mg/L respectively, all below their respective threshold values of 0.002 mg/L, 0.01 mg/L, and 0.05 mg/L. All other heavy metal parameters analyzed did not exceed their respective threshold values.
- *Microbiological parameters* – Fecal and total coliforms were well below their respective threshold values of 2,000 most probable number (MPN)/100 ml sample and 10,000 MPN/100 ml.
- *Other anion parameters* – Oil and grease, total detergent, and phenol were all below their respective threshold values.

Figure 24 River Water Sampling



Water Sampling at Pijoan River (SWQ-1)



Water Sampling at Batanghari River (SWQ-2)

Source: information from DGH/PT HK (February 2024)

Table 46 Surface Water Analytical Result – Sp. Ness to Merlung Toll Road

Parameters	Unit	Threshold value	Pijoan River (SWQ-1)	Batanghari River (SWQ-2)
Physical parameters				
Temperature	°C	±3 from air temperature	27	28
pH	-	6 – 9	7.25	6.85
Total dissolved solids (TDS)	mg/L	1,000	263	366
Total suspended solids (TSS)	mg/L	100	20	41
Color	Pt-Co	100	1.89	4.25
Chemical parameters				
Biological oxygen demand (BOD)	mg/L	6	3	4

Parameters	Unit	Threshold value	Pijoan River (SWQ-1)	Batanghari River (SWQ-2)
Chemical oxygen demand (COD)	mg/L	40	20	25
Dissolved oxygen (DO)	mg/L	3	4.3	5.0
Sulfate (SO ₄ ²⁻)	mg/L	300	9.3	35
Chloride (Cl ⁻)	mg/L	300	14.8	21.8
Nitrate (NO ₃ -N)	mg/L	20	1.25	2.50
Nitrite (NO ₂ -N)	mg/L	0.06	0.03	0.04
Ammonia (NH ₃ -N)	mg/L	0.5	0.08	0.28
Total nitrogen	mg/L	25	9.3	15
Total phosphate (as P)	mg/L	1.0	<0.02	0.23
Fluoride (F ⁻)	mg/L	1.5	0.06	0.16
Sulfur (as H ₂ S)	mg/L	0.002	<0.001	<0.001
Cyanide (CN ⁻)	mg/L	0.02	<0.004	<0.004
Free Chlorine (Cl ₂)	mg/L	0.03	<0.02	<0.02
Heavy Metals				
Boron (B)	mg/L	1.0	0.02	0.03
Mercury (Hg)	mg/L	0.002	0.0004	0.0005
Arsenic (As)	mg/L	0.05	0.007	0.008
Selenium (Se)	mg/L	0.05	<0.002	<0.002
Cadmium (Cd)	mg/L	0.01	0.003	0.003
Cobalt (Co)	mg/L	0.2	<0.04	0.05
Nickel (Ni)	mg/L	0.05	<0.01	<0.01
Zinc (Zn)	mg/L	0.05	0.018	0.020
Copper (Cu)	mg/L	0.02	<0.007	0.009
Lead (Pb)	mg/L	0.03	<0.02	<0.02
Chrome hexavalent (Cr-VI)	mg/L	0.05	<0.03	<0.03
Others				
Oils and Grease	mg/L	1	<0.8	<0.8
Total detergent	mg/L	0.2	<0.08	0.13
Phenol	mg/L	0.01	<0.01	0.003
Microbiological Parameters				
Fecal Coliform	MPN/100 mL	2,000	560	872
Total Coliform	MPN/100 mL	10,000	948	1,189

Source: Laboratory report of PT RND Teknologi Indonesia (November 2023)

5.1.8 Hydrogeology and Groundwater Quality

Hydrogeological Characteristics. According to the *Hydrogeological Maps of Jambi (No. 1014) and Muara Bungo (No. 0914) issued by the Indonesian Geological Agency (2013)*, The Sp.Ness – Merlung Toll Road segment is underlain by several hydrogeological units as described in the following table. Aquifers are generally rare and localized, with some moderately productive aquifers of wide

distribution encountered within the Project area. Groundwater levels range from 1 to 8 meters below the ground surface, with a discharge rate is less than 5 liters/second.

Table 47 Hydrogeological Characteristics - Phase 1 Development Area

Toll Road STA	Hydrogeological Characteristics	Description
STA 0 - 4 STA 18 - 20 STA 29 - 42 STA 56 - 74	Low productivity and localized aquifer	Aquifers with low to very low continuity. Groundwater is found to be limited, especially in valley areas or in rock weathering zones.
STA 4 - 16	Moderately productive aquifer with wide distribution	Aquifer with low to medium continuity. Groundwater level varies and is generally less than 15 meters below the ground surface. The groundwater discharge is less than 5 liters/second.
STA 16 - 18	Medium productive aquifer	Aquifers with varying translucency. The groundwater discharge is less than 5 liters/second.
STA 20 - 29	Rare aquifers	Groundwater regional aquifers are scarce.

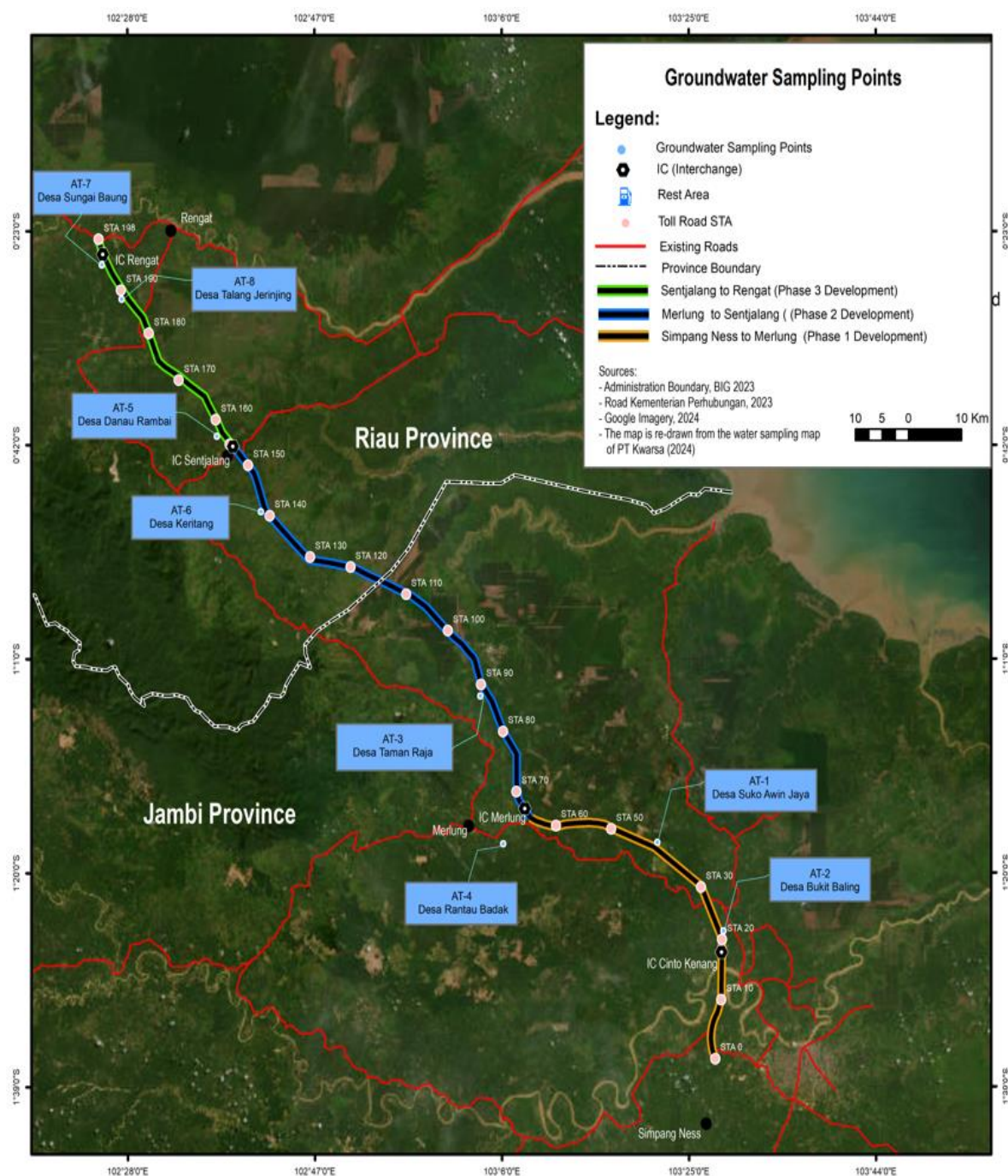
Source: Basic Design Report of Jambi – Rengat Toll Road (PT Yodya Karya, 2020)

Groundwater Quality within Jambi – Merlung Toll Road (Phase 1 Development Area). Two grab samples of groundwater were collected at two sites representing Suko Awin Jaya Village (AT-1) and Bukit Baling Villages (AT-2), representing the Phase 1 development area, as shown in the following map.

The analytical results are presented in Table 48 and interpreted against the threshold values stipulated in the regulation of the *Minister of Health (MoH) Regulation No. 2/2023 on the Implementation of Government Regulation No. 66/2014 on Environmental Hygiene, particularly on Water Quality Standards for Hygiene and Sanitation Purposes*. All groundwater parameters at both sampling points were measured below the applicable threshold values, as follow:

- All physical parameters were within their respective thresholds; turbidity and color level were below the thresholds of 3 NTU (Nephelometric turbidity unit) and 10 TCU (true color unit).
- pH values were approximately neutral at 7.2, with all other chemical parameters well below their respective threshold values of 0.01 mg/L and 3 mg/L.
- Fecal and total coliforms were zero at both sampling point.

Map 9. Groundwater Sampling Sites



Source: Redrawn from the sampling map produced by PT Kwarsa Hexagon (2024)

Table 48. Groundwater Analytical Results – Jambi to Rengat Toll Road

Parameters	Unit	Threshold Value	Suko Awin Jaya Village (AT-1)	Bukit Baling Village (AT- 2)
Physical parameter				
Odor	-	No odor	No odor	No odor
Total dissolved solid (TDS)	mg/L	<300	198	185
Turbidity	NTU	<3	2.4	1.9
Color	TCU	10	4.9	3.6

Parameters	Unit	Threshold Value	Suko Awin Jaya Village (AT-1)	Bukit Baling Village (AT- 2)
Chemical parameter				
pH	-	6.5 – 8.5	7.2	7.2
Iron (Fe)	mg/L	0.2	0.09	0.05
Chrome hexavalent (Cr ⁶⁺)	mg/L	0.01	<0.03	<0.03
Manganese (Mn)	mg/L	0.1	0.03	<0.01
Nitrate (NO ₃ -N)	mg/L	20	<0.08	<0.08
Nitrite (NO ₂ -N)	mg/L	3	<0.02	<0.02
Microbiological parameter				
Total coliform	MPN/100 mL	0	0	0
Fecal coliform	MPN/100 mL	0	0	0

Source: Laboratory Report of PT RND Teknologi Indonesia (November 2023)

5.1.9 Natural Disaster Events

In 2019, forest and peatland fires occurred primarily on company-owned oil palm plantations, affecting approximately 500 hectares in Muaro Jambi; 5 hectares of peatlands and 565 hectares of non-forest areas in Tanjung Jabung Regency. The types and numbers of natural disaster events recorded in both regencies are included in the 2020 - 2024 Natural Disaster Management Plan of the Indonesian Disaster Management Agency of the Central Government (BNPB, February 2021) and presented in Table 49.

Table 49 Natural Disaster Events

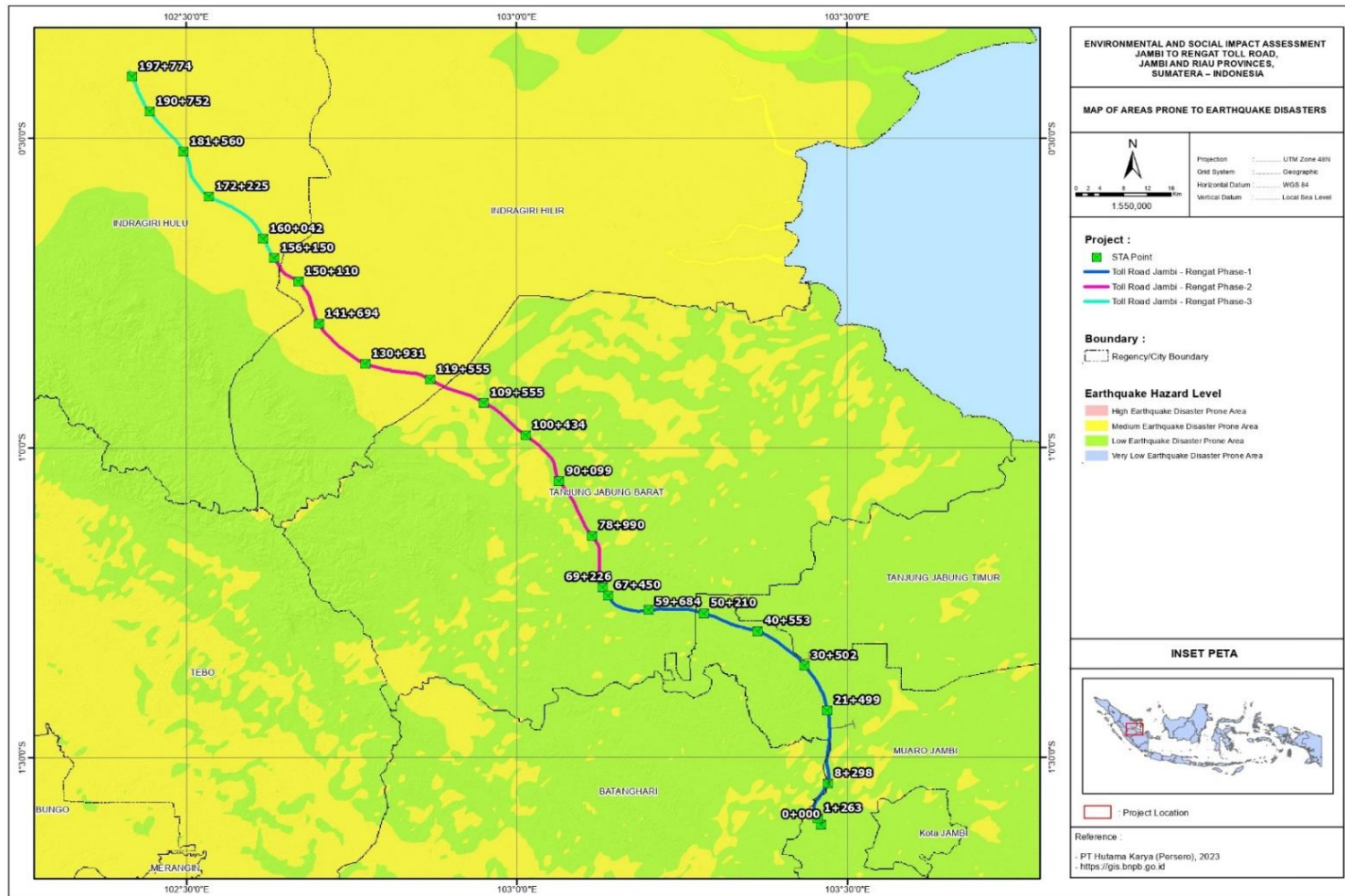
Area	Number of Events			
	Landslide	Flood	Land and Forest Fires	Whirling Wind
Muaro Jambi Regency	3	12	8	4
West Tanjung Jabung Regency	-	1	88	-

Source: 2020 - 2024 Natural Disaster Management Plan (the National Disaster Management Agency, February 2021)

An overlay of the Jambi – Rengat Toll Road alignment with the natural disaster risk maps published in the above- mentioned Natural Disaster Management Plan was undertaken to characterize the natural disaster risks to which the toll road may be exposed. The overlaid maps represent natural disaster risk across the wider landscape beyond the Project’s immediate footprints, as described below:

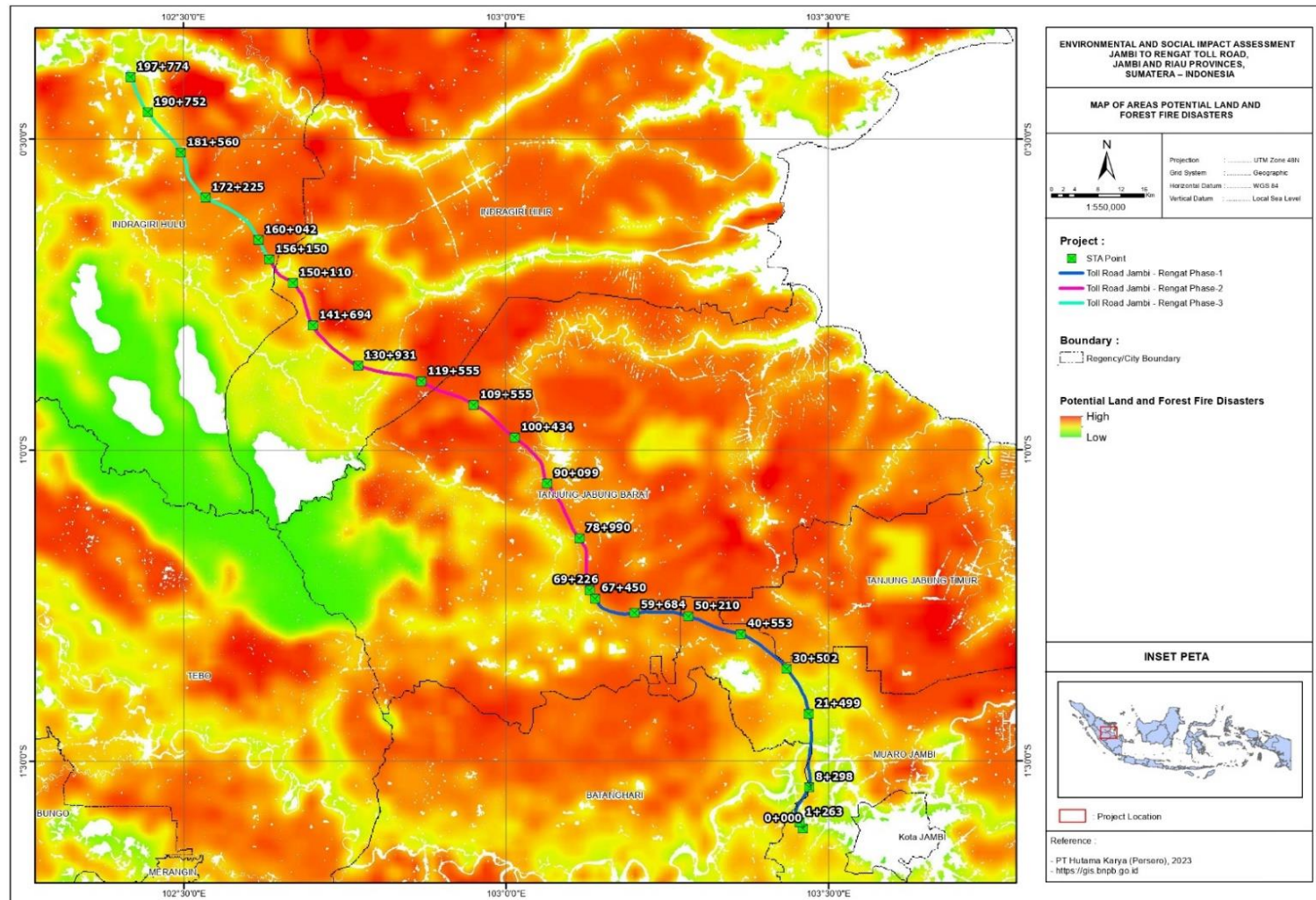
- **Earthquake Risk.** Map 10 indicates that the Jambi – Rengat Toll Road is situated within areas of low to moderate earthquake risk. The earthquake risk is classified as low from STA 0 to STA 109 and as moderate risk from STA 109 to STA 198.
- **Forest and Land Fire Risk.** Map 11 indicates that the Jambi – Rengat Toll Road is situated within areas of moderate to high risk of forest- and land-fires, with the exception of the segment from STA 0 to STA 30, which is classified as an area of low to moderate risk to fires.
- **Flood Risk.** Map 12 indicates that the Jambi – Rengat Toll Road is exposed to varying degrees of flooding risk, ranging from relatively low to high. The segment from STA 21 to STA 67 and the segment from STA 181 to 197 appear to face low flood risk, while certain sections of alignment are exposed to high flood risk.

Map 10. Areas Prone to Earthquake within Jambi - Rengat Toll Road



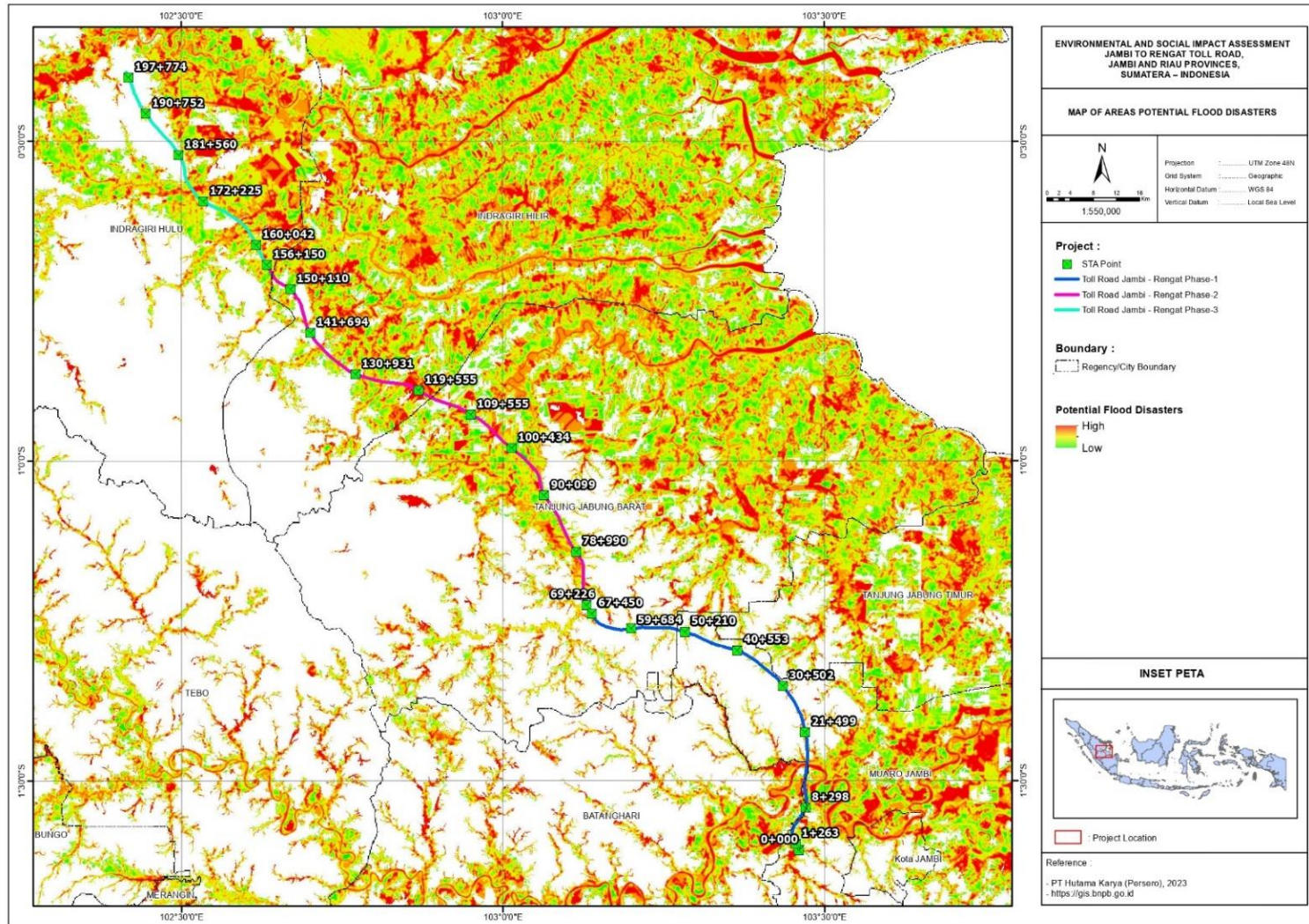
Source: Natural Disaster Management Plan 2020 - 2024 (National Disaster Management Agency, February 2021)

Map 11. Areas Prone to Forest/Land Fires within Jambi - Rengat Toll Road



Source: Natural Disaster Management Plan 2020 - 2024 (National Disaster Management Agency, February 2021)

Map 12. Areas Prone to Flooding within Jambi – Rengat Toll Road



Source: Natural Disaster Management Plan 2020 - 2024 (National Disaster Management Agency, February 2021)

5.2 Climate Risk Screening

A climate and geological risk screening of the toll road from Cinto Kenang to Sentjatang, covering the entire Jambi-Rengat Toll Road development corridor, was undertaken using Aware™ software in September 2021 to provide an indication of the climate-induced risk to the project. The screening results indicated that the overall project climate risk is high, based on the high-risk rating assigned by this software for wildfire, precipitation increase, flood, landslide, and sea level rise.

The Aware™ result indicated that there have been on average more than 20 fires per year observed in the Sumatera region between 1997 and 2010. This is based on post-processed data from UNEP/GRID-Europe. On the local scale, the wildfire risk is influenced by vegetation type, weather related impacts, and open burning commonly practiced for land-clearing for small-holder and large-scale plantation. Further, the frequency and intensity of wildfires is influenced by climate change.

The project is located, at least partly, in a region which has experienced recurring major flood events in the recent past years. The Aware™ indicated that at least one significant, large-scale flood event occurred between 1985 and 2016 based on post-processed data from the Dartmouth Flood Observatory of the University of Colorado. If floods are identified as a potential problem for the project, a site-specific flood risk assessment is required to provide a good understanding of the current and future flood risk level and define appropriate risk mitigation measures. Climate change is likely to influence the frequency and intensity of flood events.

The project area is in a region considered at risk from precipitation induced landslide events. It is classed as medium- to very high-risk from landslides, lithology, geology, soil moisture, vegetation cover, precipitation and seismic conditions. This is based on post-processed data from UNEP/ GRID-Europe. Further, site-specific factors such as local slope, vegetation, long- term precipitation, and human activities, such as excavation, deforestation, land-use conversion. If landslides are identified as a potential problem for the project, a site-specific, in-depth assessment of the landslide risk is carried out.

5.3 Biodiversity

This section summarizes the key findings and provides an overview of the biodiversity baseline survey and critical habitat assessment (CHA) carried out along the entire Jambi – Rengat Toll Road corridor throughout all three development phases. For a comprehensive understanding, the full Biodiversity Baseline Survey Report and CHA Report should be reviewed alongside this ESIA. Yapeka, serving as the biodiversity consultant, conducted the biodiversity surveys (between August - September 2023, and 2026), utilizing fieldwork, literature reviews, and consultations with stakeholders such as the Bukit Tigapuluh National Park Authority and the Natural Resource Conservation Agency (BBKSDA) of Jambi and Riau Provinces. Additional consultations took place in November 2023 with representatives of wildlife NGOs, including Our Tiger Forum (Forum Harimau Kita), the World Wide Fund for Nature (WWF), and Fauna & Flora (formerly FFI).

5.3.1 Baseline Survey

The biodiversity baseline survey carried out in November 2023 and 2026 pursued two main objectives: (i) to update the flora and fauna baseline data and information initially collected for the 2020 ANDAL (Indonesian environmental impact statement); and (ii) to generate sufficient, project-specific baseline data and information to inform the Critical Habitat Assessment (CHA) in line with IFC Performance Standard 6 (PS6) on Biodiversity Conservation and Sustainable Management of Living Natural

Resources (2012) and its associated guidance note (2019). The survey scope covered vegetation, herpetofauna, avifauna (birds), primates and large mammals, small mammals, and aquatic biota (fish), as summarized below.

Flora. Vegetation types along the Jambi – Rengat Toll Road alignment can be categorized into eight (8) types, including secondary forests, shrublands, agroforests, peatlands, plantations comprising oil palm, rubber, acacia and eucalyptus. The 2023 baseline survey identified 71 tree species, 3 liana species, 17 shrub species, and 9 grass species. According to the IUCN Red List of Threatened Species, the survey identified the followings threatened plant species:

- Two species categorized as Critically Endangered (CR) such as Agarwood (*Aquilaria malaccensis*) and Balam (*Palaquium burckii*).
- Two species listed as Vulnerable (VU), including Medang (*Litsea aban-gibotii*) and Punak (*Tetramerista glabra*) according to the IUCN Red List.
- One species categorized as Data Deficient, comprising Aru (*Ficus refusa*), which is traditionally protected by the local communities.

Herpetofauna. The survey identified 466 individuals comprising 20 amphibian species from 5 families and 22 reptile species from 13 families. The greatest number of individuals was observed at STA 15, located along the Batanghari River, with 100 individuals, followed by 66 individuals at STA 198. Two herpetofauna species—the Saltwater crocodile (*Crocodylus porosus*) and the False gharial (*Tomistoma schlegelii*)—are nationally protected under the Regulation of the Minister of Environment and Forestry No. 106/2018 on Protected Flora and Fauna Species. Among those recorded, the Black Marsh Turtle (*Siebenrockiella crassicolli*) and the Southern Asian Box Turtle (*Cuora amboinensis*) are classified as Endangered (EN) by the IUCN Red List of Threatened Species. Additionally, the survey noted the presence of the Black-spotted sticky frog (*Kalophrynus pleurostigma*), an amphibian endemic to Sumatra and listed on the IUCN Red List.

Avifauna (bird). A total of 91 bird species representing 1,242 individuals were identified during the survey. All recorded species are relatively common in the lowlands of Sumatera and were frequently found in plantation areas with shrublands or areas bordering oil palm pantation. None of the bird species identified in the surveyed area fall into the ‘Endangered’ category, instead the are categorized as ‘Least Concern (LC), Near Threatened (NT), and Vulnerable (VU)’ according to the IUCN Red List. Two bird species are listed as VU, i.e., the Lesser Adjutant (*Leptoptilos javanicus*) and Long-tiled Parakeet (*Belocercus longicaudus*) and one species listed as NT, such as Malay Brown Barbet (*Caloramphus hayii*). Eight bird species identified in the survey are included in the nationally protected species list under *regulation No. 106/2018*.

Primates. The survey team encountered six (6) primate species. Five of these species, include the Agile gibbon (*Hylobates agilis*), Slow loris (*Nycticebus coucang*), Black-crested Sumatran langur (*Presbytis melalophos*), Southern pig-tailed macaque (*Macaca nemestrina*), and Silvery langur (*Trachypithecus cristatus*), have their native habitats in Indonesia and are listed as nationally protected species under *regulation No. 106/2018*. Five of these primate species are categorized as EN and one species as VU under the IUCN Red List.

Sumatran Elephant. Signs of elephant presence were observed in Lubuk Kambing and Muara Danau Villages. Historically, there haven’t been records of elephant groups crossing the national road to the south of the Jambi – Rengat Toll Road. Therefore, it’s unlikely elephants cross the toll road directly, as they would need to cross the national road first. The Sumatran elephant (*Elephas maximus*

sumatranus) is listed as protected under MoEF regulation No. 1060/2018 and is classified as EN on the IUCN Red List.

Sumatran Tiger and Other Large Mammals. During the survey, camera traps recorded Sumatran tiger (*Panthera tigris sumatrae*) pugmarks about 14 km from the proposed alignment at STA 30 – STA 40 of the Jambi-Merlung Toll Road. Footprints of other large mammals, such as Sambar deer, Sun bear, Wild boar, and Malay tapir, were also discovered within the survey areas. Both the Sumatran tiger (*Panthera tigris sumatrae*) and Malay tapir (*Tapirus indicus*) are listed as EN on the IUCN Red List, and both are protected under the MoEF regulation No. 106/2018.

Small Mammals. During the survey, seven small mammal species were observed. Among them, the Flat-headed cat (*Prionailurus planiceps*) and Leopard cat (*Prionailurus bengalensis*) are protected nationally under MoEF regulation No. 106/2018. The Flat-headed cat is classified as Endangered (EN) on the IUCN Red List..

Aquatic biota. The survey identified a total of 11 fish species in Cenaku River, 15 in Pangabuan River, and 18 in Batanghari River. None of the species identified are listed as EN or protected. However, according to IUCN, Batanghari and Pijoan Rivers are habitat for *C. lopis* that are declared

5.3.2 Critical Habitat Assessment

The detailed CHA of the entire Jambi – Rengat Toll Road was conducted by Yapeka to confirm the presence of Critical Habitat-qualifying biodiversity values and to confirm the extent of modified and/or natural habitats that may be impacted by the Project. The CHA report and should be read in conjunction with the Biodiversity Baseline Survey report and this ESIA. This subsection provides only an **overview and highlights potential key findings of the CHA** as follows.

Critical Habitat based on Criterion 1 to 3. Twelve species of mammals, including five (5) species of primates, two (2) species of reptiles, and two (2) species of flora qualified CH designations under Criterion 1: Critically Endangered (CR) and Endangered (EN) Species and Criterion 2: Restricted-Range/Endemic Species, but none under **Criterion 3: Migratory/ Congregatory Species**. These species were recorded based on direct observation, use of camera traps, identification of animal tracks and dung, and secondary information from local community during the survey as well as secondary information from the literature.

Critical Habitat Based on Criterion 4: Highly Threatened and/or Unique Ecosystems. This habitat includes peatlands especially in the North-Eastern part of the Jambi – Rengat Toll Road. These peatlands consisted of the remaining peat swamps in the eastern coast of Sumatra that were considered as a threatened ecosystem. Some peat swamps have also been converted to oil palm plantations.

Critical Habitat Based on Criterion 6: Legally Protected Areas and Internationally Recognized Areas. These areas are identified within the Jambi – Rengat Toll Road and considered as critical habitats based on Criterion 6, including:

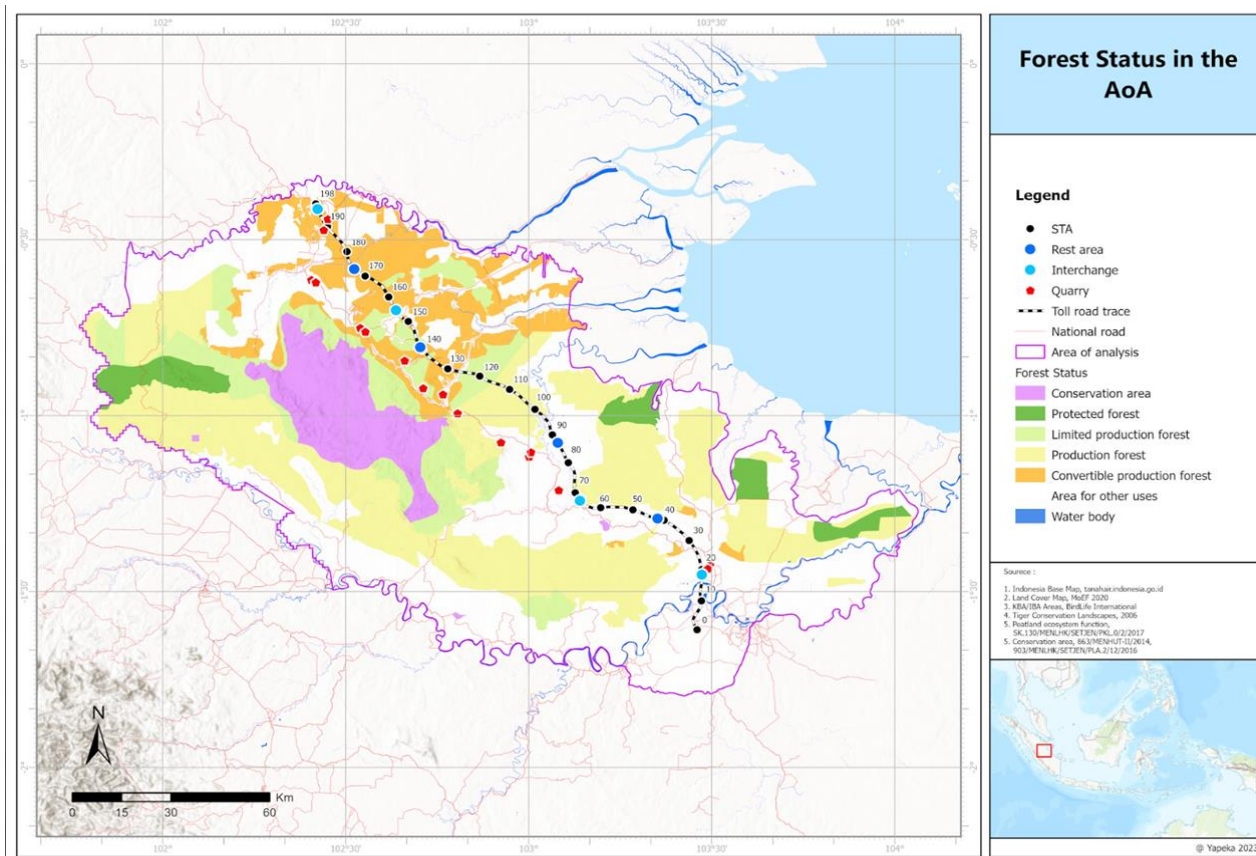
- **Tiger Conservation Landscape (TCL).** A TCL is a block or cluster of blocks of habitat meeting a minimum size threshold specific to habitat type, where tigers have been confirmed to occur in the last 10 years and are not known to have been extirpated. A TCL has specific attributes (see details in the Appendix). The TCL qualified as CH as it contained biodiversity features under CH Criterion 6. The current condition of the TCL has been converted to mostly oil palm

plantation and other land uses, while the remaining natural critical habitat is mostly within the Bukit Tigapuluh National Park.

- **Bukit Tigapuluh National Park.** Designated as IUCN Management Category II (National Park) and has an area of approximately 143,223 hectares, consisting primarily of tropical lowland forests in Riau Province and to a lesser extent in Jambi Province. The park is well known as one of the last refuges of Sumatran orangutan, Sumatran tiger, Sumatran elephant, and Asian tapir, which are all EN as well as protected species. Approximately, two-thirds of the park area have been logged, encroached and subject to land use conversion to oil palm plantations. The park is located about 20 km from STA 130 to STA 160 of the Jambi – Rengat Toll Road.
- **Sungai Betara Bukit Tambi Wildlife Reserve.** Designated as IUCN Management Category IV (Habitat or Species Management Area), it has an area of approximately 13,712 hectares. This area is the habitat and migration route for the Sumatran elephant within the Bukit Tigapuluh National Park landscape. The wildlife reserve is located about 5 km south of STA 60 of the Jambi – Rengat Toll Road.
- **Bukit Bakar - Bukit Gajah.** This area is identified as important bird area (IBA) by Birdlife in 2004 and categorized as A3 Biome-restricted species i.e., the site was known or thought to hold a significant component of the group of species whose distributions were largely or wholly confined to one biome-realm. The statue of Bukit Bakar - Bukit Gajah is a production forest that has been modified, primarily comprising oil palm plantation.

The above descriptions indicated that in general, the Jambi-Rengat Toll Road was situated in Modified Habitat. However, some sections of this Toll Road were in Critical Habitat of the Tiger Conservation Landscape (within STA 130-140 of Jambi – Rengat Toll Road). The project footprint was also crossing some rivers with the critical habitat of riparian vegetation. The forest area that overlaps with the Jambi – Rengat Toll Road alignment and the presence of nature conservation area within the toll road alignment is presented in the following map.

Map 13. Forest and Nature Conservation Areas within the Project



Source: Critical Habitat Assessment Report of Jambi – Rengat Toll Road (YAPEKA, 2023)

6.0 SOCIO-ECONOMIC BASELINE

6.1 Socio-Economic Baseline of Jambi Province

This sub-section describes the key socio-economic including cultural and public health data of the administrative areas of Muaro Jambi, Batanghari, and Tanjung Jabung Barat Regencies (in Jambi Province) to provide an overview of the baseline conditions of these regencies that overlap with the Project area. The baseline data are presented in terms of demographic, socio-economic, cultural, and public health profiles of the regencies and sourced primarily from: *the draft Andal (Indonesian EIA) document of Jambi – Rengat Toll Road (2024)*; and *the draft Socio-economic Baseline Report of Jambi – Merlung Toll Road (March 2024)*. The socio-economic baseline data in the following sections is presented based on the hierarchy of the Indonesian government system as shown in the following table.

Table 50 Government Administrative Areas within the Project Area

Government Administration Level	Administrative Areas			
Regency (Kabupaten)	Muaro Jambi	Batanghari	Tanjung Jabung Barat	
District (Kecamatan)	Jambi Luar Kota	Sekernan	Pemayung	Muara Papalik
Village (<i>Desa</i>)	Pijoan	Tantan	Selat	Dusun Mudo
		Rantau Majo	Teluk	
		Gerunggung		
		Bukit Baling		
		Suko Awin Jaya		
		Tantan		

Source: Draft Andal of Jambi – Rengat Toll Road (PT Dianzani Utama Konsultan, June 2024)

6.1.1 Demographic Profiles

Population Number and Density. Some areas of nine (9) villages within four (4) districts that are under three (3) regencies in Jambi Province are likely to be traversed by the Project. The total number of population and population density of these nine (9) villages are presented in the following table. Bukit Baling and Suko Awin Jaya Villages in Sekernan District have the highest population number of above 8,500 persons compared to the other villages. Gerunggung Village in the same Regency has the lowest population of 744 persons.

The highest population density of 490 person/km² and 411 person/km² was recorded at Selat and Teluk Villages respectively in Pemayung District, whereas the lowest population density of 13 person/km² was recorded at Dusun Mundo Village in Muara Papalik District. *The 2023 statistics of Muaro Jambi, Batanghari Regency, and Tanjung Jabung Barat Regencies* indicated that the population growth in these regencies was approximately 1.64%, 1.22%, and 0.65% respectively.

Table 51 Population Number and Density

Village/ Regency/ Regency	Population (person)			Number of Household	Total Area (km ²)	Population Density (Person /km ²)
	Male	Female	Total			

Jambi Luar Kota District (in Muaro Jambi Regency)

Village/ Regency/ Regency	Population (person)			Number of Household	Total Area (km ²)	Population Density (Person /km ²)
	Male	Female	Total			
Pijoan	3,062	2,923	5,985	1,936	92.44	65
Sekernan District (in Muaro Jambi Regency)						
Tantan	1,354	1,226	2,580	768	26.87	96
Rantau Majo	608	553	1,161	396	39.28	30
Gerunggung	388	356	744	251	22.74	33
Bukit Baling	4,595	4,265	8,860	2,789	69.09	128
Suko Awın Jaya	4,419	4,119	8,538	2,545	27.99	305
Pemayung District (Batanghari Regency)						
Selat	1,877	1,796	3,673	1,137	7.50	490
Teluk	1,774	1,716	3,490	1,124	8.50	411
Muara Papalik District (Tanjung Jabung Barat Regency)						
Dusun Mudo	1,289	1,217	2,506	805	197.31	13
Total	19,366	18,171	37,537	11,751	492.00	-

Source: The 2023 Civil Registry Office (Ministry of Home Affairs, 2023)

The following table presents the population numbers of the regencies traversed by the Jambi – Rengat Toll Road Project based on their productive-age category (as of 2023). The number of populations aged 15 to 64-years old, classified as those of productive-age according to the *Indonesian Statistics Agency*, outnumbered those of non-productive-age. The productive-age population of Jambi Luar Kota District accounted for 69.2%, Sekernan District accounted for 68.2%, Pemayung District accounted for 69.4%, and Muaro Papalik District accounted for 70.3% of total population of their respective Regencies. Therefore, the dependency ratio of these Regencies was relatively similar, ranging from 42% to 47% of the productive-age populations.

Table 52 District Population Based on Productive Age Category

Age Category	Jambi District	Luar Kota	Sekernan District		Pemayung District		Muara District	Papalik
	Population (person)	% of Total Population	Population (person)	% of Total Population	Population (person)	% of Total Population	Population (person)	% of Total Population
0 – 14*	19,586	26.4	14,056	28.0	9,611	25.1	2,735	25.9
15 - 64	51,345	69.2	34,195	68.2	26,528	69.4	7,413	70.3
65+*	3,247	4.4	1,891	3.8	2,100	5.5	401	3.8
Total	74,178	-	50,142	-	38,239		10,549	
Dependen cy Ratio	0.44		0.47		0.44		0.42	

Source: Analysis conducted based on the Civil Registry Office Data (Ministry of Home Affairs, 2023)

Note: *Considered as population without income generation capacity according to the Indonesian Statistical Agency.

6.1.2 Community Health

The project area encompasses the Sumatran regencies of Muaro Jambi (specifically the Jambi Luar Kota and Sekernan districts), Batanghari (Pemayung district), and Tanjung Jabung Barat (Muara Papalik district).

Between 2016 and 2025, the epidemiological profile of these lowland regions has been heavily shaped by their location at the boundaries of expanding agricultural and peri-urban settlements. This transitional environment creates systemic public health challenges driven by inadequate water, sanitation, and hygiene (WASH) infrastructure, residual vector habitats in disturbed forest-agriculture margins, and limited access to secondary healthcare in rural areas.

Consequently, the region is predominantly burdened by a complex mix of waterborne illnesses (such as diarrhea), vector-borne diseases, airborne infections, and other public health threats like HIV/AIDS. Within this environment, three disease categories demand particular attention:

Airborne Diseases (Pneumonia and Tuberculosis)

Airborne infections represent a critical threat to public health in the region, particularly for vulnerable populations such as young children.

- **Pediatric Pneumonia:** As highlighted in the Jambi Province Health Profile 2024, the region's ability to detect and treat pediatric pneumonia has been significantly hindered by sharp declines in healthcare utilization. Data indicates a concerning downward trend in clinic visits for toddlers experiencing a cough or difficulty breathing. In 2019, such visits stood at 157,708. In 2020, this figure plummeted by nearly 40% to 95,707 visits. The decline continued into 2021 (88,882 visits) and plateaued in 2022 (88,838 visits). Although visits briefly rebounded to 91,123 in 2023, they fell sharply once again to just 80,013 visits in 2024. This persistent drop in clinical visits directly hampers the early detection and effective treatment of pneumonia in toddlers across the province.
- **Tuberculosis (TBC):** Alongside pneumonia, Tuberculosis detection rates are rising across all three project regencies. However, the effectiveness of medical intervention remains uneven;

Batanghari, for instance, experienced a significant drop in its TBC Treatment Success Rate, which fell to 73.2% in 2022.

Vector-Borne Diseases (Dengue and Malaria)

Vector-borne threats show high volatility due to environmental factors. Dengue hemorrhagic fever (DHF) shows significant year-to-year fluctuations and has recently increased across all three regencies, especially in Batanghari, which reported 93 cases per 100,000 people in 2024. In contrast, although malaria is now nearly eradicated across the region, there remains a documented risk of resurgence linked to environmental disruption. For instance, land-use changes and agricultural expansion in Muaro Jambi have led to a rise in malaria cases from 129 in 2016 to 3,058 in 2019..

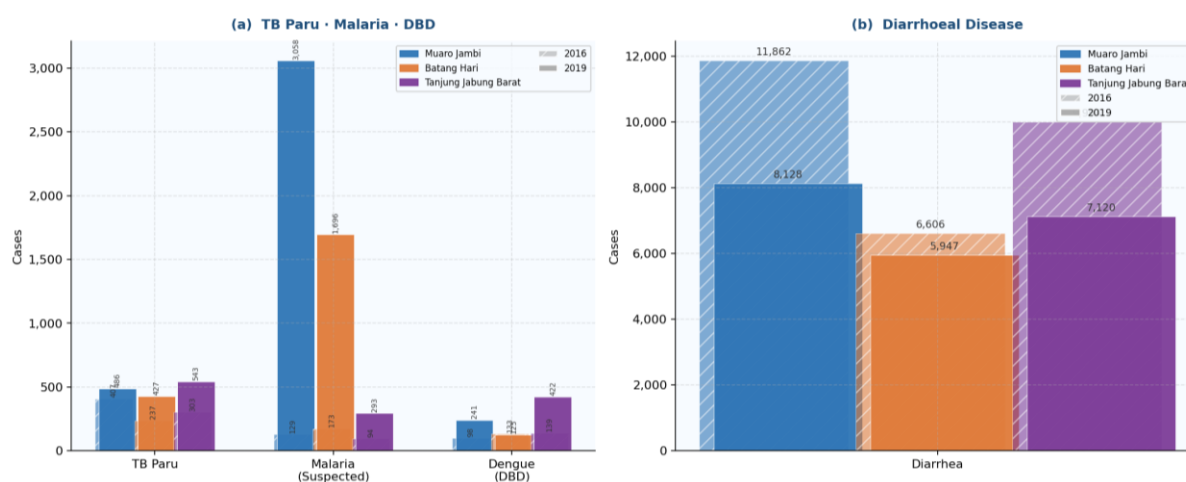
Endemic Bacterial Infections (Leprosy)

Leprosy (kusta) continues to be a localized threat, especially in Tanjung Jabung Barat. Between 2024 and 2025, its incidence remains between 3.24 and 3.88 per 100,000 people, consistently exceeding both national and provincial averages.

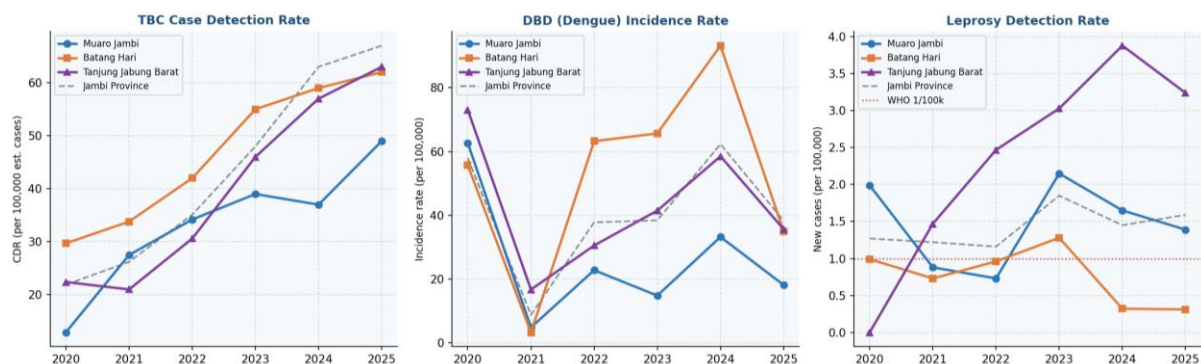
Water-Borne Diseases (Diarrheal)

Between 2016 and 2019, the three project regencies recorded some of the highest cases of diarrheal disease in Jambi Province, totaling 28,462 cases in 2016 and decreasing to 21,195 in 2019—about a 25.5% reduction. These cases are primarily caused by limited WASH infrastructure. Furthermore, riparian farming communities along the Batanghari River depend heavily on surface water from the river and its tributaries for domestic use (Pramudita et al., 2020)²¹. During the wet season (October–February), seasonal flooding of the Batanghari floodplain provides pathways for fecal contamination from farming and domestic activities into household water sources, especially on low-lying riverbanks.

Figure 25 Reported Diseases in Project Regencies (Muaro Jambi, Batanghari, and Tanjung Jabung Barat)



²¹ Paramudita, B. Paramudita, B. J., Hertati, R., & Syafrialdi. (2020). Fish Biodiversity Study in the Batanghari River of Bedaro Rampak Village, Tebo Tengah District, Tebo Regency, Jambi Province. SEMAH: Journal of Aquatic Resource Management, 4(2). <https://ojs.umb-bungo.ac.id/index.php/SEMAHJPSP>



Source: BPS - Regencies in Figures (2016 – 2025)

6.1.3 Education Participation Rate

The data in the table below indicates that the village population who had engaged in primary and secondary education levels accounted for approximately 37% and 34% respectively, and those who had engaged in tertiary education level only accounted for 4% of the total population. Approximately 25% of the total village population had not participated in the formal education system.

Table 53 Education Participation Rate at Village Level

Education Participation Level	Jambi Luar Kota Regency	Sekernan Regency					Pemayang Regency		Muara Papalik Regency	Sum per Education Level
	Pijoan	Tantan	Rantau Majo	Gerunggun g	Bukit Baling	Suko Awin Jaya	Selat	Teluk	Dusun Mudo	
Not yet in school	1,222	700	230	185	2,079	2,364	804	1,222	727	9,533
Primary education level										
Elementary school (engaged)	587	285	125	69	916	931	493	519	236	4,161
Elementary school (graduated)	1,352	1,009	464	221	2,329	2,198	806	751	636	9,766
Secondary education level										
Junior High School	1,024	290	143	124	1,343	1,338	577	404	366	5,609
Senior High school	1,436	248	176	116	1,872	1,521	757	477	448	7,051
Tertiary education level										
1-year diploma/ 2-years diploma	22	1	0	3	13	18	41	21	7	126
3-years Diploma	54	9	5	5	54	51	33	18	20	249
Bachelor's degree	271	38	18	21	236	117	158	73	64	996
Master's degree	15	0	0	0	17	0	4	5	2	43
Doctor's	2	0	0	0	1	0	0	0	0	3
Total										37,537

Source: The statistics of Muaro Jambi, Batanghari, and Tanjung Jabung Barat Regencies (The Statistics Office of the Respective Regencies, 2023)

6.1.4 Employment and Trade

The general landscape of the administrative areas of Muaro Jambi, Batang Hari, and Tanjung Jabung Barat Regency is primarily rural, dominated by oil palm plantations, forest concessions, and coal mining, as described in the following paragraphs based on data published by the statistics offices of the respective regencies. (Note that the published statistical data among these regencies is in different formats.)

Muaro Jambi Regency. As shown in the following table, a total of 193,672 workers in Muaro Jambi Regency were employed across numerous industry and trade sectors (as of 2023). Approximately 47% of the total workers were employed in the agriculture, forestry, and fishery sectors, which were the dominant livelihoods in this regency. The other industry and trade types that employed a significant number of workers included wholesale and retail sales, processing, and construction, which together accounted for approximately 31% of the total workers. The remaining industry and trade sectors contributed less than 5% of the total workers.

Table 54 Employment Types in Muaro Jambi Regency (2023)

Industry and Trade Sectors	Male Worker	Female Worker	Total Worker	Percentage of Total Workers (%)
Agriculture, forestry, and fisheries	67,058	24,031	91,089	47.03
Mining	1,720	532	2,252	1.16
Processing industry	13,926	5,380	19,306	9.97
Electricity and gas	429	0	429	0.22
Construction	16,940	489	17,429	9.00
Wholesale and retail sale	13,561	10,965	24,526	12.66
Transportation and warehousing	3,936	435	4,371	2.26
Accommodation, food, and beverage	1,400	1,595	2,995	1.55
Information and communication	1,168	0	1,168	0.60
Financial services and Insurance	2,145	0	2,145	1.11
Real estate	921	0	921	0.48
Company services	2,402	0	2,402	1.24
Government administration	3,963	2,442	6,405	3.31
Education services	4,101	6,446	10,547	5.45
Health services	299	2,000	2,299	1.19
Others	3,513	1,875	5,388	2.78
Total	137,482	56,190	193,672	100.00

Source: The statistics of Muaro Jambi Regency (Muaro Jambi Statistics Office, 2023)

Batanghari Regency. The employment or source of livelihoods in Batanghari Regency is shown in the following table, indicating that approximately 79% of the total workers were employed in the agriculture, forestry, and fishery sectors as the main source of livelihoods for the population in this regency. These industry and trade sectors were the main employers in this regency which was similar to those of Muaro Jambi Regency.

Table 55 Employment Types in Batanghari Regency (2023)

Industry and Trade Sectors	Male	Female	Total	Percentage of Total Workers (%)
Agriculture, forestry, and fisheries	41,457	18,186	56,643	79.00
Manufacturing, trade, retail, restaurant, and hotel/accommodation	11,094	2,466	13,560	17.98
Mining, building construction, transportation, and warehousing	1,325	903	2,228	2.98
Total	53,876	21,555	72,431	100.00

Source: The statistics of Batanghari Regency (Batanghari Statistics Office, 2023)

Tanjung Jabung Barat Regency. The employment or source of livelihoods in Tanjung Jabung Barat Regency suggested a total of 169,627 workers employed in numerous industry and trade sectors. Approximately 59% of the total workers were employed in agriculture, forestry and fishery sectors; 15% of them in the wholesale & retail sale, and vehicle & motorbike repair and maintenance; and 10% of them in the social and community services as shown in the following table. These industry and trade sectors were the main employers in this regency which is similar to those of Muaro Jambi Regency.

Table 56 Employment Types in Tanjung Jabung Barat Regency (2023)

Industry and Trade Sectors	Male	Female	Total	Percentage of Total Workers (%)
Agriculture, forestry, and fisheries	64,332	36,356	100,688	59.36
Mining	236	405	641	0.38
Processing industry	1,665	2,031	3,686	2.17
Procurement of electricity and gas supplies	899	0	899	0.53
Building	7,280	0	7,280	4.29
Wholesale and retail sale	13,492	11,887	25,379	14.96
Car and motorbike repair and maintenance				
Hotels and restaurants	2,933	6,666	9,599	5.66
Financial services, insurance, and services	2,564	1,024	3,588	2.12
Social and community services	9,083	8,784	17,867	10.53
Total	102,484	67,153	169,627	100.00

Source: The statistics of Tanjung Jabung Barat Regency (Tanjung Jabung Barat Statistics Office, 2023)

6.1.5 Religion and Ethnicity

As commonly observed in many parts of Indonesia, Islam (Moslem) is the majority religion in Jambi Luar Kota, Sekernan, Pemayang, and Muara Papalik Districts, with approximately more than 90% of the total population in these districts. The remaining population adopts other religious or belief, namely Christian, Catholic, Buddhism, and others. Relevant data of these religious practices is shown in the following table. Mosques and smaller mosque (known as mushola) used by the Moslem are the only praying facilities available in the four (4) districts mentioned earlier. No churches or other facilities for other religions are available in these districts.

The population of Jambi Province is a combination of several ethnicities that have lived for a long period in the area. Jambi-Malay ethnic is the majority of population living within the Project area, while the ethnic minorities are Bugis, Javanese, Batak, Nias, Chinese, and Indian who initially came to Jambi for trading activities.

Table 57 District Population Based on Their Religions

Religion	Jambi District		Kota		Sekernan District		Pemayang District		Muara District		Papalik	
	Population	%	Population	%	Population	%	Population	%	Population	%	Population	%
Islam/Moslem	69,318	93.45	3,203	92.25	38,137	99.73	9,884	93.70				
Christian	4,274	5.76	240	6.91	76	0.20	623	5.91				
Catholic	483	0.65	0	0	16	0.04	41	0.39				
Hindus	0	0	20	0.58	0	0	0	0				
Buddhism	96	0.13	5	0.14	10	0.03	0	0				
Confucianism	7	0.01	4	0.12	0	0	0	0				
Other beliefs	0	0	0	0	0	0	1	0.01				
Total	74,178	-	3,472	-	38,239	-	10,549	-				

Source: The statistics of Muaro Jambi District, Batang Hari District, and Tanjung Jabung Barat District (Respective Statistic Offices of the Regencies, 2023)

6.1.6 Cultural Heritage

Cultural heritage comprises both tangible objects (such as monuments, artifacts, or sites) and intangible attributes (including traditions, languages, or rituals) inherited from past generations and maintained for the benefit of future ones. The most renowned cultural heritage site in Muaro Jambi Regency is the Muaro Jambi Temple Complex, which features Hindu-Buddhist architecture, as depicted in the accompanying figure. This complex is believed to be the largest in Southeast Asia, extending approximately 7.5 km from west to east along the Batanghari River and covering nearly 4,000 hectares. It includes 11 main temples and potentially 82 other remains still buried underground. Situated in Maro Sebo District, the temple complex is about 20 km from the Jambi/Sp. Ness – Merlung Toll Road. Recognized by the Ministry of Education and Culture, it is designated as the 28th national cultural heritage.

Figure 26 Muaro Jambi Temple Complex



Source: <https://wonderfulimages.kemenparekraf.go.id/read/972/candi-muaro-jambi>



<https://whc.unesco.org/en/tentativelists/6827/>

6.1.7 Infrastructure and Public Facilities/Services

Existing Roads. Jambi Province's current road infrastructure includes approximately 165 km of the national Trans Sumatera Road, known as the Eastern Line (Jalur Lintas Timur), as illustrated in the following figure. This road mainly facilitates the transport of goods such as palm oil, latex, and coal. The majority of vehicles on this route are small to large haul trucks or containers (14-wheeler trucks) with tractor heads, along with road tankers that can hold up to 24,000 liters. Passenger cars and motorcycles are also common, with their numbers increasing during holidays and long weekends. The Sp. Ness – Merlung Toll Road will connect to the national road via the Cinto Kenang and Merlung interchanges.

Figure 27 Typical Condition of Trans Sumatera Road



Source: Personal photo of Budiono taken in 2024

Other national, provincial or regency roads and intersections that may be impacted due to the construction of the Project are those connecting to the following areas: Merlung – Kabupaten Tanjab; Simpang Tuan – Jambi city; Tempino – Jambi; Simpang Japura – Pematang Reba; Siberida – Jambi city; Muara Tembesi – Muara Bulian; Batang Hari II – Simpang Pelabuhan (Jambi – M Sabak).

Health Facilities and Services. The statistics indicated health facilities available at district level of the Project area in the following table. The public health centers (PHC) or known as *Puskesmas* are available in each district where there were four PHCs Sekernan District and the other district only had two (2) PHCs. Only two hospitals were available and these only in Sekernan District. A smaller unit of PHC called *Puskesmas Pembantu* (or Pustu) were only available in Jambi Luar Kota and Sekernan District.

Table 58 Health Facilities at District Level

District	Midwife Clinic	Public Health Centre (Puskesmas)	A smaller unit of PHC (Pustu)	Hospital
Jambi Luar Kota (Muaro Jambi Regency)	-	2	3	0
Sekernan (Muaro Jambi Regency)	-	4	1	2
Pemayung (Batanghari Regency)	2	2	-	-
Muara Papalik (Tanjung Jabung Barat Regency)	-	2	-	-

Source: The statistics of Muaro Jambi District, Batang Hari District, and Tanjung Jabung Barat District (Respective Statistic Agencies, 2023)

The data in the following table indicated that, in 2023, Jambi Luar Kota District has the highest number of medical workers i.e., 174 persons including 10 medical doctors compared to those of the other three (3) districts. On the other hand, Muara Papalik District has the lowest number of medical workers i.e., 70 persons including three (3) medical doctors compared to the other three (3) districts.

Table 59 Medical Workers at District Level (2023)

District	Medical Doctor	Nurse	Midwife	Others	Sum per District
Jambi Luar Kota (Muaro Jambi Regency)	10	66	89	9	174
Sekernan (Muaro Jambi Regency)	8	60	49	9	126
Pemayung (Batanghari Regency)	5	42	33	4	84
Muara Papalik (Tanjung Jabung Barat Regency)	3	26	38	3	70
Total	26	194	209	25	-

Source: The statistics of Muaro Jambi District, Batang Hari District, and Tanjung Jabung Barat District (Respective Statistic Agencies, 2023)

6.2 Socio-economic Baseline of Affected Households

A socio-economic survey (“the survey”) was conducted in November – December 2023 to identify households including lands and structures that are likely and primarily to be affected by the Sp. Ness – Merlung Toll Road (the Project). The survey identified approximately 519 households likely to be affected by the Project through land acquisition and would need to be compensated (“affected households” of AHs). In addition, an audit was undertaken to 128 AHs whose lands already acquired by the Project. The main objective of this survey and audit were to obtain key socio-economic baseline data and information in relation to a total of 647 AHs that would be impacted by the Project. The complete survey and audit results are documented in stand-alone reports and those relevant for the ESIA are presented below.²²

6.2.1 Distribution of Affected Households and Lands

Approximately 647 AHs would be impacted through land acquisition including assets required by the Project within nine (9) villages. The number of AHs in these nine (9) villages varied in the range of 4 –

²² Draft Land Acquisition and Resettlement Plan of Jambi – Merlung Toll Road (PT Kwarsa Hexagon, March 2024); and Draft Resettlement Audit of the Implementation of Land Acquisition (PT Blantickindo Aneka, March 2024).

149 AHs with the lowest one being at Teluk Village (Batang Hari Regency) and the highest one (1) being at Bukit Baling Village (Muaro Jambi Regency) and this is shown in the following table.

Table 60 Affected Households by Village

Regency	Village	Number of AHs
Muaro Jambi Regency		
Jambi Luar Kota Regency	Pijoan	69
Sekernan Regency	Tantan	45
	Rantau Majo	88
	Gerunggung	101
	Bukit Baling	149
	Suko Awın Jaya	14
Batanghari Regency		
Pemayung Regency	Selat	102
	Teluk	4
Tanjung Jabung Barat Regency		
Muara Papalik Regency	Dusun Mudo	62
Total		647

The lands likely affected by the Project are estimated at 962.24 hectares, however this figure may change depending upon the results of the land survey and confirmation by related government agencies. These include 517.48-hectares privately-owned lands, 433.95-hectares with the land right status granted to companies, and 10.81-hectares of government-owned lands. These lands are distributed in nine villages, four (4) districts, and three (3) regencies in Jambi Province.

6.2.2 Demographic Profiles

The Head of Affected Households by Gender. The following table indicated that 496 males and 151 females were the head of AHs, representing approximately 77% and 23% respectively of the total of 647 AHs within the Project area.

Table 61 Head of Affected Households by Gender

Village	Head of AHs		Total
	Male	Female	
Pijoan	52	17	69
Tantan	25	20	45
Rantau Majo	76	12	88
Gerunggung	68	33	101
Bukit Baling	122	27	149
Suko Awın Jaya	10	4	14
Selat	77	25	102
Teluk	4	0	4
Dusun Mudo	62	13	75
Total	496	151	647

Age Group. The data in the table below indicated that the heads of 441 AHs were primarily in the age group of 41 - 60-years old or approximately 68% of the total AHs, suggesting that most of the heads of AHs was in productive age i.e., those have the capacity to generate incomes. Those in the age group of less than 41-years old or more than 60-years were less than 10% of the total AHs.

Table 62 Head of Affected Households based on Age Group

Village	Age Group (year)						Total
	≤30	31 - 40	41 - 50	51 - 60	61 - 70	≥71	
Pijoan	0	2	39	24	4	0	69
Tantan	4	11	10	12	7	1	45
Rantau Majo	0	2	42	40	2	2	88
Gerunggung	0	10	39	35	14	3	101
Bukit Baling	2	12	55	74	6	0	149
Suko Awın Jaya	3	2	3	4	2	0	14
Selat	0	13	43	36	9	1	102
Teluk	0	0	1	3	0	0	4
Dusun Mudo	0	3	18	51	3	0	75
Total	9	36	203	238	29	4	647

Marital Status. The data in the table below indicated that approximately 94% of the total 519 AHs surveyed were a married couple, whereas the remaining 6% of them were either widow, widower, or single status.

Table 63 Marital Status of AHs*

Village	Married	Widow	Widower	Single	Total
Pijoan	66	2	1	0	69
Tantan	39	3	3	1	45
Rantau Majo	84	0	4	0	88
Gerunggung	31	1	1	1	34
Bukit Baling	135	2	4	8	149
Suko Awın Jaya	14	0	0	0	14
Selat	41	0	0	0	41
Teluk	4	0	0	0	4
Dusun Mudo	74	0	1	0	75
Total	488	8	13	10	519

Note: *No similar data is available for the 128 AHs identified in the Resettlement Audit of the Implementation of Land Acquisition to 128 PAPs (PT Blantickindo Aneka, 2023).

6.2.3 Education Level

The data in the table below indicated that approximately 80% of the AHs' members have pursued secondary education level (i.e., junior and senior high schools), 14% of them pursued primary education level (i.e., elementary school), and only 6% pursued tertiary education level (i.e., diploma or university degree equivalent). These figures may suggest that most of the AHs have put a significant emphasis on secondary education level for their children.

Table 64 Education Level of the Members of AHs*

Village	Elementary School	Junior School	High School	Senior High School	Diploma/ University
Pijoan	26	79		54	5
Tantan	30	28		43	9
Rantau Majo	19	82		90	24
Gerunggung	12	29		34	5
Bukit Baling	43	122		134	15
Suko Awın Jaya	9	8		18	2
Selat	12	43		39	14
Teluk	1	3		3	2
Dusun Mudo	16	80		66	8
Total	165	467		477	75

Note: *No similar data is available for the 128 AHs identified in the Resettlement Audit of the Implementation of Land Acquisition to 128 PAPs (PT Blantickindo Aneka, 2023).

In addition, the survey results indicated that 5% of the heads of AHs attended and/or graduated from the university or similar tertiary education level. Approximately, 10% of them claimed that they did not attend any formal education.

6.2.4 Ethnicity

The data in the table below indicated that the Malay and Javanese (Central/East Java) were the major ethnicity of the head of AHs in the Project area, representing approximately 86% of the 647 AHs (558 out of the total of 647 AHs). The remaining 14% of the head of AHs are a mixture of Batak (North Sumatera), Minang (West Sumatera), and Sundanese (West Java) ethnic groups.

Table 65 Ethnicity of the Head of AHs

Village	Malay	Javanese	Batak	Minang	Sundanese
Pijoan	20	28	7	4	10
Tantan	38	7	0	0	0
Rantau Majo	50	23	15	0	0
Gerunggung	25	75	0	2	0
Bukit Baling	48	80	21	1	0
Suko Awın Jaya	1	7	4	0	2
Selat	52	41	6	1	0
Teluk	4	0	0	0	0
Dusun Mudo	37	22	14	1	1
Total AHs	275	283	67	9	13

6.2.5 Livelihoods and Incomes

The data in the table below indicated that approximately 84% of the head of the 647 AHs was employed in agricultural sector and/or working in the oil palm, acacia or rubber plantations. The remaining 16% of them were employed as labor, business owner, private sector employee, etc., as presented in the following table.

Table 66 Livelihoods of the Heads of AHs

Villages	Agriculture or Plantation workers	Labor	Business Owner	Private-sector Employee	Civil Servant	Military/ Police	Retiree	Others
Pijoan	50	3	3	1	3	0	0	9
Tantan	45	0	0	0	0	0	0	0
Rantau Majo	86	0	0	0	1	0	0	1
Gerunggung	66	1	13	6	11	0	1	3
Bukit Baling	139	2	1	1	2	0	0	4
Suko Awin Jaya	11	0	0	0	1	1	1	0
Selat	79	0	8	4	5	0	0	6
Teluk	4	0	0	0	0	0	0	0
Dusun Mudo	66	0	4	2	2	0	0	1
Total	546	6	29	14	25	1	2	24

The data in the table below indicated that approximately 16% of the head of the 519 AHs had an average income of IDR 1 - 2 million/month. The AHs within this income group are potentially considered as poor households.²³ Those having an average income of more than IDR 4 million per month represented 22% of the head of AHs. About 62% of the head of AHs had an average income in the range of 2 - 4 million per month.

Table 67 Average Income per Month of the Heads of AHs*

Affected Villages	Average Income per Month (in Indonesian Rupiah or IDR)			
	1 – 2 million	2 to 3 million	3 to 4 million	>4 million
Pijoan	16	32	11	10
Tantan	24	5	6	10
Rantau Majo	17	45	24	2
Gerunggung	1	5	13	15
Bukit Baling	19	53	42	35
Suko Awin Jaya	1	5	0	8
Selat	2	20	18	1
Teluk	0	2	0	2
Dusun Mudo	3	5	33	34
Total head of AHs	83	172	147	117

Note: *No similar data is available for the 128 AHs identified in the Resettlement Audit of the Implementation of Land Acquisition to 128 PAPs (PT Blantickindo Aneka, 2023).

²³ Based on the statistical agency data of Jambi Province in 2023, the poverty line for Jambi Province was IDR 599,688/month/capita. This figure is approximately IDR 2,400,000 for a household containing 4 persons.

6.2.6 Vulnerable Households

The survey results indicated that 247 out of 519 AHs were considered as vulnerable based on the following factors: 121 females were the head of AHs with dependents; 39 AHs had elderly person as the head of family without supports; and 87 AHs were poor households with incomes under the poverty line (as defined by the Indonesian Statistics Office). None of the 519 AHs is categorized as Indigenous Peoples or disabled households within the Project area.

6.2.7 Access to Basic Facilities and Services

The 519 AHs mentioned that approximately 90% of the AHs used groundwater primarily from hand-dug, shallow wells to meet daily water needs for drinking, cooking and bathing/toileting activities. About 9% of the AHs used water that was pumped from a storage area/tank and 1% of the AHs used spring water.

About 95% of the AHs had their own bathrooms and toilets with a septic tank system and the remaining 5% of the AHs did not have similar facilities. All AHs informed that the household wastes were primarily burned on site with the remaining part buried onsite. No waste collection services and disposal facilities were provided by the local governments within the area where the AHs lived. Nevertheless, all AHs had access to electricity provided by the state-owned electricity company PLN. Most of the AHs used liquified petroleum gas (LPG) supplied in a steel cylinder by authorized distributors as the fuel source for cooking.

6.2.8 Perception in Relation to the Project

Livelihood. As part of the survey, the AHs were questioned about their opinion/perception of the Project particularly in relation to their future income or livelihoods. The survey results shown in the following table indicated that approximately 91% of the head (*kepala keluarga*) of 519 AHs perceived that the Project was unlikely to generate direct economic impacts on their livelihoods. Only 9% of them perceived that the Project might provide additional income for them.

Table 68 Livelihood Impacts due to the Project*

Village	Response Types					
	No direct economic impacts		Expected provide additional income		Other responses	
	Male	Female	Male	Female	Male	Female
PiJoan	40	17	12	0	0	0
Tantan	15	20	10	0	0	0
Rantau Majo	76	12	0	0	0	0
Gerunggung	16	11	7	0	0	0
Bukit Baling	118	27	4	0	0	0
Suko Awın Jaya	9	4	1	0	0	0
Selat	27	8	6	0	0	0
Teluk	4	0	0	0	0	0
Dusun Mudo	54	13	6	0	2	0
Total number of responses	359	112	46	0	2	0

The data in the table below indicated that almost 82% of the head of 519 AHs expected that the Project would provide improved transportation for the communities. About 17% of them expected that the

Project would provide better access to agricultural products. Similar to the survey result on the ‘livelihood impact of the Project’ presented above, very small percentage of the AHs thought that the Project would provide employment and business opportunities for them.

Table 69. Perception of the Project’s Benefits*

Affected Villages	Better access for agricultural products		Improved transportation		Better job & business opportunities		Increased business income	
	Male	Female	Male	Female	Male	Female	Male	Female
Pijoan	22	2	30	15	0	0	0	0
Tantan	9	0	16	20	0	0	0	0
Rantau Majo	10	0	66	12	0	0	0	0
Gerunggung	5	0	18	11	0	0	0	0
Bukit Baling	17	0	102	27	2	0	1	0
Suko Awin Jaya	4	0	6	4	0	0	0	0
Selat	10	1	23	7	0	0	0	0
Teluk	0	0	4	0	0	0	0	0
Dusun Mudo	7	0	54	13	0	0	1	0
Total	84	3	319	109	2	0	2	0
Grand total per response	87		428		2		2	

Note: *No similar data is available for the 128 AHs identified in the Resettlement Audit of the Implementation of Land Acquisition to 128 PAPs (PT Blantickindo Aneka, 2023).

Environmental impacts. The 519 AHs thought that dust and noise level generated at the time of the Project construction would have negative impacts on the nearby communities and health.

7.0 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

This section presents the assessment of environmental and social risks and impacts associated with the Project's activities, using the methodology described in Section 4 (ESIA Methodology) of this report. An impact is defined as an identifiable effect on people—including their activities—as well as on the physical and biological environment arising from the Project's activities.

The impact assessment in this section applies a significance-based approach consistent with the Bank's ESS1. It combines two primary criteria—the severity of the impact and the likelihood of its occurrence—to generate a risk score, which is then mapped to an impact significance level of Minor, Moderate, or Major, as described in Section 4.5 of this report.

The assessment is undertaken in two stages. The first stage evaluates the inherent significance of each impact, representing its significance level in the absence of any mitigation measures. The second stage evaluates the residual significance, representing the significance level remaining after all proposed mitigation measures have been implemented. Comparing the inherent and residual significance levels demonstrates the effectiveness of the mitigation hierarchy applied to each identified impact.

7.1 Environmental Impacts - Pre-Construction Phase

No earthworks or civil construction activities will be undertaken during the pre-construction phase of the Project. Activities during this phase will be limited to land acquisition and the tendering process for the selection of main contractors and/or sub-contractors for the construction of the toll road and associated infrastructure. The social impacts arising would be generated by the land acquisition are described in the Social Impact Assessment section of this ESIA.

The tendering process itself does generate any environmental impacts. However, DGH, as the Executing Agency, must ensure that the ESMP, BMP, and other safeguard documents are incorporated into the bidding documents as mandatory requirements for prospective main contractors and/or sub-contractors. This includes clear provisions requiring ESMP implementation and monitoring as an integral part of the construction contract, as well as the provision of adequate budget and human resources for this purpose.

7.2 Environmental Impacts - Construction Phase

Potential environmental impacts, including those on biodiversity associated with Project construction, are identified in Table 70. These impacts are evaluated using the method described in Section 4.0 of this report, and the results are presented in the subsequent sub-sections. Such impacts are commonly observed in infrastructure projects involving large-scale civil works, including earthworks, cut-and-fill activities, and the operation of substantial numbers of project fleet vehicles. Biodiversity impacts of the Project are assessed in detail in the Critical Habitat Assessment Report (YAPEKA, 2023), with a summary provided in the relevant sub-sections below.

Table 70 Environmental Impacts – Construction Phase

Components Impacted Project's Activities	Air Quality, Noise & Vibration	Soil	Surface Water & Groundwater	Road Traffic & Condition	Health & Safety	Terrestrial Biodiversity	Riparian Ecosystem
Project's basecamps operation & worker accommodation	√		√		√	√	
Earthworks and construction of toll road & related infrastructure	√	√	√	√	√	√	√
Mobilization & maintenance of vehicles, trucks & heavy equipment (the project fleet)	√		√	√	√	√	
Waste management incl. construction wastes	√	√	√	√	√	√	
Operation of ancillary facilities (i.e., access roads to construction sites, quarries & concrete batching plants)	√	√	√	√	√	√	

7.2.1 Ambient Air Quality

Risk and Impact Assessment. Increase in gaseous emissions and particulate generation into the atmosphere from the following construction activities and the operation of ancillary facilities may adversely affect human health, nearby houses, and wildlife, and potentially exceed beyond the Project area of influence (Aoi):

- Construction activities:
 - Earthworks: land clearing, cut/fill, and levelling;
 - Mobilization and demobilization: the transportation of construction materials, spoils, and other wastes using trucks and heavy equipment;
- Operation of ancillary facilities:
 - unpaved access roads used for construction;
 - quarries;
 - concrete batching plants;
 - worker's base camps at contractor basecamps

The air quality impact would be temporary and reversible upon completion of each civil work package.

The dispersion of gaseous emissions (CO, NO₂, SO₂) and particulate generation (PM_{2.5} and TSP) from construction activities and the operation of ancillary facilities is estimated using the emission rates mentioned in Section 4.4.1. These emission sources, along with terrain and meteorological data, are processed using AERMOD, the USEPA-recommended model.

The results of the air dispersion modelling are shown in Map 14 to Map 18. These maps indicate that the gaseous emissions and PM_{2.5} levels comply with the Project standards, including the national (GR No. 22/2021) and international (IFC EHS Guideline, 2012) ambient air quality standards. However, dust generation (TSP) exceeds the national standard by five times, reaching 10,052 µg/m³. A detailed discussion of each parameter follows:

- **Map 14** The modeling results present the dispersion pattern of SO₂ concentration (24-hour average), indicating that a maximum concentration of up to 10 µg/m³ may be generated by the Project at Sela and Dusun Mudo Villages. As presented in the E&S Baseline Section of the ESIA, the baseline SO₂ concentration measured at two sites representing the Sp. Ness – Merlung Toll Road project area was up to 30 µg/m³. The total SO₂ concentration from the project and baseline conditions combined would therefore reach up to 40 µg/m³, which remains below the threshold value of 75 µg/m³ stipulated in the GoI regulation No. 22/2021, Appendix 7: Ambient Air Quality Standard. **Map 15** presents the dispersion pattern of CO concentration (1-hour average) based on the modelling result, indicating that a maximum concentration of up to 50 µg/m³ may be generated by the Project at Pijoan and Dusun Mudo Villages. As presented in the E&S Baseline Section of the ESIA, the baseline CO concentration measured at two sites representing the toll road project area was at less than 1,145 µg/m³. The total CO concentration from the project and baseline condition would therefore reach up to 1,195 µg/m³, well below the threshold value of 10,000 µg/m³ stipulated in the GoI regulation mentioned above. **Map 16** presents the dispersion pattern of NO₂ concentration (24-hour average) based on the modelling results, indicating that a maximum concentration of up to 10 µg/m³ may be generated by the Project at Dusun Mudo Village. As presented in the E&S Baseline Section of the ESIA, the baseline NO₂ concentration at the site representing the

toll road project area was up to 21 $\mu\text{g}/\text{m}^3$. The total NO_2 concentration from the project and baseline condition combined would therefore reach up to 31 $\mu\text{g}/\text{m}^3$, below the threshold value of 65 $\mu\text{g}/\text{m}^3$ stipulated in the GoI regulation mentioned above. Map 17 presents the dispersion pattern of $\text{PM}_{2.5}$ concentration (24-hour average) based on the modelling results, indicating that a maximum concentration of up to 1 $\mu\text{g}/\text{m}^3$ may be generated by the Project at Pijoan, Selat, and Dusun Mudo Villages. As presented in the E&S Baseline Section of the ESIA, the baseline $\text{PM}_{2.5}$ concentration measured at the site representing the toll road project area was up to 15 $\mu\text{g}/\text{m}^3$. The total $\text{PM}_{2.5}$ concentration from the project and baseline condition would therefore reach up to 16 $\mu\text{g}/\text{m}^3$, well below the threshold value of 55 $\mu\text{g}/\text{m}^3$ stipulated in the GoI regulation mentioned above.

