This report documents the environmental impact assessment (EIA) and public participation activities conducted for the ECC application of the proposed road project of Department of Public Works. The Project is a 65.6 km high standard highway with a 60 m road-right of way that will traverse 2 cities and 4 municipalities of Misamis Oriental and Bukidnon

ENVIRONMENTAL IMPACT STATEMENT

May 2024

CENTRAL MINDANAO HIGH STANDARD HIGHWAY PROJECT

Misamis Oriental and Bukidnon, Region X

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS – CENTRAL OFFICE
Bonifacio Drive Port Area, 652 Zone 068, Manila

Preparer
Amet-Asia, Inc.
Unit 303, One Corporate Center, Meralco Ave.
corner Julia Vargas Avenue, Ortigas Center
San Antonio, Pasig City 1605

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Table of Contents

APPENDICES

ANNEXES (Separated Volume)

List of Tables

List of Figures

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
AAQ	ambient air quality
AAQMP	Ambient Air Quality Monitoring Plan
AASHTO	American Association of the State Highway and Transportation Officials
AD	Ancestral Domain
ADP	Abandonment and Decommissioning Plan
ADSDPP	Ancestral Domains Sustainable Development and Protection Plan
AET	Actual evapotranspiration
Afs	Affected Families
AL	Ancestral Land
ALDP	Alternative Livelihood Development Program
ALS	Advance Learning System
AOC	area of concern
AOR	area of responsibility
Apr	April
AQ	air quality
As	Arsenic
Aug	August
AWFP	Annual Work and Financial Plan
BCP	Biodiversity Conservation Plan
BEMONC	Basic emergency obstetric and newborn care
BF	Bukidnon Formation
BFAR	Bureau of Fisheries and Aquatic Resources
BHC	Barangay Health Centers
BHS	Barangay Health Station
BJMP	Bureau of Jail Management and Penology
BLGF	Bureau of Local Government Finance
BPC	Bubunawan Power Company’s
BPSO	Barangay Public Safety Officer
BUHITA	Bukidnon-Higaonon Tribal Association
BUSECO	Bukidnon Electric Cooperative
BZP	Buffer Zone Plan
CAA	Clean Air Act of the Philippines
CADT	Certificate of Ancestral Domain Title
CALT	Certificate of Ancestral Land Title
CBD	Central Business District
CBMS	Community Based Monitoring
CBP	Capacity Building Program
Cd	cadmium
CDF	Controlled Dump Facility
CDO	Cagayan De Oro
CDOCJ-MD	Cagayan De Oro City Jail - Mail Dormitory
CENRO	City Environment and Natural Resources Office
CEPALCO	Cagayan Electric Power and Light Co.
CFMP	Chance Find Management Plan

CFS	Central Fire Station
CGSO	City General Services Office
CH4	methane
CHO	City Health Office
CICL	Children in Conflict with the Law
CLENRO	City Local Environment and Natural resources Office
CLRD	Chronic Lower Respiratory Disease
CLS	Core Labor Standards
CLUP	Comprehensive Land Use Plan
CMH	Central Mindanao High Standard Highway Project
CMR	Compliance Monitoring Report
CMTS	cellular mobile telecommunication system
CO	carbon monoxide
CO2	carbon dioxide
COWD	Cagayan de Oro Water District
CPSO	the City Public Services Office
CSE	crime solution efficiency
CVRP	Construction Vegetation Removal Plan
CVTPP	Construction Vegetation and Tree Planting Program
CWMP	Construction Waste Management Plan
DAO	DENR Administrative Order
DCCs	Development Centers/Day Care Centers
DEARBC	Del Monte Philippines Inc. Employees Agrarian Reform Beneficiaries Cooperative
Dec	December
DED	Detailed Engineering Design
DEM	Digital Elevation Model
DENR	Department of Environment and Natural Resources
DepEd	Department of Education
DGCS	Design Guidelines, Criteria and Standards
DIA	Direct Impact Areas
DMPI	DEL MONTE PHILIPPINES INC.
DO	Dissolved Oxygen
DOF	Department of Finance
DOH	Department of Health
DOLE	Department of Labor and Employment
DOT	Department of Transportation
DOTS	Directly Observed Therapy
DPWH	Department of Public Works and Highways
DRO	Direct Runoff
DSWD	Department of Social Welfare and Development
DTTB	Doctors to the Barrios
ECA	Environmentally Critical Area
ECC	Environmental Compliance Certificate
ECCD	Early Childhood Care Development
ECM	Environmental Compliance Monitoring
ECPs	Environmentally Critical Projects
EGF	Environmental Guarantee Fund
EGGA	Engineering Geological and Geohazard Assessment
EGGAR	Engineering Geological and Geohazard Assessment Report

EHIA	Environmental Health Impact Assessment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Study
EMB	Environmental Management Bureau
EMF	Environmental Monitoring Plan
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EMVMP	Equipment and Motor Vehicle Maintenance Plan
EQPL	Environmental Quality Performance Levels
ERA	Environmental Risk Assessment
ESH	Environment Safety and Health
ESS	Environmental and Safeguards Section
ESSD	Environmental and Social Safeguards Division
FDF	Final Disposal Facility
Feb	February
FEMA	Federal Emergency Management Agency
FHA	Family Health Associates
FIES	Family Income and Expenditures Survey
FPIC	Free, Prior and Informed Consent
GA	Government Agencies
GAA	General Appropriations Act
GFA	Gross Floor Area
GHG	greenhouse gas
GLA	Gross Leasable Area
GLC	ground-level concentration
GWP	Global Warming Potential
ha	hectare
HEC-RAS	Hydrologic Engineering Center's - river analysis system
HF	Hindfoot Length
Hg	Mercury
HH	Household
HSH	High Standard Highway
IBA	Important Bird Area
IBBA	Important Bird and Biodiversity Area
ICC	Indigenous Cultural Communities
IEC	Information, Education and Communication
IIA	Indirect Impact Area
ILO	International Labor Organization
	IMP Impacts Management Plan
IP	Institutional Plan
IPs	Indigenous People
IPCC	Intergovernmental Panel on Climate Change
IPDF	Indigenous peoples Development Framework
IPO	Indigenous People's Organotin
IRA	Internal Revenue Allotment
IRR	Implementing Rules and Regulations
ISMP	Informal Settler Monitoring Plan
IUCN	International Union for the Conservation of Nature
IVSS	Impasug-ong Village Sites and services
Jan	January

JICA	Japan International Cooperation Agency
K	Potassium
KADIMADC	Kitanglad Alihuton Danao Inalad Manegay Ancestral Domain Claim
KII	Key Informant Interview
KRP	Kindergarten Regular Program
KSP	Kindergarten Summer Program
KVP	Kindergarten Volunteer Program
L90	background sound levels
Laeq	24h averaged sound levels
LCE	Local Chief Executive
LEP	Local Employment Plan
LGSF	Local Government Support Fund
LGU	Local Government Unit
Lmax	peak sound levels
Lmin	lowest sound levels
LOS	Level of Service
LPA	Low pressure area
LTNG	Lightning
MAO	Municipal Agricultural Office
Mar	March
max	maximum
May	May
mbs	millibars
MC	Memorandum Circular
MEEDO	Municipal Economic Enterprise Development Office
MENRO	Municipal Environment & Natural Resource Office
MFWD	Manolo Fortich Water District
MGB	Mines and Geosciences Bureau
min	minimum
MISS	Malaybalay Integrated Survey System
MLSP	mean sea level pressure
mm	millimeter
MMT	Multi-partite Monitoring Team
MOA	Memorandum of Agreement
MOGCHS	Misamis Oriental General Comprehensive High School
MOO	Manual of Operations
MPSC	Mindanao Polytechnic State College
MRF	Material Recovery Facilities
MSWDO	Municipal Social Welfare and Development Office
MSWM	Municipal Solid Waste Management
N	Nitrogen
NAAQGV	National Ambient Air Quality Guideline Values
NAPOCOR	National Power Corporation
NCCA	National Commission for Culture and the Arts
NCTS	National Center for Transportation Studies
NE	northeast
NEDA	National Economic and Development Authority
NGO	Non-Government Organization
NHA	National Housing Authority

NIPAS	National Integrated Protected Areas System
NMP	Noise Monitoring Plan
NNW	north-northwest
NO2	Nitrogen Dioxide
Nov	November
NPAAAD	Network of Protected Areas for Agricultural and Agro-industrial Development
NPCC	National Pollution Control Commission
NSCB	National Statistical Coordination Board
NSSMP	National Sewerage and Septage Management Program Section
NW	northwest
NWRB	National Water Resources Board
Oct	October
OWMP	Operation Waste Management Plan
P	Phosphorus
PAGASA	Philippine Atmospheric, Geophysical, and Astronomical Services Administration
PAR	Philippine area of responsibility
Pb	Lead
PBCPP	Philippine Biodiversity Conservation Prioritization Process
PCE	Passenger Car Equivalent
PCO	Pollution Control Officer
PEMAPS	Project Environmental Monitoring And Audit Prioritization Scheme
PFZ	Philippine fault zone
PGA	Peak ground acceleration
PGR	Philippine Growth Rate
PhilCom	Philippine Communications
PHIVOLCS	Philippine Institute of volcanology seismology
PHP	Philippine Peso
PIA	PHIVIDEC Industrial Authority
PLDT	Philippine Long-Distance Telecommunication
PM10	particulate matter with aerodynamic diameter of 10 microns or less
PMO	Project Management Office
PNP	Philippine National Police
PO	Public offices
PSA	Philippine Statistic Authority
PTA	Parent - Teacher Association
PWD	persons with disability
RA	Republic Act
RAP	Resettlement Action Plan
RCA	Residual Containment Area
RD	rainy days
RH	relative humidity
RHU	Rural Health Unit
RIC	Resettlement Implementation Committee
ROW	Right of way
RPM	Revised Procedural Manual
RROW	Road Right-of-Way
SAFDZ	Strategic Agriculture and Fisheries Development Zone
SDA	Strategic Development Area
SDP	Social Development Program

SE	Southeast
SEC	Security and Exchange Commission
SEMP	Soil Erosion Management Plan
Sep	September
SEP	Socioeconomic Program
SMP	Self-Monitoring Plan
SMR	Self-Monitoring Report
SO_2	sulfur dioxide
SOGI	sexual orientation and gender identities
SOTELCO	Southern Telecommunications Company Inc
SPD	wind speed in meter per second
SPL	sound pressure level
SRO	Surplus Runoff
SSE	south-southeast
SSROW	Social Safeguards and Right-of-Way Section
ST	Soil Moisture Storage
STDs	sexually transmitted diseases
STW	Soil-moisture storage withdrawal
SW	Solid Waste
SWM	Solid Waste Management
T	Temperature
TCC	Tagoloan Community College
TD	tropical depression
TESDA	Technical Education and Skills Development Authority
TIA	Traffic Impact Assessment
TL	Total Length
TMP	Traffic Management Plan
TNA	Training Needs Assessment
TS	tropical storm
TSMP	Tree Survival and Monitoring Plan
TSP	total suspended particulates
TTBP	Tree Transfer and Balling Plan
TV	Tail-vent Length
TY	tropical typhoon
UC	Ultramafic Complex
UDHA	Urban Development and Housing Act
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPMO	Unified Project Management Office
USEPA	United States Environmental Protection Agency
VTPPO	Vegetation and Tree Planting Program during Operations
WC	Wing Cord
WMP	Wildlife Monitoring Plan
WQG	Water Quality Guidelines
WT	Weight

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EXECUTIVE SUMMARY

PROJECT FACT SHEET

<table>
<tr><td>Name of Project</td><td colspan="4">Central Mindanao High Standard Highway Project (CDO - Malaybalay Section)</td></tr>
<tr><td rowspan="7">Project location</td><td>Barangay</td><td>Municipality/City</td><td>Province</td><td>Region</td></tr>
<tr><td>Bugo, Puerto, Balubal</td><td>Cagayan de Oro</td><td>Misamis Oriental</td><td>X (Northern Mindanao)</td></tr>
<tr><td>Casinglot, Natumolan</td><td>Tagoloan</td><td>Misamis Oriental</td><td>X (Northern Mindanao)</td></tr>
<tr><td>Alae, San Miguel, Damilag, Dicklum, Sankanan, Tankulan, Ticala, Mambatangan</td><td>Manolo Fortich</td><td>Bukidnon</td><td>X (Northern Mindanao)</td></tr>
<tr><td>Puntian, Vista Villa, Culasi, Poblacion, Kisolon, San Roque, Kisolon</td><td>Sumilao</td><td>Bukidnon</td><td>X (Northern Mindanao)</td></tr>
<tr><td>Poblacion, La Fortuna, Capitan Bayong, Cawayan, Impalutao</td><td>Impasug-ong</td><td>Bukidnon</td><td>X (Northern Mindanao)</td></tr>
<tr><td>Patpat, Kalasungay, Dalwangan, Barangay 10</td><td>Malaybalay</td><td>Bukidnon</td><td>X (Northern Mindanao)</td></tr>
<tr><td>Project type*</td><td colspan="4">Roads and bridges
Category A: ECP (3.4.1 Roads, new construction, NATIONAL ROAD: ≥20.0 km (length with no critical slope) OR ≥10.0 km (length with critical slope))</td></tr>
<tr><td>Proponent</td><td colspan="4">Department of Public Works and Highways Central Office</td></tr>
<tr><td>Office address:</td><td colspan="4">Bonifacio Drive Port Area, 652 Zone 068, Manila, Metro Manila</td></tr>
<tr><td>Contact Person:</td><td colspan="4">Constante A. Llanes, Jr.
Assistant Secretary, Planning Service</td></tr>
<tr><td>Project status</td><td colspan="4">Proposed</td></tr>
<tr><td>Project duration</td><td colspan="4">Construction (3.5 years)</td></tr>
<tr><td>Project Components</td><td colspan="4"><table>
<tr><th></th><th>Tagoloan</th><th>CDO</th><th>Manolo Fortich</th><th>Sumilao</th><th>Impasug-ong</th><th>Malaybalay</th><th>Total</th></tr>
<tr><td>Interchanges</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>5</td></tr>
<tr><td>Overpass</td><td>1</td><td>0</td><td>6</td><td>6</td><td>5</td><td>4</td><td>22</td></tr>
<tr><td>Underpass</td><td>2</td><td>1</td><td>15</td><td>4</td><td>5</td><td>5</td><td>32</td></tr>
<tr><td>Bridge</td><td>3</td><td>1</td><td>12</td><td>9</td><td>14</td><td>12</td><td>51</td></tr>
<tr><td>Viaduct</td><td>2</td><td>0</td><td>0</td><td>6</td><td>0</td><td>0</td><td>8</td></tr>
</table></td></tr>
<tr><td>Project length</td><td colspan="4">65.6 km</td></tr>
<tr><td>Project cost</td><td colspan="4">Approximately Php 96,312,065,917.34</td></tr>
<tr><td>Authorized Representative for ECC application:</td><td colspan="4">Julio Cesar Caculba- Authorized Representative
Amet-Asia, Inc.
Unit 303 One Corporate Center, J. Vargas Ave., corner Meralco Ave., Ortigas, Pasig City,
Metro Manila info@maet-asia.com
+0945 723 8195 | 0923 614 8431</td></tr>
</table>

*Revised Guidelines for Coverage Screening and Standardized Requirements under the Philippine EIS System (EMB Memorandum Circular 005 July 2014)

PROJECT DESCRIPTION

The proposed Central Mindanao High Standard Highway Project (Cagayan de Oro - Malaybalay Section) ("Project", "alignment") is part of the Phase II of the Master Plan on High Standard Highway Network Development. The objectives of the plan were to improve the transport efficiency in the region and contribute to enhancing the connectivity between the cities of Cagayan de Oro and Malaybalay as well as the economic development of the surrounding area. The proposed Project will be spearheaded by the Department of Public Works and Highways (DPWH) with the assistance of the Japan International Cooperation Agency (JICA).

Location, Project area**, **accessibility - The Project with a length of 65.6 kilometers will traverse 28 barangays of four municipalities and two cities in the Provinces of Misamis Oriental and Bukidnon in Region X-Northern Mindanao. The Project is accessible through Butuan-Cagayan de Oro- Iligan Rd. from the north and Sayre Highway from the south.

Project rationale - The proposed Project is expected to improve the road transport network in Mindanao through the improvement of its national roads and provide linkages between the cities of Cagayan de Oro in Misamis Oriental and Malaybalay in Bukidnon. The Project is also seen to improve the economic situation of the surrounding municipalities.

Project components - The alignment will have a 60-meter road right of way (RROW) with five interchanges constructed near urban centers. The Project will also compose of 32 AASHTO Girders, 3 Steel Bridges, 6 Steel Box Girders, 13 Underpasses, and 14 Overpasses.

Table ES-1. Length and width of the Project sections

Sections	Length (km)	Width (m)
Section 1	11.9	60
Section 2	14.9	60
Section 3	14.9	60
Section 4	12.6	60
Section 5	11.3	60
Total	**65.6**	

Table ES-2. Number of Project components per municipality

Components	Tagoloan	CDO	Manolo Fortich	Sumilao	Impasug-ong	Malaybalay	Total
Interchanges	0	1	1	1	1	1	5
Overpass	1	0	6	6	5	4	22
Underpass	2	1	15	4	5	5	32
Bridges	3	1	12	9	14	12	51
Viaduct	2	0	0	6	0	0	8

Project alternatives
This section presents the different selection criteria for siting, selection of technology, resources, and contextualization of hazards based on available hazard maps from relevant institutions.

Project development phases

1. Pre-construction - This phase mainly involves conducting studies at the site, e.g., geotechnical surveys, Right-of-Way Action Plan (RAP) Survey and possible relocation, preparation of the detailed engineering design, procurement of relevant permits and clearances from government entities, and

contractor prequalification, tendering & awarding.

2. *Construction* – These activities include site clearing, construction of temporary facilities, excavation works, construction of viaduct, bridges and superstructure and road pavement.

3. *Operation* - The operation of the project will include the following activities:

- Operation of toll gates;
- Regular inspection of road structures;
- Regular maintenance of facilities such as traffic signals, signages, and markings;
- Regular cleaning of roadways, and maintenance of toilet septic tanks;
- Preventive maintenance, monitoring and reporting; and
- Upgrade of structures and facilities, if necessary.

4. *Abandonment phase*- This phase implied as dismantling of the temporary facilities used during the construction phase. Dismantling of the temporary facilities will be phased according to the completion of each road section.

The construction contractor is responsible for the following activities:
- Dismantling of temporary facilities.
- All construction wastes and spoil materials will be hauled out from the site.
- Recyclable construction spoils will be sold to interested buyers
- Solid wastes disposed in the municipal sanitary landfill or controlled dumps, and spoils containing hazardous materials, including contaminated soils, will be hauled by a DENR- registered TSD facility.

Manpower - The indicative manpower requirement during the construction phase is ***48,154***.

Indicative construction timetable - The construction of the Project will take about ***42 months or 3.5 years.***

Indicative project investment cost - The Project will cost approximately ***Php 96,312,065,917.34***

PROCESS DOCUMENTATION

The EIA study commenced with pre-scoping IEC followed by the technical scoping, baseline characterization, impact assessment, and environmental management planning. site visit, geological survey, ambient air quality sampling, sound level measurements, flora and fauna sampling, water quality sampling, key informant interviews, perception survey) secondary data, information, literature, and expert judgment.

All public participation activities required by the ECC application process were conducted following the current COVID-19 quarantine guidelines. The documentation of the public consultation activities is attached in **Annex 10.**

Terms of reference of the EIA - The TOR of the EIA was based the pre-scoping IEC activities and the Technical Scoping Checklist signed by the proponent, EMB CO, and preparer (Amet Asia). The technical scoping was conducted with EMB CO on July 9, 2020. The outline and content of the EIS report, baseline information required for each identified impact, and impact assessment methods were specified in the said checklist (**Appendix 44**).**EIS team**

The key members of the EIA team are enumerated below.

Table ES-3. EIS Team

Specialization/Module	Name
Team Leader, Pedology, Water Quality, Climate and Air Quality	Engr. Jethro Alden C. Hipe, MSc, MA Patricia Erika Lim, EnP
Geology	Samuel Sendon
Flora and Fauna (Terrestrial and Freshwater)	Jaime Namocatcat, PhD Lorelaine Geografo
Hydrology/Hydrogeology	Engr. Emiterio Hernandez, MSc.
People	Nimfa Bracamonte Ph.D Amabelle Embornas, MSc.
Project Manager	Jan Heidel Bautista Julio Cesar

EIA study area and schedule

The activities for the EIA study started in January to December 2021. Activities included IEC, Key Informant Interviews, Focused Group Discussions, EIA perception survey, fieldwork, laboratory analysis, and impact assessment, and report writing. The EIA was conducted at the Project area, its vicinities, and 28 host barangays.

Table ES-4. EIS Schedule

Activity	2021												2022												2023												2024											
	J	F	M	A	M	Jn	Jl	A	S	O	N	D	J	F	M	A	M	Jn	Jl	A	S	O	N	D	J	F	M	A	M	Jn	Jl	A	S	O	N	D	J	F	M	A	M	Jn	Jl	A	S	O	N	D
Kick-off	▨	▨																																														
Site Visit			▨																																													
IEC Meeting			▨																																													
Public Scoping					▨																																											
Technical scoping							▨																																									
Data gathering			▨	▨	▨	▨	▨	▨	▨	▨																																						
EIS Report preparation					▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨									

Table ES-5. EIS study area

Province	City/Municipality	No. of Barangays
Misamis Oriental	Tagoloan	2
	Cagayan de Oro	3
Bukidnon	Manolo Fortich	8
	Sumilao	6
	Impasug-ong	5
	Malaybalay	3
Total		**27**

EIS SUMMARY

Table ES-6. Baseline Environmental Conditions

No.	Item	Survey Item and Methodology	Forecast Methodology
1	The Land		
1.1	Land use and classification	- Review of Comprehensive Land Use Plan of affected LGUs - Review on the list and maps of ECAs near the Project - Review on the current status of the proposed Protected Areas near the Project	Qualitative
1.2	Geology/ Geomorphology	- Observation on geological and geo-structural characteristics - Observation on geohazards - Literature review	Qualitative
1.3	Pedology	Observation on geohazards Literature review Soil sampling on 3 stations Soil analysis on the following parameters: <u>Soil Fertility:</u> Nitrogen, Organic Matter, pH, Phosphorus, Potassium, <u>Soil quality</u> – Molybdenum, zinc, Manganese, Iron, Nickel, Boron, Chlorine Literature review Sediment sampling on 10 surface water sampling points Parameters: Arsenic, Cadmium, Cyanide, Chromium, Copper, Mercury, Lead, Selenium	Qualitative and Quantitative
1.4	Terrestrial ecology	<u>Flora</u> Survey on the tree along the 20 transects within the alignment Quadrat method survey on the understory vegetation Low and high rainfall period <u>Fauna</u> 20 transect counts, 13 stations for traps and mist nets, incidental surveys, opportunistic sampling for mammals, birds, and herpetofauna respectively Low and high rainfall period Interview with three experts with regards to the Philippine Eagle, regional vegetation and remarkable point for field survey.	Qualitative and Quantitative
2	The Water		
2.1	Hydrology/hydrogeology	Direct rainfall flood modeling Literature review	Quantitative
2.3	Oceanography	Not applicable	

No.	Item	Survey Item and Methodology	Forecast Methodology
2.4	Water Quality	- Surface water sampling on 10 points traversing the alignment - Groundwater water sampling on 10 points near the alignment - Parameters: Arsenic, BOD, Cadmium, Chromium, Chlorine, COD, Coliform, Color, Cyanide, Lead, Mercury, Nitrate, Oil and Grease, pH, Phosphate, Sulfate, Surfactants, TSS	Quantitative
2.5	Freshwater ecology	13 stations for the survey of plankton, macrobenthos and fishes	Qualitative
3	The Air		
3.1	Meteorology/Climatology	Literature review	Quantitative
3.2	Air Quality and Noise	- Air quality and Noise sampling points on 10 points - Parameters: Nitrogen dioxide, sulfur dioxide, TSP, PM10, Pb, O3, CO, wind speed and wind direction - Air dispersion modelling based on the traffic volume prediction - Noise modelling	Quantitative
4	The People		
4.1	The People	Literature review Utilization on the results of the stakeholder meetings and perception survey Interviews with the IP members	Qualitative

Environmental Impact Assessment and Mitigating Measures

The summary of the significant impacts, mitigation options, and expected residual effects for the land, water, air, and people components is shown in Table ES-7. Summary of key impacts, mitigation options, and residual effects (Land Component)**Table ES-7** to **Table ES-11.**

Table ES-7. Summary of key impacts, mitigation options, and residual effects (Land Component)

Sub-component	Key Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement	Residual Impact
Topography and geological features	Change/Inconsistency in land use	-A	D	D	D	- Confirm classification of the other Project areas to the zoning regulation of the host cities and municipalities (P) - Proper implementation of buffer zone area (C) - Strict implementation of Construction Plan specifications for each Project component (C) - Maintain the construction site/ yards tidy and clean and rehabilitate after construction. (C) - Provision for temporary screens/ walls to minimize the visual clatter. (C) - Restore RROW to its state prior to Project implementation if possible or the current land use/zoning of the LGU where a road section is located. (A)	Issuance of the Zoning Clearance
	Impairment of visual aesthetics	D	-B	-B	-B	- Include susceptibility of the Project area to natural hazards in the Detailed Engineering Design (DED) (P) - Formulation of Buffer Zone Plan (BZP) during construction and operations - Design and installation of facilities to harmonize with the surrounding environment - Proper implementation of buffer zone area (C) - Strict implementation of Construction Plan specifications for each Project component (C) - Maintain the construction site/ yards tidy and clean and rehabilitate after construction. (C) - Provision for temporary screens/ walls to minimize the visual clatter. (C) - Sustained implementation of buffer zone areas(O) - Regular maintenance of the highway(O) - Proper demolition of the road, structures, and other ancillaries(A) - Proper disposal of demolition wastes(A)	Minimal impairment of visual aesthetics
	Encroachment in Environmentally Critical Areas (ECA)	D	D	D	D	Include susceptibility of the Project area to natural hazards in the Detailed Engineering Design (DED) (P)	n/a

Sub-component	Key Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement	Residual Impact
	and protected areas						
	Existing land tenure issue/s	-A	D	D	D	-Conduct parcellary survey (P) -Secure documents showing authority to develop the Project RROW (P)	Land issues resolved
	Devaluation of land value as a result of improper solid waste management and other related impacts	D	-A	-A	-A	- Identify the final disposal site for solid waste, excavated soil, and hazard waste at each LGU (P) - Strict implementation of Construction Plan specifications for each Project component (C) - Regular maintenance of the highway (O,A) - Best housekeeping practices (O,A)	Insignificant devaluation of land value due to improper solid waste management
	Change in surface landform/ topography/ terrain/ slope	D	-A	D	D	- Employ appropriate erosion control and slope protection measures. (C) - Designate a spoils storage area and optimize re-use of spoils. (C) - Increase vegetation and construction drainage canals at the break-of-slope (between the gentle to moderate slopes. (C) - Slope re-contouring, benching or lowering the slope gradient (C) - Drainage system includes drain construction and anchored structures. (C) - Strict implementation of Construction Plan specifications for each Project component (C) - Regular monitoring of slope conditions and slope stabilization measures constructed with focus on landform change. (O) - Check RROW with destabilized slopes and implement slope stabilization measures (A)	Unnecessary changes in surface landform, su-Bsurface geomorphology, and inducement of geohazards minimized
	Change in sub-surface/ underground geomorphology	D	D	D	D	- Conduct of factual Geological mapping with focus on the following: geology, geomorphology, geohazards, areas that may be prone to settlement or subsidence (P) - Field assessment in active construction sites especially after heavy and prolonged rains and after earthquakes (if it occurs) (C) - Regular monitoring of identified areas prone to subsidence particularly those underlain by the limestone (O). - Follow recommendations of the geotechnical / civil engineer / geologist to address any adverse geological and geomorphological conditions (O)	n/a

Sub-component	Key Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement	Residual Impact
	Inducement of subsidence, liquefaction, landslides, mud/debris flow	D	-A	-A	D	- Conduct of EGGA and factual geological mapping focusing on geology, geomorphology, and geohazards (P) - Apply appropriate slope protection and other engineered structures (C) - Increase vegetation cover particularly at the vicinity of the break-of-slope (C) - Surface drainage control works – construction of drainage canal at the break-of-slope (between the gentle to moderate slopes) (C) - Slope re-contouring, benching or lowering the slope gradient - Good drainage system including under drain constructions and anchored structures. (C) - Strict implementation of Construction Plan specifications for each Project component (C) - Regular monitoring of slope condition and slope stabilization measures especially after prolonged rains and earthquakes. (O). a) Regular monitoring of the slope conditions and slopes stabilization measures especially after prolong heavy rains and earthquakes. (O). b) Regular monitoring of areas with identified geological hazards, their current condition and the degree of the effects of hazards previously identified. (O). c) Recommend applicable solutions depending on the existing geological and geomorphological conditions. (O).	Inducement of subsidence, liquefaction, landslides, mud/debris flow are minimized
	Susceptibility from geo- and hydrological hazards	D	-B	-B	D	- Conduct of EGGA (P) - Strict implementation of Construction Plan specifications for each Project component. - Install sufficient protection measures such as soil improvements during excavation activities and implement appropriate materials handling program or a site protection and rehabilitation program. - Proper inspection of all installed and constructed / ongoing construction structures and facilities. - Coordinate with the PHIVOLCS during earthquake and volcanic events to adjust construction schedule. Conduct earthquake drills for workers	Susceptibility of the Project components from geo- and hydrological hazards minimized

Sub-component	Key Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement	Residual Impact
						- Strict implementation of Construction Plan specifications for each Project component (C) - Regular monitoring of areas with identified geological hazards, its current condition and the degree of the effects of hazards previously identified (O)	
Pedology	Soil erosion / Loss of topsoil/ overburden	D	-A	-B	D	- Prepare a plan to minimize cut and fill operations during construction and operation(P) - Implementation the recommendations of geotechnical engineer and EGGA Report in areas of steep slopes and traversed by surface water channels (C) - Strict implementation of Construction Plan specifications for each Project component. (C) - Immediate removal of excavated soil stockpiles(C) - Optimize re-use of spoils(C) - Surface drainage control works – construction of drainage canal at the break-of-slope (between the gentle to moderate slopes). (C) - Construct perimeter sediment barriers; (C) - Divert upstream drainage away from the stockpiles(C) - Install drainage canals and settling pond. (C) - Regular monitoring of areas previously identified as erosion prone. Focus on sections with steep slopes, areas transected by river and creek channels, and exposed areas prone to soil erosion. (O)	Soil erosion controlled and minimized
	Change in soil quality/fertility and soil contamination	D	-B	-B	-B	- Identify staging areas (P) - Include a buffer zone during construction and operations (P) - Strict implementation of Construction Plan specifications for each Project component. (C) - Proper inspection and maintenance of machines and equipment. (C) - Strictly implement solid waste management plan and proper disposal by contractor in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969. (C) - Conduct soil quality monitoring in case of any possible contamination events occur. (C)	Changes in existing soil quality and fertility controlled and minimized

Sub-component	Key Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement	Residual Impact
						- Semi-annual monitoring of soil quality and fertility at identified stations (O)	
	Vegetation removal and loss of habitat	D	-A	-B	D	- Conduct a census of flora along the RROW; (P) - Consider the locations of significant flora and fauna during Project design. (P)If possible, avoid removal of trees along the RROW and include them in the visual design. If not possible, trees will be balled and planted in areas that will not be affected by the project; - Secure a Tree Cutting Permit from the DENR; (P) - Strict implementation of Construction Plan specifications for each Project component. (C) - Proper implementation of Tree Cutting Permit conditions (C) - Limit the development activities within the planned structure or component footprint. (C) - Establish on site nurseries in accessible locations (C) - Transplant saplings to affected areas especially riparian zones(C)	Vegetation removal and loss of habitat are minimized
	- Threat to existence of important local species - Threat to abundance, frequency and distribution of important species	D	-A	-B	D	- Conduct a census of flora along the RROW; (P) - Consider the locations of significant flora and fauna during Project design. (P)If possible, avoid removal of trees along the RROW and include them in the visual design. If not possible, trees will be balled and planted in areas that will not be affected by the project; - Secure a Tree Cutting Permit from the DENR; (P) - Strict implementation of Construction Plan specifications for each Project component. (C) - Strict implementation of a “No Hunting and No Collecting” policy (C) - Collect saplings of endangered, vulnerable and other threatened species and harden in nurseries for eventual transplanting to target areas, particularly riparian zones (C) - Adoption of lower noise and vibration construction method and machines (C) - Sustained implementation of buffer zones (O) - Regular maintenance of the highway (O) - Revegetate areas occupied by the demolished road sections, structures,	Existence of important local species will be conserved

Sub-component	Key Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement	Residual Impact
						and other ancillaries. (A)	
	Hindrance to wildlife access					- Sustained implementation of buffer zones (O) - Regular maintenance of the highway (O) - Revegetate areas occupied by the demolished road sections, structures, and other ancillaries. (A)	n/a

Table ES-8. Summary of key impacts, mitigation options, and residual effects (Water Component)

Sub-ccomponent	Key Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement	Residual Impact
Hydrology/Hydro geology	Change in drainage morphology/ Inducement of flooding/ Reduction in stream volumetric flow	D	-B	D	D	- Design adequate drainage system (P); - Road design must be compatible with existing slopes, infrastructures, environmental condition (P); - Installation of silt fences (C) - Establishment of no intrusion areas during road construction (C) - Rapid re-vegetation of side slopes with anti-erosion cover, and the use of appropriate anti-erosion technologies. (C) - Strict implementation of Construction Plan specifications for each Project component. (C) - All earthworks for site preparation and trench excavation implemented during the low rainfall period if possible (C) - Reuse excavated earth material for backfilling whenever feasible (C) - Backfilling and leveling of the borrow pits to prevent water ponding (C) - Provide adequate drainage systems to minimize the impact downstream of active construction sites - Limit the area of project activities within the RROW (C) - Regular checking of temporary drainage canals to ensure adequate storm - Regular maintenance of drainage canals, pipe culvert, cross drains. (O)	- Minimized changes in the existing drainage morphology - Inducement of flooding controlled and minimized
	Change in stream depth	D	-B	D	D	- Locate staging areas far from surface stream as possible (P)	Change in stream

Sub-ccomponent	Key Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement	Residual Impact
						- Strict implementation of Construction Plan specifications for each Project component. - Restoration and maintenance of natural drainage traversed by the alignment.(O)	depth is minimized
	Depletion of water resources / competition in water use	D	-B	D	D	- Plan water conservation program during the construction phase (P) - Use of any open water body or natural water source that are being used by the general populace must not be permitted (C) - Construction of wells as source of potable water shall not be allowed (C) - No mitigation recommended. Groundwater will not be extracted during construction. (C) - Sustained implementation of the Water Conservation Plan (O)	Water depletion controlled and minimized
Water Quality	Degradation of surface water quality	D	-A	-A	-A	- Prepare plans for drainage and sediment ponds at the staging areas. (P) - Prepare a Water Quality Monitoring Plan which will include quarterly monitoring of relevant parameters during construction and operation phase(P) - Strict implementation of Construction Plan specifications for each Project component. (C) - Best housekeeping practices(C) - Provide onsite sanitary facilities(C) - Adequate drainage leading to siltation ponds(C) - Implement the Water Quality Monitoring Plan during construction phase(C) - Best housekeeping practices(O) - Provision of sanitation facilities(O) - Maintain drainage system leading to siltation ponds(O) - Implement the Water Quality Monitoring Plan for operation phase (O)	Water pollution of waterbodies controlled and minimized
Aquatic Ecology	Threat to existence and/or loss species of important local and habitat	D	-A	-A	D	- Strict implementation of Construction Plan specifications for each Project component. - Best housekeeping practices (O)	Impacts to the freshwater ecology

Sub-ccomponent	Key Potential Impact	P	C	O	A	Options for Prevention, Mitigation, Enhancement	Residual Impact
	Threat to abundance, frequency and distribution of species					- Proper implementation of the SEMP - Bunded area for tanked fuels, lubricants, etc., with drainage leading to oil-water separator. (O) - Proper implementation of the Operation Waste Management Plan (O) - Provide onsite sanitation facilities (O) - No wastewater discharges into rivers or streams (O) - Implement the Water Quality Monitoring Plan for operation phase (O)	controlled and minimized

NOTES - P = preconstruction; C= construction, O = operation; A = abandonment or closure; +/-: Positive/Adverse A= Significant impact is expected. B= Some impact is expected. C= Impact is unknown. D= No impact is expected , NPI –No perceived impact

Table ES-9 Summary of key impacts, mitigation options, and residual effect (Air Component)

Sub-component	Key Potential Impact	P	C	O	A	Options for prevention, mitigation, and enhancement	Residual impact
Air quality	Contribution in terms of greenhouse gas emissions	D	-B	-B	D	- Allocating unused portions of the RROW for tree planting(P) - Strict implementation of Construction Plan specifications for each Project component.(P) - Replacement of vegetation in non-structure areas to minimize wind erosion of topsoil(C) - Apply dust suppression measures, e.g., water application, in active construction areas; (C) - Compact exposed soil surfaces; (C) - Provide tarpaulin cover on trucks loaded with construction materials; (C) - Haul spoils/excavated earth materials immediately after excavation and stockpiled in a safe place and disposed in designated disposal sites. (C) - Prohibit idling in parking areas and emergency curb (O) - Impose speed restrictions (O)	Insignificant greenhouse gas emissions
	Degradation of air quality	D	-A	-A	D	- Prepare an Ambient Air Quality Monitoring Plan (AAQMP) which will include quarterly monitoring of relevant parameters during construction and operation phase at sensitive receptors identified in the baseline study of this EIS.	Air pollution controlled and minimized

Sub-component	Key Potential Impact	P	C	O	A	Options for prevention, mitigation, and enhancement	Residual impact
						- Strict implementation of Construction Plan specifications for each Project component. (C) - Implement the Motor Vehicle Maintenance Plan including: · PMS of construction equipment and machineries, and vehicles will be strictly complied with (C) · Daily routine check-up of construction vehicles, equipment, and machineries must be strictly complied with (C) · Implement the Ambient Air Quality Monitoring Plan (AAQMP) during construction phase (C) · Monitor air quality at identified nearby sensitive receptors regularly and evaluate effectiveness of the air pollution reduction measures provided. (C) - Use of low-sulfur gasoline (C) - Proper installation, and maintenance of selected option, e.g., vegetation barrier.(O) - Impose speed limits	
Noise and Vibrations	Noise pollution	D	-A	-A	D	- Prepare a Noise Monitoring Plan (NMP) which will include quarterly monitoring of noise at different periods of the day during construction and operation phase at sensitive receptors identified in the baseline study of this EIS.(P) - Strict implementation of Construction Plan specifications for each Project component. (C) - Maintenance of motor vehicle mufflers; (C) - Provision of barriers and shielding stationary vibrating equipment; and (C) - Scheduling of noisy activities during daytime. (C) - Implement the Noise Monitoring Plan (C) · Monitor noise levels at identified nearby sensitive receptors (residential, school and hospital areas) including ecologically significant area/s (if any) likely to be affected and evaluate effectiveness of the noise reduction measures provided. (C) - Implement the Motor Vehicle Maintenance Plan including: · Install noise control devices such as mufflers and noise	Excessive sound levels attenuated

Sub-component	Key Potential Impact	P	C	O	A	Options for prevention, mitigation, and enhancement	Residual impact
						suppressors on all construction equipment and machinery. Use of electric instead of diesel-powered equipment, hydraulic tools instead of pneumatic tools. (C) · Daily routine check-up of construction vehicles, equipment, and machineries must be strictly complied with(C) · Conduct regular inspection and preventive maintenance of heavy equipment, machineries, and · Impose a muffler sound limit - Proper design installation and maintenance of selected sound attenuation barriers option, e.g., vegetation barrier.service vehicles to meet the DENR Emission Standard(O)	

NOTES - P = preconstruction; C= construction, O = operation; A = abandonment or closure; +/ -: Positive/Adverse A= Significant impact is expected. B= Some impact is expected. C= Impact is unknown. D= No impact is expected, NPI –No Perceived Impact

Table ES-10 Summary of key impacts, mitigation options, and residual effect (People Component)

Sub-component	Key potential impact	P	C	O	A	Options for prevention, mitigation, and enhancement	Residual impact
People	- Displacement of settler/s or involuntary resettlement - Displacement / disturbance of properties - Change/conflict in land ownership - Change/conflict Right of way Impact on Public Access	-A	D	D	D	- Authority document over RROW (P) - Conduct census of properties and land affected by the staging areas and RROW (P) - implement the Resettlement Action Plan (RAP) (P) - Undergo the FPIC process as prescribed under RA 8371. (P) - Secured the authority document of the RROW (C) - Strict implementation of Construction Plan specifications for each Project component. (C) - Proper implementation of the RAP(C)- Prepare detailed Right-of-Way Action Plan; Fair and just compensations to affected families; budget allocation and resources to PAFs and properties.	None
	Impacts on IPs/Cultures/Lifestyle	D	-A	-A	D	- Proper conduct of the FPIC process as prescribed under RA 8371. (A) - Strict implementation of Construction Plan specifications for each Project component.(C) - Proper orientation of migrant workers on culture oriented on	Impacts on IP group, culture, and lifestyle minimized

Sub-component	Key potential impact	P	C	O	A	Options for prevention, mitigation, and enhancement	Residual impact
						the culture and ways of living in the city/municipality (C)	
	Impacts on physical cultural resources	S	-A	-B	D	- Conduct survey of physical cultural resources (P) - Stop all works in the vicinity of the find, until a solution is found for the preservation of these artefacts, or advice from the relevant authorities is obtained. (C) - Decisions on how to handle the find shall be taken by the responsible authorities, including changes in the layout conservation, preservation, restoration and salvage. (C) - Construction works could only resume only after permission is granted from the responsible authorities. (C)	Physical cultural resources preserved
	Threat to public health and safety	D	-A	-A	-B	- Implement the Construction Waste Management Plan (C) including: · Temporary stockpiles of excavated materials from foundation works must be properly covered and regularly hauled to DENR approved disposal sites. · Litter and other types of domestic garbage from construction sites and camps must be properly kept in trash bins and regularly disposed through LGU garbage collectors. - Implement the Operation Waste Management Plan (OWMP) (O) including: · Regular maintenance of highway to reduce visual impact due to expected wear and tear. · Implementation of best housekeeping practices and continue the regularly disposed through LGU garbage collectors. - Formulate Occupational Health and Safety Protocols during construction and operation phases. - Grievance Redress Mechanism(P) - Strict implementation of Construction Plan specifications for each Project component. (C) - Implement the Motor Vehicle Maintenance Plan (C) - Proper implementation of the CWMP (C) - Conduct sensitization campaigns both for workers and local communities about illicit behavior and crime. (C)	Threat to public health and safety controlled and minimized

Sub-component	Key potential impact	P	C	O	A	Options for prevention, mitigation, and enhancement	Residual impact
						- Coordination with local law enforcement (C) - Maintain sanitary facilities (O) - Maintenance of traffic signs (O) - Proper implementation of the Traffic Management Plan (O)	
	Enhancement for the Local Benefits/Economies of the Project - *Generation of Local Employment*	D	+A	+A	+A	- Conduct skills training at the host LGUs (P) - Prioritize local hires (P) - Enhance the opportunity for new businesses and innovation (C) - Implement the Local Employment Plan (C) - Purchase supplies from local sources (C) - Provide livelihood opportunities if possible (C) - Prompt payment of taxes and other legal fees (C) - Prioritize hiring of qualified residents from host LGUs (O) - Purchase supplies from local sources (O) - Provide livelihood opportunities if available (O) - Prompt payment of fees and taxes (O)	Local benefits from the Project maximized
	Traffic contribution along impact roads	D	-B	+A	D	- Prepare a workable Traffic Management Plan (TMP) for all affected public roads (P) - Predetermined routes of construction materials (P) - Strict implementation of Construction Plan specifications for each Project component.(C) - Implement the Traffic Management Plan (C) - Proper implementation of the Traffic Management Plan	Traffic congestion and accidents controlled and minimized

NOTES - P = pre-aconstruction; C= construction, O = operation; A = abandonment or closure; +/-: Positive/Adverse A= Significant impact is expected. B= Some impact is expected. C= Impact is unknown. D= No impact is expected, NPI- No perceived impact

Table ES-11 Integrated summary of impacts and target efficiencies

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
Pre-construction[1]	(LAND) Land use and classification	- Compatibility with existing land use - Compatibility with classification as an Environmentally Critical Area (ECA) - Existing land tenure issue/s - Impairment of visual aesthetics - Devaluation of land value as a result of improper solid waste management and other related impacts	- Confirm classification of the other Project areas to the zoning regulation of the host cities and municipalities - Include susceptibility of the Project area to natural hazards in the Detailed Engineering Design - Documents showing authority to develop the Project RROW - Formulation and proper implementation of BZP, CWMP, and OWMP	All measures implemented (100%)
	(LAND) Geology	- Change in surface landform/geomorphology/topography/terrain/slope - Change in sub-surface geology/underground conditions - Inducement of subsidence, liquefaction, landslides, mud / debris flow, etc.	- Conduct Geotechnical Investigation and EGGA and consider its recommendations in the DED - Conduct of Factual Geological mapping focusing on the geology, geomorphology, and geohazards, areas that may be prone to settlement or subsidence. - Prioritization scheme on rehabilitation of existing roads, landslide areas, and drainage canals.	100% compliance with the recommended mitigation measures
	(LAND) Pedology	Soil erosion / Loss of topsoil/overburden Change in soil quality/fertility	- Formulate a Soil Erosion Management Plan (SEMP) including: · Minimize the modified area to prevent soil erosion of new surface soil by cut and filling, · Ensure the slope protection after cut and filling as soon as possible. · Establish the adequate drainage system in the construction area” · Identify staging areas to prevent extensive development. • Formulate BZP	100% compliance with the recommended mitigation measures

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[1] Although not expected to occur, inclusion of key impacts were included to indicate the recommended plans and studies for implementation during the Construction and Operation phases as due diligence.

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
	(LAND) Terrestrial biology	Impacts on terrestrial flora and fauna	- Conduct a census of flora along the RROW; - If possible, avoid removal of trees along the RROW and include them in the visual design. If not possible, trees will be balled and planted in areas that will not be affected by the project; - Secure a Tree Cutting Permit from the DENR; - Prepare CVRP, CVTPP, TTBP, TSMP, VTPPO, BCP, WMP	100% compliance with the recommended mitigation measures
	(WATER) Hydrology/ Hydrogeology	Change in drainage morphology/ Inducement of flooding/ Reduction in stream volumetric flow Change in stream depth Water resource use and competition Degradation of surface water quality	- Design adequate drainage system - Road design must be compatible with existing slopes, infrastructures, environmental condition. - Locate staging areas far from surface stream as possible - Formulate a Spoils Management Plan - Formulate WCP for the construction phase - Prepare plans for drainage and sediment ponds at the staging areas. - Prepare a Water Quality Monitoring Plan during construction and operation phases	100% compliance with the recommended mitigation measures
	(AIR) Air quality and Noise	- Contribution in terms of greenhouse gas emissions (or GHG mitigation potential) - Degradation of air quality - Increase in ambient noise level	- Prepare an EMVMP during construction - Prepare AAQMP during construction and operation phases - Prepare a Noise Monitoring Plan (NMP) during construction and operation phases	100% compliance with the recommended mitigation measures
	PEOPLE	- Displacement of settler/s - Displacement / disturbance of properties - Change/conflict in land ownership - Change/conflict Right of way - Impact on Public Access - In-migration (proliferation of informal settlers) - Cultural/Lifestyle change (especially on Indigenous	- Authority document over RROW - Conduct census of properties and land affected by the staging areas and RROW - Prepare detailed Right-of-Way Action Plan; Fair and just compensations to affected families; budget allocation and resources to PAFs and properties. - Undergo the FPIC process - Conduct consultations with the stakeholders and formulate mutually agreed schemes - Review Journal of Assessment Transactions on Market and Assessed Land Values to ensure fair compensation	100% compliance with the recommended mitigation measures

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
		People, if any) - Impacts on physical cultural resources - Threat to public health and safety - Enhancement for the Local Benefits of the Project - *Generation of Local Employment* - Traffic congestion	- Prepare ISMP - Conduct survey of physical cultural resources - Prepare CFMP - Prepare CWMP and OWMP - Formulate Occupational Health and Safety Protocols during construction and operation phases - Grievance Redress Mechanism - Conduct skills training at the host LGUs - Prepare a LEP - Prepare a workable TMP for all affected public roads - Predetermined routes of construction materials	
Construction	(LAND) Land use and classification	- Compatibility with existing land use - Compatibility with classification as an Environmentally Critical Area (ECA) - Existing land tenure issue/s - Impairment of visual aesthetics - Devaluation of land value as a result of improper solid waste management and other related impacts	- Proper implementation of the BZP - Strict implementation of Construction Plan specifications for each Project component - Proper implementation of the CWMP	100% compliance with the recommended mitigation measures
	(LAND) Geology /Geomorphology	- Change in surface landform/geomorphology/topography/terrain/slope - Change in sub-surface geology/underground conditions - Inducement of subsidence, liquefaction, landslides, mud / debris flow, etc.	- Employ appropriate erosion control and slope protection measures. - Designate a spoils storage area and optimize re-use of spoils. - Construction drainage canals at the break-of-slope (between the gentle to moderate slopes). - Slope re-contouring, benching or lowering the slope gradient - Good drainage system including under drain construction and anchored structures. - Field assessment in active construction sites especially after heavy and prolonged rains and after earthquakes (if it occurs).	100% compliance with the recommended mitigation measures

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
			- Apply appropriate slope protection and other engineered structures - Increase vegetation cover particularly at the vicinity of the breakof-slope - Surface drainage control works – construction of drainage canal at the break-of-slope (between the gentle to moderate slopes) - Slope re-contouring, benching or lowering the slope gradient - Good drainage system including under drain constructions and anchored structures. - Strict implementation of Construction Plan specifications for each Project component.	
	(LAND) Pedology	- Soil erosion or loss of topsoil - Change in soil quality/fertility	- Strict implementation of Construction Plan specifications for each Project component. - Proper implementation of the SEMP - Immediate removal of excavated soil, stockpiled in a safe place and disposed in the designated disposal site. - Optimize re-use of spoils - Surface drainage control works – construction of drainage canal at the break-of-slope (between the gentle to moderate slopes). - Cover stockpiles with plastic sheeting; construct perimeter sediment barriers; - Divert upstream drainage away from the stockpiles - Install drainage canals and settling pond. - Proper implementation of the BZP and CWMP	- Minimize (85-99%) or avoid (100%) soil erosion and contamination
	(LAND) Terrestrial Ecology	- Vegetation removal and loss of habitat - Threat to existence of important local species - Threat to abundance, frequency and distribution of important species - Hindrance to wildlife access	- Strict implementation of Construction Plan specifications for each Project component. - Proper implementation of the CVRP, CVTPP, BZP, TTBP, and comply with the DENR requirements to remove and replace affected trees within the Road Right-of-Way (RROW) in coordination with EMB X, concerned PENROs and CENROs. Limit the development activities within the planned structure or component footprint.	-100% compliance with the recommended mitigation measures in accordance to RA 9147

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
			- Establish on site nurseries in accessible locations - Transplant saplings to affected areas especially riparian zones - Strict implementation of Construction Plan specifications for each Project component. - Strict implementation of a "*No Hunting and No Collecting*" policy - Collect saplings of endangered, vulnerable and other threatened species and harden in nurseries for eventual transplanting to target areas, particularly riparian zones	
	(WATER) Hydrology/ Hydrogeology	- Change in drainage morphology - Inducement of flooding - Reduction in stream volumetric flow Change in stream depth	- Strict implementation of Construction Plan specifications for each Project component. - All earthworks for site preparation and trench excavation implemented during the low rainfall period if possible - Reuse excavated earth material for backfilling whenever feasible - Backfilling and leveling of the borrow pits to prevent water ponding - Provide adequate drainage systems to minimize the impact downstream of active construction sites - Limit the area of project activities within the RROW - Regular checking of temporary drainage canals to ensure adequate storm water flow. - Strict implementation of Construction Plan specifications for each Project component. - Proper implementation of the SEMP and Spoils Management Plan - Installation of sedimentation basins where applicable - Strict implementation of Construction Plan specifications for each Project component. - Proper implementation of the Water Conservation Plan.	- Minimize (85-99%) or avoid siltation (100%) - 100% compliance with the recommended mitigation measures in accordance to RA 9275
	(WATER) Water Quality	Degradation of surface water quality	- Strict implementation of Construction Plan specifications for each Project component. - Best housekeeping practices - Provide onsite sanitary facilities	- Provide sufficient onsite sanitary facilities (100%) - 100% compliance with the recommended

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
			- Adequate drainage leading to siltation ponds - Implement the Water Quality Monitoring Plan during construction phase ;Engage the services of the accredited third-party water treatment companies to ensure the treatment of the wastewater coming from different sources in compliance with the DENR standards and shall comply with all the provisions of RA 9275, the Philippine Clean Water Act of 2004 and its Implementing Rules and Regulations;	mitigation measures in accordance to RA 9275 - 100% compliance with the recommended mitigation measures
	(WATER) Freshwater Ecology	- Threat to existence and/or loss species of important local and habitat - Threat to abundance, frequency and distribution of species	- Strict implementation of Construction Plan specifications for each Project component. - Proper implementation of the SEMP - Bunded area for tanked fuels, lubricants, etc., at the staging areas with drainage leading to oil-water separator. - Proper implementation of the CWMP - Provide onsite sanitation facilities - Provide cover on vehicles carrying construction materials - No wastewater discharges into rivers or streams - Contain runoff from construction areas with silt traps or curtains - Maintain water quality of the Project Site according to minimum standards or better, particularly on Total Suspended Solids, Dissolved Oxygen, and Phosphate	100% compliance with the recommended mitigation measures in accordance to RA 9275
	(AIR) Air Quality and Noise	- Degradation of air quality - Increase in ambient noise level	- Strict implementation of Construction Plan specifications for each Project component. - Divide active construction sites into smaller areas if possible; - Apply dust suppression measures, e.g., water application, in active construction areas; - Replace vegetation in non-structure areas to minimize wind erosion of topsoil; - Compact exposed soil surfaces; - Provide tarpaulin cover on trucks loaded with construction materials;	- Compliance to the Clean Air Act (100%) - 100% compliance with the recommended mitigation measures in accordance to RA 9275

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
			- . Impose speed restrictions minimize (15-20 kph). - Component for Hazardous waste, mitigation measures and target efficiency in accordance with RA 6969 - Strict implementation of Construction Plan specifications for each Project component. - Implement the Motor Vehicle Maintenance Plan - Use of low-sulfur fuel - Implement the Ambient Air Quality Monitoring Plan (AAQMP) during construction phase - Maintenance of motor vehicle mufflers; - Provision of barriers and shielding stationary vibrating equipment; and - If possible, scheduling of noisy activities during day time. - Implement the Noise Monitoring Plan - Implement the Motor Vehicle Maintenance Plan	
	PEOPLE	- Displacement of settlers - Displacement/disturbance of properties - Change/conflict in land ownership - Change/conflict Right of way - Impact on Public Access	- Secured the authority document of the RROW - Strict implementation of Construction Plan specifications for each Project component. - Proper implementation of the RAP - Prepare detailed Right-of-Way Action Plan; Fair and just compensations to affected families; budget allocation and resources to PAFs and properties.	-100% compliance with the recommended mitigation measures in accordance to all applicable provisions of RA 7279 (UDHA) , JICA Guidelines for environmental and social considerations and the ADB resettlement policy (100%) -100% compliance with the proposed mitigation measures
	PEOPLE	In-Migration	- Implement the Informal Settler Monitoring Plan - Prioritize local hiring	100% compliance with the recommended mitigation measures

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
	PEOPLE	Cultural/Lifestyle change (especially on Indigenous People, if any)	- Strict implementation of Construction Plan specifications for each Project component. - Proper orientation of migrant workers on culture oriented on the culture and ways of living in the city/municipality	100% compliance with the recommended mitigation measures in close coordination with NCIP and tribal leaders and communities
		Threat to delivery of basic services /resource competition	- Strict implementation of Construction Plan specifications for each Project component. - Implement the Informal Settler Monitoring Plan - Coordination of DPWH/contractor with the host LGUs regarding needs of the migrants and residents of the community	100% compliance with the recommended mitigation measures in accordance to RA 10066 in coordination with LGU.
		Threat to public health and safety	- Strict implementation of Construction Plan specifications for each Project component. - Implement the Construction Waste Management Plan - Implement the Motor Vehicle Maintenance Plan - Proper implementation of the CWMP - Conduct sensitization campaigns both for workers and local communities about illicit behavior and crime. - Coordination with local law enforcement	100% compliance with the recommended mitigation measures in coordination with LGU.
		Generation of local benefits from the Project (BENEFICIAL IMPACT)	- Increased LGU revenues resulting from the purchase of locally available materials and equipment for construction, translating to additional taxes. - Business establishments should be properly registered and payment of the required taxes shall be monitored. - Alleviate economy and generation of employment income to hosts, nearby barangays, and the two provinces as a whole pursuant to DPWH Department Order No. 130, Series of 2016, "Guidelines for the Implementation of the Provisions of Republic Act No. 66885 and Republic Act No. 9710 or the Magna Carta of Women which Specify the following: - Mandatory minimum percentage of 50% of the unskilled labor	100% compliance with the recommended mitigation measures in coordination with LGU.

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
			requirements shall be recruited in the Barangay where the project is located. - Mandatory 30% of the skilled labor requirement shall be recruited in the Barangay where the project is located. - Purchase supplies from local sources - Provide livelihood opportunities if possible - Prompt payment of taxes and other legal fees	
		Traffic congestion	- Strict implementation of Construction Plan specifications for each Project component. - Implement the Traffic Management Plan	100% com100% compliance with the recommended mitigation measures in accordance to RA 6685 and RA 9710 in coordination with DOLE, LGUs and Industry Sectors.
Opening of the CMH to traffic	(LAND) Land use and classification	. ▪ Devaluation of land value as a result of improper solid waste management and other related impacts	- Sustained implementation of the BZP - Regular operation and maintenance of the highway - Implementation of the OWMP - Best housekeeping practices	100% compliance with the recommended mitigation measures in accordance to RA 6685 and RA 9710 in coordination with DOLE, LGUs and Industry Sectors.
	(LAND) Geology	▪ Change in surface landform/ geomorphology/ topography/terrain/slope ▪ Change in sub-surface geology/underground conditions. ▪ Effects of geohazards to the Project	- Regular monitoring of slope conditions and slope stabilization measures constructed with focus on landform change. - Regular monitoring of identified areas prone to subsidence particularly those underlain by the limestone. - Follow recommendations of the geotechnical / civil engineer / geologist to address any adverse geological and geomorphological conditions. - Regular monitoring of slope condition and slope stabilization measures especially after prolonged rains and earthquakes. - Regular monitoring of areas with identified geological hazards, its current condition and the degree of the effects of hazards previously identified.	All measures implemented (100%)

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
	(LAND) Pedology	- Soil erosion / Loss of topsoil/overburden - Change in soil quality/fertility	- Regular monitoring of areas previously identified as erosion prone. Focus on sections with steep slopes, areas transected by river and creek channels, and exposed areas prone to soil erosion. - Sustained implementation of the Soil Erosion Management Plan - LGU/and or toll operators should have provision of emergency preparedness and response plan from implementation and strict compliance of national disaster risk reduction measures	- Minimize (85-99%) or avoid siltation (100%) - 100% compliance with the recommended mitigation measures in accordance with RA 9275
	(LAND) Terrestrial Ecology	- Vegetation removal - Threat to existence of important indigenous species - Threat to Abundance, Frequency, and Distribution of Important Species - Hindrance to Wildlife Access	- Sustained implementation of the BZP - Proper implementation of the CVRP, CVTPP, BZP, TTBP, and Tree Cutting Permit conditions - Regular maintenance of the highway	100% compliance with the recommended mitigation measures
	(WATER) Hydrology/ Hydrogeology	- Change in drainage morphology/ Inducement of flooding/ Reduction in stream flow - Change in stream depth - Water resource use and competition	- Regular maintenance of drainage canals, pipe culvert, cross drains. - Restoration and maintenance of natural drainage traversed by the alignment. - Sustained implementation of the Water Conservation Plan	100% compliance with the recommended mitigation measures
	(WATER) Water quality	Degradation of surface water quality	- Best housekeeping practices - Provision of sanitation facilities - Maintain drainage system leading to siltation ponds - Implement the Water Quality Monitoring Plan for operation phase	- Provide sufficient sanitary facilities (100%) - Compliance to the Clean Water Act (100%) - All other measures implemented (100%)
	(WATER) Freshwater Ecology	- Threat to existence and/or loss species of important local and habitat - Threat to abundance, frequency	- Sustained implementation of the SEMP and BZP - Bunded area for tanked fuels, lubricants, etc., with drainage leading to oil-water separator. - Proper implementation of the Operation Waste Management	100 % compliant to RA 9275 and other applicable regulations

Project activity	Component (Sub-component)	Key potential impact	Options for Prevention, Mitigation, Enhancement	Target efficiency
		and distribution of species	Plan - Provide onsite sanitation facilities - No wastewater discharges into rivers or streams - Implement the Water Quality Monitoring Plan for operation phase	
	(AIR) Meteorology/ Climatology	Contribution in terms of greenhouse gas emissions (or GHG mitigation potential).	- Impose speed restrictions - Prohibit idling in parking areas and emergency curbs	100% compliance with the recommended mitigation measures
	(WATER) Air Quality and Noise	Air pollution from motor vehicles	- Proper installation, and maintenance of selected option, e.g., vegetation barrier. - Impose speed limits - Impose a muffler sound limit - Proper design installation and maintenance of selected sound attenuation barriers option, e.g., vegetation barrier.	100% compliance with the recommended mitigation measures
	PEOPLE	Threat to public health and safety	- Maintain sanitary facilities - Maintenance of traffic signs - Proper implementation of the Traffic Management Plan	100% compliance with the recommended mitigation measures
	PEOPLE	Generation of local benefits from the Project (BENEFICIAL IMPACT)	- Prioritize hiring of qualified residents from host LGUs - Purchase supplies from local sources - Provide livelihood opportunities if available - Prompt payment of fees and taxes	100% compliance with the recommended mitigation measures
	PEOPLE	Traffic congestion	Proper implementation of the Traffic Management Plan	100% compliance with the recommended mitigation measures

CHAPTER 1 - PROJECT DESCRIPTION

1.1 Project location and area

1.1.1 General location and area

The proposed Central Mindanao High Standard Highway Project (Cagayan de Oro - Malaybalay Section) ("***Project***" or "***alignment***") is part of the Master Plan on High Standard Highway Network Development, Phase II. The Project is a new alignment that will supplement the existing road network in Region X. The objectives of the plan were to improve transport efficiency in the region, contribute to improving connectivity between the cities of Cagayan de Oro and Malaybalay, as well as the economic development of the surrounding areas.

The Project with a length of 65.6 kilometers will traverse 27 barangays of four municipalities and two cities in the Provinces of Misamis Oriental and Bukidnon in Region X-Northern Mindanao (**Table 1-1**). The general location and jurisdiction maps and the host barangays are shown in **Figure 1-1.**

The boundaries of the Project are defined by the geographic coordinates under WGS 89 are shown in **Table 1-2** based on points shown in **Figure 1-1.**

The proposed Project will be spearheaded by the Department of Public Works and Highways (DPWH) with the assistance of the Japan International Cooperation Agency (JICA).

Table 1-1. Jurisdictions of the Project alignment

Province	City/Municipality	Barangay
Misamis Oriental	Cagayan de Oro City	Bugo
		Puerto
		Balubal
	Tagoloan	Casinglot
		Natumolan
Bukidnon	Manolo Fortich	Alae
		San Miguel
		Damilag
		Dicklum
		Sankanan
		Tankulan
		Ticala
		Mambatangan
	Sumilao	Puntian
		Vista Villa
		Culasi
		Poblacion
		Kisolon
		San Roque
Bukidnon	Impasug-ong	Poblacion
		La Fortuna
		Cawayan
		Capitan Bayong
		Impalutao
	Malaybalay	Dalwangan
		Patpat
		Kalasungay
Total: 2	**Total: 6**	**Total: 27**

Source: JICA Study Team

Table 1-2. Point coordinates of the proposed CMH Project

Pt	Longitude	Latitude	Pt	Longitude	Latitude	Pt	Longitude	Latitude
START -1	124.7576	8.5140	171	124.7943	8.4888	341	124.8975	8.3333
2	124.7609	8.5128	172	124.7944	8.4885	342	124.8981	8.3332
3	124.7657	8.5150	173	124.7945	8.4883	343	124.8987	8.3332
4	124.7670	8.5187	174	124.7946	8.4881	344	124.9066	8.3329
5	124.7693	8.5212	175	124.7980	8.4819	345	124.9069	8.3329
6	124.7732	8.5231	176	124.7980	8.4818	346	124.9074	8.3328
7	124.7753	8.5243	177	124.7981	8.4816	347	124.9076	8.3328
8	124.7791	8.5267	178	124.7982	8.4814	348	124.9078	8.3328
9	124.7844	8.5252	179	124.7983	8.4813	349	124.9081	8.3327
10	124.7850	8.5238	180	124.7984	8.4812	350	124.9083	8.3327
11	124.7870	8.5210	181	124.7984	8.4811	351	124.9085	8.3326
12	124.7937	8.5147	182	124.7985	8.4810	352	124.9088	8.3325
13	124.7942	8.5107	183	124.7986	8.4810	353	124.9316	8.3260
14	124.7899	8.5040	184	124.7986	8.4810	354	124.9322	8.3259
15	124.7897	8.5004	185	124.7987	8.4808	355	124.9332	8.3255
16	124.7916	8.4967	186	124.7989	8.4806	356	124.9337	8.3253
17	124.7923	8.4957	187	124.7990	8.4805	357	124.9342	8.3251
18	124.7932	8.4944	188	124.7990	8.4804	358	124.9347	8.3248
19	124.7940	8.4919	189	124.7991	8.4803	359	124.9352	8.3246
20	124.7940	8.4902	190	124.7992	8.4802	360	124.9357	8.3243
21	124.7946	8.4881	191	124.7993	8.4801	361	124.9361	8.3240
22	124.7980	8.4819	192	124.7993	8.4799	362	124.9396	8.3219
23	124.8023	8.4695	193	124.8019	8.4750	363	124.9409	8.3212
24	124.7986	8.4581	194	124.8021	8.4744	364	124.9437	8.3197
25	124.7979	8.4565	195	124.8025	8.4732	365	124.9451	8.3191
26	124.7964	8.4529	196	124.8026	8.4726	366	124.9465	8.3185
27	124.7950	8.4481	197	124.8027	8.4720	367	124.9479	8.3179
28	124.7946	8.4454	198	124.8027	8.4713	368	124.9494	8.3174
29	124.7956	8.4383	199	124.8026	8.4707	369	124.9509	8.3170
30	124.7963	8.4365	200	124.8025	8.4701	370	124.9524	8.3166
31	124.7977	8.4311	201	124.8023	8.4695	371	124.9698	8.3123
32	124.7980	8.4277	202	124.7986	8.4581	372	124.9703	8.3121
33	124.7988	8.4236	203	124.7985	8.4579	373	124.9714	8.3117
34	124.8012	8.4163	204	124.7984	8.4576	374	124.9719	8.3114
35	124.8028	8.4127	205	124.7983	8.4574	375	124.9724	8.3112
36	124.8092	8.4000	206	124.7982	8.4572	376	124.9729	8.3108
37	124.8114	8.3972	207	124.7982	8.4570	377	124.9734	8.3105
38	124.8159	8.3933	208	124.7981	8.4568	378	124.9738	8.3101
39	124.8179	8.3909	209	124.7980	8.4566	379	124.9742	8.3097
40	124.8198	8.3876	210	124.7979	8.4565	380	124.9795	8.3040
41	124.8264	8.3750	211	124.7964	8.4529	381	124.9802	8.3032
42	124.8263	8.3662	212	124.7962	8.4524	382	124.9814	8.3015
43	124.8315	8.3579	213	124.7958	8.4514	383	124.9818	8.3006
44	124.8590	8.3451	214	124.7956	8.4508	384	124.9823	8.2996
45	124.8657	8.3438	215	124.7955	8.4503	385	124.9826	8.2987
46	124.8710	8.3442	216	124.7953	8.4498	386	124.9829	8.2977
47	124.8742	8.3443	217	124.7952	8.4492	387	124.9830	8.2966
48	124.8828	8.3442	218	124.7951	8.4487	388	124.9831	8.2956
49	124.8865	8.3424	219	124.7950	8.4481	389	124.9836	8.2886
50	124.8881	8.3401	220	124.7946	8.4454	390	124.9837	8.2875
51	124.8922	8.3360	221	124.7945	8.4446	391	124.9842	8.2854
52	124.8937	8.3349	222	124.7945	8.4430	392	124.9845	8.2844
53	124.8987	8.3332	223	124.7946	8.4422	393	124.9850	8.2834
54	124.9066	8.3329	224	124.7947	8.4414	394	124.9855	8.2824
55	124.9088	8.3325	225	124.7948	8.4406	395	124.9861	8.2815
56	124.9316	8.3260	226	124.7950	8.4398	396	124.9868	8.2807
57	124.9361	8.3240	227	124.7953	8.4390	397	124.9875	8.2799
58	124.9396	8.3219	228	124.7956	8.4383	398	124.9910	8.2764
59	124.9524	8.3166	229	124.7963	8.4365	399	124.9913	8.2761
60	124.9698	8.3123	230	124.7966	8.4359	400	124.9918	8.2756
61	124.9742	8.3097	231	124.7970	8.4347	401	124.9920	8.2753
62	124.9795	8.3040	232	124.7971	8.4341	402	124.9922	8.2750

Pt	Longitude	Latitude	Pt	Longitude	Latitude	Pt	Longitude	Latitude
63	124.9831	8.2956	233	124.7973	8.4335	403	124.9924	8.2747
64	124.9836	8.2886	234	124.7974	8.4329	404	124.9926	8.2744
65	124.9875	8.2799	235	124.7975	8.4323	405	124.9928	8.2741
66	124.9910	8.2764	236	124.7976	8.4317	406	124.9930	8.2738
67	124.9930	8.2738	237	124.7977	8.4311	407	124.9954	8.2699
68	124.9954	8.2699	238	124.7980	8.4277	408	124.9956	8.2695
69	124.9983	8.2669	239	124.7980	8.4272	409	124.9962	8.2688
70	125.0074	8.2612	240	124.7981	8.4263	410	124.9965	8.2684
71	125.0124	8.2528	241	124.7982	8.4259	411	124.9968	8.2681
72	125.0130	8.2440	242	124.7983	8.4254	412	124.9972	8.2678
73	125.0147	8.2383	243	124.7984	8.4249	413	124.9975	8.2675
74	125.0233	8.2229	244	124.7985	8.4245	414	124.9979	8.2672
75	125.0325	8.2139	245	124.7987	8.4240	415	124.9983	8.2669
76	125.0428	8.2085	246	124.7988	8.4236	416	125.0074	8.2612
77	125.0463	8.2053	247	124.8012	8.4163	417	125.0083	8.2605
78	125.0541	8.1928	248	124.8014	8.4159	418	125.0099	8.2590
79	125.0554	8.1891	249	124.8017	8.4151	419	125.0106	8.2581
80	125.0564	8.1808	250	124.8018	8.4147	420	125.0112	8.2571
81	125.0702	8.1673	251	124.8020	8.4143	421	125.0116	8.2561
82	125.0863	8.1657	252	124.8022	8.4139	422	125.0120	8.2550
83	125.0910	8.1650	253	124.8024	8.4135	423	125.0122	8.2539
84	125.1003	8.1631	254	124.8026	8.4131	424	125.0124	8.2528
85	124.7609	8.5128	255	124.8028	8.4127	425	125.0130	8.2440
86	124.7616	8.5126	256	124.8092	8.4000	426	125.0130	8.2433
87	124.7628	8.5126	257	124.8094	8.3996	427	125.0133	8.2420
88	124.7635	8.5128	258	124.8098	8.3990	428	125.0134	8.2414
89	124.7640	8.5130	259	124.8100	8.3986	429	125.0136	8.2407
90	124.7646	8.5134	260	124.8102	8.3983	430	125.0138	8.2401
91	124.7650	8.5138	261	124.8105	8.3980	431	125.0141	8.2395
92	124.7654	8.5144	262	124.8108	8.3977	432	125.0144	8.2389
93	124.7657	8.5150	263	124.8111	8.3975	433	125.0147	8.2383
94	124.7670	8.5187	264	124.8114	8.3972	434	125.0233	8.2229
95	124.7671	8.5190	265	124.8159	8.3933	435	125.0240	8.2217
96	124.7675	8.5197	266	124.8162	8.3931	436	125.0258	8.2193
97	124.7677	8.5200	267	124.8166	8.3926	437	125.0267	8.2183
98	124.7680	8.5203	268	124.8169	8.3923	438	125.0278	8.2173
99	124.7683	8.5206	269	124.8171	8.3921	439	125.0289	8.2163
100	124.7686	8.5208	270	124.8173	8.3918	440	125.0300	8.2154
101	124.7689	8.5211	271	124.8175	8.3915	441	125.0313	8.2146
102	124.7693	8.5212	272	124.8177	8.3912	442	125.0325	8.2139
103	124.7732	8.5231	273	124.8179	8.3909	443	125.0428	8.2085
104	124.7734	8.5232	274	124.8198	8.3876	444	125.0433	8.2082
105	124.7739	8.5235	275	124.8199	8.3873	445	125.0442	8.2076
106	124.7741	8.5236	276	124.8202	8.3869	446	125.0446	8.2073
107	124.7744	8.5237	277	124.8204	8.3867	447	125.0450	8.2069
108	124.7746	8.5238	278	124.8206	8.3865	448	125.0453	8.2065
109	124.7748	8.5240	279	124.8207	8.3863	449	125.0457	8.2061
110	124.7751	8.5241	280	124.8209	8.3861	450	125.0460	8.2057
111	124.7753	8.5243	281	124.8211	8.3859	451	125.0463	8.2053
112	124.7791	8.5267	282	124.8213	8.3858	452	125.0541	8.1928
113	124.7797	8.5270	283	124.8224	8.3848	453	125.0543	8.1924
114	124.7811	8.5273	284	124.8241	8.3827	454	125.0547	8.1916
115	124.7818	8.5272	285	124.8248	8.3816	455	125.0549	8.1912
116	124.7824	8.5270	286	124.8254	8.3803	456	125.0550	8.1908
117	124.7830	8.5267	287	124.8259	8.3790	457	125.0551	8.1904
118	124.7836	8.5263	288	124.8262	8.3777	458	125.0552	8.1899
119	124.7840	8.5258	289	124.8264	8.3764	459	125.0553	8.1895
120	124.7844	8.5252	290	124.8264	8.3750	460	125.0554	8.1891
121	124.7850	8.5238	291	124.8264	8.3651	461	125.0564	8.1808
122	124.7852	8.5235	292	124.8269	8.3628	462	125.0568	8.1785
123	124.7855	8.5228	293	124.8274	8.3618	463	125.0587	8.1743
124	124.7858	8.5225	294	124.8280	8.3608	464	125.0601	8.1725
125	124.7860	8.5222	295	124.8287	8.3599	465	125.0618	8.1709
126	124.7862	8.5219	296	124.8296	8.3591	466	125.0636	8.1695

Pt	Longitude	Latitude	Pt	Longitude	Latitude	Pt	Longitude	Latitude
127	124.7865	8.5216	297	124.8305	8.3585	467	125.0657	8.1685
128	124.7867	8.5213	298	124.8315	8.3579	468	125.0679	8.1677
129	124.7870	8.5210	299	124.8590	8.3451	469	125.0702	8.1673
130	124.7937	8.5147	300	124.8597	8.3448	470	125.0863	8.1657
131	124.7940	8.5144	301	124.8611	8.3443	471	125.0868	8.1657
132	124.7945	8.5135	302	124.8619	8.3441	472	125.0879	8.1656
133	124.7946	8.5131	303	124.8626	8.3440	473	125.0884	8.1655
134	124.7947	8.5126	304	124.8634	8.3439	474	125.0889	8.1654
135	124.7946	8.5121	305	124.8642	8.3438	475	125.0894	8.1653
136	124.7946	8.5116	306	124.8649	8.3438	476	125.0899	8.1652
137	124.7944	8.5112	307	124.8657	8.3438	477	125.0905	8.1651
138	124.7942	8.5107	308	124.8710	8.3442	478	125.0910	8.1650
139	124.7899	8.5040	309	124.8714	8.3442	479	125.1003	8.1631
140	124.7897	8.5037	310	124.8721	8.3442	480	125.1009	8.1629
141	124.7894	8.5029	311	124.8724	8.3443	481	125.1022	8.1624
142	124.7893	8.5024	312	124.8728	8.3443	482	125.1028	8.1620
143	124.7893	8.5020	313	124.8732	8.3443	483	125.1034	8.1616
144	124.7893	8.5016	314	124.8735	8.3443	484	125.1039	8.1612
145	124.7894	8.5012	315	124.8739	8.3443	485	125.1044	8.1606
146	124.7895	8.5008	316	124.8742	8.3443	486	125.1048	8.1601
147	124.7897	8.5004	317	124.8828	8.3442	487	125.1052	8.1595
148	124.7916	8.4967	318	124.8833	8.3442	488	124.7993	8.4799
149	124.7917	8.4966	319	124.8842	8.3440	489	124.8019	8.4750
150	124.7918	8.4964	320	124.8847	8.3438	490	125.1093	8.1611
151	124.7919	8.4962	321	124.8851	8.3436	491	125.1096	8.1613
152	124.7920	8.4961	322	124.8855	8.3434	492	125.1099	8.1614
153	124.7920	8.4960	323	124.8859	8.3431	493	125.1101	8.1616
154	124.7921	8.4959	324	124.8862	8.3427	494	125.1104	8.1619
155	124.7922	8.4958	325	124.8865	8.3424	495	125.1106	8.1621
156	124.7923	8.4957	326	124.8881	8.3401	496	125.1109	8.1623
157	124.7932	8.4944	327	124.8885	8.3396	497	125.1111	8.1625
158	124.7933	8.4942	328	124.8893	8.3386	498	125.1113	8.1628
159	124.7936	8.4936	329	124.8898	8.3381	499	125.1090	8.1611
160	124.7937	8.4933	330	124.8902	8.3376	500	125.1093	8.1613
161	124.7938	8.4931	331	124.8907	8.3372	501	125.1096	8.1614
162	124.7939	8.4928	332	124.8912	8.3368	502	125.1099	8.1616
163	124.7940	8.4925	333	124.8917	8.3364	503	125.1101	8.1619
164	124.7940	8.4922	334	124.8922	8.3360	504	125.1104	8.1621
165	124.7940	8.4919	335	124.8937	8.3349	505	125.1106	8.1623
166	124.7940	8.4902	336	124.8942	8.3346	506	125.1109	8.1625
167	124.7940	8.4900	337	124.8953	8.3340	507	125.1111	8.1628
168	124.7941	8.4895	338	124.8958	8.3338	END - 508	125.1113	8.1630
169	124.7941	8.4892	339	124.8964	8.3336			
170	124.7942	8.4890	340	124.8969	8.3334			

Source: derived from Google Earth

Figure 1-1. General location map of the Project

	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
NAMRIA Land Cover Map Region X	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental, Region X	Google Earth Satellite (Basemap) PSA 2016 (Administrative Boundaries) NARMIA 2020 (Land Cover)		

1.1.2 Initial impact areas

The **Revised Procedural Manual (RPM) of DAO 2003-30** defined the Direct Impact Area (DIA) at the pre-EIA stage as the extent where all "*Project facilities are proposed to be constructed/situated and where all operations are proposed to be undertaken*".
The **Direct Impact Area (DIA)** is the RROW of the 65.6-kilometer alignment following Annex 2-2 of the Revised Procedural Manual of DAO 2003-30 (**Figure 1-2**). Based on the definitions provided, Direct Impact Areas (DIA) are areas directly affected by the Project's ROW where acquisition of properties and displacement of structures will be required. The host cities, municipalities and barangays are listed in **Table 1-1.** The direct initial impact areas in the municipal and barangay levels are shown in **Figure 1-3** and **Figure 1-4** respectively.
The **Indirect Impact Area (IIA)** was initially assumed as areas within one kilometer (1km) from the center of the alignment. In addition, barangays adjacent to the Direct Impact Barangays (DIB) will be considered as Indirect Impact Barangays (IIB). The IIA is arbitrarily at the pre-EIA stage, clearly delineated after the study is completed, and is more accurately established during post-ECC monitoring (**Table 1-3**).

The Project is mostly surrounded by dense agricultural areas with some residential and forest patches. The Significant environmental features areas are shown in **Figure 1-5**. Photographs of Project alignment and interchanges are shown in **Figure 1-6** and **Figure 1-7**. The NAMRIA topographic map showing the Project site is shown in **Figure 1-8**.

Table 1-3. Guide for delineating post-EIA impact areas

Components	Details
Air	Areas where maximum ground level concentrations (GLC) of particulates are predicted to occur.
Water	Rivers and streams along the road alignment and RROW
Land	Staging areas, road alignment and RROW
Socioeconomics	Impacts in terms of relevant socioeconomic parameters

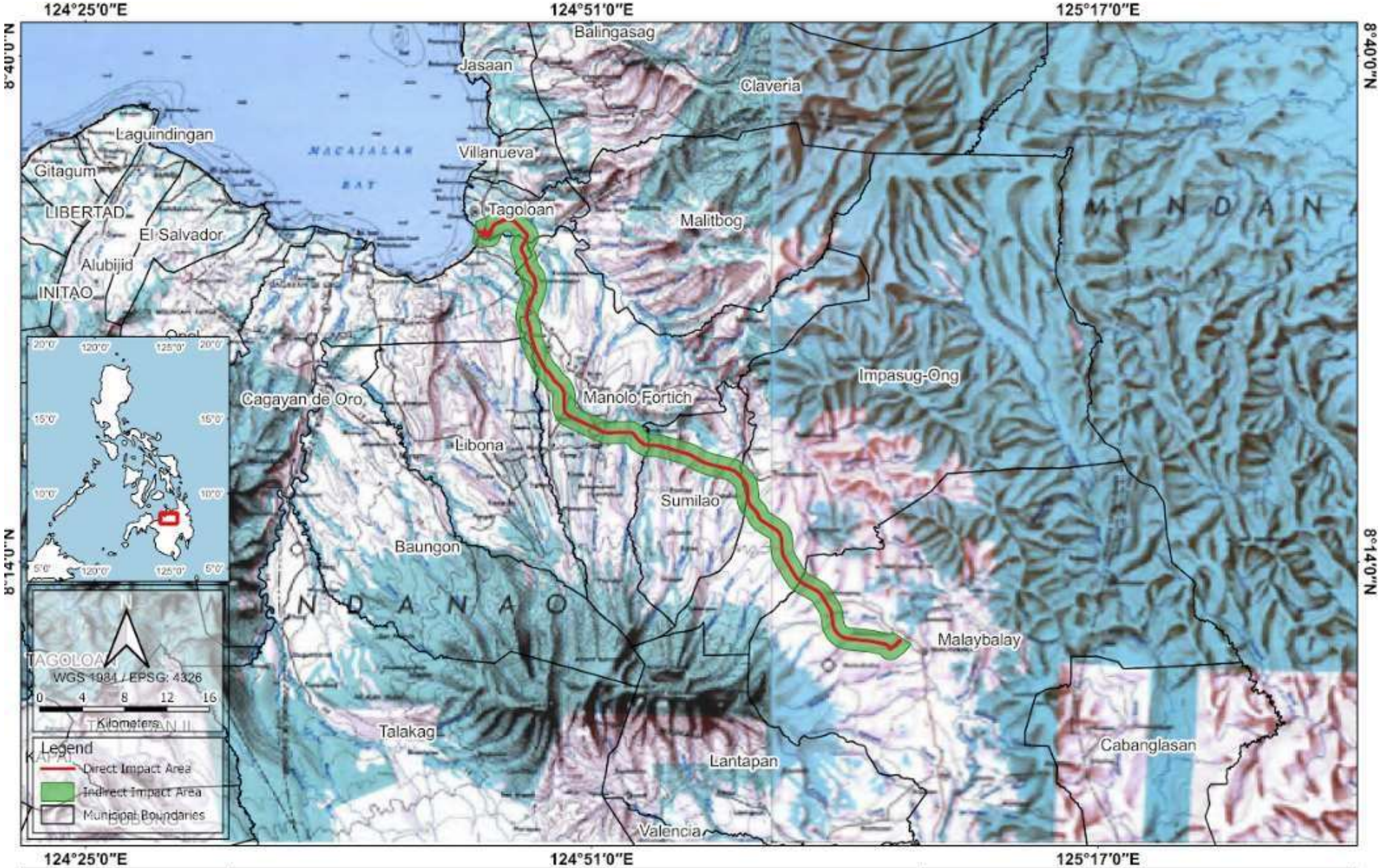
1.1.3 Site accessibility

The objective of the Project is to contribute to enhancing the connectivity between the cities of Cagayan de Oro and Malaybalay. The Project is accessible via the Butuan-Cagayan de Oro - Iligan Road in the north and the Sayre Highway in the south (**Table 1-4**).

Table 1-4. Regional access to the Project site

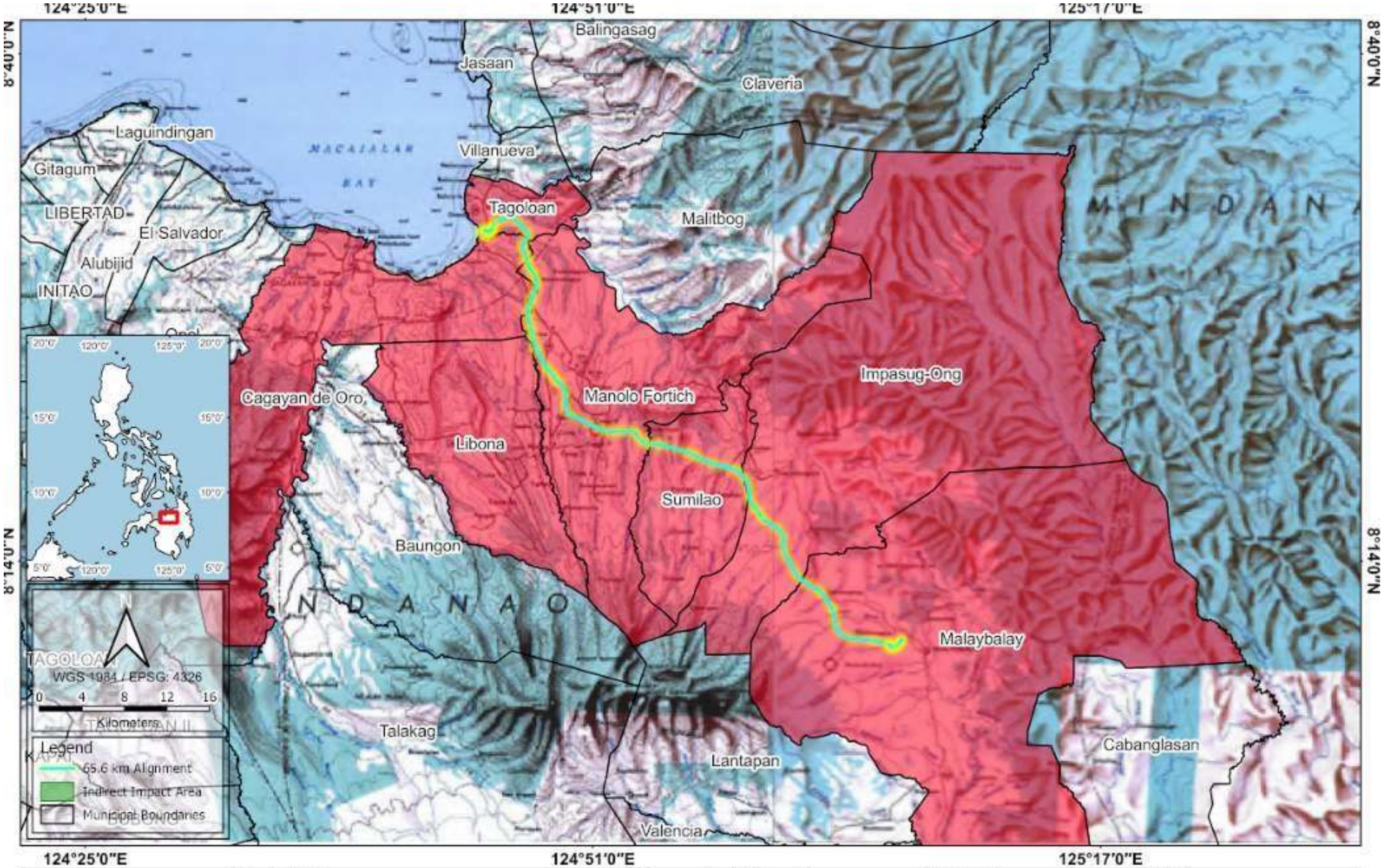
Direction	Origin	Route
North	Iligan City Lanao del Norte and Butuan, Agusan del Norte	Butuan-Cagayan de Oro – Iligan Road
South	Valencia, Bukidnon	Sayre Highway

Figure 1-2. Direct and indirect impact areas map



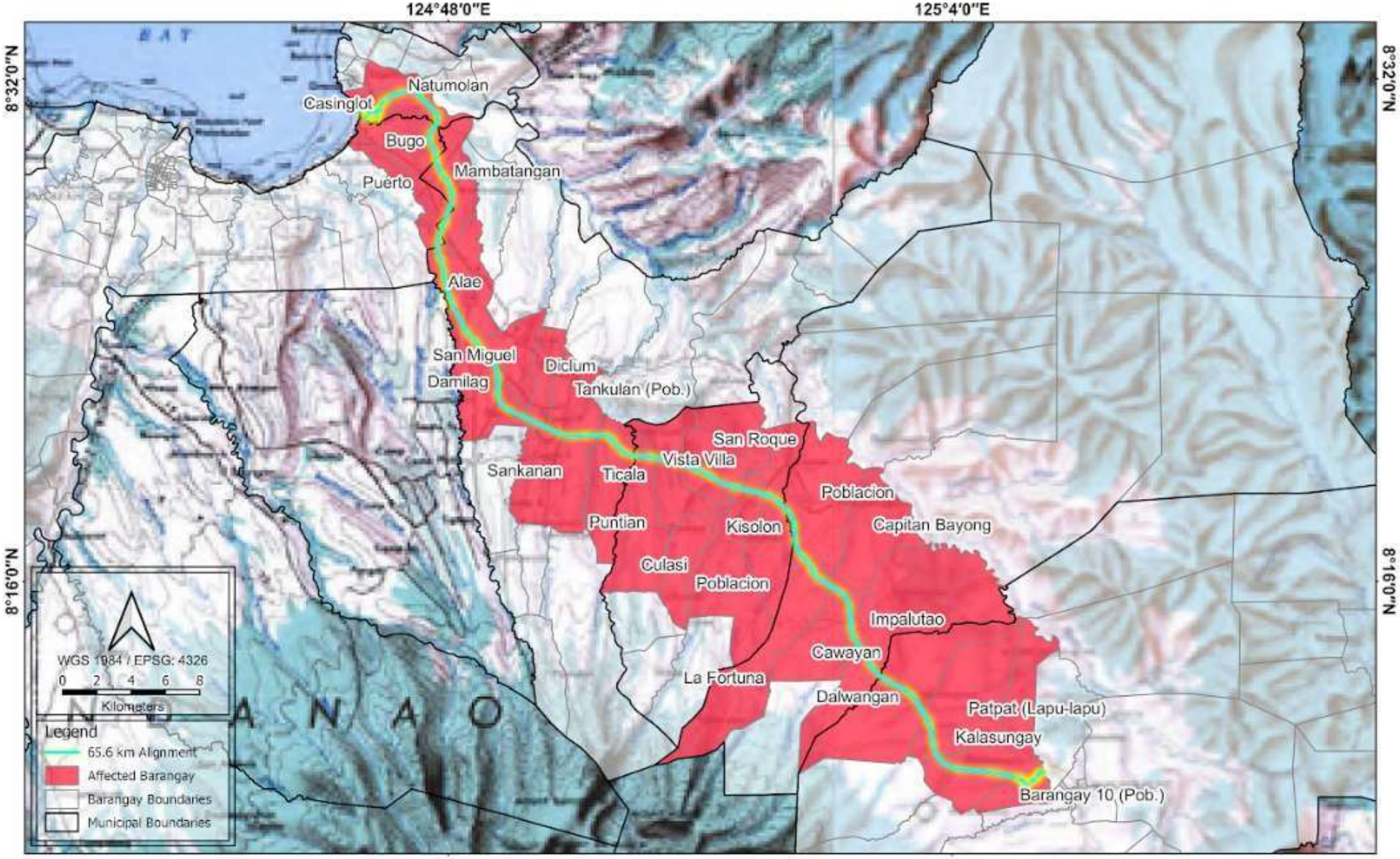
	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
Direct and Indirect Impact Areas Map	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	PSA 2016 (Administrative Boundaries) NAMRIA Topographic Map (Background)		AMET ASIA INC.

Figure 1-3. Direct Impact LGUs Area (Municipal and City levels)



Direct Impact Area (Municipal Level)	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	PSA 2016 (Administrative Boundaries) NAMRIA Topographic Map (Background)	JICA	AMET ASIA INC.

Figure 1-4. Direct Impact Barangays



	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
Direct Impact Area (Barangay Level)	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	PSA 2016 (Administrative Boundaries) NAMRIA Topographic Map (Background)	jica	AMET ASIA INC.

Figure 1-5. Significant environmental features near the Project site

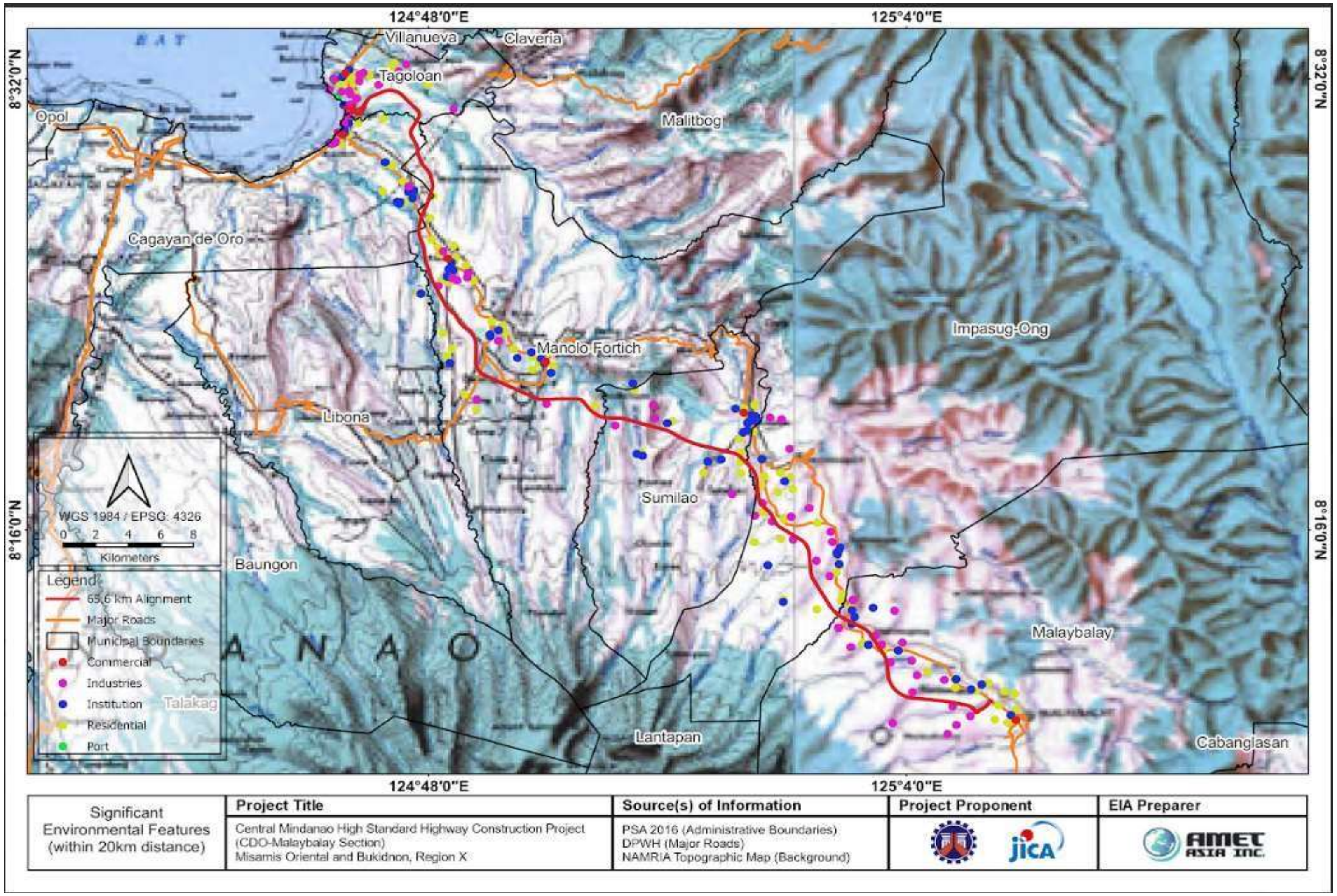


Figure 1-6. Photographs of selected points along the CMH alignment

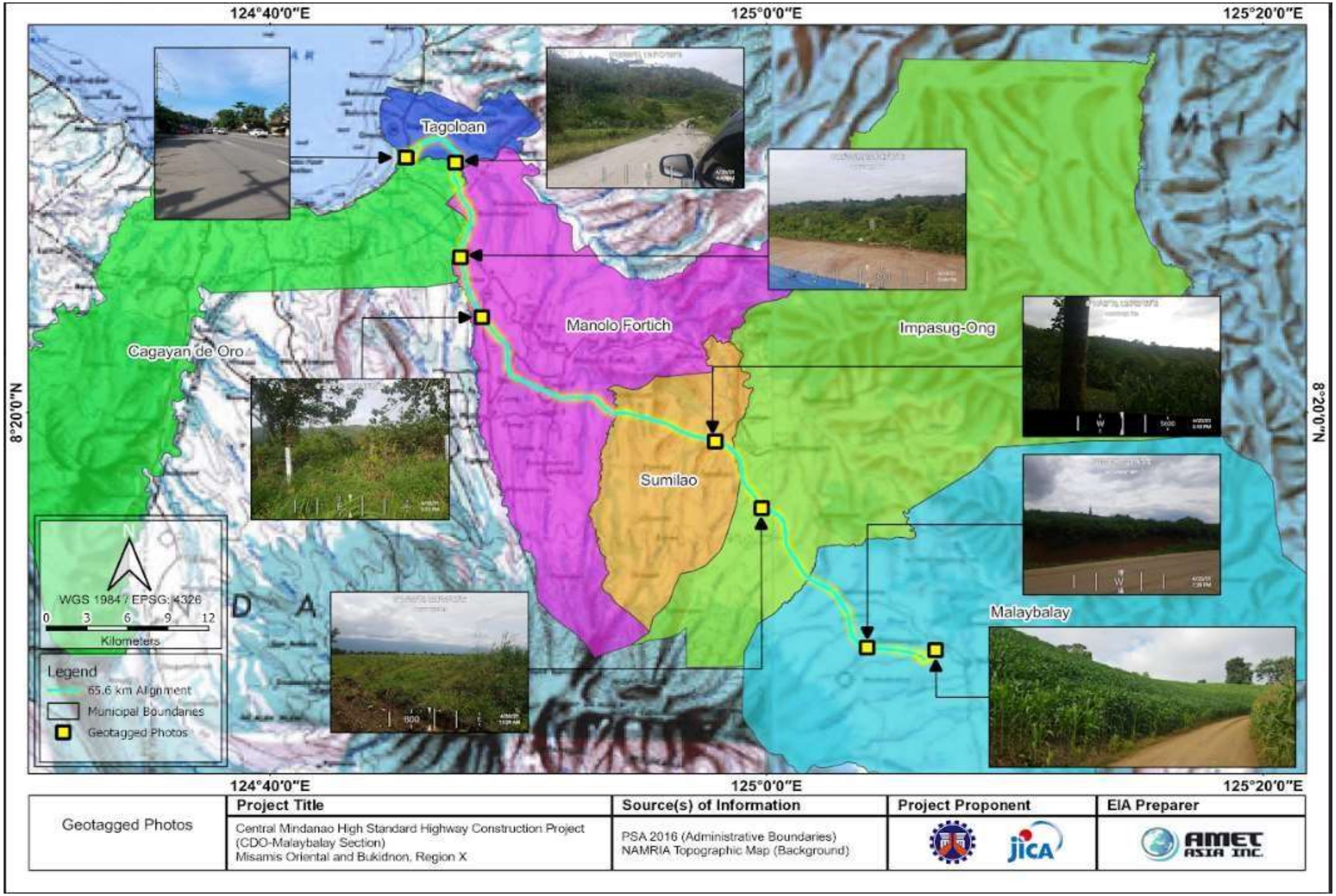


Figure 1-7. Photographs of intersections with the alignment

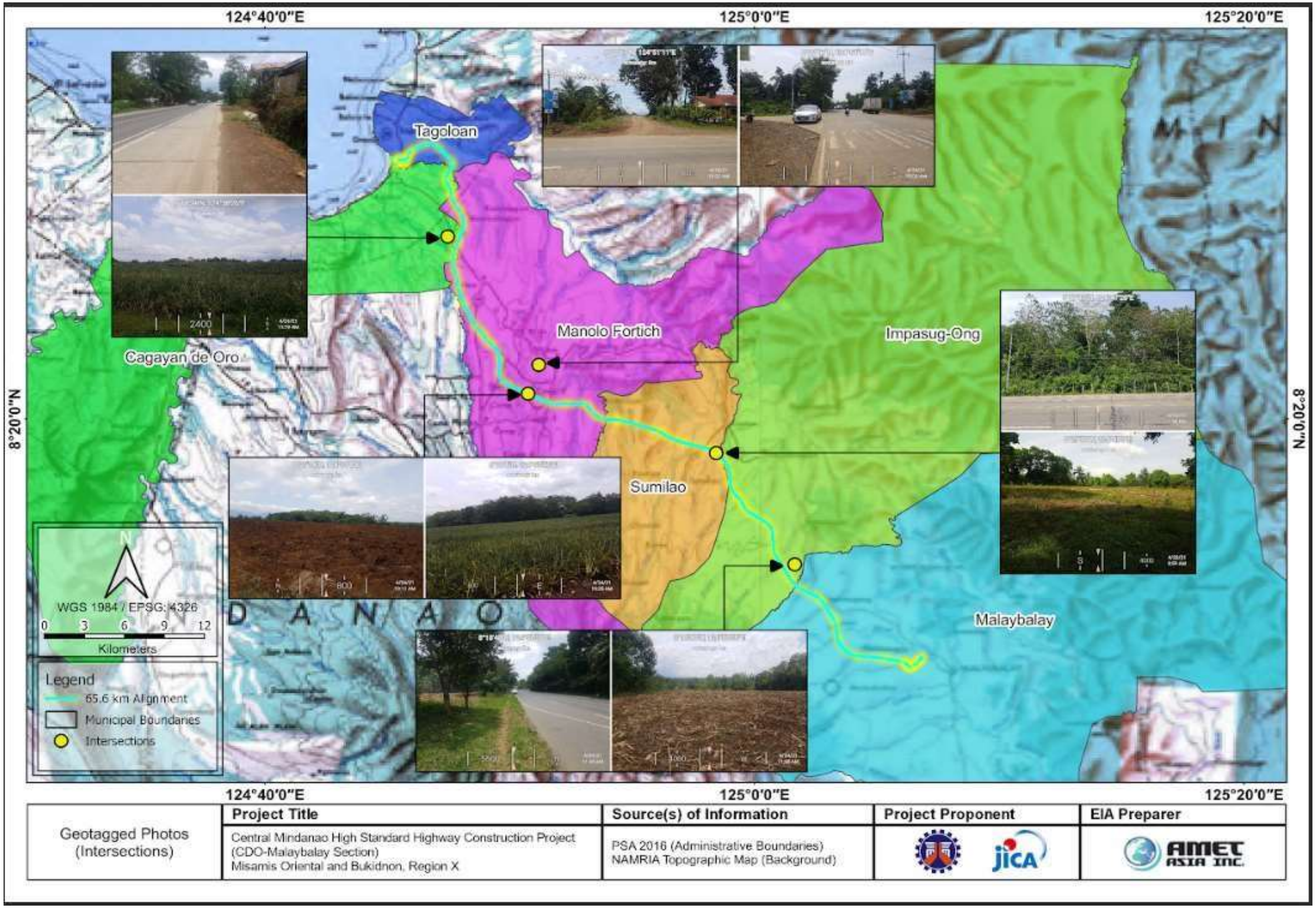
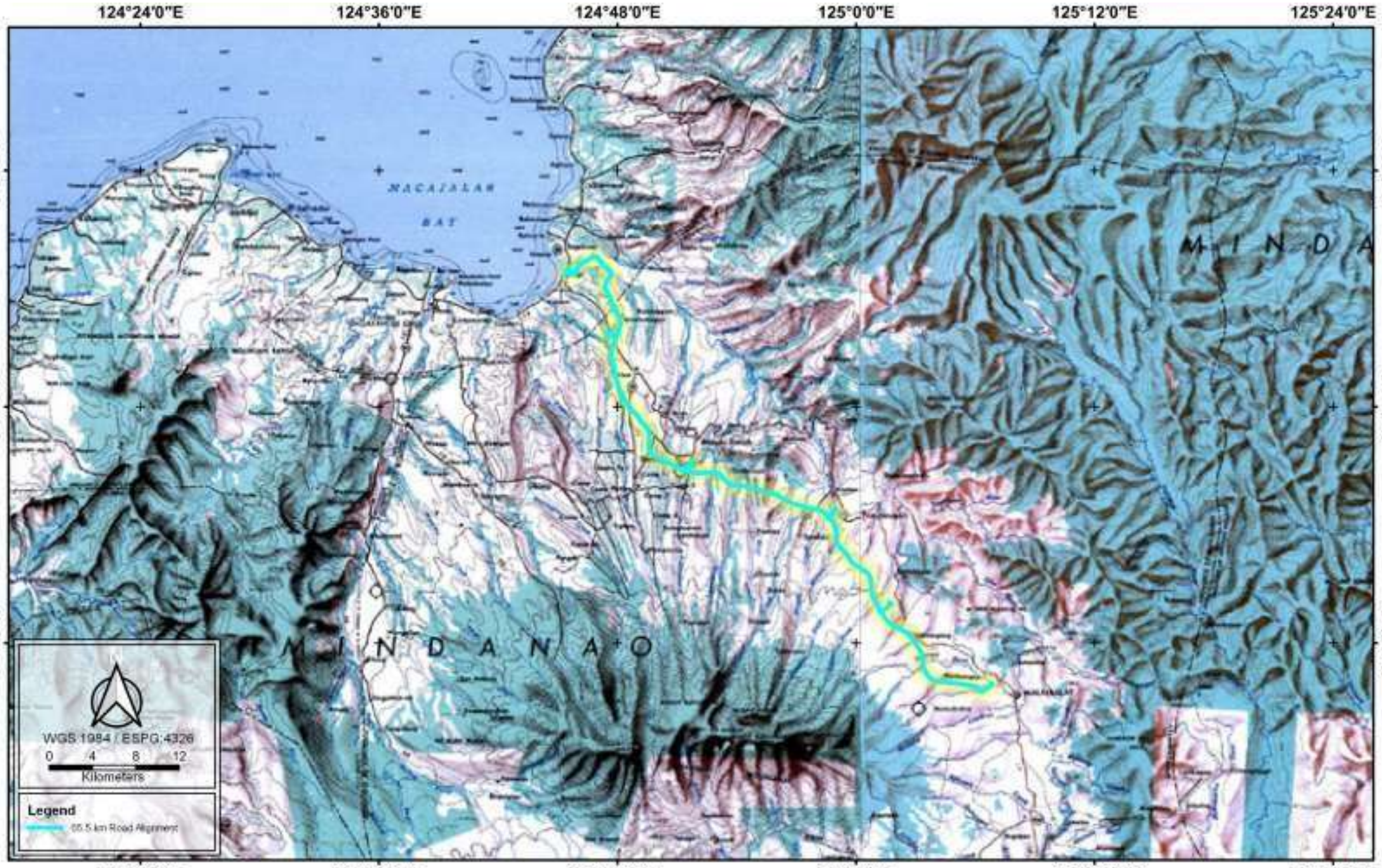


Figure 1-8. NAMRIA map showing the Project site



NARMIA Topographic Map	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	NAMRIA 1:250000 Topographic Maps: Cagayan De Oro Butuan		

1.2 Project rationale

Connectivity, mobility, and safety were the three elements identified in the Northern Mindanao Regional Development Plan 2017-2022 in developing the transport infrastructure in the region. The region's connectivity resulted in increased gains in the trade and services sectors and intra-and inter-regional efficiency of the movement of people, goods, and services.