- **Map 18** presents the dispersion of TSP concentration (24-hour average) based on the modelling results, indicating that a maximum concentration of up to 10,000 $\mu\text{g}/\text{m}^3$ may be generated by the project at Selat and Dusun Mudo Villages within radius of less than 2km from the toll road alignment. As presented in the E&S Baseline Section of the ESIA, the baseline TSP concentration measured at the site representing the toll road project area was up to 52 $\mu\text{g}/\text{m}^3$. The TSP concentration from the Project and baseline condition would therefore reach up to 10,000 $\mu\text{g}/\text{m}^3$ substantially exceeding the threshold value of 230 $\mu\text{g}/\text{m}^3$ stipulated in the GoI regulation mentioned above.

According to the following criteria (see **Table 71**), the impact magnitude of dust generation from construction activities and the operation of ancillary facilities is classified as Critical, whereas CO emissions are Minor, and the other parameters remain Low.

Table 71 Air Quality Impact Magnitude Criteria

Magnitude	Degraded Airshed (PEC > 100% AQS)	Undegraded Airshed (PEC < 100% AQS)
Negligible	PC < 10% of AQS	PC < 25% of AQS
Minor	PC 10–30% of AQS	PC 25–50% of AQS
Medium	PC 30–50% of AQS	PC 50–75% of AQS
High	PC 50–75% of AQS	PC 75–100% of AQS
Critical	PC > 75% of AQS	PC > 100% of AQS

Source: IAQM, London. URL: <https://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf>

Notes: PC = Predicted Contribution (project-related increment in pollutant concentration). AQS = Air Quality Standard (WHO guideline or national ambient standard, as applicable). PEC = Predicted Environmental Concentration (background + project contribution). A 'degraded' airshed is one where the baseline already exceeds the AQS (PEC > 100% AQS); stricter magnitude thresholds apply to reflect the reduced assimilative capacity of the airshed.

Table 72 Air Quality Impact Magnitude during Construction

Parameters	AQS	PC ($\mu\text{g}/\text{m}^3$)	Baseline ($\mu\text{g}/\text{m}^3$)	Impact Magnitude
SO ₂	75 $\mu\text{g}/\text{m}^3/24\text{hr}^*$ 40 $\mu\text{g}/\text{m}^3/24\text{hr}^{**}$	10	30	25% of AQS
CO	10,000 $\mu\text{g}/\text{m}^3/24\text{hr}^*$ 4,000 $\mu\text{g}/\text{m}^3/24\text{hr}^{**}$	50	<1,145	29% of AQS
NO ₂	200 $\mu\text{g}/\text{m}^3/1\text{-hr}^*$ 200 $\mu\text{g}/\text{m}^3/1\text{-hr}^{**}$	10	21	5% of AQS
PM _{2.5}	55 $\mu\text{g}/\text{m}^3/24\text{hr}^*$ 25 $\mu\text{g}/\text{m}^3/24\text{hr}^{**}$	1	15	4% of AQS
TSP/dust	230 $\mu\text{g}/\text{m}^3/24\text{hr}^*$	10,000	52	4348% of AQS

Note: * national standard (GR 22/2021) and ** IFC EHS Guideline (2012) on ambient air quality standard.

Given the project's proximity to the residential areas of Selat and Dusun Mudo Villages, significant dust generation and minor CO emissions may adversely affect community health, as the ambient air quality baseline (Section 5.4.2) indicates that these areas already have a high prevalence of tuberculosis and pneumonia. Under extremely dry, windy conditions, dust dispersion may extend beyond the project footprint; however, dust concentration in other villages is predicted to be approximately 1,000 $\mu\text{g}/\text{m}^3$ or less.

The increase in dust generation could also adversely affect surrounding houses, especially sensitive facilities such as educational buildings situated approximately 300 meters near the project.

The land surrounding the Jambi – Rengat Toll Road mainly covered with plantations of oil palm, rubber, acacia, and eucalyptus. During construction, dust could settle on nearby vegetation, potentially lowering crop yields. The biodiversity baseline highlights vulnerable herbivorous species like the Long-tailed Parakeet and near-threatened frugivores such as the Malay Brown Barbet, both relying on vegetation and insects. Increased dust levels may threaten these species. However, since construction activities and facilities are limited to specific areas and conducted intermittently, the impact on air quality for these sensitive species is expected to be temporary and should improve once construction ends.

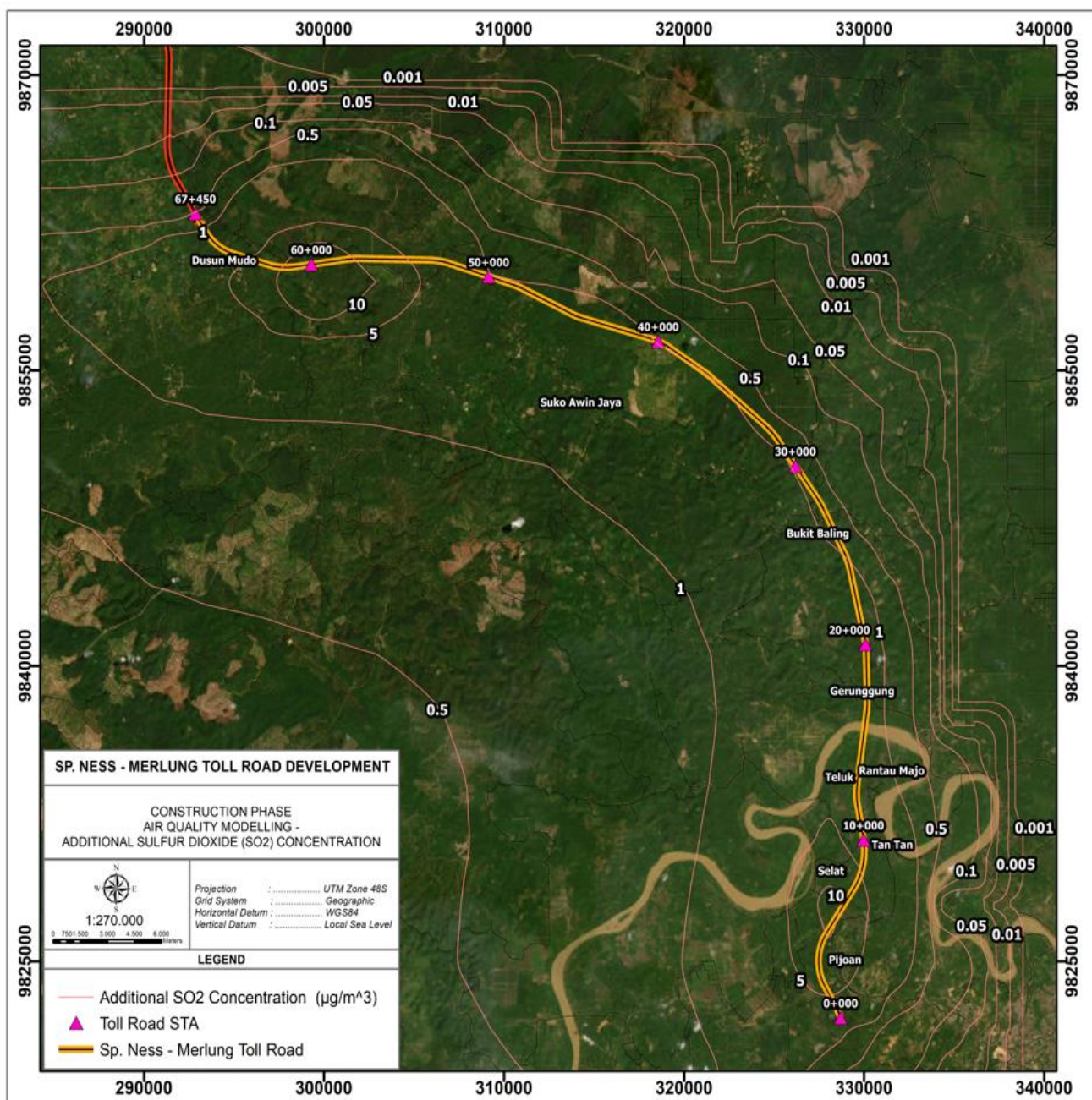
Considering the impact magnitude of construction activities and auxiliary facility operations, their contributions to gaseous emissions and particulate generation, the presence of sensitive receptors, and the duration of impacts, the severity of these activities is classified as Moderate. The likelihood of occurrence is rated as Likely, as this impact is expected during normal operations. Therefore, in the absence of mitigation measures, the project's impact on ambient air quality is assessed as **Substantial**.

Table 73 Air Quality Risk and Impact Assessment — Construction Phase

Impact	Receptor sensitivity	Identified impact	Baseline ($\mu\text{g}/\text{m}^3$)	Impact magnitude	Impact extend	Remark
Increase of gaseous emissions and particulate generation	Protected avifauna Houses Educational facilities	Direct	SO ₂ = 30 NO ₂ = 10 PM _{2.5} = 15	Emissions of SO ₂ , NO ₂ , and increase of PM _{2.5} generation is classified as	Medium-scale, along road alignment of the Jambi – Rengat Toll	

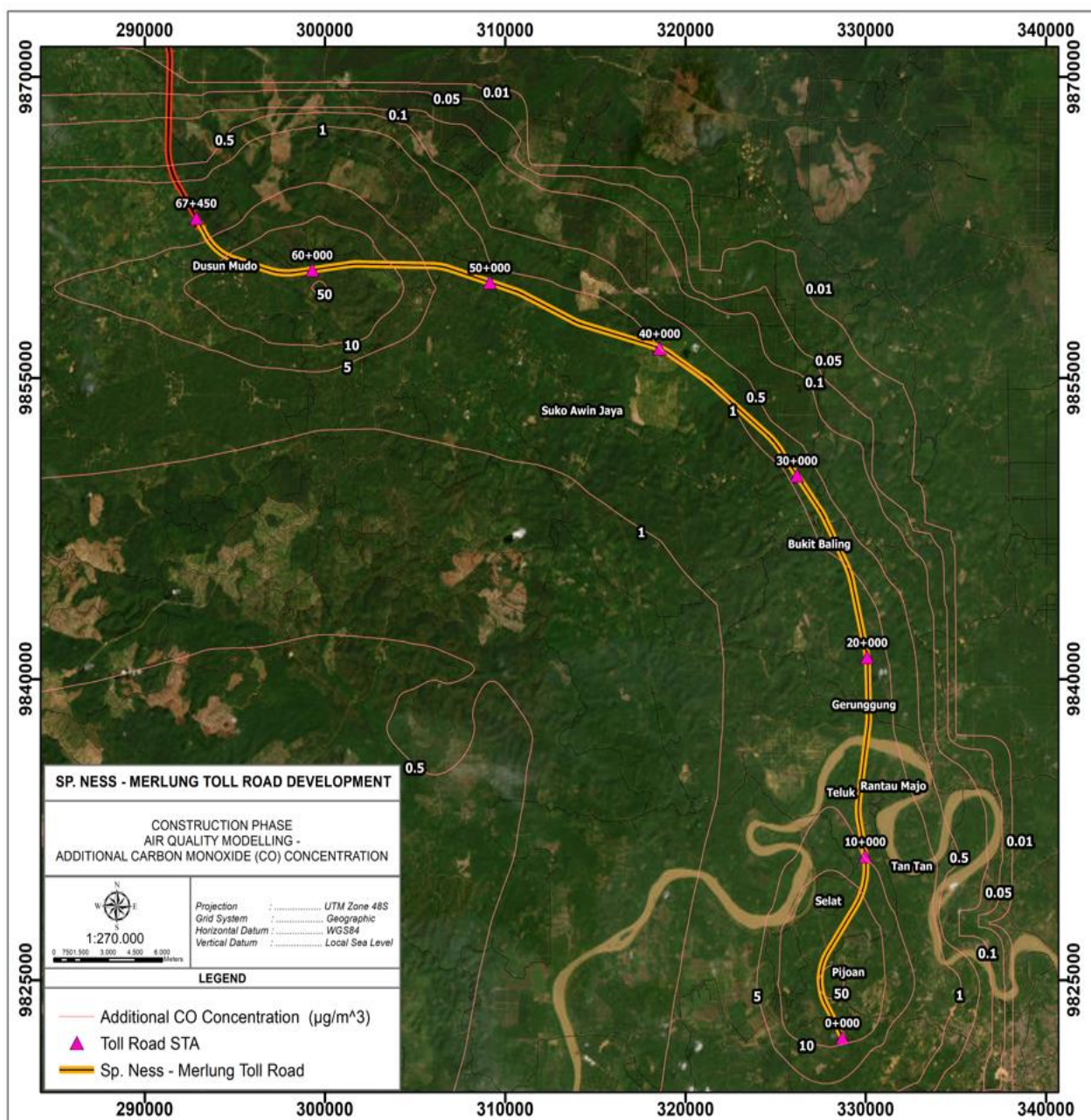
Impact	Receptor sensitivity	Identified impact	Baseline (µg/m³)	Impact magnitude	Impact extend	Remark
due to construction activities and operation of ancillary facilities	Communities (community health)		CO = <1,145	Emissions of CO is classified as Minor since PC = 25% - 50% of AQS	Road segment at Sp. Ness to Merlung.	
			TSP = 52	Dust generation is classifies as Critical due to PC>100%		
Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Increase of gaseous emissions and particulate generation due to construction activities and operation of ancillary facilities	Moderate	Likely	Substantial	Minor	Likely	Moderate

Map 14. Predicted SO₂ Concentration (Construction)



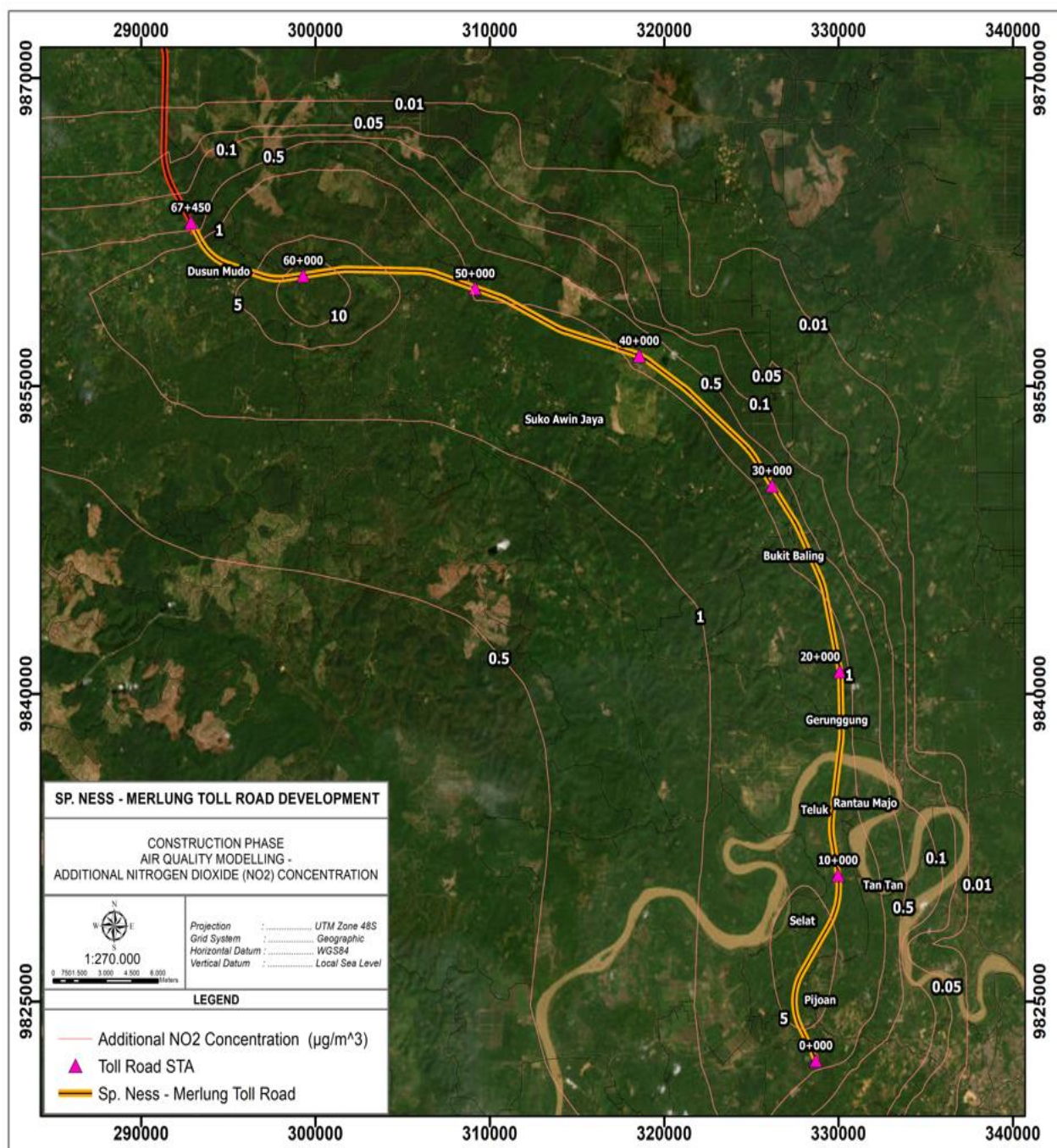
Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

Map 15. Prediction CO Concentration (Construction)



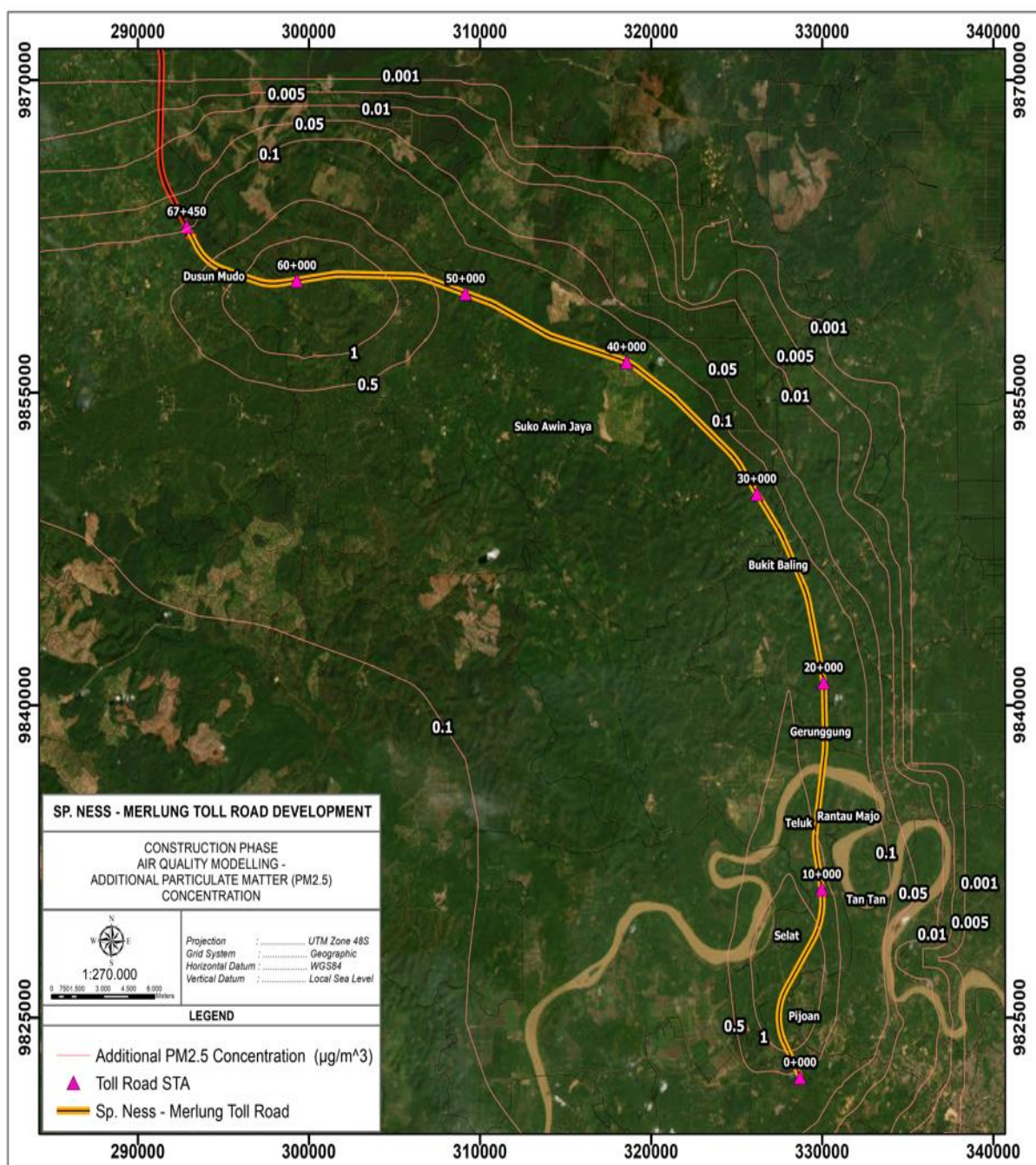
Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

Map 16. Predicted NO₂ Concentration (Construction)



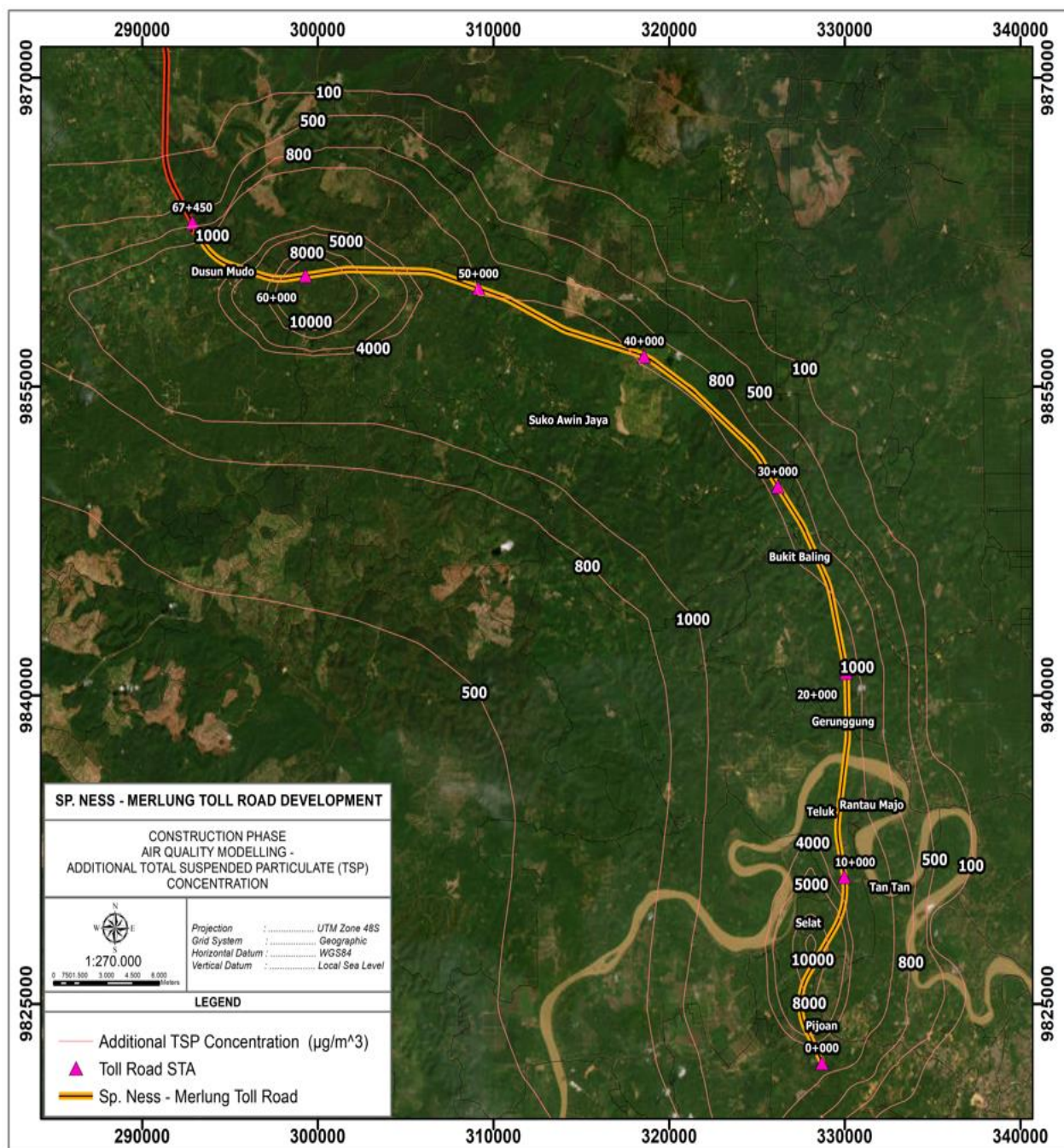
Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

Map 17. Predicted PM2.5 Concentration (Construction)



Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

Map 18. Predicted TSP Concentration (Construction)



Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

Mitigation Measures. To minimize the impact on ambient air quality described above and to comply with the ambient air quality standard stipulated by the GoI, the Project is recommended to implement at least the following mitigation measures:

- A stand-alone air quality management plan (AMP) shall be developed by the contractors as part of the construction environmental & social management plan (CESMP). The AMP shall define a more detailed mitigation measures and a monitoring plan than those listed in the ESIA's ESMP.
- Civil works for toll road construction will be divided into several work packages, enabling construction activities to proceed in stages.

- Land clearing and other earthworks shall be undertaken in stages and limited to areas immediately required for construction activities; massive land clearing shall be avoided where the construction schedule does not require it.
- Regular watering of construction sites, quarries, concrete batching plants, and access roads that generate high levels of airborne dust shall be performed using water tanker trucks at least once per day, or more frequently during dry weather conditions.
- Project fleet vehicles and equipment shall meet good standards, including being less than 10 years old, holding a valid operating license, and passing exhaust emission testing. They shall be operated by competent and licensed drivers and operators, be equipped with emissions control devices, and be inspected and maintained on a periodic basis according to the manufacturer's specifications.
- Speed limits shall be enforced for the project fleet when operating at construction sites (maximum 40 km/hour), passing through residential areas and schools (maximum 30 km/hour), and on public roads (40 – 60 km/hour, depending upon the road and traffic conditions).
- The use of tarpaulin covers on dump trucks shall be strictly enforced.
- Regular water spraying (at least once per day during the dry season, or more frequently as required) and maintenance of unpaved road surfaces shall be conducted on a regular basis.
- Open burning of construction and solid wastes at construction sites and their supporting facilities is strictly prohibited.
- Ambient air quality monitoring at the construction sites and supporting facilities shall be conducted at least quarterly, with monitoring results reported to evaluate the effectiveness of the mitigation measures and inspections undertaken.

Residual Risk. When the mitigation measures and air quality monitoring plan are implemented consistently and effectively, the impact of the Project's construction activities on ambient air quality near sensitive receptors can be lowered from a **Substantial** significance to a **Moderate** significance. Additionally, these air quality impacts would be temporary and reversible once construction is completed.

7.2.2 Noise Level

Risk and Impact Assessment. At least three sensitive receptors are located near Point 2 (see Section 4.4.2.1): the Taudhotut Tholbin religious school (about 900 meters away), Pijoan Muarojambi Hing School, and Batanghari Junior School. Noise will be generated during Project's construction activities (including access roads to construction sites, quarries, and concrete batching plants, among others), as well as the operation of associated facilities.

Following projected noise methods (see Section 4.4.2), noise increase from nine typical high-noise sources located at nine points along the Sp Ness – Merlung alignment has been calculated. The estimated maximum noise levels (L_{max}) at noise sources are presented in Table 74, together with the national applicable threshold values as per MoE Decree No. 48/1996, as well as IFC General EHS Guidelines for Noise Level Standards.

Table 74. Calculated Maximum Construction Noise Level

Distance from the Construction Area (m)	Maximum Noise Level [in dB(A)]	Threshold Values
100	81	Ministry of Environment Decree No. 48/199 stipulates the threshold values of day- and night-time environmental noise equivalent as follows: - Residential area: 55 dB(A) - Public, open area: 60 dB(A) - Industrial area: 70 dB(A)
200	75	
300	71	
400	69	
500	67	
600	65	
700	64	
800	63	
900	62	
1,000	61	

The noise baseline measurement indicates that average daytime noise levels range from 52.3 to 62 dBA. Based on the projected noise maps (see Map 19), construction activities may increase noise levels by up to 3 dB(A) during the daytime and up to 16.6 dB(A) at night within the project sites, and could elevate noise in surrounding residential areas—within a 700 m radius of the noise sources—to the current baseline levels. In general, the modeling results indicate that noise levels are anticipated to remain within the applicable threshold values.

Table 75 evaluates the inherent noise impact as ‘**Substantial**’ in the absence of mitigation measures, given Moderate severity and a ‘Likely’ likelihood. When related mitigation measures and monitoring plans are implemented consistently and effectively, the residual significance of the noise impact can be reduced to **Moderate**. The noise impact would also be temporary and reversible upon completion of construction activities.

Table 75. Noise Level Risk and Impact Assessment — Construction Phase

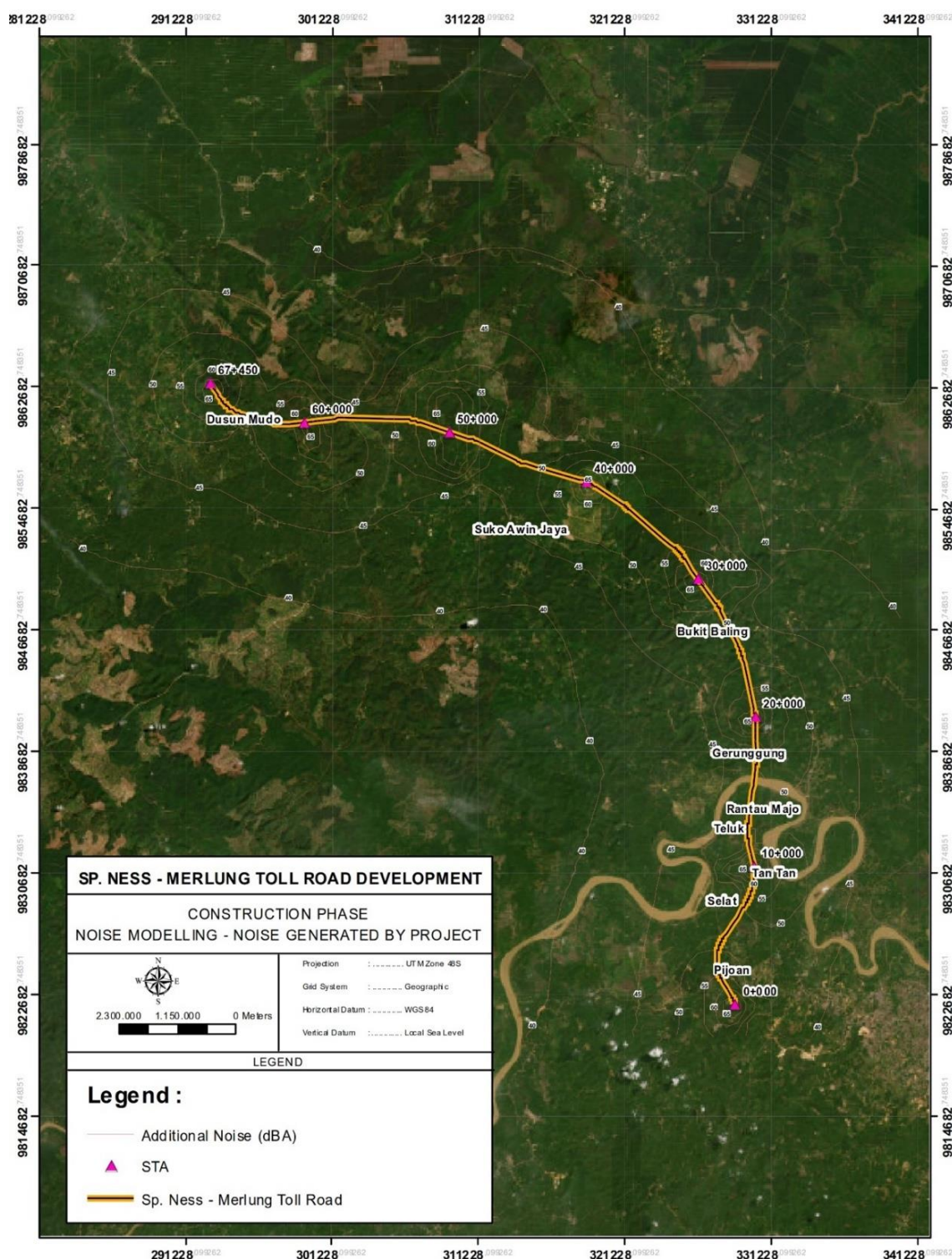
Impact	Receptor sensitivity	Identified impact	Baseline	Impact magnitude	Impact extend	Remark
Elevated noise level within the Project area and its proximity due to the Project’s construction activities	Educational facilities Vulnerable communities	Direct	Daytime: 52.3 – 62.0 dB(A) Nighttime: 48.4 – 48.7 dB(A)	The construction activities generate noise to 48 – 65 dB(A) at a maximum radius of 700 m along the toll road alignment	Local along road alignment of the Jambi – Rengat Toll Road at segment Sp. Ness to Merlung.	Daytime and nighttime noise generation due to construction activities meet the standards. However, at night, the construction noise level increases of more than 3 dB(A), which is 16.6 dB(A).

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Elevated daytime and nighttime noise level within the Project area and its proximity due to the Project's construction activities	Moderate	Likely	Substantial	Minor	Likely	Moderate

Mitigation Measures. To ensure that noise levels in the Project's vicinity remain within the threshold values stipulated by Ministry of Environment Decree No. 48/1996, the Project is recommended to implement at least the following mitigation measures:

- A stand-alone Noise Management Plan shall be developed by the contractors as part of the Construction Environmental and Social Management Plan (CESMP), defining more detailed mitigation measures and a monitoring plan compared to those listed in the ESMP of this ESIA.
- The mitigation measures for enforcing speed limits for project fleet vehicles and for enforcing tarpaulin covers on dump truck loads shall be implemented accordingly.
- Schedule construction activities during the daytime, including the mobilization of equipment and transportation of construction materials and wastes. Nighttime construction activities shall be restricted, particularly where construction sites and their access roads are in close proximity to community settlements, public facilities, and other sensitive receptors. This measures aimed at preventing a noise increase above 3 dB(A), which could impact nocturnal mammals and nearby residential zones
- Contractor base camps and worker accommodations shall be located sufficiently far from community settlements, public facilities, and other sensitive receptors to minimize noise nuisance. Temporary noise barriers made of zinc or aluminum, approximately 2 to 3 meters high, shall be installed where construction sites are located in close proximity to community settlements and other sensitive receptors.
- Equipment and machinery that generate elevated noise levels shall be fitted with noise shields or soundproofing insulation materials where practicable.
- Noise level monitoring at construction sites, supporting facilities, and within community settlements and other sensitive receptors within the Project area shall be conducted at least quarterly, with monitoring results reported to evaluate the effectiveness of mitigation measures and inspections undertaken.

Map 19. Predicted Noise Level Propagation (Construction)



Source: Noise modelling was undertaken by PT Kwarsa Hexagon (2024)

7.2.3 Vibration Level

Risk and Impact Assessment. The Project's construction activities, primarily earthworks comprising land clearing, cut and fill, and levelling, and the movement of construction materials, spoils, and other wastes using a significant number of project fleet vehicles, will generate elevated vibration levels that may be felt by humans, wildlife, and other sensitive receptors within the proximity of the construction

sites. The operation of ancillary facilities including unpaved access roads to construction sites, quarries, and concrete batching plants, will also generate elevated vibration levels that may cause nuisance to surrounding communities and other sensitive receptors.

Operating multiple heavy equipment and vehicles listed in Table 29 simultaneously at nine points (refer to Table 27) under three scenarios, including (i) the worst-case scenario involving construction activities with a hammer pile; (ii) operation of all equipment and heavy vehicles without using a pile hammer; and (iii) operations limited to earthmoving only with equipment and heavy vehicles. The vibration generated from these three scenarios is shown in Table 76. The vibrations measured at 5 meters from the sources. These levels gradually decreased with distance to 15, 25, and 40 metres, respectively, reaching vibration levels of less than 2 mm/s, which comply with the national standard and DIN 4150-3:2016 for residential structures.

Table 76 Estimated Generated Vibration from Construction Activities

Construction Point	Approximate STA	Nearest Residential (m)	Scenario 1 (mm/s)	Scenario 2 (mm/s)	Scenario 3 (mm/s)
Point 1	STA 0–10	80	0.62	0.35	0.31
Point 2	STA 10–20	120	0.34	0.19	0.17
Point 3	STA 20–30	250	0.11	0.06	0.06
Point 4	STA 30–40	280	0.09	0.05	0.05
Point 5	STA 40–50	180	0.18	0.11	0.09
Point 6	STA 50–55	140	0.27	0.15	0.13
Point 7	STA 55–60	100	0.44	0.25	0.22
Point 8	STA 60–63	280	0.09	0.05	0.05
Point 9	STA 63–67	200	0.16	0.09	0.08

As presented in Section 5.1.5 of this ESIA, baseline vibration levels measured at the five representative sites within the Project area—ranging from <0.1 to 0.6 mm/s—were significantly below the threshold values of 2 to 10 mm/s specified in Ministry of Environment Decree No. 49/1996 on Vibration Level Standards.

In the worst-case scenario (Scenario 1), vibration generated by construction activities and the operation of ancillary facilities near Point 1, close to STA 0-10, is expected to reach 31% of the vibration limit (2mm/s) due to its proximity to the residential area (80m). Considering impacts on human receptors, wildlife, and other sensitive entities from construction activities, including access roads, quarries, and concrete batching plants, the vibration impact on these receptors is classified as **Moderate** significance if no mitigation measures are applied. Typically, this vibration is localized and diminishes with distance from the source.

Table 77 Vibration Level Risk and Impact Assessment — Construction Phase

Impact	Receptor sensitivity	Identified impact	Baseline (mm/s)	Impact magnitude	Impact extend
Elevated vibration level	Protected mammals	Direct	<0.1 – 0.3	The construction activities generate	Local along road alignment of the

Impact	Receptor sensitivity	Identified impact	Baseline (mm/s)	Impact magnitude	Impact extend
felt by the community settlements and other sensitive receptors due to the Project's construction activities	Educational facilities Vulnerable houses			vibration less than 2 mm/s at nearest residential area along the toll road alignment	Jambi – Rengat Toll Road at segment Sp. Ness to Merlung.

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Elevated vibration level felt by the community settlements and other sensitive receptors due to the Project's construction activities	Minor	Likely	Moderate	Incidental	Possible	Low

Mitigation Measures.

To ensure that vibration levels near the Project remain within the thresholds set by Ministry of Environment Decree No. 49/1996, the Project is recommended to implement at least the following mitigation measures:

- **Pre-construction condition survey.** A pre-construction condition survey of buildings and structures shall be conducted and documented prior to the commencement of construction activities at each construction point to establish a baseline for assessing any vibration-related structural damage claims.
- **Operational restrictions.** Construction work shall be restricted to daytime hours (07:00–18:00 local time) in accordance with MoE Decree No. 49/1996. Speed limits shall be enforced for all project fleet vehicles on unpaved access roads within 100 m of residential areas. Heavy equipment shall be subject to regular inspection and preventive maintenance to minimize excess vibration caused by worn components.
- **High-vibration equipment controls.** The use of high-vibration equipment such as impact pile drivers and vibratory rollers shall be avoided or minimized in close proximity to community settlements, educational facilities, healthcare facilities, heritage structures, and other sensitive receptors. Specifically:
 - Impact pile driving shall not commence within 50 m of any occupied residential structure, school, or healthcare facility during school hours or hours of patient care.
 - Where impact pile driving within 50 m of sensitive structures is unavoidable, the Contractor shall obtain prior approval from the Environmental and Social Manager and apply 95th-percentile conservative PPV values in the assessment.

- Alternative low-vibration construction methods (e.g., bored pile installation, hydraulic press-in piling, pre-augering) shall be evaluated and adopted where technically feasible and proportionate to the sensitivity of the receptor.
- **Grievance Redress Mechanism (GRM).** Community members and property owners who experience vibration nuisance or believe structural damage has been caused by construction activities shall be directed to the Project's Grievance Redress Mechanism (GRM) as described in the Stakeholder Engagement Plan (SEP). The Contractor shall maintain a log of all vibration-related complaints and responses
- The mitigation measures to reduce vibration levels include restricting construction work to daytime hours, enforcing speed limits for project fleet vehicles, and maintaining and inspecting heavy equipment. These actions shall be implemented as planned.
- The use of high-vibration equipment such as vibratory pile drivers and vibratory rollers shall be avoided or minimized in close proximity to community settlements, heritage structures, and other sensitive receptors. Where unavoidable, alternative low-vibration construction methods shall be adopted.
- A pre-construction condition survey of buildings and structures located within the proximity of construction sites shall be conducted and documented prior to commencement of construction activities, to establish a baseline for assessing any vibration-related structural damage claims.
- Vibration monitoring at construction sites and within community settlements and other sensitive receptors within the Project area shall be conducted on at least a quarterly basis, with monitoring results reported to evaluate the effectiveness of mitigation measures and inspections undertaken.

Residual Significance. Where the above mitigation measures consistently and effectively can reduce the vibration impact on sensitive receptors from the Project's construction activities from Medium to **Low significance**. Additionally, this impact would be temporary and reversible once construction concludes.

Note: the most at-risk location is Point 1 (STA 0–10), where the nearest residential receptor is 80 meters away. Under the worst-case Scenario 1 (with impact pile hammer), the predicted PPV at this receptor is 0.56 mm/s, which is 28% of the 2 mm/s MoE residential standard. This level is considered distinctly perceptible according to the FTA human annoyance scale (which has a threshold of 0.71 mm/s), but it remains below the strongly perceptible threshold of 1.41 mm/s. With enhanced controls such as restricted working hours, advance community notifications, and real-time monitoring with a stop-work threshold, this residual impact is deemed acceptable under the AIIB ESF and MoE Decree No. 49/1996.

7.2.4 Soil Erosion and Consolidation

Risks and Impacts Assessment. – Soil Erosion and Consolidation. Soil layers, including topsoil, are expected to be exposed to erosion, compaction, and contamination because of land clearing, cut and fill activities, and leveling across roughly 892.49 hectares. These activities aim to create stable ground and foundation suitable for the toll road and associated infrastructure. Land clearing will remove vegetation and roots, leaving the soil exposed and vulnerable to erosion and to being washed into nearby streams and rivers during heavy rains.

To assess potential soil erosion within the area of influence, project catchment areas – located within the Batanghari watershed – are delineated using the National Topographic Map of Indonesia (Peta Rupabumi Indonesia, RBI) published by the Geospatial Information Agency (BIG), supplemented by Digital Elevation Model (DEM) data. Two major water crossings are identified, i.e., Sungai Pijoan at STA 01+975 and Sungai Batanghari at STA 16+050. The characteristics of these two rivers are presented in Table 78.

Table 78 Catchment Area Characteristics

STA	River / Feature	Catchment Area (km ²)	Main River Length (km)	Avg. Width (m)	T _c (hr)
01+975	Sungai Pijoan	19.74	9.202	–	2.934
16+050	Sungai Batanghari	3,772.39	603.663	500	636.1

Source: Hydrology Report (Laporan Akhir Perencanaan Hidrologi dan Drainase, DED Jalan Tol Ruas Jambi – Rengat Seksi 1 STA 0+000 s/d STA 40+000), PT Maratama Cipta Mandiri (February 2022).

Soil erosion has several key effects, such as reducing arable land, blocking waterways, contaminating soil through hydrocarbon spills or leaks, and causing sediment buildup in water bodies which can lead to localized flooding during heavy rainfall. Additionally, loose soil can become airborne, temporarily raising particulate levels in the air around the Project area.

Table 79 presents the predicted soil erosion rates for the Pijoan and Batanghari River watersheds, both with and without the Project. The results show a significant increase in soil erosion, from approximately **14.64 tons/ha/year** without the Project to **48.81 tons/ha/year** with the Project—more than three times the baseline level. These estimates are based on hydrological data from the 2020 Basic Design Report.

Table 79 Estimated Soil Erosion Rate — Pijoan and Batanghari River Watersheds

Watershed	Toll road area in relation to the watershed (km ²)	Without Toll Road Project		With Toll Road Project	
		Land Cover Factor	Erosion (tons/ha/year)	Land Cover Factor	Erosion (tons/ha/year)
Pijoan River	0.20	0.30	10.55	1.0	35.18
Batanghari River	3.80	0.30	4.09	1.0	13.63
Total			14.64	-	48.81

Source: Draft Andal of Jambi – Rengat Toll Road (PT. Dianzani Utama Konsultan, 2024).

The soil impact due to the Project's construction activities, including the operation of ancillary facilities comprising access roads to construction sites, quarries, and concrete batching plants, is evaluated as **Substantial significance** in the absence of mitigation measures. Where related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual significance of the soil impact can be reduced to **Moderate significance**.

**Table 80 Soil Erosion and Consolidation Risk and Impact Assessment —
Construction Phase**

Impact	Receptor sensitivity	Identified impact	Baseline (ton/ha/yr)	Impact magnitude (ton/ha/yr)	Impact extend	Remark
Soil erosion due to Soil compaction, erosion and contamination	Biodiversity Sedimentation	Direct	14.64	48.81	Along water catchment near alignment of the Jambi – Rengat Toll Road at segment Sp. Ness to Merlung.	

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Soil compaction, erosion and contamination	Major	Possible	Substantial	Moderate	Possible	Moderate

Mitigation Measures. To ensure that soil impacts within the Project area are reduced to an acceptable residual level, the Project is recommended to implement at least the following mitigation measures:

- Prior to commencement of construction activities, an adequate hydrological investigation including necessary project-specific fieldwork shall be conducted by competent personnel to understand hydrological regimes, soil erosion rates, and compaction characteristics specific to the Project area.
- Land clearing, including removal of vegetation and subsurface soils, shall be conducted in a gradual manner and restricted to areas immediately required for construction activities. Extensive land clearing shall be prioritized during dry weather conditions to minimize erosion of exposed soil layers during rainfall events.
- Revegetation or planting of fast-growing groundcover vegetation shall be conducted on disturbed areas or exposed soils that are no longer required for toll road construction or related structures.
- Natural materials shall be used for embankment and slope stabilization in combination with gabions, rather than relying entirely on concrete structures.
- Temporary water channels shall be created at construction sites along the toll road alignment on both sides of the road to channel surface water flows during rainfall events. Side channels shall be equipped with sediment traps to reduce river water pollution and sedimentation.
- The time gap between excavation, stockpiling, and backfilling of soils, as well as the disposal of spoils at erosion-prone areas, shall be minimized.
- Swales, terraces, and slope strengthening structures shall be constructed in steep terrain areas, and terraced water channels shall be created to reduce erosion and landslides.

- Roadside drainage channels and culverts or box culverts with adequate capacity shall be constructed to channel surface water flows away from interim soil and spoil stockpiles, particularly during the rainy season.
- Storage of construction materials in close proximity to drainage channels shall be avoided.
- Soil condition monitoring including visual inspections of erosion-prone areas, sediment traps, and drainage channels shall be conducted on at least a quarterly basis during construction, with monitoring results reported to evaluate the effectiveness of mitigation measures.

Residual Significance. When the above mitigation measures are applied consistently and effectively, the soil impact on Project-affected areas caused by construction activities can be lowered from Substantial to **Moderate** significance. It is important to note that some soil impacts, especially topsoil loss and compaction, are partly irreversible and may continue after construction ends. This residual impact highlights the need for timely and effective revegetation and slope stabilization efforts during the entire construction period.

7.2.5 Runoff and Surface Water Quality Impact Assessment due to Earthwork Activities

Risks and Impacts Assessment. Earthworks activities – land clearing, cut and fill, land preparation, and compaction – will take place over a 892.49-hectare area for at least 18 months. These activities, involving vegetation removal and soil compaction from vehicle movement, could lead to increased runoff, sedimentation, and TSS in the vicinity streams and rivers, especially during the rainy season. The estimated runoff discharge, sedimentation, and TSS to nearest rivers (i.e., Pijoan and Batanghari) are calculated by assuming that the ROW footprint as the catchment. Accordingly, the catchment geometries from STA 0+000 to 67+450 are delineated as shown in Table 81.

Table 81 Catchment geometry of Pijoan and Batanghari Rives from STA 0+000 to 67+450

STA Range	River	Road Length (m)	ROW (m)	ROW Area (m)	Slope (%)	CN - construction	K soil
STA 0-5	Pijoan	5.00	100	50	5.2	91	0.22
STA 5-20	Batanghari	15.00	100	150	8.7	91	0.22
STA 20-50		30.00	100	300	17.6	88	0.32
STA 50 - 67		17.45	100	175	40.4	85	0.35

Table 82 shows that the background water discharge in the Pijoan and Batanghari rivers is 78.77 m³/s and 1,327 m³/s, respectively. Whilst the erosion rate in Pijoan river is 35.18 ton/ha/yr, and 13.63ton/ha/yr in Batanghari river. Taking into account the rivers' geometry, including river discharges, combined hydrological methods are used to estimate runoff from construction activities flowing into nearby rivers. These adopted methods include the SCS-CN (Soil Conservation Service Curve Number) to estimate peak runoff discharges and TSS load from the Pijoan River ROW area (STA 0+000 to 5+000), and Rational Method for the Batanghari ROW area (STA 15+000 to STA 67+450) (Table 82).

Table 82 Estimated Runoff Discharge and TSS from ROW

Return Period	STA Segment	River	Erosion Rate (ton/ha/yr)	Qrunoff – ROW (m ³ /s)	Est. TSS in Runoff (mg/L)	Mixed TSS in River (mg/L)*
Q2	STA 0–5	Pijoan	35.18	15.51	3,850.72	649.85

Return Period	STA Segment	River	Erosion Rate (ton/ha/yr)	Qrunoff – ROW (m³/s)	Est. TSS in Runoff (mg/L)	Mixed TSS in River (mg/L)*
Q2	STA 15–67	Batanghari	13.63	151.04	3,652.24	410.51
Q10	STA 0–5	Pijoan	35.18	20.1	4,548.39	939
Q10	STA 15–67	Batanghari	13.63	228.36	4,225.29	655.04
Q25	STA 0–5	Pijoan	35.18	22.3	4,832.75	1,080
Q25	STA 15–67	Batanghari	13.63	267.27	4,475.30	784.55

*TSS baseline levels are recorded at 20 mg/L for the Pijoan River and 41 mg/L for the Batanghari River.

The potential maximum runoff discharges in the ROW areas are 22.3 m³/s from STA 0 to 5, and 267 m³/s from STA 15 to 67 m³/s. These runoff discharge potentially washes soil and contamination to the nearest water bodies (i.e., Pijoan and Batanghari rivers).

Table 82 shows potential maximum suspended solids generated directly from the construction runoff can reach up to 4,832.75 mg/L. Once this runoff is discharged and diluted into the receiving water bodies (see equation below), the total TSS concentrations are estimated to peak at 1,080 mg/L in the Pijoan River and 784.55 mg/L in the Batanghari River.

$$TSS_{total} = \frac{(Q_{river} \times TSS_{baseline}) + (Q_{runoff} \times TSS_{runoff})}{Q_{river} + Q_{runoff}}$$

Where TSS total : mixed TSS concentration, Qriver is river discharge, TSS baseline is initial TSS concentration, Qrunoff is surface runoff discharge, and TSS runoff is TSS concentration in the surface runoff.

Compared to baseline levels of 20 mg/L (Pijoan) and 41 mg/L (Batanghari), and the GR No. 22/2021 Class III standard (100 mg/L), these levels are significantly above the permissible threshold. However, during major Batanghari floods (Q₅₀–Q₁₀₀, estimated >30,000 m³/s,), mixed TSS would be approximately 65 mg/L, within 100mg/L standard.

Table 83 Estimate Peak Discharge Design Floods

Return Period	STA Segment	River	Catchment Area (km²)	Peak Discharge Qpeak (m³/s)	Notes
Q50 (design)	01+975	Pijoan River	19.74	115.131	Rational Method (full watershed); design basis for box culvert
Q100 (design)	01+975	Pijoan River	19.74	146.624	Snyder HSS (full watershed); design basis for bridge & pileslab
Q50 (design)	16+050	Batanghari River	3,772.39	457.205	Snyder HSS (3 sub-watersheds); bridge design discharge

Source: Design flood values (Q50, Q100): Laporan Akhir Perencanaan Hidrologi dan Drainase, DED Jalan Tol Ruas Jambi – Rengat Seksi 1 (PT Maratama Cipta Mandiri, 2022).

In addition to the high estimated TSS concentration, rainfall over the construction area can increase runoff into nearby water bodies and wash contamination from the vicinity of the construction area, including ROW, to the nearest rivers. This runoff may affect low-lying communities along the Batanghari and Pijoan riverbanks in three regencies near the project site, as it can carry additional pollutants that may affect community health.

In 2016 and 2019, the affected regencies experienced significantly higher levels of diarrhea than the overall Jambi province. Additional pollution in these rivers could increase the risk of waterborne diseases, despite a 25% reduction in diarrhea cases from 2016 to 2019. Although no protected riparian biodiversity or aquatic species were observed in the Batanghari and Pijoan Rivers near the project area during surveys, increased runoff, sediment, TSS, and pollutant loads may generate impacts on riparian flora and fauna, as well as common aquatic life such as nekton, diatoms, and plankton. This, in turn, can affect ecosystem services essential for local communities engaged in aquaculture or fishing in these rivers, given that 546 affected households work in the aquaculture and plantation sectors.

Table 84 Runoff and Surface Water Quality — Construction Phase

Impact	Receptor sensitivity	Identified impact	Baseline (mg/L)	Impact magnitude	Impact extend
Decrease of water quality, due to runoff discharge from construction area during earthwork activities	Community health Community income from Ecosystem services Aquatic biota and riparian biodiversity	Indirect	Baseline TSS levels of 20 mg/L for the Pijoan River and 41 mg/L for the Batanghari River.	Runoff discharges ranging from 15.51 m ³ /s to 22.3 m ³ /s in the Pijoan River and from 151.04 m ³ /s to 267.27 m ³ /s in the Batanghari River. After runoff is discharged and diluted into the receiving water bodies, the total TSS concentrations are estimated to peak at 1,080 mg/L in the Pijoan River and 784.55 mg/L in the Batanghari River.	Limited to catchment area near alignment of the Jambi – Rengat Toll Road at segment Sp. Ness to Merlung.

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Soil compaction, erosion and contamination	Major	Likely	High	Moderate	Likely	Substantial

Based on the above, the surface water impact due to the Project's construction activities is evaluated as Moderate in terms of its severity and Likely in terms of its likelihood to occur. Therefore, in the absence of mitigation, the impact significance is **High**. However, even with the implementation of standard mitigation measures, the **residual impact** on surface water resources remains a **Substantial** risk due to the scale of earthworks, requiring consistent and effective monitoring and adaptive management.

Mitigation Measures. Erosion and Sediment Control Plan (ESCP) and washout pollution prevention are mandatory prior to and during earthworks activities, which include:

- **Runoff Management.** Install clean water diversion berms or trenches upstream of the construction footprint to prevent off-site stormwater from flowing across exposed soil.
- **Phased Land Clearing.** Limit the total area of active bare soil at any one time to a maximum of 50 ha. Sequential clearing should proceed in defined construction packages aligned with

actual earthwork progress. Cleared areas awaiting further work must be stabilized within 14 days of initial clearing.

- **Sediment Retention Ponds (SRP).** Install SRPs at all stormwater discharge points draining into the Pijoan and Batanghari watercourses. SRPs must be designed to achieve a minimum 70% TSS removal efficiency prior to release, sized using the minimum 10-year storm event, and desilted when 50% of design volume is filled. A minimum of one SRP per 50 ha of active earthworks area is recommended.
- **Perimeter Silt Fencing and Check Dams.** Install geotextile silt fencing along all drainage channels and the downslope perimeter of active clearing areas. Install rock check dams in natural drainage lines at intervals not exceeding 100 m in areas with slopes greater than 10%.
- **Re-vegetation and Ground Stabilization.**
 - Revegetation shall be conducted in a phased and gradual manner restricted to areas immediately required for construction activities.
 - Apply hydroseeding or biodegradable erosion control matting on all cut slopes and finished earthwork surfaces within 14 days of final grade.
 - A re-vegetation species list compatible with local soil conditions must be included in the ESCP. Natural materials shall be used for embankment and slope stabilization in combination with gabions, rather than relying entirely on concrete structures.
- **Seasonal Scheduling.**
 - All high-volume cut-and-fill operations involving slopes greater than 15% must be scheduled outside of the peak rainfall season (October–March) to the maximum extent practicable. Where wet-season works are unavoidable, enhanced silt controls (double silt fencing, enlarged SRP capacity) must be deployed.
 - Earth-moving and civil work activities within rivers, streams, and other water bodies shall be closely supervised by qualified personnel throughout the construction phase.
- **Wastewater, Hazardous Material and Vehicle Pollution Control.**
 - All vehicle washing, concrete washout, fuel storage areas, and vehicle refueling and maintenance areas must be located at least 100 m from any natural watercourse.
 - Oil, fuel, and other hazardous material containment must be provided around fuel storage with waterproof floors, roofing, restricted access, and a drainage system connected to an oil-water separator.
 - Wastewater and mud generated from concrete batching plant operations and washing of cement trucks shall be managed using settling ponds with periodic removal of sludge for safe disposal.
 - Any leaks from construction vehicles and equipment shall be repaired immediately.
 - Surface water quality monitoring at representative sampling points along the toll road alignment shall be conducted on at least a quarterly basis during construction, with monitoring results reported to evaluate the effectiveness of mitigation measures.
- **TSS Trigger-Based Adaptive Management.** Establish downstream TSS monitoring stations at the Pijoan River (immediately downstream of STA 0–5 discharge zone) and Batanghari River (downstream of STA 20–67 earthworks area). If TSS exceeds 200 mg/L at the monitoring station for two consecutive readings, earthwork operations in the contributing sub-catchment must be suspended until readings return to below 100 mg/L.

A corrective action report must be submitted to AIIB within 5 business days of any exceedance trigger.

7.2.6 Water Resources

Risks and Impacts Assessment. Construction activities and ancillary operations include the construction of a toll road, interchanges, access roads, pavements, bridges, overpasses/underpasses, and culverts, as well as the operation of a batching plant, workers' accommodations, and site offices. These activities will require a continuous water supply, estimated at approximately 142.5 m³/day for construction purposes (see Table 85).

The Hydrological Basic Design Report indicates that the average discharges of the Pijoan and Batanghari rivers are 78.77 m³/s and 1,327 m³/s, respectively. Maintaining the ecological baseflow (estimated at 20% of average discharge) is crucial for aquatic life and overall ecosystem health. Furthermore, water requirements for downstream agriculture are estimated at 40% of the available discharge, equating to 31.51 m³/s for the Pijoan River and 530.80 m³/s for the Batanghari River. After accounting for ecological and agricultural needs, the remaining available surface water flow is approximately 31.51 m³/s for the Pijoan River and 530.80 m³/s for the Batanghari River.

The estimated water consumption from these rivers totals 171.4 m³/day (approximately 0.002 m³/s or 2.0 L/s) for both construction and community domestic use (see Table 85). This extraction rate represents less than 0.01% of the remaining available flow in the Pijoan and Batanghari Rivers. Considering these metrics, both rivers have sufficient capacity to meet the Project's water needs without compromising ecological baseflows or agricultural demands.

Table 85 Estimated Water Consumption

Purpose	Description	Total Water Needs	References
Construction of the Project	Dust suppression and washing	20 m ³ /day	Section 2.4.7 - 10 m ³ /day/contractor (assuming 2 contractors)
Construction of the Project	Workers' basecamp	20 m ³ /day	Section 2.4.7
Construction of the Project	Batching plant (mixing)	87.5 m ³ /day	Mixing water: typical water need is 150 – 200 L/m ³ of concrete ¹ , assuming 500m ³ . Water requirement is 87.5 m ³ /day.
Construction of the Project	Batching plant (washing & maintenance)	15 m ³ /day	Estimated at 15-20% of mixing water requirements (approx. 300-500 L per mixer truck).
Estimated total project abstraction need		171.4 m³/day	Equivalent to ~0.002 m³/s or 2.0 L/s.
Community water consumption	496 male require of 19.84 m ³ /the day and 151 female of 9.06 m ³ /day.	28.9 m ³ /day	NHCR Guidelines recommend 60 L/person/day for women, while IFC guidelines specify 40 L/day.
Ecological baseflow	Ecological baseflow for Pijoan river is 15.75 m ³ /s, and Batanghari river is 265.4 m ³ /s.	281.12 m ³ /s	20% of average discharge

Purpose	Description	Total Water Needs	References
Downstream agriculture	Estimated require water for agriculture is 530.8 m ³ /s, and 31.51 m ³ /s, for Pijoan and Batanghari rivers, respectively.	562.31 m ³ /s,	40% of available water discharge

¹SNI 7656:2012 and ACI 211.1-91 (American Concrete Institute)

Table 86 Impact Assessment of Water Abstraction during Construction Phase

Impact	Receptor sensitivity	Identified impact	Baseline (mg/L)	Impact magnitude	Impact extend
Decrease of water resource quantity during construction	Community health Ecosystem services Aquatic biota and riparian biodiversity	Direct	The average discharges of the Pijoan and Batanghari rivers are 78.77 m ³ /s and 1,327 m ³ /s, respectively	The estimated water consumption from these rivers totals 171.4 m ³ /day (approximately 0.002 m ³ /s or 2.0 L/s) for both construction and community domestic use	Limited to catchment area near alignment of the Jambi – Rengat Toll Road at segment Sp. Ness to Merlung.

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Decrease of water resource quantity during construction	Minor	Rare	Low	-	-	-

Considering the adequate available water resources to support the construction, community water uses, and agriculture needs, the impact is evaluated **Low** significance. However, as a precautionary measure, the project shall implement water resource efficiency in accordance with AIIB ESS 1.

7.2.7 Hydrological Impact from Batanghari Bridge Construction

Risk and Impact Assessment. The project will construct a 1,227-meter bridge at Batanghari River (from STA 15+818 to STA 17+488), a 45.8-meter bridge at Pijoan River (STA 1+96), and toll road overpasses crosscutting water bodies and drainage channels along the alignment.

This construction, particularly the bridge installation at the Batanghari River, may generate significant changes in the flow rate and drainage patterns of surface water. These alterations can affect the quantity and quality of water available to maintain aquatic ecosystems and meet human needs, such as household water supply, agriculture, aquaculture, and recreation. Additionally, physical disturbance to the riverbed will occur during the installation of foundations for both bridges and overpasses along the toll road alignment.

Nonetheless, detailed technical specifications for the bridge construction—including the hydraulics study, the updated DED, and the cross-section of the Batanghari River—were not yet available at the time of ESIA preparation. These data will be essential for refining and accurately assessing the hydrological impacts of the bridge construction. As such, precautionary measures are being implemented at this stage.

To mitigate any potential environmental impacts at the Batanghari River bridge, a balanced cantilever design is adopted to minimize the project footprint of in-river piers. This aims to reduce localized flow

blockage. Additionally, the elevated viaduct structure designated for the approach spans toward STA 17+488 preserves the hydrological connectivity across the wider floodplain.

Despite these design optimizations, large-scale in-river works will introduce temporary hydrological risks during the construction phase. The physical presence of sheet pile cofferdams potentially causes localized channel narrowing, increased flow velocities, and a temporary backwater effect (afflux) upstream. Additionally, boring operations for the foundation piles will structurally disturb the riverbed, which will be the primary driver for elevated Total Suspended Solids (TSS) and downstream sedimentation.

Based on the project assumptions—specifically that construction will be strictly restricted to the dry season, utilizing temporary cofferdams, bored piling methods, and a temporary steel trestle platform—the potential impacts are evaluated as follows:

1. **Seasonal Hydrodynamic Safety Margins:** Restricting in-river construction to the dry season window (April–September) leverages the river's lowest seasonal water levels. While the peak design discharge for the Batanghari River at STA 15+780 is established at 1,327.00 m³/s, the dry season baseflow recedes significantly to an estimated 300–500 m³/s. This lower baseline stage ensures that active water levels remain well below the 12.53 m structural clearance zone, providing a stable hydraulic safety buffer over the temporary cofferdams.
2. **Blockage Ratio and Velocity Alteration:** The combined physical footprint of the temporary trestle and sheet pile cofferdams (approximately 2 × 10 m by 15 m per pier) will constrict the 200–300 m wide Batanghari River channel by an estimated 8% to 12%. This localized channel encroachment is projected to accelerate flow velocities immediately adjacent to the cofferdam structures by 18% to 25% relative to ambient dry-season baselines. *Note: these values require validation via site-specific cross-sectional bathymetric surveys and final cofferdam detailed designs.*
3. **Upstream Afflux (Backwater Effect):** Based on a conservative application of the Yarnell bridge backwater equation, the calculated channel constriction will trigger a minor hydraulic backwater effect. Given the high width-to-depth ratio and low-gradient energy slope of the Batanghari River channel, the maximum temporary afflux (Δh) immediately upstream of the cofferdams is estimated to range between +5 cm and +15 cm, representing a negligible risk of out-of-bank flooding.
4. **Riverbed Disturbance and Fine Sediment Release:** Mechanical boring into the riverbed will structurally disrupt the cohesive sandy clay matrix characteristic of this river segment. Despite containment inside the sheet pile cells, localized sediment escape will occur during structural interactions, cofferdam dewatering discharges, and initial trestle piling, releasing fine silts and clays directly into the active water column.
5. **TSS Spikes against Ambient Baselines:** Considering the high background watershed erosion rate of 13.63 tons/ha/year, natural baseline TSS in the Batanghari River fluctuates seasonally. Primary data from February 2024 (wet season) recorded a baseline TSS concentration of 41 mg/L, with ambient concentrations typically hitting their lowest levels during the dry season due to reduced surface runoff. During active in-river construction phases, unmitigated boring operations are projected to cause localized, short-term TSS spikes of +150 mg/L to +350 mg/L directly downstream of the drilling zone, creating a highly visible turbidity plume against the clearer dry-season background.

6. **Downstream Plume Dispersion:** Due to the low settling velocity of fine clay and silt particles, a visible turbid suspension plume (>50 mg/L above baseline) will develop. Supported by the strong dilution capacity of the river's baseflow (ranging from 300 m³/s up to 1,327.00 m³/s during transitional flows), this sediment plume is modeled to gradually disperse, with suspended particles settling out completely within a distance of 1.5 km to 2.5 km downstream from the construction zone at STA 15+818.

A summary of the estimated impact magnitude is presented in Table 87

**Table 87 Summary of Impact Magnitude from The Construction of Batanghari Bridge
(STA 15+818 to STA 17+488)**

Hydrological Parameter	Estimated Impact Magnitude (Construction Phase)	Primary Spatial Zone of Influence	Duration / Reversibility
Flow Velocity Change	+18% to +25% local velocity increase	Within 50 m radius of cofferdams	Temporary; fully reversed post-cofferdam removal.
Backwater / Afflux (Δh)	+5 cm to +15 cm upstream rise	Extending 200 m to 500 m upstream	Temporary; fully reversed post-cofferdam removal.
Local Scouring Depth	2.0 m to 3.5 m bed erosion	Immediate perimeter of cofferdam walls. <i>Note: there is potential community flooding risk (particularly for communities along the Batanghari floodplain)</i>	Mid-term; stabilizes during operations via permanent scour protection.
Downstream Sedimentation	5 cm to 15 cm bed deposition	100 m to 300 m directly downstream.	Transient; redistributed by natural river dynamics during subsequent wet seasons.
TSS / Turbidity Increase	+150 mg/L to +350 mg/L spike	Plume disperses within 1.5 km to 2.5 km downstream	Short-term; linked directly to active piling and earth-disturbing hours.

Table 88 Impact Assessment of The Construction of Batanghari Bridge

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Flow Velocity Change	Minor	Likely	Moderate	Incidental	Possible	Low
Backwater / Afflux (Δh)	Moderate	Likely	Substantial	Minor	Likely	Moderate
Local Scouring Depth	Moderate	Likely	Substantial	Minor	Likely	Moderate
Downstream Sedimentation	Moderate	Likely	Substantial	Minor	Likely	Moderate
TSS / Turbidity Increase	Moderate	Likely	Substantial	Minor	Likely	Moderate

The hydrological impact of bridge construction is evaluated as **Moderate** for changes in flow velocity. Residual impacts are expected to stay **Low** with consistent and effective mitigation measures. However, the estimated blockage ratio of 8–12% and the 18–25% increase in flow velocity are based on assumed cofferdam sizes. These figures need validation once the hydraulic study is completed. The

Low residual impact is acceptable only if the cofferdam design is optimized to stay within the assumed blockage range.

Impact generation from Batanghari bridge construction, such as backwater, scour depth, downstream sedimentation, and increases in TSS/turbidity, is **Substantial** in the absence of mitigation measures. Even with standard mitigation measures, residual impacts on local scour depth, downstream sedimentation, and TSS/turbidity will remain **Moderate**. Consistent and effective monitoring and adaptive management are strictly required.

Mitigation Measures.

Required mitigation measures to manage the impacts of the Batanghari Bridge construction on flow velocity alterations include:

- **Hydraulic Study Condition Precedent.** A site-specific Surface Water Management Plan (WMP), including a hydraulic study; bathymetric cross-sections at STA 15+818 to determine the maximum blockage ratio of the active cross-sectional area; low rates and drainage patterns; and site-specific mitigation measures. This study must be completed and reviewed prior to the first cofferdam is installed.
- **Sequential Cofferdam Installation.** Sheet pile cofferdams must be installed in stages, not simultaneously on both sides of the channel. A maximum of one pier per construction stage should be active in the river at any time.
- **Real-Time Upstream Water Level Monitoring.** Install automatic water level gauges at a minimum of 150 m upstream of the active cofferdam. Gauge data must be recorded at 15-minute intervals and made available to the site engineer in real time. If water level rises more than 20 cm above the predicted afflux estimate, works must be reviewed.
- **Emergency Response Plan for Unexpected Flooding.** An Emergency Response Plan must be prepared addressing the scenario of unexpected wet-season flows entering the work zone. This plan must include pre-defined suspension triggers, evacuation routes for in-river workers, and communication protocols with downstream communities.

Mitigation measures to manage the impacts of the Batanghari Bridge construction on upstream afflux/backwater effect include:

- **Floodplain Community Notification.** Prior to in-river works, communities residing in low-lying areas within 500 m upstream of STA 15+818 must be formally notified of the anticipated temporary water level increase. This notification must be documented and included in the stakeholder engagement record.
- **Cofferdam Removal Sequence.** Upon completion of each pier, the cofferdam must be removed within 30 days to restore the original cross-section. The removal sequence must prioritize the downstream side first to avoid sudden hydraulic pressure release.

Mitigation measures to manage the impacts of the Batanghari Bridge construction from local scour depth encompass:

- **Scour Protection Design.** Permanent scour protection must be installed at all in-river piers prior to removal of the cofferdams.
- **Cofferdam Scour Monitoring.** During active cofferdam operation, weekly bathymetric surveys must be conducted immediately adjacent to all cofferdam structures. If observed scour depth

approaches 80% of the predicted maximum, operations must be halted, and the structural engineer consulted.

- **Post-Construction Survey.** A bathymetric survey of the riverbed at all pier locations must be conducted within 3 months after the first wet season following construction to confirm scour stabilization.

7.2.8 Waste Generation

Risks and Impacts Assessment. Construction of the Jambi–Rengat Toll Road will generate multiple categories of waste over the construction period. These include (i) domestic wastewater and solid wastes from contractor base camp operations and remote work sites; (ii) construction solid waste from construction activities; and (iii) hazardous and scheduled waste (B3). These waste generations potentially impact to occupational and community health, given its proximity to the Batanghari and Pijoan rivers and the presence of communities engaged in riverine livelihoods.

Domestic waste water. Total estimated construction workforce is approx. 500 workers (Section 2.2.5.1) with an assumption ~80 – 150 workers are stationed at remote sites along the alignment, with remaining accommodated at contractor basecamp. Applying a standard domestic water consumption reference of 40–60 liters per person per day for construction camp settings, and assuming that 80% of consumed water becomes wastewater, the estimated domestic wastewater generation is approx. 19,360L/day (~19.4 m³/day).

Table 89 Estimated Domestic Waste Water Generation

Location	Wastewater treatment	Workers	Est. Water Use (L/person/day)	Wastewater Generated
Base camps	Blackwater: a modular wastewater treatment system — comprising a bio-filter or bio-septic tank with a seepage system. Greywater: temporary retention ponds for sediment separation and effluent attenuation prior to discharge to nearby water bodies	~420 workers	40L/person/day for male, and 50L/person/day for female	14,448/day (~14.4 m ³ /day)
Remote sites	individual bio-septic tanks and seepage systems	~80 workers	40L/person/day	~2,560 L/person/day (~2.5 m ³ /day)
Total		~ 500 workers		~17,008 L/day (~17.0 m ³ /day)

The total coliform and fecal coliform levels in Pijoan River are 948 MPN/100mL and 560 MPN/100mL, respectively. In Batanghari River, these levels are 1,189 MPN/100mL for total coliform and 872 MPN/100mL for fecal coliform. The estimated potential flow of untreated fecal coliform from basecamp into these rivers is calculated using Chick's Law, as shown in the following equation and data presented in Table 90.

$$C_{ww} = C_0 x e^{-kt} \quad L_{ww} = Q_{ww} x C_{ww}$$

$$C_{mix} = \frac{(Q_{ww}C_{ww} + Q_{runoff}C_{runoff} + Q_{bg}C_{bg})}{(Q_{ww} + Q_{runoff} + Q_{bg})}$$

$$Q_{total} = Q_{ww} + Q_{runoff} + Q_{bg}$$

$$Load_{ww} = \frac{Q_{ww}}{C_{ww}}$$

Where C = FC concentration at distance d (MPN/100mL), C₀=Initial FC concentration (MPN/100mL), k = First-order die-off rate constant (/day), t = Travel time (days) = d / (v x 86,400), d = Distance from source to river (m), v = Channel flow velocity (m/s), Q_{ww} = Wastewater flow rate (m³/s), C_{ww} = FC concentration in wastewater after die-off (MPN/100mL), Q_{runoff} = Construction stormwater runoff discharge (m³/s), C_{runoff} = FC concentration in stormwater runoff (MPN/100mL), Q_{bg} = Background river discharge (m³/s), C_{bg} = Background FC concentration (MPN/100mL).

Table 90 Input Parameters

No	Parameter	Value	Basis / Reference
1	C ₀ – Initial FC concentration (raw wastewater)	10 ⁷ MPN/100mL	APHA (2017)
2	k – First-order die-off rate	1.5 /day	Tropical surface water; Mara & Cairncross (1989)
3	v – Drainage channel velocity	0.5 m/s	Typical construction site drainage channel
4	Distance (basecamp to river)	2,000 m	Map 8
5	Travel time t = 2000 / (0.5 x 86,400)	0.0463 day	Calculated
6	C _{runoff} – FC in construction stormwater	2,000 MPN/100mL	Conservative estimate; equals PP 22/2021 Class III threshold
7	C _{baseline} in Batanghari Sta. 1	1,189 MPN/100mL	Table 40
8	C _{baseline} in Batanghari Sta. 2 / Pijoan proxy	872 MPN/100mL	Table 40
9	Q _{background} Pijoan River	78.77 m ³ /s	Table 39
10	Q _{background} Batanghari River	1,327 m ³ /s	Table 39
11	Maximum Q runoff ROW to Pijoan River	22.3 m ³ /s	Table 80
12	Maximum Q runoff ROW to Batanghari River	267 m ³ /s	Table 80
13	Minimum Q runoff ROW to Batanghari River	151.04 m ³ /s	Table 80
14	Minimum Q runoff ROW to Pijoan River	15.51 m ³ /s	Table 80

The estimated Fecal Coliform (FC) is calculated under a worst-case scenario where the untreated FC is washed by maximum runoff. The estimated runoff FC concentration in the river bodies – Pijoan and Baranghari rivers—shows the following results:

- The Pijoan River at STA 01+975 receives construction runoff from the 50 ha ROW area (STA 0+000 to STA 5+000). Two runoff scenarios are evaluated for the Q2 and Q25 return-period storms. Under the Q2 return-period storm, the runoff FC concentration is 1,080 MPN/100mL. During the Q25 return-period storm, the runoff FC concentration in this river is 1,142 MPN/100mL.
- The Batanghari River receives construction runoff from the ROW between STA 5+000 and STA 67+450 (catchment area: 150–175 ha). Two runoff scenarios (minimum Q_{runoff} = 151.04 m³/s, and maximum Q_{runoff} = 267.27 m³/s) are applied. The estimated runoff FC concentration in

Batanghari river under minimum and maximum runoff discharge is 989 MPN/100mL and 1,062 MPN/100mL.

The results show that the runoff fecal coliform (FC) concentration is below the national standard (GR 22/2021), which sets a maximum FC concentration of 2,000 MPN/100 mL. Given that two rivers support riverine communities engaged in aquaculture (546 households identified), riverine communities depend heavily on surface water from these rivers and its tributaries for domestic use, and that there were 28,462 reported diarrhea cases in 2016, an additional 208–207 MPN/100 mL of FC in these water bodies could have a significant impact on public health.

Table 91 Impact Assessment of Increase of Pollutant Discharge in Water Bodies – Construction Phase

Impact	Receptor sensitivity	Identified impact	Baseline	Impact magnitude	Impact extend
Increase of pollutant discharged from basecamp facilities to water bodies near the project area during construction	Surface water quality Community health Ecosystem services Aquatic biota	Direct	Baseline fecal coliform is 1,189 MPN/100mL in Baranghari river and 872 MPN/100mL in Pijoan river	During the Q25 return-period storm in Pijoan river, the runoff FC concentration in this river is 1,142 MPN/100mL. The estimated runoff FC concentration in Batanghari river under maximum runoff discharge is 1,062 MPN/100mL	Limited to catchment area near alignment of the Jambi – Rengat Toll Road at segment Sp. Ness to Merlung.

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Increase of pollutant discharged from basecamp facilities to water bodies near the project area during construction	Major	Likely	High	Minor	Likely	Moderate

Impact significance generated by increase of pollutant discharged from basecamp facilities to water bodies near the project area during construction, such as backwater, scour depth, downstream sedimentation, and increases in TSS/turbidity, is **High** in the absence of mitigation measures. Even with standard mitigation measures, residual impacts on increases pollutant will remain **Moderate**. Consistent and effective monitoring and adaptive management are strictly required.

Mitigation Measures. The following mitigation measures shall be conducted consistently and effectively, including:

- Eliminate the surface runoff FC pathway first.
 - Upgrading the septic system without addressing the stormwater FC pathway will have minimal measurable effect. Intercepting FC-laden site runoff before it enters drainage channels.

- Install sediment retention ponds (SRPs) of Q25 design with a minimum 4-day hydraulic retention time at every stormwater discharge point draining to Pijoan or Batanghari.
- Two-stage treatment at the base camp
 - Install single bio-septic tank meeting SNI 2398:2017 reduces FC from $\sim 10^7$ to approximately 10^4 – 10^5 MPN/100mL, which is still several orders of magnitude above Class III.
 - Add a **constructed wetland polishing cell** (gravel-bed, minimum 4-day retention) downstream of the septic outlet.
 - Sewage and wastewater from worker accommodation facilities shall be treated using a modular wastewater treatment system and a filtered seepage system prior to any discharge.
- Reclassify remote sites as high-risk and treat accordingly
 - The document allocates only individual bio-septic tanks and seepage systems for the 80 remote-site workers. On low-permeability clay soils within the floodplain, seepage systems are largely ineffective — effluent will surface-pool and enter drainage channels as overland flow.
 - Replace seepage systems at floodplain-adjacent remote sites with **sealed holding tanks emptied on a weekly schedule** to the main basecamp treatment system.
 - At elevated remote sites (>20 masl, outside floodplain), urine-diversion dry toilets (UDDTs) are an appropriate and maintenance-light alternative.
- Wet-season contingency: temporary chlorination buffer at drainage outfalls
 - During peak wet-season months (November–February), when stormwater FC loading is highest, deploy **portable chlorination dosing units** at the SRP outlets feeding Pijoan and Batanghari.
- Wastewater and mud generated from concrete batching plant operations and washing of cement trucks shall be managed using settling ponds with periodic removal of sludge for safe disposal.
- Contractor basecamps, workshops, and materials storage areas shall be equipped with a perimeter drainage system and settling pond.
- Surface water quality monitoring at representative sampling points along the toll road alignment shall be conducted on at least a quarterly basis during construction, with monitoring results reported to evaluate the effectiveness of mitigation measures.

Solid domestic waste. Domestic solid waste generation from the contractor's base camp is estimated at approximately 2.0 litres per person per day, equivalent to approximately 0.30 kg per person per day. Based on a base camp population of approximately 500 workers or permanent residents, the estimated daily domestic solid waste generation is: $\sim 1 \text{ m}^3/\text{day}$ ($\sim 150 \text{ kg/day}$). Domestic waste will be temporarily stored in 20- to 40-liter labeled containers at the base camp prior to collection and transport to a government-approved disposal facility.

Nonetheless, since base camps are located within or adjacent to the Batanghari floodplain, leachate from improperly stored organic waste (i.e., food leftovers) could reach surface water during rainfall events. Daily generation of approximately 300 kg of domestic waste from 500 base camp workers is a manageable volume provided that collection, temporary storage in appropriate containers, and

transport to the potential disposal site in Batang Asam District are consistently implemented. The risk escalates during periods of delayed waste collection or when the transport route to the disposal site is disrupted by wet-season road conditions.

Construction solid waste. Construction activities will generate the following primary solid waste streams:

- *Spoil material* – Excavated earthworks from cut operations, unsuitable fill materials, and cleared vegetation and topsoil. Given the scale of the 892.49 ha earthworks area, spoil volumes are expected to be significant and will require designated spoil disposal or reuse sites.
- Construction debris – Concrete offcuts and over-poured waste, steel reinforcing bars that fail quality or specification requirements, used timber formwork and planks.
- Packaging waste – Cement bags, chemical containers, wrap and packing materials from delivered construction materials.

However, solid waste can be exacerbated by stockpiling spoil in unstable areas prone to erosion and runoff; informal dumping of construction debris into drainage channels, rivers, or low-lying land; and burning of timber formwork or packaging.

Increased sedimentation in drainage channels and watercourses from spoil runoff; landscape degradation; potential drainage blockage causing localized flooding near communities or agricultural land.

Spoil management represents the highest-volume construction waste stream. Without designated and engineered spoil disposal sites, and without a formal Spoil Management Plan, the risk of uncontrolled disposal is high. Steel and concrete waste present lower risk volumes but must be managed to avoid river obstructions particularly near the Batanghari and Pijoan bridge crossings.

Table 92 Impact Assessment of Increase of Solid Waste during Construction Phase

Impact	Receptor sensitivity	Identified impact	Baseline	Impact magnitude	Impact extend
Increase of solid waste from worker's base camp and construction activities	Surface water quality Community health Ecosystem services Aquatic biota	Direct	No solid waste from worker's base camp and construction activities as construction hasn't been started	Solid waste generation of 150 kg from domestic blackwater and spoil generation of 892.49 ha from earthworks are manageable volumes with proper containerization and transportation.	Limited to catchment area near alignment of the Jambi – Rengat Toll Road at segment Sp. Ness to Merlung.

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Increase of solid waste from worker's base camp and construction activities	Moderate	Likely	Substantial	Minor	Likely	Moderate

Impact significance from increase of solid waste from worker's base camp and construction activities is **substantial** in the absence of mitigation measures. Consistent, effective, and proper management of mitigation measures will reduce the impact significance to Moderate.

Mitigation Measures. The following mitigation measures shall be conducted consistently and effectively, including:

- Secure spoil disposal sites before earthworks commence —construction pre-condition: The contractor should be contractually required to identify, permit, and construct at least two engineered spoil disposal sites with perimeter berms, lined surface drainage, and vegetated cover within 90 days of mobilisation — and prohibited from commencing cut operations on any segment until the disposal site is operational.
- Seal the waste transport chain against wet-season disruption: prepare a wet-season contingency waste storage plan specifying: maximum on-site retention time for organic waste (24 hours), elevated storage platforms (minimum 0.5 m above flood level) at all floodplain-adjacent sites, and a pre-identified secondary licensed facility within 50 km as
- Zero informal disposal enforcement, particularly nformal dumping into drainage channels or rivers

Hazardous waste. Hazardous waste arising from construction operations includes, but is not limited to:

- Used lubricant and engine oil from heavy equipment maintenance;
- Contaminated fuel filters, oily rags, and absorbent materials;
- Used vehicle batteries;
- Chemical containers, paint residues, and solvent waste; and
- Infectious clinic waste: used medicine packaging and bandages generated by the on-site first-aid or health clinic; and
- Spillage, leakage, or improper disposal of used oils, lubricants, chemical containers, or battery acid from the equipment maintenance yard or B3 storage area.

The primary risk pathway is surface lateral transport. The area that traverse floodplains at elevations of 5 to 20 masl, with moderate slopes ranging from 0° to 16°, and low-permeability clay soils, such as Batanghari floodplain will limit vertical infiltration. As such, uncontained spillage from maintenance yards and hazardous storage areas will mobilise as surface runoff into drainage channels during rainfall, with potential secondary loading to the Batanghari River. Petroleum hydrocarbons and heavy metals from battery acid and lubricants represent a persistent near-surface contamination source at these locations. Co-mingling of infectious clinic waste with general domestic solid waste creates a separate biological exposure pathway for waste handlers and adjacent communities.

Table 93 Impact Assessment of Increases of Hazardous Waste during Construction Phase

Impact	Receptor sensitivity	Identified impact	Baseline	Impact magnitude	Impact extend
Increase of hazardous waste from construction activities and operation of ancillary facilities	Community health	Direct	Table 46 on Surface Water Quality	Uncontained spillage from maintenance yards and hazardous storage areas will mobilise as surface runoff into drainage channels during rainfall, including infectious clinic waste.	Limited to catchment area near alignment of the Jambi – Rengat Toll Road at segment Sp. Ness to Merlung.

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Increase of hazardous waste from construction activities and operation of ancillary facilities	Minor	Possible	Moderate	Incidental	Possible	Low

Impact significance from increase of hazardous waste from worker's base camp and construction activities is **Moderate** in the absence of mitigation measures. Consistent, effective, and proper management of mitigation measures will reduce the impact significance to **Low**.

Mitigation Measures. The following mitigation measures shall be conducted consistently and effectively, including:

- Secure spoil disposal sites before earthworks commence —construction pre-condition: Oils, fuels, and other hazardous materials shall be stored separately from other materials in bunded areas with waterproof floors, roofing, restricted access, and a drainage system connected to an oil-water separator.
- Appropriate spill response equipment shall be maintained at construction sites and materials storage areas at all times.
- Any leaks from construction vehicles and equipment shall be repaired immediately.
- Surface water quality monitoring at representative sampling points along the toll road alignment shall be conducted on at least a quarterly basis during construction, with monitoring results reported to evaluate the effectiveness of mitigation measures.
- Manifested hazardous transport on a fixed schedule — Indonesian PP 101/2014 requires B3 waste to be stored no longer than 180 days.

7.2.9 Groundwater Resources

Risks and Impact Assessment. The Project's construction activities, primarily land clearing, cut and fill, and modification of an estimated **892.49 hectares** of land required for the construction of the toll road, its right-of-way, and related infrastructure, will result in hydrogeological impacts on groundwater resources within the affected areas. These impacts include, among others: a reduction in groundwater table levels affecting water quality and availability; disruption to groundwater flow

patterns causing water to discharge vertically rather than horizontally; and the risk of aquifers becoming disconnected, with the potential for reduced quality and yield.

Hydrogeological information specific to the Project area, as presented in Section 5.1.8 of this ESIA, is currently limited to publicly available information on the general hydrogeological regime of the Jambi area and spot groundwater sampling at selected wells representing the toll road alignment. The Project area is underlain by rare to localized aquifers and moderately productive aquifers of wide distribution, with groundwater levels generally encountered at depths of more than 15 meters below the ground surface and discharge rates of less than 5 liters/second. Groundwater abstraction is anticipated to occur to supply clean water requirements for contractor basecamps, worker accommodation, and concrete batching plants during the construction phase (see Table 94).

Uncontrolled groundwater pumping could result in water resource depletion and reduced water quality. Improper management of solid and household-type wastes, including open dumping without secured containment, may generate leachate and other contaminants that could lead to localized soil and groundwater contamination.

Excavation of existing subsurface soils may intercept groundwater tables, requiring dewatering to establish the designed slope, stability, and embankment suitable for road construction. Uncontrolled dewatering would lower groundwater levels, potentially affecting the hydrogeological flow regime and water quality in the affected area. Groundwater recharge will also be reduced as water interception and percolation into the ground diminishes following the removal of vegetation and subsurface soils.

The overall impacts on groundwater resources, including changes in infiltration rates, groundwater table, and groundwater yield due to the Project's construction activities, are evaluated as **Substantial significance** in the absence of mitigation measures. These impacts are not unprecedented for toll road construction projects of this scale and can be reduced to **Moderate significance** where related mitigation measures and monitoring plans are implemented in a consistent and effective manner. The summary of the groundwater risk and impact assessment is presented in Table 94.

Table 94 Groundwater Impact Assessment due to Groundwater Abstraction and Earthwork – Construction Phase

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Changes in groundwater table, yield, and quality as well as water infiltration (recharge) to the ground	Major	Possible	Substantial	Moderate	Possible	Moderate

Based on the above, the groundwater impact due to the Project's construction activities is evaluated as **Major** in terms of severity and **Possible** in terms of likelihood, given the partially irreversible nature of hydrological and hydrogeological changes. Accordingly, the groundwater resource impact of the Project is evaluated as **Substantial significance** in the absence of mitigation measures.

Mitigation Measures.

To ensure that groundwater impacts within the Project-affected areas are reduced to an acceptable residual level, the Project is recommended to implement at least the following mitigation measures:

- Prior to commencement of earthworks and civil works, an adequate project-specific hydrogeological study including necessary fieldwork shall be conducted by a competent party to characterize groundwater availability, flow rate, direction, discharge, and quality within the Project-affected areas.
- Based on the above study, a Groundwater Management Plan shall be developed and implemented to minimize impacts on the affected hydrogeological regime and areas subject to earthworks and civil work activities.
- Revegetation or planting of fast-growing groundcover vegetation shall be conducted progressively on disturbed areas or exposed soils that are no longer required for construction activities.
- Solid and liquid wastes and any products containing hazardous substances or high organic and metal content shall not be stored in proximity to groundwater wells. These materials shall be stored in secured containers and designated areas equipped with adequate roofing, secondary containment, and warning signage in compliance with applicable regulations on hazardous materials and waste management.
- Standard operating procedures for managing solid and liquid wastes, both hazardous and non-hazardous, shall be developed and communicated to all workers of main contractors and their subcontractors.
- Groundwater quality monitoring at representative sampling points along the toll road alignment shall be conducted on at least a quarterly basis during construction, with monitoring results reported to evaluate the effectiveness of mitigation measures.

Residual Significance. Where the above mitigation measures are implemented in a consistent and effective manner, the groundwater resource impacts due to the Project's construction activities can be reduced from **Substantial** significance to **Moderate** significance. The groundwater impact would be adverse and partly irreversible upon completion of construction activities, given the permanent changes to groundwater recharge patterns resulting from toll road development.

7.2.10 Existing Road Traffic and Related Infrastructure

Risk and Impact Assessment. The mobilization of heavy-duty trucks and heavy equipment transporting construction materials to the Project area will disrupt existing road traffic and may cause damage to existing national and regional roads and related infrastructure. The existing road sections most likely to be frequently used for construction purposes include the roads between Merlung and the Tanjung Jabung Barat Regency border, and between Simpang Tuan and Jambi City..

Construction materials including sand, gravel, wooden planks, and cement will be purchased in bulk quantities from quarries and suppliers selected by the main contractors. Fuel and lubricants will also be procured primarily for refueling heavy equipment and trucks operating far from public fuel stations. These materials will be transported using flatbed haul trucks or road tankers as appropriate, with load capacities of up to 20 tons or more depending on the road class used.

The daily traffic survey conducted as part of the Andal study in 2020 showed traffic flows ranging from **3,189 vehicles/day** (or 111 PCU/hour) along the Merlung to Tanjung Jabung Barat Regency border road to **10,354 vehicles/day** (or 321 PCU/hour) along the Simpang Tuan to Jambi City border road, as presented in Table 95. Peak hours were recorded during mid-morning, late afternoon, and evening periods.

Table 95 Daily Traffic Counting

Road Section	Daily Traffic Rate		PCU/Hour	Peak Hour	Average Vehicle Speed (km/hour)
	No of Vehicle (unit)	Passenger Car Unit (PCU)			
Merlung-West Tanjung Jabung Regency Border	3,189	2,666	111	8.45 - 15.00 / 17.00 - 21.30	50 - 60
Merlung- West Tanjung Jabung Regency Border	3,027	2,646	110		50 - 60
Simpang Tuan-Jambi City Border	9,723	7,323	305	8.45 - 15.00 / 17.00 - 21.30	40 - 50
Simpang Tuan- Jambi City Border	10,354	7,713	321		40 - 50

Source: Draft ANDAL document of Jambi-Rengat Toll Road Project (PT Dianzani Utama Konsultan, 2024)..

Overloaded and frequent movement of project trucks and other heavy vehicles typically operated at relatively slow speeds due to their loads could impede the movement of other road users, causing traffic disruption. Overloaded trucks and the mobilization and demobilization of heavy equipment using vehicles with three or more axles could damage existing roads, particularly where roads have not been upgraded to accommodate the tonnage of the loads.

Beyond physical road damage, construction traffic operating on public roads shared with local communities introduces road safety risks to vulnerable road users including pedestrians, cyclists, and schoolchildren, particularly in settlements and market areas adjacent to the access road corridors. Settlements and community facilities located along the Merlung to Tanjung Jabung Barat border corridor and the Simpang Tuan to Jambi City corridor are exposed to increased risk of vehicle-pedestrian conflicts, road crossing hazards, and dust and noise from frequent heavy vehicle movements. This community exposure dimension requires dedicated assessment and targeted mitigation measures proportionate to the level of risk at each sensitive location.

This impact, if it occurs, would be adverse but reversible upon completion of the Project, as road traffic conditions are expected to return to baseline following road repair and the cessation of construction traffic.

Based on the above, the impact on existing road traffic and road infrastructure is evaluated as **Moderate** in terms of severity and **Possible** in terms of likelihood. Accordingly, this impact is evaluated as **Moderate significance** in the absence of mitigation measures.

**Table 96 Road Traffic and Infrastructure Risk and Impact Assessment —
Construction Phase**

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Disruption to the current road traffic Damage to existing national and regional roads including its infrastructure, such as bridges, culvert boxes, etc.	Moderate	Possible	Moderate	Incidental	Possible	Low

Mitigation Measures. To minimize impacts on existing road traffic and related infrastructure, the Project is recommended to implement at least the following mitigation measures:

- Prior to the commencement of construction traffic on approved haul routes, the Project shall conduct a Community Exposure Assessment to identify settlements, schools, health facilities, places of worship, markets, and other community facilities located within or adjacent to the haul route corridors. The assessment shall evaluate the nature and degree of exposure of community members, including vulnerable groups such as children, elderly persons, and persons with disabilities, to construction traffic hazards.
- Prior to the commencement of civil works, the implementing agency and main contractors shall prepare a Construction Traffic Management Plan (CTMP).
- Prior to heavy equipment mobilization and demobilization activities, contractors and/or implementing agencies shall coordinate with local road and transportation agencies and local authorities to disseminate the transportation and journey management plan of the Project.
- Heavy equipment such as bulldozers, rollers, excavators, and bore pile rigs shall be transported using specialized wide-body and long trucks, selecting road classes appropriate for the load and dimensions involved.
- Transportation of oversize heavy equipment and construction materials shall be regulated, coordinated, and escorted by road authorities and/or relevant agencies responsible for the roads used.
- An emergency response system shall be activated and adequately resourced in the event of vehicle breakdowns or accidents along public roads used for construction purposes.
- Adequate budget allocation for repairing damaged public and private roads to their baseline conditions shall be included in the civil work contracts of main contractors and their sub-contractors.
- Damage to existing roads and related infrastructure, including bridges, crash barriers, and culverts, shall be repaired in a timely manner by the responsible contractor and/or sub-contractors.
- Main contractors shall be required, through contract provisions, to establish internal traffic safety management systems covering driver competency verification, vehicle roadworthiness inspection, fatigue management, and incident and near-miss reporting. Evidence of compliance with these requirements shall be subject to periodic audit by the supervision consultant and reported to the implementing agency.
- All construction drivers and vehicle operators assigned to haul routes passing through or adjacent to community areas shall receive traffic safety induction training prior to deployment, covering applicable speed limits, pedestrian safety protocols, load securing requirements, and emergency response procedures.

Residual Significance. When the above mitigation measures are implemented consistently and effectively, the impacts on existing road traffic and road infrastructure can be reduced from **Moderate** to **Low** significance. The impact would be temporary and reversible upon completion of construction activities.

7.2.11 Impacts to Habitat

Risks and Impacts Assessment. The Critical Habitat Assessment (CHA) was undertaken for the entire Sp. Ness–Merlung Toll Road in 2023. The results of the CHA are reported in detail in a stand-alone report, which should be read in conjunction with this ESIA. The potential habitat impacts associated with the construction of the Sp. Ness–Merlung Toll Road are summarized as follows:

- Increased sediment loads in streams and rivers due to construction earthworks, impacting wildlife and fish stocks in the riparian ecosystem.
- Disturbance and partial loss of riparian vegetation classified as Critical Habitat under IFC PS6, particularly at the Pijoan River and Batanghari River crossings.
- Loss or degradation of habitat and vegetation cover in quarry areas used to supply construction materials.
- Introduction and spread of Invasive Alien Species (IAS) through movement of construction equipment, vehicles, and personnel.
- Potential fire ignition within and beyond the toll road alignment due to construction activities in peatland areas and dry vegetation.

These impacts, including Critical Habitat impacts from the Project's construction activities, are evaluated as Major significance in the absence of mitigation measures, given the identification of Critical Habitat along the toll road alignment, particularly at riparian vegetation crossings at the Pijoan and Batanghari Rivers. The detailed assessment of habitat impacts is presented in the stand-alone CHA Report and the BMP (YAPEKA, 2023 and 2024), both of which should be read in conjunction with this ESIA. When the mitigation measures and monitoring programs defined in the BMP are implemented consistently and effectively, the residual significance of these impacts can be reduced to Moderate significance. The summary of the habitat impact assessment is presented in Table 97.

Table 97. Habitat Risk and Impact Assessment — Construction Phase

Impact	Without Mitigation Measures			With Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Significance	Severity	Likelihood	Residual Significance
Loss or degradation of habitat including Critical Habitat due to construction activities	Major	Possible	Substantial	Moderate	Possible	Moderate

Mitigation Measures. The Biodiversity Management Plan (BMP) has been prepared specifically for the Sp. Ness–Merlung segment as the Phase 1 development of the Jambi–Rengat Toll Road, detailing mitigation measures and monitoring programs to be implemented by the Client. The BMP is presented in a stand-alone report, which should be read in conjunction with this ESIA. Key mitigation measures and monitoring programs defined in the BMP in relation to mitigating potential impacts on habitat include:

- The boundary of the right-of-way within the riparian vegetation zone required for construction shall be clearly delineated on the ground prior to commencement of

construction activities to minimize encroachment beyond the designated construction footprint.

- At unstable locations within the riparian zone, a capillary barrier system (CBS) using a combination of coarse aggregate, geocell, and fine aggregate shall be installed to reduce the potential for soil erosion.
- Riparian vegetation zones disturbed by construction activities shall be replanted using native species upon completion of the relevant construction works.
- Already degraded or non-natural habitats shall be prioritized over natural habitats when siting new quarries to supply construction materials for the Project.
- Mandatory training for workers on the identification and control of invasive alien species shall be conducted prior to commencement of construction activities.
- All tracked and wheeled construction equipment, including trucks, bulldozers, and excavators, shall be cleaned through washing bays installed at construction site entry and exit points to remove dirt and plant material from vehicle wheels and tracks before leaving the site.

Residual Significance. Where the above mitigation measures from the BMP are implemented in a consistent and effective manner, the habitat impact can be reduced from **Substantial significance** to **Moderate significance**. Given the Critical Habitat designation of riparian vegetation at the river crossing locations, ongoing monitoring and adaptive management as defined in the BMP will be essential to ensuring that residual impacts remain at an acceptable level.

7.2.12 Impacts on Species

Risks and Impact Assessment. The potential impacts on wildlife species within the Area of Analysis associated with the construction of the Sp. Ness–Merlung Toll Road are summarized as follows:

- Illegal collection, possession, and trafficking of wildlife species by project workers, particularly given the presence of nationally and internationally protected species within the project area.
- Wild animal collisions with project vehicles and heavy equipment during construction activities.
- Barrier effects to the movement and dispersal of terrestrial animals, particularly wide-ranging species such as Sumatran Tiger and Malay Tapir, due to the physical presence of the toll road alignment and associated construction activities.
- Potential wildlife-human conflict at contractor basecamps and worker accommodation areas, particularly where these are located in proximity to wildlife habitats.
- Wildlife disturbance due to construction noise, the physical presence of large structures, and the installation of power distribution lines along the alignment.

The impacts on wildlife species due to the Project's construction activities are evaluated as **High** significance in the absence of mitigation measures, given the presence of multiple Critically Endangered (CR) and Endangered (EN) species within the Area of Analysis. The detailed assessment of species impacts is presented in the stand-alone CHA Report and BMP (YAPEKA, 2023 and 2024).

When the mitigation measures and monitoring programs defined in the BMP are implemented consistently and effectively, the residual significance of these impacts can be reduced to **Substantial** significance. Continued biodiversity monitoring and adaptive management as prescribed in the BMP will be fundamental to ensuring that species impacts are effectively managed throughout the construction and operation phases of the Project. The summary of the species impact assessment is presented in **Table 98**.

Table 98. Species Risk and Impact Assessment — Construction Phase

Impact	Without Mitigation Measures			With Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Significance	Severity	Likelihood	Residual Significance
Disturbance, displacement, injury, or mortality of wildlife species including CR and EN species due to construction activities	Major	Likely	High	Moderate	Likely	Substantial

Mitigation Measures. The BMP defines mitigation measures and monitoring programs to be implemented by the Client to minimize potential impacts on wildlife species. Key mitigation measures and monitoring programs include:

- A Code of Conduct and standard operating procedures (SOPs) against wildlife collection, possession, and trafficking, as well as for human-wildlife conflict management, shall be developed and enforced for all project personnel prior to commencement of construction activities.
- All employees, consultants, contractors, sub-contractors, and workers are prohibited from: hunting terrestrial or aquatic fauna; collecting native flora for personal or commercial use; possessing firearms, traps, snares, or other hunting equipment; and chasing or disturbing fauna. Violations shall be subject to disciplinary action including termination of employment or contract.
- Wildlife monitoring programs focusing on species populations and their associated habitats, particularly those of priority biodiversity value, shall be conducted on a regular basis to provide feedback to the Client and support an effective adaptive management process throughout Project implementation.
- Camera traps or other intensive, remote, and online monitoring methods shall be established along the toll road alignment, with recordings analyzed periodically by competent biodiversity experts.
- Relevant government agencies, including the Natural Resources Conservation Agency (Balai Konservasi Sumber Daya Alam/BBKSDA) and conservation NGOs as appropriate, shall be proactively engaged to establish a rapid response wildlife management unit capable of reacting to human-wildlife conflict and supporting wildlife monitoring activities.
- Information on the behavior of wildlife species that may interact with humans, including guidance on how to avoid and deter wildlife from interactions with project personnel and local communities, shall be communicated to workers and surrounding communities on a regular basis.

7.3 Environmental Impact - Operation Phase

Upon completion of the construction of the toll road and related infrastructure, the Project will proceed into the operation phase, during which the scale and extent of environmental impacts will be

significantly reduced compared to those during construction. Nevertheless, certain impacts will persist during the operation phase, albeit to a lesser extent and over a more limited geographic distribution, as identified in Table 99 and described in the following sub-sections. .

Table 99 Potential Environmental Impacts - Operation Phase

Key Activities	Impacts			
	Air Quality	Noise	Soil and Groundwater	Biodiversity
Toll road traffic	√	√	-	√
Repair and maintenance (road, bridges, and related infrastructure)	-	-	-	√
Toll Road Office and Rest/Service Area operations	-	-	√	-

7.3.1 Ambient Air Quality

Risk and Impact Assessment. Traffic intensity on the Sp. Ness–Merlung Toll Road is expected to gradually increase over time. To predict the impact on air quality during the operation phase, air pollutant dispersion modelling was conducted using AERMOD (see Section 4.4.1). The number of vehicles travelling on the toll road on a 24-hour basis was assumed based on the traffic impact analysis undertaken by PT Kwarsa Hexagon in 2022 (see Table 24). A total of up to **6,253 vehicles per day** is estimated to use the toll road, with Class I vehicles assumed to travel at an average speed of 80 km/h and other vehicle classes at 60 km/h (see Table 100).

Table 100 Estimated Number of Vehicles Using the Toll Road

Class of Vehicles	Predicted Traffic (number of vehicles/day)	Average Speed (km/h)
Class I: Passenger cars, small trucks & buses	3,651	80
Class II: Trucks with 2 axles	1,912	60
Class III: Trucks with 3 axles	659	60
Class IV: Trucks with 4 axles	10	60
Class V: Trucks with 5 axles	21	60
Total	6,253	-

The *Gaussian dispersion source line method* and the *AERMOD 8.9 software* are used for air quality dispersion modeling of the toll road in the operation phase. The calculated emission rates of each air quality parameters used for the modelling are presented in Table 101.

Table 101 Calculated Gaseous Emission from Toll Road Operation

Air Quality Parameter	(gram/m ² .detik)
Carbon monoxide (CO)	5.5 x 10 ⁻⁵
Nitrogen dioxide (NO ₂)	2.5 x 10 ⁻⁶
Sulphur dioxide (SO ₂)	1.8 x 10 ⁻⁷
Particulate matter ≤2.5 µm (PM _{2.5})	6.9 x 10 ⁻⁹

Total suspended particulates $\leq 100 \mu\text{m}$

6.9×10^{-8}

The results of the air dispersion modelling are presented in Map 20 to Map 24. These maps show that, with the exception of NO_2 and SO_2 , all ambient air quality parameters comply with the Project standards, including national standards (GR No. 22/2021) and international benchmarks (IFC General EHS Guidelines, 2007). However, modelling results indicate that SO_2 and NO_2 concentrations from toll road traffic may exceed applicable threshold values at Dusun Mudo Village in the vicinity of STA 60+000. A detailed discussion of each parameter is provided below:

- **Map 20** indicates that the predicted SO_2 concentration (24-hour average) from toll road operation could reach up to **$100 \mu\text{g}/\text{m}^3$** at Dusun Mudo Village (STA 60+000), which is well above the baseline concentration of $30 \mu\text{g}/\text{m}^3$. The cumulative SO_2 concentration from toll road operation and baseline conditions combined would therefore likely reach approximately **$130 \mu\text{g}/\text{m}^3$** , exceeding the threshold value of **$75 \mu\text{g}/\text{m}^3$** (24-hour measurement) stipulated in GR No. 22/2021, Appendix VII. Predicted SO_2 concentrations at other villages along the Sp. Ness–Merlung Toll Road alignment are expected to remain within the applicable threshold value .
- **Map 21** indicates that the predicted CO concentration (1-hour average) from toll road operation could reach up to **$1,000 \mu\text{g}/\text{m}^3$** at Pijoan Village (STA 0+000) and Dusun Mudo Village (STA 60+000). As the baseline CO concentration was measured at less than **$1,145 \mu\text{g}/\text{m}^3$** , the cumulative CO concentration from toll road operation and baseline conditions combined would remain well below the threshold value of **$10,000 \mu\text{g}/\text{m}^3$** (1-hour measurement) stipulated in GR No. 22/2021 .
- **Map 22** indicates that the predicted NO_2 concentration (24-hour average) from toll road operation could reach up to **$100 \mu\text{g}/\text{m}^3$** at Dusun Mudo Village (STA 60+000), which is well above the baseline concentration of $21 \mu\text{g}/\text{m}^3$. The cumulative NO_2 concentration from toll road operation and baseline conditions combined would therefore likely reach approximately **$121 \mu\text{g}/\text{m}^3$** , exceeding the threshold value of **$65 \mu\text{g}/\text{m}^3$** (24-hour measurement) stipulated in GR No. 22/2021. Predicted NO_2 concentrations at other villages along the toll road alignment are expected to remain within the applicable threshold value.
- **Map 23** indicates that the predicted $\text{PM}_{2.5}$ concentration (24-hour average) from toll road operation could reach up to **$10 \mu\text{g}/\text{m}^3$** at Pijoan Village (STA 0+000) and Dusun Mudo Village (STA 60+000). The baseline $\text{PM}_{2.5}$ concentration was measured at up to **$15 \mu\text{g}/\text{m}^3$** . The cumulative $\text{PM}_{2.5}$ concentration from toll road operation and baseline conditions combined would therefore likely reach approximately **$25 \mu\text{g}/\text{m}^3$** , remaining below the threshold value of **$55 \mu\text{g}/\text{m}^3$** stipulated in GR No. 22/2021.
- **Map 24** indicates that the predicted TSP concentration (24-hour average) from toll road operation could reach up to **$100 \mu\text{g}/\text{m}^3$** at Pijoan Village (STA 0+000) and Dusun Mudo Village (STA 60+000). The baseline TSP concentration was measured at up to **$52 \mu\text{g}/\text{m}^3$** . The cumulative TSP concentration from toll road operation and baseline conditions combined would therefore likely reach approximately **$152 \mu\text{g}/\text{m}^3$** , remaining below the threshold value of **$230 \mu\text{g}/\text{m}^3$** stipulated in GR No. 22/2021.

Table 102 Air Quality Impact Magnitude during Operation

Parameters	AQS	PC ($\mu\text{g}/\text{m}^3$)	Baseline ($\mu\text{g}/\text{m}^3$)	Impact Magnitude
SO ₂	75 $\mu\text{g}/\text{m}^3/24\text{hr}^*$ 40 $\mu\text{g}/\text{m}^3/24\text{hr}^{**}$	100	30	250% of AQS
CO	10,000 $\mu\text{g}/\text{m}^3/24\text{hr}^*$ 4,000 $\mu\text{g}/\text{m}^3/24\text{hr}^{**}$	1,000	<1,145	25% of AQS
NO ₂	200 $\mu\text{g}/\text{m}^3/1\text{-hr}^*$ 200 $\mu\text{g}/\text{m}^3/1\text{-hr}^{**}$ 65 $\mu\text{g}/\text{m}^3/24\text{-hr}^{**}$	100	21 ^{*1}	153% of AQS
PM _{2.5}	55 $\mu\text{g}/\text{m}^3/24\text{hr}^{**}$ 25 $\mu\text{g}/\text{m}^3/24\text{hr}^*$	10	15	40% of AQS
TSP/dust	230 $\mu\text{g}/\text{m}^3/24\text{hr}^*$	100	52	43% of AQS

Given the proximity of the project area to residential and protected zones, SO₂ emissions (at critical impact levels) and NO₂ emissions (at high impact levels) potentially present significant risks to human health, particularly at Dusun Mudo Village in the vicinity of STA 60+000. This threat is exacerbated by the already elevated rates of pneumonia in the region.

Even minor levels of dust and other fine particles released during dry, windy weather—especially under atmospheric inversion conditions—can increase the spread of airborne infectious diseases. Under these conditions, dust may also settle on nearby vegetation, reducing insect and plant availability as food for which can harm protected bird species (for example, vulnerable herbivores such as the Long-tailed Parakeet and near-threatened frugivores such as the Malay Brown Barbet) and reducing agricultural productivity by lowering crop yields.

Considering the impact magnitude of toll road operation, its contributions to gaseous emissions and particulate generation, the presence of sensitive receptors, and the duration of impacts, the severity of these activities is classified as Major. The likelihood of occurrence is rated as Likely, as this impact is expected during normal operations. Therefore, in the absence of mitigation measures, the project's impact on ambient air quality is assessed as **High**. The summary of the air quality risk and impact assessment is presented in Table 103

Table 103 Ambient Air Quality Risk and Impact Assessment — Operation Phase

Impact	Receptor sensitivity	Identified impact	Baseline ($\mu\text{g}/\text{m}^3$)	Impact magnitude	Impact extend
Increased air pollution in the ambient air due to toll road traffic	Protected mammals Educational facilities Vulnerable communities	Direct	SO ₂ = 30 CO = <1,145 NO ₂ = 21 PM _{2.5} = 15 TSP = 52	PC of SO ₂ increases = 250% of AQS PC of CO increases = 25% of AQS Increase of NO ₂ = 153% of AQS Increase of PM _{2.5} = 40% of AQS	Specific area along road alignment of the Jambi – Rengat Toll Road at segment Sp. Ness to Merlung.

Impact	Receptor sensitivity	Identified impact	Baseline ($\mu\text{g}/\text{m}^3$)	Impact magnitude	Impact extend
				PC of TSP increases= 43% of AQS	

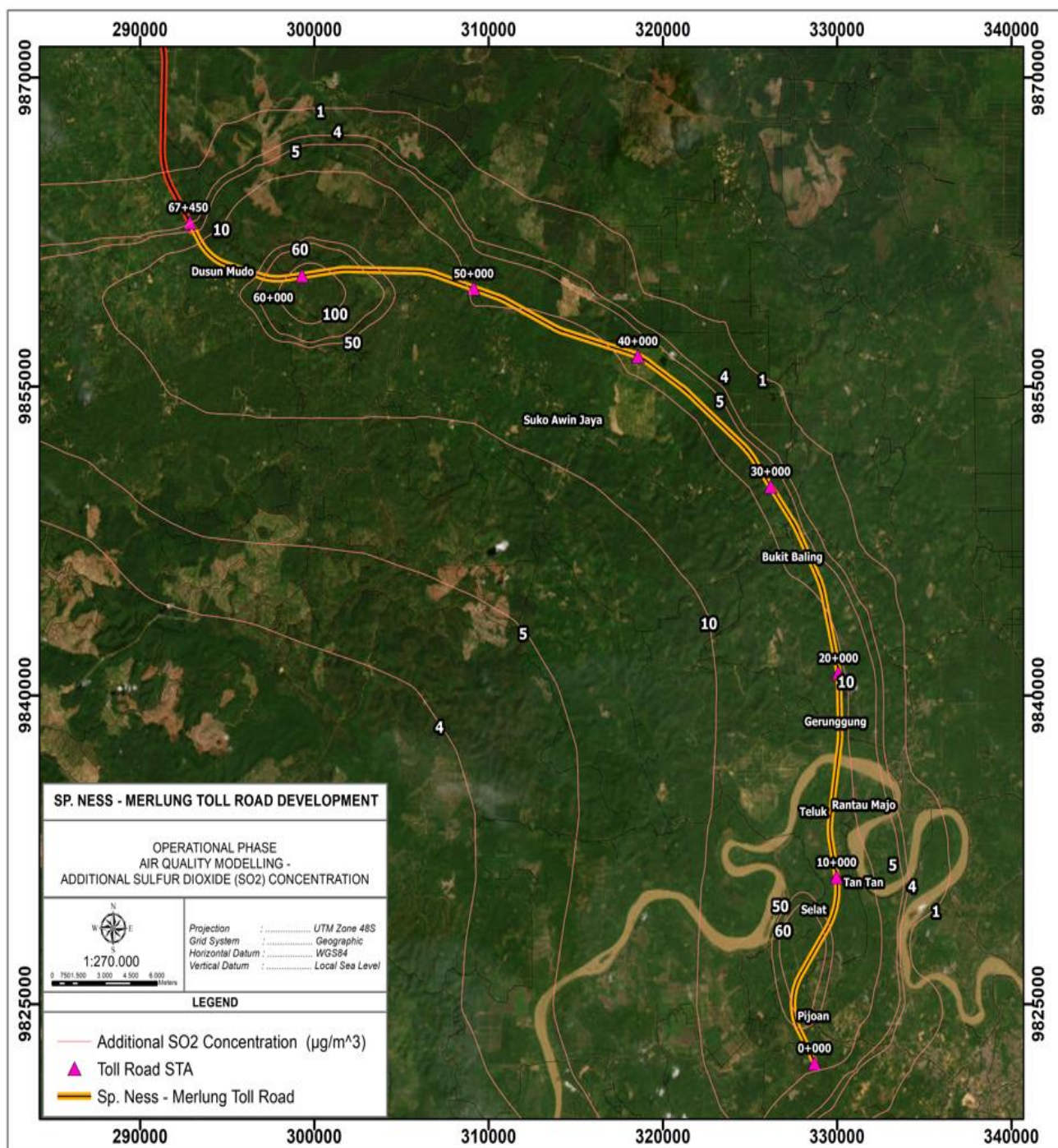
Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Increased SO_2 and NO_2 in the ambient air due to toll road traffic	Major	Likely	High	Moderate	Likely	Moderate

Mitigation Measures. To minimize air quality impacts during the toll road operation phase, the following mitigation measures have been incorporated into the DED of the toll road approved by DGH in 2023, and shall be maintained throughout the operation phase:

- A 2 to 3-meter-high wall partition shall be constructed at sections where the toll road passes in close proximity to sensitive receptors such as community settlements, hospitals, schools, and other public facilities and services.
- Vegetation within the toll road right-of-way shall be maintained as a natural barrier between the toll road and sensitive receptors to minimize air pollutant dispersion.
- Road maintenance shall be undertaken regularly to preserve the road surface condition, and road repairs shall be carried out in a timely and quality manner to minimize airborne dust from such activities.

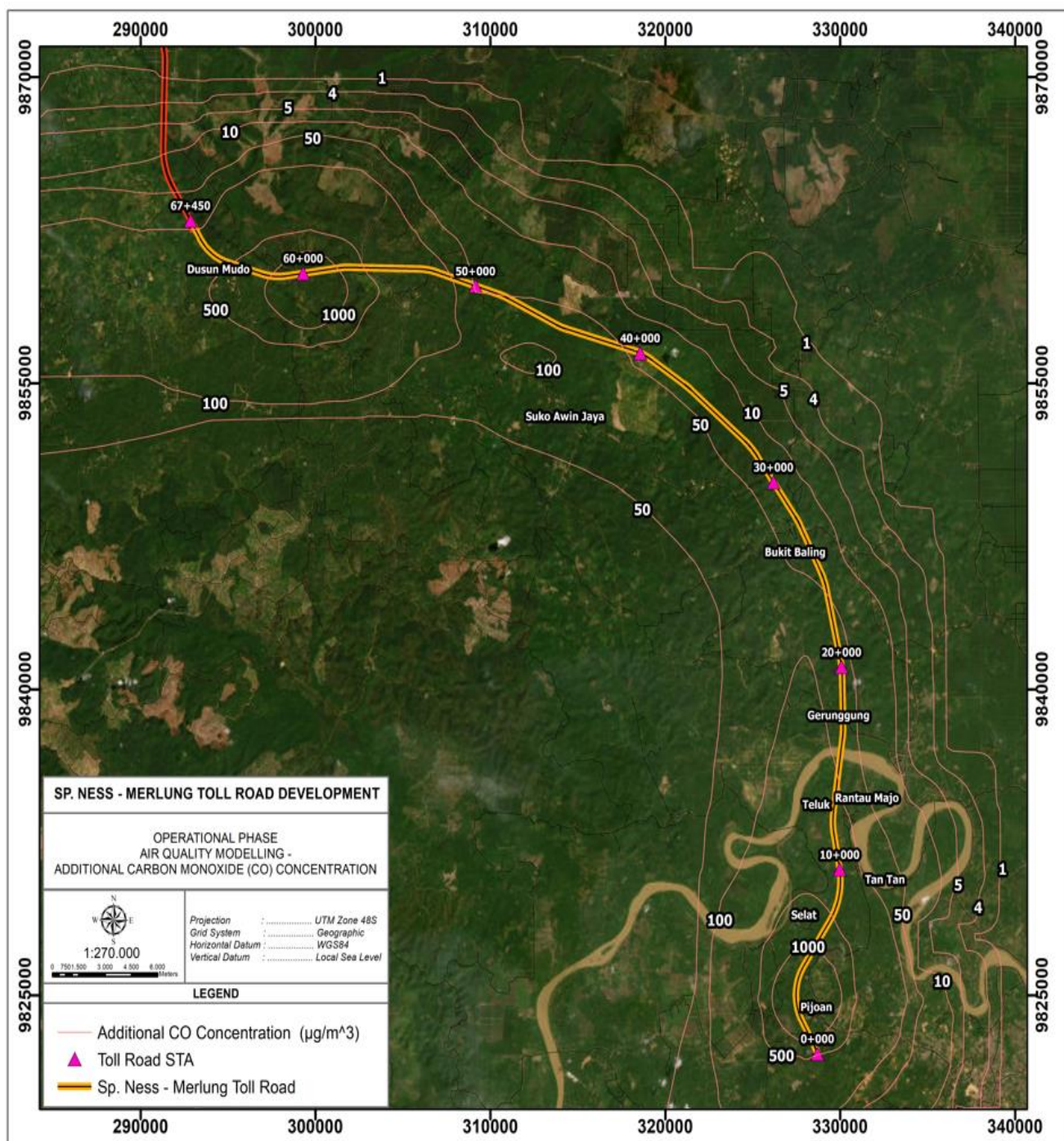
Residual Significance. Where the above mitigation measures are implemented in a consistent and effective manner, the air quality impact on sensitive receptors due to toll road traffic can be reduced from **High significance** to **Moderate significance**. Given that predicted SO_2 and NO_2 exceedances are limited to Dusun Mudo Village only and are expected to occur gradually as traffic volumes increase over time, the implementation of the mitigation measures described above is considered sufficient to manage this residual impact.

Map 20. Predicted SO₂ Concentration (Operation)



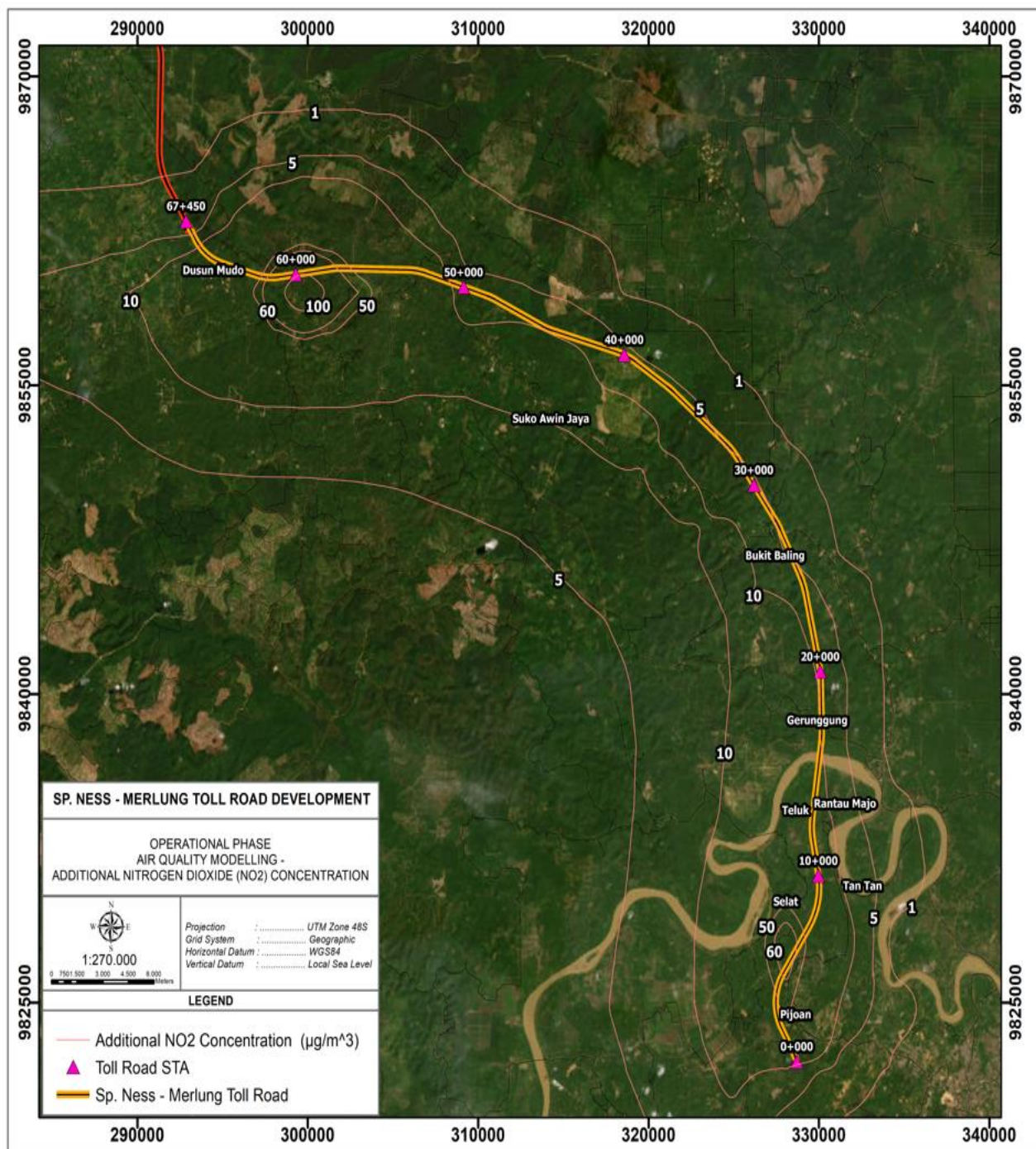
Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

Map 21. Predicted CO Concentration (Operation)



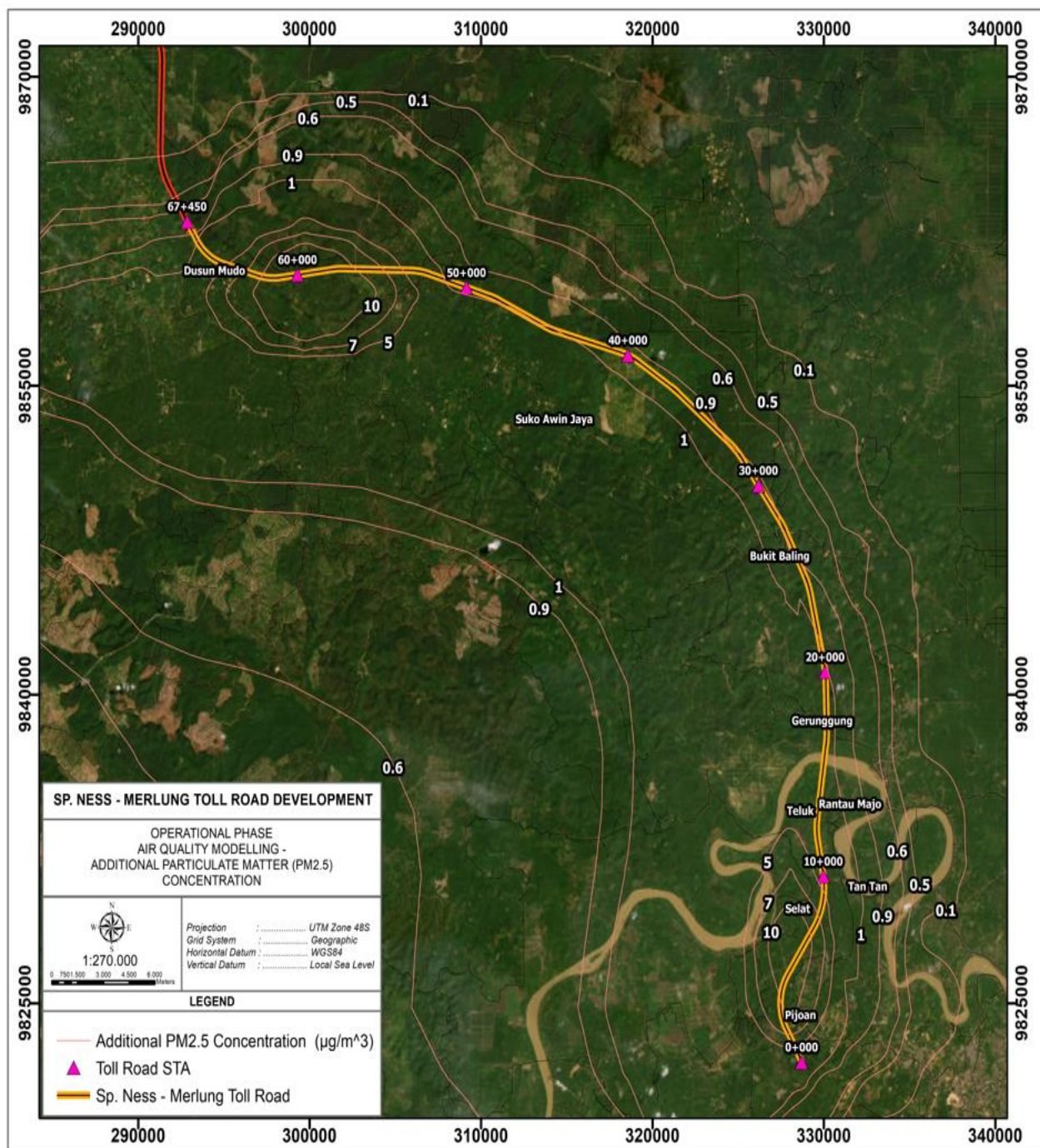
Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

Map 22. Predicted NO₂ Concentration in Operation Phase



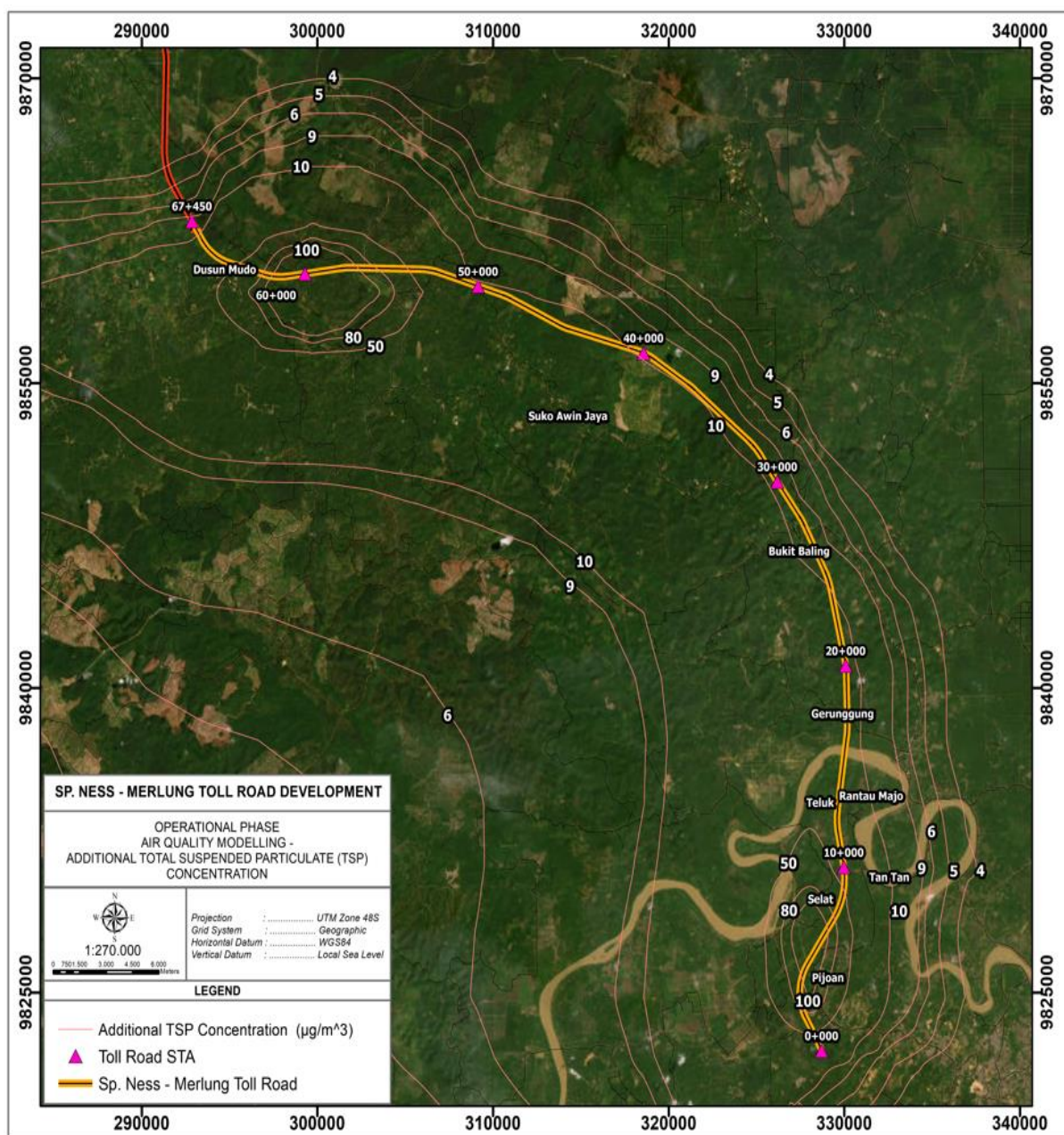
Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

Map 23. Predicted PM_{2.5} Concentration (Operation)



Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

Map 24. Predicted TSP Concentration (Operation)



Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

7.3.2 Noise Level

Risk and Impact Assessment. The Toll Road is a long-term infrastructure project, operating continuously, 24 hours a day, for a minimum of 30 years. Baseline studies have identified several sensitive receptors, including protected mammals such as primates, Sumatran elephants, protected cats, and Sumatran tigers found within a 14 km radius of the noise sources. Residential zones are situated at least 250 meters away from the Toll Road alignment. Furthermore, three sensitive receptors near Point 2 include the Taudhotut Tholbin religious school (900 m away), Pijoan Muarojambi Hing School (300 m), and Batanghari Junior School (2.8 km).

The noise baseline in the project areas is 52.3 – 62.0 dB(A) during the daytime and 48.4 – 48.7 dB(A) at night. Modeling results (see Map 25 and Map 26) indicate that noise levels along the Toll Road

alignment range from 48 to 60 dB(A). The noise level remains 54dB(A) at a radius of 250 meter from the Toll Road alignment, while Toll Road wide is approximately of 100 meter. These levels comply with both national and international standards and are consistent with daytime baseline levels.

Table 104. Calculated Maximum Operation Noise Level

Distance from the Construction Area (m)	Maximum Noise Level [in dB(A)]	Threshold Values
100 - 200	60	Ministry of Environment Decree No. 48/199 stipulates the threshold values of day- and night-time environmental noise equivalent as follows: - Residential area: 55 dB(A) - Public, open area: 60 dB(A) - Industrial area: 70 dB(A)
200 - 350	54	
350 - 700	48	

At night, the maximum operational noise level increases by 6 dB(A) above the baseline noise, whereas the IFC EHS Guideline states that the maximum incremental noise level is 3 dB(A). These elevated nighttime noise levels may affect nocturnal mammals, such as the slow loris, leopard cat, and flat-headed cat. In the absence of appropriate mitigation measures, this intermittent nighttime noise could drive these mammals to migrate to similar habitats, in the longer term. As such, the impact severity is Moderate with a Possible likelihood.

Generally, without mitigation measures, the impact of daytime noise on sensitive receptors from toll road traffic during operation is categorized as '**Low**' significance, whereas nighttime noise impacts are considered to be of **Moderate**. When mitigation measures and monitoring plans are implemented consistently and effectively, the residual significance of nighttime noise impact may continue to be classified as **Low** (see Map 25 and Map 26).

Table 105 Noise Level Risk and Impact Assessment — Operation Phase

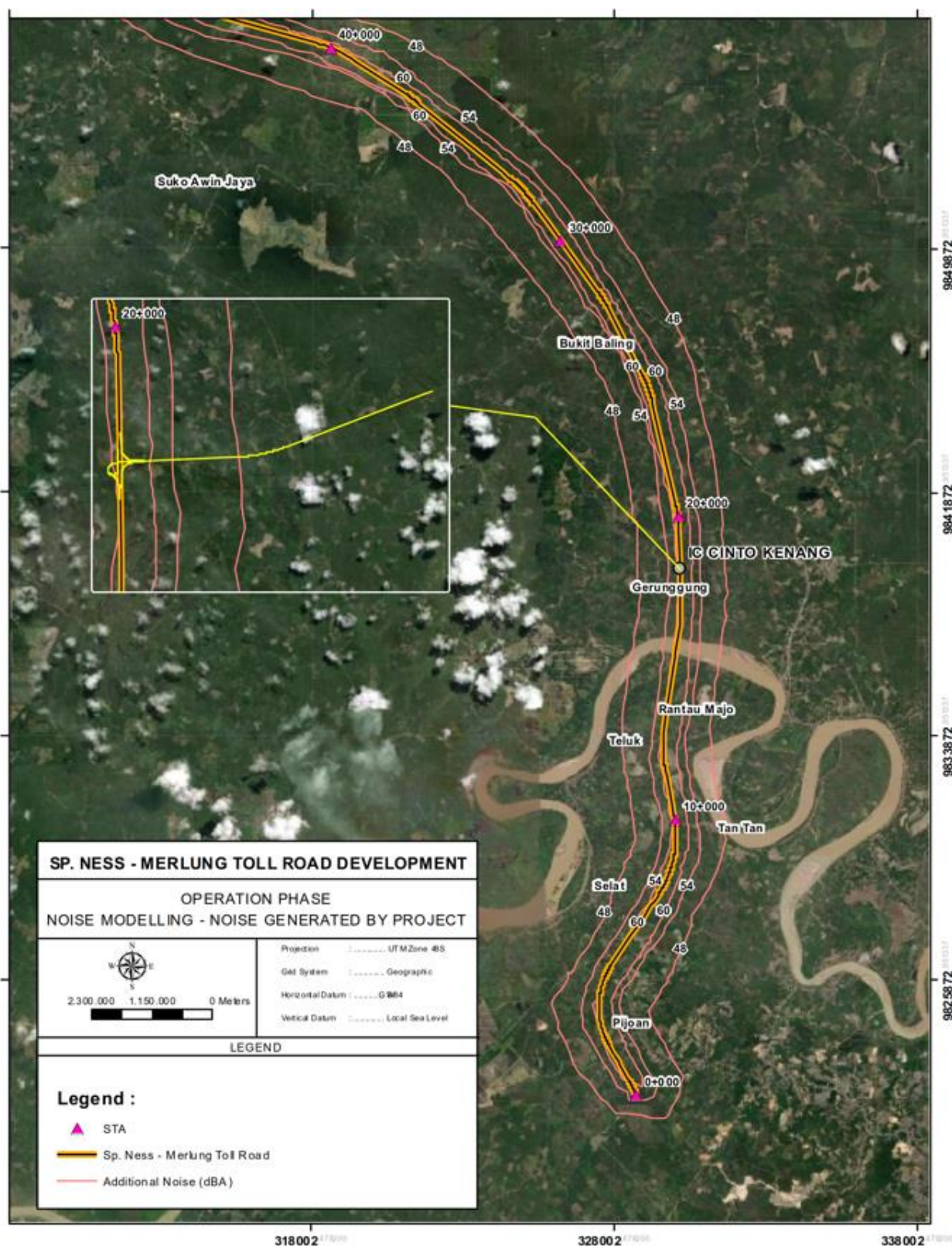
Impact	Receptor sensitivity	Identified impact	Baseline	Impact magnitude	Impact extend	Remark
Increased daytime noise and vibration due to toll road traffic	Protected mammals Educational facilities Vulnerable communities	Direct	Daytime: 52.3 – 65.0 dB(A)	The toll road traffic activities generates noise to 48 – 60 dB(A) at a maximum radius of 250 m along the toll road alignment	Local along road alignment of the Jambi – Rengat Toll Road at segment Sp. Ness to Merlung.	Daytime noise generation due to toll road traffic activities meet the standards and consistent with the baseline noise level.
Increased nighttime noise and vibration due to toll road traffic	Protected mammals Educational facilities Vulnerable communities	Direct	Nighttime: 48.4 – 48.7 dB(A)	The toll road traffic activities generates noise to 48 – 60 dB(A) at a maximum radius of 250 m along the toll road alignment	Local along road alignment of the Jambi – Rengat Toll Road at segment Sp.	Daytime noise generation due to toll road traffic activities meet the standards and consistent with the

Impact	Receptor sensitivity	Identified impact	Baseline	Impact magnitude	Impact extend	Remark
					Ness to Merlung.	baseline noise level.
Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Increased daytime noise and vibration due to toll road traffic	Minor	Rare	Low	-	-	-
Increased nighttime noise and vibration due to toll road traffic	Moderate	Possible	Moderate	Minor	Rare	Low

Mitigation Measures. Although the noise impact during the operation phase is evaluated as Minor significance and mitigation measures are therefore discretionary, the following measures have been incorporated into the DED of the toll road and shall be maintained throughout the operation phase:

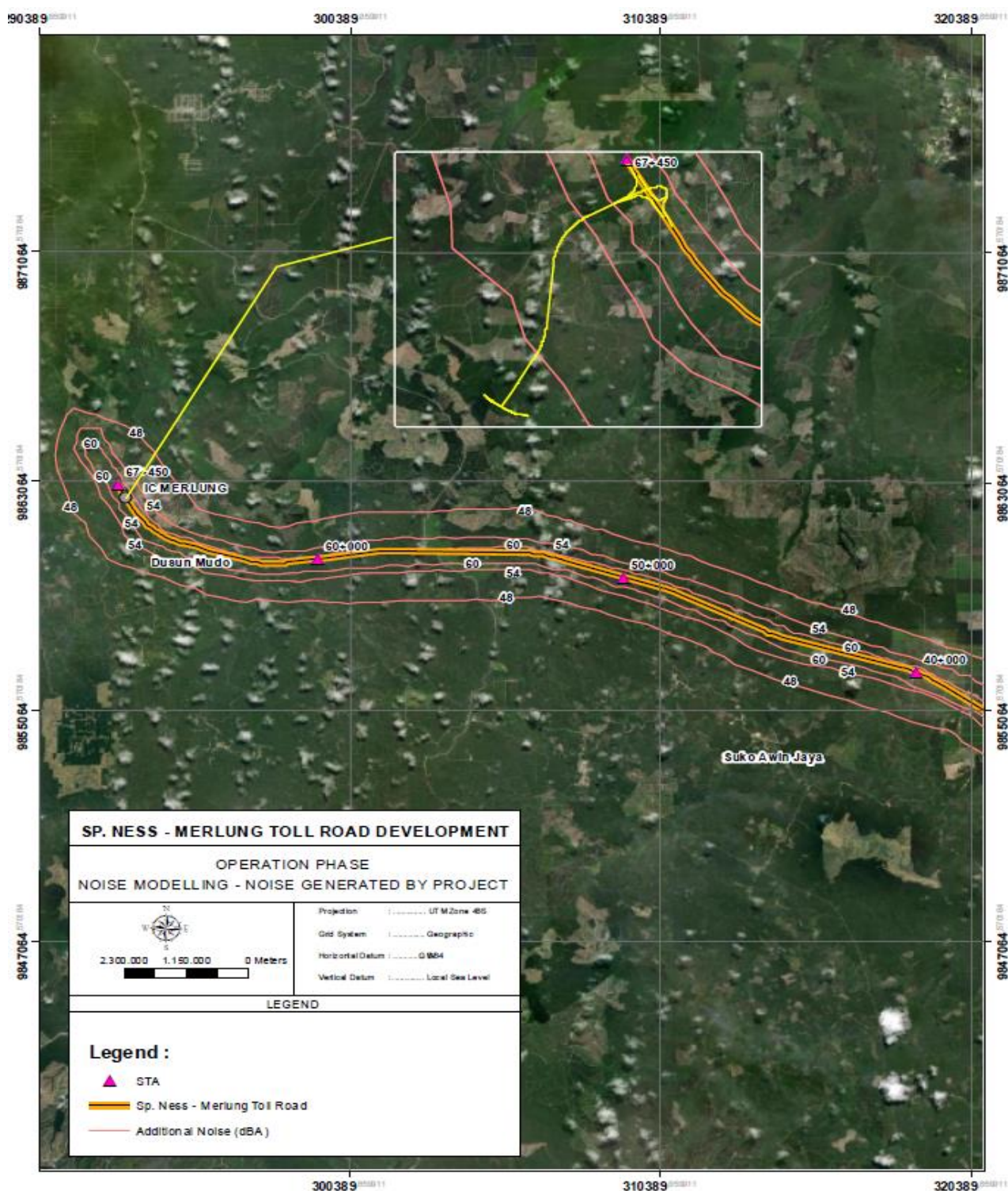
- Adequate right-of-way shall be maintained in the toll road design to preserve sufficient distance between the toll road and nearby residential areas and other sensitive receptors. This measure has been incorporated in the DED of the toll road approved by DGH in 2023.
- Where feasible and depending on natural terrain conditions, the road elevation shall be constructed below the elevation of the surrounding land to reduce noise propagation toward sensitive receptors.

Map 25. Predicted Noise Level (Operation) – STA 0+000 to 40+000



Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

Map 26. Predicted Noise Level (Operation) – STA 40+000 to 67+450



Source: Air quality modelling was undertaken by PT Kwarsa Hexagon (2024).

7.3.3 Groundwater Abstraction

Risk and Impact Assessment. The potential for soil and groundwater contamination exists from the operation of the rest and service area at STA 42+000 and the toll gate offices at the Cinto Kenang (STA 18+305) and Merlung (STA 67+100) Interchanges. Required groundwater consumption for 2 toll gate offices and 1 rest area is presented in **Table 106**.

Table 106 Water Consumption in Operation Phase

Activities	Total Consumption	Remark
24-hour toll gate office operation	1,840 L/s or ~ 0.021 L/s	20 workers each toll gate Total gates = 2 gates Assuming 30% females and 70% males. Total water consumption= ~1,840 L/person/day (i.e., 720 for females and 1,120 for males).
24-hour rest area operation	1,500L/hr = ~ 0.417 L/s	<i>High season:</i> High number of visitor numbers, estimated at up to 300 visitors/hour using clean water of up to 50 liters/person, hence requiring a total of 15,000 liters/hour. ²⁴ This estimated water needs equal to 15 m ³ /hour or 360 m ³ /day.
Estimated total project abstraction need	0.438 L/s	
Total community groundwater abstraction for domestic use	~0.24 L/s	The 519 AHs reported that approximately 90% of AHs used groundwater to meet daily water needs for drinking, cooking, and bathing/toileting. Assuming water consumption is 40 L/person/day, total community water use is approximately 0.24 L/s.
Total groundwater consumption	0.89 L/s	Total required clean water for Toll Road operations and maintenance activities, as well as the community's domestic
Groundwater capacity	<5L/s	Aquifer depth = 15 meters below the ground surface

Table 106 indicates that groundwater yield is sufficient to support Toll Road operations and maintenance activities, as well as the community's domestic needs, by providing clean water. However, given the aquifer in the project area is categorized as a localized, moderately productive aquifer of wide distribution, groundwater discharge shall be maintained, and alternative clean water sources (i.e., surface water or PDAM²⁵) shall be assessed.

²⁴ The number of employees working on the rest area is already included under the number of visitors mentioned under high, medium, and low scenarios.

²⁵ government-owned water enterprises operating at the city or regency level in Indonesia, responsible for treating, managing, and distributing clean, piped water to the public.

Table 107 Groundwater Abstraction — Operation Phase

Impact	Receptor sensitivity	Identified impact	Baseline	Impact magnitude	Impact extend
Groundwater abstraction	Community health Groundwater yield Community water consumption	Direct	~0.24 L/s	The additional groundwater abstraction required for toll road operation and maintenance is approximately 0.438 L/s. Since the available groundwater discharge is less than 5 L/s, this capacity is sufficient to meet both the Project's and the community's groundwater demand of about 0.89 L/s.	Local aquifer -beyond the project boundary but remains within the local study area

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Groundwater abstraction	Moderate	Likely	Substantial	Minor	Possible	Moderate

Based on the above, the groundwater abstraction impact due to the operation of rest areas and toll gate offices is evaluated as **Moderate** in terms of severity and **Likely** in terms of likelihood. Accordingly, the soil and groundwater impact during the operation phase is evaluated as **Substantial significance** in the absence of mitigation measures.

Mitigation Measures. The following mitigation measures to reduce the impacts of groundwater abstraction during toll road operation and maintenance will be implemented consistently and effectively, including:

- **Source Diversification and Demand Reduction.** Prior to the commencement of toll road operations, a feasibility assessment shall be conducted to evaluate connection to the regional piped water network (PDAM) as the primary clean water supply for the rest area at STA 42+000 and both toll gate offices at Cinto Kenang (STA 18+305) and Merlung (STA 67+100). Where PDAM connection is technically and economically feasible, groundwater abstraction shall be reduced to a supplementary or emergency-only role. The feasibility report shall be submitted to the Project's E&S team at least six months before the start of operations
- **Water-Efficient Fixtures and Operational Controls.** All sanitary facilities at the rest area and toll gate offices shall be equipped with water-efficient fixtures, including low-flow taps (maximum 6 L/min), dual-flush toilets (3/6-litre flush), and waterless or low-water urinals at male facilities. All abstraction points shall be fitted with calibrated water meters, and daily abstraction volumes shall be recorded in the operational logbook. A maximum daily

abstraction limit of 0.438 L/s (combined project facilities) shall be established and enforced to ensure total groundwater demand does not exceed 0.890 L/s in combination with community use, maintaining a minimum safety buffer of approximately 1 L/s against the available aquifer yield of less than 5 L/s.

- Community Water Supply Safeguard. If PDAM connection proves infeasible, a dedicated community groundwater monitoring point (observation well) shall be installed within or adjacent to the settlement area of the 519 affected households at the nearest sensitive location to project abstraction infrastructure. Groundwater levels in the community zone shall be measured bi-monthly during the first two years of operation and quarterly thereafter. If measured groundwater levels decline more than 1.5 metres below the pre-operational baseline over any six-month period, or if community residents formally report reduced well yields, abstraction by project facilities shall be curtailed within 14 days pending investigation and remedial action.
- A groundwater monitoring program shall be implemented throughout the operational phase, covering: groundwater level and quality, as well as abstraction volume.
- An Operational Water Supply Contingency Plan shall be prepared and kept current by the facility operator.

7.3.4 Waste Generation

Risks and Impact Assessment. During the operation of toll gate offices and rest areas, wastewater including sewage and latrine waste will be generated from workers and visitors utilizing washroom and toilet facilities. This wastewater contains high concentrations of organic and inorganic compounds, including coliform bacteria that are harmful to human health.

Assuming that 80% of the consumed water (Table 106) becomes wastewater, the estimated domestic wastewater generation from the rest area and 2 toll gates is approx. 30,274 L/day or ~30.2 m³/day, whereas the solid waste generation is ~10,091.5 kg/day or ~ 10 tonnes/day, equivalent to approximately 0.30 kg per person per day.

The standalone rest area will generate wastewater of 28,823 L/day or ~28.8 m³/day, during high season. Given that the Project plans to install 4 sewage treatment plants (STPs) with a capacity of 5 m³ each (see Figure 18), or equal to 20 m³, there will be an excess of 8.8 L/day wastewater and 9.6 tonnes/day solid waste. If this wastewater is discharged directly into natural drainage systems or receiving water bodies without treatment, this wastewater may result in deterioration of surface water quality, creation of foul odour and septic conditions in receiving water bodies, and potential soil and groundwater contamination.

Since the three project regencies recorded some of the highest cases of diarrheal disease in Jambi Province, totalling 28,462 cases in 2016 and 21,195 in 2019 due to limited WASH infrastructure, and riverine communities depend heavily on surface water from these rivers and their tributaries for domestic use, an estimated of more than 8.8 L/day of wastewater discharged to the river potentially increases the diarrheal prevalence and threatens riverine communities.

Solid household-type wastes, including food leftovers, used packaging, and plastic bags will also be generated from human activities and the operation of restaurants and kiosks at the rest areas. Improper waste management practices such as open dumping, waste burning, and the use of inadequate waste containers may attract flies and wildlife, including monkeys. Underground fuel storage tanks at the rest area fuel stations represent a potential source of soil and groundwater

contamination if tank leakage occurs. Fuel spills during transfer from road tankers to storage tanks are also a potential source of localized soil contamination if not cleaned up promptly and adequately.

Table 108 Waste Generation — Operation Phase

Impact	Receptor sensitivity	Identified impact	Baseline	Impact magnitude	Impact extend
Waste generation during operation	Community health Surface and groundwater quality Soil quality	Direct	-	The Project potentially generates 28.8 m³/day wastewater, and 10 tonnes/day solid waste.	Along Batanghari and Pijoan rivers

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Waste generation during operation	Moderate	Likely	Substantial	Minor	Possibe	Moderate

Based on the above, the waste generation impact due to the operation of rest areas and toll gate offices is evaluated as **Moderate** in terms of severity and **Likely** in terms of likelihood. Accordingly, the waste generation impact during the operation phase is evaluated as **Substantial significance** in the absence of mitigation measures.

- **Mitigation Measures.** To minimize soil, surface and groundwater contamination risks during the operation phase, the following mitigation measures are recommended: wastewater Treatment System Upsizing. Prior to the commencement of toll road operations, an independent hydraulic loading assessment shall be conducted to verify peak wastewater generation volumes under high-season visitor conditions, with a design safety factor of at least 20%.
- Increase capacity of sewage treatment plants (STP) to accommodate the waste generation during high seasons.
- Sewage and latrine waste shall be conveyed through a closed drainage system and directed to a properly designed and maintained wastewater treatment facility prior to discharge into a seepage system or nearby water bodies. The drainage network shall be inspected for leaks quarterly, and any identified leakage shall be repaired within seven calendar days.
- Solid non-hazardous household-type wastes shall be temporarily stored in separate, closed containers for organic (biodegradable) and non-biodegradable wastes and disposed of regularly at designated disposal sites by licensed contractors appointed by the local government.
- Biodegradable wastes such as vegetable food wastes and leaves may be composted as soil enrichment materials where appropriate measures per applicable regulations are undertaken.
- Hazardous wastes contaminated with fuel and other hazardous materials shall be collected, transported, treated, and disposed of by licensed hazardous waste management providers and facilities.

- Double-wall underground tanks shall be used for fuel storage at rest area fuel stations, and all other applicable standards stipulated by the Indonesian Government shall be complied with.

Residual Significance. Where the above mitigation measures are implemented in a consistent and effective manner, the soil and groundwater contamination risk due to the operation of rest areas and toll gate offices can be reduced from **Substantial significance** to **Moderate significance**.

7.3.5 Impacts to Habitat and Species

Risks and Impacts Assessment. The CHA conducted in 2023 for the entire Jambi–Rengat Toll Road identified that potential impacts on wildlife species and their habitats during the operation phase would not only occur within the toll road alignment but also beyond it, given the wide roaming areas of the species concerned. These potential impacts are closely related to those described in Sections 6.2.8 and 6.2.9 for the construction phase. Key operation phase impacts on habitat and species include:

- Barrier effects on the movement and dispersal of terrestrial animals, particularly wide-ranging species including Sumatran Tiger and Malay Tapir, due to the permanent presence of the toll road structure and associated traffic.
- Wildlife mortality due to vehicle collisions on the toll road.
- Ongoing disturbance to wildlife species from traffic noise, artificial lighting at toll gates and rest areas, and the presence of human activity along the alignment.
- Spread of invasive alien species along the toll road right-of-way through maintenance activities and vehicle movements.
- Risk of forest and land fires spreading along the toll road alignment, particularly in peatland areas.

The potential impacts on habitat and wildlife species during the operation phase of the toll road are evaluated as Substantial significance in the absence of mitigation measures, given that the physical presence of the toll road may create long-term barriers to the movement and dispersal of wildlife species, including Critically Endangered and Endangered species within the Area of Analysis. Where the mitigation measures defined in the BMP are implemented in a consistent and effective manner, the residual significance of these impacts can be reduced from Substantial to Moderate significance, noting that certain long-term impacts on wildlife movement corridors are inherently difficult to fully mitigate.

Table 109 Habitat and Species Risk and Impact Assessment — Operation Phase

Impact Assessment	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Barrier effects on wildlife movement and dispersal; ongoing habitat disturbance due to toll road operation and maintenance	Moderate	Likely	Substantial	Minor	Possible	Moderate

The CHA conducted in 2023 for the entire Jambi–Rengat Toll Road identified that potential impacts on wildlife species and their habitats during the operation phase would not only occur within the toll road

alignment but also beyond it, given the wide roaming areas of the species concerned. These potential impacts are closely related to those described in Sections 6.2.8 and 6.2.9 for the construction phase. Key operation phase impacts on habitat and species include:

Barrier effects on the movement and dispersal of terrestrial animals, particularly wide-ranging species including Sumatran Tiger and Malay Tapir, due to the permanent presence of the toll road structure and associated traffic.

Wildlife mortality due to vehicle collisions on the toll road.

Ongoing disturbance to wildlife species from traffic noise, artificial lighting at toll gates and rest areas, and the presence of human activity along the alignment.

Spread of invasive alien species along the toll road right-of-way through maintenance activities and vehicle movements.

Risk of forest and land fires spreading along the toll road alignment, particularly in peatland areas. **Mitigation Measures.** The complete mitigation measures for operation phase biodiversity impacts are detailed in the BMP (YAPEKA, 2024) and should be read in conjunction with this ESIA. Key mitigation measures include:

- Native species shall be planted and invasive species removed regularly within the toll road right-of-way. Native plants will also assist in stabilizing soil and reducing erosion along the alignment.
- Invasive species shall be removed during their flowering periods to prevent seed dispersal, using biological, mechanical, or thermal vegetation control methods where practicable. Where herbicides are used to control fast-growing vegetation within the toll road right-of-way, the precautions stipulated in the IFC EHS Guidelines for Toll Roads (April 2007) shall be strictly followed.¹⁷
- An adequate number of mobile water tankers equipped with water pump engines, fire extinguishers, and firefighting tools shall be maintained along the toll road to respond to forest and land fire events.
- Wildlife that are caught, handled, or rescued shall be translocated to alternate habitats in accordance with the IUCN Guidelines on Reintroductions and Other Conservation Translocations, with key factors including timing, relocation site, food availability, and suitable habitat conditions duly considered.
- Natural canopy bridges within power distribution line corridors shall be maintained or trimmed as necessary to minimize mortality of primates and other arboreal mammals due to electrocution.

8.0 SOCIAL IMPACT ASSESSMENT

Potential socio-economic, cultural and community health and safety impacts associated with the key project construction activities of the Sp. Ness – Merlung Toll Road development from pre-construction through to operation phases are identified in the following table. These impacts are commonly observed in infrastructure projects where large-scale civil works, including earth moving activities and the operation of significant numbers of motor vehicles, trucks, and heavy equipment as well as significant number of workers are involved. The assessment was conducted and described in the following to appreciate the risk level of the social risk and impacts anticipated from the Project.

Table 110 Potential Social Impacts of the Project

Potential Impacts Key Activities	Physical and Economic Displacement & Loss of Livelihoods	Local Economy	Labor Influx (incl. Local Infrastructure & Public Services)	Vulnerable Groups Discrimination	Gender	Gender-based Violence	Access restrictions to Land Use, Natural Resources & Assets	Inadequate Labor and Working Conditions	Risks an impacts from Use of Security Personnel	Impact on Cultural Resources & Heritage
Pre-Construction Phase										
Land acquisition	√	√		√	√		√			√
Construction Phase										
Recruitment of construction workers	√	√	√	√	√	√		√	√	
Construction/ operation of contractor basecamps and accommodation		√	√	√		√		√	√	
Operation of project trucks and heavy equipment			√					√		
Earth moving/civil work activities			√	√		√	√	√	√	√
Construction of toll roads and supporting facilities							√	√	√	
Operation of auxiliary facilities								√	√	
Operation Phase										
Toll road repair and maintenance								√		
Toll road office and rest area operation		√		√	√	√		√		

8.1 Social Impact Assessment – Pre-construction Phase

8.1.1 Physical and Economic Displacements

Overview. The result of the risk assessment suggests that the physical and economic displacement impacts including potential loss of livelihood of the project-affected persons (PAPs) that would occur due to land acquisition by the Project are evaluated as substantial risk without implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of these impacts is evaluated as medium. The summary of the related air quality risk and impact assessment is presented below.

Risk Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Inherent Risk
Physical and economic displacement including potential loss of livelihoods	Moderate	Likely	Substantial	Minor	Possible	Medium

Risk and Impact Assessment – Physical and Economic Displacements. The construction of Sp. Ness – Merlung Toll Road is estimated to require approximately 892.49-hectares land, comprising 516-hectares land owned by private individuals; 434-hectares land owned by oil palm plantations; and 10.8-hectares land of Jambi Province. The affected lands owned by the Jambi Province include village and provincial roads, cemeteries, primary schools, rivers, village land, district land, and mosques.

The land acquisition activities will change in partial or full ownership including loss of physical structures, such as houses and building on the acquired land. Further impacts of the land acquisition are changes in the livelihoods of 647 PAPs including their households who own and cultivate agricultural land and small-holder oil palm plantations. The loss of livelihoods would result in economic displacement of the PAPs who are entirely dependent upon their agricultural lands and small-holder plantations for their livelihoods. The impacts on loss of livelihoods and economic displacement would be adverse and permanent for those who need to relinquish their entire land. However, some PAPs would experience partial income loss as only parts of their lands would be acquired by the Project, making part of their impacts reversible.

Considering the above, the physical and economic displacement impacts on the PAPs due to the land acquisition by the Project's is evaluated as moderate in term of its severity and likely in term of its probability to occur. Therefore, this impact is evaluated as a substantial risk if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize the above impacts, the Project is proposed to implement the following mitigation measures:

- The establishment of a dedicated land acquisition team within the Client is required.
- Ongoing consultations with the local government agencies and affected landowners should be conducted together with proper and open disclosure of the land acquisition process including the schedule of compensation payment.

- Payment of compensation for the acquired land including building, vegetation, and other assets within the land should be provided at replacement cost principles based on an independent valuation made by the licensed appraisal,
- The livelihood restoration program set out in the LARP document should be consulted with the PAPs and mutually agreed.
- The Project's stakeholder engagement plan (SEP) should be implemented by the Client in an effective manner through a meaningful, proactive engagement with the Project's stakeholder and disclosing relevant Project information on a regular basis.
- The Project's grievance redress mechanism (GRM) should be established to enable the PAPs and other interested parties to raise their concerns, expectations, and inputs for the Project.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the loss of livelihood and economic displacement impacts on the PAPs due to the land acquisition by the Project could be reduced from substantial risk to moderate risk. On the other hand, the implementation of the LRP is expected to alleviate these impacts within the PAPs.

8.1.2 Local Economy Development

Risk and Impact Assessment – Local Economy Development. The result of the risk assessment suggests that the Project's construction activities would be anticipated to generate significant and positive impacts to the local economy development within the three regencies in Jambi Province traversing the toll road alignment. These local economic impacts would be expected to reach a wider region particularly in the central part of Sumatera. Considering the positive impact on local economy development due to the Project, only the impact assessment is undertaken and described below.

The impact on the local economy would be, among others, employment and business opportunities for the local communities, particularly the PAPs and productive (working age) people within the Project area and other regions in Sumatera. The recruitment of workers for the road construction would be prioritized for those of the local communities if they meet the skill and requirements of the Project. Further, the Project will treat each applicant with equal opportunities to apply for the employment opportunities.

The emergence of business opportunities for the local communities and those from Jambi and Sumatera regions to support the toll road construction would be anticipated. These opportunities may include the provision of basic needs of workers, building materials (e.g., sand and rocks, wood, iron, cement), daily goods and services (e.g., house rented for the worker accommodation, vehicle rentals, workshops, kiosk, and food stalls). business opportunities in rest areas and other business opportunities.

The impact on the local economy is anticipated to be positive and beneficial, and therefore, the risk assessment is not required. Instead, the Project is recommended to promote and implement enhancement measures to optimize this impact through, among others:

- The Livelihood Restoration Programs (included in the LARP document) for the PAPs should be consulted and implemented in a transparent and timely manner by actively involving the PAPs, the Client, and the local government agencies involved.
- The Project's stakeholder engagement plan (SEP) should be implemented by the Client in an effective manner through a meaningful, proactive engagement with the Project's stakeholder and disclosing relevant Project information on a regular basis.