The region, however, faces major challenges in the transport sector which primarily result in traffic congestion in key cities and poor connectivity in rural production and lagging areas. Traffic congestion is a primary problem in main thoroughfares in urban areas due to the concentration of motor vehicles and narrow road networks. Unpaved local roads cause slow growth in rural areas due to poor linkage of production areas to market centers.

The proposed Project is expected to improve the road transport network in Mindanao through the improvement of its national roads and provide linkages between the cities of Cagayan de Oro in Misamis Oriental and Malaybalay in Bukidnon. The Project is also seen to improve the economic situation of the surrounding municipalities.

Contribution to development plans

Contribution to the National Development Plan - Transport infrastructure, such as high standard highways, is envisioned to facilitate national development, in line with the objectives of the Philippine Development Plan (2017-2022). The Central Mindanao High Standard Highway (CMH) will contribute to the enhancement of security in Mindanao, reduction of economic disparities, and increase in the growth potential of inland areas.

Contribution to the Regional Development Plan - The Mindanao Spatial Strategy/ Development Framework 2015-2045 identified the Cagayan de Oro City-Malaybalay City-Valencia City-Davao City axis as a major development axis in Mindanao. Once completed, the CMH will traverse Malaybalay City and Valencia City, which are identified as sub-regional centers featuring agribusiness and eco-tourism.

Contribution to the DPWH Highway Development Policy - The Government of the Philippines, through DPWH, pursues the development of land-based transportation projects to sustain the expansion of strategic corridors. The Master Plan for the High Standard Highway Network Development (Phase 2) identified the CMH (Cagayan de Oro-Malaybalay section) as a high priority project for short-term implementation. Once realized, the project will be part of a nationwide program that will add about 1,044.6 kilometers of high standard national roads and expressways.

Improvement of quality of life of the residents

Better access to urban services - In addition to an international airport and a container port, Cagayan de Oro City, as a metropolitan center, features a high concentration of urban services (e.g., health care, education, cultural facilities, etc.). The project will provide inland inhabitants in Central Mindanao an equitable access to employment opportunities and other essential services, generally available in highly urbanized cities.

Enhanced manufacturing and logistics - According to the survey conducted by the JICA Study Team, the perceived benefits of manufacturing and logistics companies from the completion of the CMH include the following: (1) faster delivery of goods, (2) minimized damage on cargoes, (3) reduced transport cost, and (4) increased access to source of materials.

Improvement of quality of life of the residents

Enhanced linkage of metropolitan centers - The Project will connect Cagayan de Oro City and Davao City, two important metropolitan centers in Mindanao. Once realized, travel time between the two cities will be reduced from six hours and thirty minutes to three hours and thirty minutes.
Development of industrial and trade corridor - NEDA Regional Office X envisions the Iligan City – Cagayan de

Oro corridor as a Strategic Development Area (SDA) for industry and trade. The CMH will enhance access to the businesses and shipping ports in Northern Mindanao, which serves as a major gateway to growth areas of Luzon and Visayas.

Development of agribusiness and eco-tourism - Bukidnon is envisioned to serve as an SDA for agribusiness ventures and eco-tourism. With large-scale plantations and fertile land along the road alignment, the project has the capacity to develop the untapped potential of agriculture, forestry, and livestock industries in Bukidnon.

Solving current road traffic problems

Additional road capacity - The existing Sayre Highway carries approximately 9,000 vehicles/ day. The capacity will imminently be surpassed by the traffic volume, and a new 4-lane highway would be needed. The Project offers an alternate route that is designed to carry a significant traffic load within the corridor.

Increased travel speed - The existing alignment of the Sayre Highway poses vertical (steep slopes) and horizontal (sharp curves) challenges to road users. This prevents smooth travel, especially of large vehicles (buses and trucks), which comprise a combined 55% of the existing traffic. As a result, travel speed along sharp curves was observed to be less than 20 km/hr. The project is expected to facilitate faster travel within the corridor, with a design speed of 80 km/hr.

Safer travel option - The zigzag sections of the existing national highway also pose traffic safety issues. From January 2018 to March 2019, a total of 130 accidents occurred along the Sayre Highway. The project, as a high standard highway, will be designed with gentle gradients (both horizontally and vertically) to ensure smooth and safe travel of road users.

1.3 Current situation of road network and traffic

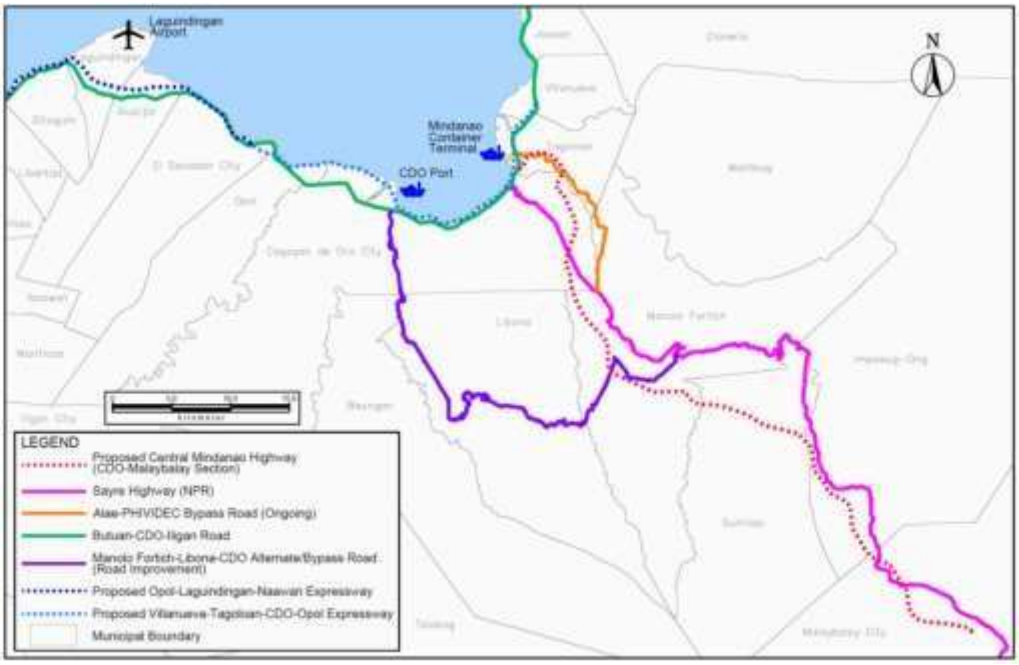
1.3.1 Current Road network

The total length of the existing major road network in the area is 115.66 km while 32.9 km are still in proposal. Most roads are generally narrow with two (2) lanes and a few of the roads are four to six (4 to 6) lanes.

The following existing and planned roads, major ports and airport are illustrated in **Figure 1-9.**

- Sayre Highway
- Alae-PHIVIDEC Bypass Road (under construction)
- Butuan City-Cagayan de Oro City-Iligan City Road
- Manolo-Fortich- Libona-CDO Bypass/Alternate Road (road improvement)
- Proposed Villanueva-Cagayan de Oro City-Opol Expressway
- CDO Port/Mindanao Container Terminal/Laguindingan Airport

Figure 1-9. Location of existing/planned roads and port/airport



Source: JICA Study Team

1.3.2 Current Road traffic situation

Traffic study along Sayre and Coastal Highway was conducted by the JICA Study Team last 2020. The traffic volume trend is observed to be different along the Cagayan de Oro to Manolo Fortich section, as compared to the section between Manolo Fortich and Malaybalay. The traffic volume along the Coastal Road is approximately 15,000 vehicles/day. The traffic volume along Sayre Highway from Cagayan de Oro to Manolo Fortich is approximately 9,000-10,000 vehicles/day while along the Manolo Fortich to Malaybalay section is approximately 6,000-6,500 vehicles/day.

Along Sayre Highway, passenger cars, taxis, and HOVs occupied more than 50% of the traffic. The survey also found out that a significant number of trucks pass through Sayre Highway. Trucks comprised approximately 40% of the traffic volume. Large trucks accounted for 25-30% of the traffic volume. This suggests that Sayre Highway plays an important role in logistics within the region.

1.4 Project alternatives

This section presents the different selection criteria for siting, selection of technology, resources, and contextualization of hazards based on available hazard maps from relevant institutions.

1.4.1 Interchange Location

In selecting the alignment, the interchange locations were first considered based on the following criteria.

- The interchange should be located the road near the center of the city/municipality (Tagoloan; Manolo Fortrich; Impasug-ong; Sumilao; and City of Malaybalay).
- The interchanges in mountainous areas should be placed at an average interval of 10-15 km as per Japan standard (No standard for interchange intervals in the Philippines).

Based on the above criteria, the detailed conditions of interchanges are stated as follows. The interchange location should:

- have an easy to access from/to the national road (Sayre Highway),
- have a smooth terrain that is approximately 500m to 1km away from the national road to allow space for an IC and a toll gate,
- not be a deformed intersection when intersecting with the national road, and

- avoid direct connection to city center and high-density residential areas.

As a special case, the Manolo Fortich IC in Sections 2 and 3 is located near the existing access roads in Manolo Fortich due to the difficulty of connecting directly to the national road in a configuration that meets the above conditions (see **Figure 1-10**).

1.4.2 Selection criteria of Alignment

1.4.2.1 Siting

The Project alignment for the study is divided into five sections based on major interchange locations. Each section has three alternatives (**Figure 1-10**) that were assessed according to the following criteria established by the JICA Study Team: road performance, project cost, environmental and social impacts, and project constructability (**Table 1-5**). The priority considerations as basic prerequisites for the design of the alignment are enumerated below.

1. Road performance comprises of four sub items, namely: drivability, detour rate, traffic demand and time. These items are used to quantify road performance corresponding to the level of High Standard Highway Class 1. Drivability is normally affected by vertical curves used to change the elevations of highways, and horizontal circular curves which can be specified by the radius. To keep drivability requirement for High Standard Highway Class-1, vertical gradient is limited up to 4% and radii of horizontal curves should be as large as possible. Detour rate is also calculated to see how much longer or shorter a new route would be compared with the existing road. Traffic demand and travel time can indicate the design capacity that the highway can handle.
2. Project cost consists of construction cost like earthwork, medium-sized and long-span bridges which are more than 100 m of span length, and compensation expenses related to ROW. In order to make the Project economically feasible, cost estimate should be shown and reviewed to determine if the required function can be accomplished in a less expensive way.
3. Environmental and social impacts are divided into length of high cutting section, number of river crossings, lengths of passages through forest and agricultural areas, and number of affected houses. High cutting section may involve massive soil excavation work causing topographical and geographical change to some extent, which should be minimized as much as possible. Constructing river crossing structures as well as underpass/overpass may also affect the environment. When the alignment may pass through the existing forest and agricultural areas, not only landscape but cultivated land or local pathway would be disturbed. Involuntary resettlement may cause a conflict and force local communities to be divided physically and socially. To consider these kinds of impacts, their quantities are surveyed, calculated and used in the evaluation process.
4. Project constructability is taken as one of criteria items since the project anticipates the construction of a long bridge with a long span length and high piers in a mountainous valley, there are constraints on the choice of construction method and the application of appropriate construction machinery. Therefore, project constructability is one of the criterion items.

Scores allocation was set up considering the level of importance of each item in the criteria through the discussion with relevant departments of DPWH.

The criteria of the project cost and the environmental and social impacts are 35 points as the most important item in this project. Twenty points are allocated to the road performance criteria as the next most important items. The rest comes to constructability 10 points.

The criteria item and score allocation are defined and established with reference to the past FS by DPWH and based on a result of discussion and agreement with technical working group and relevant departments of DPWH, such as Planning Service (PS), Roads Management Cluster I (RMC-I), Bureau of Design (BOD), and Environmental and Social Safeguards Division (ESSD) and others.

Table 1-5. Criteria description of the selection of final alignment

Criteria		Highest Probable Score	Description
Road Performance (20)	Drivability (Comfort, Safety)	5	Road geometric features about planar and vertical alignments decide drivability. When a route has many sections with vertical gradient of more than 4%, it has a low drivability. As section becomes less rough and linear, the score increases.
	Detour rate	5	When a new route detours far away from the existing road and its length becomes longer, traveling vehicles would take more gasoline cost and transportation cost increases. Detour rate is defined as new route length / existing road length. As detour rate decreases, the score increases.
	Traffic demand (2040)	5	A new route that could accommodate the large number of traffic volume and future traffic demand anticipated in 2040 is highly scored.
	Travel Time	5	As travel time is taken shorter, the score increases.
Cost (35)	Cost of Construction, Land Acquisition, Compensation	35	The total cost including construction, land acquisition and relocation compensation is estimated. As the cost decreases, the score increases.
Environmental and Social Impacts (35)	Length of High Cut section	5	High cut section (H>10m) causes massive soil excavation work and large-scale topographical change. As the section becomes longer, the score decreases.
	No. of river crossing	5	As the number of river crossings increases, the score decreases.
	Length of passage through forest areas	5	Part of the forest area would be affected by the planned route. As the forest section to be affected becomes longer, the score decreases.
	Length of passage through agricultural areas	5	Some existing farmlands decrease when interfered with route planning and farmer's living may be affected. As farmland to be acquired becomes longer, the score decreases.
	Number of affected houses	15	How many houses would be affected and relocated on the route. As the number of houses to be relocated increases, the score decreases.
	Constructability (10)	10	As the length of bridge increases, the score decreases.
Total		100	—

Source: JICA Study Team

Road Performance has sub-items of drivability, detour rate, traffic demand and travel time, they are allocated equally with five points. Environmental and Social Impacts includes sub-items of length of high cut section, number of river crossing, length of passage through forest and agricultural areas, and number of affected houses, to which five points are also equally allocated to each sub-item, except for the sub-item number of affected houses. The number of affected houses is given 15 points because it is considered highly important. Table 1-6 shows the calculation and scoring for each of the above criteria items. Scoring is done in two ways. One is to score the maximum to the best and the rest is simply scored by multiplying the ratio with the given point. Another is to score within a range frame as defined, based on data obtained, because data are scattered. For example, the number of affected houses varies widely from a minimum of 8 to a maximum of 72, as a result of this study – estimated about 170 in the Pre-F/S. These data have been estimated from digital files and need to be refined more accurately through site survey. To make a buffer of accommodating some variation of the data as a result of the site survey, a range scoring is used.

Table 1-6. Calculation and Scoring

<table>
<tr><th colspan="2">Item</th><th>Score</th><th>Criteria</th><th>Evaluation</th></tr>
<tr><td>Road</td><td>Drivability</td><td>5</td><td>Horizontal curve radius: not less than 400m,
Vertical gradient: not more than 4%</td><td>5-point is given when the curve length is 10% or less per total length. 1-point is subtracted for every 10% increase.</td></tr>
<tr><td></td><td>Detour Rate (r)*</td><td>5</td><td>r=Alignment length / Existing road length</td><td>Refer to the score calculation sheet (see Table 1-7).</td></tr>
<tr><td>Traffic</td><td>Traffic Volume</td><td>5</td><td>Future traffic demand forecast</td><td>5-point is given when traffic volume is maximum. The rest is scored by multiplying the ratio with 5-point.</td></tr>
<tr><td></td><td>Travel Time</td><td>5</td><td>Alignment length / Travel speed</td><td>5-point is given when travel time is minimum. The rest is scored by multiplying the ratio with 5-point.</td></tr>
<tr><td>Project Cost</td><td>Construction Cost, ROW Cost</td><td>35</td><td>Construction cost = Structure length x Unit price per structure type.
ROW cost = Affected section length x Unit price per section type.
Relocation cost = No. of affected houses x unit price per house.</td><td>35-point is given when Project Cost is minimum. The rest is scored by multiplying the ratio with 35-point.</td></tr>
<tr><td>Environmental</td><td>High Cutting Section*</td><td>5</td><td>Total length of soil cutting section with the height over 10m</td><td><table>
<tr><td>L < 0.1 km</td><td>5</td></tr>
<tr><td>~0.3 km</td><td>4</td></tr>
<tr><td>~0.6 km</td><td>3</td></tr>
<tr><td>~0.9 km</td><td>2</td></tr>
<tr><td>~1.2 km</td><td>1</td></tr>
<tr><td>L > 1.2 km</td><td>0</td></tr>
</table></td></tr>
<tr><td></td><td>River Crossing</td><td>5</td><td>Number of river crossings</td><td>5-point is given to the minimum number. The rest is scored by multiplying the ratio with 5-point.</td></tr>
<tr><td></td><td>Affected Forest Section*</td><td>5</td><td>e=Affected forest length / Route length</td><td>Refer to the score calculation sheet (see Table 1-7).</td></tr>
<tr><td></td><td>Affected Agriculture Section*</td><td>5</td><td>e=Affected agricultural length / Route length</td><td>Refer to the score calculation sheet (see Table 1-7).</td></tr>
<tr><td>Social</td><td>No. of Affected Houses*</td><td>15</td><td>Number of houses required for relocation (n)</td><td><table>
<tr><td>n <= 10</td><td>15</td></tr>
<tr><td>~20</td><td>14</td></tr>
<tr><td>~30</td><td>13</td></tr>
<tr><td>~40</td><td>12</td></tr>
<tr><td>~50</td><td>11</td></tr>
<tr><td>~60</td><td>10</td></tr>
<tr><td>~70</td><td>9</td></tr>
<tr><td>~80</td><td>8</td></tr>
<tr><td>~90</td><td>7</td></tr>
<tr><td>~100</td><td>6</td></tr>
<tr><td>~110</td><td>5</td></tr>
<tr><td>~120</td><td>4</td></tr>
<tr><td>~130</td><td>3</td></tr>
<tr><td>~140</td><td>2</td></tr>
<tr><td>~150</td><td>1</td></tr>
<tr><td>n > 150</td><td>0</td></tr>
</table></td></tr>
<tr><td>Construction</td><td>Constructability*</td><td>10</td><td>Bridge section length (km)</td><td>Refer to the score calculation sheet (see Table 1-7).</td></tr>
<tr><td colspan="2">Total</td><td>100</td><td>-</td><td>-</td></tr>
</table>

Note:* Scoring is by a range set for each item, based on data range obtained from the survey.
Source: JICA Study Team

Table 1-7. Score Calculation Sheet

Detour Rate (r)	Score	Forest and Agricultural Section Length / Route Length (e)	Score	Bridge Length (km)	Score
r<0.6	5.0	e<0.1	5.0	0.0≦L≦0.5	10
0.6≦r<0.7	4.5	0.1≦e<0.2	4.5	0.5<L≦1.0	9
0.7≦r<0.8	4.0	0.2≦e<0.3	4.0	1.0<L≦1.5	8
0.8≦r<0.9	3.5	0.3≦e<0.4	3.5	1.5<L≦2.0	7
0.9≦r<1.0	3.0	0.4≦e<0.5	3.0	2.0<L≦2.5	6
1.0	2.5	0.5≦e<0.6	2.5	2.5<L≦3.0	5
1.0<r≦1.1	2.0	0.6≦e<0.7	2.0	3.0<L≦3.5	4
1.1<r≦1.2	1.5	0.7≦e<0.8	1.5	3.5<L≦4.0	3
1.2<r≦1.3	1.0	0.8≦e<0.9	1.0	4.0<L≦4.5	2
1.3<r≦1.4	0.5	0.9≦e<1	0.5	4.5<L≦5.0	1
1.4<r	0	1.0=e	0	5.0<L	0

Note: Scoring range is framed, based on data obtained.
Source: JICA Study Team

Figure 1-10. Alternatives prior to selection of Project alignment

Source: JICA Study Team

1.4.2.2 Technology selection

There were no alternative technologies, operation processes, or measures to minimize wastes have been identified at this stage. The construction technology used, type of structures erected, and pollution control measures are standard to typical road projects. The measures for minimizing adverse impacts of residuals during Project implementation are discussed in *Section 1.5.2*.

1.4.2.3 Resources

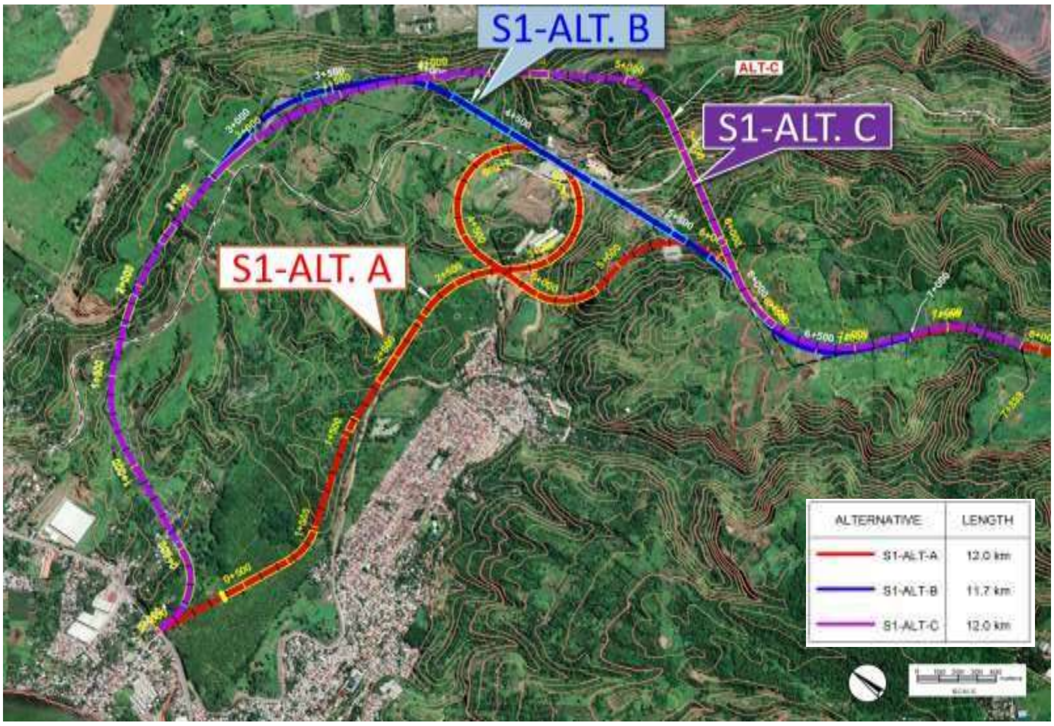
Resources in this context mean water, power, manpower, and material requirements during Project implementation. The potable water requirement of the Project will be sourced from existing water systems in active construction sites. The potential sources of power for the temporary facilities are the Cagayan Electric Power & Light Company, Inc. (CEPALCO), Bukidnon Power Corporation (BPC), and power generators for construction site far from the CEPALCO and BPC power lines. The generator sets will also be used as standby power sources during power outages. Construction materials will be sourced locally when available.

1.4.2.4 Rationale for the chosen option

1.4.2.4.1 Section 1

As a result of the Pre-F/S in the Master Plan, two alternative alignments were recommended – Alternative C, consisting of a continuous loop bridge, and Alternative A, detouring to avoid steep slopes with a relatively straight bridge – within a distance of about 8 km from the beginning point. In the Pre-F/S in the Master Plan with desk-based study, there was no difference from environmental and social aspects of each alternative, because the alternatives were almost same on the slope and hilly area and land was used as cultivated and bush area in section 1, and there were not so many structures. Although Alternative C was preferentially selected and its preliminary design was developed by the JICA Study Team at that time, it was concluded that it would be necessary to conduct a comparative study by adding more alternatives and select the best one through discussion with DPWH and related stakeholders. In this study, including Alternative C selected in the Pre-F/S, two more new alternative routes are added and compared with it. The outline of them is shown in **Figure 1-11**.

Figure 1-11. Alignments in Section 1



Source: JICA Study Team

- S1-ALT. A is making a detour north and climbing up gradually toward mountainous areas, like S1-ALT. B, and then going further and turning back slightly to cross a deep valley, which will lead to long-span bridge construction.

- S1-ALT. B is making a detour north and climbing up gradually toward mountainous areas, and then turning right to cross a deep valley, which will lead to long-span bridge construction.

- S1-ALT. C, renamed and proposed in the Pre-F/S, is passing through a flat terrain before hilly area comes out near where a loop bridge is situated about 100m high or higher above the ground, as shown in **Figure 1-12**.

Figure 1-12. Image of Loop Bridge Proposed in the Pre-F/S (Alt.C)

Source: JICA Study Team

The evaluation result is listed in **Table 1-8**.

Table 1-8. Evaluation of Section 1

Criteria		Unit	Score	S1-ALT. A		S1-ALT. B		S1-ALT. C	
				Result	Score	Result	Score	Result	Score
Road	Drivability	-	5	**No sharp curve**	**5.0**	0.5 km long curve (R=500m)	5.0	1.8 km long curve (R=320m)	3.0
	Detour rate	-	5	**1.403**	**0.0**	1.368	0.5	1.403	0.0
	Sub total		10	**-**	**5.0**	-	5.5	-	3.0
Traffic	Traffic volume	veh./ day	5	**16,500**	**5.0**	16,500	5.0	16,500	5.0
	Travel time	min	5	**9.0**	**5.0**	8.78	5.0	9.0	5.0
	Sub total		10	**-**	**10.0**	-	10.0	-	10.0
PJT Cost	Earthwork	mil. peso		**3,071 (9.2 km)**		2,951 (8.9 km)		2,560 (7.7 km)	
	Medium-sized Bridge	mil. peso		**5,551 (1.1 km)**		6,736 (1.2 km)		7,905 (1.2 km)	
	Long-span Bridge	mil. peso		**15,713 (1.6 km)**		18,647 (1.6 km)		27,620 (3.1 km)	
	Construction	mil. peso		**24,335**		28,334		38,085	
	ROW	mil. peso		**426.5**		419.5		607.9	
	Sub total (mil. peso)		35	**24,761**	**35.0**	28,754	30.1	38,693	22.4
Environmental	High Cut Section	km	5	**1.2**	**1.0**	1.1	1.0	1.0	1.0
	River Crossing	ea	5	**1**	**5.0**	1	5.0	1	5.0

	Aff. Forest	%	5	**58**	**2.5**	56	2.5	53	2.5
	Sub total		15	**-**	**8.5**	-	8.5	-	8.5
Social	Aff. Agriculture	%	5	**25**	**4.0**	27	4.0	28	4.0
	Aff. Houses	ea	15	**32**	**12.0**	32	12.0	54	10.0
	Sub total		20	**-**	**16.0**	-	16.0	-	14.0
Constructability		-	10	**Bridge L=2.7 km**	**5.0**	Bridge L=2.8 km	5.0	Bridge L=4.3 km	2.0
Total			100	**1**	**79.5**	2	75.1	3	59.9

Source: JICA Study Team

The above evaluation results are as follows.

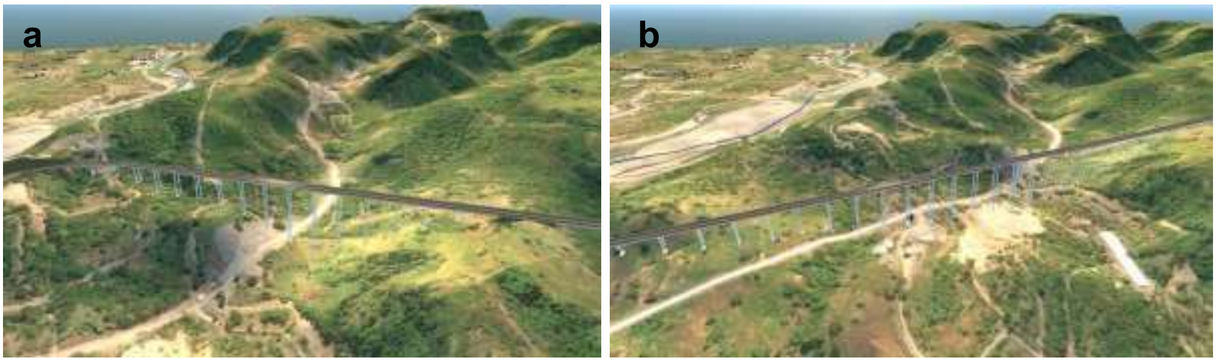
- S1-ALT. A, like S1-ALT. B, is the route to ascend gradually toward mountainous areas and go further and turn back slightly to cross a deep valley through a long-span bridge. The long-span bridge has the superstructure made of steel box girder in the length of about 0.8 km and pre- stressed concrete girder or rigid frame in the length of about 0.8 km, respectively. The bridge construction costs less than that of S1-ALT. B despite of the same total length. Regarding environmental and social impacts, no difference is shown between S1-ALT. B and C.

- S1-ALT. B is the route to ascend gradually toward mountainous areas and then turn right to cross a deep valley through a long-span bridge. The long-span bridge has the superstructure made of steel box girder with the length of about 1.4 km and prestressed concrete box girder in the length of about 0.2 km. Constructing steel-type bridge may generally cost higher compared to prestressed concrete bridge, and steel box girder bridge accounts for over 80% of the total bridge length. Therefore, it may give a negative impact to the construction cost. The number of affected houses is 32, which is similar to the S1-ALT-A and less impactful than the S1-ALT-C. More than half of the proposed route passes through forests and other vegetated areas, but the other alternatives are almost identical and have comparable environmental impact.

- S1-ALT. C is consisting of a loop bridge that turns its direction around and goes up slowly about 100m high from the ground, attempting not to stay over vertical gradient to the maximum of 4%. The longitudinal line is curved at a radius of 320 m including relatively small curves on a carriageway. This may make drivability low. The superstructure of the bridge comprises largely of steel elements, and the superstructure needs to be supported on 100m high or taller piers, which implies that this may be less cost-effective and technically difficult. There are fifty-four (54) houses affected and required to be relocated, greater than those in other two alternatives. More than half of the proposed route passes through forests and other vegetated areas, but the other alternatives are almost identical and have comparable environmental impact.

As a result of the evaluation shown in table above, there is comprehensive perspective, S1-ALT. A is recommended for Section 1.

Figure 1-13. Steel Box Bridges on (a) S1-ALT. A (b) S1-ALT. B and in Section 1



Long-span Bridge on **S1-ALT. A**
L=813 m (Steel Narrow Box Girder)
Max. High Pier 140 m

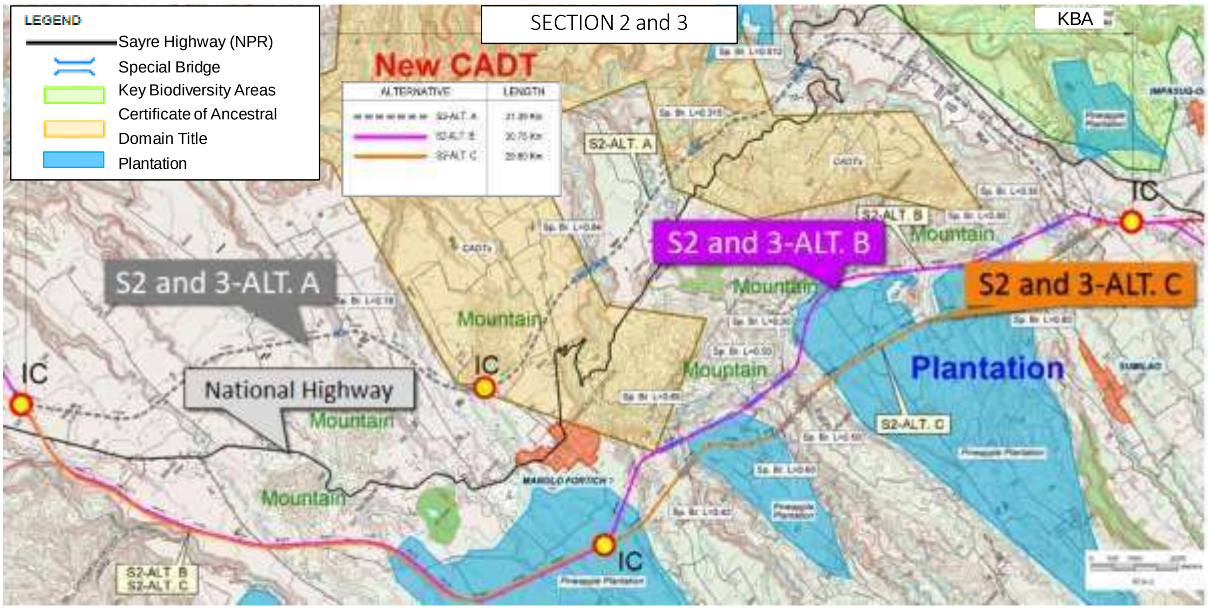
Long-span Bridge on **S1-ALT. B**
L=1,440 m (Steel Narrow Box Girder)
Max. High Pier 135 m

Source: JICA Study Team

1.4.2.4.2 Section 2 and 3

The geographical features, such as mountains, hills, urban areas, plantations, farmlands, and golf courses near the existing road, are widely distributed in Section 2 and 3, and they put constraints on the alternative route planning. The outline of the alternative routes is shown in **Figure 1-14**.

Figure 1-14. Alignments in Section 2 and 3



Source: JICA Study Team

- S2 and 3-ALT. A is the south route going rather straighter on the flat terrain and avoiding mountains and urban areas, as well as the CADT but needs to pass through some plantation areas and CADT under application. However, passing through the CADT under application is unavoidable because of surrounding topographic conditions.
- S2 and 3-ALT. B is also the south route relatively stretching far away from the existing road and avoiding mountains and urban areas, as well as the CADT but needs to pass through some plantation areas and CADT under application. However, passing through the CADT under application is unavoidable because of surrounding topographic conditions.

- S2 and 3-ALT. C is the north route less far from the existing road, avoiding mountains and urban areas. During this study, it has been found that the new CADT is widely distributed in the northern part and S2 and 3-ALT. C is passing through parts of the CADT that consists of mostly mountainous and agricultural lands. This CADT was under review to see if it will be designated as development restriction and protection area in the time of this alignment selection study.

The evaluation result is listed in **Table 1-9**.

Table 1-9. Evaluation of Section 2 and 3

Criteria		Unit	Score	Route					
				S2 and 3-ALT. A		S2 and 3-ALT. B		S2 and 3-ALT. C	
				Result	Score	Result	Score	Result	Score
Road	Drivability	-	5	**Flat**	**4.0**	Flat	4.0	-	-
	Detour rate	-	5	**0.694**	**4.5**	0.714	4.0	-	-
	Sub total		10	-	**8.5**	-	8.0	-	-
Traffic	Traffic volume	veh./ day	5	**18,500**	**5.0**	18,000	4.9	-	-
	Travel time	min	5	**22.72**	**5.0**	23.35	4.9	-	-
	Sub total		10	-	**10.0**	-	9.8	-	-
PJT Cost	Earthwork	mil. peso		**8,776 (24.0 km)**		9,097 (24.8 km)		-	
	Medium-sized Bridge	mil. peso		**4,566 (2.6 km)**		5,227 (3.0 km)		-	
	Long-span Bridge	mil. peso		**10,764 (3.2 km)**		9,694 (2.9 km)		-	
	Construction time	mil. peso		**24,106**		24,017		-	
	ROW	mil. peso		**1,358 (29.8 km)**		1,448 (30.7 km)		-	
	Sub total (mil.peso)		35	**25,464**	**30.9**	25,466	30.9	-	-
Environmental	High Cut Section	km	5	**0.8**	**2.0**	2.2	0.0	-	-
	River Crossing	ea	5	**18**	**4.2**	18	4.2	-	-
	Aff. Forest	%	5	**21**	**4.0**	23	4.0	-	-
	Sub total		15	-	**10.2**	-	8.2	-	-
Social	Aff. Agriculture	%	5	**74**	**1.5**	72	1.5	-	-
	Aff. Houses	ea	15	**72**	**8.0**	61	9.0	-	-
	Sub total		20	-	**9.5**	-	10.5	-	-
Constructability		-	10	**Bridge L=5.8 km**	**0.0**	Bridge L=5.9 km	0.0	-	-
Total			100	**1**	**69.1**	2	67.4	-	-

Source: JICA Study Team

The above evaluation results are as follows.

- S2 and 3-ALT. A is the south route going rather straighter on the flat terrain, showing a good drivability, and avoiding mountains and the CADT. The high cutting section is about 0.8km long, shorter than that of S2 and 3-ALT. B, and causes relatively less environmental change. The number of affected houses is 72, and is slightly higher than in S2 and 3-ALT-Proposal B.

- S2 and 3-ALT. B is also the south route going on the relatively flat terrain, showing a good drivability, and avoiding the mountainous areas and the CADT. However, there are about 2.2km long high cutting section that requires massive soil cutting work and may cause a radical change in environment and topography. The natural environment impact is high due to the major topographical changes with large scale cutting section. The number of affected houses is 61 and is slightly lower than in S2 and 3-ALT A.

- As both S2 and 3-ALT. B and S2 and 3-ALT. A require crossing deep valleys, both alternatives require the construction of long bridges: 2.9 km for S2 and 3-ALT. B and 3.2 km for S2 and 3-ALT. A. Although S2 and 3-ALT. A is slightly longer and has higher bridge costs, the project costs are the same for S2 and 3-ALT. A due to the shorter road length.

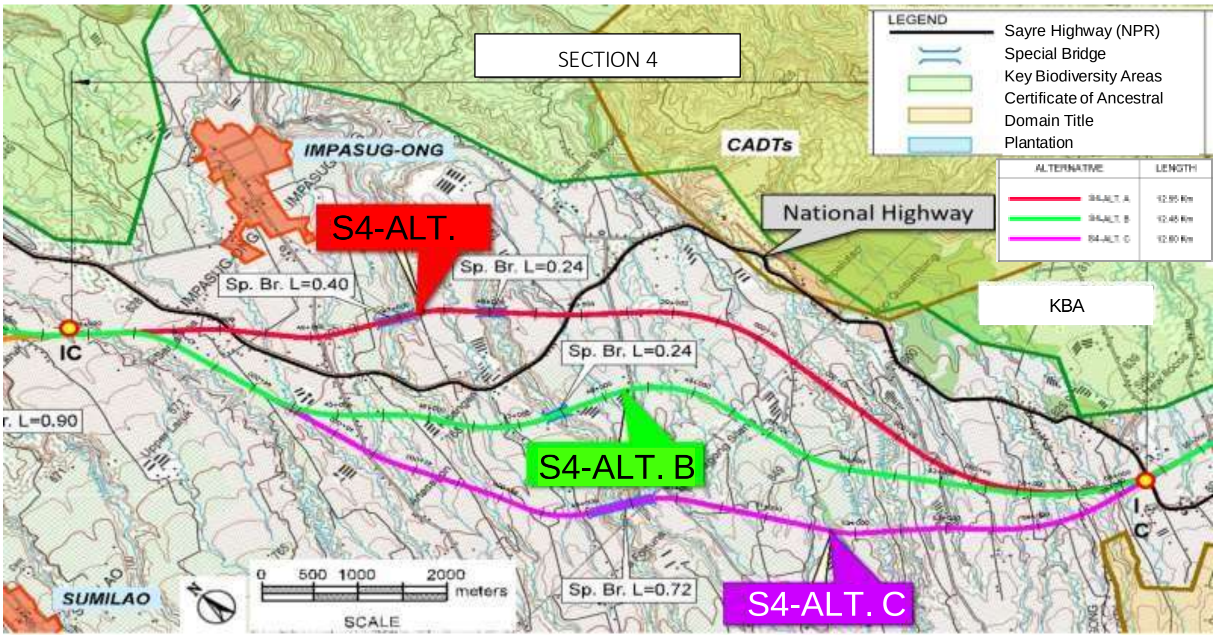
- S2 and 3-ALT. C, proposed in the Pre-F/S, is decided to be excluded from the route evaluation in this study, in order to avoid negative social impact to the people who live in the CADT.

As a result of evaluation shown in table above, there is comprehensive perspective, <u>S2 and 3-ALT. A is recommended in Section 2 and 3</u>.

1.4.2.4.3 Section 4

In Section 4, the existing road is located close to the environmental preservation areas, Key Biodiversity Areas (KBA) and CADT – which is provisional and being applied for designation – so the alternative routes are laid out to go to the south, as shown in **Figure 1-15**.

Figure 1-15. Alignments in Section 4



Source: JICA Study Team

- S4-ALT. A is moving to the south from the existing road, as presented in the Pre-F/S with the purpose of improving the accessibility from the southern region.

- S4-ALT. B is going through the existing road and laid out in less curved direction, avoiding KBA and CADT areas.

- S4-ALT. C is laid out to go further southbound from the existing road and improve the accessibility to the southern region.

The evaluation result is listed in **Table 1-10**.

Table 1-10. Evaluation of Section 4

Criteria	Unit	Score	Route		
			S4-ALT. A	S4-ALT. B	S4-ALT. C

				Result	Score	Result	Score	Result	Score
Road	Drivability	-	5	**Flat**	**5.0**	Flat	5.0	Flat	5.0
	Detour rate	%	5	**0.795**	**4.0**	0.799	4.0	0.803	3.5
	Sub total		10	-	9.0	-	9.0	-	8.5
Traffic	Traffic volume	veh./ day	5	**17,400**	**5.0**	17,400	5.0	17,400	5.0
	Travel time	min	5	**9.48**	**5.0**	9.53	5.0	9.57	5.0
	Sub total		10	-	10.0	-	10.0	-	10.0
PJT Cost	Earthwork	mil. peso		**3,642 (9.9 km)**		4,253 (9.9 km)		2,657 (8.2 km)	
	Medium-sized Bridge	mil. peso		**4,079 (2.4 km)**		3,470 (2.0 km)		6,453 (3.7 km)	
	Long-span Bridge	mil. peso		**802 (0.2 km)**		2,139 (0.6 km)		2,407 (0.7 km)	
	Construction	mil. peso		**8,523**		9,862		11,517	
	ROW	mil. peso		**548 (12.5 km)**		472 (12.6 km)		364 (12.6 km)	
	Sub total (mil.peso)		35	9,072	35.0	10,334	30.7	11,881	26.8
Environmental	High Cut Section	km	5	**0.0**	**5.0**	2.0	0.0	0.0	5.0
	River Crossing	ea	5	**22**	**3.6**	16.0	5.0	21	3.8
	Aff. Forest	%	5	**11**	**4.5**	22.0	4.0	17	4.5
	Sub total		15		13.1	-	9.0		13.3
Social	Aff. Agriculture	%	5	**84**	**1.0**	75.0	1.5	82	1.0
	Aff. Houses	ea	15	**49**	**11.0**	16.0	14.0	25	13.0
	Sub total		20		12.0	-	15.5		14.0
Constructability		-	10	Bridge L=2.6 km	5.0	Bridge L=2.6 km	5.0	Bridge L=4.4 km	2.0
Total			100	1	84.1	2	79.2	3	74.6

Source: JICA Study Team

The above evaluation results are as follows.

- S4-ALT. A has the total bridge length of 2.6 km, the same as S4-ALT. B has, and a long-span bridge which accounts for only 0.2 km. The project cost is less than those of both S4-ALT. B and S4-ALT. C. There is no high cutting section distributed, which gives less impact to the surroundings. The forest section to be affected is the shortest of the three alternatives. There are 49 houses affected and required to be relocated, and over 80% of agricultural land to be cultivated. The number is greater than those in other routes and its score is lowest but can be traded off with scores of project cost and environment.

- S4-ALT. B is going relatively along the existing road and crossing two long-span bridges in the length of 0.64 km and medium-sized bridge in the total length of 2.0 km. It has about 2.0 km long high cutting section that requires massive soil cutting work which may give a negative impact on the environment. There are 16 houses required to be relocated and 75% of agricultural land to be cultivated, the minimum compared to those of other two alternatives.

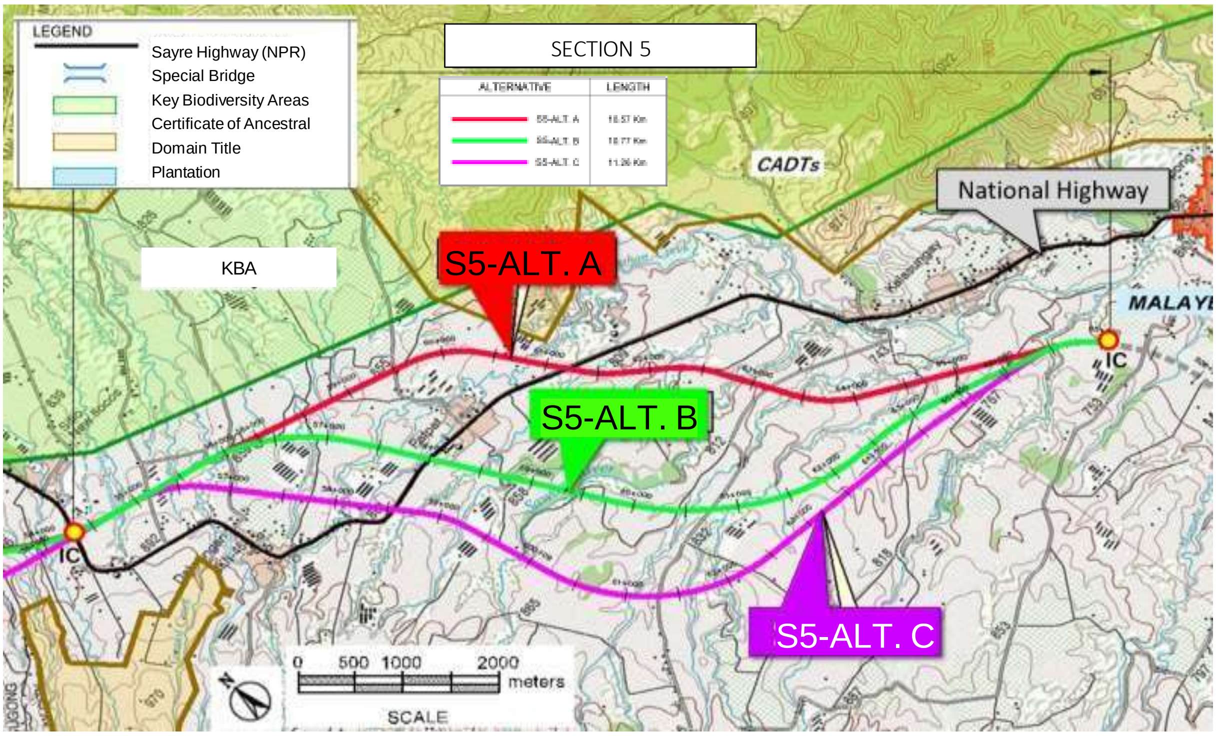
- S4-ALT. C detours the existing road far to the southward and no high cutting section is distributed like S4-ALT. A. The total bridge length reaches up to 4.4 km, the longest among the alternative routes, hence, the bridge construction becomes less cost-effective. The environmental impact is expected to be less than that of S4-ALT-B and about the same as that of S4-ALT-A. There are 25 houses affected and required to be relocated, which is intermediate compared to the other two proposals. More than 80% of the route is agricultural land and is expected to have about the same social impact as the S4-ALT-A. proposal.

As a result of evaluation shown in Table 1-10, there is a comprehensive perspective, S4-ALT. A is recommended for Section 4.

1.4.2.4.4 Section 5

In Section 5, the environmental preservation areas, KBA and CADT, are distributed on the north, and the alternative routes are laid out to cross the existing road, as shown in **Figure 1-16**.

Figure 1-16. Alignments in Section 5



Source: JICA Study Team

- S5-ALT. A is making a detour south further and curving down to the terrain.
- S5-ALT. B, proposed in the Pre-F/S, is making a detour south and going through the existing road.
- S5-ALT. C is going straight along with the boundary of KBA and CADT and then crossing the existing road.

The evaluation result is listed in **Table 1-11**.

Table 1-11. Evaluation of Section 5

Criteria		Unit	Score	Route					
				S5-ALT.A		S5-ALT.B		S5-ALT.C	
				Result	Score	Result	Score	Result	Score
Road	Drivability	-	5	**Flat**	**5.0**	Flat	5.0	Flat	5.0
	Detour rate	-	5	**0.84**	**3.5**	0.804	3.5	0.789	4.0
	Sub total		10		**8.5**	-	8.5	-	9.0
Traffic	Traffic volume	veh./ day	5	**16,800**	**4.9**	17,000	5.0	17,100	5.0
	Travel time	min	5	**8.56**	**4.7**	8.17	4.9	8.06	5.0
	Sub total		10		**9.6**	-	9.9	-	10.0
PJT Cost	Earthwork	mil. peso		**3,669 (9.4 km)**		2,876 (7.9 km)		2,782 (6.9 km)	
	Medium-sized Bridge	mil. peso		**3,287 (1.9 km)**		4,992 (2.9 km)		6,461 (3.7 km)	
	Long-span Bridge	mil.		**-**		-		-	

		peso							
	Construction	mil. peso		**6,956**		7,867		9,244	
	ROW	mil. peso		**691 (11.3 km)**		488 (10.8km)		434 (10.6km)	
	Sub total (mil.peso)		35	**7,647**	**35.0**	8,355	32.0	9,678	27.7
Environmental	High Cut Section	km	5	**0.2**	**4.0**	0.0	5.0	0	5.0
	River Crossing	ea	5	**15**	**4.7**	14	5.0	22	3.2
	Aff. Forest	%	5	**15**	**4.5**	18	4.5	13	4.5
	Sub total		15	**-**	**13.2**	-	14.5	-	12.7
Social	Aff. Agriculture	%	5	**77**	**1.5**	78	1.5	84	1.0
	Aff. Houses	ea	15	**8**	**15.0**	12	14.0	15	14.0
	Sub total		20	**-**	**16.5**	-	15.5	-	15.0
Constructability		-	10	**Bridge L=1.9 km**	**7.0**	Bridge L=2.9km	5.0	Bridge L=3.7 km	3.0
Total			100	**1**	**89.8**	2	85.4	3	77.4

Source: JICA Study Team

The above evaluation results are as follows.

- S5-ALT. A has medium-sized bridges in the total length of 1.9km and the bridge construction cost is the least among the three routes. As for the natural environment, there is no high cuttings sections, this route is assessed as average of three alternatives. As for the social aspect, more than 80% of the route is agricultural land and the social impact is expected to be about the same as the S5-ALT-B, but the number of affected houses (8) is the lowest of the alternatives.

- S5-ALT. B has medium-sized bridges in the total length of 2.9 km and the bridge construction cost is the second largest, compared with those of other two alternatives. As for the natural environment, this plan is the highest evaluation of the three proposals, as there are few river crossings and no high cuttings. As for the social aspect, more than 80% of the route is agricultural land and the social impact is expected to be about the same as the S5-ALT-A proposal, and the number of affected houses (12) is about the average of the three alternatives.

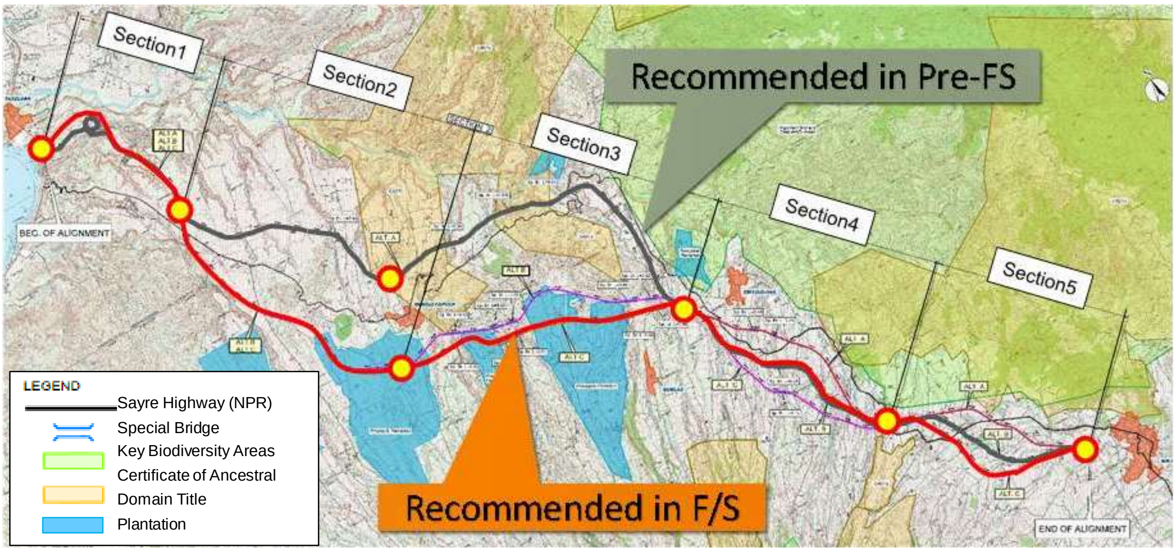
- S5-ALT. C has medium-sized bridges in the total length of 3.7 km and the bridge construction cost is the largest, compared with those of other two alternatives. As for the natural environment, the forest affected section is the shortest, but there are more river crossings, which is the lowest rated of the three alternatives. The impact on agricultural land and the number of affected houses (15) are the highest among the three alternatives.

As a result of evaluation shown in **Figure 1-14**, there is a comprehensive perspective, S5-ALT. A is recommended for Section 5.

1.4.2.4.5 Summary of Alignment

The selected alternative route under this F/S is passing toward south direction with a total length of 65.6 km and having a total of 161 houses affected to be relocated.

Figure 1-17. Recommended Alignment



Source: JICA Study Team

1.4.3 Hazard contextualization

The geological profiling, factual field geological mapping and hazard maps showed that Project implementation is not expected to induce natural hazards, e.g., liquefaction, subsidence, landslides. The Project however may be affected by the following natural hazards: ground shaking, ground rupture, earthquake and rain-induced landslides, and flooding (**Table 1-12**). The reader is referred to *Section 3.1.2.3.2* for the detailed discussion on the hazards.

Table 1-12. Hazard contextualization of the Project

Natural hazard	Hazard assessment
Liquefaction	Safe
Ground Shaking	Prone
Ground Rupture Earthquake-induced landslides	High Susceptibility High Susceptibility
Subsidence	Safe
Volcanic eruptions	Safe
Tsunami	Safe
Rain-Induced Landslide	High Susceptibility
Flooding	Susceptible to Moderate to High Flooding Hazard
Storm surge	Safe

1.4.4 The "No Project" option

The existing national highway (Sayre Highway) is classified as a primary two-lane national highway. At present, many sections of the road are in poor condition, a situation which becomes big problems for road users. Particularly, many zigzag paths with a series of sharp curves have been found along the 3- km stretch section near Cagayan de Oro and two canyons where serious traffic troubles often happen. Due to above road traffic problems on the Sayre Highway, the Alae-PHIVIDEC Link Road is under construction, but the design speed is 20 km/h based on the bypass road design drawing' grade and curve elements, and this traffic problem has not been fully solved.

Heavy trucks and vehicles driving at low speed along this zigzag and steep slopes in Sayre Highway often cause traffic accidents that are approximately four times higher than accidents occurring at other road sections.

The present daily traffic volume of 4-wheeled or more vehicles account for around 8,000 vehicles. Hence, the road is getting into full capacity. Just in case this road happened to be closed for certain reasons like traffic accidents, natural disasters, etc., many road users would have no choice but finding another path and forced to detour through a longer route which would also take longer travel time.

Moreover, there are some agri-business places with very high development potentials located near the project site. The NEDA Regional Office X is now planning to make the province of Bukidnon a strategic development area. The proposed CMH project could certainly provide strong infrastructure support and provide opportunities related to the following development plans of Region X:
Agri-business ventures and Eco-tourism (Bukidnon)

- Build factories to process agricultural products and raw materials,
- Revitalize eco-tourism and recreation,
- Increase productivity of food crops, industrial crops, high value crops, poultry, piggery and large livestock, and
- Develop production of high value-added crops and vegetables.

The project through high-speed mobility, is envisioned to provide a safe and comfortable travel of people and goods and propel the socio-economic development activities in Mindanao regions. From the foregoing, it could be deduced that the project implementation is therefore inevitable.

1.5 Project components

This section presents the Project's layout, site development plan, and major components as well as the processes, facilities (support and material handling), and pollution control and waste management system of the Project.

1.5.1 General layout of the facilities

The design of the structures will conform to the DPWH Design Standard Guidelines and other specifications of, where necessary. These design standards contain principles and requirements for road safety, serviceability, and durability. The locations of major structures of the Project are located **in Figure 1-18, Figure 1-19** and **Figure 1-20.** The location of the support facilities will be updated along with the Feasibility Study and Preliminary Design as the design and studies progress to subsequent stages.

1.5.2 Major components

The major components of the Project are the 65.6-km road with a 60-meter road right of way (RROW) and six interchanges constructed near urban centers. The presence of toll booths will be updated along with the Feasibility Study and Preliminary Design as the design and studies progress to subsequent stages. Other components of the Project are shown in **Table 1-13.**

Table 1-13. Major Project components

Component	Tagoloan	CDO	Manolo Fortich	Sumilao	Impasug-ong	Malaybalay	Total
Interchanges	0	1	1	1	1	1	5
Overpass	1	0	6	6	5	4	22
Underpass	2	1	15	4	5	5	32
Bridges	3	1	12	9	14	12	51
Viaduct	2	0	0	6	0	0	8

Source: JICA Study Team

1.5.2.1 Preliminary designs

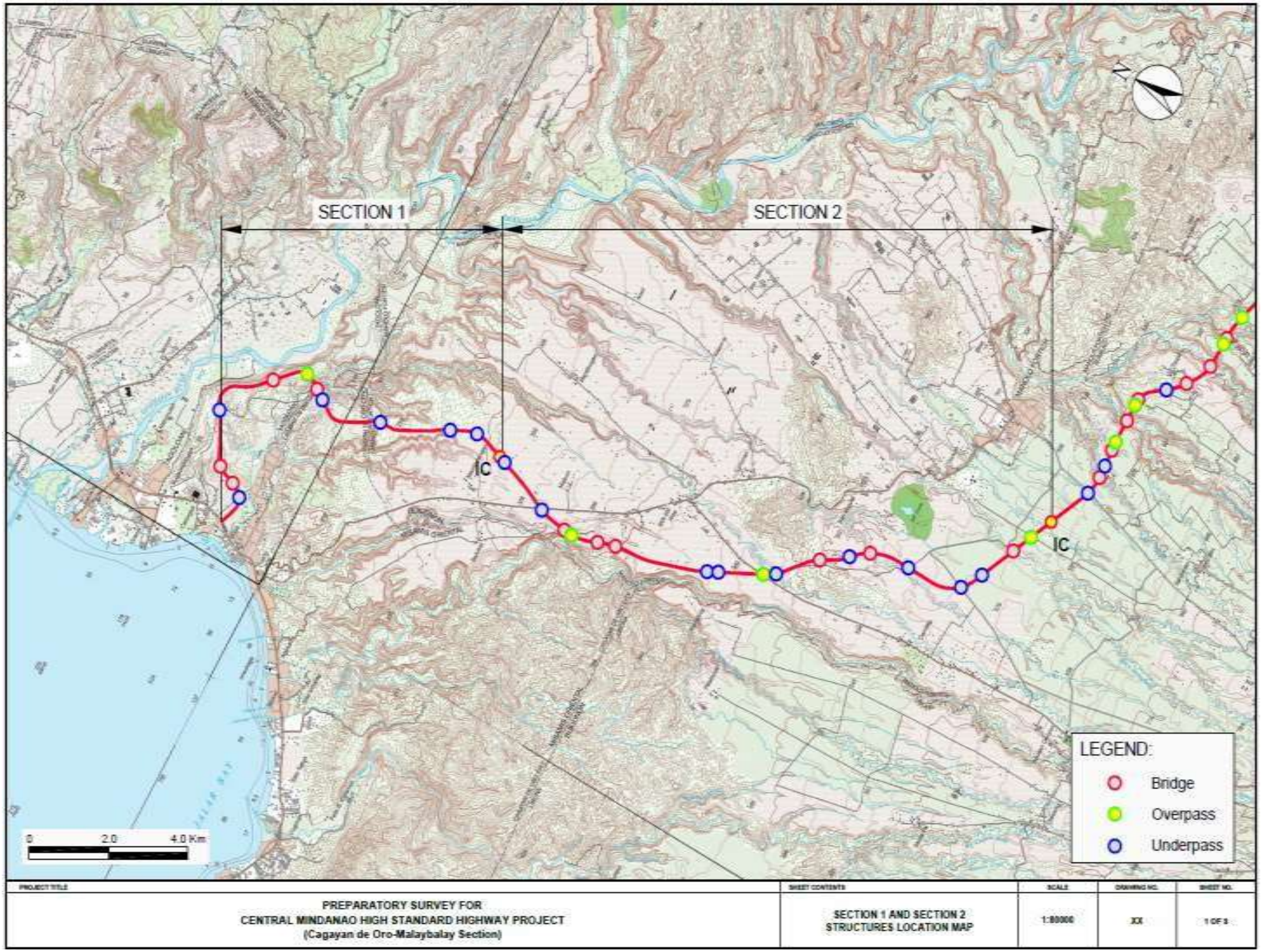
Geometric design standard - The standard references used for the Central Mindanao High Standard Highway are a) Policy on Geometric Design of Highways and Streets, AASHTO 2011, 6th Edition, b) Design Guidelines, Criteria & Standards, volume 4 Highway Design, 2015, DPWH, and c) Japan Road Association, Road Structure Ordinance, 2019.

Design speed - The recommended design speed of 80 kph taken from the previous pre-feasibility study (HSH MP Phase-2 report) was used for the main alignment. The design speed was selected considering moderate topographic conditions at the proposed alignment and traffic safety.

Interchange ramps - The interchange ramp design speed is 40 kph which is half of the highway design speed. It is also the identified minimum design speed in AASHTO 2011.

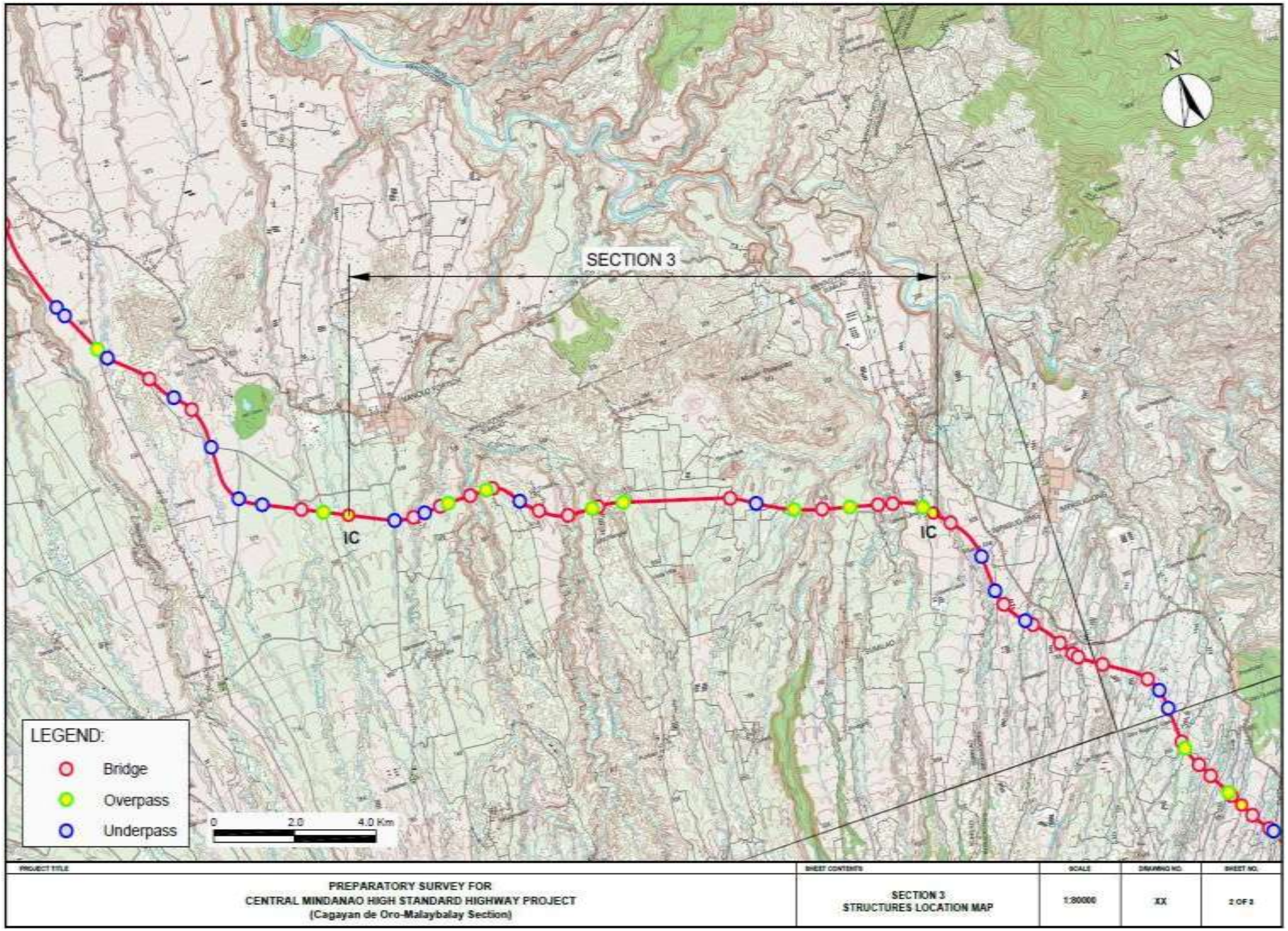
High Standard Highway geometry - The geometry applied to the design of main alignment and ramp is summarized in **Table 1-14** and **Table 1-15.**

Figure 1-18. Sections 1 and 2 Structural Map



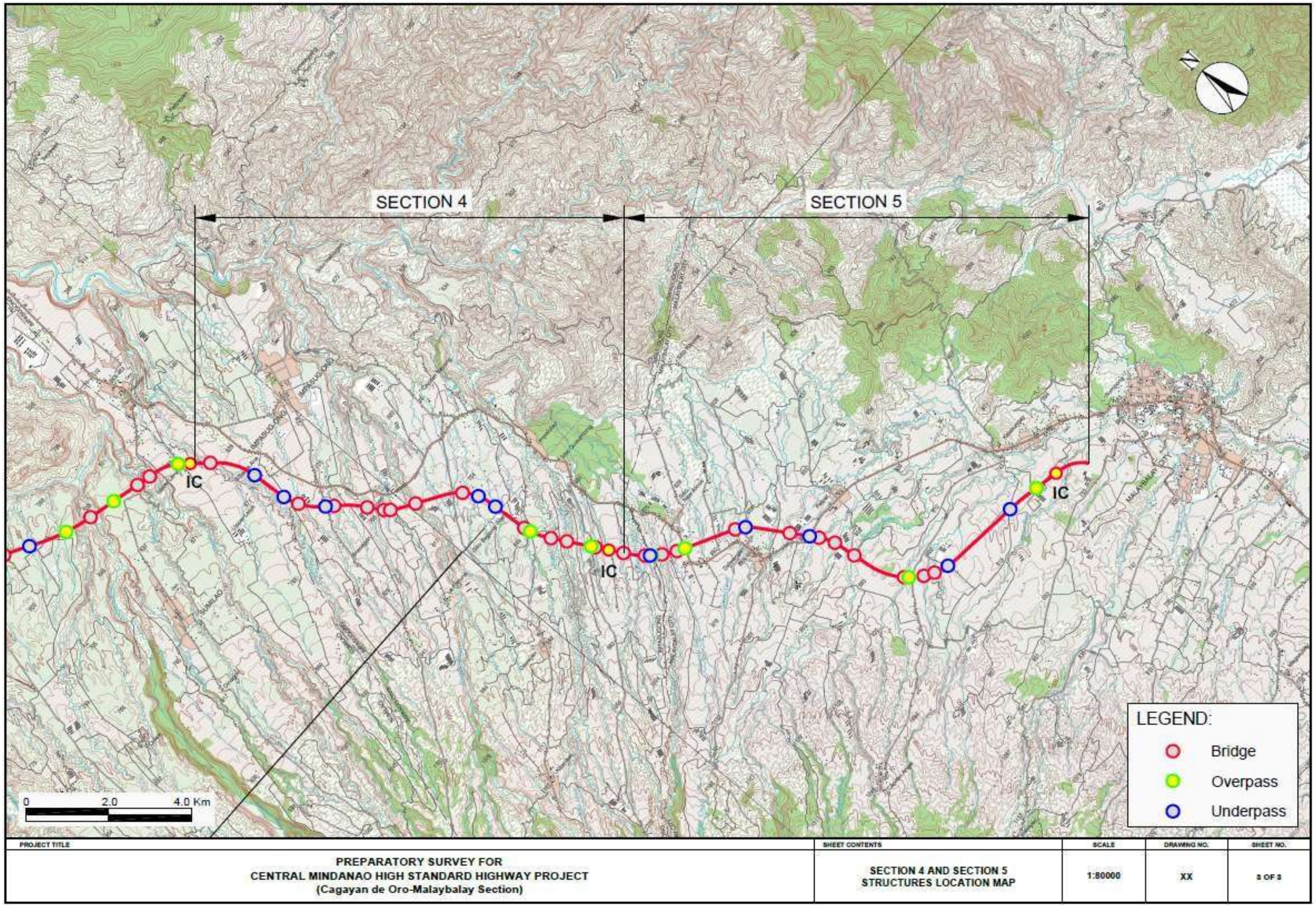
Source: JICA Study Team

Figure 1-19. Section 3 Structural Map



Source: JICA Study Team

Figure 1-20. Section 4 and 5 Structural Map



Source: JICA Study Team

Table 1-14. Road geometric design standard for main alignment (80kph design speed)

Item		Unit	Standard	Absolute minimum
Design Speed		kph	80	
Design Vehicle		-	WB-19	
Stopping Sight Distance		m	130	
Passing Sight Distance		m	245	
ROW		m	60	
Terrain Condition			Rolling	
Cross Section Elements				
Pavement				
Lane Width		m	3.65	
Median Width		m	3.0	
Inner shoulder Strip		m	0.75	
Outer shoulder Strip		m	3.0	2.5
Number of Lanes		Nos	5	
Normal Cross Slope		%	2	
Horizontal Alignment				
Minimum Radius		m	252	
Min. Transition Curve Length		m	70	
Min. Radius not requiring Transition Curve		m	379	
Min. Radius not requiring Super elevation		m	3,500	
		m	2,000	
Max. Relative Slope			1/200	
Vertical Alignment				
Maximum Vertical Gradient		%	4	5
Minimum K value	Sag		30	
	Crest		26	
Minimum Radius	Sag	m	2,000	
	Crest	m	3,000	
Min Vertical Curve Length		m	70	
Max. Composition Grade		m	10.5	
Vertical Clearance				
Road		m	5.2	

Source: JICA Study Team

Table 1-15. Road geometric design standard for ramp (40kph design speed)

Item	Unit	Standard	Absolute minimum
Design Speed	kph	40	
Design Vehicle	-	WB-15	
Stopping Sight Distance	m	50	
Passing Sight Distance	m	140	
ROW	m	60	
Terrain Condition		Rolling	
Cross Section Elements			
Pavement			
Lane Width	m	4.5	
Median Width	m	0	
Inner shoulder Strip	m	0.75	
Outer shoulder Strip	m	3.0	2.50
Number of Lanes	Nos	1	
Normal Cross Slope	%	2	
Horizontal Alignment			
Minimum Radius	m	43	
Min. Transition Curve Length	m	50	
Min. Radius not requiring	m	95	

Item		Unit	Standard	Absolute minimum
Transition Curve				
Superelevation Runoff			1/143	
Vertical Alignment				
Maximum Vertical Gradient		%	6	8
Minimum K value	Sag		9	
	Crest		4	
Min Vertical Curve Length		m	35	
Max. Composition Grade		m	11.5	
Vertical Clearance				
Road		m	5.2	

Source: JICA Study Team

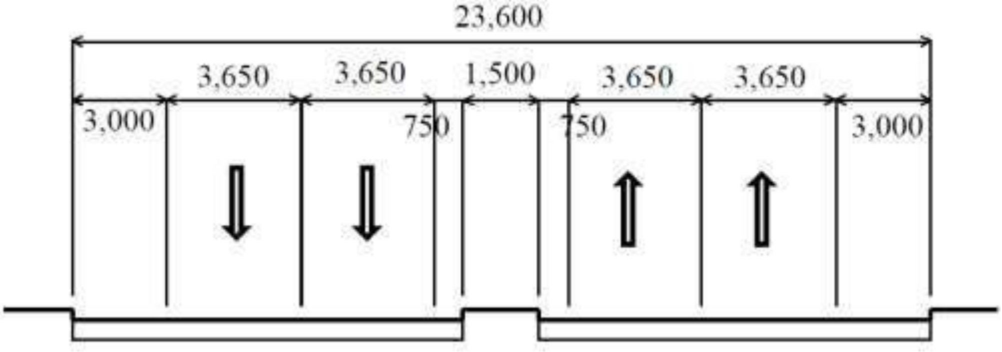
Vertical clearance - The design vertical clearances of the highway and crossing road is 4.0 to 5.2 meters.

Number of lanes - The alignment is a dual 2-lane (2x2) road in accordance with the traffic demand.

Carriageway, Shoulder, and Median widths - The recommended cross-section configurations are presented in the succeeding paragraphs.

a) *Main Alignment* - The carriageway of the main alignment is 3.65 m in accordance with HSH MP Phase-2 Report The deign widths of the inner and outer shoulders are 0.75 meter (using median island) and 3.00 meters respectively. The design widths will allow emergency stops at the shoulder without serious conflict to traffic on the main lanes. The design width of median is 3.00 m with a guard rail post on median island or a New Jersey Barrier that includes the inner shoulder as a lateral clearance (**Figure 1-21**).

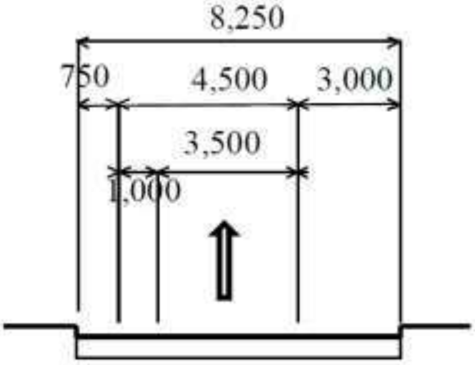
Figure 1-21. Cross-sectional Configuration (4 Lanes) Main Expressway



Source: JICA Study Team

b) *Ramp* - The design width of the carriageway of the 1-lane ramp is 4.5 meters. A 3.5-m lane width and a widening of 1.0 meter is added to the carriageway at inner lateral clearance. The inner and outer shoulders have design widths of 0.75 and 3.0 meters with provision for passing a stalled vehicles with consideration for semi-trailers (**Figure 1-22**).

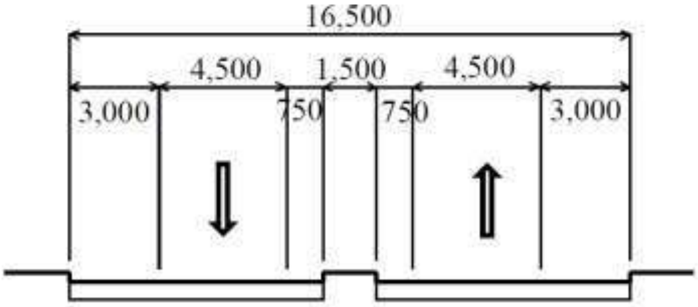
Figure 1-22. Cross-sectional Configuration (1 Lane Ramp)



Source: JICA Study Team

c) *Medium/ Small size bridge (L=<100m)* – the cross-sectional configuration of small and medium sized bridges (L=<100m) is the same as embankment roadway section (**Figure 1-23**).

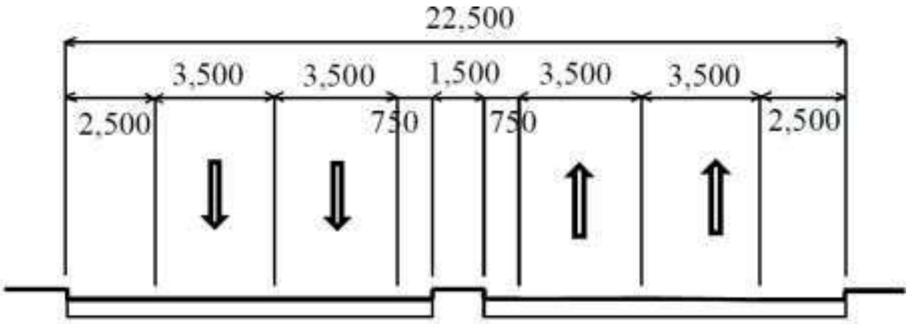
Figure 1-23. Cross-sectional Configuration (1 Lane Ramp)



Source: JICA Study Team

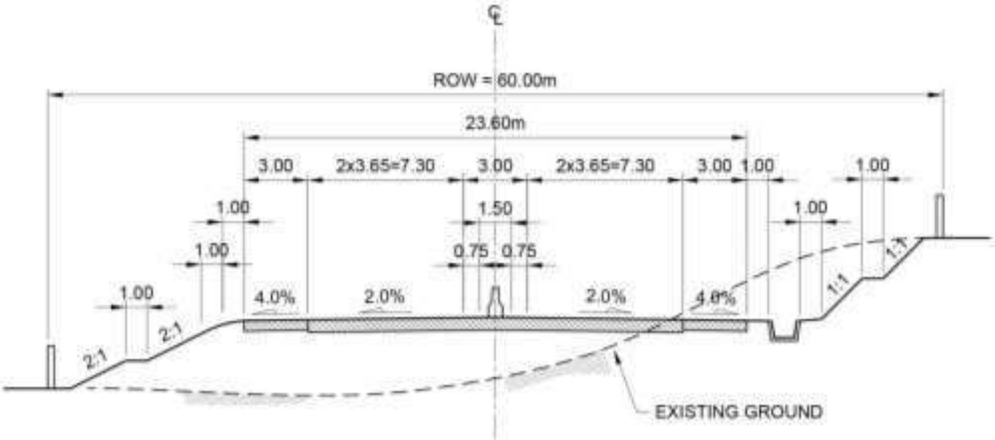
d) *Viaduct Bridge (L>100m)* – The inner and outer shoulder widths of viaduct bridges are 0.5 and 1.5m for economic reasons (**Figure 1-24**).

Figure 1-24. Cross-sectional Configuration (2 Direction 5 Lane Main Ramp Approaching Intersection)



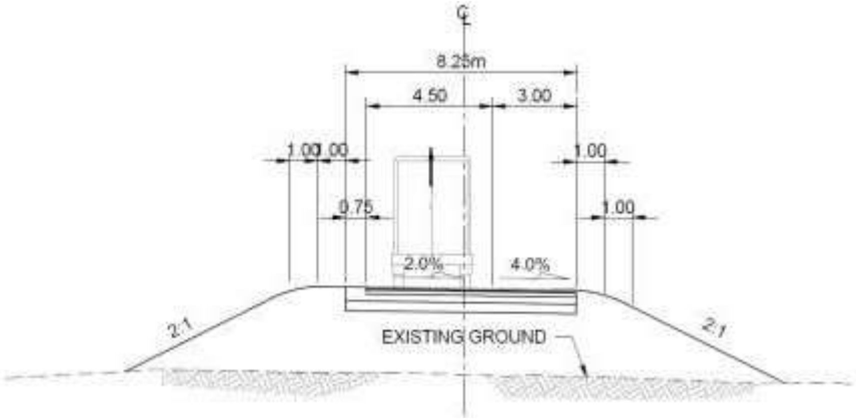
Source: JICA Study Team

Figure 1-25. Typical Cross Section Embankment and Cut: Row=60m



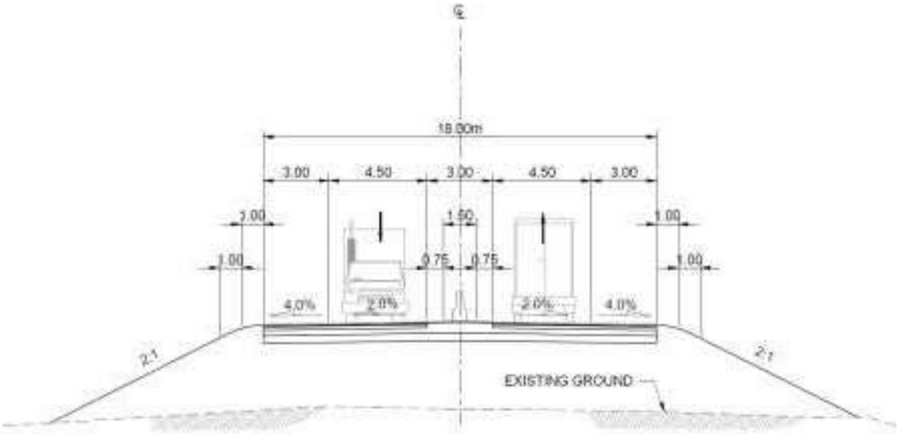
Source: JICA Study Team

Figure 1-26. Typical Cross Section at Interchange: One-Lane Ramp



Source: JICA Study Team

Figure 1-27. Typical Cross Section at Interchange: Two-Lane, Two-Direction Ramp



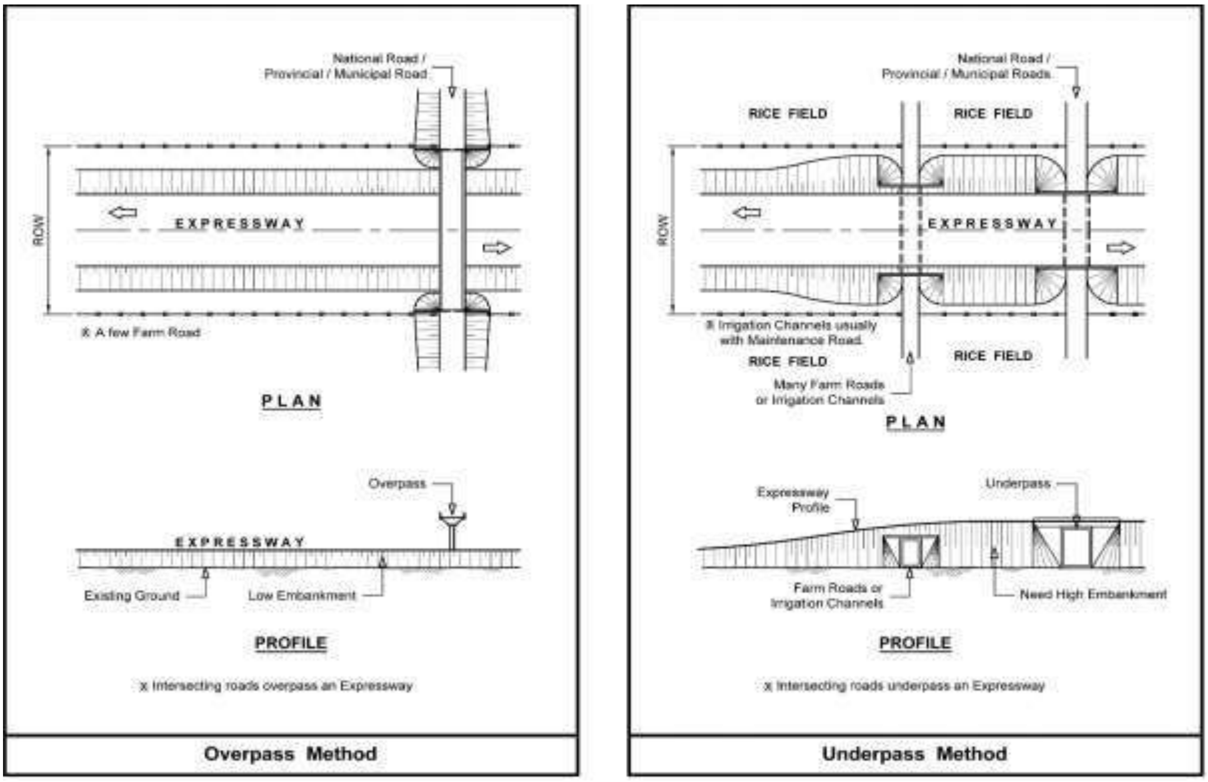
Source: JICA Study Team

1.5.2.2 Expressway design

Crossing road design - Crossing roads (under or over the highway) and service roads are included in the designed to maintain the accessibility of the Sayre Highway after the construction of the CMH alignment. while **Table 1-17** shows the lists and types of road crossings of the alignment.

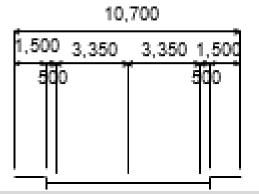
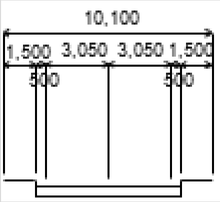
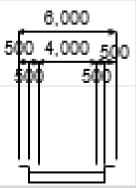
Figure 1-28 and Table 1-16 show the typical design of the under- and overpasses and their cross-sectional configuration respectively while **Table 1-17** shows the lists and types of road crossings of the alignment.

Figure 1-28. Typical Crossing Road of Expressway



Source: JICA Study Team

Table 1-16. Cross-sectional configuration of crossing road

No.	Road category	Road width (m)	Cross sectional configuration	Vertical clearance (m)	Remark
1	National Road	10.7 m		Vertical clearance (4.9 m) + overlay (0.3m) = 5.2 m 5.2 m	According to the DPWH Highway Design Guidelines, Criteria and Standards, the width of lane for Philippines's roads are dependent which classification of highways according to system the particular crossing road is subjected. For National Roads, the minimum width of 2-lane travelled way is 6.7m or 3.35m each direction. For other road crossings which constitute as Provincial, City, Municipal, Tourism roads require a minimum standard of 6.10m for 2-lane. Barangay and Farm to Market roads is provided with minimum 4.0m width of travelled way.
2	Provincial, City, Municipality Road	10.1 m		Vertical clearance (4.9 m) + overlay (0.3 m) = 5.2 m	
3	Barangay Road (1 lane)	6.0 m		Vertical clearance (4.9 m) + overlay (0.3 m) = 5.2 m	

Source: JICA Study Team

Table 1-17. Road Crossing List (underpass, overpass and interchanges)

No.	Station	Road Classification	Crossing Type	Type of Crossing Structure	Vertical Clearance
1	0+520	Trail	R.C. Box	Underpass	4
2	2+736	Tertiary	R.C. Box	Underpass	6
3	5+419	Trail	Bridge	Overpass	5.2
4	6+140	Farm	R.C. Box	Underpass	3.5
5	7+870	Trail	R.C. Box	Underpass	4
6	9+679	Trail	R.C. Box	Underpass	4
7	10+367	Farm	R.C. Box	Underpass	4
8	11+147.23	Interchange 1	R.C. Box	Underpass	0
9	INT 1 (0+873.871)	Farm	R.C. Box	Underpass	4
10	INT 1 (0+406.073)	Farm	R.C. Box	Underpass	4
11	11+340	Farm	R.C. Box	Underpass	4
12	13+800	Tertiary	Bridge	Overpass	5.2
13	17+309	Farm	R.C. Box	Underpass	4
14	17+596	Trail	R.C. Box	Underpass	4
15	18+732	Tertiary	Bridge	Overpass	5.2
16	19+060	Farm	R.C. Box	Underpass	4
17	20+980	Farm	R.C. Box	Underpass	4
18	22+546	Farm	R.C. Box	Underpass	4
19	23+999	Secondary	R.C. Box	Underpass	6
20	24+606	Trail	R.C. Box	Underpass	4
21	26+130	Farm	Bridge	Overpass	5.2
22	26+750.00	Interchange 2	Bridge	Overpass	0
23	27+902	Farm	R.C. Box	Underpass	4
24	28+677	Farm	R.C. Box	Underpass	4
25	29+300	Trail	Bridge	Overpass	5.2

No.	Station	Road Classification	Crossing Type	Type of Crossing Structure	Vertical Clearance
26	30+278	Trail	Bridge	Overpass	5.2
27	31+218	Trail	R.C. Box	Underpass	4
28	33+110	Trail	Bridge	Overpass	5.2
29	33+893	Farm	Bridge	Overpass	5.2
30	37+200	Trail	R.C. Box	Underpass	4
31	38+154	Farm	Bridge	Overpass	5.2
32	39+537	Trail	Bridge	Overpass	5.2
33	41+364	Tertiary	Bridge	Overpass	5.2
34	41+657.27	Interchange 3	Bridge	Overpass	0
35	43+283	Farm	R.C. Box	Underpass	4
36	44+172	Farm	R.C. Box	Underpass	4
37	45+228	Secondary	R.C. Box	Underpass	6
38	49+010	Trail	R.C. Box	Underpass	4
39	49+495	Farm	R.C. Box	Underpass	4
40	50+540	Trail	Bridge	Overpass	5.2
41	52+064	Farm	Bridge	Overpass	5.2
42	52+500.00	Interchange 4	R.C. Box	Underpass	4.5
43	53+511	Farm	R.C. Box	Underpass	5.2
44	53+553	Farm	Bridge	Overpass	4
45	55+940	Farm	R.C. Box	Underpass	5.2
46	60+160	Tertiary	Bridge	Overpass	6
47	61+I65	Tertiary	R.C. Box	Underpass	4
48	63+219	Trail	R.C. Box	Underpass	5.2
49	64+040	Farm	Bridge	Overpass	5.2
50	64+666.10	Interchange 5	R.C. Box	Underpass	0

Source: JICA Study Team

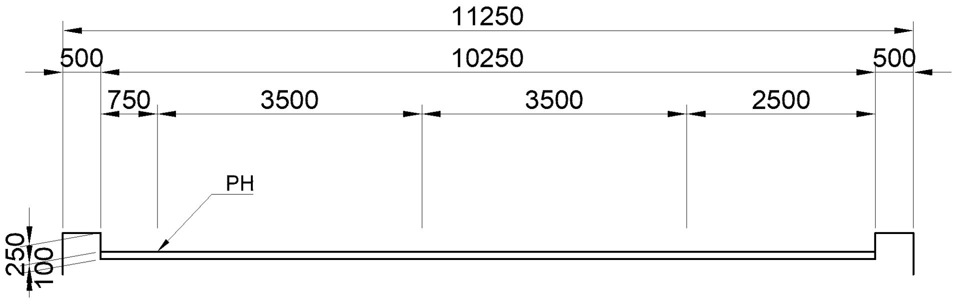
Vertical control – The vertical control design of the proposed alignment will be designed according to the following: a) the embankment and cut height shall be kept minimum while providing sufficient clearance at road crossing points to minimize construction cost; b) the minimum distance between PI point of vertical profile shall be 600m to provide smooth driving; and c) minimum vertical gradient is set as 0.3% to optimize surface drainage.

1.5.2.3 Bridge design

Section 1 can be constructed with piers with heights exceeding 100m using Japanese state-of-the-art technology. The provisionary design flood levels for creeks and rivers are 3m and 5m from the bed respectively.

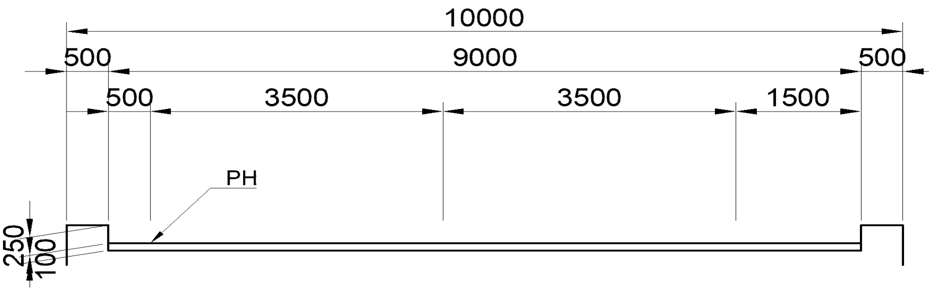
Other sections will be constructed using local technology, bridges with pier heights of 50m or more will be avoided, and instead select long bridges. The typical bridge dimensions are shown in **Figure 1-29** to **Figure 1-31** while **Table 1-18** and **Table 1-19** show the lists of the bridges, their length and type of structure. .

Figure 1-29. Schematic diagram of a medium or small bridge (L<100m)



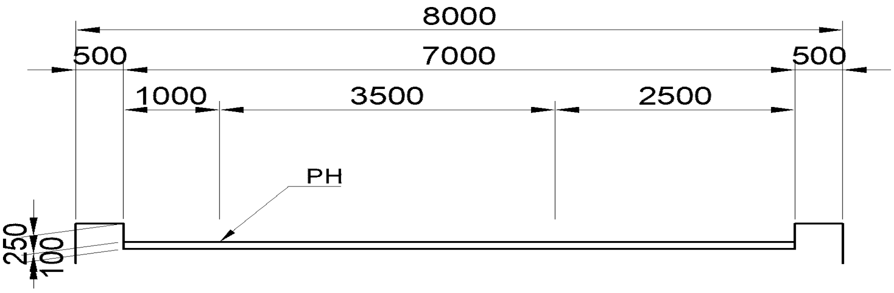
Source: JICA Study Team

Figure 1-30. Schematic diagram of a long bridge (L>100m)



Source: JICA Study Team

Figure 1-31. Schematic diagram of a ramp bridge



Source: JICA Study Team

Table 1-18. Summary of applicable superstructure type for each span

Range of Span	Pre-stressed Concrete	Steel
L≤40 m	AASHTO girder	---
40≤L≤50 m	Box Girder	Plate Girder
50≤L≤150 m		Box Girder
150≤L≤200 m		Truss
200≤L≤240 m	Extra-dosed	Arch
240≤L≤300 m	Cable Stayed	
300≤L≤400 m		Cable Stayed

Source: JICA Study Team

Table 1-19. List of bridges, length and type of structure

Bridge No.	Section	Length of Bridge (m)	Type of Structure
Viaduct-1	1	665	AASHTO Girder
BR-1	1	245	AASHTO Girder
BR-2	1	400	Steel Bridge
BR-3	1	540	Steel Bridge
BR-4	2	335	AASHTO Girder
BR-5	2	140	AASHTO Girder
BR-6	2	175	AASHTO Girder
BR-7	2	560	AASHTO Girder
BR-8	2	140	AASHTO Girder
BR-9	2	315	AASHTO Girder+ Steel
BR-10	3	240	Steel Bridge
BR-11	3	140	AASHTO Girder
BR-12	3	420	Steel Bridge
BR-13	3	175	AASHTO Girder
BR-14	3	210	AASHTO Girder
BR-15	3	540	Steel Bridge

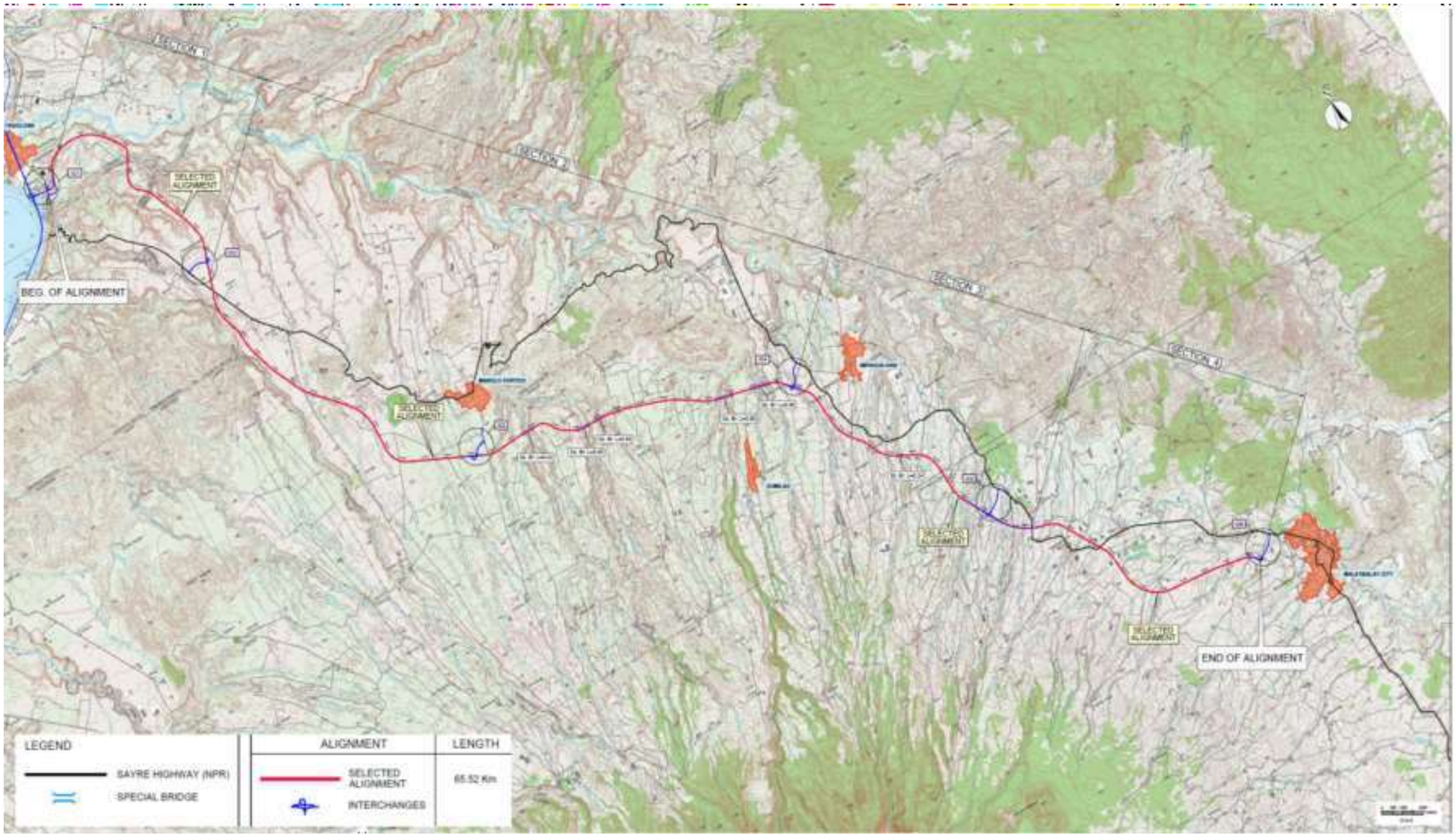
Bridge No.	Section	Length of Bridge (m)	Type of Structure
BR-16	3	210	Steel Bridge
BR-17	3	210	AASHTO Girder
BR-18	3	720	Steel Bridge
BR-19	3	350	Steel Bridge
BR-20	3	240	Steel Bridge
BR-21	4	170	Steel+AASHTO+ Steel
BR-22	4	315	AASHTO Girder
BR-23	4	210	AASHTO Girder
BR-24	4	245	AASHTO Girder
BR-25	4	105	AASHTO Girder
BR-26	4	105	AASHTO Girder
BR-27	4	240	Steel Bridge
BR-28	4	525	AASHTO Girder
BR-29	4	140	AASHTO Girder
BR-30	4	210	Steel+AASHTO+Steel
BR-31	4	175	AASHTO Girder
BR-32	4	140	AASHTO Girder
BR-33	4	280	AASHTO Girder
BR-34	5	210	AASHTO Girder
BR-35	5	245	AASHTO Girder
BR-36	5	400	AASHTO Girder
BR-37	5	175	AASHTO I Girder
BR-38	5	175	AASHTO Girder
BR-39	5	210	AASHTO Girder
BR-40	5	175	AASHTO Girder
BR-41	5	90	AASHTO Girder
BR-42	5	400	AASHTO Girder
BR-43	5	175	AASHTO Girder
BR-44	5	90	AASHTO Girder
BR-45	5	170	Steel+AASHTO+ Steel

Source: JICA Study Team

1.5.2.4 Interchange design

Figure 1-32 shows the location while **Table 1-20** shows the specifications of the interchanges at the proposed CMH alignment. The trumpet type as the most common interchange structure will be adopted for the Project. The schematic diagrams the CMH interchanges are shown in **Figure 1-33** to **Figure 1-38**.

Figure 1-32. Location map of the CMH interchanges



Source: JICA Study Team

Table 1-20. Location and specifications of the interchanges

Station	Road Classification	Crossing Type	TCS	MVC
11+147.23	Interchange 1	R.C. Box	Underpass	5.20
INT 1 (0+873.871)	Farm	R.C. Box	Underpass	4.00
INT 1 (0+406.073)	Farm	R.C. Box	Underpass	4.00
26+750.00	Interchange 2	Bridge	Overpass	5.20
41+657.27	Interchange 3	Bridge	Overpass	5.20
52+500.00	Interchange 4	R.C. Box	Underpass	5.20
64+666.10	Interchange 5	R.C. Box	Underpass	5.20

Source: JICA Study Team; NOTES: TCS – type of crossing structure; MVC – minimum vertical clearance (meters)

Figure 1-33. CDO Interchange

Source: JICA Study Team

Figure 1-34. Mambatangan Interchange

Source: JICA Study Team

Figure 1-35. Manolo Fortich Interchange

Source: JICA Study Team

Figure 1-36. Impasug-ong Interchange

Source: JICA Study Team

Figure 1-37. Dalwangan Interchange

Source: JICA Study Team

Figure 1-38. Malaybalay Interchange

Source: JICA Study Team

1.5.2.5 Pavement design

The pavement design will be conducted according to the Guide for Design of Pavement Structures (1993) by the American Association of the State Highway and Transportation Officials (AASHTO) and the Design Guidelines, Criteria and Standards for Public Works and Highways of the Department of Public Works and Highways (DPWH). The pavement design will be conducted after the traffic demand forecast.

1.5.2.6 Drainage design

Flooding and protection against inundation of a roadway and its facilities are some of the major problems in road design. Adequate flood control and drainage measures reduce damage to a roadway and its facilities resulting to minimal maintenance, operational and even reconstruction cost.

The general references used for the design criteria and standards concerning hydrology and hydraulics in were a) Design Guidelines, Criteria and Standards (DGCS) for DPWH (Department of Public Works and Highways) published in 2015.; b) HEC (Hydraulic Engineering Circular) series, by FHWA (Federal Highway Administration, USA); and c) HEC-HMS, HEC-RAS and HY-8 Manuals and Technical References, by U.S. Army Corps of Engineers, Hydrologic Engineering Center.

These standards will serve as bases for the proposed hydrologic and hydraulic design criteria appropriate for the Project. In addition, these standards will cover a) hydrologic design, b) Design Frequency or Return Period, c) Runoff Computation Methods, Runoff Coefficients, d) Rainfall Intensity, e) Level of Development in the Watersheds, f) Hydraulic Design, g) Manning's Roughness Coefficient, h) Expansion and Contraction Loss Coefficients, and i) Freeboard.

1.5.2.7 Road Markings and Signs and Safety

Besides the warning signs along the expressway, both the rest areas and the service areas should be equipped with road markings and signs for the following purposes; a) to limit speeds to the allowable speed limit; b) to give advance warning of junctions; c) to prevent stopping outside the zones specifically designated for parking; d) to advertise the various services offered by the service area. The proponent will also institute safety measures such as street lighting. The Project will be designed based on the Road Safety Design Manual of DPWH.

1.5.3 Support facilities

Camp sites which include offices, storage facilities, bunk houses, fabrication yards, and other temporary construction facilities, will be constructed during the duration of the construction phase. The Contractor shall designate camp site/s within the vicinity of active construction sites. Temporary access roads may be also constructed in hard-to-reach areas of the alignment. The support facilities will be updated along with the Feasibility Study and Preliminary Design as the design and studies progress to subsequent stages.

The water and power requirements during Project implementation are existing water systems in the areas and the Cagayan Electric Power & Light Company, Inc. (CEPALCO) and Bukidnon Power Corporation (BPC). Onsite generators will also be provided onsite during power outages.

1.5.4 Pollution control facilities

Construction Phase - Material Recovery Facilities (MRF) will be constructed at the camp sites for segregating recyclable, biodegradable, and hazardous construction wastes. Temporary drainage and sewage facilities will be also constructed and provided. Drainage leading to silt ponds will also be constructed in active construction sites.

Project management will coordinate with the concerned local government units (LGUs) for the use of their existing waste management facilities such MRFs, composting and recycling facilities, and sanitary landfills. Construction spoil materials such as excavated soil, demolition and construction debris, and other spoil materials will be disposed and used as filling materials in nearby reclamation/real estate/land development projects or land cover for as regular maintenance of sanitary landfills.

Operation and Maintenance Phase – Sanitary facilities (comfort rooms, septic vaults) will be provided for employees at the toll gates. The septic vaults will be regularly siphoned and maintained by contracted service providers. Garbage bins will be provided at all toll gates for municipal solid wastes and collected daily.

Noise barriers will be constructed along the alignment near the noise sensitive receptors such as schools, churches, hospitals, and residential areas. Tree planting will be actively conducted to air and noise pollution from vehicles using the CMH highway. Adequate drainage system with grease traps will be constructed to prevent oil and grease and other pollutants drain to the nearby surface waters. The potential wastes, key environmental impacts, and planned mitigations with activities associated in each Project phase are shown in **Table 1-21.**

Table 1-21. Pollution control strategies for the Project

Project phase	Brief description of process/ activities involved	Waste generation information	Key environmental and social issues	Planned mitigation built into design
Pre-construction	Detailed Architectural and Engineering Design, conduct of EIA, and securing of permits and licenses	None expected	None expected	Activities done: - Traffic Impact Assessment - Perception Survey - Public Consultations - Tree Inventory - EIA Formulate the following prior to construction: - Construction Waste Management Plan (CWMP) - Integrated Waste Management Plan

Project phase	Brief description of process/ activities involved	Waste generation information	Key environmental and social issues	Planned mitigation built into design
				(IWMP) during operations - Secure Permit to Cut from DENR (if required) Activities prior to Construction and Operation - Designation and accreditation of a PCO - Apply and secure a HW Generator ID and Permit-To-Operate for the Emission Source Installations, e.g., power generators and Discharge Permit from EMB-RX - Apply and secure surface water permit from NWRB
Construction	Site preparation and development, Erection of structures	- Sewage - Contaminated runoff - Resuspension of sediments during pipe laying and construction of intake structure	Water pollution	- Provision of an oil-water separator and silt ponds - Silt curtains at active pipe laying sites - Onsite sanitary facilities - Good construction practices - Set up adequate toilet facilities, ensure sufficient wash room for workers
		- Emissions of fugitive particulates (TSP, PM10) - Emissions of gaseous pollutants (SO2, NO2)	Air pollution	- Dust suppression on exposed soil surfaces - Proper maintenance of vehicles and heavy equipment - Set up adequate toilet facilities, ensure sufficient wash room for workers
		- Construction wastes - Hazardous wastes	Land pollution	- Implement the CWM - Set up adequate toilet facilities, ensure sufficient wash room for workers
Operation	Operation of toll gates and equipment maintenance	- Municipal solid wastes - Hazardous wastes	Land pollution	Implement the IWMP
		- Emissions of fugitive particulates (TSP, PM10) - Emissions of gaseous pollutants (SO2, NO2)	Air pollution	- Establishment of noise barriers - Planting of vegetation barriers
		- Sewage - Storm water runoff	Water pollution	- Provision of adequate drainage system - Adequate treatment of process wastewater

1.6 Process/Technology

1.6.1 Technology description

The construction technology used are standard to typical road projects. Regular inspection and maintenance will be done during the opening of the Project to motorists. Replacement or repair of degraded components will be done as necessary to ensure that the reliability of the structures during its intended service life. Maintenance may be classified as routine, periodic or annual activities depending on the requirements.

1. Routine maintenance activities will include a) Pothole patching, sealing of cracks on pavement, b) grading and patching of shoulders, c) drainage cleaning and clearing, d) roadside and future maintenance; vegetation control, road signs and guardrail cleaning and repainting; and maintenance of other street furniture, e) road marking maintenance, and f) bridge maintenance, structure inspection;
2. Periodic maintenance activities will include resealing of pavement and re-gravelling of shoulders; and
3. Annual preventive maintenance activities will include asphalt concrete overlays and sectional replacement of Portland Cement Concrete pavement and road markings.

1.6.2 Waste management systems

Waste management systems (WMS) in the context of the Project refer to the identification, quantification, collection, treatment, and disposal of residuals during the construction and operation phases. The environmental aspects that generated wastes, corresponding mitigations, and Project timeframe were already presented in **Table 1-21.** In summary, the following mitigating measures earlier presented comprise the WMS for each environmental component:

1. Air Pollution Management System
   - Identification of air pollution sources
   - Regular dust suppression on exposed soil surfaces
   - Proper maintenance of vehicles and heavy equipment
   - Restrict activities during daytime
   - Good housekeeping practices
   - Establishment of vegetation barriers

2. Water pollution management system
   - Identification of water pollution sources
   - Provision of drainage leading to siltation ponds
   - Provision of an oil-water separator
   - Provision of sanitation facilities
   - Provision of silt curtains during pipe installation
   - Proper treatment of process wastewater
   - Proper collection, storage, and disposal of hazardous wastes using DENR- accredited TSDs
   - Good housekeeping practices

3. Noise
   - Identification of noise generators
   - Restrict activities during daytime
   - Establishment of noise barriers

4. Land pollution management system
   - Identification of land pollution sources
   - Proper spoils management
   - Formulate and implement an integrated waste management system
   - Proper collection, storage, and disposal (using DENR- accredited TSDs) of hazardous wastes
   - Good housekeeping practices

1.7 Project size

The proposed Project is a four-lane 65.6 km road with a RROW of 60 meters. Other components include bridges, underpass, overpass and interchanges as shown in **Table 1-22** to **Table 1-24.**

Table 1-22. Road Crossing List (underpass, overpass and interchanges)

No.	Station	Road Classification	Crossing Type	Type of Crossing Structure	Vertical Clearance
1	0+520	Trail	R.C. Box	Underpass	4
2	2+736	Tertiary	R.C. Box	Underpass	6
3	5+419	Trail	Bridge	Overpass	5.2
4	6+140	Farm	R.C. Box	Underpass	3.5
5	7+870	Trail	R.C. Box	Underpass	4
6	9+679	Trail	R.C. Box	Underpass	4
7	10+367	Farm	R.C. Box	Underpass	4
8	11+147.23	Interchange 1	R.C. Box	Underpass	0
9	INT 1 (0+873.871)	Farm	R.C. Box	Underpass	4
10	INT 1 (0+406.073)	Farm	R.C. Box	Underpass	4
11	11+340	Farm	R.C. Box	Underpass	4
12	13+800	Tertiary	Bridge	Overpass	5.2
13	17+309	Farm	R.C. Box	Underpass	4
14	17+596	Trail	R.C. Box	Underpass	4
15	18+732	Tertiary	Bridge	Overpass	5.2
16	19+060	Farm	R.C. Box	Underpass	4
17	20+980	Farm	R.C. Box	Underpass	4
18	22+546	Farm	R.C. Box	Underpass	4
19	23+999	Secondary	R.C. Box	Underpass	6
20	24+606	Trail	R.C. Box	Underpass	4
21	26+130	Farm	Bridge	Overpass	5.2
22	26+750.00	Interchange 2	Bridge	Overpass	0
23	27+902	Farm	R.C. Box	Underpass	4
24	28+677	Farm	R.C. Box	Underpass	4
25	29+300	Trail	Bridge	Overpass	5.2
26	30+278	Trail	Bridge	Overpass	5.2
27	31+218	Trail	R.C. Box	Underpass	4
28	33+110	Trail	Bridge	Overpass	5.2
29	33+893	Farm	Bridge	Overpass	5.2
30	37+200	Trail	R.C. Box	Underpass	4
31	38+154	Farm	Bridge	Overpass	5.2
32	39+537	Trail	Bridge	Overpass	5.2
33	41+364	Tertiary	Bridge	Overpass	5.2
34	41+657.27	Interchange 3	Bridge	Overpass	0
35	43+283	Farm	R.C. Box	Underpass	4
36	44+172	Farm	R.C. Box	Underpass	4
37	45+228	Secondary	R.C. Box	Underpass	6
38	49+010	Trail	R.C. Box	Underpass	4
39	49+495	Farm	R.C. Box	Underpass	4
40	50+540	Trail	Bridge	Overpass	5.2
41	52+064	Farm	Bridge	Overpass	5.2
42	52+500.00	Interchange 4	R.C. Box	Underpass	4.5
43	53+511	Farm	R.C. Box	Underpass	5.2
44	53+553	Farm	Bridge	Overpass	4
45	55+940	Farm	R.C. Box	Underpass	5.2
46	60+160	Tertiary	Bridge	Overpass	6
47	61+I65	Tertiary	R.C. Box	Underpass	4
48	63+219	Trail	R.C. Box	Underpass	5.2
49	64+040	Farm	Bridge	Overpass	5.2
50	64+666.10	Interchange 5	R.C. Box	Underpass	0

Source: JICA Study Team

Table 1-23. List, length, and type of bridges at the alignment

Bridge	Section	Length, m	Structure type	Bridge	Section	Length, m	Structure type
Viaduct-1	1	665	AASHTO Girder	BR-23	4	210	AASHTO Girder
BR-1	1	245	AASHTO Girder	BR-24	4	245	AASHTO Girder
BR-2	1	400	Steel Bridge	BR-25	4	105	AASHTO Girder
BR-3	1	540	Steel Bridge	BR-26	4	105	AASHTO Girder
BR-4	2	335	AASHTO Girder	BR-27	4	240	Steel Bridge
BR-5	2	140	AASHTO Girder	BR-28	4	525	AASHTO Girder
BR-6	2	175	AASHTO Girder	BR-29	4	140	AASHTO Girder
BR-7	2	560	AASHTO Girder	BR-30	4	210	Steel+AASHTO+Steel
BR-8	2	140	AASHTO Girder	BR-31	4	175	AASHTO Girder
BR-9	2	315	AASHTO Girder+ Steel	BR-32	4	140	AASHTO Girder
BR-10	3	240	Steel Bridge	BR-33	4	280	AASHTO Girder
BR-11	3	140	AASHTO Girder	BR-34	5	210	AASHTO Girder
BR-12	3	420	Steel Bridge	BR-35	5	245	AASHTO Girder
BR-13	3	175	AASHTO Girder	BR-36	5	400	AASHTO Girder
BR-14	3	210	AASHTO Girder	BR-37	5	175	AASHTO I Girder
BR-15	3	540	Steel Bridge	BR-38	5	175	AASHTO Girder
BR-16	3	210	Steel Bridge	BR-39	5	210	AASHTO Girder
BR-17	3	210	AASHTO Girder	BR-40	5	175	AASHTO Girder
BR-18	3	720	Steel Bridge	BR-41	5	90	AASHTO Girder
BR-19	3	350	Steel Bridge	BR-42	5	400	AASHTO Girder
BR-20	3	240	Steel Bridge	BR-43	5	175	AASHTO Girder
BR-21	4	170	Steel+AASHTO+ Steel	BR-44	5	90	AASHTO Girder
BR-22	4	315	AASHTO Girder	BR-45	5	170	Steel+AASHTO+ Steel

Source: JICA Study Team

Table 1-24. Location and specifications of the interchanges

Station	Road classification	Crossing type	Crossing structure	MVC
11+147.23	Interchange 1	R.C. Box	Underpass	5.20
INT 1 (0+873.871)	Farm	R.C. Box	Underpass	4.00
INT 1 (0+406.073)	Farm	R.C. Box	Underpass	4.00
26+750.00	Interchange 2	Bridge	Overpass	5.20
41+657.27	Interchange 3	Bridge	Overpass	5.20
52+500.00	Interchange 4	R.C. Box	Underpass	5.20
64+666.10	Interchange 5	R.C. Box	Underpass	5.20

Source: JICA Study Team; MVC – minimum vertical clearance (meters)

1.8 Development Plan, Description of Project Phases and Corresponding Timeframes

1.8.1 Pre-construction phase

This phase mainly involves conducting studies at the Project site involving the following activities:

a) Pre-Feasibility and Feasibility Studies;
b) Environmental Impact Assessment and Acquisition of Environmental Compliance Certificate (ECC) for the Project;
c) Securing Various Permits and Clearances (i.e., Special Tree Cutting Permit, Project Endorsements, LGU Clearances, etc.);
d) Conduct of Detailed Engineering Design (DED);
e) Implementation of Right-of-Way (ROW) / Land Acquisition and Implementation of the Resettlement Action Plan (RAP) by DPWH;
f) Pre-qualification, Tendering, and Awarding of Contract for the Construction of the Project; and
g) Financing for the Project.

h) Conduct of FPIC and Securing of Certificate Precondition (CP)

1.8.2 Construction phase

This section presents the construction timetable, major construction activities, indicative equipment used, source of construction materials, and support service and availability during the construction.

***Indicative project timeline* –** The construction phase will take about three years after the acquisition of the RROW (**Table 1-25**).

Table 1-25. Indicative Project implementation schedule

Activity	2021				2022				2023				2024				2025			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Feasibility Study	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨							
Selection of Consultant														▨	▨	▨	▨			
Detailed Engineering Design																		▨	▨	▨
ROW Acquisition																				
Construction																				

Activity	2026				2027				2028				2029				2030			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Feasibility Study																				
Selection of Consultant																				
Detailed Engineering Design	▨	▨	▨	▨	▨															
ROW Acquisition		▨	▨	▨	▨	▨	▨	▨	▨											
Construction										▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨

Source: JICA Study Team

Major construction activities – The typical construction activities are enumerated and described below.

1. *Site clearing* - This activity includes cutting of trees and vegetation and removal of affected structures along the RROW. A Tree Cutting Permit, land and ROW acquisition documents, and other necessary permits and clearances related to site clearing will be secured prior to site clearing.

2. *Construction of temporary facilities* – location of temporary facilities is not established as of this time. The temporary facilities will be composed of engineer's site offices, bunk houses for construction workers, warehouse/storage areas, parking area for heavy equipment and vehicles, batching plant, and fabrication yard, among others.

   Wastewater treatment facilities, siltation ponds, materials recovery facility, buffer walls, and other pollution control devices should be constructed in this temporary facility to mitigate adverse environmental impacts.

3. *Excavation works* - all the accessible and fertile topsoil, together with the natural root systems, will be removed to stock piles for later use on cut-and-fill slopes before placing the embankment. The depth of excavation for topsoil stripping will be carefully controlled, on the basis of previously ascertained topsoil thickness and to avoid contamination with subsoils.
   If the excavated soil is not suitable for embankment material, it will be used as soil enhancer in agricultural areas (if the soil is fertile), soil cover for sanitary landfill and dump sites, and other appropriate uses.

4. *Construction of viaduct foundations* - Viaduct foundations will be constructed by excavation/drilling and cleaning of rock formation, installation of pile reinforcements, and concrete pouring. In the cases where

viaduct foundations are located in surface waters, silt traps or curtains will be installed to mitigate siltation of the surface waters.

5. *Construction of superstructure and road pavement* – The roads and interchanges will be paved and facilities such as toll gates and guardrails will be constructed and installed. Ancillaries such as traffic signage, light posts, and other facilities will also be installed.

Types of equipment – The typical equipment during the construction phase are shown in **Table 1-26**

Table 1-26. Major equipment during the construction phase

Equipment	Capacity	No.
Dump Track	11 ton	48
Wheel Loder	1.53 m^3	5
Motor Grader 14G	3m/200HP	1
Vibratory Roller	11 ton, 125 Hp	2
Tired Roller	12.6 ton	2
Crawler Tractor (w/ Bulldozer)	Caterpillar D7G PS	4
Hydraulic Excavator	1.0 m^3	13
Backhoe	0.6 m^3	6
Vibratory Plate Compactor	7 Hp	21
Track Crane	160 ton, 300Hp	1
Crawler Crane	60T/275Hp	10
Drill Rig for Pile	CWV Model TRM35/31	10
Concrete transit Mixer	5 m^3	26
Concrete Pump	60 yd^3	7
Concrete Plant	40m^3/hr	2
Track Mounted Crane	21-25t, 200Hp	5
Concrete Vibrator	Gasoline type	53
Semi-Trailer	20 tons	4
Asphalt Paver	4.7 m, 112 Hp	2
Asphalt Distributor	5 tons	4
Asphalt Plant	60 t/hr	2
Lane Marker	8 ton Track	61
Crane,Hydraulic Tel Boom,	121-140 tons	5
High Bed Trailer	65 tons	1

Source: JICA Study Team

Source of construction materials - Construction materials, equipment, and machinery will be sourced locally according to the design specifications of the Project if available.

Support services, facilities requirements, and availability - Support services and facilities at the site will include a field office, barracks for workers, canteen, warehouse, temporary sanitary facilities, First Aid Team, communication. Water and power requirements will be sourced locally.

1.8.3 Operation phase

The operation of the project will include the following activities:

a) Operation of toll gates, as necessary;
b) Regular inspection of road structures;
c) Regular maintenance of facilities such as traffic signals, signages, and markings;
d) Regular cleaning of roadways, and maintenance of toilet septic tanks;
e) Preventive maintenance, monitoring and reporting; and
f) Upgrading of structures and facilities, if necessary.

1.8.4 Abandonment phase

Abandonment or decommissioning in the context of the Project is implied as dismantling of the temporary facilities used during the construction phase. Dismantling of the temporary facilities will be phased according to the completion of each road section.

The construction contractor is responsible for the dismantling of temporary facilities. All construction wastes and spoil materials will be hauled out from the site. Recyclable construction spoils will be sold to interested buyers, solid wastes disposed in the municipal sanitary landfill or controlled dumps, and spoils containing hazardous materials, including contaminated soils, will be hauled by a DENR-registered TSD facility. It is expected that the modular nature of the temporary facilities will facilitate it dismantling and demobilization. Restoration work will be according to procedures and standards prescribed in the approved civil works contract following DPWH standards.

Most of the proposed locations of temporary facilities are planned to be developed as residential or commercial areas. It is expected that the site of the temporary facilities ready for development once removed.

1.9 Workforce Requirements

Most of the available jobs during the construction phase are masons, laborers, steel men, electricians, plumbers, welders, heavy equipment operators, among others (**Table 1-27**). Office staffs and site engineers, however, can be represented by women. The operation of the Project, on the other hand, will be manned by toll supervisors, tollgate personnel, cashiers, patrol crews, janitors, security staffs, and road maintenance staffs. These jobs can be represented by both men and women.

A percentage of the construction manpower will be provided by the contractor; hence DPWH will require the contractor to adopt strict policy requiring to source workforce from qualified locals and to develop scheme of prioritization in local hiring. In addition, the DPWH will strictly enforce RA 6685 during Project implementation. This Act requires private contractors hire at least 50% of the qualified unskilled and at least 30% of the qualified skilled workers from the host city or municipality. As much as possible, all non-skilled workers will be hired locally. Available local skilled workers will be also be prioritized. The Contractor, with the help of LGU, will be required to post job vacancies needed for the Project in public bulletin boards. Job fairs will be also conducted to enhance local manpower sourcing.

The contractor will also be required to apply labor standards and equal opportunities for both men and women. A target percentage of female workers will be set at the DED stage of the project. Lastly, it will be part of the policy of DPWH to hire qualified applicants including persons with disability (PWD), members of indigenous communities, senior citizens and those any sexual orientation and gender identities (SOGI). These all will be part of the Terms of References (TOR) of the contractor during construction and operations phase.

Table 1-27. Workforce requirements of the Project

Type	Contractor	Consultant	Total
Professional	20	60	80
Skilled Labor	25,159		25,159
Unskilled Labor	21,835		21,835
Technical and Support Staff	40	40	80
Total	47,054	100	48,154

Source: JICA Study Team

1.10 Indicative project cost

The indicative cost of the Project is Php 96,312,065,917.34

CHAPTER 2 - LEGAL AND INSTITUTIONAL FRAMEWORK ON ENVIRONMENTAL IMPACT ASSESSMENT

2.1 Philippines policy of environmental and social considerations

Environmental related laws in the Philippines are composed of under the Presidential Decree (PD) No.1151 as environmental policy and PD No. 1152 as environmental regulation in relation to the national policy and regulation. Other major environmental laws are established for natural resources, protection of wildlife and bio-diversity, forest resources, mining, coastal and marine, ambient air, water quality, waste and disposal, land use and resettlement, conservation of historical and cultural assets, environmental assessment, and national integrated protected area system. Major legislations on environmental and social conservation related to the proposed project are listed in **Table 2-1**, and relevant international treaties, agreements, and protocols that the Government of the Philippines has ratified in **Table 2-2.**

Table 2-1. Environment-related laws and regulations in the Philippines

Category	Law/Regulation	Content
Environmental basis	PD 1151	Philippine environmental policy
	PD 1152	Philippine environmental code
Natural Resource	1987 Constitution Article 12 Section 2	Exploration, development, and utilization of natural resources
	PD 1198	Restoration or rehabilitation of areas affected by the construction of infrastructure projects
Wildlife and Ecosystem	RA 826: An Act Creating the Commission on Parks and Wildlife, Defining its Powers, Functions, and Duties of 1952	Promotion and preservation of national parks
	RA 6147: An Act Declaring the *Pithecophaga jefferyi* Commonly Known as Monkey-Eating Eagle as a Protected Bird in the Philippines of 1970	Preservation of Monkey Eating Eagle
	RA 9147: Wildlife Resources Conservation and Protection Act of 2001	Conservation and protection of wildlife resources and their habitats
	RA 7586: National Integrated Protected Areas System (NIPAS) Act of 1992	Establishment and management of national integrated protected areas
	RA 11038: Expanded National Integrated Protected Areas System (eNIPAS) Act of 2018	Expansion of national integrated protected areas
Forest Resources	PD 331	Regulation on development application for forest resources and forest land development use
	PD 389	Development and conservation of forests
	PD 705	Protection, development, and rehabilitation of forest lands
	PD 865	Regulation on log exportation
	PD 1153	Forest recovery through citizen action
Pollution Control	RA 3931: Act creating the national water and air pollution control commission of 1964	Establishment of national air, water pollution control committee, definition of pollution and penalty

Category	Law/Regulation	Content
	PD 1160	Authority to barangay captains to enforce pollution control and environmental laws
Water Quality	RA 9275: Clean Water Act of 2003	Water Quality Management
	MC 2004-11	Compliance of all wastewater dischargers to upgraded and reclassified water bodies
	MC 2004-13	List of classified/reclassified water bodies in 2003
	PD 856	Sanitation standards
	PD 1067	Utilization and development of water resources
	DAO 1990-34	Water usage and classification, water quality criteria
	DAO 1990-35	Water quality on effluent discharge for industrial and urban drainage
	DAO 2016-08	Updated water quality guidelines and general effluent standards
Air Quality	RA 8749: Clean Air Act of 1999	Air pollution Control
	PD 1181	Control, and abate the emission of air pollution from motor vehicles
	DAO 2003-25	Hydrocarbon emission standards for motorcycle
	DAO 2003-31	Emission standard for motor vehicles
	DAO 2003-45	Designation of the members for the governing board for Metro Cagayan de Oro airshed, Province of Misamis Oriental, Region X
Waste disposal	RA 6969: Toxic Substance and Hazardous and Nuclear Wastes Control Act of 1990	Control of toxic substances and hazardous waste substances disposal
	RA 9003: Ecological Solid Waste Management Act of 2000	Establishment of ecological solid waste management program, creation of national solid waste management committee
	PD 825	Penalties for improper disposal of waste
	DAO 2004-36	Streamline procedures for generation and compliance to RA 6969
	DAO 1998-49	Technical guidelines for municipal solid waste management

NOTES: RA – Republic Act; PD – Presidential Decree; DAO – DENR Administrative Order

Table 2-2. International environmental agreements with the Philippines as signatory

Name of international treaty/agreement	Year
Washington Treaty Convention on the International Trade in Endangered Species of Wild Flora and Fauna	1981
International Tropical Timber Agreement	1983
United Nations Convention on the Law of the Sea	1984
World Heritage Convention Concerning the Protection of the World Cultural and Natural Heritage	1985
Montreal Protocol on Substances that Deplete the Ozone Layer	1991
Vienna Convention for the Protection of the Ozone Layer	1991
Convention on Biological Diversity	1993
Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal	1993
Ramsar Convention on Wetlands of International Importance, Especially as Waterfowl Habitat	1994
Framework Convention on Climate Change	1994
Kyoto Protocol	1998
Cartagena Protocol on Bio-Safety to the Convention on Biological Diversity	2000

Name of international treaty/agreement	Year
Stockholm Convention on Persistent Organic Pollutants	2001

2.2 Laws and Regulations of Environmental Impact Assessment (EIA)

Any Project or activity which are likely to have adverse effects on the environment are required to conduct an environmental impact assessment (EIA) in accordance with the Philippine Environmental Impact System (PEISS). The governing laws and guidelines of the PEISS are shown in Table 2-3.

Table 2-3. Important laws and manuals of PEISS

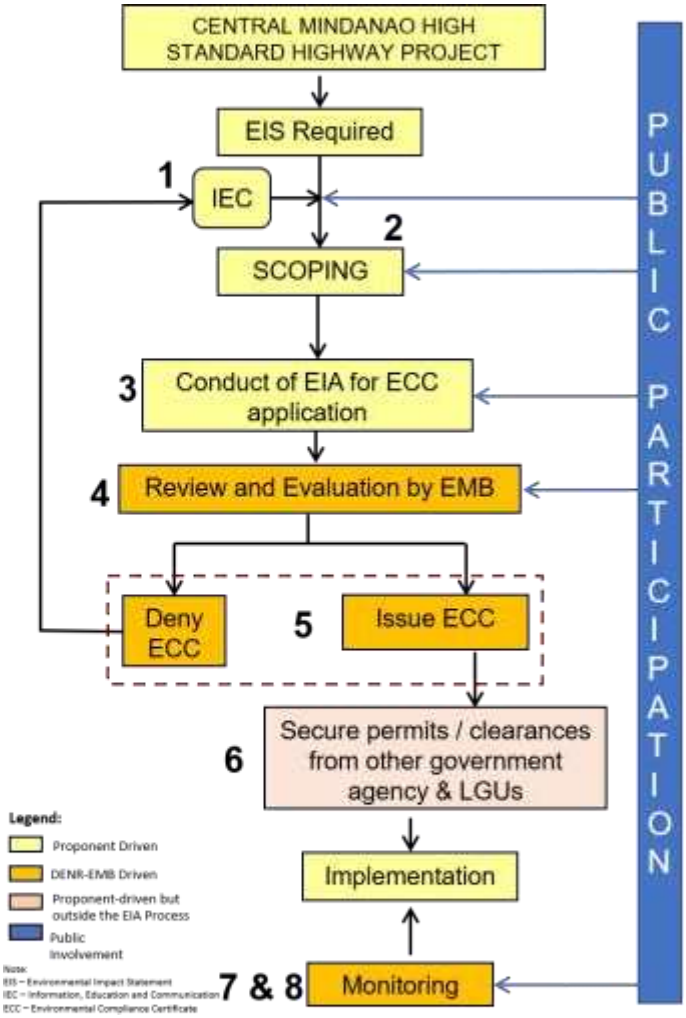
Law/Guideline	Content
PD 1152	Philippine Environmental Code – the concept of environmental impact assessment was introduced for the first time
PD 1586	PEISS was established
PP 2146 and 803	Proclamation of Environmentally Critical Areas and classification of project as Environmentally Critical Projects
DAO 2003-30	Implementing Rules and Regulations for the Philippine Environmental Impact Statement System (PEISS) of PD 1586
DAO 2017-15	Guidelines on Public Participation under PEISS
DAO 2007-002	Revised Procedural Manual for DAO 2003-30
DENR MC 2010-14	Standardization of Requirement and Enhancement of Public Participation in the Streamlined Implementation of the PEISS
EMB MC 2010-004	Guideline for Use of Screening and Environmentally Critical Area (ECA) Mapping Systems
EMB MC 2011-005	Incorporating Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) concerns in the PEISS
EMB MC 2014-005	Guidelines of Coverage Screening and Standardized Requirement under the PEISS

NOTES: PD – Presidential Decree; PP – Presidential Proclamation; DAO – DENR Administrative Order; MC – Memorandum Circular

2.3 Environmental Impact Assessment System process in the Philippines (PEISS)

The Philippine EIA Process has six (6) sequential stages 1) Screening, 2) Scoping, 3) EIA Study and Report Preparation, 4) EIA Review and Evaluation, 5) Decision Making, and 6) Post ECC Monitoring, Validation and Evaluation/Audit stage. A summary flowchart of the complete process is presented in **Figure 2-1.**

Figure 2-1. PEISS process



2.3.1 EIA Project Categorization

At the Screening stage, the Project is assessed whether it is subject to go through EIA process. Projects which have been originally declared as ECPs or projects in ECAs presumed to have significant impacts on the quality of the environment are subject to PEISS. The projects have been classified into four (4) major groups as shown in **Table 2-4.**

Table 2-4. Project categories under PEISS

Category	Type and location of the Project
Category A : Environmentally Critical Projects	Projects or undertakings which are classified as ECPs under Presidential Proclamation No. 2146 (1981) Proclamation No. 803 (1996) and any other projects that may later be declared as such by the President of the Philippines. Proponents of these projects implemented from 1982 onwards are required to secure an Environmental Compliance Certificate (ECC)
Category B : Non-Environmentally Critical Projects (NECP) but Located in ECA	Projects or undertakings which are not classified as ECP under Category A but which are likewise deemed to significantly affect the quality of the environment by virtue of being located in Environmentally Critical Area (ECA) as declared under Proclamation 2146 and according to the parameters set forth in the succeeding sections. Proponents of these

Category	Type and location of the Project
	project implemented from 1982 onwards are required to secure an ECC
Category C: Environmental Enhancement or Direct Mitigation Project	Projects or undertakings not falling under Category A or B which are intended to directly enhance the quality of the environment or directly address existing environmental problem
Category D: Non-Covered Project	Projects or undertakings that are deemed unlikely to cause significant adverse impact on the quality of the environment according to the parameters set forth in the Screening Guidelines. These projects are not covered by the Philippine EIS system and are not required to secure an ECC. However, such non-coverage will not be construed as an exemption from compliance with other environmental laws and government permitting requirement

Table 2-5 shows the classification of the project in accordance with the EMB Memorandum Circular 2014-005 or the Revised Guidelines for Coverage Screening and Standardized Requirements under the Philippine EIS System. The proposed high standard highway is a new national road construction that will have a total length of 65.6 kilometers, with viaducts and bridges. The proposed project is therefore classified under Category A or Environmentally critical projects. As a Category A project, a preparation of an Environmental Impact Statement (EIS) to be submitted to Environmental Management Bureau Central Office (EMB-CO) serves as a requirement for the issuance of the project's Environmental Compliance Certificate (ECC).

Table 2-5. EIA Project type categorization

Project/Description	Category A: ECP	Category B: Non-ECP		Category D: CNC
	EIS	EIS	IEE Checklist	PD
Bridges and viaducts (including elevated roads), new construction	≥10.0 km	≥5.0 km but <10.0 km	≥50 m but <5.0 km	≤50 m
Roads, new construction	National Road ≥ 20.0 km (length with no critical slope) or ≥ 10.0 km (length with critical slope	Provincial road and other types of roads ≥ 20.0 km (length with no critical slope) or ≥ 10.0 km (length with critical slope	All types of roads ≥ 2.0 km but <20.0 km (length with no critical slope) or ≥2 km but <10.0 km (length with critical slope	≤2 km

NOTE: ECP - Environmentally Critical Projects Source, CNC – Certificate of Non-compliance, PD – Project description: EMB Memorandum Circular 2014-005

2.4 Other Permits and Requirements

The proposed Project may require by government agencies to apply for the following permits prior to implementation. These are summarized in **Table 2-6.**

Table 2-6. Required environmental and social permits

Permit Name	Laws/Regulations	Rationale	Issuing Agency	Application Procedure
Zoning Clearance	Republic Act (RA) 7160 Local Government Code	Check the compatibility with the land use plan/ zoning ordinance of LGUs	LGUs (City Planning/ Development Office)	To be obtained in planning/ FS stage
Locational Clearance (if	Republic Act (RA) 7160 Local	Proposed project is allowed in a	LGUs (City Planning/	To be obtained in planning/ FS stage

Permit Name	Laws/Regulations	Rationale	Issuing Agency	Application Procedure
needed)	Government Code	particular zone/ district	Development Office)	
Certificate of non Overlap (CNO)	Republic Act (RA) 8371 Indigenous People Rights Act	The project site is not overlapping with the Ips ancestral domain claim	National Commission for Indigenous Peoples (NCIP)	To be obtained in planning/ FS stage
Certification for non coverage of National Cultural Treasure (NCT)/ Important Cultural Property (ICP)	Republic Act (RA) 10066 National Cultural Heritage Act	The project site is not overlapping other objects which are considered as cultural properties	National Commission for Culture and Arts (NCAA)	To be obtained in planning/ FS stage
Waste Management Plan (WMP)	Republic Act (RA) 6969 Toxic Substance and Hazardous and Nuclear Wastes Control Act Republic Act (RA) 9003 Ecological and Solid Waste Management Act	Plan to manage solid, liquid and hazardous wastes	DENR EMB Regional LGUs	Prior to construction
Tree Cutting and/or Tree Earth Balling Permit	Presidential Decree (PD) 953	Removal, transfer, and planting of trees	DENR EMB Region PENRO CENRO MENRO	
Traffic Impact Assessment (TIA)		Manage and control traffic due to project implementation		To be accomplished after DED stage

2.5 Roles and Responsibilities of the Relevant Agencies

As the Project proponent, DPWH main role is to prepare the EIS and secure the ECC while Environmental Management Bureau Central Office (EMB CO) reviews the EIS and manage the EIA review committee (EIARC). The ECC will is issued by the director of EMB CO and by DENR Secretary, while logistical arrangements in the project area such as arrangement of public consultation are conducted by the EMB Regional Office (RO EMB). Roles of the relevant agencies for EIA in the project are show in **Table 2-7.**

Table 2-7. Roles and responsibilities of concerned government agencies on EIA

Relevant Agency	Roles and Responsibilities
DPWH	● Holding of a meeting for Information, Education and Communication (IEC) ● Holding a meeting for Public Scoping for EIA ● Preparation & submission of project description for scoping (PDS) and Environmental Impact Statement (EIS) ● Payment of EIA review support fund
	● Making the necessary logistical arrangements for public consultation ● Submission of final EIS

Relevant Agency	Roles and Responsibilities
EMB CO	● Facilitating of EIA Review Committee (EIARC) (scoping stage and substantive review stage) ● Procedural screening of EIS ● Conduct of public consultation ● Preparation of decision document
EMB CO and DENR CO	● Approval of ECCs from EMB Director / DENR Secretary
RO EMB	● Supporting of EIA process in the project area; ● Participation of public scoping facilitated by proponent of the project ● Making the necessary arrangements for EIARC site validation and public consultation

2.6 Environmental Monitoring and Management Plan

Under the PEISS, the primary purpose of monitoring, validation and evaluation/audit is to ensure the judicious implementation of sound environmental management within a company/ corporation and its areas of operation as stipulated in the ECC and other related documents. Specifically, it aims to ensure the following:

- Compliance with the conditions set in the ECC;
- Compliance with the EMP commitments;
- Effectiveness of environmental measures on prevention or mitigation of actual project impacts vis-a-vis the predicted impacts used as basis for the EMP design; and
- Continuous updating of the EMP for sustained responsiveness in addressing environmental impacts of undertakings.

2.6.1 Responsible organization for the implementation environmental management and monitoring

Monitoring by Project Proponent
The Proponents with issued ECCs are primarily responsible for monitoring their projects. A proponent is required to submit an ECC Compliance Monitoring Report (CMR) to the designated monitoring EMB office on a semi-annual frequency. The detailed report on compliance to environmental standards specific to environmental laws will be submitted through the Self-Monitoring Report (SMR) on a quarterly basis to the concerned EMB office.

Multi-partite Monitoring Team
The MMT is primarily responsible of validating the proponent’s environmental performance and submits findings/recommendations as a Compliance Monitoring and Validation Report (CMVR) to the concerned EMB office.

Environmental Management Bureau
The EMB is primarily responsible for the over-all evaluation/audit of the Proponent’s monitoring and the MMT’s validation.

2.7 Comparison of PEISS and JICA Guidelines

The results of the gap analysis between current relevant regulations in the Philippines to the JICA Guidelines are shown in **Table 2-8**. Countermeasures are proposed to fill the gap.

Table 2-8. Gap between JICA Environmental Guidelines and Relevant Regulations in the Philippine EIS System

Topic	JICA Guidelines for Environmental and Social Considerations (2010 April)	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
Principle	Environmental impact must be assessed and examined from the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impact must be examined and incorporated into the project plan.	The Philippines Environmental Impact Statement System (PEISS) requires for the project proponent to examine possible impact and to conduct scoping in the pre-feasibility study stage. In addition, PEISS requires to conduct alternative study at the feasibility study stage.	No significant gap	Not Applicable
Information Disclosure	EIA reports (which may be referred to differently in a different system) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them. EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.	As a form of disclosure of the EIA findings, Public Hearing is required for all new ECPs for which public scoping was undertaken and for PEISS-based applications. EIA report will be disclosed. EIA report is prepared in English which is the common language in the Philippines. In addition, in the EIA report, Project Fact Sheet is prepared by mixing the language which is familiar with the local communities.	No significant gap	Not Applicable
Consultation	For projects with a potentially large environmental impact, sufficient consultations with local stakeholders,	The revised procedural manual (2008) stipulates to conduct below: Information, education and communication	No significant gap	Not Applicable

Topic	JICA Guidelines for Environmental and Social Considerations (2010 April)	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into contents of project plans. In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared. Consultations with relevant stakeholders, such as local residents, should take place, if necessary, throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared.	(IEC) activities Public scoping Participation of local stakeholders Holding public hearing Sharing ECC and EIA reports Prior to holding public hearing or consultation meetings, the EIA report shall be available at the EMB and the local government offices in which the project is located.		
Impacts to be Assessed	The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil,	Items below are required to be assessed and to be included in EIS report. Land (land use, geology, topography, soil, land organisms), water (hydrology including groundwater, ocean, water quality, freshwater and marine organisms), air (including climate	No significant gap in the evaluation items and contents. However, environmental standards are not	Internationally recognized standards including Japanese standard for soil, sediment and vibrations shall

Topic	JICA Guidelines for Environmental and Social Considerations (2010 April)	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. There also include social impacts. In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the projects are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.	change, air quality, noise), people (relocation, migration, indigenous people, public health, community contribution, basic services and resource distribution, transportation, regional environmental management, affected regional assets)	established for soil, sediment and vibration.	be referred to as benchmark.
Monitoring	Project proponents should make efforts to make the results of the monitoring process available to local project stakeholders. When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in relevant projects. Project proponents should make efforts to reach an agreement on	The project proponent who obtained the ECC shall submit the Compliance Monitoring Report (CMR) semi-annually and the Self-Monitoring Report (SMR) quarterly to the EMB. In addition, as a monitoring by a third party, Multipartite Monitoring Team (MMT) shall submit the Compliance Monitoring and Validation Report (CMVR) to the EMB semi-annually. These are the targets of information disclosure.	No significant gap	Not Applicable

Topic	JICA Guidelines for Environmental and Social Considerations (2010 April)	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	procedures to be adopted with a view to resolving problems.			
Ecosystem and Biota	Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests. Projects must, in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of nature or cultural heritage.	All designated, critical habitats shall be protected, in coordination with the local government units and other concerned groups, from any form of exploitation or destruction which may be detrimental to the survival of the threatened species dependent therein. (RA9147) Project in protected areas is subjected to environmental impact assessment and allowed to be implemented only when the ECC is issued. In addition, project proponent shall plan and implement environmental mitigation measures. (RA7586)	There is no precise provision to prohibit a project in an environmentally sensitive area.	Accordingly, JICA Guidelines shall be applied. It is necessary to confirm the location of the protected area and the project alignment to avoid traversing it, in principle.

Source: JICA Study Team

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CHAPTER 3 - ANALYSIS OF KEY ENVIRONMENTAL IMPACTS

3.1 THE LAND

3.1.1 Land use and classification

3.1.1.1 Scope

This section described the existing land uses traversed by the proposed CMH alignment and the protected areas and ancestral domains in its vicinity. The key impacts assessed were compatibility with existing land use, compatibility with classification as an Environmentally Critical Area (ECA), land tenure issues, impairment of visual aesthetics, and devaluation of land value because of improper SWM and other related impacts.

3.1.1.2 Methodology

The existing land use was described using the Comprehensive Land Use Plans and Socio-economic Profiles of the six host municipalities and cities. Assessment of the key impacts was done using site visits, qualitative analysis, and related documents.

3.1.1.3 Assessment of key impacts

3.1.1.3.1 Compatibility with existing land use

The summary of the land uses of the six (6) LGUs traversed by the proposed alignment is shown in **Table 3-1**. Further processing of the data showed that the dominant land use in the host LGUs is forest and agricultural (green cells in **Table 3-1**) occupying 88.36 percent of the total their total land areas.

Table 3-1. Summary of land uses at the six host LGUs

Land use	Total area, ha	% of total
Forest	193,732.39	57.79%
Agricultural	102,486.44	30.57%
Agri-Industrial	10,402.09	3.10%
General Residential	15,340.91	4.58%
Commercial	75.97	0.02%
Parks and Recreation	33.96	0.01%
Institutional Zone	506.75	0.15%
Industrial	449.73	0.13%
Mineral Land (mining and quarry)	130.39	0.04%
Tourism	2,963.77	0.88%
Utilities, Transportation and Services Zone	1,277.87	0.38%
Rivers and creeks	1,660.31	0.50%
Open Land	3,118.04	0.93%
Cemetery	67.49	0.02%
Cockpit	1.49	0.00%
Pasture	3,010.00	0.90%
TOTAL	**335,257.61**	**100.00%**

Source: derived from **Table 3-2**

Interpretation of the land use maps of the LGUs in **Figure 3-1** to **Figure 3-6** shows that the alignment traverses different land uses enumerated below.

a) Cagayan de Oro – Urban, Agricultural
b) Tagoloan – Agricultural (Production, Industrial), Forest (Production)
c) Manolo Fortich – Agricultural, Agricultural (Industrial), Forest
d) Sumilao – Agricultural, Agricultural (Industrial), Waterbodies (rivers, creeks), Tourism
e) Impasug-ong – Agricultural, Forest, Institutional
f) Malaybalay - Agricultural (Production), Agricultural (Plantation), Residential

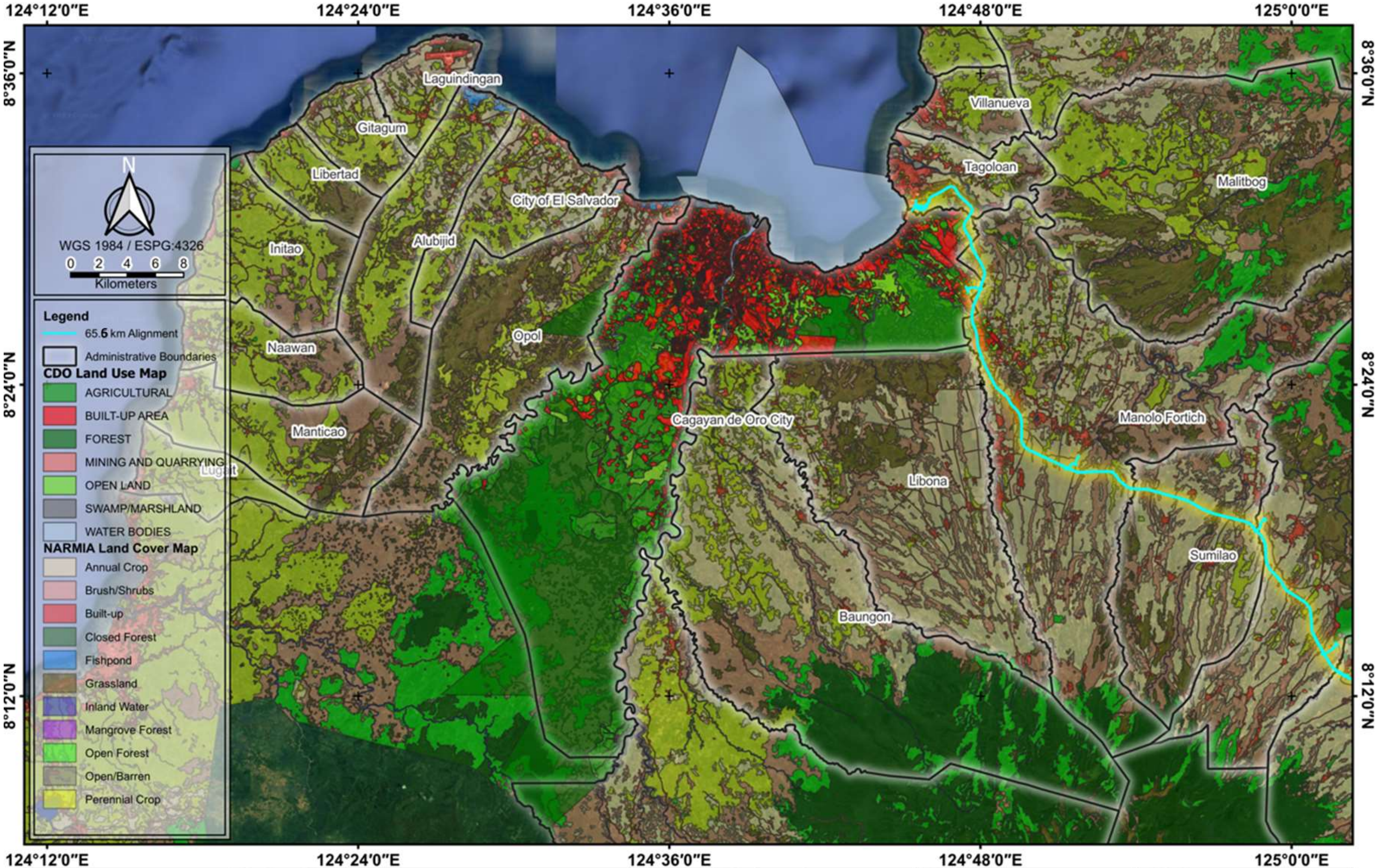
The proposed CMH alignment with a 60-meter RROW is incompatible with the existing land uses and zoning ordinances of the six LGUs it will be traversing. The proper land use compatibility process and corresponding land use certificate should be secured prior to the construction phase.

Table 3-2. Land use distribution at the host LGUs

	CDO (2012)		Malay (2016)		Tagoloan (2017)		Manolo Fortich (2013)		Sumilao (2011)		Impasug-ong (2019)	
Land Use	**Area, ha**	**% of total**	**Area, ha**	**% of total**	**Area, ha**	**% of total**	**Area, ha**	**% of total**	**Area, ha**	**% of total**	**Area, ha**	**% of total**
Forest	24,755.28	43.13%	73,682.03	68.25%	1,530.35	17.93%	16741.21	34.97%	6763.92	32.72%	70259.6	75.69%
Agricultural	16,393.39	28.56%	32,238.16	29.86%	6116.32	71.65%	22888.49	47.82%	10422.03	50.42%	14428.05	15.54%
Agri-Industrial	-	-	67.62	0.06%			5251.07	10.97%	2,343.50	11.34%	2,739.90	2.95%
General Residential	11,977.09	20.86%	1248.52	1.16%	241.44	2.83%	1251	2.61%	449.401	2.17%	173.46	0.19%
Commercial			62.56	0.06%					7.4961	0.04%	5.91	0.01%
Parks and Recreation			19.37	0.02%					11.1847	0.05%	3.41	0.00%
Institutional Zone			260.98	0.24%					105.3638	0.51%	140.41	0.15%
Industrial			-	-	187.43	2.20%	-	-	217.3269	1.05%	44.97	0.05%
Mineral Land (mining and quarry)	31.12	0.05%	-	-			79.27	0.17%	-	-	20	0.02%
Tourism	1,167.34	2.03%	6.38	0.01%	-	-	157.7	0.33%	4.8943	0.02%	1,627.46	1.75%
Utilities, Transportation and Services Zone	-	-	8.54	0.01%	99.4	1.16%	492.7	1.03%	325.3442	1.57%	351.89	0.38%
Rivers and creeks	-	-	298.59	0.28%	354.96	4.16%	1,006.76	2.10%	-	-	-	-
Open Land	3,079.18	5.36%	38.86	0.04%	-	-	-	-	-	-	-	-
Cemetery	-	-	21.3	0.02%	5.89	0.07%	-	-	17.0502	0.08%	23.25	0.03%
Cockpit	-	-			-	-	-	-	1.4893	0.01%	-	-
Pasture	-	-	-	-	-	-	-	-	-	-	3,010.00	3.24%
Total	57,403.40	100.00%	107,952.91	100.00%	8,535.79	100.00%	47,868.20	100.00%	20,669.00	100.00%	92,828.31	100.00%

Sources: CLUP of Cagayan de Oro, Tagoloan, Manolo Fortich, Sumilao, Impasug-ong, and Malaybalay

Figure 3-1. Existing Land Use Map of Cagayan de Oro City



Cagayan de Oro Land Use Map (2012) Overlayed in NAMRIA Land Cover Map	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) CDO CLUP (2013-2022) NARMIA 2020 (Land Cover Map)		AMET ASIA INC.

Figure 3-2. Existing Land Use Map of Tagoloan

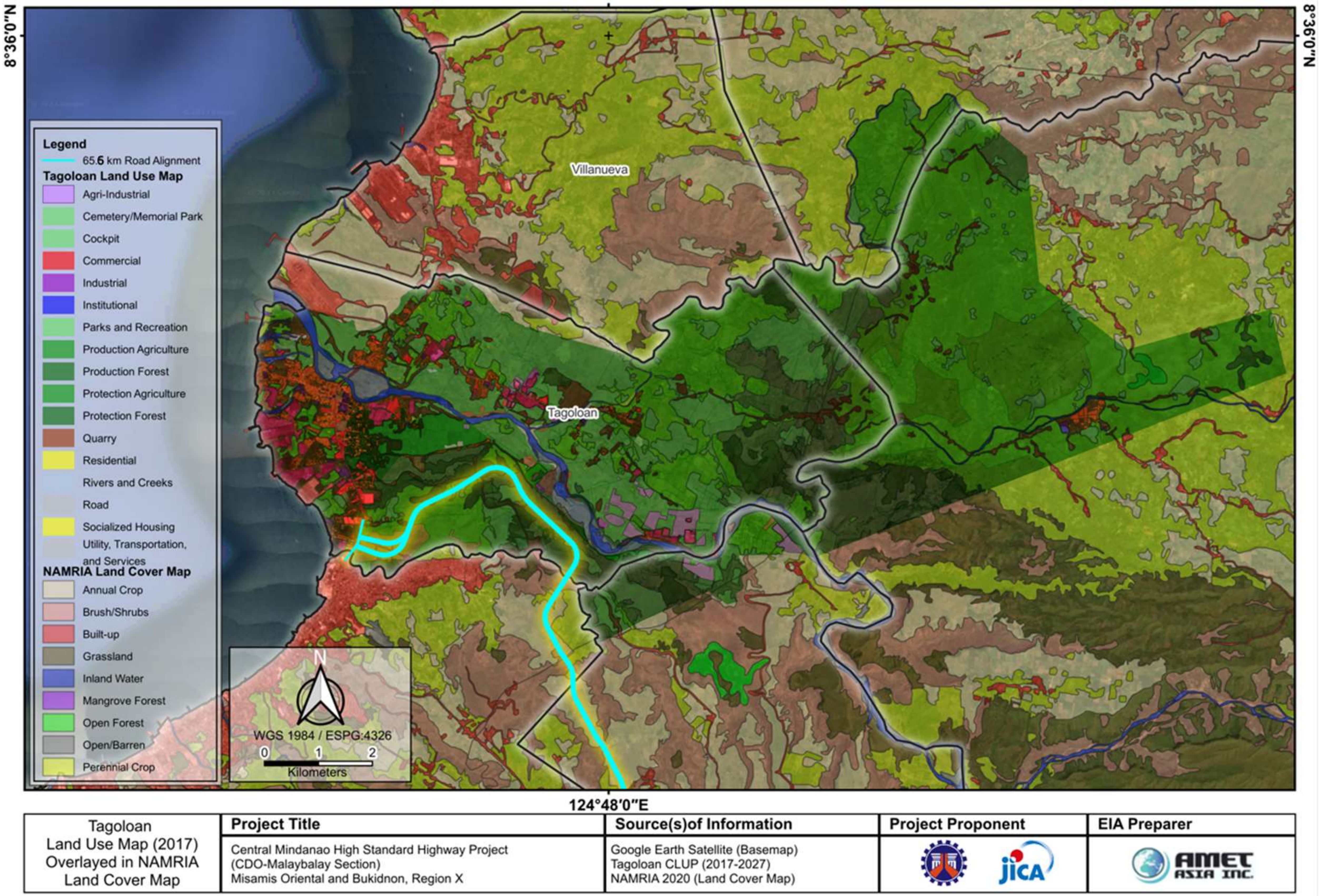
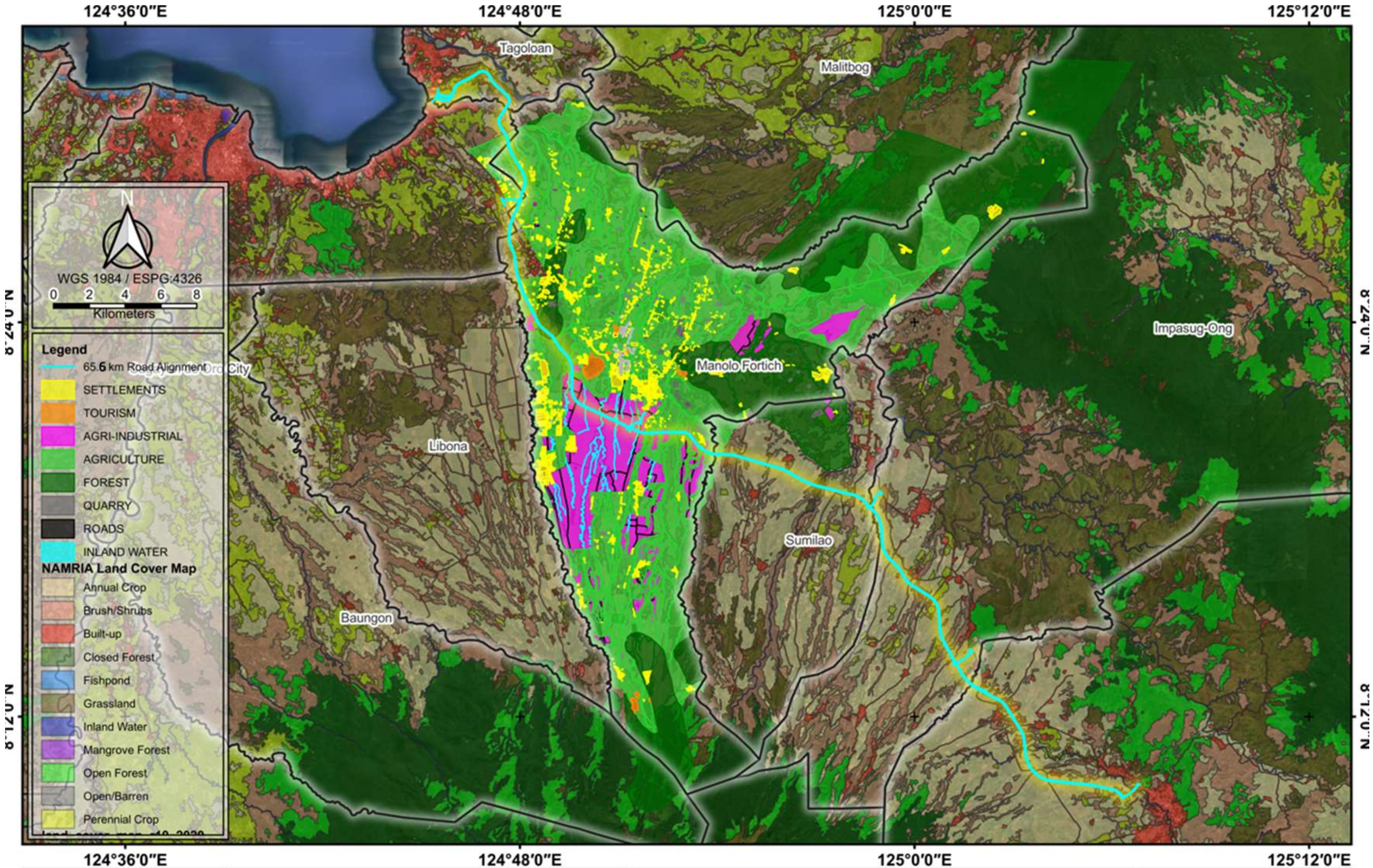
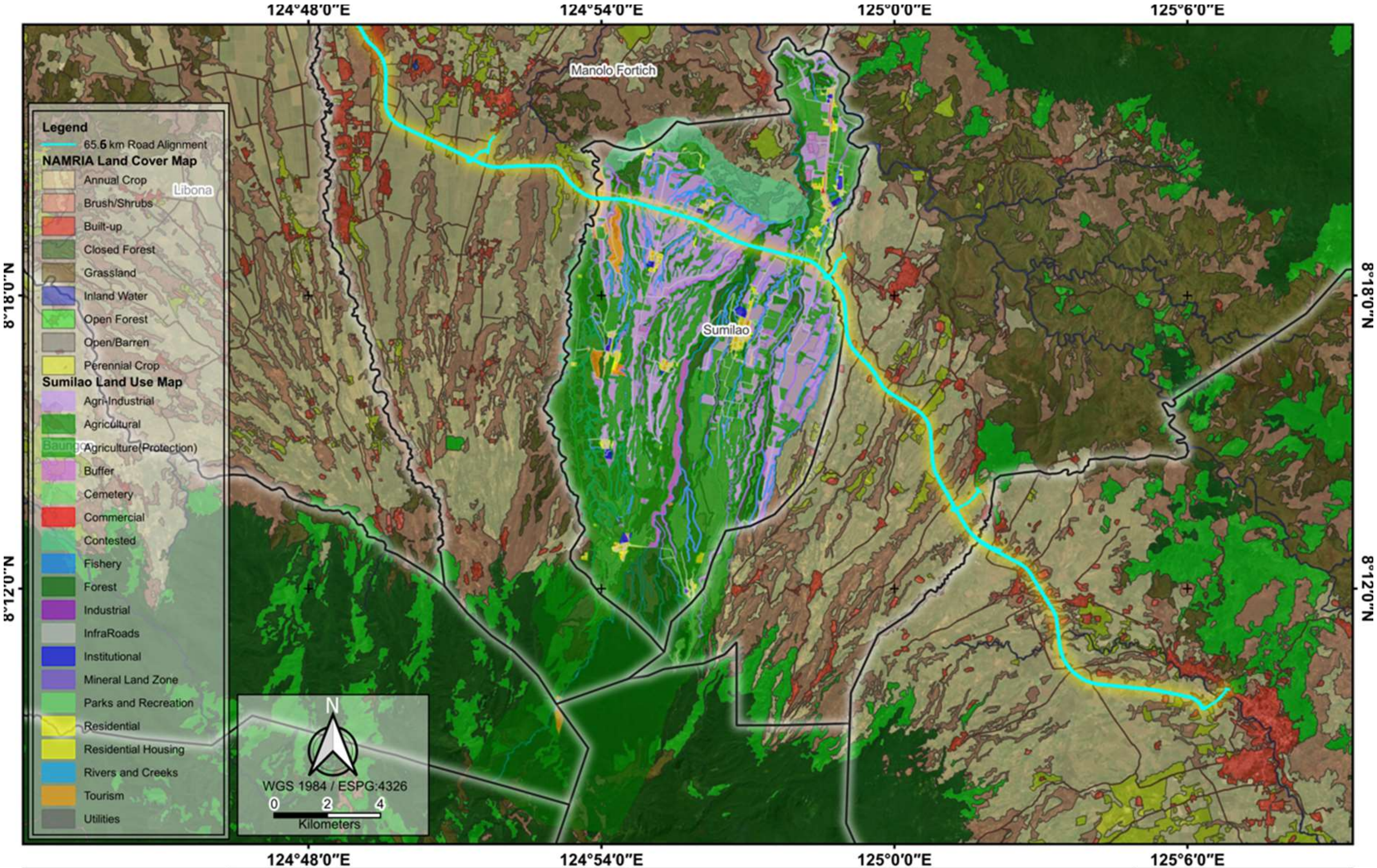


Figure 3-3. Existing Land Use Map of Manolo Fortich



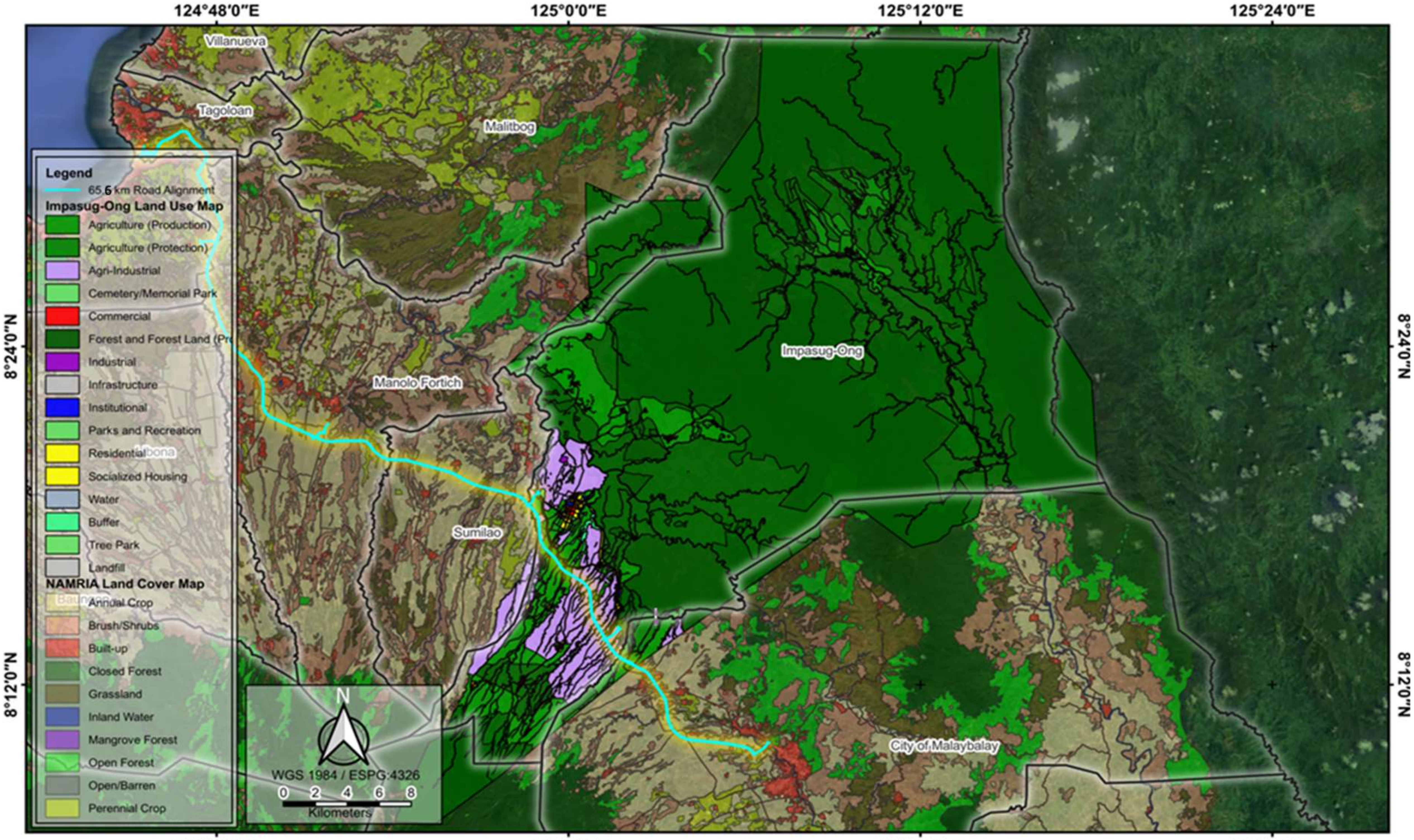
Manolo Fortich Land Use Map (2013) Overlayed in NAMRIA Land Cover Map	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) Manolo Fortich CLUP (2013-2022) NAMRIA 2020 (Land Cover Map)		

Figure 3-4. Existing Land Use Map of Sumilao



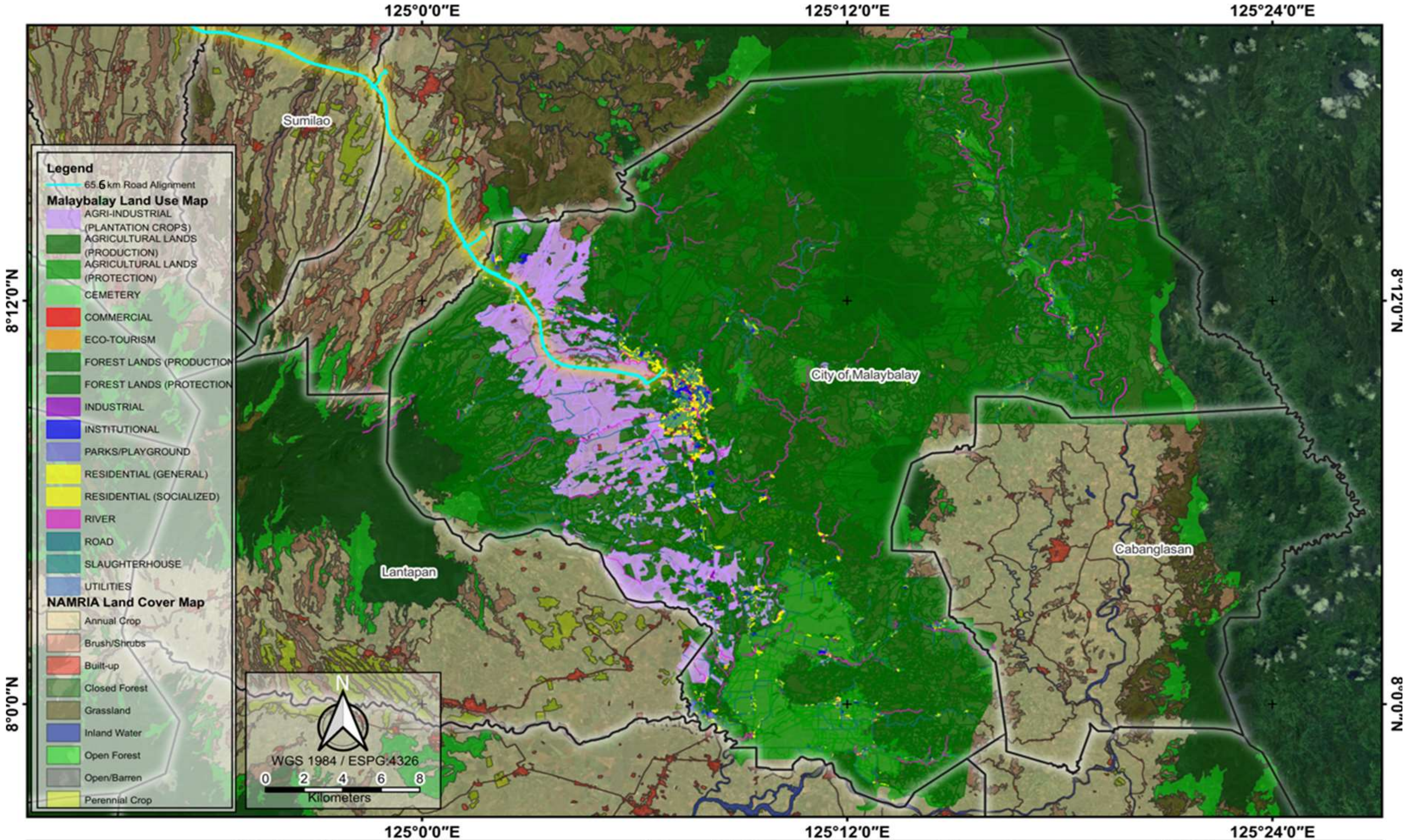
Sumilao Land Use Map (2010) Overlayed in NAMRIA Land Cover Map	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) Sumilao CLUP (2011-2020) NAMRIA 2020 (Land Cover Map)		

Figure 3-5. Existing Land Use Map of Impasug-ong



Impasug-ong Existing Land Use Map Overlayed in NAMRIA Land Cover Map	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) Land Use Map Shapefiles (Local Government) NAMRIA 2020 (Land Cover Map)		

Figure 3-6. Existing land use map of Malaybalay City



Malaybalay Land Use Map (2016) Overlayed in NAMRIA Land Cover Map	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) Malaybalay CLUP (2016-2025) NAMRIA 2020 (Land Cover Map)		

3.1.1.3.2 Compatibility with classification as an Environmentally Critical Area (ECA)

The evaluation of the proposed CMH alignment with ECAs defined in Table 1 of the Revised Guidelines for Coverage Screening and Standardized Requirements (EMB Memorandum Circular 2014-05) is shown in **Table 3-3**.

Table 3-3. Evaluation of the proposed CMH alignment according to ECAs

No.	ECA Category	Within ECA?	Comments
1	All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries	No	The proposed alignment is outside of any Protected Area (**Table 3-4, Table 3-8** and **Figure 3-7**).
2	Areas set aside as aesthetic, potential tourist spots	Possible	The proposed alignment appeared to traverse tourism areas in Sumilao (**Figure** 3-4)
3	Areas which constitute the habitat for any endangered or threatened species of Indigenous Philippine wildlife (Flora and Fauna)	No	The proposed alignment is outside of any Protected Area (**Table 3-4**) and traverses mostly agricultural lands.
4	Areas of unique historic, archeological, geological, or scientific interests	No	The proposed alignment mostly traverses agricultural lands.
5	Areas which are traditionally occupied by cultural communities or tribes	Yes	The proposed alignment will avoid the approved CADTs or CADC (**Table 3-5** and **Figure 3-9**) but will traverse the AD Applied area (**Figure 3-10**)
6	Areas frequently visited arid or hard hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity)	Yes	The proposed alignment traverse areas prone to natural hazards (subsidence hazard, landslide, creep, flood hazard, erosion/ slope failure, ground rupture (***Section 3.1.2.3.3***)
7	Areas with critical slope. All lands with slope of 50% or more classified as geohazard by Mines and Geosciences Bureau (MGB)	Yes	Some portions of the proposed alignment will traverse the critical slopes (**Figure 3-14**).
8	Areas classified as prime agricultural lands	Possible	Most of the alignment traverse the agricultural lands (**Figure 3-1 to Figure 3-6**)
9	Recharge areas of aquifers	No	The proposed alignment mostly traverses the agricultural lands in the lowlands.
10	Water bodies characterized by one or any combination of the following conditions: tapped for domestic purposes, within the controlled and/or protected areas declared by appropriate authorities, which support wildlife and fishery activities	No	The proposed alignment will traverse water bodies (rivers, creeks) that are not tapped as a source of domestic water or within Protected Areas.
11	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth or major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.	No	The proposed alignment is inland and far from the sea.
12	Coral reefs characterized by one or any combination of the following conditions: with 50% and above live coralline cover; spawning and nursery grounds for fish; act as natural	No	The proposed alignment is inland and far from the sea.

No.	ECA Category	Within ECA?	Comments
	breakwater of coastlines		

3.1.1.3.3 Land tenure issues

The proposed CMH alignment will not traverse the protected areas (**Table 3-4** and **Figure 3-7)**. The nearest is the Mt. Kitanglad Range in Baungon, Sumilao, Malaybalay, and Talakag, which is about seven kilometers to the alignment.

Table 3-4. Protected areas in the vicinity of the proposed CMH alignment

Name	Location	Area, ha	Distance*, km	Type
Mahoganao	Cagayan de Oro, Mis. Oriental	139	11.67	Watershed forest reserve
Mt Kitanglad Range	Baungon, Sumilao, Malaybalay, Talakag, Bukidnon	271.01	7.07	National Park
Manupali	Valencia, Talakag, Lantapan, Bukidnon	376.58	14.78	Watershed forest reserve
Proposed Protected Areas				
Mt. Lumot	Gingoog City and Claveria, Misamis Oriental	6,000	~27.77	Watershed forest reserve
Mt Tago	Manolo Fortich and Impasug-ong, Bukidnon	21409	13.36	Natural Park
Mt. Tangkulan	Quezon, San Fernando and Valencia, Bukidnon	23,803	34.31	Watershed forest reserve
Mt. Pantaron	Cabanglasan, Malaybalay and San Fernando, Bukidnon	17,056	26.42	Watershed forest reserve
Mt. Palaopao Hill Cave	Manolo Fortich and Sumilao, Bukidnon	1,482	~2.23	Watershed forest reserve
Mt. Kimangkil Range	Malitbog and Manolo Fortich	13,341	~36.32	Watershed forest reserve

Source: PENRO Bukidnon, *Distance to the project

Two Key Biodiversity Areas (KBAs) (**Table 3-5** and **Figure 3-8)**, which are also defined as the Important Bird and Biodiversity Areas (IBAs) at same area, named as the Mount Tago Range and the Mount Kitanglad, are found near the project area. For the sake of simplicity, this report uses the term KBA when referring to an IBA cum KBA area. The nearest KBA is the Mt. Tago KBA with 950m distance from the Project (green cells in **Table 3-5**). Although declared as an IBA in 2001[1] and KBA, Mt. Tago Mountain Range is not a declared Critical Habitat under RA 7586; however, it listed as a biodiversity conservation priority area (CPA) by the Philippine Biodiversity Conservation Prioritization Process (PBCPP) in 2002, a second iteration of the National Biodiversity Strategy and Action Plan (NBSAP).

Table 3-5. KBA in the vicinity of the proposed CMH alignment

Name	Location	Area, ha	Distance*
Mt. Tago Range KBA	Manolo, Impasug-ong, Malaybalay	83,416	0.95
Mt. Kaluayan - Mt. Kinabalian Complex	Claveria, Gingoog, Misamis Oriental Malatbalay, Malitbog, Impasug-ong, Cabanglasan, Bukidnon Las Nieves, Agusan de Norte Esperanza, San Luis, La Paz, Loreto, Veruela, Agusan del sur	80,000	25.76
Mt. Kitanglad KBA	Manolo Fortich, Sumilao, Malaybalay, Baungon, Lantapan,	31,015	8.14

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[1] http://datazone.birdlife.org/site/factsheet/mount-tago-range-iba-philippines

	Talakag, Bukidnon		

NOTES: KBA - Key Biodiversity Area; IBA - Important Bird and BIodinersity Area
Source: PENRO Bukidnon *to the project in kilometers

The list and location of approved, proposed, and converted CADT and CALT area are shown in **Table 3-7** and **Figure 3-9.** The proposed CMH alignment is not traversing the approved CADTs or CADC. but will traverse the AD Applied area (**Figure 3-8**).
The target barangays of the Indigenous Peoples Plan are Barangay Ticala in the Municipality of Manolo Fortich and the Barangays of Puntian, Vista Villa, San Roque, Kulasi, Poblacion, and Kisolon, all in the Municipality of Sumilao as shown in **Table 3-6**.

On September 18, 2023, the NCIP Region X issued the Certification Precondition (CP) stating that after the conduct of FPIC in accordance with NCIP Administrative Order No. 3, Series of 2012 and CEB Resolution No. 08-083-2021, it is found that the DPWH and JICA have complied with the procedural and documentary requirements of NCIP. The CP was issued after the finalization of Resolution of Consent. Said document is synonymous to the Memorandum of Agreement (MOA) being required by NCIP before they release the CP.

The implementation of FPIC is designated at the barangay level and is not applicable to individual IPs or families. These designated target barangays are not recorded in the Certificate of Non-Overlap (CNO) but have been assigned within the Working Order (WO), except for Barangay Kisolon. Following a subsequent confirmation, Kisolon has been acknowledged as one of the impacted barangays within the Ancestral Domain (AD). Consequently, it is treated as an additional affected barangay, distinct from the six barangays initially listed in the WO.

Table 3-6. Jurisdictions of the Project Alignment and Units within the AD

Province	City/ Municipality	Barangay	Number of IP PAFs	CNO	WO	CP
Misamis Oriental	Cagayan de Oro City	Casinglot	N/A	Issued		
		Natumolan	N/A	Issued		
		Bugo	N/A	Issued		
	Tagoloan	Balubal	N/A	Issued		
		Puerto	N/A	Issued		
Bukidnon	**Manolo Fortich**	Mambatangan	N/A	Issued		
		Alae	N/A	Issued		
		San Miguel	N/A	Issued		
		Damilag	N/A	Issued		
		Diclum	N/A	Issued		
		Tankulan (Poblacion)	N/A	Issued		
		Sankanan	N/A	Issued		
		Ticala (AD Area*)	**6 PAFs**	N/A	**Issued**	**Issued**
	Sumilao	**Puntian (AD Area)**	**N/A**	N/A	**Issued**	**Issued**
		Vista Villa (AD Area)	**N/A**	N/A	**Issued**	**Issued**
		San Roque (AD Area)	**N/A**	N/A	**Issued**	**Issued**
		Kulasi (AD Area)	**N/A**	N/A	**Issued**	**Issued**
		Poblacion (AD Area)	**N/A**	N/A	**Issued**	**Issued**
		Kisolon (AD Area)	**7 PAFs**	N/A	**	**
	Impasug-ong	Poblacion	N/A	Issued		
		La Fortuna	N/A	Issued		
		Capitan Bayong	N/A	Issued		
		Cawayan	N/A	Issued		
		Impalutao	N/A	Issued		

Province	City/ Municipality	Barangay	Number of IP PAFs	CNO	WO	CP
	Malaybalay	Dalwangan	N/A	Issued	**Issued*** **	N/A
		Patpat (Lapu-Lapu)	N/A	Issued		
		Kalasungay	N/A	Issued		

* Names of Seven Barangays in Bold with "AD Area" are located within MPUMUKAD.

**Kisolon is not recorded in the WO, however, it was confirmed by NCIP as the target of FPIC-P (within MPUMUKAD)

*** Dalawangan is falling into another AD with CADT which does not overlap with the project. Therefore, another separated CNO for the project was issued for Dalawangan, 18th September 2023.

Table 3-7. CADT/CALT areas in the vicinity of the proposed CMH alignment

Name	Location	Area (ha)	Distance*	Tribe
	Approved CADT/CALT			
Baleteon AD	Portion of Sitio Baleteon, Brgy. Dalwangan, Malaybalay	467.01	1.04	Bukidnon
Kibuwa AD	Sitio Kibuwa, Impalutao, Impasug-ong	2,954.54	1.76	Higao-non
Tagoloan AD	Sumpong, Can-ayan, Malaybalay	991.71	1.86	Higao-non
Kalasungay AD	Portion of Brgy. Kalasungay, Malaybalay Portion of Patpat, Malaybalay Portion of Sumpong, Malaybalay	4,556	2.39	Bukidnon
Dalwangan AD	Sitios Inhandig, Green Valley and Damitan, Dalwangan, Malaybalay	4,205.57	3.62	Higao-non
Dinlayan AL	Portion of Can-ayan, Malaybalay	258.11	3.67	Higao-non
Kitanglad Alituhon Inalad Man-egay ancestral Domain Claimant (KADIMADC) AD	Portion of San Juan, Sumilao Portion of Sumpong, Malaybalay Portion of La Fortuna, Lupiagan, Kisolon, Sumilao, Portion of Poblacion, Sitio Intavas (Including Kibenton), Impasug-ong	3,251	4.14	Higao-non
Ayoc AD	Guinawahan, Bontongan, Impasug-Ong	1,653.28	6.39	Bukidnon
Bukidnon-Higaonon Tribal Association (BUHITA) AD	Upper Pulangi, Malaybalay	36,626	8.51	Bukidnon-Higaonon
Abunda-Berial AL	Siloo, Malitbog	102.8	17.2	Higao-non
Kalanawan AD	Brgy. Hindangon & Balason, Gingoog Portion of Brgy. San Luis, Malitbog Portion of Guilang-Guilang, Manolo Fortich	20,170	20.4	Higao-non
Hagpa AD	Brgy. Hagpa, Impasug-ong Portion of Brgy. Kalabugao, Impasug-ong	258.11	35.53	Higao-non
	Proposed CADT/CALT			
Libhigad AD	Brgy. Gango, Libona Sitio Bugsok and Piglintian of Poblacion, Libona	4,367.18	6.82	Higao-non
Santiago AD	Santiago, Manolo Fortich	351.52	11.95	Bukidnon
Linsahay-Edubos AL	Sitio Lapinigan & Kalakala, Kiliog, Libona	351.52	12.21	Bukidnon
	CADC to CADT Conversion			
Guilang-guilang AD	Guilang-guilang, Manolo Fortich	19,325	0.6	Bukidnon

Note: Table3-7 shows the recent ADs from NCIP in 2021 while the available figure from NCIP in 2016 swon in Figure 3-9 does not reflect all ADs listed. No available latest GIS/maps.
Source: NCIP Region X, (2021) * distance to the project in kilometers

Table 3-8 shows the DENR land tenures within the vicinity of the Project. The Project alignment may traverse a FLGLA land tenure managed by the Green Acres Agricultural Farm located in Alae, Manolo Fortich which is currently under the provisional agreement with DENR.

- Forest Land Grazing Management Agreement (FLGMA) and Forest Land Grazing Lease Agreement (FLGLA) is a production sharing agreement between a qualified person, association and/or corporation and the government to develop, manage and utilize grazing lands[2].

- Community Based Forest Management Agreement is a production sharing agreement between the Department of Environment Natural Resources and the participating people's organization (POs) for a period of 25 years renewable for another 25 years and shall provide tenurial security and incentives to develop, utilize and manage specific portions of forest lands[3].

- Protected Area Community-Based Resource Management Agreement (PCBRMA) is an agreement entered into by and between the DENR and organized tenured migrant communities or interested indigenous people in protected areas and buffer zones[4].

- Tree Farm Lease Agreement (TFLA) is an agreement between DENR and an organization of which a communal organization may harvest, process, and sell forest products from the area in accordance with a management plan previously submitted to the DENR.

Table 3-8. DENR land tenures in the vicinity of the proposed CMH alignment

Holder's Name	Location	Area, ha	D*, km	Type
Julian Ong	Can-ayan, Malaybalay	203	2.95	FLGLA
Mezi	Damilag, Manolo Fortich	251	4.49	TFLA
Green Acres Agricultural Farm	Alae, Manolo Fortich	255	0	FLGLA
Lunocan Agricultural Development Corp.	Darilig, Manolo Fortich	645	2.45	FLGLA
Romulo T. De Leon	La Fortuna, Impasug-ong	115	4.58	FLGMA
Cosmes Sulogan	Capitan Anghel, Malaybalay	126	4.01	FLGLA
Mantibugao Small Scale Tree Planters Association, Inc.	Bugo and Puerto, CDO and Mambatangan, Manolo Fortich	90.76	0.34	CBFMA
Pulog Hill ISF PKS Farmers Association	Lunocan and San Miguel, Manolo Fortich	256.91	1.51	CBFMA
Diamond Hill Farmers Assn.	Darilig, Manolo Fortich and Vista Villa, Sumilao	153.56	1.56	CBFMA
Sitio Palaopao ISF Farmers Association	Palaopao, Maluko, Manolo Fortich	319.24	1.20	CBFMA
Capitan Bayong ISF Farmers Asso	Capitan Bayong,	140	1.97	CBFMA
Cultural Communities Religious Farmers Assn. Agro Ind. Coop	Habiugan, Dumalaguing, Impasug-ong, Bukidnon	2000	6.20	CBFMA
Dumalaguing Highland Farmers Coop	Dumalaguing, Kalabugao, Impasug-ong	2800	6.60	CBFMA
Gaboc ISF Farmers Assn	Gaboc, Lingion, Manolo	210	4.42	CBFMA

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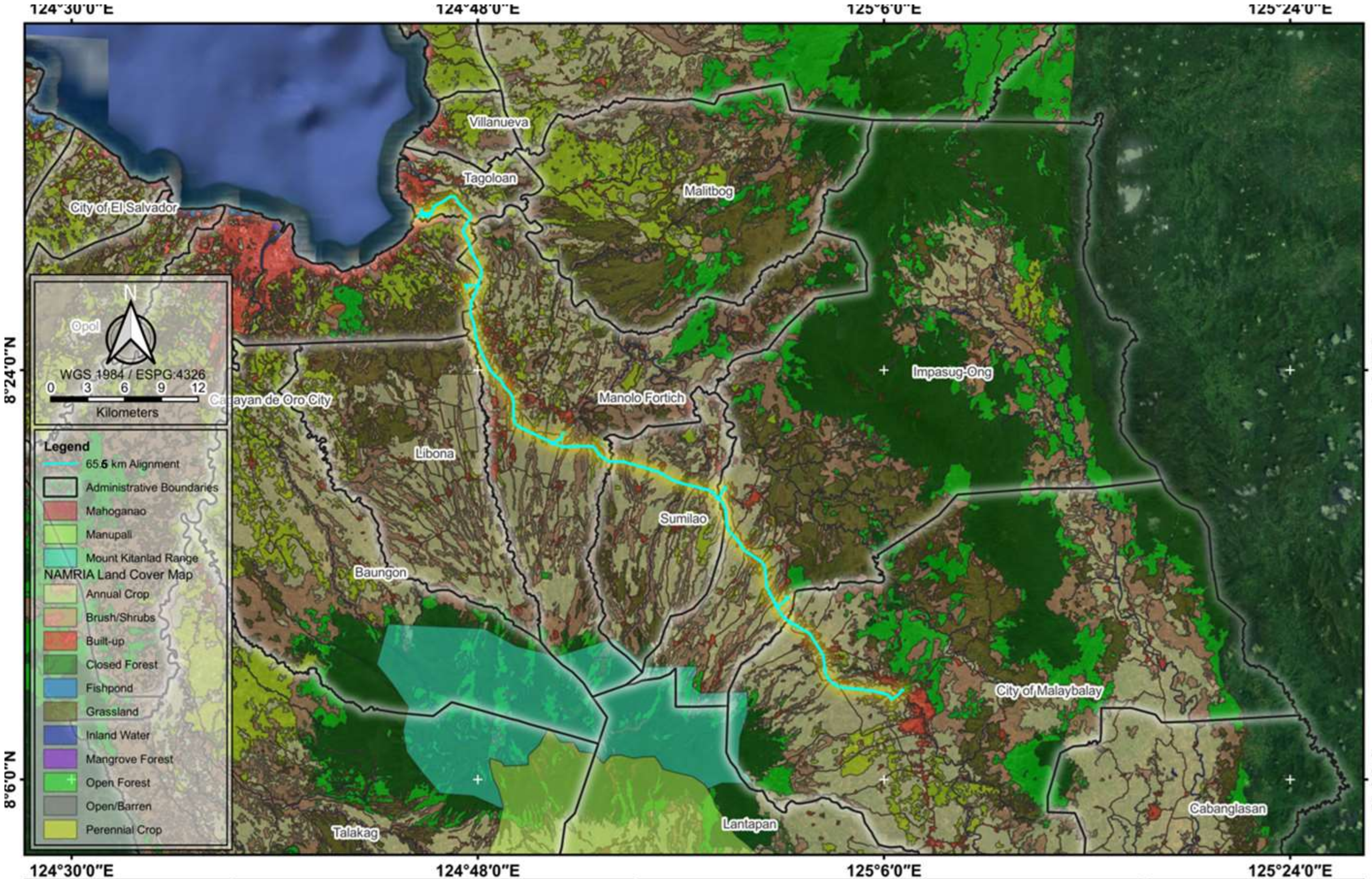
[2] DENR Administrative Order No. 99-36
[3] DENR Administrative Order No. 96-29
[4] DENR Administrative Order N0. 04-32

Holder's Name	Location	Area, ha	D*, km	Type
Sagpang Upland Farmers Asso., Inc.	Maluko, Manolo Fortich	390.6	7.59	CBFMA
Ilignan Forest Dev't. Producers Cooperative, Inc.	Guiehan, Manolo Fortich	2626	9.39	CBFMA
Kibenton Forest Occupants Asso.	Kibenton, Impasug-ong	594.96	5.65	CBFMA
Kibenton United Farmers Association		897.3	0.89	CBFMA
Zigzag Upland Dwellers Association	Maluko, Manolo Fortich	58	6.08	CBFMA

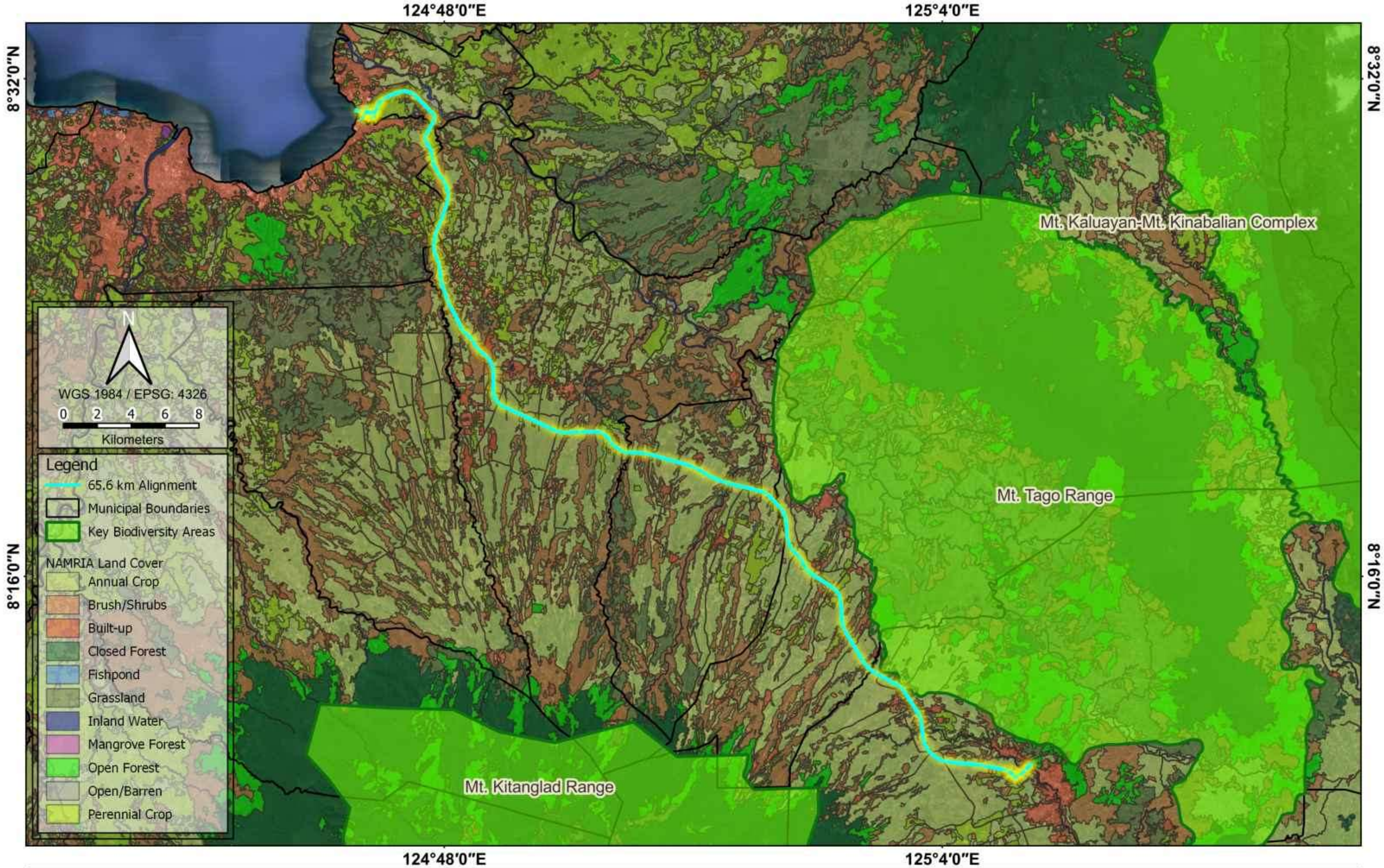
NOTE: CBFMA - Community Based Forest Management Agreement, FLGMA – Forest Land Grazing Management Agreement, FLGLA – Forest Land Grazing Lease Agreement; *to the project in kilometers
Source: CENRO

Figure 3-7. Location of the proposed CMH alignment in relation to protected areas



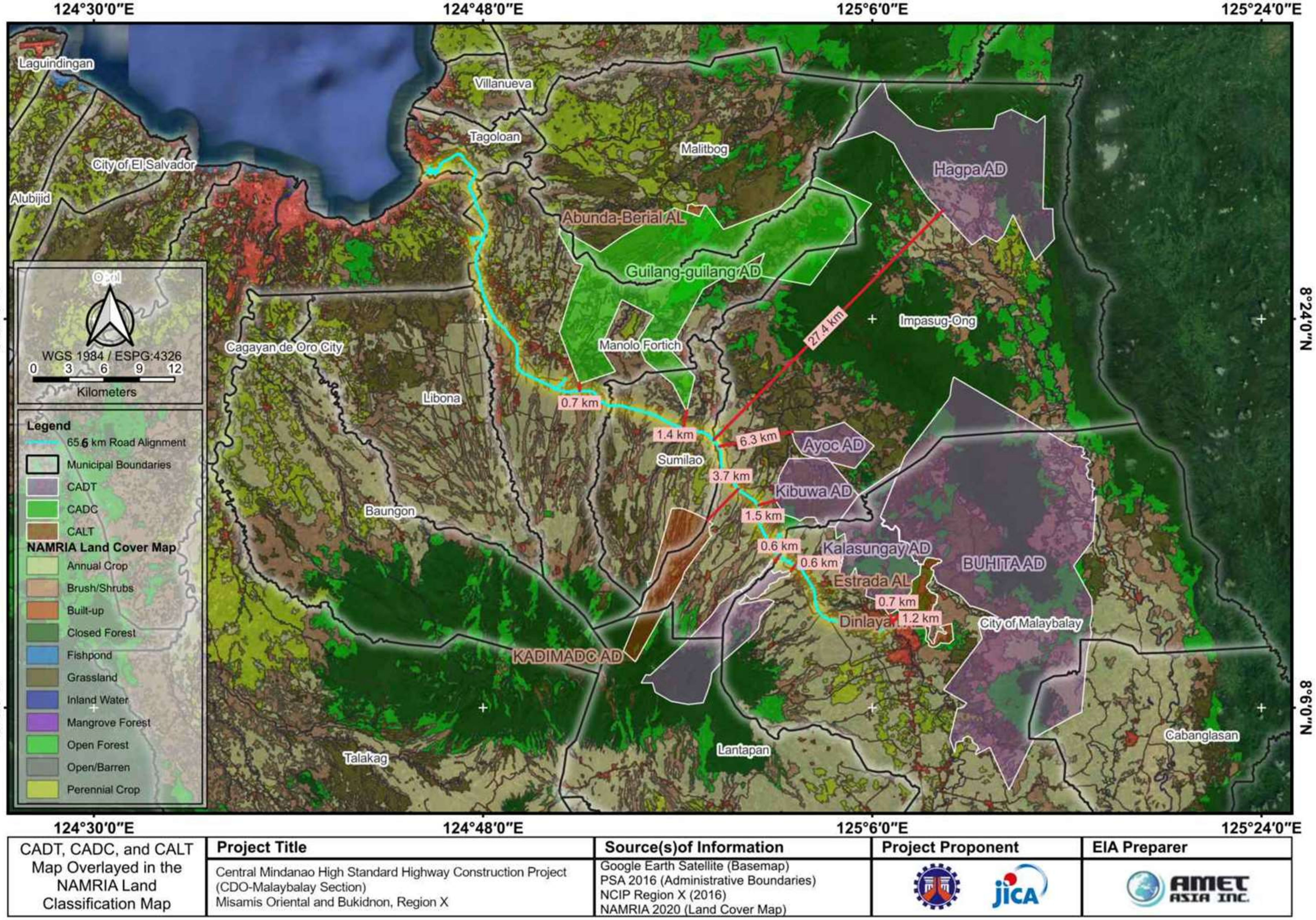
Map of Key Protected Areas with respecet to the CMH Alignment Overlayed in LC Map	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental, Region X	Google Earth Satellite (Basemap) PSA 2016 (Administrative Boundaries) NAMRIA 2020 (Land Cover Map)	JICA	AMET ASIA INC.

Figure 3-8. Location of the proposed CMH alignment in relation to KBA



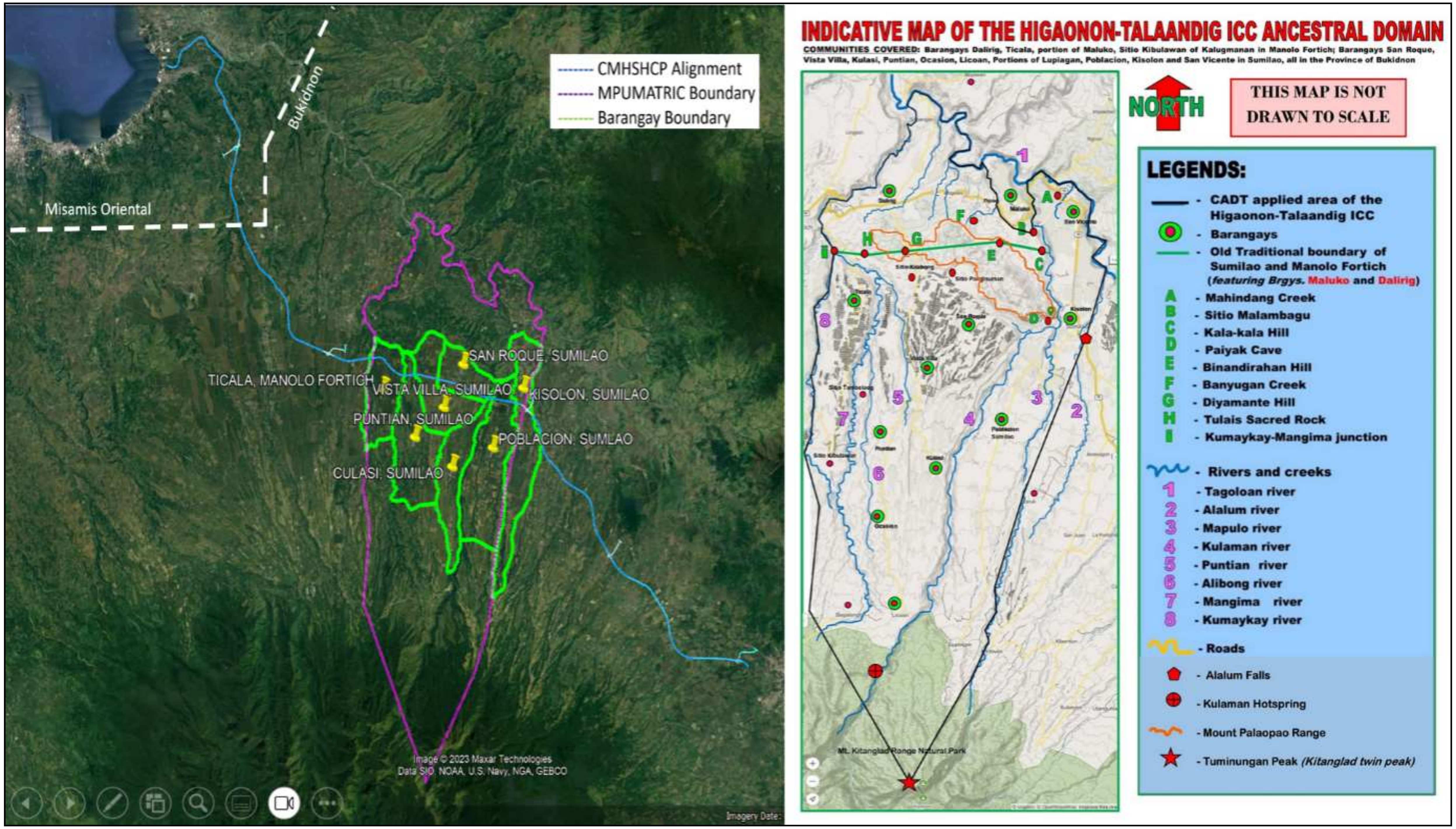
	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
Key Biodeiversity Areas Map	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	PSA 2016 (Administrative Boundaries) DENR (Key Biodiversity Areas)	jica	AMET ASIA INC.

Figure 3-9. Map of ancestral domains showing the proposed CMH alignment



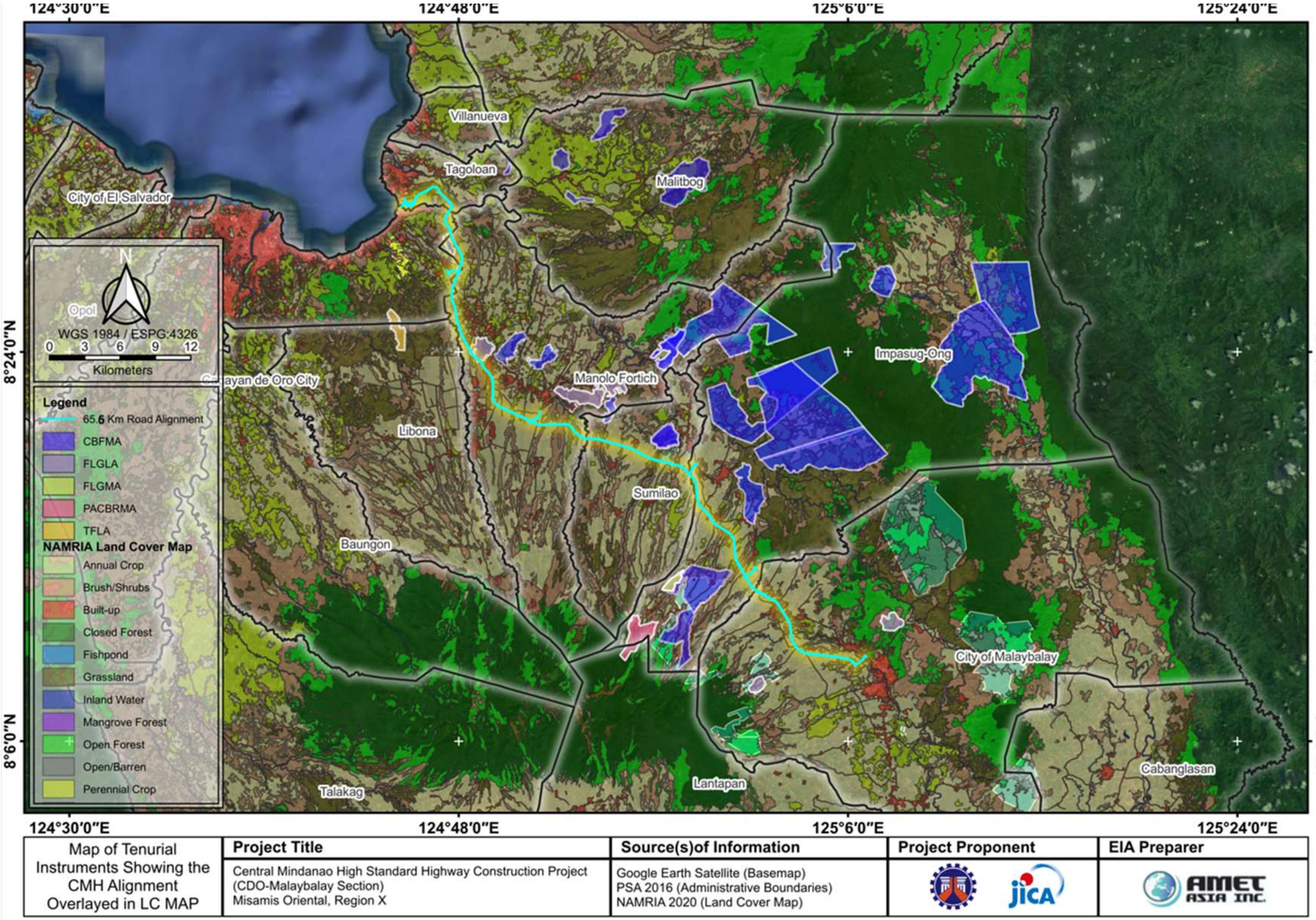
Note: Table3-7 shows the recent ADs from NCIP in 2021 while the available figure from NCIP in 2016 swon in Figure 3-9 does not reflect all ADs listed. No available latest GIS/maps.

Figure 3-10. Indicative Map of the Higaonon- Taalaandig ICC Ancestral Domain Applied Area



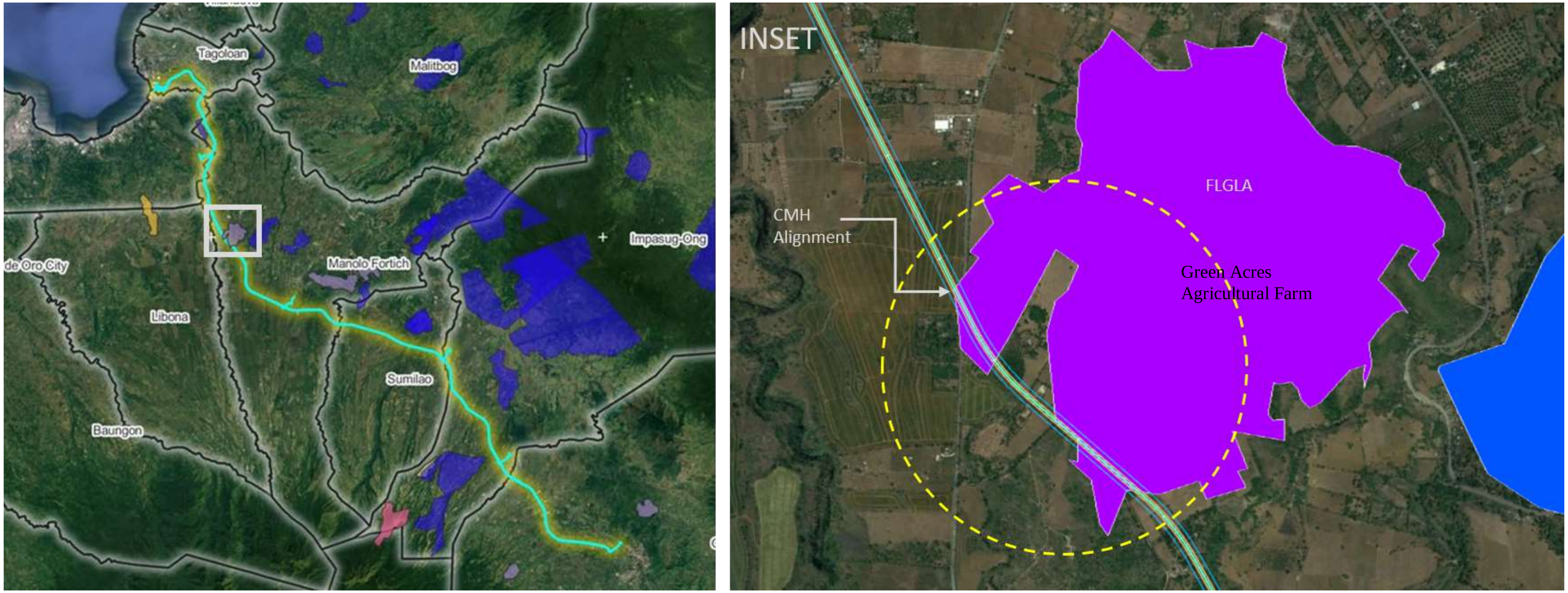
Source: Based on the NCIP Region X data (Right), JICA Study Team prepared

Figure 3-11. Location of the proposed CMH alignment in relation to DENR tenurial instruments



Sources: PSA 2016, NAMRIA 2020.

Figure 3-12. Encroachment of the CMH alignment in the DENR Land Tenure (FLGLA)



Note: Detail location map shows the Green Acres Agricultural Farm mentioned in Table 3-8.
Source: Based on data of City Environment and Natural Resources Office (CENRO) Office DENR Manolo Fortich Bukidnon

3.1.1.3.4 Impairment of visual aesthetics

Visual quality is a measure of the attractiveness of a place that includes the landscape, the architectural features, and historic sites. These are evaluated by three criteria of unity, variety, and vividness (Litton et al., 1974) and provide a basis for determining the visual quality of an object or a combination of objects.

Visual sensitivity describes the ability of a natural or man-made landscape to absorb visual change and is a measure of how readily an area's appearance is affected by the introduction of something new. Areas of low visual sensitivity can easily absorb change, i.e., much alteration would be required to affect overall appearance. Conversely, areas of high visual sensitivity are markedly susceptible to changes in their visual aspects. Visual sensitivity was determined by mapping land use, homogeneity, and topography.

The evaluation of visual quality pertains to the degree and nature of contrast between the proposed Project and its surroundings. The existing visual quality at the Project area is compared to the expected appearance of the site to determine whether the visual character of the area would be degraded. Factors such as changes in the appearance of the Project site from structure configuration, massing, setbacks, landscape buffers and other features are taken into account. The evaluation further considers whether the Project would enhance aesthetic conditions through the creation of new resources and whether the Project includes design features that would offset or mitigate specific impacts.

The Project will be an additional view of development, whether or not visual aesthetics of the area is impaired is subjective to the viewer. Major new visible objects brought about by the Project are the road and its appurtenances, e.g., guardrails, curbs, toll booths, etc., interchanges, under- and overpasses, bridges, RROW fence, and vegetated buffer zones. However, Project objects which will be likely seen by the populace are those located near residential areas. Most of the road and its components will be visible only to motorists using it.

Impairment of visual aesthetics is seen an insignificant in the long term because people will get use to visible Project structures in addition to vegetated buffer zones and other landscaping within the RROW.

3.1.1.3.5 Devaluation of land value because of improper SWM and other related impacts

The six LGUs traversed by the proposed CMH alignment have solid waste management (SWM) systems required by RA 9003. Important components of the SWM system in the LGUs are the presence of Material Recovery Facilities (MRF), collection, and final disposal. A description of the SWM in the host LGUs is briefly described below.

1. Cagayan de Oro City - The 25-hectare City Sanitary Landfill opened in 2017 in Barangay Pagalungan about 12 kilometers from the city proper was the first in the city.

2. Tagoloan - The municipality temporarily established a Residual Containment Area (RCA) while in the process finalizing its sanitary landfill. The LGU has also an eco-SWM park in Barangay Santa Ana where municipal solid waste is sorted and processed.

3. Manolo Fortich - The municipal government is currently operating a five-hectare Controlled Dump Facility (CDF) at Barangay Alae. About 60 percent of the barangays have MRF. Major industries are required to manage their own waste because the conversion of municipal CDF to a Sanitary Landfill will only accommodate household waste.

4. Sumilao - Solid waste management in the urban barangays is handled by the Ecological Solid Waste Management Coordinator. Households and commercial establishments practice segregation of SW at source and hauled and temporarily disposed in a one-hectare dump site in Barangay San Vicente.

5. Impasug-ong – The municipality has a controlled dump site located in Barangay Capitan Bayong with an area of two hectares.

6. Malaybalay City - The City government uses a controlled disposal facility in Barangay Can-ayan for the final disposal of the collected waste. Biodegradables wastes is processed as organic fertilizer through Bioreactor and *vermi* composting. Non-biodegradable wastes are disposed in the City MRF for segregation and sorting with residual wastes are finally disposed in the final disposal area.

Solid wastes generation during construction and operation is expected. The initial estimate of municipal solid waste generation based on the maximum number of personnel during construction and the average generation rate of 0.4 kg/cap/day[5] is 19.2 MT/day. These non-hazardous wastes generally consist of paper, metals, glass, plastics, and food wastes.

Devaluation of land due to improper SW management however is unlikely because of the existing solid waste collection system of the host municipalities and the waste management plans that will be implemented during the construction and operation phases by the DPWH, construction contractor, and toll operator.

3.1.1.4 Mitigating measures

The recommended measures to minimize or address incompatibility with existing land uses, compatibility with classification as an Environmentally Critical Area (ECA), land tenure issues, devaluation of land value because of improper SWM and other related impacts are enumerated below. Impairment of visual aesthetics is not expected to have a significant impact.

Pre-construction

a) Reclassification of Project RROW to the appropriate land use category of the host LGU;
b) Conduct parcellary survey and proper compensation of affected property owners;
c) Consider the presence of ECAs in the detailed engineering design (DED); and
d) Formulate a Construction Waste Management Plan (CWMP) and Operation Waste Management Plan (CWMP).
e) Formulation of Buffer Zone Plan (BZP) during construction and operations.

Construction

a) Proper implementation of Construction Waste Management Plan (CWMP) and Operation Waste Management Plan (CWMP).
b) Construction activities that necessitate utilizing portion of the road/street should be undertaken upon permission by the LGU Traffic management team and outside of traffic rush hours. Construction activities should not be a hindrance to the operations in neighboring area.
c) Proper implementation of buffer zone area.
d) Maintain the construction site/ yards tidy and clean and rehabilitate after construction.
e) Temporary stockpiles of excavated materials from foundation works must be properly covered and regularly hauled to DENR approved disposal sites.
f) Litter and other types of domestic garbage from construction sites and camps must be properly kept in trash bins and regularly disposed through LGU garbage collectors.

Operation

a) Regular maintenance of highway to reduce visual impact due to expected wear and tear.
b) Implementation of best housekeeping practices.

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[5] National Solid Waste Management Status Report (2008-2018), EMB-DENR

3.1.2 Geology/Geomorphology

3.1.2.1 Scope

This module described the existing geological conditions traversed by the alignment with focus on a) general geological and geomorphologic setting, b) regional seismicity, geology and structural setting, c) site geological setting, and d) possible geologic hazards that may affect the Project or may be induced by the development.

The key impacts assessed were changes in surface landform and sub-surface geology and inducement of geo-hazards, e.g., subsidence, liquefaction, landslides, mud or debris flow.

3.1.2.2 Methodology

The existing geological and geomorphological conditions traversed by the CMH alignment was described using primary (geological profiling and factual field geological mapping) and available secondary data, maps, and literature. The impact assessment was qualitative and guided by the MGB Memorandum Circular No. 2000-33 and DENR A.O. No. 2000-28. The existing conditions were integrated in the assessment of the key impacts previously mentioned. The geological conditions at the observation points, field logs summary of the road alignment, and road alignment profiles are attached in **Appendices 3** to **5**.

3.1.2.3 Assessment of key impacts

3.1.2.3.1 Change in surface landform and geomorphology

The composite topographic and slope maps showing the proposed alignment and existing Sayre Highway are shown in **Figure 3-13** and **Figure 3-14**, respectively. Photographs of the geological observation points are in **Appendix 3**. The general morphology and slopes along the CMH alignment from Cagayan de Oro to Malaybalay are defined by the following:

a) **Cagayan de Oro to Tagoloan** - Generally characterized by broadly undulating to flattish on top of rolling terrain with intermittent steep river valleys. Elevation varies from low (<20m) to ≤150m before the break-of-slope towards the south. Slope gradient varies from 10° to 30°.

b) **Manolo Fortich** - Elevation ranges from 320 to 650m. Slope gradient mostly from 10° to 30° with steep slopes of 50° to 70° across the existing river channels. Morphology is broadly undulating to flattish with ravines and steep riverbanks.

c) **Sumilao** - Elevation ranges from 550 to 850m. Slope gradient mostly from 10° to 30° with numerous creek channels having 30° slopes and steep slopes of 50° to 70° across the existing major river channels. Morphology is undulating to rolling with ravines and steep riverbanks.

d) **Impasug-ong** - Elevation ranges from 580 to 700m. Slope gradient mostly from 10° to 30° with numerous creek channels having 30° slopes. Terrain with steep slopes of 50° to 70° are found across the existing major river channels. Morphology is undulating to rolling with ravines and steep riverbanks.

e) **Malaybalay** - Elevation ranged from 750 to 950m. Slope gradient mostly from 10° to 30° with numerous creek channels having 30° slopes. Terrain with steep slopes of 50° to 70° are found across the existing major river channels. Morphology is broadly undulating to rolling with ravines and steep riverbanks.