- The Project's grievance redress mechanism (GRM) should be established to enable the PAPs and other interested parties to raise their concerns, expectations, and inputs for the Project.
- Employment and business opportunities with the Project including its requirements should be communicated in a transparent and easily understood manner.
- The local governments should be informed and involved regarding the need for workers in the toll road construction while promoting equal opportunity and non-discrimination for the poor, disadvantaged, women and indigenous people.
- Local entrepreneurs, small- and medium enterprises should be provided with the opportunity to supply goods and services for the Project if they meet the specified criteria.

8.1.3 Labor Influx

Overview. The result of the risk assessment suggests that the labor influx due to worker recruitment for the toll road construction could cause constraints on the existing infrastructure, public facilities and services. These impacts are evaluated as medium risk without implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of these impacts is evaluated as low risk. The summary of the related labor influx risk and impact assessment is presented below.

Risk Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Inherent Risk
Labor influx resulting in constraints on infrastructure and public facilities and services	Minor	Possible	Medium	Incidental	Rare	Low

Risk and Impact Assessment – Labor Influx. The potential constraints on existing infrastructure and public facilities as well as services provided by the local communities are identified as potential adverse impacts that could be indirectly generated by the toll road construction activities. The constraints on the existing infrastructure such as increased demand for power and water supplies, and the need for waste disposal facilities that could not possibly met by the local government due to limitation of service and coverage in this regard. Existing Trans Sumatera and other national as well as local government roads have been frequently experiencing traffic congestion and frequent damages on the road pavement and its road shoulder due to overloaded tonnage of trucks carrying coal and palm oil products passing through those roads.

Some workers of the Project are expected to stay in the contractor's basecamp, local accommodation, and some community houses rented or converted for the worker accommodation during the toll road construction. This situation would create demand for food, goods and services, and entertainment that could not possibly meet by the existing shops, kiosks and other providers within the Project area. Furthermore, the demand for public health facilities and services including health centers (*puskesmas*), clinics, and medical doctors would increase pressure due to limitation of its number, expertise, and geographical distribution within the Project area. Furthermore, the labor influx could also attract entrepreneurs and goods and service providers from other areas of Jambi and wider region in Sumatera to stay within the Project area to open businesses and services that would be required by the workers and Projects that could not be met by the existing local providers and business entities.

Meanwhile, at the operational stage, the labor influx will be small, as the number of workers required would be relatively small considering some skilled and experienced workers are required.

Considering the above, the severity of the overall labor influx impacts described earlier is evaluated as minor and its likelihood of occurring as possible, and therefore, the labor influx is inherently evaluated as medium risk without implementation of any mitigation measures.

Mitigation Measures. To minimize the above impacts, the Project is proposed to implement the following mitigation measures:

- The PAPs and local communities within the Project area and Jambi region would be prioritized and treated with equal opportunities as other applicants when applying for the job vacancies.
- Induction on local norms and customs should be conducted to all workers to support social harmony within the Project area and nearby communities.
- Adequate, basic health facilities and services at the construction site and/or contractor's basecamps should be provided to reduce the burden on local health facilities and services.
- Effective coordination among the local police, the Project's security personnel, and the local government are required to manage potential security disturbances within the Project area and local communities.
- The Project's GRM, SEP and other measures should be implemented as collaborative efforts of the Client, implementing agencies, contractors, and local governments to better engage the PAPs and other interested parties to contribute to the local economy development as part of the Project implementation.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the labor influx impacts described above could be reduced from medium risk to low risk.

8.2 Vulnerable Groups or Individuals

Overview. The result of the risk assessment suggests that the potential social impacts, particularly on vulnerable groups or individuals due to the toll road construction activities are evaluated as medium risk without implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of these impacts is evaluated as low risk. The summary of the related labor influx risk and impact assessment is presented below.

Risk Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Inherent Risk
Social related impacts on vulnerable groups or individuals	Moderate	Possible	Medium	Incidental	Unlikely	Low

Risk and Impact Assessment – Vulnerable Groups or Individuals. The socio-economic survey conducted for the Project in 2023 identified vulnerable groups and/or individuals of the PAPs whose lands and assets would be acquired and/or affected by the toll road construction. These vulnerable groups or individuals are elderly, women as the household's head, indigenous people, those with certain disabilities living or staying within the Project area. Potential impacts that may be encountered by these vulnerable groups or individuals include health and safety risk associated with construction

activities and the operation of project's vehicles and heavy equipment; environmental hazards due to exposure to elevated dust and noise levels; and discrimination or limitation when applying for the job vacancies and seeking business opportunities with the Project. Therefore, vulnerable groups are an important aspect that needs attention because their resources are not able to deal with the environmental and social changes that occur.

Considering the above, the severity of the social-related impacts on vulnerable groups or individuals is evaluated as moderate and its likelihood of occurring as possible, and therefore, these impacts are evaluated as medium risk without implementation of any mitigation measures.

Mitigation Measures. To minimize the above impacts, the Project is proposed to implement the following mitigation measures:

- The Project related information (e.g., simple, clear language brochures, leaflets, and other forms as appropriate) should be disclosed and disseminated in a regular manner to raise safety and risk awareness associated with the toll road construction.
- The main contractors and vendors should be briefed in the bidding process and contract awards to promote equal and non-discrimination opportunities when involving the vulnerable groups or individuals as part of the toll road construction.
- The involvement of vulnerable groups should be encouraged to participate in project activities by monitoring the number of vulnerable groups involved and comparing it with the number of vulnerable groups previously identified in the LARP study.
- Potential barriers to employment of women should be removed.
- The Project's GRM, SEP and other measures should be implemented as collaborative efforts of the Client, implementing agencies, contractors, and local governments to better engage the PAPs and other interested parties to contribute to the local economy development as part of the Project implementation.

Residual Risk. The Project's GRM, SEP and other measures should be implemented as collaborative efforts of the Client, implementing agencies, contractors, and local governments to better engage the PAPs and other interested parties to contribute to the local economy development as part of the Project implementation.

8.3 Gender

Overview. The result of the risk assessment suggests that the potential social impacts, particularly on vulnerable groups or individuals due to the toll road construction activities are evaluated as medium risk without implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of these impacts is evaluated as low risk. The summary of the related labor influx risk and impact assessment is presented below.

Risk Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Inherent Risk
Impacts on gender such as discrimination gender bias, discrimination, and harassment	Minor	Possible	Medium	Incidental	Possible	Low

The potential impact on gender during land acquisition is identified from the socio-economic surveys conducted for the Project, particularly women of the households of the PAPs are often not involved in the decision-making process within her households. In the recruitment of construction workers and in the operational activities of toll road offices and rest areas, women are often unable to participate in the work. It is identified in the Project's socio-economic survey that the households likely affected by the Project are primarily headed by men, comprising approximately 77% of the total household survey over 23% of them headed by women. The highest number of women as the heads of the household was identified in Gerunggung Village, while the lowest number of them was in Teluk Village. The analysis shows that the access to and control over financial resources within the affected households remains unequal in that the women plays a primarily role in household activities, but under certain conditions must also seek additional income by working in plantations. The men of the households surveyed tend to focus on earning a living but are less involved in the household sector. The women's access and control over the family's financial incomes are more for fulfilling daily needs and children's education. The decision-making is dominated by the husband due to patriarchal culture and his education level.

In relation to recruitment activities, both in construction and operational labor, women are rarely involved. Husbands play more of a role in finding employment or jobs outside the home, whereas their wives primarily work as housewives, so they do not have income generating activities.

Women's limited access to economic resources, such as land or financial capital, can affect their ability to contribute to economic decisions at the household level. Most women have limited access to project-related information and information is only obtained during FGD meetings/activities. This situation may reduce participation of women in the stakeholder engagement of the Project that may lead to inequality of their participation and receive incorrect information of the Project.

Considering the above, the severity of the gender impacts is evaluated as minor but its likelihood of occurring as possible, and therefore, these impacts are evaluated as medium risk without implementation of any mitigation measures.

Mitigation Measures. To minimize the above impacts on gender, the Project is proposed to implement the following mitigation measures:

- The Project's GRM, SEP and other measures should be implemented as collaborative efforts of the Client, implementing agencies, contractors, and local governments to better engage the PAPs and other interested parties so that women within the Project area receive adequate and accurate information and opportunities with the Project.
- The Project related information (e.g., simple, clear language brochures, leaflets, and other forms as appropriate) should be disclosed and disseminated in a regular manner to raise safety and risk awareness associated with the toll road construction.
- The main contractors and vendors should be briefed in the bidding process and contract awards to promote equal and non-discrimination opportunities when involving the vulnerable groups or individuals as part of the toll road construction.
- The involvement of women in the Project should be encouraged through opportunities in employment, not limited to casual works, but also on technical and meaningful works if they meet the Project's criteria and have the capacity to be trained to do the job.

- Potential barriers to women in establishing a business to provide good and services for the Project should be diminished.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the gender impacts described above could be reduced from medium risk to low risk.

8.4 Gender-Based Violence

Overview. The result of the risk assessment suggests that the potential impact on gender-based violence due to the toll road construction activities are evaluated as medium risk without implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of the impact is evaluated as low risk. The summary of the risk and impact assessment of gender-based violence is presented below.

Risk Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Inherent Risk
Gender-Based Violence	Moderate	Possible	Medium	Minor	Rare	Low

Risk and Impact Assessment – Gender-based Violence. Gender-based violence (GBV) can occur in various forms, from recruitment process and during employment of women in the Project, and the attitude of migrant worker to women in the local communities within the Project area. In the recruitment phase, especially involving migrant workers from outside Jambi area with differences in socio-cultural backgrounds can increase the risk of gender-based violence to women. Lack of understanding of local social norms and customs can lead to unintended behavior, such as sexual harassment, intimidation, or discrimination against female workers. The worker's base camp comprises many individuals from different backgrounds, both local and migrant, and can be prone to gender-based violence. Lack of supervision and restrictions on social interactions in the worker basecamp has the potential for increasing sexual harassment through physical violence and word abuse.

Civil works and highway construction activities, which often involve heavy physical labor and male-dominant work environments can exacerbate gender tensions. The women working in administrative or non-physical roles may experience marginalization, harassment or violence from the male workers and superiors due to patriarchal norms or attitudes that dominate the construction works.

Ancillary facilities and toll operation offices built to support project operations are also potential areas of increased vulnerability to gender-based violence. Workers involved in the construction of these facilities, particularly female workers, may face discrimination, sexual harassment, or other violence if there are no policies or protocols in place that support safety and gender equality. In addition, imbalances in access to employment or training opportunities can also exacerbate gender inequality, creating an unsafe climate for women.

Rest areas built for the convenience of workers and toll road users can present additional GBV-related challenges, especially if they are operated without adequate supervision. Workers and communities living or stopping at rest areas are vulnerable to incidents of gender-based violence, be it physical violence, sexual harassment or exploitation.

Considering the above, the severity of the gender-based violence impacts is evaluated as moderate and its likelihood of occurring as possible, and therefore, these impacts are evaluated as medium risk without implementation of any mitigation measures.

Mitigation Measures. To minimize the above impacts on gender-based violence, the Project is proposed to implement the following mitigation measures:

- A gender perspective should be integrated in each Project phases to ensure women's participation and protection of their rights.
- Inclusive recruitment mechanisms and transparent processes should be the condition of the employee recruitment process to avoid discrimination or exploitation.
- Regulations and code of the worker's conduct at the basecamps, including rules of interaction that respect local social and cultural boundaries should be integral part of the working agreement between the Project and the worker.
- Induction for all workers on gender equality and prevention of gender-based violence to create a safe working environment should be conducted on the first day of their work.
- Appoint a trained rapid response team to handle reported cases of gender-based violence, in collaboration with authorities and victim support organizations.
- The Project's GRM, SEP and other measures should be implemented as collaborative efforts of the Client, implementing agencies, contractors, and local governments to better engage the PAPs and other interested parties so that women within the Project area receive adequate and accurate information and opportunities with the Project.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the gender-based violence impacts of the Project described above could be reduced from medium risk to low risk.

8.5 Access to Land Use, Natural Resources, and Assets

Overview. The result of the risk assessment suggests that the potential impact on the community access to land use, natural resources, and assets during toll road construction activities are evaluated as substantial risk without implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of the impact is evaluated as medium risk. The summary of the risk and impact assessment in this regard is presented below.

Risk Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Inherent Risk
Access constraints to land use, natural resources, and assets	Moderate	Likely	Substantial	Minor	Possible	Medium

Risk and Impact Assessment – Access to Land Use, Natural Resources, and Assets. The Project's construction activities would result in the permanent loss or intermittent constraints for the local communities including PAPs and their family members to access their cultivated lands, assets, and other resources that may be available within the Project area. This can limit community mobility, especially for those who depend on direct access to important areas such as farmland, markets or

other public facilities. This impact can lead to the disruption of local economic activities, such as trade, agriculture and livestock, which form the backbone of the local economy.

The construction of bridges over rivers as part of toll road support activities also has its own consequences. Bridges that are designed without considering the activities of communities that depend on the river can disrupt their accessibility. For example, local fishermen looking for fish may find it difficult to access their catchment areas due to space limitations and restrictions imposed on certain parts of the river to ensure safety of the fishermen, and other community and business activities relying on the river at the time of the bridge, overpass and underpass construction. caused by the bridge structure. In addition, vessel or boat traffic commonly used for transportation of goods and people along the river may be disrupted by inadequate bridge construction or design, such as height or width that does not match operational needs.

Considering the above, the severity of the impacts on access to community's land use, natural resources are evaluated as moderate and its likelihood of occurring is likely, and therefore, these impacts are evaluated as substantial risk without implementation of any mitigation measures.

Mitigation Measures. To minimize the above impacts on the access to land use, natural resources, and assets, the Project is proposed to implement the following mitigation measures:

- Temporary and safe access roads, pedestrian bridges or underpasses for affected communities should be provided to prevent them from entering the Project's construction sites in order to reach their cultivated lands or other destinations.
- A construction schedule that minimizes disruption to community access should be established.
- Providing temporary passage and safety zones for boats and fishermen during the bridge construction.
- The Project's GRM, SEP and other measures should be implemented as collaborative efforts of the Client, implementing agencies, contractors, and local governments to better engage the PAPs and other interested parties so that women within the Project area receive adequate and accurate information and opportunities with the Project.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the impact of the Project on the access to land use, natural resources, and assets described above could be reduced from substantial risk to medium risk.

8.6 Labor and Working Condition

Overview. The result of the risk assessment suggests that the potential impact on the labor and working conditions during toll road construction activities are evaluated as substantial risk without implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of the impact is evaluated as medium risk. The summary of the risk and impact assessment of gender-based violence is presented below.

Risk Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Inherent Risk

Unsafe and Unfavorable Labor and Working Conditions	Major	Possible	Substantial	Moderate	Possible	Medium
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Risk and Impact Assessment – Labor and Working Conditions. In the construction and operational stages of the Project, many risks will arise, especially those related to the state of utility labor and infrastructure related to worker health and safety. Labor risks can include accidents and health risks from, among others: operating the Project’s vehicles and heavy equipment as well as material handling in bulk quantities; working on or near water; and performing hot work such as arc welding. Construction work can result in adverse impacts on labor and working conditions in many ways, including health, safety, and well-being, such as:

- Construction workers often develop neck, shoulder, back, leg, foot, and head pain due to repetitive work and poor working practices
- Construction workers are exposed to risk of falling from working at height, being struck by the Project’s vehicles and heavy machinery, and exposure to airborne dust.
- Low wages, irregular or late payment systems can lead to financial instability.
- Insufficient access to healthcare services can contribute to increased rates of work-related illnesses
- Long working hours can negatively impact health and well-being.
- Irregular employment which can negatively impact health and well-being.
- Sub-standard contractors’ policies regarding health and safety can impact health and well-being.
- The use of forced labor and child workers.

Considering the above, the severity of the impacts on labor and working conditions are evaluated as major and its likelihood of occurring as possible, and therefore, these impacts are evaluated as substantial risk without implementation of any mitigation measures.

Mitigation Measures. To minimize the above impacts on labor and working conditions, the Project is proposed to implement the following mitigation measures:

- The Project’s and the contractors’ policies on labor and working conditions shall be stipulated to comply with the applicable GoI laws and regulations as well as internationally recognized standards
- Working conditions and terms of employment should be provided to the workers considering aspects such as a reasonable working hours and wages, adequate days off and worker’s insurance against accidents.
- The Project and its contractors should establish and enforce the implementation of a reliable health and safety management system including their monitoring.
- Each and every worker is required to undertake EHS induction prior to commencement of their works; and this induction would also apply for guests visiting the construction sites.
- Adequate trainings and budgets particularly for high-risk jobs should be conducted by competent personnel of the contractor, CSC or PMC, and this include refreshers trainings.
- Job Safety Analysis (JSA) system, signage and access restrictions and provision of Personal Protective Equipment (PPE) should be consistently implemented/
- Forced and child labor practices should be prohibited in the Project.

- The Project should provide a workplace that is free from harassment and abuse to all workers.
- The workplace rules that are reasonable, unambiguous, and clear sanctions and rewards should be enforced to all levels of worker.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the impact of the Project on the labor and working conditions as described above could be reduced from substantial risk to medium risk.

8.7 Impacts due to Security Arrangements

Overview. The result of the risk assessment suggests that the potential impacts due to security arrangement of the Project during toll road construction activities are evaluated as medium risk without implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of this impact is evaluated as low risk. The summary of the risk and impact assessment in this regard is presented below.

Risk Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Inherent Risk
Unfavorable impacts such as intimidation on the local communities and workers due to security arrangement of the Project	Moderate	Possible	Medium	Incidental	Rare	Low

Risk and Impact Assessment – Impacts due to Security Arrangements of the Project. The use of security personnel either through third party or individuals directly employed by the contractors may be perceived by the local communities within the Project area as well as the workers as discomfort and intimidation if the excessive presence of security personnel are established. The potential for social unrest or contentious circumstances between the Project and local communities may occur if security personnel are not well trained to interact with the community in a persuasive and trustworthy manner. Furthermore, if the community feels that the presence of security personnel focuses more on surveillance than protection, they may develop a negative perception of the Project, which may lead to serious grievances or community protest.

Considering the above, the severity of the impacts due to security arrangement of the Project is evaluated as moderate and its likelihood of occurring as possible, and therefore, these impacts are evaluated as medium risk without implementation of any mitigation measures.

Mitigation Measures. To minimize the above impacts due to security arrangements, the Project is proposed to implement the following mitigation measures:

- The Client should conduct a risk-based assessment whether the Project is required or not required to develop a stand-alone security management plan (SMP).
- Some mitigation measures that reduce security risks and impacts may be associated with implementation of a meaningful community development programs.
- Good stakeholder engagement with local communities should be implemented.

- Limiting the actions that can be taken by security personnel for prevention and defense purposes according to the nature and extent of the threat should be defined in the contractor's regulations.
- Security personnel are required to take reasonable steps to avoid violence in the event of an offense as well as appropriate trainings on handling security issues and events.
- Provide appropriate training to security personnel, including specific codes of conduct for security personnel.
- Strengthen perimeter fencing and warning signs around the project site to prevent unauthorized access and provide information to the community about dangerous areas.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the impact of the Project on its security arrangements as described above could be reduced from medium risk to low risk.

8.8 Cultural Resources and Heritage

Overview. The result of the risk assessment suggests that the potential impacts on cultural resources and heritage due to the toll road construction activities are evaluated as medium risk without implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of these impacts is evaluated as low risk. The summary of the related labor influx risk and impact assessment is presented below.

Risk Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Inherent Risk
Potential disturbance to cultural resources and heritage	Minor	Possible	Medium	Incidental	Unlikely	Low

Risk and Impact Assessment – Cultural Resources and Heritage. When earthworks and civil works are carried out, there is a potential that cultural resources such as customary practices and physical cultural heritage. The possibility of cultural resources is found within the Project area may be possible considering there is no specific information or studies conducted in this regard. Further, there is a little possibility that the cultural heritage or objects are found within the Project areas considering no site-specific information or studies in this regard.

The Muaro Jambi Temple complex, which is a major cultural heritage object in Jambi Province, is located approximately 20 km to the nearest point of the Sp. Ness – Merlung Toll Road alignment. The temple complex is said to have the largest area in Southeast Asia, stretching 7.5 km from west to east on the banks of the Batanghari River and covering almost 4,000 hectares. The temple complex has 11 main temples and possibly 82 remains that are still buried underground.

Considering the above and as a precautionary measure for an unexpected discovery of cultural resources and heritage within the Project area, the severity of the potential impact on cultural resources and heritage is evaluated as minor and its likelihood of occurring as possible, and therefore, this impact is evaluated as medium risk without implementation of any mitigation measures.

Mitigation Measures. To minimize the above impacts, the Project is proposed to implement the following mitigation measures:

- Development of a Chance Find Procedures for the unexpected discovery of cultural resources and heritage if during construction activities they are excavated or discovered should be developed and disseminated to all parties involved in the Project.
- Any findings on cultural resources and heritage within the Project area should be immediately reported to the Project's supervisor and implementing agencies, and the construction activities in that area should stop for an interim period.
- Construction sites should be delineated and clearly marked to minimize potential disturbance to unknown cultural resources and heritage that may exist in the area.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the potential impact on cultural resources and heritage could be reduced from medium risk to low risk.

9.0 CUMULATIVE IMPACT ASSESSMENT

This section presents the CIA of the Sp. Nessel–Merlung Toll Road and its management plan, prepared using the RCIA approach in accordance with the IFC Good Practice Handbook (August 2013), as elaborated in the following sub-sections.

9.1 Overview

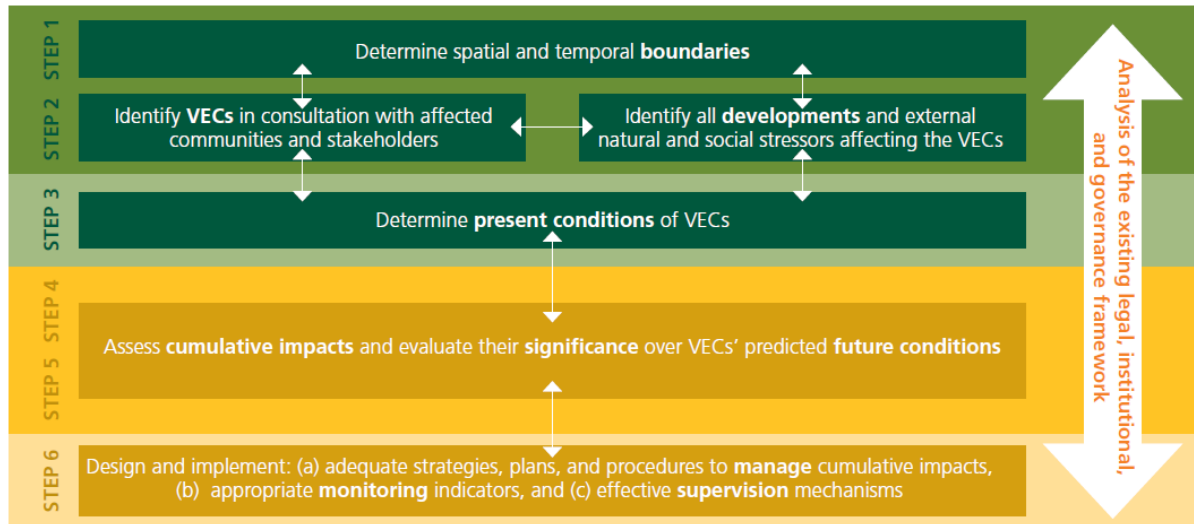
To meet the requirements of Good International Industry Practice (GIIP), a Rapid Cumulative Impact Assessment (RCIA) of the Sp. Nessel–Merlung Toll Road was conducted to assess the Project's contribution to cumulative impacts that may have been or would be generated by other existing or future developments on Valued Environmental and Social Components (VECs). Similar to the ESIA, the RCIA is aimed at avoiding and/or minimizing the Project's contribution to cumulative impacts to the greatest extent possible. Considering time, resource, and data limitations, it is unlikely that every E&S aspect can be factored into the RCIA. Accordingly, the assessment is focused on the most significant VECs. The step-by-step approach adopted for conducting the RCIA of the toll road, including the corresponding results, is presented in the following sub-sections. .

9.2 Methodology

Figure 28 presents the six steps to be undertaken as part of the CIA, in accordance with the Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets (IFC, August 2013). These six steps include:

- Scoping process to identify the Aol and the valued environmental components (VECs) including social ones and development activities other than the planned toll road project, as well as identification of natural and social stressors affecting the VECs (Steps 1 and 2);
- Determination the presence condition of VECs (Step 3);
- Impact assessment of the contribution of the project to the predicted cumulative impacts (Step 4);
- Evaluation of significance of the predicted cumulative impacts to the sustainability of the affected VECs (Step 5); and
- Design and implement additional mitigation measures and monitoring programs if those included in the ESMP are considered to require enhancement (Step 6).

Figure 28. Step-by Step Approach of Cumulative Impact Assessment



Source: Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets (IFC, August 2013)

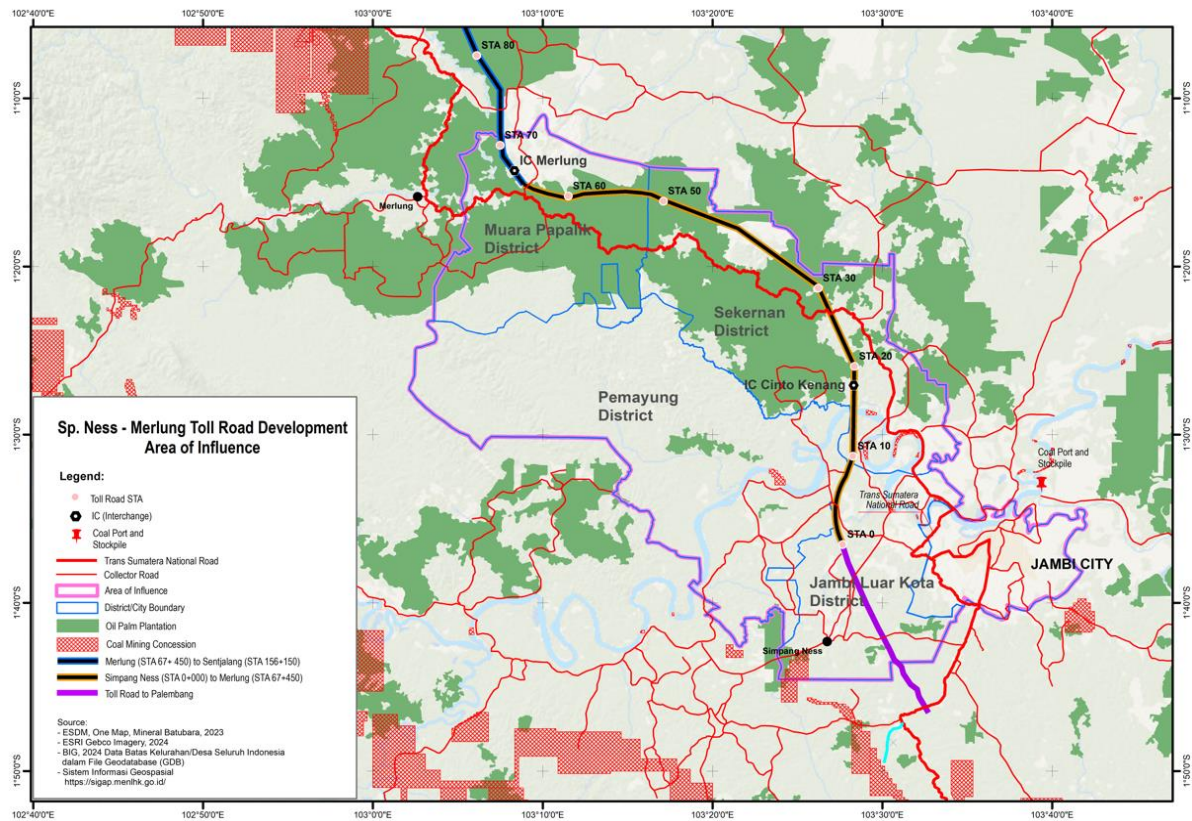
Spatial and Temporal Boundaries. The spatial boundary of the CIA is defined as the Area of Influence (AoI) of the Sp. Ness–Merlung Toll Road, as described in Section 2.3 of this ESIA. The AoI also encompasses existing and future developments up to the legally protected areas and internationally recognized areas identified through the Critical Habitat Assessment completed for the toll road. The CIA further requires the determination of a temporal boundary, which carries inherent uncertainties due to the unpredictable nature of future projects, activities, and natural and social stressors. Considering this, a **3-year temporal boundary** in accordance with the relevant IFC guideline is adopted for this CIA. **Existing Development and Activities**

A review of publicly available documents and information, including those presented in the E&S baseline sections of this ESIA, was undertaken to assess existing and foreseeable future development within the Aol of the Sp. Ness–Merlung Toll Road and its resulting cumulative impacts .

Road Networks and Developed or Opened Area. Current national, provincial, and local road networks are prevalent within the toll road project area, and several road crossings among them have been identified and will be constructed using either underpasses or overpasses. The existing national roads include the Trans-Sumatera road traversing Jambi Province northward to Riau Province and southward to South Sumatera Province. Provincial roads connecting the Trans-Sumatera national road with roads within Tanjung Jabung Barat, Muaro Jambi, and Batanghari Regencies include: Muara Tembesi–Muara Bulian; Merlung–Tanjung Jabung; Simpang Tuan–Jambi City; and Batanghari II Road–Zona Lima (Harbor Intersection).

Revenue-generating activities within the Trans-Sumatera National Road corridor traversing Jambi Province are dominated by oil palm plantations and associated palm oil processing at both large company-operated and smallholder scales. Coal mining activities constitute another key revenue-generating sector, with concessions distributed across different parts of Jambi Province. Other economic activities in the existing road network corridor include a mixture of residential and commercial areas, including unplanned settlements and businesses. The existing road network and developed areas within the AoI are shown in Map 27.

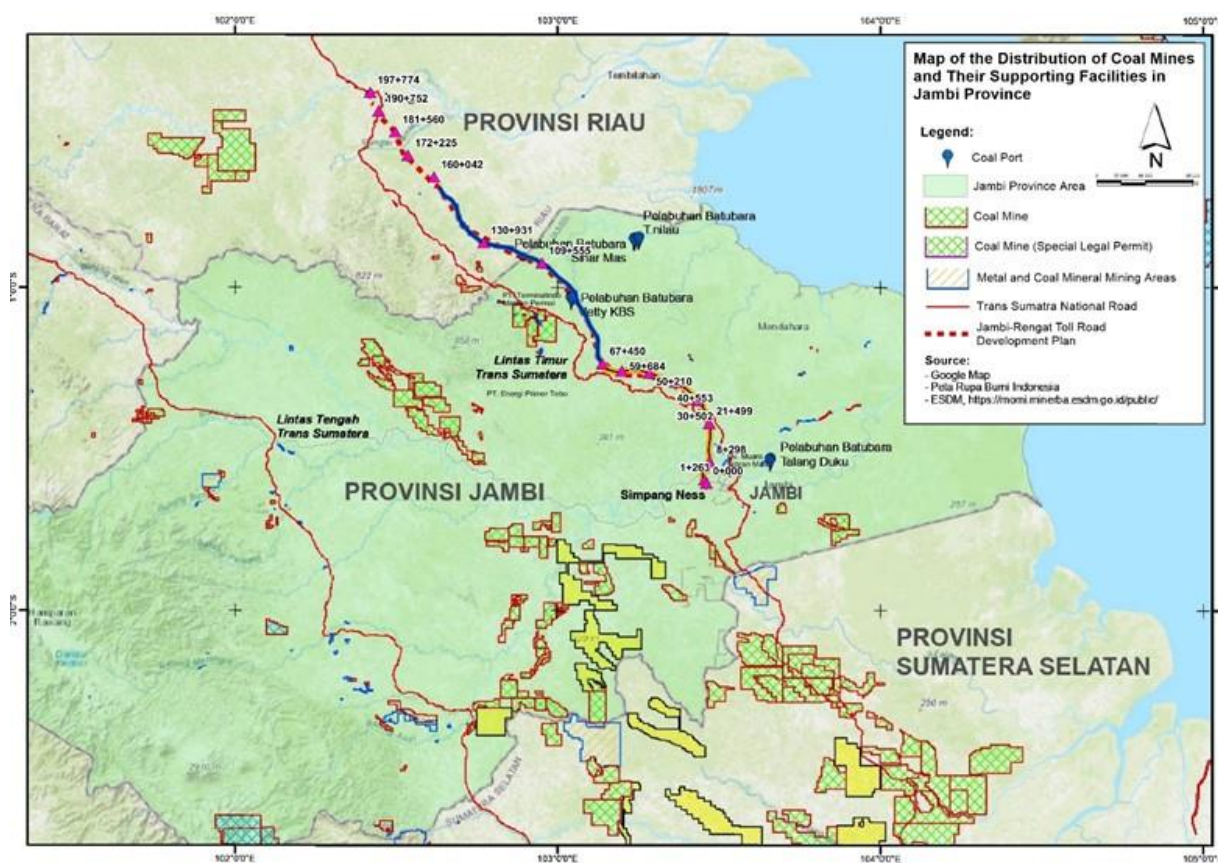
Map 27. Existing Road Network and Developed Areas



Mining and Quarrying Concessions. Coal, metal, and mineral mining concessions and jetties in Jambi Province were identified based on the Minerba One Map Indonesia published by the Indonesian Ministry of Energy and Mineral Resources (2024). The alignment of the Sp. Ness–Merlung Toll Road in relation to the mining concessions and coal jetties is shown in Map 28, indicating that the number of mining concessions in Jambi Province is greater compared to those in Riau Province. The majority of coal mining concessions are located at a reasonable distance to the west of the Jambi–Rengat Toll Road alignment, while coal export jetties are situated at relatively close proximity to the east. Key coal export jetties identified include Talang Duku, KBS Jetty, and Sinar Mas, among others.

Oil and gas, coal mining, and construction material quarries were reported as primary revenue sources in Jambi Province, with revenues experiencing substantial growth in recent years. The overall economic growth of Jambi Province is significantly driven by the coal mining and construction material quarrying sectors.¹⁸

Map 28. Coal Mining Concessions and Related Jetties



Source: Minerba One Map Indonesia, The Ministry of Energy and Mineral Resources of Indonesia (2024)

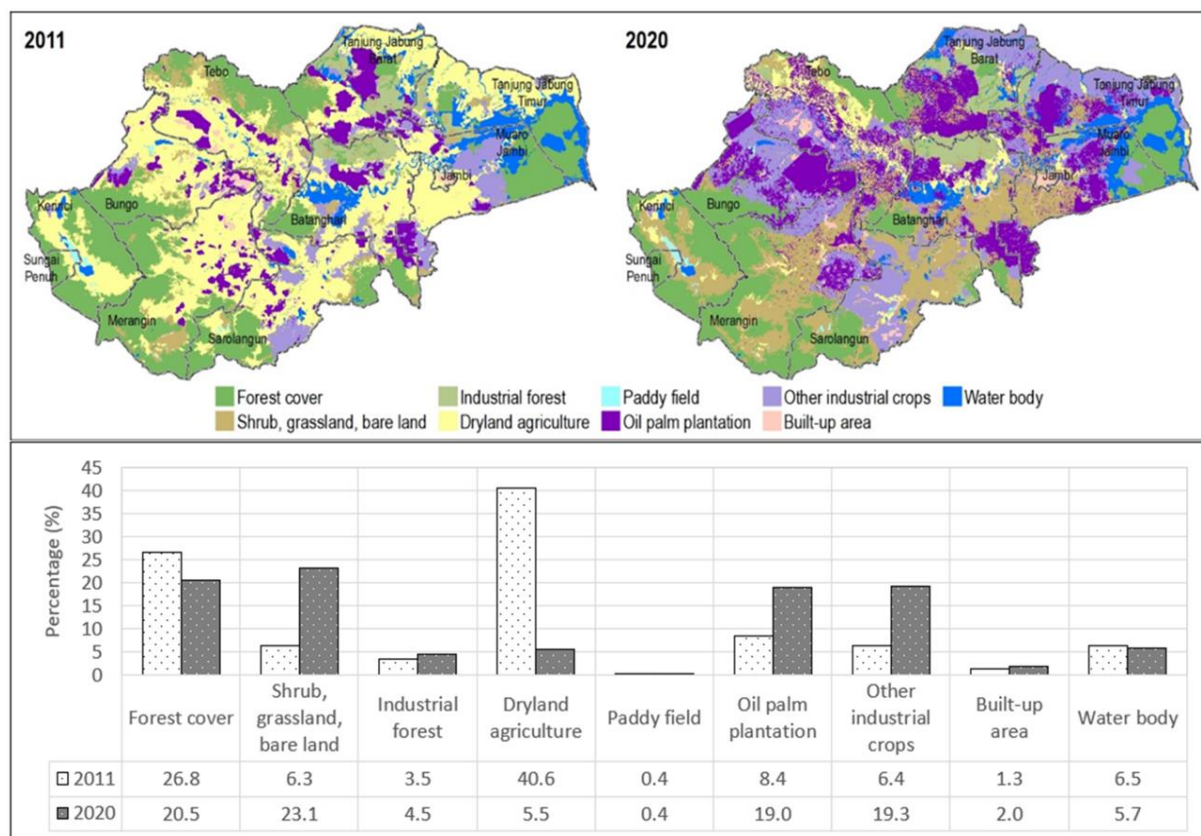
Land Use Conversion in Jambi Province. According to a published study on regional development, rural transformation, and land use/cover changes in Jambi Province (Ernan, R. et al., May 2023), economic development in Jambi Province has been accompanied by significant land use conversion from forest land cover and agricultural areas to plantations, industrial crops, and bare land, as shown in Map 29. Key land use conversions recorded over the 2011 to 2020 period were as follows:

- The area of dryland agriculture declined from **40.6%** (2011) to **5.5%** (2020), representing a loss of approximately **17,600 km²** over 10 years, or approximately **176,000 hectares per year**.¹⁹ The dryland agricultural practice was dominated by seasonal crops including cassava, corn, vegetables, and fruits.
- Forest land cover declined from **26.8%** (2011) to **20.5%** (2020), representing a loss of approximately **3,160 km²** over 10 years, or approximately **31,600 hectares per year**.

The land use conversion resulted in corresponding increase in bare land (grown primarily by shrubs and grass), oil palm plantation, and other industrial crops areas, as follows:

- Bare land increased from **6.3%** (2011) to **23.1%** (2020), an increase of approximately **8,595 km²** over 10 years, or approximately **85,900 hectares per year**.
- Industrial crop areas increased from **6.4%** (2011) to **19.3%** (2020), an increase of approximately **6,600 km²** over 10 years, or approximately **66,600 hectares per year**. Industrial crops planted include rubber, coconut, vegetables, and fruits.
- The area of oil palm plantations increased from **8.4%** (2011) to **19.0%** (2020), an increase of approximately **5,282 km²** over 10 years, or approximately **52,800 hectares per year**.

Map 29. Land Cover Changes in Jambi Province 2011 - 2020



Most oil palm and industrial crop plantations are concentrated in Bungo, Muaro Jambi, and Tanjung Jabung Barat Regencies. Jambi Province ranks fourth in crude palm oil (CPO) production compared to other provinces in Sumatera. The growth of oil palm plantations and CPO production constitutes the main income source for the province, providing employment for local farmers and communities and contributing substantially to the regional gross domestic product (GDP). Industrial crop plantations have expanded particularly in Tanjung Jabung Barat, Batanghari, and Tebo Regencies, parts of which overlap with the Sp. Ness–Merlung Toll Road alignment..

Villages. According to the Village Potential Data (*Data Potensi Desa*) published by the Indonesian Statistics Agency, the number of villages, including urban villages (*kelurahan*), in Jambi Province grew from 1,372 in 2011 to 1,562 in 2020, representing an addition of 190 villages over the 10-year period.

Key Utilities and Infrastructure. Very-high and high-voltage power transmission lines owned by PT PLN are identified to traverse the Jambi–Rengat Toll Road alignment at STA 29+000 to 30+000, STA 59+000 to 60+000, and STA 75+000 to 76+000. Oil and gas pipelines owned by PT Pertamina are identified to cross the alignment at STA 39+000 to 40+000 and STA 66+000 to 67+000.

Muaro Jambi Temple Complex. The 2013–2033 Spatial Plan of Jambi Province designates the Muaro Jambi Temple Complex in Muaro Jambi Regency as a planned international tourist destination to attract both domestic and international travelers.

9.3 Foreseeable Future Development, Activities, and Natural Factors

Regional development in Jambi Province and surrounding areas is anticipated to continue to be driven by coal mining, oil palm, and industrial crop plantations as the primary sources of provincial revenue and local employment. This development will occur across Muaro Jambi, Batanghari, and Tanjung

Jabung Barat Regencies, parts of which are traversed by the Sp. Ness–Merlung Toll Road. The provincial government further intends to develop the Muaro Jambi Temple Complex as an international tourist destination.

Economic development is expected to be characterized by increased per capita income and regional GDP, improved infrastructure and utilities, and more developed villages dependent on oil palm and industrial crop plantations, compared to the less developed communities that rely on forest and wetland resources. Urbanization to Jambi City as the provincial capital will continue as public facilities, services, and entertainment improve over time. Labor influx to developed villages driven by the expansion of plantations and improving infrastructure will remain a key contributing factor in regional development.

Natural events anticipated to affect toll road construction and operation in the future include wildfires, flooding, and landslides associated with climate change effects, including prolonged dry periods, elevated air temperatures, and extreme rainfall events, as well as the slash-and-burn land clearing practices commonly employed in the region.

9.4 Valued Environmental and Social Components

Valued Environmental and Social Components (VECs) are defined as "E&S attributes considered important to assess risks on physical features, habitats, wildlife populations, ecosystem services, natural processes, social conditions, or cultural aspects" (IFC, 2013). The VECs for this RCIA are identified and selected based on their perceived ecological, social, economic, and cultural importance, and their potential interactions with impacts generated by the toll road and other existing and future activities and developments within the Aol.

Data and information used to determine the VECs are drawn from the E&S baseline sections of this ESIA and publicly available publications, articles, and news. Public consultations conducted as part of the Indonesian Andal preparation in 2020, and focused group discussions conducted in 2023 as part of the LARP and ESIA preparation, also inform the determination of VECs. The risk and impact assessment results presented in Section 6 of this ESIA further form the basis for VEC selection. Based on the above considerations, the VECs considered for the RCIA and their rationale are as follows:

- **Air quality** – The toll road construction activities will generate elevated airborne particulates and fugitive emissions, with the resulting air quality impact evaluated as Major significance in Section 6.2.1. Ongoing similar emissions from coal mining, quarries, unpaved plantation roads, and annual land and forest fires within the Aol further contribute to air pollution.
- **Surface water and groundwater resources** - The toll road construction will result in increased soil erosion and surface runoff due to earthwork activities, with the resulting impact on surface water and groundwater resources evaluated as Major significance in Sections 6.2.5 and 6.2.6. Prolonged drought periods and flooding have also been reported in the Aol due to forest and non-forest area conversion, contributing to water scarcity and reduced surface water flows.
- **Road traffic and infrastructure** – The toll road construction will generate significant road traffic from the mobilization of heavy equipment and construction materials, with the resulting impact evaluated as Moderate significance in Section 6.2.7. Toll road traffic during the operation phase will also contribute to the cumulative road traffic within the Aol.
- **Terrestrial and aquatic biodiversity** – Land clearing and the construction of bridges, underpasses, and overpasses will result in habitat fragmentation and the removal of terrestrial

vegetation, with habitat and species impacts evaluated as Major significance in Sections 6.2.8 and 6.2.9. Part of the riparian vegetation classified as Critical Habitat will also be disturbed at the Batanghari and Pijoan River crossings.

- **Socioeconomic development and livelihoods** — The toll road will generate both positive and adverse socioeconomic outcomes through employment and business opportunities for local communities, as well as the displacement of affected households whose lands and assets will be acquired for construction. These outcomes need to be enhanced by the Project to create multiplier benefits for local community welfare and economic development in Jambi Province.

Socio-cultural aspects - The influx of workers from outside the region due to the construction and operation of the toll road, as well as the planned development of industrial and tourism sectors in the province, may lead to tensions between migrant workers and local communities where social norms and cultural backgrounds differ.

The above VECs have been degraded to varying degrees by ongoing human activities including substantial land use conversions and large-scale development, as well as natural disaster events in Jambi Province, as described in the E&S baseline and RCIA sections of this ESIA.

9.5 Cumulative Impact Assessment

The cumulative impact assessment for each VEC is presented in Table 111.

Table 111. Cumulative Impact Assessment

VEC	Key E&S Impacts	Cumulative E&S Impacts
Air Quality	Impacts due to Toll Road Construction and Operation As described in the impact assessment section of the ESIA, the toll road construction activities, particularly earthworks, mobilization of the project fleets, and the operation of quarries and concrete batching plants would elevate total suspended particulates (TSP), PM_{2.5}, CO, SO₂, and NO₂ concentrations within the airshed of the project Aol. The air quality modelling indicates that the concentration of total suspended particulate/TSP (i.e., particulates of <100 µm) during toll road construction could be elevated up to 10,000 µg/m³ (on 24-hour average) and this figure is well above the baseline level in some project areas, and this is well above the threshold value of 230 µg/m³ stipulated in the GR No. 22/2021. However, the modelling results do not indicate an elevated concentration of the air quality parameters mentioned earlier. For the operation phase, the modelling results indicate that the concentration of total particulates in the operation phase of the toll road is predicted up to 100 µg/m³ and this is significantly lower than that of the construction phase. However, the concentrations of CO, NO₂, SO₂, and PM_{2.5} in the operation phase are predicted to be higher than those of the construction phase due to higher number and different types of vehicles using the toll road. Nevertheless, these elevated concentrations are unlikely to exceed the respective threshold values stipulated in the GR No. 22/2021.	Based on the air quality impacts described herein, the cumulative impact on air quality within the Aol is evaluated as major in term of its severity and the impact is likely to occur and, therefore, ranked as substantial risk. This cumulative impact that would be felt is particularly due to the elevated concentration of total suspended particulates (i.e., those <100 µm) in the atmosphere. The air quality in Jambi Province has been subject to ongoing impacts due to air pollutants generated by coal mining, land- and forest-fires, transportation, and climate-induced risks. The construction of the toll road project is anticipated to contribute to the air quality impact within the Aol due to elevated concentration of particulates resulted from earthworks, mobilization of the project fleets, and the operation of quarries and concrete batching plants.
Air Quality (continued)	Impacts due to Past, Present, and Foreseeable Future Development As described in relevant sections of the ESIA, massive land use changes in Jambi Province have occurred in 2011- 2020 period due to major expansion of oil palm plantations, coal mining, and quarries for construction material. This trend of land use change will continue to occur in the future as the plantation and mining sectors are the main source of revenues, employment, and local economy development in Jambi Province as indicated, among other, in the 2013 - 2033 Jambi Province Spatial Plan.	As above

VEC	Key E&S Impacts	Cumulative E&S Impacts
	Air quality issues due to oil palm plantation and other plantation crops in Jambi Province are rarely reported, except at the time of land clearing and forest encroachment using slash-and-burn method. On the other hand, air quality issues, particularly elevated airborne dust including coal dust impacting the environment and human health within the proximity of coal mining, hauling, and stockpiling activities in Jambi Province are widely reported. Approximately 12,100 coal trucks operating in Merangin, Bungo, Tebo, Muaro Jambi, Sarolangun, and Tembesi Regencies and Jambi City to Talang Duku and Niaso coal jetties using approximately 223 km of public roads in 2023. Approximately, 117 mining licenses covering an area of 193,000 hectares are registered in the province. Due to the road traffic deadlock caused by these coal trucks in 2023, the Governor of Jambi instructs the coal mining companies to stop transporting the coal using trucks and to use river barges instead, while dedicated haul roads for transporting the coal from the mine sites to the dedicated ports are being constructed. (Ref: Suprpto, Y., 2020; and Suprayitno, T., 2024.)	
Air Quality (continued)	Impacts due to natural events Land/forest fires in Jambi Province are the natural disaster events occurred on annual basis in Indonesia due to human factors and climate-induced risks, affecting up to 56,592 ha in 2019 and reducing to 540 ha in 2021. Most of forest fires in Sumatera region primarily occurred in South Sumatra, Jambi, and Riau Provinces resulting in adverse impacts on human health, transportation, and economic activities in Sumatera region. The burnt land and vegetation releases, among others, CO, CO₂, NO_x, CH₄, and some heavy metals into the atmosphere. Approximately 70% of the forest-fire related events in Tanjung Jabung Barat Regency and 56% of similar events in Muaro Jambi Regency where parts of its administrative areas overlap with the area of the toll road project mentioned above. The occurrence of forest-fire was associated with encroachment, land-use conversion, and the slash-and-burn method commonly applied by the local communities as well as companies for land clearing due to its practicality and the resulting ash can improve the soil nutrients and minimize weed growth. The	As above

VEC	Key E&S Impacts	Cumulative E&S Impacts
	vegetation slash generally occurs in March and the vegetation burning in July – August period. (Ref: Wibowo, A., et al., 2021; Sundari, C., et al, 2022 Hawam, M., et al., 2024).	
Surface and Groundwater Resources	Impacts due to Toll Road Construction and Operation As described in the impact assessment section of the ESIA, alteration and increased surface runoff and soil erosion would occur due to land clearing and civil work-related activities for the toll road construction and the operation of borrow pits and concrete batching plants. This change in hydrological regime would subsequently impact the quality of receiving water bodies. Further, land clearing, cut and fill, and compaction of subsurface soils would affect groundwater recharge and changes in hydrogeological regime within the Aol. The samples analyzed for surface water and groundwater collected within the toll road project area indicate that none of the water parameters were measured at concentrations above the applicable Gol standards. The overall impacts on surface water and groundwater resources due to the toll road project is evaluated as substantial risk during construction phase, particularly due to limited hydrological and hydrogeological data and water quality information specific to the Aol. However, the impacts on the mentioned water resources would reduce to low risk in the operation phase of the toll road as the surface runoff is better controlled through the establishment of stable slopes, engineered contoured, and drainage channel within the alignment of the toll road.	Considering the impacts on surface water and groundwater resources described herein, the cumulative impact on these resources within the Aol is evaluated as major in term of its severity and the impact is likely to occur and, therefore, ranked as substantial significance. In the light of hydrological and hydrogeological data and water quality information specific to the Aol, the cumulative impacts that would be observed are increased runoff and associated soil erosion, increasing turbidity and water pollutants in the river and nearby water bodies affecting water quality and increased sedimentation in the receiving water bodies. As described herein, the river water quality in Jambi Province, particularly Batanghari River has been subject to ongoing impacts due to untreated discharges from coal mining, palm oil and rubber processing, and household discharges. The construction of the toll road project is anticipated to contribute to these ongoing water quality and availability issues, particularly during earthworks associated with the construction of toll road and related infrastructure.
Surface and Groundwater Resources (continued)	Impacts due to Past, Present, and Foreseeable Future Development The Batanghari River, starting from its middle part in Tebo Regency to downstream part in Jambi City, Muaro Jambi and Tanjung Jabung Timur Regencies are designated as flood plains, with a lot of meanders. Increased soil compaction due to the expansion of monoculture plantations and substantial forest conversion resulting in reduced water infiltration into the soils, and this is the main cause in an increase in surface runoff compared to climate-induced risk, such as alterations in rainfall patterns. Higher bulk densities of the soil in monoculture plantations than in forests are more likely to cause soil	As above.

VEC	Key E&S Impacts	Cumulative E&S Impacts
	erosion and changes in its properties due to compaction caused by heavy machinery during land clearing and harvesting. Meanwhile, current oil palm cultivation practices increase the risks of droughts and floods which in turn could lead to a shortage of freshwater availability for the local communities and irrigation of paddy field and other crops. The oil palm plantation is perceived as a water and nutrient greedy crop. (Ref: German Development Institute, 2017; and Merten, J., et al., 2020.)	
Surface and Groundwater Resources (continued)	Impacts due to Natural Events Deforestation can modify rainfall patterns and result in river discharge due to interactions between vegetation and the atmosphere within the area affected. In the case of forest conversion to homogenous oil palm plantations, evapotranspiration remains relatively high and, therefore, rainfall may be limited. However, deforestation in relatively heterogeneous landscapes may increase rainfall and thereby increase both river discharge and river water levels. Moreover, climate-induced risk over time is expected to increase extreme rainfall rate and droughts over time which subsequently leads to increase river water level, but also reduce river water level respectively.	As above.
Road Traffic	Impacts due to Toll Road Construction and Operation Traffic disruption damage to existing roads would occur on those that will be frequently used for mobilization of heavy equipment and material transport vehicles starting from the material source location, which is estimated to cross national roads, Regency roads and then onto village roads, plantation roads and public roads. (if no roads are built Work). Road sections that may be frequently used for the construction of Phase 1 development of the Project are, among others from Merlung to West Tanjung Jabung Regency boundary that has relatively good condition and from Simpang Tuan to Jambi City boundary that has moderate conditions based on the international roughness index of the road Construction materials such as sands, gravels, wooden planks, and cements for road construction will be purchased in bulk quantity from quarries and suppliers that will be selected by the main contractors. Fuel and lubricants will also be purchased primarily for refueling the heavy equipment and trucks operated far	Increased vehicle traffic from existing activities and project activities during equipment and material mobilization. The increase in traffic that occurs during the construction period will cause an increase in the level of road service, traffic problems, disruption to traffic safety and a decrease in road quality due to heavy vehicles passing through during the construction period. Based on the above assessment, the severity of the impact of traffic disruption and damage to existing roads is considered moderate and its likelihood to occur is possible. Therefore, the impact on this environmental component is considered Moderate significance (without mitigation measures).

VEC	Key E&S Impacts	Cumulative E&S Impacts
	away from the public fuel stations. These materials will be transported using flat-bed trucks, haul trucks or road tankers where appropriate with a load capacity of up to 20 tons or more depending upon the road class that will be used. From the table above, the daily traffic rate (LHR) at the time of the survey was between 3,189 vehicles/day (or 111 PCU/hour) at the road between Merlung and West Tanjung Jabung Regency border and 10,354 vehicles/day (or 321 PCU/hour) at the road between Simpang Tuan – and Jambi City border. The average speed of the vehicles was estimated at 40 – 60 km/hour. Peak hours for traffic flow on each road section studied were around mid-morning, afternoon and in the evening. The level of service of some known roads that will be used by the Project was calculated as 'A' at baseline level, meaning that the road is characterized with relatively free traffic, low volume, high speed, and the driver can choose the desired speed according to the Indonesian Road Capacity Manual (1997). Overloaded and frequent movements of the project trucks and other vehicles typically operated with relatively slow speed due to its loads could slow down the speed of other road users that would, in turn, cause traffic disruption. Further, overloaded trucks and mobilization/demobilization of heavy equipment using trucks with three or more axles could damage the existing roads, particularly if the road is not upgraded to match the tonnage of the load. This impact, if occurred, would be quite adverse, but reversible upon completion of the Project where the road traffic is expected to return to its baseline condition and repair of the damaged roads are undertaken in a timely manner.	
Road Traffic (continued)	Impacts due to Past, Present, and Foreseeable Future Development Based on the analysis results, traffic conditions around the project site area are quite high at certain times resulting from the activities of the surrounding community, agricultural product transportation activities and the palm oil industry. Road sections that are potentially affected by the Jambi - Rengat Toll Road section are: ▪ National Road (Tempino - South Sumatra Province Border (Jambi Province) ▪ Provincial Roads:	Based on the Traffic Impact Analysis document for the Jambi-Rengat Toll Road Development in Jambi-Riau Province (PT. Kwarsa Hexagon, 2022), fluctuations in traffic volume show the traffic volume of Jalan Merlung - Tanjung Jabung Regency Boundary during a 16-hour period, where the peak hour volume occurs in the morning at 172 passenger car units/hour towards Sekernan and towards Merlung at 239 passenger car units/hour. This has the potential to produce cumulative impacts along with project activities involving transportation of construction

VEC	Key E&S Impacts	Cumulative E&S Impacts
	▪ Muara Tembesi - Muara Bulian City Border (Jambi Province) ▪ Merlung - Tanjung Jabung Regency Border (Jambi Province) ▪ Simpang Tuan - Jambi City Border (Jambi Province) ▪ Batanghari II Road - Zona Lima (Harbor Intersection) (Jambi Province)	equipment and materials. Increased construction vehicle routes and travel frequency will accumulate with existing traffic conditions.
Terrestrial and Aquatic Biodiversity	Impacts due to Toll Road Construction and Operation Project construction activities will increase disturbance to biodiversity and change the natural habitat conditions of flora and fauna around the project site. Land clearing and the construction of bridges, underpasses, and overpasses would result in habitat fragmentation of the wildlife and removal of terrestrial vegetation. Part of the riparian vegetation will also be removed within parts of Batanghari and Pijoan Rivers including their tributaries required for constructing the bridges and culverts.	Increased conversion and changes in land use of natural habitats of flora and fauna from project activities and community activities. Another cumulative impact is the increase in the intensity of animal encounters due to land changes that have the potential to increase animal hunting.
	Impacts due to Past, Present, and Foreseeable Future Development Land clearing activities for agriculture by the community. Referring to the document of the Jambi Province Medium-Term Regional Development Plan for 2021-2026, the areas included in the Jambi-Rengat Toll Road Development Plan, namely West Tanjung Jabung Regency and Muaro Jambi Regency are the highest contributors to provincial income from the secondary sector which operates in the processing industry sector, the electricity and gas procurement sector and the construction sector.	As above.
Socio-economic development and Livelihoods	Impacts due to Toll Road Construction and Operation Changes in agricultural land from toll road construction activities have the potential to cause a decrease in community agricultural production and allow economic and livelihood changes. There is spatial overlap of the mine with the Project; truck traffic from the mine and the Project would normally need to pass through settlement. Apart from that, the addition of project workers from outside the area can increase sales of workers' basic needs which can be purchased from local shops or stalls.	Positive impacts The proposed toll road will have a cumulative impact on agriculture in the area. The route and the economic growth it is planned to stimulate will ultimately affect the economy of the community in terms of income and the likelihood that affected communities will change livelihoods. In general, private development projects provide large dividends to landowners over and above the agricultural value, which more than compensates for the loss of land, allowing farmers to change their

VEC	Key E&S Impacts	Cumulative E&S Impacts
	At the land acquisition stage there will be people who lose access to land, as well as when toll road work is carried out there will be access to community-owned resources that are blocked.	livelihoods into entrepreneurs or industrial workers with the encouragement of the project.
	Impacts due to Past, Present, and Foreseeable Future Development Community agricultural activities are a source of economic support for community households. The increase in the industrial sector due to regional development will reduce agricultural land and allow for economic and livelihood changes. Daily activities of people in the agricultural sector. Local economic growth due to local government planning for the development of industrial and tourism areas. Existing mining and plantation activities have an impact on limiting community access to assets and land resources. Plans to develop industrial and tourism areas can result in limited community access to assets and land resources.	The activities that are the source of the community's economy are the agricultural and plantation sectors. The existence of the Jambi-Rengat Toll Road construction project can potentially increase community income from the trade and service sectors to meet the needs of project workers. With the activities of the mining sector, plantations and the planned development of the Jambi-Rengat Toll Road as well as the development plan for the industrial and tourism sectors, it has limited public access to land and asset resources owned by the community. Land development and land acquisition that are carried out will reduce accessibility to land owned by the community.
Socio-cultural aspects	Impacts due to Toll Road Construction and Operation With the entry of workers from outside the region, there is a negative potential in the form of social jealousy if the implementation of labor recruitment activities does not prioritize local residents and is not carried out fairly by involving the local government. In addition, in-migration originating from labor recruitment activities in the construction and operation of toll roads, as well as activities carried out by workers from outside the region, the nature and characteristics and different socio-cultural backgrounds are drivers of violations of social norms by migrant groups. If there is a violation of social norms, there will be conflict, both between individuals and between groups.	With the recruitment of workers from the mining sector, plantations and the planned development of the Jambi-Rengat Toll Road as well as the development plan for the industrial and tourism sectors, it has resulted in the need for workers from outside the region, which has resulted in an increase in migration into the study area. This potentially can lead to conflict/issues between migrant workers and local communities.
	Impacts due to Past, Present, and Foreseeable Future Development	As above.

VEC	Key E&S Impacts	Cumulative E&S Impacts
	The influx of workers from outside the region due to the recruitment of workers in the plantation and mining sectors. The influx of workers from outside due to planning for the development of industrial and tourism areas. There is a discovery of cultural heritage objects in the form of a temple complex Possible discovery of cultural heritage objects during planned development activities.	

9.6 Cumulative Impact Management Plan

The following outlines the Cumulative Impact Management Plan for the Sp. Ness – Merlung Toll Road project (Table 112). This plan is designed to address and mitigate the combined effects of various factors associated with the toll road's construction and operation.

Table 112. Cumulative Impact Management Plan

Impact	Mitigation Measure for PMU/TIU Implementation	Stakeholders	Timeline
General Mitigation Measures	- Comprehensive evaluation and address of impacts on Valued Environmental and Social Components (VECs) - Engagement and consultation with relevant international NGOs and local conservation authorities. - Close collaboration with local authorities and enhanced coordination efforts, especially with neighboring projects. - Provide information about the Grievance Redress Mechanism (GRM), including details on contact points and channels for receiving complaints and grievances. - Arrange meetings with developers of other projects identified in CIA to address challenges, discuss mitigation measures, and explore opportunities for continuous improvement. - Share knowledge and practices, monitoring results, and implementation status of ESMPs and other E&S subplans with relevant stakeholders. Conduct meetings among stakeholders to discuss challenges and mitigation measures	- Regencies of Muaro Jambi, Batanghari, and Tanjung Jabung Barat - Provincial Government of Jambi - Local Conservation Agency (BKSDA Jambi Province) - Local environment and forestry agencies in Jambi Province - Forest Management Units in Jambi Province - Plantation Companies in Jambi Province - Coal mining companies - Conservation NGOs - Traffic Police Force in the regencies of Jambi Province	Construction and Operation
Biodiversity	Share relevant information on biodiversity baseline surveys, CHA, and BMP and implementation results with developers of other projects identified in CIA and BMP. Initiate workshops and meetings among plantations and companies, together with conservation agencies and NGOs to discuss challenges, share good practices, lessons learned, and reach collective agreement on actions/mitigation measures.	- Local Conservation Agency (BKSDA Jambi Province) - Local environment and forestry agencies in Jambi Province - Forest Management Units in Jambi Province - Plantation Companies in Jambi Province - Conservation NGOs	Construction and Operation

10.0 MITIGATION MEASURES

10.1 Mitigation Hierarchy Application

This Environmental and Social Management Plan (ESMP) consolidates all environmental and social (E&S) risk management commitments for the construction of Phase I of the Jambi-Rengat Toll Road segment of the Sp. Ness to Merlung Project (Section 1, STA 0+000 to 67+450). All E&S risks and impacts identified in this ESIA have been addressed following the mitigation hierarchy stipulated in IFC PS1, in the following order of preference:

- **Avoid:** Eliminate the risk or impact entirely by not undertaking certain activities or by design modifications (e.g., avoiding Critical Habitat clearing where alternative alignments are feasible; avoiding nighttime construction near sensitive wildlife areas).
- **Minimize:** Reduce the duration, intensity, or extent of the risk or impact (e.g., phasing land clearing to limit active bare soil area; restricting pile driving to daytime hours).
- **Mitigate:** Provide on-site compensatory measures to address remaining impacts (e.g., installing Sediment Retention Ponds; erecting temporary noise barriers; conducting revegetation).
- **Offset/Compensate:** Where adverse impacts cannot be fully mitigated, provide compensation to affected parties or undertake ecological offsetting (e.g., 5:1 offset planting for Critical Habitat clearance; community access compensation).

The ESMP links each identified impact from Section 6.0 – Environmental and Social Impact Assessment to: (i) specific actionable mitigation measures; (ii) measurable monitoring indicators with defined compliance limits; (iii) responsible parties; and (iv) a timetable for implementation. It is designed to comply with relevant national regulations, the AIIB Environmental and Social Standard 1, and Good International Industry Practice (GIIP). The structure follows a hierarchy: the ESMP and its sub-plans operate at the project level (under TIU oversight), the Construction Environmental and Social Management Plan (CESMP) functions at the contractor level, and specific impact categories are detailed in operational sub-plans within the CESMP. Additionally, the matrix in Table 113 outlines the mitigation hierarchy level applied to each impact, the residual risk after mitigation, and the monitoring indicators to verify mitigation effectiveness.

10.2 Summary of Environmental and Social Management Plan (ESMP)

All mitigation measures identified in the impact assessment at Chapter 6.0 of this ESIA are covered in Table 113.

Table 113 Summary of Environmental and Social Mitigation Measures

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
ENVIRONMENTAL IMPACTS – CONSTRUCTION PHASE										
Construction	ENV-01	Increase in gaseous emissions and particulate generation (TSP/dust rated Critical at 4,348% of AQS; CO Minor; SO ₂ , NO ₂ , PM _{2.5} Low). Maximum TSP up to 10,052 µg/m ³ near Selat and Dusun Mudo Villages, exceeding 230 µg/m ³ national standard fivefold.	Earthworks (land clearing, cut/fill, levelling); mobilization/demobilization of project fleet; operation of quarries, concrete batching plants, base camps; unpaved access roads	- Develop standalone Air Management Plan (AMP) as mandatory CESMP sub-plan; submitted for TIU/CSC approval 30 days before earthworks commence in each work package - Phase civil works into packages; restrict active land clearing to areas immediately required; maximum 50 ha of active bare soil at any one time - Water tanker dust suppression: spray construction sites, quarries, batching plants, and unpaved access roads at minimum 2x per day; increase to 3x during dry weather (no rain for 3+ consecutive days) - Enforce speed limits: 40 km/h at construction sites; 30 km/h near residential areas and schools; 40-60 km/h on public roads - Enforce tarpaulin covers on 100% of dump trucks carrying loose material; daily spot checks by contractor ES officer	Along toll road alignment STA 0+000 to 67+450; highest risk at Selat Village (STA 50-55), Dusun Mudo Village (STA 60), and Taudhotut Tholbin school (STA 10)	Throughout construction phase; AMP approved before earthworks commence	- TSP: 230 µg/m³/24hr (GR 22/2021) - PM_{2.5}: 25 µg/m³/24hr (IFC EHS 2007) - SO₂: 20 µg/m³/24hr (IFC EHS 2007); CO: 10,000 µg/m³/1hr (GR 22/2021); NO₂: 40 µg/m³/24hr (IFC EHS 2007) - Zero open burning incidents - Watering log: minimum 2x/day recorded at each active site	Contractor: AMP preparation and implementation, daily dust suppression, fleet compliance. TIU/CSC: AMP approval, bi-weekly audit	TIU/CSC: quarterly ambient air quality monitoring at 4 stations (Selat, Dusun Mudo, school vicinity, batching plant boundary)	IDR 4,150 Mitigation (dust suppression ops., 3 yrs): IDR 3,500 Monitoring (ambient AQ, quarterly, 4 stations, 3 yrs): IDR 650

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
				• Project fleet and equipment: maximum 10 years old; valid operating license and exhaust emission test certificate; fitted with emissions control devices; maintained per manufacturer schedule • Strictly prohibit open burning of vegetation, construction waste, and domestic waste at all sites; enforce via written contractor policy and site signage • At sites within 200 m of schools: install temporary wind barriers (timber fence or shade cloth) around perimeter during peak earthworks						
Construction	ENV-02	Construction noise up to 81 dB(A) at 100 m from sources; exceeds 55 dB(A) residential standard within 700 m radius. Nighttime increase of up to 16.6 dB(A) exceeds IFC 3	Heavy construction equipment (excavators, bulldozers, compactors, pile drivers); transportation of materials and equipment on access	• Develop standalone Noise Management Plan (NMP) as CESMP sub-plan; map all sensitive receptors within 700 m for each work package before commencement • Restrict construction to daytime: 07:00-18:00 local time; no nighttime construction within 700 m of residential areas, schools, or healthcare facilities • Install temporary noise barriers (zinc or aluminum sheet, minimum 2 m height) along perimeter of construction sites	Within 700 m of active construction sites along STA 0+000 to 67+450; critical zones at STA 0-20 (Pijoan area, 3 schools within 900 m) and STA 55-	Throughout construction phase; NMP approved before first work package commences	• Residential: 55 dB(A) daytime; 40 dB(A) nighttime (MoE Decree No. 48/1996) • IFC EHS: max 3 dB(A) incremental nighttime increase above baseline • No nighttime construction within 700 m of sensitive receptors	Contractor: NMP, noise barriers, daytime-only scheduling. TIU/CSC: verification of noise barrier installation and pre-activity	TIU/CSC: quarterly noise monitoring	IDR 1,980,000,000 Mitigation (noise barriers, NMP): IDR 1,500

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		dB(A) incremental limit. Sensitive receptors: 3 schools, residential settlements, 5 protected primate species, Sumatran elephant.	roads near communities and wildlife habitats	- within 300 m of any school or residential cluster; inspect monthly - Fit high-noise equipment with sound insulation enclosures where practicable; specify noise emission standards (IEC 60034-14) in equipment procurement - Issue advance community notification minimum 72 hours before pile driving or high-noise activities; maintain notification log - Contractor base camps and worker accommodation sited minimum 500 m from community settlements; noise curfew at base camps after 22:00	67 (Dusun Mudo)		- Noise barriers installed at all sites within 300 m of receptors - Pre-activity notification logs maintained for 100% of pile driving events	notification records		Monitoring (noise, quarterly, 4 stations, 3 yrs): IDR 480
Construction	ENV-03	Vibration PPV up to 0.62 mm/s at 80 m from sources (Point 1, STA 0-10), representing 31% of 2 mm/s residential standard. Distinctly perceptible (FTA	Impact pile driving; vibratory compaction equipment; heavy earthmoving machinery; heavy haulage on unpaved	- Pre-construction condition survey (photographic and written record) of all structures within 100 m before each work package; document in baseline register accessible to community members - Restrict construction activities to daytime: 07:00-18:00 local time (MoE Decree No. 49/1996) - Prohibit impact pile driving within 50 m of any occupied residential building, school, or healthcare facility; written ES	Within 100 m of construction sites; highest risk at Point 1 (STA 0-10, nearest residential structure 80 m) and Point	Throughout construction phase; pre-construction survey before each work package commences	- PPV residential structures: 2 mm/s peak (MoE Decree No. 49/1996) - DIN 4150-3:2016 structural integrity criteria - Operational stop-work trigger: 1.5 mm/s PPV at nearest receptor (STA 0-10)	Contractor: pre-construction survey, vibration controls, real-time monitoring during piling. TIU/CS C: survey	TIU/CSC: semi-annually PPV monitoring	IDR 1,000 Mitigation (pre-con. surveys, vibration controls): IDR 500 Monitoring (PPV semi-

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementati on Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		scale). Risk to residential structures, educational facilities, and protected mammals.	roads near residential areas	Manager and CSC approval required for any exception - Evaluate and adopt low-vibration alternatives at STA 0-10 and STA 55-60: bored pile, hydraulic press-in piling, pre-augering; document technical feasibility assessment - Real-time stop-work trigger: 1.5 mm/s PPV at nearest receptor during piling at STA 0-10; suspend works immediately if exceeded; report to TIU within 24 hours - Enforce speed limits on all unpaved access roads within 100 m of residential areas; regular preventive maintenance of heavy equipment to minimize excess vibration from worn components - GRM accessible to property owners reporting vibration nuisance or structural damage; maintain vibration complaint log; investigate and respond within 15 days	7 (STA 55-60, 100 m)		Zero unresolved structural damage complaints beyond 30 days	record review, corrective action oversight		annually, 3 yrs): IDR 500
Construction	ENV-04	Soil erosion rate increases from baseline 14.64 to 48.81	Land clearing across 892.49 ha; cut and fill; levelling;	Commission project-specific hydrological and geotechnical field investigation before earthworks;	Pijoan River watershed (STA 0-5) and Batanghari	Throughout construction phase; ESCP approved	Active bare soil: maximum 50 ha simultaneously	Contractor: ESCP implementati on,	CSC/TIU: monthly visual inspection using standard	IDR 7,300

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		ton/ha/year (3.3x increase) across 892.49 ha construction footprint. Topsoil loss and compaction are partly irreversible. Risk of drainage channel blockage, sediment pollution, and localized flooding.	operation of heavy equipment across ROW; spoil disposal	incorporate results into ESCP approved by TIU/CSC • Phased land clearing: restrict active bare soil to minimum required; prioritize clearing during dry season (April-September); stabilize cleared areas with hydroseeding or biodegradable matting within 14 days of final grading • Schedule all high-volume cut-and-fill on slopes >15% outside peak rainfall season (October-March) except where enhanced silt controls are deployed • Construct temporary drainage channels on both sides of alignment with geotextile sediment traps at discharge points; install rock check dams at maximum 100 m intervals on drainage lines with slopes >10% • Use natural materials (gabions, stone pitching, geotextile) for embankment and slope stabilization; revegetate all graded areas not needed for further work within 30 days of final grading • Designate and construct minimum 2 engineered spoil disposal sites with perimeter berms and lined drainage	River watershed (STA 15-67); entire 892.49 ha earthworks footprint; all sediment traps and drainage channels along alignment	before any earthworks commence; spoil disposal sites operational before cut operations begin	• Revegetation: minimum 80% ground cover within 90 days of final grade • 100% of stockpile areas covered or seeded within 14 days • Sediment traps desilted when 50% capacity reached • Check dams in place at maximum 100 m intervals on slopes >10%	revegetation, sediment trap maintenance, spoil sites. TIU/CSC: ESCP approval, monthly site inspection	checklist; contractor daily check; drone survey quarterly for bare soil extent; after every rainfall >25 mm/24hr	Mitigation (ESCP, erosion control structures, revegetation, spoil sites): IDR 7,000 Monitoring (monthly visual + quarterly drone, 3 yrs): IDR 300

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
				before earthworks commence; prohibit spoil dumping in watercourses Minimize time between excavation, stockpiling, and backfilling; cover all spoil stockpiles within 14 days of placement						
Construction	ENV-05	Peak mixed TSS: 1,080 mg/L in Pijoan River and 785 mg/L in Batanghari River (8-11x above 100 mg/L Class III standard). Adverse impacts on aquatic biodiversity, community health (28,462 diarrhea cases/yr baseline), and 546 AH aquaculture/fishing livelihoods. Residual risk	Runoff from earthworks (892.49 ha); sediment mobilization from cleared areas during rainfall; potential hydrocarbon and chemical spills from construction operations	- Mandatory Erosion and Sediment Control Plan (ESCP) as CESMP sub-plan; approved by TIU/CSC before any earthworks commence; updated for each work package - Install clean water diversion berms upstream of construction footprint to prevent off-site stormwater from flowing across exposed soil - Limit active bare soil to maximum 50 ha at any one time; cleared areas stabilized within 14 days of initial clearing - Install Sediment Retention Ponds (SRPs) at all stormwater discharge points to Pijoan and Batanghari Rivers: minimum 70% TSS removal efficiency; sized for Q10 storm; desilt when 50% design volume reached; minimum 1 SRP per 50 ha of active earthworks	Pijoan River at STA 01+975 (catchment STA 0-5) and Batanghari River at STA 16+050 (catchment STA 15-67); all SRP discharge points; construction operations within 892.49 ha ROW	Throughout construction phase; ESCP and SRPs operational before any earthworks commence	- River TSS at downstream station: 100 mg/L Class III (GR No. 22/2021) - River pH: 6-9; Oil and grease: <1 mg/L - SRP TSS removal efficiency: minimum 70% - Zero uncontrolled fuel spills reaching watercourses - Active bare soil: maximum 50 ha at any one time (verified monthly)	Contractor: ESCP, SRP installation/maintenance, spill prevention. TIU/CSC: ESCP approval, adaptive management oversight	Contractor + accredited laboratory: monthly water quality	IDR 5,800 Mitigation (SRPs, ESCP, spill prevention): IDR 4,000, Monitoring (surface WQ monthly, 6 stations, 3 yrs): IDR 1,800

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		remains Substantial due to scale of earthworks.		- TSS adaptive management trigger: suspend earthworks in contributing sub-catchment if TSS exceeds 200 mg/L for two consecutive readings; corrective action report to AIIB within 5 business days - All vehicle washing, concrete washout, and fuel storage minimum 100 m from natural watercourses; fuel storage with waterproof floor, secondary containment, oil-water separator drainage - Emergency spill response kits at all sites; quarterly spill drills; all spills reaching watercourses reported to TIU within 4 hours - No discharge of concrete washout, drilling fluid, or untreated wastewater directly to watercourses; manage in designated sealed settling pits						
Construction	ENV-HYD-01	Flow velocity increases +18% to +25% relative to ambient dry-season baseline, localised within	Installation of temporary sheet pile cofferdams and steel trestle	Hydraulic Study — Condition Precedent Complete site-specific Surface Water Management Plan (WMP) including hydraulic study and bathymetric cross-sections at STA 15+818 before the first cofferdam is installed; confirm maximum blockage ratio and validate	Within 50 m radius of active cofferdam structures, Batanghari	Active during cofferdam installation and operation only (dry season, April-	Cofferdam blockage ratio: maximum 8-12% of active cross-section (confirmed by hydraulic study before installation)	Contractor: WMP/hydraulic study preparation, sequential cofferdam	TIU/CSC: daily water level gauge review during active cofferdam operation;	IDR 1,200 Mitigation (hydraulic study, WMP preparation,

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		50 m radius of cofferdam structures. Driven by 8-12% channel constriction from combined trestle and sheet pile cofferdam footprint (~2 × 10 m × 15 m per pier) across the 200-300 m wide Batanghari River channel. Velocity acceleration increases local scour potential at pier bases. Note: blockage ratio and velocity values require validation by hydraulic study.	platform for Batanghari River bridge piers; combined physical footprint of cofferdam and trestle structures constricts active river cross-section	velocity increase estimates; WMP submitted to TIU/AIIB for review <u>Sequential Cofferdam Installation</u> - Install sheet pile cofferdams in stages — never simultaneously on both sides; maximum one pier active in river at any time; second pier cofferdam must not be installed until first cofferdam is removed and cross-section restored - Restrict all in-river works strictly to dry season (April-September) to exploit lowest seasonal water levels and maximum hydraulic safety buffer beneath the 12.53 m structural clearance zone <u>Real-Time Upstream Water Level Monitoring</u> - Install automatic water level gauges at minimum 150 m upstream of the active cofferdam; 15-minute recording intervals; data transmitted to site engineer in real time; if water level rises >20 cm above the predicted afflux estimate, works must be immediately reviewed and suspended if required <u>Emergency Response Plan (ERP)</u>	River STA 15+818 to STA 17+488; velocity effects attenuate to ambient conditions beyond 150 m of cofferdam	September); fully reversed within hours of cofferdam removal; each cofferdam removed within 30 days of pier completion	- Velocity increase: maximum +25% above dry-season baseline at cofferdam cross-section - Water level trigger: suspend works if upstream gauge records >+20 cm above predicted afflux - Hydraulic study and WMP approved before any cofferdam installation — condition precedent (zero exceptions) - Maximum one pier active in-river at any time — no simultaneous cofferdam installation	installation, dry-season scheduling, automatic gauge deployment, ERP preparation. TIU/CSC: WMP review and written approval before works commence	Contractor (coordinated with TIU): verify community notification in SER before works commence; post-removal gauge comparison confirms backwater fully reversed	automatic water level gauges, ERP, sequential works planning): IDR 800 Monitoring (real-time gauge operation and review, daily data transmission , CSC technical review, 2 dry seasons): IDR 400

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
				Prepare ERP as apart of CESMP before in-river works commence: pre-defined suspension triggers, in-river worker evacuation routes, communication protocols with downstream communities in event of unexpected wet-season flows						
	ENV-HYD-02	Upstream backwater/afflux (Δh) of +5 cm to +15 cm immediately upstream of cofferdam structures, extending 200-500 m upstream of STA 15+818. Calculated via conservative Yarnell bridge backwater equation applied to the high width-to-depth	Channel constriction from sheet pile cofferdam installation at Batanghari River bridge (STA 15+818 to STA 17+488); hydraulic damming effect of cofferdam structures on dry-season	<u>Floodplain Community Notification</u> - Prior to in-river works, formally notify all communities in low-lying areas within 500 m upstream of STA 15+818 of the anticipated temporary water level increase (+5 to +15 cm); notification documented in the Stakeholder Engagement Record (SER) before works commence; notification to include magnitude, duration, emergency contacts, and dry-season restriction rationale <u>Cofferdam Removal Sequence</u> - Upon completion of each pier, the cofferdam must be removed within 30 days to restore original river cross-section; removal sequence must prioritize the downstream side first to avoid sudden hydraulic pressure release into the upstream water	200 m to 500 m upstream of STA 15+818, Batanghari River; communities in low-lying areas within 500 m upstream of bridge site; Batanghari River floodplain settlements	Active during cofferdam operation only; fully reversed within hours of cofferdam removal; each cofferdam removed within 30 days of pier completion	- Maximum Δh: +15 cm upstream water level rise (Yarnell equation, assumed blockage ratio 8-12%) - Water level monitoring trigger: suspend works if upstream gauge records $>+20$ cm above predicted Δh - Community notification: 100% of communities in low-lying areas within 500 m upstream notified and documented	Contractor: community notification (coordinated with TIU), cofferdam removal scheduling, downstream-first removal protocol. TIU/CSC: SER documentation review, water level monitoring oversight, removal	TIU/CSC: daily water level gauge review during active cofferdam operation; Contractor (coordinated with TIU): verify community notification in SER before works commence; post-removal gauge comparison confirms	IDR 300 Mitigation (community notification program, SER documentation, cofferdam removal planning and sequencing): IDR 150 Monitoring (water level