The proposed CMH alignment will traverse areas underlain by the Cagayan Gravel in the northeast and the Bukidnon Formation consisting of moderate to thick beds of the tuffaceous sandstone/conglomerate/shale with localized andesitic volcaniclastics towards the south to Malaybalay.

The Project traversing Cagayan de Oro, Tagoloan, Manolo Fortich, Sumilao, Impasug-on and Malaybalay is expected to induce significant changes in the surface landform, topography, and slope. The road development involves rock excavations that will expose poorly consolidated gravel/sandstone/shale at the northeastern section and the dominantly poorly indurated pebbly to conglomeratic tuffaceous sandstone of the Bukidnon formation towards the south. Voluminous materials during the construction will be disturbed and loose materials stockpiled.

Inclement weather conditions will induce downslope movement of rocks and regolith particularly on exposed and barren surfaces along the stretch of the proposed road alignment. Excavated areas with steep rock walls will be prone to mass-wasting processes such as rockfall, rockslide, erosion, slope failure and localized landslides. In addition, unconsolidated sediments will be prone to rill erosion by concentrated but intermittent flow of water usually during and immediately following moderate to heavy rains. Concomitant to this will be the sedimentation of the adjacent water channels that may induce flooding at the lower ground.

Figure 3-13. Composite topographic map showing proposed road alignment and existing highway with observation points

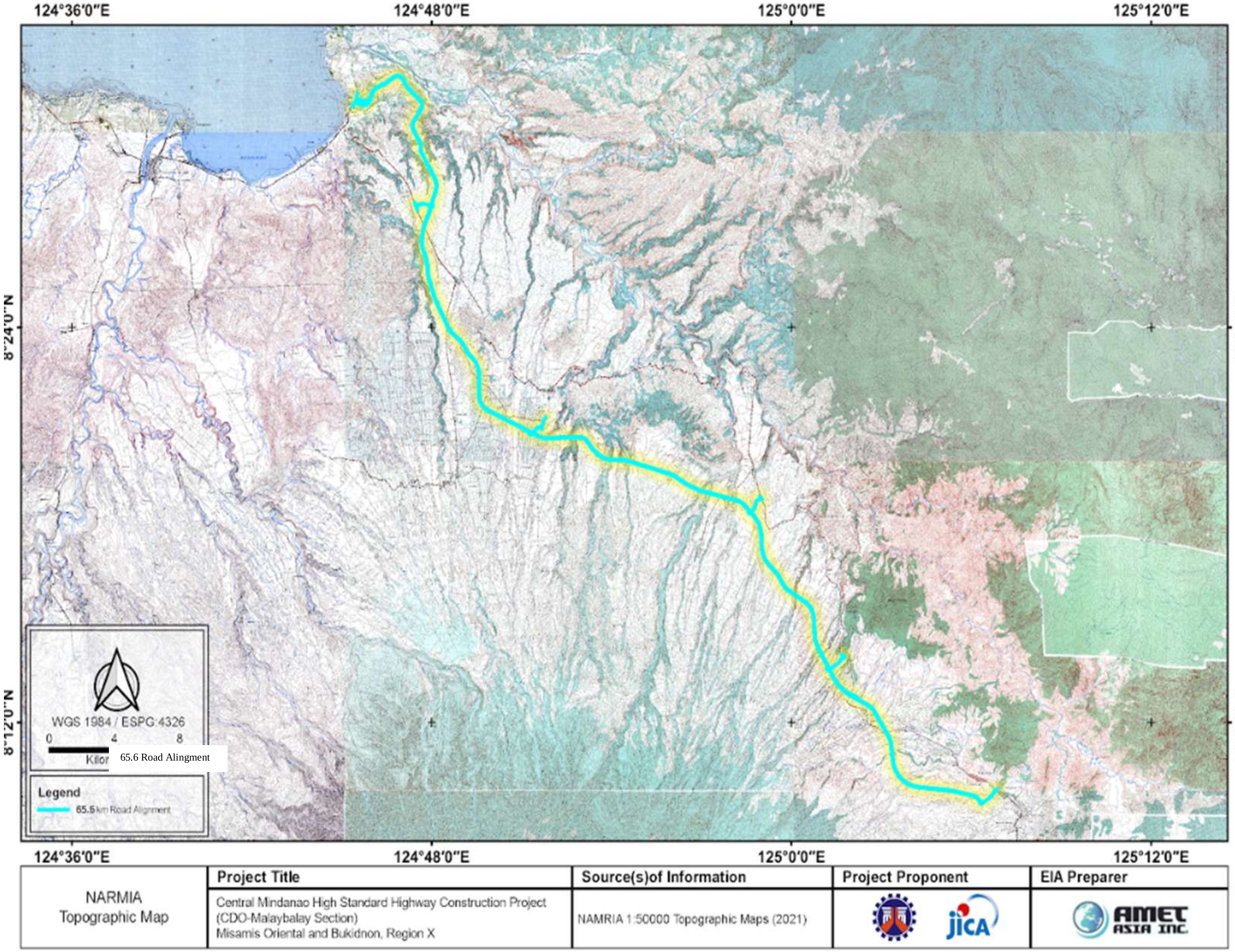
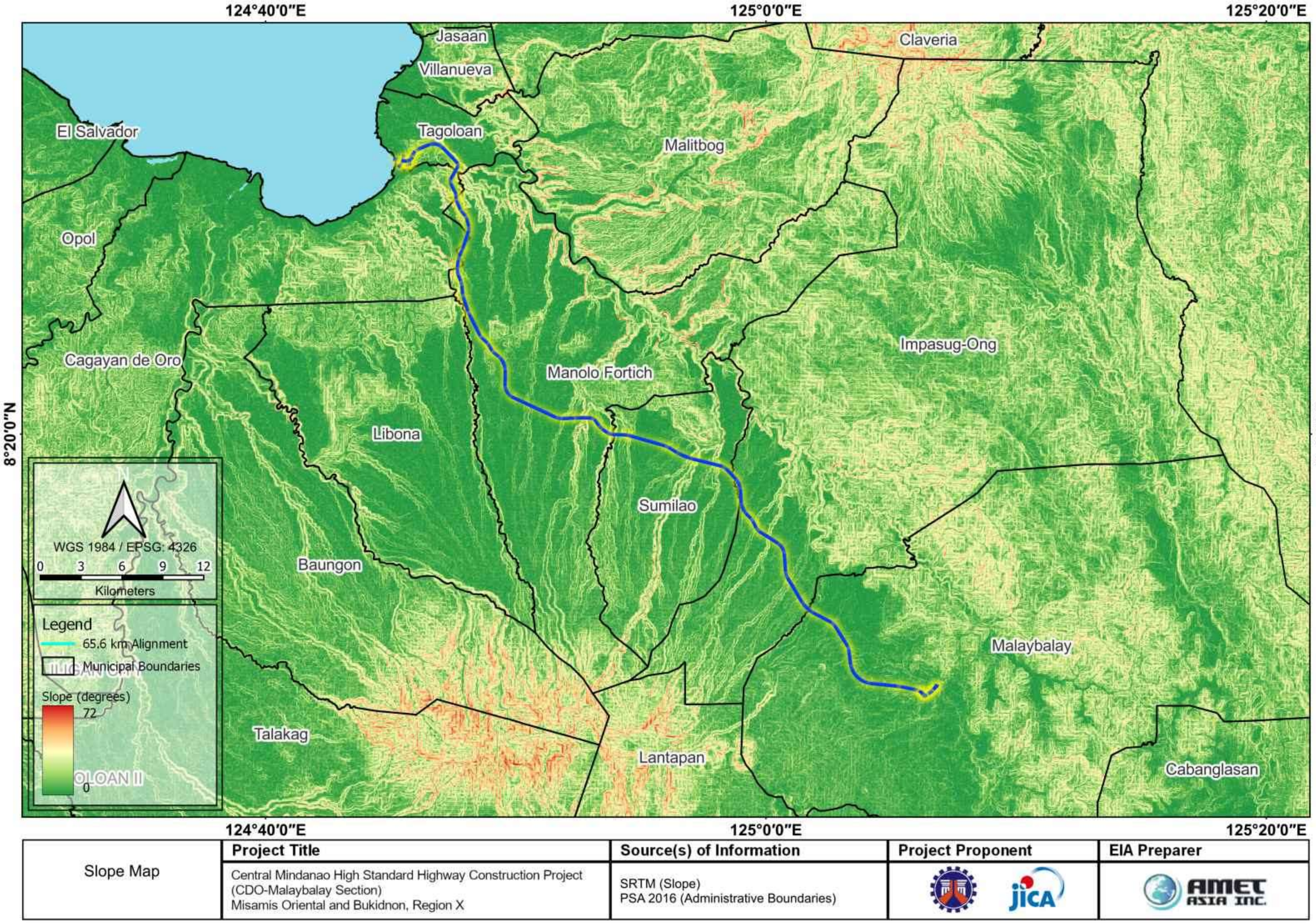


Figure 3-14. Slope map of the Project alignment



3.1.2.3.2 Change in sub-surface geology and underground conditions

Regional geological setting

Tectonic setting - The Philippine Islands are within a complex and rapidly deforming area between the two opposing subduction zones: the Philippine Trench subduction zone on the east and the Manila Trench to the west (**Figure 3-15**)[6]. The 1,200-km-long Philippine fault zone (PFZ) is a major tectonic feature that transects the whole Philippine archipelago from northwestern Luzon to southeastern Mindanao[7.] It is divided into several segments and has been the source of large-magnitude earthquakes in recent years[8]. The Philippine Fault runs on a NW–SE direction offshore on the western half of Ragay Gulf.

In the southern Philippines, the Island of Mindanao is defined by the Philippine Trench to the east, the Cotabato Trench to the southwest, and the Sulu-Negros Trench-arc system to the northwest.

Stratigraphy - The general stratigraphy and regional geological map covering the proposed RROW from Cagayan De Oro to Malaybalay is shown in **Figure 3-16** and **Figure 3-17** respectively. Five (5) rock formations characterized the stretch of the proposed RROW: The Pleistocene Cagayan Terrace Gravel, Late Pliocene to Pleistocene Bukidnon Formation, Early Pliocene Indahag Formation, the Cretaceous Awang Ultramafic Complex, and the pre-Cretaceous Tago Schist, in the order of increasing age. The description of the rock formations is summarized in **Table 3-9**.

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[6] Wong, et.al., Evaluating the Seismic Hazards in Metro Manila, 2006

[7] H. Tsutsumi, et.al, Timing of Surface-Rupturing Earthquakes on the Philippine Fault Zone in Central Luzon Island, Philippines

[8] PHIVOLCS, Large-scale digital mapping of the Philippine fault zone based on aerial photograph interpretation, July 2000

Figure 3-15. Regional tectonic setting in the southern portion of the Philippines

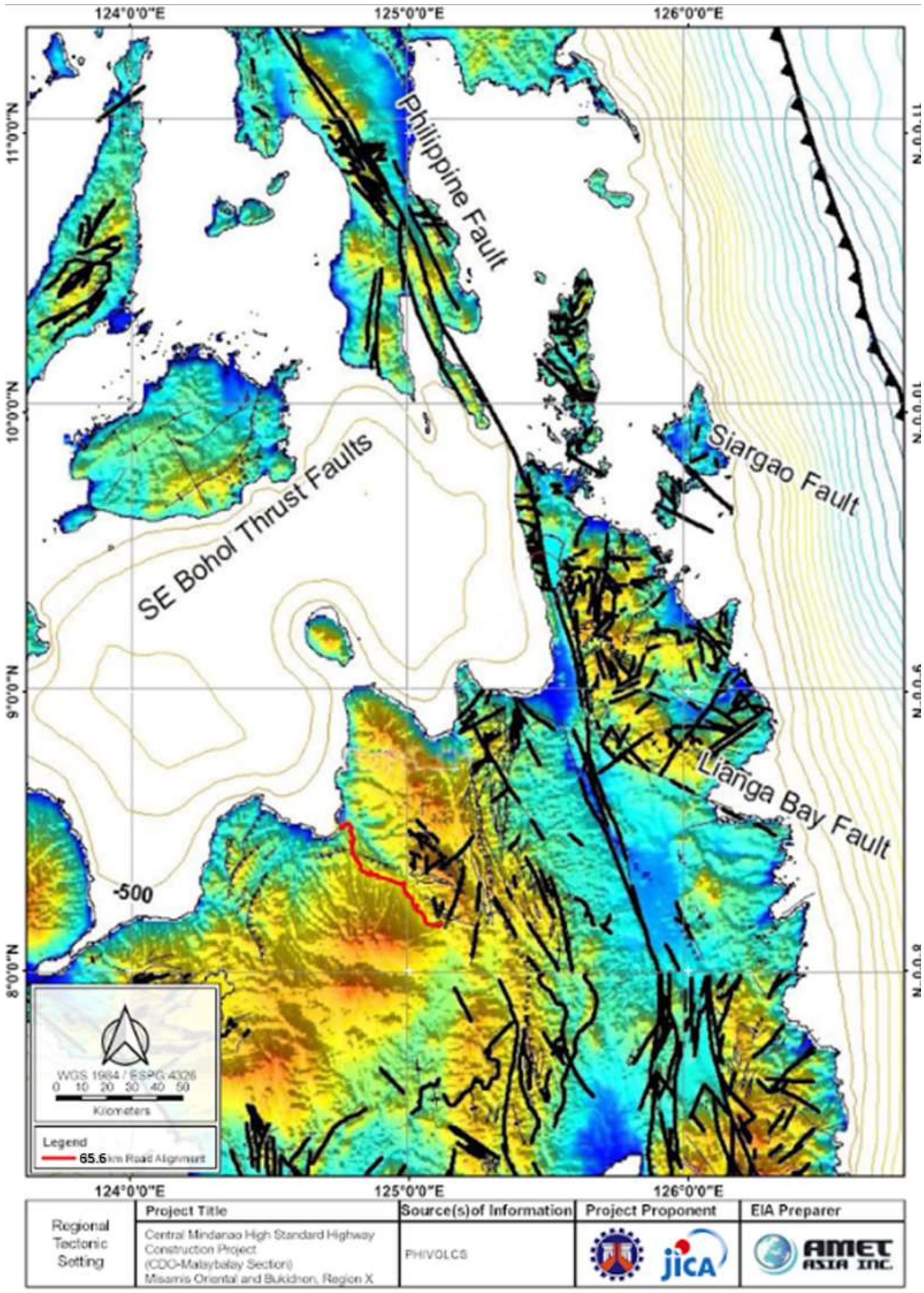
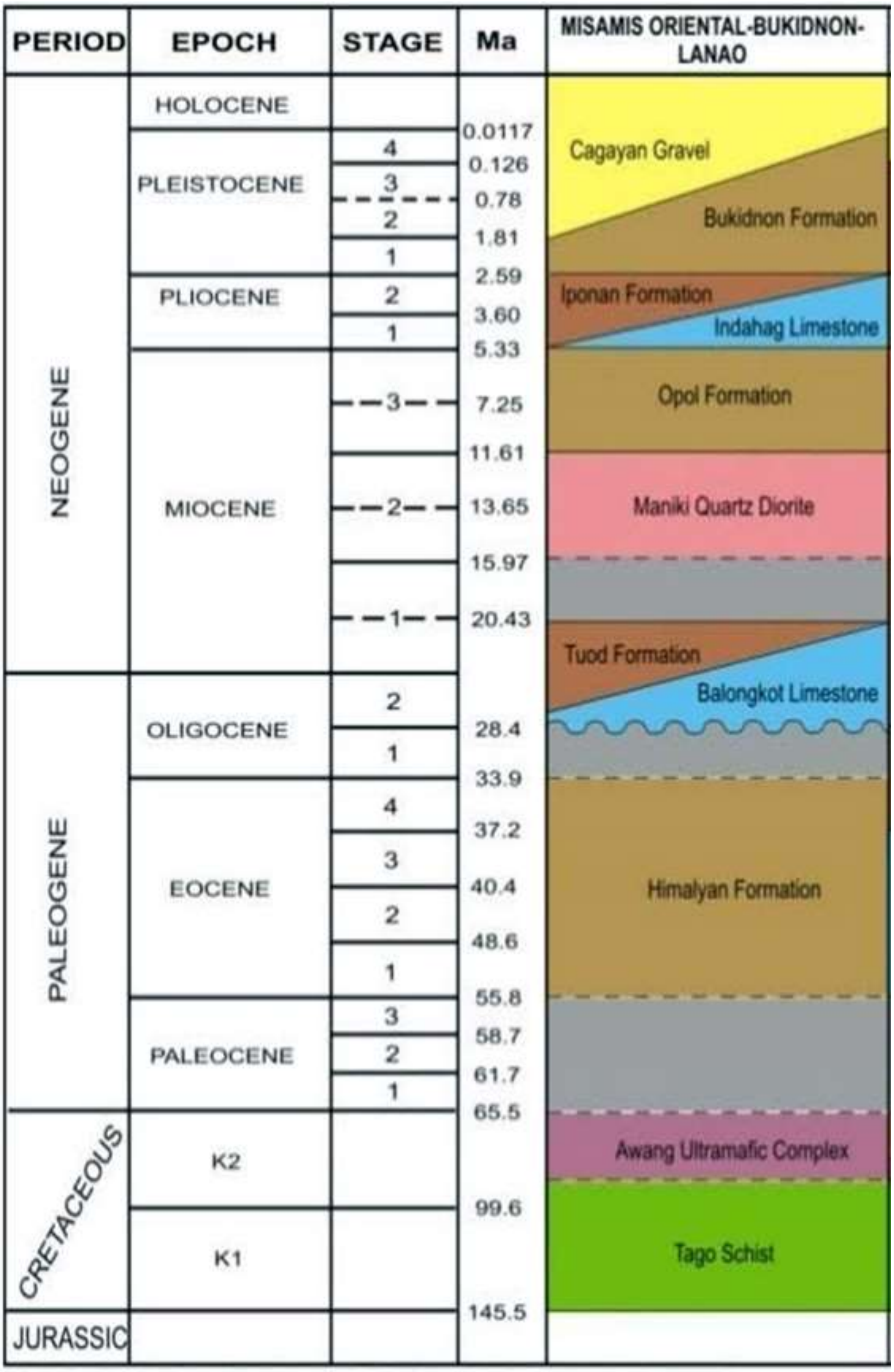


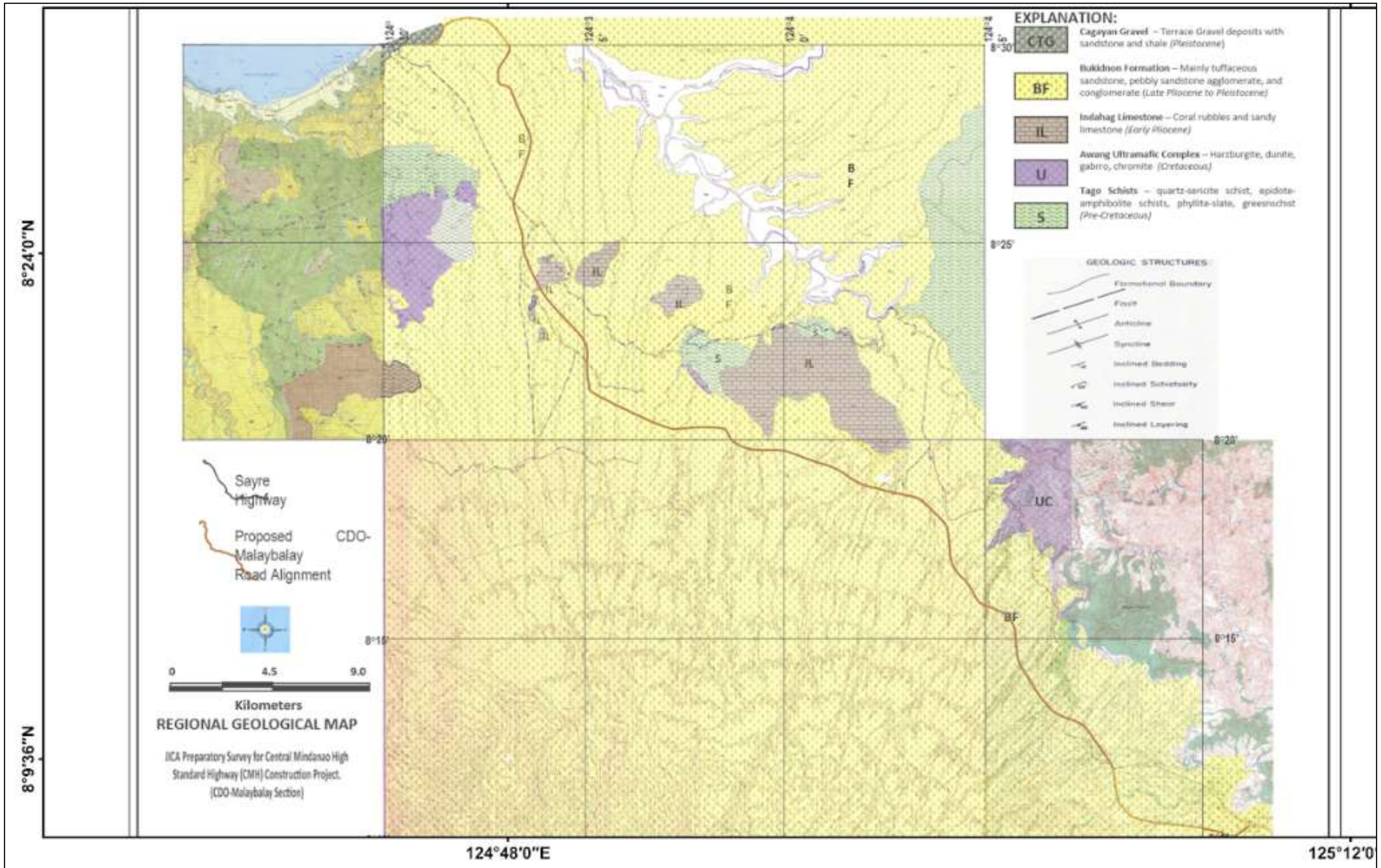
Figure 3-16. Generalized stratigraphy of Misamis Oriental-Bukidnon-Lanao



Geologic Time Scale adopted from International Commission on Stratigraphy (2009)

Source: Geology of the Philippines, 2nd Ed., 2010

Figure 3-17. Regional geologic map showing the proposed Project



Geologic Map	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) PSA 2016 (Administrative Boundaries)		

Table 3-9. Description of rock formations at the proposed alignment

Rock formation	Description
Tago Schist (Cretaceous)[9]	The oldest rock in the region which is composed of the garnetiferous quartz-sericite-epidote-amphibolite, greenschists, phyllite and slate. The rocks are distributed in Mt. Tago, Mangima Canyon, Sayre Highway between Manolo Fortich and Damay, Alae-Damilag area and vicinity of Mt Tagiptip in Bukidnon. Barangays Cugman, Balubal and Pigsag-an, Umalag Creek, Cagayan and Bobonawan Rivers in Misamis Oriental. The largest exposure in Bukidnon underlies the western slope of Mt. Tago, bounded by Amusig and Tagaloan Rivers on the northwest and southwest, respectively. In Misamis Oriental, the schist is extensively exposed along an east-west trending belt from Malasag in Brgy. Cugman to the upper reaches of Agusan River in Brgy. Balubal, Cagayan de Oro City. Other large exposures are to be found within the vicinity of Brgy. Pigsag-an, Cagayan de Oro City and the upper reaches of Cugman River. Smaller isolated bodies occur as erosional windows along Umalag Creek and Cagayan and Bobonawan rivers in Misamis Oriental and along Sayre Highway between Manolo Fortich and Damay, Mangima Canyon, and the western portion of Alae-Damilag area in the vicinity of Mt. Tagiptip in the province of Bukidnon. Most of the schists, which are intensely folded, are in fault contact with ultramafic rocks. The garnetiferous quartz-sericite schist is fine-to medium-grained and contains sericite, quartz, plagioclase and garnet. The epidote-amphibolite schist is closely associated with the garnetiferous quartz-sericite schist.
Awang Ultramafic Complex (Cretaceous)[10]	– consists of serpentinite, dunite, peridotite which is in fault contact with the Magina Schist and unconformably underlies the Himalyan Formation. This complex occurs as three (3) large bodies in the Caballero Range within the vicinity of Lourdes, southeast of Opol and between Bigaan and Agusan rivers. Serpentinites make up the largest portion of the Cretaceous ultramafic rocks. In the vicinity of Cagayan de Oro City, the rocks are lenticular bodies within a northeast trending fault zone. The serpentinite is usually highly sheared, locally schistose and contorted. It varies from dark to bluish green; when mylonitized, it is grayish, reddish or light greenish. It consists mainly of serpentine and chlorite with minor amounts of actinolite and talc. Along Iponan River, an elongated body of serpentinized peridotite is medium to coarse-grained, olive green to gray when fresh and reddish brown when weathered. It exhibits a shiny luster and has a soapy feel. Protoliths of the serpentinite are mainly harzburgite and dunite with minor pyroxenite. Fine- to medium-grained dunite usually occurs as small lenses interlayered in places with chromite. It is dense and dark when fresh and yellowish brown or dirty white when weathered.
Indahag Limestone (Pliocene)[11]	– consists of massive to well-bedded, dull white to brown and red, and coralline limestone with interbeds of conglomerate, tuffaceous sandstone and shale. The rocks are distributed in Indahag, Cagayan de Oro City; Lumbia; Opol; Lugait near Iligan City; Cagayan River, Brgy. Alae, Cagayan de Oro. Exposures can also be found along the seashore from Opol westward to Lugait near Iligan City; along Cagayan River and southeast of Barangay Alae, Cagayan de Oro City. Minor interbeds of clastic rocks include conglomerate, tuffaceous sandstone and shale. Three distinct horizons are recognizable along the banks of Cagayan River, where the outcrops are thickest. Pacis (1966) noted that the lowest horizon of the section along Cagayan River is largely coralline limestone with

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[9] Geology of the Philippines, 2nd Ed. 2010, pp 398-399
[10] Geology of the Philippines, 2nd Ed. 2010, pp. 399-400
[11] Ibid, p. 403

Rock formation	Description
	calcisiltites, calcarenites and calcirudites. The middle section consists of limestone rubble and coral fingers. Intercalated layers of coralline limestone, calcarenite and limy tuff comprise the upper horizon. Projected thickness of the Indahag limestone ranges from 250 to 300m.
Bukidnon Formation (Pleistocene)	– consists of agglomerate, tuffaceous pebbly sandstone and conglomerate. Exposures are well observed in the area east of Cagayan River. The conglomerate is poorly sorted with pebble- to boulder-sized clasts of volcanic rocks, schists and serpentinite. The thickness of this formation is estimated at 800 m
Cagayan Gravel (Pleistocene – Holocene)	– consists of intercalated gravel deposits, with interbeds of tuffaceous sandstone and shale largely distributed in found along the National Road in Cagayan de Oro City to Indahag road; from Bugo to Alae; and on the west bank of Cagayan River just before the airport. The slightly consolidated and poorly sorted gravel is composed of rounded to sub-rounded pebble- to boulder-sized igneous and metamorphic rocks. The shales and tuffaceous sandstones are slightly compacted. Thickness is estimated at 100 m.

Structures - Two main fault systems (Philippine Fault and Mindanao Fault) and hundreds of fault splays and lineaments transect the region. The Diwata Range lies within the southern part of the Philippine between two major tectonic structures that influence the geologic evolution of the Philippine Archipelago: the NNW-SSE trending Philippine Fault Zone demarcating the western flank of the eastern Mindanao ridge and the Philippine trench located about 75 km east offshore of the Mindanao coastline (**Figure 3-18**).

Bukidnon is part of the seismically active region of Northern Mindanao (Region X) because of the presence of several active faults in the area which include the Central Mindanao Fault, Linugos River Fault, Cabanglasan Fault, Tagoloan River Fault, Lanao Fault System and segments of the Mindanao Fault.

Site geological setting

The geology of the individual host LGUs are presented in the succeeding paragraphs. The reader is referred to **Appendix 3** and **Appendix** 4 for the factual geological mapping and field logs of the sections traversed by the proposed Project.

Cagayan de Oro - The northeast area of the city traversed by the proposed Project was basically underlain by the Cagayan Gravel (CTG) consisting of gravel deposits with interbeds of tuffaceous sandstone and shale. Good exposures can be observed along the northern end of the Alae Bypass Road. Towards the south, the observable rock types consisted of agglomerate, tuffaceous pebbly sandstone and poorly sorted polymictic conglomerate of the Bukidnon Formation (BF). Exposures were well observed along the Alae Bypass Road and along the Sayre Highway.

Manolo Fortich - Most of the rocks observed along the Sayre Highway including the southern section of the Alae Bypass Road and the proposed alignment were the rocks of the BF consisting of moderately to thickly bedded pebbly to conglomeratic tuffaceous sandstone, conglomerate, and shale beds. Localized fragments of the lndahag Limestone (IL) were also noted along the Sayre Highway.

Sumilao – Three rock formations underlie the municipality: the Bukidnon Formation, Indahag Limestone, and the Tago Schist. The general area of Sumilao is underlain mostly by the pebbly to conglomeratic sandstone with shale interbeds, agglomerate, and volcaniclastics of the BF including the sections that could be traversed by the proposed alignment. Most of the rocks observed along the Sayre Highway belonged to the Tago Schist (TS) with intermittent occurrences of the tuffaceous sandstone/conglomerate and the Indahag Limestone.

Impasug-ong - The area that could be traversed by the proposed alignment was basically underlain by the rocks of the BF consisting variably of andesitic volcaniclastics, moderately to thickly bedded tuffaceous sandstone, conglomerate and shale. The Sayre Highway was generally underlain by the tectonized harzburgite with pyroxenite and dunite of the Ultramafic Complex (UC).

Malaybalay - The general area traversed by the Sayre Highway, the Diversion Road and the proposed alignment in Malaybalay was basically underlain by the BF consisting of bedded pebbly to conglomeratic sandstone/shale, poorly sorted conglomerate, and andesitic volcaniclastics. Most of the underlying rocks along the Diversion Road were moderately to heavily weathered leaving behind reddish brown to brown 2- to 3-meter-thick soil materials.

Geological structures

The beds of the sandstone and shale, for both the terrace gravel and the volcaniclastic rocks of the Bukidnon Formation area generally low dipping (5° to 15°) with variable strike directions to the NE for the gravel/sandstone/shale, and NW to NE for the tuffaceous sandstone/shale/conglomerate towards Malaybalay. Beds of the Indahag Limestone have moderate dips (20° to 45°) mostly towards the SE. The schistose rocks of the Tago Schist are moderately to highly jointed, mostly with crenulation folds, with variable orientations and having moderate to steep schistosity. The Ultramafic rocks along the Old Sayre Highway are generally tectonized/fragmented.

Road networks transecting the thick Bukidnon Formation, the Ultramafic Complex, and the Tago Schist are prone to creep, landslides and rockfall.

The nearest active fault relative to the northern section of the Project site is the segment of the Tagoloan River Fault which lies around 16km to the east. Other faults with their relative distances to the Project alignment are shown in **Figure 3-18** and **Figure 3-19.**

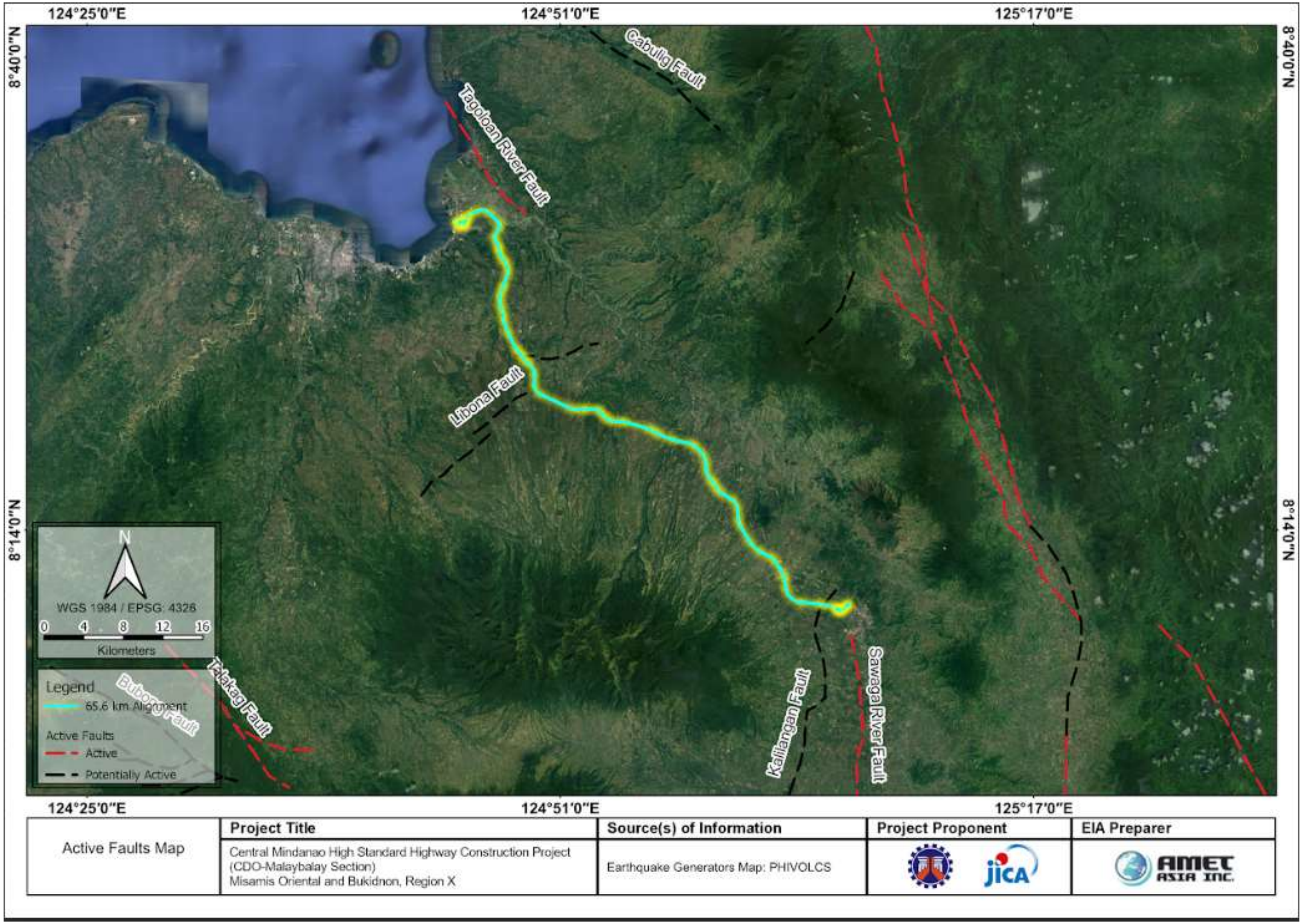
Table 3-10. Nearest active fault relative to the Project

Nearest Fault	Relative Distance to the Project
Cabangalasan Fault	37kms to the Northeast
Central Mindanao Fault	52kms to the East
Lianga Fault	80kms to the East-Northeast
Lanao Fault System	70kms to the West
Mindanao Fault Western Mindanao Extension	77kms to the West

The proposed alignment will traverse areas underlain by the Cagayan Gravel in the northeast and the Bukidnon Formation consisting of moderate to thick beds of the tuffaceous sandstone/conglomerate/ shale with localized andesitic volcaniclastics towards the south to Malaybalay.

Based on this, Project implementation will not induce significant change in the underlying rock types except during excavation where the sub-surface morphology will be locally altered. However, changes in the sub-surface morphology and the underlying soil types will be insignificant.

Figure 3-18. Distribution of active faults in Mindanao showing the Project



Active Faults Map	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Earthquake Generators Map: PHIVOLCS		

3.1.2.3.3 Inducement of subsidence, liquefaction, landslides, mud/debris flow

The project development, which will cover 65.6 linear-kilometers stretching from Cagayan de Oro to Tagoloan to Manolo Fortich to Sumilao to Impasug-on to Malaybalay, will definitely induce significant change in the surface landform / topography / terrain or slope. Road development will involve rock excavations that will expose poorly consolidated gravel/sandstone/shale at the northeastern section and the dominantly poorly indurated pebbly to conglomeratic tuffaceous sandstone of the Bukidnon formation towards the south. During construction, voluminous materials will be disturbed, and loose materials will be stockpiled.

Increment climatic conditions will induce downslope movement of rocks and regoliths particularly on exposed and barren surfaces along the stretch of the road alignment project. Excavated areas with steep rock walls will be prone to mass-wasting processes such as rockfall, rockslide, erosion, slope failure and localized landslides. In addition, unconsolidated sediments will be prone to rill erosion by concentrated but intermittent flow of water, usually during and immediately following moderate to heavy rains. Concomitant to this will be the sedimentation of the adjacent water channels that may induce flooding at the lower ground.

3.1.2.3.3.1 Ground acceleration

Ground acceleration is the actual trembling or jerking motion produced by an earthquake[12]. The degree of shaking is generally affected by the underlying materials; hence, shaking is more severe on areas underlain by unconsolidated sediments than site underlain by bedrocks.

The Deterministic Method developed by Fukushima and Tanaka (1990) represented by the equation below was used to assess the worst-case scenario of ground shaking.

$$\text{Log10 } A = 0.41M - \log10\,(R + 0.32 \times 10\,(0.41M)) - 0.0034R + 1.30$$

where A = mean peak acceleration (cm/sec2)
R = shortest distance between site and fault (km)
M = surface-wave magnitude

The method presumed that the highest magnitude earthquake (MCE) recorded along the segments of the active fault has the possibility to recur and that the epicenter will be at the nearest distance of the fault from the Project site. An MCE of Ms=7.5 was used for computing the worst peak ground acceleration (PGA). Amplification factors used for the different ground conditions were for medium soil is 1x, and for hard soil or bedrock is 0.6x. The attenuation relation used in the calculation has been applied to western Pacific Island settings[13]. The distance of the major seismogenic structure from the Project site was estimated using available maps from PHIVOLCS and Google Earth.

The result of the calculations for rock and soil conditions is shown in **Table 3-11**. The calculated deterministic PGA values for rock and soil conditions are high relative to the calculated values using the deterministic method[14].

Table 3-11. PGA and computed acceleration values for the Project Site

Earthquake Source			Computed PGA (g) acceleration				
mag	nearest fault	dist (km)	g	soft soil	rock	med soil	hard soil
7.5	Tagoloan River Fault	16	0.395114	0.549208	0.237068	0.343749	0.422772
7.5	Cabangalasan Fault	37	0.241394	0.335538	0.144837	0.210013	0.258292

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[12] http://www.mona.uwi.edu/uds/GEOHAZARDS_2001/GEOHAZ2001-029.html
[13] Thenhaus et al., 1994
[14] Fukushima and Tanaka, 1990

Earthquake Source			Computed PGA (g) acceleration				
mag	**nearest fault**	**dist (km)**	**g**	**soft soil**	**rock**	**med soil**	**hard soil**
7.5	Central Mindanao Fault	52	0.178886	0.248652	0.107332	0.155631	0.191408
7.5	Lanao Fault	70	0.129486	0.179985	0.077691	0.112652	0.13855
7.5	Lianga Fault	80	0.109591	0.152331	0.065754	0.095344	0.117262
7.5	Mindanao Fault Western Mindanao Extension	97	0.083857	0.116561	0.050314	0.072955	0.089727

Note: In relation to potential earthquakes from various sources at various distances; mag – magnitude, dist – distance in km, g – acceleration

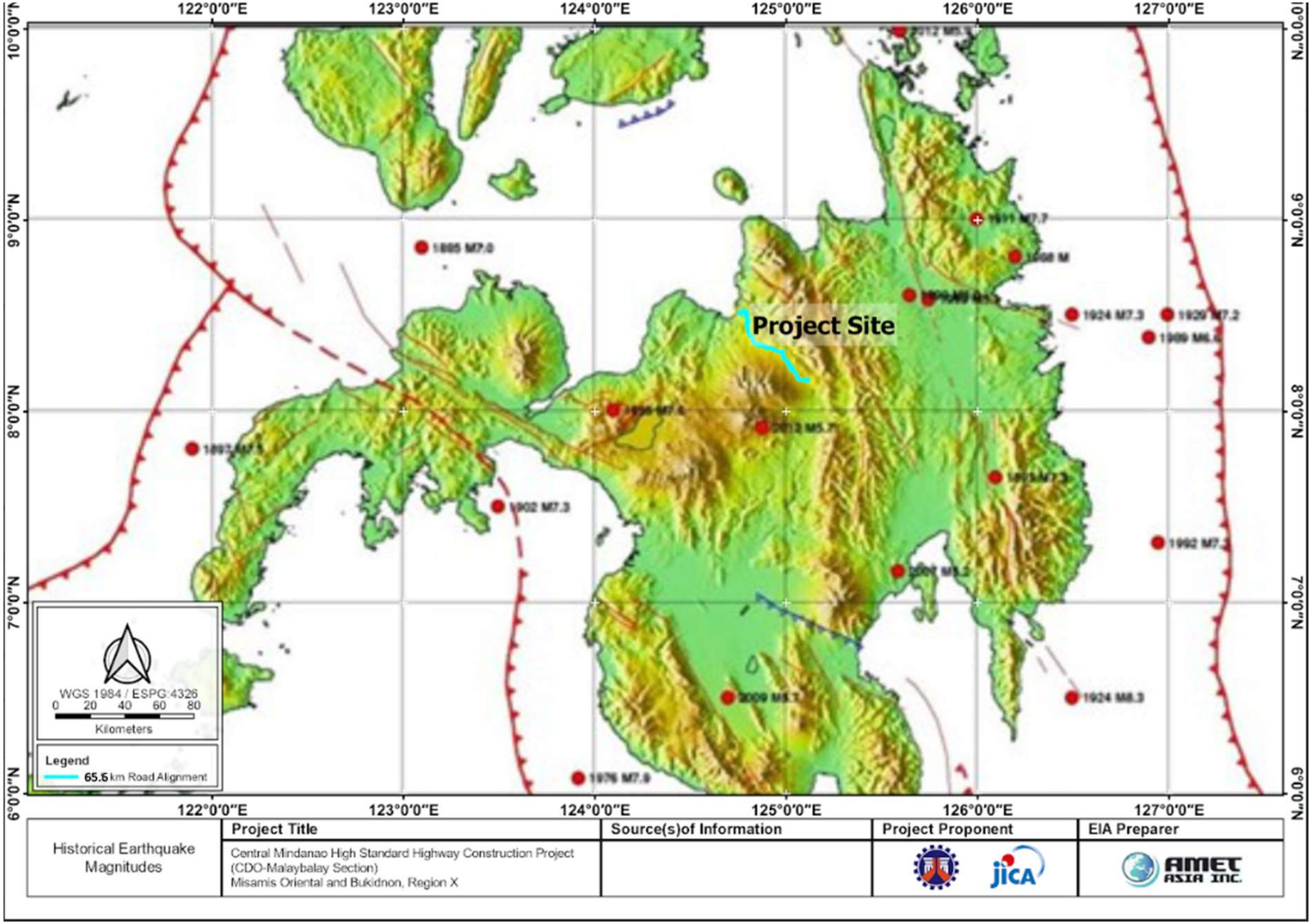
Using the Instrumentality Intensity Scale, the computed values originating from the Tagoloan River Fault (Intensity VIII) and Cabanglasan Fault (Intensity VII) with magnitude 7.5 earthquake will have very strong to severe perceive shaking with moderate to heavy potential damage at the site (**Table 3-12**).

Table 3-12. Instrumental Intensity Scale

Instrumental Intensity	Acceleration (g)	Velocity (cm/sec)	Perceived Shaking	Potential Damage
I	<0.0017	<0.1	Not Felt	None
II	0.0017-0.014	0.1-1.1	Weak	None
III	0.0017-0.014	0.1-1.1	Weak	None
IV	0.014-0.039	1.1-3.4	Light	None
V	0.039-0.092	3.4-8.1	Moderate	Very Light
VI	0.092-0.18	8.1-16	Strong	Light
VII	0.18-0.34	16-31	Very Strong	Moderate
VIII	0.34-0.65	31-60	Severe	Moderate to Heavy
IX	0.65-1.24	60-116	Violent	Heavy
X+	>1.24	116	Extreme	Very Heavy

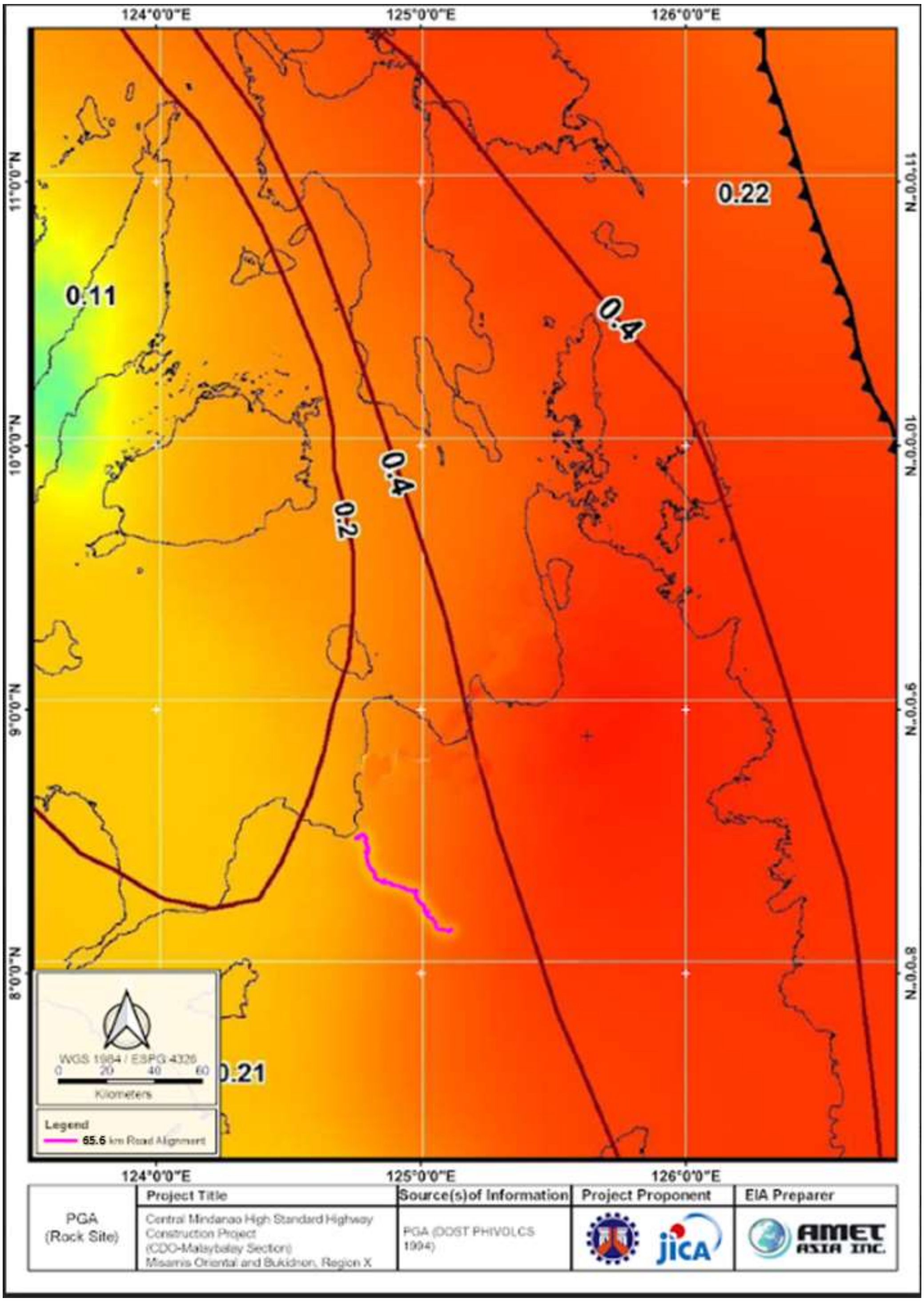
Source: USGS

Figure 3-19. Map indicating earthquakes intensities in Mindanao



Probabilistic zonation maps shown in **Figure 3-20** to **Figure 3-22** provide a guide for estimating the peak ground acceleration (PGA) in the Philippines[15]. Using these maps, the estimated peak horizontal accelerations at the vicinity of the Project would be around 0.4g for the rock and medium soil component and 0.6 for the soft component. These estimated peak ground accelerations have a 10% chance of occurrence in 50 years. These standards will then apply to the 1 in 500-year probability.

Figure 3-20. PGA values for rock components in Northern Mindanao



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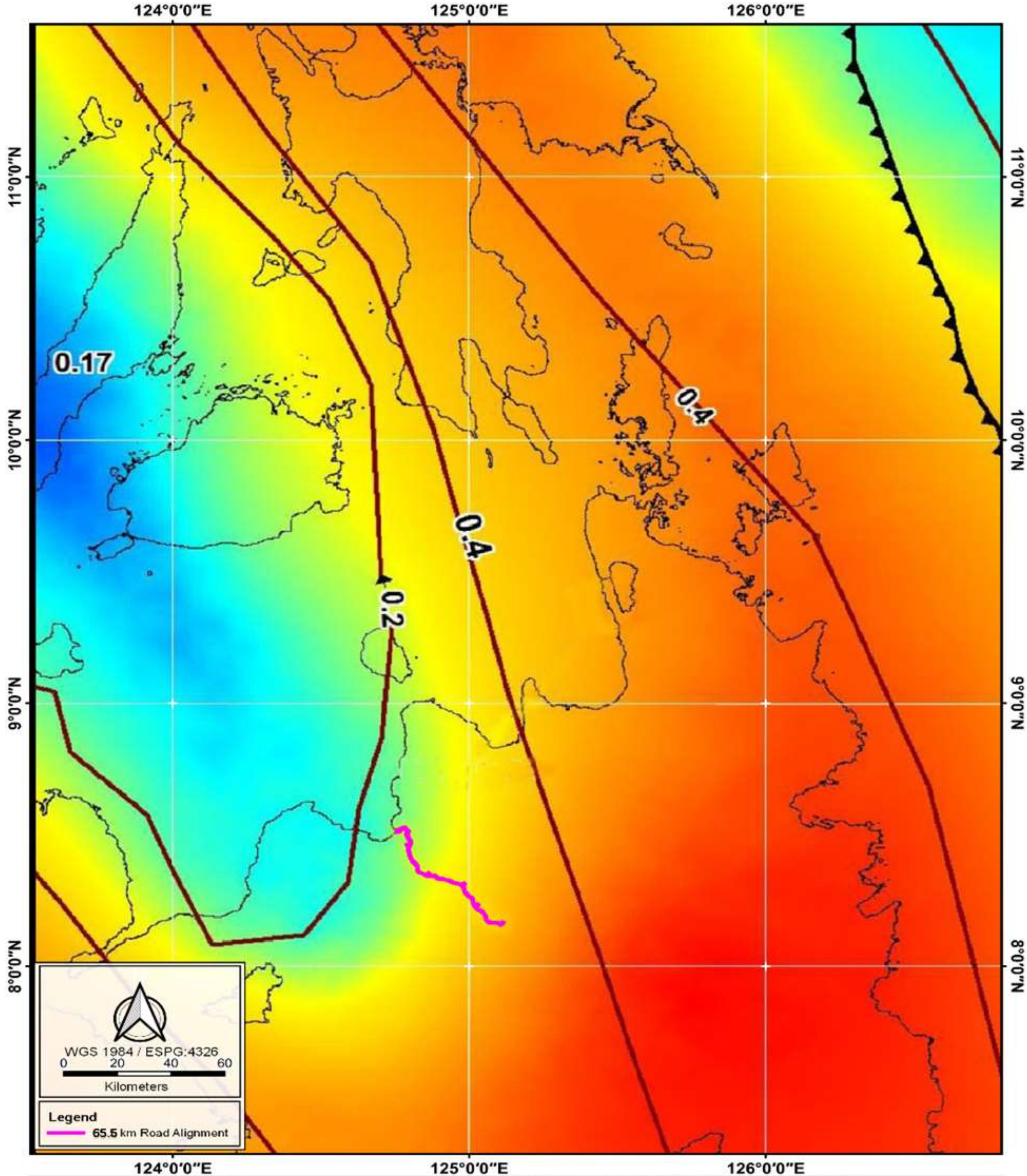
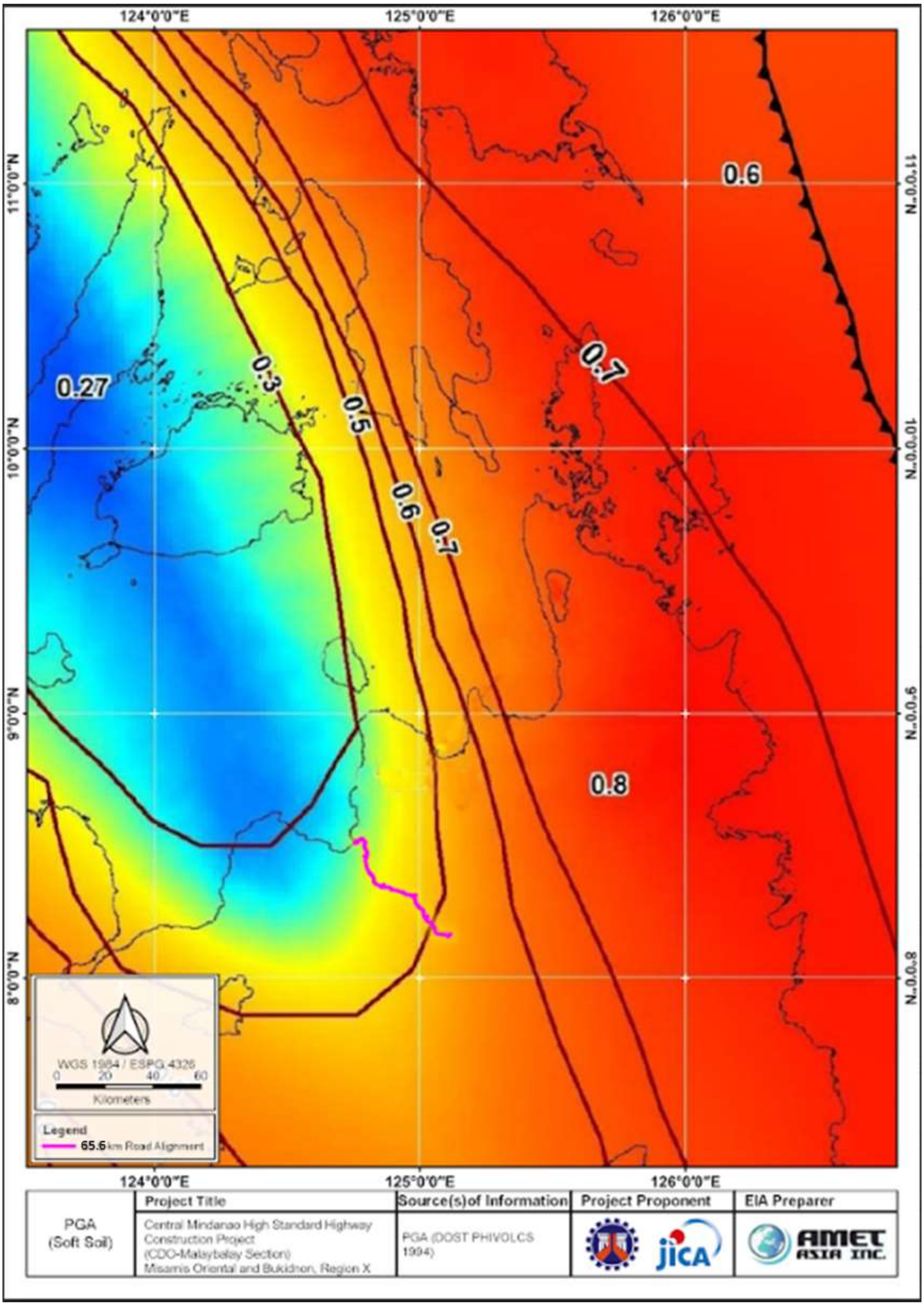
[15] Thenhaus, et. al, 1995

Figure 3-21. PGA values for medium soil components in Northern Mindanao



	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
PGA (Medium Soil)	Central Mindanao High Standard Highway Construction Project Municipality of Tagoloan and Cagayan de Oro City, Misamis Oriental, Region X	PGA (DOST PHIVOLCS 1994)		

Figure 3-22. PGA values for soft soil components in Northern Mindanao



3.1.2.3.3.2 Liquefaction

Liquefaction is a phenomenon where the strength and stiffness of soil is reduced by earthquake shaking or other rapid loading[16]. It occurs in saturated soils where the space between individual particles is completely filled with water. Earthquake shaking can cause the water pressure to increase to the point where the soil particles can readily move with respect to each other. When liquefaction occurs, the strength of the soil decreases and the ability of a soil deposit to support foundations for buildings and bridges is reduced. Liquefied soil also exerts higher pressure on retaining walls which can cause tilting or sliding. This movement can cause settlement of the retained soil and destruction of structures on the ground surface.

The CMH alignment is generally underlain by the bedrocks of the Cagayan Terrace Gravel and the tuffaceous sandstone/shale/conglomerate and andesitic volcaniclastics of the Bukidnon Formation which are not susceptible to liquefaction hazard (**Figure 3-23**).

3.1.2.3.3.3 Subsidence hazard

Localized outcrop of the Indahag Limestone was observed at the southern section of Barangay Alae, Manolo Fortich (**Figure 3-17**) which could be susceptible to subsidence hazard. The rest of the Road Alignment will traverse areas mostly underlain by conglomerate and sandstone of the Bukidnon Formation.

3.1.2.3.3.4 Landslide

The earthquake-triggered landslide susceptibility map showing the CMH alignment is shown in **Figure 3-28.** Based on this map, the northern section in Barangay Sugbongcogon, Tagoloan and the Alae Bypass Road has a high susceptibility to landslide and a localized portion with moderate susceptibility. Those areas with existing major deep river valleys from Cagayan de Oro southwards to Sumilao and the southern section of Impasug-ong have relatively high susceptibility to landslide with the smaller secondary river tributaries exhibiting moderate susceptibility. The major river channel approaching Malaybalay is susceptible to moderate landslide hazard.

Factual geological mapping identified several landslide zones on areas characterized by steeply sloping barren or less vegetated rock walls with exposed loosely consolidated gravel deposits (CG), the tuffaceous pebbly to conglomeratic sandstone and the heavily weathered andesitic volcaniclastics (BF), the schistose rocks (TS), and the limestone (IL).

Any road work involving deep excavations transecting the loosely consolidated gravel/sandstone/shale of the Cagayan Terrace Gravel, conglomerate/tuffaceous sandstone/shale of the Bukidnon Formation, the Tago Schist, and the Indahag Limestone will induce landslide, rock fall and associated mass-wasting hazard.

3.1.2.3.3.5 Creep

Soil creep is a slow and long-term process of mass wasting. The creep makes trees and shrubs curve to maintain their perpendicularity and can trigger landslides if they lose their root footing. In the course of time, the combination of small movements of soil or rock in different directions may contribute to mass downslope failure. Creep was observed in Barangay Puerto, CDO at 8°26’33” N/124°47’41” E where ‘terracettes’ or ‘soil ripples’ were observed along the slopes.

3.1.2.3.3.6 Flood hazard

Those areas transected by the proposed CMH alignment from the boundary of Impasug-ong to Malaybalay are susceptible to moderate to high flooding hazard while areas from the southern boundary of Impasug-ong to Malaybalay have high flood susceptibility (**Figure 3-24)**

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[16] http://www.ahabreviewsandtips.com/2011/08/phivolcs-liquefaction-susceptibility.html

Any loose and unprotected stockpiled materials during the road development will be affected by rill and gully erosion that may cause siltation of the nearby streams. This will induce flooding not only at the Project segments but also areas at the lower ground.

3.1.2.3.3.7 Erosion/Slope failure

Several sections of the proposed road in **Figure 3-27** will traverse steep rivers banks that are highly prone to erosion or slope failure hazards.

3.1.2.3.3.8 Ground rupture

Ground rupture may arise during large earthquakes with the ground surface being displaced along the fault[17]. Any structure built across the fault is at risk of being torn apart as the two sides of the fault slip past each other.

In the event of strong earthquake along the Libona Fault, possible surface rupture may occur at the vicinity of 8°20’47”/124°51’22” and 8°21’12”/124°50’29.5”. Similar scenario may occur at the western segment of the Diclum Fault at 8°23’13”/124°49’14” (**Figure 3-29**).

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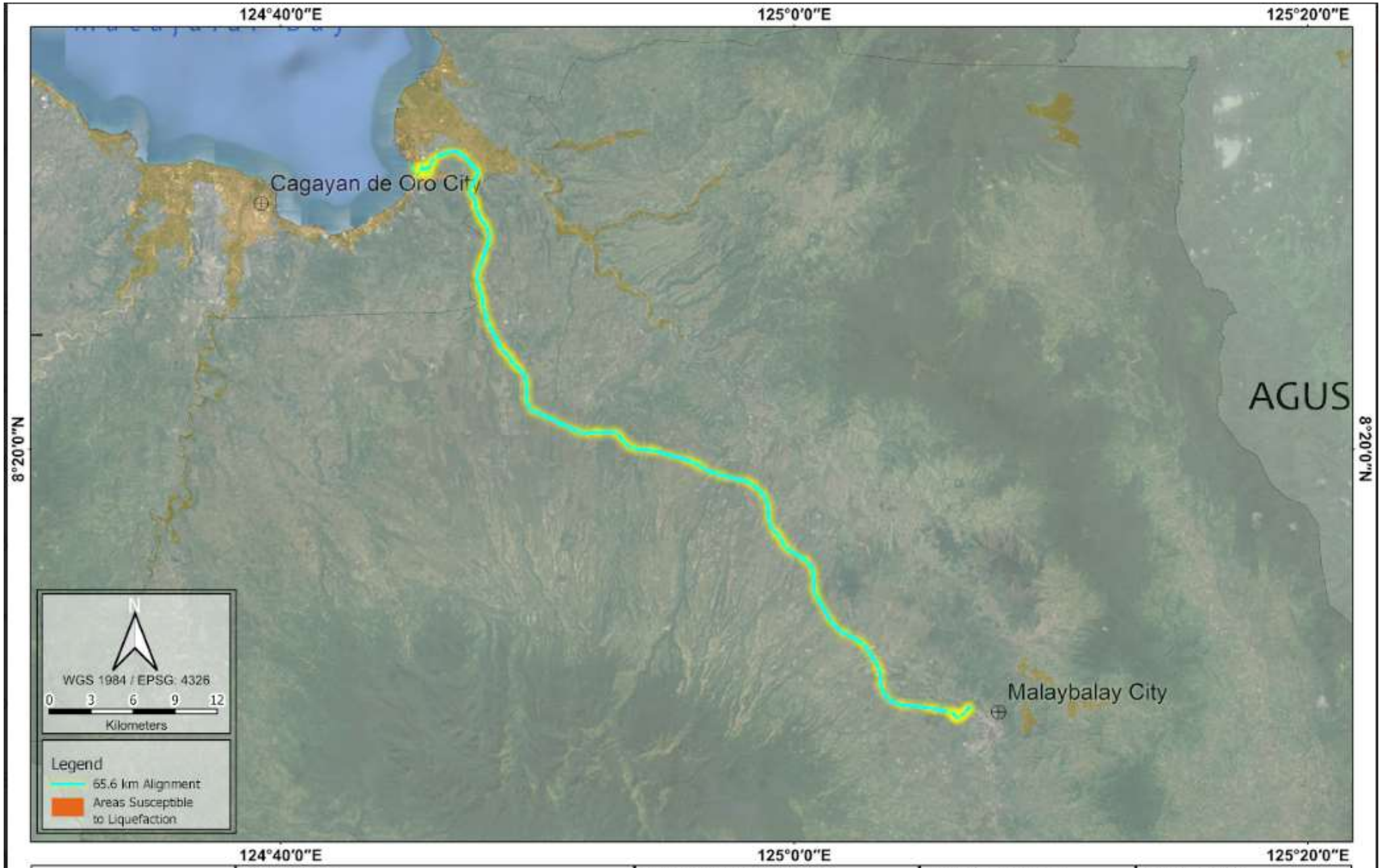
[17] https://www.google.com/search?q=what+is+ground+or+surface+rupture

Figure 3-23. Liquefaction hazard map of Mindanao



Liquefaction Hazard Map	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Liquefaction Hazard Map: PHIVOLCS		

Figure 3-24. Flood hazard map of Project site

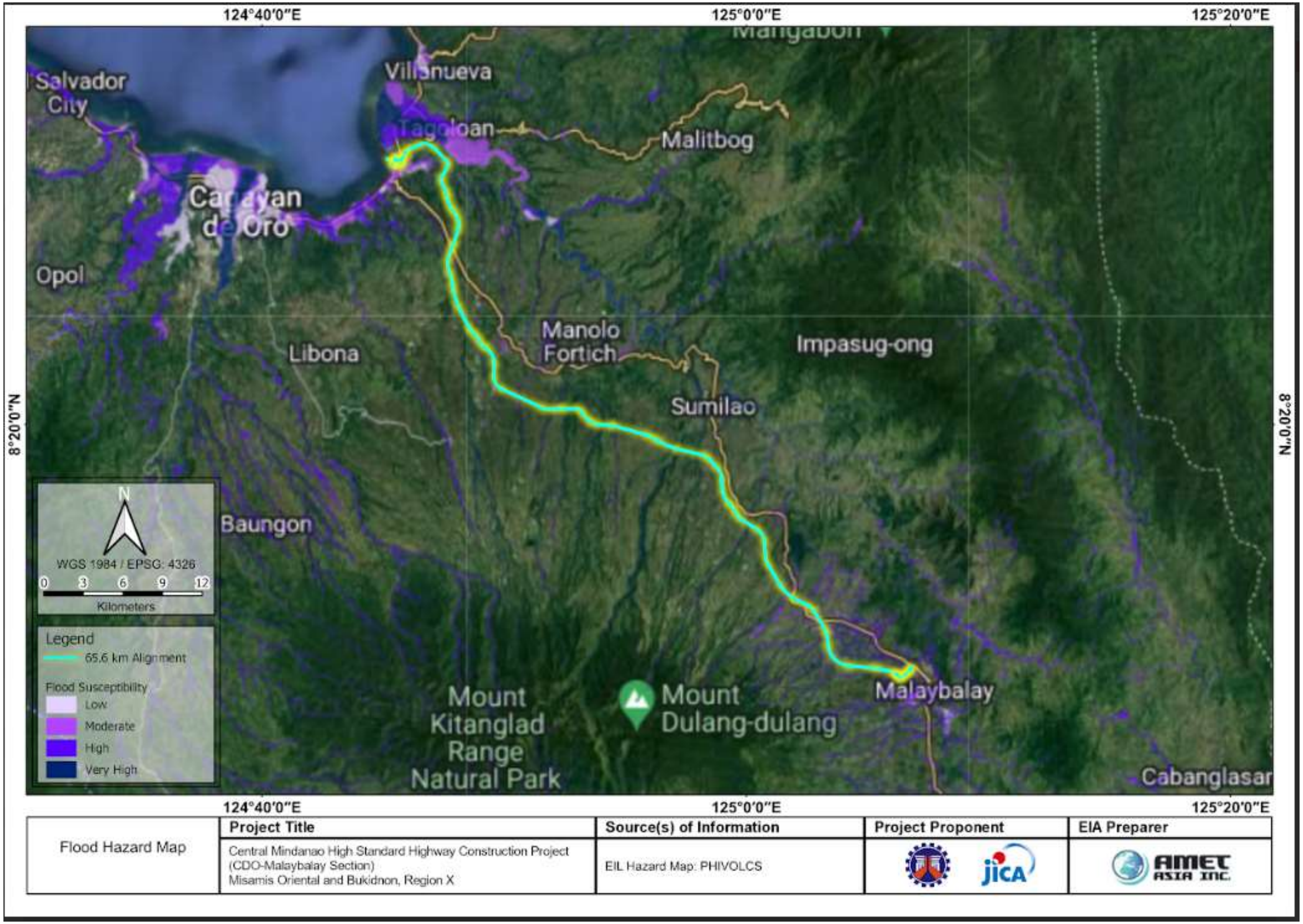


Figure 3-25. Eatthquake hazard map of Project site

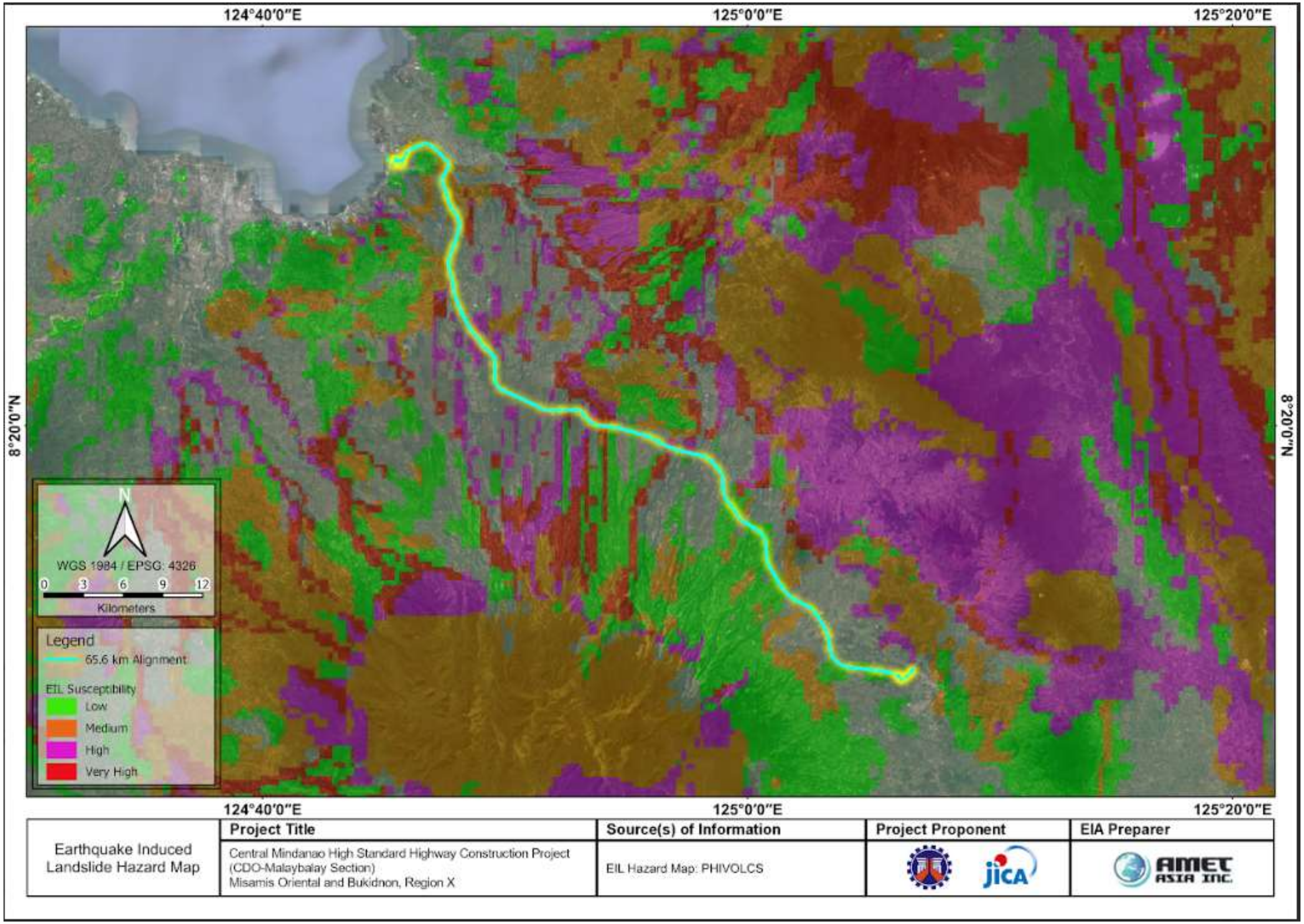


Figure 3-26. Volcanic Hazard Susceptability map of Project site

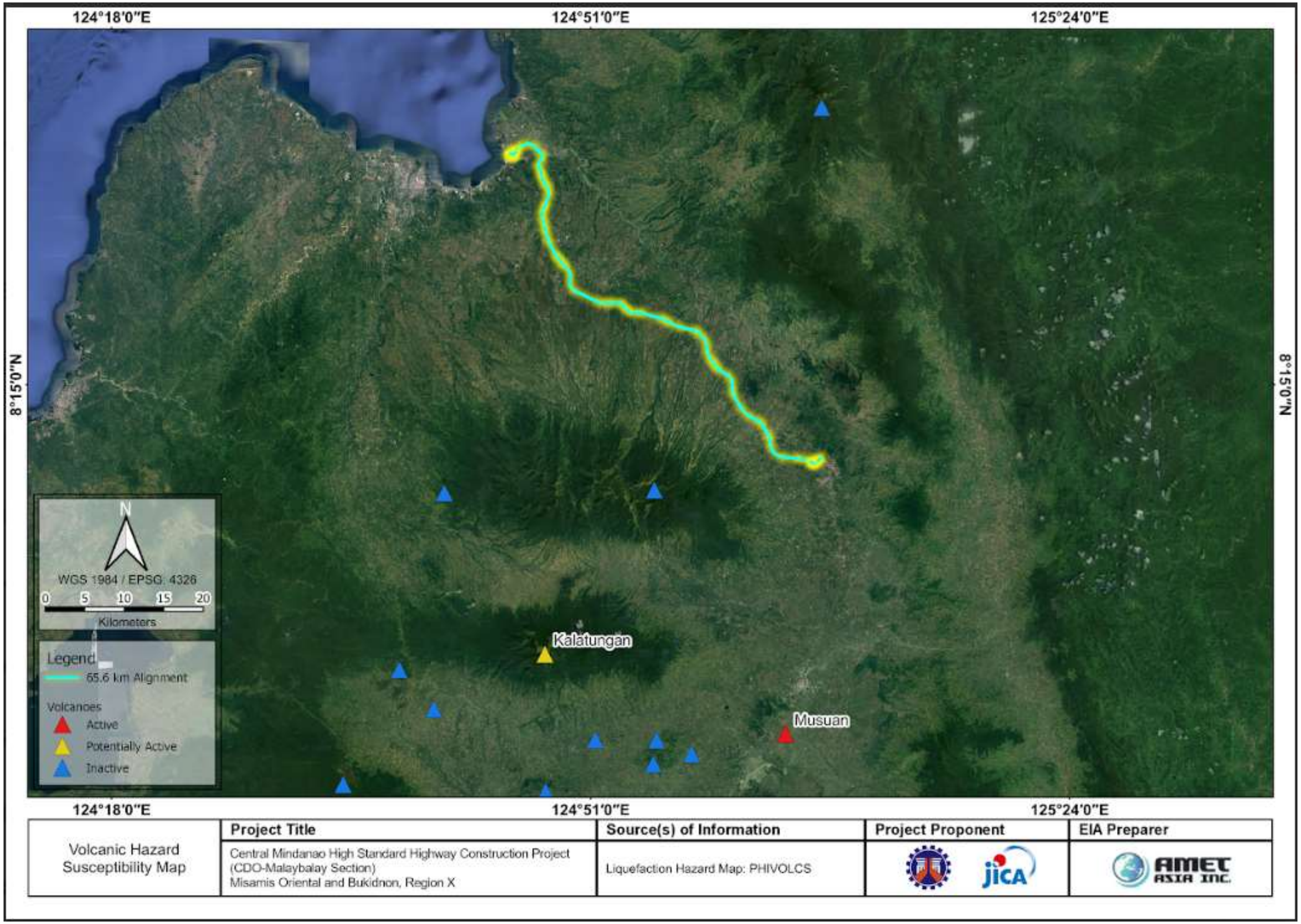


Figure 3-27. Rain Induced Landslide map of Project site

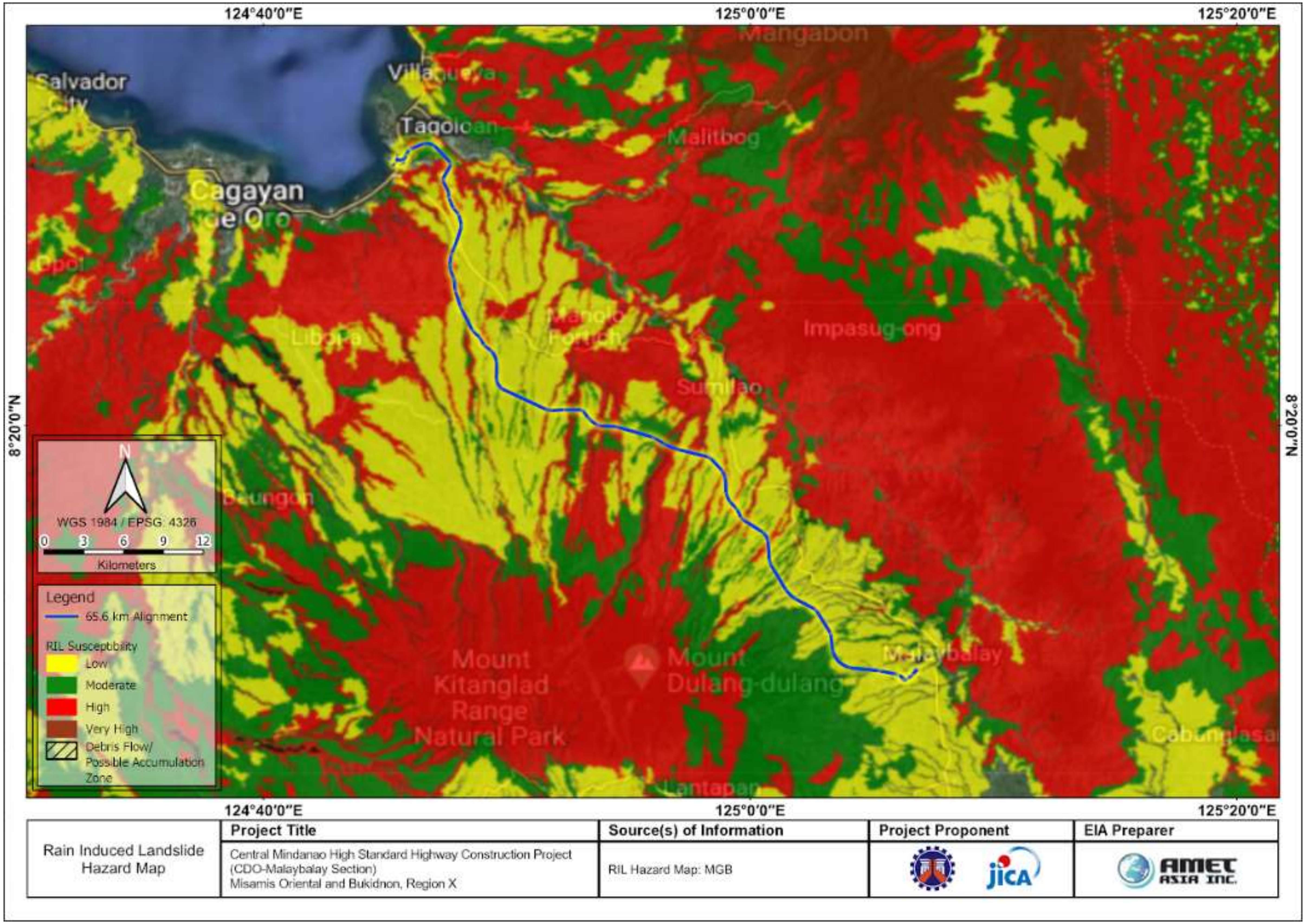


Figure 3-28. Landslide and flood hazard map of Project site

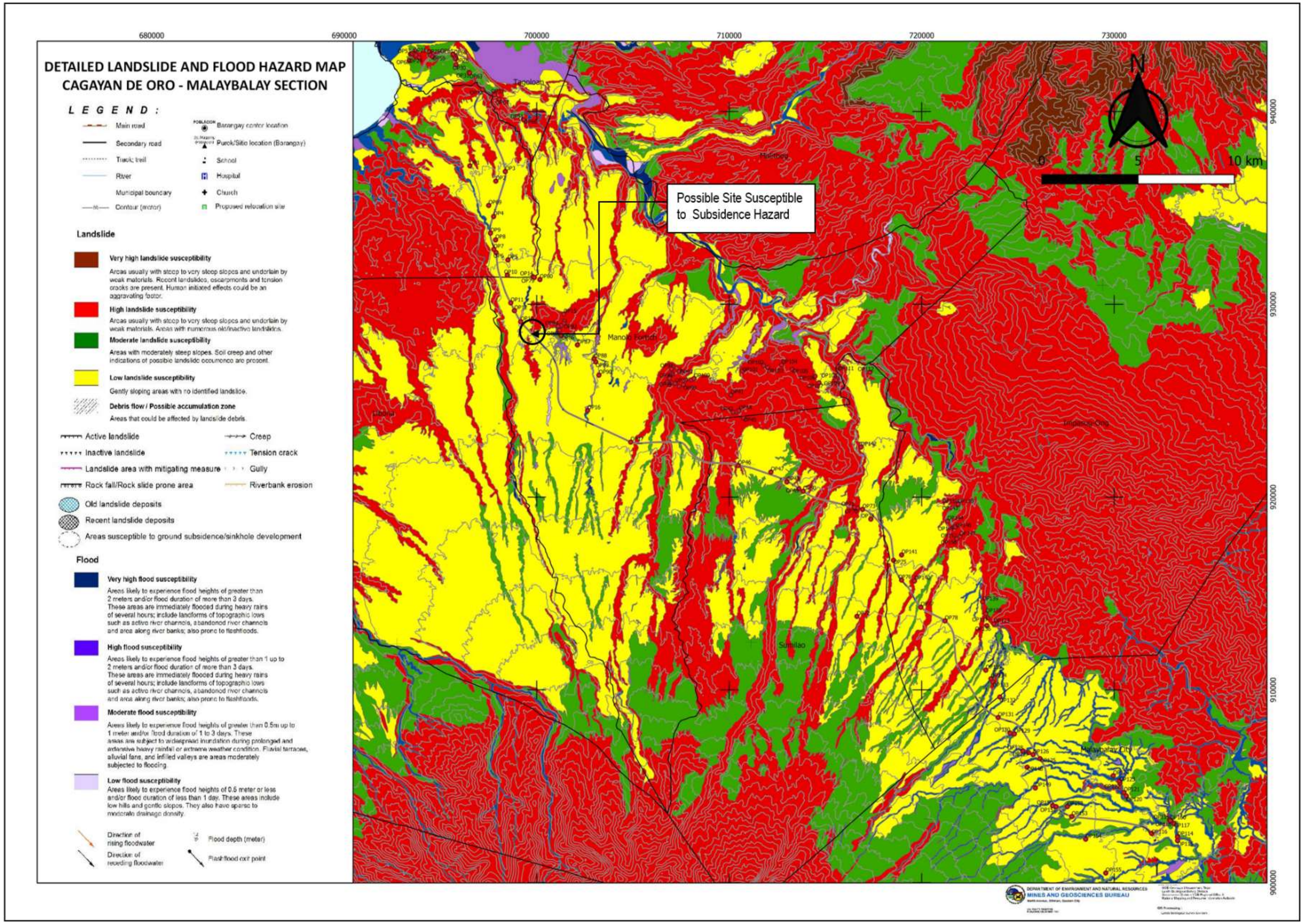
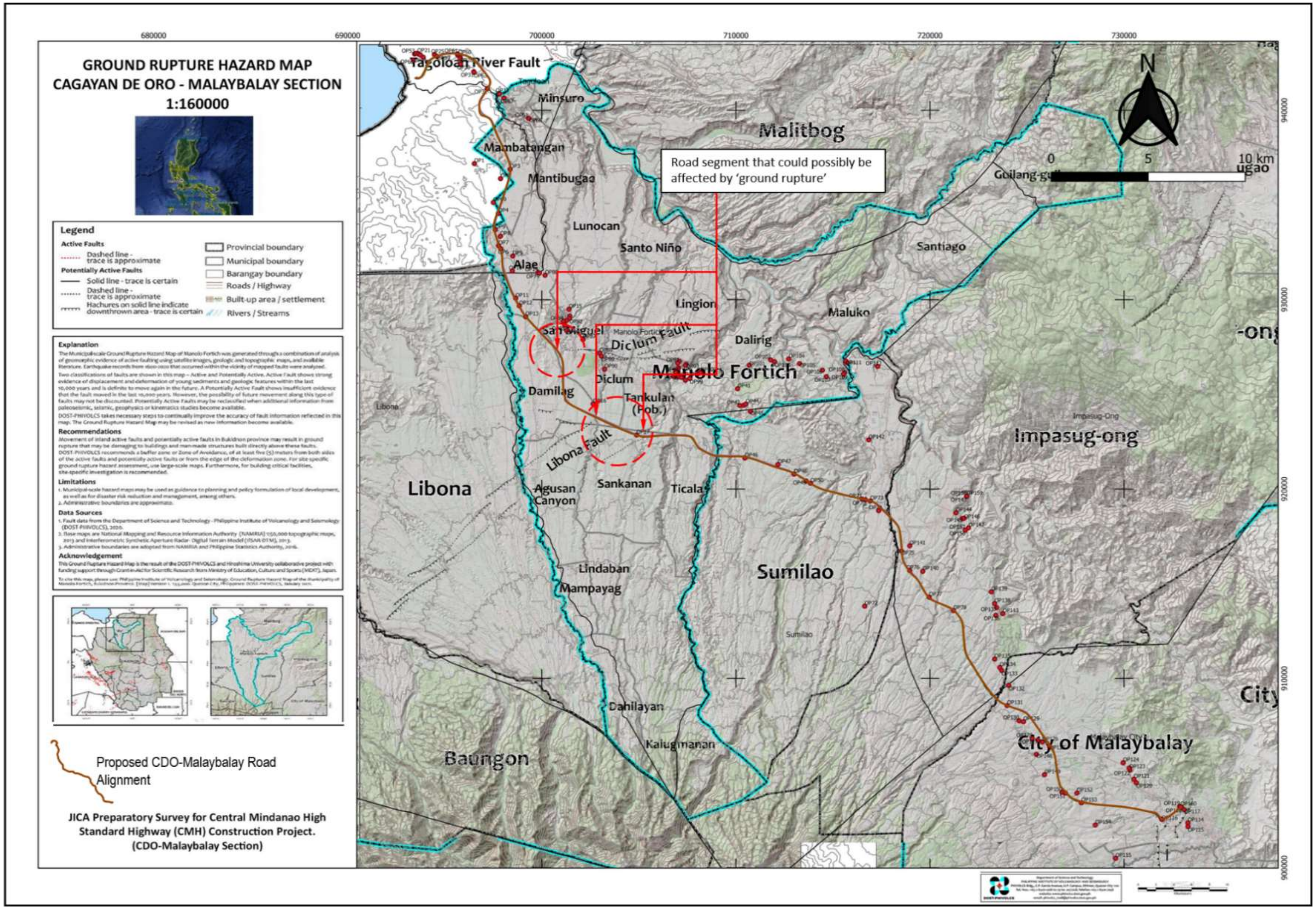


Figure 3-29. Ground rupture hazard map at the Project site



3.1.2.4 Proposed mitigating measures

3.1.2.4.1 Change in surface landform, geomorphology, topography, terrain, and slope

Pre-construction - Project development will induce significant change in the surface landform, topography, terrain or slope. Thus, it is necessary to conduct geological investigation, engineering geological and geohazard assessment and factual geological mapping that will focus on the geology, geomorphology, and geohazards at the CMH alignment in accordance with DAO 2000-28.

Construction – Road development will involve rock excavations that will expose poorly consolidated gravel/sandstone/shale at the northeastern section and the dominantly poorly indurated pebbly to conglomeratic tuffaceous sandstone of the Bukidnon formation towards the south. Construction activities will disturb voluminous materials and loose materials will be stockpiled. Inclement weather conditions will induce downslope movement of rocks and regolith particularly on exposed and barren surfaces along the stretch of the CMH alignment. Excavated areas with steep rock walls will be prone to mass-wasting processes such as rock fall, rockslide, erosion, slope failure and localized landslides. The following mitigation measures enumerated below will minimize these impacts.

a) Application of retaining walls, appropriate erosion control and slope protection measures and other engineered structures along steep walls;
b) Increase vegetation cover particularly at the vicinity of the break-of-slope;
c) Surface drainage control works – construction of drainage canal at the break-of-slope (between the gentle to moderate slopes).
d) Recontouring of the slopes, benching or lowering the slope gradient;
e) Appropriate drainage system including under drain constructions and anchored structures.

Operation - Regular monitoring on the condition of the slopes and slopes stabilization measures particularly on landform changes. Recommend applicable solutions depending on the currently observed geological and geomorphological conditions.

3.1.2.4.2 Change in sub-surface geology/underground conditions

Construction -The construction of the proposed road will not induce any change in the underlying rock types. However, sub-surface morphology will be locally altered by any excavations. There must be a conduct of field assessment to include occurrences of any mass-wasting (landslide, rockfall, mudflow, creep, etc.) especially after heavy and prolonged rains and after earthquake occurrences.

Operation - Regular monitoring of areas identified as subsidence prone in the southern section of Brgy. Alae, Manolo Fortich where localized outcrop of the Indahag Limestone was identified. Follow the ecommendations of the geotechnical/civil engineer/geologist to address any identified adverse geological and geomorphological conditions.

3.1.2.4.3 Inducement of subsidence, liquefaction, landslides, mud/debris flow, etc.

Pre-construction – The Project appeared to be susceptible to ground acceleration; landslide, rock fall, creep, settlement; road slip, and flooding. It is essential to conduct factual geological mapping focusing on the geology, geomorphology and geohazards and identification of sensitive areas that will be prone to any possible settlement or subsidence.

Construction phase - The following measures are recommended to minimize the occurrences and effect of the natural hazards previously presented.

a) Application of retaining walls and other engineered structures along steep walls;
b) Increase vegetation cover particularly at the vicinity of the break-of-slope;

c) Surface drainage control works – construction of drainage canal at the break-of-slope (between the gentle to moderate slopes).
d) Contouring of the slopes re-contouring, benching or lowering the slope gradient;
e) Good drainage system including under drain constructions and anchored structures.
f) Implementation of the recommendations given by the geotechnical engineer and those stipulated in the geological/geohazard assessment report particularly on area identified to be prone to various geohazards.

Landslide:

- The northern section in Brgy. Sugbongcogon, Tagoloan, Alae Bypass Road.
- Those areas with existing major deep river valleys from Cagayan de Oro southwards to Sumilao and the southern section of Impasug-ong.
- The major river channel approaching Malaybalay
- Areas characterized by steeply sloping barren or less vegetated rock walls with exposed loosely consolidated gravel deposits (CG), the tuffaceous pebbly to conglomeratic sandstone and the heavily weathered andesitic volcaniclastics (BF), the schistose rocks (TS), and the limestone (IL).

Creep:

Brgy. Puerto, CDO at 8°26’33”N /124°47’41”E where ‘terracettes’ or ‘soil ripples’ were observed along the slopes.

Flood Hazard:

Areas transected by the proposed alignment from the boundary of Impasug-ong to Malaybalay, are susceptible to moderate to high flood hazard, while areas from the southern boundary of Impasug-ong to Malaybalay have high flood susceptibility.

Erosion / Slope Failure**:**

Sections of the proposed road will traverse steep rivers banks which are highly prone to erosion / slope failure hazard.

Ground Rupture:

Along the Libona Fault, possible surface rupture may occur at the vicinity of 8°20’47”/124°51’22” and 8°21’12”/124°50’29.5”.

Similar scenario may occur at the western segment of the Diclum Fault at 8°23’13”/124°49’14”

Operation – the following measures are recommended during the opening of the CMH road to traffic:

a) Regular monitoring of the slope conditions and slopes stabilization measures especially after prolonging heavy rains and earthquakes.
b) Regular monitoring of areas with identified geological hazards, their current condition, and the degree of the effects of hazards previously identified.

3.1.3 Pedology

3.1.3.1 Scope

This module described the existing soil types and quality traversed by the alignment. The key impacts assessed were soil erosion, loss of topsoil or overburden and change in soil quality or fertility that included sediment quality in streams affected by the Project.

3.1.3.2 Methodology

Soil quality and fertility -Soil samples were collected at three stations: at the start of the alignment in Cagayan de Oro City, middle segment in Sumilao, and at the end in Malaybalay City (**Table 3-13** and **Figure 3-30**). Composite soil samples were collected at the surface and at a depth of one meter. The parameters analyzed and their corresponding method are shown in **Table 3-14.**

Table 3-13. Location of the soil quality sampling points

Station	Latitude	Longitude	Location	Description
S1	8.509855	124.791145	Bugo, CDO	Located near an existing paved road
S2	8.313177	124.965641	Kisolon, Sumilao	Located near an existing road unpaved road and agricultural area
S3	8.165251	125.113072	Kalasungay, Malaybalay	Located near an existing road unpaved road and agricultural area

Table 3-14. Laboratory methods of analysis for soil quality

	Parameter	Analytic method
Primary Nutrients	Nitrogen	Kjeldahl
	Organic Matter	Walkley - Black
	pH	On-site instrument
	Phosphorus	Titrimetric
	Potassium	Direct Air-Acetylene Flame
Micronutrients	Molybdenum	Direct Nitrous Oxide-Acetylene Flame
	Zinc	Direct Air-Acetylene Flame
	Manganese	Direct Air-Acetylene Flame
	Iron	Direct Air-Acetylene Flame
	Nickel	Direct Air-Acetylene Flame
	Boron	Titrimetric
	Chlorine	Titrimetric

Stream sediment - Grab samples of sediment were collected at the same stations for surface water quality analyzed for five parameters following the laboratory analytic method in **Table 3-15.**

Table 3-15. Laboratory methods of analysis for riverbed sediment quality

Parameter	Analytic method
Arsenic	Manual Hydride Generation AAS
Cadmium, Chromium, Lead	Direct Air-Acetylene Flame
Mercury	Cold Vapor AAS

Table 3-16. Description of the stream sediment sampling stations

Stn.	Name of river	Coordinates		Barangay	Description
		Latitude	Longitude		
WQ1	Tagoloan River	8.52971N	124.788609E	Natumolan, Tagoloan	Major river with quarrying activities
WQ2	Dicklum River	8.35425N	124.84182E	Dicklum, Manolo Fortich	Located near agricultural area
WQ3	Kumaykay Stream	8.34422N	124.87815E	Ticala, Manolo Fortich	Located near agricultural area used for bathing
WQ4	Puntian River	8.29619N	124.91088E	Villa Vista/Puntian, Sumilao	Used for washing vehicles
WQ5	Tagalongon River	8.29878N	124.92311E	Culasi/Vista Villa, Sumilao	Used for bathing and washing
WQ6	Mapolo River	8.31123N	124.96838E	Poblacion/ Kisolon, Sumilao	Used for bathing and washing
WQ7	Ipoon River	8.21708N	125.02844E	Impalutao, Impasug-ong	Used for bathing and washing
WQ8	Komotal River	8.215275 N	125.030295E	Dalwangan, Malaybalay	Used for bathing and washing
WQ9	Sawaga River	8.17999 N	125.05012 E	Patpat, Malaybalay	Used for bathing
WQ10	Sawaga River	8.16246 N	125.11364 E	Sumpong, Malaybalay	Used for bathing

Figure 3-30. Map of the soil sampling stations

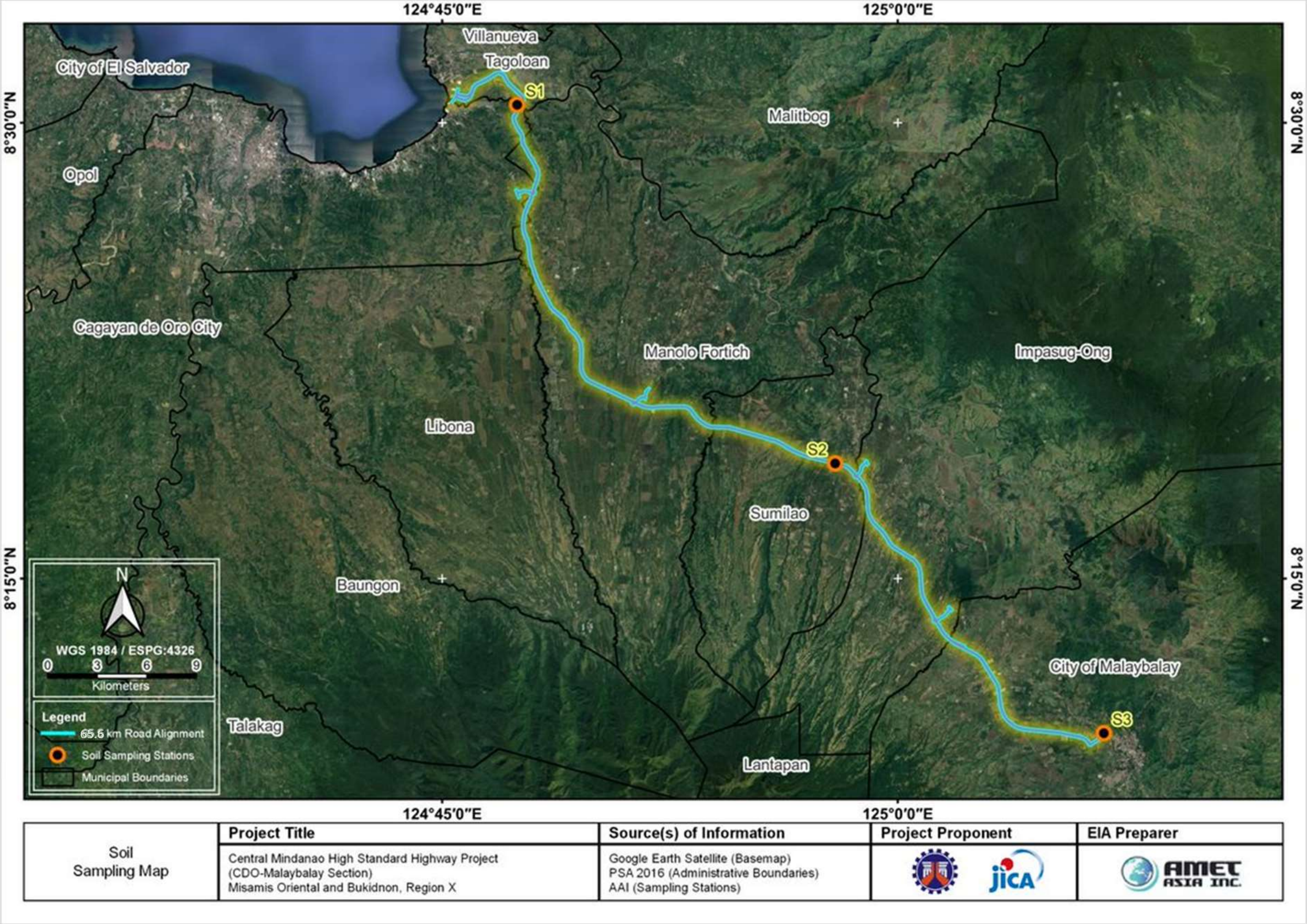
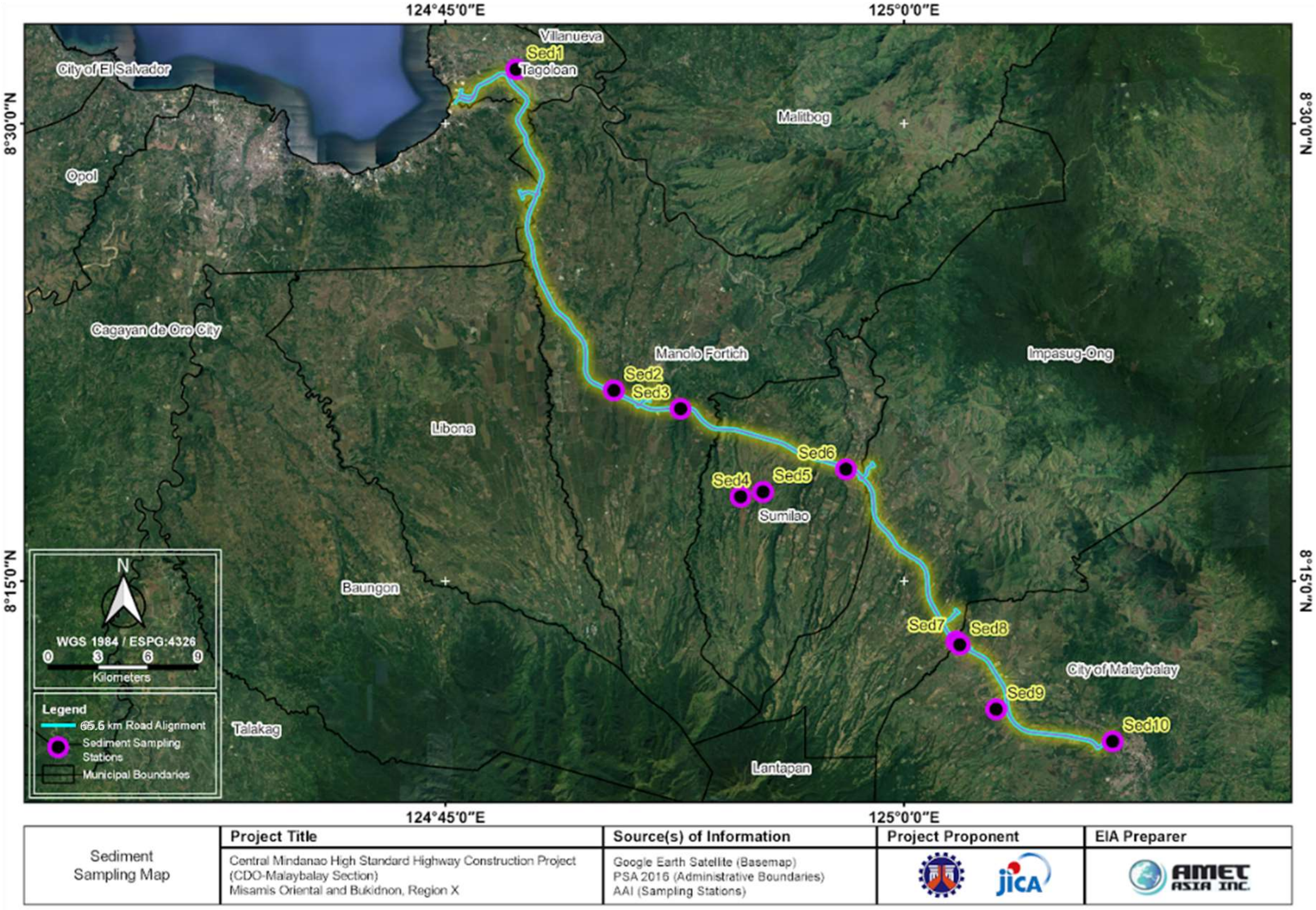


Figure 3-31. Map of the stream sediment sampling stations



3.1.3.3 Assessment of key impacts

3.1.3.3.1 Soil erosion, loss of topsoil or overburden

The proposed CMH alignment is will traverse lands with eight soil types (**Table 3-17**): San Manuel Loam, Umingan Clay Loam, Jasaan Clay Loam, Jasaan Silt Loam, Jasaan Clay, Adtuyan Clay, Calauag Clay, and Mountain Soil (undifferentiated). The brief description of these soil types is presented in **Table 3-17**.

Table 3-17. Soil types traversed by the CMH alignment

Soil type	Description
San Manuel Loam	The parent material of this soil type is recent alluvium deposit belonging to the soil order/great group of Inceptisol and Dystropepts. It is found in small areas along Pulangi River near Valencia and south-east of Dologon, Bukidnon. This soil type is characterized by fine loamy textured clay and sand soil with no particular mineral of any kind.
Umingan Clay Loam	This soil has a loamy texture with many gravels and pebbles skeletal occurring along the banks or rivers. It is subject to flooding fluventic receiving yearly depositions of alluvial soil materials from rivers. It is in the incipient development stage toward a mature soil Inceptisol but has not yet fully developed its diagnostic horizons.
Jasaan Clay Loam Jasaan Silt Loam Jasaan Clay	These soil type belong to the topographic group “Soils on a plateau” with volcanic materials as its parent material. It belongs to the soil order Ultisol/Hapludults and is found in Barangay Alae and its vicinity in the north central part adjoining Misamis Oriental.
Adtuyon Clay	This soil type covers almost the entire Bukidnon Plateau. Its parent material is volcanic lava or lahars composed of mixed boulders (basalt and andesite) and belongs to the soil order/soil great group Ultisol/Paleudults,Hapludults.
Calauag Clay	These soil type belong to the topographic group “Soils on a plateau” with metamorphic rocks (schist) as its parent material. It is found in the low grassy hills east of Malaybalay.
Mountain Soil (undifferentiated)	Mountain soils are found in Mt. Kitanglad and Mt. Kalatungan and the whole portion of the Pantadon Range and Mt. Malambo which borders Agusan and Davao Provinces.

Sources: Philippine Rice Research Institute, Dejarme-Calalang, Guadalupe M. and Colinet, Gilles (2014)

The proposed CMH alignment will transect areas mostly characterized by slopes of 0° to 10° (nearly level to gentle). Soil erosion in these areas is expected to be minimal and will only occur during the construction phase. At least five sections of the proposed road development, however, will transect existing natural drainages with steep slope channels varying from 30° to 70° (**Figure 3-14**). In general, the land can accommodate the proposed development with minimal loss of soil or overburden and soil erosion.

The general characteristic of the blanketing soil varies from clayey to sandy on the northern portion which becomes more lateritic with localized portion which are also clayey silt to sandy towards the elevated sections of Bukidnon. The dominant erosional processes along the proposed alignment will be sheet/rill and gully erosion where the finer soil and other unconsolidated materials are removed by concentrated but intermittent flow of water usually during and immediately following moderate rains.

3.1.3.3.2 Change in soil quality and fertility

Soil quality and fertility - The laboratory analysis showed high levels of soil fertility parameters in the soil samples (green cells in **Table 3-18**). For example, the organic matter content of the samples ranged from 11,890 to 94,480 mg/kg of soil while the NPK (Nitrogen, Phosphorus, Potassium) content ranged from 130 to 3000 mg/kg. This is indicative of suitability of the surrounding soils to agriculture and evidenced by the presence of large farmlands, orchards, and plantations along the alignment.

The results also showed adequate levels of Zinc, Manganese, and Iron across the stations (green cells in **Table 3-19**). The zinc content ranged from 76-112 mg/kg, manganese from 737 to 1,438 mg/kg, and iron from 44,900 to 72,500 mg/kg.

Table 3-18. Soil fertility at the sampling stations

	Lab results			Soil fertility guideline values*			Soil fertility evaluation		
Parameter	**S1**	**S2**	**S3**	**High**	**Mod**	**Low**	**S1**	**S2**	**S3**
pH	8.3	8.2	8.11	5.5 - 7.5	5.0 - 5.5	<5.0 & > 8.0	Low	Low	Low
Organic Matter, %	1.189	9.448	3.675	> 3	1 – 3	< 1	Mod	High	High
Nitrogen, %	0.05	0.3	0.3	> 0.25	0.15 - 0.25	< 0.15	Low	High	High
Phosphorus, ppm	310	130	520	> 35	26 – 35	< 25	High	High	High
Potassium, mg/kg	450	720	790	> 250	150 – 250	< 150	High	High	High

NOTES: S1, S2, S3 – soil sampling stations; *BSWM Soil fertility Rating Guideline Values; Mod - moderate

Table 3-19. Soil micronutrients at the sampling stations

		Lab results			Soil fertility guideline values			Soil fertility evaluation*		
Parameter	**Unit**	**S1**	**S2**	**S3**	**Deficient**	**Marginal**	**Adequate**	**S1**	**S2**	**S3**
Molybdenum	mg/kg	<0.20	<0.20	<0.20						
Zinc	mg/kg	78.34	112.4	76.22	<0.5	0.5-1.5	>1.5	Adequate	Adequate	Adequate
Manganese	mg/kg	833.07	737.67	1438.57	<1.0	none	>1.0	Adequate	Adequate	Adequate
Iron	mg/kg	44900	72500	45300	<1.5	2.5-4.5	>4.5	Adequate	Adequate	Adequate
Nickel	mg/kg	150.73	37.71	461.17						
Boron	%	0.41	0.41	0.3						
Chlorine	ppm	13.051	1.684	0.842						

NOTES: S1, S2, S3 – soil sampling stations; * values with < sign means analyte is below the method detection limit; If (-) adverse impact, (+) no impact. Value is the impact magnitude; NI - no impact; Source: General Guidelines for the Fertility of Soils, Bureau of Soils and Water Management

Stream sediment - Very low levels of sediment contaminants were detected across stations based on the Dutch soil intervention values indicating that the riverbed has not been contaminated (**Table 3-20** and **Table 3-21**). For example, Arsenic, Cadmium, Mercury, and Lead levels were undetected because these were below the Method Detection Limit of the laboratory analytic method.