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		ratio and low-gradient energy slope of the Batanghari River. Represents negligible risk of out-of-bank flooding under dry-season conditions, but formal community notification is required given the proximity of floodplain communities.	baseflow of 300-500 m³/s	column; removal schedule approved in writing by CSC structural engineer <u>Hydraulic Controls (shared with ENV-HYD-01)</u> - Real-time upstream water level gauge (minimum 150 m upstream): 15-minute intervals; if Δh exceeds +20 cm, works suspended until cause identified and addressed - Sequential cofferdam installation (maximum 1 pier active) limits cumulative blockage ratio and thereby limits maximum afflux generation at any one time			in SER before in-river works commence - Cofferdam removal: completed within 30 days of pier completion; downstream side removed first; zero exceptions without CSC written approval - Zero out-of-bank flooding events attributable to cofferdam backwater effect	schedule written approval	backwater fully reversed	gauge operation during cofferdam period; SER verification; community liaison): IDR 150
	ENV-HYD-03	Local scour depth of 2.0-3.5 m at the immediate perimeter of cofferdam walls, driven by accelerated flow	Flow velocity acceleration around sheet pile cofferdam structures during bridge	<u>Scour Protection Design</u> Permanent scour protection (rock riprap, concrete mattress, or equivalent) designed and specified before cofferdam installation, based on site-specific hydraulic study results addressing both dry-season and peak discharge (1,327 m³/s) scour	Immediate perimeter (within 5 m) of all cofferdam structures and	During active cofferdam operation (construction, dry season); stabilizes after	Maximum scour depth: 2.0-3.5 m at cofferdam perimeter (per site-specific hydraulic study estimates)	Contractor: scour protection design and installation, weekly bathymetric	Contractor + qualified hydrographer: weekly bathymetric surveys during active	IDR 700 Mitigation (scour protection design, rock

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		velocities (+18-25%) concentrating shear stress on the cohesive sandy clay riverbed. Scour limited to the immediate cofferdam footprint during active operation. Note: potential community flooding risk if scour undermines cofferdam structural integrity; residual scour risk at permanent piers if scour	construction (STA 15+818 to STA 17+488); additional mechanical disruption of riverbed from bored pile foundation drilling inside cofferdam cells	conditions; installed at all in-river piers before cofferdam removal Cofferdam Scour Monitoring - Conduct weekly bathymetric surveys immediately adjacent to all active cofferdam structures throughout the period of cofferdam operation; surveys by qualified hydrographer using calibrated echo sounder; all records submitted to TIU/CSC within 48 hours - Stop-work trigger: if observed scour depth approaches 80% of predicted maximum (i.e., >1.6 m to 2.8 m depending on location), operations must be halted immediately and the structural engineer consulted before any resumption of works Post-Construction Verification Survey - Conduct comprehensive bathymetric survey of riverbed at all pier locations within 3 months after the first wet season following bridge completion to confirm scour stabilization and verify that permanent scour protection is performing as designed	permanent in-river pier foundations, Batanghari River STA 15+818 to STA 17+488	permanent scour protection installation; long-term monitoring via post-construction survey within 3 months of first wet season	- Stop-work trigger: if observed scour reaches ≥80% of predicted maximum, works halted and structural engineer consulted — zero exceptions - Permanent scour protection installed at ALL in-river piers before cofferdam removal — condition precedent to removal - Post-construction bathymetric survey within 3 months of first wet season confirms scour stabilization; submitted to TIU and AIIB within 60 days of survey - Weekly bathymetric	surveys (qualified hydrographer), cofferdam monitoring records. TIU/CSC: scour protection design review, stop-work protocol enforcement, survey records review	cofferdam operation. TIU/CSC structural engineer: weekly scour trend analysis; stop-work decision authority, post-construction survey within 3 months of first wet season.	riprap/mattress installation at all in-river piers): IDR 350 Monitoring (weekly bathymetric surveys during 2 dry seasons, qualified hydrographer fees, post-construction survey, report preparation) : IDR 350

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		protection is inadequate.					survey records submitted to TIU/CSC within 48 hours of each survey			
	ENV-HYD-04	Downstream riverbed deposition of 5-15 cm in the zone 100-300 m directly downstream of the active construction zone (STA 15+818). Fine silt and clay particles released during mechanical boring and cofferdam dewatering operations settle progressively with distance	Mechanical boring into cohesive sandy clay riverbed inside sheet pile cofferdam cells for Batanghari Bridge pier foundations; incidental sediment escape during cofferdam dewatering operations and initial trestle piling	<u>Sheet Pile Containment and Boring Protocol</u> - All boring and excavation for pier foundations performed inside sheet pile cofferdam cells to physically contain disturbed sediment; boring equipment maintains positive internal pressure to minimize sediment escape into the active channel - All dewatering discharge from cofferdam cells passes through a settlement tank or geotextile bag filter before release to river to remove suspended solids; dewatering flow rate controlled to avoid hydraulic turbulence re-suspending settled material from cell boundaries <u>Dry-Season Restriction</u> - Restrict all boring, dewatering, and trestle piling operations strictly to the dry season (April-September) when natural background TSS and fine	100 m to 300 m directly downstream of STA 15+818, Batanghari River; settling plume attenuates to negligible levels beyond 2.5 km downstream; natural redistribution expected within 1st post-construction wet season	Active during boring and cofferdam dewatering phases only; transient — sediment redistributed naturally by wet-season flows (October-March) within the first post-construction wet season	- Bed deposition: maximum 5-15 cm at 100-300 m downstream during active boring operations (per estimated impact magnitude) - Dewatering discharge from cofferdam cells: TSS maximum 200 mg/L after settlement tank/geotextile bag treatment before release to river - Post-construction wet-season bathymetric survey (within 3	Contractor: boring inside cofferdam cells, settlement tank/geotextile bag filter installation and operation, dry-season scheduling, downstream bathymetric survey program. TIU/CSC: boring protocol compliance	Contractor + qualified hydrographer: monthly downstream bathymetric surveys during active boring phase, weekly TSS sampling at 100 m and 500 m downstream during boring; post-construction, bathymetric survey within 3 months of first wet season. TIU/CSC:	IDR 350 Mitigation (settlement tanks, geotextile bag filters for dewatering discharge, boring containment protocol implementation): IDR 150 Monitoring (monthly downstream

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		downstream. Transient impact — expected to be redistributed by natural river dynamics during subsequent wet-season high flows. Background watershed erosion rate: 13.63 tons/ha/year.	at STA 15+818 to STA 17+488	sediment transport are at their lowest levels; maximizes signal-to-noise ratio for detection of construction-derived sediment <u>Downstream Bed Level Monitoring</u> Conduct bathymetric cross-sections at 100 m, 200 m, and 300 m downstream of STA 15+818 before, during (monthly), and after active boring operations; results compared against pre-construction baseline; adaptive management decision if deposition exceeds estimated range			months of first wet season) confirms natural redistribution of deposited sediment toward pre-construction bed levels Gol GR No. 22/2021 Class III TSS: 100 mg/L at 500 m downstream monitoring station	inspection and dewatering discharge quality verification	bathymetric survey report review.	bathymetric surveys, weekly TSS water quality at 2 downstream stations, post-construction survey, laboratory analysis): IDR 200
	ENV-HYD-05	TSS/turbidity spikes of +150 mg/L to +350 mg/L directly downstream of boring zone at STA 15+818 during active in-river construction.	Mechanical boring into cohesive sandy clay riverbed during pier foundation construction inside cofferdam	<u>Source Containment — In-Cell Boring and Dewatering Controls</u> All boring and mechanical earth disturbance performed inside sheet pile cofferdam cells; cells maintained structurally watertight to minimize direct sediment leakage into the active channel; dewatering discharge passes through settlement tank or silt bag filter (target: TSS <200 mg/L before river discharge)	Directly downstream of STA 15+818 (high-intensity zone within 200 m of boring); visible turbidity	Short-term only — directly linked to active boring and earth-disturbing hours; TSS returns to background	Gol GR No. 22/2021 Class III TSS: 100 mg/L at 500 m downstream monitoring station (note: exceedance within immediate 200 m zone is permissible during active boring with	Contractor: turbidity curtain deployment and daily inspection, settlement tank/silt bag installation and	Contractor+ accredited laboratory: daily TSS water quality sampling at 200 m and 500 m downstream during active boring phases;	IDR 450 Mitigation (turbidity curtains, settlement tanks, geotextile silt bag

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		Against a dry-season baseline of approximately 41 mg/L (reference: February 2024 wet-season reading; actual dry-season baseline expected lower). Visible turbidity plume (>50 mg/L above baseline) disperses and settles within 1.5-2.5 km downstream, supported by large dilution capacity (dry-season baseflow 300-500 m³/s). Exceeds Gol Class	cells at STA 15+818 to STA 17+488; localized sediment escape from sheet pile cell boundaries during boring, cofferdam dewatering, and initial trestle piling; release of fine silt and clay fractions into active water column	<u>Turbidity Curtain Deployment</u> - Deploy geotextile turbidity/silt curtain around the downstream perimeter of each active cofferdam to intercept and reduce transport of fine suspended sediment from the immediate construction zone into the wider channel; curtain integrity inspected and documented daily <u>Dry-Season Restriction and Active Hours Management</u> - Restrict all boring and earth-disturbing operations to the dry season (April-September); no simultaneous boring at more than one pier location; stagger high-turbidity activities with recovery periods to allow plume settling between successive boring operations <u>TSS Adaptive Management Trigger</u> - If daily TSS monitoring at 500 m downstream exceeds 200 mg/L for two consecutive daily readings during active boring, boring operations suspended for a minimum of 24 hours; contractor must review cofferdam cell integrity	plume (>50 mg/L above baseline) disperses within 1.5-2.5 km downstream; returns to background beyond 2.5 km	within hours of boring cessation; no residual turbidity impact beyond the construction phase	- documented adaptive management) - Adaptive management trigger: TSS at 500 m downstream >200 mg/L for 2 consecutive daily readings → boring suspended for minimum 24 hours; corrective action to TIU within 48 hours - Dewatering discharge TSS: maximum 200 mg/L after settlement tank/silt bag treatment before release to river - Turbidity plume: confirmed to settle within 2.5 km downstream by monitoring	operation, boring schedule management (one pier at a time), dry-season restriction enforcement. TIU/CSC: boring protocol compliance inspection; adaptive management trigger decision authority	weekly sampling at 1 km and 2 km to confirm plume dispersion within 2.5 km; trigger decisions within 24 hours of exceedance detection	filters, boring schedule management, one-pier-at-a-time protocol): IDR 200 Monitoring (daily TSS sampling at 4 downstream stations during boring phases, weekly sampling at 1 km and 2 km, accredited lab analysis,

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		III TSS standard (100 mg/L) within the immediate construction zone during active boring.		and dewatering treatment performance before resuming; corrective action report submitted to TIU within 48 hours of trigger event			data; no measurable TSS elevation beyond 2.5 km • Turbidity curtain: inspected and integrity documented daily throughout boring phase			adaptive management reporting): IDR 250
Construction	ENV-07	Loss or degradation of Critical Habitat riparian vegetation at Pijoan and Batanghari River crossings; Invasive Alien Species (IAS) spread through construction equipment; potential peatland fire	Land clearing within ROW including riparian vegetation zones at river crossings; movement of construction equipment and vehicles; quarry operations; construction in peatland-	- Implement Biodiversity Management Plan (BMP): stand-alone document read in conjunction with this ESMP; BMP approved by PIU before any land clearing commences - Delineate ROW boundary within riparian vegetation zones on ground before clearing; install exclusion fencing at boundary; no clearing beyond approved ROW; inspect monthly - Install capillary barrier system (CBS: coarse aggregate, geocell, fine aggregate) at unstable locations within riparian zone to reduce soil erosion - Replant riparian vegetation disturbed by construction with native species	Critical Habitat riparian vegetation zones at Pijoan River (STA 01+975) and Batanghari River (STA 16+050); quarry areas; entire 67.45 km alignment buffer	Throughout construction phase; BMP approved before land clearing; offset planting completed within 12 months of clearing	- Zero clearing beyond approved ROW boundary without independent ecologist review - BMP submitted and approved before land clearing commences - Exclusion fencing: 100% intact at monthly inspections - Offset planting: 5:1 ratio	Contractor: BMP implementation, IAS control, exclusion fencing, vehicle washing bays, fire response. PIU: BMP approval; TIU/BKSDA	Refer to BMP	Refer to BMP

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		ignition; loss of habitat in quarry areas. Evaluated as Substantial per IFC PS6 Critical Habitat designation.	adjacent areas	upon completion of works at each crossing; ecological offset planting at minimum 5:1 ratio (planted:cleared) for Critical Habitat • Prioritize already-degraded or non-natural habitats when siting quarries; avoid natural habitat unless no feasible alternative exists • Mandatory IAS identification and control training for all workers before clearing commences; install vehicle washing bays at all site entry/exit points to remove plant material from equipment • Maintain fire response resources in peatland-adjacent sections: water tankers, fire extinguishers, communication systems			completed within 12 months of clearing			
Construction	ENV-08	Traffic disruption and reduction in Level of Service on haul routes (3,189-10,354 vehicles/day baseline); road damage from	Mobilization/demobilization of heavy equipment (bulldozers, excavators, pile rigs) using flatbed	• Prepare Construction Traffic Management Plan (CTMP) before mobilization; coordinate with Dinas Perhubungan, Traffic Police, and Dinas PUPR before works commence • Conduct Community Exposure Assessment to identify settlements, schools, and vulnerable road users	National road: Merlung to Tanjung Jabung Barat Regency border; Simpang	CTMP and Community Exposure Assessment completed before mobilization; traffic safety	• Zero overloaded vehicles on public roads (enforce axle load limits per road class) • CTMP submitted and approved before	Contractor: CTMP, driver training, road damage repair fund. TIU: community exposure	TIU/CSC: monthly haul route road condition inspection; CTMP compliance audit; incident	IDR 1,700 Mitigation (CTMP, flagmen, signage, road repair fund, driver

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		overloaded trucks on national and regional roads; community road safety risk from heavy vehicle-pedestrian conflict near settlements.	trucks; bulk material transport from quarries using trucks up to 20-ton capacity	within haul route corridors; implement pedestrian safety measures at hotspots • Pre-construction road condition survey (photographic + IRI) of all designated haul routes; coordinate with road authority on axle load limits • Internal traffic safety management system: driver competency verification, vehicle roadworthiness inspection, fatigue management, incident reporting; evidence subject to CSC audit • All construction drivers on community haul routes receive traffic safety induction: speed limits, pedestrian safety, load securing, emergency response • Establish and implement timely road damage repair program; cost-sharing mechanism with road authority included in contractor contracts • Emergency response system for vehicle breakdowns or accidents on public roads; 24-hour incident hotline	Tuan to Jambi City border; all designated provincial and local haul routes	management throughout construction	mobilization commences • Monthly road condition survey on all active haul routes • Road damage repaired within 60 days of identification • Zero traffic fatalities involving project vehicles on public roads	assessment review. Dinas Perhubungan and Traffic Police: coordination and enforcement	log reviewed monthly	training): IDR 1,500 Monitoring (monthly haul route inspection, 3 yrs): IDR 200
Construction	ENV-08	Fecal coliform (FC) from basecamp	Operation of contractor base camps	• Two-stage wastewater treatment at all base camps: (1) bio-septic tank per SNI 2398:2017; (2) constructed wetland	Main contractor base camp	Throughout construction phase;	• FC standard: 2,000 MPN/100mL Class III (GR 22/2021) at	Contractor: wastewater treatment	Contractor + accredited laboratory:	IDR 1,600

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		wastewater (~17 m ³ /day for 500 workers) reaches Pijoan River (1,142 MPN/100mL under Q25) and Batanghari River (1,062 MPN/100mL under max runoff), adding 208-270 MPN/100mL above already high baselines. Significant diarrheal disease risk given 28,462 cases/year baseline and riverine communities depending on	(~420 workers) and remote work sites (~80 workers) generating ~17 m ³ /day domestic wastewater; construction stormwater runoff carrying FC from base camp areas and sanitation facilities	polishing cell (gravel-bed, minimum 4-day hydraulic retention time) downstream of septic outlet - All sewage conveyed through closed drainage system to treatment facility before discharge; no direct discharge of any wastewater to surface water bodies - Replace seepage systems at all floodplain-adjacent remote work sites (elevation <20 masl) with sealed holding tanks emptied weekly to main basecamp treatment system - Install SRPs with minimum 4-day hydraulic retention time at all stormwater discharge points to Pijoan and Batanghari (dual function: TSS and FC retention) - During peak wet season (November-February): deploy portable chlorination dosing units at SRP outlets discharging to Pijoan and Batanghari; maintain chlorination dosing log - Concrete batching plant washout and mud managed in sealed settling ponds; no discharge of untreated washout to watercourses	(~2,000 m from Batanghari River); remote work sites along alignment; drainage channels discharging to Pijoan River (STA 0-5) and Batanghari River (STA 15-67)	wastewater treatment systems operational before base camp occupation	river monitoring stations - Basecamp final effluent FC: <2,000 MPN/100mL (after constructed wetland polishing) - STP performance inspection: no visible overflow or bypass of treatment system - Zero direct discharge of untreated sewage to surface water	installation and operation, chlorination dosing during wet season. TIU/CSC: treatment system approval, performance inspection quarterly	quarterly FC monitoring at Pijoan (500 m downstream STA 01+975) and Batanghari (1 km downstream STA 16+050); TIU/CSC: quarterly STP performance inspection; monthly during wet season	Mitigation (two-stage wastewater treatment systems at all base camps): IDR 1,200 Monitoring (quarterly FC river monitoring + monthly STP inspection): IDR 400

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		surface water for domestic use.								
Construction	ENV-09	Substantial solid waste generation from construction activities and worker base camp operations: domestic waste (~150 kg/day from 500 workers), excavated spoil from 892.49 ha earthworks (highest-volume stream), concrete offcuts, steel reinforcing waste, timber formwork, and packaging materials.	Earthworks (cut operations across 892.49 ha generating spoil); construction activities generating concrete offcuts, steel waste, and timber formwork; worker base camp operations generating domestic and packaging waste; stockpiling of	<u>Secured Spoil Disposal Sites — Construction Pre-Condition</u> - The contractor must be contractually required to identify, permit, and construct at least two (2) engineered spoil disposal sites with perimeter berms, lined surface drainage, and vegetated cover within 90 days of mobilisation - Cut operations on any segment are strictly prohibited until the designated disposal site serving that segment is confirmed operational in writing by TIU/CSC — this is an enforceable contract condition precedent, not a recommendation <u>Wet-Season Waste Transport Chain Resilience</u> - Prepare a wet-season contingency waste storage plan before the first wet season (October) specifying: maximum on-site retention time for organic waste: 24 hours; elevated storage platforms (minimum 0.5 m above flood	Entire 67.45 km toll road alignment (STA 0+000 to 67+450); 892.49 ha earthworks footprint; worker base camps along alignment; bridge crossing zones at Batanghari River (STA 15+818 to 17+488) and Pijoan River (STA 01+975); drainage channels	Throughout construction phase (approx. 36 months); engineered spoil disposal sites must be operational before cut operations commence on any segment; wet-season contingency plan in place before October of each construction year	- Spoil disposal sites operational before cut operations commence on each segment — condition precedent confirmed in writing by TIU/CSC - Maximum on-site organic waste retention: 24 hours at each work site and base camp - Elevated storage platforms at minimum 0.5 m above flood level at ALL floodplain-adjacent sites - Zero informal dumping incidents into drainage channels, rivers, or	Contractor: spoil disposal site design and construction, waste transport chain management, zero informal dumping enforcement, wet-season contingency plan preparation. TIU/CSC: spoil disposal site approval before cut operations commence,	CSC/TIU: quarterly waste audit at all base camps and major construction sites (waste volumes by category, manifest records, storage compliance checklist); weekly informal dumping spot check; verification of spoil site operational status before cut operations	IDR 1,000 Mitigation (2 engineered spoil disposal sites with berms/drainage, wet-season elevated storage platforms, licensed waste contractor, transport manifests): IDR 800

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		Unmanaged solid waste risks sedimentation in drainage channels and watercourses, landscape degradation, drainage blockage, and localized flooding near communities and agricultural land. Potential for waterway obstruction near Batanghari and Pijoan bridge crossings.	spoil in erosion-prone areas without engineered containment	- level) at ALL floodplain-adjacent work sites and base camps; pre-identified and contracted secondary licensed disposal facility within 50 km as backup during weather-related transport disruptions - Engage licensed waste contractor for transport and disposal of general and recyclable waste; maintain waste transport manifests; verify secondary facility contract before each wet season <u>Zero Informal Disposal Enforcement</u> - Strictly prohibit informal dumping of any construction debris, spoil, or domestic waste into drainage channels, rivers, low-lying land, or roadsides; enforce via written contractor policy, site signage, and documented daily inspection by contractor ES officer - Prohibit open burning of timber formwork, packaging materials, and domestic waste at all construction sites and base camps - Steel and concrete waste managed separately: steel reinforcing waste segregated and removed from near bridge crossing zones (Batanghari STA	adjacent to floodplain-level sections (elevation 5-20 masl)		- low-lying land (verified via monthly inspection) - Secondary licensed facility identified and contracted within 50 km before each wet season - Zero open burning incidents (domestic waste, formwork, packaging) - Waste transport manifests maintained; submitted to TIU monthly	monthly compliance audit	on each segment	Monitoring (quarterly waste audit, weekly spot check, manifest review, disposal site verification, 3 years): IDR 200

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				15+818; Pijoan STA 01+975) within 24 hours of generation to avoid waterway obstruction risk						
	ENV-10	Hazardous (B3) waste generation from equipment maintenance yards and ancillary facilities: used lubricant and engine oil, contaminated fuel filters and oily rags, used vehicle batteries, chemical containers, paint and solvent residues, and infectious clinic waste. Primary risk pathway is surface lateral transport:	Heavy equipment maintenance operations (oil changes, filter replacements); fuel and lubricant storage and dispensing; on-site first-aid and health clinic operations; chemical use in construction activities; spillage or improper	<u>Bunded B3 Storage and Handling Areas</u> - Oils, fuels, and all other hazardous materials shall be stored separately from other construction materials in bunded areas with: waterproof floors (concrete or HDPE-lined), roofing, restricted access control, and a closed drainage system connected to an oil-water separator; bunded areas sized to contain 110% of the largest single container volume - B3 storage areas must be operational and inspected by TIU/CSC before any heavy equipment is mobilised to site — construction pre-condition <u>Spill Response Readiness</u> - Appropriate spill response equipment (absorbent booms, drip trays, neutralizing agents, PPE, and spill kits) maintained at all construction sites and material storage areas at all times; spill kits replenished immediately after any use	Equipment maintenance yards and B3 storage areas at all contractor base camps along STA 0+000 to 67+450; Batanghari River floodplain sections (elevation 5-20 masl) presenting highest surface runoff risk; on-site health	Throughout construction phase; B3 storage areas operational before equipment mobilisation (construction pre-condition); B3 waste stored maximum 180 days per Gol PP 101/2014; disposal on fixed schedule throughout construction	- B3 storage areas: bunded, waterproof floor, drainage to oil-water separator — verified operational before equipment mobilisation - B3 waste on-site storage duration: maximum 180 days (Gol PP No. 101/2014); manifest records 100% complete for all B3 transport events - Vehicle/equipment leaks: repaired immediately upon detection; zero leaking equipment in active service	Contractor: bunded B3 storage area construction and operation, spill response equipment maintenance, immediate leak repair, licensed B3 transporter engagement, infectious waste segregation. TIU/CSC: B3 storage area pre-mobilisation	TIU/CSC: semi-annually inspection of bunded storage areas and oil-water separator functionality; semi-annually B3 manifest compliance review	IDR 1,000 Mitigation (bunded B3 storage areas with oil-water separators, spill response kits, quarterly drills, licensed B3 transporter, infectious waste collection): IDR 600

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		Batanghari floodplain areas (elevation 5-20 masl, 0-16° slopes, low-permeability clay soils) restrict vertical infiltration, causing uncontained spillage to mobilize as surface runoff into drainage channels during rainfall, with secondary loading to Batanghari River. Petroleum hydrocarbons and heavy metals from battery acid	disposal of used oils and battery acid from maintenance yards and B3 storage areas	- All construction workers who handle or are adjacent to B3 materials must receive spill response induction training before working at relevant locations; conduct quarterly refresher spill response drills at maintenance yards <u>Immediate Leak Repair Protocol</u> - Any leaks detected from construction vehicles, equipment, or storage containers must be repaired immediately upon detection; no leaking equipment may remain in service; document all leak incidents and repairs in the daily EHS log <u>Manifested B3 Waste Disposal per PP 101/2014</u> - All B3 waste transported by licensed hazardous waste contractor on a fixed schedule; B3 waste stored on-site for a maximum of 180 days per GoI PP No. 101/2014; maintain full B3 waste manifest records from generation to final disposal; manifests submitted to TIU quarterly <u>Infectious Clinic Waste Segregation</u>	clinic areas at base camps		- Spill response equipment: present at all construction sites and storage areas at all times; kits replenished after each use - Quarterly surface water quality monitoring at representative sampling points along alignment; results reported to TIU - Infectious clinic waste: 100% segregated and collected by licensed medical waste contractor; zero co-mingling incidents	inspection, semi-annually manifest review		Monitoring (semi-annually surface WQ at representative stations along alignment, semi-annually storage inspection, B3 manifest review, accredited lab analysis, 3 years): IDR 400

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		represent persistent near-surface contamination. Co-mingling of infectious clinic waste with general domestic waste creates a separate biological exposure pathway for waste handlers and adjacent communities.		Infectious clinic waste (used medicine packaging, bandages, sharps) segregated from general domestic and construction waste at source in labeled, leak-proof containers; collected by licensed medical waste contractor; under no circumstances co-mingled with general domestic solid waste						
Construction	ENV-11	Surface water abstraction for construction purposes estimated at 171.4 m³/day (~0.002 m³/s). Total demand	Water abstraction from Pijoan River and Batanghari River for: dust suppression	- Maintain total combined abstraction below estimated 0.002 m³/s (171.4 m³/day); monitor daily abstraction volumes against this cap - Abstract from Batanghari River (1,327 m³/s average discharge) as primary source where technically feasible; minimize direct groundwater extraction	Pijoan River abstraction point near STA 01+975; Batanghari River abstraction point near			Contractor: daily abstraction monitoring, meter installation. TIU: water use permit	TIU/CSC: semi-annual review of daily abstraction logs; semi-annual river flow observation at	IDR 250 Mitigation (water use permits, abstraction

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		represents <0.01% of available combined river discharge. Evaluated as Low significance given adequate available water resources; precautionary measures required per AIIB ESS1.	(20 m³/day), worker base camps (20 m³/day), concrete batching plant mixing (87.5 m³/day), and batching plant washing (15 m³/day)	• Maintain ecological baseflow: do not abstract in a manner that reduces river discharge below 20% of average (Pijoan: 15.75 m³/s; Batanghari: 265.4 m³/s) • Implement water-efficient practices at all base camps and batching plants: recycling of concrete washout water where practicable; install meters at abstraction points • Ensure all water abstraction complies with applicable GoI water use permit requirements; coordinate with local Dinas PUPR/SDA on permit applications	STA 16+050; base camps and batching plants along alignment			coordination with Dinas PUPR/SDA	abstraction points	meters): IDR 150 Monitoring (semi-annual abstraction log review, semi-annual river flow): IDR 100
Construction	ENV-12	Batanghari Bridge construction (STA 15+818 to 17+488): flow velocity increase +18-25%; upstream afflux +5-15 cm; local scour depth 2.0-3.5 m;	Sheet pile cofferdam installation; bored pile foundation drilling in active 200-300 m wide river channel; dewatering	• Hydraulic Study Condition Precedent: complete site-specific Surface Water Management Plan (WMP) including bathymetric cross-sections at STA 15+818 before first cofferdam installed; submit to AIIB for review • Sequential cofferdam installation: maximum 1 pier active in the river at any time; restrict all in-river works to dry season (April-September)	Batanghari River at STA 15+818 to STA 17+488; Pijoan River at STA 01+960; communities within 500 m	During bridge construction activities in dry season (April-September); hydraulic study completed before in-	• Cofferdam blockage ratio: must not exceed 12% of active river cross-section • Water level trigger: halt works if upstream rise exceeds 20 cm above predicted afflux	Contractor: WMP, cofferdam sequencing, real-time monitoring, scour protection, community notification,	TIU/CSC: hydraulic study review, weekly bathymetric data review	IDR 2,600 Mitigation (hydraulic study, real-time gauges, scour protection,

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		downstream sedimentation 5-15 cm; TSS spikes +150 to +350 mg/L directly downstream. Potential community flooding risk in low-lying areas upstream.	operations; temporary steel trestle platform; piling at Pijoan River bridge (STA 01+960)	- Install automatic water level gauge 150 m upstream of active cofferdam, recording at 15-minute intervals; halt works if water level rises >20 cm above predicted afflux estimate - Formally notify communities in low-lying areas within 500 m upstream of STA 15+818 of anticipated temporary water level increase before in-river works commence; document in stakeholder engagement record - Remove each cofferdam within 30 days of pier completion; remove downstream side first to avoid sudden hydraulic pressure release; install permanent scour protection at all in-river piers before cofferdam removal - Weekly bathymetric surveys adjacent to all cofferdam structures during active operation; halt works if observed scour approaches 80% of predicted maximum (2.0-3.5 m) - Emergency Response Plan for unexpected wet-season flows: suspension triggers, worker evacuation routes, communication protocols with downstream communities	upstream of STA 15+818	river works commence; post-construction survey within 3 months of first wet season	- Scour halt trigger: observed scour at 80% of predicted maximum (2.0-3.5 m) - TSS: 100 mg/L Class III standard at 2.5 km downstream of construction zone - Post-construction bathymetric survey confirming scour stabilization	real-time water level during in-river works, weekly bathymetric surveys; post-construction survey; accredited laboratory for downstream water quality		ERP): IDR 2,000 Monitoring (real-time water level + weekly bathymetric surveys): IDR 600

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
Construction	ENV-11	Changes in groundwater infiltration rates, table levels, and yield across 892.49 ha construction footprint; potential contamination from construction activities; dewatering may lower local water table affecting rare to localized moderately productive aquifers. Impact partly irreversible given permanent changes to	Land clearing and compaction over 892.49 ha; dewatering for excavations; groundwater abstraction for construction water supply; hazardous material storage near aquifer recharge areas	- Commission project-specific hydrogeological investigation and test wells before earthworks; develop Groundwater Management Plan (GMP) identifying recharge zones and sensitive abstraction points - Groundwater abstraction cap at 0.002 m³/s; use surface water from Batanghari River as primary source where technically feasible; minimize groundwater dependency - Revegetate disturbed areas progressively; no area left unvegetated for more than 30 days after final grading to restore infiltration - B3 materials and hazardous liquids not stored within 200 m of identified groundwater wells; sealed secondary-containment facilities only; SOP for all workers on hazardous material handling - Install minimum 3 groundwater monitoring wells along alignment before construction commences; establish pre-construction baseline levels and quality	Across 892.49 ha project footprint; aquifer zones in Batanghari and Pijoan watersheds; nearest community groundwater wells along alignment	Hydrogeological investigation and monitoring well installation before construction; GMP approved before earthworks; monitoring throughout construction	- Groundwater level: trigger review if decline >0.5 m below pre-construction baseline over any 3-month period - GoI PP 22/2021 Class II groundwater quality standards at monitoring wells - GMP submitted and approved before earthworks - Minimum 3 monitoring wells installed with baseline data established	Contractor: hydrogeological investigation, GMP implementation, monitoring well installation, revegetation, quarterly groundwater quality and level monitoring at 3 monitoring wells with accredited laboratory; trigger event reported to TIU within 5 business days	TIU/CSC: GMP approval, quarterly monitoring oversight	IDR 1,800, Mitigation (hydrogeological study, GMP, monitoring wells, revegetation): IDR 1,200 Monitoring (quarterly GW quality + level at 3 wells, 3 yrs): IDR 600

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
hydrogeological regime.										
Construction	ENV-HAB-01	Disturbance, displacement, injury, or mortality of protected and critically endangered species: Sumatran tiger (within 14 km), 5 primate species (agile gibbon, slow loris, black-crested and Sumatran langur, silvery langur), Sumatran elephant, flat-headed cat, leopard cat; protected avifauna. Human-	Land clearing; construction noise and vibration; artificial lighting at base camps and work sites; physical presence of workers and equipment in or near wildlife habitats; vehicle movements on new access roads	- Implement all species-specific measures in BMP; mandatory Code of Conduct (CoC) prohibiting wildlife collection, hunting, trap possession for 100% of workers; violations result in immediate employment termination - Workers strictly prohibited from: hunting or trapping wildlife; collecting native flora; possessing firearms, traps, or snares; chasing, disturbing, or feeding fauna - Wildlife-friendly lighting: directional, downward-shielded LED at base camps; no light spillage toward forest edge beyond 50 m perimeter; schedule high-impact activities during diurnal hours - Wildlife exclusion fencing at all base camps and construction sites within 5 km of identified Sumatran elephant range; coordinate crossing point design with BKSDA Jambi - Deploy minimum 20 camera traps along alignment at STA 0-20 and STA 50-67; analyze data monthly; report CR/EN species detections to TIU	Entire 67.45 km alignment buffer; priority zones at STA 0-20 and STA 50-67 for wildlife presence; Sumatran tiger range within 14 km radius; Sumatran elephant range within 5 km	Throughout construction phase; CoC signed at induction; camera traps deployed before land clearing commences; BKSDA coordination established before construction	- Zero poaching incidents involving project workers - BMP implementation: 100% of measures - CoC signed by 100% of workers before site entry - Wildlife incidents (injury/mortality) reported to BKSDA within 24 hours - Camera trap data reviewed monthly; CR/EN detection reported to TIU within 24 hours	Contractor: CoC enforcement for construction workers, lighting controls, exclusion fencing, camera trap deployment. TIU/CSC: BMP oversight. BKSDA Jambi: rapid response coordination and permit management	TIU/ESMC: quarterly monitoring of BMP implementation	IDR 2,500 Mitigation (BMP species measures, exclusion fencing, camera traps, BKSDA coordination): IDR 2,500 Monitoring (included in ENV-06 biodiversity survey budget)

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		wildlife conflict at base camps. Barrier effects to wildlife movement corridors. Evaluated as High significance given presence of multiple CR and EN species.		immediately; stop work if active CR/EN species in direct work zone - Engage BKSDA Jambi to establish rapid-response wildlife management unit for human-wildlife conflict incidents - Regular communication to workers and communities on wildlife behavior, deterrence procedures, and reporting protocols						
Construction	ENV-HAB-02	Loss or degradation of habitat including Critical Habitat (designated under IFC PS6) due to construction activities, evaluated as Substantial significance in the absence of	Construction earthworks across 892.49 ha ROW generating sediment loads in streams and rivers; site clearing and civil works at riparian vegetation	<u>ROW Delineation within Riparian Vegetation Zones</u> The boundary of the right-of-way within the riparian vegetation zone required for construction shall be clearly delineated on the ground prior to commencement of construction activities at each river crossing to minimise encroachment beyond the designated construction footprint; delineation verified and approved by TIU/CSC before clearing commences <u>Capillary Barrier System (CBS) at Unstable Riparian Locations</u>	Entire 67.45 km toll road alignment (STA 0+000 to 67+450); priority zones: Critical Habitat riparian vegetation at Pijoan River crossing (STA 01+975) and	Throughout construction phase; ROW delineation and IAS training completed before construction commences at each work package; CBS installation	- ROW boundary delineated and verified on ground before clearing commences at each riparian crossing — TIU/CSC written approval required - CBS installed at all unstable riparian locations before earthworks commence in those zones —	Contractor: ROW delineation, CBS installation, replanting program, quarry alternatives assessment, IAS training delivery, washing bay	TIU/ESMC: quarterly monitoring of BMP implementation	IDR 4,700, Mitigation (BMP implementation, ROW delineation, CBS installation, riparian replanting, washing

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		mitigation. Five impact pathways identified: (1) elevated sediment loads from earthworks impacting riparian ecosystem, wildlife, and fish stocks; (2) disturbance and partial loss of riparian vegetation classified as Critical Habitat at Pijoan River and Batanghari River crossings; (3) habitat loss or degradation at quarry areas supplying	crossing zones (Pijoan River STA 01+975; Batanghari River STA 15+818 to 17+488); quarry operations for construction materials supply; movement of wheeled construction equipment and personnel along alignment; construction	- At unstable locations within the riparian zone, a capillary barrier system (CBS) comprising a combination of coarse aggregate, geocell, and fine aggregate shall be installed to reduce the potential for soil erosion and associated sediment loading into riparian watercourses; CBS design approved by TIU/CSC before installation <u>Replanting of Disturbed Riparian Vegetation</u> - Riparian vegetation zones disturbed by construction activities shall be replanted using native species upon completion of the relevant construction works at each crossing location; replanting program per BMP specifications; progress reported monthly to TIU/CSC <u>Prioritization of Non-Natural Habitats for Quarry Siting</u> - Already degraded or non-natural habitats shall be prioritized over natural habitats when siting new quarries to supply construction materials; any proposal to site a quarry on natural or	Batanghari River crossing (STA 15+818 to 17+488); quarry areas supplying construction materials; peatland-adjacent sections along alignment where fire risk is highest	before earthworks at unstable riparian locations; replanting upon completion of works at each crossing; washing bays operational before equipment mobilisation to site	- confirmed by TIU/CSC inspection - Riparian vegetation replanting: native species replanting completed upon construction completion at each crossing; replanting success rate (minimum 80% survival at 12 months) reported to TIU and AIIB - Quarry siting: zero new quarries on natural or semi-natural habitat without documented alternatives assessment and TIU written approval - IAS training: 100% of workers trained before	installation and operation, full BMP implementation. TIU/CSC: ROW delineation verification, CBS design review, quarry siting approval, IAS training records review, washing bay compliance audit		bays, IAS training, quarry siting management): IDR 2,500 Monitoring (quarterly biodiversity and habitat surveys by independent ecologist per BMP program, monthly inspection, camera traps, reporting, 3 years): IDR 2,200

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		construction materials; (4) introduction and spread of Invasive Alien Species (IAS) through movement of construction equipment, vehicles, and personnel; and (5) fire ignition risk within and beyond the alignment in peatland areas and dry vegetation zones. Detailed assessment presented in the standalone Critical Habitat	activities in peatland-adjacent areas and dry vegetation zones	semi-natural habitat must be subject to prior written approval by TIU and supported by a documented alternatives assessment demonstrating no feasible alternative degraded site exists <u>Mandatory IAS Identification and Control Training</u> - Mandatory training on the identification and control of Invasive Alien Species (IAS) shall be conducted for all construction workers prior to commencement of construction activities; training records maintained and submitted to TIU; refresher training conducted at each new work package commencement <u>Vehicle and Equipment Washing Bays</u> - All tracked and wheeled construction equipment, including trucks, bulldozers, and excavators, shall be cleaned through washing bays installed at construction site entry and exit points to remove dirt and plant material (including IAS propagules) from vehicle wheels and tracks before leaving the site; washing bay operation and			construction commences; training records submitted to TIU; refresher training at each new work package - Washing bay compliance: 100% of tracked and wheeled equipment cleaned through washing bays before leaving each site; compliance logged daily in EHS log - BMP implementation: all BMP measures and monitoring programs implemented schedule; monitoring reports submitted to TIU			

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementati on Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		Assessment (CHA) Report and Biodiversity Management Plan (BMP), to be read in conjunction with this ESIA.		compliance documented in daily EHS log <u>BMP Implementation</u> All mitigation measures and monitoring programs defined in the BMP shall be implemented consistently and effectively throughout the construction phase; the BMP is a standalone document to be read in conjunction with this ESIA and constitutes an enforceable annex to the ESMP			and AIIB bi-annually			
ENVIRONMENTAL IMPACTS – OPERATION PHASE										
Operation	ENV-AQ-OP-01	SO ₂ (Sulphur Dioxide): Predicted SO ₂ , Nitrogen dioxide (NO ₂) concentration, and particulate generation from toll road traffic reaches up to 100 µg/m ³ at Dusun Mudo Village (STA 60+000),	Combustion of sulphur-containing diesel fuel in heavy goods vehicles (Class II-V trucks: 2,602 vehicles/day) and NO ₂ as well as particulate generation	<u>Wall Partition at Sensitive Receptor Locations</u> A 2 to 3-meter-high wall partition shall be constructed along sections where the toll road passes in close proximity to sensitive receptors — community settlements, hospitals, schools, and other public facilities — as incorporated into the DED approved by DGH in 2023; wall partition shall be maintained in structurally sound condition throughout the operation phase <u>Vegetation Buffer Maintenance</u>	Dusun Mudo Village vicinity (STA 60+000): primary exceedance location per AERMOD modelling. All other villages along STA 0+000 to 67+450	Throughout operation phase (30+ year concession period); exceedance expected to increase gradually as traffic volumes grow from 6,253 to	- IFC EHS Guideline: SO₂ ≤ 40 µg/m³/24hr, NO₂ ≤ 65 µg/m³/1hr, PM2.5 ≤ 25 µg/m³/24hr, and TSP ≤ 230 µg/m³/24h (recommended threshold), - Predicted SO₂, NO₂, PM_{2.5}, and TSP, at Dusun Mudo: ~130 µg/m³ (173% of EHS	Toll Road Operator: wall partition construction and maintenance, vegetation buffer maintenance, road surface maintenance program, ETC lane	Toll Road Operator + accredited laboratory: bi-annual ambient SO ₂ , NO ₂ , PM _{2.5} , and TSP monitoring at Dusun Mudo Village (STA 60+000) and at 3 additional stations along	IDR 2,500,000,000 Mitigation (wall partition construction at Dusun Mudo section, vegetation

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		against a baseline of 30 µg/m³. Cumulative concentration of approximately 130 µg/m³ exceeds the national standard of 75 µg/m³/24hr (GR No. 22/2021) and the IFC EHS guideline of 40 µg/m³/24hr. Impact magnitude rated Critical at 250% of the national AQS (Air Quality Standard). Poses significant health risk particularly given elevated pneumonia prevalence in the	from other road vehicles using the Sp. Ness–Merlung Toll Road.	- Vegetation within the toll road right-of-way shall be maintained as a natural barrier between the toll road and sensitive receptors to minimize air pollutant dispersion; vegetation management plan updated annually; maintenance undertaken quarterly - Native tree species with dense canopy prioritized within the 100 m ROW corridor adjacent to Dusun Mudo Village (STA 60+000), Pijoan Village (STA 0+000), and other community settlements <u>Regular Road Surface Maintenance</u> - Road maintenance shall be undertaken regularly to preserve the road surface condition; road repairs shall be carried out in a timely and quality manner to minimize airborne dust from deteriorating pavement surfaces and exposed aggregates - Quarterly pavement condition survey (IRI-based); deteriorating surface sections repaired within 30 days of identification; include as a key performance requirement in the toll	predicted within standard.	design-year volumes; wall partition and vegetation buffer required before toll road opens to traffic	standard without mitigation), ~65 µg/m³ (50% exceed Gol standard without mitigation), 10 µg/m³ (40% of Gol standard without mitigation), and 100 µg/m³ (153% of Gol standard without mitigation), 10 µg/m³ (40% of EHS standard without mitigation), and 100 µg/m³ (43% of Gol standard without mitigation), respectively.	management. PIU: receiving and checking annual air quality compliance review from toll road operator	alignment; results in Annual Environmental and Social Report to PIU	maintenance, road maintenance program, ETC expansion, 5 years): IDR 2,200,000,000 Monitoring (bi-annual SO₂ ambient monitoring, accredited lab analysis, annual reporting, 5 years): IDR 300,000,000

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		project region. Other villages along the alignment remain within standard.		road operations and maintenance contract ETC and Lane Configuration Optimisation Expand electronic toll collection (ETC) lanes to minimise vehicle queuing and engine idling at toll gates, which are a concentrated point source of SO₂; optimise lane configuration to maintain throughput and prevent congestion-induced idling emissions			- Bi-annual SO₂ ambient monitoring at Dusun Mudo Village; results reported to TIU and AIIB - ETC: all toll gates equipped with functional ETC lanes before operation commences			
Operation	ENV-O-02	Nighttime noise from toll road traffic +6 dB(A) above baseline, exceeding IFC EHS 3 dB(A) incremental limit. Daytime noise within standards. Risk to nocturnal protected mammals (slow loris, leopard cat,	24-hour toll road vehicle traffic at estimated 6,253 vehicles/day; toll gate and rest area operations; maintenance activities	- Maintain minimum 250 m distance between toll road centerline and nearest residential area per DED approved by DGH in 2023 - Where terrain permits, construct road at below-grade elevation to reduce lateral noise propagation toward sensitive receptors and wildlife habitats - Maintain 2-3 m barrier walls constructed per ENV-O-01; inspect structural integrity semi-annually; repair damage within 30 days - Implement wildlife-sensitive lighting on toll road: directional, downward-	Residential areas within 250 m of toll road alignment; wildlife habitats within 5 km buffer of entire 67.45 km alignment; critical zones	Throughout 30-year operation period; barrier maintenance and lighting review annually	- Residential: 55 dB(A) daytime; 40 dB(A) nighttime (MoE Decree No. 48/1996) - IFC EHS: maximum 3 dB(A) incremental increase above baseline nighttime level - Wildlife-sensitive lighting: zero lateral spillage into	Toll Road Operator: barrier maintenance, road grade design compliance, lighting management.	Toll Road Operator: bi-annual noise monitoring coinciding with air quality monitoring; annual nocturnal mammal survey for noise-sensitive species (slow loris, felids)	IDR 500 Mitigation (barrier maintenance, wildlife-sensitive lighting management): IDR 500

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		flat-headed cat) that may migrate from habitats over time. Daytime: Low significance; nighttime: Moderate significance.		shielded LED; no lateral light spillage into adjacent habitat areas; review and adjust as part of annual BMP monitoring	at STA 0-20 and STA 50-67		habitat beyond 50 m ROW boundary Barrier structural integrity: 100% per semi-annual inspection		PIU: receiving and checking the report of annual noise, air quality, nocturnal mammal survey for noise sensitive species from toll road operator	Monitoring (bi-annual noise monitoring; nocturnal wildlife survey annually): included in ENV-O-01
Operation	ENV-O-03	Groundwater abstraction for toll gate offices (0.021 L/s total at Cinto Kenang and Merlung) and rest area (0.417 L/s at STA 42+000) = 0.438 L/s total project demand. Combined with	Operation of 2 toll gate offices (Cinto Kenang STA 18+305, Merlung STA 67+100) and rest/service area (STA 42+000): sanitation, operations,	- Feasibility assessment for PDAM connection as primary water supply for all three facilities, submitted to TIU at least 6 months before operations commence; groundwater reduced to supplementary/emergency role if PDAM feasible - Install water-efficient fixtures at all facilities: low-flow taps (max 6 L/min), dual-flush toilets (3/6-litre), waterless urinals at male facilities; calibrated water meters at all abstraction points; log daily abstraction volumes	Cinto Kenang Interchange toll gate office (STA 18+305); Merlung Interchange toll gate office (STA 67+100); rest/service area (STA	PDAM feasibility study at least 6 months before operations; monitoring throughout operation phase	- Combined project daily abstraction: maximum 0.438 L/s (metered and logged) - Community groundwater level trigger: >1.5 m decline over 6 months requires curtailment within 14 days - PDAM feasibility study submitted 6	Toll Road Operator: water meters, abstraction monitoring, OWSCP maintenance.	Toll Road Operator: bi-monthly community groundwater level monitoring for first 2 years, then quarterly; trigger events to PIU within 14 days; accredited lab for quarterly water quality	IDR 900 Mitigation (PDAM feasibility study, water meters, community observation well, OWSCP): IDR 500

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementation Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		community use (0.24 L/s) = 0.89 L/s against estimated aquifer yield of <5 L/s. Substantial risk if aquifer capacity is at lower end of estimate.	and maintenance water use	- Maximum daily combined project abstraction: 0.438 L/s; enforcement via metered monitoring with monthly review; investigate and resolve any excess within 14 days - Install community groundwater monitoring observation well adjacent to 519 AH settlement if PDAM not feasible; measure water level bi-monthly for first 2 years, then quarterly; trigger: decline >1.5 m over any 6-month period requires curtailment within 14 days - Prepare and maintain Operational Water Supply Contingency Plan (OWSCP): alternative sources, emergency supply options, response procedures for supply disruption	42+000); community groundwater wells adjacent to 519 AH settlement		- months before operations; OWSCP updated annually - Daily abstraction log maintained; monthly compliance review		PIU: receiving and checking the groundwater level monitoring report from toll road operator	Monitoring (bi-monthly GW level, quarterly WQ, 3 yrs): IDR 400
Operation	ENV-O-04	Rest area and toll gate operation generates approximately 30.2 m ³ /day wastewater; 4 STPs with 20 m ³ total capacity	Operation of rest/service area (STA 42+000) and 2 toll gate offices: sanitation facilities for	- Conduct independent hydraulic loading assessment before operations commence with 20% design safety factor; upsize STP capacity to accommodate peak high-season visitor flow (estimated 300 visitors/hour) - All sewage and latrine waste conveyed through closed drainage to wastewater treatment facility before any discharge;	Rest and Service Area at STA 42+000; Cinto Kenang Interchange toll gate (STA 18+305);	STP upsizing before toll road operations commence; monitoring throughout operation	- STP effluent: BOD5 <30 mg/L; TSS <80 mg/L; FC <2,000 MPN/100mL (GR 22/2021 Class III discharge) - Wastewater generated: zero	Toll Road Operator: STP operation and maintenance, waste management, fuel tank leak monitoring.	Toll Road Operator + accredited laboratory: monthly STP effluent monitoring; quarterly STP	IDR 1,000 Mitigation (STP upsizing, waste management contract,

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementati on Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		leaves 10+ m ³ /day untreated if not upsized; 10 tonnes/day solid waste. Diarrheal disease risk to riverine communities (28,462 cases/yr baseline). Potential soil and groundwater contamination from underground fuel storage leaks.	workers and visitors; food and beverage services; fuel station with underground storage tanks	- quarterly drainage leakage inspection; repair identified leaks within 7 calendar days - Solid waste: segregate organic and non-biodegradable waste in labeled, covered containers; licensed waste contractor for disposal at approved facility; compost food waste where practicable - Hazardous waste (contaminated fuel, lubricants) collected by licensed B3 transporter with manifest documentation; double-wall underground fuel tanks per Gol standards; quarterly leak inspection using leak detection system	Merlung Interchange toll gate (STA 67+100); drainage channels discharging to Batanghari and Pijoan River tributaries	phase; fuel tank leak inspection quarterly	- untreated overflow from STP - Zero fuel tank leakage incidents undetected beyond quarterly inspection - Solid waste: 100% disposed at licensed facility; monthly records	PIU: receiving and checking quarterly STP compliance inspection from toll road operator	performance inspection; semi-annual B3 waste manifest audit	fuel tank leak detection): IDR 800 Monitoring (monthly STP effluent, semi-annual B3 audit, 3 yrs): IDR 200
Operation	ENV-O-05	Barrier effects on movement and dispersal of wildlife (Sumatran tiger, Malay tapir, 5 primates) due to permanent	24-hour toll road vehicle traffic; ROW vegetation maintenance activities; lighting at toll gates and	- Maintain native species planting within ROW; remove invasive species during flowering periods using biological, mechanical, or thermal control methods; herbicide use only per IFC EHS Toll Roads Guidelines (2007) - Natural canopy bridges within power line corridors maintained or trimmed to minimize primate and arboreal	Entire 67.45 km toll road ROW; peatland-adjacent sections for fire risk; wildlife	Throughout 30-year operation phase; vegetation management quarterly; fire response	- IAS: zero establishment of invasive species along ROW (quarterly inspection) - Wildlife mortality events: zero unreported	Toll Road Operator: ROW vegetation management, fire response, lighting management.	Toll road operator/B KSDA Jambi : annual operation phase biodiversity monitoring; semi-annual IAS inspection	IDR 2,900 Mitigation (ROW vegetation mgmt., fire response

Phase	Impact ID	E&S Risk and Impact	Source Activity	Mitigation Measures	Location	Timeframe	Key Performance Indicators and Compliance Limits	Implementati on Responsibility	Monitoring Responsibility	Indicative Cost Estimate (IDR) [Mitigation + Monitoring] million
		physical presence of toll road; wildlife mortality from vehicle collisions; ongoing noise and lighting disturbance to nocturnal species; IAS spread along ROW maintenance corridor; fire risk in peatland-adjacent sections.	rest area; ongoing human activity along alignment; maintenance vehicles using ROW	mammal electrocution risk; coordinate with PLN on power line management schedule - Maintain minimum 3 mobile water tankers equipped with pump engines, fire extinguishers, and firefighting tools along alignment in peatland-adjacent sections for rapid fire response - Wildlife-sensitive ROW lighting: directional downward-shielded LED; no lateral spillage into adjacent habitat; review and adjust annually with BKSDA Jambi - Wildlife translocation: any wildlife caught, handled, or rescued to be translocated per IUCN Guidelines on Reintroductions and Other Conservation Translocations; coordinate with BKSDA Jambi	corridor zones at STA 0-20 and STA 50-67; power line corridors along alignment	resources maintained throughout operation; BMP implementati on and monitoring annually	incidents; reported to BKSDA within 24 hours - Fire response resources: 3 water tankers available along alignment with firefighting equipment at all times - BMP operation phase measures: 100% implementation	BKSDA Jambi: wildlife coordination, rapid response.	report; wildlife incidents logged and reported to BKSDA within 24 hours PIU: receiving and checking biodiversity monitoring report from toll road operator	resources, BKSDA coordination , 5 yrs): IDR 2,000 Monitoring (annual biodiversity monitoring, semi-annual IAS inspection, 5 yrs): IDR 900

11.0 EMERGENCY RESPONSE PLAN

This Emergency Response Plan (ERP) has been prepared for the construction and operation of the Sp. Ness–Merlung segment of the Jambi–Rengat Toll Road. It forms an integral part of the project Environmental and Social Management Plan (ESMP) and is contractually binding on all civil works contractors, the construction supervision consultant (CSC), the Technical Implementation Unit (TIU), and the toll road operator (BUJT).

The ERP establishes: (i) a risk-based EHS management framework, including hazard identification and risk assessment (HAZID/HIRA) for all major hazards, a project-specific EHS Risk Register, Job Safety Analysis (JSA) requirements for high-risk activities, and application of the hierarchy of controls; (ii) an emergency classification system; (iii) response procedures for ten key emergency scenarios; (iv) defined roles and responsibilities; (v) communication and notification protocols aligned with AIIB ESP requirements; (vi) an emergency equipment inventory; (vii) coordination arrangements with local authorities; and (viii) a training and drill program.

The key risk factors informing this ERP are drawn from the project ESIA and ESMP:

- Batanghari River bridge construction (STA 15+818–17+488): cofferdams, bored piling, and in-river works. Estimated peak Batanghari discharge is 1,327 m³/s; cofferdam blockage ratio must remain below 12%. Highest-priority emergency scenario.
- Large-scale earthworks: 892.49 ha of land clearing and cut/fill over 18 months; slopes up to 40.4% at STA 50–67. TSP modeled at 10,000 ug/m³ during peak earthworks — 43 times the national standard of 230 ug/m³ near Selat and Dusun Mudo Villages.
- Low baseline community health due to prevalent diseases: three project regencies recorded 28,462 diarrheal disease cases in 2016. Riverine communities depend heavily on Batanghari and Pijoan rivers for domestic water. Fecal coliform runoff from construction may approach regulatory limits.
- Utility crossings: PLN high-voltage transmission lines at STA 29–30, 59–60, and 75–76 km; Pertamina oil/gas pipelines at STA 39–40 and 66–67 km — all representing electrocution and explosion hazards.
- Occupational H&S: labor and working conditions impact assessed as Major severity (Substantial inherent risk) due to pile driving, bridge erection, confined space work, and heavy equipment operations involving 500+ workers.
- Social hazards: GBV risk at basecamps housing 500+ workers; proximity to Muaro Jambi Temple Complex (20 km); annual wildfire season (July–August) and flood-prone Batanghari floodplain.

11.1 Risk-based EHS Frameworks

Health and safety risks are assessed using the 5x5 EHS risk assessment matrix. Likelihood (1–5) and Consequence (1–5) are scored independently. Risk score = Likelihood x Consequence. Classification: Low (1–4), Medium (5–9), High (10–15), Critical (16–25).

Likelihood / Consequence	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
5 Almost Certain	5	10	15	20	25
4 Likely	4	8	12	16	20
3 Possible	3	6	9	12	15

Likelihood / Consequence	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
2 Unlikely	2	4	6	8	10
1 Rare	1	2	3	4	5

11.2 EHS Risk Register

Table 114 presents the EHS Risk Register covering 12 key hazards from this ESIA study, following the EHS risk assessment matrix. For each hazard, current controls and additional controls are mapped to the Hierarchy of Controls. This register shall be maintained and updated monthly by the Contractor EHS Manager and reviewed quarterly at the EHS Committee meeting

Table 114 EHS Risk Register

Risk Register #	Activity / Task	Hazard Description	Consequence	Current Controls	L	C	Score	Level	Controls — Hierarchy Applied
H-01	In-water works: cofferdam & bored piling at Batanghari River (STA 15+818–17+488)	Uncontrolled flooding; cofferdam failure; drowning of in-river workers	Worker fatality; community downstream flooding; project shutdown	Dry season restriction; trestle; sheet pile cofferdams; lifejackets	4	5	20	CRITICAL	ELIMINATE: Restrict all in-river works to dry season (Apr–Sep). SUBSTITUTE: Bored piling instead of driven piles. ENGINEER: Automated upstream water gauge (15-min interval); stop-work if level rises >20 cm. ADMIN: ERP-01; community pre-notification; daily level briefing. PPE: Lifejackets mandatory; throw bags at worksite.
H-02	Impact pile driving at STA 0–10 (80 m from nearest residential area)	Structural vibration damage; community noise nuisance; flying debris	Property damage; structural collapse; community grievances; suspension	Daytime only; PPV monitoring; pre-construction building survey	3	3	9	MEDIUM	ELIMINATE: Avoid impact piling within 50 m of occupied structures. SUBSTITUTE: Bored/hydraulic press-in piling within 100 m of settlements. ENGINEER: Real-time PPV monitor with stop-work at >2 mm/s. ADMIN: Pre-construction building survey; advance community notice 48 hr; GRM log.

Risk Register #	Activity / Task	Hazard Description	Consequence	Current Controls	L	C	Score	Level	Controls — Hierarchy Applied
H-03	Steep slope earthworks at STA 50–67 (slope up to 40.4%); cut-and-fill on 892.49 ha	Slope failure; landslide; burial of workers; unstable cut face	Worker fatality; road closure; sedimentation of Batanghari River	Geotechnical surveys; drainage channels; phased clearing; sediment traps	3	5	15	HIGH	ELIMINATE: Optimize design to reduce cut height; avoid steepest angles. SUBSTITUTE: Retained walls where feasible. ENGINEER: Slope inclinometers; perimeter drainage before cutting; benched slopes >15%. ADMIN: ERP-05; geotechnical review each lift; restricted access; daily visual inspection. PPE: Hard hat and boots in cut zones.
H-04	Fuel storage and vehicle maintenance at basecamp (~200,000+ L diesel on site)	Fire, explosion, or spill reaching drainage channels	Worker burns/fatality; community evacuation; river contamination; B3 pollution	Bunded storage; fire extinguishers; no-smoking policy; spill kits	3	4	12	HIGH	ELIMINATE: Limit on-site fuel to 7-day rolling stock. SUBSTITUTE: Bladder tanks with integrated secondary containment. ENGINEER: Double-wall tanks; 110% bunded unloading area; oil-water separators; fire detection. ADMIN: ERP-02 and ERP-03; hot work permit; daily fuel area inspection. PPE: Chemical gloves and boots for fuel handling.

Risk Register #	Activity / Task	Hazard Description	Consequence	Current Controls	L	C	Score	Level	Controls — Hierarchy Applied
H-05	Working at height >2 m: bridge deck erection, formwork, steel erection at Batanghari Bridge	Falls from height; dropped objects onto workers and river traffic below	Worker fatality; community injury from dropped objects	Safety harness; edge protection; exclusion zone; toolbox talks	3	5	15	HIGH	ELIMINATE: Prefabricate elements at ground level. SUBSTITUTE: Scaffolding with integrated edge protection. ENGINEER: Safety netting below deck; catch platforms over river; exclusion zone for boat traffic. ADMIN: JSA mandatory; 100% harness enforcement; PTW for work over water. PPE: Full harness + double lanyard; hard hat; non-slip footwear.
H-06	Confined space entry: box culverts, drainage chambers, pipeline crossings	Asphyxiation (O2 deficiency or toxic gas); entrapment; drowning	Worker fatality; multiple casualties if rescuers enter unprotected	Warning signs; atmospheric testing required	2	5	10	HIGH	ELIMINATE: Redesign to avoid confined spaces where possible. SUBSTITUTE: Forced ventilation for all pre-entry conditioning. ENGINEER: 4-gas monitor at all entries; mechanical ventilation during occupation; retrieval harness system. ADMIN: Confined space PTW; trained standby attendant; rescue plan in place before entry; ERP training. PPE:

Risk Register #	Activity / Task	Hazard Description	Consequence	Current Controls	L	C	Score	Level	Controls — Hierarchy Applied
									SCBA for rescue team; full harness with retrieval line for entrant.
H-07	Heavy equipment operations: excavators, bulldozers, dump trucks on 892.49 ha earthworks	Struck-by or run-over; equipment rollover on unstable slopes; tipping into Batanghari	Worker fatality; serious injury; equipment loss; community injury	Spotters; exclusion zones; speed limits; daily pre-start checks; reverse alarms	4	3	12	HIGH	ELIMINATE: Segregate vehicle and pedestrian traffic with physical barriers. SUBSTITUTE: Smaller equipment near sensitive areas. ENGINEER: Proximity detection on excavators; physical stop-blocks at steep cuts and riverbank edges. ADMIN: JSA for each equipment type; daily pre-start checklist; spotter for reversing ops; fatigue management max 10 hrs/day. PPE: Hard hat; high-vis vest; safety boots.
H-08	PLN HV transmission line crossings (STA 29–30, 59–60, 75–76 km); Pertamina pipelines (STA 39–40, 66–67 km)	Electrocution from equipment contact with HV lines; pipeline rupture	Worker fatality; community power outage; fire/explosion; gas release	Pre-construction utility survey; utility consultation; exclusion zones	2	5	10	HIGH	ELIMINATE: Reroute equipment movement away from line crossings. SUBSTITUTE: Low-profile equipment or ground anchoring under crossings. ENGINEER: Fixed-height gantries at all HV crossings;

Risk Register #	Activity / Task	Hazard Description	Consequence	Current Controls	L	C	Score	Level	Controls — Hierarchy Applied
		causing fire/explosion							pipeline detector and vacuum excavation within 2 m of known pipelines. ADMIN: Pre-excavation utility marking; EHS permit within 5 m of HV or pipeline; PLN (123) and Pertamina (135) on-call; ERP-10. PPE: Rubber-insulated PPE; gas detector at pipeline crossings.
H-09	GBV risk at basecamps: 500+ workers from varied backgrounds with local communities	Sexual harassment, assault, or exploitation of female workers or community members	Physical and psychological harm; community conflict; reputational risk; project suspension	Workers Code of Conduct; separate facilities for men/women	3	3	9	MEDIUM	ELIMINATE: Zero-tolerance GBV policy with immediate dismissal for confirmed violations. SUBSTITUTE: Separate sleeping, washing, and toilet facilities; lighting in all communal areas. ENGINEER: CCTV in communal areas; panic buttons in female accommodation. ADMIN: GBV induction Day 1; confidential reporting channel; trained GBV RRO; P2TP2A partnership; ERP-07. PPE: N/A — prevention-focused.

Risk Register #	Activity / Task	Hazard Description	Consequence	Current Controls	L	C	Score	Level	Controls — Hierarchy Applied
H-10	Extreme dust generation: TSP modeled at 10,000 ug/m³ (43x national standard) near Selat and Dusun Mudo Villages; baseline TB/pneumonia prevalence high	Acute respiratory exposure; chronic lung disease; exacerbation of TB and pneumonia	Community health emergency; multiple respiratory casualties; project suspension	Water spraying; speed limits; tarpaulin on trucks; staged clearing	4	3	12	HIGH	ELIMINATE: Schedule major earthworks outside dry season where feasible. SUBSTITUTE: Chemical dust suppressants on high-traffic unpaved roads. ENGINEER: Mist cannons at highest-dust points; real-time air quality monitoring with automated alerts. ADMIN: ERP-06 if TSP >2,000 ug/m ³ ; community advisory protocol; work suspension trigger at TSP >5,000 ug/m ³ at community monitor. PPE: N95 for all workers in active earthworks; FFP3 within 50 m of cutting operations.
H-11	Surface water contamination: TSS peaks 1,080 mg/L (Pijoan) and 784.55 mg/L (Batanghari) vs standard 100 mg/L; FC from	River contamination; community waterborne disease outbreak (28,462	Community health emergency; loss of livelihoods; legal action; AIIB suspension	SRPs; silt fencing; closed drainage; two-stage wastewater treatment	4	4	16	CRITICAL	ELIMINATE: Zero discharge of untreated wastewater or direct sediment to Batanghari or Pijoan. SUBSTITUTE: Constructed wetland polishing systems downstream of basecamp STP. ENGINEER: SRPs (Q10 design, 70% TSS removal);

Risk Register #	Activity / Task	Hazard Description	Consequence	Current Controls	L	C	Score	Level	Controls — Hierarchy Applied
	basecamp wastewater	diarrhea cases (2016 baseline)							automated TSS monitors with stop-work at 200 mg/L. ADMIN: ERP-08 (public health) if community waterborne illness reported; monthly river water quality reports. PPE: Engineering and admin controls are primary.
H-12	Night construction near Sumatran elephant corridor (<14 km) and protected primate habitat	Disturbance to nocturnal wildlife; animal-human conflict; elephant intrusion into construction site	Worker injury/fatality from elephant encounter; ecological damage to critically sensitive species	Daytime works only (general); wildlife monitoring; buffer zones	2	4	8	MEDIUM	ELIMINATE: Prohibit night construction without prior wildlife corridor assessment. SUBSTITUTE: Passive IR wildlife detection cameras at sensitive corridor crossings. ENGINEER: Inward-pointing floodlighting if night works required. ADMIN: Wildlife intrusion protocol: cease activities, retreat to vehicles, notify TIU; coordinate with BKSDA Jambi. PPE: Workers must remain in vehicles if elephant alert issued.

11.3 Hierarchy of Control

All controls in this ERP and the ESMP (Section 8.0) follow the internationally recognized Hierarchy of Controls, applied in strict priority order. Higher-order controls (Eliminate, Substitute, Engineer) are always preferred over lower-order controls (Administrative, PPE). While, the implementation of this ERP is consistent to the ERP classification system (see Table 115).

Table 115 Hierarchy of Controls — Application to Jambi-Rengat Toll Road Project

Priority	Level	Definition	Project-Specific Examples
1	Eliminate	Remove the hazard or risk source entirely. Most effective. Always consider first.	Restrict all in-water works to dry season only (eliminates flood risk). Avoid impact pile driving within 50 m of residential structures (eliminates vibration damage). Prohibit night construction in wildlife corridor areas. Zero discharge of untreated wastewater to Batanghari or Pijoan rivers.
2	Substitute	Replace hazardous process, material, or equipment with a lower-risk alternative.	Replace impact pile driving with hydraulic press-in or bored piling near sensitive receptors. Sealed holding tanks instead of seepage systems at floodplain-adjacent remote sites. Chemical dust suppressants as supplement to road watering. Prefabricated bridge elements to reduce in-situ height work.
3	Engineering controls	Isolate people from the hazard through physical design. Effective but requires maintenance.	Automated upstream water level gauges with stop-work trigger (ERP-01). Fixed-height gantries at PLN HV line crossings. Oil-water separators at all fuel storage areas. SRPs sized to Q ₁₀ storm; 70% TSS removal. Safety netting below bridge deck. Double-wall underground storage tanks. Slope inclinometers and settlement gauges at cuts >5 m.
4	Administrative controls	Change how people work: procedures, training, scheduling. Effective when consistently enforced.	Job Safety Analysis (JSA) completed and signed before every high-risk task. PTW system for confined space, hot work, in-water works, and HV proximity. Mandatory ERP induction within 3 days of deployment. Suspension of earthworks during rainfall >25 mm/hr. Community notification 48 hours before pile driving. Sequential cofferdam installation. Workers Code of Conduct with zero-tolerance GBV clause.
5	PPE	Last line of defense. Required even when higher-order controls are in place.	Lifejackets (ISO 12402-5) for all in-water personnel. Full harness + double lanyard for all height work >2 m. N95 respirators in active earthworks areas; FFP3 within 50 m of cutting operations. 4-gas monitor + SCBA for confined space entry and rescue. Chemical-resistant gloves and boots for B3 handling. Hard hat, high-vis vest, steel-toed boots for all workers at all worksites at all times.

Table 116 Emergency Classification System

Level	Name	Definition / Criteria	Command and Notification
LEVEL 1	Routine Incident	Minor incident or near miss confined to the immediate work zone; no fatalities; no community impact; no environmental release beyond site boundary. First aid may be required.	Site Foreman manages. Log in daily register. Report to EHS Officer within 1 hour. External notification only if regulatory threshold triggered. Included in monthly EHS report.
LEVEL 2	Significant Incident	Potential or actual impact beyond site boundary; serious injury requiring hospitalization; OR environmental release that may affect receiving watercourses or communities.	EC assumes command. Notify TIU within 2 hours. Notify Dinas LH/Disnaker within 24 hours. Written preliminary report within 48 hours. AIIB notified if KPI threshold breached.
LEVEL 3	Major Emergency	Fatality; mass casualty; critical infrastructure damage; significant community impact; or uncontrolled release reaching Batanghari or Pijoan rivers.	Senior EC assumes full Incident Command. Stop-work for affected area. Notify PMU, TIU, AIIB within 1 hour (phone) and 24 hours (written). Notify BPBD, Police, and relevant ministries immediately. All public comms via PMU only.

11.4 Emergency Response Team

This ERP for construction phase shall be adopted into CESMP in a detailed sub-plans and its management practices or SOP. The implementation of this ERM requires the involvement of roles and responsibilities of the key parties and personnels as outlined in Table 117. Whilts ERP for operation phase will adopt the existing procedures under DGH, Ministry of Public Work, or respective toll road operator.

Table 117 Roles and Responsibilities of Emergency Response Team

Role	Position / Party	Key Responsibilities
Emergency Coordinator (EC)	TIU Project Manager (construction); BUJT GM (operation)	Overall incident command for LEVEL 2 and 3. Authorize stop-work orders. Interface with AIIB, PMU, and government agencies. Sign all incident reports. Declare incident level. Authorize community communications.
Deputy Emergency Coordinator	Main Contractor Construction Manager	Assume EC duties when EC unavailable. Manage on-site resources. Coordinate with Bridge Engineer and specialist subcontractors. Ensure all areas evacuated and mustered.
Site EHS Manager	Main Contractor EHS Department	Activate ERP procedures. Lead immediate response for LEVEL 1 and 2. Compile and preserve evidence. Manage first response team and equipment. Submit preliminary reports to TIU/CSC. Maintain risk register.
EHS Officer (Construction Supervision)	ESMC Environmental and Social Inspector	Independent monitoring of ERP activation and compliance. Report to PIU/TIU on response effectiveness. Verify corrective actions before return to work.
GBV Rapid Response Officer (RRO)	TIU	First responder to all GBV incidents. Survivor support and referral to specialist services. Maintain confidential GBV log. Liaise with P2TP2A and police as applicable.

Role	Position / Party	Key Responsibilities
First Aid Officers	Designated trained workers: minimum 1 per 25 workers on site	Provide immediate first aid. Coordinate medical evacuation. Maintain first aid kit inventory. Complete injury report forms.
Community Liaison Officer (CLO)	TIU	Notify affected communities. Coordinate with village leaders and BPBD. Manage community communication during recovery. Manage GRM.
Environmental Monitor	CSC Environmental Inspector / Environmental Consultant	Monitor environmental triggers (TSS, TSP, groundwater). Activate monitoring stop-work thresholds. Collect and preserve samples for evidence during environmental emergencies.
Bridge Engineer	Structural/Hydraulic Engineer (contractor or CSC)	Assess and certify structural safety of cofferdam and bridge elements before and after flooding or disturbance. Define return-to-work criteria for ERP-01 and ERP-05.
Security Coordinator	Main Contractor Security Team	Secure incident perimeter. Control unauthorized access. Coordinate with local police department. Implement site access lockdown during LEVEL 3.

11.5 ERP Monitoring and Review

Scheduled Annual Review. This ERP shall be formally reviewed annually by the Contractor EHS Manager, CSC EHS Inspector, and TIU EHS Team. Review findings shall be reported to the PMU. Updated versions shall replace superseded copies at all sites; superseded versions shall be archived with a "SUPERSEDED" marking.

Triggered Out-of-Cycle Review. An immediate review is required following any: Level 3 emergency activation; worker fatality; serious environmental emergency reaching the Batanghari or Pijoan rivers; significant change in project scope or workforce; change in key ERT personnel; or AIIB/regulatory direction to update the ERP.

Post-Incident Root Cause Analysis (RCA). Following any Level 2 or Level 3 emergency activation, a formal RCA shall be completed by the Contractor EHS Manager and an independent investigator within 14 days (serious injury) or 21 days (fatality or Level 3 event). The RCA report shall include: timeline of events, root causes, immediate and systemic corrective actions, lessons learned, and recommended ERP updates. The report shall be submitted to TIU and AIIB within the required notification timeframe. All corrective actions shall be tracked to verified closure before the affected work area resumes operation.

12.0 STAKEHOLDER ENGAGEMENT AND INFORMATION DISCLOSURE

This section summarizes key objectives, requirements, and other aspects in relation to stakeholder engagement and information disclosure of the Jambi – Rengat Toll Road project that have been conducted by the implementing agency as part of the Indonesian Amdal process and the preparation of E&S safeguard documents up to 2023. Detailed strategy and key activities related to stakeholder engagement and information disclosure to be undertaken when the toll road project is implemented is included in the draft *Stakeholder Engagement Plan* or SEP (PT Blantickindo Aneka, January 2024).

12.1 Key Objectives and Requirements

Key Objectives. The SEP serves as a guidance document, providing a strategy and key activities that should be undertaken to establish and maintain a conducive and trustworthy relationship between the toll road project and its stakeholders including the workers who would be engaged for construction. This relationship is key for the toll road project to obtain its social license to operate from its stakeholders. Furthermore, the SEP includes guidelines and methods to disclose the project information in an effective manner. The SEP is a living document that would need updating if a specific circumstance triggers this update.

In particular, the SEP has the following key objectives:

- To identify key stakeholders including affected households and vulnerable groups of people and then mapping their influence, interest or concern on the toll road project;
- To identify the most effective methods, timing and structures to disclose project information in a timely and transparent manner;
- To establish a formal and functional grievance/resolution mechanisms accessible for all parties;
- To maintain up-to-date records of all consultations (formal or informal) with the project's stakeholders and complaints using the stakeholder database;
- To define roles and responsibilities of the parties in charge of SEP implementation and reporting; and
- To specify reporting and monitoring actions required, ensuring the effectiveness of the SEP and periodical reviews of the SEP implementation.

The Bank's E&S Framework and Policy. The Banks believes that transparency and meaningful collaboration are critical for project design and implementation, and it collaborates closely with its clients to achieve these goals. The process of meaningful collaboration starts early and continues all the way through the project. It is conducted in a transparent manner ensuring it's timely, inclusive, and accessible. It facilitates the consideration of stakeholders' opinions during the decision-making process by providing sufficient information that is simple to understand and available to stakeholders in a culturally acceptable manner.

Engagement with stakeholders is carried out in a way that is appropriate for the risks and effects the project will have on people impacted. In the context of a Project in which the Bank determines that there are risks of retaliation against the Project's stakeholders, or of other threats to their safety, it seeks to work with the Client so that the Client avoids or minimizes such risks.

Prevailing Indonesian Laws and Regulations. No specific regulations on stakeholder engagement and disclosure on project information is stipulated for this purpose by the GoI (at the time of the preparation of the project's ESIA). Instead, the stakeholder engagement requirements are generally

included in the laws and regulations related to: Land acquisition (i.e., Law No. 2/2012 and its implementing Government Regulation No. 19/2021); Public Information Disclosure stipulated in the Law No. 14/2008; and Indonesian Amdal (similar to EIA and EMP) as stipulated in some clauses and annexes of the Government Regulation No. 22/2021.

12.2 The Project's Stakeholders

Identification of the project's stakeholders was conducted by reviewing primary and secondary data and information. The stakeholders include individuals, groups of individuals or organizations who may feel affected or have the potential to be affected by the toll road project and those who may have interests in the project. This involves stakeholders who may be favorable toward the project, such as local and regional government and part of the local communities and those who may pose challenges to the project such as advocacy groups and environmental conservation organizations. The stakeholders identified in relation to the toll road project are:

- *Affected parties* – the villages and companies affected by the land acquisition process as well as project-affected people (PAP) whose land may need to be relinquished.
- *Interested parties* - broader stakeholders who have interest in the project including Central Government; local and regional governments; and civil society organizations (CSOs) or also known as non-government organizations (NGOs).
- *Vulnerable groups* - An individual or groups of individuals who may be disadvantaged or vulnerable due to their circumstances.
- *Indigenous Peoples (IPs)* – They are a distinct social and cultural group possessing: (i) Self-identification as members of a distinct indigenous cultural group and recognition of this identity by others; (ii) Collective attachment to geographically distinct habitats, ancestral territories or areas of seasonal use or occupation in the Project area and to the natural resources in these areas; (iii) Customary cultural, economic, social or political institutions that are distinct or separate from those of the dominant society or culture; and (iv) a distinct language or dialect, often different from the official language or languages of the country or region in which they live.²⁶

The stakeholders identified for the Sp. Ness – Merlung Toll Road project are presented in the following table.

Table 118. The Project's Stakeholders

Types of Stakeholders	Name	Anticipated Role in the Project
Government entities		
Central Government	Directorate General of Highways (DGH) - the Ministry of Public Works	▪ Executing agency of the toll road project ▪ Toll road planning, construction, and supervision
Central Government	Directorate of System and Strategy Management for Road and Bridge Delivery; and Directorate of Freeways – the DGH	Implementing agencies of the toll road project at central government level

²⁶ AIIB's E&S Framework (May 2021).

Types of Stakeholders	Name	Anticipated Role in the Project
Central government	The Ministry of Environment	Reviewing the ToR of the impact assessment, Andal and RKL-RPL documents as the basis to issue the Environmental Permit of the toll road project.
Central government	The Ministry of Forestry	Issuing the forestry permit for the production forest area overlapping with the toll road project into non-forest area
Regional/provincial government	The National Road Implementing Agency (BPJN) in Jambi	Implementing agencies of the toll road project at provincial government level
Regional/provincial government	The Provincial Government of Jambi	- Formulating Spatial Plan and Medium-Term Development Plan for the province - Issuing the designated location permit (Penlok) for the toll road project
Regional/provincial government	The Spatial Plan/Land Agency (ATR/BPN) at provincial and local government levels	- Assisting BPJN to conduct land acquisition including land mapping and data collection, payment of compensation - Facilitating settlement of the compensation if land disputes occur
Local/regency (<i>kabupaten</i>) governments of Jambi Province	- Muaro Jambi - Batanghari - West Tanjung Jabung Barat	- Formulating Spatial Plan and Medium-Term Development Plan for the province - Facilitating stakeholder engagement and information disclosure
District administration (<i>kecamatan</i>) under each of the three regencies mentioned earlier	- Jambi Luar - Sekernan - Pemayung - Muara Palik District	- Supporting the land acquisition - Facilitating stakeholder engagement and information disclosure to local communities - Facilitating the coordination required between the project and local communities
Village (<i>desa</i>) administration under each of the four district administrations mentioned earlier	- Pijoan - Tantan - Rantau Majo - Gerunggung - Bukit Baling - Suko Awin Jaya - Selat - Teluk - Dusun Mudo	- Supporting land acquisition in all stages - Facilitating stakeholder engagement and information disclosure to local communities - Facilitating the coordination required between the project and local communities - Assisting communities affected by toll road construction
Private Entities		
The oil palm plantation companies and other industrial plantation	- PT Bahar Pasifik Utama - PT BBIP - PT Bus/Bratanata, - PT Brahma Bina Sakti, - PT AKA,	Relinquishing the land under the utilization/plantation rights for the toll road construction

Types of Stakeholders	Name	Anticipated Role in the Project
	- PT Tama Buana, - PT ABC, - PT Rudi Agung Laksana	
Future toll road operator	PT Hutama Karya (Persero)	Assigned by the Indonesian Government to conduct operation and maintenance of Jambi – Merlung Toll Road
Contractors, sub-contractors, and vendors of the toll road construction	Not yet determined as the bidding process for constructing the toll road is yet to start	- Executing construction work in accordance with the specifications of the bidding documents, civil work contracts, and subsequent amendments - Managing material procurement and overseeing supplier contracts - Communicating effectively with stakeholders, including government and the community in relation to construction activities
Local communities		
Project affected persons (PAPs) and/or households (PAHs)	The village residents or those affected by the land acquisition and/or by construction of the toll road	- The main beneficiaries of toll road construction - Supervise the implementation of toll road construction in the area - Partnering with the government in realizing toll road development that is smooth, fair and beneficial to the community
Local Community/Civil Society	- NGO/CSO - Youth Group - Women Group	- The main beneficiaries of toll road construction - Supervise the implementation of toll road construction in the area - Partnering with the government in realizing toll road development that is smooth, fair and beneficial to the community
Vulnerable Groups	- Women, including those as the head of a family, has low-income, and/or without land ownership - Elderly people - Children and Youth - Poor households - People with disabilities - Squatters/households without land ownership - Indigenous Peoples (IPs)	- The main beneficiary of toll road construction - Supervise the implementation of toll road construction in the area - Partner with the government in realizing toll road development that is smooth, fair and beneficial to the community

Source: Draft Stakeholder Engagement Plan of Jambi – Rengat Toll Road (PT Blantickindo Aneka, January 2024).

12.3 Stakeholder Engagement Conducted to Date

Several stakeholder engagements including public consultation and information disclosure in relation to the Jambi – Rengat Toll Road project have been conducted in 2020 – 2023 period through the following media and events²⁷:

- *Media campaign* - The disclosure of the toll road project through national and local newspapers was conducted in October 2020 as one of the mandatory requirements of the Indonesian Amdal process.
- *Public consultation* - The public consultations were conducted in October – November 2020 as part of the Indonesian Amdal process. The toll road development plan was presented community opinions, concerns, and interests were sought from the attendees. The representatives of the local governments and related agencies, affected communities, and civil society organizations attended this event. The process and outcomes of this public consultation event was reported to the Indonesian Government as part of the Amdal process.
- *Focus group discussions (FGDs)* – These FGDs were carried out in November 2023 as part of the community engagement process to prepare some E&S safeguard documents (i.e., LARP, SEP, IPP, GAP, and ESIA) according to the Bank’s Policies and standards. Two-way, focused discussions to gather concerns, thoughts, and interest of the project’s stakeholders were conducted, providing valuable inputs for the preparation of the aforementioned documents. These discussions involved stakeholders from various categories, primarily the village administration (head of village) and the affected community.