Table 3-20. Heavy metal levels at the sediment sampling stations

	Lab results, mg/kg										
Parameter	**Sed1**	**Sed2**	**Sed3**	**Sed4**	**Sed5**	**Sed6**	**Sed7**	**Sed8**	**Sed9**	**Sed10**	**DSIV****
Arsenic (As)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	55
Cadmium (Cd)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	12
Chromium (Cr)	64.48	59.10	19.97	22.04	8.57	<0.20	23.11	14.95	14.35	45.08	380
Mercury (Hg)	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	10
Lead (Pb)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	530

NOTES: S1, S2, S3 – soil sampling stations; * Dutch soil intervention value

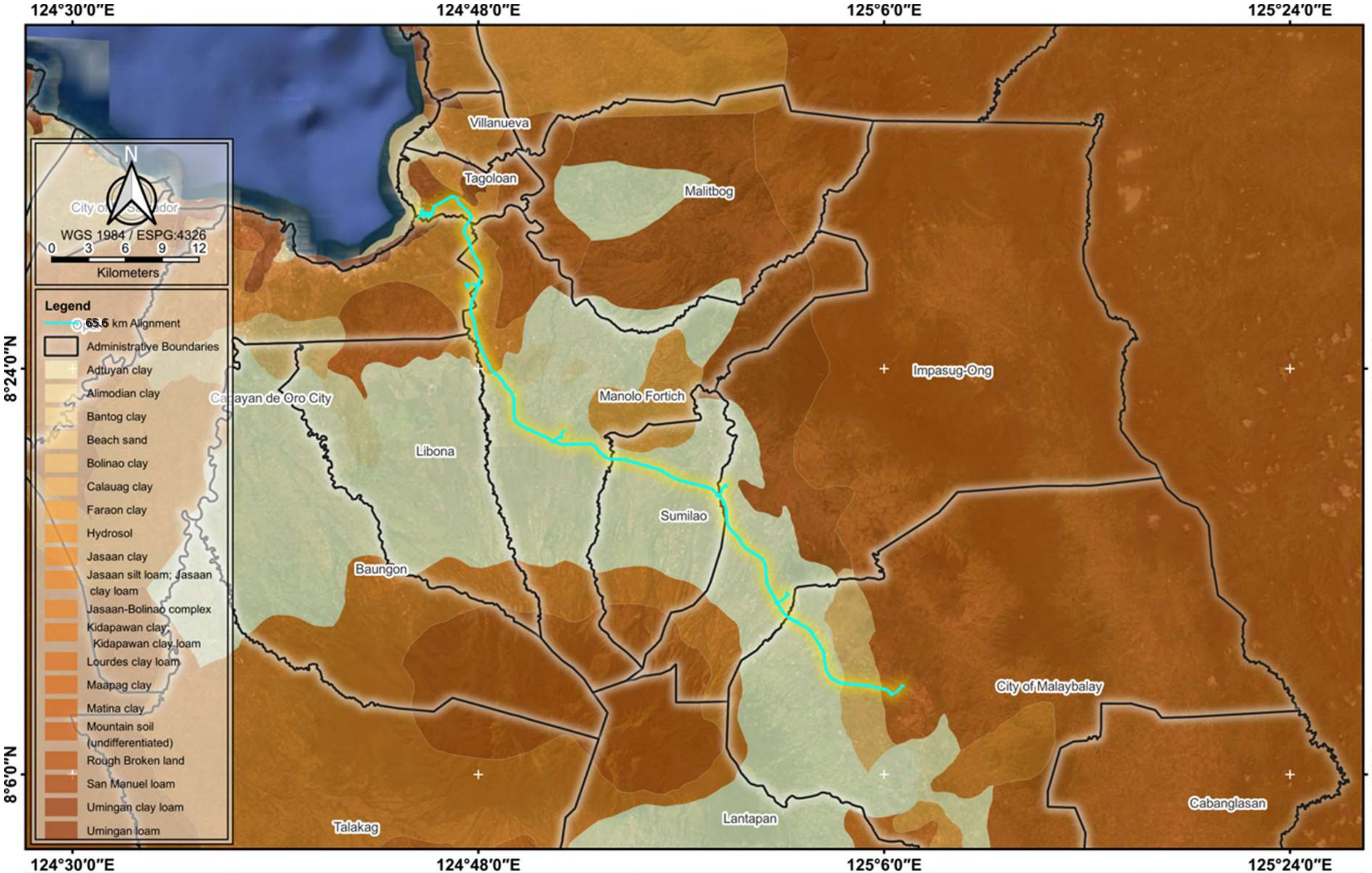
Table 3-21. Summary of heavy metal exceedances at the sediment sampling stations

	Lab results, mg/kg*										
Parameter	**Sed1**	**Sed2**	**Sed3**	**Sed4**	**Sed5**	**Sed6**	**Sed7**	**Sed8**	**Sed9**	**Sed10**	**DSIV****
Arsenic (As)	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	55
Cadmium (Cd)	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	12
Chromium (Cr)	315.52	320.9	360.03	357.96	371.43	NI	356.89	365.05	365.65	334.92	380
Mercury (Hg)	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	10
Lead (Pb)	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	530

NOTES: * values with < sign means analyte is below the method detection limit; **Dutch soil intervention value, mg/kg. Value is the impact magnitude: (a) difference between DSIV and lab result. If (-) adverse impact, (+) no impact, NI - no impact

The photo documentation of the soil and sediment sampling are shown in **Appendices 6 and 7** while the laboratory reports are shown in **Annexes 1 and 2**.

Figure 3-32. Soil types traversed by the proposed CMH alignment



BSWM Soil Map	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental, Region X	Google Earth Satellite (Basemap) PSA 2016 (Administrative Boundaries) BSWM 2013 (Soil Map)		AMET ASIA INC.

3.1.3.4 Proposed mitigation measures

The measures to prevent soil erosion and contamination of the soil and sediment during Project implementation are enumerated below.

Pre-construction

a) Formulate a Soil Erosion Management Plan (SEMP) that includes among others minimized cut and fill operations during construction and operation.to minimize the modified area to prevent soil erosion of new surface soil due to cut and filling
b) Identify staging areas
c) Formulate Buffer Zone Plan during construction and operations

Construction

a) Implement the recommendations of the geotechnical engineer and the Engineering Geological and Geohazard Assessment (EGGA) Report particularly on areas with steep slopes and dissected or traversed by natural surface-water channels;
b) Surface drainage control works, e.g., construction of drainage canals at the break-of-slope (between the gentle to moderate slopes);
c) Ensure the slope protection after cut and filling as soon as possible
d) Immediate removal of excavated soil stockpiles;
e) Optimize re-use of spoils
f) Cover stockpiles with plastic sheeting;
g) Construct perimeter sediment barriers;
h) Divert upstream drainage away from the stockpiles; and
i) Install drainage canals and settling pond.

Operation - Regular monitoring of areas previously identified to be prone to soil erosion particularly sections with steep slopes, areas transected by river and creek channels, and identified exposed areas prone to soil erosion.

3.1.4 Terrestrial ecology

3.1.4.1 Scope

This section investigated the existing terrestrial flora and fauna at the proposed CMH alignment to determine species of interest under DAO 2007-01 and International Union for the Conservation of Nature (IUCN) Redlist during the low (April-May 2021) and high (July-August 2021) rainfall periods. The srvey season was decide based on the advises from the local ecological academic experts through Key Informant Interview on Biodiversity Experts (Annex 3).

The key impacts assessed were a) vegetation removal and loss of habitat, b) threat to existence of important local species, abundance, frequency and distribution of important species, and c) hindrance to wildlife access.

National legislation and regulations of known relevance to the proposed project were compiled as shown in **Table 3-22**. The listed legislation and regulations are focused on the conservation, management, and operations of the vegetation and wildlife that are present in the project area.

Table 3-22. National and Local Legislations on Terrestrial Ecology

National Legislations and Regulations	Description
Presidential Decree No. 1152 (1977)	The Environmental Code of the Philippines. Comprehensive environmental management was addressed, as were mitigating strategies, and the notion of environmental impact assessment was

National Legislations and Regulations	Description
	presented for the first time.
Presidential Decree No. 1586	Establishing an Environmental Impact Statement System which requires all governments and projects that are likely to have significant environmental impacts to undergo an environmental impact assessment (EIA) and secure an environmental compliance certificate (ECC) prior the implementation.
Revised Procedural Manual DAO No. 30 Series of 2003 (IRR of Presidential Decree No. 1586)	Provide procedural guidelines for the conduct of environmental impact assessments (EIAs) under the Philippine Environmental Impact Statement (EIS) System Law. The manual provides detailed procedures and requirements for various stages of the EIA process, including scoping, impact assessment, review and evaluation, public participation, and decision-making.
Republic Act 9147, otherwise known as the Wildlife Conservation and Protection Act of 2001	Provides for the regulation of wildlife trade and penalizes activities such as hunting, killing, trading, and collecting wildlife without proper permits or licenses. The law also establishes protected areas, wildlife sanctuaries, and critical habitats and mandates the creation of a national wildlife database and monitoring system.
DAO 2019-09 Updated National List of Threatened Fauna of the Philippines	Provides an up-to-date list of vulnerable fauna species in the country. The order revises the existing national list of threatened wildlife species and categorizes them based on their level of endangerment. The decree intends to give a more thorough and accurate assessment of the conservation status of wildlife in the Philippines.
DAO 2007-01 Establishing the National List of Threatened Philippine Plant and their Categories. DAO 2017-11 Updated National List of Threatened Philippine Plants and their Categories	Provides an updated list of threatened plant species in the country. The order classifies threatened plant species into different categories based on their level of endangerment, such as critically endangered, endangered, vulnerable, and other categories. The order aims to promote the conservation and sustainable use of Philippine plant species.
International Union for Conservation of Nature (IUCN) Red List of Threatened Species 2022	The Red List provides information on the conservation status of plant and animal species and categorizes them based on their level of endangerment. Thousands of species have been assessed in the 2022 update, including newly identified species and those that have been appraised based on new information.
Memorandum Circular No. 01, Series of 2014. Guidelines for the implementation of the DPWH-DENR-DSWD Partnership on the Tree Replacement Project	A joint memorandum circular issued by the DPWH, DENR, and (DSWD) in the Philippines. The circular provides guidelines for the implementation of the DPWH-DENR-DSWD Partnership on the Tree Replacement Project, which aims to address the negative impacts of road construction and development activities on trees and forests in the country.

3.1.4.2 Methodology

3.1.4.2.1 Survey locations

A total of 20 transects and 13 wildlife stations at the proposed CMH alignment were established for the terrestrial flora and fauna survey during low and high rainfall periods. The description of the survey stations and locations are shown in **Table 3-23**, **Figure 3-33**, and **Figure 3-34,** respectively.

Table 3-23. Description of survey transect locations and wildlife sampling stations

Transect	WS*	Coordinates		Location	Description	Elevation (Transect)	Elevation (WS)
		Latitude	Longitude				
T1		8.526824N	124.773805E	Brgy. Natumolan, Tagoloan, Misamis Oriental	- Near residential areas - Coconut and mango plantation areas, open grassland, and residual secondary forest patches at the ravine - Along a recently constructed bypass road	90 m	
T2		8.509145N	124.790908E	Brgy. Natumolan, Tagoloan, Misamis Oriental	- Residual secondary forest patches, with dragon fruit farms at the middle - Along a river designated as Station A2 in the Aquatic Ecology Report	79 m	
770	W1	8.471173N	124.801985E	Brgy. Puerto, Cagayan De Oro, Misamis Oriental	- Mix Agroforestry areas – mango orchards, tree plantation, and cornfields - Near residential areas	306 m	297m
T4	W2	8.440797N	124.794726E	Brgy. Alae, Manolo Fortich, Bukidnon	- Open grasslands, mango farms, and sugarcane plantations - Relatively dense vegetation - Near existing road	369 m	335 m
T5		8.390226N	124.818877E	Brgy. San Miguel, Manolo Fortich, Bukidnon	- Corn and pineapple plantations - Relatively dense vegetation of residual forest patches - Along existing farm road	488 m	
T6	W3	8.353218N	124.841403E	Brgy. Damilag, Manolo Fortich, Bukidnon	- Agroforest patches near the river - Surrounded by pineapple plantation - Along a river designated as	535 m	547 m

Transect	WS*	Coordinates		Location	Description	Elevation (Transect)	Elevation (WS)
		Latitude	Longitude				
					Station A4 in the Aquatic Ecology Report - Along a recently constructed bypass road		
T7	W4	8.344273N	124.878687E	Brgy. Ticala, Manolo Fortich, Bukidnon	- Along Mangima river designated as Station A5 in the Aquatic Ecology Report - Mix agroforest areas on both sides of the ravine - Cornfields near the river and pineapple plantation at the top of the plateau	437 m	448 m
T8	W5	8.334346N	124.899387E	Brgy, Ticala, Manolo Fortich, Bukidnon	- Pineapple plantations at the top of the plateau - Along Mangima river - Thick agroforest areas at the ravine	486 m	483 m
T9	W6	8.316875N	124.949273E	Brgy. Poblacion, Sumilao, Bukidnon	- Mix agroforest areas with pineapple plantations and cornfields - Open grasslands - Along Kulaman river designated as Station A8 in the Aquatic Ecology Report	585 m	615 m
T10	W7	8.312623N	124.968161E	Brgy. Kisolon, Sumilao, Bukidnon	- Cornfields and pineapple plantations with thick agroforest patches. - Along a river designated as Station A9 in the Aquatic Ecology Report - Along an existing road	527 m	527 m
T11	W8	8.304293N	124.979158E	Brgy. Kisolon, Sumilao, Bukidnon	- Cornfields and pineapple plantations at the top of the ravines with thick agroforest patches near the river - Along a river designated as Station A10 in the Aquatic Ecology Report	592 m	604 m

Transect	WS*	Coordinates		Location	Description	Elevation (Transect)	Elevation (WS)
		Latitude	Longitude				
T12		8.280694N	124.986617E	Brgy. Poblacion, Impasug-ong, Bukidnon	- Plantations of pineapple, sugarcane and corn - Near residential areas and existing road - Near poultry farms	715 m	
T13	W9	8.263415N	125.001206E	Brgy. La Fortuna, Impasug-ong, Bukidnon	- Sugarcane, corn and pineapple plantations - Thick agroforest areas on the ravines - Along a river designated as Station A11 in the Aquatic Ecology Report - Along existing road	731 m	757 m
T14		8.235670N	125.015447E	Brgy. Impalutao, Impasug-ong, Bukidnon	- Primarily grasslands - Plantations of pineapple, banana, corn and rice. - Generally minimal vegetation	846 m	
T15	W10	8.223170N	125.023118E	Brgy. Impalutao, Impasug-ong, Bukidnon	- Pineapple and cornfields with minimal vegetations - Open grasslands	867 m	
T16		8.212647N	125.037700E	Brgy. Dalwangan, Malaybalay, Bukidnon	- Open grasslands with minimal vegetations - Near poultry farms and community areas	869 m	
T17	W11	8.198904N	125.050225E	Brgy. Dalwangan, Malaybalay, Bukidnon	- Primarily pineapple plantations and plantation of lemons were noted. - Near large poultry farms and community areas - Along existing road	872 m	
T18	W12	8.183185N	125.055739E	Brgy. Patpat, Malaybalay, Bukidnon	- Plantation of corn, pineapple, sugarcane and rubber tree - Near Sawaga river designated as Station A15 in the Aquatic Ecology Report	867 m	
T19		8.166587N	125.077612E	Brgy. Kalasungay, Malaybalay, Bukidnon	- Plantation of pineapples, corn and sugarcane - Generally minimal vegetation	820 m	
T20	W13	8.162120N	125.110368E	Brgy.	- Plantation of corn,	685 m	

Transect	WS*	Coordinates		Location	Description	Elevation (Transect)	Elevation (WS)
		Latitude	Longitude				
				Kalasungay, Malabalay, Bukidnon	pineapples, sugarcane and some fruit bearing trees - Minimal vegetation - Near residences and large poultry farms - Along existing road - Near Sawaga river designated as Station A16 in the Aquatic Ecology Report		

NOTE: WS* – wildlife station

Figure 3-33. Terrestrial flora and fauna survey stations map

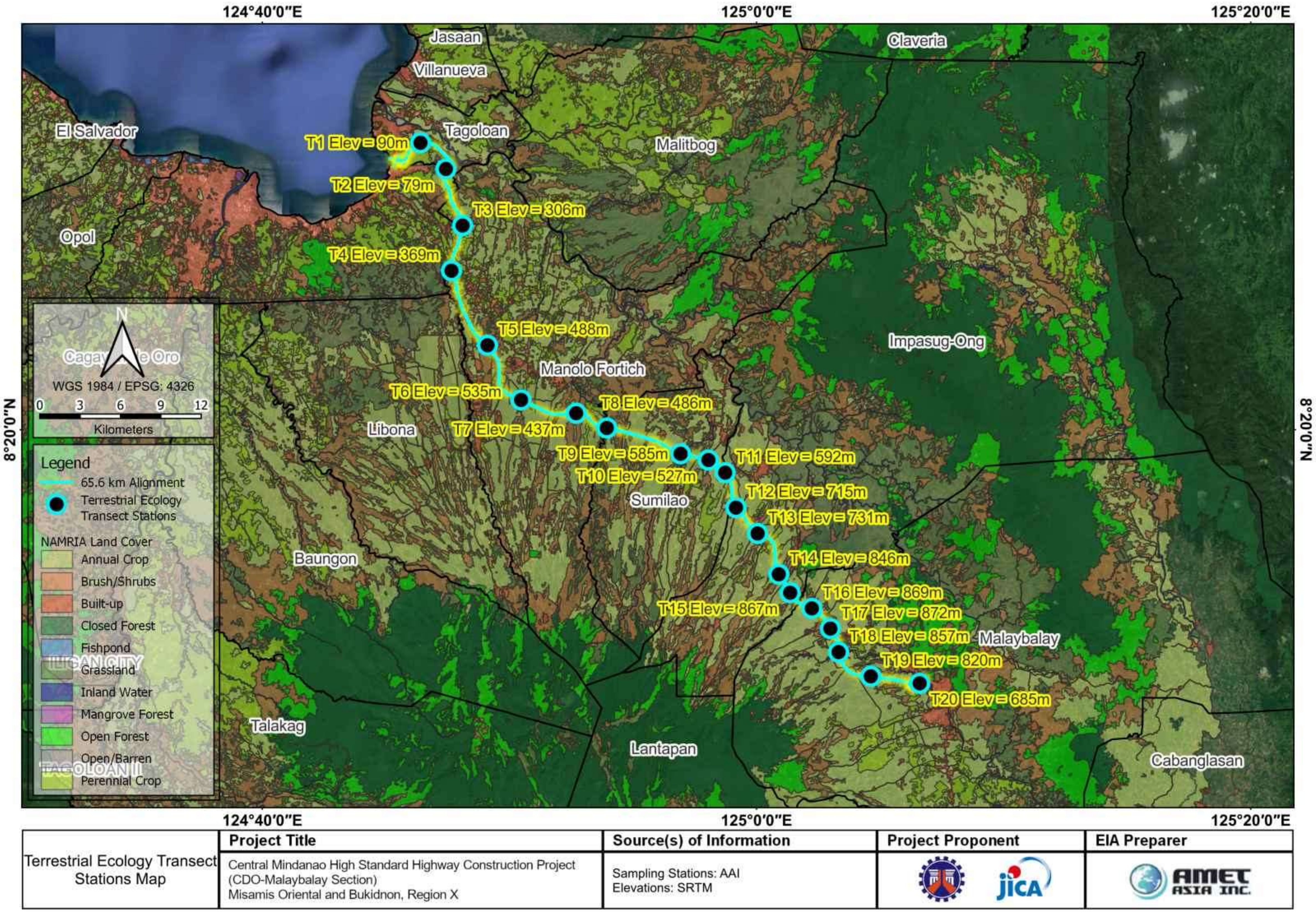
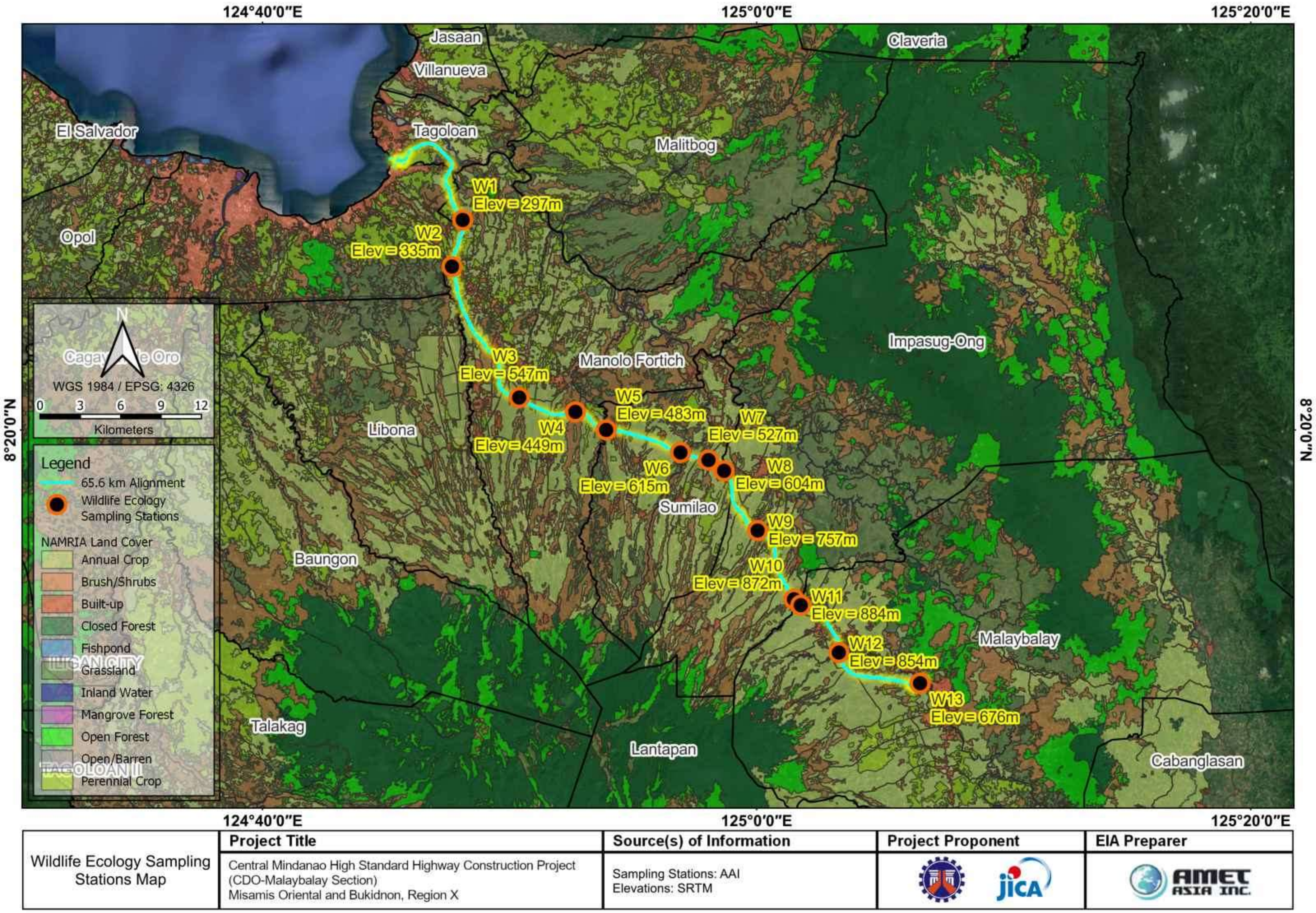


Figure 3-34. Wildlife survey stations map



3.1.4.2.2 Flora survey

Trees - Trees that fall within the survey stations including those within the riparian zones were counted beginning from the entry point of the proposed CMH alignment in Tagoloan, Misamis Oriental to its exit point in Malaybalay, Bukidnon. Trees were identified down to the species level as possible.

Grassland and understory vegetation - Grassland and understory vegetation along selected sections of the tree transects were assessed using 1.0 m^2 quadrats spaced 50m apart along the transect line for a total of 20 quadrats. All species documented within each 1.0 m^2 quadrat were identified and classified according to life form such as grass, shrub, tree seedling, fern, or vine, as applicable.

3.1.4.2.3 Wildlife Survey

Avifauna - Birds were surveyed by transect count, mist netting, and incidental surveys from Transect 1 to Transect 20 and by point surveys at the wildlife/riparian stations. Transect counts were done by walking a 2-km transect in each survey location for two hours. Two standard mist nets were installed in each of the 13 wildlife stations for a total of two net-nights/net-days per station.

Birds were identified using local names by acoustic calls and visual appearance with the aid of field guides (Kennedy et al., 2000; Fisher and Hicks, 2000; Strange, 2000). All birds captured using mist nets were subjected to standard biometric measurements such as total length (TL), tail-vent length (TV), weight (WT), wing cord (WC), bill or culmen (B), gape (G), and tarsus (T) and were released after documentation.

Bats - Bats were collected using mist-nets installed near fruiting *Ficus* trees and along probable flyways. Age and sex of bats were determined, alongside external measurements such as total length (TL), tail vent length (TV), ear length (EL), forearm length (FA), and hindfoot length (HF). Bats were identified using the Key to Philippine Bats (Ingle and Heaney, 1992). The bats were revitalized with sugar solution and released after documentation.

Herpetofauna - Herpetofauna were sampled using the cruising method (opportunistic sampling) or incidental surveys including nocturnal sampling for frogs. Streams, creeks, and microhabitats of each sampling station were thoroughly searched for the presence of frogs guided by frog vocalization. All captured individuals were subjected to morphometrics (snout-vent length, SVL). Identification of frogs is based on Alcala (1986), Alcala and Brown (1998), and Brown et al. (2000).

Non-volant mammals - Small mammals were sampled using cage traps or snap traps baited with roasted coconut meat and coated with peanut butter. Traps were positioned 5 to 10 m apart along possible runways, near burrow entrances, under root tangles, on top of fallen logs, and other probable faunal corridors.

All individuals captured were photographed and subjected to biometric measurements such as weight, sex, approximate age (adult, sub-adult or adult) and when applicable, reproductive condition, total length (TL), tail-vent length, (TV), ear length (E), and hindfoot length (HF). For large mammals such as macaques and wild pigs, survey techniques were carried out by detection of footprints and droppings.

Insects - Insects were collected via opportunistic sampling using a hand net. Specimens collected were placed in paper packets (paper wax/ glassine paper) or centrifuge tubes with a pre-filled 95% ethanol for preservation. After the collection period, rehydration and air drying will be done for butterflies and moths. Where possible, insects were identified down to the genus or species level.

3.1.4.3 Data analysis

The relative frequency, relative density, relative dominance and species importance value (SIV) were computed for all species as shown below:

Relative Frequency $$\frac{\text{No. of plots containing a species}}{\text{Sum of frequencies of all species}} \text{ x } 100$$

Relative Density $$\frac{\text{No. of individual species}}{\text{Total no. of individuals of all species}} \text{ x } 100$$

Relative Dominance $$\frac{\text{Dominance of species}}{\text{Total dominance of species}} \text{ x } 100$$

Abundance $$\frac{\text{Total Number of Individual species}}{\text{Total Number of Species Population}} \text{ x } 100$$

Relative abundance $$\frac{\text{Abundance of one species}}{\text{Total Number of Species Population}} \text{ x } 100$$

SIV = relative frequency + relative density + relative dominance

3.1.4.4 Assessment of key impacts

The results of the surveys were integrated in the assessment of the key impacts previously presented. The reader is referred to the appendices enumerated below because only the salient findings of the survey were included in this section.

a) Appendices 11, 15, 19, 21, 23, 26 - Photo documentation of the terrestrial ecology survey
b) Appendix 8 - Tree inventory data
c) Appendix 9 - Importance values of trees recorded across the stations
d) Appendix 10 - Species and conservation status of trees documented across stations
e) Appendix 12 – List of Flora Species indicated in the IUCN Red List
f) Appendix 13 - Importance values of grassland and understory vegetation recorded across the stations
g) Appendix 14 - Abundance and distribution of birds across stations
h) Appendix 16 – List of Avifaunal Species indicated in the IUCN Red List
i) Appendix 17 - Total bat captures across stations in the Project Site
j) Appendix 18 - Individual morphometrics of bats captured per site
k) Appendix 20 - Abundance of murid species collected across the stations
l) Appendix 22 - Relative abundance of herpetofauna captured
m) Appendix 24 – List of Herpetofauna Species indicated in the IUCN Red List
n) Appendix 25 - Terrestrial insect distribution and abundance at the sampling sites

3.1.4.4.1 Vegetation removal and loss of habitat

Trees - The tree and bamboo survey recorded a total of 10,929 individuals and clumps with 98 species under 37 families. Trees further classified into a) forest-associated species, b) orchard, c) and plantation species were generally dominated by plantation species with a relative abundance of 84.14% (Figure **3-35).**

Across all sites, forest species were the most abundant with 72 species (73.46%) relative to orchard or plantation species both with 13 species (13.72%) (**Figure 3-36**). Diverse species of forest trees were generally observed in remnant forest patches along riparian zones. Transects with less tree diversity or abundance are generally associated with pineapple plantation or agricultural areas, starting from Transect 1 in Tagaloan, Misamis Oriental towards Transect 20 in Malaybalay, Bukidnon.

The most abundant species recorded was *Hevea brasiliensis* (Brazilian fire tree) with a total count of 4,903 individuals, followed by *Dendrocalamus asper* (Giant Bamboo) with 1,278 clumps, and *Falcataria moluccana* (falcata) with a total count of 1,131 individuals (**Table 3-25**). The rest of the top 10 most abundant trees were all tree plantation and orchard species, notably *Nephelium lappaceum* (rambutan), *Durio zibethinus* L. (durian), *Lansium domesticum* Correa (lanzones), *Gmelina arborea* Roxb. ex Sm. (gmelina), *Mangifera indica* L. (manga), *Swietenia macrophylla* King (mahogany), and *Spathodea campanulata* P.Beauv. (Tulip tree). *Spathodea campanulata* P.Beauv. (Tulip tree) was also the most frequently observed tree across the Project Site with a Relative Frequency of 90%, followed by *Gmelina arborea* (gmelina) and *Artocarpus odoratissimus* (marang) at 85 and 80% Relative Frequency, respectively (**Table 3-26**).

Table 3-24. Taxonomic Classification of the Flora Species Present in the Project Area

Family	Species	Common Name
Achariaceae	*Pangium edule*	Football Fruit
Actinidiaceae	*Saurauia sp.*	-
Adoxaceae	*Sambucus javanica*	Elderberry
Anacardiaceae	*Anacardium occidentale*	Cashew Nut
Anacardiaceae	*Mangifera indica*	Mango
Anacardiaceae	*Semecarpus sp.*	-
Anacardiaceae	*Rhus taitensis*	Sumac
Annonaceae	*Annona muricata*	Soursop
Annonaceae	*Annona squamosa*	Sugar apple
Annonaceae	*Polyalthia longifolia*	False Asoka
Araliaceae	*Osmoxylon sp.*	-
Araliaceae	*Polyscias nodosa*	Malapapaya
Apocynaceae	*Alstoniascholaris*	Blackboard Tree
Araucariaceae	*Araucaria heterophylla*	Norfolk Island Pine
Arecaceae	*Cocos nucifera*	Coconut Palm
Bignoniaceae	*Spathodeacampanulata*	African tuliptree
Bignoniaceae	*Tabebuia chrysotricha*	Golden Trumpet Tree
Bignoniaceae	*Hydroanthus chrysotrichus*	Yellow Trumpet Tree
Bombacacee	*Ceiba pentandra*	Kapok Tree
Brownlowiaceae	*Diplodiscuspaniculatus*	Balobo
Burseraceae	*Canarium ovatum*	Pilinut
Cannabaceae	*Trema orientalis*	Oriental Trema
Clusiaceae	*Garcinia mangostana*	Mangosteen
Combretaceae	*Terminalia catappa*	Tropical Almond Tree
Cunoniacee	*Spiraeopsissp*	-
Dipterocarpaceae	*Shorea contorta*	White Lauan
Elaeocarpaceae	*Elaeocarpus sp.*	-
Euphorbiaceae	*Macaranga bicolor*	Hamindang
Euphorbiaceae	*Macaranga hispida*	Nasturtium Tree
Euphorbiaceae	*Macaranga sp.*	-
Euphorbiaceae	*Macaranga tanarius*	Parasol Leaf Tree
Euphorbiaceae	*Mallotussp.*	-
Euphorbiaceae	*Melanolepismultiglandulosa*	Ayum-ayum
Euphorbiaceae	*Homalanthusmacradenius*	The bleeding Heart
Euphorbiaceae	*Hevea brasiliensis*	Brazilian Fire Tree
Fabaceae	*Acacia mangium*	Black Wattle
Fabaceae	*Casia fistula*	Golden Shower Tree
Fabaceae	*Erythrina variegata*	Variegated Coral Tree
Fabaceae	*Falcatariamoluccana*	Moluccan albizia
Fabaceae	*Leucaena leucocephala*	Ipil-ipil

Family	Species	Common Name
Fabaceae	*Pithecellobium dulce*	Manila Tamarind
Fabaceae	*Pterocarpus indicus*	Narra
Fabaceae	*Schizolobiumparahyba*	Brazilian Fern Tree
Fabaceae	*Caesalpinia pulcherrima*	Peacock Flower
Fabaceae	*Albizia saman*	Rain Tree
Fabaceae	*Albizia saponaria*	Soap Acacia
Hypericaceae	*Cratoxylumsumatranum*	Kansilay Tree
Lamiaceae	*Gmelina arborea*	Yemane
Lauraceae	*Litsea cordata*	Litsea
Lauraceae	*Litseaphilippinensis*	Bakan
Lauraceae	*Persea americana*	Avocado
Lauraceae	*Cinnamomum mercadoi*	Kalingag
Lecythidaceae	*Barringtonia reticulata*	Barringtonia
Lythraceae	*Duabanga sp.*	-
Malvaceae	*Duriozibethinus*	Durian
Melastomataceae	*Astroniasp.*	-
Meliaceae	*Lansiumdomesticum*	Lanzones
Meliaceae	*Sandoricumkoetjape*	Santol
Meliaceae	*Swietenia macrophylla*	Mahogany
Meliaceae	*Azadirachtaexcelsa*	Giant Neem Tree
Meliaceae	*Azadirachta indica*	Neem Tree
Moraceae	*Artocarpus blancoi*	Tipolo
Moraceae	*Artocarpus heterophyllus*	Jackfruit
Moraceae	*Artocarpus odoratissimus*	Marang
Moraceae	*Ficus ampelas*	Ampelas
Moraceae	*Ficus fiskei*	Sandpaper Leaf
Moraceae	*Ficus minahassae*	Cluster Fig Tree
Moraceae	*Ficus nota*	Tibig
Moraceae	*Ficus pseudopalma*	Philippine Fig
Moraceae	*Ficus septica*	Hauli Tree
Moraceae	*Ficus ruficaulis*	Ficus Tree
Moraceae	*Ficus sp. 1*	-
Moraceae	*Ficus sp. 2*	-
Moraceae	*Ficus sp. 3*	-
Moraceae	*Ficus balete*	Balete Tree
Moraceae	*Ficus magnoliifolia*	Common Fig
Moraceae	*Streblus asper*	Kalios Tree
Myrtaceae	*Eucalyptus camaldulensis*	River Red Gum
Myrtaceae	*Eucalyptus deglupta*	Mindanao Gum
Myrtaceae	*Psidium guajava*	Guava
Myrtaceae	*Syzygiumaqueum*	Water Apple
Myrtaceae	*Syzygiumcumini*	Java Plum
Pinaceae	*Pinus kesiya*	Khasi Pine
Poaceae	*Dendrocalamus asper*	Rough Bamboo
Phyllanthaceae	*Antidesmaghaesembilla*	Black Currant Tree
Rhamnaceae	*Rhamnus philippinensis*	Buckthorn
Rhamnaceae	*Ziziphus jujuba*	Jujube
Rubiaceae	*Greeniopsissp.*	-
Rubiaceae	*Neonauclea sp.*	-
Rubiaceae	*Morindacitrifolia*	Indian Mulberry
Rutaceae	*Melicopetriphylla*	Three Leaf
Sapindaceae	*Pometia pinnata*	Lychee

Family	Species	Common Name
Sapindaceae	*Nephelium lappaceum*	Rambutan
Sapotaceae	*Chrysophyllumcainito*	Star Apple
Sterculiaceae	*Sterculia rubiginosa*	Rusty Sterculia
Sterculiaceae	*Kleinhoviahospita*	Guest Tree
Urticaceae	*Dendrocnide sp.*	-
Verbenaceae	*Vitex parviflora*	Molave

Table 3-25. Abundance estimates of top 10 tree species recorded across stations

Common Name	Scientific name	Species category	Number*
Rubber tree	*Hevea brasiliensis (Willd. ex A.Juss.) Müll.Arg.*	Plantation	4,903
Giant Bamboo	*Dendrocalamus asper (Schult.f.) Backer ex Heyne*	Plantation	1,278
Peacocks plume	*Falcataria moluccana (Miq.) Barneby & J.W.Grimes*	Plantation	1,131
Rambutan	*Nephelium lappaceum L.*	Orchard	493
Durian	*Durio zibethinus L.*	Orchard	455
Lanzones	*Lansium domesticum Correa*	Orchard	327
Gmelina	*Gmelina arborea Roxb. ex Sm.*	Plantation	292
Mango	*Mangifera indica L.*	Orchard	272
Mahogany	*Swietenia macrophylla King*	Plantation	232
Tulip tree	*Spathodea campanulata P.Beauv.*	Plantation	216

*Number of individuals or clumps

Table 3-26. Top 10 species of trees frequently recorded across survey sites

Common Name	Scientific name	Species Category	Frequency (%)
Tulip tree	*Spathodea campanulata* P. Beauv.	Tree Plantation	90
Gmelina	*Gmelina arborea Roxb.* ex Sm.	Tree Plantation	85
Marang	*Artocarpus odoratissimus* Merr.	Orchard	80
Mahogny	*Swietenia macrophylla* King	Tree Plantation	70
Bakan	*Litsea philippinensis* Merr.	Forest	70
Antipolo	*Artocarpus blancoi* (Elmer) Merr.	Forest	65
Jackfruit	*Artocarpus heterophyllus* Lam.	Orchard	65
Malapapaya	*Polyscias nodosa* (Blume) Seem	Forest	60
Ipil-ipil	*Leucaena leucocephala* (Lam.) de Wit	Exotic Reforestation	55
Alim	*Melanolepis multiglandulosa* (Reinw. ex Blume) Rchb. & Zoll.	Forest	55

Figure 3-35. Abundance of trees at the survey stations

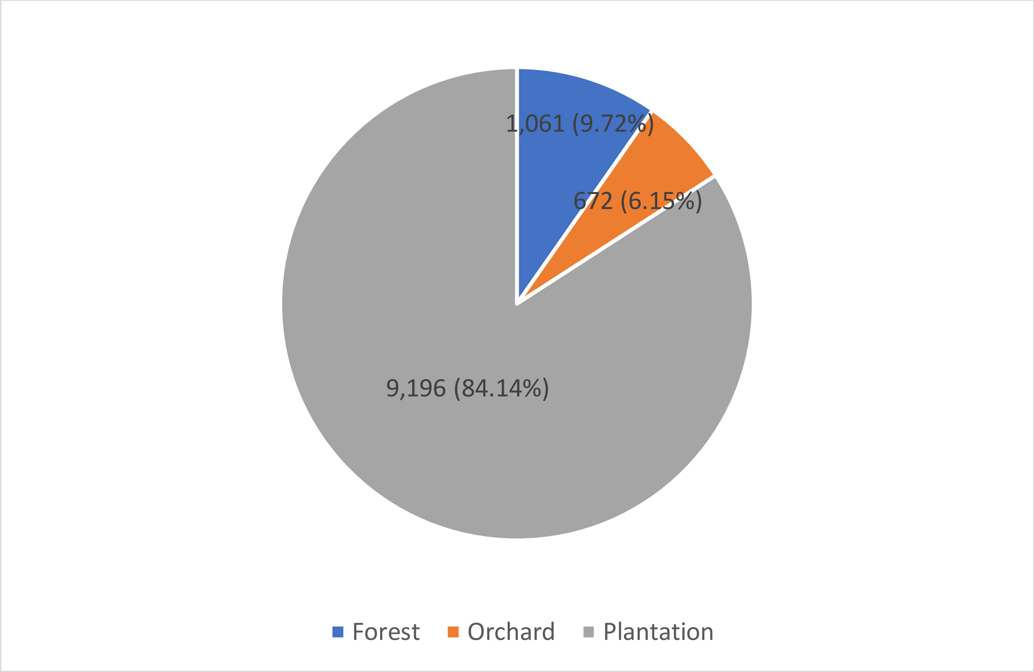
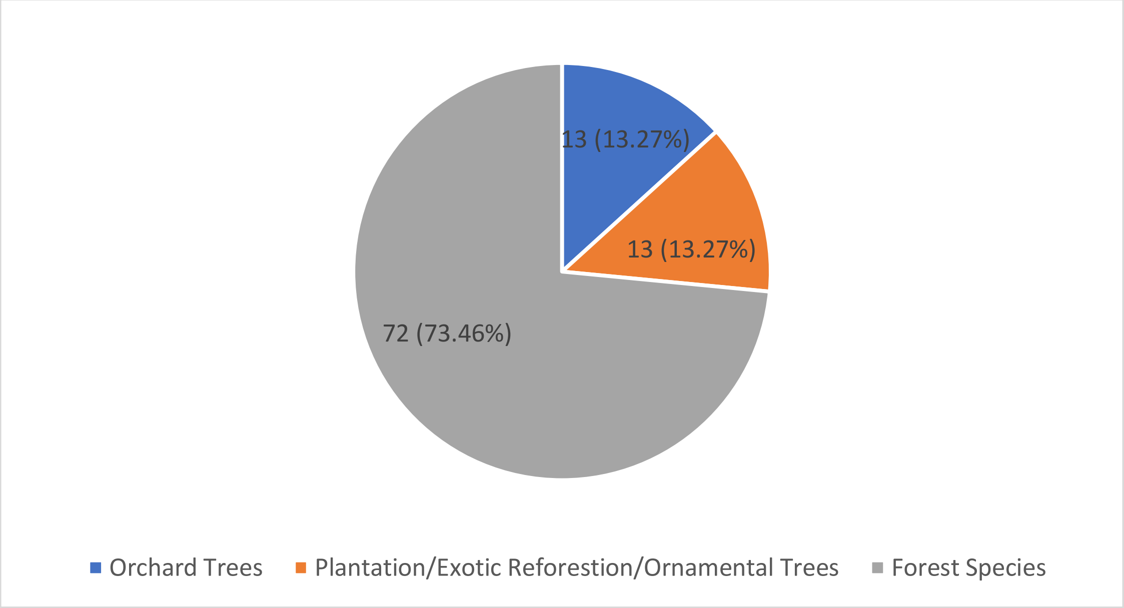


Figure 3-36. Species richness per tree category recorded at the survey stations



The proposed CMH alignment will cut across vast agricultural areas that will affect existing orchards and tree and pineapple plantations. As such, majority of trees that will be removed during road construction are orchard/plantation species (Relative Abundance=90.3%) such as coconuts, mango trees, Brazilian rubber tree, Brazilian fire tree, gmelina, mahogany, and cash crops like corn and vegetables. Only sections around Barangay Natumolan in Tagoloan, Barangay Alae in Manolo Fortich and riparian zones have significant stands of forest trees (Relative Abundance=9.7%), usually interspersed with or surrounded by small farms.

3.1.4.4.2 Threat to existence, abundance, frequency, and distribution of important species

The IBAT Proximity Report identified 523 species in the IUCN Red List that are potentially found within 50 km of the area of interest. IBAT Proximity Report using buffer of 50 km indicates that there are 40 species listed as endangered (EN) and 11 species listed as critically endangered (CR), 246 are Vulnerable (VU), 226 are Near Threatened (NT). IBAT results also show that there are two Key Biodiversity Areas near the Project (i.e., Mt. Tago Range and Mt. Kaluayan - Mt. Kinabalian Complex) and three Protected Areas (i.e., Mahoganao, Mt Kitanglad Range and Manupali)

As for habitats of birds and/or others in the area, it may be changed due to cutting trees though its impact is considered as small degree. However, road projects may enhance access to the biodiversity-rich areas and protected areas that might lead to habitat destruction and the catalyst for the spread of major threats. Since the project is located outside the nearest Protected Area (Mt. Kitanglad at 7.07 km) and KBA (Mt. Tago Range at 950m), minimal impacts were expected.

3.1.4.4.2.1 Flora

Trees - Calculations of Species Importance Values (SIVs) showed *Hevea brasiliensis* (Brazilian fire tree) as the 'most important species' vis-à-vis most planted commercial species with an SIV of 91.95, followed by *Dendrocalamus* asper and *Falcataria moluccana* (falcata) at SIVs of 25.85 and 19.67, respectively. The rest of the top 10 species with highest SIVs are all tree plantation or orchard species. *Hevea brasiliensis* (Para rubber tree) is a widespread species native to the Amazon region of South America. This species has been introduced to several tropical countries outside its natural range where plantations to produce natural rubber have been established[18].

Species Diversity

Table 3-27 displays data collected from transects regarding species diversity. There are 20 transects listed, and for each transect, the number of species, individuals, dominance, evenness, H-diversity, and criterion are recorded. The number of species identified in each transect ranges from 3 to 50, and the number of individuals ranges from 4 to 1427. Dominance is a measure of the most common species, and it ranges from 6.93% to 77.57%. Evenness is a measure of how equally distributed the species are, and it ranges from 9.31% to 75.37%.

H-diversity is a measure of the diversity of the area, and it ranges from 0.76 to 3.06. A higher H-diversity indicates a more diverse area. The criterion ranges from very low to high and is based on the H-diversity score. Overall, the data suggests that most of the transects have very low to low diversity, with only a few having moderate or high diversity. The evenness of the diversity index varies widely, indicating that some areas have a more evenly distributed variety of species than others. The dominance measure also varies widely, with some areas having a few dominant species and others having more evenly distributed dominance.

Table 3-27. Species Diversity Indices of the Transects Established for Flora

Transects	Species	Individuals	Dominance	Evenness	H-diversity	Criterion
1	50	498	6.93%	42.64%	3.06	High
2	15	89	18.80%	50.09%	2.02	Low
3	28	1016	48.64%	14.44%	1.4	Very Low
4	20	312	24.55%	32.28%	1.87	Very Low
5	24	252	12.64%	45.12%	2.38	Low
6	20	120	61.67%	15.62%	1.14	Very Low
7	24	55	7.44%	75.37%	2.9	Moderate
8	21	536	75.38%	10.22%	0.76	Very Low

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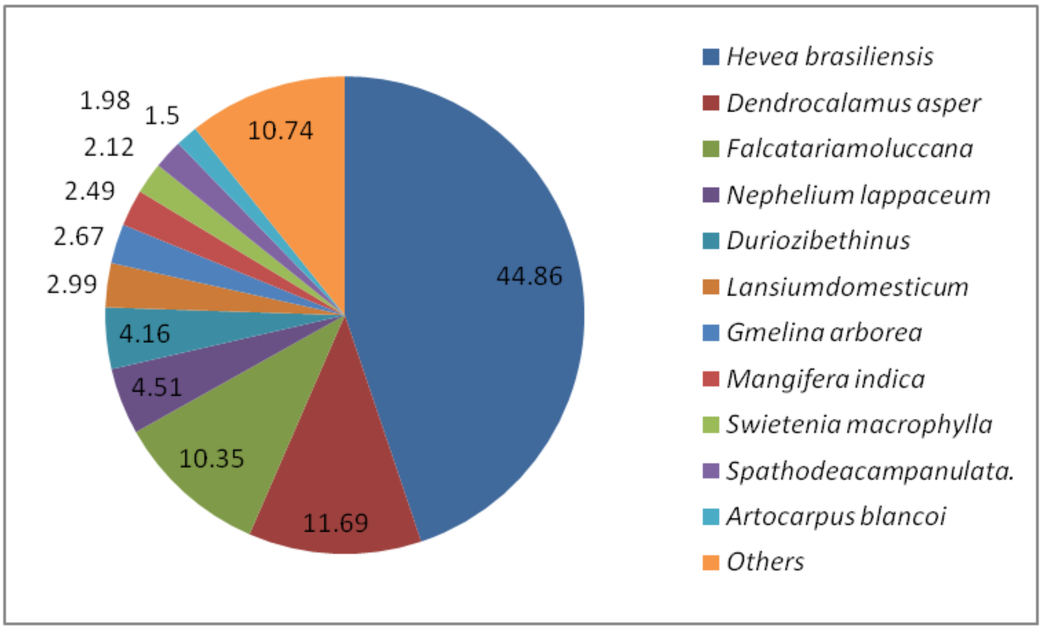
[18] Fabriani, F. & Hills, R. 2020. *Hevea brasiliensis.* The IUCN Red List of Threatened Species 2020

Transects	Species	Individuals	Dominance	Evenness	H-diversity	Criterion
9	28	78	8.88%	61.70%	2.85	Moderate
10	23	147	29.63%	31.34%	1.98	Very Low
11	15	137	64.87%	17.73%	0.98	Very Low
12	8	37	29.47%	56.80%	1.51	Very Low
13	24	182	55.49%	15.56%	1.32	Very Low
14	3	4	37.50%	94.28%	1.04	Very Low
15	16	277	42.16%	27.27%	1.47	Very Low
16	26	1215	30.41%	17.15%	1.5	Very Low
17	16	42	11.90%	72.42%	2.45	Low
18	21	1101	76.56%	9.31%	0.67	Very Low
19	18	456	77.57%	9.73%	0.56	Very Low
20	24	1427	37.54%	17.83%	1.45	Very Low

Relative Abundance

Figure 3-37 shows the most abundant species recorded was *Hevea brasiliensis* (Brazilian fire tree) with a total count of 4,903 individuals, followed by *Dendrocalamus asper* (Giant Bamboo) with 1,278 clumps, and Falcataria moluccana (falcata) with a total count of 1,131 individuals. However, the species "Others" were the summation of trees which has less than 1% relative abundance that overall comprises as 10.74%. Across all sites, forest species were the most abundant with 72 species (73.46%) relative to orchard or plantation species both with 13 species (13.72%). Diverse species of forest trees were generally observed in remnant forest patches along riparian zones. Transects with less tree diversity or abundance are generally associated with pineapple plantation or agricultural areas, starting from Transect 1 in Tagaloan, Misamis Oriental towards Transect 20 in Malaybalay, Bukidnon.

Figure 3-37. Overall Relative Abundance of Terrestrial Flora



Species Presence

Table 3-28 lists below shows tree species observed with their presence or absence in 20 transects. Some species are present in almost all transects, such as *Albizia saman*, while others are only present in a few transects, such as *Astronia* sp. One interesting thing to note is the presence of certain species in specific transects. For example, *Artocarpus blancoi* is present in all transects except for transect 1 and 13. In addition,there are clustering of certain species in the transects. For instance, transects 1, 6, and 9 have a high number of *Artocarpus heterophyllus*, while transects 4, 5, and 7 have a high number of *Ceiba pentandra*. This could be because these species are adapted to specific environmental conditions that are present in these transects.

Table 3-28. Presence of Floral Species per Station and their Location

Species	Transects																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantation	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In between forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Acacia mangium					+												+	+		+
Albizia saman	+	+																		
Albizia saponaria									+											
Alstoniascholaris				+																
Anacardium occidentale	+						+													
Annona muricata	+		+	+					+											
Annona squamosa	+																			
Antidesmaghaesembilla	+		+																	
Araucaria heterophylla																+				
Artocarpus blancoi	+	+	+	+	+	+	+	+	+	+			+					+		+
Artocarpus heterophyllus	+	+	+	+	+		+	+			+		+			+	+	+		+
Artocarpus odoratissimus	+			+	+	+	+		+	+	+	+	+		+	+	+	+	+	+
Astronia sp.																			+	

Species	Transects																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantatio n	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In between forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Azadirachtaexcelsa	+												+							
Azadirachta indica	+																			
Barringtonia reticulata.	+																			
Caesalpinia pulcherrima																				+
Canarium ovatum	+																			
Casia fistula			+		+	+														
Ceiba pentandra	+	+	+	+					+	+			+							+
Chrysophyllumcaimito	+		+										+							+
Cinnamomum mercadoi							+													
Cocos nucifera	+						+													
Cratoxylumsumatranum								+	+	+							+			
Dendrocalamus asper			+			+		+		+	+		+		+			+	+	+
Dendrocnide sp.						+														
Diplodiscuspaniculatus													+							

Species	Transects																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantation	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In between forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Duabanga sp.	+																			
Duriozibethinus															+	+		+		+
Elaeocarpus sp.								+	+											
Erythrina variegata					+								+							
Eucalyptus camaldulensis															+					
Eucalyptus deglupta			+														+			
Falcatariamoluccana			+	+	+					+		+		+		+	+		+	
Ficus ampelas													+							
Ficus balete	+			+																
Ficus fiskei										+										
Ficus magnoliifolia	+		+																	
Ficus minahassae					+	+	+		+	+	+		+			+	+			+
Ficus nota					+	+	+			+	+		+			+			+	
Ficus pseudopalma	+									+	+									

Species	Transects																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantation	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In between forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Ficus ruficaulis	+	+	+			+														
Ficus septica	+					+			+											
Ficus sp.					+		+	+	+		+								+	+
Ficus sp. 2																+			+	
Ficus sp. 3	+															+		+		
Ficus sp. 4																		+		
Garcinia mangostana																+				+
Gmelina arborea	+	+	+	+	+		+	+	+	+	+	+	+		+	+	+	+		+
Greeniopsis sp.										+	+								+	
Hevea brasiliensis												+			+			+	+	+
Hydroanthuschrysotrichus			+							+										4
Kleinhoviahospita	+																			
Lansiumdomesticum				+	+			+	+							+		+		+
Leucaena leucocephala	+			+	+	+			+	+	+			+	+		+	+	+	

Species	Transects																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantation	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In between forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Litsea cordata																			+	
Litseaphilippinensis			+		+	+	+	+	+		+		+		+		+	+	+	+
Macaranga bicolo	+							+		+			+			+	+		+	
Macaranga hispida	+	+	+	+		+							+						+	
Macaranga sp.									+				+							
Macaranga tanarius	+	+	+		+	+	+	+	+		+		+							
Mallotus sp.	+																		+	
Mangifera indica	+	+	+	+											+	+	+	+		+
Melanolepismultiglandulosa	+	+	+	+	+	+	+	+	+	+										+
Melicopetriphylla								+											+	
Morindacitrifolia							+													
Neonauclea sp.	+									+										
Nephelium lappaceum			+	+												+				
Omalanthuspopulneus								+	+								+			

Species	Transects																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantation	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In between forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Osmoxylon sp.					+	+	+			+	+		+							
Palaquium sp.	+																			
Pangiumedule							+													
Persea americana	+			+			+								+	+				
Pinus kesiya					+							+			+	+		+		
Pithecellobium dulce	+						+		+	+	+									
Polyalthia longifolia			+																	
Polyscias nodosa	+	+	+		+	+	+	+	+		+				+	+		+		
Pometia pinnata	+						+			+			+							
Psidium guajava	+		+						+							+				
Pterocarpus indicus	+			+			+			+		+			+	+	+	+		+
Rhamnus philippinensis																			+	
Rhus taitensis								+	+											
Sandoricumkoetjape	+		+	+	+				+				+			+		+		+

Species	Transects																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantation	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In between forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Saurauia sp.								+									+			
Schizolobiumparahyba	+		+					+	+	+								+		+
Semecarpus sp.	+					+		+												
Shorea contorta															+					
Spathodeacampanulata.	+		+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+
Spiraeopsis sp.						+														
Sterculia rubiginosa	+						+		+											
Streblus asper	+																			
Swietenia macrophylla	+	+	+	+	+	+	+	+	+			+	+		+	+				+
Syzygiumaqueum																+				
Syzygiumcumini	+																			
Terminalia catappa	+				+											+				
Trema orientalis	+	+	+		+				+				+			+		+		
Vitex parviflora	+	+																		

Species	Transects																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantation	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In between forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Ziziphus jujuba		+																		

From the 98 species recorded, *Pterocarpus indicus Willd.* is classified as Endangered according to IUCN and Vulnerable as per DAO 2017-11, while the others were classified as follows based on DAO 2017-11: *Vitex parviflora and Shorea contorta* – Endangered; *Azadirachta excelsa* – Vulnerable; *Canarium ovatum* and *Cinnamommum mercadoi* - Other Threatened Species (**Table 3-29**).

Pterocarpus indicus is a large tree species native to much of China, India and Southeast Asia. The species has a very wide native range but is experiencing severe population decline in all parts of the distribution and in each country within the range. Vitex parviflora is known from 13 localities in the Philippines and Indonesia (Moluccas and Lesser Sunda Islands) and East Timor. Reported to be one of the dominant trees in the Philippine monsoon forest. There is a decline in area of occupancy and extent of occurrence as well as loss of quality of habitat[19]. While *Shorea contorta* is a large tree endemic to the Philippines. It has been a commercially important source of timber. *Shorea contorta* has experienced decline due to illegal logging and timber extraction as it is one of the premium hardwoods in the country[20].

The three species "Introduced" were *Anacardium occidentale L., Casia fistula L.*, and *Falcataria moluccana (Miq.) Barneby & J.W. Grimes*. Invasive tree species recorded were the *Gmelina arborea Roxb. ex Sm.*, *Eucalyptus camaldulensis Dehnh.*, and *Psidium guajava L.*

Table 3-29. Conservation status of recorded tree and plant species

Common Name	Scientific name	IUCN	DAO 2017-11
Narra	*Pterocarpus indicus* Willd.	En	Vu
Molave	*Vitex parviflora*	LC	En
White lauan	*Shorea contorta*	LC	En
Philippine Neem Tree	*Azadirachta excelsa*	LC	Vu
Pili	*Canarium ovatum*	LC	OTS
Kalingag	*Cinnamommum mercadoi*	LC	OTS

NOTES: Conservation status: En=Endangered, Vu = vulnerable, and OTS = Other Threatened Species

Grassland and Understory Vegetation - A total of 38,654 individuals of grassland and understory vegetation representing 62 species in 24 families across habitat gradients were sampled from Transect 1 to Transect 20. *Astraceae* was the dominant family across all transects with 10 species followed by *Fabaceae* with 8 species. On a per Family basis, *Poaceae* was the dominant family with 12,476 individual counts followed by *Acanthaceae* with 11,972 individuals.

Across all species, *Asytasia gangetica* subsp. Micrantha (Chinese violet) had the highest Species Importance Value (SIV) with 74.06 followed by *Axonopus compressus* (carabao grass), *Rottboellia cochinchinensis*, *Sphagneticola trilobata*, and *Oplimenus hirtellu,* with Species Importance Values of 54.18, 18.37, 13.32, 12.48, respectively. Except for saplings of *Coffea arabica*, *Swietenia macrophylla*, *Colocasia esculenta* (taro), and *Manihot esculenta* (cassava), most understory plants across the Project Site were generally weed vegetation.

Based on **Table 3-30,** there are a total of 64 species belonging to 28 families of which family Poaceae has the highest number of species observed, which is 7 species. This is followed by the Asteraceae family with 6 species listed and Fabaceae family with 5 species listed.

Moreover, the Poaceae family, also known as the grass family, is represented by several species including *Axonopus compressus*, commonly called Carpet Grass, *Eleusine indica*, known as Goosegrass, and Eragotis amabilis, or Lovegrass. These grasses are commonly found in lawns and pastures due to their tolerance for heavy foot traffic and grazing.

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[19] de Kok, R. 2020. *Vitex parviflora*. The IUCN Red List of Threatened Species 2020

[20] Energy Development Corporation (EDC). 2020. *Shorea contorta*. The IUCN Red List ofThreatened Species 2020

Table 3-30. Taxonomic Classification of the Grass and Shrubs Present in the Project Area

Family	Species	Common Name
Acanthaceae	*Asytasia gangetica subsp. Micrantha*	Chinese violet
Acanthaceae	*Ruella tuberosa*	Minnieroot
Acanthaceae	*Odontonema cuspidatum*	Firespike
Acanthaceae	*Phaulopsis imbritica*	Purple phaulopsis
Amaranthaceae	*Amaranthus spinosus*	Spiny amarath
Amaranthaceae	*Amaranthus viridis*	Slender amaranth
Araceae	*Colocasia esculenta*	Taro
Araceae	*Alocasia cucullate*	Chinese Taro
Aspleniaceae	*Cyathillium cinereum*	Soft tree fern
Asteraceae	*Sphagneticola trilobata*	Creeping oxeye
Asteraceae	*Ageratum conyzoides*	Billygoat Weed
Asteraceae	*Chromolaena odorata*	Siam Weed
Asteraceae	*Synedrella nodiflora*	None
Asteraceae	*Crassocephalum crepidiodes*	Unknown
Asteraceae	*Spilanthes paniculata*	Toothache plant
Asteraceae	*Acmella paniculata*	Toothache plant
Asteraceae	*Erigeron canadensis*	Canadian fleabane
Asteraceae	*Eclipta prostata*	False daisy
Asteraceae	*Tridax procumbens*	Coatbuttons
Bromeliaceae	*Ananas comosus*	Pineapple
Commelinaceae	*Commelina diffusa*	None
Commelinaceae	*Tradescantia fluminensis*	Inch plant
Convolvulaceae	*Ipomea batatas*	Sweet potato
Cornaceae	*Cornus sericea*	Red osier dogwood
Cucurbitaceae	*Melothria pendula*	Creeping cucumber
Cucurbitaceae	*Melonchia corchorifolia*	Heartleaf melon
Cyperaceae	*Kylinga nemoralis*	None
Euphorbiaceae	*Euphorbia hirta*	Asthma plant
Euphorbiaceae	*Euphorbia heterophylla*	Wild poinsettia

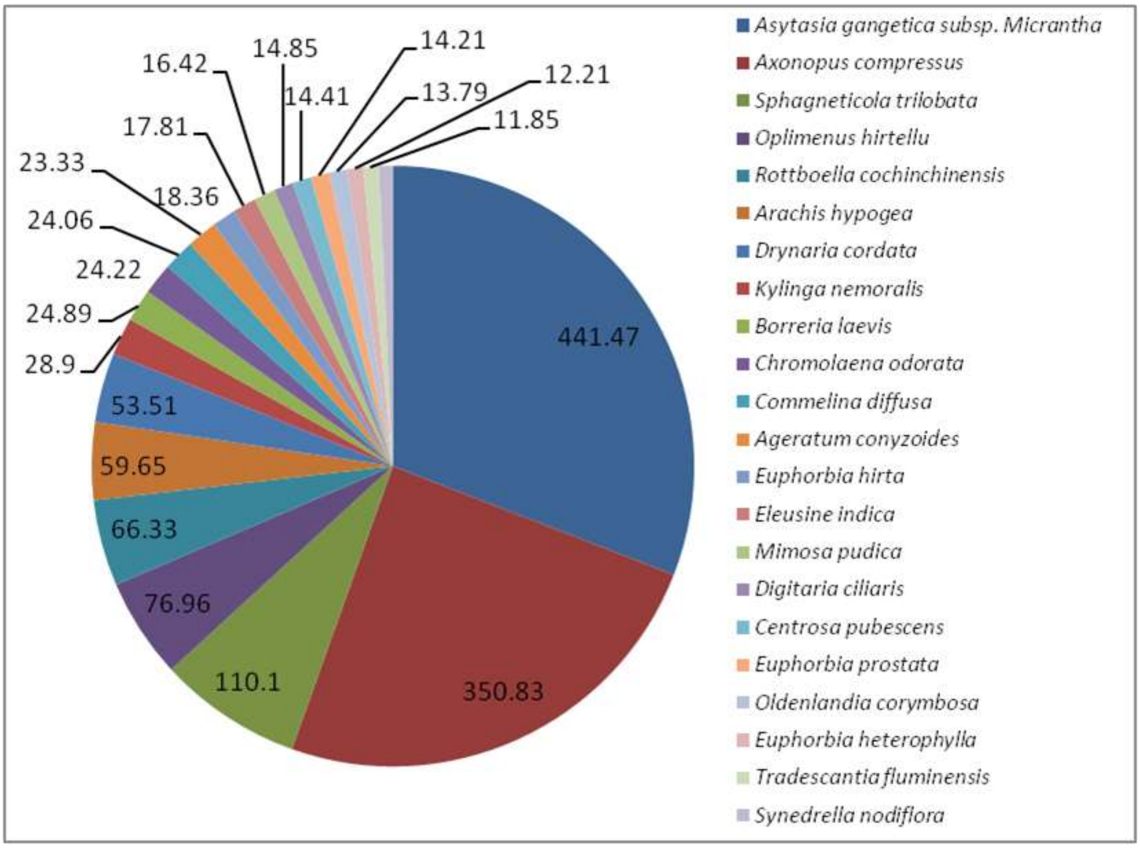
Family	Species	Common Name
Euphorbiaceae	*Euphorbia prostata*	None
Euphorbiaceae	*Manihot esculenta*	Cassava
Fabaceae	*Mimosa pudica*	Sensitive Plant
Fabaceae	*Arachis hypogea*	Peanut
Fabaceae	*Calopogonium mucunoides*	None
Fabaceae	*Crotalaria pallida*	None
Fabaceae	*Mimosa diploticha*	Giant Sensitive Plant
Fabaceae	*Chamaecrista nictitans*	Sensitive Partridge Pea
Malvaceae	*Sida rhombifolia*	Arrowleaf sida
Malvaceae	*Corchorus olitorus*	Jew's mallow
Meliaceae	*Swietenia sapling*	Mahogany
Nephrolepidaceae	*Nephrolepis bisserata*	Sword fern
Piperaceae	*Peperomia pellucida*	Shiny bush
Piperaceae	*Piper sarmentosum*	Wild betel
Poaceae	*Axonopus compressus*	Carpet Grass
Poaceae	*Rottboella cochinchinensis*	None
Poaceae	*Oplimenus hirtellu*	Basket grass
Poaceae	*Eleusine indica*	Goosegrass
Poaceae	*Digitaria ciliaris*	Southern crabgrass
Poaceae	*Cloeme rutidosperma*	Sweetgrass
Poaceae	*Echinocloa colona*	Jungle Rice
Poaceae	*Grona trifloral*	Clustered bluegrass
Poaceae	*Eragotis amabilis*	Lovegrass
Polygonaceae	*Polygonum tomentosum*	Woolly jointweed
Polypodiaceae	*Drynaria cordata*	Heartleaf fern
Rubiaceae	*Centrosa pubescens*	Buttonweed
Rubiaceae	*Borreria laevis*	Smooth Borreria
Rubiaceae	*Richardia grandiflora*	largeflower pusley
Rubiaceae	*Oldenlandia corymbosa*	
Rubiaceae	*Borreria ocymoides*	Smooth buttonweed

Family	Species	Common Name
Rubiaceae	*Coffea arabica* seedlings*	Arabica coffee
Solanaceae	*Solanum torvum*	Turkey berry
Thelypteridaceae	*Christella normalis*	None
Verbenaceae	*Stachytarpheta jamaicensis*	Blue porterweed
Verbenaceae	*Lantana camara*	Lantana

Species Density

Figure 3-38 displays the density of species in both grassland and understory vegetation, with a threshold of 10 individuals/m^2. According to the data presented, the plant species with the highest density is *Asytasia gangetica* subsp. Micrantha, with 441.47 individuals/m^2. On the other hand, the species with the lowest density is *Melonchia corchorifolia*, with only 0.33 individuals/m^2.

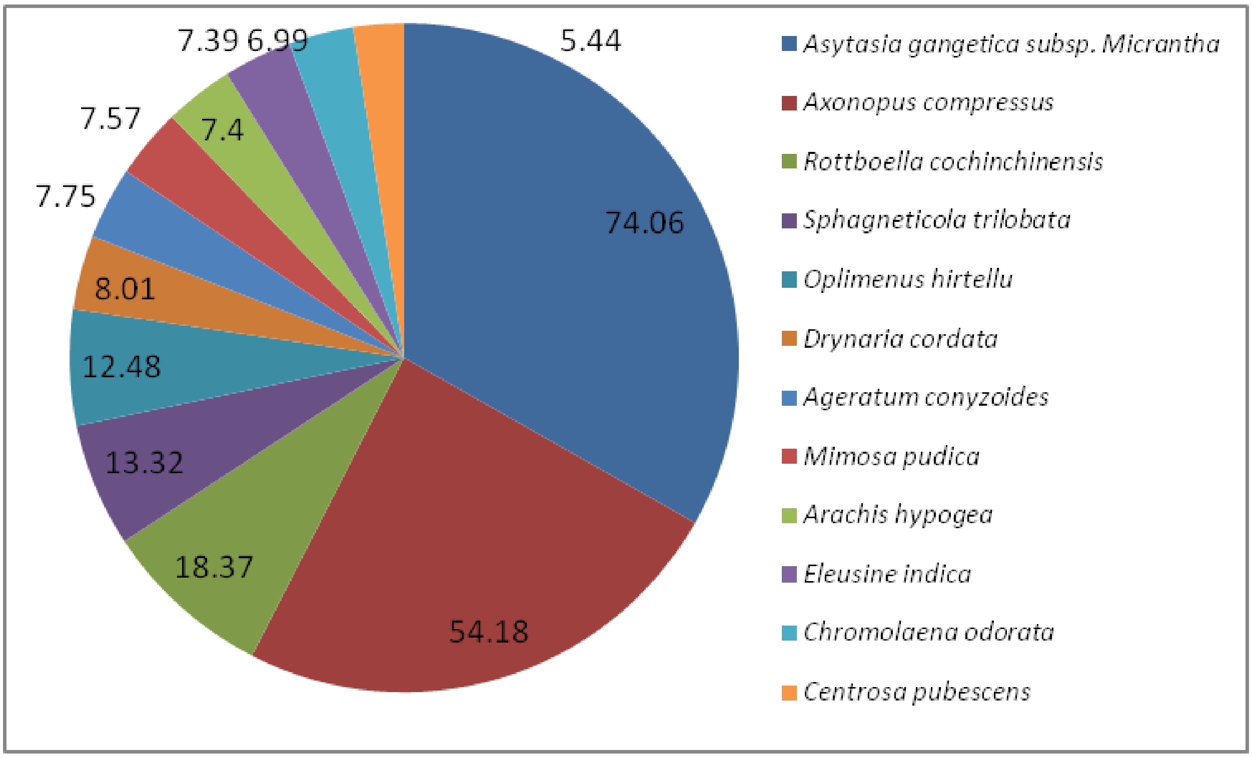
Figure 3-38. Overall Relative Abundance of Grass and Shrubs Present in the Project Area



Species Importance Values

Across all species, Asytasia gangetica subsp. Micrantha (Chinese violet) had the highest species importance value (SIV) with 74.06, followed by *Axonopus compressus* (carabao grass), *Rottboella cochinchinensis*, *Sphagneticola trilobata, and Oplimenus hirtellu*, with species importance values of 54.18, 18.37, 13.32, and 12.48, respectively. Except for saplings of *Coffea arabica*, *Swietenia macrophylla*, *Colocasia esculenta* (taro), and *Manihot esculenta* (cassava), most understory plants across the project site were generally weed vegetation.

Figure 3-39. Importance Value of Grass and Shrubs Present in the Project Area



List of Important Flora Species

Appendix 12 Flora species were recorded as vulnerable, endangered and near threatened species, according to IUCN and DAO 2017-11, which was observed in the survey. These species were considered as important flora species.

3.1.4.4.2.2 Fauna

Avifauna - *Columbidae* was the most species-rich family throughout the sampling season with a total of four species during the low rainfall period and six species during the high-rainfall period.

Table 3-31. Taxonomic Classification of the Avifauna Species

Family	Common Name	Scientific Name
Accipitridae	*Brahminy kite*	*Haliastur indus****
Accipitridae	*Philippine serpent-eagle*	*Spilornis cheela**
Accipitridae	*Black-shouldered kite*	*Elanus axillaris***
Alcedinidae	*Collared Kingfisher*	*Todiramphus chloris****
Alcedinidae	*Southernsilvery kingfisher*	*Ceyx argentatus**
Alcedinidae	*White-throated kingfisher*	*Halcyon gularis***

Family	Common Name	Scientific Name
Anatidae	*Philippine Duck*	*Anas luzonica**
Apodidae	*Fork-tailed swift*	*Apus pacificus***
Apodidae	*House swift*	*Apus nipalensis***
Apodidae	*Glossy swiftlet*	*Collocalia esculenta****
Ardeidae	*Cattle egret*	*Bubulcus ibis****
Artamidae	*White breasted wood swallow*	*Artamus leucoryn****
Bucerotidae	*Mindanao hornbill*	*Penelopides affinis***
Campephagidae	*Pied triller*	*Lalage nigra**
Columbidae	*Grey-capped emerald dove*	*Chalcophaps indica****
Columbidae	*Pied Imperial Pigeon*	*Ducula bicolor***
Columbidae	*Philippine Cuckoo Dove*	*Macropygia tenuirostris****
Columbidae	*Red Collared Dove*	*Streptopelia tranquebarica***
Columbidae	White-eared brown dove	*Phapitreron leucotis****
Columbidae	Zebra dove	*Geopelia striata****
Corvidae	Large-billed crow	*Corvus macrorhynchos****
Cuculidae	Black-faced coucal	*Centropus melanops****
Cuculidae	Philippine coucal	*Centropus viridis****
Dicaeidae	Fire-breasted flowerpecker	*Dicaeum ignipectus****
Dicaeidae	Red keeled flowerpecker	*Dicaeum austral****
Estrildidae	White-bellied Munia	*Lonchura leucogastra***
Estrildidae	Chestnut munia	*Lonchura atricapilla****
Falconidae	Philippine falconet	*Microhierax erythrogenys**
Hirundinidae	Barn Swallow	*Hirundo rustica***
Laniidae	Long-tailed shrike	*Lanius schach****
Locustellidae	Striated grassbird	*Megalurus palustris****
Locustellidae	Tawny grassbird	*Megalurus timoriensis****
Megalaimidae	Coppersmith barbet	*Psilopogon haemacephalus****
Meropidae	Blue-throated bee-eater	*Merops viridis****
Monarchidae	Black-naped Monarch	*Hypothymis azurea***
Motacillidae	Eastern Yellow Wagtail	*Motacilla flava**

Family	Common Name	Scientific Name
Muscicapidae	Blue-and-white flycatcher	*Cyanoptila cyanomelana**
Muscicapidae	Oriental magpie-robin	*Copsychus saularis****
Muscicapidae	Pied Buschat	*Saxicola caprata****
Nectariniidae	Brown-throated sunbird	*Anthreptes malacensis**
Nectariniidae	Lina's sunbird	*Aethopyga linaraborae****
Nectariniidae	Olive-backed sunbird	*Cinnyris jugularis****
Oriolidae	Black-naped Oriole	*Oriolus chinensis***
Pachycephalidae	White-vented whistler	*Pachycephala homeyeri**
Passeridae	Eurasian tree sparrow	*Passer montanus****
Psittacidae	Philippine hanging parrot	*Loriculus philippensis****
Psittaculidae	Guaiabero	*Bolbopsittacus lunulatus***
Pycnonotidae	Philippine bulbul	*Hypsipetes philippinus****
Pycnonotidae	Yellow-vented bulbul	*Pycnonotus goiavier****
Rallidae	Barred rail	*Hypotaenidia torquata****
Rhipiduridae	Black-and-cinnamon fantail	*Rhipidura nigrocinnamomea**
Rhipiduridae	Philippine pied fantail	*Rhipidura nigritorquis****
Sturnidae	Asian glossy starling	*Aplonis panayensis****
Sturnidae	Coleto	*Sarcops calvus**
Timaliidae	Brown tit-babbler	*Macronus striaticeps**
Turdidae	Island thrush	*Turdus poliocephalus**
Turnicidae	Barred Button quail	*Turnix suscitator****
Tytonidae	Eastern Grass-owl	*Tyto longimembris****
Zosteropidae	Mountain white-eye	*Zosterops japonicus****
Note: (*) means present during Low Rainfall Period; (**) means present during High Rainfall Period; (***) means present in both Period		

Species Diversity
Table 3-32 shows the diversity of species across different locations and times. The data accumulated during the two sampling periods has a criterion ranging from very low to moderate diversity. The number of species identified greatly influences the diversity of the area. Species count or number is directly proportional to the value of H-diversity, the greater number of species the higher H-diversity. Moreover, the table below shows that Transect 9 under low rainfall period has the highest H-diversity with 2.55 which categorized to moderate diversity on Shannon-Weiner index with a total of 17 species, dominance of 9.80% and evenness 75.05%. With the result, it shows that the species are highly distributed and poorly dominated in the area. Dominance

considers both the richness and evenness of the species. Moreover, the evenness in the diversity index presents the degree of evenness on the area composition and richness. It is a measure of biodiversity which quantifies how equal the community is.

Table 3-32. Species Diversity Indices of Avifauna

Transect	Period	Species	Individuals	Dominance	Evenness	H-diversity	Criterion
1	Low-Rainfall Period	15	60	16.83%	59.07%	2.18	Low
	High-Rainfall Period	19	408	29.85%	29.23%	1.71	Very Low
2	Low-Rainfall Period	8	17	16.26%	86.65%	1.94	Very Low
	High-Rainfall Period	13	50	29.04%	44.95%	1.77	Very Low
3	Low-Rainfall Period	3	13	62.13%	66.26%	0.69	Very Low
	High-Rainfall Period	18	124	28.43%	35.89%	1.87	Very Low
4	Low-Rainfall Period	6	6	16.67%	100%	1.79	Very Low
	High-Rainfall Period	14	170	32.29%	33.77%	1.55	Very Low
5	Low-Rainfall Period	2	2	50%	100%	0.69	Very Low
	High-Rainfall Period	17	58	27.23%	43.03%	1.99	Very Low
6	Low-Rainfall Period	10	18	11.73%	91.72%	2.22	Low
	High-Rainfall Period	9	20	29.00%	59.60%	1.68	Very Low
7	Low-Rainfall Period	23	63	9.15%	70.60%	2.79	Moderate
	High-Rainfall Period	13	40	28.63%	46.78%	1.81	Very Low
8	Low-Rainfall Period	11	14	11.22%	91.09%	2.31	Low
	High-Rainfall Period	12	22	27.27%	55.28%	1.89	Very Low
9	Low-Rainfall Period	17	39	9.80%	75.05%	2.55	Moderate
	High-Rainfall Period	9	21	26.98%	62.37%	1.73	Very Low
10	Low-Rainfall Period	21	80	13.28%	54.96%	2.45	Low
	High-Rainfall Period	8	13	25.44%	71.07%	1.74	Very Low
11	Low-Rainfall Period	9	11	12.40%	94.66%	2.15	Low
	High-Rainfall Period	9	47	37.35%	40.40%	1.29	Very Low
12	Low-Rainfall Period	3	3	33.33%	100%	1.1	Very Low
	High-Rainfall Period	4	6	33.33%	86.60%	1.24	Very Low
13	Low-Rainfall Period	11	17	14.88%	79.30%	2.17	Low
	High-Rainfall Period	13	60	32.83%	36.68%	1.56	Very Low
14	Low-Rainfall Period	2	15	68%	82.47%	0.5	Very Low

Transect	Period	Species	Individuals	Dominance	Evenness	H-diversity	Criterion
	High-Rainfall Period	4	6	33.33%	86.60%	1.24	Very Low
15	Low-Rainfall Period	22	110	14.94%	48.25%	2.36	Low
	High-Rainfall Period	19	42	24.38%	46.52%	2.18	Low
16	Low-Rainfall Period	3	7	34.69%	98.06%	1.08	Very Low
	High-Rainfall Period	19	54	26.95%	41.24%	2.06	Low
17	Low-Rainfall Period	3	14	38.78%	90.99%	1	Very Low
	High-Rainfall Period	13	24	27.08%	53.29%	1.94	Very Low
18	Low-Rainfall Period	16	124	20.72%	48.31%	2.05	Low
	High-Rainfall Period	18	80	27.97%	37.54%	1.91	Very Low
19	Low-Rainfall Period	3	38	42.38%	85.56%	0.94	Very Low
	High-Rainfall Period	13	28	27.56%	51.17%	1.9	Very Low
20	Low-Rainfall Period	13	157	24.44%	46.95%	1.81	Very Low
	High-Rainfall Period	28	232	28.50%	25.16%	1.95	Very Low

Relative Abundance

The five most commonly encountered bird species across transects during the low-rainfall period were the Eurasian tree sparrow (*Passer montanus*) with a mean relative abundance of 29.58%, Yellow-vented bulbul (*Pycnonotus goiavier*) at 12.62%, Glossy swiftlet (*Collocalia esculenta*) at 11.01%, Zebra dove (*Geopelia striata*) at 7.05%, and Olive-backed sunbird (*Cinnyris jugularis)* at 4.70% (orange cells **Table 3-33**).

During high rainfall period, the Glossy swiftlet (*Collocalia esculenta*) with a mean relative abundance of 21.46%, Eurasian tree sparrow (*Passer montanus*) at 19.82%, Yellow-vented bulbul (*Pycnonotus goiavier*) at 9.91%, White breasted wood swallow (*Artamus leucoryn*) at 6.56%, and Zebra dove (*Geopelia striata*) at 5.47% were the dominant species (orange cells in **Table 3-33**). The dominance of these birds was greatly influenced by the availability of food items such as in the case of granivores like *Passer montanus* which were common and abundant near rice fields, and *Pycnonotus goiavier* which feeds on nearby fruiting trees[21] [22]

Passer montanus species has an extremely large range from Asia and Europe. The population was suspected to be stable overall in the absence of evidence for any declines or substantial threats. It is found increasingly not only in built-up areas, but also in open arid countries. Their breeding season begins in April or May and goes on to January. Declines in this species in Europe may be a result of changes in agricultural practices such as the increased use of pesticides and herbicides[23]. *Pycnonotus goiavier* is described as common throughout its range and abundant in lowland and mid-altitude areas of Borneo. The population is suspected to be increasing rapidly as this species benefits from deforestation and the creation of artificial habitats[24]. *Collocalia esculenta* global population size has not been quantified, but the species is reported to be

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[21] Tanalgo, K. C., Pineda, J. A., Agravante, M. E., & Amerol, Z. M. (2015). Bird Diversity and Structure in Different Land-use Types in Lowland South-Central Mindanao, Philippines. Tropical life sciences research, 26(2), 85–103.

[22] Sekercioglu, C. H. (2012). Bird functional diversity and ecosystem services in tropical forests, agroforests and agricultural areas. Journal of Ornithology, 153(1), 153-161.

[23] BirdLife International. 2017. *Passer montanus*. The IUCN Red List of Threatened Species.2017

[24] BirdLife International. 2016. *Pycnonotus goiavier*. The IUCN Red List of Threatened Species 2016

abundant. The population is suspected to be stable in the absence of evidence for any declines or substantial threats[25]

Table 3-33. Composition and abundance of bird species during the low-rainfall period

Family	Common Name	Scientific Name	Total	RA (%)
Accipitridae	Brahminy kite	*Haliastur indus*	4	0.5
	Philippine serpent-eagle	*Spilornis cheela*	1	0.12
Alcedinidae	Collared Kingfisher	*Todiramphus chloris*	33	4.08
	Southern silvery kingfisher	*Ceyx argentatus*	1	0.12
	White-throated kingfisher	*Halcyon gularis*	9	1.11
Anatidae	Philippine Duck	*Anas luzonica*	1	0.12
Apodidae	Glossy swiftlet	*Collocalia esculenta*	89	11.01
Ardeidae	Cattle egret	*Bubulcus ibis*	14	1.73
Artamidae	White breasted wood swallow	*Artamus leucoryn*	17	2.1
Campephagidae	Pied triller	*Lalage nigra*	2	0.25
Columbidae	Grey-capped emerald dove	*Chalcophaps indica*	3	0.37
	Philippine Cuckoo Dove	*Macropygia tenuirostris*	1	0.12
	White-eared brown dove	*Phapitreron leucotis*	31	3.84
	Zebra dove	*Geopelia striata*	57	7.05
Corvidae	Large-billed crow	*Corvus macrorhynchos*	5	0.62
Cuculidae	Black-faced coucal	*Centropus melanops*	3	0.37
	Philippine coucal	*Centropus viridis*	2	0.25
Dicaeidae	Fire-breasted flowerpecker	*Dicaeum ignipectus*	2	0.25
	Red keeled flowerpecker	*Dicaeum austral*	11	1.36
Estrildidae	Chestnut munia	*Lonchura atricapilla*	5	0.62
Falconidae	Philippine falconet	*Microhierax erythrogenys*	2	0.25
Laniidae	Long-tailed shrike	*Lanius schach*	4	0.5
Locustellidae	Striated grassbird	*Megalurus palustris*	8	0.99
	Tawny grassbird	*Megalurus timoriensis*	1	0.12
Megalaimidae	Coppersmith barbet	*Psilopogon haemacephalus*	6	0.74
Meropidae	Blue-throated bee-eater	*Merops viridis*	10	1.24
Motacillidae	Eastern Yellow Wagtail	*Motacilla flava*	1	0.12
Muscicapidae	Blue-and-white flycatcher	*Cyanoptila cyanomelana*	4	0.5
	Oriental magpie-robin	*Copsychus saularis*	5	0.62
	Pied Buschat	*Saxicola caprata*	1	0.12
Nectariniidae	Brown-throated sunbird	*Anthreptes malacensis*	11	1.36
	Lina's sunbird	*Aethopyga linaraborae*	4	0.5
	Olive-backed sunbird	*Cinnyris jugularis*	38	4.7
Pachycephalidae	White-vented whistler	*Pachycephala homeyeri*	3	0.37
Passeridae	Eurasian tree sparrow	*Passer montanus*	239	29.58
Psittacidae	Philippine hanging parrot	*Loriculus philippensis*	2	0.25
Pycnonotidae	Philippine bulbul	*Hypsipetes philippinus*	11	1.36
	Yellow-vented bulbul	*Pycnonotus goiavier*	102	12.62
Rallidae	Barred rail	*Hypotaenidia torquata*	5	0.62
Rhipiduridae	Black-and-cinnamon fantail	*Rhipidura nigrocinnamomea*	2	0.25
	Philippine pied fantail	*Rhipidura nigritorquis*	11	1.36
Sturnidae	Asian glossy starling	*Aplonis panayensis*	35	4.33
	Coleto	*Sarcops calvus*	2	0.25
Timaliidae	Brown tit-babbler	*Macronus striaticeps*	3	0.37
Turdidae	Island thrush	*Turdus poliocephalus*	1	0.12
Turnicidae	Barred Button quail	*Turnix suscitator*	1	0.12
Tytonidae	Eastern Grass-owl	*Tyto longimembris*	2	0.25
Zosteropidae	Mountain white-eye	*Zosterops japonicus*	3	0.37
Total			**808**	**100.00**

NOTE: RA – relative abundance

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[25] BirdLife International. 2020. *Collocalia esculenta*. The IUCN Red List of Threatened Species 2020

Figure 3-40. Relative abundance of Avifaunal species in Low Rainfall Period.

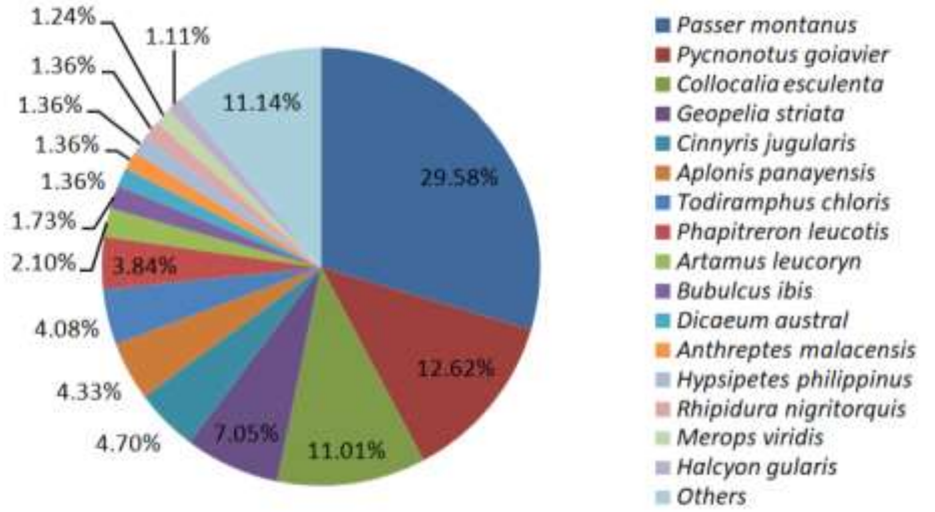


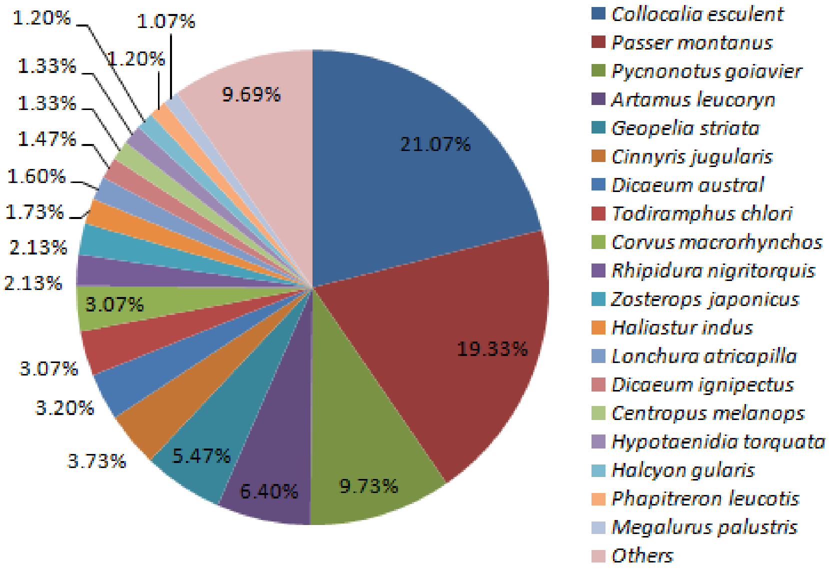
Table 3-34. Composition and abundance of bird species during the high-rainfall period

Family	Common Name	Scientific Name	Total	RA (%)
Accipitridae	Brahminy kite	*Haliastur indus*	13	1.72
	Black-shouldered kite	*Elanus axillaris*	2	0.27
Alcedinidae	Collared Kingfisher	*Todiramphus chloris*	22	2.95
	White-throated kingfisher	*Halcyon gularis*	9	1.24
Apodidae	Fork-tailed swift	*Apus pacificus*	2	0.27
	Glossy swiftlet	*Collocalia esculenta*	157	21.55
	House swift	*Apus nipalensis*	3	0.41
Ardeidae	Cattle egret	*Bubulcus ibis*	2	0.21
Artamidae	White breasted wood swallow	*Artamus leucoryn*	48	6.59
Bucerotidae	Mindanao hornbill	*Penelopides affinis*	1	0.14
Columbidae	Grey-capped emerald dove	*Chalcophaps indica*	2	0.21
	Pied imperial pigeon	*Ducula bicolor*	1	0.07
	Philippine Cuckoo Dove	*Macropygia tenuirostris*	1	0.14
	Red collared dove	*Streptopelia tranquebarica*	2	0.27
	Zebra dove	*Geopelia striata*	40	5.49
	White-eared brown dove	*Phapitreron leucotis*	9	1.17
Corvidae	Large-billed crow	*Corvus macrorhynchos*	22	3.02
Cuculidae	Black-faced coucal	*Centropus melanops*	10	1.37
	Philippine coucal	*Centropus viridis*	1	0.07
Dicaeidae	Fire-breasted flowerpecker	*Dicaeum ignipectus*	11	1.44
	Red keeled flowerpecker	*Dicaeum austral*	23	3.16
Estrildidae	Chestnut munia	*Lonchura atricapilla*	11	1.51
	White-bellied Munia	*White-bellied munia*	2	0.21
Hirundinidae	Barn swallow	*Hirundo rustica*	7	0.89
Laniidae	Long-tailed shrike	*Lanius schach*	4	0.48
Locustellidae	Tawny grassbird	*Megalurus timoriensis*	5	0.69
	Striated grassbird	*Megalurus palustris*	7	0.96
Megalaimidae	Coppersmith barbet	*Psilopogon haemacephalus*	7	0.96
Meropidae	Blue-throated bee-eater	*Merops viridis*	1	0.14
Monarchidae	Black-naped monarch	*Hypothymis azurea*	1	0.14
Muscicapidae	Oriental magpie-robin	*Copsychus saularis*	7	0.96
	Pied Buschat	*Saxicola caprata*	1	0.14
Nectariniidae	Lina’s sunbird	*Aethopyga linaraborae*	1	0.14
Nectariniidae	Olive-backed sunbird	*Cinnyris jugularis*	27	3.71

Family	Common Name	Scientific Name	Total	RA (%)
Oriolidae	Black-naped oriole	*Oriolus chinensis*	1	0.14
Passeridae	Eurasian tree sparrow	*Passer montanus*	145	19.9
Psittacidae	Philippine hanging parrot	*Loriculus philippensis*	1	0.14
Psittaculidae	Guaiabero	*Bolbopsittacus lunulatus*	1	0.14
Pycnonotidae	Philippine bulbul	*Hypsipetes philippinus*	7	0.89
	Yellow-vented bulbul	*Pycnonotus goiavier*	73	9.95
Rallidae	Barred rail	*Hypotaenidia torquata*	9	1.24
Rhipiduridae	Philippine pied fantail	*Rhipidura nigritorquis*	15	1.99
Sturnidae	Asian glossy starling	*Aplonis panayensis*	2	0.27
Turnicidae	Barred Button quail	*Turnix suscitator*	3	0.34
Tytonidae	Eastern Grass-owl	*Tyto longimembris*	1	0.14
Zosteropidae	Mountain white-eye	*Zosterops japonicus*	16	2.2
Total			**729**	**100.00**

NOTE: RA – relative abundance

Figure 3-41. Relative abundance of Avifaunal species in High Rainfall Period.



The 808 birds recorded during low-rainfall period sampling (April-May 2021) resolved into 48 species and 32 families comprised of 15 Philippine endemics with three (3) island endemics, 32 resident species, one (1) migratory species, and one (1) introduced. The high-rainfall period sampling (July-August 2021) recorded 732 individuals classified into 47 species and 30 families, with only nine (9) Philippine endemics, one (1) island endemic, eighteen (18) resident species, one (1) migratory, and one (1) introduced.

Philippine endemic species were the Philippine serpent-eagle (*Spilornis cheela*) under family Accipitridae, Philippine Duck (*Anas luzonica*) under Anatidae, White-eared brown dove (*Phapitreron leucotis*) and Philippine Cuckoo Dove (*Macropygia tenuirostris*) under family Columbidae, Black-faced coucal (*Centropus melanops*) and Philippine coucal (*Centropus viridis*) under Cuculidae, Red keeled flowerpecker (*Dicaeum austral*) under Dicaeidae, Philippine falconet (*Microhierax erythrogenys*) under family Falconidae, Yellow-vented bulbul (*Pycnonotus goiavier*), Philippine pied fantail *(Rhipidura nigritorquis*) under Rhipiduridae, Coleto (*Sarcops calvus*) under Sturnidae, and Brown tit-babbler (*Macronus striaticeps*) under family Timaliidae (green cells in **Table 3-35**).

The survey also documented three Mindanao endemics, namely, Southern silvery kingfisher (*Ceyx argentatus*) under family Alcedinidae, Lina's sunbird (*Aethopyga linaraborae*) under Nectariniidae, and Black-and-cinnamon fantail (*Rhipidura nigrocinnamomea*) under the family Rhipiduridae. New endemic species recorded during the high-rainfall period sampling were the Mindanao tarictic hornbill (*Penelopides affinis*) under the family Bucerotidae, and Guaiabero (*Bolbopsittacus lunulatus*) under family Psittaculidae (yellow cells in **Table 3-35**).

The Mindanao endemic Southern Silvery Kingfisher (*Ceyx argentatus*) is classified as Near Threatened by IUCN and Vulnerable according to DAO 2019-09 (reds cell in **Table 3-35**), while Philippine endemic Philippine Duck (*Anas luzonica*) is classified as Vulnerable both in IUCN and DAO 2019-09 (red cells in **Table 3-35**) and Lina's sunbird (*Aethopyga linaraborae*) as Near Threatened as per IUCN and Vulnerable by DAO 2019-09 (**Table 3-35**). Eurasian tree sparrow *(Passer montanus*) is an introduced species with a conservation status of Least Concern (blue cell in **Table 3-35**).

Table 3-35. Species, endemicity and conservation status of bird species along the CMH alignment[26]

Family	Species	Residency	IUCN Status	DAO 2019-09
Accipitridae	Black-shouldered kite (*Elanus axillaris*)	Mig	LC	NI
	Brahminy kite (*Haliastur indus)*	N	LC	NI
	Philippine serpent-eagle (*Spilornis cheela*)	PE	LC	NI
Alcedinidae	Collared Kingfisher (*Todiramphus chloris*)	N	LC	NI
	Southern silvery kingfisher (*Ceyx argentatus*)	ME	NT	VU
	White-throated kingfisher (*Halcyon gularis*)	PE	LC	NI
Anatidae	Philippine Duck (*Anas luzonica*)	PE	VU	VU
Apodidae	Fork-tailed swift (*Apus pacificus*)	N	LC	NI
	Glossy swiftlet (*Collocalia esculenta*)	N	LC	NI
	House swift (*Apus nipalensis*)	N	LC	NI
Ardeidae	Cattle egret (*Bubulcus ibis*)	N	LC	NI
Artamidae	White breasted wood swallow (*Artamus leucorynchus*)	N	LC	NI
Bucerotidae	Mindanao tarictic hornbill (*Penelopides affinis*)	ME	LC	EN
Campephagidae	Pied triller (*Lalage nigra*)	N	LC	NI
Columbidae	Zebra dove (*Geopelia striata*)	N	LC	NI
	Philippine Cuckoo Dove (*Macropygia tenuirostris)*	PE	LC	NI
	Pied imperial pigeon (*Ducula bicolor*)	N	LC	NI
	Red collared dove (*Streptopelia tranquebarica*)	N	LC	NI
	White-eared brown dove (*Phapitreron leucotis*)	PE	LC	NI
	Grey-capped emerald dove (*Chalcophaps indica*)	N	LC	NI
Corvidae	Large-billed crow (*Corvus macrorhynchos*)	N	LC	NI
Cuculidae	Black-faced coucal (*Centropus melanops*)	PE	LC	NI
	Philippine coucal (*Centropus viridis*)	PE	LC	NI
Dicaeidae	Red keeled flowerpecker (*Dicaeum australe*)	PE	LC	NI
	Fire-breasted flowerpecker (*Dicaeum ignipectus*)	N	LC	NI
Estrildidae	White-bellied Munia (*White-bellied Munia*)	N	LC	NI
	Chestnut munia (*Lonchura atricapilla*)	N	LC	NI
Falconidae	Philippine falconet (*Microhierax erythrogenys*)	PE	LC	NI
Hirundinidae	Barn swallow (*Hirundo rustica*)	N	LC	NI
Laniidae	Long-tailed shrike (*Lanius schach*)	N	LC	NI
Locustellidae	Striated grassbird (*Megalurus palustris*)	N	LC	NI
	Tawny grassbird (*Megalurus timoriensis*)	N	LC	NI
Megalaimidae	Coppersmith barbet (*Psilopogon haemacephalus*)	N	LC	NI
Monarchidae	Black-naped monarch (*Hypothymis azurea*)	N	LC	NI
Meropidae	Blue-throated bee-eater (*Merops viridis*)	N	LC	NI
Monarchidae	Black-naped monarch (*Hypothymis azurea*)	N	LC	NI
Motacillidae	Eastern Yellow Wagtail (*Motacilla flava*)	N	LC	NI
Muscicapidae	Oriental magpie-robin (*Copsychus saularis*)	N	LC	NI

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[26] low and high-rainfall periods

Family	Species	Residency	IUCN Status	DAO 2019-09
	Pied Buschat (*Saxicola caprata*)	N	LC	NI
	Blue-and-white flycatcher (*Cyanoptila cyanomelana*)	N	LC	NI
Nectariniidae	Brown-throated sunbird (*Anthreptes malacensis*)	N	LC	NI
	Lina's sunbird (*Aethopyga linaraborae*)	ME	NT	VU
	Olive-backed sunbird (*Cinnyris jugularis*)	N	LC	NI
Oriolidae	Black-naped oriole (*Oriolus chinensis*)	N	LC	NI
Pachycephalidae	White-vented whistler (*Pachycephala homeyeri*)	N	LC	NI
Passeridae	Eurasian tree sparrow (*Passer montanus*)	I	LC	NI
Psittacidae	Philippine hanging parrot (*Loriculus philippensis*)	N	LC	NI
	Guaiabero (*Bolbopsittacus lunulatus*)	ME	LC	NI
Pycnonotidae	Yellow-vented bulbul (*Pycnonotus goiavier*)	N	LC	NI
	Philippine bulbul (*Hypsipetes philippinus*)	E	LC	NI
Rallidae	Barred rail (*Hypotaenidia torquata*)	N	LC	NI
Rhipiduridae	Philippine pied fantail (*Rhipidura nigritorquis*)	PE	LC	NI
	Yellow-vented bulbul (*Pycnonotus goiavier*)	PE	LC	NI
	Black-and-cinnamon fantail (*Rhipidura nigrocinnamomea*)	ME	LC	NI
Sturnidae	Asian glossy starling (*Aplonis panayensis*)	N	LC	NI
	Coleto (*Sarcops calvus*)	PE	LC	NI
Timaliidae	Brown tit-babbler (*Macronus striaticeps*)	PE	LC	NI
Turdidae	Island thrush (*Turdus poliocephalus*)	N	LC	NI
Turnicidae	Barred Button quail (Tur*nix suscitator*)	N	LC	NI
Tytonidae	Eastern Grass-owl (*Tyto longimembris*)	N	LC	NI
Zosteropidae	Mountain white-eye (*Zosterops japonicus*)	N	LC	NI

NOTES: Residency status: I = introduced, N = Native, PE=Philippine endemic, ME=Mindanao endemic, M = migratory. Conservation status: CR = Critically Endangered, EN=Endangered, VU = vulnerable, NT = Near Threatened, and LC = Least concern

Species Presence

Table 3-36 shows the species presence in each transect between two different sampling periods. However, there are only 13 species that were only observed during low rainfall periods. Meanwhile, there are 11 species that were recorded during the high rainfall sampling period.

Table 3-36. Presence of the Identified Avifauna per Station and their Location

Species	Transect																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantation	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In etween forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Aethopyga linaraborae	a					b	a													
Anas luzonica															a					
Anthreptes malacensis																				a
Aplonis panayensis	a		b				a		a	a					a	b		a		b
Apus nipalensis				b																b
Apus pacificus	b																			b
Artamus leucoryn	a	ab	b		a		ab			a			a	b	ab		b	a		ab
Bolbopsittacus lunulatus						b														
Bubulcus ibis															a	b				b
Centropus melanops	b	b		b					a						b			a		ab
Centropus viridis	a												a			b				
Ceyx argentatus								a												
Chalcophaps indica	b		b		b			a	a				a							

Species	Transect																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantatio n	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In etween forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Cinnyris jugularis	b	ab	b	ab	b	a	ab	a	a	ab	ab	a	ab		a	b		ab	b	ab
Collocalia esculenta	ab	ab	ab	b	b	b	a	ab	a	ab	b				ab	ab	a	ab	b	ab
Copsychus saularis	b			b		a	b	ab	a	a			b					a		b
Corvus macrorhynchos	b		b						b		b	b	ab		ab	b		b		ab
Cyanoptila cyanomelana						a	a			a			a							
Dicaeum austral	b	b	b	b			a			ab			ab		ab	b		ab	b	b
Dicaeum ignipectus	b				b	b	b	a	b	ab			b		b			b		b
Ducula bicolor																b				
Elanus axillaris																				b
Geopelia striata	ab	b	b	ab	b	a	ab	ab	b	a			b		b	b	ab	a	ab	ab
Halcyon gularis	ab	b		b	b	a	a	b					a					a		
Haliastur indus			b		b		ab	b	a	a		b			b	b	b		b	b
Hirundo rustica		b	b																	b
Hypotaenidia torquata	b	ab			b		a	b	a		b				ab		b	b	b	

Species	Transect																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantation	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In etween forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Hypothymis azurea																			b	
Hypsipetes philippinus	b				b	b	a		a	a	a				a	b		b		
Lalage nigra	a										a									
Lanius schach								b		a					b		b	a		ab
Lonchura atricapilla				b			ab	b							b	b	b	b		ab
Loriculus philippensis							a		b											
Macronus striaticeps							a								a					
Macropygia tenuirostris		a																b		
Megalurus palustris	ab	b			b		a	a		a	a				ab	b		b		
Megalurus timoriensis			b								ab				b	b		b		b
Merops viridis	a					a	a		b						a					
Microhierax erythrogenys								a		a										
Motacilla flava											a									

Species	Transect																			
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
	Forest Patch	Riparian Forest	Plantation	Plantation	Forest Patch/Plantation	Plantation	Riparian Flora	Riparian Forest	Riparian Forest	Riparian Forest	In etween forest and plantation	Plantation	Riparian Forest	Plantation	Plantation	Farm Field	Plantation/ Farm Field	Riparian Forest	Plantation	Riparian Forest
Oriolus chinensis																				b
Pachycephala homeyeri																		a		
Passer montanus	ab	ab	ab	b	b	ab	ab	ab	a	a	ab	ab	ab	ab	a	ab	ab	ab	ab	ab
Penelopides affinis							b													
Phapitreron leucotis	a		b		ab	a	a	a	ab	a	a		ab		ab			ab		b
Psilopogon haemacephalus				a	b		ab		b	a					a			b		
Pycnonotus goiavier	ab	ab	b	ab	b	ab	ab	b	a	ab	b		ab	ab	a	ab	b	ab	ab	ab
Rhipidura nigritorquis	ab		b	ab	b		a		a	b					ab	b	b	ab	b	b
Rhipidura nigrocinnamomea																				a
Sarcops calvus		a								a										
Saxicola caprata									a											b
Spilornis cheela									a											
Streptopelia								b									b			

Species	**Transect**																			
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**T16**	**T17**	**T18**	**T19**	**T20**
	Forest Patch	**Riparian Forest**	**Plantation**	**Plantation**	**Forest Patch/Plantation**	**Plantation**	**Riparian Flora**	**Riparian Forest**	**Riparian Forest**	**Riparian Forest**	**In etween forest and plantation**	**Plantation**	**Riparian Forest**	**Plantation**	**Plantation**	**Farm Field**	**Plantation/ Farm Field**	**Riparian Forest**	**Plantation**	**Riparian Forest**
tranquebarica																				
Todiramphus chloris	ab		ab	ab	b	ab	ab		a	a		a	b		ab	b		ab	b	ab
Turdus poliocephalus															a					
Turnix suscitator													b		ab		b			
Tyto longimembris															a					b
White-bellied Munia			b														b			
Zosterops japonicus									a	a	a		b							
Note: (a) means present in Low Rainfall Period; (b) means present in High Rainfall Period; (ab) means present in both Periods																				

List of Important Species

Appendix 16 shows the list of avifaunal species found across the stations as listed in the IUCN Red List. Avifaunal species were recorded as vulnerable, endangered and near threatened species, according to IUCN and DAO 2019-09, which was observed in the survey. These species were considered as important avifaunal species.

Bats

A total of 71 bats were collected during low rainfall period across 11 stations resolved into five (5) species of fruit bats (*Pteropodidae*) and one (1) species of insect bat (*Hipposideridae*). *Ptenochirus jagori* was the most abundant with a relative abundance of 70.42% followed by *Cynopterus brachyotis* and *Rousettus amplexicaudatus* with relative abundances of 19.72 and 4.23%, respectively. A lone insect bat, *Hipposideros diadema* was also collected. Majority of bats collected had almost 1:1 age and sex ratio.

Table 3-37. Taxonomic Classification of Volant Mammals

Family	Common Name	Scientific Name
Pteropodidae	Greater Musky Fruit Bat	*Ptenochirus jagori****
	Lesser Short-Nosed Fruit Bat	*Cynopterus brachyotis****
	Long-tongued Nectar Bat	*Macroglossus minimus****
	Geoffroy’s Rousette	*Rousettus amplexicaudatus****
	Fischer’s pygmy Fruit Bat	*Haplonycteris fischeri**
	Lesser Musky Fruit Bat	*Ptenochirus minor***
Hipposideridae	Diadem Leaf-Nosed Bat	*Hipposideros diadema**
Note: (*) means present during Low Rainfall Period; (**) means present during High Rainfall Period; (***) means present in both Period		

Species Diversity

Table 3-38 shows the species diversity between stations in different sampling periods. The data accumulated during the two sampling periods has a criterion ranging from none to very low diversity. The number of species identified greatly influences the diversity of the area. The result shows that the species are highly distributed and averagely to highly dominated the area. Dominance considers both the richness and evenness of the species. Moreover, the evenness in the diversity index presents the degree of evenness on the area composition and richness. It is a measure of biodiversity which quantifies how equal the community is. However, it can be inferred in the table that during high rainfall period it has a higher H-diversity than the low rainfall period.