Similarly, the engagement with the government’s nature conservation agencies in Jambi and Riau Provinces and related non-governmental conservation organizations (NGOs) was conducted in November 2023 as part of the biodiversity baseline surveys, critical habitat assessment, and drafting the Biodiversity Management Plan. Information disclosed and key points discussed in this engagement were included in the *Biodiversity Management Plan – Jambi to Rengat Toll Road Phase 1: Sp. Ness to Merlung Segment* (YAPEKA, 2024).

- *Household socio-economic census* – This detailed census was undertaken in June to August 2023 and in December 2023 to the persons/households of nine villages likely affected through land acquisition for the construction of Sp. Ness – Merlung Toll Road segment in Jambi Province. In this census, each affected household was interviewed using a standard questionnaire to obtain data and information related to basic socio-economic conditions, project perceptions, and identification of potential income and asset losses due to the project. This census was undertaken concurrently with the preparation of the LARP document.

The following table presents a summary of the stakeholder engagements/information disclosure conducted to date as part of the Indonesian Amdal process and preparation of the safeguard documents of the toll road project. The representation of the attendees and key objectives of the engagement/disclosure are outlined in this table.

²⁷ The Indonesian Amdal is prepared for the Jambi – Rengat toll road while the ESIA is for the Jambi/Sp. Ness – Merlung Toll road (see the Introduction section for the rationale).

Table 119. Summary of Previous Stakeholder Engagements

Date	Activities	Attendees	Key Objectives
Overall			
5 October 2020	Announcement of the toll road project via Jambi Independent and Riau Pos newspapers	Not applicable	This announcement was made as part of the mandatory requirement of the Indonesian Amdal process.
23, 24, and 27 November 2023	Discussions with the Government's nature conservation agencies and NGOs of similar nature	▪ The representatives of (BBKSDA) of Riau Province and Jambi Provinces ▪ The Management of Bukit Tigapuluh National Park (Taman Nasional) ▪ NGOs: WWF; Fauna & Flora International (FFI); <i>Forum Harimau Kita</i> (Tiger Conservation Forum)	Topics discussed were on the biodiversity baseline survey and critical habitat assessment findings to solicit local knowledge and issues on nature conservation and inputs/thoughts for the biodiversity management plan.
Jambi Province			
25 October 2020	Public Consultation (PC) in Muaro Jambi and Batanghari Regencies	44 persons (Female: 4, Male: 40), representing PT Hutama Karya, the Environmental Agency, Land Agency, Public Works and Spatial Planning Agency, Transportation Agency of Muaro Jambi Regency, and some village residents	This PC was undertaken as part of the mandatory requirement of the Indonesian Amdal process.
27 October 2020	Public Consultation in Tanjung Jabung Barat Regency	25 persons (Female: 6, Male: 19), representing PT Hutama Karya, the Environmental Agency of the regency, and related districts and villages	This PC was undertaken as part of the mandatory requirement of the Indonesian Amdal process.
21 November 2023	Focused Group Discussion (FGD) at Tungkal Ulu District of Muaro Jambi Regency	26 persons (Female: 10, Male: 16), representing the village administration officials and affected persons of Tungkal Ulu and Kuala Dasal Villages	The FGD was undertaken as part of the preparation of the safeguard documents required by the Banks.
22 November 2023	FGD at Muara Papalik District of Tanjung Jabung Barat Regency	26 persons (Female: 4, Male: 22) representing the village administration officials and affected persons of Dusun Mundo Village.	The FGD was undertaken as part of the preparation of the safeguard documents required by the Banks.
23 November 2023	FGD at Jambi Luar Kota District, Tanjung Jabung Barat Regency	29 persons (Female: 7, Male: 22) representing the village administration officials and affected persons of Pijoan and Simpang Selat Villages	The FGD was undertaken as part of the preparation of the safeguard documents required by the Banks.

Date	Activities	Attendees	Key Objectives
23 November 2023	FGD at Sekernan District, Muaro Jambi Regency	Total: 37 persons (Female: 10, Male: 27) representing the village administration officials and affected persons of Bukit Baling, Gerunggung, Suko Awin Jaya and Rantau Majo Villages	The FGD was undertaken as part of the safeguard documents preparation.
Riau Province			
18 November 2020	Public Consultation (PC) in Indragiri Hulu Regency	35 persons (female: 4, Male: 31), representing PT Hutama Karya, the Environmental Office, Land Office, Public Works and Spatial Planning Office, and Transportation Office of the regency, and related districts and villages	This PC was undertaken as part of the mandatory requirement of the Indonesian Amdal process.
19 November 2020	Public Consultation in Indragiri Hilir Regency	36 persons (female: 6, Male: 30), representing PT Hutama Karya, the Environmental Office of the regency, and related districts and villages	This PC was undertaken as part of the mandatory requirement of the Indonesian Amdal process.
22 November 2023	Focused Group Discussion (FGD) at Rengat Barat District	27 persons (Female: 4, Male: 23) representing the village administration officials and affected persons of Sungai Dawu, Sungai Baung, and Talang Jerinjing Villages.	
22 November 2023	FGD at Seberida District of Indragiri Hulu Regency	48 persons (Female: 8, Male: 40) representing the village administration officials and affected persons of Paya Rumbai Village	
23 November 2023	FGD at Kemuning Sub-Regency, Indragiri Hilir Regency	26 persons (Female: 1, Male: 25) representing the village administration officials and affected persons of Sekara, Lubuk Besar, Limau Manis, and Sekayan Villages	

Source: Draft Stakeholder Engagement Plan of Jambi – Rengat Toll Road (PT Blantickindo Aneka, January 2024).

In addition to the above stakeholder engagement, the Project conducted consultations in August – November 2023 period as part of the Biodiversity Baseline Survey and preparation of the Biodiversity Management Plan with the following parties: (i) the Government’s Nature Conservation Agencies of Jambi and Riau Provinces; (ii) The management of Bukit Tigapuluh National Park in Rengat (Riau Province); and (iii) Conservation NGOs including the World Wide Fund for Nature (WWF), Fauna & Flora International (FFI); Forum Harimau Kita (Tiger Conservation Forum).

The appointed Biodiversity Consultant held discussions with the relevant personnel of the Ministry of Public Works and Housing (at that time) and the DED consultants of the Jambi- Rengat Toll Road

project. These stakeholder engagement and discussions were aimed to increase knowledge and awareness of the biodiversity issues related to the Project among their stakeholders since its planning phase rather than at a later stage.

12.4 Stakeholder Engagement in the Future

Planned future stakeholder engagement and information disclosure activities are aimed at ensuring that the stakeholders feel informed, involved, and their concerns heard and followed up by the Project. A range of proposed stakeholder engagement and information dissemination methods that could be implemented by the Project is presented in the following table.

Table 120. Stakeholder Engagement/Information Disclosure Methods

Tools/Instrument	Remark
Newsletter and flyer	- Newsletters and flyers enable the Project proponent to consistently keep stakeholders in the database informed about key project developments, such as the commencement of the construction phase. - Newsletters allow for the incorporation of graphics, including illustrations and photographs, enhancing the communication stream with design elements. Written materials may need to be translated for some local individuals.
Media campaign	Most media campaigns include elements of advertising, speeches and press releases that allow for clear, simple information dissemination to the community within a short time.
Public displays	- Public displays are used to promote key progress during the investigation and development schedule, such as at the commencement of construction. - Public displays are a non-invasive way of displaying Project infrastructure layout and gathering feedback. They can be held in public markets or at a local shop front.
Website	- Information disclosure to the public and stakeholders through the project website - Information disclosure on GRM procedures
Correspondence via telephone and/or email	- Request/distribute project information - Inform stakeholders about consultation meetings
Formal meeting	- Present project information - Build impersonal relationships with high-level stakeholders - Distribute technical documents - Note discussions, comments/questions asked and responses
Public meeting	- Present project information to multiple stakeholders or specific communities, including the status of project development and implementation, environmental and social impacts and risks as well as steps and actions to address them. - Build relationships with local communities - Distribute non-technical project information - Disseminate information regarding the Complaint Handling Mechanism and contact persons

Tools/Instrument	Remark
	Record discussions, comments/questions asked and responses
Focus Group Discussion	- Facilitate meetings in small groups of 5 to 15 people to discuss specific topics regarding project technical or non-technical issues, including the status of project development and implementation, environmental and social impacts and risks and steps and actions to address them. - Record discussions, comments/questions asked and responses
Site visit	- Collect assessments from each stakeholder through visits to the project site - Show planned activities and construction progress

12.5 Disclosure of Project Information

Upon endorsement by the Implementing Agencies and the Bank, the E&S safeguard documents and other related documents prepared for the Project will be posted on the websites of the Bank and the Project. Timely disclosure of these documents is crucial for effectiveness in the stakeholder engagement process and promote the reputation of the Project. The primary objective of information disclosure is to reach out to all Project's stakeholders through prioritizing the accuracy of information, project stages, timelines, and potential impacts, and other relevant aspects crucial for the benefits of the Project and the stakeholder themselves.

Information disclosure encompasses, among others, dissemination of the proposed development plan and activities of the Project at construction and operation phases, and E&S risks and impacts including associated mitigation measures and monitoring plans. GRM and considerations for community health and safety will also be informed. The methods of information disclosure are presented in the above table.

The draft ESIA and other environmental and social instruments is disclosed to stakeholders prior to Project approval to provide access to Project information and facilitate stakeholder review and feedback. The disclosure process is to provide stakeholders with an opportunity to seek clarification on the findings of the environmental and social assessments, proposed mitigation measures, implementation arrangements, and commitments contained in the Project's environmental and social documents. Comments, questions, and recommendations received during the disclosure period and stakeholder engagement activities will be documented, reviewed, and considered during finalization of the ESIA and associated environmental and social instruments, as appropriate. The final ESIA may therefore be updated to reflect stakeholder feedback, clarification of assessment findings, refinement of mitigation measures, and other relevant information available prior to commencement of Project implementation. The timeline for disclosure of the draft safeguard documents by the Bank is sixty (60) calendar days prior to the meeting of the Bank's Board of Directors. The Bank's Management may decide that a longer or a shorter disclosure period is appropriate, in exceptional circumstances, due to the specific nature and scope of the E&S risks and impacts of the Project. In this case, the disclosure period decided by the Management is reported to the Bank's Board of Directors.

13.0 GRIEVANCE REDRESS MECHANISM

A Project-specific Grievance Redress Mechanism (GRM) has been prepared and is included in the draft Stakeholder Engagement Plan or SEP (dated January 2024), which includes stakeholder engagement strategies and methods to be implemented by the Project during preparation and implementation phases. The GRM presentation herein may be subject to future amendment if the SEP has been accepted for implementation by the Implementing Agencies of there are specific circumstances warranting such amendment.

The GRM is a systematic process to receive and facilitate resolution of project-related grievances (e.g., complaints, concerns, claims, etc.) raised by the affected communities including PAPs, project workers, and wider communities (“aggrieved person”) who believe that they may have been adversely affected by the Project’s E&S impacts. These stakeholders will be informed on this GRM including their rights for presenting grievances through formal as well as informal meetings to be primarily undertaken by the IA and, to some extent, by local government agencies and the future contractors of the Project. The GRM places the communities as the main beneficiaries and does not close the opportunity for them to pursue legal and administrative efforts. No cost should be borne to the PAPs and other stakeholders in submitting their grievances.

Key Requirements

The Banks’ Requirements. It is mandated that the Client establish an appropriate grievance mechanism in alignment with the ESP and relevant ESSs. This mechanism is intended to receive and facilitate the resolution of concerns or complaints from individuals who believe they have been negatively impacted by the environmental or social effects of the project. It is also required to inform those affected by the project of its availability. The scale of the grievance mechanism is tailored to the risks and impacts associated with the project.

Utilization of existing formal or informal grievance mechanisms is allowed, provided they are well-designed and implemented, and approved by the Bank as suitable for the project. If necessary, these may be complemented with project-specific arrangements. The grievance mechanism is structured to address concerns and complaints promptly, employing an understandable and transparent process that is sensitive to gender, culturally appropriate, and easily accessible to all affected parties. Additionally, it includes provisions to safeguard complainants from retaliation and allows for anonymity if requested. The mechanism involves maintaining a publicly accessible case register and generating reports on grievance redress and outcomes, which are disclosed in accordance with applicable ESS.

Besides the above, the Law No. 22/2021 stipulates provision that every person has the right to make a complaint due to alleged pollution and/or destruction of the environment. However, this Law is silent on the procedures to raise the complaint.

Project-specific Grievance Redress Mechanism

GRM for a Wider Stakeholders. Contractors or government officials need to encourage the public to raise their complaints if they believe may have been adversely affected by the Project’s E&S impacts. Likewise, stakeholders are expected to understand that the GRM can be carried out anonymously. The GRM is to be handled at three levels i.e., project, government, and court level. If the aggrieved person is not satisfied with the proposed resolution of their grievance or the way the grievance is handled at

a particular level, he/she can proceed to the next, higher level of the GRM as described in the following:

Level 1 – Local / Field Level (Project-level GRM)

At the first level, grievances are handled at the local or field level, with an emphasis on early and practical resolution. This level includes:

- initial handling by local government;
- resolution of site-specific issues by contractors or relevant stakeholder, under the supervision of Head of the relevant Public Works Agency; and
- intake and facilitation by community-level points of contact or CLOs, where applicable.

Level 1 focuses on the prompt resolution of straightforward and localized grievances through consultation, verification, and corrective action.

Level 2 – Regional / Technical Implementation Unit (TIU) (Project-level GRM)

If a grievance:

- is not resolved at Level 1;
- requires coordination across multiple institutions or Project components; or
- involves significant, complex, or sensitive impacts, the grievance is escalated to the PIU.

At this level, the TIU:

- reviews the grievance and actions taken at Level 1;
- undertakes further assessment or coordination, as required;
- issues a documented decision; and
- communicates the outcome to the complainant.

Level 3 – Central Level (DGH) (Project-level GRM)

If the complainant remains dissatisfied after resolution at the TIU level, or where the grievance has strategic, policy, or cross-regional implications, the grievance may be escalated to the DGH (central level) for final review within the Project-level GRM.

At Level 3:

- DGH, under the supervision of Directorate of Internal Compliance, reviews the grievance file and decisions taken at Levels 1 and 2;
- may seek additional clarification or technical input, as needed; and
- issues a final Project-level decision on the grievance.

Decisions at Level 3 represent the final level of resolution within the Project-level GRM.

Outside the Project-level GRM – External Remedies

Administrative and judicial mechanisms under national law, as well as the PPM, are not part of the Project-level GRM. Where a grievance remains unresolved after completion of Levels 1–3 of the Project-level GRM, or where the complainant is dissatisfied with the final Project-level decision issued by DGH, the complainant retains the right to seek resolution through:

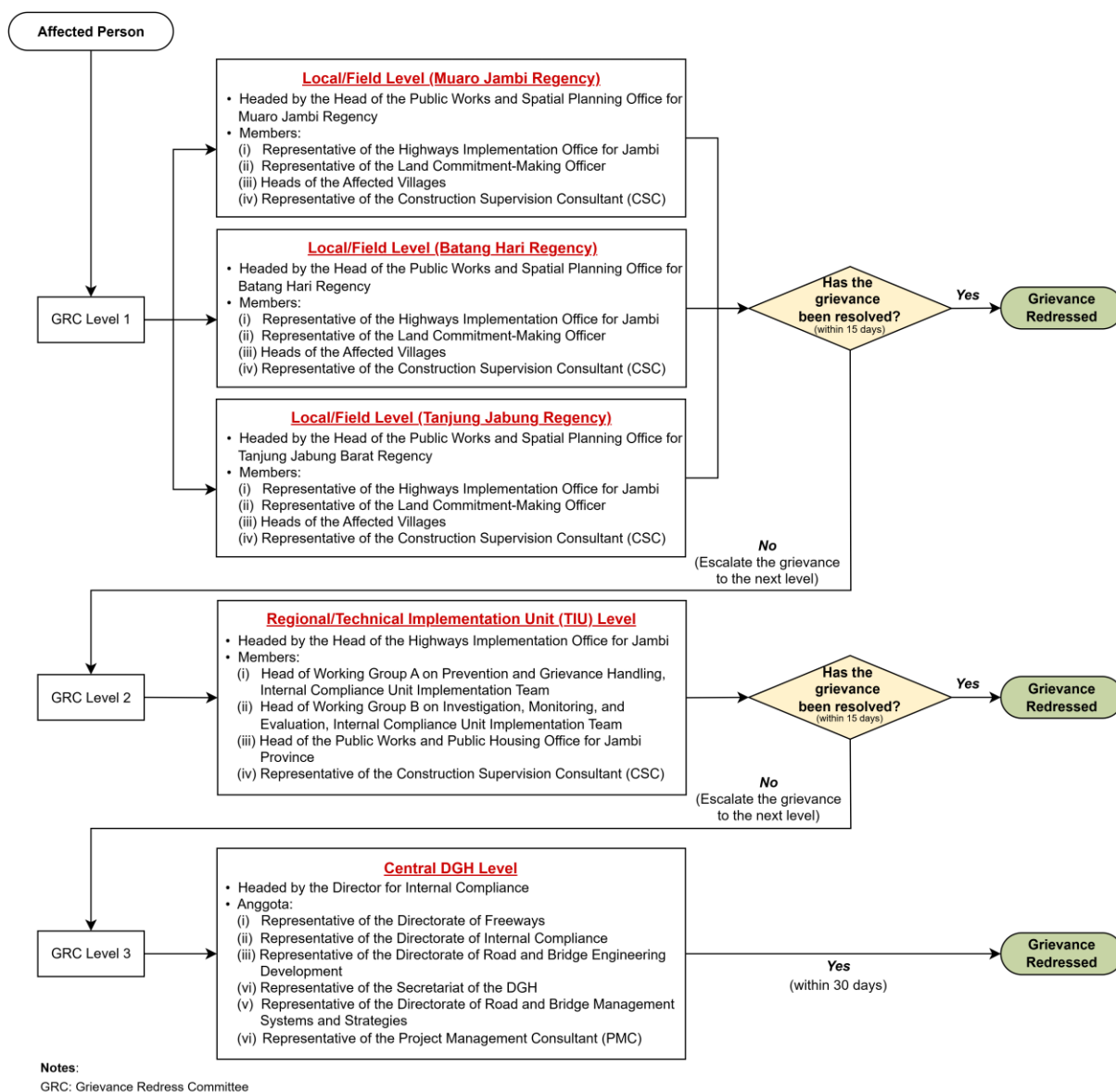
- competent administrative or judicial bodies under national law; and/or
- the PPM, in accordance with its applicable procedures.

Access to administrative or judicial remedies is independent of, and not conditional upon, engagement with the Project-level GRM.

With respect to the PPM, complainants are expected to have made good-faith efforts to resolve their concerns through the Project-level GRM and with AIIB Management's processes before submitting a request to the PPM. Where such efforts have not been made, or where the complainant has not demonstrated to the satisfaction of the PPM why they were unable to do so, a submission to the PPM may be deemed ineligible, in accordance with the applicable PPM policy. Use of the Project-level GRM therefore represents the primary channel for grievance resolution, with the PPM serving as an independent accountability mechanism of last resort, consistent with AIIB requirements.

Figure 29 presents step-by-step procedures of the GRM based on the stages described earlier.

Figure 29 Grievance Redress Mechanism



GRM for Indigenous People. The GRM should follow their internal grievance mechanism (if any) or any mechanism provided by the local governments based on community request. The APs may bring their complaints to the village leaders and/or IP leaders. The village/IP leaders will settle the complaint within 2 to 7 working days upon receipt of the complaint notice. If this grievance has not been settled within the timeframe, they may bring it to the project officers in charge at the field office level.

The IAs supported by consultants and future contractors will be responsible for recording the complaints received, documenting the process of grievance resolution, and reporting on the outcomes mutually agreed by the parties involved.

The Bank's Project-affected People's Mechanism

AIIB's Project-affected People's Mechanism (PPM) also applies to the project in addition to the GRM procedures described earlier. However, while the Project-level GRM is the responsibility of the IA, the

PPM is the responsibility of the Banks. The PPM provides opportunities for people who are adversely affected by AIIB-financed projects' E&S impacts for an independent and impartial review of complaints in situations where their concerns cannot be addressed satisfactorily through Project-level GRMs. Details of the PPM procedures can be found at the following link: (<https://www.aiib.org/en/about-aiib/who-we-are/project-affected-peoples-mechanism/how-we-assist-you/index.html>).

14.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This section describes the environmental mitigation and monitoring plan that should be implemented, monitored, and reported on semi-annual basis by the Project throughout the implementation phase, from construction through to the operation phase are presented in the following tables. The social mitigation and monitoring plan is also presented as separate section of the ESIA. Similarly, the Cumulative Impact Management Plan which should be implemented by the Project is also presented in a separate section of the ESIA (Section 9.8).

14.1 Pre-construction Phase

Table 121. Environmental Mitigation and Monitoring Plan - Preconstruction Phase

Anticipated Impacts	Mitigation Measures (Pre-construction Phase)	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
Incomplete/absence of E&S requirements included in the bidding documents and working contract	- Bidding documents preparation by PMU side which should include ES requirements so can be costed by contractors (Construction-ESMP(CESMP), and its relevant requirements, BMP requirements preparation and approval also, among others, etc.) - Provision on training on ESMP, BMP, etc. - Preparation and approval of Construction ESMP and other environmental- specific management plans. - PMU's hiring of Project Management consultants - Hydrological and hydrogeological studies to be conducted prior to construction process as a basis to develop a water management plan that needs to be implemented during construction.	Review of bidding documents, selection process of potential contractors and contract awards	Ongoing during the bidding and contractor selection process	Not applicable	BPJN Jambi Province assisted by the Construction Supervision Consultants (CSCs) DGH assisted by the Project Management Consultant (PMC) has the overall accountability on the overall project implementation	Included under DGH, BPJN Jambi, CSCs, and PMU budgets as appropriate.

14.2 Construction Phase

Table 122. Environmental Mitigation and Monitoring Plan - Construction Phase

Anticipated Impacts	Mitigation Measures Construction Phase	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
Ambient Air Quality						
Increased airborne particulates (dust) and fugitive emissions into the local watershed due to the following activities: Construction and operation of contractor's basecamp and worker accommodation; Operation and maintenance of project's trucks and heavy equipment; Earthmoving/civil work activities; Transportation and disposal of construction and other non-hazardous wastes; Operation of borrow pits and concrete batching plants, and the use of existing roads for construction (as associated facilities to the Project).	Develop an Air Quality Management Plan (AQMP), describing a more detailed, site-specific environmental mitigation measures and monitoring of air quality impact. The AQMP is included as the appendix of the construction E&S management plan (CESMP). Operate the trucks and heavy equipment that have valid operating licenses. Employ the drivers and heavy equipment operators with valid driving and operating licenses. Use of newer trucks and heavy equipment instead of the old ones that emit less exhaust pollutants. Conduct a periodic inspection and maintenance of the trucks and heavy equipment, and the results are documented. Conduct a regular watering of the construction sites and access roads that generate high-level of airborne dust within the nearby villages. Restrict the speed limit of trucks (i.e., max 40 km/hour or less) at the project area including access roads used for construction and the operation of auxiliary facilities.	The CESMP including AQMP developed and endorsed prior to commencement of the civil works. Review the validity of operating and driving licenses, and maintenance records of trucks and heavy equipment used by the contractor. Conduct a regular inspection of the active construction sites, access roads, and the operation of auxiliary facilities, ensuring that the regular watering of those areas and roads is undertaken, and dust dispersion is managed to acceptable level. Conduct a periodic air quality monitoring using the methodology stipulated in the <i>Government Regulation No. 22 Year 2021 – Appendix VII: Ambient Air Quality Standard</i> ; and use the accredited laboratory to collect and analyzed the air samples.	The CESMP/AQMP should be reviewed and endorsed prior to commencement of the civil works. Other mitigation measures are conducted on a weekly or monthly basis as appropriate. Air quality monitoring is conducted as follows: - Once prior to commencement of construction activities. - Quarterly during construction activities. - Once within three months after completion of construction activities.	Active construction sites. Community settlements and public facilities within the proximity to the project, such as the following villages: - Pijoan - Tantan - Rantau Majo - Gerunggung - Bukit Baling - Suko Awin Jaya - Selat - Teluk - Dusun Mudu. Existing access roads used for construction activities. The operation of auxiliary facilities. Air quality monitoring to be conducted at sensitive receptor areas (e.g., community settlement, environmentally sensitive site); and the monitoring sites should be detailed in the AQMP.	The contractors, including their subcontractors, are responsible for implementing environmental mitigation measures and monitoring. BPJN Jambi Province assisted by the Construction Supervision Consultants (CSC) is responsible for supervising the civil works including E&S obligations undertaken by the contractors. DGH assisted by the Project Management Consultant (PMC) has the overall accountability on the project implementation including compliance with E&S obligations.	Adequate environmental mitigation measures and monitoring budget should be included in the bidding documents and civil works contracts awarded. The above budget should cover for the whole construction period including for any contract variations and/or timeline extension where appropriate.

Anticipated Impacts	Mitigation Measures Construction Phase	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
Noise and Vibration						
Increased noise and vibration level due to the same toll road construction activities.	Develop a <u>Noise and Vibration Management Plan (NVP)</u> describing a more detailed, site-specific environmental mitigation measures and monitoring of noise and vibration impacts. The NVP is included as the appendix of the CESMP. Select and use the trucks and heavy equipment that has relatively low noise and vibration levels. Limit the construction activities to day-light period (e.g., 6:00 to 18:00), particularly at areas close to community settlements and hospitals if considered practical to do so. If extended working hour for the above areas is required, implement additional measures such as limiting the number of trucks and heavy equipment including their workloads and seek the consent shall from the project-affected peoples.	The CESMP including NVP developed and endorsed prior to commencement of the civil works. Review the validity of operating and driving licenses, and maintenance records of trucks and heavy equipment used by the contractor. Conduct a periodic noise monitoring using the methodology stipulated in the <i>Decree of the Minister of Environment No. 48 of 1996</i> concerning noise level standards.	The CESMP/NVP should be reviewed and endorsed prior to commencement of the civil works. Other mitigation measures are conducted on a weekly or monthly basis as appropriate. Noise and vibration monitoring is conducted as follows: - Once prior to commencement of construction activities. - Quarterly during construction activities. - Once within three months after completion of construction activities.	Community settlement and public areas within the proximity of active construction sites within the following villages: - Pi Joan - Tantan - Rantau Majo - Gerunggung - Bukit Baling - Suko Awin - Jaya - Selat - Teluk - Dusun Mudu. The contractor's basecamps and worker accommodations Existing access roads used for construction.	The same as above.	The same as above.
Soil Erosion and Consolidation						
Alteration of storm water flow and increased soil erosion due to toll road construction activities as follows: Earth moving/civil work activities; and Operation of borrow pits and concrete batching plants, and the use of	Prior to carrying out the earth work/civil works, conduct an adequate hydrological investigation, including necessary field works specific to the Phase 1 development area, among others: - to understand hydrological regimes that may be affected by the Project; - to conduct inventory of surface water bodies; - to determination of storm water flow rate and direction in the field; and	The CESMP including Soil Erosion and Water Management (SEWMP) developed and endorsed prior to commencement of the civil works. Review the validity of operating and driving licenses, and maintenance records of trucks and heavy equipment used by the contractor. Conduct a periodic monitoring for Soil Erosion and Water Quality	The CESMP/SEWMP should be reviewed and endorsed prior to commencement of the civil works. Other mitigation measures are conducted on a weekly or monthly basis as appropriate.	Batanghari and Pi Joan River watersheds and sub-watersheds that may be impacted by the construction activities of Jambi/Sp. Ness to Merlung Toll Road (Phase 1 development).	The same as above.	The same as above.

Anticipated Impacts	Mitigation Measures Construction Phase	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
existing roads for construction	to conduct a modelling to predict potential hydrological impacts and flooding risks. Based on the ESIA study, develop and implement a <u>Soil Erosion and Water Management Plan (SEWMP)</u> to mitigate impacts on the affected hydrological regime as well as areas subject to earth- and civil-work activities. Conduct revegetation or planting the fast-growing groundcover vegetation shall be conducted on disturbed areas or exposed soils that are no longer required for the construction of toll road and other related structures. Conduct land clearing including removal of vegetation and subsurface soils in a phased manner and is limited to the areas immediately required for construction activities. Prioritize extensive land clearing during dry weather conditions instead of during rainfall period to minimize soil erosion if practicable and feasible to do so. Use natural materials for embankment and slope stabilization of the construction sites in combination with gabions instead of entirely concrete structures. Prohibit earth moving and civil work activities within rivers, streams and other water bodies except to construct a particular structure required for bridges, embankment, and drainage system. Reduce off-site sediment transport through use of settlement ponds, silt fences, and water treatment. Modify or suspend the construction activities during extreme rainfall and high winds to the extent practical. Adjust the planned schedule for land clearing and earthwork (excavation and embankment) to be carried out in the dry season (avoiding work in the rainy season) to reduce increased runoff and erosion, turbidity and sedimentation. Create temporary water channels at the construction sites along the toll road alignment on both sides of the road to channel surface water flow when it rains; and the side channels are equipped with soil/mud settling		Soil and Water Quality monitoring is conducted as follows: - Once prior to commencement of construction activities. - Quarterly during construction activities. - Once within three months after completion of construction activities.	Pi Joan River at STA 1+984 and Batanghari River at STA 15+780 where the bridge construction will be undertaken. Community settlement and public areas within the proximity of active construction sites at the following villages: - Pi Joan - Tantan - Rantau Majo - Gerunggung - Bukit Baling - Suko Awin Jaya - Selat - Teluk - Dusun Mudu. The sites where quarries/borrow pits are operated. The sites where the concrete batching plants are operated. Existing roads actively used to access construction sites.		

Anticipated Impacts	Mitigation Measures Construction Phase	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
	tanks (sediment traps) to reduce river water pollution and sedimentation in the river. Minimize time gap between excavation, stockpiling and backfilling of soils as well as disposal of spoils at erosion-prone areas. Avoid high sediment generating activities such as road paving and exposed surfaces and stored materials covered if necessary to reduce erosion of sediments into surface waters. Direct muddy water generated from the concrete batch plant operation operations and washing of cement trucks into settling ponds; and periodic removal of the sludge for safe disposal shall be carried out.					
Surface Water Resources						
Reduced surface water quality due to toll road construction activities as follows: Construction and operation of contractor basecamps and worker accommodation; Operation and maintenance (primarily) of project trucks and heavy equipment; Earth moving/civil work activities; Management of construction wastes and other solid and liquid wastes; and Operation of borrow pits and concrete batching plants and use of existing access roads for construction	Develop a <u>Surface Water Quality Management Plan (SWQMP)</u> describing a more detailed, site-specific environmental mitigation measures and monitoring of surface water quality impacts. The SWQMP is included as the appendix of the CESMP. Implement the mitigation measures defined for 'Alteration of Stormwater Flow and Increased Soil Erosion' to mitigate the impacts on surface water quality in addition to the measures mentioned below. Treat sewage and latrine from the toilets and wash water from the bathroom of the workers accommodation using a modular municipal wastewater treatment system and a filtered seepage system. Construct a temporary, perimeter drainage system within the contractor's basecamp including workshop and materials storage areas. Keep oil, fuel, and other materials considered hazardous separate from non-hazardous substances; and this hazardous material storage shall be in bunded areas with waterproof floors, roof, restricted access, and drainage system connected to oil-water/substance separator or pit.	The CESMP including SWQMP developed and endorsed prior to commencement of the civil works. Conduct a periodic surface water monitoring using the methodology stipulated in the Government Regulation No. 22 Year 2021 – Appendix VI: Water Quality Standard; and use the accredited laboratory to collect and analyzed the water sample.	The CESMP/SWQMP should be reviewed and endorsed prior to commencement of the civil works. Other mitigation measures are conducted on a weekly or monthly basis as appropriate. Surface Water Quality monitoring is conducted as follows: - Once prior to commencement of construction activities. - Every months during construction activities.	Batanghari and Pijoan River watersheds and sub-watersheds that may be impacted by the construction activities of Jambi/Sp. Ness to Merlung Toll Road (Phase 1 development). Pijoan River at STA 1+984 and Batanghari River at STA 15+780 where the bridge construction will be undertaken.	The same as above.	The same as above.

Anticipated Impacts	Mitigation Measures Construction Phase	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
	Provide appropriate oil/material spill response equipment and materials/absorbents within at the material storage areas. Conduct reparation of any leaks of the trucks and heavy equipment in a timely manner.					
Groundwater Resources						
Disturbance to shallow groundwater table and groundwater quality due to toll construction activities as follows: Earth moving/civil work activities; Management of construction wastes and other solid and liquid wastes; and Operation of borrow pits and concrete batching plants (as associated facilities to the Project).	Prior to carrying out the earth work/civil works, conduct an adequate hydrogeological investigation by competent personnel, including necessary field works specific to the Phase 1 development area, among others through: - Geo-electrical survey. - Groundwater mapping (e.g., inventory, flow rate, direction, recharge, and discharge). Based on the above study, develop and subsequently implement a <u>Groundwater Management Plan (GMP)</u> to minimize impacts on the affected hydrogeological regime. Conduct revegetation or planting the fast-growing groundcover vegetation (native species) on disturbed areas or exposed soils that are no longer required for the construction activities. Develop an SOP for groundwater extraction and monitoring (for water table and quality) at the contractor basecamp and worker accommodation, the concrete batching plants and other sites where a groundwater abstraction for some periods may be required; and train this SOP to the personnel in charge for groundwater abstraction for a consistent implementation. Keep solid and liquid wastes and any other product containing hazardous substances, high organic and metal contents further away from groundwater wells; and store them in a secured container and areas completed with adequate roof, secondary containment, and warning signage; The SOP for managing solid and liquid wastes, both hazardous and non-hazardous ones shall be developed and trained	The CESMP including GMP developed and endorsed prior to commencement of the civil works. Conduct a periodic surface water monitoring using the methodology stipulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2023 Concerning Implementing Regulations of Government Regulation Number 66 of 2014 Concerning Environmental Health; and use the accredited laboratory to collect and analyzed the water sample.	The CESMP should be reviewed and endorsed prior to commencement of the civil works. Other mitigation measures are conducted on a weekly or monthly basis as appropriate. Surface Water Quality monitoring is conducted as follows: - Once prior to commencement of construction activities. - Every months during construction activities.	At the same sites as those defined for mitigating the impacts of 'Alteration of Stormwater Flow and Increased Soil Erosion' (above).	The same as above.	The same as above.

Anticipated Impacts	Mitigation Measures Construction Phase	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
	for the workers of the contractors and sub-contractors.					
Road Traffic and Damages						
Traffic disruption and damage to existing roads due to toll road construction activities as follows: Operation and maintenance of project trucks and heavy equipment; Earth moving/civil work activities; Management of construction wastes and other solid and liquid wastes; and Operation of borrow pits and concrete batching plants, and the use of existing roads for construction (as associated facilities to the Project).	Prior to mobilization/demobilization activities of the truck and heavy equipment fleet for the Project, the contractors and/or implementing agencies will develop a <u>Traffic Management Plan (TMP)</u> of the Project (including the results of the road survey) and subsequently coordinate with the local road and transportation agencies as well as local polices to disseminate this plan. Use special wide-body and long trucks with police escort to mobilize/demobilize heavy equipment such as bulldozers, rollers, excavators, and bore pile rigs using the road class that is suitable. Develop an <u>Emergency Preparedness and Response Plan (EPRP)</u> that will be activated in the event the transportation of heavy equipment above encounters road breakdown or other emergency situations. Allocate adequate budget for repairing damaged public and private roads used by the Project to its baseline conditions. Repair the damage to existing roads and associated accessories (e.g., bridge, rail guards, and culverts) in a timely manner.	The CESVP including TMP and EPRP developed and endorsed prior to commencement of the civil works. There are no complaints from the public regarding traffic jams and road damage.	The CESVP/TMP/EPRP should be reviewed and endorsed prior to commencement of the civil works. Other mitigation measures are conducted on a weekly or monthly basis as appropriate. Road traffic monitoring is conducted as follows: - Once prior to commencement of construction activities. - Every months during construction activities.	Trans-Sumatra National Road (between Jambi and Merlung) Tembesi – Jambi provincial road intersection (at STA 4+600) District road (at STA 56+200) Village/local roads and plantation roads (at the following: - STA 30+500 - STA 50+100 - STA 53+800 - STA 54+200 - STA 56+000	The same as above.	The same as above.
Terrestrial Biodiversity						
Disruption to terrestrial habitat and wildlife species due to toll road construction activities as follows: Construction and operation of contractor's basecamp and worker accommodation; Earth moving/civil work activities; and	Implement mitigation measures as detailed in the <u>Biodiversity Management Plan (BMP)</u> of Jambi – Rengat Toll Road - Phase 1 Development (Jambi/Sp. Ness to Merlung Segment). Use the existing quarries that have valid government licenses and environmental approvals as well as those implementing environmental mitigation measures and monitoring. In the case of a new quarry, select degraded or modified habitats over natural habitats that will supply construction materials for the Project.	BMP Monitoring Plan details the monitoring requirements and indicators. There is no conflict between humans and animals related to pests in community plantation. There is no information from the public regarding cases of wild animal hunting and wild animals dying after being hit by vehicles. The condition of the terrestrial biodiversity diversity index is equivalent to or better than the condition before the project activities.	The CESVP including the requirements of the BMP should be reviewed and endorsed prior to commencement of the civil works. BMP Monitoring Plan is implemented accordingly, and for this aspect related to Terrestrial Biodiversity	The area cleared for construction within the Phase 1 development area. Existing and future quarries (borrow pits) supplying materials for the Project.	The same as above.	The same as above.

Anticipated Impacts	Mitigation Measures Construction Phase	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
Operation of borrow pits and concrete batching plants, and the use of existing roads for construction (as associated facilities to the Project).	Undertake land clearing in a phased approach such that it complements wildlife shepherding activities; all proposed clearance areas will be clearly marked using visible tapes and pegs or similar in the field prior to any vegetation being cleared. Develop and subsequently implement a Code of Conduct (CoC) against wildlife collection, possession, and trafficking shall be developed and disseminated to the workers including enforcing sanction for those violating this CoC. Develop and subsequently implement a SOP for wildlife protection and handling training/awareness materials on human-wildlife conflict management. Conduct an inspection immediately upon completion of land clearing to determine if such activity has been conducted within the boundary of the marked areas; and to report any clearing outside of the marked area if occurred.		monitoring is conducted as follows: - Once prior to commencement of construction activities. - Quarterly during construction activities. - And as indicated in the BVP.			
Aquatic Ecosystem and Biota/Riparian Ecosystem						
Disturbance to riparian zone and aquatic ecosystem due to activities as follows: Construction and operation of contractor's basecamp and worker accommodation; Earthmoving/civil work activities; Management of construction wastes and other solid and liquid wastes; and Operation of borrow pits and concrete batching plants, and the use of existing roads for construction (associated facilities to the Project).	Minimize the riparian area likely to be disturbed by the construction of bridges and other toll road structures by properly delineating and marking the footprints required for the foundation and working base. Develop and subsequently implement an SOP in handling, transporting and storage of lubricant and fuel and other materials categorized as hazardous substances; Conduct replating the riparian zone disturbed by construction activities using the existing, native species; Construct a temporary water channel, protection wall, sediment trap and maintain them (i.e., cleaning, maintaining structure integrity from collapsing or non-functioning) within construction sites; and Implement the detailed mitigation measures as defined in the <u>Biodiversity Management Plan (BVP)</u> of Jambi – Rengat Toll Road - Phase 1 Development (Jambi/Sp. Ness to Merlung Segment).	BVP Monitoring Plan details the monitoring requirements and indicators. The condition of the aquatic biodiversity diversity index is equivalent to or better than the condition before the project activities.	The CESVP including the requirements of the BVP should be reviewed and endorsed prior to commencement of the civil works. BVP Monitoring Plan is implemented accordingly, and for this aspect related to Aquatic monitoring is conducted as follows: - Once prior to commencement of construction activities. - Quarterly during construction activities.	The stream and river receiving drainage from the area cleared and constructed for the toll road, particularly: Pijoan River (at STA 1+984) and Batanghari River (at STA 15+780) where the bridge construction will be undertaken. Existing and future quarries (borrow pits) supplying materials for the Project.	The same as above.	The same as above.

Anticipated Impacts	Mitigation Measures Construction Phase	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
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- And as indicated in the BVP.

Based on the results of the biodiversity baseline survey and CHA described above as well as consultation with relevant conservation agencies in Jambi and Riau as well as non-governmental organizations (NGOs), a Biodiversity Management Plan (BMP) of Jambi – Merlung Toll Road project (Phase 1 development of Jambi – Rengat Toll Road). The BMP (dated January 2024) was developed. The BMP including mitigation measures and monitoring programs defined herein should be implemented by the implementing agencies for the design, construction, and operation of the project. The BMP is referred to in the ESMP of the ESIA, and, therefore, these two (2) reports should be read together.

The BMP has been prepared by considering good international practices including the provisions of the relevant Indonesian regulations: (i) *Presidential Instruction No. 1/2023 on Mainstreaming Biodiversity in Sustainable Development*, which requires that MPWH taking into account the distribution of biodiversity area in the infrastructure design and support the sustainability of wildlife habitats and/or areas of high biodiversity value; (ii) *MoEF Regulation No. 23/2019 on Strategic Roads in Forest Areas*; (iii) *MoEF Regulation No. 106/2018 on Protected Plant and Animal species*; and (iv) the *Circulation Letter (Surat Edaran) of Directorate General of Highways on Guidelines for Road Construction and Mitigation Structure in Forest Area*.

14.3 Operation Phase

Table 123. Environmental Mitigation and Monitoring Plan—Operation Phase

Anticipated Impacts	Mitigation Measures OPERATION PHASE	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
Ambient Air Quality						
Increased dust and air emissions due to the following activities: Toll road traffic; Repair and maintenance (road, bridges, etc.); and Toll road office and Rest area operations.	Build and maintain a 2 to 3-meter high wall partition at areas where the toll road is within the close proximity of sensitive areas such as settlements, hospitals and other public facilities and services. Maintain the vegetation growth within the right-of-way of the toll roads as a natural mean to reduce dispersion of dust and gaseous emissions without impairing visibility of the toll road users. Conduct road maintenance through preserving road surface and repairs in a timely and quality manner to prevent dust accumulation.	Conduct a periodic air quality monitoring using the methodology stipulated in the <i>Government Regulation No. 22 Year 2021 – Appendix VII: Ambient Air Quality Standard</i> ; and use the accredited laboratory to collect and analyzed the air samples.	Other mitigation measures are conducted on a weekly or monthly basis as appropriate. Air quality monitoring is conducted quarterly during operational activities.	Community settlement and public areas within the proximity of the toll roads with the following villages: Pijon Tantan Rantau Majo Gerunggung Bukit Baling Suko Awin Jaya Selat Teluk Dusun Mudu. ▪ Toll Road Area between STA 0+000–68+000	The toll road operator	Included in the operation & maintenance budget of the toll road operator.
	Visually monitor the vegetation growth within the right-of-way of the toll roads and cut the vegetation as required as not to impair visibility of the toll road users.	During monitoring, the observed aspects were the growth of tree height and diameter. The average growth of tree height was 2.5 - 8.3 cm per month. The average growth of tree diameter was 0.5 - 1 cm per year.	Monthly Monitoring	▪ Toll Road Area between STA 0+000–68+000	The same as above.	The same as above.
Noise Level						
Increased noise and vibration level due to the operation and maintenance of toll road, and toll road office and rest area operations.	Inspect the integrity of the wall, vegetation, etc., that function as a noise barrier. Maintain sufficient distance between the toll road and nearby settlement or residential areas (Note: this has been included in the DED of the toll road approved by DGH in 2023); and Construct the road elevation below the elevation of surrounding land if appropriate.	The condition of noise barriers such as forts, vegetation and others are in good condition and functioning as they should. Noise conditions in toll road areas do not exceed the quality standards as stipulated in the Ministry of Environment Decree No. 48/1996 on Noise Standards.	Monthly Monitoring Other mitigation measures are conducted on a weekly or monthly basis as appropriate.	Toll Road Area between STA 0+000–68+000 Community settlement and public areas within the proximity of the toll roads with the following villages: Pijon	The same as above.	The same as above.

Anticipated Impacts	Mitigation Measures OPERATION PHASE	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Responsibility	Budget
	Conduct periodic monitoring of ambient noise level for 24-hours sampling as stipulated in the Ministry of Environment Decree No. 48/1996 on Noise Standards. Conduct periodic monitoring of vibration level as stipulated in the Ministry of Environment Decree No. 49/1996 on Vibration Standards. The above monitoring should be conducted using the laboratory accredited by the Indonesian Government.	The same as above.	Air quality monitoring is conducted Quarterly during operational activities.	Tantan Rantau Majo Gerunggung Bukit Baling Suko Awin Jaya Selat Teluk Dusun Mudo.		
	In Rest Area operations, the same mitigation as above is carried out if necessary.			Rest areas (at STA 42+000)		
Terrestrial Biota and Wildlife						
Disruption to terrestrial habitat and wildlife species due to: Toll road traffic; and Toll road office and Rest area operations.	Implement the detailed mitigation measures as defined in the Biodiversity Management Plan (BMP) of Jambi – Rengat Toll Road - Phase 1 Development (Jambi – Sp. Ness to Merlung Segment).	Ensure that there are no accidents or disruptions to terrestrial animal mobilization during toll road operations.	Monthly monitoring	Refer to the BMP mentioned earlier.	The toll road operator	Included in the operation & maintenance budget of the toll road operator.

15.0 ENVIRONMENTAL AND SOCIAL MITIGATION MEASURES AND MONITORING EFFORTS

This section describes the social mitigation and monitoring plan that should be implemented, monitored, and reported on semi-annual basis by the Project throughout the implementation phase, from construction through to the operation phase are presented in the following tables. The social mitigation and monitoring plan is also presented as separate section of the ESIA.

15.1 Preconstruction Phase

Table 124. Social Mitigation and Monitoring Plan – Preconstruction Phase

Key Component/ Anticipated Impact	Mitigation Measure PRECONSTRUCTION PHASE	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/ Monitoring Site	Responsibility	Budget
Economic Displacement and Loss of Livelihoods						
Changes in employment and livelihood of the affected households (AHs) due to land acquisition and construction-related activities of the toll road.	Establish a land acquisition implementation team at the early phase of the project. Involve the AHs and government stakeholders in all consultations related to implementation of the land acquisition and resettlement plan (LARP) and disclosure of project information on a regular basis. Engage an independent, competent appraisal team to conduct an evaluation of compensation value of the lands including crops and assets to be acquired for the project. Design the compensation framework in accordance with Indonesian regulations and AIB's E&S policies as included in the LARP Implement the livelihood restoration program (LRP) set out in the LARP for eligible AHs in coordination with the local government. Establish and inform the AHs, government and other interested stakeholders on the project's grievance redress mechanism (GRM) as a formal way to raise concerns, complaints or feedback related to the project. Regularly communicate employment and business opportunities with the project including their standards and requirements to the AHs and local communities. See LARP for proposed plans related to livelihood restoration programs.	Monitor increases or decreases in employment due to the project, including new sectors that emerge such as trade or services supporting the project. Periodic surveys to monitor changes in prices of basic goods due to increased demand in the local economy. Evaluate whether the economic benefits of the project reach all groups in the community, including vulnerable groups such as the poor or indigenous peoples. Collect data on the number of local businesses that have had to relocate due to the project, including the type of business and the extent of losses. Monitor the impact of the project on community access to key livelihood resources, such as agricultural land, water, or forest products. Monitor the effectiveness of skills training or alternative business development programs provided to affected communities. Ensure that compensation is equitable, covering land, business assets, or other resources lost to the project. Outcomes of skills or entrepreneurship training to ensure participants can secure new jobs or start independent businesses. Periodic reports on the results of monitoring economic and livelihood impacts for evaluation by all stakeholders.	Mitigation measures are implemented during pre-construction phase. Monitoring actions are conducted on a monthly basis and the results are reported on a monthly, quarterly, and semi-annual basis as appropriate	AHs, the community and, wider stakeholders at the following villages: ▪ Pijoan ▪ Tantan ▪ Rantau Majo ▪ Gerunggung ▪ Bukit Baling ▪ Suko Awin Jaya ▪ Selat ▪ Teluk ▪ Dusun Mudu.	BPJN of Jambi Province assisted by the LAIT and Land Commitment Making Officer (PPK Tanah) of DGH/Public Works BPJN Jambi Province assisted by the Construction Supervision Consultants (CSC) is responsible for supervising the civil works including E&S obligations undertaken by the contractors. DGH assisted by the Project Management Consultant (PMC) has the overall accountability on the project implementation including compliance with E&S obligations.	Adequate social mitigation measures and monitoring budget should be included in the bidding documents and civil works contracts awarded.

Key Component/ Anticipated Impact	Mitigation Measure PRECONSTRUCTION PHASE	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/ Monitoring Site	Responsibility	Budget
Vulnerable Groups and Discrimination						
Discrimination against vulnerable groups.	Develop and disclose a grievance redress mechanism (GRM) for local communities. This mechanism will allow communities to formally file, record, and resolve complaints related to issues arising from project activities. Disclosure of information and consultation, related to project activities ranging from land acquisition mechanisms, employment and business opportunities to communities around the project. Involve vulnerable groups to be able to participate in project activities by monitoring the number of vulnerable groups involved and comparing it with the number of vulnerable groups previously identified in the LARP study. Promote equal opportunities and non-discrimination by increasing employment opportunities for the poor, disadvantaged, and people with disabilities. Eliminate potential barriers to employment for vulnerable groups, including women. The Project Information Brochure (PIB) must be distributed using local regional languages and national languages so that it is easily understood by the local community.	Outcomes of skills or entrepreneurship training to ensure participants can secure new jobs or start independent businesses. Track the effectiveness of the grievance redress mechanism (GRM) by measuring the average resolution time and the level of community satisfaction with the solutions provided. Evaluate the disclosure of project information, including the number of consultation sessions conducted and the coverage of communities receiving information related to land acquisition, employment, and business opportunities. Monitor the number of vulnerable groups participating in the project, compare it with the data identified in the LARP study, and ensure their involvement in the various stages of the project. Track the percentage of workers from the poor, underprivileged, and people with disabilities, and ensure equal employment opportunities for them in various fields of work. Evaluate the effectiveness of nondiscrimination policies by identifying barriers faced by vulnerable groups, including women, in accessing employment opportunities and ensuring mitigation measures are implemented. Monitor the distribution of Project Information Brochures (PIBs) in local and national languages and evaluate community understanding of the information provided through surveys and interviews. Evaluate the effectiveness of the implementation of empowerment programs for vulnerable groups, including job skills training and business opportunities for communities around the project. Monitor transparency in the provision of compensation for project-affected communities, including ensuring that compensation is provided in a fair and transparent manner in accordance with identified rights.	Mitigation measures are implemented during pre-construction phase. Monitoring actions are conducted monthly and the results are reported on a monthly, quarterly, and semi-annual basis as appropriate	AHs, the community and, wider stakeholders at the following villages: ▪ Pijoan ▪ Tantan ▪ Rantau Majo ▪ Gerunggung ▪ Bukit Baling ▪ Suko Awin Jaya ▪ Selat ▪ Teluk ▪ Dusun ▪ Mudu.	The same as above.	The same as above.

Key Component/ Anticipated Impact	Mitigation Measure PRECONSTRUCTION PHASE	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/ Monitoring Site	Responsibility	Budget
		Track the effectiveness of grievance mechanisms related to social and environmental issues, including the number of grievances relating to discrimination, rights violations, or environmental impacts of the project.				
Gender						
Discrimination against gender equality in development activities	Give women equal rights to be involved in project planning activities. Ensure women receive open information on the land acquisition process and full recognition of their property rights. Ensure that land acquisition and compensation processes are transparent, and compensation is equal for male and female PAPs, and where applicable, compensation and benefits are provided in the name of the spouse and/or female head of household/widow. Provide easy access for women to utilize toll road projects by providing gender-friendly facilities. Improve project design to promote equal employment opportunities for women and empower them. Ensure female labor is employed at least 10% (including skilled and unskilled positions) of the total workers in civil works on the Sp. Ness-Merlung Toll Road. Ensure women in the project area receive gender equality training to strengthen their understanding and skills.	Monitor the number of women participating in project planning activities, including their contribution and role in decision-making. Track the number of women who receive clear and transparent information on land acquisition and compensation processes. Evaluate the recognition of women's land tenure rights in official documents during the land acquisition process. Monitor transparency and fairness in the provision of compensation to women, including ensuring that compensation is equal for men and women and is provided in the name of the woman's spouse or head of household. Track the percentage of women workers in civilian employment, ensuring the target of at least 10% of the total workforce is achieved, including both skilled and unskilled positions. Monitor the number of training sessions or capacity building programs related to gender equality attended by local women workers and women. Evaluate the effectiveness of the grievance mechanism (GRM) in handling complaints related to discrimination or gender-based violence, including tracking the number of complaints received and resolved.	Mitigation measures are implemented during pre-construction phase. Monitoring actions are conducted monthly and the results are reported on monthly, quarterly, and semi-annual basis as appropriate	AHs, the community and, wider stakeholders at the following villages: ▪ Pijoan ▪ Tantan ▪ Rantau Majo ▪ Gerunggung ▪ Bukit Baling ▪ Suko Awin ▪ Jaya ▪ Selat ▪ Teluk ▪ Dusun ▪ Mudo.	The same as above.	The same as above

15.2 Construction Phase and Operation Phase

The entire mitigation measures and monitoring plan described in the table below shall be implemented by the Client throughout the construction phase of the toll road. The Client is required to implement the mitigation measures and monitoring plan considered relevant for the operation phase of the toll road.

Table 125. Social Mitigation and Monitoring Plan—Construction and Operation Phases

Key Component/ Anticipated Impact	Mitigation Measure	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/Monitoring Site	Responsibility	Budget
LOCAL ECONOMY						
Establishment of employment and business opportunities at local scale.	Publicly announce the recruitment process at village and sub-district offices in the study area. Provide transparent information regarding job opportunities in construction projects. Coordinate and cooperate with local governments to meet labor needs by prioritizing workers from local communities. Prioritize locals according to their skills, education level, experience, and competencies. Promote equal employment opportunities and non-discrimination by increasing employment opportunities for the poor, marginalized, and people with disabilities. Give opportunities and priority to the use of local resources, including small and medium enterprises (SMEs) in the fields of crafts, culinary, traditional medicine, and clothing. Provide promotional facilities to support business activities of local products and brands. Consider rental	Monitor the number of local workers involved in construction projects, including types of jobs, wage rates, and employment status. Evaluate whether employment opportunities are equally available, especially for vulnerable groups such as women, people with disabilities, and the poor. Monitor the number of contracts awarded to local SMEs, including crafts, culinary, transportation, and other support services. Monitor changes in income of local SMEs due to increased economic activity. Monitor the use of local products in the construction or operation of toll road projects. Evaluate the availability and utilization of facilities such as rest areas, kiosks, or economic centers that can be used by local businesses. Monitor the number of training or capacity building programs for local workers and businesses.	Mitigation measures implemented throughout the construction phase. Monitoring conducted monthly and results reported monthly, quarterly, and semi-annually as appropriate.	AHs, the community, and wider stakeholders at the following villages: Pijoan; Tantan; Rantau Majo; Gerunggung; Bukit Baling; Suko Awin Jaya; Selat; Teluk; Dusun Mudu. Local businesses near the project site.	Contractors including their subcontractors are responsible for implementing social mitigation measures and monitoring. BPJN Jambi Province assisted by the Construction Supervision Consultants (CSC) is responsible for supervising civil works including E&S obligations. DGH assisted by the Project Management Consultant (PMC) has overall accountability on project implementation including compliance with E&S obligations.	Costs for community empowerment programs and training: recurring cost, to be included in contractor social management budget. Costs for monitoring and reporting: recurring monthly cost, to be included in contractor E&S monitoring budget. All budget items shall be included in the bidding documents and civil works contracts awarded, and shall cover the whole construction period including any contract variations and/or timeline extensions.

Key Component / Anticipated Impact	Mitigation Measure	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/Monitoring Site	Responsibility	Budget
	rates that are within the means of local entrepreneurs. To optimize the positive impact on employment opportunities and local businesses, design and implement a community empowerment plan comprising the following steps: hold consultations with local businesses to identify development needs and potential; conduct targeted training to increase the community's capacity to provide goods and services required by the Project; and carefully coordinate stakeholder strategies and integrate them into the Project's Stakeholder Engagement Plan (SEP).					
LABOR INFLUX (incl. pressure on local infrastructure, public facilities and services)						
Social jealousy. Violation of social norms by migrant groups.	Recruit labor from local communities first to reduce the need for labor from outside the region. Specify in detail the number and type of workers required to minimize the arrival of excess workers. Consult with the local government to regulate the arrival of workers from outside the region. Avoid uncontrolled recruitment by implementing an organized recruitment system through the main contractor. Provide training to the external	Monitor the recruitment process to ensure that workers are recruited from the local community first, and document the number and type of local workers hired. Monitor the number and type of workers deployed in the field, ensuring that labor demand is in line with planning to avoid excessive labor arrivals. Monitor coordination activities with local governments to ensure that the arrival of non-local workers is properly managed.	Mitigation measures implemented throughout the construction phase. Monitoring conducted monthly and results reported monthly, quarterly, and semi-annually as appropriate.	AHs, the community, and wider stakeholders at the following villages: Pijoan; Tantan; Rantau Majo; Gerunggung; Bukit Baling; Suko Awin Jaya; Selat; Teluk; Dusun Mudu. Project workers.	The same as above.	The same as above.

Key Component / Anticipated Impact	Mitigation Measure	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/Monitoring Site	Responsibility	Budget
	workforce on local customs, culture, and community norms to support social harmony. Monitor interactions between the outside workforce and local communities to prevent conflicts or tensions. Provide adequate health facilities at work camps to reduce the burden on local health services. Coordinate with local security forces to manage potential security disturbances due to labor influx. Ensure that there is no discrimination between local and outside labor in terms of wages, facilities, or employment opportunities. Provide a safe and accessible grievance channel for local communities and workers to report problems or violations. Handle any complaints quickly, fairly, and transparently to maintain trust and harmony between all parties.	Monitor the labor recruitment system to ensure it is transparent and organized. Monitor training programs on local customs, culture, and community norms. Monitor interactions between external workers and local communities. Monitor health facilities in work camps. Monitor equality in wages, facilities, and employment opportunities between local and non-local workers. Monitor the effectiveness of grievance channels provided to local communities and workers.				
VULNERABLE GROUPS AND INDIVIDUALS						
Discrimination against vulnerable groups and individuals.	Develop and disclose a grievance redress mechanism (GRM) for local communities to formally file, record, and resolve complaints related to issues arising from project activities. Disclose information and conduct consultations related to	Monitor outcomes of skills or entrepreneurship training to ensure participants are able to secure new jobs or start independent businesses. Track the effectiveness of the GRM by measuring average resolution time and community satisfaction with solutions provided. Evaluate	Mitigation measures implemented throughout the construction phase. Monitoring conducted monthly and results reported monthly, quarterly, and semi-annually as appropriate.	AHs, the community, and wider stakeholders at the following villages: Pijoan; Tantan; Rantau Majo; Gerunggung; Bukit Baling; Suko Awin Jaya; Selat; Teluk; Dusun Mudu.	The same as above.	The same as above.

Key Component / Anticipated Impact	Mitigation Measure	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/Monitoring Site	Responsibility	Budget
	project activities, covering land acquisition mechanisms, employment, and business opportunities. Involve vulnerable groups in project activities and monitor their participation against the number previously identified in the LARP. Promote equal opportunities and non-discrimination by increasing employment opportunities for the poor, disadvantaged, and people with disabilities. Eliminate potential barriers to employment for vulnerable groups, including women. Distribute the Project Information Brochure (PIB) in local and national languages to ensure it is easily understood by the local community.	information disclosure activities, including the number of consultation sessions conducted and community coverage. Monitor the number of vulnerable groups participating in the project against the LARP data. Track the percentage of workers from poor, underprivileged, and disabled groups and ensure equal employment opportunities. Evaluate non-discrimination policies and identify barriers faced by vulnerable groups, including women. Monitor PIB distribution and evaluate community understanding through surveys and interviews. Evaluate empowerment programs for vulnerable groups including job skills training and business opportunities. Monitor transparency in compensation provision and ensure it is fair and in accordance with identified entitlements. Track the effectiveness of grievance mechanisms relating to discrimination, rights violations, and environmental impacts.				
GENDER						
Discrimination against gender equality in Project	Provide women with equal rights to be involved in project planning activities. Ensure women receive open information on the land acquisition process and full recognition of their	Monitor the number of women participating in project planning activities,	Mitigation measures implemented throughout the construction phase.	AHs, the community, and wider stakeholders at the following villages:	The same as above.	The same as above.

Key Component / Anticipated Impact	Mitigation Measure	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/Monitoring Site	Responsibility	Budget
construction activities.	property rights. Ensure that land acquisition and compensation processes are transparent and that compensation is equal for male and female project-affected persons (PAPs); where applicable, compensation and benefits shall be provided in the name of the spouse and/or female head of household/widow. Provide easy access for women to utilize toll road facilities by providing gender-friendly amenities. Improve project design to promote equal employment opportunities for women and empower them. Ensure female labor comprises at least 10% (including skilled and unskilled positions) of the total workers in civil works on the Sp. Ness-Merlung Toll Road. Ensure women in the project area receive gender equality training to strengthen their understanding and skills.	including their contribution and role in decision-making. Track the number of women receiving clear and transparent information on land acquisition and compensation processes. Evaluate the recognition of women's land tenure rights in official documents during land acquisition. Monitor transparency and fairness in compensation provision to women. Track the percentage of women workers in civil works employment, ensuring the target of at least 10% of total workforce is achieved. Monitor gender equality training sessions attended by local women workers. Evaluate the effectiveness of the GRM in handling complaints related to discrimination or gender-based violence.	Monitoring conducted monthly and results reported monthly, quarterly, and semi-annually as appropriate.	Pijoan; Tantan; Rantau Majo; Gerunggung; Bukit Baling; Suko Awin Jaya; Selat; Teluk; Dusun Mudu.		

GENDER-BASED VIOLENCE

Gender-based violence in Project construction activities.	Adopt a zero-tolerance policy on gender-based violence (GBV) for all parties involved in the project, including workers, management, and contractors. Include anti-GBV clauses in employment contracts with all service providers and contractors. Conduct mandatory training for workers and contractors	Monitor whether the GBV policy has been implemented, with documentation in the work contract and project manual. Monitor attendance of workers and contractors in GBV-related training through attendance lists and training materials. Conduct surveys or interviews to measure the effectiveness of gender	Mitigation measures implemented throughout the construction phase. Monitoring conducted monthly and results reported monthly, quarterly, and semi-annually as appropriate.	AHs, the community, and wider stakeholders at the following villages: Pijoan; Tantan; Rantau Majo; Gerunggung; Bukit Baling; Suko Awin Jaya; Selat; Teluk; Dusun Mudu. Project workers.	The same as above.	The same as above.
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Key Component / Anticipated Impact	Mitigation Measure	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/Monitoring Site	Responsibility	Budget
	on GBV prevention, human rights, and professional conduct. Organize awareness campaigns in the project environment and surrounding communities. Install posters, banners, or other communication materials in basecamps, offices, and rest areas with anti-GBV messages and reporting information. Provide separate accommodation spaces for male and female workers to prevent potential harassment. Enforce curfews and strict rules at basecamps to reduce the potential for GBV incidents. Ensure rest area management involves security officers trained on GBV prevention and response. Ensure rest areas are gender-friendly by providing facilities such as separate toilets and safe breastfeeding rooms. Establish an accessible, safe, and anonymous reporting system for victims or witnesses of GBV. Provide access to health services, psychological counseling, and legal assistance for GBV victims. Work with social agencies or local government to provide temporary protection if needed. Ensure all GBV	awareness campaigns. Monitor the availability of anti-GBV communication materials in strategic locations. Monitor accommodations that separate male and female workers, including safety and comfort assessments. Inspect the quality and accessibility of gender-friendly facilities in project areas. Evaluate the effectiveness of the GRM in handling complaints related to gender-based discrimination or violence, including tracking the number of complaints received and resolved.				

Key Component / Anticipated Impact	Mitigation Measure	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/Monitoring Site	Responsibility	Budget
	reports are followed up promptly and transparently. Enforce strict sanctions on perpetrators, including contract termination or reporting to authorities. Develop and disclose a GRM for local communities to formally file, record, and resolve complaints arising from project activities.					
ACCESS RESTRICTIONS ON LAND USE, NATURAL RESOURCES AND ASSETS						
Project-affected persons and local communities' access to land, natural resources, and assets.	Create temporary access roads for affected communities. Establish a construction schedule that minimizes disruption to community access. Create temporary waterways to maintain water flow. Provide connecting roads and bridges for community access. Provide supporting facilities such as underpasses and overpasses for pedestrians and small vehicles. Green the area around the toll road. Protect sensitive areas such as water sources and forest areas. Provide temporary passage for boats and fishermen during the construction period. Create safety zones around bridge construction areas to protect aquatic activities. Develop and disclose a GRM for local communities to formally file, record, and resolve	Conduct regular monitoring of the condition of temporary access roads to ensure feasibility and safety. Monitor the construction schedule to ensure minimal disruption to community access. Conduct regular inspections of temporary waterways, especially during heavy rainfall, to ensure no blockages occur. Regularly check the condition of connecting roads and bridges. Monitor the use of underpass and overpass facilities and identify areas requiring repair or maintenance. Monitor the effectiveness of the GRM by recording the number and type of complaints received and response times.	Mitigation measures implemented throughout the construction phase. Monitoring conducted monthly and results reported monthly, quarterly, and semi-annually as appropriate.	AHs, the community, and wider stakeholders at the following villages: Pijoan; Tantan; Rantau Majo; Gerunggung; Bukit Baling; Suko Awin Jaya; Selat; Teluk; Dusun Mudo.	The same as above.	The same as above.

Key Component / Anticipated Impact	Mitigation Measure	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/Monitoring Site	Responsibility	Budget
	grievances arising from project activities.					
LABOR AND WORKING CONDITIONS						
Poor and unsafe working conditions prone to incidents.	Ensure workers comply with established regulations through regular discipline monitoring and supervision. Manage and ensure that worker camp facilities meet comfort, health, and safety standards. Develop and implement a transparent recruitment system including clear criteria and fair selection methods. Include relevant labor standards requirements in tender documents. Implement strict safety and security procedures, including OHS training, Lockout/Tagout (LOTO) system, job safety analysis (JSA), and supervision of personal protective equipment (PPE) usage. Conduct strict verification in the recruitment process to ensure no child laborers under the age of 18 or workers engaged in forced labor are employed. Ensure minimum age requirements are clearly stated in tender documents and employment contracts and monitor their implementation. Conduct age verification prior to recruitment and maintain records for staff and	Conduct regular monitoring to ensure workers comply with regulations, including disciplinary checks and internal audits. Monitor the recruitment process to ensure transparency and fairness, including implementation of fair selection methods. Monitor labor standards clauses in tender documents. Monitor safety and security procedures including OHS, LOTO, JSA, and PPE usage. Monitor worker age verification practices. Monitor minimum age requirements in tender documents and employment contracts. Monitor the quality of labor received from key suppliers. Monitor worker welfare management including health facilities, recreational facilities, and work-life balance.	Mitigation measures implemented throughout the construction phase. Monitoring conducted monthly and results reported monthly, quarterly, and semi-annually as appropriate.	Project workers.	The same as above.	The same as above.

Key Component / Anticipated Impact	Mitigation Measure	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/Monitoring Site	Responsibility	Budget
	subcontractors. Include requirements related to key suppliers in tender documents and contracts. Manage workforce welfare by providing health, recreation, and other basic services, and monitor work-life balance with proper OHS training.					
RISK FROM THE USE OF SECURITY PERSONNEL						
Potential conflict and intimidation between local communities and security personnel employed by the Project including its contractors.	Apply security regulations that comply with applicable Indonesian laws and regulations. Limit the actions that can be taken by security personnel to prevention and defense purposes according to the nature and extent of the threat. Instruct security personnel to take reasonable steps to avoid the use of force. Provide appropriate training to security personnel, including a specific code of conduct and knowledge related to the risks of gender-based violence. Hold regular meetings with surrounding communities to discuss security issues and obtain their input. Engage communities in security programs such as community neighborhood watch (<i>siskamling</i>) to participate in surveillance and report suspicious activities. Implement campaigns to raise awareness about the importance of security in the project environment. Cooperate with local security forces to ensure regular patrols and provide support in dealing with security issues. Reinforce perimeter fencing and install warning signs around the project site to prevent unauthorized access.	Monitor security regulations to ensure compliance by all relevant parties. Monitor and evaluate the implementation of restrictive measures by security personnel against the existing threat level. Monitor violence avoidance measures by security personnel. Monitor security personnel training programs. Monitor regular community meetings. Evaluate the effectiveness of security awareness campaigns. Monitor perimeter fencing and warning signs to ensure they are maintained and effective.	Mitigation measures implemented throughout the construction phase. Monitoring conducted monthly and results reported monthly, quarterly, and semi-annually as appropriate.	AHs, the community, and wider stakeholders at the following villages: Pijoan; Tantan; Rantau Majo; Gerunggung; Bukit Baling; Suko Awin Jaya; Selat; Teluk; Dusun Mudu. Project workers.	The same as above.	The same as above.
IMPACT ON CULTURAL RESOURCES AND HERITAGE						
Unexpected discovery of cultural heritage objects.	Immediately stop all construction activities at the discovery site. Secure the discovery area to prevent damage from ongoing project activities. Report the discovery to the relevant	Conduct daily checks by project supervisors to ensure suspension of activities following discovery of unexpected objects. Inspect the installation of fences and warning signs at the	Mitigation measures implemented throughout the construction phase. Monitoring conducted monthly and results reported monthly, quarterly, and semi-annually as appropriate.	AHs, the community, and wider stakeholders at the following villages: Pijoan; Tantan; Rantau Majo; Gerunggung; Bukit Baling; Suko Awin Jaya; Selat; Teluk;	The same as above.	The same as above.

Key Component / Anticipated Impact	Mitigation Measure	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation Area/Monitoring Site	Responsibility	Budget
	authorities, including the Culture Office or the agency responsible for cultural heritage preservation. Provide an initial report including a description of the find, its location, and its physical condition. Invite an archaeologist, historian, or cultural preservation team to conduct an initial assessment. Complete documentation of the find, including photographs, records of location, dimensions, physical condition, and other characteristics. Hand over the find to the authorities or authorized agencies for further management and follow official directions on next steps. Install temporary fences or barriers around the discovery site and provide warning signs. Provide training to project workers on chance find procedures prior to commencement of construction. Re-evaluate the construction plan to ensure project activities do not damage the discovered cultural heritage objects, and adjust the project location or design if recommended by experts and authorities.	discovery site. Monitor the submission of discovery reports to the authorities. Monitor expert assessment results through written reports. Check for complete documentation of the find including photographs and records. Check that clear warning signs are installed at the discovery site. Monitor that training on chance find procedures has been conducted for all workers prior to construction commencement.		Dusun Mudo. Project workers.		

Source: ESIA Team, 2026

16.0 PROJECT IMPLEMENTATION ARRANGEMENT

16.1 Civil Work and Construction Supervision Packages

The implementation of the Project will be organized into civil works, project management consultancy, and construction supervision packages during the pre-construction and construction phases. During the operational phase, BPJT, the toll road operator, and the HSE Officer will be responsible for ensuring the continued implementation of the Project, as well as the ESMP, CESMP, and any subsequent sub-plans. The organization chart of the development of Jambi – Rengat Toll Road Project at Sp. Ness – Merlung, follows the hierarchy shows in Figure 30 and Figure 31.

Figure 30. Organization Structure of Sp. Ness - Merlung Toll Road (Construction)

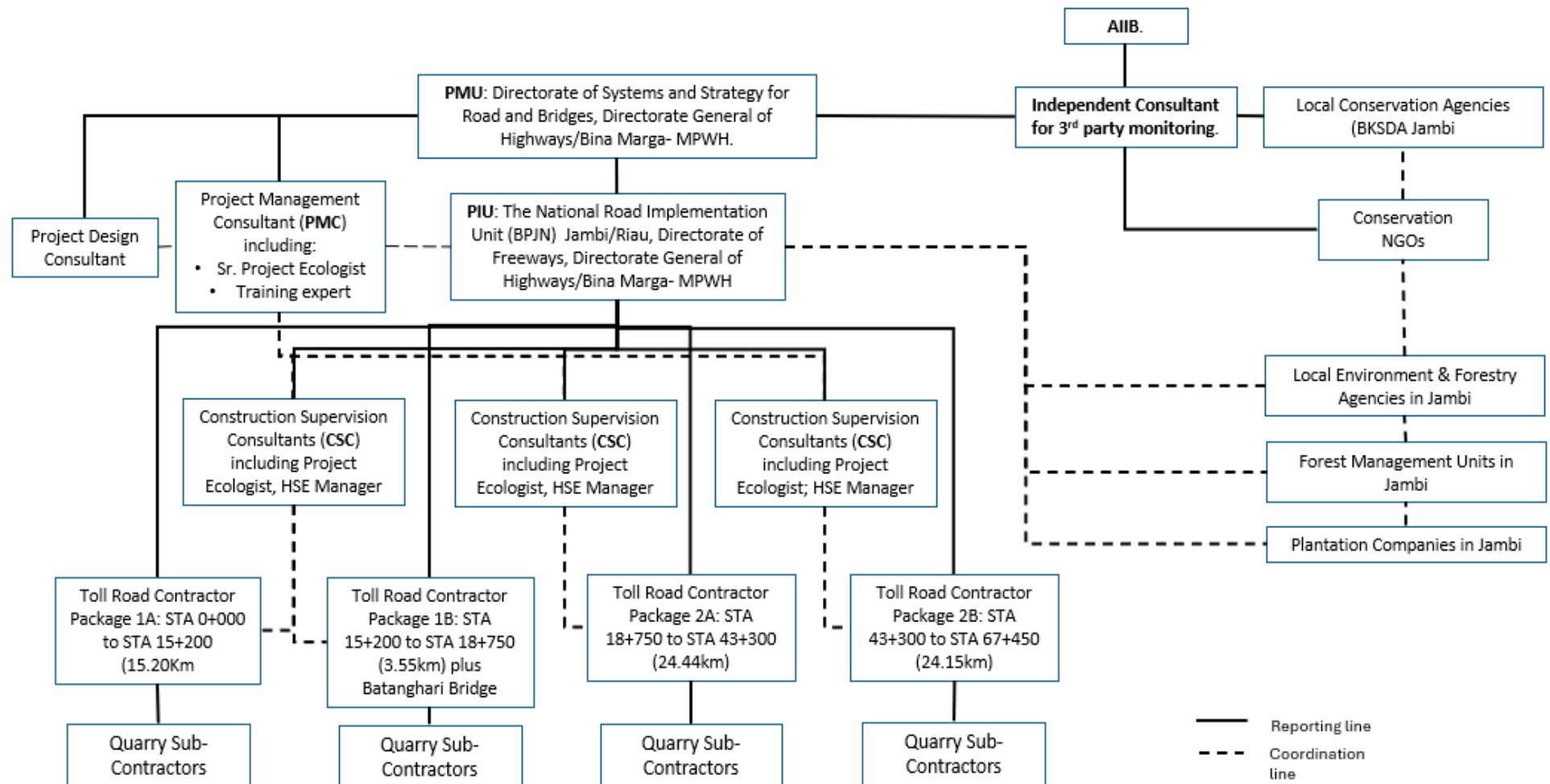
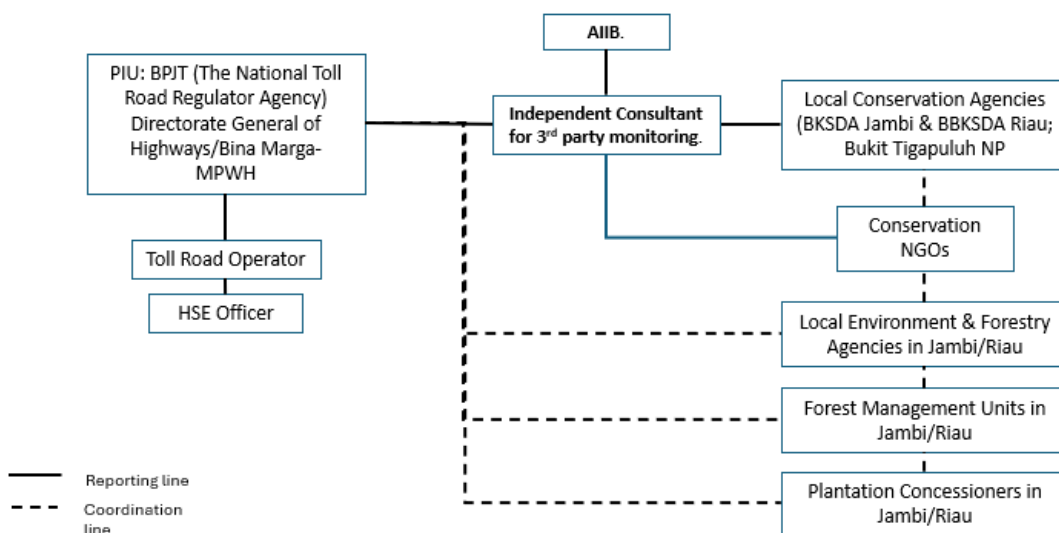


Figure 31. Organization Structure of Sp. Ness - Merlung Toll Road (Operation)



16.2 Institutional Roles and Responsibilities

Table 126. Key Roles and Responsibilities in the Project

Institution / Agency	Key Roles and Responsibilities
The Directorate General of Highways (DGH) of the Ministry of Public Works (MPW) as the Executing Agency (EA)	- Acts as the Implementing Agency through the Directorate of Financing Implementation System and Strategy Development, which oversees project implementation together with the designated commitment-making official. - Monitor key aspects of the Project, including project design, preparation and disclosure of E&S instruments, monitor procurement planning and implementation, and financial management. - Ensures that the Project's E&S requirements, including relevant ESMP provisions, sub-plans, and E&S risk allocation measures, are properly reflected in project outputs and any subsequent documents.
The Directorate of System and Strategy Management for Road and Bridge Delivery (DSSPJJ) of the DGH as the Project Management Unit (PMU) - Central Government Level	DSSPJJ, as the PMU and supported by the PMC, is responsible for overseeing the overall technical, financial, environmental and social (E&S), and administrative aspects of the Project. Its responsibilities include: - Report to DGH regarding the project performance; - Coordinate overall ESMP implementation across the PIU and TIU, consolidate E&S monitoring reports for submission to the Lenders, and ensure adequate budget allocation for ESMP implementation and E&S capacity building; - Assessing the Project's E&S risks and impacts; - Preparing the required E&S documents in accordance with the AIIB ESF, IFC PS 6, and GIIP; - Implementing the E&S obligations under the Legal Agreements governing the Project;

	▪ Incorporating relevant E&S requirements into tender documents and contracts for goods and services required for the Project; ▪ Requiring contractors, in accordance with their contracts, to implement corrective actions for non-compliant items; ▪ Submitting all required E&S assessment, safeguard, and monitoring reports to the Bank in a timely manner; and ▪ Allocating adequate resources, including budget, to develop the capacity required to properly fulfill the E&S obligations under the Legal Agreements.
The Directorate of Freeways (DJBH) of the DGH as the Project Implementation Unit (PIU) - Central Government Level	▪ The PIU will be led by the Director for Freeways (Head of PIU) with his/her authority to be delegated to an appointed PIU Officer in Charge (OIC). ▪ PIU coordination is supported by the PIU Coordinator (Head of the Subdirector of Freeway Technical Planning) and a Secretary for the PIU Coordinator. ▪ The PIU will be supported by the same PMC that will also support the PMU. ▪ Oversee the project components related to design and implementation of technical works and E&S safeguards associated with the Project implementation. ▪ Propose the annual budget required for construction of the Project to PMU. ▪ Include the bidding documents with E&S safeguard requirements as presented in the Project's ESMP and evaluate the bidder's proposal and budget related to this aspect. ▪ Include E&S obligations to be implemented, monitored and reported by the winning bidder in the contract documents. ▪ Administer the engagement of the External Environmental and Social Monitoring Consultant (EESMC) through the commitment-making officials (<i>Pejabat Pembuat Komitmen</i> or PPK) for EESMC established within the PIU
The Highways Implementation Office for Jambi (National Road Implementing Agency – BPJN Jambi) as the Technical Implementation Unit (TIU) - Regional Level	▪ The TIU will be responsible for day-to-day implementation of the Project including implementation, monitoring and reporting on E&S safeguards, land acquisition, and other E&S requirements required by the Indonesian Government. ▪ Implementation at the TIU is organised through the Head of the Freeway Construction Working Unit (<i>Satuan Kerja</i> or <i>Satker</i>) and commitment-making officials (<i>Pejabat Pembuat Komitmen</i> or PPK), comprising the PPK for Civil Works and the PPK for CSC. ▪ The PPK for Civil Works administers the civil works contracts with the Contractors; the PPK for CSC administers the construction supervision contract with the CSC (contractual arrangements per the organizational chart). ▪ Endorse the contractors' construction E&S management plans (CESMP) following review by the CSC. ▪ Coordinate with the PMC, the EESMC and relevant local government agencies on E&S matters during implementation
AIIB and IsDB (Lenders)	The Asian Infrastructure Investment Bank (AIIB) and the Islamic Development Bank (IsDB) will co-finance the Project and maintain direct coordination with DGH as the Executing Agency and Implementing Agency. Their responsibilities include: ▪ reviewing and providing no objection to the Project's key E&S instruments, including the ESIA/ESMP and land acquisition and resettlement instruments, as well as any material changes to those instruments; and

	▪ monitor compliance with the E&S covenants of the Legal Agreements through periodic E&S monitoring reports and implementation support or supervision missions.
Project Management Consultant (PMC)	▪ The PMC will be hired by DGH to support the PMU, and will also support the PIU and the TIU. ▪ The PMC will ensure that the implementation of the Project from technical, financial, E&S, and administrative aspects are according to the Loan Agreement, Project Administration Manual, and other documents considered relevant and applicable to the Project. ▪ Support the preparation and quality assurance of periodic E&S monitoring reports and the tracking of ESMP corrective actions to closure.
External Environmental and Social Monitoring Consultant (EESMC)	▪ The EESMC will be engaged through a contractual arrangement with the PPK for EESMC established within the PIU. ▪ Undertake independent external monitoring and verification of the implementation of the ESMP, land acquisition and resettlement instruments, and other E&S commitments. It will report its findings and recommended corrective actions to the PIU/PMU for onward reporting to the Lenders. ▪ Coordinate with the PMC and relevant local government agencies during monitoring activities.
Construction Supervision Consultant (CSC)	▪ Supervise, evaluate, and report on Project implementation, including the grievance redress mechanism (GRM), to support the TIU. ▪ The CSC team, hired by DGH and contracted through the PPK for CSC within the TIU, will report directly to the TIU (Highways Implementation Office for Jambi). ▪ The CSC will be supervised three construction packages (i.e., 1A, 1B & 2A, and 2B). ▪ Review the contractors' CESMP before TIU approval, and oversee their daily adherence to the approved CESMP and the Project ESMP. ▪ Supervise implementation of CESMP and its subsequent E&S instruments.
Contractors, sub-Contractors, and Vendors	▪ Comply with and implement the E&S requirements including biodiversity enforced by the Project. ▪ The main contractors will be required to develop a construction E&S management plan (CESMP) and submit this plan to Construction Supervision Consultants (CSCs) for review and subsequent endorsement by the TIU at BPJN office. ▪ Sub-contractors and vendors working under the main contractors shall also comply with the provisions of the CESMP and those of the Project's Loan Agreements. ▪ The borrow sites, quarries and concrete batching plants must have valid permits and environmental approvals, as well as free from any disputes.