Table 3-38. Species Diversity Indices of the Stations Established for Volant Mammals

Station	Period	Species	Individuals	Dominance	Evenness	H-diversity	Criterion
1	Low-Rainfall Period	2	6	72.22%	78.46%	0.45	Very Low
	High-Rainfall Period	4	7	30.61%	89.65%	1.27	Very Low
2	Low-Rainfall Period	2	2	50%	100%	0.69	Very Low
	High-Rainfall Period	-	-	-	-	-	-
3	Low-Rainfall Period	2	4	62.5%	87.74%	0.56	Very Low

Station	Period	Species	Individuals	Dominance	Evenness	H-diversity	Criterion
	High-Rainfall Period	4	23	38.37%	75.37%	1.10	Very Low
4	Low-Rainfall Period	0	0	-	-	-	-
	High-Rainfall Period	4	18	30.25%	89.58%	1.28	Very Low
5	Low-Rainfall Period	3	6	50%	79.37%	0.86	Very Low
	High-Rainfall Period	2	8	62.5%	87.74%	0.56	Very Low
6	Low-Rainfall Period	3	12	43.06%	83.51%	0.92	Very Low
	High-Rainfall Period	4	19	45.15%	69.89%	1.03	Very Low
7	Low-Rainfall Period	3	12	43.06%	83.51%	0.92	Very Low
	High-Rainfall Period	3	15	39.56%	91.48%	1.01	Very Low
8	Low-Rainfall Period	1	8	100%	100%	0	None
	High-Rainfall Period	2	5	52%	98.01%	0.67	Very Low
9	Low-Rainfall Period	1	3	100%	100%	0	None
	High-Rainfall Period	3	8	46.88%	82.01%	0.90	Very Low
10	Low-Rainfall Period	1	3	100%	100%	0	None
	High-Rainfall Period	2	3	55.56%	94.46%	0.64	Very Low
11	Low-Rainfall Period	3	15	66.22%	62.44%	0.63	Very Low
	High-Rainfall Period	3	5	36%	95.72%	1.06	Very Low
12	Low-Rainfall Period	-	-	-	-	-	-
	High-Rainfall Period	4	21	50.57%	61.61%	0.90	Very Low
13	Low-Rainfall Period	-	-	-	-	-	-
	High-Rainfall Period	2	11	70.25%	80.33%	0.47	Very Low

Relative Abundance

In the low-rainfall period, *Ptenochirus jagori* was the most abundant with a relative abundance of 70.42% followed by *Cynopterus brachyotis* and *Rousettus amplexicaudatus* with relative abundances of 19.72 and 4.23%, respectively. A lone insect bat, *Hipposideros diadema* was also collected. Majority of bats collected had almost a 1:1 age and sex ratio.

During the high-rainfall period, a total of 144 bats were collected representing 5 under Pteropodidae. Across all sites, *Ptenochirus jagori* was the most abundant bat species with a relative abundance of 55.56% (blue cell in **Table 3-39** followed by *Cynopterus brachyotis* and *Ptenochirus minor* with relative abundances of 20.83 and 12.50% respectively. Majority of bats captured were adults (79.8%) and female (64.9%), suggesting relatively high reproductive capacity. Although this is a widespread and abundant species with large populations, *Ptenochirus jagori* has likely experienced low-level population declines due to forest loss. The species is most common in lowland forest and is also common in secondary forest, often present in cropland and urban parks and residential areas and relatively common in Ultramafic Forest and mangrove forest. This frugivorous tree and cave roosting species which occurs from sea level to at least 1,950 m is abundant in primary forest and common in secondary forest. *Ptenochirus jagori* is occasionally present in agricultural areas near forest and has been found in degraded habitats[27]

In terms of species endemicity and conservation status, *Ptenochirus jagori, P. minor* and *Haplonycteris fischeri* are Philippine endemics while the rest are native species. All of the bat species were under the least concern category of IUCN and not included in DAO 2019-09.

Figure 3-42. Overall relative abundance of bat species surveyed during the low and high rainfall periods

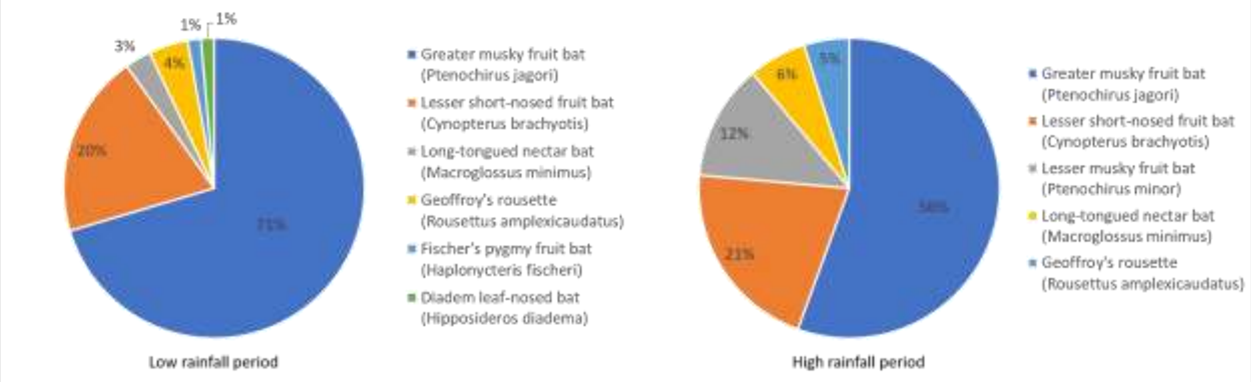

Table 3-39. Composition and abundance of bats species captured across survey sites

Low rainfall period			High rainfall period		
Species name	**Abundance**	**RA (%)**	**Species name**	**Abundance**	**RA (%)**
Ptenochirus jagori	50	70.42	*Ptenochirus jagori*	80	55.56
Cynopterus brachyotis	14	19.72	*Cynopterus brachyotis*	30	20.83
Macroglossus minimus	2	2.82	*Ptenochirus minor*	18	12.50
Rousettus amplexicaudatus	3	4.23	*Macroglossus minimus*	9	6.25
Haplonycteris fischeri	1	1.41	*Rousettus amplexicaudatus*	7	4.86
Hipposideros diadema	1	1.41	**Total**	**144**	**100.00**
Total	**71**	**100.00**			

NOTE: RA – relative abundance

Species Presence
The table below shows the presence of volant species in different stations. The table shows that species *Ptenochirus minor* was only observed in high rainfall sampling period, while *Hipposideros diadema* and *Haploncyteris fischeri* were present in the low rainfall sampling period.

Table 3-40. Species Presence Per Station for Volant Mammals

Common Name	Species Name	Stations												
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Greater Musky Fruit Bat	*Ptenochirus jagori*	ab		ab	b	ab	ab	ab	ab	ab	ab	ab	b	b
Lesser Short-Nosed Fruit Bat	*Cynopterus brachyotis*	ab		ab	b		ab	ab	b	b	b	ab	b	b
Long-tongued Nectar Bat	*Macroglossus minimus*			b		a	b					a	b	
Geoffroy's	*Rousettus*	b		b	b	a	ab	a				b	b	

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[27] Alviola, P.A. et al. 2021. Ptenochirus jagori. The IUCN Red List of Threatened Species 2021

Common Name	Species Name	Stations												
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Rousette	*amplexicaudatus*													
Fischer's pygmy Fruit Bat	*Haplonycteris fischeri*		a											
Lesser Musky Fruit Bat	*Ptenochirus minor*	b			b	b	b	b		b				
Diadem Leaf-Nosed Bat	*Hipposideros diadema*		a											
Note: (a) means present in Low Rainfall Period; (b) means present in High Rainfall Period; (ab) means present in both Periods														

Conservation Status and Endemicity
In terms of species endemicity and conservation status, *Ptenochirus jagori, P. minor* and *Haplonycteris fischeri* are Philippine endemics while the rest are native species. All the bat species were under the least concern category of IUCN and not included in DAO 2019-09.

Table 3-41. Species, endemicity and conservation status of bat species across survey sites

Family	Common Name	Scientific name	Residency	IUCN Status	DAO 2019-09
Pteropodidae	Greater musky fruit bat	*Ptenochirus jagori*	PE	LC	NI
	Lesser short-nosed fruit bat	*Cynopterus brachyotis*	N	LC	NI
	Long-tongued nectar bat	*Macroglossus minimus*	N	LC	NI
	Geoffroy's rousette	*Rousettus amplexicaudatus*	N	LC	NI
	Fischer's pygmy fruit bat	*Haplonycteris fischeri*	PE	LC	NI
	Lesser musky fruit bat	*Ptenochirus minor*	PE	LC	NI
Hipposideridae	Diadem leaf-nosed bat	*Hipposideros diadema*	N	LC	NI

NOTES: Residency status: N - native, PE - Philippine endemic, Conservation status: LC - Least concern, NI- not included

Herpetofauna **–** A total of eight (8) species were recorded belonging to seven (7) families of which three (3) species were observed in two rainfall periods. These are frogs or toads such as *Rhinela marina, Limnonectes mangnus* and *Kaloula pulchra.* However, 4 species were only observed during the high rainfall period, which comprises snakes and toads. The table below shows the species composition present in different rainfall periods.

Table 3-42. Taxonomic Classification of the Herpetofauna Present in the Project Area

Family	Common Name	Scientific Name
Bufonidae	Cane Toad	*Rhinela marina****
Ceratobatrachidae	Platymantis	*Platymantis sp***
Dicroglossidae	Giant Philippine Frog	*Limnonectes mangnus****
Megaphrydae	Mindanao Horned Frog	*Megophrys stejnegeri***
Microhyalidae	Painted Narrowmouth Toad	*Kaloula picta***

Family	Common Name	Scientific Name
	Banded Bullfrog	*Kaloula pulchra****
Colubridae	Rat Snake	*Coelagnathus* sp.**
Varanidae	Yellow Headed Water Monitor	*Varanus cumingi***
Note: (*) means present during Low Rainfall Period; (**) means present during High Rainfall Period; (***) means present in both Period		

Relative Abundance
The 34 frogs collected during the low rainfall period and resolved into 3 families and 3 species was dominated by *Limnonectes magnus* with a relative abundance of 70.59% (**Table 3-44**).

During high rainfall season, total frog captures were also dominated by *Limnonectes magnus* with a relative abundance of 53.33% (blue cell in **Table 3-44**) followed by *Rhinela marina* at 33.33%. Other herpetofauna captured were three (3) individuals of *Coelognathus* sp. and one (1) individual of *Varanus cumingi* both captured during high-rainfall period. Frog abundance and diversity across all sites were very low and high poaching pressure for the edible *Limnonectes magnus.*

Limnonectes magnus species complex is found on Mindanao, Basilan, Bohol, Camiguin, Samar and Leyte Islands in the Philippines. It is common to very common where its habitat remains intact, although some subpopulations are in decline because of over-exploitation. It inhabits undisturbed and disturbed streams and rivers in lower montane and lowland forests. It breeds and deposits egg clutches in quiet side pools of forested riverine habitats. Due to its large size, the species is collected in large numbers for human consumption, which may pose a threat to the overall population. On Mindanao, the major threat is the destruction and conversion of both lowland and montane rainforest habitat due to small-scale agricultural activities, large-scale oil palm plantations, wood collection for charcoal production, and expanding human settlements[28]

With regards to frog species endemicity, the *Megophrys stejnegeri* and *Kaloula picta* are Philippine endemics while *Limnonectes magnus* and *Varanus cumingi* is a Mindanao endemic. However, *Kaloula pulchra* and *Rhinela marina* are considered as introduced and invasive species. In terms of conservation status, *Limnonectes magnus* is under Near Threatened category under IUCN and Other Threatened Species (red cells in **Table 3-46**) as per DAO 2019-09 with the rest under Least Concern and not included in DAO 2019-09.

Conservation Status and Endemicity
With regards to frog species endemicity, the *Megophrys stejnegeri* and *Kaloula picta* are Philippine endemics while *Limnonectes magnus* and *Varanus cumingi* are Mindanao endemic. However, *Kaloula pulchra* and *Rhinela marina* are considered as introduced and invasive species. In terms of conservation status, *Limnonectes magnus* is under Near Threatened category under IUCN and Other Threatened Species as per DAO 2019-09 with the rest under Least Concern and not included in DAO 2019-09.

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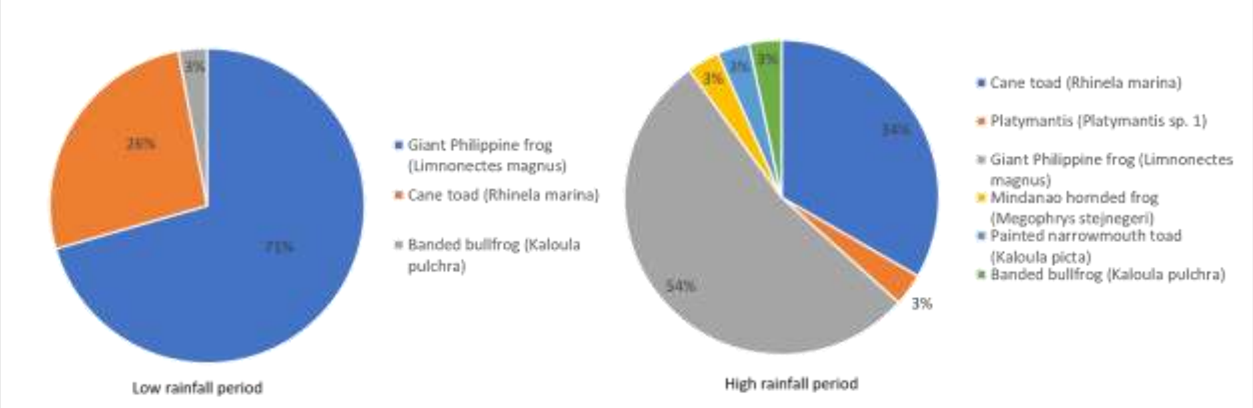
[28] IUCN SSC Amphibian Specialist Group. 2020. Limnonectes magnus (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2020

Figure 3-43. Overall relative abundance of frog species during low and high rainfall periods



Species Presence

Table 3-43 shows the occurrences or presence of herpetofauna observed in different stations between the two rainfall periods. The table shows that the species *Platymantis* sp was only observed in Station 7. As well as the species *Megophrys stejnegeri, Kaloula picta. Kaloula pulchra* and *Varanus cumingi* were observed at stations 6, 7, 8 and 4 alone, respectively. However, it can also be observed that there are no species that were present in the same station for two rainfall periods. Consequently, there are certain stations in which this species favors the vegetation and food availability during such rainfall period.

Table 3-43. Species Presence of Herpetofauna

Species Name	Stations												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Rhinela marina	b	a	b		a				a	a	a	a	
Platymantis sp.							b						
Limnonectes mangnus	b	a	a	b				a	b	b	b	b	
Megophrys stejnegeri						b							
Kaloula picta							b						
Kaloula pulchra								b					
Coelagnathus sp.								b			b		b
Varanus cumingi				b									
Note: (a) means present in Low Rainfall Period; (b) means present in High Rainfall Period; (ab) means present in both Periods													

Table 3-44. Composition and abundance of frog species captured

Low rainfall period			High rainfall period		
Species name	**Abundance**	**RA (%)**	**Species name**	**Abundance**	**RA (%)**
Kaloula pulchra	1	2.94	*Rhinela marina*	10	33.33
Limnonectes magnus	24	70.59	*Platymantis* sp. 1	1	3.33
Rhinela marina	9	26.47	*Limnonectes magnus*	16	53.33
Total	**34**	**100.00**	*Megophrys stejnegeri*	1	3.33
NOTE: RA – relative abundance			*Kaloula picta*	1	3.33
			Kaloula pulchra	1	3.33
			Total	**30**	**100.00**

Table 3-45. Composition and abundance of other herpetofauna captured (high rainfall)

Family	Common Name	Scientific Name	Abundance	RA (%)
Colubridae	Rat snake	*Coelognathus sp.*	3	75.00
Varanidae	Yellow headed water monitor	*Varanus cumingi*	1	25.00
Total			**4**	**100.00**

Conservation Status and Endemicity

With regards to frog species endemicity, the Megophrys stejnegeri and Kaloula picta are Philippine endemics while Limnonectes magnus and Varanus cumingi are Mindanao endemic. However, Kaloula pulchra and Rhinela marina are considered as introduced and invasive species. In terms of conservation status, Limnonectes magnus is under Near Threatened category under IUCN and Other Threatened Species as per DAO 2019-09 with the rest under Least Concern and not included in DAO 2019-09.

Table 3-46. Species, endemicity and conservation status of herpetofauna across survey sites

Family	Common Name	Scientific name	Residency	IUCN	DAO 2019-09
Bufonidae	Cane toad	*Rhinela marina*	I	LC	NI
Ceratobatrachidae	Platymantis	*Platymantis* sp. 1	-	-	-
Dicroglossidae	Giant Philippine frog	*Limnonectes magnus*	ME	NT	OTS
Megophrydae	Mindanao horned frog	*Megophrys stejnegeri*	PE	LC	NI
Microhyalidae	Painted Narrowmouth Toad	*Kaloula picta*	PE	LC	NI
	Banded Bullfrog	*Kaloula pulchra*	I	LC	NI
Colubridae	Rat snake	*Coelognathus sp.*	-	-	-
Varanidae	Yellow headed water monitor	*Varanus cumingi*	ME	LC	NI

NOTES: Residency status: I = introduced, PE=Philippine endemic, ME=Mindanao endemic; Conservation status: LC = Least concern, NT=Near Threatened, NI= not included, OTS=Other Threatened Species

List of Important Species

In this report, only species *Limnonectes magnus* was recorded as Near threatened by IUCN and Other Threatened species in DAO 2019-09**. Appendix 24** shows the details of the important species.

Small Mammals **–** There are 3 species of non-volant mammals recorded in the report that belonged to only one family- Muridae. Furthermore, only *Rattus tanezumi* was observed in two rainfall sampling period, while *Rattus norvegicus* and *Rattus rattus* was only observed during high rainfall period.

Table 3-47. Taxonomic Classification of Small Mammals

Family	Common Name	Scientific Name
Muridae	Brown Rat	*Rattus norvegicus***
	Asian House Rat	*Rattus tanezumi****
	Black Rat	*Rattus rattus***
Note: (*) means present during Low Rainfall Period; (**) means present during High Rainfall Period; (***) means present in both Period		

Relative Abundance

Only one rodent (*Rattus tanezumi*) was captured during low-rainfall survey (orange cell in **Table 3-48**) while three species were recorded during high-rainfall period where the *Rattus norvegicus ad* a relative abundance of 50% and *Rattus tanezumi* and *Rattus rattus* both with 25% each. All murid species collected were introduced species and considered as pests in households and agricultural areas.

Figure 3-44. Relative Abundance of Non-volant Mammals in Low-rainfall and High-rainfall Period

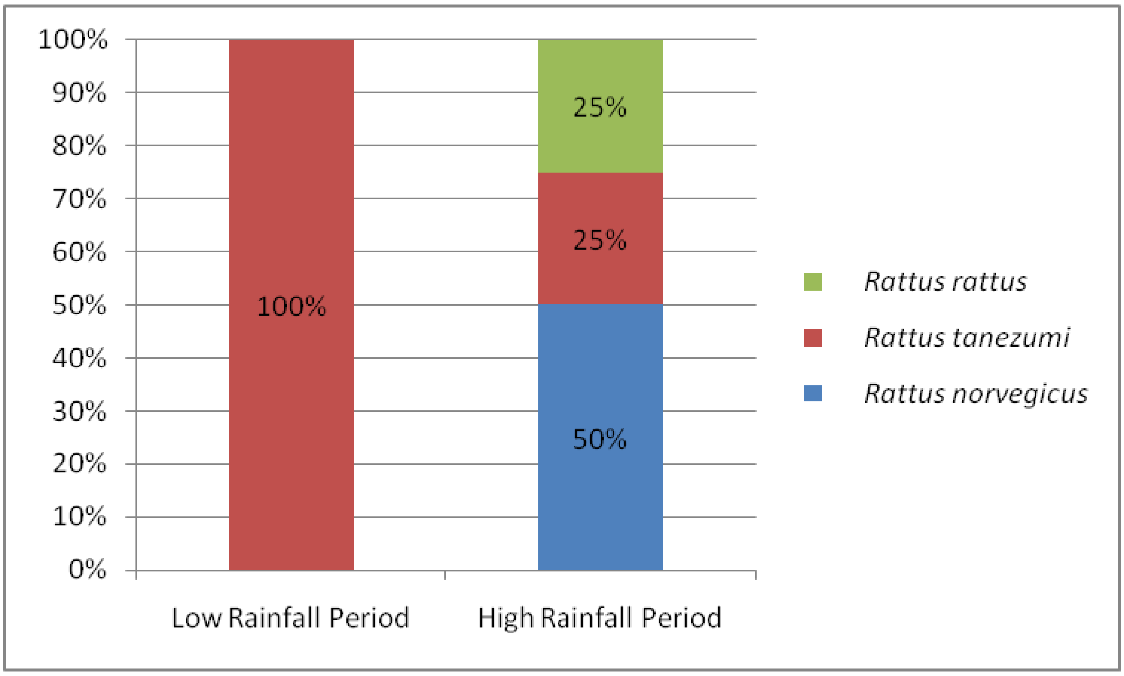
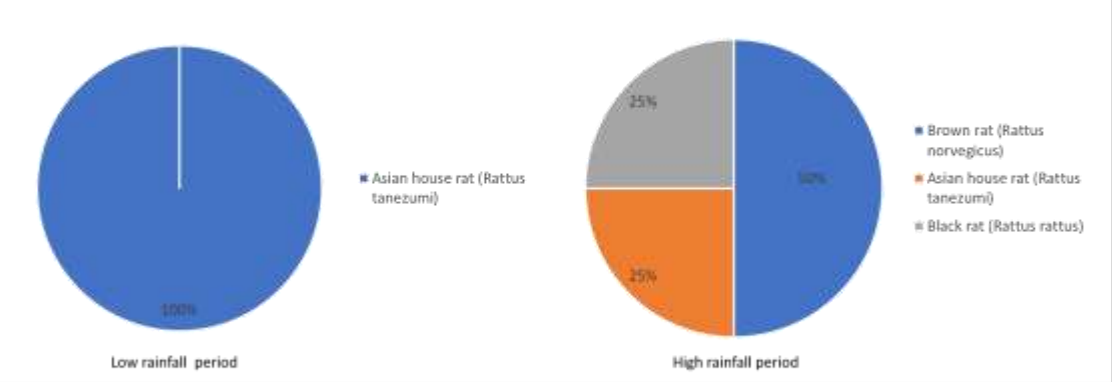


Table 3-48. Composition and abundance of murid species captured (high rainfall)

Low rainfall period			High rainfall period		
Species name	Abundance	RA (%)	Species name	Abundance	RA (%)
Rattus tanezumi	1	100.00	*Rattus norvegicus*	2	50
Total	*1*	**100.00**	*Rattus tanezumi*	1	25
	NOTE: RA – relative abundance		*Rattus rattus*	1	25
			Total	**4**	**100.00**

Figure 3-45. Overall relative abundance of non-volant mammals during low and high rainfall periods



Conservation Status and Endemicity

All murid species collected were introduced species and considered as pests in households and agricultural areas.

Table 3-49. Species, endemicity and conservation status of murid species across survey sites

Common Name	Scientific name	Residency	IUCN	DAO 2019-09
Brown rat	*Rattus norvegicus*	I	LC	NI
Asian house rat	*Rattus tanezumi*	I	LC	NI
Black rat	*Rattus rattus*	I	LC	NI

Insects - A total of 109 individuals under 26 genera belonging to seven Orders of insects were recorded during low rainfall period sampling and 100 individuals in 24 genera representing 8 orders were recorded during the high rainfall period (**Table 3-50**). All the insects identified and recorded in the project area were not classified as threatened species according to DAO 2019-09, which presents the 'Updated National List of Threatened Philippine Fauna and Other Categories'.

Table 3-50. Taxonomic Classification of the Insect Identified within the Project Area

Order	Common Name	Family/ Scientific Name
Blattodea	Roach	*Blattodea***
Coleoptera	Metallic flea beetle	*Alticini sp.****
Coleoptera	Jewel beetle	*Buprestidae**
Coleoptera	Tortoise beetle	*Cassidinae**
Coleoptera	Leaf beetle	*Chrysomelidae****
Coleoptera	Long nose weevil	*Rhinotia sp.**
Coleoptera	Asian lady beetle	*Harmonia sp.****
Coleoptera	Firefly	*Lampyridae****
Coleoptera	Broad nose weevil	*Curculionidae****
Coleoptera	Long horn beetle	*Oberea nigriventis****

Order	Common Name	Family/ Scientific Name
Coleoptera	Tiger beetle	*Neocollyris sp.***
Coleoptera	Tiger Beetles	*Cicindelinae***
Coleoptera	Weevil	*Pseudapocyrtus sp.****
Diptera	Mosquito hawk	*Tipulidae**
Hemiptera	Red cotton stainer	*Dysdercus cingulatus****
Hemiptera	Assasin bug	*Rhynocoris iracundus***
Hemiptera	Kissing bug	*Triatominae***
Hymenoptera	Carpenter ant	*Camponotus**
Hymenoptera	Yellow spotted mason wasp	*Odynerus bicinctus**
Hymenoptera	Velvet ant	*Mutillidae***
Lepidoptera	Common grass yellow	*Eurema hecabe**
Lepidoptera	Blue moon butterfly	*Hypolimas bolina philippinensis**
Lepidoptera	Metalmark moths	*Choreutidae***
Lepidoptera	Scarlet Mormon	*Papilio rumanzovia***
Lepidoptera	Common Mormon	*Papilio polytes alphenor***
Odonata	Dancer Damselfly	*Argia sp.**
Odonata	Ebony jewel wing	*Calopteryx maculata**
Odonata	Blue ground Skimmer	*Diplacodes trivialis****
Odonata	Crimson marsh glider	*Trithemis aurora***
Odonata	Green skimmer	*Orthetrum serapia***
Odonata	Red parasol dragonfly	*Neurothermis terminata**
Odonata	Slender skimmer	*Orthetrum sabina sabina****
Odonata	Black bambootail damselfly	*Prodasineura verticalis**
Odonata	Jewel damselfly	*Rhinocypha colorata****
Odonata	Red-veinted darter dragonfly	*Sympetrum fonscolombii**
Odonata	Pigmy skimmer dragonfly	*Tetrathemis platyptera**
Orthoptera	Grasshopper	*Caelifera****
Phasmatodea	Stick insect	*Phasmatodea***
Note: (*) means present during Low Rainfall Period; (**) means present during High Rainfall Period; (***) means present in both Period		

Species Diversity

Table 3-51 displays the variation in species diversity across stations during different sampling periods. The data collected during these periods indicates a range of diversity from none to very low. Based on the results, it is evident that the species are widely distributed due to its high evenness and less likely to dominate the area. However, the data shows no relationship with H-diversity between two sampling periods.

Table 3-51. Species Diversity Indices Per Station Established for Insects

Station	Period	Family/Species	Individuals	Dominance	Evenness	H-diversity	Criterion
1	Low-Rainfall Period	6	7	18.37%	95.71%	1.74	Very Low
	High-Rainfall Period	-	-	-	-	-	-
2	Low-Rainfall Period	-	-	-	-	-	-
	High-Rainfall Period	7	11	15.7%	94.92%	1.89	Very Low
3	Low-Rainfall Period	6	19	39.06%	59.01%	1.26	Very Low
	High-Rainfall Period	1	7	100%	100%	0	None
4	Low-Rainfall Period	5	10	26%	82.85%	1.60	Very Low
	High-Rainfall Period	4	13	32.54%	85.61%	1.23	Very Low
5	Low-Rainfall Period	3	4	37.5%	94.28%	1.04	Very Low
	High-Rainfall Period	2	5	68%	82.47%	0.50	Very Low
6	Low-Rainfall Period	7	10	22%	82.05%	1.75	Very Low
	High-Rainfall Period	5	7	26.53%	87.43%	1.47	Very Low
7	Low-Rainfall Period	7	11	17.36%	90.51%	1.85	Very Low
	High-Rainfall Period	5	14	38.78%	67.43%	1.22	Very Low
8	Low-Rainfall Period	7	14	20.41%	83.63%	1.77	Very Low
	High-Rainfall Period	7	11	19.01%	86.31%	1.80	Very Low
9	Low-Rainfall Period	6	10	20%	90.84%	1.70	Very Low
	High-Rainfall Period	5	8	25%	89.11%	1.49	Very Low
10	Low-Rainfall Period	3	7	38.78%	90.99%	1.00	Very Low
	High-Rainfall Period	7	10	18%	89.45%	1.83	Very Low
11	Low-Rainfall Period	9	16	28.13%	62.85%	1.73	Very Low
	High-Rainfall Period	6	14	25.51%	80.44%	1.57	Very Low

Relative Abundance

Terrestrial insects under Order *Coleoptera* were the most dominant taxa in both low and high rainfall sampling with a mean relative abundance of 66.67% and 79% of the total population, respectively (orange and blue cells in **Table 3-52** followed by order *Odonata* with a mean relative abundance of 19.44 and nine percent during the low- and high rainfall periods. Other major groups of terrestrial insects were poorly represented in both low and high rainfall period with a mean relative abundance of below 5 percent each.

Broad-nose weevils (*Curculionidae*) of order *Coleoptera* were the most dominant species (30 individuals) representing 28 percent mean relative abundance (orange cell in **Table 3-53**) of the total population during the low rainfall period and a mean relative abundance of 34% in high rainfall period (blue cell in **Table 3-54**). This species was the most common across survey sites and occurs conspicuously in groups. Moreover, the top five most abundant species in the low and high rain periods were all from Order *Coleoptera*. Data further suggested a low diverse terrestrial insect community throughout the sampling periods essentially dominated by broad-nose weevils (*Curculionidae*). As the largest group in the *Coleoptera*, *Curculionidae* are common in the Philippines (Bacras et al., 2021).

Table 3-52. Composition and abundance of insect Orders captured

Low rainfall			High rainfall		
Order	**Abundance**	**RA (%)**	**Order**	**Abundance**	**RA (%)**
Coleoptera	73	66.67	Coleoptera	79	79.00
Odonata	21	19.44	Odonata	9	9.00
Lepidoptera	4	3.7	Lepidoptera	4	4.00
Orthoptera	4	3.7	Orthoptera	1	1.00
Hemiptera	3	2.78	Hemiptera	4	4.00
Hymenoptera	3	2.78	Hymenoptera	1	1.00
Diptera	1	0.93	Phasmatodea	1	1.00
Total	**109**	**100.00**	Blattodea	1	1.00
			Total	**100**	**100.00**

NOTE: RA – relative abundance

Table 3-53. Composition and abundance of terrestrial insects captured (low rainfall)

Order	Common Name	Scientific name	Abundance	RA (%)
Coleoptera	Metallic flea beetle	*Alticini sp.*	7	6.42
	Jewel beetle	Buprestidae	1	0.92
	Tortoise beetle	Cassidinae	2	1.83
	Leaf beetle	Chrysomelidae	6	5.50
	Long nose weevil	*Rhinotia sp.*	12	11.01
	Asian lady beetle	*Harmonia sp.*	4	3.67
	Firefly	Lampyridae	4	3.67
	Broad nose weevil	Curculionidae	30	27.52
	Long horn beetle	*Oberea nigriventis*	2	1.83
	Weevil	*Pseudapocyrtus sp.*	4	3.67
Diptera	Mosquito hawk	Tipulidae	1	0.92
Hemiptera	Red cotton stainer	*Dysdercus cingulatus*	3	2.75
Hymenoptera	Carpenter ant	Camponotus	1	0.92
	Yellow spotted mason wasp	*Odynerus bicinctus*	2	1.83
Lepidoptera	Common grass yellow	*Eurema hecabe*	1	0.92
	Blue moon butterfly	*Hypolimas bolina philippinensis*	3	2.75
Odonata	Dancer Damselfly	*Argia sp.*	1	0.92
	Ebony jewel wing	*Calopteryx maculata*	4	3.67
	Blue ground Skimmer	*Diplacodes trivialis*	1	0.92
	Red parasol dragonfly	*Neurothermis terminata*	2	1.83
	Slender skimmer	*Orthetrum sabina sabina*	1	0.92
	Black bambootail	*Prodasineura verticalis*	2	1.83

Order	Common Name	Scientific name	Abundance	RA (%)
	damselfly			
	Jewel damselfly	*Rhinocypha colorata*	6	5.50
	Red-veinted darter dragonfly	*Sympetrum fonscolombii*	3	2.75
	Pigmy skimmer dragonfly	*Tetrathemis platyptera*	1	0.92
	Grasshopper	Caelifera	4	3.67
	Total		**109**	**100.00**

NOTE: RA – relative abundance

Table 3-54. Composition and abundance of terrestrial insects captured (high-rainfall)

Order	Common Name	Scientific Name	Abundance	RA (%)
Blattodea	Roach	Blattodea	1	1
Coleoptera	Asian lady beetle	*Harmonia sp.*	8	8
	Broad nose weevil	Curculionidae	34	34
	Firefly	Lampyridae	3	3
	Leaf beetle	Chrysomelidae	6	6
	Long horn beetle	Cerambycidae	2	2
	Metallic flea beetle	*Alticini sp.*	8	8
	Tiger beetle	*Neocollyris sp.*	1	1
	Tiger beetle	Cicindelinae	3	3
	Weevil	*Pseudapocyrtus sp.*	14	14
Hemiptera	Assasin bug	*Rhynocoris iracundus*	1	1
	Kissing bug	Triatominae	1	1
	Red cotton stainer	*Dysdercus cingulatus*	2	2
Hymenoptera	Velvet ant	Mutillidae	1	1
Lepidoptera	Common Mormon	*Papilio polytes alphenor*	2	2
	Metalmark moths	Choreutidae	1	1
	Scarlet Mormon	*Papilio rumanzovia*	1	1
Odonata	Blue ground Skimmer	*Diplacodes trivialis*	2	2
	Crimson marsh glider	*Trithemis aurora*	3	3
	Green skimmer	*Orthetrum serapia*	2	2
	Jewel damselfly	*Rhinocypha colorata*	1	1
	Slender skimmer	*Orthetrum sabina sabina*	1	1
Orthoptera	Grasshopper	Caelifera	1	1
Phasmatodea	Stick insect		1	1
Total			**100**	**100**

NOTE: RA – relative abundance

Figure 3-46. Overall relative abundance of terrestrial insect order

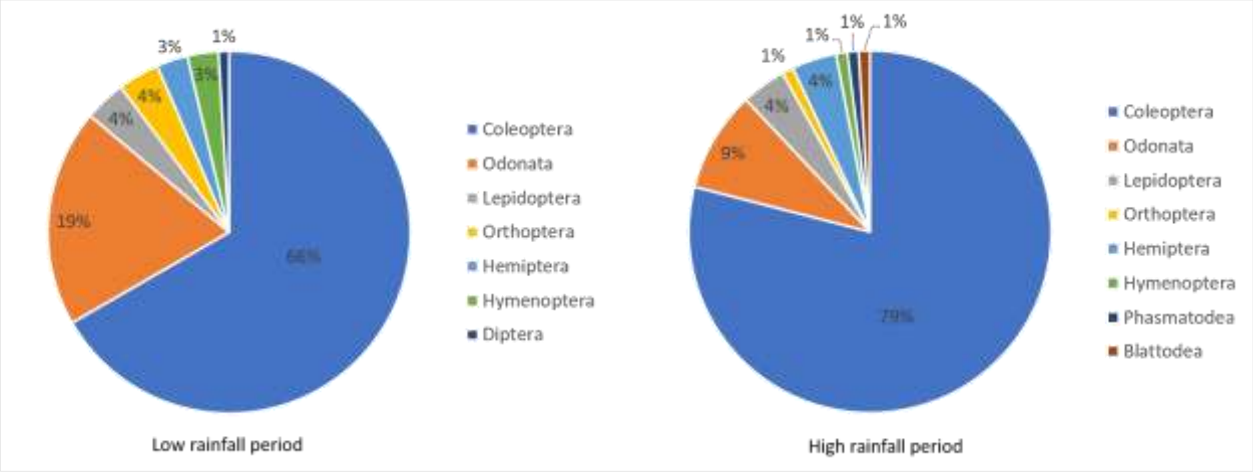
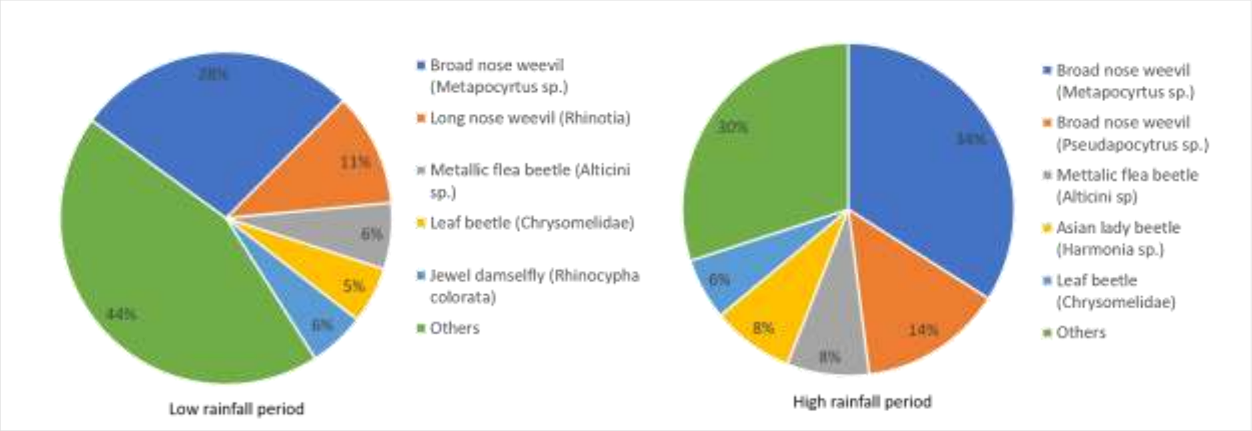


Figure 3-47. Overall relative abundance of dominant terrestrial insect species



3.1.4.4.3 Hindrance to wildlife access

Ecologically significant areas are the limited remnant forest patches in riparian zones surrounded or interspersed with small farms. The entire stretch of the proposed CMH alignment is highly disturbed following massive conversion to agricultural areas, thus there will be no hindrance to wildlife access that will be affected by the Project.

Murid species recorded were considered as pests. No large mammals were documented, e.g., highly mobile species, Philippine macaques, wild pigs, and deers, whose mobility or habitat access might be limited by the Project. According to the interview with Philippine Haribon Foundation, the known nesting habitats of the Philippine Eagle were mostly in Mt. Tago and Mt. Kitanglad and were also remotely located to be affected by the Project. However, the Project cuts across a portion of the Kulaman River in Poblacion Sumilao, a known staging area of Philippine eagle juveniles in search of territories.

3.1.4.5 Proposed mitigation measures

3.1.4.5.1 Vegetation removal and loss of habitat

Direct impacts of road construction refer to the physical changes and disturbances that occur in the natural environment because of the construction activities. This includes habitat loss or fragmentation, soil erosion and vegetation removal. Indirect impacts may not become evident until some time after construction has been completed. However, mitigating measures for both direct and indirect impacts are provided in the discussion below.

The proposed CMH alignment will cut across vast agricultural areas affecting existing orchards and plantations (tree and pineapple). As such, the majority of trees that will be removed during road construction are orchard/plantation species and cash crops like corn and vegetables. Vegetation clearing will be involved prior to the road construction which can result in loss of habitat and decrease in biodiversity.

Pre-construction – It is necessary to consider the locations of significant vegetation types and populations during Project design. A complete census of flora in the planned development areas must be conducted to determine the number and species of vegetation that will be affected followed by securing a Tree Cutting/Earth-balling Permit from the DENR. Establishment of buffer zone with widths around ecologically sensitive areas, especially the area near the foot of Mount Tago, which is approximately 950 meters from the proposed alignment will be part of the mitigating measures. Buffer zones are determined based on the sensitivity of vegetation areas, wildlife habitats, and riparian zones, with an approximate buffer zone width of 100 meters. Non-sensitive areas, on the other hand, can accommodate buffer zone widths of approximately 10 to 20 meters.

Construction – Roads can act as barriers that fragment habitats, making it difficult for plants to disperse and colonize new areas which may eventually make the plant populations more vulnerable to disease, pests and other threats. Earthworks and rock excavations during construction can lead to increased soil erosion. Soil erosion can result in the loss of valuable topsoil which is important for plant growth. Emissions from vehicles and heavy machines during construction of road infrastructure.

Generation of dust may occur during construction activities due to the removal of vegetation and disturbance to the topsoil, vehicle movements on unsealed roads and wind dispersion of stockpile materials. This may affect the transpiration and photosynthesis which can cause smothering of vegetation. Key important species for both flora and fauna might be affected. The following measures are recommended to minimize the impacts of vegetation removal.

Avoidance of unnecessary tree cutting. If tree cutting is required, secure a tree cutting permit from DENR and DPWH. Replacement of cut trees will be in accordance with DENR Memorandum Order (DMO) 2012-02. Create and provide an infrastructure plan with tree charting indicating the geotagged location of individual trees affected by the project. Regular inspections will be carried out to ensure that vegetation is cleared and stockpiled in the appropriate locations, that no necessary flora is impacted, and that the relevant databases are kept up to date. Stockpiles should be appropriately shaped and compacted to avoid erosion and sedimentation of nearby open water courses or drains. Incorporating green infrastructure into road and highway design can help to mitigate the impacts of roads on terrestrial flora. For example, roadside vegetation can act as wildlife corridors, and permeable surfaces can help to reduce runoff and soil erosion. Reroute the alignment of highways to avoid hitting the Key Biodiversity Area and disturbing key important species.

3.1.4.5.2 Threat to existence, abundance, frequency and distribution of important species

Construction – Sapling collection of endangered, vulnerable and other threatened species such as *Vitex parviflora* (Endangered), *Pterocarpus indicus* (Vulnerable), *Shorea contorta* (Vulnerable), *Azadirachta excelsa* (Vulnerable), *Canarium ovatum* (Other Threatened Species), and *Cinnamommum mercadoi* (Other Threatened Species), hardening in established nurseries, and transpplanting the hardened saplings in target reforestation areas. It is also necessary to implement a *"no hunting, no collection"* policy on wildlife during the construction.

It is imperative to institutionalize the practice of reforesting road buffer zones with native trees and integrate substantial reforestation funding in the overall road construction budget. Reforestation of the buffer lanes on both sides of the road with native species should be a default mitigation plan for road projects to protect local indigenous species of trees and enhance vegetation cover.

3.1.4.5.3 Hindrance to wildlife access

Despite the fact that the stretch of the Project alignment is highly disturbed following massive conversion to agricultural areas, reforestation of riparian zones with native species will improve riparian ecology and enhance habitat access and utilization and minimize hindrance of wildlife access. Even though there is a little possibility of the occurrence of road killings of wildlife, walls should be installed on both sides of the project alignment. Speed limits during the construction phase should be implemented.

Unnatural lighting effects that may impact upon flora and fauna or deplete the sense of naturalness of the area. This can negatively impact insects and animals through attraction and disorientation or by disrupting their natural habitats. Artificial nighttime lighting is thought to reduce occupancy of habitat areas adjacent to roadways for some species and may decrease use of wildlife crossing structures. Additionally, nighttime lighting attracts insects and may indirectly lead to increased road mortality for bats and other insectivorous animals. Among the possible management options to reduce the effect of light pollution at night is the reduction of light intrusion by modifying the height of streetlamps, lighting intensity, spectral composition.

In addition, the establishment of underpasses or box culverts may be considered a critical mitigating measure to protect wildlife and promote ecological connectivity. Road alignment can act as a physical barrier, hindering the movement of wildlife and disrupting their natural migration patterns. Also, by providing underpasses or box culverts, the chances of wildlife-vehicle collisions will be greatly reduced, ensuring safer roads.

3.1.4.5.4 Invasion of weed species and loss of important local species

Roads can act as corridors for invasive plant species, which can quickly spread into new areas and outcompete native plant species. This can lead to the displacement of native flora and a reduction in biodiversity. One of the most effective ways to mitigate the impacts of roads on terrestrial flora is to restore habitats that have been disturbed or destroyed during construction. This can involve replanting native species, removing invasive species, and restoring natural water flows. Site nurseries in partnership with the Barangay LGU are recommended to establish in accessible locations to serve as repositories of recovered saplings of forest trees when vegetation removal becomes inevitable. After saplings are hardened in nurseries, saplings will be transferred to highly impacted areas, especially riparian zones. The development activities must also be limited within the planned structure or component footprint.

3.2 THE WATER

3.2.1 Hydrology/Hydrogeology

3.2.1.1 Scope

This module described the existing hydrology and hydrogeology at the proposed CMH alignment and its vicinities relevant to assessing the following key impacts: a) change in drainage morphology, b) inducement of flooding, c) reduction in stream volumetric flow, d) change in stream depth, and e) water source use and competition.

3.2.1.2 Methodology

Primary data was obtained by doing streamflow measurements of streams traversed by the alignment **(Table 3-55**). The stream width, depth, and velocity were measured to estimate its discharge rate. The activity was conducted on April 25 to 30 and July 27 to 31, 2021 covering the low and high rainfall periods. The photo-documentation of the field work is shown in **Appendix 27**.

Table 3-55. Location and observations of streamflow measurement points

Station	Coordinates		Name of river	Location	Description
	Latitude	Longitude			
H1	8.5292191 N	124.7891425 E	Tagoloan River	Natumolan, Tagoloan	Sand and gravel mining activities; near the bay
H2	8.3535948 N	124.8405358 E	Dicklum River	Dicklum, Manolo Fortich	Small tributary stream surround by bamboo
H3	8.3447317 N	124.8745521 E	Kumaykay River	Ticala, Manolo Fortich	Located in deep ravines, used for swimming and animal bathing.
H4	8.3357613 N	124.9051012 E	Puntian River Tributary	Vista-Villa-Puntian Boundary, Sumilao	Used for swimming and washing
H5	8.3170328 N	124.9496271 E	Tagolongon River Tributary	Culasi-Vista Villa Boundary, Sumilao	Used for washing
H6	8.3161957 N	125.0009035 E	Kulaman River Tributary	Poblacion Boundary, Sumilao, Bukidnon	Used for swimming and washing.
H7	8.2167793 N	125.0289096 E	Ipoon River	Impalutao, Impasug-ong	Clear cold water with reddish sediments
H8	8.2167793 N	125.0289096 E	Komotal River	Dalwangan, Malaybalay	Has a small dam for irrigation water supply. Used for swimming and washing.
H9	8.1839268 N	125.0575419 E	Sawaga River	Patpat, Malaybalay	Used for swimming and washing.
H10	8.1640427 N	125.1130562 E	Sawaga River	Sumpong, Malaybalay	Used for swimming and washing.

Secondary data consisted of literature from recent surveys and key informant interviews with focus on the portion of the Tagoloan River watershed traversed by the proposed CMH road. The assessment and the corresponding methodology for floodplain inundation are made with respect to Tagoloan River.

3.2.1.2.1 Flood analysis

The flood hazard analysis was conducted for the 100-year return period using the 2-D option of HEC-RAS defined by underlying topography and 2D shallow water and momentum equations. The model simulates flood properties such as flood extent, flood depths and velocities. It consisted of a short-term storm event simulation module for flooding by river overflow and flash flood events with a time scale within a couple of hours to a few days. The physical characteristics of the Project area and a digital elevation model were combined with the result of flood simulations to generate the flood hazard map.

The areal extent of 2D model showing in **Figure 3-50** is the watershed of Tagoloan River taking into account the location of the proposed CMH alignment. The simulation results can be used as a basis in the detailed design of flood control facilities or as part of engineering measures for the proposed CMH Project.

3.2.1.2.2 Tagoloan river basin spatial analysis

The Tagoloan River Basin crosses Malaybalay City, municipalities of Sumilao, Baungon, Impasug-ong, Manolo Fortich, and Malitbog in the province of Bukidnon; and municipalities of Tagoloan, Villanueva, and Claveria in the Province of Misamis Oriental, and drains to Macajalar Bay through the municipality of Tagoloan.

The basin has an area of 177,300.16 hectares based on spatial analysis. The extent of this area was used to estimate the river basin discharge. A digital terrain model (DTM) was generated using a digital elevation model (DEM) of a portion of Northern Mindanao processed by an open-source GIS platform. The Tagoloan River Basin and its tributary channels were delineated using the generated DEM and DTM.

3.2.1.2.3 Water balance analysis

Water balance in hydrology is a study where portions of the precipitation in the form of rain go in each of the stages in the hydrologic cycle. It is used to describe and quantify the flow of water in and out of a system.

A monthly water balance estimate for the Tagoloan River Basin was simulated using a site-specific water balance model developed by the US Geological Survey (USGS, 2007). The model, referred to as the Thornthwaite Monthly Water Balance Program, computes the components of the hydrologic cycle such as precipitation, evapotranspiration, and runoff, among others.

Inputs to the model are data on mean monthly temperature, *(T)* in degrees Celsius (°C); monthly total precipitation, *(P)* in millimeters; and the latitude (in decimal degrees) of the location of interest. Temperature and rainfall records (1985 - 2020) from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) station in Lumbia, Cagayan de Oro City was used because it is closest to the river basin. The latitude of the location of interest (in this case, 8°) was used for computing the day length needed for the calculating potential evapotranspiration *(PET)*. The PET represents the climatic demand for water, relative to the available energy.

According to the Thornthwaite Program, when *P* for a month is less than PET, then the *AET* is equal to *P* plus the amount of soil moisture that can be withdrawn from storage in the soil. Soil-moisture storage withdrawal (STW) linearly decreases with decreasing S such that as the soil becomes drier, water becomes more difficult to remove from the soil and less is available for AET. The water balance diagram is shown in **Figure 3-48**.

Figure 3-48. Diagram of a water balance model

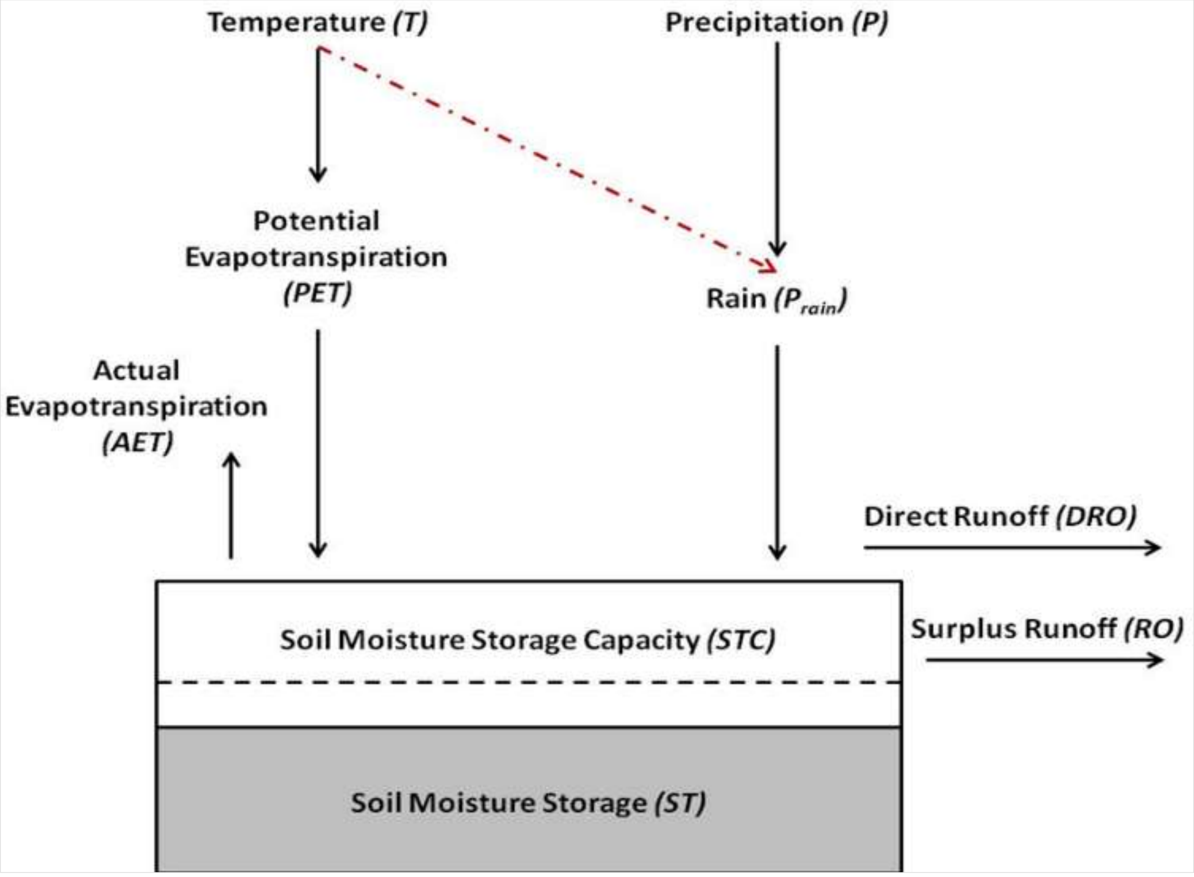


Figure 3-49. Location map of streamflow measurements

	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
Hydrology Sampling Map	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) PSA 2016 (Administrative Boundaries) AAI (Sampling Stations)		

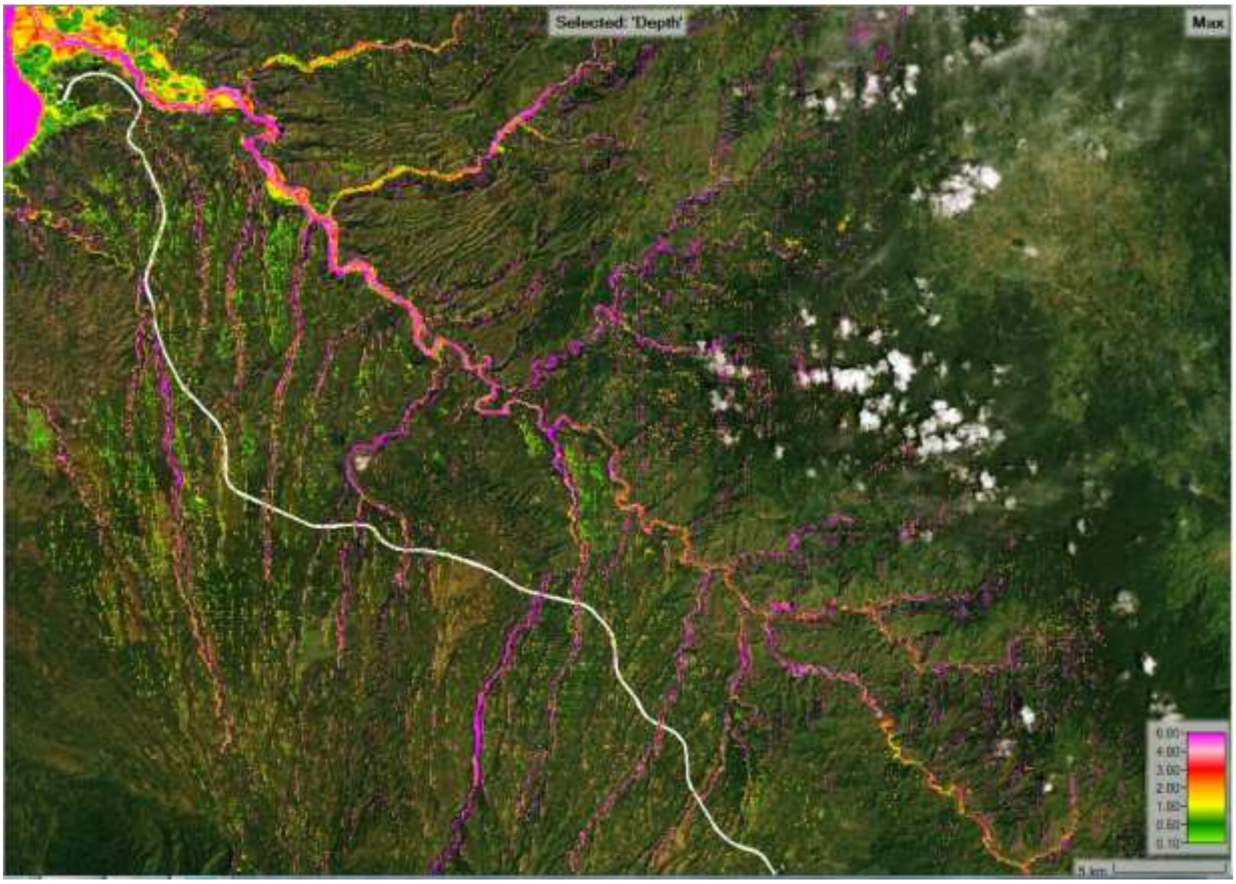
Figure 3-50. Extent of the 2D flood model (cyan-colored polygon) and river networks surrounding the proposed Project

3.2.1.3 Assessment of key impacts

3.2.1.3.1 Change in drainage morphology/inducement of flooding/reduction in stream volumetric flow

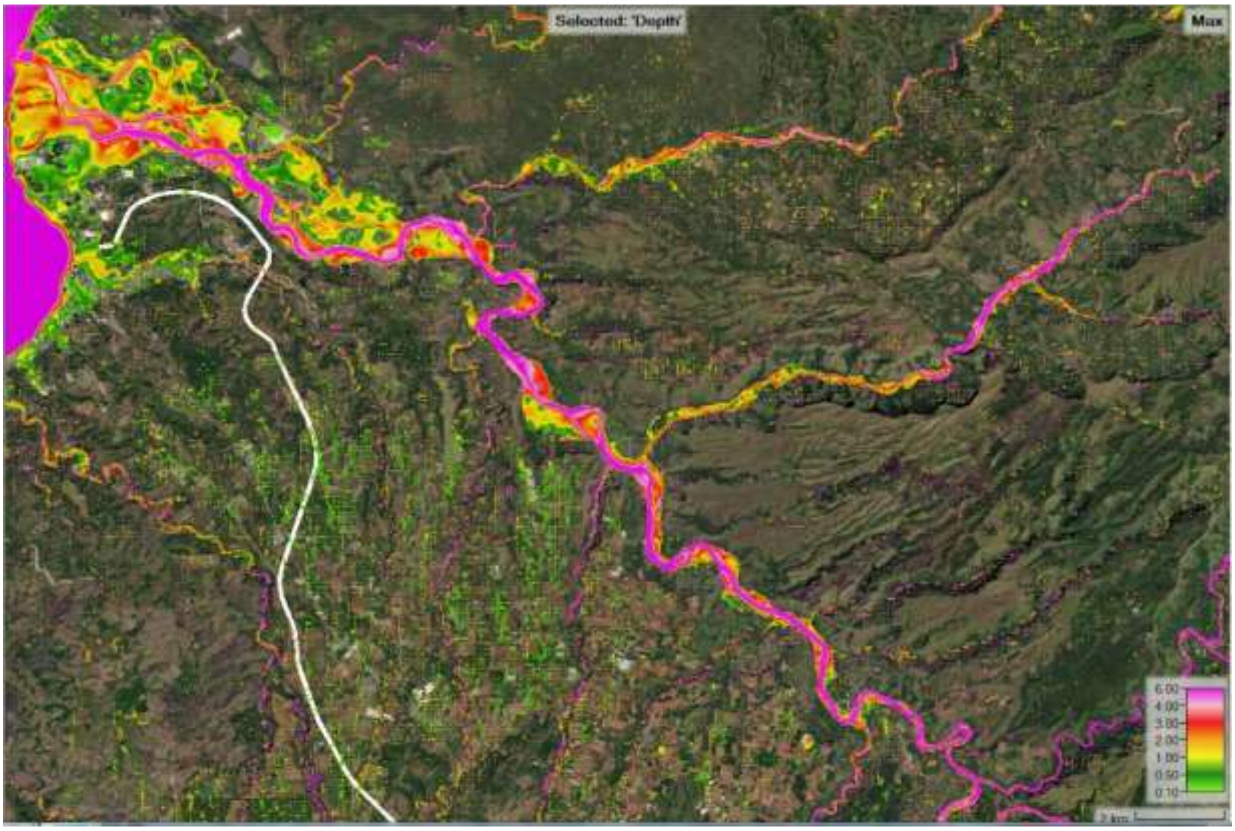
Flood analysis - **Figure 3-51** and **Figure 3-52** show the simulated maximum flood depth (meters) including portions of the floodplain for the 100-year return period indicating the general trends of floodplain inundation. Most of the floodwaters were confined in the main rivers and tributaries, with large swatches of inundation visible near the riverbanks indicating overflows and those isolated areas representative of depression storages in the catchment.

Figure 3-51. Predicted 100-year flood inundation map of the Project site at baseline conditions



NOTES: in meters

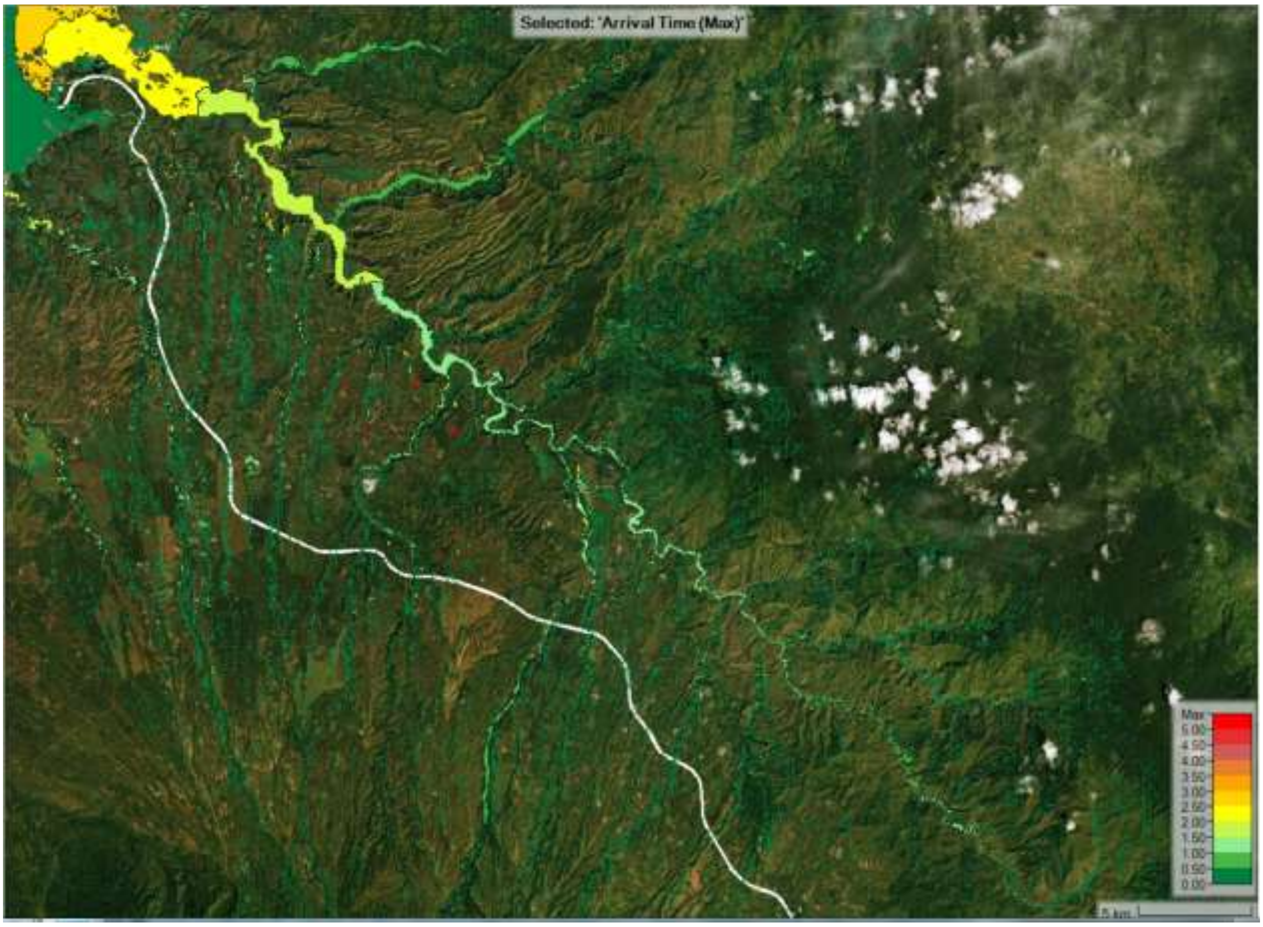
Figure 3-52. Predicted 100-year flood inundation map of the Project site at baseline condition (zoom)



NOTES: in meters

The hourly contours (delineated by white lines in **Figure 3-53**) of peak flood arrival time were generated to visualize the peak arrival times of the flood in the downstream areas starting from the peak of the rainfall event. For example, the peak flood in the area near the coast will arrive in less than 3 hours while it will take less than 1 hour for the maximum flood to reach the midstream area of Tagoloan River. Thus, the maximum floodwaters are predicted to reach the sea in less than 3.5 hours reckoned from the peak hours of rainfall.

Figure 3-53. Estimated arrival times (hr) of flood peaks as it flows downstream for a 100-year storm event



NOTES: in meters

Higher than normal flow velocities are expected with the sudden rush of floodwater due to rainfall-induced storms which may cause major structural damage or collapse of existing flood protection works along the river or scouring of riverbeds, among others. High flow velocities may also delay the response for emergencies and evacuation which may contribute significant losses to life and property within the most flood-vulnerable communities.

The velocity map in **Figure 3-54** shows high flood events occurring at the main channels that are potential hotspots for structural damage or property losses, which in main river sections reach more than 4 meters per second. Different communities near the riverbanks located within the towns traversed by Tagoloan River were predicted to be the most vulnerable to flood water inundation in less than 3 hours after the peak of rainfall are likewise vulnerable to high flood flow velocities.

Figure 3-54. Predicted maximum flood velocity map for a 100-year storm event

NOTES: in meters

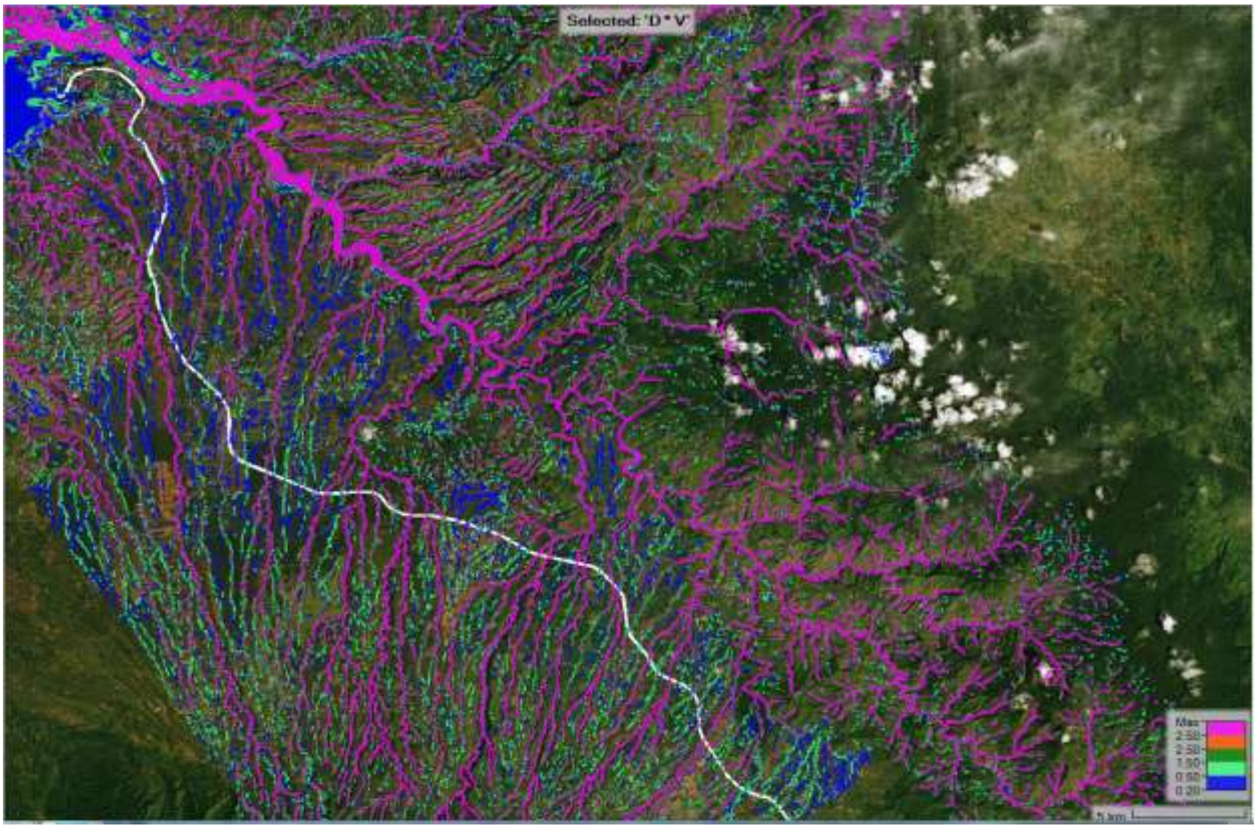
Using the predicted maximum depth and velocity values, the flood severity grid map was derived by multiplying the depth grid times with the velocity grid. The flood severity grid map represents the combined effect of depth and velocity, most often communicated in categories of Low, Medium, High, Very High and Extreme Hazard. As a simplified approach, the Federal Emergency Management Agency (FEMA) uses the depth velocity categories in **Table 3-56**. The resulting flood severity grid map derived from the maximum depth and velocity values predicted by the HEC-RAS model using the FEMA metric is shown in **Figure 3-55.**

Table 3-56. Simplified flood depth and velocity severity grid symbolization categories

Flood Severity Category	Depth Velocity Range (ft^2/sec)	Depth Velocity Range (m^2/sec)
Low	<2.2	<0.2
Medium	2.2 – 5.4	0.2 – 0.5
High	5.4 – 16.1	0.5 – 1.5
Very high	16.1 – 26.9	1.5 – 2.5
Extreme	>26.9	>2.5

Source: FEMA, 2018

Figure 3-55. Flood severity grid map using FEMA categories for the Project area, 100-year storm event



Flood analysis due to climate change – Rainfall is the most important natural factor in flooding. **Table 3-57** shows that climate-change induced changes in rainfall at the headwaters of Tagoloan River are decreasing in trend. The positive change in June, July, and August downstream of Tagoloan River in the area of Misamis Oriental resulted in small rainfall change of 32 mm (or 5.2% increase from 615.7 mm) for the 2050 projection. Thus, climate change impacts on flooding in the area may be considered insignificant.

Table 3-57. Seasonal rainfall changes in 2020 and 2050 under medium-range emission scenario

Province	Observed Baseline (1971-2000) mm				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Bukidnon	329.7	335.6	653.8	559.5	2.9	-10.3	-4.4	-0.3	-5.1	-13.0	-9.7	-5.8
Lanao del Norte	337.5	350.3	662.5	621.1	9.6	-0.6	-2.2	6.9	2.5	-1.9	1.4	7.1
Misamis Occidental	392.1	323.4	633.1	728.3	9.1	1.4	-6.1	6.1	5.2	0.3	-5.1	4.6
Misamis Oriental	442.5	296.0	615.7	581.1	4.6	10.4	3.7	2.9	1.8	17.8	5.2	0.1

Source: Climate Change in the Philippines", PAGASA, February 2011; NOTES: DJF – December, January, February; MAM – March, April, May; JJA – June July August; SON – September, October, November

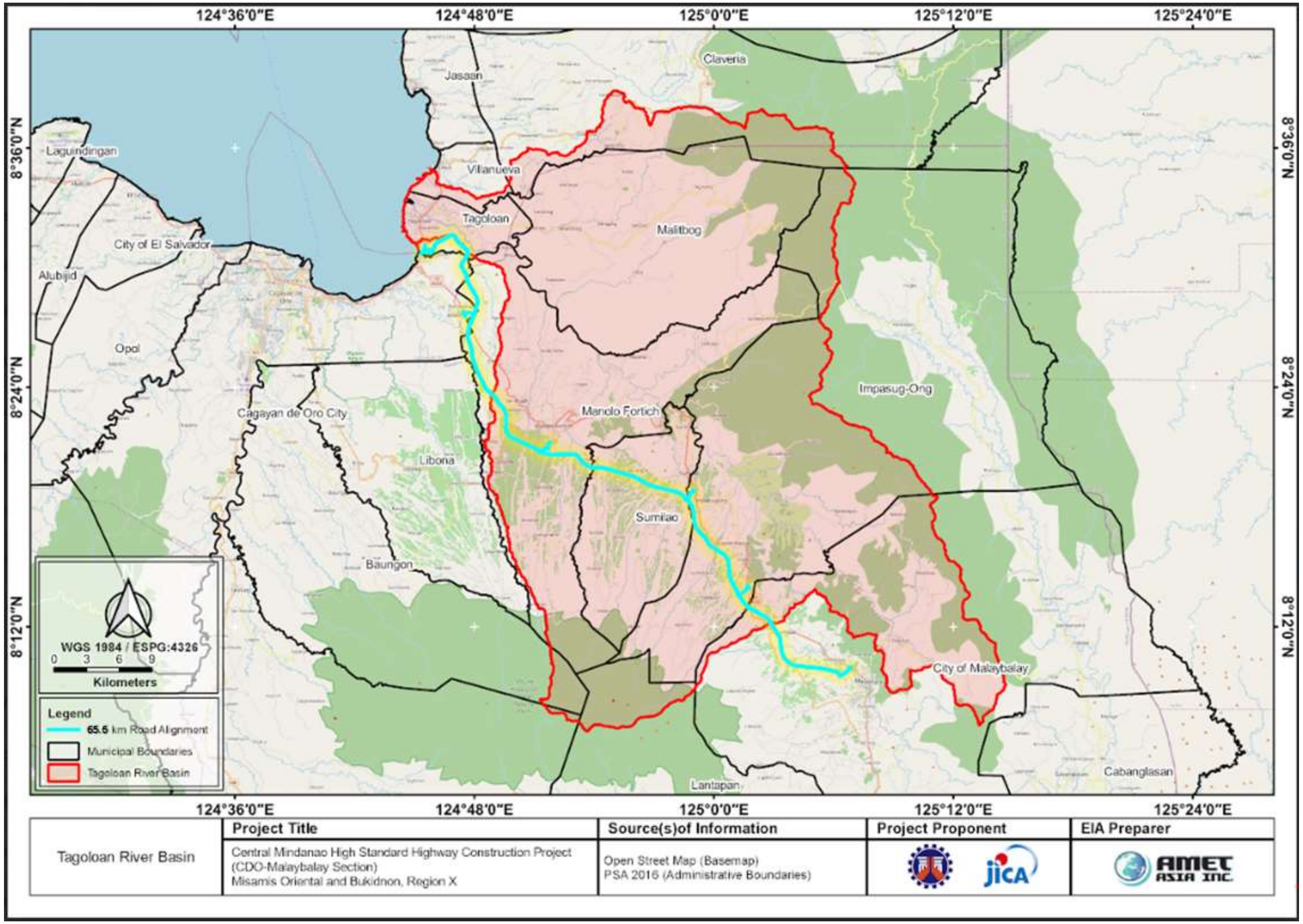
Flood assessment – The flood inundation modeling showed that segments of the CMH alignment will traverse some flooded portions delineated by the 100-year flood of Tagoloan River as well as the construction of new bridges crossing various tributary rivers. Slope protection works for the construction of river crossings has the potential to impact water flow in the river. These waterways are recommended to be examined during the detailed engineering design for any localized flooding problems related to the alignment. Identified problems should be corrected to the extent practicable. The proposed Project will provide an opportunity to construct river crossings and other river improvement works that are more compatible with current DPWH standards for hydraulic structures and other applicable stream management practices.

In addition to stream crossings, it will be necessary to provide small culvert crossings to allow water to drain properly and prevent inducement of flooding. Natural flows in rivers and creeks will be maintained and may be widened or deepened so that flood discharges are not adversely affect upstream areas of highway crossings. Any man-made canals and channel improvement works that may be affected, if any, will be modified to the extent possible to maintain its existing use and capacity. Coordination regarding the river improvement works will be conducted with the DPWH and/or the LGUs concerned. With these interventions, changes in drainage morphology, inducement of flooding and/or reduction in stream flow will be minimized, if not prevented.

3.2.1.3.2 Change in stream depth

Tagoloan River Basin discharge flows - The Tagoloan River Basin where the alignment traverses shown in **Figure 3-56** illustrates the extent of the river basin and the associated tributary network. The river basin is delineated in white while the river channels are in blue lines.

Figure 3-56. Tagoloan River Basin and its tributary network in Northern Mindanao



The monthly discharge flows of Tagoloan River Basin were derived from the monthly water balance results. Preliminary results indicated a decreasing trend in flows from January to April and September to December while an increasing trend may be observed from May to September (**Figure 3-57**). The average monthly flow for the 36-year simulation from 1985 to 2020 is calculated at 41,886.45 liters per second (lps) while the 2050 projection shows an average monthly flow of 30,078.88 lps. The monthly flow estimates for 2020 and 2050 are shown in **Attachment 25**.

Figure 3-57. Average monthly simulated flow of Tagoloan River Basin (simulation year 1995-2020)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	44,689.85	30,790.78	21,343.59	16,517.39	22,673.64	40,462.18	46,006.61	47,821.18	61,556.85	60,456.71	57,952.40	52,366.17
Max	236,195.00	229,012.70	193,306.42	160,131.04	235,374.16	221,693.60	196,589.76	169,707.44	165,261.26	144,672.00	202,198.79	240,435.97
Min	684.03	342.01	1,162.85	136.81	1,436.46	2,736.11	6,019.45	4,514.59	4,309.38	4,925.00	684.03	2,804.52

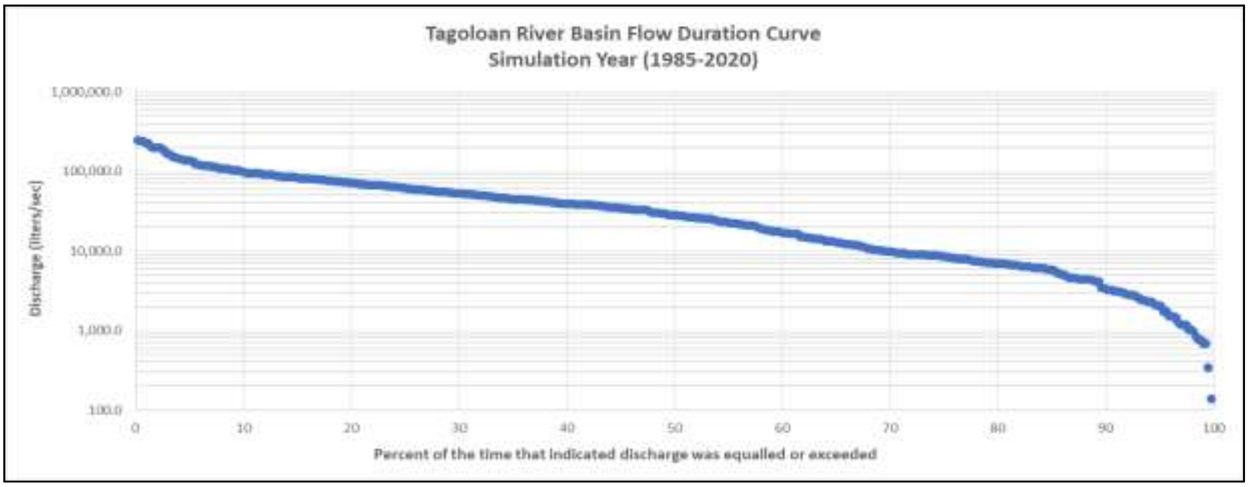
Figure 3-58. Average monthly simulated flow of Tagoloan River Basin (simulation year 2050 projection)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	39,764.85	27,606.25	17,062.71	11,485.98	14,524.20	24,908.13	24,805.53	26,122.28	40,566.68	43,576.41	46,016.11	44,507.45
Max	230,380.76	224,292.90	153,564.37	118,405.31	168,202.58	174,222.03	158,968.19	137,352.90	143,509.15	128,392.13	185,371.69	232,501.25
Min	68.40	342.01	684.03	68.40	1,094.45	2,530.90	5,198.62	3,351.74	1,162.85	1,436.46	684.03	2,120.49

Tagoloan River Basin flow duration analysis - A flow-duration analysis (as post-analysis) was also performed on the monthly simulated stream flows. For every value of exceedance probability (or fraction of time of availability and hence of its dependability), the corresponding amount of flow that at least is available is presented in the flow duration curve. The curve can be used to show the percentage of time river flow that is expected to exceed a design flow of a specified value (e.g., the daily requirement of the Project) or to show the discharge of the stream that occurs or is exceeded some percent of the time (e.g., what is the available flow, say 90% of the time?).

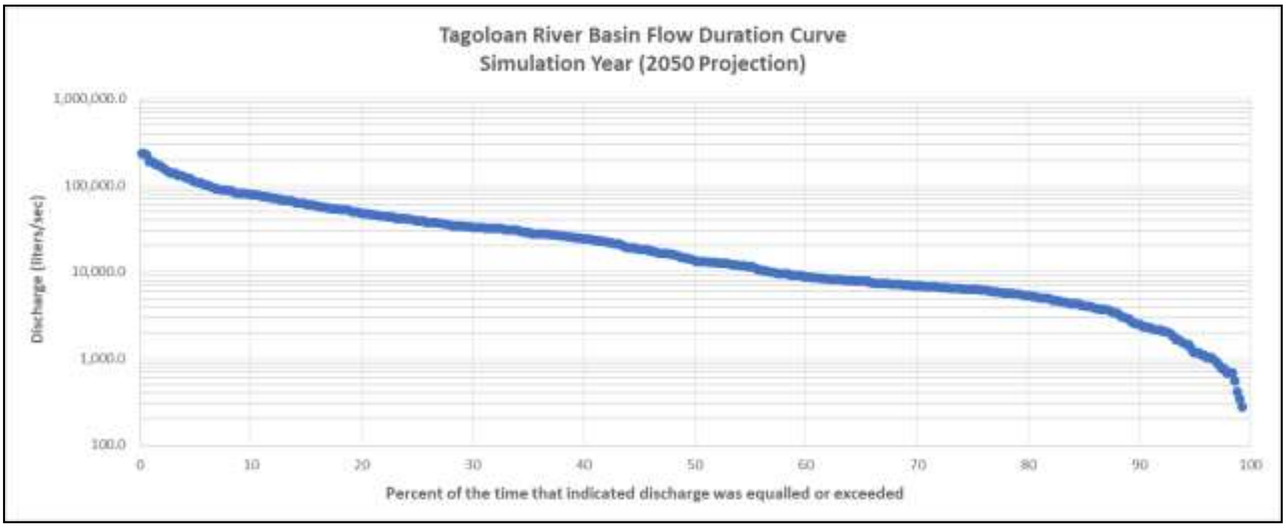
As an illustration, the derived flow duration curve in the **Figure 3-59** shows that for an annual basis, the flow at 50% dependability level of the Tagoloan River Basin is about 27,839.95 liters per second. In the assessment of water permit applications for example, the National Water Resources Board (NWRB) use the discharge of river that equals or exceeds 80% of the time. Applying this concept in the river basin, the 80% dependability level of the basin is around 6,908.69 liters per second.

Figure 3-59. Flow duration curve of Tagoloan River Basin derived from the 1985-2020 runoff simulation



Similarly, the flow duration curve of the Tagoloan River Basin derived from runoff simulations using 2050 PAGASA climate projection showed dependable flows at 50% and 80% of the time are 13,372.75 Lps and 5,267.02 Lps respectively (**Figure 3-60**).

Figure 3-60. Flow duration curve of Tagoloan river basin from the 2050 Projection runoff simulation



Change in stream depth - The alteration of upstream rivers' flow capacities will translate to changes in water levels and flow downstream. The processes involved with building roads and highways often involve adding or removing large masses of dirt and stone along the route. If standard methods of construction are not followed, it is possible that excavated materials and loose soils may end up in the waterways, creeks or stream which will eventually alter its natural topography.

The short-term increase in runoff with sediment may also occur due to the removal of vegetation cover and topsoil of the road alignment. The sediments may get washed into these water sources leading to change in stream depths.

3.2.1.3.3 Water source use and competition

3.2.1.3.3.1 Tagoloan River Basin water balance

Baseline monthly water balance (1985-2020) - Initially, a monthly water balance was simulated using the 1985-2020 observed data to establish a baseline for the following output parameters: potential evapotranspiration (PET); precipitation (P); (P-PET); soil moisture storage (ST); actual evapotranspiration (AET); water deficit (PET-AET); surplus; and total runoff (ROtotal).

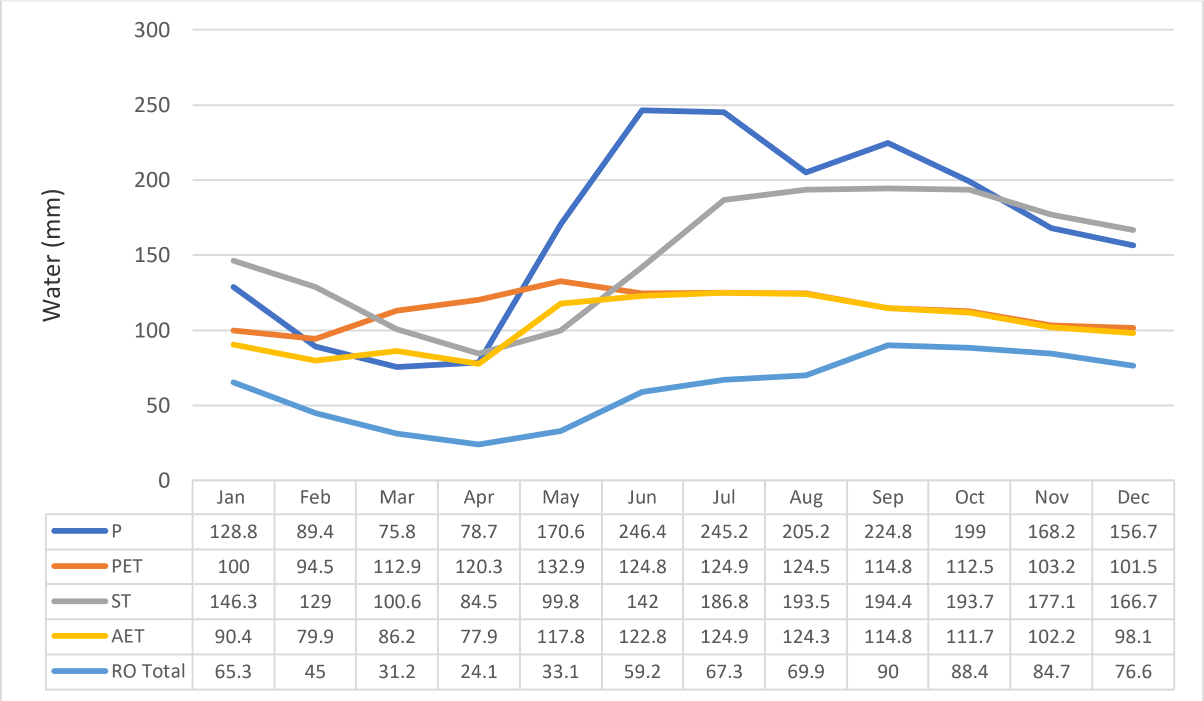
From **Figure 3-61**, the average monthly water balance based on the 1985 to 2020 data generally implied that most part of the precipitation (P) is lost to actual evapotranspiration by an average of 63% while 37% goes to soil moisture and total runoff.

If the sum of P and STW is less than PET, then a water deficit is calculated as (PET–AET). If P exceeds PET, then AET is equal to PET and the water in excess of PET replenishes ST. When ST is greater than Soil-moisture storage Capacity (STC), the excess water becomes surplus (S) and is eventually available for runoff. With reference to **Figure 3-61**, water deficits occur between February to April since precipitation is less than the PET and that PET is generally greater than AET.

Runoff (RO) is generated from the surplus (S), at a specified rate (rfactor). The *rfactor* parameter determines the fraction of surplus that becomes runoff in a month. The remaining surplus is carried over to the following month to compute total S for that month. Direct runoff (DRO), in millimeters, is added directly to the runoff generated from surplus (RO) to compute total monthly runoff (ROtotal), in millimeters. The generated monthly ROtotal may be used to estimate the monthly discharge (Q) of a given catchment area which may be considered in designing the drainage system of the Project.

For example, a catchment area of 100 hectares and an average *ROtotal* of 100 mm in a given month, the corresponding catchment discharge *(Q)* for that month will be 0.039 m^3/sec or 38.58 liters per second (lps).

Figure 3-61. Simulated monthly water balance (1985-2020)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P	128.8	89.4	75.8	78.7	170.6	246.4	245.2	205.2	224.8	199	168.2	156.7
PET	100	94.5	112.9	120.3	132.9	124.8	124.9	124.5	114.8	112.5	103.2	101.5
ST	146.3	129	100.6	84.5	99.8	142	186.8	193.5	194.4	193.7	177.1	166.7
AET	90.4	79.9	86.2	77.9	117.8	122.8	124.9	124.3	114.8	111.7	102.2	98.1
RO Total	65.3	45	31.2	24.1	33.1	59.2	67.3	69.9	90	88.4	84.7	76.6

NOTES: P – Precipitation, PET – Potential Evapotranspiration, AET – Actual Evapotranspiration, ST Soil Moisture Storage, RO_{Total} – Total Runoff

Projected monthly water balance (2050) – The PAGASA 2050 climate change projections highlighted that the annual mean temperatures all over the country are expected to rise by 1.8 to 2.2 °C. In terms of seasonal rainfall change, there is generally a substantial spatial difference in the projected changes in rainfall in 2050 in most parts of the country, with reduction in rainfall in most provinces during the low rainfall (MAM), while rainfall increases are likely in most areas during the southwest monsoon (JJA, SON). **Table 3-58** summarizes the 2050 projections of PAGASA seasonal changes in temperature and rainfall for Northern Mindanao.

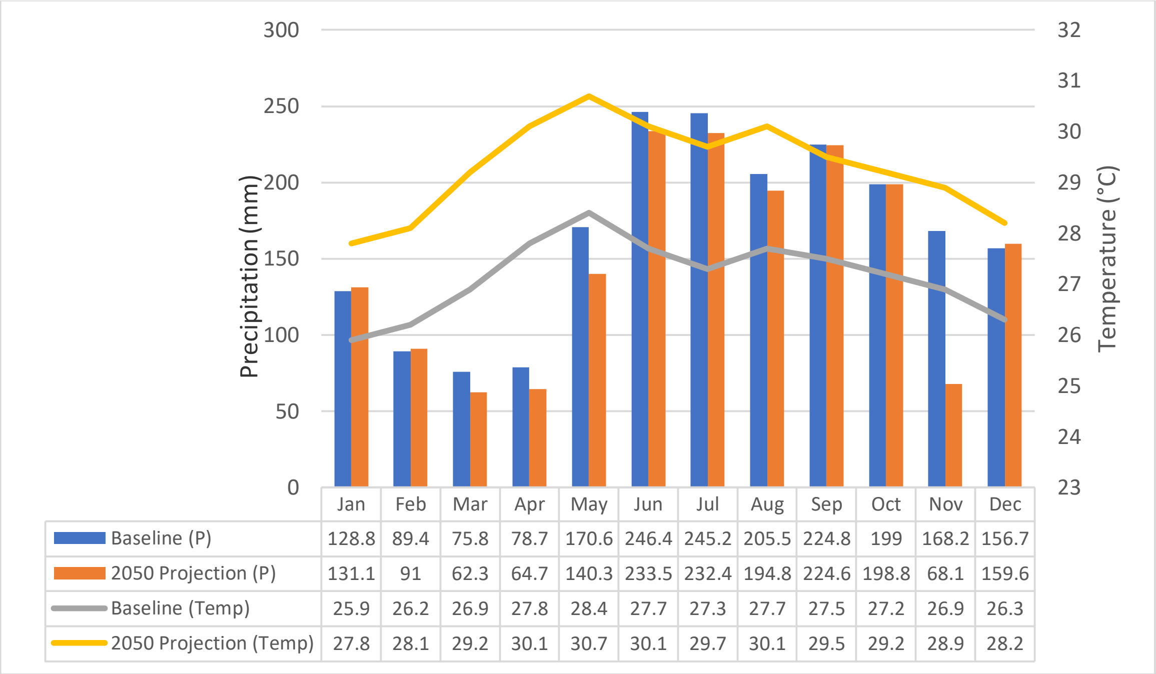
Table 3-58. Climate change projection in 2050 for Region X

Seasonal change*	DJF	MAM	JJA	SON
Seasonal temperature increases (in °C)	1.9	2.3	2.4	2.0
Seasonal rainfall change (in %)	1.8	-17.8	-5.2	-0.1

Source PAGASA: NOTES: *medium-range emission scenario DJF – Dec Jan Feb, MAM – March April May, JJA – June July Aug, SON – Sept Oct Nov

Figure 3-62 illustrates the changes in temperature and rainfall as projected in 2050. Temperature is generally expected to be higher than the observed baseline throughout the year and more marginal precipitation in the months of December, January, and February and lesser precipitation is expected for the rest of the year.

Figure 3-62. Baseline vs 2050 projections on precipitation and temperature

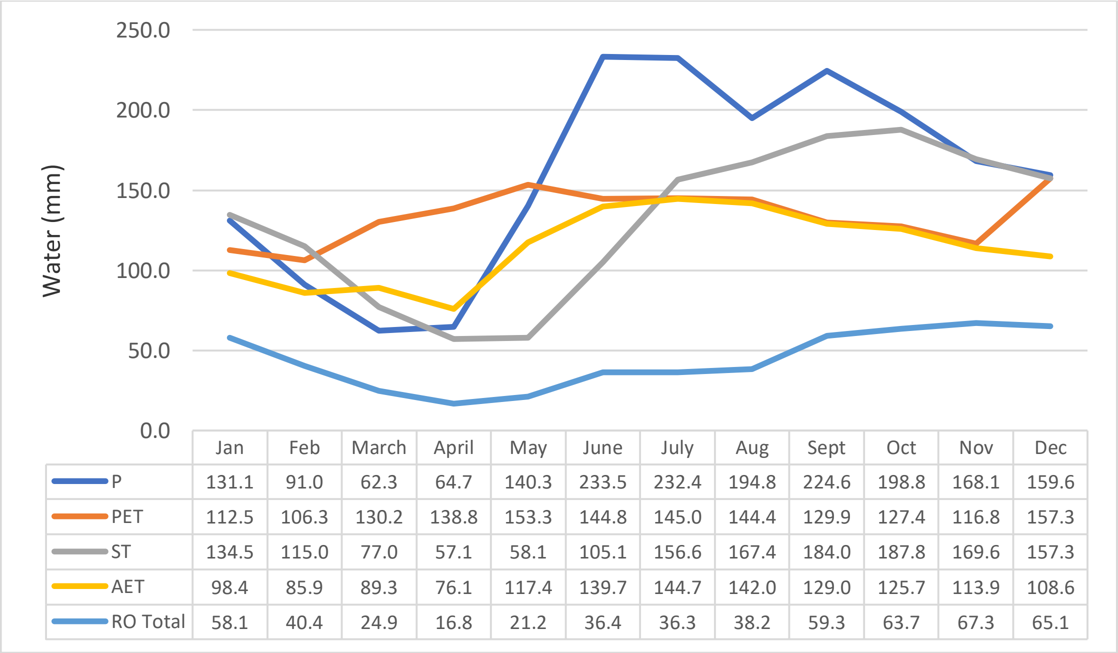


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baseline (P)	128.8	89.4	75.8	78.7	170.6	246.4	245.2	205.5	224.8	199	168.2	156.7
2050 Projection (P)	131.1	91	62.3	64.7	140.3	233.5	232.4	194.8	224.6	198.8	68.1	159.6
Baseline (Temp)	25.9	26.2	26.9	27.8	28.4	27.7	27.3	27.7	27.5	27.2	26.9	26.3
2050 Projection (Temp)	27.8	28.1	29.2	30.1	30.7	30.1	29.7	30.1	29.5	29.2	28.9	28.2

NOTES: P – precipitation, Temp – temperature

The effect of temperature and rainfall changes on the water balance was examined using the 2050 projections. The effect of higher temperatures consequently raises the potential evaporation (PET) because it is highly dependent on available energy (heat). Likewise, the actual evapotranspiration (AET) became generally higher than the observed baseline. The projected change in rainfall affected both soil moisture storage and runoff. Soil moisture storage and runoff significantly decreased throughout the year. **Figure 3-63** illustrates the 2050 projected monthly water balance for the Tagoloan River Basin.

Figure 3-63. Monthly water balance using temperature and rainfall changes projected in 2050



	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
P	131.1	91.0	62.3	64.7	140.3	233.5	232.4	194.8	224.6	198.8	168.1	159.6
PET	112.5	106.3	130.2	138.8	153.3	144.8	145.0	144.4	129.9	127.4	116.8	157.3
ST	134.5	115.0	77.0	57.1	58.1	105.1	156.6	167.4	184.0	187.8	169.6	157.3
AET	98.4	85.9	89.3	76.1	117.4	139.7	144.7	142.0	129.0	125.7	113.9	108.6
RO Total	58.1	40.4	24.9	16.8	21.2	36.4	36.3	38.2	59.3	63.7	67.3	65.1

Table 3-59 shows the detailed summary of the changes between the baseline and projections. From these results discussed in the earlier section, there is a marginal increase in precipitation for 2050 against the baseline data (in the months of DJF) and because of the increase in ambient temperature affecting evapotranspiration rates, an increase in potential and actual ET by 14.4% and 9.6% was predicted respectively. Likewise, due to predicted increase in evapotranspiration losses in year 2050, a corresponding reduction in soil moisture storage and total runoff by 13.5% and 28.2% respectively was also predicted.

Table 3-59. Summary of changes in P, PET, ST, AET, and RO_{Total} from the 36-year baseline (1985-2020) to 2050

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Precipitation (P)													
Baseline	128.8	89.4	75.8	78.7	170.6	246.4	245.2	205.5	224.8	199.0	168.2	156.7	**1989.2**
2050 Projection	131.1	91.0	62.3	64.7	140.3	233.5	232.4	194.8	224.6	198.8	168.1	159.6	**1901.2**
Potential Evapotranspiration (PET)													
Baseline	100.0	94.5	112.9	120.3	132.9	124.8	124.9	124.5	114.8	112.5	103.2	101.5	**1366.9**
2050 Projection	112.5	106.3	130.2	138.8	153.3	144.8	145.0	144.4	129.9	127.4	116.8	114.2	**1563.7**
Soil Moisture Storage (ST)													
Baseline	146.3	129.0	100.6	84.5	99.8	142.0	186.8	193.5	194.4	193.7	177.1	166.7	**1814.3**
2050 Projection	134.5	115.0	77.0	57.1	58.1	105.1	156.6	167.4	184.0	187.8	169.6	157.3	**1569.5**
Actual Evapotranspiration (AET)													
Baseline	90.4	79.9	86.2	77.9	117.8	122.8	124.9	124.3	114.8	111.7	102.2	98.1	**1251.0**
2050 Projection	98.4	85.9	89.3	76.1	117.4	139.7	144.7	142.0	129.0	125.7	113.9	108.6	**1370.5**
Total Runoff (RO_{Total})													
Baseline	65.3	45.0	31.2	24.1	33.1	59.2	67.3	69.9	90.0	88.4	84.7	76.6	**734.8**
2050 Projection	58.1	40.4	24.9	16.8	21.2	36.4	36.3	38.2	59.3	63.7	67.3	65.1	**527.7**

Baseline annual water balance - The annual water balance for the Tagoloan River Basin based on the hydrologic simulations is summarized **Table 3-60.** The 36-year average showed that about 33% of 1,989.15 mm of precipitation becomes total runoff (or 734.82 mm) and about 63% of precipitation is lost as actual evapotranspiration (about 1,250.99 mm). Around 8% of rainfall (151.19 mm) is retained into the soil that eventually contributes to the groundwater becoming baseflow.

Because the Tagaloan River Basin is large with land cover dominated by cultivated crops, grassland, and brushland, a significant amount of precipitation is lost to actual evapotranspiration and leaves little to be absorbed and infiltrated into the soil column. This was evidenced by the low value of rainfall-runoff ratio of 0.33 (runoff coefficient).

Table 3-60. Annual water balance estimates for the Tagoloan River Basin

Year	(P)	(PET)	(AET)	(ST)	(RO_{Total})	Year	(P)	(PET)	(AET)	(ST)	(RO_{Total})
1985	1,818.80	1,307.30	1,130.90	128.62	551.00	2004	1,144.60	1,364.30	1,225.40	94.48	209.60
1986	1,584.00	1,301.30	1,189.40	146.16	536.80	2005	1,609.30	1,363.10	1,091.90	114.11	381.70
1987	1,093.90	1,338.40	1,075.30	82.60	130.50	2006	1,386.70	1,345.80	1,202.40	138.41	272.20
1988	1,554.50	1,343.50	1,008.70	103.25	354.30	2007	1,640.20	1,340.30	1,145.30	127.88	378.00
1989	2,082.20	1,306.70	1,285.00	181.25	847.70	2008	2,133.00	1,303.10	1,302.40	196.63	810.20
1990	1,964.60	1,340.00	1,118.60	138.53	736.20	2009	2,352.10	1,361.10	1,361.10	174.96	1,044.40
1991	1,416.00	1,327.70	1,211.60	131.14	384.40	2010	1,799.90	1,393.50	1,250.70	129.57	538.50
1992	1,202.90	1,352.10	958.50	101.67	256.80	2011	2,163.80	1,363.20	1,356.20	185.34	684.70
1993	1,831.40	1,310.50	1,075.50	124.10	563.70	2012	1,670.30	1,386.70	1,344.50	146.88	425.10
1994	1,749.90	1,299.20	1,267.50	152.68	672.60	2013	2,067.60	1,366.00	1,350.80	183.56	707.10
1995	1,849.80	1,312.40	1,109.70	127.38	556.60	2014	2,824.10	1,467.70	1,467.70	200.00	1,340.70
1996	1,780.80	1,304.20	1,304.20	189.76	573.10	2015	2,183.40	1,491.70	1,488.40	187.19	676.50

Year	(P)	(PET)	(AET)	(ST)	(RO_{Total})	Year	(P)	(PET)	(AET)	(ST)	(RO_{Total})
1997	1,614.80	1,350.60	1,280.90	138.58	409.60	2016	2,682.20	1,512.60	1,496.80	177.04	1,107.30
1998	1,325.30	1,405.90	968.30	92.80	268.00	2017	4,885.50	1,468.80	1,468.80	200.00	3,242.70
1999	2,306.20	1,314.00	1,314.00	197.65	888.70	2018	3,668.90	1,490.90	1,490.90	194.02	2,321.60
2000	2,094.70	1,320.60	1,320.20	188.45	878.10	2019	2,462.10	1,492.80	1,492.80	193.06	1,102.50
2001	2,000.60	1,332.30	1,262.20	154.63	680.30	2020	2,014.90	1,429.50	1,286.90	145.66	678.70
2002	1,718.30	1,344.50	1,287.30	156.22	596.40	**36-year average**	**1,989.15**	**1,366.87**	**1,250.99**	**151.19**	**734.82**
2003	1,932.10	1,354.90	1,044.90	118.62	647.20						

NOTE: P – Precipitation, PET – Potential Evapotranspiration, AET – Actual Evapotranspiration, ST Soil Moisture Storage, RO_{Total} – Total Runoff

3.2.1.3.3.2 Local sources of water supply

There local water districts supplying the domestic water requirements of concession areas within the areas traversed by the proposed CMH alignment are enumerated and described below and shown **Figure 3-64**. Some water sources lack geographic coordinates and were not included in this plot. The reader is referred to **Annex 6** for additional information about the water districts described below.

1. The Tagoloan Water District covers the eight (8) Barangays of the municipality of Tagoloan, namely: Brgy. Mohon, Santa Cruz of Sihayon left and right, Poblacion, Baluarte, Sogbongcogon, Gracia, Promise Land, and Natumolan. The majority of its water sources come from deep wells with chlorination as the primary mode of treatment and distributed via a Level III water distribution system (water metering). Unfortunately, water production data was not available nor included in the data provided. The same is true for the municipality of Impasug-ong, Bukidnon where it only indicated the two sources of its water supply: from Iglerop spring and a deep well in Barangay Poblacion.

2. The Cagayan de Oro Water District (COWD) service area covers a portion of the municipality of Tagoloan, the City of Cagayan de Oro, and Manolo Fortich. The water sources in the COWD Cagayan de Oro Service area are 31 groundwater production wells, a spring (Malasag Spring), and surface water from Cagayan de Oro Bulk Water, Inc. in Baungon, Bukidnon. From 2018 to 2020, the average annual volume of water distributed in the service area is about 66.56 million cubic meters (MCM) or about 5.55 MCM per month.
3. In the Manolo Fortich service area of the COWD, 20 water sources mainly from groundwater through deep wells and springs using chlorination delivered an annual average of 2.781 MCM of potable water from 2018 to 2020 to.

4. In the Municipality of Sumilao, data from Kisolon-San Vicente Water Supply System showed that the volume of water distributed for 2018-2019 averaged of 532,459.50 cubic meters from the two major water sources, Larok and Kisolon Spring.

5. The Municipal Economic Enterprise Development Office (MEEDO) of Impasug-ong have two springs (Iglerop and Intavas spring in La Fortuna) and a deep well in Poblacion producing water serving the following areas in the municipality: Barangay Poblacion, La Fortuna, Sitio San Juan in Barangay La Fortuna, Sitio Kiasin in Barangay Capitan Bayong, and Sitio Kibangan in Barangay Poblacion. The monthly volume of water distributed by the MEEDO is 0.4428 MCM.

6. Data from the Malaybalay Water District including Primewater Malaybalay showed that its water supply is sourced from five (5) mountain creeks and seven (7) deep well pumping stations. Based on their monthly water production data, the total water produced from these water sources was approximately 8.607 MCM per year from 2018 to 2020.

From the water production data gathered, the total annual average water supplied to various water concession areas is about 78.483 MCM (**Table 3-61**).

Table 3-61. Annual water volume distributed to various water concession areas

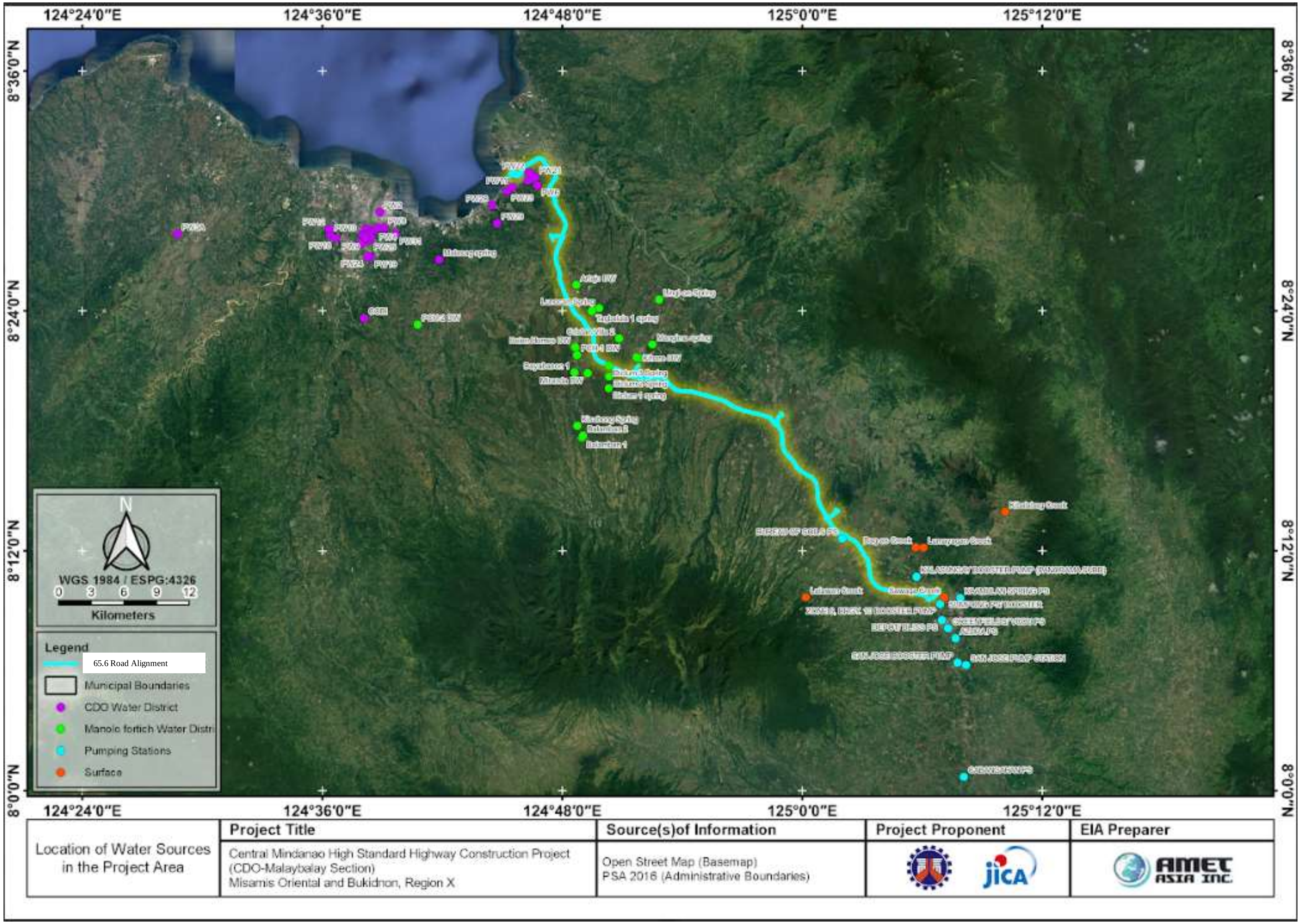
Municipality	Annual Water Distributed*			Annual Average
	2018	2019	2020	
Cagayan de Oro	51,580,308.00	73,215,745.00	74,891,720.00	66,562,591.00
Manolo Fortich	2,556,883.00	2,784,395.00	3,001,935.00	2,781,071.00
Sumilao	485,634.00	579,285.00		532,459.50
Malaybalay	8,223,893.30	8,945,379.66	8,653,009.00	8,607,427.32
Annual total average				78,483,548.82

*in cubic meters

From the flow duration curve, the 80% dependability level of the Tagoloan River Basin is around 6,908.69 liters per second or about 217.87 MCM per year. Comparing this with the volume of water distributed amounting to 78.483 MCM by various water service providers, showed sufficient enough surface water available in the basin for abstraction and use.

In addition, considering that groundwater sources are the primary source of water supply in the area, the water balance analysis previously presented showed that around 8% of rainfall is retained into the soil that eventually contributes to the groundwater becoming baseflow. This translates to about 268.06 MCM of annual rainfall volume that percolates into the soil and replenishes the groundwater table showing more than adequate water supply. Based on this, the Project is not expected to cause depletion and cause undue competition of the water resources in the area.

Figure 3-64. Location of water supply sources in the Project area



3.2.1.3.3.3 Water resource competition

The use of water for the Project is temporary in nature and is needed only during construction. Water abstraction from surface water resources would be used for construction activities and for equipment cleaning, dust control, and staging areas. The proposed Project may temporarily impact surface water volume in locations suitable for water withdrawals. During withdrawals, minimal disruption of the normal access to and use of surface water resources is expected in the proposed RROW and adjacent areas. The water resources affected by Project construction, as well as temporary access roads, would be restored following construction.

Project implementation will not involve installation of new wells for potable water. Instead, water supply requirements for construction personnel, temporary facilities and site offices will rely on existing water service providers and will not compete with the requirements of the domestic water users in the area. Thus, water resource use and competition are considered insignificant for the Project.

3.2.1.4 Proposed mitigation measures

3.2.1.4.1 Change in drainage morphology, inducement of flooding, reduction in stream volumetric flow

Pre-construction – the construction of the proposed Project and its appurtenant structures such as river crossings and slope protection work have the potential to impact water flow in the river altering its drainage morphology, induce flooding risk due to the presence of structures in or along the stream, and the effects of the reduction of flow downstream. The impact of these changes should be addressed and mitigated in the planning and detailed engineering design stage such as examination of any localized flooding problems related to the highway.

In addition to carefully designed stream crossings and slope protection works, it is necessary to provide small culvert crossings to allow water to properly drain and prevent flooding. Natural flows in rivers and creeks will be maintained or may be widened or deepened so that flood discharges would not adversely affect upstream of highway crossings. Any man-made canals and channel improvement works that may be affected by the Project, if any, should be modified to maintain its existing use and capacity. Coordination with the DPWH and/or the LGUs concerned regarding the river improvement works is emphasized.

Construction - Best management practices will be utilized during construction to further minimize changes in drainage morphology and riverine impacts. It is anticipated these practices will include properly installed silt fences, establishment of no intrusion areas during road construction, rapid re-vegetation of side slopes with anti-erosion cover, and the use of appropriate anti-erosion technologies.

Operation - Regular maintenance of drainage canals, pipe culvert, cross drains.

3.2.1.4.2 Change in stream and water depth

Pre-construction – During pre-constrution, staging areas must be located far from surface stream as possible and Spoils Management Plan must be formulated.

Construction - if standard methods of construction are not followed, it is possible that excavated materials and loose soils may end up in the waterways, creeks or streams, eventually altering its natural topography. The short-term increase in runoff with sediment may also occur due to vegetation and topsoil removal at the road alignment. Sediments may get washed into these water sources leading to changes in stream depths.

Disposal of unused or excess fill material during construction will comply with the DPWH standard specifications and other applicable environmental laws, policies and regulations. Disposal will not be allowed in wetlands, floodplains, or other environmentally sensitive areas. Erosion and sedimentation will be controlled using temporary and permanent erosion and sediment control plans based on DPWH standard specifications and other applicable guidelines.

Earthworks will be conducted in a manner that minimizes disturbance to river sediments and containing sediments that become waterborne. Temporary mitigation measures to minimize physical impacts to the water resource may include floating booms where appropriate to contain sediment plumes and debris to the greatest extent practical within the river. Other erosion control measures for the land side of the Project may include silt fences, temporary sediment basins, diversion dikes, and other common engineering practices.

Operation - Restoration and maintenance of natural drainage traversed by the alignment.

3.2.1.4.3 Water resource use and competition

Construction - the water requirements of the Project deal with the potable water for construction personnel, equipment cleaning, washing, dust suppression, compaction of soil, among others. To minimize competition of water use, site staff shall not be permitted to use any open water body or natural water source adjacent to or within the designated site that are being used by the general populace, for the purposes of bathing or washing of clothes. Construction of wells as source of potable water shall not be allowed, instead the services of water service providers for the water supply requirement of the Project staff shall be engaged.

The water usage of the Project is temporary and is needed only during construction. Water abstraction from surface water resources by the proposed Project would be used for construction processes and would consist of equipment cleaning, dust control, and in the construction barracks. The proposed Project may temporarily impact surface water volume in locations suitable for water withdrawals. During withdrawals, minimal disruption of the normal access to and use of surface water resources would be anticipated in the proposed Project ROW and adjacent areas. The water resources affected by the proposed Project construction, as well as temporary access roads, would be restored following construction.

The Project will not involve installation of new wells for potable water. Instead, water supply requirements for construction personnel, temporary facilities and site offices will rely on existing water service providers and will not compete with the requirements of the domestic water users in the area. Thus, water resource use and competition are deemed insignificant for the Project.

3.2.2 Oceanography

Oceanography is not applicable because the proposed Project or any of its components are not located near the seas. The nearest coastal area to the RROW is more than 800 meters.

3.2.3 Water quality

3.2.3.1 Scope

Gathering of secondary data from various sources combined with primary data gathering through groundwater survey and obtaining samples of surface and groundwater was done in order to determine the baseline data of water quality along the Project site in line with DAO 2021-19 and DAO 2016-08.

3.2.3.2 Methodology

Groundwater quality - A survey was done to determine locations of deep wells or springs near the Project. Grab samples were collected at 10 stations during the high rainfall period (July 26, 27, 29 to 30, 2021). The seuver season was set in consideration of the abundant of water and the availability of sampling of deep wells or springs. All of the groundwater quality stations are utilized for drinking, bathing and washing by the locals. The location and description of the stations are shown in **Table 3-62** and **Figure 3-65**. Photographs of the sampling stations and the laboratory reports are shown in **Appendix 30** and **Annex 5** respectively. The existing groundwater quality was described by comparing the laboratory results with the DENR Class A WQG values.

Table 3-62. Description of the groundwater water quality sampling stations

Stn.	Groundwater Name	Source type	Coordinates		Barangay	Municipality
			Latitude	Longitude		
GW1	Purok 6 Tubod Casinglot Reservoir	Deep well (Electric pump)	8.51721N	124.76284E	Casinglot	Tagoloan
GW2	Purok 1A Spring	Spring water	8.39112 N	124.83234 E	San Miguel	Manolo Fortich
GW3	Enlapay Spring	Spring water	8.33595 N	124.89176 E	Ticala	
GW4	Lumok Spring	Spring water	8.34294 N	124.91293 E	Puntian	Sumilao
GW5	Briana Spring	Spring water	8.30061 N	124.94921 E	Poblacion	
GW6	Kisolon Reservoir	Spring water	8.31803 N	124.96956 E	Kisolon	
GW7	Kalahi Seeds Reservoir	Spring water	8.26076 N	125.00866 E	Capt. Bayong	Impasug-ong
GW8	Bureau of Soils Reservoir	Deep well (Electric pump)	8.20972 N	125.0334 E	Dalwangan	Malaybalay
GW9	Patpat Waterbrake	Deep well (Electric pump)	8.19605 N	125.05702 E	Patpat	
GW10	Kalasungay Spring	Spring water	8.16255 N	125.11394 E	Kalasungay	

Surface water quality - The existing water quality of the rivers and streams traversing the Project alignment were described by collecting grab samples at ten stations near the alignment from April 25, 28 to 30 and July 26, 27, 29 to 30, 2021 to cover the low- and high rainfall periods (**Table 3-63** and **Figure 3-66**). The survey period was set to one sample for one season in consideration of the annual rainfall trend near project area (the low rain season is from November to May and the high rain season is from June to October). Photographs of the sampling stations and the laboratory reports are shown in **Appendix 29** and **Annex 4**, respectively.

Table 3-63. Description of the surface water quality sampling stations

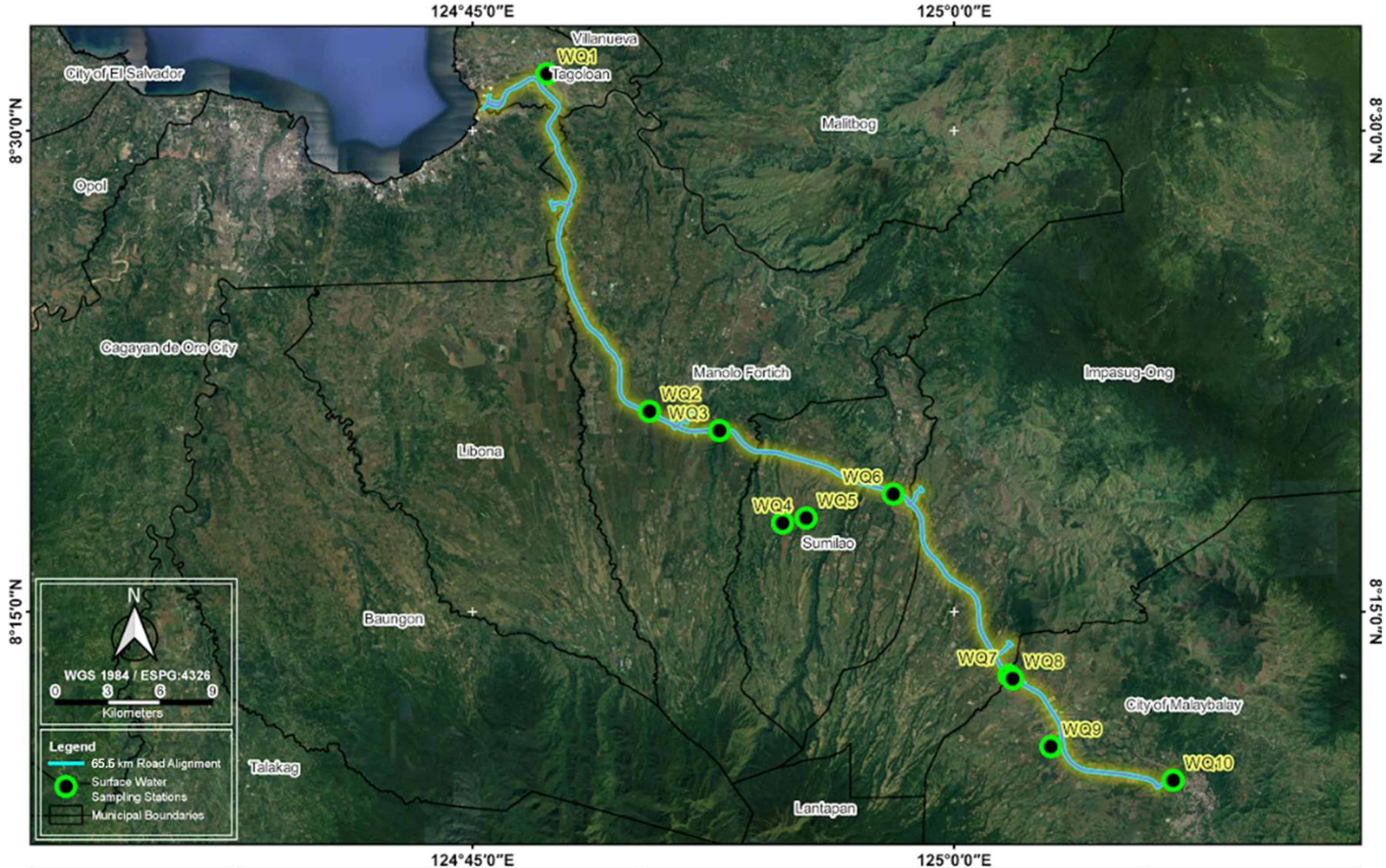
Stn.	Name of river	Coordinates		Barangay	Municipality
		Latitude	Longitude		
WQ1	Tagoloan River	8.52971N	124.788609E	Natumolan	Tagoloan
WQ2	Dicklum River	8.35425N	124.84182E	Dicklum	Manolo Fortich
WQ3	Kumaykay Stream	8.34422N	124.87815E	Ticala	
WQ4	Puntian River	8.29619N	124.91088E	Villa Vista/Puntian	Sumilao
WQ5	Tagalongon River	8.29878N	124.92311E	Culasi/Vista Villa	
WQ6	Mapolo River	8.31123N	124.96838E	Poblacion/ Kisolon	
WQ7	Ipoon River	8.21708N	125.02844E	Impalutao	Impasug-ong
WQ8	Komotal River	8.215275 N	125.030295E	Dalwangan	Malaybalay
WQ9	Sawaga River	8.17999 N	125.05012 E	Patpat	
WQ10	Sawaga River	8.16246 N	125.11364 E	Sumpong	

The sampling procedures and analyses for both groundwater and surface water samples were done according to the Water Quality Guidelines and General Effluent Standards of 2016 (DENR Administrative Order 2016-08).

Figure 3-65. Groundwater quality stations along the Project alignment

Groundwater Sampling Map	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) PSA 2016 (Administrative Boundaries) AAI (Sampling Stations)		AMET ASIA INC.

Figure 3-66. Surface water quality stations along the Project alignment



Surface Water Sampling Map	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) PSA 2016 (Administrative Boundaries) AAI (Sampling Stations)		

3.2.3.3 Assessment of key impacts

3.2.3.3.1 Degradation of groundwater quality

The results of the laboratory analysis are shown in **Table 3-64**. The salient findings after comparing the results with the DENR Class A WQG values with reference to **Table 3-65** are enumerated below.

a) The pH in all stations were less than the WQG values except in Stations GW5 GW6, GW9, and GW10 (green cells in **Table 3-65**). The low pH may be caused by minerals and organic decaying matter present in the soil.
b) All other water quality parameters were less than the DENR Class A WQG values.

Project implementation is not expected to affect groundwater quality because water requirements during construction and operation will not be sourced from deep wells.

3.2.3.3.2 Degradation of surface water quality

Low rainfall period - The results of the laboratory analysis are shown in **Table 3-66.** The salient findings after comparing the results with the DENR Class C (assumed) WQG values with reference to **Table 3-67** are enumerated below.

a) Fecal coliform levels at all stations were less than the WQG values except in Station WQ10 - Sawaga River (green cell in **Table 3-67**). The exceedance may be due to the presence of the game farm near the station.
b) The TSS levels at all stations were less than the WQG values except for Stations WQ1 and WQ2 (yellow cells in **Table 3-67**). The TSS WQG values in Stations WQ1 and WQ2 were exceeded by 425 and 18 mg/Li respectively. The high exceedance in Station WQ10 was likely due to the proximity of a sand and gravel quarry to the station.
c) All other water quality parameters were less than the DENR Class C WQG values.

High rainfall period - - The results of the laboratory analysis during the high rainfall period are shown in **Table 3-68.** The salient findings after comparing the results with the DENR Class C (assumed) WQG values with reference to **Table 3-69** are enumerated below.

a) Fecal coliform levels in all stations were less than the WQG values except in Station WQ1 – Tagoloan River, Station WQ2 – Dicklum River and Station WQ5 – Tagolongon River (green cells in **Table 3-69**). The highest was in Station WQ2 with an exceedance of 9000 MPN/100mL. The exceedance in Station WQ1 may be caused by the domestic animals grazing along the riverside while a barnyard and poultry farm were observed upstream of Stations WQ2 and WQ5 respectively.
b) The dissolved oxygen in all stations were higher than the WQG values except for Station WQ2 (orange cell in **Table 3-69**). Possible causes of this low DO level are surface runoff and organic loads entering the river upstream of the station.
c) All other water quality parameters were less than the DENR Class C WQG values.

Table 3-64. Groundwater quality at the sampling stations

Parameter	Unit	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10	DENR*
Arsenic	mg/L	<0.00697	<0.00697	<0.00697	<0.00697	<0.00697	<0.00697	<0.00697	<0.00697	<0.00697	<0.00697	0.01
BOD	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	3
Cadmium	mg/L	<0.000723	<0.000723	<0.000723	<0.000723	<0.000723	<0.000723	<0.000723	<0.000723	<0.000723	<0.000723	0.003
Chromium (hex)	mg/L	<0.00114	<0.00114	ND	ND	ND	ND	ND	<0.00114	<0.00114	<0.00114	0.01
Chlorine (residual)	mg/L	<0.200	<0.200	ND	ND	ND	ND	ND	<0.200	<0.200	<0.200	250
COD	mg/L	4.00	6.00	4.00	7.00	13	14.00	3.00	<2.00	5.00	4.00	NWQV
Fecal Coliform	MPN/100mL	<1.8	27	33	14	<1.8	4.5	<1.8	<1.8	17	2	50
Color	TCU	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	50
Cyanide	mg/L	0.0205	<0.0159	ND	ND	ND	ND	ND	<0.0159	<0.0159	<0.0159	0.07
Lead	mg/L	<0.00365	<0.00365	<0.00365	<0.00365	<0.00365	<0.00365	<0.00365	<0.00365	<0.00365	<0.00365	0.01
Mercury	mg/L	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	0.001
Nitrate	mg/L	0.91	0.68	1.09	1.74	1.03	0.42	0.69	1.19	0.81	0.4	7
Oil and Grease	mg/L	<0.939	<0.939	ND	ND	ND	ND	ND	<0.939	<0.939	<0.939	1
pH	--	7.43	6.57	6.71	6.57	6.48	6.10	7.83	6.90	6.28	5.53	6.5-8.5
Phosphate	mg/L	0.31	0.06	<0.01	0.14	0.01	0.1	0.12	0.04	<0.01	0.1	0.5
Sulfate	mg/L	46	<1	<1	<1	<1	<1	10	2	4	3	250
Surfactants	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.2
TSS	mg/L	<3	<3	<3	<3	<3	<3	<3	<3	3	<3	50

NOTES: NWQG – no WQG value, ND – none detected; *DENR CLASS A values based on DAO 2021-19 (Updated Water Quality Guidelines and General Effluent Standards for Selected Parameters) and DAO 2016-08 (Water Quality Guidelines and Effluent Standards of 2016)

Table 3-65. Existing groundwater quality impacts

Parameter	Unit	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
Arsenic	mg/L	0.00303	0.00303	0.00303	0.00303	0.00303	0.00303	0.00303	0.00303	0.00303	0.00303
BOD	mg/L	2	2	2	2	2	2	2	2	2	2
Cadmium	mg/L	0.002277	0.002277	0.002277	0.002277	0.002277	0.002277	0.002277	0.002277	0.002277	0.002277
Chromium (hex)	mg/L	0.00886	0.00886	NAND	NAND	NAND	NAND	NAND	0.00886	0.00886	0.00886
Chlorine (residual)	mg/L	249.8	249.8	NAND	NAND	NAND	NAND	NAND	249.8	249.8	249.8
COD	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fecal Coliform	MPN/100mL	48.2	23	17	36	48.2	45.5	48.2	48.2	33	48
Color	TCU	45	45	45	45	45	45	45	45	45	45
Cyanide	mg/L	0.0495	0.0541	NAND	NAND	NAND	NAND	NAND	0.0541	0.0541	0.0541
Lead	mg/L	0.00635	0.00635	0.00635	0.00635	0.00635	0.00635	0.00635	0.00635	0.00635	0.00635
Mercury	mg/L	0.00093	0.00093	0.00093	0.00093	0.00093	0.00093	0.00093	0.00093	0.00093	0.00093
Nitrate	mg/L	6.09	6.32	5.91	5.26	5.97	6.58	6.31	5.81	6.19	6.6
Oil and Grease	mg/L	0.061	0.061	NAND	NAND	NAND	NAND	NAND	0.061	0.061	0.061
pH	--	WR	WR	WR	WR	BLR	BLR	WR	WR	BLR	BLR
Phosphate	mg/L	0.19	0.44	0.49	0.36	0.49	0.4	0.38	0.46	0.49	0.4
Sulfate	mg/L	204	249	249	249	249	249	240	248	246	247
Surfactants	mg/L	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TSS	mg/L	47	47	47	47	47	47	47	47	47	47

NOTES: (+) values means no impact; NWQG – no WQG value; NA – not applicable; NAND – not applicable, not detected; WR – within range; AUR – above Upper Range; BLR – below Lower Range

Table 3-66. Stream water quality at the sampling stations (low rainfall sampling period)

Parameter	Unit	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8	WQ9	WQ10	DENR*
Arsenic	mg/L	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	0.02
BOD	mg/L	1	1	<1	5	<5	<1	<1	<1	<1	<1	7
Cadmium	mg/L	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727	0.005
Chromium (hex)	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01
COD	mg/L	45	41	44	51	12	21	23	20.1	21	20	NWQG
Fecal Coliform	MPN/100mL	150	170	6.1	27	44	34	47	16	36	280	200
Color	TCU	10	10	10	10	5	5	10	16	10	10	75
Cyanide	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1
Dissolve Oxygen	mg/L	5.85	5.6	6.26	5.34	5.86	5.63	6.14	7.7	7.86	5.63	5
Lead	mg/L	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	0.05
Mercury	mg/L	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	0.002
Nitrate	mg/L	0.58	1.11	0.2	0.41	0.72	0.19	0.18	0.18	0.14	0.44	7
Oil and Grease	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2
pH	--	7.97	5.6	6.26	7.62	7.4	7.88	7.22	7.22	7.63	7.64	6.5-9.0
Phosphate	mg/L	0.06	0.03	0.04	0.04	0.03	0.07	0.05	0.05	0.05	0.12	0.5
Residual Chlorine	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	350
Sulfate	mg/L	<1	7	<1	5	8	<1	<1	<1	<1	8	275
Surfactants	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	1.5
Temperature	°C	33.5	30.7	30.7	25.2	24.3	26.9	32.4	24.6	26.6	23	25-31
TSS	mg/L	505	98	24	11	12	6	13	17	11	8	80

NOTES: NWQG – no WQG value, ND – none detected; *DENR CLASS C values based on DAO 2021-19 (Updated Water Quality Guidelines and General Effluent Standards for Selected Parameters) and DAO 2016-08 (Water Quality Guidelines and Effluent Standards of 2016)

Table 3-67. Existing stream water quality impacts (low rainfall sampling period)

Parameter	Unit	Class C	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8	WQ9	WQ10
Arsenic	mg/L	0.02	0.01584	0.01584	0.01584	0.01584	0.01584	0.01584	0.01584	0.01584	0.01584	0.01584
BOD	mg/L	7	6	6	6	2	2	6	6	6	6	6
Cadmium	mg/L	0.005	0.004273	0.004273	0.004273	0.004273	0.004273	0.004273	0.004273	0.004273	0.004273	0.004273
Chlorine (residual)	mg/L	NWQG	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (hex)	mg/L	0.01	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND
COD	mg/L	NWQG	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Color	TCU	75	65	65	65	65	70	70	65	59	65	65
Cyanide	mg/L	0.1	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND
Dissolve Oxygen	mg/L	5	0.85	0.6	1.26	0.34	0.86	0.63	1.14	2.7	2.86	0.63
Fecal coliform	MPN/100mL	200	50	30	193.9	173	156	166	153	184	164	-80
Lead	mg/L	0.05	0.04483	0.04483	0.04483	0.04483	0.04483	0.04483	0.04483	0.04483	0.04483	0.04483
Mercury	mg/L	0.002	0.00193	0.00193	0.00193	0.00193	0.00193	0.00193	0.00193	0.00193	0.00193	0.00193
Nitrate	mg/L	7	6.42	5.89	6.8	6.59	6.28	6.81	6.82	6.82	6.86	6.56
Oil and Grease	mg/L	2	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND
pH	--	6.5 - 9.0	WR	WR	WR	WR	WR	WR	WR	WR	WR	WR
Phosphate	mg/L	0.5	0.44	0.47	0.46	0.46	0.47	0.43	0.45	0.45	0.45	0.38
Sulfate	mg/L	275	274	268	274	270	267	274	274	274	274	267
Surfactants	mg/L	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Temperature	°C	25 - 31	AUR	WR	WR	WR	BLR	WR	AUR	BLR	WR	BLR
TSS	mg/L	80	-425	-18	56	69	68	74	67	63	69	72

NOTES: (+) values means no impact, (-) adverse impact, value is impact magnitude; NWQG – no WQG value; NA – not applicable; NAND - not applicable, not detected; WR – within range; AUR – above Upper Range; BLR – below Lower Range

Table 3-68. Surface water quality at the stations (high rainfall sampling period)

Parameter	Unit	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8	WQ9	WQ10	DENR*
Arsenic	mg/L	<0.0035	<0.0035	<0.0035	<0.0035	<0.0035	<0.0035	0.0035	<0.0035	<0.0035	<0.0035	0.02
BOD	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	7
Cadmium	mg/L	<0.00028	<0.00028	<0.00028	<0.00028	<0.00028	<0.00028	<0.00028	<0.00028	<0.00028	<0.00028	0.005
Chlorine (residual)	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	350
Chromium (hex)	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01
COD	mg/L	ND	ND	14	5.00	3.00	4.00	ND	3.00	4.00	4.00	NWQG
Color	TCU	5	10	10	5	<5	5	10	10	5	15	75
Cyanide	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1
Dissolve Oxygen	mg/L	6.9	4.97	7.79	6.14	5.03	6.48	5.43	5.27	5.46	5.25	5
Fecal Coliform	MPN/100mL	350	9200	53	40	350	55	55	21	11	8.2	200
Lead	mg/L	<0.0026	<0.0026	<0.0026	<0.0026	<0.0026	<0.0026	<0.0026	<0.0026	<0.0026	<0.0026	0.05
Mercury	mg/L	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	0.002
Nitrate	mg/L	0.03	0.41	0.13	0.26	0.44	0.12	0.05	0.03	<0.01	0.03	7
Oil and Grease	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2
pH	--	8.36	7.23	7.42	7.59	7.1	8.08	7.69	8.00	7.09	7.81	6.5 – 9.0
Phosphate	mg/L	0.08	0.11	0.03	0.03	<0.01	0.04	<0.01	0.12	<0.01	0.04	0.5
Sulfate	mg/L	<1	8	2	4	<1	<1	11	<1	20	<1	275
Surfactants	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	1.5
Temperature	°C	27.9	26.1	26.7	24.30	24.8	23.00	20.7	26.8	23.7	24.7	25 – 31
TSS	mg/L	47	50	13	4	<3	3	10	4	<3	5	80

NOTES: NWQG – no WQG value, ND – none detected; *DENR CLASS C values based on DAO 2021-19 (Updated Water Quality Guidelines and General Effluent Standards for Selected Parameters) and DAO 2016-08 (Water Quality Guidelines and Effluent Standards of 2016)

Table 3-69. Existing stream water quality impacts (high rainfall sampling period)

Parameter	Unit	Class C	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8	WQ9	WQ10
Arsenic	mg/L	0.02	0.01650	0.01650	0.01650	0.01650	0.01650	0.01650	0.01650	0.01650	0.01650	0.01650
BOD	mg/L	7	6	6	6	6	6	6	6	6	6	6
Cadmium	mg/L	0.005	0.00472	0.00472	0.00472	0.00472	0.00472	0.00472	0.00472	0.00472	0.00472	0.00472
Chlorine (residual)	mg/L	350	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND
Chromium (hex)	mg/L	0.01	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND
COD	mg/L	NWQG	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Color	TCU	75	70	65	65	70	70	70	65	65	70	60
Cyanide	mg/L	0.1	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND
Dissolve Oxygen	mg/L	5	1.9	-0.03	2.79	1.14	0.03	1.48	0.43	0.27	0.46	0.25
Fecal Coliform	MPN/100mL	200	-150	-9000	147	160	-150	145	145	179	189	191.8
Lead	mg/L	0.05	0.0474	0.0474	0.0474	0.0474	0.0474	0.0474	0.0474	0.0474	0.0474	0.0474
Mercury	mg/L	0.002	0.00193	0.00193	0.00193	0.00193	0.00193	0.00193	0.00193	0.00193	0.00193	0.00193
Nitrate	mg/L	7	6.97	6.59	6.59	6.74	6.56	6.88	6.95	6.97	6.99	6.97
Oil and Grease	mg/L	2	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND	NAND
pH	--	6.5 – 9.0	WR	WR	WR	WR	WR	WR	WR	WR	WR	WR
Phosphate	mg/L	0.5	0.42	0.39	0.39	0.47	0.49	0.46	0.49	0.38	0.49	0.46
Sulfate	mg/L	275	274	267	275	271	274	274	264	274	255	274
Surfactants	mg/L	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Temperature	°C	25 – 31	WR	WR	WR	BLR	BLR	BLR	BLR	WR	BLR	BLR
TSS	mg/L	80	33	30	67	76	77	77	70	76	77	75

NOTES: NWQG – no WQG value; NA – not applicable; NAND – not applicable, not detected; WR – within range; AUR – above Upper Range; BLR – below Lower Range

3.2.3.4 Proposed mitigation measures

The proposed mitigating measures to minimize ground and surface water pollution in the different Project phases are presented below.

Pre-construction phase

a) Prepare plans for drainage and sediment ponds at the staging areas and active construction sites; and
b) Prepare a Water Quality Monitoring Plan for the construction and operation phases.

Construction phase

a) Strict implementation of Construction Plan specifications for each Project component;
b) Provide sanitary facilities at the staging areas and active construction sites;
c) Provide adequate drainage leading to siltation ponds;
d) Implement the Water Quality Monitoring Plan during construction phase; and
e) Best housekeeping practices.

Operation phase

a) Provision of sanitation facilities, e.g., septic vaults in the offices;
b) Maintain drainage system leading to siltation ponds;
c) Implement the Water Quality Monitoring Plan during operation phase; and
d) Best housekeeping practices.

3.2.4 Freshwater ecology

3.2.4.1 Scope

This section described the existing aquatic ecology of the freshwater waterbodies and assessment of potential Project impacts. The existing aquatic ecology was described by 14 (low rain period) and 17 (high rain period) sampling sites at the rivers and streams traversed by or adjacent to the proposed CMH alignment. The objectives of the assessment are enumerated below.

1. Determine species composition, diversity, abundance, distribution, and seasonality of plankton, fishes and macrobenthic fauna, and aquatic insects;
2. Assess endemism and conservation status of aquatic species based on DAO 2004-15 and DAO 2007-1 as amended in DAO 2007-24 and IUCN/CITES Appendix I and II criteria;
3. Identify, assess, and propose mitigation measures of the potential impacts of the Project to local aquatic biodiversity and ecological conditions in relation to Fisheries Act (RA 10654), Wildlife Resources Conservation and Protection Act (2001), and DENR Memorandum Circular 2007-2 (Critical Habitats);

3.2.4.2 Methodology

The assessment done from April 28 to May 7, 2021 (low rain period) and July 25 to August 5, 2021 (high rain period), determined species composition, diversity, abundance, distribution, and seasonality of aquatic ecology using the 17 stations Site (**Table 3-70** and **Figure 3-67**). In-situ water quality analysis and streamflow measurements were also done at the sampling areas. **Appendix 31** shows the photo documentation of the ecological assessment. As for the ecology sampling period,

Table 3-70. Locations of aquatic ecology sampling stations

Station	Coordinates		Water body	Station	Coordinates		Water body
	Latitude	Longitude			Latitude	Longitude	
A1	8.523545°	124.791755°	Tagoloan River	A10	8.304605°	124.978894°	Atugan River

Station	Coordinates		Water body
	Latitude	Longitude	
A2	8.510598°	124.791472°	Bugo Stream
A3	8.399158°	124.810456°	Alae River
A4	8.353080°	124.841668°	Dicklum River
A5	8.344272°	124.878038°	Kumaykay River
A6	8.295869°	124.910720°	Puntian River
A7	8.298831°	124.923080°	Tagolongon River
A8	8.316260°	124.953292°	Kulaman River
A9	8.312597°	124.968263°	Mapolo River
A11	8.263309°	125.001386°	Atugan River
A12	8.217137°	125.028438°	Ipoon River
A13	8.215390°	125.030989°	Komotal River
A14	8.187729°	125.050267°	Sawaga River
A15	8.183277°	125.056200°	Sawaga River
A16	8.162573°	125.110856°	Sawaga River
A17	8.162461°	125.113840°	Sawaga River

Figure 3-67. Aquatic ecology sampling stations along the Project alignment

Stream measurements and in-situ water quality analysis

Discharge rate - Streamflow measurements were done using a transect meter and a digital water velocity meter (Xylem, USA). The streamflow was calculated using the Velocity Area Method (EMB-DENR Manual for Ambient Water Quality Monitoring Vol I).

In situ water quality analysis – the pH, Dissolved Oxygen (DO), Electrical Conductivity, and Total Dissolved Solids (TDS) at each station were determined using a calibrated portable water quality meter.

Aquatic ecological assessment

Plankton - Plankton samples were collected using 4-inch diameter plankton sieves with 20-µm and 90-µm mesh sizes to filter phytoplankton and zooplankton, respectively, from 16 L river or stream water samples. The filtrate was carefully rinsed with filtered water and stored in carefully labelled plastic containers. Phytoplankton and zooplankton samples were fixed *in situ* using 5% buffered formalin solution and 95% ethanol respectively. Three replicate samples were collected for phytoplankton analysis and one composite sample for zooplankton from three sub-stations. The average plankton density was determined using two aliquots per sample examined microscopically using a Sedgewick-Rafter counting cell with 1-ml volume. Plankton organisms were identified down to the lowest taxa where possible using plankton guides and references. Photomicrographs of plankton representatives were taken using a digital camera for documentation.

Fishes and macrobenthic fauna - Fishes and macrobenthic fauna were collected from upstream, midstream and downstream sections of a river or stream using a Dip net for three minutes by vigorously agitating the bottom. Samples were emptied into a white basin and sieved through a 100-µm metal sieve to remove plant litter and other organic debris. Samples were sorted into fishes, mollusks, crustaceans, and aquatic insects, and stored in 15-mL screw-capped, centrifuge tubes, preserved with 95% ethanol, and labeled with date, station number, and stream section.

3.2.4.3 Assessment of key impacts

3.2.4.3.1 Threat to existence of important local species, abundance, frequency and distribution of important species

3.2.4.3.1.1 Stream measurements and in-situ water quality

In situ water quality analysis – The Dissolved Oxygen (DO, mg/L) content was relatively high ranging from 8.8 to 15.9 ppm during the high rainfall period and 9.8–14.5 ppm during the low rainfall. The pH was slightly basic ranging from 7.1 to 8.0 and 6.8–7.9 during the during the low and high rainfall periods respectively. Water temperatures, depending on time of measurements ranged from 22.4–28.4 °C and 22.4–32 °C during the low and high rainfall periods respectively. Electrical conductivity values in the 17 stations ranged from 54–188 µS/cm (low rainfall) and 46–174 µS/cm (high rainfall). The Total Dissolved Solids (TDS) readings ranged from 27 – 94 mg/L during low rainfall and 23 – 88 mg/L during high rainfall. DO and pH values are within parameter limits specified under DAO 2016-08. **Figure 3-68** and **Figure 3-69** shows the water quality and discharge rates at the aquatic ecology assessment during the low and high rainfall periods.

Figure 3-68. In-situ water quality (DO, pH, temperature, EC) at the aquatic sampling stations

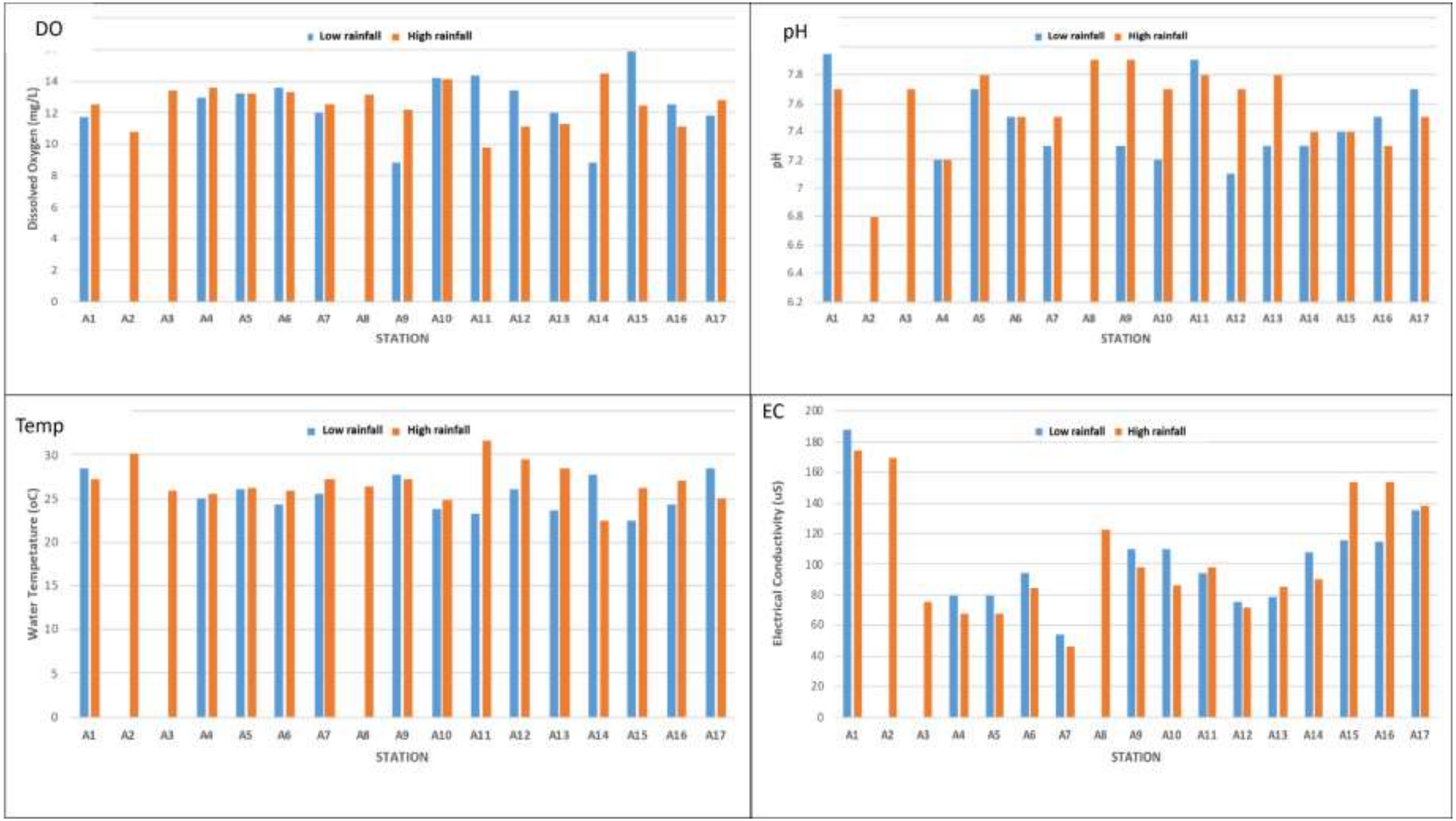
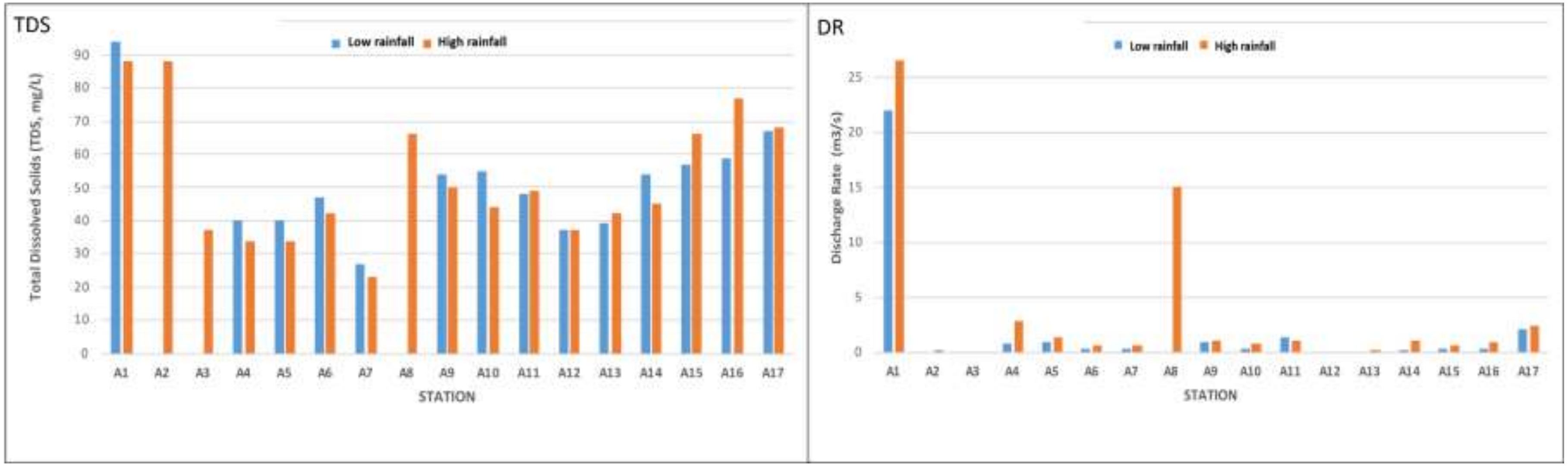


Figure 3-69. In-situ Total Dissolved TDS and discharge rate at the aquatic sampling stations



Discharge rate - Discharge rates of rivers and streams representing natural ecological flows ranged from 0.024 – 21.979 m^3/s and 0.04 – 26.562 m^3/s the low and high rainfall period, respectively. The highest discharge rate during low rainfall period was recorded in Station A1 (Tagoloan River) at 21.979 m^3/s and Station A17 (Sawaga River) at 2.095 21.979 m^3/s while the lowest discharge rate was recorded at Station A12 (Ipoon river) with 0.0024 m^3/s.

The highest discharge rate during the high rain period was also recorded at Station A1 at 26.562 m^3/s followed by Station A8 (Kulaman river) at 15.105 m^3/s while the lowest discharge rate was also recorded at Station A12 at 0.04 m^3/s (Ipoon river). Discharge rates increased during the high rain period that was brought about by monsoon rains.

3.2.4.3.1.2 Phytoplankton

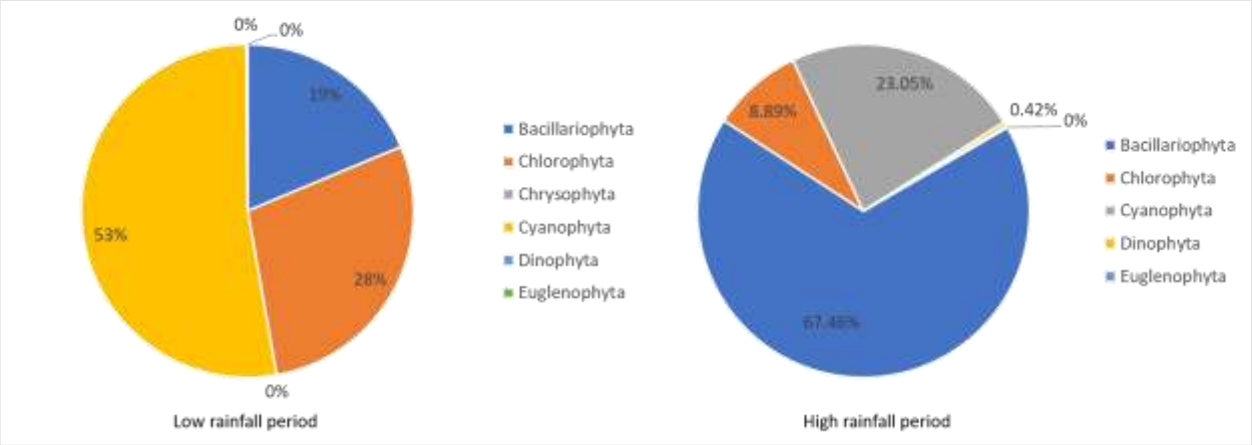
Dominant major phytoplankton groups - A total of 54 taxa in six major phytoplankton groups were recorded during the low rainfall period and 42 taxa in five major phytoplankton groups during the high rainfall period. Cyanobacteria (blue-green algae) was the most dominant group observed during the low rainfall period with mean relative abundance of 52.66%, while diatoms (Bacillariophyta) were the most abundant group with mean relative abundance of 67.46% on the high rainfall period (**Table 3-71** and **Figure 3-70**).

Table 3-71. Density* and relative abundance of major phytoplankton groups

Low rainfall period			High rainfall period		
Phylum	**Density**	**RA (%)**	**Phylum**	**Density**	**RA (%)**
Bacillariophyta	4657	18.71	Bacillariophyta	4200	67.46
Chlorophyta	7090	28.49	Chlorophyta	554	8.89
Chrysophyta	2	0.01	Cyanophyta	1437	23.05
Cyanophyta	13107	52.66	Dinophyta	28	0.42
Dinophyta	24	0.09	Euglenophyta	12	0.18
Euglenophyta	9	0.03	**Total**	**6225**	**100**
Total	**4657**	**100**	Note: RA – relative abundance		

NOTE: *in cells/L, RA – relative abundance

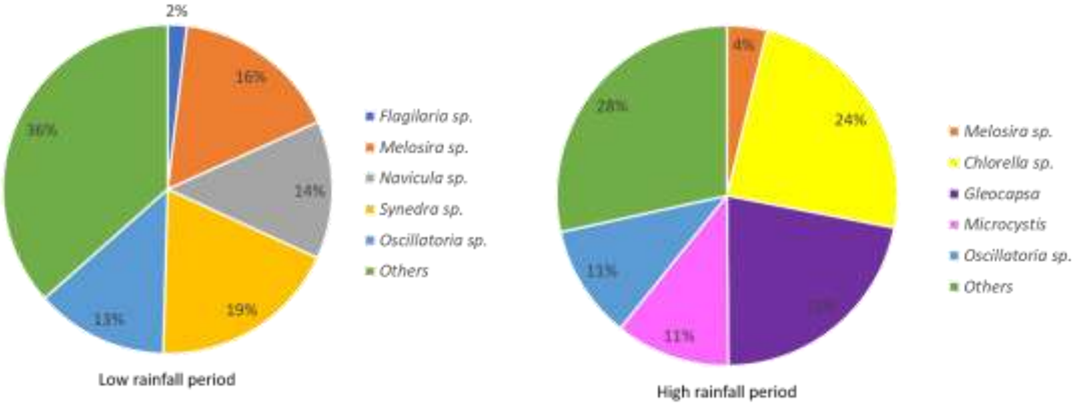
Figure 3-70. Relative abundance of major phytoplankton groups



Dominant phytoplankton genera - *Chlorella sp.,* a green alga (Chlorophyta) was the most abundant taxa during the low rainfall period with a mean relative abundance of 24.60% followed by *Gleocapsa sp.*, a blue-green algae (Cyanobacteria) with a mean relative abundance of 21.68%. During the high rainfall period, *Fragillaria sp.* and *Synedra sp.,* both diatoms (Bacillariophyta), were the most abundant phytoplankton having mean relative abundances of 17.57% and 15.61% respectively (**Figure 3-71**). Other phytoplankton major groups and taxa were poorly represented in the samples. The species composition of phytoplankton is shown in **Appendix 32.**

The phytoplankton communities present in these stations were diverse and showed seasonality. The blue-green algae (*Cyanobacteria*) dominated during the low rainfall period, but the green alga *Chlorella sp.* (*Chlorophyta*) was the most abundant phytoplankton during this time period (**Figure 3-71**). As fresh influx of freshwater increases during the high rainfall period, the diatoms (*Bacillariophyta*) become the dominant group that is dominated by *Fragillaria sp.*, *Synedra sp., Melosira sp.,* and *Navicula sp.* in the plankton samples (**Figure 3-71**). A blue-green alga (Cyanobacteria), *Oscillatoria sp.* was the fifth most abundant taxa during the high rainfall period. The variations in abundances between taxa and phytoplankton groups was mainly governed by the influx of freshwater and residence times.

Figure 3-71. Relative abundance of dominant phytoplankton genera



Comparative abundance of phytoplankton per rainfall periods - **Figure 3-72** and **Figure 3-73** illustrates the comparative abundance of phytoplankton organisms across the aquatic ecology stations. During the low rainfall period, Aquatic Station 10 (Atugan river) had the highest total phytoplankton density of 13,277 cells/L while the lowest was Aquatic Station 16 (Sawaga river) with only 160 cells/L. Aquatic Stations 11 (Atugan river), A15 (Sawaga river), and A7 (Tagolongon river) had relatively high phytoplankton densities of 3,125 cells/L, 1,970 cells/L and 1,704 cells/L respectively. All other stations had densities below 1,000 cells/L. Phytoplankton densities during the high rainfall sampling period were comparatively lower, with the highest phytoplankton count of only 1,238 cells/L in aquatic station 8 (Kulaman river) and the lowest density was at station 3 (Alae River) with only 2 cells/L phytoplankton density. These values were considerably higher than those observed in the head waters of Alanib River, Mt. Kitanglad, Bukidnon (Opiso et. Al. 2014). The relatively higher densities observed during these assessment periods can be explained by nutrient influx from domestic origins and runoff coming from the surrounding agricultural lands (Bertomen et. al., 2017).

The influx of freshwater during the high rainfall period disrupts the proliferation and population growth of phytoplankton due to increased water volume and flow leading to lesser residence times of phytoplankton (dilution effect) and increased turbidity. Phytoplankton population growth lags the influx of freshwater despite the influx of nutrients into the aquatic environment which needs sufficient time to proliferate. Flowing waters generally have lower phytoplankton densities compared to stagnant waters due to higher residence times that promote higher population densities. This explains why stagnant pools of water, ponds, and lakes are visibly greener than flowing streams or rivers. During heavy rains, silt and clay particles are carried into streams and rivers which lower water clarity due to higher turbidity impeding light penetration that is needed by these photosynthetic organisms in order to grow and reproduce.

In general, the phytoplankton communities present in these rivers and streams are diverse in terms of major groups and species composition. Higher diversity and higher phytoplankton densities are experienced during the low rainfall period than in high rainfall period (**Figure 3-72** and **Figure 3-73**). The observed phytoplankton densities were relatively lower compared to stagnant pools, ponds and lakes but this shows that even in clear and flowing bodies of water, a healthy community of microscopic phytoplankton grows and thrives. Some of the representative phytoplankton taxa

Figure 3-72. Comparative abundance of phytoplankton organisms across aquatic ecology stations

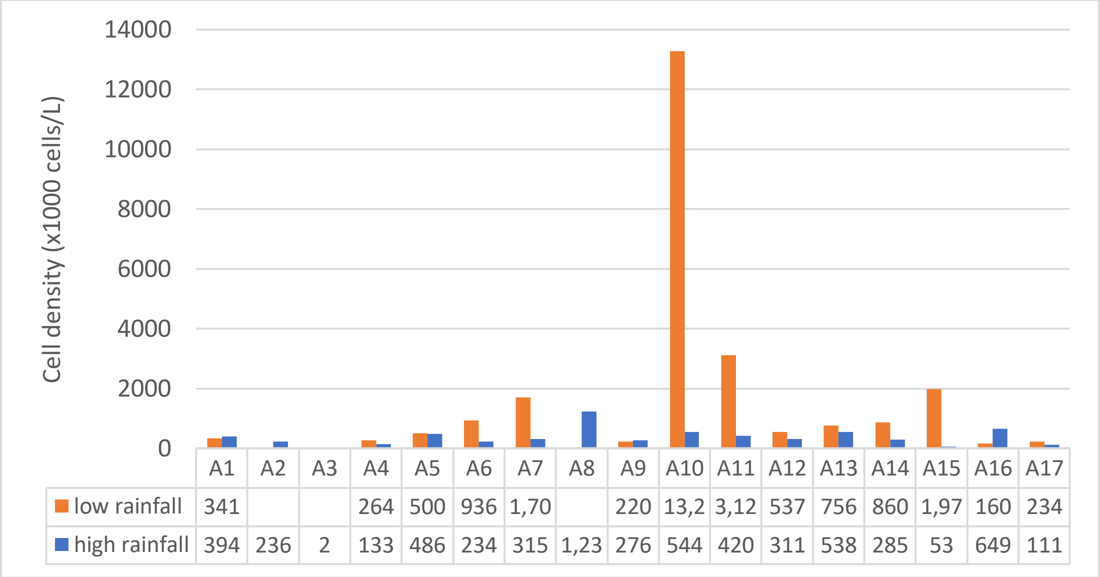
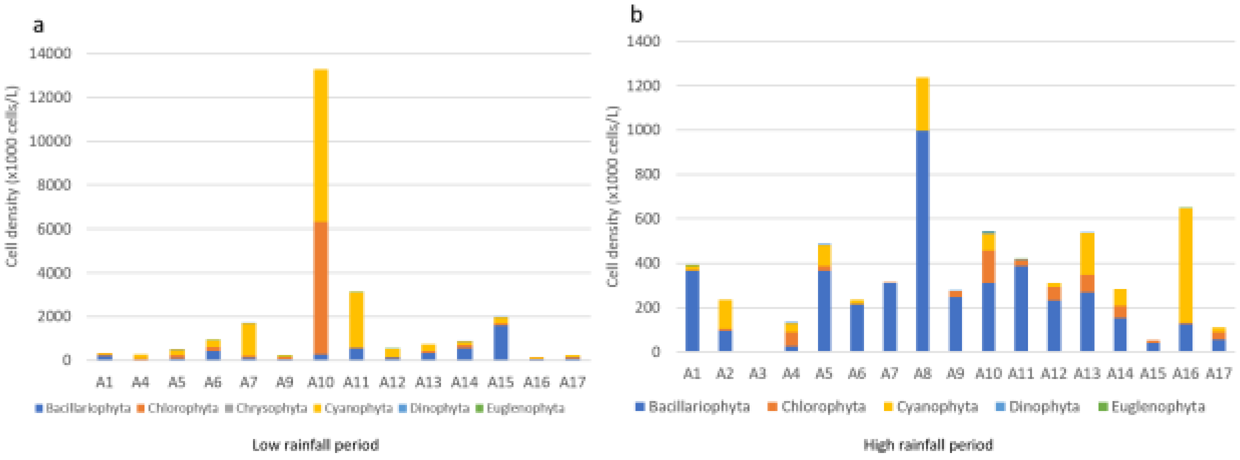


Figure 3-73. Species composition of phytoplankton across stations



3.2.4.3.1.3 Zooplankton

Dominant major zooplankton groups – the zooplankton community observed across all stations was relatively diverse, with eight taxa in four major groups - Amoebozoa, Arthropods, Nematoda, and Rotifera. Amoebozoa was the most abundant group during low rain period with a mean relative abundance of 54.29%, followed by Nematoda (round worms) and Rotifera with mean relative abundance of 20%, and Arthropoda (*Diaptomus* sp.) with only 6.05% mean relative abundance (**Table 3-72** and **Figure 3-74**). **Appendix 32** shows the representative zooplankton species.

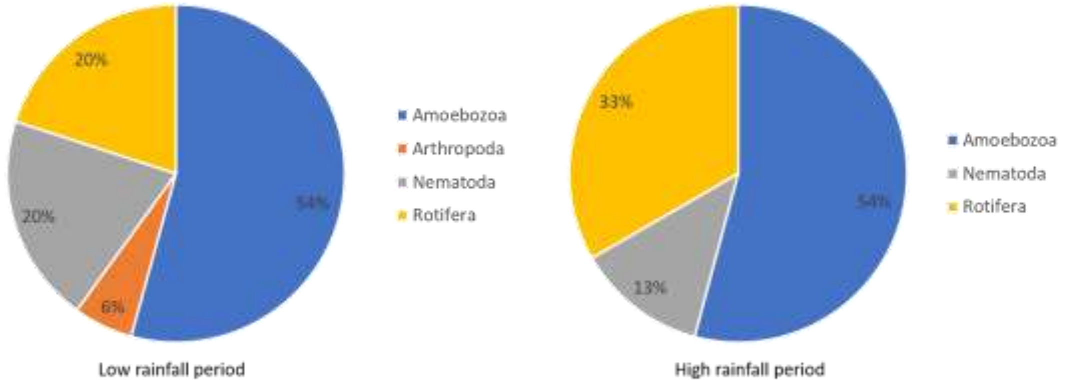
Only five zooplankton taxa in three (3) major groups were recorded during high rain period. Amoabozoa (*Arcella sp.* and *Centropyxis sp.*) was also the most dominant group with a mean relative abundance of 52.99%, followed by Rotifera (*Asplanchna sp.* and *Lecane sp.*), with 32.61%, and Nematoda (Nematodes) with only 12.23% mean relative abundance (**Table 3-72** and **Figure 3-74**).

Table 3-72. Composition and relative abundance of major zooplankton groups

Phylum	Abundance	RA (%)	Phylum	Abundance	RA (%)

Phylum	Abundance	RA (%)	Phylum	Abundance	RA (%)
Amoebozoa	19	54.28	Amoebozoa	13	54.17
Arthropoda	2	5.71	Nematoda	3	12.50
Nematoda	7	20.00	Rotifera	8	33.33
Rotifera	7	20.00	**Total**	**24**	**100**
Total	**35**	**100.00**	Note: F – frequency, RA – relative abundance		

Figure 3-74. Relative abundance of major zooplankton groups during low and high rainfall periods

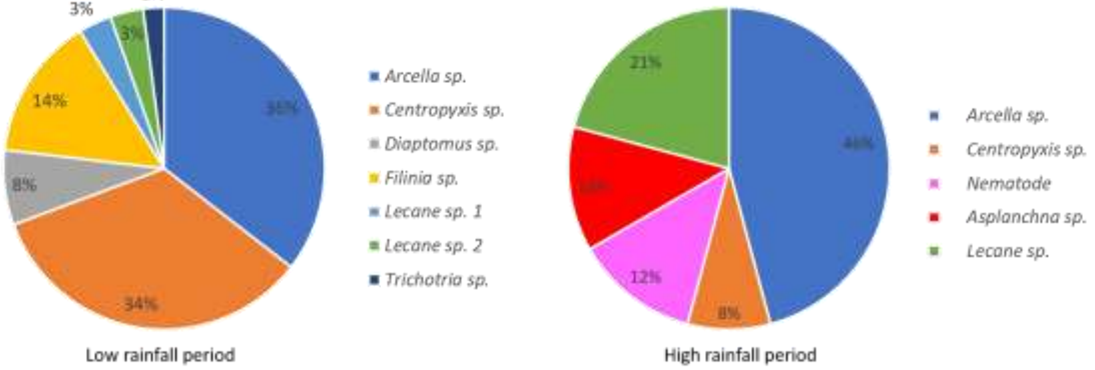


Dominant zooplankton genera - With regards to the dominant taxa, *Arcella* sp. was the most abundant during the low rainfall period with 16.62% followed by *Centropyxis* sp. with 15.84%. *Arcella* sp. is also the most abundant species during the high rainfall period with 45.83% followed by *Lecane* sp. with 20.83% (**Table 3-73** and **Figure 3-75**)

Table 3-73. Composition and relative abundance of zooplankton per genera

Low rainfall period			Low rainfall period		
Zooplankton Genera	**Abundance**	**RA (%)**	**Zooplankton Genera**	**Abundance**	**RA (%)**
Arcella sp.	9	16.62	*Arcella sp.*	11	45.83
Centropyxis sp.	10	15.84	*Centropyxis sp.*	2	8.33
Diaptomus sp.	2	3.52	Nematode	3	12.50
Filinia sp.	4	6.74	*Asplanchna sp.*	0	12.50
Lecane sp. 1	1	1.56	*Lecane sp.*	3	20.83
Lecane sp. 2	1	1.56	**Grand Total**	**24**	**100.00**
Trichotria sp.	1	0.98	Note: F – frequency, RA – relative abundance		
Grand Total	**35**	**100.00**			

Figure 3-75. Relative abundance of zooplankton genera during low and high rainfall periods



Comparative abundance of phytoplankton per rainfall periods – The zooplankton density per station was relatively low with the highest density of only 11 individuals/L (Station A1) observed during the low rain period and 8 individuals/L (Station A8) during the high rain period. Zooplankton density during the low rain period ranged from 1 – 11 individuals/L compared to 0 – 8 individuals/L during the high rain period (**Figure 3-76** and **Figure 3-77**). These zooplankton densities were low compared to standing bodies of water where densities often reach hundreds of individuals per liter. These values are considered normal due to the relatively low phytoplankton densities observed in streams and rivers.

Figure 3-76. Species composition of zooplankton across stations

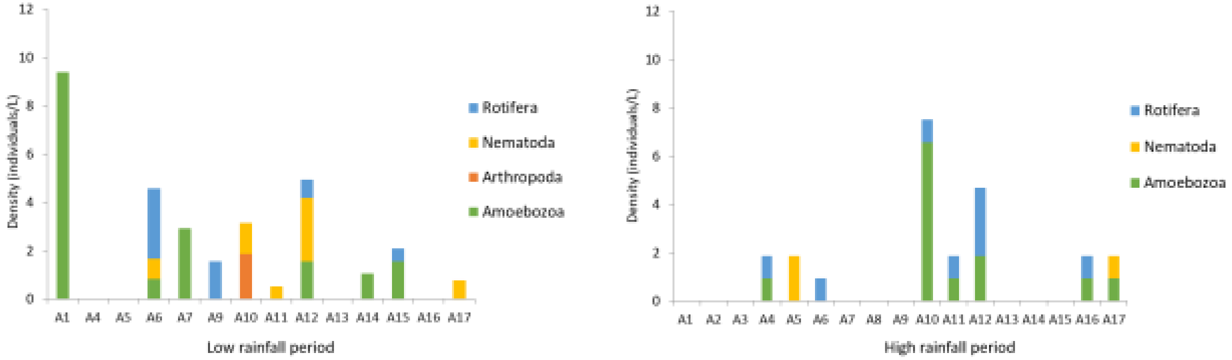
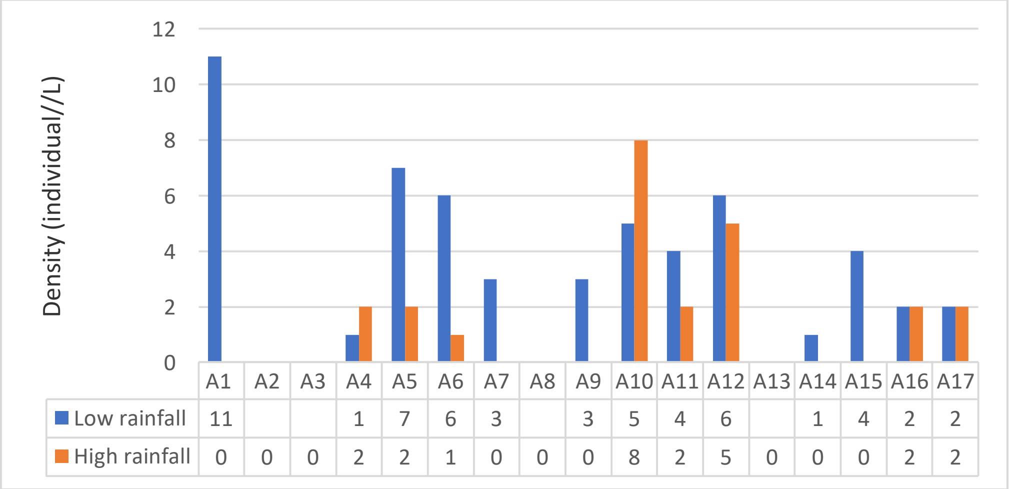


Figure 3-77. Comparative abundance of phytoplankton organisms across stations



	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17
Low rainfall	11			1	7	6	3		3	5	4	6		1	4	2	2
High rainfall	0	0	0	2	2	1	0	0	0	8	2	5	0	0	0	2	2

3.2.4.3.1.4 Fishes and Macrobenthic Fauna

A total of 189 individuals of fishes and macrobenthic fauna were collected during low rain period across stations resolved into 10 families and 15 species. The most abundant species was *Gambusia affinis* (mosquito fish, introduced) with a relative abundance of 37.04%, followed by *Macrobrachium rosenbergii* (native) and *Oreochromis niloticus* (tilapia, aquaculture species, introduced), with relative abundance of 23.81% and 19.58%, respectively (**Table 3-74** and **Figure 3-78**).

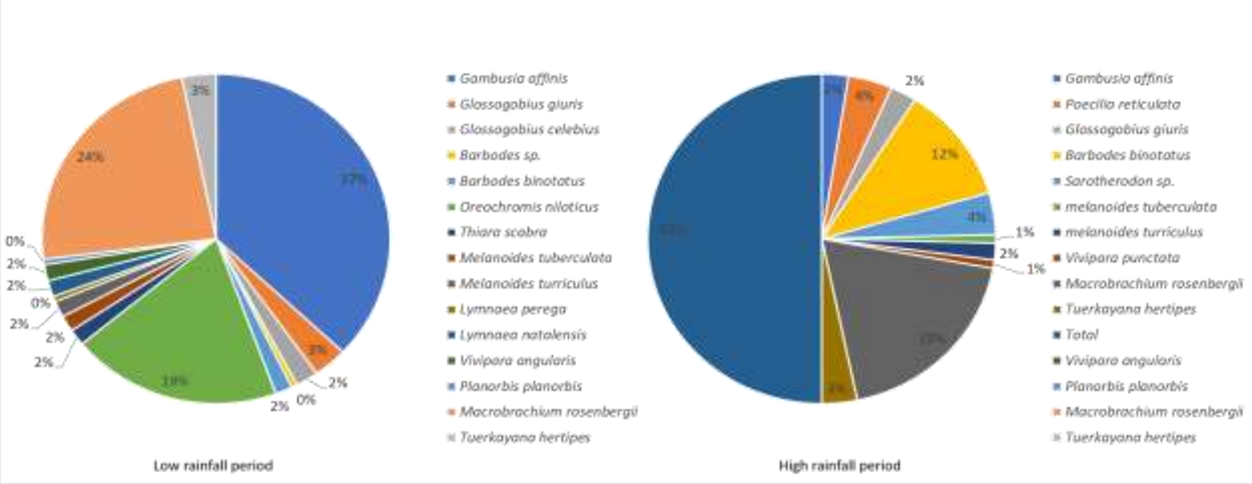
Only 69 individuals were collected during high rain period sampling representing eight families and 10 species, dominated by *Barbodes binotatus* with a relative abundance of 22.95%, followed by *Macrobrachium rosenbergii* and *Poecilia reticulata/Sarotherodon* sp. with relative abundances of 37.7 and 8.20%, respectively (**Table 3-74** and **Figure 3-78**). Commercial species were absent in all stations except *Tilapia nioloticus. Macrobrachium rosenbergii* is being propagated as a commercial aquaculture species. Representative species and macrobenthic fauna are shown in **Appendix 37.**

Table 3-74. Composition and relative abundance of fishes and macrobenthos

Low rainfall period			High rainfall period		
Species Name	**Abundance**	**RA (%)**	**Species Name**	**Abundance**	**RA (%)**
Gambusia affinis	70	37.04	*Gambusia affinis*	3	4.92
Glossogobius giuris	6	3.17	*Poecilia reticulata*	5	8.2
Glossogobius celebius	4	2.12	*Glossogobius giuris*	3	4.92
Barbodes sp.	1	0.53	*Barbodes binotatus*	14	22.95
Barbodes binotatus	3	1.59	*Sarotherodon sp.*	5	8.2
Oreochromis niloticus	37	19.58	*Melanoides tuberculata*	1	1.64
Thiara scabra	3	1.59	*Melanoides turriculus*	2	3.28
Melanoides tuberculata	3	1.59	*Vivipara punctata*	1	1.64
Melanoides turriculus	3	1.59	*Macrobrachium rosenbergii*	23	37.7
Lymnaea perega	1	0.53	*Tuerkayana hertipes*	4	6.56
Lymnaea natalensis	3	1.59	Total	61	100
Vivipara angularis	3	1.59			
Planorbis planorbis	1	0.53			
Macrobrachium rosenbergii	45	23.81			
Tuerkayana hertipes	6	3.17			
Total	**189**	**100**			

Note: RA – relative abundance

Figure 3-78. Relative abundance of fishes and macrobenthos during low and high rainfall periods



Species endemicity and conservation status – **Table 3-75** shows that majority of the species captured were native species except *Gambusia affinis, Oreochromis niloticus, Lymnaea natalensis, Poecilia reticulata, Glossogobius giuris* (introduced species) and one Philippine endemic (*Vivipara angularis*). All of the identified fishes and macrobenthos up to species level were under the Least Concern except for *Thiara scabra* which is under Not Evaluated. All species recorded were not included in the DAO 2019-09 list.

Table 3-75. Endemicity and conservation status of fish and macrobenthos during low and high rain periods

Common Name	Species name	Residency	IUCN	DAO 2019-09
Mosquito fish	*Gambusia affinis*	I	LC	NI
White goby	*Glossogobius giuris*	N	LC	NI
Celebes goby	*Glossogobius celebius*	N	LC	NI
--	*Barbodes sp.*		--	--
Spotted barb	*Barbodes binotatus*	N	LC	NI
Tilapia	*Oreochromis niloticus*	I	LC	NI
Pagoda thiara	*Thiara scabra*	N	NE	NI

Common Name	Species name	Residency	IUCN	DAO 2019-09
Red rimmed melania	*Melanoides tuberculata*	N	LC	NI
Fawn melania	*Melanoides turriculus*	N	LC	NI
Wondering pond snail	*Lymnaea peregra*	N	LC	NI
Big-eared radix	*Lymnaea natalensis*	I	LC	NI
Igi	*Vivipara angularis*	PE	LC	NI
Ram's horn snail	*Planorbis planorbis*	I	LC	NI
Gian river prawn	*Macrobrachium rosenbergii*	N	LC	NI
--	*Tuerkayana hertipes*	N	LC	NI
Guppy	*Poecilia reticulata*	I	LC	NI
Bareye goby	*Glossogobius giuris*	I	LC	NI
--	*Sarotherodon sp.*	--	--	--

NOTES: N=Native, I=Introduced, LC = Least Concern, NE=Not Evaluated, NI=Not Included

3.2.4.3.1.5 Aquatic insects

A total of 105 individuals resolved into 10 families and five orders were recorded during low rain period and 91 individuals in 14 families and five orders during high rain period. The Order *Odonata* (Dragonflies and Damselflies) was the most dominant group during low rainfall period with 50 individuals and a mean relative abundance of 47.93% (orange cell in **Table 3-76** and **Figure 3-79**). Ephemoptera dominated the high rainfall period with 38 individuals and a mean relative abundance of 41.67% (blue cell in **Table 3-76** and **Figure 3-79**). The *Calopterygidae* (Damselflies) had the highest count during the low rain period with a mean relative abundance of 35.24% (orange cell in **Table 3-77** and **Figure 3-80**) followed by *Vellidae* (Broad-shouldered Water strider) with mean relative abundance of 19.05%. Dominance shifted to *Baetidae* and *Ephemerellidae* during high rain period with a mean relative abundance of 20.88% (blue cell in **Table 3-77** and **Figure 3-80**).

Pollution-sensitive species identified during low rainfall period were *Ephemoptera* and *Trichoptera* (14.65%), while pollution tolerant species (*Hemiptera*) represented 34.55% of the total population count (**Table 3-76**).

The pollution-sensitive species *Ephemoptera* and *Trichoptera* during the high rainfall period increased to 57.23% of the total population of aquatic insects, suggesting an indication of good water quality across all stations especially in Stations 8 to 15. Families under *Coleoptera* and *Hemiptera* that were considered to be pollution-tolerant organisms constituted 37.23% of the population indicating relatively polluted areas in Aquatic Stations 5, 13, and 16.

Macroinvertebrates such as aquatic insects were classified based on their tolerance to pollution and are widely used as bio-indicators of ecological assessments because they have unique responses to anthropogenic activities (Albutra et al., 2017, Tampus et al., 2012). *Ephemoptera*, *Plecoptera* and *Trichoptera* (EPT) are classified to be pollution-sensitive organisms while *Hemiptera* are tolerant to pollution and environmental extremes (Argouridis et al., 2015, Opiso et al., 2014).

Table 3-76. Composition and relative abundance of aquatic insects per Order

Low rainfall period			High rainfall period		
Order	Abundance	RA (%)	Order	Abundance	RA (%)
Coleoptera	3	3.00	Coleoptera	11	11.96
Ephemeroptera	15	14.00	Ephemoptera	38	41.30
Hemiptera	37	35.00	Hemiptera	24	26.09
Odonata	50	47.00	Odonata	5	5.43
Trichoptera	1	1.00	Trichoptera	14	15.22
Grand Total	106	100	Grand Total	92	100.00

Note: RA – relative abundance

Figure 3-79. Relative abundance of aquatic insect Orders between the two sampling periods

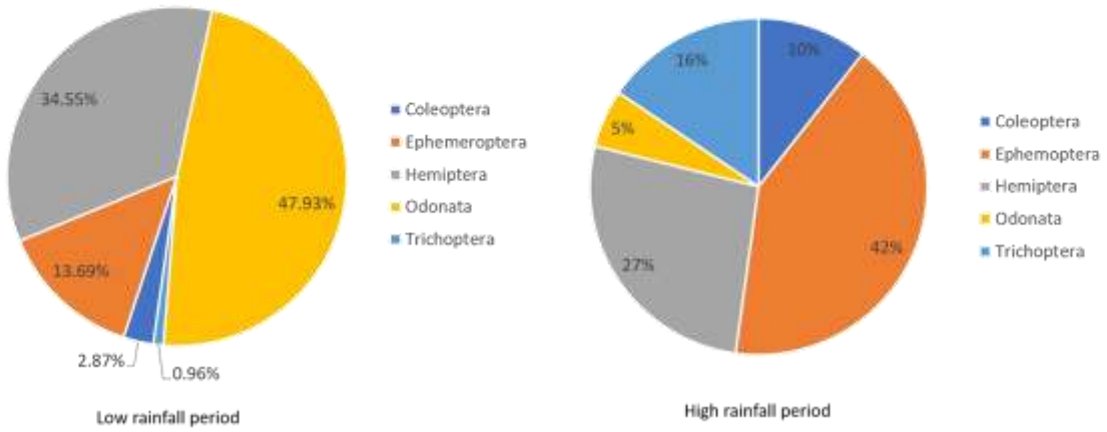
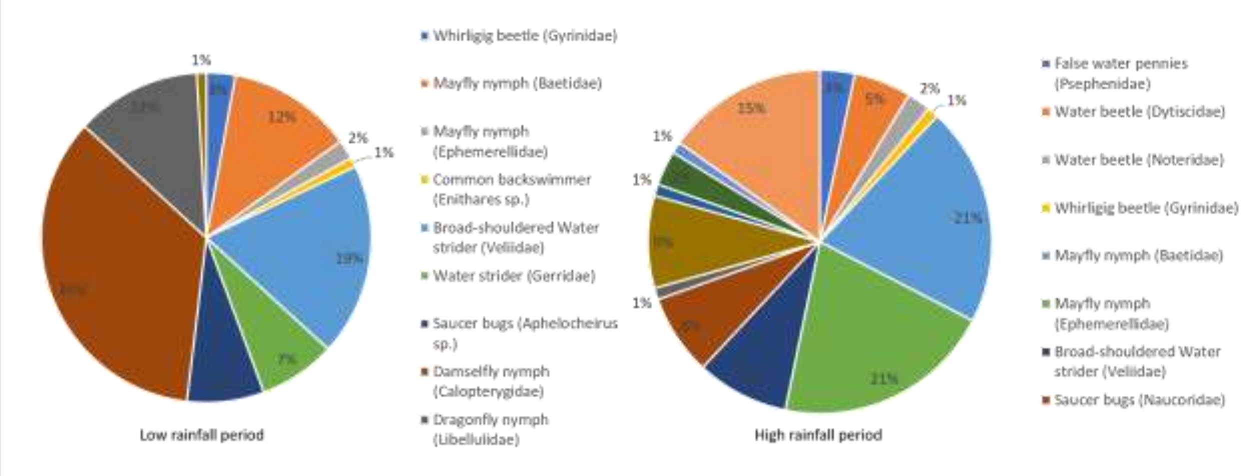


Table 3-77. Family composition and relative abundance of aquatic insects

Low rainfall period			High rainfall period		
Family name	**Abundance**	**RA (%)**	**Family name**	**Abundance**	**RA (%)**
Whirligig beetle (Gyrinidae)	3	2.83	False water pennies (Psephenidae)	3	3.26
Mayfly nymph (Baetidae)	13	12.26	Water beetle (Dytiscidae)	5	5.43
Mayfly nymph (Ephemerellidae)	2	1.89	Water beetle (Noteridae)	2	2.17
Common backswimmer (*Enithares sp.*)	1	0.94	Whirligig beetle (Gyrinidae)	1	1.09
Broad-shouldered Water strider (Veliidae)	20	18.87	Mayfly nymph (Baetidae)	19	20.65
Water strider (Gerridae)	8	7.55	Mayfly nymph (Ephemerellidae)	19	20.65
Saucer bugs (*Aphelocheirus sp.*)	8	7.55	Broad-shouldered Water strider (Veliidae)	8	8.70
Damselfly nymph (Calopterygidae)	37	34.91	Saucer bugs (Naucoridae)	7	7.61
Dragonfly nymph (Libellulidae)	13	12.26	Water scorpion (Nepidae)	1	1.09
Caddisfly nymph (Rhyacophilidae)	1	0.94	Water strider (Gerridae)	8	8.70
Grand Total	**106**	**100**	Dragonfly nymph (Aeshnidae)	1	1.09
			Dragonfly nymph (Libellulidae)	3	3.26
			Dragonfly nymph (Macromiidae)	1	1.09
			Caddisfly nymph (Rhyacophilidae)	14	15.22
			Grand Total	**91**	**100.00**

Note: RA – relative abundance

Figure 3-80. Relative abundance of aquatic insect species between the two sampling periods



Comparative abundance of aquatic insects per rainfall periods – Among the sites, Station A12 (Ipoon river) scored the highest count of aquatic insects with a total of 18 individuals during low rainfall period followed by Station A13 (Komotal river) with 17 individual counts (**Figure 3-81** and **Figure 3-82**). Stations A1, A2, A3, A5, A8, A11, A14, and A17 (8 stations) yielded no aquatic insects. Station A13 had the highest count of aquatic insects during high rain period with 13 individuals followed by Station A9 and Station 15 with 12 and 11 individuals respectively. There were no aquatic insects recorded in Stations A1, A3, A7, and A17 (4 stations).

Figure 3-81. Aquatic insect composition across stations

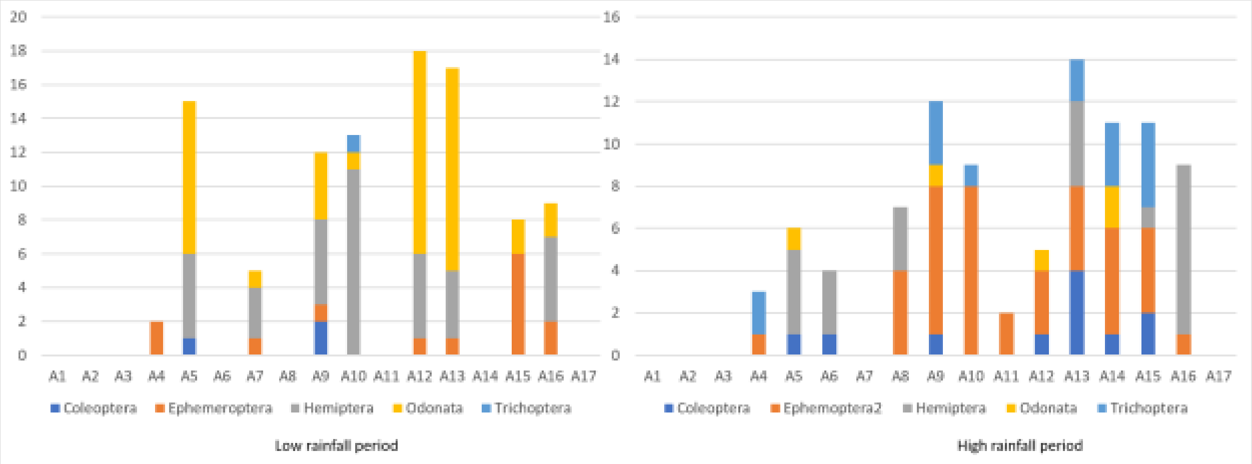
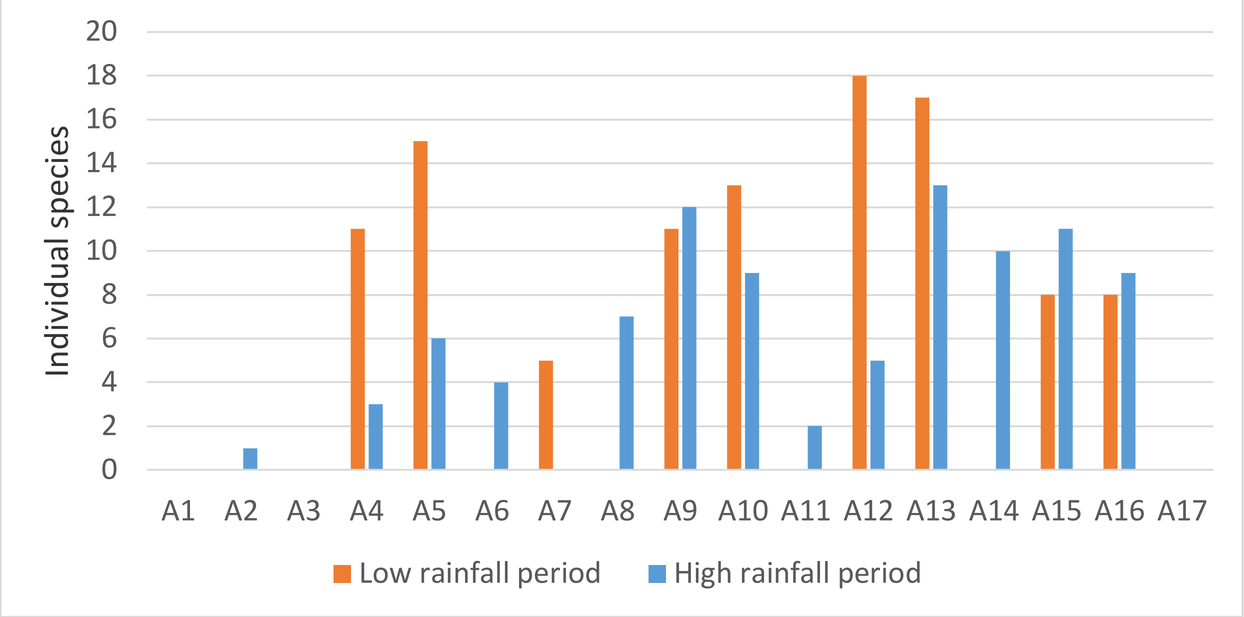


Figure 3-82. Comparative abundance of phytoplankton organisms across stations



3.2.4.3.1.6 Impact to the aquatic ecology

Direct major impacts of the proposed Project to river and stream ecology emanate from road and bridge construction activities that generate loose materials. During runoff, these loose materials can potentially increase TSS levels in rivers and streams if not properly contained. Pollution-sensitive aquatic insects (*Ephemoptera and Trichoptera*), *Macrobrachium rosenbergii*, and plankton species are particularly vulnerable to siltation. Loss of species is not expected; only localized displacement of species.

Habitat loss from siltation especially during construction may displace local aquatic species or interfere in their natural reproductive cycles, which may impact abundance, frequency, and distribution of aquatic species, particularly the pollution-sensitive aquatic insects, *Epheromoptera* and *Trichoptera*.

3.2.4.4 Proposed mitigating measures

Construction - Major impacts of the Project to river and stream biota are potential siltation and oil pollution. Siltation and oil slicks can be minimized by constructing drainage canals and silt ponds and installation of geotextiles, silt traps, and silt curtains to prevent runoff towards rivers and streams during a heavy downpour. Oil pollution can be minimized by installing oil-water separators at the staging areas and motor pools. Bunded area for tanked fuels, lubricants, etc. located at the staging areas must contain drainage leading to oil-water separator. On-site sanitation facilities must also be established during construction and run-off from the construction areas must be contained with silt traps or curtains.

Monitoring of phytoplankton, zooplankton, fishes and macrobenthic fauna, and aquatic insects during the low and high rain periods in conjunction with water quality is recommended to detect changes in diversity and abundance of aquatic species.

3.2.5 Marine ecology

Similar to the oceanography module, marine ecology is not applicable because the proposed Project or any of its components are not located near the seas. The nearest coastal area to the RROW is more than 800 meters.

3.3 THE AIR

3.3.1 Meteorology

3.3.1.1 Methodology

This section describes the existing meteorological conditions at the Project area using available primary and secondary data. Emphasis was placed on parameters relevant to the assessment of air pollution impacts and contribution to climate change in terms of greenhouse gas (GHG) emissions.

Regional and local meteorology

The regional meteorological conditions were described using records from the PAGASA stations at the Lumbia Airport Station in Misamis Oriental and Malaybalay City in Bukidnon (**Figure 3-83**). Records and data used were a) climatological normals (**Table 3-78**, **Table 3-79**), b) climate extremes (**Table 3-80, Table 3-81**) c) the modified Coronas climate map of the Philippines (**Figure 3-84)**; d) wind rose analysis data; and e) tropical cyclone risk and frequency maps (**Figure 3-85**).

Figure 3-83. PAGASA stations nearest to the Project alignment

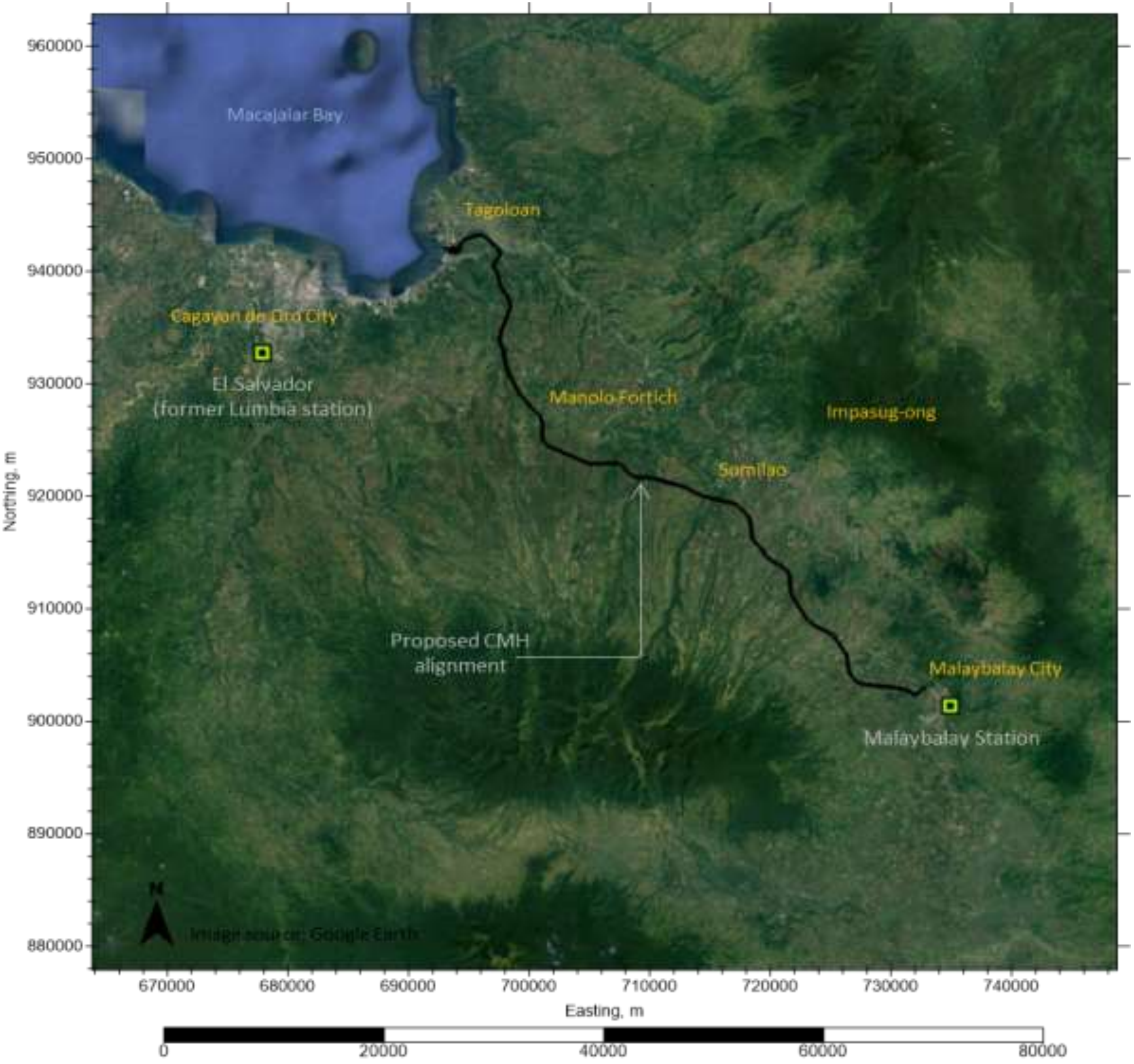


Table 3-78. Climatological normal records at the Lumbia Airport Station, Misamis Oriental (1981-2010)

Month	Rainfall		Temperature						VP	RH	MSLP	Wind		Cloud
	Amount	No. of RD	Max	Min	Mean	Dry Bulb	Wet Bulb	Dew Pt.				Direction	Speed	cover
	mm	#	°C	°C	°C	°C	°C	°C	mbs	%	mbs	16 pt	m/s	okta
JAN	98.9	12	29.6	21.6	25.6	25	23	22.2	26.7	84	1010.7	N	2	5
FEB	68	8	30.2	21.4	25.8	25.2	22.9	22	26.3	82	1011	N	2	5
MAR	49.8	6	31.3	21.6	26.5	25.9	23.3	22.3	26.8	80	1010.7	N	2	4
APR	52.6	5	32.5	22.4	27.5	26.9	23.8	22.6	27.3	77	1009.8	N	2	4
MAY	125	10	32.9	23.2	28	27.3	24.3	23.2	28.3	78	1009.2	N	2	5
JUN	212.7	17	32	22.8	27.4	26.5	24	23.1	28.1	81	1009.4	S	2	6
JUL	245.6	18	31.6	22.4	27	26.1	23.8	22.9	27.9	83	1009.5	S	2	6
AUG	195.8	15	32.1	22.5	27.3	26.4	23.8	22.8	27.7	80	1009.4	S	2	6
SEP	219.7	16	31.8	22.3	27.1	26.1	23.7	22.8	27.6	82	1009.8	S	2	6
OCT	185.9	16	31.4	22.3	26.9	26.1	23.8	22.9	27.9	83	1009.5	S	2	5
NOV	136	12	30.9	22.1	26.5	25.9	23.7	22.9	27.8	83	1009.3	S	2	5
DEC	113.2	11	30.1	21.8	26	25.5	23.4	22.6	27.3	84	1010	N	2	5
ANNUAL	**1703.3**	**148**	**31.4**	**22.2**	**26.8**	**26.1**	**23.6**	**22.7**	**27.5**	**81**	**1009.9**	**N**	**2**	**5**

Source: PAGASA; RD – rainy days; VP – vapor pressure; RH – relative humidity; MSLP – Mean Sea Level Pressure; mbs – millibars

Table 3-79. Climatological normal records at the Malaybalay Station, Bukidnon (1981-2010)

Month	Rainfall		Temperature						VP	RH	MSLP	Wind		Cloud cover
	Amount	No. of RD	Max	Min	Mean	Dry Bulb	Wet Bulb	Dew Pt.				Direction	Speed	
	mm	#	°C	°C	°C	°C	°C	°C	mbs	%	mbs	16 pt	m/s	okta
JAN	142.5	16	29	17.9	23.4	23	21.2	20.4	23.9	85	1009.4	S	1	6
FEB	106.1	13	29.4	17.6	23.5	23.1	21.2	20.4	23.9	84	1009.9	E	1	6
MAR	112.5	13	30.6	17.6	24.1	23.9	21.5	20.5	24	81	1005.4	S	1	5
APR	115.6	12	31.7	18.1	24.9	24.6	22	20.9	24.6	80	1008.9	S	1	5
MAY	224.8	10	31.2	19.1	25.1	24.9	22.7	21.8	26.1	83	1006	S	1	6
JUN	313.5	23	29.8	19.2	24.5	24.1	22.4	21.7	25.9	86	1008.9	S	1	6
JUL	323.3	24	29	18.9	24	23.6	22.1	21.5	25.6	88	1008.8	S	1	7
AUG	294.4	22	29.1	18.8	23.9	23.5	22	21.4	25.4	88	1009	S	1	7
SEP	315.7	24	29.5	18.7	24.1	23.6	22.1	21.5	25.6	88	1009.1	S	1	7
OCT	314.7	23	29.6	18.9	24.2	23.7	22.2	21.6	25.7	88	1008.9	S	1	6
NOV	176.1	18	30	18.6	24.3	23.8	22.1	21.4	25.4	86	1008.6	S	1	6
DEC	130.7	16	29.5	18.3	23.9	23.5	21.6	20.8	24.5	85	1009.1	S	1	6
ANNUAL	**2569.9**	**222**	**29.9**	**18.5**	**24.2**	**23.8**	**21.9**	**21.1**	**25**	**85**	**1008.5**	**S**	**1**	**6**

Source: PAGASA; RD – rainy days; MSLP – Mean Sea Level Pressure; SPD- wind speed in meters per second; TSTM – thunderstorm; LTNG - lightning

Table 3-80. Climatological extremes at the Lumbia Airport Station, Misamis Oriental (as of 2019)

Month	Temperature (°C)				Greatest daily rainfall (mm)		Strongest winds (mps)			Sea level pressures (mbs)			
	High	Date	Low	Date	Amount	Date	Spd	Dir	Date	High	Date	Low	Date
JAN	36.2	01-08-2016	16.1	01-03-1991	104.4	01-13-2009	14	WNW	01-28-2017	1018.1	01-27-1983	982.8	01-21-1989
							14	NNE	01-27-2019				
FEB	36.0	02-14-2003	17.1	02-05-1980	107.8	02-05-1999	14	N	02-02-1993	1018.8	02-25-2016	1001.6	02-24-1980
							14	N	02-02-2015				
							14	N	02-12-2017				
MAR	37.6	03-28-1998	17.1	03-10-1992	84.2	03-19-1982	13	ENE	03-26-1984	1018.9	03-07-1981	1002.0	03-19-1982
APR	37.0	04-11-1998	18.0	04-13-1983	88.4	04-14-2014	20	NNW	04-29-1983	1017.3	04-14-1993	1002.8	04-01-2000
MAY	38.2	05-07-1998	20.7	05-28-1984	94.3	05-21-1990	18	W	05-27-1998	1015.6	05-10-2016	1003.3	05-05-2002
JUNE	38.4	06-06-2009	20.0	06-11-1992	124.2	06-21-2016	18	WNW	06-10-1997	1015.6	06-20-1982	1002.4	06-17-2007
JULY	36.2	07-11-2002	20.0	07-17-1994	142.0	07-13-1999	22	W	07-31-1999	1016.0	07-22-2015	1001.0	07-03-2001
			20.0	07-02-2015									
AUG	37.8	08-28-1990	19.4	08-26-1995	129.3	08-21-1998	25	SW	08-05-1997	1015.6	08-11-1997	1002.9	08-17-1990
SEP	36.7	09-02-1992	19.0	09-23-1991	117.0	09-09-2017	24	NNW	09-23-1996	1016.1	09-26-1982	983.8	09-16-1988
OCT	35.2	10-20-2015	19.0	10-31-1982	114.1	10-20-1980	18	SW	10-04-2014	1017.5	10-04-2015	1001.4	10-29-1995
			19.0	10-25-2015									
NOV	34.7	11-30-2006	18.0	11-25-1992	237.1	11-24-2009	18	NW	11-20-1990	1016.3	11-17-1982	1000.7	11-06-1996
DEC	34.4	12-08-1996	17.8	12-31-1990	180.9	12-16-2011	34	S	12-04-2012	1017.8	12-28-2015	1001.0	12-22-2017
ANNUAL	38.4	06-06-2009	16.1	01-03-1991	237.1	11-24-2009	34	S	12-04-2012	1018.9	03-07-1981	982.8	01-21-1989
Period	1979 - 2019				1977 - 2019		1979 - 2019			1979 - 2019			

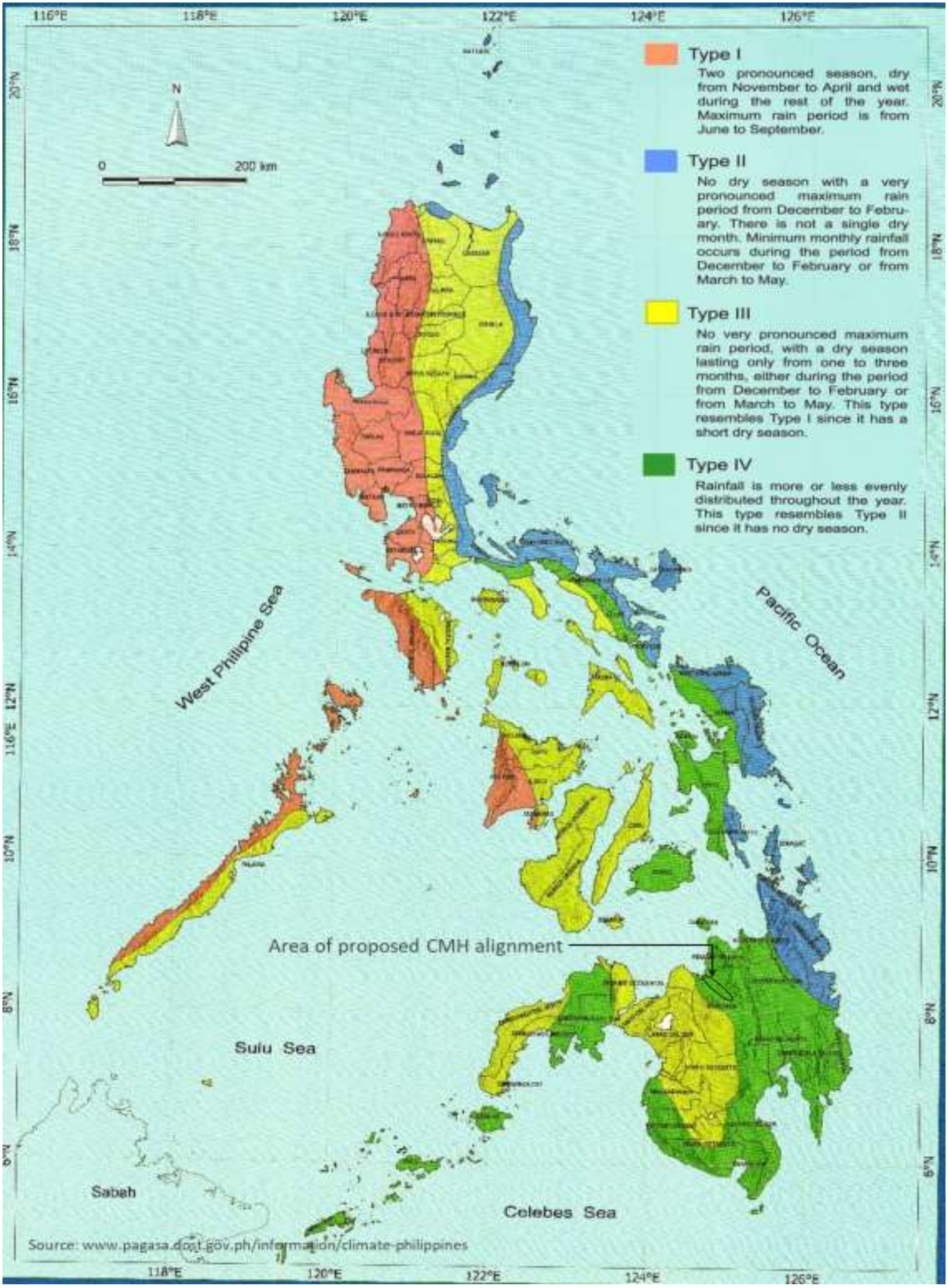
Source: PAGASA; Spd – speed; Dir – direction; mbs - millibars

Table 3-81. Climatological extremes at the Malaybalay Station, Bukidnon (as of 2019)

Month	Temperature (°C)				Greatest daily rainfall (mm)		Strongest winds (mps)			Sea level pressures (mbs)			
	High	Date	Low	Date	Amount	Date	Spd	Dir	Date	High	Date	Low	Date
JAN	34.0	01-23-1988	11.7	01-16-1956	140.6	01-14-2014	22	NE	01-07-1974	1020.5	01-28-1949	987.0	01-07-1972
FEB	35.2	02-05-2002	10.0	02-04-1973	109.2	02-07-1962	19	NE	02-10-1974	1019.4	02-19-1949	998.1	02-28-1972
MAR	35.5	03-31-1990	12.0	03-01-1949	170.6	03-19-1982	14	NE	03-01-1992	1019.6	03-26-1949	998.9	03-17-1970
APR	36.4	04-15-2016	12.5	04-02-1996	184.2	04-06-1999	21	NW	04-05-1966	1019.2	04-27-1949	996.6	04-24-1971
MAY	36.2	05-16-1998	14.0	05-08-2010	126.3	05-15-1991	18	WNW	05-05-1966	1019.9	05-02-1949	997.9	05-25-1971
JUNE	34.5	06-14-2017	13.0	06-26-1962	130.4	06-07-2002	18	N	06-20-1985	1019.6	06-11-1949	999.4	06-14-1974
JULY	33.0	07-15-2001	14.0	07-04-2017	138.2	07-26-2018	15	S	07-28-1992	1015.3	07-22-2015	997.4	07-04-1967
	33.0	07-15-2016											
AUG	33.5	08-07-2000	15.0	08-24-2010	113.6	08-01-1978	22	SW	08-28-1984	1016.2	08-11-1997	998.0	08-23-1967
			15.0	08-10-2016									
SEP	34.0	09-03-2007	15.3	09-21-1986	128.6	09-29-2010	18	NW	09-02-1971	1015.9	09-30-1997	998.6	09-20-1971
OCT	34.0	10-31-1995	14.9	10-30-1968	195.9	10-08-1979	20	N	10-21-1982	1016.3	10-11-1997	960.6	10-12-1970
NOV	34.8	11-29-1968	13.1	11-29-1967	144.8	11-20-1993	19	SW	11-22-1973	1015.9	11-07-1997	996.1	11-20-1973
DEC	33.6	12-08-2002	12.5	12-06-2009	112.4	12-21-2017	14	NE	12-21-1973	1017.4	12-12-2002	998.2	12-24-1954
ANNUAL	**36.4**	**04-15-2016**	**10.0**	**02-04-1973**	**195.9**	**10-08-1979**	**22**	**NE**	**01-07-1974**	**1020.5**	**01-28-1949**	**960.6**	**10-12-1970**
							22	**SW**	**08-28-1984**				
Period	**1949 - 2019**				**1952 - 2019**		**1966 - 2019**			**1949 - 2019**			

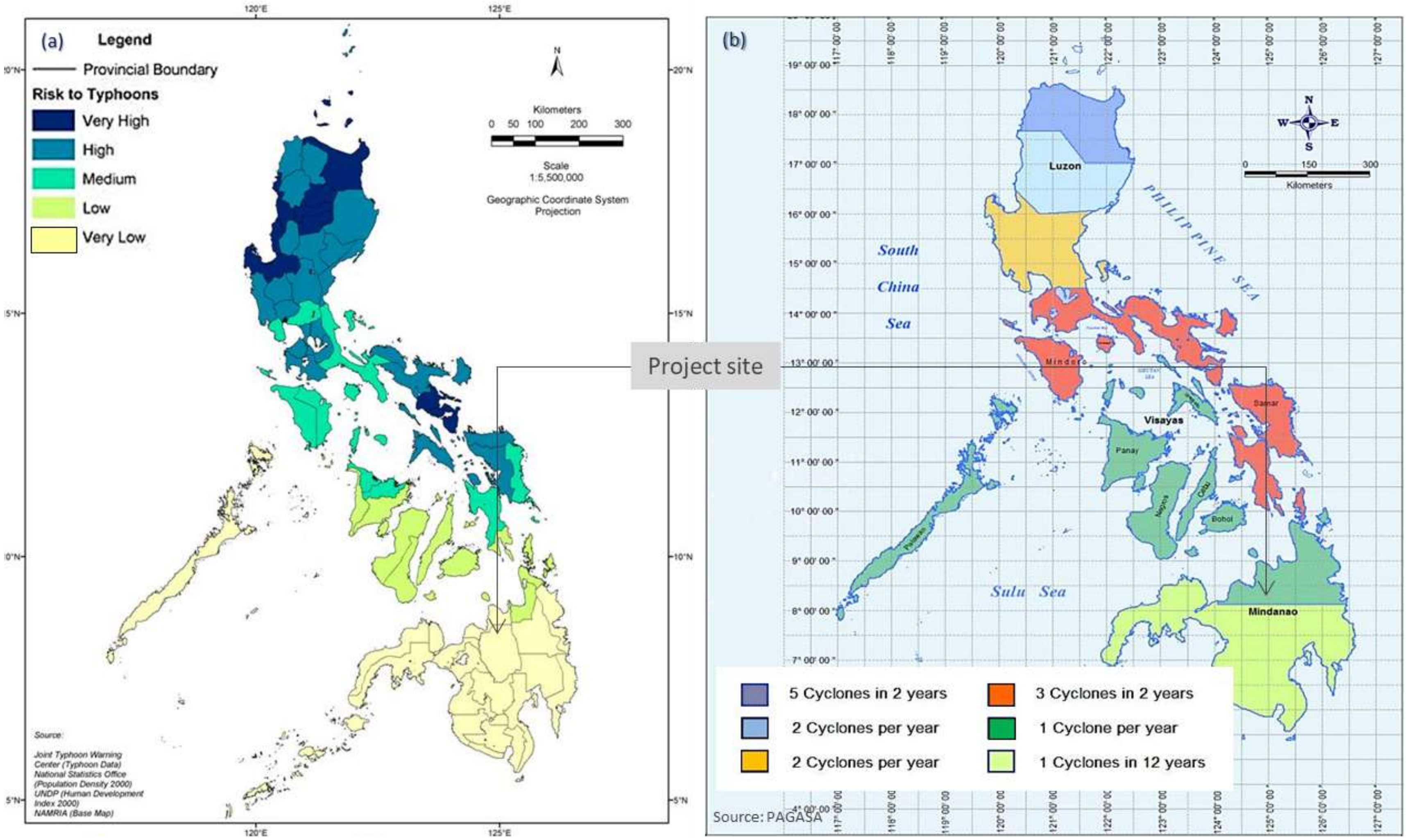
Source: PAGASA; Spd – speed ; Dir – direction; mbs - millibars

Figure 3-84. Modified Coronas classification of Philippine climate showing the Project



Source: www.pagasa.dost.gov.ph/information/climate-philippines

Figure 3-85. Tropical cyclone frequency map of the Philippines showing the Project



Source:

Joint Typhoon Warning Center (Typhoon Data)
National Statistics Office (Population Density 2000)
UNDP (Human Development Index 2000)
NAMRIA (Base Map)

Source: PAGASA

Impact assessment

Climate change projections - Climate change projections on rainfall and temperatures in 2020 and 2050 was based on the paper "*Climate Change in the Philippines 2011*" published by the PAGASA. The projections were based on the normal data using the medium-range emission scenario (A1B) defined by the IPCC as:

> *A1: The A1 storyline and scenario family describe a future world of very rapid economic growth, a global population that peaks mid-century and declines thereafter, and a rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family is further developed into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil-intensive (A1FI), non-fossil energy sources (A1T), or balanced across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).*

Greenhouse gas (GHG) emissions – Significant GHG emissions are expected during the opening of the proposed Project to the public. The emission factors used to estimate the GHG from vehicle emissions and its equivalent Global Warming Potential (GWP) are shown in **Table 3-82**. The traffic projections of the four scenarios *Baseline* (Sayre 2020), *No Project* (Sayre 2040), *Project only* (CMH 2040), and *ALL* (both Sayre and CMH 2040 in **Table 3-83** were used to estimate the GHG emissions. The detailed estimation of the traffic projections is presented in *Annex8 – Air Dispersion Modelling Methodology*. Vehicle Type wise GHGs is caliculated following formular.