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16.3 E&S Requirements of the Project

Bidding and Contract Documents. The bidding document outlines the following environmental and social requirement, but not limited to:

- Obligation to prepare, submit, and implement a CESMP approved by the TIU/CSC before construction commences;

- Compliance with all applicable national regulations, AIIB ESP, IFC Performance Standards 6, and World Bank Group EHS Guidelines as referenced in this ESMP
- Appointment of a qualified Environmental and Social (ES) Manager and a Safety and Health (SHE) Manager as full-time dedicated personnel at each construction site package
- Obligation to bear all costs of rectifying non-compliance incidents at the contractor's expense
- Right of TIU to issue stop-work orders for any serious or persistent EHS non-compliance
- Right of TIU to terminate contracts for repeated or material EHS violations
- Obligation to ensure all sub-contractors comply with CESMP requirements; contractors retain full responsibility for sub-contractor EHS performance
- Requirement to report all serious incidents (fatalities, severe injuries, significant environmental incidents, security incidents) to TIU within 24 hours and to AIIB within 48 hours

No construction or mobilization activities shall commence until the CESMP has been reviewed and approved in writing by the TIU Construction Supervision Consultant (CSC), and obtain No Objection Letter from AIIB.

The CESMP shall include, but not limited to the following sub-plans and management practices:

- Air Management Plan (AMP)
- Noise and Vibration Management Plan (NMP)
- Erosion and Sediment Control Plan (ESCP)
- Waste Management Plan (WMP)
- Traffic Management Plan (TMP/RMLLP)
- Hazardous Materials and Spill Response Plan
- Biodiversity and Habitat Protection Plan (aligned with BMP/CHA)
- Labor Management Procedures (LMP)
- Worker Health, Safety, and Welfare Plan (aligned with LMP)
- Community Health and Safety Plan (CHSP)
- Emergency Response Plan (ERP)
- Chance Find Procedures (CFP)
- Worker and Community Grievance Redress Mechanism (GRM) Procedures

All sub-plans and management practices shall contain: clear objectives; specific engineering controls and administrative procedures; assigned responsibilities; key performance indicators; monitoring frequency and methods; and corrective action triggers.

Contractor EHS Management Plan. Prior to construction workers' mobilization, each contractor at every package in Phase I shall prepare and submit a Construction Environmental and Social Management Plan (CESMP) specific to their work package, within the agreed timeline stipulated in their contract award.

Periodic Monitoring and Reporting. The main contractor is required to submit the CESMP monitoring report on a semi-annual basis to the TIU.

Reporting of E&S Incidents or Breaches. In the event of any design changes or unanticipated E&S impacts, the TIU is required to inform the PMU of an amendment that may be required to the E&S safeguard documents and other relevant for the Project.

16.4 Capacity Building and Trainings

The management plan of this project shall be implemented within DGH's Environmental Management System. The management system (to be developed) will provide DGH with the systems and structures to enable implementation of the plan, monitoring, reporting and delegation of roles to third parties.

All those responsible for the management and implementation/operation of any aspect of the ESMP (see Section 8.2) shall be adequately trained for their role. Evidence of training will be maintained on site, for inspection/auditing purposes. DGH will maintain a training schedule, and procedure for keeping records. Records of training attendance and training programs shall be kept and be available for inspection/auditing. The Contractors will also maintain their own training schedule and records.

Table 127 Capacity Building for Construction Phase

Implementer	Training Scope	Purpose / Objective	Training Material	Trainees / Audience	Schedule & Budget
Supervision Engineers	Implementation and Monitoring of ESMP	- The requirements of the ESMP - How to execute the environmental requirements of the project - How to supervise, monitor and audit - How non-compliance with the ESMP will be handled	- Key issues covered in ESMP - The agreed environmental monitoring checklist - The environmental monitoring form - Particular attention will be paid to the specific provisions in each contract's technical specifications indicating how the ESMP is to be complied with Regulation	Environmental Supervision Engineers DGH staff Contractor's Safety and Env. Officer Workers as part of the training	Construction phase The budget allocated in Supervision Engineers' contract
	Health and Safety	- The health and safety requirements mentioned in ESMP - Health issues identified by the Contractors	- Key issues covered in ESMP - The agreed environmental monitoring checklist - The ESHSI monitoring form - Health and safety provisions in each contract's technical specifications	Supervision Engineers DGH staff Contractor's Safety and Env. Officer Workers as part of the training	

Implementer	Training Scope	Purpose / Objective	Training Material	Trainees / Audience	Schedule & Budget
Supervision Engineers	Hazardous Substances Management and Emergency Procedures (must be trained in handling, spill and emergency procedures)	How to handle, implement and monitor the hazardous substances and emergency procedures	- Regulation - Key issues covered in ESMP - General Hazardous Procedures - Hazardous Materials Storage - MSDS Requirement - Emergency procedures - Hazardous and Emergency Regulation	All staff involved in the handling and use of chemicals, fuel and explosives (Contractor, Supervision Engineers, DGH)	
	Concrete and Asphalt Management	How to implement Concrete and Asphalt management in handling, spill, dust, water and emergency procedures	- Key issues covered in ESMP - Emergency procedures - Procedures to handle spill, dust and water	All staff involved in the manufacturing, transport and handling of concrete and asphalt (Contractor, Supervision Engineers, DGH)	
	Sediment Control and Control of Discharges	- To manage the impact of Construction and maintenance - To manage the environmental protection	- Key issues covered in ESMP - The control of discharge and Sediment Control procedures	The officers in charge of construction, maintenance and monitoring (Contractor, Supervision Engineers, DGH)	

Implementer	Training Scope	Purpose / Objective	Training Material	Trainees / Audience	Schedule & Budget
		To monitor discharge			
Contractors	OHS Training and Capacity Training (for each activity that has risk)	To ensure all staff are trained and have suitable skills and experience to avoid and manage risks while carrying out their tasks	In-house materials, task-specific	Workers	Construction phase The budget allocated in Contractors' contract
	Safe Control and Driving of Heavy Road-Construction Vehicles	To ensure safe passage during and after working hours	Procedure of Safe control of road traffic Procedure of driving the heavy road-construction vehicles	- The management of traffic officer - Drivers - Pedestrians in and around the project construction areas	- Construction phase - The budget allocated in Contractors' contract
	Training and Awareness Programs	The safety risks regarding road construction and heavy vehicle operations	- Brochure - Leaflet	The community, including school children	
	Concrete and Asphalt Management	How to implement Concrete and Asphalt management in handling, spill, dust, water and emergency procedures	- Key issues covered in ESMP - Emergency procedures - Procedures to handle spill, dust and water	All staff involved in the manufacturing, transport and handling of concrete and asphalt	
	Hazardous Substances Management and Emergency Procedures (must be trained in handling, spill and emergency procedures)	How to handle, implement and monitor the hazardous substances and emergency procedures	- Key issues covered in ESMP - General Hazardous Procedures - Hazardous Materials Storage - MSDS Requirement - Emergency procedures	All staff involved in the handling and use of chemicals, fuel and explosives	

Implementer	Training Scope	Purpose / Objective	Training Material	Trainees / Audience	Schedule & Budget
			Hazardous and Emergency Regulation		
	Sediment Control and Control of Discharges	- To manage the impact of Construction and maintenance - To manage the environmental protection - To monitor discharge	- Key issues covered in ESMP - The control of discharge and Sediment Control procedures	The officers in charge of construction, maintenance and monitoring	
DGH (By External Specialists: forest ecology, primate ecology, and fish ecology)	Biodiversity Management	How to implement the biodiversity management plan	- Biodiversity Management Plan - Options, strategy of the Plan	DGH Staff	Prior to main Construction implementation The budget provided in ESMP (see Section 8.2)
DGH (By Archaeologists)	Cultural Heritage	How to manage cultural heritage finding and the appropriate protection techniques and procedures for relocation of the documented religious facilities and graves	Procedure of Chance Finding	Officers of Contractor Officers of Supervision Engineer DGH Staff	Prior to main Construction implementation The budget provided in ESMP (see Section 8.2)

Table 128 Capacity Building for Operation Phase

Implementer	Training Scope	Purpose / Objective	Training Material	Audience	Schedule & Budget
All workers	Environmental and Social Management Plan	Understand the Project ESMP, including its sub-plans, to be implemented during operation phase			
DGH • By External specialists (forest ecology, primate ecology, and fish ecology)	Biodiversity Management	Understanding the theory and practicalities of: Reestablishing indigenous habitats in buffer zone areas The protection of buffer zone areas and the reservoirs from occupation, for safety reasons	Theory and practicalities of managing habitats for primates Biodiversity Management Plan	DGH Environmental Unit staff	• Prior to main Construction implementation • The budget provided in ESMP Section 7.2
DGH • By External specialists ○ ecologists and ○ hydrologists)	River Habitat Management	- Understanding the theory and practicalities of: - Ecology and habitat of rivers The habitat changes due to sediment and flow changes downstream - Adaptive management	The methods to monitor habitat condition and change	DGH Environmental Unit staff	

17.0 MONITORING, REPORTING, AND REVIEW ARRANGEMENTS

The DGH Environmental Team will periodically monitor and audit the effectiveness and implementation of the plan whether a document review is required. Audit programs and procedures include the scope, frequency and methods as well as the responsibilities and requirements for conducting audits and reporting results. The frequency of audits reflects the level of significance of environmental impacts and the results of previous audits.

17.1 Construction Phase Monitoring

Table 129 presents the detailed monitoring plan during construction phase specifying what will be monitored, where (station locations), when (frequency), how (methods and equipment), and who (responsible parties) for each key E&S parameter. All monitoring results shall be reported as specified in the reporting framework (Section 14.3) and included in the ESMP compliance reports submitted to TIU and AIIB.

Table 129 Environmental and Social Monitoring Plan (ESMP) – Construction Phase

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Monitoring Cost (IDR)
MON-ENV-01 (ENV-01)	Ambient Air Quality: TSP, PM2.5, PM10, SO2, CO, NO2	TSP: 230 µg/m ³ /24hr (GR 22/2021); PM2.5: 25 µg/m ³ /24hr (IFC EHS 2007); PM10: 50µg/m ³ /24hr (IFC EHS 2007); SO2: 20 µg/m ³ /24hr (IFC EHS 2007); CO: 10,000 µg/m ³ /1hr (GR 22/2021); NO2: 200 µg/m ³ /1hr (IFC EHS 2007). Zero open burning incidents; watering log: minimum 2x/day recorded at each active site.	Station AQ-1: Selat Village (500 m downwind from active construction); Station AQ-2: Dusun Mudo Village (700 m from alignment); Station AQ-3: Taudhotut Tholbin school vicinity; Station AQ-4: Batching plant boundary	High-volume sampler for TSP; gravimetric analysis for PM2.5; electrochemical gas analyzer for SO2, CO, NO2; 24-hour composite samples per SNI 7119.2:2017; laboratory analysis by accredited lab	Quarterly (4x per year during construction); additional sampling if GRM dust complaints received	Sampling: Contractor with accredited environmental lab. Equipment inspection: Contractor daily (dust suppression log)	Results included in Quarterly ESMP Compliance Report submitted to TIU, PIU, and PMU	IDR 650,000,000 (quarterly ambient AQ, 4 stations, 3 yrs)
MON-ENV-02 (ENV-02)	Noise Levels: Leq daytime, Leq nighttime	Residential: 55 dB(A) daytime, 40 dB(A) nighttime; Public/open area: 60 dB(A) daytime (MoE Decree No. 48/1996); IFC EHS: maximum 3 dB(A) incremental nighttime increase above baseline;	Station N-1: Nearest residential area (Point 2, STA 10-20, 120 m from alignment); Station N-2: Taudhotut Tholbin school (900 m); Station N-3: Pijoan community center;	Class 1 precision sound level meter with data logger; 15-minute Leq measurements; calibrated per	Quarterly (4x/year); real-time monitoring during nighttime work (if permitted) and high-noise	Sampling: Contractor; Real-time monitoring: Contractor during critical works. Calibration: instrument owner annually	Quarterly ESMP Compliance Report; immediate notification to TIU/CSC and ES Team	IDR 480,000,000

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Monitoring Cost (IDR)
		pre-activity notification logs maintained for 100% of pile driving events (per ESMP matrix)	Station N-4: Dusun Mudo Village boundary	IEC 61672; assessment per SNI 7231:2009	operations (pile driving)		under contractor if nighttime noise triggers any complaint	
MON-ENV-03 (ENV-03)	Ground vibration: Peak Particle Velocity (PPV) in mm/s	Residential structures: 2 mm/s peak (MoE Decree No. 49/1996); DIN 4150-3:2016 structural integrity criteria (Line 2); stop-work trigger at nearest receptor (STA 0-10): 1.5 mm/s PPV; zero unresolved structural damage complaints beyond 30 days (per ESMP matrix)	Station VIB-1: Point 1 nearest receptor (STA 0-10, 80 m); Station VIB-2: Point 7 nearest receptor (STA 55-60, 100 m); Station VIB-3: Nearest educational facility; on-receiver measurements at property boundary	Triaxial geophone accelerometer; seismograph datalogger; measurements in 3 axes; PPV calculation per ISO 4866:2010; pre-construction structural condition survey documented photographically	Semi-annual ambient PPV monitoring; real-time continuous monitoring during pile driving and heavy earthworks at STA 0-10 and STA 55-60	Pre-construction survey: Contractor. Semi-annual and real-time monitoring: TIU/CSC. Structural damage assessment (if triggered): CSC structural engineer	Pre-construction survey report before each construction package; semi-annual monitoring results in ESMP report; stop-work trigger events reported to TIU within 24 hours	IDR 500,000,000
MON-ENV-04 (ENV-04)	Soil condition: erosion-prone area visual inspection; sediment trap performance ; drainage	Active bare soil area: maximum 50 ha; sediment traps desilted at 50% capacity; revegetation coverage minimum 80% within 90 days of final grade; 100% of stockpile areas covered or seeded within 14 days; check dams in place at maximum 100 m	All active construction packages; focus on STA 0-5 (Pijoan catchment) and STA 15-67 (Batanghari catchment); all sediment traps and drainage channels	Visual inspection using standard inspection checklist; photographic documentation ; sediment trap sediment depth measurement	Monthly formal inspection by CSC; contractor daily visual checks; after every rainfall event exceeding 25	Contractor: daily visual checks, sediment trap maintenance. CSC/TIU: monthly formal inspection and checklist verification; quarterly drone survey	Semi-annually ESMP compliance inspection record; Semi-annually ESMP report	IDR 200,000,000

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Monitoring Cost (IDR)
	channel status; bare-soil extent	intervals on slopes >10% (per ESMP matrix)		using graduated rod; GPS-referenced erosion area mapping; quarterly drone survey for bare-soil extent (per ESMP matrix)	mm/24hr; quarterly drone survey for bare-soil extent			
MON-ENV-05 (ENV-05)	Surface water quality: TSS, Turbidity, pH, BOD5, COD, Oil and Grease, Fecal Coliform	TSS: 100 mg/L (Class III, GR 22/2021); pH: 6-9; BOD5: 6 mg/L; COD: 50 mg/L; Oil and Grease: 1 mg/L; Turbidity: 25 NTU (IFC EHS benchmark); Fecal Coliform: 2,000 MPN/100mL (Class III, GR 22/2021); SRP TSS removal efficiency: minimum 70%; zero uncontrolled fuel spills reaching watercourses (per ESMP matrix)	Station WQ-1: Pijoan River upstream (STA 01+975, 200 m upstream of construction); Station WQ-2: Pijoan River downstream (500 m downstream of construction); Station WQ-3: Batanghari River upstream (STA 16+050, reference point); Station WQ-4: Batanghari River downstream; Station WQ-5: SRP discharge point (Pijoan); Station WQ-6: SRP discharge point (Batanghari)	Grab samples at consistent time (09:00-11:00 local); field measurement of pH and turbidity with portable meter; preserved samples to accredited laboratory; analysis per SNI standards; chain of custody maintained	Water quality sampling at all stations: monthly during active earthworks; quarterly during passive construction; additional triggered sampling after rainfall events exceeding 50 mm/24hr; SRP performance test quarterly.	Sampling: Contractor with accredited laboratory; SRP performance check: Contractor with CSC verification; TIU/CSC oversight	Quarterly ESMP and CESMP report; immediate notification to TIU if TSS exceeds 500 mg/L at downstream station	IDR 1,800,000,000
MON-ENV-HYD-01 (ENV-HYD-01, ENV-	River flow velocity, water level and upstream	Cofferdam blockage ratio: maximum 8-12% of active cross-section, confirmed by hydraulic study before installation (condition	Batanghari River STA 15+818 to STA 17+488: cofferdam cross-sections and 200-500 m upstream (afflux zone);	Automatic water level gauges upstream and downstream of	Daily water level gauge review during active cofferdam	TIU/CSC: daily water level gauge review during active cofferdam operation;	Monthly ESMP and CESMP reports; trigger	ENV-HYD-01 monitoring: IDR 400,000,000; ENV-HYD-02

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Monitoring Cost (IDR)
HYD-02, ENV-12)	afflux at cofferdam structures; flooding/inundation of riparian zones	precedent — zero exceptions); velocity increase: maximum +25% above dry-season baseline; maximum afflux (Δh): +15 cm; suspend works if upstream gauge records >+20 cm above predicted afflux; maximum one pier active in-river at any time; cofferdam removal within 30 days of pier completion (downstream side first; zero exceptions without CSC written approval); zero out-of-bank flooding attributable to cofferdam backwater; 100% of communities in low-lying areas within 500 m upstream notified and documented in SER before in-river works commence	riparian zones and settlements within 500 m upstream; velocity effects attenuate beyond 150 m of cofferdam	cofferdam; hydraulic study review before installation; gauge data compared against predicted afflux; post-removal gauge comparison.	operation; post-removal gauge comparison confirms backwater fully reversed	Contractor (coordinated with TIU): verify community notification in SER before works commence; post-removal gauge comparison	events (>+20 cm) and work suspensions reported to TIU immediately	monitoring: IDR 150,000,000
MON-ENV-HYD-02 (ENV-HYD-03, ENV-HYD-04, ENV-12)	Riverbed bathymetry; local scour at cofferdam and pier perimeter; downstream bed deposition;	Maximum scour depth: 2.0-3.5 m at cofferdam perimeter (per site-specific hydraulic study estimates); stop-work trigger: observed scour $\geq 80\%$ of predicted maximum — works halted and structural engineer consulted (zero exceptions);	Immediate perimeter (within 5 m) of all cofferdam structures and permanent in-river pier foundations, Batanghari River STA 15+818 to STA 17+488; deposition zone 100-300 m downstream;	Bathymetric survey by qualified hydrographer; scour trend analysis against predicted maxima; survey records	Weekly bathymetric surveys during active cofferdam operation; monthly downstream bathymetric	Contractor + qualified hydrographer: bathymetric surveys; TIU/CSC structural engineer: weekly scour trend analysis and stop-	Weekly survey records to TIU/CSC within 48 hours; post-construction survey report	ENV-HYD-03 monitoring: IDR 350,000,000; ENV-HYD-04 monitoring: IDR 200,000,000

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Monitoring Cost (IDR)
	scour trend analysis	permanent scour protection installed at all in-river piers before cofferdam removal (condition precedent to removal); bed deposition: maximum 5-15 cm at 100-300 m downstream during active boring; post-construction bathymetric survey (within 3 months of first wet season) confirms scour stabilization and natural redistribution of deposited sediment	settling plume attenuates beyond 2.5 km downstream	submitted to TIU/CSC within 48 hours of each survey	surveys during active boring phase; post-construction survey within 3 months of first wet season	work decision authority	submitted to TIU and AIIB within 60 days of survey; monthly ESMP and CESMP reports	
MON-ENV-HYD-03 (ENV-HYD-05, ENV-12; cross-ref ENV-05)	In-river TSS and turbidity during boring and cofferdam dewatering; dewatering discharge quality	TSS: 100 mg/L Class III (GR 22/2021) at 500 m downstream station (exceedance within immediate 200 m zone permissible during active boring with documented adaptive management); adaptive management trigger: TSS at 500 m downstream >200 mg/L for 2 consecutive daily readings → boring suspended for minimum 24 hours, corrective action to TIU within 48 hours; dewatering discharge TSS: maximum 200 mg/L after	200 m and 500 m downstream of STA 15+818 (daily stations); 1 km and 2 km downstream (weekly plume-dispersion stations); cofferdam dewatering discharge points	Grab samples; field turbidity meter; TSS analysis by accredited laboratory; chain of custody per MON-ENV-05 protocols	Daily TSS sampling at 200 m and 500 m downstream during active boring phases; weekly sampling at 1 km and 2 km to confirm plume dispersion within 2.5 km; trigger decisions within 24 hours of exceedance	Contractor + accredited laboratory: daily/weekly sampling and trigger decisions; TIU/CSC oversight	Daily results log; exceedances and boring suspensions reported to TIU within 24 hours with corrective action within 48 hours; monthly ESMP and CESMP reports	Included in ENV-HYD-05 management and monitoring budget (total IDR 450 million incl. mitigation)

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Monitoring Cost (IDR)
		settlement tank/geotextile bag treatment before release to river; turbidity plume confirmed to settle within 2.5 km downstream						
MON-ENV-06 (ENV-07, ENV-HAB-01, ENV-HAB-02)	Terrestrial biodiversity: presence/absence of protected species; BMP implementation status; vegetation clearing compliance; IAS establishment; riparian replanting performance; CBS installation status	Zero poaching incidents; zero clearing outside approved ROW (independent ecologist review required for any exceedance); BMP submitted and approved before land clearing commences; 100% relevant BMP implemented	Bi-annual biodiversity surveys: systematic transects across 5 km buffer of alignment; focus on Critical Habitat areas at Pijoan (STA 01+975) and Batanghari (STA 16+050) crossings; camera traps at STA 0-20 and STA 50-67; quarry areas; entire 67.45 km alignment buffer	Refer to BMP (Annex 1)	Bi-annual surveys (once wet season, once dry season); monthly exclusion fencing inspection; nocturnal mammal survey annually; camera trap data download and review monthly; quarterly drone survey; quarterly BMP implementation monitoring	Bi-annual surveys: TIU/CSC; Monthly patrols: Contractor environmental officer with BKSDA coordination. Camera trap review: BKSDA Jambi/TIU monthly. Quarterly BMP implementation monitoring: TIU/EESMC	Refer to BMP	IDR 2,200,000,000
MON-ENV-07 (ENV-08 — haul-route traffic)	Haul route road condition; CTMP compliance; traffic	Zero overloaded vehicles on public roads (axle load limits enforced per road class); CTMP submitted and approved before mobilization commences;	National road: Merlung to Tanjung Jabung Barat Regency border; Simpang Tuan to Jambi City border; all	Road condition survey (visual and photographic documentation); CTMP	Monthly haul route road condition inspection; monthly CTMP compliance	TIU/CSC: monthly inspections, CTMP compliance audit and incident log review; Contractor:	Monthly inspection records in Monthly ESMP report;	IDR 200,000,000

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Monitoring Cost (IDR)
	incidents involving project vehicles; axle load compliance	road damage repaired within 60 days of identification; zero traffic fatalities involving project vehicles on public roads (per ESMP matrix)	designated provincial and local haul routes	compliance audit checklist; incident log review; axle load spot checks	audit and incident log review	incident logging and road repairs	quarterly ESMP report; traffic fatalities or serious incidents reported to TIU within 24 hours	
MON-ENV-08 (ENV-08 — basecamp wastewater / fecal coliform)	Fecal Coliform in receiving rivers downstream of basecamp discharges; basecamp wastewater treatment (STP) performance	FC: 2,000 MPN/100mL Class III (GR 22/2021) at river monitoring stations; basecamp final effluent FC <2,000 MPN/100mL (after constructed wetland polishing); STP performance: no visible overflow or bypass of treatment system; zero direct discharge of untreated sewage to surface water (per ESMP matrix)	Pijoan River 500 m downstream of STA 01+975; Batanghari River 1 km downstream of STA 16+050; basecamp STP outlets (main contractor base camp ~2,000 m from Batanghari River); remote work-site sanitation facilities	Grab samples analysed by accredited laboratory (FC per SNI methods); STP performance inspection using standard checklist	Quarterly FC monitoring at both river stations; quarterly STP performance inspection; monthly during wet season (per ESMP matrix)	Contractor + accredited laboratory	Quarterly ESMP Compliance Report; STP overflow or bypass reported to TIU within 24 hours	IDR 400,000,000
MON-ENV-09 (ENV-09)	Solid waste management: waste volumes by category; manifest records; storage compliance;	Spoil disposal sites operational before cut operations commence on each segment (condition precedent, confirmed in writing by TIU/CSC); maximum 24-hour on-site organic waste retention at each work site and base	All base camps and major construction sites along STA 0+000 to 67+450; 892.49 ha earthworks footprint; engineered spoil disposal sites; floodplain-adjacent	Waste audit (volumes by category, manifest records, storage compliance checklist); informal	Quarterly waste audit at all base camps and major construction sites; weekly informal dumping spot check; spoil-	CSC/TIU: quarterly audits, weekly spot checks, spoil-site verification; Contractor: waste records and manifests	Quarterly waste audit findings in Quarterly ESMP report; informal dumping incidents	150,000,000

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Monitoring Cost (IDR)
	informal dumping; spoil disposal site status	camp; elevated storage platforms minimum 0.5 m above flood level at ALL floodplain-adjacent sites; zero informal dumping incidents into drainage channels, rivers, or low-lying land; secondary licensed facility identified and contracted within 50 km before each wet season; zero open burning incidents (per ESMP matrix)	storage areas; bridge crossing zones	dumping spot check; written verification of spoil-site operational status	site verification before cut operations commence on each segment		reported to TIU within 48 hours	
MON-ENV-10 (ENV-10)	Hazardous (B3) waste: banded storage condition; oil-water separator function; manifest compliance; on-site storage duration; equipment leaks; spill kit availability	B3 storage areas: banded, waterproof floor, drainage to oil-water separator — verified operational before equipment mobilisation; B3 on-site storage duration maximum 180 days (Gol PP No. 101/2014); manifest records 100% complete for all B3 transport events; vehicle/equipment leaks repaired immediately — zero leaking equipment in active service; spill response equipment present at all sites and replenished after each use (per ESMP matrix)	Equipment maintenance yards and B3 storage areas at all contractor base camps along STA 0+000 to 67+450; Batanghari River floodplain sections (elevation 5-20 masl, highest surface runoff risk)	Banded storage and oil-water separator inspection checklist; B3 manifest reconciliation; equipment leak checks; spill kit inventory	Semi-annual inspection of banded storage areas and oil-water separator functionality; semi-annual B3 manifest compliance review	TIU/CSC: inspections and manifest review; Contractor: B3 records, storage maintenance, immediate leak repairs	Semi-annual inspection and manifest review records in ESMP reports; spills reported to TIU within 24 hours	150,000,000
MON-ENV-11	Surface water	Total construction abstraction: approximately	PiJoan River abstraction point near STA 01+975;	Abstraction meter readings	Daily abstraction	Contractor: daily abstraction logs;	Semi-annual review	IDR 100,000,000

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Monitoring Cost (IDR)
(ENV-11 — surface water abstraction)	abstraction volumes; river flow at abstraction points	171.4 m ³ /day (~0.002 m ³ /s; <0.01% of available combined river discharge); valid water use permits maintained; abstraction meters operational; daily abstraction logs maintained	Batanghari River abstraction point near STA 16+050; base camps and batching plants along alignment	with daily logbook entry; visual river flow observation at abstraction points	logging (Contractor); semi-annual abstraction log review; semi-annual river flow observation (per ESMP matrix)	TIU/CSC: semi-annual log review and river flow observation	findings in ESMP reports	
MON-ENV-12 (ENV-11 — groundwater)	Groundwater level and quality at monitoring wells; dewatering effects on local water table and community wells	Groundwater level: trigger review if decline >0.5 m below pre-construction baseline over any 3-month period; GoI PP 22/2021 Class II groundwater quality standards at monitoring wells; GMP submitted and approved before earthworks; minimum 3 monitoring wells installed with baseline data established (per ESMP matrix)	Minimum 3 monitoring wells across 892.49 ha project footprint; aquifer zones in Batanghari and Pijoan watersheds; nearest community groundwater wells along alignment	Hydrogeological investigation and monitoring well installation before construction; dip meter level measurement; grab samples analysed by accredited laboratory per SNI standards	Quarterly groundwater level and quality monitoring at 3 wells	Contractor + accredited laboratory: quarterly monitoring; TIU/CSC: GMP approval and monitoring oversight	Quarterly results in Quarterly ESMP Compliance Report; trigger events reported to TIU within 14 days	IDR 600,000,000
MON-SOC-01 (SOC-01)	Occupational Health and Safety (OHS): TRIR, LTIFR, near-miss frequency, fatalities; worker	TRIR: target <3.5/200,000 person-hours; LTIFR: target <1.0/1,000,000 person-hours; zero fatalities; payroll compliance: 100%; PPE usage: 100% on site	All construction sites, base camps, quarries, and batching plants	Monthly OHS statistics report from contractor; random PPE spot checks; payroll spot audit; worker welfare	Monthly OHS statistics; weekly PPE spot check; quarterly payroll audit; semi-annual worker welfare survey	Contractor: monthly OHS report, PPE provision. CSC/TIU: quarterly payroll audit and welfare inspection, contract	Monthly OHS statistics in Monthly ESMP report; serious incidents reported to	IDR 500,000,000

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Monitoring Cost (IDR)
	welfare: wages, hours, PPE compliance			inspection using standard checklist; confidential worker interviews		compliance review	TIU within 24 hours and to AIIB within 72 hours; quarterly labor compliance status	
MON-SOC-02 (SOC-02 to SOC-06)	Social monitoring: GRM status; GBV complaints; community perception; access disruption; security incidents	GRM complaints resolved within 30 days (access: 14 days); GBV complaints: zero unresolved; community satisfaction: tracked trend; security incidents: zero excessive force	All project-affected communities in 3 regencies; GRM register maintained at TIU office and contractor site offices	GRM log review; quarterly community consultation meetings; semi-annual community perception survey (stratified sample minimum 50 households per affected village); key informant interviews	Monthly GRM log review; quarterly community consultation; semi-annual community perception survey	Contractor: maintain worker GRM and camp community liaison. TIU: community GRM, consultation. TIU/CSC: GBV monitoring and coordination with support services	Monthly GRM status in Monthly ESMP report; semi-annual community survey results in Semi-Annual ESMP Audit Report	IDR 600,000,000

Monitoring instruments shall be calibrated seismographs or vibration meters meeting the requirements of ISO 4866:2010. Monitoring results shall be reported monthly to the Project's Environmental and Social Management Team and shall be included in semi-annual ESMP compliance reports submitted to AIIB.

17.2 Operation Phase Monitoring

Table 130 demonstrates a detailed environmental and social monitoring during operation phase. All monitoring results shall be reported as specified in the reporting framework (Section 14.3) and included in the ESMP compliance reports submitted to the TIU.

Table 130 Environmental and Social Monitoring Plan – Operation Phase

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Cost (IDR)
MON-OP-01 (ENV-AQ-OP-01)	Ambient Air Quality: SO ₂ , NO ₂ , PM _{2.5} , PM ₁₀ , TSP, CO at sensitive receptor locations along toll road alignment	SO ₂ : ≤20 µg/m ³ /24hr; NO ₂ : ≤200 µg/m ³ /1hr; PM _{2.5} : ≤25 µg/m ³ /24hr; PM ₁₀ : ≤50 µg/m ³ /24hr; TSP: ≤230 µg/m ³ /24hr (IFC General EHS Guidelines); and CO µg/m ³ /8hr Wall partition: structurally intact and maintained per annual inspection. ETC operational at all toll gates before operations commence.	Station AQ-OP-1: Dusun Mudo Village (STA 60+000) - primary exceedance location; Station AQ-OP-2: Pijoan Village (STA 0+000); Station AQ-OP-3: nearest community settlement along alignment; Station AQ-OP-4: downwind of Merlung toll gate (STA 67+100)	High-volume sampler for TSP; gravimetric analysis for PM _{2.5} ; electrochemical gas analyser for SO ₂ , CO, NO ₂ ; 24-hour composite samples per SNI 7119.2:2017; analysis by accredited laboratory. Annual wall partition inspection by qualified engineer.	Bi-annual (twice per year: dry season and wet season); annual wall partition structural inspection; additional triggered sampling if GRM air quality complaints received	Sampling: Toll Road Operator with accredited environmental laboratory. Wall partition inspection: Toll Road Operator (qualified structural engineer). PIU: receiving and checking annual air quality compliance review from toll road operator.	Bi-annual results included in Annual Environmental and Social Report submitted to toll road operator and MoPW; exceedance events reported to Toll Road Operator and MoPW within 14 days; report to KLHK and Bapedalda Jambi Province annually	IDR 300,000,000 (bi-annual AQ monitoring, 4 stations, accredited lab analysis, annual wall partition inspection, 5 years)

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Cost (IDR)
MON-OP-02 (ENV-O-02)	Noise levels: Leq daytime and Leq nighttime at residential areas and wildlife habitats along alignment; nocturnal mammal presence/absence monitoring for noise-sensitive protected species	Residential: 55 dB(A) daytime; 45 dB(A) nighttime (MoE Decree No. 48/1996); IFC EHS: maximum 3 dB(A) incremental nighttime increase above baseline. Wildlife-sensitive lighting: zero lateral spillage into habitat beyond 50 m ROW boundary. Barrier walls: 100% structurally intact per semi-annual inspection.	Station N-OP-1: Nearest residential area within 250 m of alignment (STA 10-20); Station N-OP-2: Dusun Mudo Village boundary (STA 60+000); Station N-OP-3: wildlife habitat transect at STA 0-20; Station N-OP-4: wildlife habitat transect at STA 50-67	Class 1 precision sound level meter with data logger; 15-minute Leq measurements; calibrated per IEC 61672; assessment per SNI 7231:2009. Nocturnal mammal survey: acoustic monitoring devices and spotlight transects for slow loris, leopard cat, and flat-headed cat.	Bi-annual noise monitoring coinciding with air quality monitoring (dry and wet season); annual nocturnal mammal survey; semi-annual barrier wall structural inspection	Noise monitoring: Toll Road Operator with PIU oversight Nocturnal mammal survey: Toll road operator coordinated with BKSDA Jambi. Barrier inspection: Toll Road Operator (structural engineer).	Bi-annual noise results included in Annual Environmental and Social Report to Toll Road Operator and MoPW ; nocturnal mammal survey report to toll road operator and BKSDA Jambi annually; barrier inspection record maintained by Toll Road Operator	Included in MON-OP-01 budget for bi-annual monitoring; additional IDR 200,000,000 for annual nocturnal mammal surveys and semi-annual barrier inspections (5 years)
MON-OP-03 (ENV-O-03)	Groundwater level and quality at toll gate offices and rest area; daily abstraction volume against maximum cap;	Combined daily project abstraction: maximum 0.438 L/s (metered and logged). Community	GW-OP-1: Abstraction point at rest area, STA 42+000; GW-OP-2: Abstraction	Calibrated water meters at all abstraction points; daily manual reading and logbook entry.	Daily abstraction volume logging; monthly compliance review by Toll Road Operator.	Daily logging and monthly review: Toll Road Operator. Bi-monthly/quarterly community level monitoring: Toll	Monthly abstraction logs reported to PIU; trigger events (community water level	IDR 400,000,000 (water meters installation, bi-monthly community GW level,

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Cost (IDR)
	community groundwater level at 519 AH settlement (if PDAM connection not established)	groundwater level trigger: decline of more than 1.5 m over any 6-month period requires curtailment within 14 days. Gol PP 22/2021 Class II groundwater quality standards. PDAM feasibility study submitted at least 6 months before operations commence; OWSCP updated annually (per ESMP matrix).	point at Cinto Kenang toll gate, STA 18+305; GW-OP-3: Abstraction point at Merlung toll gate, STA 67+100; GW-OP-4: Community observation well adjacent to 519 AH settlement (if PDAM not feasible)	Community observation well: manual dip meter measurement (water table depth). Groundwater quality: grab samples analysed by accredited laboratory per SNI standards (pH, TDS, heavy metals, coliform, nitrate).	Community groundwater level: bi-monthly for first 2 years of operation, then quarterly thereafter. Groundwater quality: quarterly sampling at project abstraction wells; semi-annual at community observation well.	Road Operator with PIU oversight. Quarterly groundwater quality sampling: Toll Road Operator with accredited laboratory. PIU: oversight of trigger event response	decline) reported to PIU within 14 days; quarterly groundwater quality results included in Quarterly ESMP Compliance Report to PIU and AIIB; annual summary in Annual Environmental and Social Report	quarterly GW quality at 3 wells, accredited lab analysis, community observation well installation, 3 years)
MON-OP-04 (ENV-O-04)	STP effluent quality (wastewater treatment performance); solid waste disposal records; underground fuel tank leak	STP effluent: BOD5 less than 30 mg/L; TSS less than 80 mg/L; FC less than 2,000 MPN/100mL (GR 22/2021 Class III discharge	WQ-OP-1: STP effluent discharge point, rest area STA 42+000; WQ-OP-2: STP effluent discharge point, Cinto	STP effluent: grab samples analysed by accredited laboratory for BOD5, TSS, FC, pH, COD, Oil and Grease. Fuel tank: electronic	Toll Road Operator: Monthly STP effluent monitoring, quarterly STP performance inspection, and quarterly fuel	Monthly STP sampling: Toll Road Operator with accredited laboratory. Quarterly STP performance inspection: Toll Road Operator.	Monthly STP results maintained in Operational EHS Log; quarterly inspection report to Toll Road Operator;	IDR 200,000,000 (monthly STP effluent monitoring at 3 facilities, semi-annual receiving water quality

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Cost (IDR)
	detection status; surface water quality at receiving water bodies downstream of rest area and toll gate drainage outlets	standard). Zero untreated wastewater overflow from STP. Solid waste: 100% disposed at licensed facility with monthly records. Zero undetected fuel tank leakage beyond quarterly inspection cycle. Double-wall underground fuel tanks per Gol standards.	Kenang toll gate STA 18+305; WQ-OP-3: STP effluent discharge point, Merlung toll gate STA 67+100; WQ-OP-4: receiving water body (nearest drainage channel or river tributary) 500 m downstream of rest area drainage outlet	leak detection system with quarterly manual inspection log. Solid waste: monthly waste manifest review by Toll Road Operator. Receiving water quality: grab samples for TSS, BOD5, FC, pH per SNI standards.	tank leak inspection, monthly solid waste manifest review; semi-annual receiving water quality sampling downstream of drainage outlets; semi-annual B3 waste manifest audit	Fuel tank inspection: Toll Road Operator (certified technician). Solid waste records: Toll Road Operator. Receiving water quality: Toll Road Operator with accredited laboratory; MoPW and Toll Road Operator oversight	semi-annual B3 manifest audit submitted to MoPW; annual summary in Annual Environmental and Social Report; STP failure or fuel leak reported to PIU within 24 hours	at 1 station, fuel tank leak detection system, accredited lab analysis, 3 years)
MON-OP-05 (ENV-O-05)	Operation phase biodiversity monitoring: presence/absence of protected species along ROW; IAS establishment and spread; wildlife mortality incidents (road kills); BMP operation phase	IAS: zero establishment along ROW — quarterly inspection with semi-annual consolidated IAS inspection report. Wildlife mortality: zero unreported incidents; all	BIO-OP-1: Wildlife corridor transect zone STA 0-20 (priority primate and felid habitat); BIO-OP-2: Wildlife corridor transect zone STA 50-67 (Sumatran tiger	Annual biodiversity surveys: transect counts and point counts for birds and mammals; camera trap deployment along alignment; IAS identification checklist per BMP (YAPEKA,	Annual biodiversity monitoring survey (once per year per BMP 2024 program); quarterly IAS inspection along ROW; daily fire risk visual check in	Annual biodiversity survey: Toll Road Operator Ecologist with BKSDA Jambi coordination. IAS inspection: Toll Road Operator environmental officer. Fire monitoring: Toll	Annual biodiversity monitoring report to Toll Road Operator, MoPW, and BKSDA Jambi; IAS inspection reports to PIU (semi-annual consolidated); wildlife	IDR 900,000,000 (annual biodiversity monitoring surveys, semi-annual IAS inspection reporting, camera trap maintenance,

ID / Impact Ref	Monitoring Parameter	KPI and Compliance Standard	Monitoring Location / Station	Method and Equipment	Frequency	Responsible Party (PIC)	Reporting Destination	Indicative Cost (IDR)
	implementation status; fire events along peatland-adjacent sections	events reported to BKSDA within 24 hours. Fire response resources: 3 mobile water tankers available along alignment at all times. BMP operation phase measures: 100% implementation per annual review schedule. Zero lateral light spillage from ROW lighting into habitat beyond 50 m boundary.	range overlap); BIO-OP-3: Peatland-adjacent sections for fire risk monitoring; BIO-OP-4: Power line corridor sections for arboreal mammal electrocution risk; IAS inspection along entire 67.45 km ROW	2024). Wildlife mortality: incident report form submitted to BKSDA within 24 hours of discovery. Fire monitoring: daily visual check by toll road maintenance crew; incident log. Lighting: semi-annual illuminance measurement at ROW boundary.	peatland sections (logged); immediate reporting of wildlife mortality to BKSDA within 24 hours; semi-annual lighting compliance check; annual BMP implementation review	Road Operator maintenance crew. Wildlife mortality reporting: Toll Road Operator to BKSDA Jambi. BMP annual review: PIU with ESMC and BKSDA Jambi	mortality incidents to BKSDA within 24 hours and to PIU within 48 hours; fire incidents to PIU within 24 hours; annual BMP implementation review included in Annual Environmental and Social Report	BKSDA coordination, annual BMP review, 5 years)

17.3 Reporting

This chapter sets out the reporting arrangements for ESF compliance and the indicative ESMP budget supporting implementation across the project lifecycle. Reporting obligations span PIU, PMU, AIIB, and the local government. Reports to PIU, PMU and AIIB include the quarterly E&S performance report covering ESMP implementation status, GRM register summary, monitoring results, and forward-looking risk assessment, plus the annual ESF compliance report and ad-hoc reports for incidents, material changes, or as requested by AIIB. In addition, the Project TIU should submit environmental and social monitoring implementation report to local authorities, including monitoring of cultural heritage especially during construction phase.

Table 131 Reporting Period – Construction and Operation Phases

Report Type	Content Requirements	Frequency	Prepared By	Submitted To
Daily EHS Log – Construction Phase	- Active construction areas and key activities - Incidents and near-misses - Workforce counts - Mitigation measure implementation (dust watering, noise barriers, PPE)	Daily	Contractor EHS Officer	CSC ES Specialist (filed; reviewed weekly)
Weekly Toolbox Report – Construction Phase	- Safety topic discussed - Attendance record - Outstanding issues and actions	Weekly	Contractor Site Safety Officer	CSC ES Specialist
Monthly ESMP Compliance Report – Construction Phase	- OHS statistics (TRIR, LTIFR, incidents) - Mitigation measure implementation status (by impact category) - Ambient monitoring results (air, noise, vibration, water) - GRM status (new, resolved, pending) - Non-conformances and corrective action status - Workforce statistics (total, local, female) - Progress photo log	Monthly (by 15th of following month)	CSC ES Specialist with Contractor input	TIU ESMU
Monthly Toll Road Operator’s Operational EHS Log – Operation Phase	- Daily water abstraction volumes at toll gates and rest area; - STP effluent readings; - Waste disposal manifests; - Fuel tank inspection status; - IAS inspection findings (quarterly); - Road maintenance defects identified and corrective action taken; - GRM entries (new, resolved, pending);	Continuous (Operational EHS Log maintained daily) during operation phase; reviewed monthly by TIU ESMU.	Toll Road Operator EHS Officer (Operational EHS Log); TIU ESMU (monthly review).	TIU ESMU

Report Type	Content Requirements	Frequency	Prepared By	Submitted To
	- Wildlife mortality incidents reported to BKSDA; and - Any environmental or safety incidents with response actions taken. - The Operational EHS Log shall be retained on site and made available to TIU upon request.			
Quarterly Compliance Report – Construction Phase	ESMP - Summary of monthly reports with trend analysis - Quarterly monitoring data analysis and comparison with KPIs/standards - Key issues and systemic non-conformances - Corrective action plan status - AIIB safeguard compliance status - Cumulative monitoring data tables and graphs	Quarterly (within 45 days of quarter end)	TIU/CSC ESMU	TIU, PIU, and PMU
Quarterly Compliance Report – Operation Phase	ESMP The Quarterly ESMP Compliance Report shall include as a minimum: - bi-annual ambient air quality monitoring results for MON-OP-01 (SO2, NO2, PM2.5, PM10, TSP, CO at Dusun Mudo and 3 additional stations); - bi-annual noise monitoring results for MON-OP-02; - groundwater abstraction compliance review versus 0.438 L/s cap (MON-OP-03); - community groundwater level trend versus 1.5 m trigger (MON-OP-03); - STP effluent performance summary for MON-OP-04; - IAS quarterly inspection results for MON-OP-05; - GRM status (new, resolved, pending); - any environmental or safety incidents and corrective action status; - AIIB ESF operation phase compliance status; and - forward-looking risk assessment for the following quarter. Monitoring results are to be compared against KPIs and compliance standards defined in the ESMP matrix (Table 123) and Table 130.	Quarterly (within 45 days of quarter end)	Toll Road Operator (monitoring data and Operational EHS Log summary).	PIU and PMU
Semi-Annual Report – Construction Phase	ESMP Audit - Independent audit findings and compliance rating - Corrective action plan with assigned responsibilities and timelines - Community perception survey results	Semi-Annual (June and December) – (within	Independent ESMP Auditor	TIU, PIU, PMU, and AIIB

Report Type	Content Requirements	Frequency	Prepared By	Submitted To
	GRM cumulative performance analysis	45 days of semi-annual end)		
Semi-Annual ESMP Audit Report – Operation Phase	The Semi-Annual E&S Compliance Audit Report shall additionally include: - compliance audit findings against operation phase ESMP commitments (ENV-AQ-OP-01 through ENV-O-05) and KPIs defined in Table 130 (Operation Phase Monitoring); - review of Toll Road Operator’s Operational EHS Log for the preceding six months; STP effluent performance trend (MON-OP-04); - groundwater abstraction compliance and community water level trend (MON-OP-03); - BMP operation phase implementation status per annual review; - wildlife mortality incident log and BKSDA response record (MON-OP-05); - wall partition and noise barrier structural condition (MON-OP-02); and B3 waste manifest audit results. The audit shall be conducted by an independent auditor appointed by TIU and shall cover at minimum one field inspection visit per six-month period. Findings and corrective action plan submitted to TIU and PMO.	Semi-Annual (June and December) – (within 45 days of semi-annual end)	Independent ESMP Auditor	TIU, PIU, PMU, and AIIB
Annual Environmental and Social Report – Construction Phase	- Annual E&S performance summary - Full-year cumulative monitoring data with trend analysis - Status of all CESMP sub-plans - Progress of biodiversity offset program - Community development and livelihood program outcomes - Outlook and management priorities for next year	Annual (within 90 days of year end)	TIU/CSC ESMU	AIIB, KLHK, Bapedalda Jambi Province
Annual Environmental and Social Report – Operation Phase	The Annual Environmental and Social Report shall additionally include: - full-year cumulative operation phase monitoring data for all parameters in Table 130 with trend analysis against baseline and KPIs; - status of operation phase mitigation measures per Table 123 with residual risk assessment; annual biodiversity monitoring report per	Annual (within 90 days of year end)	Toll Road Operator	AIIB, PIU, KLHK, Bapedalda Jambi Province

Report Type		Content Requirements	Frequency	Prepared By	Submitted To
		BMP including nocturnal mammal survey results, IAS inspection findings, and camera trap data summary; ▪ PDAM connection status and groundwater management update; STP capacity adequacy assessment against actual peak visitor loads; ▪ annual BMP operation phase review outcomes; ▪ GRM annual performance analysis; ▪ Operational Water Supply Contingency Plan update; and ▪ road safety performance indicators (traffic volume, incident records). The Annual Environmental and Social Report for the operation phase is submitted to TIU, PIU, PMU, and AIIB, within 90 days of each year end throughout the concession period.			
Serious Notification	Incident	Immediate notification of: fatalities, permanently disabling injuries, major environmental incidents (spills, watercourse contamination), or security incidents; followed by formal Incident Investigation Report within 10 working days	Within 24 hours to TIU; 72 hours to AIIB (Construction Phase)	Construction Phase: Contractor (notification); TIU (formal report) Operation Phase: Toll Road Operator (notification within 24 hours); TIU (formal Incident Investigation Report within 10 working days).	PIU, and PMU (mandatory)

17.4 E&S Implementation Budget Items

Table 132 Indicative Budget Items for E&S Implementation and Reporting

Budget Items	Responsibility	Budget Provision
Construction Phase		
Implementation of the overall CESMP as well as RKL-RPL; BMP; Social safeguard; and Traffic management and monitoring with breakdown, for example: - Air quality management - Water quality management - Mitigation of social impacts - Environmental safeguard specialists, health & safety specialists to be assigned for each civil work package - Social specialist to be assigned	Contractors	To be specified in the bidding and contract documents — number and man-month of specialist to be engaged and their unit rates per month as applicable
- E&S monitoring and reporting, including engagement of external consultants and laboratories (as required) - Contractor to conduct the monitoring and monthly reporting according to the CESMP - CSC to review/collect the monitoring report from each contractor. - PMC to consolidate the CESMP implementation reports submitted by each contractor into the Quarterly ESMP Compliance Report	Contractors CSCs PMC	To be specified in the bidding and contract documents — unit rate per reporting period as applicable
- Personnel Protective Equipment (PPE) - Mandatory health screening and regular monitoring for the worker	Contractors	To be specified in the bidding and contract documents — unit rate per person as applicable
- Development of a general induction and specific training materials on E&S, gender, biodiversity. - Delivery of general inductions and specific trainings on a regular basis	PMC and/or CSCs (as appropriate)	To be specified in the bidding and contract documents — unit rate per training subject as applicable
Biodiversity implementation, monitoring and reporting including assignment of a biodiversity specialist	Contractors PMC CSCs	To be specified in the bidding and contract documents — per unit rate or other units as appropriate.

Budget Items	Responsibility	Budget Provision
Grievance handling and resolution	BPJN DGH	To be allocated in the annual work plan and budget
Engagement of medical health personnel (of appropriate level) at the contractor's basecamp or project office	Contractors	To be specified in the bidding and contract documents — unit rate per person/month
Periodic sampling, measurement and analysis of the following as required in the E&S safeguard documents: • Ambient air quality • Noise level • Vibration level • Surface water quality and discharge into streams or rivers • Groundwater quality and level (at nearby community's wells) • Traffic monitoring • Biodiversity monitoring • Socio-economic and cultural monitoring	Contractors	To be specified in the bidding and contract documents — unit rate per sample collected and analyzed in the accredited laboratory
Periodic external E&S monitoring and reporting	AIIB and IsDB	To be allocated from the Bank's budget
Fielding of review missions		
Operation Phase		
Implementation of the Operation Phase ESMP (ENV-AQ-OP-01 through ENV-O-05), including wall partition maintenance, vegetation buffer management, road surface maintenance, ETC lane operations, water-efficient fixture maintenance at toll gates and rest area, STP operation and upkeep, double-wall underground fuel tank inspection, PDAM connection feasibility study, water metering and community observation well operation, Operational Water Supply Contingency Plan (OWSCP) updates, ROW vegetation management and IAS control, fire response resources maintenance, and wildlife-sensitive ROW lighting management	Toll Road Operator	To be specified in the toll road concession agreement and Operations and Maintenance contract; unit rates per activity type as applicable (annual wall partition inspection, quarterly IAS patrol, annual BMP review, fire response resource maintenance). Indicative total: IDR 6,000,000,000 over first 5 years of operation.
Operation phase E&S monitoring and reporting, including engagement of accredited laboratories and independent specialists, covering as a minimum: bi-annual ambient air quality monitoring	Toll Road Operator	To be specified in the concession agreement and TIU annual work plan. Unit rates for

Budget Items	Responsibility	Budget Provision
(MON-OP-01, 4 stations); bi-annual noise monitoring (MON-OP-02); monthly STP effluent monitoring (MON-OP-04); bi-monthly (first 2 years, then quarterly) community groundwater level monitoring and quarterly groundwater quality monitoring (MON-OP-03); annual biodiversity monitoring survey as per BMP (MON-OP-05) and annual nocturnal mammal survey by independent ecologist (MON-OP-02); quarterly IAS inspection; and semi-annual independent E&S compliance audit. Toll Road Operator to conduct monitoring and compile Operational EHS Log. TIU ESMU to consolidate into Quarterly E&S Performance Report and Annual Environmental and Social Report.		accredited laboratory analysis and independent ecologist per agreed schedule of rates.
Engagement of E&S specialist(s) within TIU ESMU for operation phase oversight, including review of Toll Road Operator Operational EHS Log, coordination of bi-annual monitoring, management of GRM, liaison with BKSDA Jambi on biodiversity matters, and compilation of quarterly and annual reports to DGH.	PIU (DGH)	To be allocated in the annual TIU work plan and budget; unit rate per E&S specialist per month as applicable throughout the concession period.

Note: The items presented in the table are indicative only and to be adjusted based on the scope of civil works and services required.

17.5 Audit and Inspection

An independent third-party ESMP audit shall be conducted twice per year throughout the construction period. The audit scope shall include compliance with the ESMP (construction and operation phases), CESMP sub-plans for construction phase, applicable national regulations, and AIIB ESP requirements. Audit reports with corrective action plans shall be submitted to TIU during construction and operation phases, and made available to AIIB within 30 days of each audit during construction phase.

In addition to independent audits, the following routine inspection program shall apply:

- Construction phase:
 - Contractor ES Officer: daily site walk-through; record on standard EHS inspection checklist during construction phase.
 - CSC ES Specialist: minimum monthly site inspections during active earthworks; weekly inspection reports during construction phase.
 - TIU: minimum monthly joint inspection with CSC; formal non-conformance tracking register.
 - PIU ESMU and AIIB: joint inspection at minimum quarterly.

- Operation phase:
 - Toll Road Operator EHS Officer: daily visual check for road surface condition, drainage channel blockages, wall partition and noise barrier structural integrity, vegetation buffer condition, waste container fill levels at rest area and toll gates, STP visual status (no overflow or bypass), fire response equipment availability in peatland sections, and wildlife mortality incident check along ROW. Results entered in Operational EHS Log.
 - Toll Road Operator with PIU oversight: quarterly structured patrol of entire 67.45 km ROW for IAS establishment and spread using BMP identification checklist; quarterly inspection of STP drainage leakage (ENV-O-04); quarterly review of groundwater abstraction meter logs versus 0.438 L/s cap (MON-OP-03); quarterly fuel tank leak detection system check (ENV-O-04); quarterly STP effluent monitoring data review (MON-OP-04); quarterly wall partition structural check (ENV-AQ-OP-01); ETC lane functionality at all toll gates; waste disposal manifest review; Operational EHS Log review against KPIs in Table 131.
 - Independent ESMP Auditor: semi-annual independent compliance audit (ESMP implementation and compliance against KPI), including field inspection of wall partition condition and vegetation buffer at Dusun Mudo (STA 60+000); STP effluent trend review against BOD₅, TSS, and FC discharge standards; groundwater level trend at community observation well versus 1.5 m trigger (MON-OP-03); abstraction log compliance with 0.438 L/s cap; Operational EHS Log review for preceding 6 months; B3 waste manifest audit; fuel tank leak detection records; BMP operation phase implementation status; annual review; wildlife mortality incident log and BKSDA response records; GRM cumulative performance analysis. Minimum one field visit per semi-annual audit cycle covering toll gates, rest area, and representative ROW sections.

Unscheduled inspection covering all phases can be conducted triggering by any of the following: GRM complaint alleging serious environmental or social harm; Serious Incident Notification (fatality, major spill, STP failure, fuel tank leak, fire in peatland sections, CR/EN species mortality); monitoring data exceeding adaptive management trigger thresholds (TSS above 200 mg/L at downstream station; SO₂/NO₂ above standard at Dusun Mudo; groundwater level decline above 1.5 m trigger; PPV stop-work trigger during piling); community escalation; or written request from PIU/PMU. This inspection can be proceeded by PIU ESMU; CSC ES Specialist (construction); and/or Toll Road Operator EHS Officer (operation) within 48 hours of trigger event (construction); and within 72 hours (operation).

All non-conformances shall be documented in a Corrective Action Request (CAR) register with assigned responsibility, root cause analysis, corrective action, and target closure date. Open CARs exceeding their target closure date shall be escalated to the TIU Director and reported to AIIB in the quarterly report.

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APPENDICES

SERTIFIKAT HASIL ANALISA
Nomor Sertifikat: RND 2310-0301

SERTIFIKAT HASIL ANALISA

Nomor Sertifikat: RND 2310-0301

Nomor Seri Pekerjaan : 2310-0301

Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon

PT. Utama Karya Indonesia

Alamat : Jl. Rancabolang No.36, Sekejati, Kec. Buah Batu, Kota
Bandung

u.p. : -

Deskripsi : Uji Kualitas Lingkungan

Jumlah Halaman : 30 halaman

Catatan : -

Kepala Laboratorium




Dahlan Suteja

Sertifikat ini diterbitkan sesuai dengan syarat dan ketentuan PT RND Teknologi Indonesia. Hasil yang dilaporkan hanya berlaku untuk contoh yang diuji.
Sertifikat ini tidak boleh diperbanyak kecuali secara keseluruhan (utuh), tanpa persetujuan tertulis dari PT RND Teknologi Indonesia.
Keluhan/keberatan setelah 2 (dua) minggu dari tanggal penerbitan sertifikat ini tidak akan diterima.

INFORMASI CONTOH UJI

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

No	ID Lab	ID Contoh	Lokasi	Jenis Contoh	Tanggal Diterima
1	23100301-1	AT-1	Lokasi di sekitar TIP	Air Bersih	02 November 2023
2	23100301-2	AT-2	Lokasi di sekitar <i>Base Camp</i>	Air Bersih	02 November 2023
3	23100301-3	AT-3	Lokasi di sekitar TIP 2	Air Bersih	02 November 2023
4	23100301-4	AT-4	Lokasi di sekitar <i>Base Camp 2</i>	Air Bersih	02 November 2023
5	23100301-5	AT-5	Lokasi di sekitar <i>Base Camp 3</i>	Air Bersih	02 November 2023
6	23100301-6	AT-6	Lokasi di sekitar TIP 3	Air Bersih	02 November 2023
7	23100301-7	AT-7	Lokasi Permukiman	Air Bersih	02 November 2023
8	23100301-8	AT-8	Lokasi di sekitar <i>Base Camp</i>	Air Bersih	02 November 2023
9	23100301-9	AP-1	Sungai Pijoan Sta 1+ 984	Air Permukaan & Biota	02 November 2023
10	23100301-10	AP-2	Sungai Batanghari Sta 15+780	Air Permukaan & Biota	02 November 2023
11	23100301-11	AP-3	Sungai Pangabuan Sta 96+092	Air Permukaan & Biota	02 November 2023
12	23100301-12	AP-4	Sungai Retih Sta 126+154	Air Permukaan & Biota	02 November 2023
13	23100301-13	AP-5	Sungai Batang Asam S	Air Permukaan & Biota	02 November 2023
14	23100301-14	AP-6	Sungai Keruing Sta 138+296	Air Permukaan & Biota	02 November 2023
15	23100301-15	AP-7	Sungai Keritang Sta 154+385	Air Permukaan & Biota	02 November 2023
16	23100301-16	AP-8	Sungai Ketilang Sta 164+438	Air Permukaan & Biota	02 November 2023
17	23100301-17	AP-9	Sungai Ketilang Gangsal Sta 176+030	Air Permukaan & Biota	02 November 2023
18	23100301-18	AP-10	Sungai Cenaku Sta 176+030	Air Permukaan & Biota	02 November 2023
Keterangan :					

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
 Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
 u.p. : -

ID Contoh : AT-1
 Jenis Contoh : Air Bersih
 Lokasi : Lokasi di sekitar TIP
 Tanggal Sampling : 30 Oktober 2023

ID Lab : 23100301-1
 Koordinat : S 1°17'41.19" E 103°21'31.24"
 Waktu Sampling : 10:15 WIB

Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
Fisika					
Bau	Tak Berbau	Tak Berbau	-	-	Organoleptik
Padatan Terlarut Tottal (TDS) ^{*)}	198	<300	4,8	mg/L	SNI 06-6989.27-2005
Kekeruhan ^{*)}	2,4	<3	0,03	NTU	SNI 06-6989.25-2005
Suhu ^{1) *)}	28	Udara ± 3	-	°C	SNI 06-6989.23-2005
Warna	4,9	10	2	TCU	SNI 06-6989.24-2005
Kimia Anorganik					
Besi (Fe)	0,09	0,2	0,03	mg/L	SNI 6989.4:2009
Krom Heksavalen (Cr-VI)	<0,01	0,01	0,01	mg/L	SNI 6989.71:2009
Mangan (Mn)	0,03	0,1	0,01	mg/L	SNI 6989.5:2009
Nitrat (NO ₃ -N)	<0,08	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
Nitrit (NO ₂ -N) ^{*)}	<0,02	3	0,02	mg/L	SNI 06-6989.9-2004
pH ^{1) *)}	7,21	6,5 – 8,5	-	-	SNI 06-6989.11-2004
Mikrobiologi					
Total Coliform	0	0	0	Jlh/100 mL	APHA 9222 B-2017
Fecal Coliform	0	0	0	Jlh/100 mL	APHA 9222 D-2017
Keterangan : ^{a)} Baku Mutu dari Peraturan Menteri Kesehatan Republik Indonesia No. 2 Tahun 2023 (Standar Baku Mutu Kesehatan Lingkungan untuk Media Air Keperluan Higiene Sanitasi) ^{*)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) ¹⁾ Hasil analisa in-situ (lapangan) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AT-2
Jenis Contoh : Air Bersih
Lokasi : Lokasi di sekitar *Base Camp*
Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-2
Koordinat : S 1°25'52.14" E 103°28'17.09"
Waktu Sampling : 07:30 WIB

Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
Fisika					
Bau	Tak Berbau	Tak Berbau	-	-	Organoleptik
Padatan Terlarut Tottal (TDS) ^{*)}	185	<300	4,8	mg/L	SNI 06-6989.27-2005
Kekeruhan ^{*)}	1,9	<3	0,03	NTU	SNI 06-6989.25-2005
Suhu ^{1) *)}	28	Udara ± 3	-	°C	SNI 06-6989.23-2005
Warna	3,6	10	2	TCU	SNI 06-6989.24-2005
Kimia Anorganik					
Besi (Fe)	0,05	0,2	0,03	mg/L	SNI 6989.4:2009
Krom Heksavalen (Cr-VI)	<0,01	0,01	0,01	mg/L	SNI 6989.71:2009
Mangan (Mn)	<0,01	0,1	0,01	mg/L	SNI 6989.5:2009
Nitrat (NO ₃ -N)	<0,08	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
Nitrit (NO ₂ -N) ^{*)}	<0,02	3	0,02	mg/L	SNI 06-6989.9-2004
pH ^{1) *)}	7,2	6,5 – 8,5	-	-	SNI 06-6989.11-2004
Mikrobiologi					
Total Coliform	0	0	0	Jlh/100 mL	APHA 9222 B-2017
Fecal Coliform	0	0	0	Jlh/100 mL	APHA 9222 D-2017
Keterangan : ^{a)} Baku Mutu dari Peraturan Menteri Kesehatan Republik Indonesia No. 2 Tahun 2023 (Standar Baku Mutu Kesehatan Lingkungan untuk Media Air Keperluan Higiene Sanitasi) ^{*)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) ¹⁾ Hasil analisa in-situ (lapangan) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
 Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
 u.p. : -

ID Contoh : AT-3
 Jenis Contoh : Air Bersih
 Lokasi : Lokasi di sekitar TIP 2
 Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-3
 Koordinat : S 1°3'31.05" E 103° 4'1.88"
 Waktu Sampling : 08:00 WIB

Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
Fisika					
Bau	Tak Berbau	Tak Berbau	-	-	Organoleptik
Padatan Terlarut Tottal (TDS) ^{*)}	211	<300	4,8	mg/L	SNI 06-6989.27-2005
Kekeruhan ^{*)}	2,9	<3	0,03	NTU	SNI 06-6989.25-2005
Suhu ^{1) *)}	27,5	Udara ± 3	-	°C	SNI 06-6989.23-2005
Warna	3,5	10	2	TCU	SNI 06-6989.24-2005
Kimia Anorganik					
Besi (Fe)	0,14	0,2	0,03	mg/L	SNI 6989.4:2009
Krom Heksavalen (Cr-VI)	<0,01	0,01	0,01	mg/L	SNI 6989.71:2009
Mangan (Mn)	0,06	0,1	0,01	mg/L	SNI 6989.5:2009
Nitrat (NO ₃ -N)	<0,08	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
Nitrit (NO ₂ -N) ^{*)}	<0,02	3	0,02	mg/L	SNI 06-6989.9-2004
pH ^{1) *)}	7,21	6,5 – 8,5	-	-	SNI 06-6989.11-2004
Mikrobiologi					
Total Coliform	0	0	0	Jlh/100 mL	APHA 9222 B-2017
Fecal Coliform	0	0	0	Jlh/100 mL	APHA 9222 D-2017
Keterangan : ^{a)} Baku Mutu dari Peraturan Menteri Kesehatan Republik Indonesia No. 2 Tahun 2023 (Standar Baku Mutu Kesehatan Lingkungan untuk Media Air Keperluan Higiene Sanitasi) ^{*)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) ¹⁾ Hasil analisa in-situ (lapangan) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AT-4
Jenis Contoh : Air Bersih
Lokasi : Lokasi di sekitar *Base Camp 2*
Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-4
Koordinat : S 1°17'26.61" E 103°6'8.34"
Waktu Sampling : 08:30 WIB

Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
Fisika					
Bau	Tak Berbau	Tak Berbau	-	-	Organoleptik
Padatan Terlarut Tottal (TDS) ^{*)}	154	<300	4,8	mg/L	SNI 06-6989.27-2005
Kekeruhan ^{*)}	0,3	<3	0,03	NTU	SNI 06-6989.25-2005
Suhu ^{1) *)}	27,8	Udara ± 3	-	°C	SNI 06-6989.23-2005
Warna	4,8	10	2	TCU	SNI 06-6989.24-2005
Kimia Anorganik					
Besi (Fe)	0,07	0,2	0,03	mg/L	SNI 6989.4:2009
Krom Heksavalen (Cr-VI)	<0,01	0,01	0,01	mg/L	SNI 6989.71:2009
Mangan (Mn)	0,04	0,1	0,01	mg/L	SNI 6989.5:2009
Nitrat (NO ₃ -N)	<0,08	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
Nitrit (NO ₂ -N) ^{*)}	<0,02	3	0,02	mg/L	SNI 06-6989.9-2004
pH ^{1) *)}	7,0	6,5 – 8,5	-	-	SNI 06-6989.11-2004
Mikrobiologi					
Total Coliform	0	0	0	Jlh/100 mL	APHA 9222 B-2017
Fecal Coliform	0	0	0	Jlh/100 mL	APHA 9222 D-2017
Keterangan : ^{a)} Baku Mutu dari Peraturan Menteri Kesehatan Republik Indonesia No. 2 Tahun 2023 (Standar Baku Mutu Kesehatan Lingkungan untuk Media Air Keperluan Higiene Sanitasi) ^{*)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) ¹⁾ Hasil analisa in-situ (lapangan) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AT-5
Jenis Contoh : Air Bersih
Lokasi : Lokasi di sekitar *Base Camp 3*
Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-5
Koordinat : S 0°40'53.39" E 102°37'34.09"
Waktu Sampling : 11:30 WIB

Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
Fisika					
Bau	Tak Berbau	Tak Berbau	-	-	Organoleptik
Padatan Terlarut Tottal (TDS) ^{*)}	120	<300	4,8	mg/L	SNI 06-6989.27-2005
Kekeruhan ^{*)}	1,1	<3	0,03	NTU	SNI 06-6989.25-2005
Suhu ^{1) *)}	28	Udara ± 3	-	°C	SNI 06-6989.23-2005
Warna	3,5	10	2	TCU	SNI 06-6989.24-2005
Kimia Anorganik					
Besi (Fe)	0,04	0,2	0,03	mg/L	SNI 6989.4:2009
Krom Heksavalen (Cr-VI)	<0,01	0,01	0,01	mg/L	SNI 6989.71:2009
Mangan (Mn)	<0,01	0,1	0,01	mg/L	SNI 6989.5:2009
Nitrat (NO ₃ -N)	<0,08	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
Nitrit (NO ₂ -N) ^{*)}	<0,02	3	0,02	mg/L	SNI 06-6989.9-2004
pH ^{1) *)}	7,10	6,5 – 8,5	-	-	SNI 06-6989.11-2004
Mikrobiologi					
Total Coliform	0	0	0	Jlh/100 mL	APHA 9222 B-2017
Fecal Coliform	0	0	0	Jlh/100 mL	APHA 9222 D-2017
Keterangan : ^{a)} Baku Mutu dari Peraturan Menteri Kesehatan Republik Indonesia No. 2 Tahun 2023 (Standar Baku Mutu Kesehatan Lingkungan untuk Media Air Keperluan Higiene Sanitasi) ^{*)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) ¹⁾ Hasil analisa in-situ (lapangan) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
 Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
 u.p. : -

ID Contoh : AT-6
 Jenis Contoh : Air Bersih
 Lokasi : Lokasi di sekitar TIP 3
 Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-6
 Koordinat : S 0°47'57.08" E 102°42'2.13"
 Waktu Sampling : 13:00 WIB

Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
Fisika					
Bau	Tak Berbau	Tak Berbau	-	-	Organoleptik
Padatan Terlarut Tottal (TDS) ^{*)}	205	<300	4,8	mg/L	SNI 06-6989.27-2005
Kekeruhan ^{*)}	2,6	<3	0,03	NTU	SNI 06-6989.25-2005
Suhu ^{1) *)}	27,0	Udara ± 3	-	°C	SNI 06-6989.23-2005
Warna	3,2	10	2	TCU	SNI 06-6989.24-2005
Kimia Anorganik					
Besi (Fe)	0,09	0,2	0,03	mg/L	SNI 6989.4:2009
Krom Heksavalen (Cr-VI)	<0,01	0,01	0,01	mg/L	SNI 6989.71:2009
Mangan (Mn)	0,05	0,1	0,01	mg/L	SNI 6989.5:2009
Nitrat (NO ₃ -N)	<0,08	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
Nitrit (NO ₂ -N) ^{*)}	<0,02	3	0,02	mg/L	SNI 06-6989.9-2004
pH ^{1) *)}	6,95	6,5 – 8,5	-	-	SNI 06-6989.11-2004
Mikrobiologi					
Total Coliform	0	0	0	Jlh/100 mL	APHA 9222 B-2017
Fecal Coliform	0	0	0	Jlh/100 mL	APHA 9222 D-2017
Keterangan : ^{a)} Baku Mutu dari Peraturan Menteri Kesehatan Republik Indonesia No. 2 Tahun 2023 (Standar Baku Mutu Kesehatan Lingkungan untuk Media Air Keperluan Higiene Sanitasi) ^{*)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) ¹⁾ Hasil analisa in-situ (lapangan) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AT-7
Jenis Contoh : Air Bersih
Lokasi : Lokasi Permukiman
Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-7
Koordinat : S 0°25'27.46" E 102°25'37.90"
Waktu Sampling : 10:00 WIB

Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
Fisika					
Bau	Tak Berbau	Tak Berbau	-	-	Organoleptik
Padatan Terlarut Tottal (TDS) ^{*)}	155	<300	4,8	mg/L	SNI 06-6989.27-2005
Kekeruhan ^{*)}	1,9	<3	0,03	NTU	SNI 06-6989.25-2005
Suhu ^{1) *)}	27,4	Udara ± 3	-	°C	SNI 06-6989.23-2005
Warna	2,8	10	2	TCU	SNI 06-6989.24-2005
Kimia Anorganik					
Besi (Fe)	0,05	0,2	0,03	mg/L	SNI 6989.4:2009
Krom Heksavalen (Cr-VI)	<0,01	0,01	0,01	mg/L	SNI 6989.71:2009
Mangan (Mn)	<0,01	0,1	0,01	mg/L	SNI 6989.5:2009
Nitrat (NO ₃ -N)	<0,08	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
Nitrit (NO ₂ -N) ^{*)}	<0,02	3	0,02	mg/L	SNI 06-6989.9-2004
pH ^{1) *)}	7,05	6,5 – 8,5	-	-	SNI 06-6989.11-2004
Mikrobiologi					
Total Coliform	0	0	0	Jlh/100 mL	APHA 9222 B-2017
Fecal Coliform	0	0	0	Jlh/100 mL	APHA 9222 D-2017
Keterangan : ^{a)} Baku Mutu dari Peraturan Menteri Kesehatan Republik Indonesia No. 2 Tahun 2023 (Standar Baku Mutu Kesehatan Lingkungan untuk Media Air Keperluan Higiene Sanitasi) ^{*)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) ¹⁾ Hasil analisa in-situ (lapangan) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AT-8
Jenis Contoh : Air Bersih
Lokasi : Lokasi di sekitar *Base Camp*
Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-8
Koordinat : S 0°28'23.01" E 102°27'23.88"
Waktu Sampling : 10:30 WIB

Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
Fisika					
Bau	Tak Berbau	Tak Berbau	-	-	Organoleptik
Padatan Terlarut Tottal (TDS) ^{*)}	136	<300	4,8	mg/L	SNI 06-6989.27-2005
Kekeruhan ^{*)}	1,4	<3	0,03	NTU	SNI 06-6989.25-2005
Suhu ^{1) *)}	28,2	Udara ± 3	-	°C	SNI 06-6989.23-2005
Warna	3,6	10	2	TCU	SNI 06-6989.24-2005
Kimia Anorganik					
Besi (Fe)	0,10	0,2	0,03	mg/L	SNI 6989.4:2009
Krom Heksavalen (Cr-VI)	<0,01	0,01	0,01	mg/L	SNI 6989.71:2009
Mangan (Mn)	<0,01	0,1	0,01	mg/L	SNI 6989.5:2009
Nitrat (NO ₃ -N)	<0,08	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
Nitrit (NO ₂ -N) ^{*)}	<0,02	3	0,02	mg/L	SNI 06-6989.9-2004
pH ^{1) *)}	7,11	6,5 – 8,5	-	-	SNI 06-6989.11-2004
Mikrobiologi					
Total Coliform	0	0	0	Jlh/100 mL	APHA 9222 B-2017
Fecal Coliform	0	0	0	Jlh/100 mL	APHA 9222 D-2017
Keterangan : ^{a)} Baku Mutu dari Peraturan Menteri Kesehatan Republik Indonesia No. 2 Tahun 2023 (Standar Baku Mutu Kesehatan Lingkungan untuk Media Air Keperluan Higiene Sanitasi) ^{*)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) ¹⁾ Hasil analisa in-situ (lapangan) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AP-1
Jenis Contoh : Air Permukaan & Biota
Lokasi : Sungai Pijoan Sta 1+ 984
Tanggal Sampling : 30 Oktober 2023

ID Lab : 23100301-9
Koordinat : S 1°35'35.11" E 103°27'6.10"
Waktu Sampling : 08:00 WIB

No.	Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
1.	Suhu ^{1) *)}	27,0	Deviasi 3	-	°C	SNI 06-6989.23-2005
2.	pH ^{1) *)}	7,25	6 – 9	-	-	SNI 06-6989.11-2004
3.	Padatan Terlarut Total (TDS) ^{*)}	263	1000	5	mg/L	SNI 06-6989.27-2005
4.	Padatan Tersuspensi Total (TSS) ^{*)}	20	100	5	mg/L	SNI 06-6989.3-2004
5.	Warna	1,89	100	0,05	Pt-Co	SNI 06-6989.24-2005
6.	Kebutuhan Oksigen Biokimia (BOD)	3	6	2	mg/L	APHA 5210 B-2017
7.	Kebutuhan Oksigen Kimiawi (COD)	20	40	4	mg/L	SNI 6989:73-2009
8.	Oksigen Terlarut (DO) ^{*)}	4,3	3	2,1	mg/L	SNI 06-6989.14-2004
9.	Sulfat (SO ₄ ²⁻)	9,3	300	3	mg/L	SNI 6989.20:2009
10.	Klorida (Cl ⁻) ^{*)}	14,8	300	2,9	mg/L	SNI 6989.19:2009
11.	Nitrat (NO ₃ -N)	1,25	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
12.	Nitrit (NO ₂ -N) ^{*)}	0,03	0,06	0,02	mg/L	SNI 06-6989.9-2004
13.	Amonia (NH ₃ -N) ^{*)}	0,08	0,5	0,04	mg/L	SNI 06-6989.30-2005
14.	Total Nitrogen	9,3	25	0,005	mg/L	APHA 4500-N C-2017
15.	Fosfat Total (sebagai P)	<0,02	1,0	0,02	mg/L	SNI 06-6989.31-2005
16.	Fluorida (F ⁻)	0,06	1,5	0,06	mg/L	SNI 06-6989.29-2005
17.	Sulfur (sebagai H ₂ S)	<0,001	0,002	0,001	mg/L	APHA 4500-S ²⁻ F-2017
18.	Sianida (CN ⁻)	<0,004	0,02	0,004	mg/L	APHA 4500-CN ⁻ E-2017
19.	Klorin Bebas (Cl ₂)	<0,02	0,03	0,02	mg/L	APHA 4500-Cl G-2017
20.	Boron (B)	0,02	1,0	0,01	mg/L	APHA 3120 B-2017
21.	Raksa (Hg)	0,0004	0,002	0,0002	mg/L	APHA 3112 B-2017
22.	Arsen (As)	0,007	0,05	0,002	mg/L	APHA 3114 B-2017
23.	Selenium (Se)	<0,002	0,05	0,002	mg/L	APHA 3114 B-2017
24.	Kadmium (Cd)	0,003	0,01	0,002	mg/L	SNI 6989.16:2009
25.	Kobalt (Co)	<0,04	0,2	0,04	mg/L	APHA 3111 B-2017
26.	Nikel (Ni)	<0,01	0,05	0,01	mg/L	SNI 6989.18:2009
27.	Seng (Zn)	0,018	0,05	0,008	mg/L	SNI 6989.7:2009
28.	Tembaga (Cu)	<0,007	0,02	0,007	mg/L	SNI 6989.6:2009
29.	Timbal (Pb)	<0,02	0,03	0,02	mg/L	SNI 6989.8:2009
30.	Krom Heksavalen (Cr-VI)	<0,03	0,05	0,03	mg/L	SNI 6989.71:2009
31.	Minyak dan Lemak ^{*)}	<0,8	1	0,8	mg/L	SNI 6989.10:2011

32.	Detergen total ^{a)}	<0,08	0,2	0,08	mg/L	SNI 06-6989.51-2005
33.	Fenol	<0,01	0,01	0,001	mg/L	SNI 06-6989.21-2004
34.	Fecal Coliform	560	2.000	0	MPN / 100 mL	APHA 9222 B-2017
35.	Total Coliform	948	10.000	0	MPN / 100 mL	APHA 9222 G-2017

Keterangan : ^{a)} Baku Mutu Air Sungai dan Sejenisnya dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VI – Kelas 3)

^{b)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017)

^{c)} Hasil analisa in-situ (lapangan)

< Kurang dari batas deteksi yang dapat dilaporkan

LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Phytoplankton		
No.	Organism	Hasil
	Bacillariophyceae	
1	<i>Bacteriastrum sp.</i>	976
2	<i>Coscinodiscus sp.</i>	651
3	<i>Navicula sp.</i>	488
4	<i>Synedra sp.</i>	325
5	<i>Diploneis sp.</i>	163
6	<i>Cyclotella sp.</i>	1464
7	<i>Surirella sp.</i>	1301
	Cyanophyceae	
8	<i>Cloniophora sp.</i>	1139
	Kelimpahan (Sel/m3)	6507
	Jumlah Taksa (S)	8
	Indeks Keragaman (H')	1.61
	Indeks Keseragaman (E)	0.77
	Indeks Dominasi (D)	0.16

Zooplankton		
No.	Organism	Hasil
	Ciliata	
1	<i>Eutintinnus sp.</i>	163
2	<i>Favella sp.</i>	488
	Protozoa	
3	<i>Arcella sp.</i>	813
	Crustaceae	
4	<i>Acartia sp.</i>	1139
5	<i>Nauplius sp.</i>	1464
	Kelimpahan (Sel/m3)	4067
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	1.07
	Indeks Keseragaman (E)	0.67
	Indeks Dominasi (D)	0.19
Benthos		
No.	Organism	Hasil
	Nematoda	
1	<i>Melanoides sp.</i>	1
2	<i>Leptolaimus sp.</i>	4
	Naididae	
3	<i>Naidium</i>	7
	INSECTA	
4	<i>Tricoptera</i>	6
	Oligochaeta	
5	<i>Lumbriculus sp.</i>	8
	Kelimpahan (Sel/m3)	26
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	1.13
	Indeks Keseragaman (E)	0.70
	Indeks Dominasi (D)	0.25

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AP-2
Jenis Contoh : Air Permukaan & Biota
Lokasi : Sungai Batanghari Sta 15+780
Tanggal Sampling : 30 Oktober 2023

ID Lab : 23100301-10
Koordinat : S 1°28'37.29" E 103°28'21.41"
Waktu Sampling : 08:30 WIB

No.	Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
1.	Suhu ^{1) *)}	28	Deviasi 3	-	°C	SNI 06-6989.23-2005
2.	pH ^{1) *)}	6,85	6 – 9	-	-	SNI 06-6989.11-2004
3.	Padatan Terlarut Total (TDS) ^{*)}	366	1000	4,8	mg/L	SNI 06-6989.27-2005
4.	Padatan Tersuspensi Total (TSS) ^{*)}	41	100	4,2	mg/L	SNI 06-6989.3-2004
5.	Warna	4,25	100	0,05	Pt-Co	SNI 06-6989.24-2005
6.	Kebutuhan Oksigen Biokimia (BOD)	4	6	2	mg/L	APHA 5210 B-2017
7.	Kebutuhan Oksigen Kimiawi (COD)	25	40	4	mg/L	SNI 6989.73-2009
8.	Oksigen Terlarut (DO) ^{*)}	5,0	Minimum 3	2,1	mg/L	SNI 06-6989.14-2004
9.	Sulfat (SO ₄ ²⁻)	35	300	3	mg/L	SNI 6989.20:2009
10.	Klorida (Cl ⁻) ^{*)}	21,8	300	2,9	mg/L	SNI 6989.19:2009
11.	Nitrat (NO ₃ -N)	2,50	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
12.	Nitrit (NO ₂ -N) ^{*)}	0,04	0,06	0,02	mg/L	SNI 06-6989.9-2004
13.	Amonia (NH ₃ -N) ^{*)}	0,28	0,5	0,04	mg/L	SNI 06-6989.30-2005
14.	Total Nitrogen	15	25	0,005	mg/L	APHA 4500-N C-2017
15.	Fosfat Total (sebagai P)	0,23	1,0	0,02	mg/L	SNI 06-6989.31-2005
16.	Fluorida (F ⁻)	0,16	1,5	0,06	mg/L	SNI 06-6989.29-2005
17.	Sulfur (sebagai H ₂ S)	<0,001	0,002	0,001	mg/L	APHA 4500-S ²⁻ F-2017
18.	Sianida (CN ⁻)	<0,004	0,02	0,004	mg/L	APHA 4500-CN ⁻ E-2017
19.	Klorin Bebas (Cl ₂)	<0,02	0,03	0,02	mg/L	APHA 4500-Cl G-2017
20.	Boron (B)	0,03	1,0	0,01	mg/L	APHA 3120 B-2017
21.	Raksa (Hg)	0,0005	0,002	0,0002	mg/L	APHA 3112 B-2017
22.	Arsen (As)	0,008	0,05	0,002	mg/L	APHA 3114 B-2017
23.	Selenium (Se)	<0,002	0,05	0,002	mg/L	APHA 3114 B-2017
24.	Kadmium (Cd)	0,003	0,01	0,002	mg/L	SNI 6989.16:2009
25.	Kobalt (Co)	0,05	0,2	0,04	mg/L	APHA 3111 B-2017
26.	Nikel (Ni)	<0,01	0,05	0,01	mg/L	SNI 6989.18:2009
27.	Seng (Zn)	0,020	0,05	0,008	mg/L	SNI 6989.7:2009
28.	Tembaga (Cu)	0,009	0,02	0,007	mg/L	SNI 6989.6:2009
29.	Timbal (Pb)	<0,02	0,03	0,02	mg/L	SNI 6989.8:2009
30.	Krom Heksavalen (Cr-VI)	<0,03	0,05	0,03	mg/L	SNI 6989.71:2009
31.	Minyak dan Lemak ^{*)}	<0,8	1	0,8	mg/L	SNI 6989.10:2011

32.	Detergen total ^{a)}	0,13	0,2	0,08	mg/L	SNI 06-6989.51-2005
33.	Fenol	0,003	0,01	0,001	mg/L	SNI 06-6989.21-2004
34.	Fecal Coliform	872	2.000	0	MPN / 100 mL	APHA 9222 B-2017
35.	Total Coliform	1189	10.000	0	MPN / 100 mL	APHA 9222 G-2017

Keterangan : ^{a)} Baku Mutu Air Sungai dan Sejenisnya dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VI – Kelas 3)

^{b)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017)

^{c)} Hasil analisa in-situ (lapangan)

< Kurang dari batas deteksi yang dapat dilaporkan

LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Phytoplankton		
No.	Organism	Hasil
	Bacillariophyceae	
1	<i>Bacteriastrum sp.</i>	976
2	<i>Coscinodiscus sp.</i>	813
3	<i>Navicula sp.</i>	651
4	<i>Synedra sp.</i>	488
5	<i>Diploneis sp.</i>	325
6	<i>Cyclotella sp.</i>	163
7	<i>Surirella sp.</i>	1464
	Cyanophyceae	
8	<i>Cloniophora sp.</i>	1301
	Kelimpahan (Sel/m ³)	6182
	Jumlah Taksa (S)	8
	Indeks Keragaman (H')	1.59
	Indeks Keseragaman (E)	0.76
	Indeks Dominasi (D)	0.16

Zooplankton		
No.	Organism	Hasil
	Ciliata	
1	<i>Eutintinnus sp.</i>	651
2	<i>Favella sp.</i>	325
	Protozoa	
3	<i>Arcella sp.</i>	1139
	Crustaceae	
4	<i>Acartia sp.</i>	1464
5	<i>Nauplius sp.</i>	488
	Kelimpahan (Sel/m ³)	4067
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	0.85
	Indeks Keseragaman (E)	0.53
	Indeks Dominasi (D)	0.25
Benthos		
No.	Organism	Hasil
	Nematoda	
1	<i>Melanoides sp.</i>	3
2	<i>Leptolaimus sp.</i>	6
	Naididae	
3	<i>Naidium</i>	9
	INSECTA	
4	<i>Tricoptera</i>	4
	Oligochaeta	
5	<i>Lumbriculus sp.</i>	9
	Kelimpahan (Sel/m ³)	31
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	1.26
	Indeks Keseragaman (E)	0.78
	Indeks Dominasi (D)	0.23

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AP-3
Jenis Contoh : Air Permukaan & Biota
Lokasi : Sungai Pangabuan Sta 96+092
Tanggal Sampling : 30 Oktober 2023

ID Lab : 23100301-11
Koordinat : S 1° 0'23.89" E 103° 2'33.19"
Waktu Sampling : 09:30 WIB

No.	Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
1.	Suhu ^{1) *)}	28,5	Deviasi 3	-	°C	SNI 06-6989.23-2005
2.	pH ^{1) *)}	7,15	6 – 9	-	-	SNI 06-6989.11-2004
3.	Padatan Terlarut Total (TDS) ^{*)}	280	1000	4,8	mg/L	SNI 06-6989.27-2005
4.	Padatan Tersuspensi Total (TSS) ^{*)}	35	100	4,2	mg/L	SNI 06-6989.3-2004
5.	Warna	3,80	100	0,05	Pt-Co	SNI 06-6989.24-2005
6.	Kebutuhan Oksigen Biokimia (BOD)	3	6	2	mg/L	APHA 5210 B-2017
7.	Kebutuhan Oksigen Kimiawi (COD)	23	40	4	mg/L	SNI 6989:73-2009
8.	Oksigen Terlarut (DO) ^{*)}	5,6	Minimum 3	2,1	mg/L	SNI 06-6989.14-2004
9.	Sulfat (SO ₄ ²⁻)	33	300	3	mg/L	SNI 6989.20:2009
10.	Klorida (Cl ⁻) ^{*)}	23,5	300	2,9	mg/L	SNI 6989.19:2009
11.	Nitrat (NO ₃ -N)	2,21	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
12.	Nitrit (NO ₂ -N) ^{*)}	0,03	0,06	0,02	mg/L	SNI 06-6989.9-2004
13.	Amonia (NH ₃ -N) ^{*)}	0,24	0,5	0,04	mg/L	SNI 06-6989.30-2005
14.	Total Nitrogen	11	25	0,005	mg/L	APHA 4500-N C-2017
15.	Fosfat Total (sebagai P)	0,20	1,0	0,02	mg/L	SNI 06-6989.31-2005
16.	Fluorida (F ⁻)	0,12	1,5	0,06	mg/L	SNI 06-6989.29-2005
17.	Sulfur (sebagai H ₂ S)	<0,001	0,002	0,001	mg/L	APHA 4500-S ²⁻ F-2017
18.	Sianida (CN ⁻)	<0,004	0,02	0,004	mg/L	APHA 4500-CN ⁻ E-2017
19.	Klorin Bebas (Cl ₂)	<0,02	0,03	0,02	mg/L	APHA 4500-Cl G-2017
20.	Boron (B)	<0,01	1,0	0,01	mg/L	APHA 3120 B-2017
21.	Raksa (Hg)	0,0003	0,002	0,0002	mg/L	APHA 3112 B-2017
22.	Arsen (As)	0,005	0,05	0,002	mg/L	APHA 3114 B-2017
23.	Selenium (Se)	<0,002	0,05	0,002	mg/L	APHA 3114 B-2017
24.	Kadmium (Cd)	<0,002	0,01	0,002	mg/L	SNI 6989.16:2009
25.	Kobalt (Co)	<0,04	0,2	0,04	mg/L	APHA 3111 B-2017
26.	Nikel (Ni)	<0,01	0,05	0,01	mg/L	SNI 6989.18:2009
27.	Seng (Zn)	0,015	0,05	0,008	mg/L	SNI 6989.7:2009
28.	Tembaga (Cu)	0,007	0,02	0,007	mg/L	SNI 6989.6:2009
29.	Timbal (Pb)	<0,02	0,03	0,02	mg/L	SNI 6989.8:2009
30.	Krom Heksavalen (Cr-VI)	<0,03	0,05	0,03	mg/L	SNI 6989.71:2009
31.	Minyak dan Lemak ^{*)}	<0,8	1	0,8	mg/L	SNI 6989.10:2011

32.	Detergen total ^{a)}	0,09	0,2	0,08	mg/L	SNI 06-6989.51-2005
33.	Fenol	<0,001	0,01	0,001	mg/L	SNI 06-6989.21-2004
34.	Fecal Coliform	754	2.000	0	MPN / 100 mL	APHA 9222 B-2017
35.	Total Coliform	1009	10.000	0	MPN / 100 mL	APHA 9222 G-2017

Keterangan : ^{a)} Baku Mutu Air Sungai dan Sejenisnya dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VI – Kelas 3)

^{b)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017)

^{c)} Hasil analisa in-situ (lapangan)

< Kurang dari batas deteksi yang dapat dilaporkan

LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Phytoplankton		
No.	Organism	Hasil
	Bacillariophyceae	
1	<i>Bacteriastrum sp.</i>	325
2	<i>Coscinodiscus sp.</i>	163
3	<i>Navicula sp.</i>	488
4	<i>Diploneis sp.</i>	813
5	<i>Cyclotella sp.</i>	651
	Cyanophyceae	
6	<i>Cloniophora sp.</i>	976
	Kelimpahan (Sel/m3)	3416
	Jumlah Taksa (S)	6
	Indeks Keragaman (H')	0.93
	Indeks Keseragaman (E)	0.52
	Indeks Dominasi (D)	0.06

Zooplankton		
No.	Organism	Hasil
	Ciliata	
1	<i>Eutimninus sp.</i>	325
2	<i>Favella sp.</i>	651
3	<i>Tintinnopsis sp.</i>	976
	Protozoa	
4	<i>Arcella sp.</i>	1139
	Crustaceae	
5	<i>Nauplius sp.</i>	976
	Kelimpahan (Sel/m3)	4067
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	1.54
	Indeks Keseragaman (E)	0.95
	Indeks Dominasi (D)	0.23

Benthos		
No.	Organism	Hasil
	Nematoda	
1	<i>Melanoides sp.</i>	3
2	<i>Leptolaimus sp.</i>	4
	Naididae	
3	<i>Naidium</i>	6
	Oligochaeta	
4	<i>Lumbriculus sp.</i>	1
	Kelimpahan (Sel/m3)	14
	Jumlah Taksa (S)	4
	Indeks Keragaman (H')	1.00
	Indeks Keseragaman (E)	0.72
	Indeks Dominasi (D)	0.09

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AP-4
Jenis Contoh : Air Permukaan & Biota
Lokasi : Sungai Retih Sta 126+154
Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-12
Koordinat : S 0°52'32.80" E 102°48'45.75"
Waktu Sampling : 14:30 WIB

No.	Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
1.	Suhu ^{1) *)}	28	Deviasi 3	-	°C	SNI 06-6989.23-2005
2.	pH ^{1) *)}	6,95	6 – 9	-	-	SNI 06-6989.11-2004
3.	Padatan Terlarut Total (TDS) ^{*)}	346	1000	4,8	mg/L	SNI 06-6989.27-2005
4.	Padatan Tersuspensi Total (TSS) ^{*)}	21	100	4,2	mg/L	SNI 06-6989.3-2004
5.	Warna	5,61	100	0,05	Pt-Co	SNI 06-6989.24-2005
6.	Kebutuhan Oksigen Biokimia (BOD)	3	6	2	mg/L	APHA 5210 B-2017
7.	Kebutuhan Oksigen Kimiawi (COD)	27	40	4	mg/L	SNI 6989.73-2009
8.	Oksigen Terlarut (DO) ^{*)}	5,3	Minimum 3	2,1	mg/L	SNI 06-6989.14-2004
9.	Sulfat (SO ₄ ²⁻)	37	300	3	mg/L	SNI 6989.20:2009
10.	Klorida (Cl ⁻) ^{*)}	25,6	300	2,9	mg/L	SNI 6989.19:2009
11.	Nitrat (NO ₃ -N)	3,20	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
12.	Nitrit (NO ₂ -N) ^{*)}	0,04	0,06	0,02	mg/L	SNI 06-6989.9-2004
13.	Amonia (NH ₃ -N) ^{*)}	0,42	0,5	0,04	mg/L	SNI 06-6989.30-2005
14.	Total Nitrogen	19	25	0,005	mg/L	APHA 4500-N C-2017
15.	Fosfat Total (sebagai P)	0,29	1,0	0,02	mg/L	SNI 06-6989.31-2005
16.	Fluorida (F ⁻)	0,22	1,5	0,06	mg/L	SNI 06-6989.29-2005
17.	Sulfur (sebagai H ₂ S)	<0,001	0,002	0,001	mg/L	APHA 4500-S ²⁻ F-2017
18.	Sianida (CN ⁻)	<0,004	0,02	0,004	mg/L	APHA 4500-CN ⁻ E-2017
19.	Klorin Bebas (Cl ₂)	<0,02	0,03	0,02	mg/L	APHA 4500-Cl G-2017
20.	Boron (B)	0,05	1,0	0,01	mg/L	APHA 3120 B-2017
21.	Raksa (Hg)	0,0007	0,002	0,0002	mg/L	APHA 3112 B-2017
22.	Arsen (As)	0,009	0,05	0,002	mg/L	APHA 3114 B-2017
23.	Selenium (Se)	0,003	0,05	0,002	mg/L	APHA 3114 B-2017
24.	Kadmium (Cd)	0,005	0,01	0,002	mg/L	SNI 6989.16:2009
25.	Kobalt (Co)	<0,04	0,2	0,04	mg/L	APHA 3111 B-2017
26.	Nikel (Ni)	<0,01	0,05	0,01	mg/L	SNI 6989.18:2009
27.	Seng (Zn)	0,028	0,05	0,008	mg/L	SNI 6989.7:2009
28.	Tembaga (Cu)	0,012	0,02	0,007	mg/L	SNI 6989.6:2009
29.	Timbal (Pb)	<0,02	0,03	0,02	mg/L	SNI 6989.8:2009
30.	Krom Heksavalen (Cr-VI)	<0,03	0,05	0,03	mg/L	SNI 6989.71:2009
31.	Minyak dan Lemak ^{*)}	0,8	1	0,8	mg/L	SNI 6989.10:2011

32.	Detergen total ^{a)}	0,18	0,2	0,08	mg/L	SNI 06-6989.51-2005
33.	Fenol	0,005	0,01	0,001	mg/L	SNI 06-6989.21-2004
34.	Fecal Coliform	789	2.000	0	MPN / 100 mL	APHA 9222 B-2017
35.	Total Coliform	1215	10.000	0	MPN / 100 mL	APHA 9222 G-2017

Keterangan : ^{a)} Baku Mutu Air Sungai dan Sejenisnya dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VI – Kelas 3)

^{b)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017)

^{c)} Hasil analisa in-situ (lapangan)

< Kurang dari batas deteksi yang dapat dilaporkan

LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Phytoplankton		
No.	Organism	Hasil
	Bacillariophyceae	
1	<i>Bacteriastrium sp.</i>	1464
2	<i>Coscinodiscus sp.</i>	1301
3	<i>Navicula sp.</i>	1139
4	<i>Diploneis sp.</i>	976
5	<i>Cyclotella sp.</i>	813
	Cyanophyceae	
6	<i>Cloniophora sp.</i>	488
	Kelimpahan (Sel/m3)	6182
	Jumlah Taksa (S)	6
	Indeks Keragaman (H')	1.54
	Indeks Keseragaman (E)	0.86
	Indeks Dominasi (D)	0.18

Zooplankton		
No.	Organism	Hasil
	Ciliata	
1	<i>Eutintinnus sp.</i>	163
2	<i>Favella sp.</i>	488
3	<i>Tintinnopsis sp.</i>	813
	Protozoa	
4	<i>Arcella sp.</i>	1139
	Crustaceae	
5	<i>Nauplius sp.</i>	325
	Kelimpahan (Sel/m3)	2928
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	1.13
	Indeks Keseragaman (E)	0.71
	Indeks Dominasi (D)	0,14

Benthos		
No.	Organism	Hasil
	Nematoda	
1	<i>Melanoides sp.</i>	8
2	<i>Leptolaimus sp.</i>	5
	Naididae	
3	<i>Naidium</i>	9
	Oligochaeta	
4	<i>Lumbriculus sp.</i>	1
	Kelimpahan (Sel/m3)	23
	Jumlah Taksa (S)	4
	Indeks Keragaman (H')	1.11
	Indeks Keseragaman (E)	0.80
	Indeks Dominasi (D)	0.18

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AP-5
Jenis Contoh : Air Permukaan & Biota
Lokasi : Sungai Batang Asam S
Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-13
Koordinat : S 0°56'13.35" E 102°57'57.60"
Waktu Sampling : 15:10 WIB

No.	Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
1.	Suhu ^{1) *)}	27,0	Deviasi 3	-	°C	SNI 06-6989.23-2005
2.	pH ^{1) *)}	7,15	6 – 9	-	-	SNI 06-6989.11-2004
3.	Padatan Terlarut Total (TDS) ^{*)}	329	1000	4,8	mg/L	SNI 06-6989.27-2005
4.	Padatan Tersuspensi Total (TSS) ^{*)}	25	100	4,2	mg/L	SNI 06-6989.3-2004
5.	Warna	3,50	100	0,05	Pt-Co	SNI 06-6989.24-2005
6.	Kebutuhan Oksigen Biokimia (BOD)	3	6	2	mg/L	APHA 5210 B-2017
7.	Kebutuhan Oksigen Kimiawi (COD)	22	40	4	mg/L	SNI 6989:73-2009
8.	Oksigen Terlarut (DO) ^{*)}	5,7	Minimum 3	2,1	mg/L	SNI 06-6989.14-2004
9.	Sulfat (SO ₄ ²⁻)	32	300	3	mg/L	SNI 6989.20:2009
10.	Klorida (Cl ⁻) ^{*)}	23,7	300	2,9	mg/L	SNI 6989.19:2009
11.	Nitrat (NO ₃ -N)	3,15	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
12.	Nitrit (NO ₂ -N) ^{*)}	0,03	0,06	0,02	mg/L	SNI 06-6989.9-2004
13.	Amonia (NH ₃ -N) ^{*)}	0,17	0,5	0,04	mg/L	SNI 06-6989.30-2005
14.	Total Nitrogen	13	25	0,005	mg/L	APHA 4500-N C-2017
15.	Fosfat Total (sebagai P)	0,20	1,0	0,02	mg/L	SNI 06-6989.31-2005
16.	Fluorida (F ⁻)	0,14	1,5	0,06	mg/L	SNI 06-6989.29-2005
17.	Sulfur (sebagai H ₂ S)	<0,001	0,002	0,001	mg/L	APHA 4500-S ²⁻ F-2017
18.	Sianida (CN ⁻)	0,006	0,02	0,004	mg/L	APHA 4500-CN ⁻ E-2017
19.	Klorin Bebas (Cl ₂)	<0,02	0,03	0,02	mg/L	APHA 4500-Cl G-2017
20.	Boron (B)	0,05	1,0	0,01	mg/L	APHA 3120 B-2017
21.	Raksa (Hg)	0,0004	0,002	0,0002	mg/L	APHA 3112 B-2017
22.	Arsen (As)	0,009	0,05	0,002	mg/L	APHA 3114 B-2017
23.	Selenium (Se)	<0,002	0,05	0,002	mg/L	APHA 3114 B-2017
24.	Kadmium (Cd)	<0,002	0,01	0,002	mg/L	SNI 6989.16:2009
25.	Kobalt (Co)	<0,04	0,2	0,04	mg/L	APHA 3111 B-2017
26.	Nikel (Ni)	<0,01	0,05	0,01	mg/L	SNI 6989.18:2009
27.	Seng (Zn)	0,022	0,05	0,008	mg/L	SNI 6989.7:2009
28.	Tembaga (Cu)	0,008	0,02	0,007	mg/L	SNI 6989.6:2009
29.	Timbal (Pb)	<0,02	0,03	0,02	mg/L	SNI 6989.8:2009
30.	Krom Heksavalen (Cr-VI)	<0,03	0,05	0,03	mg/L	SNI 6989.71:2009
31.	Minyak dan Lemak ^{*)}	<0,8	1	0,8	mg/L	SNI 6989.10:2011

32.	Detergen total ^{a)}	0,15	0,2	0,08	mg/L	SNI 06-6989.51-2005
33.	Fenol	0,002	0,01	0,001	mg/L	SNI 06-6989.21-2004
34.	Fecal Coliform	812	2.000	0	MPN / 100 mL	APHA 9222 B-2017
35.	Total Coliform	1024	10.000	0	MPN / 100 mL	APHA 9222 G-2017

Keterangan : ^{a)} Baku Mutu Air Sungai dan Sejenisnya dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VI – Kelas 3)

^{b)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017)

^{c)} Hasil analisa in-situ (lapangan)

< Kurang dari batas deteksi yang dapat dilaporkan

LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Phytoplankton		
No.	Organism	Hasil
	Bacillariophyceae	
1	<i>Bacteriastrium sp.</i>	651
2	<i>Coscinodiscus sp.</i>	325
3	<i>Navicula sp.</i>	488
4	<i>Diploneis sp.</i>	163
5	<i>Cyclotella sp.</i>	813
	Cyanophyceae	
6	<i>Cloniophora sp.</i>	1139
7	<i>Pediastrum sp.</i>	1464
	Kelimpahan (Sel/m ³)	5043
	Jumlah Taksa (S)	7
	Indeks Keragaman (H')	0.93
	Indeks Keseragaman (E)	0.48
	Indeks Dominasi (D)	0.12

Zooplankton		
No.	Organism	Hasil
	Ciliata	
1	<i>Eutintinnus sp.</i>	163
2	<i>Favella sp.</i>	325
	Protozoa	
3	<i>Arcella sp.</i>	488
	Crustaceae	
4	<i>Nauplius sp.</i>	651
	Kelimpahan (Sel/m ³)	1627
	Jumlah Taksa (S)	4
	Indeks Keragaman (H')	0.88
	Indeks Keseragaman (E)	0.63
	Indeks Dominasi (D)	0.05
Benthos		
No.	Organism	Hasil
	Nematoda	
1	<i>Melanoides sp.</i>	3
2	<i>Leptolaimus sp.</i>	5
	Naididae	
3	<i>Naidium</i>	1
	Oligochaeta	
4	<i>Lumbriculus sp.</i>	7
5	<i>Branchiura sp.</i>	9
	Kelimpahan (Sel/m ³)	25
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	0.69
	Indeks Keseragaman (E)	0.43
	Indeks Dominasi (D)	0.24

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AP-6
Jenis Contoh : Air Permukaan & Biota
Lokasi : Sungai Keruing Sta 138+296
Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-14
Koordinat : S 0°42'25.87" E 102°38'28.71"
Waktu Sampling : 11:45 WIB

No.	Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
1.	Suhu ^{1) *)}	29,0	Deviasi 3	-	°C	SNI 06-6989.23-2005
2.	pH ^{1) *)}	7,20	6 – 9	-	-	SNI 06-6989.11-2004
3.	Padatan Terlarut Total (TDS) ^{*)}	485	1000	4,8	mg/L	SNI 06-6989.27-2005
4.	Padatan Tersuspensi Total (TSS) ^{*)}	29	100	4,2	mg/L	SNI 06-6989.3-2004
5.	Warna	3,40	100	0,05	Pt-Co	SNI 06-6989.24-2005
6.	Kebutuhan Oksigen Biokimia (BOD)	3	6	2	mg/L	APHA 5210 B-2017
7.	Kebutuhan Oksigen Kimiawi (COD)	20	40	4	mg/L	SNI 6989.73-2009
8.	Oksigen Terlarut (DO) ^{*)}	5,4	Minimum 3	2,1	mg/L	SNI 06-6989.14-2004
9.	Sulfat (SO ₄ ²⁻)	28	300	3	mg/L	SNI 6989.20:2009
10.	Klorida (Cl ⁻) ^{*)}	20,2	300	2,9	mg/L	SNI 6989.19:2009
11.	Nitrat (NO ₃ -N)	3,04	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
12.	Nitrit (NO ₂ -N) ^{*)}	0,02	0,06	0,02	mg/L	SNI 06-6989.9-2004
13.	Amonia (NH ₃ -N) ^{*)}	0,20	0,5	0,04	mg/L	SNI 06-6989.30-2005
14.	Total Nitrogen	10	25	0,005	mg/L	APHA 4500-N C-2017
15.	Fosfat Total (sebagai P)	0,17	1,0	0,02	mg/L	SNI 06-6989.31-2005
16.	Fluorida (F ⁻)	0,11	1,5	0,06	mg/L	SNI 06-6989.29-2005
17.	Sulfur (sebagai H ₂ S)	<0,001	0,002	0,001	mg/L	APHA 4500-S ²⁻ F-2017
18.	Sianida (CN ⁻)	0,005	0,02	0,004	mg/L	APHA 4500-CN ⁻ E-2017
19.	Klorin Bebas (Cl ₂)	<0,02	0,03	0,02	mg/L	APHA 4500-Cl G-2017
20.	Boron (B)	04	1,0	0,01	mg/L	APHA 3120 B-2017
21.	Raksa (Hg)	0,0003	0,002	0,0002	mg/L	APHA 3112 B-2017
22.	Arsen (As)	0,007	0,05	0,002	mg/L	APHA 3114 B-2017
23.	Selenium (Se)	<0,002	0,05	0,002	mg/L	APHA 3114 B-2017
24.	Kadmium (Cd)	<0,002	0,01	0,002	mg/L	SNI 6989.16:2009
25.	Kobalt (Co)	<0,04	0,2	0,04	mg/L	APHA 3111 B-2017
26.	Nikel (Ni)	<0,01	0,05	0,01	mg/L	SNI 6989.18:2009
27.	Seng (Zn)	0,018	0,05	0,008	mg/L	SNI 6989.7:2009
28.	Tembaga (Cu)	<0,007	0,02	0,007	mg/L	SNI 6989.6:2009
29.	Timbal (Pb)	<0,02	0,03	0,02	mg/L	SNI 6989.8:2009
30.	Krom Heksavalen (Cr-VI)	<0,03	0,05	0,03	mg/L	SNI 6989.71:2009
31.	Minyak dan Lemak ^{*)}	<0,8	1	0,8	mg/L	SNI 6989.10:2011

32.	Detergen total ^{a)}	0,13	0,2	0,08	mg/L	SNI 06-6989.51-2005
33.	Fenol	<0,001	0,01	0,001	mg/L	SNI 06-6989.21-2004
34.	Fecal Coliform	905	2.000	0	MPN / 100 mL	APHA 9222 B-2017
35.	Total Coliform	1289	10.000	0	MPN / 100 mL	APHA 9222 G-2017

Keterangan : ^{a)} Baku Mutu Air Sungai dan Sejenisnya dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VI – Kelas 3)

^{b)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017)

^{c)} Hasil analisa in-situ (lapangan)

< Kurang dari batas deteksi yang dapat dilaporkan

LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Phytoplankton		
No.	Organism	Hasil
	Bacillariophyceae	
1	<i>Bacteriastrium sp.</i>	1464
2	<i>Coscinodiscus sp.</i>	813
3	<i>Navicula sp.</i>	976
4	<i>Diploneis sp.</i>	488
5	<i>Cyclotella sp.</i>	163
	Cyanophyceae	
6	<i>Spirogyra sp.</i>	1139
7	<i>Pediastrum sp.</i>	651
	Kelimpahan (Sel/m3)	5694
	Jumlah Taksa (S)	7
	Indeks Keragaman (H')	1.20
	Indeks Keseragaman (E)	0.61
	Indeks Dominasi (D)	0.15

Zooplankton		
No.	Organism	Hasil
	Ciliata	
1	<i>Eutintinnus sp.</i>	813
2	<i>Favella sp.</i>	976
	Crustaceae	
3	<i>Nauplius sp.</i>	1139
	Kelimpahan (Sel/m3)	2928
	Jumlah Taksa (S)	3
	Indeks Keragaman (H')	1.02
	Indeks Keseragaman (E)	0.93
	Indeks Dominasi (D)	0.18
Benthos		
No.	Organism	Hasil
	Nematoda	
1	<i>Melanoides sp.</i>	1
2	<i>Leptolaimus sp.</i>	9
	Naididae	
3	<i>Naidium</i>	7
	Oligochaeta	
4	<i>Branchiura sp</i>	8
	Kelimpahan (Sel/m3)	25
	Jumlah Taksa (S)	4
	Indeks Keragaman (H')	0.81
	Indeks Keseragaman (E)	0.58
	Indeks Dominasi (D)	0.20

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
 Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
 u.p. : -

ID Contoh : AP-7
 Jenis Contoh : Air Permukaan & Biota
 Lokasi : Sungai Keritang Sta 154+385
 Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-15
 Koordinat : S 0°49'43.02" E 102°43'24.48"
 Waktu Sampling : 13:20 WIB

No.	Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
1.	Suhu ^{1) *)}	29,5	Deviasi 3	-	°C	SNI 06-6989.23-2005
2.	pH ^{1) *)}	7,30	6 – 9	-	-	SNI 06-6989.11-2004
3.	Padatan Terlarut Total (TDS) ^{*)}	266	1000	4,8	mg/L	SNI 06-6989.27-2005
4.	Padatan Tersuspensi Total (TSS) ^{*)}	33	100	4,2	mg/L	SNI 06-6989.3-2004
5.	Warna	4,71	100	0,05	Pt-Co	SNI 06-6989.24-2005
6.	Kebutuhan Oksigen Biokimia (BOD)	5	6	2	mg/L	APHA 5210 B-2017
7.	Kebutuhan Oksigen Kimiawi (COD)	29	40	4	mg/L	SNI 6989.73-2009
8.	Oksigen Terlarut (DO) ^{*)}	5,7	Minimum 3	2,1	mg/L	SNI 06-6989.14-2004
9.	Sulfat (SO ₄ ²⁻)	39	300	3	mg/L	SNI 6989.20:2009
10.	Klorida (Cl ⁻) ^{*)}	28,5	300	2,9	mg/L	SNI 6989.19:2009
11.	Nitrat (NO ₃ -N)	4,96	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
12.	Nitrit (NO ₂ -N) ^{*)}	0,05	0,06	0,02	mg/L	SNI 06-6989.9-2004
13.	Amonia (NH ₃ -N) ^{*)}	0,45	0,5	0,04	mg/L	SNI 06-6989.30-2005
14.	Total Nitrogen	20	25	0,005	mg/L	APHA 4500-N C-2017
15.	Fosfat Total (sebagai P)	0,32	1,0	0,02	mg/L	SNI 06-6989.31-2005
16.	Fluorida (F ⁻)	0,25	1,5	0,06	mg/L	SNI 06-6989.29-2005
17.	Sulfur (sebagai H ₂ S)	<0,001	0,002	0,001	mg/L	APHA 4500-S ²⁻ F-2017
18.	Sianida (CN ⁻)	0,007	0,02	0,004	mg/L	APHA 4500-CN ⁻ E-2017
19.	Klorin Bebas (Cl ₂)	<0,02	0,03	0,02	mg/L	APHA 4500-Cl G-2017
20.	Boron (B)	0,08	1,0	0,01	mg/L	APHA 3120 B-2017
21.	Raksa (Hg)	0,0009	0,002	0,0002	mg/L	APHA 3112 B-2017
22.	Arsen (As)	0,013	0,05	0,002	mg/L	APHA 3114 B-2017
23.	Selenium (Se)	0,004	0,05	0,002	mg/L	APHA 3114 B-2017
24.	Kadmium (Cd)	0,007	0,01	0,002	mg/L	SNI 6989.16:2009
25.	Kobalt (Co)	<0,04	0,2	0,04	mg/L	APHA 3111 B-2017
26.	Nikel (Ni)	0,02	0,05	0,01	mg/L	SNI 6989.18:2009
27.	Seng (Zn)	0,030	0,05	0,008	mg/L	SNI 6989.7:2009
28.	Tembaga (Cu)	0,014	0,02	0,007	mg/L	SNI 6989.6:2009
29.	Timbal (Pb)	<0,02	0,03	0,02	mg/L	SNI 6989.8:2009
30.	Krom Heksavalen (Cr-VI)	<0,03	0,05	0,03	mg/L	SNI 6989.71:2009
31.	Minyak dan Lemak ^{*)}	<0,8	1	0,8	mg/L	SNI 6989.10:2011

32.	Detergen total ^{a)}	0,14	0,2	0,08	mg/L	SNI 06-6989.51-2005
33.	Fenol	<0,001	0,01	0,001	mg/L	SNI 06-6989.21-2004
34.	Fecal Coliform	495	2.000	0	MPN / 100 mL	APHA 9222 B-2017
35.	Total Coliform	899	10.000	0	MPN / 100 mL	APHA 9222 G-2017

Keterangan : ^{a)} Baku Mutu Air Sungai dan Sejenisnya dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VI – Kelas 3)

^{b)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017)

^{c)} Hasil analisa in-situ (lapangan)

< Kurang dari batas deteksi yang dapat dilaporkan

LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Phytoplankton		
No.	Organism	Hasil
	Bacillariophyceae	
1	<i>Bacteriastrum sp.</i>	1464
2	<i>Coscinodiscus sp.</i>	1301
3	<i>Navicula sp.</i>	1139
4	<i>Diploneis sp.</i>	976
5	<i>Cyclotella sp.</i>	813
	Cyanophyceae	
6	<i>Cloniophora sp.</i>	651
7	<i>Pediastrum sp.</i>	488
	Kelimpahan (Sel/m ³)	6833
	Jumlah Taksa (S)	7
	Indeks Keragaman (H')	1.51
	Indeks Keseragaman (E)	0.77
	Indeks Dominasi (D)	0.18

Zooplankton		
No.	Organism	Hasil
	Ciliata	
1	<i>Eutintinnus sp.</i>	488
2	<i>Favella sp.</i>	163
	Crustaceae	
3	<i>Nauplius sp.</i>	813
4	<i>Calanus sp.</i>	1139
	Kelimpahan (Sel/m ³)	2603
	Jumlah Taksa (S)	4
	Indeks Keragaman (H')	0.74
	Indeks Keseragaman (E)	0.53
	Indeks Dominasi (D)	0.13
Benthos		
No.	Organism	Hasil
	Nematoda	
1	<i>Melanoides sp.</i>	1
2	<i>Leptolaimus sp.</i>	5
	Naididae	
3	<i>Naidium</i>	7
	OLIGOCHAETA	
4	<i>Limnodrillus sp.</i>	8
	Kelimpahan (Sel/m ³)	21
	Jumlah Taksa (S)	4
	Indeks Keragaman (H')	0.80
	Indeks Keseragaman (E)	0.57
	Indeks Dominasi (D)	0.21

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AP-8
Jenis Contoh : Air Permukaan & Biota
Lokasi : Sungai Ketilang Sta 164+438
Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-16
Koordinat : S 0°49'26.81" E 102°43'10.04"
Waktu Sampling : 14:10 WIB

No.	Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
1.	Suhu ^{1) *)}	28,0	Deviasi 3	-	°C	SNI 06-6989.23-2005
2.	pH ^{1) *)}	7,20	6 – 9	-	-	SNI 06-6989.11-2004
3.	Padatan Terlarut Total (TDS) ^{*)}	430	1000	4,8	mg/L	SNI 06-6989.27-2005
4.	Padatan Tersuspensi Total (TSS) ^{*)}	22	100	4,2	mg/L	SNI 06-6989.3-2004
5.	Warna	3,12	100	0,05	Pt-Co	SNI 06-6989.24-2005
6.	Kebutuhan Oksigen Biokimia (BOD)	4	6	2	mg/L	APHA 5210 B-2017
7.	Kebutuhan Oksigen Kimiawi (COD)	27	40	4	mg/L	SNI 6989.73-2009
8.	Oksigen Terlarut (DO) ^{*)}	5,2	Minimum 3	2,1	mg/L	SNI 06-6989.14-2004
9.	Sulfat (SO ₄ ²⁻)	34	300	3	mg/L	SNI 6989.20:2009
10.	Klorida (Cl ⁻) ^{*)}	25,7	300	2,9	mg/L	SNI 6989.19:2009
11.	Nitrat (NO ₃ -N)	3,57	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
12.	Nitrit (NO ₂ -N) ^{*)}	0,03	0,06	0,02	mg/L	SNI 06-6989.9-2004
13.	Amonia (NH ₃ -N) ^{*)}	0,34	0,5	0,04	mg/L	SNI 06-6989.30-2005
14.	Total Nitrogen	16	25	0,005	mg/L	APHA 4500-N C-2017
15.	Fosfat Total (sebagai P)	0,27	1,0	0,02	mg/L	SNI 06-6989.31-2005
16.	Fluorida (F ⁻)	0,23	1,5	0,06	mg/L	SNI 06-6989.29-2005
17.	Sulfur (sebagai H ₂ S)	<0,001	0,002	0,001	mg/L	APHA 4500-S ²⁻ F-2017
18.	Sianida (CN ⁻)	0,005	0,02	0,004	mg/L	APHA 4500-CN ⁻ E-2017
19.	Klorin Bebas (Cl ₂)	<0,02	0,03	0,02	mg/L	APHA 4500-Cl G-2017
20.	Boron (B)	0,04	1,0	0,01	mg/L	APHA 3120 B-2017
21.	Raksa (Hg)	0,0005	0,002	0,0002	mg/L	APHA 3112 B-2017
22.	Arsen (As)	0,008	0,05	0,002	mg/L	APHA 3114 B-2017
23.	Selenium (Se)	<0,002	0,05	0,002	mg/L	APHA 3114 B-2017
24.	Kadmium (Cd)	0,005	0,01	0,002	mg/L	SNI 6989.16:2009
25.	Kobalt (Co)	<0,04	0,2	0,04	mg/L	APHA 3111 B-2017
26.	Nikel (Ni)	<0,01	0,05	0,01	mg/L	SNI 6989.18:2009
27.	Seng (Zn)	0,027	0,05	0,008	mg/L	SNI 6989.7:2009
28.	Tembaga (Cu)	0,010	0,02	0,007	mg/L	SNI 6989.6:2009
29.	Timbal (Pb)	<0,02	0,03	0,02	mg/L	SNI 6989.8:2009
30.	Krom Heksavalen (Cr-VI)	<0,03	0,05	0,03	mg/L	SNI 6989.71:2009
31.	Minyak dan Lemak ^{*)}	<0,8	1	0,8	mg/L	SNI 6989.10:2011

32.	Detergen total ^{a)}	<0,08	0,2	0,08	mg/L	SNI 06-6989.51-2005
33.	Fenol	<0,001	0,01	0,001	mg/L	SNI 06-6989.21-2004
34.	Fecal Coliform	820	2.000	0	MPN / 100 mL	APHA 9222 B-2017
35.	Total Coliform	1312	10.000	0	MPN / 100 mL	APHA 9222 G-2017

Keterangan : ^{a)} Baku Mutu Air Sungai dan Sejenisnya dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VI – Kelas 3)

^{b)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017)

^{c)} Hasil analisa in-situ (lapangan)

< Kurang dari batas deteksi yang dapat dilaporkan

LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Phytoplankton		
No.	Organism	Hasil
	Bacillariophyceae	
1	<i>Bacteriastrium sp.</i>	163
2	<i>Coscinodiscus sp.</i>	488
3	<i>Navicula sp.</i>	813
4	<i>Diploneis sp.</i>	1139
5	<i>Synedra sp.</i>	1464
6	<i>Surirella sp.</i>	325
	Kelimpahan (Sel/m3)	4392
	Jumlah Taksa (S)	6
	Indeks Keragaman (H')	1.37
	Indeks Keseragaman (E)	0.77
	Indeks Dominasi (D)	0.12

Zooplankton		
No.	Organism	Hasil
	Ciliata	
1	<i>Eutintinnus sp.</i>	976
2	<i>Favella sp.</i>	1139
	Protozoa	
3	<i>Arcella sp.</i>	1464
	Crustaceae	
4	<i>Nauplius sp.</i>	325
	Kelimpahan (Sel/m3)	3904
	Jumlah Taksa (S)	4
	Indeks Keragaman (H')	1.27
	Indeks Keseragaman (E)	0.92
	Indeks Dominasi (D)	0.27

Benthos		
No.	Organism	Hasil
	Nematoda	
1	<i>Melanoides sp.</i>	4
2	<i>Leptolaimus sp.</i>	6
	Naididae	
3	<i>Naidium</i>	8
	OLIGOCHAETA	
4	<i>Branchiura sp</i>	9
5	<i>Lumbriculus sp.</i>	1
	Kelimpahan (Sel/m3)	28
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	0.93
	Indeks Keseragaman (E)	0.58
	Indeks Dominasi (D)	0.21

Kepala Laboratorium



 RND
 TEKNOLOGI INDONESIA

Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AP-9
Jenis Contoh : Air Permukaan & Biota
Lokasi : Sungai Ketilang Gangsal Sta 176+030
Tanggal Sampling : 31 Oktober 2023

ID Lab : 23100301-17
Koordinat : S 0°37'45.63" E 102°35'43.60"
Waktu Sampling : 11:15 WIB

No.	Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
1.	Suhu ^{1) *)}	29,0	Deviasi 3	-	°C	SNI 06-6989.23-2005
2.	pH ^{1) *)}	7,0	6 – 9	-	-	SNI 06-6989.11-2004
3.	Padatan Terlarut Total (TDS) ^{*)}	182	1000	4,8	mg/L	SNI 06-6989.27-2005
4.	Padatan Tersuspensi Total (TSS) ^{*)}	19	100	4,2	mg/L	SNI 06-6989.3-2004
5.	Warna	2,49	100	2	Pt-Co	SNI 06-6989.24-2005
6.	Kebutuhan Oksigen Biokimia (BOD)	3	6	2	mg/L	APHA 5210 B-2017
7.	Kebutuhan Oksigen Kimiawi (COD)	15	40	4	mg/L	SNI 6989.73-2009
8.	Oksigen Terlarut (DO) ^{*)}	5,3	Minimum 3	2,1	mg/L	SNI 06-6989.14-2004
9.	Sulfat (SO ₄ ²⁻)	22	300	3	mg/L	SNI 6989.20:2009
10.	Klorida (Cl ⁻) ^{*)}	16	300	2,9	mg/L	SNI 6989.19:2009
11.	Nitrat (NO ₃ -N)	0,84	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
12.	Nitrit (NO ₂ -N) ^{*)}	0,04	0,06	0,02	mg/L	SNI 06-6989.9-2004
13.	Amonia (NH ₃ -N) ^{*)}	0,08	0,5	0,04	mg/L	SNI 06-6989.30-2005
14.	Total Nitrogen	10,9	25	0,005	mg/L	APHA 4500-N C-2017
15.	Fosfat Total (sebagai P)	<0,02	1,0	0,02	mg/L	SNI 06-6989.31-2005
16.	Fluorida (F ⁻)	<0,06	1,5	0,06	mg/L	SNI 06-6989.29-2005
17.	Sulfur (sebagai H ₂ S)	<0,001	0,002	0,001	mg/L	APHA 4500-S ²⁻ F-2017
18.	Sianida (CN ⁻)	<0,004	0,02	0,004	mg/L	APHA 4500-CN ⁻ E-2017
19.	Klorin Bebas (Cl ₂)	<0,02	0,03	0,02	mg/L	APHA 4500-Cl G-2017
20.	Boron (B)	0,04	1,0	0,01	mg/L	APHA 3120 B-2017
21.	Raksa (Hg)	<0,0002	0,002	0,0002	mg/L	APHA 3112 B-2017
22.	Arsen (As)	0,007	0,05	0,002	mg/L	APHA 3114 B-2017
23.	Selenium (Se)	<0,002	0,05	0,002	mg/L	APHA 3114 B-2017
24.	Kadmium (Cd)	0,004	0,01	0,002	mg/L	SNI 6989.16:2009
25.	Kobalt (Co)	<0,04	0,2	0,04	mg/L	APHA 3111 B-2017
26.	Nikel (Ni)	<0,01	0,05	0,01	mg/L	SNI 6989.18:2009
27.	Seng (Zn)	0,021	0,05	0,008	mg/L	SNI 6989.7:2009
28.	Tembaga (Cu)	<0,007	0,02	0,007	mg/L	SNI 6989.6:2009
29.	Timbal (Pb)	<0,02	0,03	0,02	mg/L	SNI 6989.8:2009
30.	Krom Heksavalen (Cr-VI)	<0,03	0,05	0,03	mg/L	SNI 6989.71:2009
31.	Minyak dan Lemak ^{*)}	<0,8	1	0,8	mg/L	SNI 6989.10:2011

32.	Detergen total ^{a)}	0,11	0,2	0,08	mg/L	SNI 06-6989.51-2005
33.	Fenol	<0,001	0,01	0,001	mg/L	SNI 06-6989.21-2004
34.	Fecal Coliform	532	2.000	0	MPN / 100 mL	APHA 9222 B-2017
35.	Total Coliform	875	10.000	0	MPN / 100 mL	APHA 9222 G-2017

Keterangan : ^{a)} Baku Mutu Air Sungai dan Sejenisnya dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VI – Kelas 3)

^{b)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017)

^{c)} Hasil analisa in-situ (lapangan)

< Kurang dari batas deteksi yang dapat dilaporkan

LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Phytoplankton		
No.	Organism	Hasil
	Bacillariophyceae	
1	<i>Bacteriastrium sp.</i>	651
2	<i>Coscinodiscus sp.</i>	976
3	<i>Navicula sp.</i>	1301
4	<i>Synedra sp.</i>	163
5	<i>Cyclotella sp.</i>	488
6	<i>Surirella sp.</i>	813
	Cyanophyceae	
7	<i>Cloniophora sp.</i>	1139
	Kelimpahan (Sel/m ³)	5531
	Jumlah Taksa (S)	7
	Indeks Keragaman (H')	1.38
	Indeks Keseragaman (E)	0.71
	Indeks Dominasi (D)	0.13

Zooplankton		
No.	Organism	Hasil
	Ciliata	
1	<i>Eutintinnus sp.</i>	651
2	<i>Favella sp.</i>	976
	Protozoa	
3	<i>Arcella sp.</i>	1464
	Crustaceae	
4	<i>Calanus sp.</i>	163
5	<i>Nauplius sp.</i>	813
	Kelimpahan (Sel/m ³)	4067
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	1.00
	Indeks Keseragaman (E)	0.62
	Indeks Dominasi (D)	0.25
Benthos		
No.	Organism	Hasil
	Nematoda	
1	<i>Melanoides sp.</i>	9
2	<i>Leptolaimus sp.</i>	6
	Naididae	
3	<i>Naidium</i>	3
	Oligochaeta	
4	<i>Limnodrillus sp.</i>	2
5	<i>Lumbriculus sp.</i>	
	Kelimpahan (Sel/m ³)	29
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	1.32
	Indeks Keseragaman (E)	0.82
	Indeks Dominasi (D)	0.31

Kepala Laboratorium



 RND
 TEKNOLOGI INDONESIA

Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2310-0301
Tanggal Pelaporan : 15 November 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : AP-10
Jenis Contoh : Air Permukaan & Biota
Lokasi : Sungai Cenaku Sta 176+030
Tanggal Sampling : 01 November 2023

ID Lab : 23100301-18
Koordinat : S 0°34'7.38" E 102°30'47.31"
Waktu Sampling : 08:00 WIB

No.	Parameter Analisa	Hasil	Baku Mutu ^{a)}	LOD	Unit	Metode Analisa
1.	Suhu ^{1) *)}	27,5	Deviasi 3	-	°C	SNI 06-6989.23-2005
2.	pH ^{1) *)}	7,15	6 – 9	-	-	SNI 06-6989.11-2004
3.	Padatan Terlarut Total (TDS) ^{*)}	180	1000	4,8	mg/L	SNI 06-6989.27-2005
4.	Padatan Tersuspensi Total (TSS) ^{*)}	17	100	4,2	mg/L	SNI 06-6989.3-2004
5.	Warna	2,48	100	2	Pt-Co	SNI 06-6989.24-2005
6.	Kebutuhan Oksigen Biokimia (BOD)	3	6	2	mg/L	APHA 5210 B-2017
7.	Kebutuhan Oksigen Kimiawi (COD)	14	40	4	mg/L	SNI 6989.73-2009
8.	Oksigen Terlarut (DO) ^{*)}	5,2	Minimum 3	2,1	mg/L	SNI 06-6989.14-2004
9.	Sulfat (SO ₄ ²⁻)	20	300	3	mg/L	SNI 6989.20:2009
10.	Klorida (Cl ⁻) ^{*)}	15	300	2,9	mg/L	SNI 6989.19:2009
11.	Nitrat (NO ₃ -N)	0,82	20	0,08	mg/L	APHA 4500-NO ₃ ⁻ C-2017
12.	Nitrit (NO ₂ -N) ^{*)}	0,04	0,06	0,02	mg/L	SNI 06-6989.9-2004
13.	Amonia (NH ₃ -N) ^{*)}	0,07	0,5	0,04	mg/L	SNI 06-6989.30-2005
14.	Total Nitrogen	9,5	25	0,005	mg/L	APHA 4500-N C-2017
15.	Fosfat Total (sebagai P)	<0,02	1,0	0,02	mg/L	SNI 06-6989.31-2005
16.	Fluorida (F ⁻)	<0,06	1,5	0,06	mg/L	SNI 06-6989.29-2005
17.	Sulfur (sebagai H ₂ S)	<0,001	0,002	0,001	mg/L	APHA 4500-S ²⁻ F-2017
18.	Sianida (CN ⁻)	<0,004	0,02	0,004	mg/L	APHA 4500-CN ⁻ E-2017
19.	Klorin Bebas (Cl ₂)	<0,02	0,03	0,02	mg/L	APHA 4500-Cl G-2017
20.	Boron (B)	<0,01	1,0	0,01	mg/L	APHA 3120 B-2017
21.	Raksa (Hg)	<0,0002	0,002	0,0002	mg/L	APHA 3112 B-2017
22.	Arsen (As)	0,005	0,05	0,002	mg/L	APHA 3114 B-2017
23.	Selenium (Se)	<0,002	0,05	0,002	mg/L	APHA 3114 B-2017
24.	Kadmium (Cd)	0,003	0,01	0,002	mg/L	SNI 6989.16:2009
25.	Kobalt (Co)	<0,04	0,2	0,04	mg/L	APHA 3111 B-2017
26.	Nikel (Ni)	<0,01	0,05	0,01	mg/L	SNI 6989.18:2009
27.	Seng (Zn)	0,020	0,05	0,008	mg/L	SNI 6989.7:2009
28.	Tembaga (Cu)	<0,007	0,02	0,007	mg/L	SNI 6989.6:2009
29.	Timbal (Pb)	<0,02	0,03	0,02	mg/L	SNI 6989.8:2009
30.	Krom Heksavalen (Cr-VI)	<0,03	0,05	0,03	mg/L	SNI 6989.71:2009
31.	Minyak dan Lemak ^{*)}	<0,8	1	0,8	mg/L	SNI 6989.10:2011

32.	Detergen total ^{a)}	<0,08	0,2	0,08	mg/L	SNI 06-6989.51-2005
33.	Fenol	<0,001	0,01	0,001	mg/L	SNI 06-6989.21-2004
34.	Fecal Coliform	614	2.000	0	MPN / 100 mL	APHA 9222 B-2017
35.	Total Coliform	942	10.000	0	MPN / 100 mL	APHA 9222 G-2017

Keterangan : ^{a)} Baku Mutu Air Sungai dan Sejenisnya dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VI – Kelas 3)

^{b)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017)

^{c)} Hasil analisa in-situ (lapangan)

< Kurang dari batas deteksi yang dapat dilaporkan

LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Phytoplankton		
No.	Organism	Hasil
	Bacillariophyceae	
1	<i>Bacteriastrum sp.</i>	163
2	<i>Coscinodiscus sp.</i>	651
3	<i>Navicula sp.</i>	1139
4	<i>Diploneis sp.</i>	235
5	<i>Surirella sp.</i>	651
	Kelimpahan (Sel/m3)	2928
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	1.04
	Indeks Keseragaman (E)	1.64
	Indeks Dominasi (D)	0.06

Zooplankton		
No.	Organism	Hasil
	Ciliata	
1	<i>Eutintinnus sp.</i>	651
2	<i>Favella sp.</i>	488
	Protozoa	
3	<i>Arcella sp.</i>	163
	Crustaceae	
4	<i>Calanus sp.</i>	488
5	<i>Nauplius sp.</i>	976
	Kelimpahan (Sel/m3)	2766
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	0.68
	Indeks Keseragaman (E)	0.42
	Indeks Dominasi (D)	0.11

Benthos		
No.	Organism	Hasil
	Nematoda	
1	<i>Melanoides sp.</i>	1
2	<i>Leptolaimus sp.</i>	4
	Naididae	
3	<i>Naidium</i>	6
	Oligochaeta	
4	<i>Limnodrillus sp.</i>	9
5	<i>Lumbriculus sp.</i>	3
	Kelimpahan (Sel/m3)	23
	Jumlah Taksa (S)	5
	Indeks Keragaman (H')	0.92
	Indeks Keseragaman (E)	0.57
	Indeks Dominasi (D)	0.15

Kepala Laboratorium




Dahlan Suteja

SERTIFIKAT HASIL ANALISA
Nomor Sertifikat: RND 2311-0340

SERTIFIKAT HASIL ANALISA

Nomor Sertifikat: RND 2311-0340

Nomor Seri Pekerjaan : 2311-0340

Tanggal Pelaporan : 08 Desember 2023

Pelanggan : PT. Kwarsa Hexagon

PT. Utama Karya Indonesia

Alamat : Jl. Rancabolang No.36, Sekejati, Kec. Buah Batu, Kota
Bandung

u.p. : -

Deskripsi : Uji Kualitas Lingkungan

Jumlah Halaman : 10 halaman

Catatan : -

Kepala Laboratorium




Dahlan Suteja

Sertifikat ini diterbitkan sesuai dengan syarat dan ketentuan PT RND Teknologi Indonesia. Hasil yang dilaporkan hanya berlaku untuk contoh yang diuji.
Sertifikat ini tidak boleh diperbanyak kecuali secara keseluruhan (utuh), tanpa persetujuan tertulis dari PT RND Teknologi Indonesia.
Keluhan/keberatan setelah 2 (dua) minggu dari tanggal penerbitan sertifikat ini tidak akan diterima.

INFORMASI CONTOH UJI

Nomor Sertifikat : RND 2311-0340
 Tanggal Pelaporan : 08 Desember 2023

Pelanggan : PT. Kwarsa Hexagon
 u.p. : -

No	ID Lab	ID Contoh	Lokasi	Jenis Contoh	Tanggal Diterima
1	23110340-1	UB-1	Permukiman di Desa Pijoan, Kec. Jambi Luar Kota, Kabupaten Muaro Jambi	Ambien & Kebisingan	27 November 2023
2	23110340-2	UB-2	Permukiman di Desa Kuala Dasai, Kec. Tungkal Ulu, Kab. Tanjung Jabung Barat	Ambien & Kebisingan	27 November 2023
3	23110340-3	UB-3	Permukiman di Desa Tawang Kempas, Kec. Batang Asam, Kab. Tanjung Jabung Barat	Ambien & Kebisingan	27 November 2023
4	23110340-4	UB-4	Permukiman di Desa Sakra, Kec. Kemuning, Kab. Indragiri Hilir	Ambien & Kebisingan	27 November 2023
5	23110340-5	UB-5	Permukiman di Desa Sungai Dawu, Kec. Rengat Barat, Kab. Indragiri Hulu	Ambien & Kebisingan	27 November 2023
6	23110340-6	UB-1	Permukiman di Desa Pijoan, Kec. Jambi Luar Kota, Kabupaten Muaro Jambi	Getaran	27 November 2023
7	23110340-7	UB-2	Permukiman di Desa Kuala Dasai, Kec. Tungkal Ulu, Kab. Tanjung Jabung Barat	Getaran	27 November 2023
8	23110340-8	UB-3	Permukiman di Desa Tawang Kempas, Kec. Batang Asam, Kab. Tanjung Jabung Barat	Getaran	27 November 2023
9	23110340-9	UB-4	Permukiman di Desa Sakra, Kec. Kemuning, Kab. Indragiri Hilir	Getaran	27 November 2023
10	23110340-10	UB-5	Permukiman di Desa Sungai Dawu, Kec. Rengat Barat, Kab. Indragiri Hulu	Getaran	27 November 2023
Keterangan :					

Kepala Laboratorium




Dahlan Suteja

HASIL UJI LABORATORIUM

Nomor Sertifikat : **RND 2311-0340**
 Tanggal Pelaporan : 08 Desember 2023

Pelanggan : PT. Kwarsa Hexagon
 u.p. : -

ID Contoh : **UB-1**
 Jenis Contoh : Ambien & Kebisingan
 Lokasi : Permukiman di Desa Pijoan, Kec. Jambi Luar Kota, Kabupaten Muaro Jambi
 Tanggal Sampling : 20 November 2023

ID Lab : 23110340-1
 Koordinat : S 1°30'32" E 103°52'46"
 Waktu Sampling : 08:00 WIB

Parameter Analisa	Hasil	Baku Mutu	LOD	Unit	Metode Analisa
Data Meteorologi					
Temperatur	29,5	-	-	°C	D3.RND-LAB.IK-07.2.1-04.10
Kelembaban	80	-	-	%RH	D3.RND-LAB.IK-07.2.1-04.10
Tekanan Udara Rata-rata	754,6	-	-	mmHg	D3.RND-LAB.IK-07.2.1-04.10
Kecepatan Angin	0,2	-	-	m/detik	D3.RND-LAB.IK-07.2.1-04.10
Arah Angin Dominan Dari	Utara	-	-	-	D3.RND-LAB.IK-07.2.1-04.10
Kualitas Udara Ambien					
Sulfur Dioksida (SO ₂) ^{a)}	<29,2	150/1H ^{a)}	29,2	µg/m ³	SNI 7119.7:2017
Karbon Monoksida (CO) ^{a)}	<1145,2	10.000/1H ^{a)}	1145,2	µg/m ³	MASA 27-1988
Nitrogen Dioksida (NO ₂) ^{a)}	20,4	200/1H ^{a)}	5,9	µg/m ³	SNI 7119-2:2017
Oksidan (O ₃) ^{a)}	<23,2	150/1H ^{a)}	23,2	µg/m ³	SNI 7119-8:2017
Hidrokarbon Non Metana (NMHC)	1,18	160/3H ^{a)}	0,65	µg/m ³	SNI 7119.13:2009
Partikulat (TSP) ^{a)}	45	230/24H ^{a)}	3	µg/m ³	SNI 7119.3:2017
Partikulat < 10 µm (PM ₁₀) ^{a)}	30	75/24H ^{a)}	3	µg/m ³	SNI 7119.15:2016
Partikulat < 2,5 µm (PM _{2,5}) ^{a)}	10	55/24H ^{a)}	3	µg/m ³	SNI 7119.14:2016
Timah Hitam (Pb)	<0,005	2/24H ^{a)}	0,005	µg/m ³	SNI 19-7119.4-2005
Kebisingan					
Kebisingan Siang (L _s) ^{a)}	62,0	55 ^{b)}	-	dB(A)	SNI 8427:2017
Kebisingan Malam (L _M) ^{a)}	48,4	55 ^{b)}	-	dB(A)	SNI 8427:2017
Kebisingan Siang-Malam (L _{SM}) ^{a)}	60,5	55 ^{b)}	-	dB(A)	SNI 8427:2017
Keterangan : ^{a)} Baku Mutu Udara Ambien dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VII) ^{b)} Baku Mutu dari Keputusan Menteri Negara Lingkungan Hidup No. 48 Tahun 1996 (Lampiran I – Perumahan dan Permukiman) ^{c)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




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PT RND TEKNOLOGI INDONESIA

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 Website : www.rndindonesia.com

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HASIL UJI LABORATORIUM

Nomor Sertifikat : **RND 2311-0340**
 Tanggal Pelaporan : 08 Desember 2023

Pelanggan : PT. Kwarsa Hexagon
 u.p. : -

ID Contoh : **UB-2**
 Jenis Contoh : Ambien & Kebisingan
 Lokasi : Permukiman di Desa Kuala Dasai, Kec.
 Tungkal Ulu, Kab. Tanjung Jabung Barat
 Tanggal Sampling : 21 November 2023

ID Lab : 23110340-2
 Koordinat : S 1°17'37" E 103°15'50"
 Waktu Sampling : 09:00 WIB

Parameter Analisa	Hasil	Baku Mutu	LOD	Unit	Metode Analisa
Data Meteorologi					
Temperatur	30	-	-	°C	D3.RND-LAB.IK-07.2.1-04.10
Kelembaban	76	-	-	%RH	D3.RND-LAB.IK-07.2.1-04.10
Tekanan Udara Rata-rata	755	-	-	mmHg	D3.RND-LAB.IK-07.2.1-04.10
Kecepatan Angin	1,2	-	-	m/detik	D3.RND-LAB.IK-07.2.1-04.10
Arah Angin Dominan Dari	Barat	-	-	-	D3.RND-LAB.IK-07.2.1-04.10
Kualitas Udara Ambien					
Sulfur Dioksida (SO ₂) ^{a)}	29,9	150/1H ^{a)}	29,2	µg/m ³	SNI 7119.7:2017
Karbon Monoksida (CO) ^{a)}	<1145,2	10.000/1H ^{a)}	1145,2	µg/m ³	MASA 27-1988
Nitrogen Dioksida (NO ₂) ^{a)}	18,5	200/1H ^{a)}	5,9	µg/m ³	SNI 7119-2:2017
Oksidan (O ₃) ^{a)}	<23,2	150/1H ^{a)}	23,2	µg/m ³	SNI 7119-8:2017
Hidrokarbon Non Metana (NMHC)	1,04	160/3H ^{a)}	0,65	µg/m ³	SNI 7119.13:2009
Partikulat (TSP) ^{a)}	52	230/24H ^{a)}	3	µg/m ³	SNI 7119.3:2017
Partikulat < 10 µm (PM ₁₀) ^{a)}	34	75/24H ^{a)}	3	µg/m ³	SNI 7119.15:2016
Partikulat < 2,5 µm (PM _{2,5}) ^{a)}	15	55/24H ^{a)}	3	µg/m ³	SNI 7119.14:2016
Timah Hitam (Pb)	<0,005	2/24H ^{a)}	0,005	µg/m ³	SNI 19-7119.4-2005
Kebisingan					
Kebisingan Siang (L _s) ^{a)}	52,3	55 ^{b)}	-	dB(A)	SNI 8427:2017
Kebisingan Malam (L _M) ^{a)}	48,7	55 ^{b)}	-	dB(A)	SNI 8427:2017
Kebisingan Siang-Malam (L _{SM}) ^{a)}	52,8	55 ^{b)}	-	dB(A)	SNI 8427:2017
Keterangan : ^{a)} Baku Mutu Udara Ambien dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VII) ^{b)} Baku Mutu dari Keputusan Menteri Negara Lingkungan Hidup No. 48 Tahun 1996 (Lampiran I – Perumahan dan Permukiman) ^{c)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




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HASIL UJI LABORATORIUM

Nomor Sertifikat : **RND 2311-0340**
 Tanggal Pelaporan : 08 Desember 2023

Pelanggan : PT. Kwarsa Hexagon
 u.p. : -

ID Contoh : **UB-3**
 Jenis Contoh : Ambien & Kebisingan
 Lokasi : Permukiman di Desa Tawang Kempas, Kec.
 Batang Asam, Kab. Tanjung Jabung Barat
 Tanggal Sampling : 23 November 2023

ID Lab : 23110340-3
 Koordinat : S 0°58'45.22" E 102°47'31"
 Waktu Sampling : 10:00 WIB

Parameter Analisa	Hasil	Baku Mutu	LOD	Unit	Metode Analisa
Data Meteorologi					
Temperatur	29	-	-	°C	D3.RND-LAB.IK-07.2.1-04.10
Kelembaban	81	-	-	%RH	D3.RND-LAB.IK-07.2.1-04.10
Tekanan Udara Rata-rata	754,2	-	-	mmHg	D3.RND-LAB.IK-07.2.1-04.10
Kecepatan Angin	0,4	-	-	m/detik	D3.RND-LAB.IK-07.2.1-04.10
Arah Angin Dominan Dari	Selatan	-	-	-	D3.RND-LAB.IK-07.2.1-04.10
Kualitas Udara Ambien					
Sulfur Dioksida (SO ₂) ^{a)}	31,5	150/1H ^{a)}	29,2	µg/m ³	SNI 7119.7:2017
Karbon Monoksida (CO) ^{a)}	<1145,2	10.000/1H ^{a)}	1145,2	µg/m ³	MASA 27-1988
Nitrogen Dioksida (NO ₂) ^{a)}	23,4	200/1H ^{a)}	5,9	µg/m ³	SNI 7119-2:2017
Oksidan (O ₃) ^{a)}	<23,2	150/1H ^{a)}	23,2	µg/m ³	SNI 7119-8:2017
Hidrokarbon Non Metana (NMHC)	1,48	160/3H ^{a)}	0,65	µg/m ³	SNI 7119.13:2009
Partikulat (TSP) ^{a)}	55	230/24H ^{a)}	3	µg/m ³	SNI 7119.3:2017
Partikulat < 10 µm (PM ₁₀) ^{a)}	38	75/24H ^{a)}	3	µg/m ³	SNI 7119.15:2016
Partikulat < 2,5 µm (PM _{2,5}) ^{a)}	12	55/24H ^{a)}	3	µg/m ³	SNI 7119.14:2016
Timah Hitam (Pb)	<0,005	2/24H ^{a)}	0,005	µg/m ³	SNI 19-7119.4-2005
Kebisingan					
Kebisingan Siang (L _s) ^{a)}	55,7	55 ^{b)}	-	dB(A)	SNI 8427:2017
Kebisingan Malam (L _m) ^{a)}	46,2	55 ^{b)}	-	dB(A)	SNI 8427:2017
Kebisingan Siang-Malam (L _{SM}) ^{a)}	54,6	55 ^{b)}	-	dB(A)	SNI 8427:2017
Keterangan : ^{a)} Baku Mutu Udara Ambien dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VII) ^{b)} Baku Mutu dari Keputusan Menteri Negara Lingkungan Hidup No. 48 Tahun 1996 (Lampiran I – Perumahan dan Permukiman) ^{c)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




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HASIL UJI LABORATORIUM

Nomor Sertifikat : **RND 2311-0340**
 Tanggal Pelaporan : 08 Desember 2023

Pelanggan : PT. Kwarsa Hexagon
 u.p. : -

ID Contoh : **UB-4**
 Jenis Contoh : Ambien & Kebisingan
 Lokasi : Permukiman di Desa Sakra, Kec. Kemuning,
 Kab. Indragiri Hilir
 Tanggal Sampling : 23 November 2023

ID Lab : 23110340-4
 Koordinat : S 0°23' 06.82" E 102°24'37.18"
 Waktu Sampling : 11:30 WIB

Parameter Analisa	Hasil	Baku Mutu	LOD	Unit	Metode Analisa
Data Meteorologi					
Temperatur	31	-	-	°C	D3.RND-LAB.IK-07.2.1-04.10
Kelembaban	70	-	-	%RH	D3.RND-LAB.IK-07.2.1-04.10
Tekanan Udara Rata-rata	755,4	-	-	mmHg	D3.RND-LAB.IK-07.2.1-04.10
Kecepatan Angin	0,6	-	-	m/detik	D3.RND-LAB.IK-07.2.1-04.10
Arah Angin Dominan Dari	Barat	-	-	-	D3.RND-LAB.IK-07.2.1-04.10
Kualitas Udara Ambien					
Sulfur Dioksida (SO ₂) ^{a)}	33,8	150/1H ^{a)}	29,2	µg/m ³	SNI 7119.7:2017
Karbon Monoksida (CO) ^{a)}	<1145,2	10.000/1H ^{a)}	1145,2	µg/m ³	MASA 27-1988
Nitrogen Dioksida (NO ₂) ^{a)}	21,9	200/1H ^{a)}	5,9	µg/m ³	SNI 7119-2:2017
Oksidan (O ₃) ^{a)}	26,4	150/1H ^{a)}	23,2	µg/m ³	SNI 7119-8:2017
Hidrokarbon Non Metana (NMHC)	1,80	160/3H ^{a)}	0,65	µg/m ³	SNI 7119.13:2009
Partikulat (TSP) ^{a)}	58	230/24H ^{a)}	3	µg/m ³	SNI 7119.3:2017
Partikulat < 10 µm (PM ₁₀) ^{a)}	41	75/24H ^{a)}	3	µg/m ³	SNI 7119.15:2016
Partikulat < 2,5 µm (PM _{2,5}) ^{a)}	14	55/24H ^{a)}	3	µg/m ³	SNI 7119.14:2016
Timah Hitam (Pb)	<0,005	2/24H ^{a)}	0,005	µg/m ³	SNI 19-7119.4-2005
Kebisingan					
Kebisingan Siang (L _s) ^{a)}	62,6	55 ^{b)}	-	dB(A)	SNI 8427:2017
Kebisingan Malam (L _M) ^{a)}	48,5	55 ^{b)}	-	dB(A)	SNI 8427:2017
Kebisingan Siang-Malam (L _{SM}) ^{a)}	61,1	55 ^{b)}	-	dB(A)	SNI 8427:2017
Keterangan : ^{a)} Baku Mutu Udara Ambien dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VII) ^{b)} Baku Mutu dari Keputusan Menteri Negara Lingkungan Hidup No. 48 Tahun 1996 (Lampiran I – Perumahan dan Permukiman) ^{c)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




Dahlan Suteja

PT RND TEKNOLOGI INDONESIA

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HASIL UJI LABORATORIUM

Nomor Sertifikat : **RND 2311-0340**
 Tanggal Pelaporan : 08 Desember 2023

Pelanggan : PT. Kwarsa Hexagon
 u.p. : -

ID Contoh : **UB-5**
 Jenis Contoh : Ambien & Kebisingan
 Lokasi : Permukiman di Desa Sungai Dawu, Kec.
 Rengat Barat, Kab. Indragiri Hulu
 Tanggal Sampling : 24 November 2023

ID Lab : 23110340-5
 Koordinat : S 0°20'5.96" E 102°21'12.47"
 Waktu Sampling : 12:00 WIB

Parameter Analisa	Hasil	Baku Mutu	LOD	Unit	Metode Analisa
Data Meteorologi					
Temperatur	30	-	-	°C	D3.RND-LAB.IK-07.2.1-04.10
Kelembaban	76	-	-	%RH	D3.RND-LAB.IK-07.2.1-04.10
Tekanan Udara Rata-rata	756,2	-	-	mmHg	D3.RND-LAB.IK-07.2.1-04.10
Kecepatan Angin	1,2	-	-	m/detik	D3.RND-LAB.IK-07.2.1-04.10
Arah Angin Dominan Dari	Barat	-	-	-	D3.RND-LAB.IK-07.2.1-04.10
Kualitas Udara Ambien					
Sulfur Dioksida (SO ₂) ^{a)}	30,9	150/1H ^{a)}	29,2	µg/m ³	SNI 7119.7:2017
Karbon Monoksida (CO) ^{a)}	<1145,2	10.000/1H ^{a)}	1145,2	µg/m ³	MASA 27-1988
Nitrogen Dioksida (NO ₂) ^{a)}	23,7	200/1H ^{a)}	5,9	µg/m ³	SNI 7119-2:2017
Oksidan (O ₃) ^{a)}	27,8	150/1H ^{a)}	23,2	µg/m ³	SNI 7119-8:2017
Hidrokarbon Non Metana (NMHC)	1,93	160/3H ^{a)}	0,65	µg/m ³	SNI 7119.13:2009
Partikulat (TSP) ^{a)}	56	230/24H ^{a)}	3	µg/m ³	SNI 7119.3:2017
Partikulat < 10 µm (PM ₁₀) ^{a)}	38	75/24H ^{a)}	3	µg/m ³	SNI 7119.15:2016
Partikulat < 2,5 µm (PM _{2,5}) ^{a)}	15	55/24H ^{a)}	3	µg/m ³	SNI 7119.14:2016
Timah Hitam (Pb)	<0,005	2/24H ^{a)}	0,005	µg/m ³	SNI 19-7119.4-2005
Kebisingan					
Kebisingan Siang (L _s) ^{a)}	64,5	55 ^{b)}	-	dB(A)	SNI 8427:2017
Kebisingan Malam (L _m) ^{a)}	48,5	55 ^{b)}	-	dB(A)	SNI 8427:2017
Kebisingan Siang-Malam (L _{SM}) ^{a)}	62,9	55 ^{b)}	-	dB(A)	SNI 8427:2017
Keterangan : ^{a)} Baku Mutu Udara Ambien dari Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 Tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup (Lampiran VII) ^{b)} Baku Mutu dari Keputusan Menteri Negara Lingkungan Hidup No. 48 Tahun 1996 (Lampiran I – Perumahan dan Permukiman) ^{c)} Parameter terakreditasi oleh KAN (ISO/IEC 17025:2017) < Kurang dari batas deteksi yang dapat dilaporkan LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)					

Kepala Laboratorium




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HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2311-0340
Tanggal Pelaporan : 08 Desember 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : UB-1
Jenis Contoh : Getaran
Lokasi : Permukiman di Desa Pijoan, Kec. Jambi Luar Kota, Kabupaten Muaro Jambi
Tanggal Sampling : 20 November 2023

ID Lab : 23110340-6
Koordinat : S 1°30'32" E 103°52'46"
Waktu Sampling : 08:10 WIB

Parameter Analisa	Hasil	Baku Mutu ¹				LOD	Unit	Metode Analisa
Kelas		1	2	3	4			
Kecepatan Getaran	<0,1	2	5	10	10 - 40	0,1	mm/s	IK No. D3.RND-LAB.IK-06.4.1-01.16 (Vibration Meter)
Keterangan : ¹ KepMenLH No 49 tahun 1996 (Lampiran IV - Tentang Baku Tingkat Getaran Kejut) LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan) Catatan : 1 : Peruntukan dan bangunan kuno yang mempunyai nilai sejarah yang tinggi 2 : Bangunan dengan kerusakan yang sudah ada, tampak keretakan-keretakan pada tembok 3 : Bangunan untuk dalam kondisi teknis yang baik, ada kerusakan-kerusakan kecil seperti: plesteran yang retak 4 : Bangunan "kuat" (misalnya: bangunan industri terbuat dari beton atau baja)								

ID Contoh : UB-2
Jenis Contoh : Getaran
Lokasi : Permukiman di Desa Kuala Dasai, Kec. Tungkal Ulu, Kab. Tanjung Jabung Barat
Tanggal Sampling : 21 November 2023

ID Lab : 23110340-7
Koordinat : S 1°17'37" E 103°15'50"
Waktu Sampling : 09:10 WIB

Parameter Analisa	Hasil	Baku Mutu ¹				LOD	Unit	Metode Analisa
Kelas		1	2	3	4			
Kecepatan Getaran	<0,1	2	5	10	10 - 40	0,1	mm/s	IK No. D3.RND-LAB.IK-06.4.1-01.16 (Vibration Meter)
Keterangan : ¹ KepMenLH No 49 tahun 1996 (Lampiran IV - Tentang Baku Tingkat Getaran Kejut) LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan) Catatan : 1 : Peruntukan dan bangunan kuno yang mempunyai nilai sejarah yang tinggi 2 : Bangunan dengan kerusakan yang sudah ada, tampak keretakan-keretakan pada tembok 3 : Bangunan untuk dalam kondisi teknis yang baik, ada kerusakan-kerusakan kecil seperti: plesteran yang retak 4 : Bangunan "kuat" (misalnya: bangunan industri terbuat dari beton atau baja)								

Kepala Laboratorium




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HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2311-0340
Tanggal Pelaporan : 08 Desember 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : UB-3
Jenis Contoh : Getaran
Lokasi : Permukiman di Desa Tawang Kempas, Kec. Batang Asam, Kab. Tanjung Jabung Barat
Tanggal Sampling : 23 November 2023

ID Lab : 23110340-8
Koordinat : S 0°58'45.22" E 102°47'31"
Waktu Sampling : 10:10 WIB

Parameter Analisa	Hasil	Baku Mutu ¹				LOD	Unit	Metode Analisa
Kelas		1	2	3	4			
Kecepatan Getaran	<0,1	2	5	10	10 - 40	0,1	mm/s	IK No. D3.RND-LAB.IK-06.4.1-01.16 (Vibration Meter)
Keterangan : ¹ KepMenLH No 49 tahun 1996 (Lampiran IV - Tentang Baku Tingkat Getaran Kejut) LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan) Catatan : 1 : Peruntukan dan bangunan kuno yang mempunyai nilai sejarah yang tinggi 2 : Bangunan dengan kerusakan yang sudah ada, tampak keretakan-keretakan pada tembok 3 : Bangunan untuk dalam kondisi teknis yang baik, ada kerusakan-kerusakan kecil seperti: plesteran yang retak 4 : Bangunan "kuat" (misalnya: bangunan industri terbuat dari beton atau baja)								

ID Contoh : UB-4
Jenis Contoh : Getaran
Lokasi : Permukiman di Desa Sakra, Kec. Kemuning, Kab. Indragiri Hilir
Tanggal Sampling : 23 November 2023

ID Lab : 23110340-9
Koordinat : S 0°23' 06.82" E 102°24'37.18"
Waktu Sampling : 11:40 WIB

Parameter Analisa	Hasil	Baku Mutu ¹				LOD	Unit	Metode Analisa
Kelas		1	2	3	4			
Kecepatan Getaran	0,2	2	5	10	10 - 40	0,1	mm/s	IK No. D3.RND-LAB.IK-06.4.1-01.16 (Vibration Meter)
Keterangan : ¹ KepMenLH No 49 tahun 1996 (Lampiran IV - Tentang Baku Tingkat Getaran Kejut) LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan) Catatan : 1 : Peruntukan dan bangunan kuno yang mempunyai nilai sejarah yang tinggi 2 : Bangunan dengan kerusakan yang sudah ada, tampak keretakan-keretakan pada tembok 3 : Bangunan untuk dalam kondisi teknis yang baik, ada kerusakan-kerusakan kecil seperti: plesteran yang retak 4 : Bangunan "kuat" (misalnya: bangunan industri terbuat dari beton atau baja)								

Kepala Laboratorium




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HASIL UJI LABORATORIUM

Nomor Sertifikat : RND 2311-0340
Tanggal Pelaporan : 08 Desember 2023

Pelanggan : PT. Kwarsa Hexagon
u.p. : -

ID Contoh : UB-5
Jenis Contoh : Getaran
Lokasi : Permukiman di Desa Sungai Dawu, Kec.
Rengat Barat, Kab. Indragiri Hulu
Tanggal Sampling : 23 November 2023

ID Lab : 23110340-10
Koordinat : S 0°20'5.96" E 102°21'12.47"
Waktu Sampling : 12:10 WIB

Parameter Analisa	Hasil	Baku Mutu ¹				LOD	Unit	Metode Analisa
Kelas		1	2	3	4			
Kecepatan Getaran	0,3	2	5	10	10 - 40	0,1	mm/s	IK No. D3.RND-LAB.IK-06.4.1-01.16 (Vibration Meter)

Keterangan : ¹ KepMenLH No 49 tahun 1996 (Lampiran IV - Tentang Baku Tingkat Getaran Kejut)
LOD = Limit of Detection (Batas deteksi yang dapat dilaporkan)

Catatan :

- 1 : Peruntukan dan bangunan kuno yang mempunyai nilai sejarah yang tinggi
2 : Bangunan dengan kerusakan yang sudah ada, tampak keretakan-keretakan pada tembok
3 : Bangunan untuk dalam kondisi teknis yang baik, ada kerusakan-kerusakan kecil seperti: plesteran yang retak
4 : Bangunan "kuat" (misalnya: bangunan industri terbuat dari beton atau baja)

Kepala Laboratorium



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