Vehicle Type wise GHG,i in Target Year= [GHG-ef,i] × [TV,i,y] × L (Unit :ton/year)

i :Vehicle type（Car, Jeepney, Bus, Truck）
GHG -ef,i : GHG emission factors for each vehicle type (SeeTable 3-82) (unit: mg/km or g/km)
TV,i,y : Annual Traffic volume of each vehicle type in target year (See Table 3-83) (unit: vehicle/year)
L : Travel length of road (Syare Hygyway or CMH) (unit: km)

Table 3-82. GHG emission factors used and corresponding GWP values

GHG	Car	Jeepney	Bus	Truck	GWP (c)
CO2 (a)	60	80	95	95	1
N2O (b)	0.7	4	30	30	265
CH4 (b)	0	0	70	70	28

Sources: IPCC, JICA for GHG emission factors; IPCC for GWP; NOTES: (a) g/km with speeds greater than 20kph; (b) mg/km travelled; (d) mean of Light Duty Gas and Diesel vehicles; (c) 100-year Global Warming Potential (IPCC Fifth Assessment Report, 2014)

Table 3-83. Scenarios and total annual number of vehicles for estimating GHG

Scenario	Year	CAR	JPY	BUS	TRU	TOTAL
Baseline (a)	2020	7,609,506	1,315,404	281,454	7,381,854	16,588,218
No Project (b)	2040	7,234,356	1,448,262	154,818	671,610	9,509,046
Project only (c)	2040	14,807,994	0	3,316,326	15,430,194	33,554,514
ALL (d)	2040	22,042,350	1,448,262	3,471,144	16,101,804	43,063,560

NOTES: (a) Sayre 2020; (b) Sayre 2040; (c) CMH 2040; (d) Sayre and CMH 2040; JPY – jeepney; TRU – truck

3.3.1.2 Assessment of key impacts

3.3.1.2.1 Change in the local microclimate

Regional meteorology

The Project site falls under a Type IV climate (**Figure 3-84**). A Type IV climate has a relatively even distribution of rainfall throughout the year and resembles a Type II climate because it has no dry season. Generally, November to May is considered the low rain season, while June to October is regarded as the high rain season, and PAGASA officially declares the onset of the rainy season.

The potential meteorology at the proposed alignment was described using the mean values (**Table 3-84**) of normal records at the Misamis Oriental and Bukidnon stations of PAGASA derived from **Table 3-78** and **Table 3-79**.

***Rainfall* -** The proposed alignment may experience a monthly rainfall range of 81.2 (February) to 284.5 mm (July) with an annual rainfall of 2,137 mm. The number of rainy days may range from eight to 21 days in a month with an annual frequency of 51 percent. The rainfall trend in **Figure 3-86 a** shows the absence of a distinct dry season resembling the Type II climate. The trend also shows low and high rainfall periods from November to May and June to October respectively. The site may experience an extreme daily rainfall range of 195 to 237mm in October and November respectively (**Table 3-80, Table 3-81**).

Surface temperatures - The highest mean temperature at the alignment may reach 27°C in May with a low of 24.5 °C in January (**Figure 3-86 b**) resulting to a normal difference of about two degrees and an annual mean of 26 degrees Celsius. The site may experience an extreme daily temperature range of 38.4 in June to 36.4 degrees Celsius in April (**Table 3-80, Table 3-81**).

Relative humidity - Relative humidity is expressed in percentage of water vapor present in air using psychrometric charts with the dry- and wet-bulb temperatures as input. The Project alignment may experience a relative humidity range of 78 to 86 percent (**Figure 3-86 c**) with an annual average of 83 percent.

Cloud cover - The monthly cloud cover at the alignment may range from four to six okta (**Figure 3-86 d**). The site may be generally cloudy from June to September (cloud cover ≥ 6 okta) which coincides with the high rainfall period.

Table 3-84. Average climate normal records of Misamis Oriental and Bukidnon stations

Month	Rainfall		Temperature						VP	RH	MSLP	Wind		Cloud cover
	Amount	No. of RD	Max	Min	Mean	Dry Bulb	Wet Bulb	Dew Pt.				Direction	Speed	
	mm	#	°C	°C	°C	°C	°C	°C	mbs	%	mbs	16 pt	m/s	okta
JAN	120.7	14.0	29.3	19.8	24.5	24.0	22.1	21.3	25.3	84.5	1010.1	N,S	1.5	5.5
FEB	87.1	10.5	29.8	19.5	24.7	24.2	22.1	21.2	25.1	83.0	1010.5	N,E	1.5	5.5
MAR	81.2	9.5	31.0	19.6	25.3	24.9	22.4	21.4	25.4	80.5	1008.1	N,S	1.5	4.5
APR	84.1	8.5	32.1	20.3	26.2	25.8	22.9	21.8	26.0	78.5	1009.4	N,S	1.5	4.5
MAY	174.9	10.0	32.1	21.2	26.6	26.1	23.5	22.5	27.2	80.5	1007.6	N,S	1.5	5.5
JUN	263.1	20.0	30.9	21.0	26.0	25.3	23.2	22.4	27.0	83.5	1009.2	S,S	1.5	6.0
JUL	284.5	21.0	30.3	20.7	25.5	24.9	23.0	22.2	26.8	85.5	1009.2	S,S	1.5	6.5
AUG	245.1	18.5	30.6	20.7	25.6	25.0	22.9	22.1	26.6	84.0	1009.2	S,S	1.5	6.5
SEP	267.7	20.0	30.7	20.5	25.6	24.9	22.9	22.2	26.6	85.0	1009.5	S,S	1.5	6.5
OCT	250.3	19.5	30.5	20.6	25.6	24.9	23.0	22.3	26.8	85.5	1009.2	S,S	1.5	5.5
NOV	156.1	15.0	30.5	20.4	25.4	24.9	22.9	22.2	26.6	84.5	1009.0	S,S	1.5	5.5
DEC	122.0	13.5	29.8	20.1	25.0	24.5	22.5	21.7	25.9	84.5	1009.6	N,S	1.5	5.5
ANNUAL	**2136.6**	**185.0**	**30.7**	**20.4**	**25.5**	**25.0**	**22.8**	**21.9**	**26.3**	**83.0**	**1009.2**	N,S	**1.5**	**5.5**

Figure 3-86. Regional normal rainfall, temperature, relative humidity, and cloud cover at the Project site

Surface winds - The mean normal records showed potential wind speeds at the Project site ranging from one to two meters per second (average of 1.5) with prevailing directions in the North (Dec to May) and South (Jun to Nov) (**Figure 3-90 a**). The alignment area may experience an extreme wind speed range of 22 in August to 34 meters per second in December (**Table 3-80, Table 3-81**).

Further processing of the wind rose analysis records from 1981 to 2010 at the Misamis Oriental and Bukidnon stations showed a more detailed potential wind speed distribution at the Project site. About 50 percent of the wind speeds ranged from 1.25 to 1.6 meters per second after discarding outliers (**Figure 3-90 b**). In addition, about 74 percent of the wind speeds ranged from 1.2 to two meters per second (**Figure 3-90 c**).

Tropical cyclones - In general, cyclone frequency in the country is highest from June to December. These tropical cyclones are associated with the occurrence of low pressures areas (LPA) normally originating over the Northwestern Pacific Ocean side of the Philippine Area of Responsibility (PAR) and generally moving northwestward. Tropical cyclones also originate in the South China Sea or at the western part of the country, having unusual motions, and quite rare with 52 occurrences in 50 years (Perez, 2001). In general, from 1948-1993, PAGASA has determined an annual average of 20 tropical cyclones in the PAR, nine of these making landfall. Overall, PAGASA had tracked 917 cyclones within the PAR, with 415 (45.3%) crossing the archipelago and 120 (22.5%) considered disastrous.

The Project alignment is located in an area with very low typhoon risk and visited by two cyclones every year (**Figure 3-87**). The tracks of tropical cyclones crossing the provinces of Misamis Oriental and Bukidnon are shown in **Figure 3-88** and **Figure 3-89**. Aggregating the data of the two provinces showed that tropical depressions, tropical storms, and typhoons **(Figure 3-87 b**) may cross the Project area with the highest frequency in December, November, and March (**Figure 3-87 a**).

Figure 3-87. Aggregated tropical cyclone crossings at the Project area

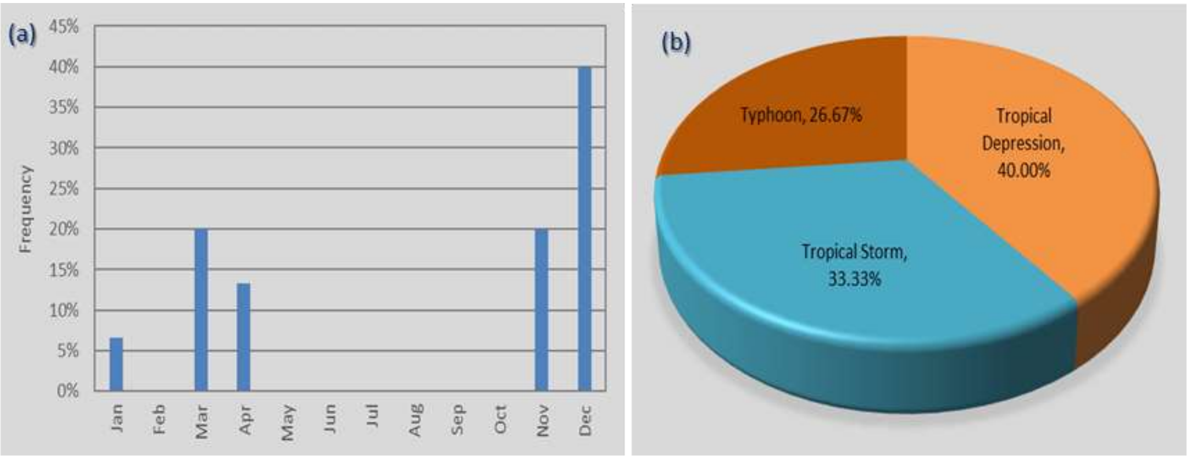
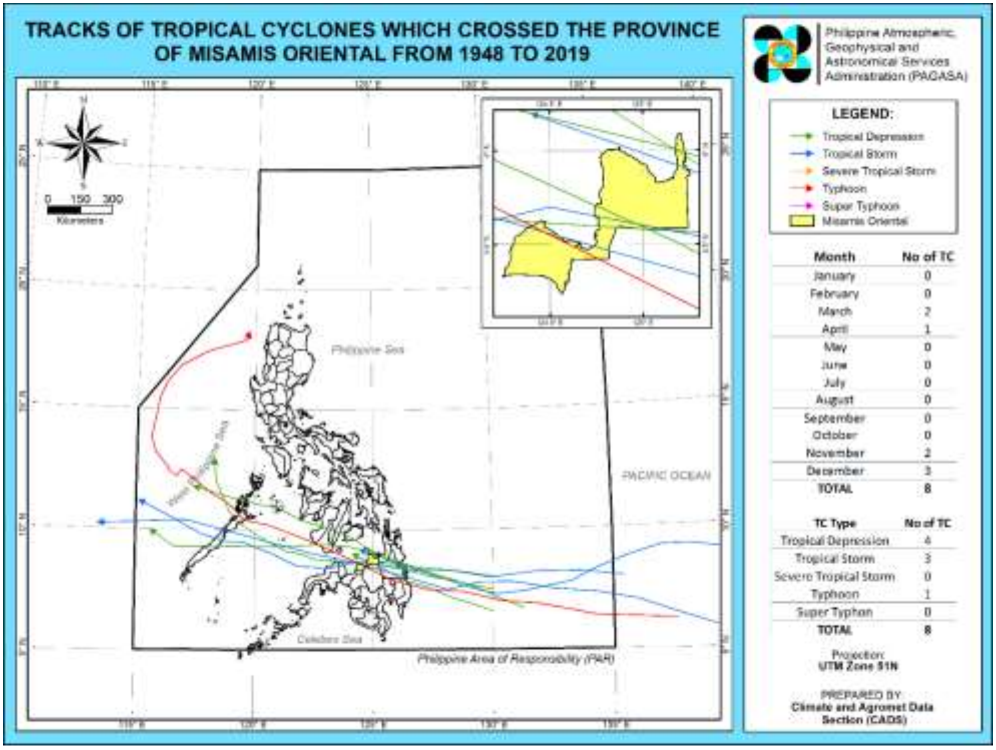


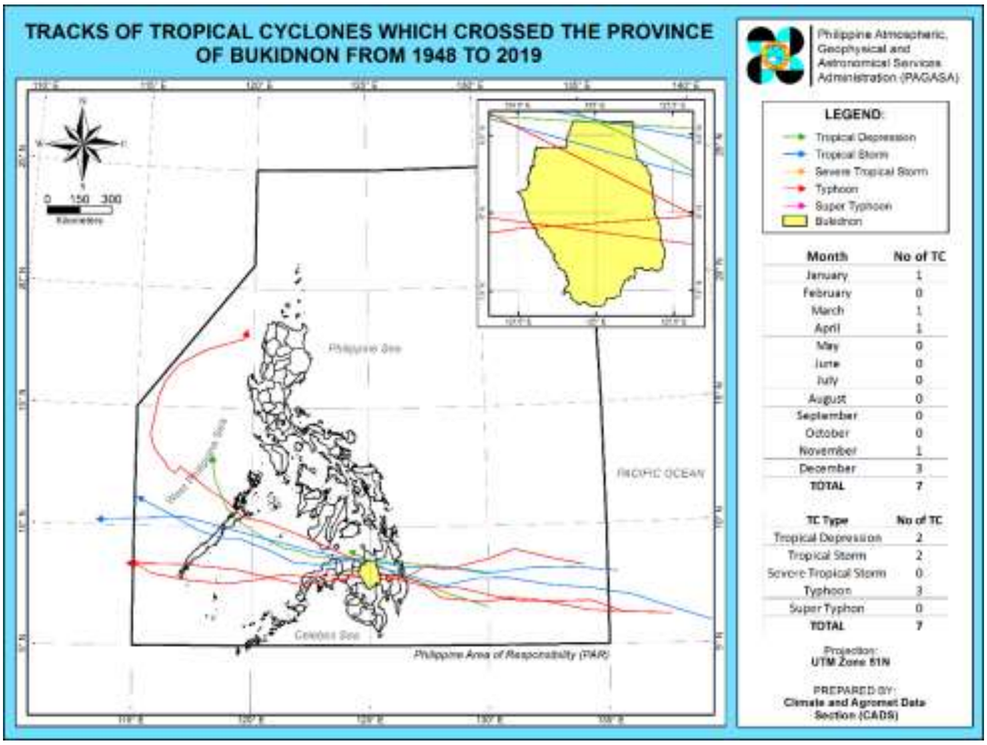
Figure 3-88. Tropical cyclones crossing the province of Misamis Oriental (1948-2019)



Month	No of TC
January	0
February	0
March	2
April	1
May	0
June	0
July	0
August	0
September	0
October	0
November	2
December	3
TOTAL	8

TC Type	No of TC
Tropical Depression	4
Tropical Storm	3
Severe Tropical Storm	0
Typhoon	1
Super Typhon	0
TOTAL	8

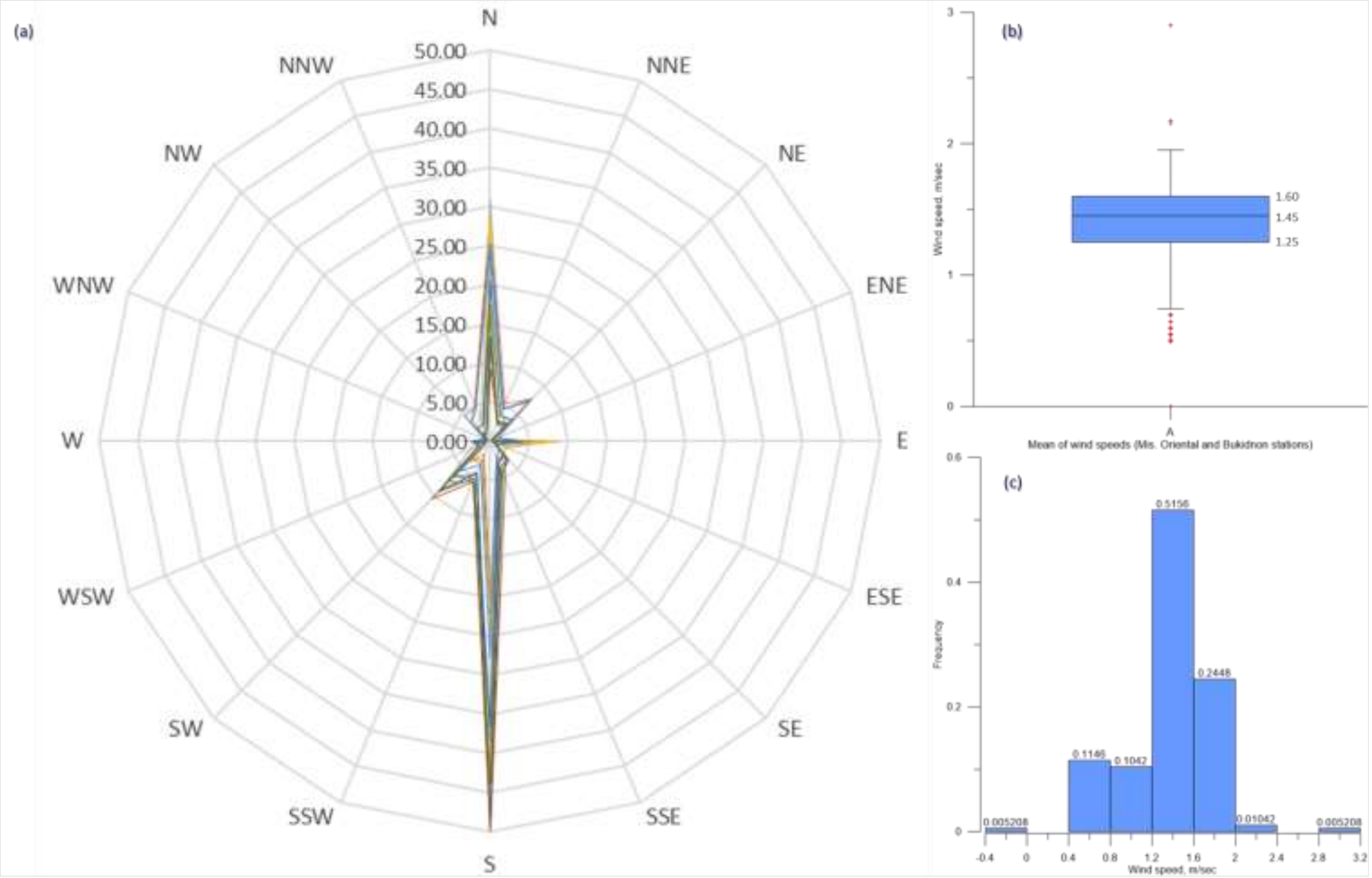
Figure 3-89. Tropical cyclones crossing the province of Bukidnon (1948-2019)



Month	No of TC
January	1
February	0
March	1
April	1
May	0
June	0
July	0
August	0
September	0
October	0
November	1
December	3
TOTAL	7

TC Type	No of TC
Tropical Depression	2
Tropical Storm	2
Severe Tropical Storm	0
Typhoon	3
Super Typhon	0
TOTAL	7

Figure 3-90. Regional wind direction and mean speeds at the Project alignment



Prognostic meteorology

The prognostic meteorology data set derived from modeling using global weather records as input to the air dispersion model was also used to describe the meteorology at the Project alignment. Compared to PAGASA data, the 2020 Prognostic meteorology data has the data needed for the model run. Future weather changes from current prognostic meteorological data are small or insignificant. These are also observed in predicted GLCs from near-ground releases.

Rainfall - The data set showed similar low and high rain periods from November to May and June to October respectively (**Figure 3-91**). The major differences were high and very low predicted rainfalls in December and April respectively.

Temperature and humidity - Similarly, local surface temperatures and relative humidity also followed the monthly PAGASA trend (**Figure 3-92, Figure 3-93, Table 3-88**). The predicted temperatures, however, were lower than the PAGASA normal records by two to three degrees. In addition, the predicted humidities had an average difference of about two percent.

Figure 3-91. Comparison of prognostic and PAGASA rainfall data

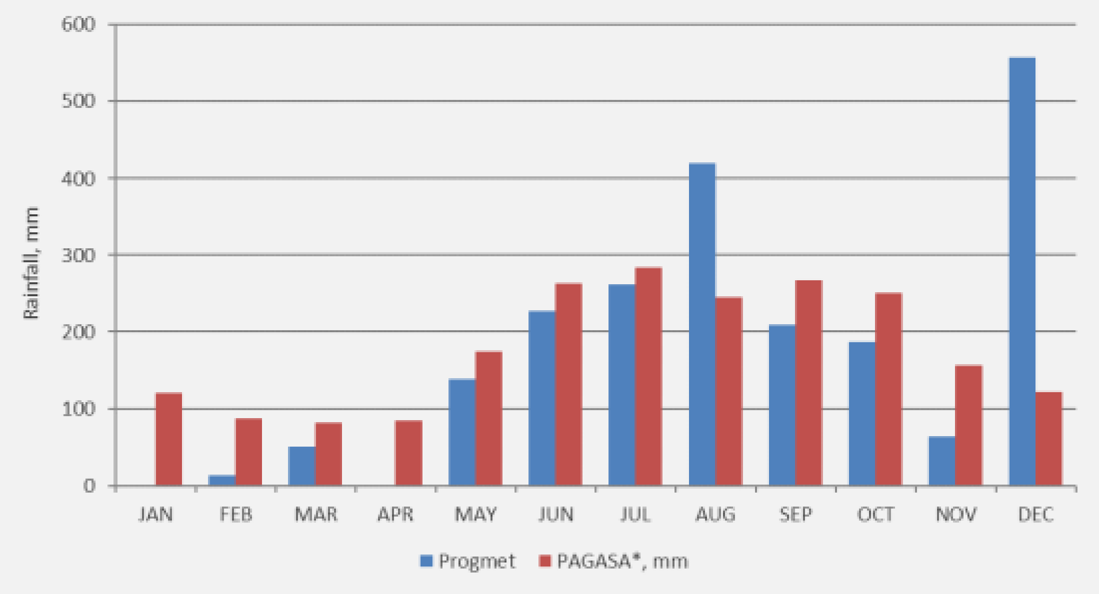


Figure 3-92. Comparison of prognostic and PAGASA surface temperatures

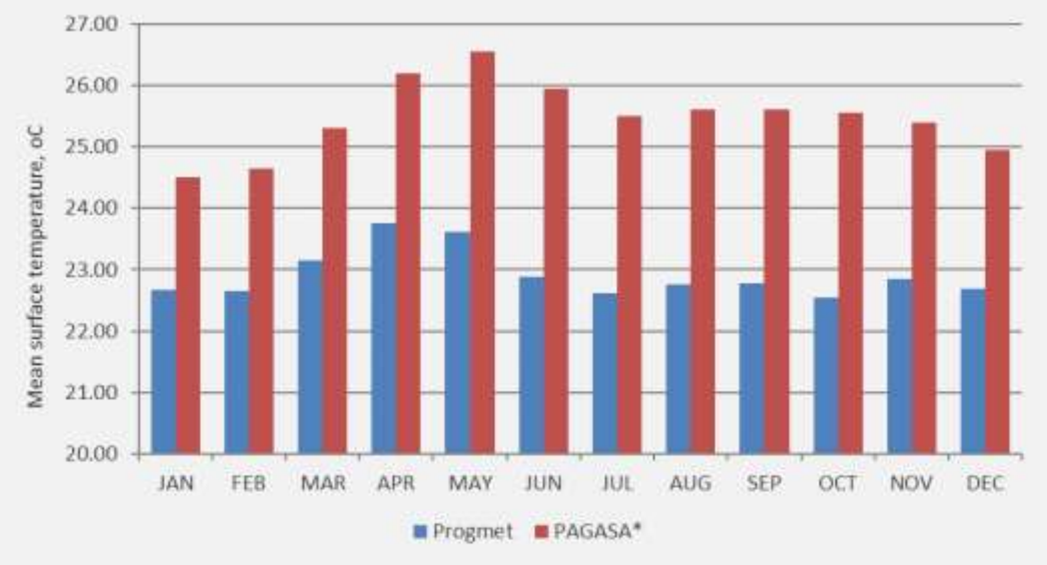
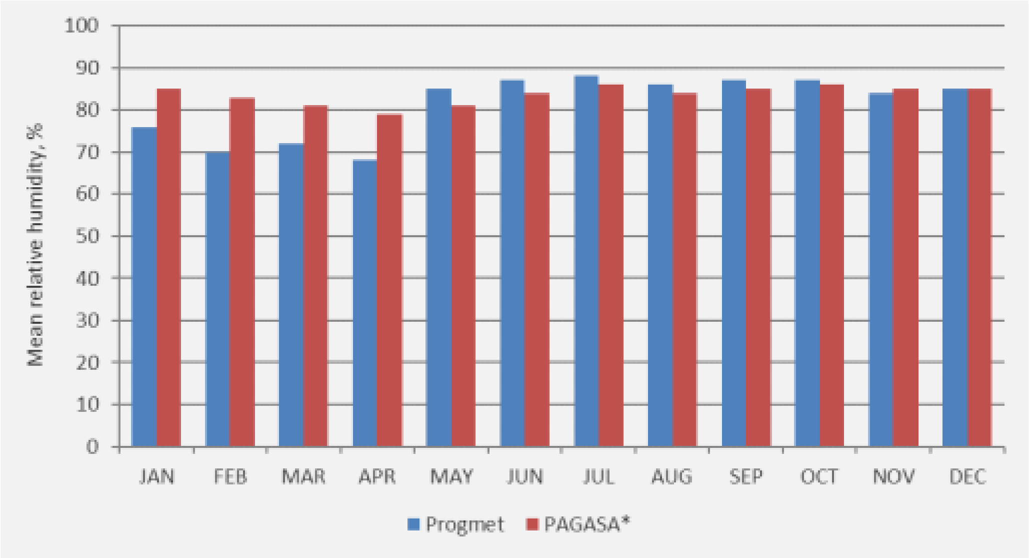


Figure 3-93. Comparison of prognostic and PAGASA humidity values



The salient findings of the processed prognostic wind speeds and directions representing the low and high rain periods in **Figure 3-95** and **Figure 3-96,**respectively, are enumerated below.

Low rain period (November to May)

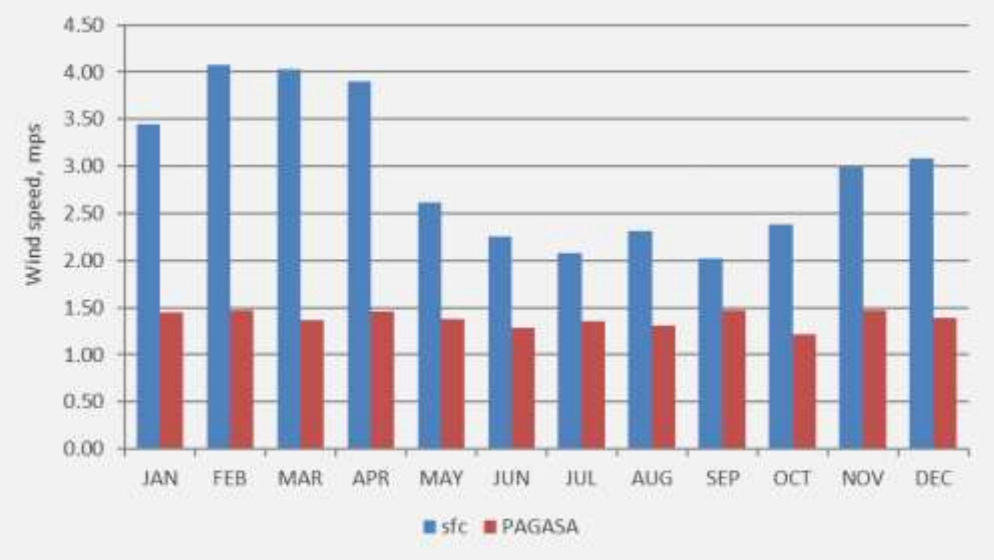
a) South-southeast wind direction prevailing
b) Calm conditions (wind speeds less than 0.5 m/sec) occur 14 percent of the time
c) Wind speeds of 1 to 4 meters per second occur 50 percent of the time
d) Wind speeds of 4 to 8 meters per second occur 34 percent of the time

High rain period (June to October)

a) Prevailing North-Northwest and South-southeast wind directions
b) Calm conditions (wind speeds less than 0.5 m/sec) occur 23 percent of the time
c) Wind speeds of 1 to 4 meters per second occur 67 percent of the time
d) Wind speeds of 4 to 8 meters per second occur 10 percent of the time

Wind profile - Comparison of prognostic and PAGASA wind records shows differences in values but a relatively similar monthly pattern (**Figure 3-94**). A high proportion of higher wind speeds were recorded and predicted during the low rainfall months compared to the high rainfall months of June to October.

Figure 3-94. Comparison of prognostic and PAGASA wind speeds



NOTE: sfc - surface meteorology file derived from prognostic modelling. The data contains hourly resolution by AERMET, the meteorological processor of the AERMOD model. The variables included in the surface file are sensible heat flux, friction velocity, convective velocity, vertical temperature gradient in the first 500m above the planetary boundary layer, extents of the convective and mechanical boundary layers, the Monin-Obukhov length, surface roughness, Bowen ratio, albedo, wind speed, wind direction, anemometer height, temperature, and thermometer height.

Figure 3-95. Wind rose and class frequency distribution during low rain period (Nov to May)

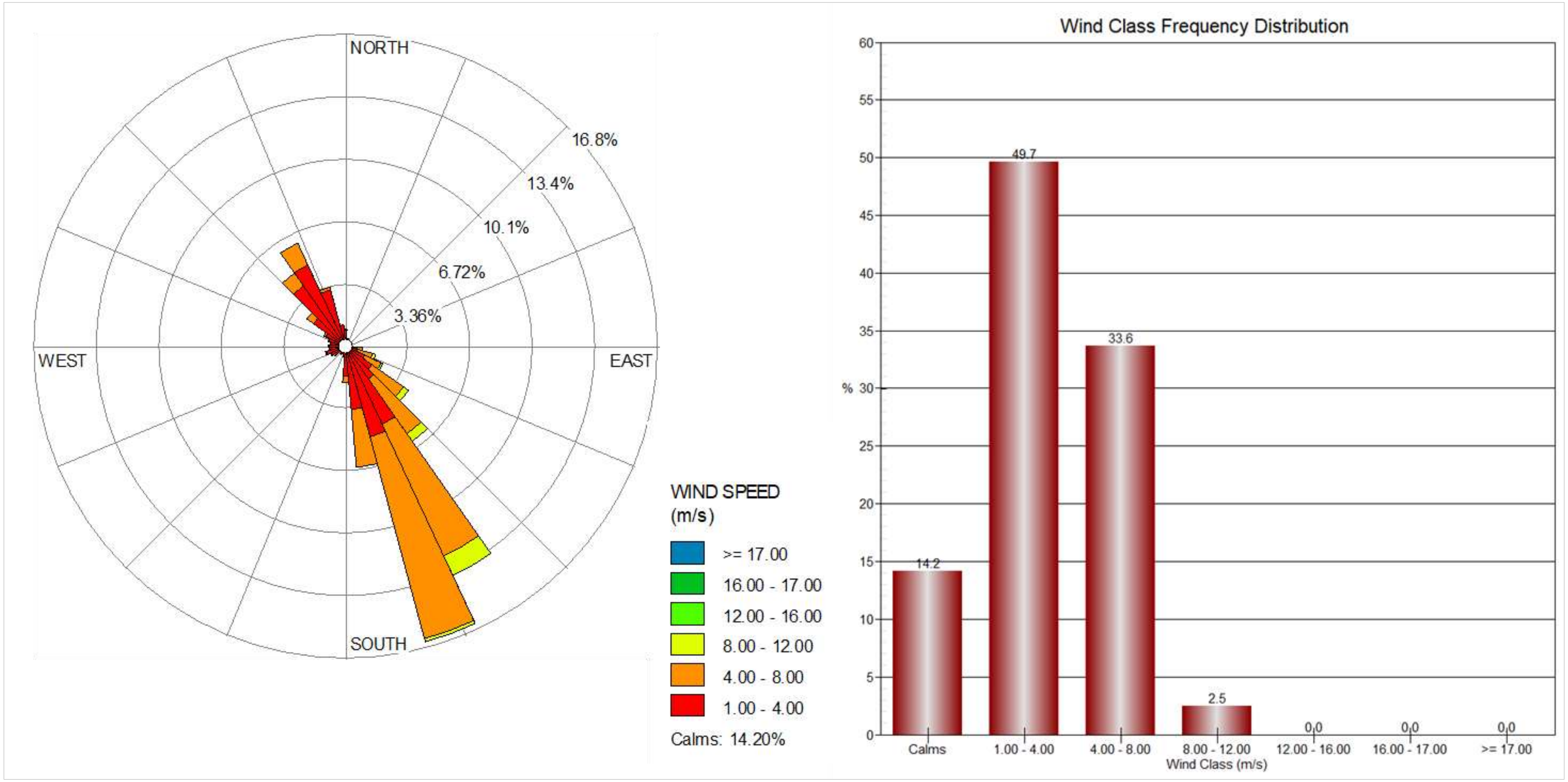
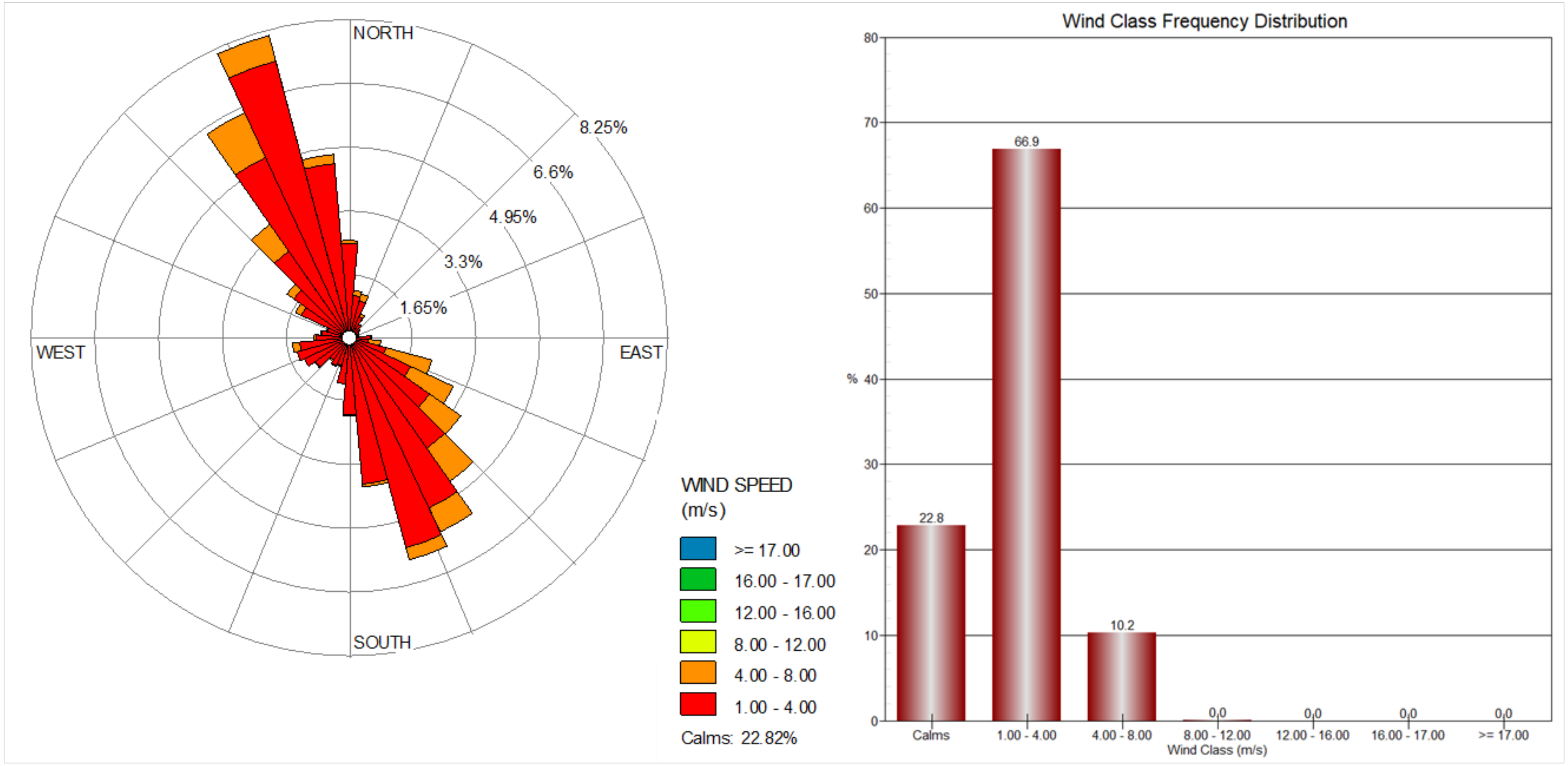


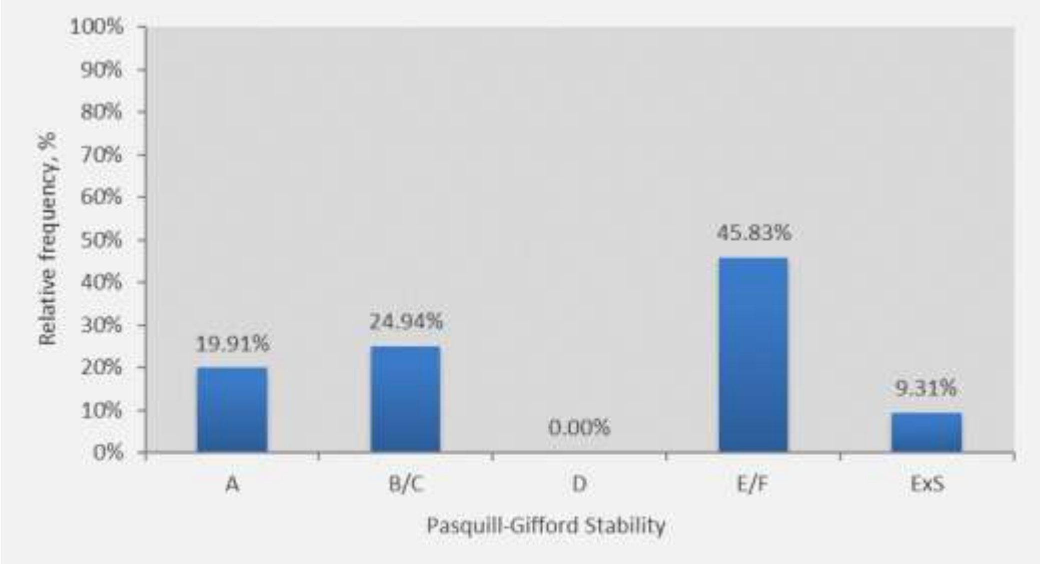
Figure 3-96. Wind rose and class frequency distribution during high rain period (Jun to Oct)



Stability - The atmospheric stabilities at the site, derived by converting the Monin-Obukhov Length scalars in the prognostic data to the Pasquill-Gifford stability classification showed the prevalence of a stable atmosphere (E - slightly stable, F - stable, ExS - extremely stable) at 55 percent followed by unstable atmospheres (A – Extremely unstable, B - unstable /C - slightly unstable) at the Project alignment (**Figure 3-97**). Unstable atmospheres occur during daytime due to insolation while a stable atmosphere occurs during nighttime. The descriptions of the prevailing stabilities are described below.

a) A stability (very unstable): daytime; strong insolation and wind < 3 m/s or moderate insolation and wind < 2 m/s
b) B stability (unstable): daytime; strong insolation with wind speed between 3 and 5 m/s or moderate insolation with wind speed between 2 and 4 m/s or slight insolation and wind < 2 m/s
c) C stability slightly unstable: daytime; strong insolation and wind speed >5 m/s or moderate insolation with wind between 4 and about 5.5 m/s or slight insolation and wind between 2 and 5 m/s
d) E stability (slightly stable): nighttime; thin overcast or > 50% cloud cover and wind < 3 m/s; < 50% cloud cover and wind between 3 and 5 m/s
e) F stability (stable): nighttime; < 50% cloud cover and wind < 3 m/s

Figure 3-97. Atmospheric stabilities at the Project area



PAGASA climate projections

Surface temperatures - Since 1971 the country in general has experienced an increase in mean, maximum, and minimum temperatures by 0.14°C per decade (IPCC, 2007). Studies by Tibig (2004) and Manton et al. (2001) reported departures of 0.61, 0.34 and 0.89 degrees from the annual mean, maximum, and minimum temperatures, respectively, of the 1961–1990 normal values (ADB, 2009).

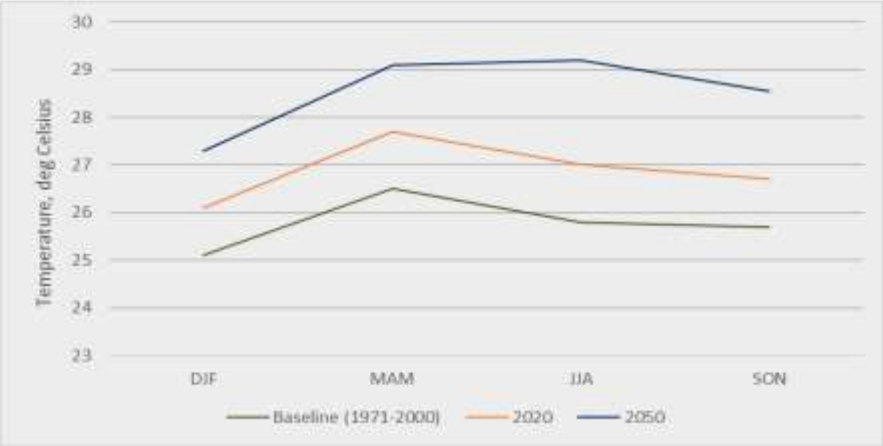
The aggregated PAGASA projections for the provinces of Misamis Oriental and Bukidnon under a medium range scenario showed surface temperature increases of 0.8 to 2.46 degrees in 2020 and 2050 respectively. With these projections, the Project area may experience mean surface temperatures from 26.1 to 27.7 degrees in 2020 and 27.3 to 29.2 degrees in 2050 (**Table 3-85**). The projections followed the trend of the baseline temperatures where temperatures peaks in the months of March, April, and are lowest in December, January, and February (**Figure 3-98**).

Table 3-85. Mean temperature projections in Bukidnon and Misamis Oriental

Quarter	Bukidnon	Mis. Oriental	Mean of Bukidnon & Mis. Oriental		
	Baseline (1971-2000)		Baseline	2020	2050
DJF	25.10	25.4	25.25	26.10	27.30
MAM	26.50	26.8	26.65	27.70	29.10
JJA	25.80	26.8	26.30	27.00	29.20
SON	25.70	26.5	26.10	26.70	28.55
		Annual mean	26.08	26.88	28.54

Source: derived from the PAGASA report *Climate Change in the Philippines*; NOTES: *1971-2000; DJF – Dec, Jan, Feb, MAM – Mar, Apr, May, JJA – Jun, Jul, Aug, SON, Sep, Oct, Nov

Figure 3-98. Trend of projected temperatures at the Project area



Rainfall - In contrast to the projected temperature increase, the mean annual rainfall and the number of rainy days in the country has increased since 1960. The country also experienced variability in the onset of the rainy season. The trend has been toward decreasing rainfall over Luzon and parts of Mindanao and increasing rainfall over the central western part of the country (Anglo, 2006).

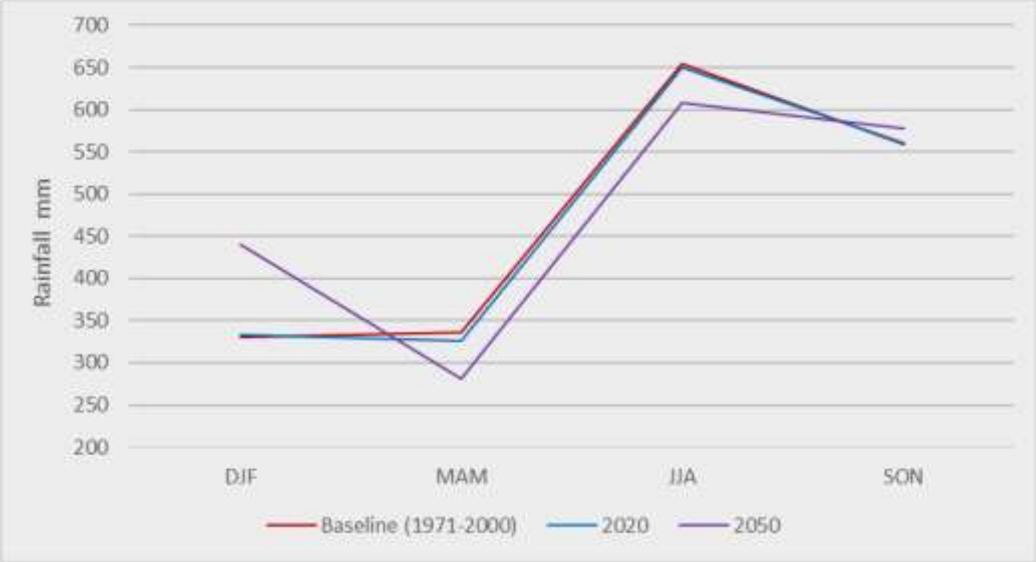
The aggregated PAGASA predictions for the medium-ranged scenario showed both rainfall decreases and increases in 2020 and 2050 from the observed baseline. The highest increase from the baseline were projected the months of June, July, and August 2020 with an increase of 15mm while the 55mm in December, January, and February 2050. There was a predicted decrease in the annual 2020 rainfall by about 38mm and a small increase of 1mm in 2050 (**Table 3-86**). Similar to projected temperatures, the rainfall projections also followed the baseline trend with the lowest rainfall in March, April, and May and highest in June, July, and August **(Figure 3-99**).

Table 3-86. Mean rainfall projections in Bukidnon and Misamis Oriental

Quarter	Bukidnon	Mis. Oriental	Mean of Bukidnon & Mis. Oriental		
	Baseline (1971-2000)		Baseline	2020	2050
DJF	329.70	442.5	386.10	333.45	440.85
MAM	335.60	296	315.80	325.25	280.60
JJA	653.80	615.7	634.75	649.75	608.25
SON	559.50	581.1	570.30	560.80	578.15
		Annual total	1,906.95	1,869.25	1,907.85

Source: derived from the PAGASA report *Climate Change in the Philippines*; NOTES: ***1971-2000;** DJF – Dec, Jan, Feb, MAM – Mar, Apr, May, JJA – Jun, Jul, Aug, SON, Sep, Oct, Nov

Figure 3-99. Trend of projected rainfall at the Project area



3.3.1.2.2 Change in greenhouse gas emissions

The GHG estimates and corresponding GWP from vehicle emissions for the different scenarios are shown in **Table 3-87**. The estimated GHG emissions from the operation of Sayre Highway only in 2040 is 9,522 MT (megatonnes) with a corresponding GWP of 9,726 MT CO_2e (megatonnes of carbon dioxide equivalent) (orange cells in **Table 3-87**). The GHG emissions from CMH only in 2040 was estimated at 35,715MT and a GWP of 38,200MT CO_2-e (green cells in **Table 3-87**). This estimated GHG and corresponding GWP for both (CMH and Sayre) in 2040 is 45,238MT and 47,927 MT respectively (purple cells in **Table 3-87**). The CMH was predicted to contribute about four times GHG compared to Sayre Highway emissions in 2040. The distribution of the estimates by vehicle type shows that trucks have the highest GHG emissions followed by cars when the Project will open to the public in 2026 (green cells in **Table 3-88**).

Table 3-87. Estimates of GHG emissions and GWP

		GHG, MT				GWP, MT			
Scenario	**Year**	CO_2	N_2O	CH_4	TOTAL	CO_2	N_2O	CH_4	TOTAL
Baseline (a)	2020	18,652	3.52	7.88	18,663	18,652	933	221	19,806
No Project (b)	2040	9,520	0.65	1.16	9,522	9,520	173	32	9,726
Project only (c)	2040	35,690	7.63	17.43	35,715	35,690	2,022	488	38,200
ALL (d)	2040	45,211	8.28	18.58	45,238	45,211	2,195	520	47,927

NOTES: GHG emissions and GWP are in MT;(a) Sayre 2020; (b) Sayre 2040; (c) CMH 2040; (d) Sayre and CMH 2040

Table 3-88. Distribution of annual total GHG estimates by vehicle type

Scenario	Year	CAR	JPY	BUS	TRU
Baseline (a)	2020	6,636.98	1,314.97	403.11	10,308.01
No Project (b)	2040	6,230.24	1,722.00	314.35	1,255.62
Project only (c)	2040	11,968.92	0.00	4,200.12	19,546.44
ALL (d)	2040	18,199.16	1,722.00	4,514.47	20,802.05

NOTES: GHG emissions in MT; (a) Sayre 2020; (b) Sayre 2040; (c) CMH 2040; (d) Sayre and CMH 2040; JPY – jeepney; TRU – truck

While it is anticipated that traffic volume will increase from 2020 to 2040, a comparison between scenarios where the future traffic conditions are the same (continuation of the use of the existing road network) and scenarios involving the bypass effect of CMH development (realization of congestion relief through road development) reveals that congestion relief is expected in the latter case, allowing for the maintenance of high speeds. Generally, as the emission intensity of greenhouse gases is higher for slower vehicles, the effects of congestion relief enable comfortable driving at higher speeds, leading to an anticipated reduction in CO2 emissions.

3.3.1.3 Proposed mitigating measures

The contribution of the Project to the enhancement of climate change was described by estimating the vehicle GHG emissions and the corresponding GWP. The new road alignment is mostly located in agricultural land and forested areas further away. With few GHG emissions sources along the alignment except at its start and end, existing vegetation can act as carbon sinks for the additional GHG emissions from motor vehicles using the new highway.

To further increase and provide a controllable carbon sink, allocating unused portions of the road ROW to tree planting is recommended. The carbon sequestered by different tree land covers using the available area for tree planting estimated at 298 hectares[29] is shown in **Figure 3-89**. The table shows that using fast-growing species like *Mahogany, dipterocarps, Gmelina, A. auriculiformis, P. falcataria, T. grandis, Pinus kesia, Acacia, Eucalyptus citrodora, E. cloeziana, E. pellita, E. tereticornis* has the largest carbon sequestration potential among the different tree land covers (orange cell in Figure 3-89).

Table 3-89. Carbon sequestration rates and GHG absorbed by RROW area

Land cover	Carbon sequestration rate (Mgha^{-1}yr^{-1})*	GHG sequestered by available area, MT
Protection Forest [PF]	1.5	447
Second-growth forest [SGF]	2.2	655
Tree Plantations [TP]	4	1,191
Agroforestry [AF]	2.7	804
Tree Plantations (fast growing)* [FGTP]	17.5	5,212

* Lasco, R.D. et. al., 2000; *****Mahogany, dipterocarps, Gmelina, A. auriculiformis, P. falcataria, T. grandis, Pinus kesia, Acacia, Eucalyptus citrodora, E. cloeziana, E. pellita, E. tereticornis

The areas needed to sequester GHG emissions for the four scenarios are shown in **Table 3-90**. The table also shows the carbon reduction by using the available area along the RROW (298ha) as a carbon sink using different vegetation types.

Using fast-growing tree species at the available area appeared to have the highest carbon reduction for the four scenarios, despite needing additional areas for full sequestration. The additional areas to fully sequester the carbon estimates in **Table 3-91** showed that again, fast-growing tree species had the lowest areas needed (orange cells). An additional area of 2,287 hectares will be required for a 100 percent carbon sequestration from the Sayre Highway and CMH assuming the available RROW area is also planted with the fast-growing species and traffic projections and emission factors used hold.

It is important to note that while the fast-growing trees have the highest potential for GHG sequestration, these are not endemic and invasive. Planting endemic and native tree species is highly recommended and prioritized.

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[29] Calculated using a RROW of 60m, actual road width of 14.6m, and road length of 65.6km

Table 3-90. Carbon reduction using different vegetation land covers

	C sequestration rate ($Mgha^{-1}yr^{-1}$)			PF	SGF	TP	AF	FGTP**
	Scenario	**Year**	**Total GHG, MT**	1.5	2.2	4	2.7	17.5
Area needed as carbon sink, ha	Baseline (a)	2020	18,663	12,442	8,483	4,666	6,912	1,066
	No Project (b)	2040	9,522	6,348	4,328	2,381	3,527	544
	Project only (c)	2040	35,715	23,810	16,234	8,929	13,228	2,041
	ALL (d)	2040	45,238	30,158	20,563	11,309	16,755	2,585
GHG sequestered in available area*	Baseline (a)	2020	18,663	2.39%	3.51%	6.38%	4.31%	27.93%
	No Project (b)	2040	9,522	4.69%	6.88%	12.51%	8.44%	54.73%
	Project only (c)	2040	35,715	1.25%	1.83%	3.34%	2.25%	14.59%
	ALL (d)	2040	45,238	0.99%	1.45%	2.63%	1.78%	11.52%

NOTES: (a) Sayre 2020; (b) Sayre 2040; (c) CMH 2040; (d) Sayre and CMH 2040; PF - Protection Forest; SGF - Second-growth forest; TP - Tree Plantations; AF – Agroforestry; FGTP - Fast growing tree Plantations; *percent reduction of GHG by available plantable area along the CMH RROW**; ****Mahogany, dipterocarps, Gmelina, A. auriculiformis, P. falcataria, T. grandis, Pinus kesia, Acacia, Eucalyptus citrodora, E. cloeziana, E. pellita, E. tereticornis

Table 3-91. Additional area needed for carbon sequestration, ha

Scenario	Year	PF	SGF	TP	AF	FGTP
Baseline (a)	2020	12,144	8,185	4,368	6,614	769
No Project (b)	2040	6,050	4,030	2,083	3,229	246
Project only (c)	2040	23,512	15,936	8,631	12,930	1,743
ALL (d)	2040	29,861	20,265	11,012	16,457	2,287

NOTES: Assuming available area in RROW is fully planted; (a) Sayre 2020; (b) Sayre 2040; (c) CMH 2040; (d) Sayre and CMH 2040; PF - Protection Forest; SGF - Second-growth forest; TP - Tree Plantations; AF – Agroforestry; FGTP - Fast growing tree Plantations, e.g., Mahogany, dipterocarps, Gmelina, A. auriculiformis, P. falcataria, T. grandis, Pinus kesia, Acacia, Eucalyptus citrodora, E. cloeziana, E. pellita, E. tereticornis

3.3.2 Ambient air quality (& Noise)

This section presents the existing ambient air quality along the alignment and its vicinities in the context of the applicable ambient air guideline values. The ambient air guideline values of the Philippines, Japan, and IFC relevant to the project are summarized **Table 3-92**. Except for suspended particulates (TSP), guideline values for SO_2 and NO_2 in Japan are expressed in parts per million (ppm) to make them independent of ambient temperature.

Table 3-92. Impact assessment criteria for the Project

Pollutant	AT	NAAQGV	JAPAN	IFC
TSP	24h	230	0.1 (a)	None
	Annual	90	None	None
PM10	24h	150	None	150
	Annual	60	None	70
SO_2	24h	180	0.04 (b)	125
	Annual	80	None	None
NO_2	24h	150	0.04 - 0.06 (c)	200

NOTES: AT – averaging time; NAAQGV – Philippine DENR National Ambient Air Quality Guideline Values, units are in ug/ncm; JAPAN - Environmental Quality Standards in Japan - Air Quality (env.go.jp); IFC - IFC Environmental, Health, and Safety Guidelines, General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality, units are in ug/m3; (a) mg/m^3; (b) in ppm. Equivalent to 55 ug/ncm upon conversion; (c) in ppm. Equivalent to 39 to 59 ug/ncm upon conversion

Air dispersion modeling was done to determine the ambient air quality impacts when the proposed CMH opens.

3.3.2.1 Methodology

3.3.2.1.1 Air quality

The existing ambient air quality was characterized by measuring the 24h concentrations of NO_2, SO_2, TSP, PM10 in ten locations along and at the vicinities of the proposed road alignment during the low and high rain periods (**Figure 3-100**, **Table 3-93**) in consideration of the annual rainfall trend near project area (the low rain season is from November to May and the high rain season is from June to October). The methods for sampling and analysis conformed to methods prescribed in Sec. 1(b) Rule VII Part II of the Clean Air Act Implementing Rules and Regulation (IRR). The sampling results were compared to the National Ambient Air Quality Guidelines Values (NAAQGV), Rule VII, Part II to determine the existing ambient air quality impacts**.**

The ambient air quality impacts during the Project implementation, specifically during the opening of the new road to the public was assessed by conducting air dispersion modelling and comparing model results to the CAA NAAQGV. Comparison with other averaging times is for reference only. The major activities of the impact assessment are enumerated below.

1. Predicted the 98th percentile ground-level concentrations (GLC) of NO_2, SO_2, TSP, and PM10 from vehicle emissions along the existing Sayre Highway (near the alignment) and the new CMH;
2. Compared model results with the NO_2, SO_2, TSP, and PM10 ambient air guideline values;
3. Identified air pollution "hotspots", i.e., areas where 98th percentile GLCs were predicted to occur or greater than 50% of the NAAQGV but no exceedance; and
4. Proposed mitigating measures to minimize the significant ambient air quality impacts.

Tier 4 of the EMB Air Dispersion Modeling Guidelines (EMB Memorandum Circular 2008-003) was used to predict the GLCs of NO_2, SO_2, TSP, and PM10 from vehicle emissions and travel on paved roads. The Breeze^{TM} AERMOD v10.0.0.15 Pro Plus software using the latest U.S. EPA 21112 executable was used for the simulations.
The scenarios for predicting the incremental impacts of the Project were a) Baseline (Sayre 2020), b) No project (Sayre 2040), c) Project Only (CMH 2040), and d) Cumulative (Sayre 2040 and CMH 2040. A total of 120 runs were done to predict the 98p GLC of NO_2, SO_2, TSP, and PM10 from the Sayre Highway and CMH emissions.

The model logic diagram for the air dispersion modeling and the ADM procedure are shown in
and **Annex 8,** respectively.

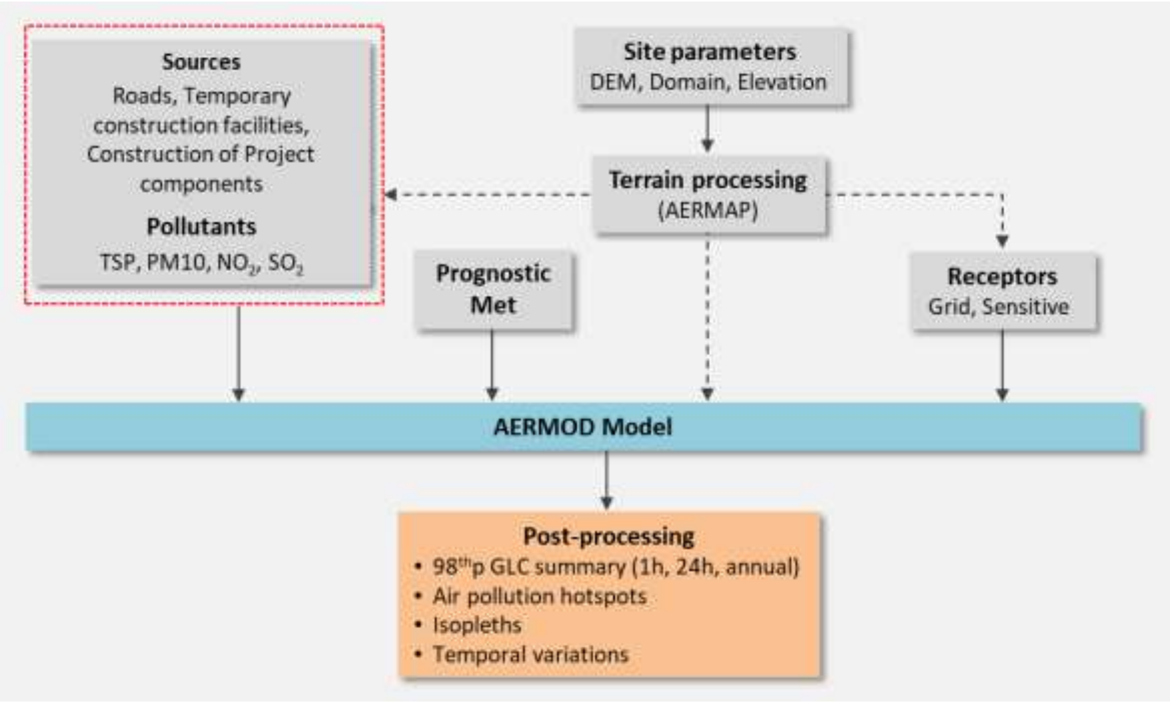
Figure 3-100. EIA ambient air quality sampling stations

	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
Air Quality Sampling Map	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) PSA 2016 (Administrative Boundaries) AAI (Sampling Stations)		

Table 3-93. Description of the AAQ sampling stations

Station ID	Barangay	Municipality/ City	Typical land use	Longitude (degrees)	Latitude (degrees)
AQ1	Zone 2B, Casinglot	Tagoloan	Residential	124.757942	8.515825
AQ2	Purok 7, Mambatangan	Manolo Fortich	Residential	124.800872	8.463833
AQ3	Zone 4, Alae		Agricultural	124.804962	8.412193
AQ4	Zone 1, Diclum		Residential	124.852996	8.371687
AQ5	Purok 4, San Roque	Sumilao	Residential	124.933255	8.329792
AQ6	San Antonio	Impasug-ong	Agro-industrial	124.983626	8.312317
AQ7	Purok 7, La Fortuna		Agricultural	124.996892	8.266137
AQ8	Zone 3, Impalutao		Agricultural	125.028944	8.23260
AQ9	Zone 9, Patpat	Malaybalay	Agro-industrial	125.053188	8.195157
AQ10	Casanova St. Kalasungay		Residential	125.11344	8.165801

Figure 3-101. Air dispersion modeling logic diagram of the Project



3.3.2.1.2 Noise

The existing sound profile along the alignment and its vicinities was determined by taking sound measurements every five minutes for 24h at the ambient air quality sampling stations in **Figure 3-100.** The noise descriptors shown in **Table 3-94** were derived from the measurements to describe the existing sonic profile at the Project area. The existing noise impacts were determined by comparing the noise descriptors and modelling results with the DENR Environmental Quality Standards for Noise in General Areas (**Table 3-95**, **Table 3-96**)[30], Japan Environmental Quality Standards for Noise (**Table 3-97**, **Table 3-98**), and IFC Noise Standards (**Table 3-99**).

Table 3-94. Noise descriptors for describing the existing sonic profile at the Project area

Descriptor	Description
L10	Noise level exceeded 10% of the time of the measurement period.
L50	Noise level exceeded 50% of the time. It is statistically the midpoint of the noise readings representing the median of the fluctuating noise levels.
L90	Noise level exceeded 90% of the time and represents the background levels.
Lmax	Highest recorded sound level
Lmin	Lowest recorded sound level

Table 3-95. Environmental Quality Standards for noise in general areas (dB(A))

Category	Daytime	Morning/Evening	Night-time
AA	50	45	40
A	55	50	45
B	65	60	55
C	70	65	60
D	75	70	65

NOTE: Morning: 5am-9am; Daytime: 9am-6pm; Evening: 6pm-10pm; Night-time 10pm-5am

Category description:

AA	100 m from schools, nurseries, hospitals, home of the aged
A	residential area
B	commercial area
C	light industrial area
D	heavy industrial area

Table 3-96. Environmental Quality Standards for noise in areas facing 4-lane roads (dB(A))

Category	Daytime	Morning/Evening	Night-time
AA	55	50	45
A	60	55	50
B	70	65	60
C	75	70	65
D	80	75	70

NOTE: Morning: 5am-9am; Daytime: 9am-6pm; Evening: 6pm-10pm; Night-time 10pm-5am

Category description:

AA	100 m from schools, nurseries, hospitals, home of the aged
A	residential area
B	commercial area
C	light industrial area
D	heavy industrial area

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[30] NPCC Memorandum Circular No. 002 issued May 12, 1980 (amending Section 78 of Presidential Decree 984)

For areas corresponding to the ones mentioned in the following table (hereinafter referred to as "areas facing roads"), the standard values in this table shall be applied instead of the table above.

Table 3-97. Japan Environmental Quality Standards for Noise (dB(A))

Type of area	Daytime (6am – 10pm)	Night-time (10pm – 6am)
AA	50 dB or less	40 dB or less
A and B	55 dB or less	45 dB or less
C	60 dB or less	50 dB or less

Source: Ministry of Environment, Government of Japan (https://www.env.go.jp/en/air/noise/noise.html)
NOTES: a) Area category AA shall be applied to areas where quietness is specially required, such as those where convalescent facilities and welfare institutions are concentrated; b) Area category A shall be applied to areas used exclusively for residences; c) Area category B shall be applied to areas used mainly for residences; d) Area category C shall be applied to areas used for commerce and industry as well as for a significant number of residences.

Table 3-98. Japan Environmental Quality Standards for Noise in areas facing or adjacent to roads (dB(A))

Area category	Daytime (6am – 10pm)	Night-time (10pm – 6am)
Area A facing roads with two or more lanes	60 dB or less	55 dB or less
Area B facing roads with two or more lanes	65 dB or less	60 dB or less
Area C facing a road with one or more lanes		
Space adjacent to a road carrying arterial traffic*	70 dB or less	65 dB or less

Source: Ministry of Environment, Government of Japan (https://www.env.go.jp/en/air/noise/noise.html)
NOTES: "Lane" refers to a longitudinal strip of road with uniform width to enable a single line of cars to travel safely and without hindrance; *as an exception regardless of the for areas facing roads

Table 3-99. IFC General EHS Guidelines: Environmental Noise Level

Receptor	Daytime (0700 – 2200)	Nighttime (2200 – 0700)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Source: IFC Noise Level Guidelines of General EHS Guidelines; NOTE: Noise impacts should not exceed the levels presented in the following table, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site

The noise impacts during construction were assessed by predicting the sound propagated by typical construction equipment typically used during construction comparing predicted values with the DENR criteria for construction noise (**Table 3-100**).

Predicting sound generation from the equipment was done using the point source attenuation rate for geometric spreading. Sound from a small, localized source (approximating a point source) radiates uniformly outward as it travels away from the source in a spherical pattern. The sound level attenuates at a rate of six decibels for each doubling of distance. This decrease, due to the geometric spreading of the energy over an increasing area, is referred to as the inverse square law. The law states that the mean-square sound pressure level varies inversely as the square of the distance from the source. The general rule of thumb is that under ideal conditions (no reflecting surfaces or other background sound or interference), sound level drops six decibels for every doubling of the distance from the source. The inverse square law is represented by the formula:

$$\Delta D = 10\log\left(\frac{d_1}{d_2}\right)^2$$

where d_1 and d_2 are the distances and ΔD is the decibel difference.

Table 3-100. Maximum noise levels allowed during construction[31]

Class	Construction activities	Limit, dB(A)
1	Pile drivers (excluding manual type), riveting hammers or combination thereof. Does not include pile drivers used in combination with earth augers.	90
2	Rock drills, or similar equipment like jack hammers or pavement breakers	85
3	Air compressors (limited to compressors which use power other than electric motors with a rated output of 15kW or more). Air compressors power rock drills, jack hammers, and pavement breakers are excluded.	75
4	Batching plant operation (limited to those with mixer capacities of 200kg or more. Batching plants for mortar-making are excluded.	75

NOTE: No construction in Class AA, A, B areas (except during emergencies, calamities, disasters) from 7pm to 7am for Class 1&2 construction activities and from 9pm to 7am for Class 3&4 construction activities

The potential noise impacts from motor vehicles were assessed for three scenarios: *Baseline* (Sayre Highway 2020); *No Project* (Sayre Highway 2040), and *With Project* (CMH and Sayre Highway 2040) using the CUSTIC software and comparing the results to the limits in **Table 3-95** to **Table 3-99**. The noise modelling methodology is shown in **Annex 10.**

3.3.2.2 Assessment of key impacts

3.3.2.2.1 Degradation of air quality

Sources of air emissions

The major sources of emissions within the model domain are roads and urban centers of the six LGUs. The existing Sayre Highway is the major source of vehicle emissions followed by the city, municipal, and barangay roads.

Gaseous pollutants (SO_2, NO_2, CO) and particulates (TSP, PM10) are emitted by motor vehicles travelling these roads. Fugitive particulates are also generated in unpaved roads. Domestic activities like household cooking, backyard waste burning, and burning of agricultural wastes also contribute to the emissions within the mode domain.

Existing ambient air quality

The results of the 24h sampling showed levels of SO_2, NO_2, TSP, and PM10 that were less than the CAA guideline values except for a single instance of TSP exceedance in Station AQ1 during the high rain period (orange cell in **Table 3-101**, **Figure 3-102**). The likely source of the TSP exceedance in Station AQ1 are motor vehicle emissions and fugitive particulates.

The SO_2 and NO_2 concentrations were very low (most were below the method detection limit of the analytic method for SO_2) at both sampling periods (green cells in **Table 3-101**). The particulate detections (TSP and PM10) were likely due to fugitive dust from the roads and vehicle emissions.

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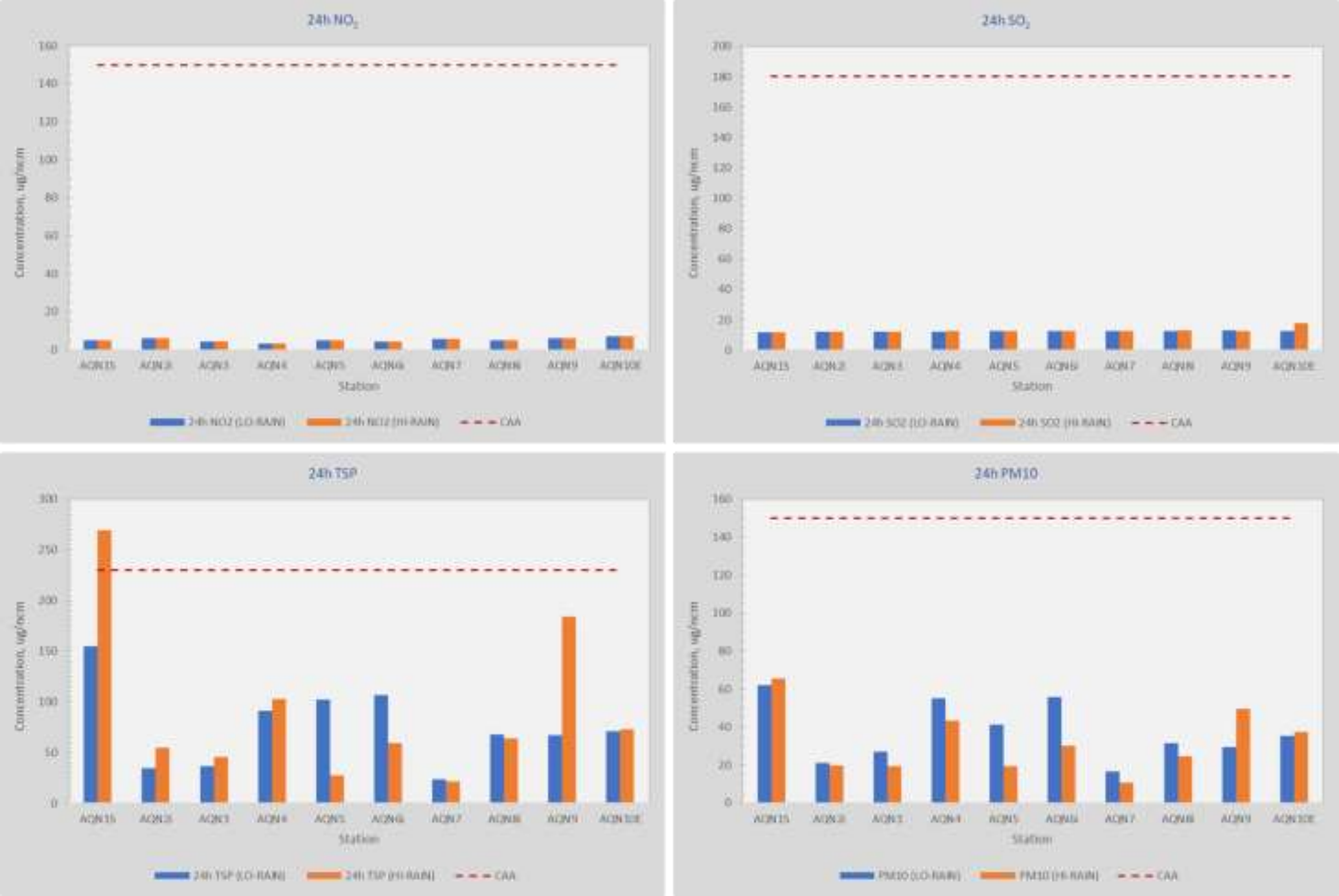
[31] measured at 30m

Table 3-101. Existing pollutant levels at the Project area

	24h NO_2		24h SO_2		24h TSP		24h PM10	
Station	LO-RAIN*	HI-RAIN*	LO-RAIN*	HI-RAIN*	LO-RAIN*	HI-RAIN*	LO-RAIN*	HI-RAIN*
AQ1	8.56	5.02	<11.8**	<11.9**	155	269.0	62.1	65.6
AQ2	6.41	6.2	<12.1**	<12.2**	34.3	54.5	21.0	19.7
AQ3	4.88	4.44	<12.3**	<12.4**	36.7	45.8	27.0	19.5
AQ4	6.57	<3.27**	<12.4**	<12.5**	91	103	55.1	43.5
AQ5	3.88	5.03	<12.5**	<12.6**	102	27.6	41.4	19.3
AQ6	6.61	4.5	<12.5**	<12.6**	107	59.2	55.8	30.0
AQ7	3.94	5.64	<12.7**	<12.7**	23.3	21.5	16.5	10.8
AQ8	6.76	4.91	<12.8**	<12.9**	67.9	63.5	31.7	24.5
AQ9	5.69	6.25	<12.9**	<12.8**	67.3	184	29.5	49.7
AQ10	3.37	7.19	<12.7**	18	71.2	73	35.4	37.6
CAA	150	150	180	180	230	230	150	150

Units are in ug/Ncm; CAA – CAA NAAAQGV; * ; ** below the Method Detection Limit

Figure 3-102. Graph of existing AAQ at the proposed alignment and its vicinities



Predicted pollutant levels

The impact assessment focused on the effect of vehicle emissions using the new CMH alignment and the existing Sayre Highway on ambient air quality. Construction phase emissions are expected to be temporary, unsteady (i.e., emissions only during active construction), and local to a particular active construction area. On the hand, emissions from motor vehicles using both the new CMH and existing Sayre Highway will be constant and long term.

The ambient AQ impacts of vehicle emissions using the existing Sayre and new CMH road were presented by showing statistical summaries of the predicted 98th percentile (*98p*) GLCs at the grid and AQ sampling stations as sensitive receptors. Grid receptors are points within the model domain with equal resolutions where the GLCs were calculated. An ***Index***, i.e., ratio of maximum 98p GLCs and the corresponding CAA standard or guideline value and averaging time, was used to determine whether or not the CAA was exceeded.

A significant AQ impact was defined as an index exceeding unity using the 24-hour averaging time. Other averaging times were used as reference only.

The simulations showed that NO_2 was the pollutant of concern because of the predicted exceedances. Other criteria pollutants (SO_2, TSP, PM10) were less than their corresponding CAA standards and guideline values. Sample model and post-processing files are shown in the following attachments in **Annex 7**

- **Attachment 1** Sample AERMOD Meteorological Input File (*.sfc/.pfl*)
- **Attachment 2**. Sample DEM for AERMOD
- **Attachment 3** Sample AERMAP output file
- **Attachment 4** AERMOD 98th percentile output file (*.pco*)
- **Attachment 5** Sample Spreadsheet of processing model outputs

1. Nitrogen dioxide (NO_2)

The predicted 98p 1h and 24h GLCs (**Table 3-102**) from vehicle emissions at the grid receptors across scenarios showed no exceedances to the CAA 1h standard and 24h guideline value except for the Project Only and Cumulative scenarios with indices greater than unity (red text in **Table 3-102**). Vehicles emissions from the CMH had the higher contribution to the NO_2 concentrations in 2040 (14 years after its opening) with 1h and 24h concentrations of 272.08 and 78.59 ug/ncm respectively (green cells in **Table 3-102**). Traffic emissions from the CMH contributed about 86 percent to the 24h ambient NO_2 concentration from both the CMH and Sayre Highway emissions.

Table 3-102. Summary of predicted 98p NO_2 GLCs at the grid receptors

	Maximum GLC		CAA		Index		% exceed	
Scenario	1h	24h	1h	24h	1h	24h	1h	24h
Baseline (a)	137.16	54.61	260	150	0.53	0.36	0.00%	0.00%
Without Project (b)	97.25	32.84	260	150	0.37	0.22	0.00%	0.00%
Project Only (c)	272.08	78.59	260	150	1.05	0.52	0.23%	0.00%
Cumulative (d)	311.01	91.20	260	150	1.20	0.61	0.23%	0.00%

NOTES: (a) Baseline - Sayre only 2020; (b) Sayre only 2040; (c) CMH only 2040; (d) Sayre and CMH 2040; Max GLC and CAA are in ug/ncm; CAA – Clean Air Act ambient air quality standards or guideline value; Index = ratio of max GLC and CAA; %Ex – percentage of receptors where GLC > CAA; 1h, 2h – averaging time

There was no predicted exceedance to either 1h and 24h NO_2 standard and guideline value across scenarios at the sensitive receptors. The highest predicted 1h and 24h NO_2 GLCs at the sensitive receptors from both CMH and Sayre Highway traffic emissions 247.6 and 114.23 ug/ncm respectively in Station AQ2 (green cells in **Table 3-103**).

Table 3-103. Summary of predicted 98p NO_2 GLCs at the sensitive receptors

		Maximum GLC					Index			
AT	**Receptor**	**BASE**	**NP**	**PO**	**ALL**	**CAA**	**BASE**	**NP**	**PO**	**ALL**
1h	Station AQ1	21.85	15.06	143.16	153.24	260	0.08	0.06	0.55	0.59
	Station AQ2	36.14	25.14	224.79	247.60	260	0.14	0.10	0.86	0.95
	Station AQ3	18.93	12.58	138.81	146.53	260	0.07	0.05	0.53	0.56
	Station AQ4	99.95	85.16	61.08	143.69	260	0.38	0.33	0.23	0.55
	Station AQ5	6.78	4.34	117.20	121.05	260	0.03	0.02	0.45	0.47
	Station AQ6	60.12	48.89	90.36	131.41	260	0.23	0.19	0.35	0.51
	Station AQ7	16.89	11.48	149.81	153.26	260	0.06	0.04	0.58	0.59
	Station AQ8	74.05	43.53	73.46	115.08	260	0.28	0.17	0.28	0.44
	Station AQ9	100.93	30.13	158.12	185.68	260	0.39	0.12	0.61	0.71
	Station AQ10	90.07	27.08	39.89	66.76	260	0.35	0.10	0.15	0.26
24h	Station AQ1	6.34	4.49	45.13	48.89	150	0.04	0.03	0.30	0.33
	Station AQ2	10.77	7.79	106.17	114.23	150	0.07	0.05	0.71	0.76
	Station AQ3	4.88	3.60	50.38	52.13	150	0.03	0.02	0.34	0.35
	Station AQ4	33.11	27.46	18.42	45.17	150	0.22	0.18	0.12	0.30
	Station AQ5	1.94	1.39	33.02	33.96	150	0.01	0.01	0.22	0.23
	Station AQ6	19.78	15.11	26.84	41.06	150	0.13	0.10	0.18	0.27
	Station AQ7	5.39	3.26	70.09	71.18	150	0.04	0.02	0.47	0.47
	Station AQ8	24.95	15.04	22.19	36.32	150	0.17	0.10	0.15	0.24
	Station AQ9	31.29	9.74	52.15	60.11	150	0.21	0.06	0.35	0.40
	Station AQ10	26.90	8.68	12.77	20.78	150	0.18	0.06	0.09	0.14

NOTES: AT - averaging time; BASE - Baseline (Sayre only 2020); NP - Sayre only 2040; PO - CMH only 2040; ALL - Sayre and CMH 2040; Maximum GLC and CAA are in ug/ncm; CAA – Clean Air Act ambient air quality standards or guideline value; Index = ratio of max GLC and CAA

2. Sulfur dioxide (SO_2)

The simulations showed that ambient concentrations of SO_2 at the grid and sensitive receptors across scenarios and averaging times were less than its CAA standards and guideline values at both grid and sensitive receptors (**Table 3-104**, **Table 3-105**). Traffic emissions from the CMH contributed about 99 percent to the 24h ambient SO2 concentration across averaging times.

Similar to NO_2, the highest 98p SO_2 GLCs at the grid receptors were due to cumulative traffic emissions from both CMH and Sayre Highway with 1h, 24h, and annual values of 121.15, 35.47, and 14.49 ug/ncm respectively (green cells in **Table 3-104**).

The highest cumulative 98p SO_2 GLCs at the sensitive receptors from both CMH and Sayre Highway traffic emissions were also predicted in Station AQ2 with values of 185, 74.27, and 30 ug/ncm for the 1h, 24h, and annual averaging times respectively (green cells in **Table 3-105**).

Table 3-104. Summary of predicted 98p SO_2 GLCs at the grid receptors

	Maximum GLC			CAA			Index			% exceed		
Scenario	1h	24h	Ann	1h	24h	Ann	1h	24h	Ann	1h	24h	Ann
Baseline (a)	83.60	29.09	13.31	340	180	80	0.25	0.16	0.17	0.00%	0.00%	0.00%
Without Project (b)	16.64	5.74	2.49	340	180	80	0.05	0.03	0.03	0.00%	0.00%	0.00%
Project Only (c)	120.61	35.25	14.43	340	180	80	0.35	0.20	0.18	0.00%	0.00%	0.00%
Cumulative (d)	121.15	35.47	14.49	340	180	80	0.36	0.20	0.18	0.00%	0.00%	0.00%

NOTES: (a) Baseline - Sayre only 2020; (b) Sayre only 2040; (c) CMH only 2040; (d) Sayre and CMH 2040; Max GLC and CAA are in ug/ncm; Ann – annual averaging time; CAA – Clean Air Act ambient air quality standards or guideline value; Index = ratio of max GLC and CAA; %Ex – percentage of receptors where GLC > CAA; 1h, 24h, Ann – averaging times

Table 3-105. Summary of predicted 98p SO_2 GLCs at the sensitive receptors

		Maximum GLC					Index			
AT	**Receptor**	**BASE**	**NP**	**PO**	**ALL**	**CAA**	**BASE**	**NP**	**PO**	**ALL**
1h	Station AQ1	9.84	0.83	98.27	98.90	340	0.03	0.00	0.29	0.29
	Station AQ2	17.85	2.76	182.05	184.99	340	0.05	0.01	0.54	0.54
	Station AQ3	9.99	2.01	89.96	90.75	340	0.03	0.01	0.26	0.27
	Station AQ4	52.47	12.93	28.87	40.79	340	0.15	0.04	0.08	0.12
	Station AQ5	3.81	0.31	51.31	51.57	340	0.01	0.00	0.15	0.15
	Station AQ6	39.37	3.76	40.87	43.29	340	0.12	0.01	0.12	0.13
	Station AQ7	9.95	0.62	107.19	107.29	340	0.03	0.00	0.32	0.32
	Station AQ8	43.33	2.21	33.55	35.54	340	0.13	0.01	0.10	0.10
	Station AQ9	42.12	0.31	68.29	68.60	340	0.12	0.00	0.20	0.20
	Station AQ10	37.83	0.31	17.34	17.56	340	0.11	0.00	0.05	0.05
24h	Station AQ1	2.96	0.23	28.59	28.73	180	0.02	0.00	0.16	0.16
	Station AQ2	5.19	0.83	73.49	74.27	180	0.03	0.00	0.41	0.41
	Station AQ3	2.57	0.52	30.56	30.70	180	0.01	0.00	0.17	0.17
	Station AQ4	17.77	4.13	8.87	13.13	180	0.10	0.02	0.05	0.07
	Station AQ5	1.05	0.11	16.14	16.21	180	0.01	0.00	0.09	0.09
	Station AQ6	12.69	1.20	12.35	13.38	180	0.07	0.01	0.07	0.07
	Station AQ7	3.07	0.21	41.12	41.26	180	0.02	0.00	0.23	0.23
	Station AQ8	15.07	0.79	10.20	10.90	180	0.08	0.00	0.06	0.06
	Station AQ9	13.48	0.12	22.51	22.61	180	0.07	0.00	0.13	0.13
	Station AQ10	12.10	0.11	5.55	5.64	180	0.07	0.00	0.03	0.03
Annual	Station AQ1	1.06	0.07	11.53	11.60	80	0.01	0.00	0.14	0.15
	Station AQ2	1.99	0.29	29.37	29.66	80	0.02	0.00	0.37	0.37
	Station AQ3	0.67	0.13	12.64	12.77	80	0.01	0.00	0.16	0.16
	Station AQ4	8.99	1.92	2.75	4.67	80	0.11	0.02	0.03	0.06
	Station AQ5	0.32	0.03	5.88	5.91	80	0.00	0.00	0.07	0.07
	Station AQ6	5.52	0.44	3.70	4.13	80	0.07	0.01	0.05	0.05
	Station AQ7	1.04	0.06	20.46	20.52	80	0.01	0.00	0.26	0.26
	Station AQ8	6.56	0.33	3.28	3.61	80	0.08	0.00	0.04	0.05
	Station AQ9	5.95	0.04	8.10	8.14	80	0.07	0.00	0.10	0.10
	Station AQ10	3.30	0.03	1.39	1.42	80	0.04	0.00	0.02	0.02

NOTES: AT - averaging time; BASE - Baseline (Sayre only 2020); NP - Sayre only 2040; PO - CMH only 2040; ALL - Sayre and CMH 2040; Maximum GLC and CAA are in ug/ncm; CAA – Clean Air Act ambient air quality standards or guideline value; Index = ratio of max GLC and CAA

3. Total Suspended Particulates (TSP)

Similar to SO_2, the predicted TSP GLCs across scenarios and averaging times were less than the CAA standards and guideline values at both grid and sensitive receptors (indices less than unity in **Table 3-106**, **Table 3-107**) with higher predicted GLCs at the sensitive receptors. Traffic emissions from the CMH contributed about 94 percent to the 24h ambient TSP concentration across averaging times.

The highest predicted 98p TSP GLCs at the grid receptors from both CMH and Sayre Highway traffic emissions in 2040 were 2.23, 1.74, and 0.58 ug/ncm respectively (green cells in **Table 3-106**).

The highest predicted 98p TSP GLCs at the sensitive receptors from both CMH and Sayre Highway traffic emissions in 2040 were predicted in Station AQ2 with values of 7.06, 4.51, and 1.0 ug/ncm for the 1h, 24h, and annual averaging times respectively (green cells in **Table 3-107**).

Table 3-106. Summary of predicted 98p TSP GLCs at the grid receptors

	Maximum GLC			CAA			Index			% exceed		
Scenario	1h	24h	Ann	1h	24h	Ann	1h	24h	Ann	1h	24h	Ann
Baseline (a)	2.09	0.95	0.35	300	230	90	0.0070	0.0041	0.0039	0.00%	0.00%	0.00%
Without Project (b)	1.77	0.66	0.26	300	230	90	0.0059	0.0029	0.0029	0.00%	0.00%	0.00%
Project Only (c)	2.10	1.63	0.54	300	230	90	0.0070	0.0071	0.0060	0.00%	0.00%	0.00%
Cumulative (d)	2.23	1.74	0.58	300	230	90	0.0074	0.0076	0.0064	0.00%	0.00%	0.00%

NOTES: (a) Baseline - Sayre only 2020; (b) Sayre only 2040; (c) CMH only 2040; (d) Sayre and CMH 2040; Max GLC and CAA are in ug/ncm; Ann – annual averaging time; CAA – Clean Air Act ambient air quality standards or guideline value; Index = ratio of max GLC and CAA; %Ex – percentage of receptors where GLC > CAA; 1h, 24h, Ann – averaging times

Table 3-107. Summary of predicted 98p TSP GLCs at the sensitive receptors

		Maximum GLC					Index			
AT	**Receptor**	BASE	NP	PO	ALL	CAA	BASE	NP	PO	ALL
1h	Station AQ1	0.54	0.38	0.57	0.90	300	0.0018	0.0013	0.0019	0.0030
	Station AQ2	0.78	0.63	6.88	7.06	300	0.0026	0.0021	0.0229	0.0235
	Station AQ3	0.79	0.73	0.93	1.32	300	0.0026	0.0024	0.0031	0.0044
	Station AQ4	2.82	2.19	0.32	2.37	300	0.0094	0.0073	0.0011	0.0079
	Station AQ5	0.10	0.09	0.67	0.74	300	0.0003	0.0003	0.0022	0.0025
	Station AQ6	0.71	0.54	0.17	0.73	300	0.0024	0.0018	0.0006	0.0024
	Station AQ7	0.20	0.18	2.09	2.12	300	0.0007	0.0006	0.0070	0.0071
	Station AQ8	0.24	0.19	0.38	0.54	300	0.0008	0.0006	0.0013	0.0018
	Station AQ9	0.46	0.20	0.59	0.74	300	0.0015	0.0007	0.0020	0.0025
	Station AQ10	0.16	0.06	0.06	0.13	300	0.0005	0.0002	0.0002	0.0004
24h	Station AQ1	0.27	0.19	0.50	0.64	230	0.0012	0.0008	0.0022	0.0028
	Station AQ2	0.28	0.28	4.35	4.51	230	0.0012	0.0012	0.0189	0.0196
	Station AQ3	0.24	0.21	0.37	0.48	230	0.0010	0.0009	0.0016	0.0021
	Station AQ4	2.40	1.77	0.10	1.82	230	0.0105	0.0077	0.0004	0.0079
	Station AQ5	0.04	0.04	0.24	0.27	230	0.0002	0.0002	0.0010	0.0012
	Station AQ6	0.31	0.31	0.10	0.33	230	0.0014	0.0013	0.0004	0.0014
	Station AQ7	0.10	0.09	1.78	1.80	230	0.0004	0.0004	0.0078	0.0078
	Station AQ8	0.13	0.11	0.14	0.21	230	0.0005	0.0005	0.0006	0.0009
	Station AQ9	0.29	0.11	0.25	0.32	230	0.0012	0.0005	0.0011	0.0014
	Station AQ10	0.07	0.02	0.02	0.04	230	0.0003	0.0001	0.0001	0.0002
Annual	Station AQ1	0.05	0.04	0.15	0.19	90	0.0006	0.0004	0.0017	0.0021
	Station AQ2	0.08	0.06	0.94	1.00	90	0.0009	0.0006	0.0105	0.0111
	Station AQ3	0.11	0.08	0.13	0.21	90	0.0012	0.0008	0.0014	0.0023
	Station AQ4	0.82	0.59	0.03	0.62	90	0.0091	0.0066	0.0003	0.0069
	Station AQ5	0.01	0.01	0.07	0.08	90	0.0001	0.0001	0.0008	0.0009
	Station AQ6	0.10	0.07	0.02	0.09	90	0.0011	0.0008	0.0002	0.0010
	Station AQ7	0.04	0.03	0.67	0.69	90	0.0004	0.0003	0.0074	0.0077
	Station AQ8	0.06	0.04	0.04	0.08	90	0.0006	0.0004	0.0004	0.0008
	Station AQ9	0.11	0.04	0.07	0.11	90	0.0012	0.0004	0.0008	0.0012
	Station AQ10	0.01	0.00	0.00	0.01	90	0.0002	0.0001	0.0000	0.0001

NOTES: AT - averaging time; BASE - Baseline (Sayre only 2020); NP - Sayre only 2040; PO - CMH only 2040; ALL - Sayre and CMH 2040; Maximum GLC and CAA are in ug/ncm; CAA – Clean Air Act ambient air quality standards or guideline value; Index = ratio of max GLC and CAA

4. Particulate Matter-10 (PM10)

The predicted PM10 GLCs across scenarios and averaging times were less than the CAA standards and guideline values at both grid and sensitive receptors (**Table 3-108**, **Table 3-109**) with higher predicted GLCs at the sensitive receptors. Traffic emissions from the CMH contributed about 77 to 89 percent to the 24h ambient PM10 concentration across averaging times.

The highest predicted 98p PM10 GLCs at the grid receptors from both CMH and Sayre Highway traffic emissions in 2040 were 16.91, 5.07, and 2.45 ug/ncm for the 1h, 24h, and annual averaging times respectively (green cells in **Table 3-108**).

The highest predicted 98p PM10 GLCs at the sensitive receptors from both CMH and Sayre Highway traffic emissions in 2040 were predicted in Station AQ7 with values of 15.93, 6.02, and 5.90 ug/ncm for the 1h, 24h, and annual averaging times (green cells in **Table 3-109**).

Table 3-108. Summary of predicted 98p PM10 GLCs at the grid receptors

	Maximum GLC			CAA			Index			% exceed		
Scenario	1h	24h	Ann	1h	24h	Ann	1h	24h	Ann	1h	24h	Ann
Baseline (a)	10.70	3.89	1.74	200	150	60	0.053	0.026	0.029	0.00%	0.00%	0.00%
Without Project (b)	4.73	1.76	0.77	200	150	60	0.024	0.012	0.013	0.00%	0.00%	0.00%
Project Only (c)	15.04	4.49	1.88	200	150	60	0.075	0.030	0.031	0.00%	0.00%	0.00%
Cumulative (d)	16.91	5.07	2.45	200	150	60	0.085	0.034	0.041	0.00%	0.00%	0.00%

NOTES: (a) Baseline - Sayre only 2020; (b) Sayre only 2040; (c) CMH only 2040; (d) Sayre and CMH 2040; Max GLC and CAA are in ug/ncm; Ann – annual averaging time; CAA – Clean Air Act ambient air quality standards or guideline value; Index = ratio of max GLC and CAA; %Ex – percentage of receptors where GLC > CAA; 1h, 24h, Ann – averaging times

Table 3-109. Summary of predicted 98p PM10 GLCs at the sensitive receptors

		Maximum GLC					Index			
AT	**Receptor**	**BASE**	**NP**	**PO**	**ALL**	**CAA**	**BASE**	**NP**	**PO**	**ALL**
1h	Station AQ1	0.69	0.54	6.41	6.73	200	0.0035	0.0027	0.0321	0.0336
	Station AQ2	1.27	1.06	13.00	13.86	200	0.0064	0.0053	0.0650	0.0693
	Station AQ3	0.58	0.41	8.59	8.73	200	0.0029	0.0020	0.0430	0.0437
	Station AQ4	6.89	4.94	2.17	6.87	200	0.0344	0.0247	0.0109	0.0343
	Station AQ5	0.16	0.14	8.38	8.49	200	0.0008	0.0007	0.0419	0.0424
	Station AQ6	2.98	2.72	4.57	6.88	200	0.0149	0.0136	0.0229	0.0344
	Station AQ7	0.69	0.57	15.74	15.93	200	0.0034	0.0029	0.0787	0.0796
	Station AQ8	3.56	2.54	2.80	5.34	200	0.0178	0.0127	0.0140	0.0267
	Station AQ9	4.72	1.52	7.57	8.84	200	0.0236	0.0076	0.0378	0.0442
	Station AQ10	3.75	1.21	1.30	2.40	200	0.0188	0.0060	0.0065	0.0120
24h	Station AQ1	0.22	0.16	1.79	1.94	150	0.0015	0.0011	0.0120	0.0129
	Station AQ2	0.42	0.35	5.38	5.72	150	0.0028	0.0023	0.0359	0.0381
	Station AQ3	0.15	0.11	2.95	2.99	150	0.0010	0.0008	0.0197	0.0199
	Station AQ4	2.27	1.62	0.81	2.32	150	0.0152	0.0108	0.0054	0.0154
	Station AQ5	0.05	0.05	2.74	2.78	150	0.0004	0.0003	0.0183	0.0186
	Station AQ6	1.05	0.90	1.58	2.45	150	0.0070	0.0060	0.0105	0.0163
	Station AQ7	0.22	0.18	5.91	6.02	150	0.0015	0.0012	0.0394	0.0402
	Station AQ8	1.25	0.93	0.93	1.80	150	0.0084	0.0062	0.0062	0.0120
	Station AQ9	1.51	0.49	2.58	3.02	150	0.0100	0.0033	0.0172	0.0201
	Station AQ10	1.32	0.42	0.48	0.86	150	0.0088	0.0028	0.0032	0.0057
Annual	Station AQ1	0.10	0.06	0.77	0.06	60	0.0016	0.0011	0.0128	0.0010
	Station AQ2	0.19	0.12	2.14	0.27	60	0.0031	0.0021	0.0356	0.0046
	Station AQ3	0.05	0.03	1.26	1.29	60	0.0008	0.0005	0.0210	0.0215
	Station AQ4	1.12	0.75	0.31	1.06	60	0.0187	0.0125	0.0051	0.0176
	Station AQ5	0.02	0.01	1.16	1.20	60	0.0003	0.0002	0.0193	0.0199
	Station AQ6	0.47	0.35	0.47	1.31	60	0.0078	0.0058	0.0079	0.0218
	Station AQ7	0.08	0.05	2.92	5.90	60	0.0013	0.0008	0.0487	0.0983

		Maximum GLC					Index			
AT	**Receptor**	**BASE**	**NP**	**PO**	**ALL**	**CAA**	**BASE**	**NP**	**PO**	**ALL**
	Station AQ8	0.57	0.39	0.33	1.27	60	0.0095	0.0065	0.0055	0.0212
	Station AQ9	0.71	0.22	0.95	1.20	60	0.0119	0.0037	0.0158	0.0200
	Station AQ10	0.37	0.12	0.12	0.24	60	0.0062	0.0020	0.0019	0.0040

NOTES: AT - averaging time; BASE - Baseline (Sayre only 2020); NP - Sayre only 2040; PO - CMH only 2040; ALL - Sayre and CMH 2040; Maximum GLC and CAA are in ug/ncm; CAA – Clean Air Act ambient air quality standards or guideline value; Index = ratio of max GLC and CAA

Air pollution hotspots

The predicted 98p GLCs of the criteria pollutants SO_2, NO_2, TSP, and PM10 at the all receptors, i.e., grid and sensitive, were processed to determine the air pollution hotspots, defined as locations within the model domain where a particular CAA standard or guideline value was exceeded (*potential hotspot*) or where predicted GLCs are greater than 50% of the CAA standard or guideline value with no exceedance (*area of concern*).

The matrix of the hotspot evaluation in **Table 3-110** showed two *Potential Hotspots* for the 1h NO_2 (red cells) due to traffic emissions from the CMH only and both CMH and Sayre Highway in 2040 (Scenarios PO and ALL in **Table 3-110**. The dominant land use at the Potential Hotspots is agricultural with small clusters of houses.

There were also three *Areas of Concern* for NO_2 (green cells in **Table 3-110**) for the Scenarios BASE (Sayre only 2o20), PO (CMH Only 2040), and ALL (CMH and Sayre 2040). There were neither *Potential Hotspots* nor *Areas of Concern* for SO_2, TSP, and PM10. The isopleths in **Figure 3-103** to **Figure 3-106** show the 24h GLCs of NO_2, NO_2, TSP and PM10 from traffic emissions for all scenarios. High pollutant concentrations near the roads are expected because vehicle emissions are near ground-level with insignificant buoyant flux that prohibits long range dispersion.

Table 3-110. Hotspot matrix of criteria pollutants

		Maximum GLC			CAA			Index			Hotspots		
CP	**Scenario**	**1h**	**24h**	**Ann**	**1h**	**24h**	**Ann**	**1h**	**24h**	**Ann**	**1h**	**24h**	**Ann**
NO_2	BASE	137.16	54.61	NS	260	150	NGV	0.53	0.36	n/a	AOC	NONE	n/a
	NP	97.25	32.84	NS	260	150	NGV	0.37	0.22	n/a	NONE	NONE	n/a
	PO	272.08	78.59	NS	260	150	NGV	1.05	0.52	n/a	PH	AOC	n/a
	ALL	311.01	91.20	NS	260	150	NGV	1.20	0.61	n/a	PH	AOC	n/a
SO_2	BASE	83.60	29.09	13.31	340	180	80	0.25	0.16	0.17	NONE	NONE	NONE
	NP	16.64	5.74	2.49	340	180	80	0.05	0.03	0.03	NONE	NONE	NONE
	PO	120.61	35.25	14.43	340	180	80	0.35	0.20	0.18	NONE	NONE	NONE
	ALL	121.15	35.47	14.49	340	180	80	0.36	0.20	0.18	NONE	NONE	NONE
TSP	BASE	2.09	0.95	0.35	300	230	90	0.0070	0.0041	0.0039	NONE	NONE	NONE
	NP	1.77	0.66	0.26	300	230	90	0.0059	0.0029	0.0029	NONE	NONE	NONE
	PO	2.10	1.63	0.54	300	230	90	0.0070	0.0071	0.0060	NONE	NONE	NONE
	ALL	2.23	1.74	0.58	300	230	90	0.0074	0.0076	0.0064	NONE	NONE	NONE
PM10	BASE	10.70	3.89	1.74	200	150	60	0.053	0.026	0.029	NONE	NONE	NONE
	NP	4.73	1.76	0.77	200	150	60	0.024	0.012	0.013	NONE	NONE	NONE
	PO	15.04	4.49	1.88	200	150	60	0.075	0.030	0.031	NONE	NONE	NONE
	ALL	16.91	5.07	2.45	200	150	60	0.085	0.034	0.041	NONE	NONE	NONE

NOTES: CP – criteria pollutant; BASE - Baseline (Sayre only 2020); NP - Sayre only 2040; PO - CMH only 2040; ALL - Sayre and CMH 2040; Maximum GLC and CAA are in ug/ncm; CAA – Clean Air Act ambient air quality standards or guideline value; Index = ratio of max GLC and CAA; 1h, 24h, Ann are averaging times; PH – potential hotspot; AOC – area of concern

Figure 3-103. Isopleths of 24h NO_2 GLCs from vehicle emissions

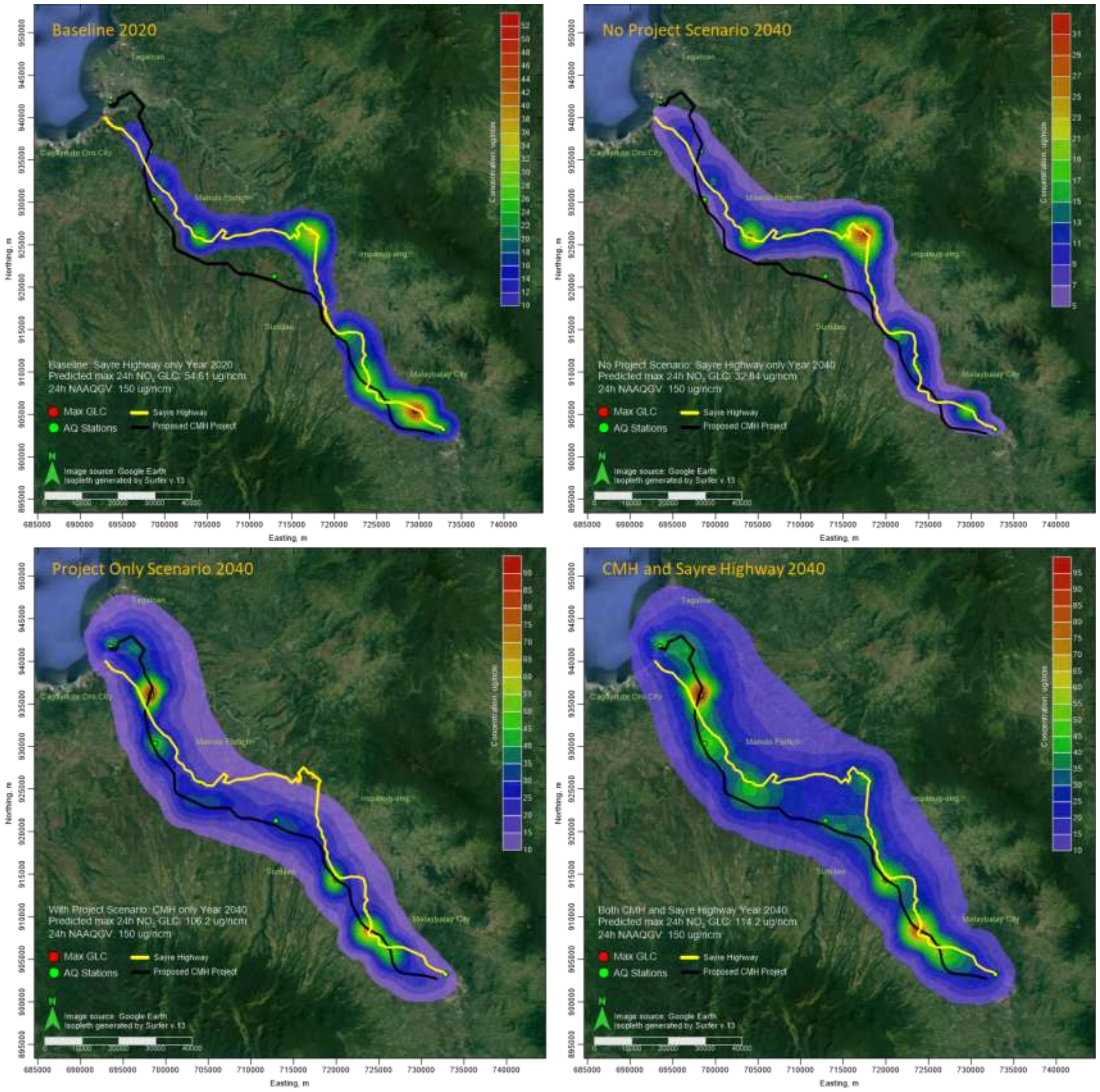


Figure 3-104. Isopleths of 24h SO_2 GLCs from vehicle emissions

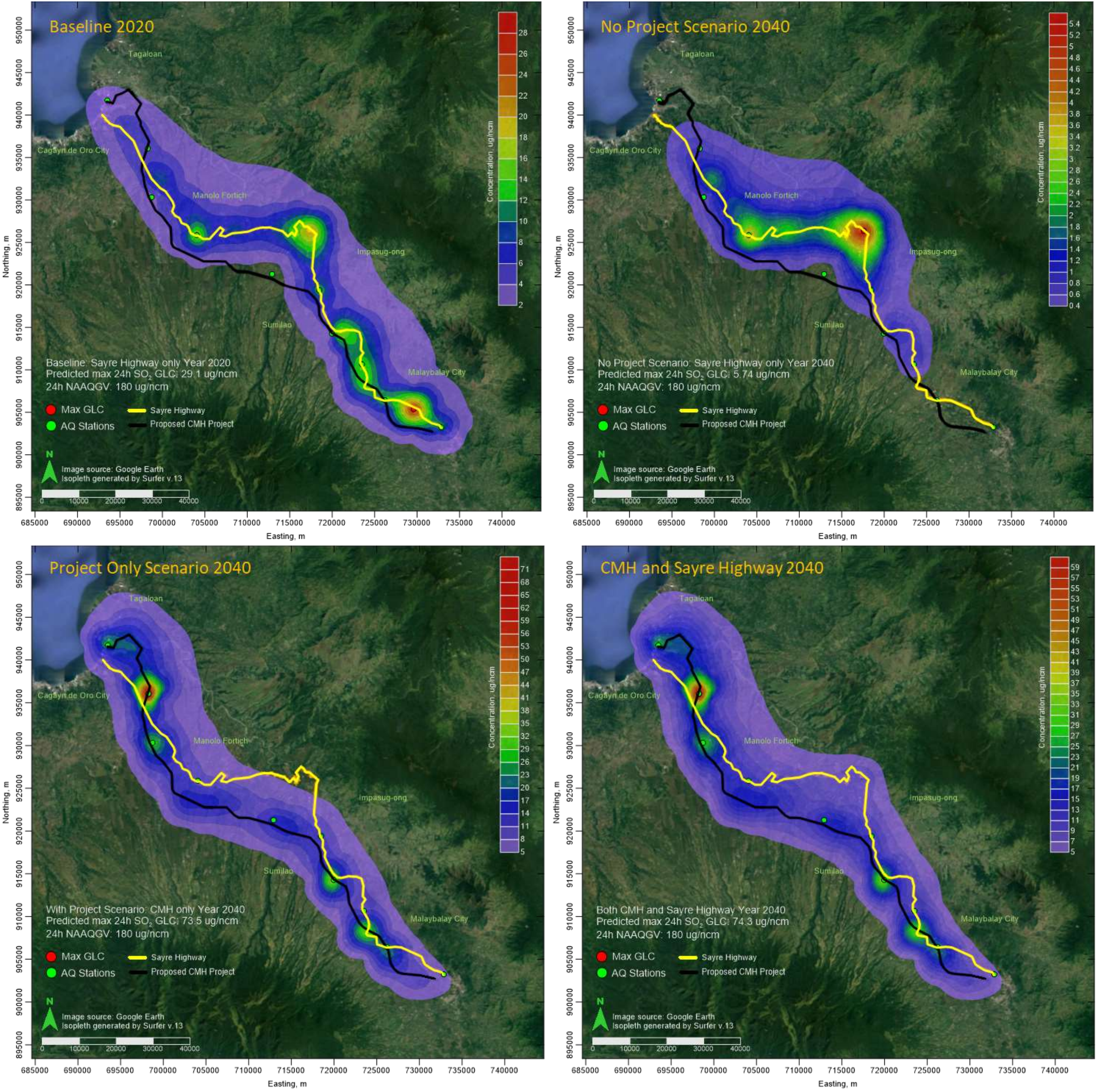
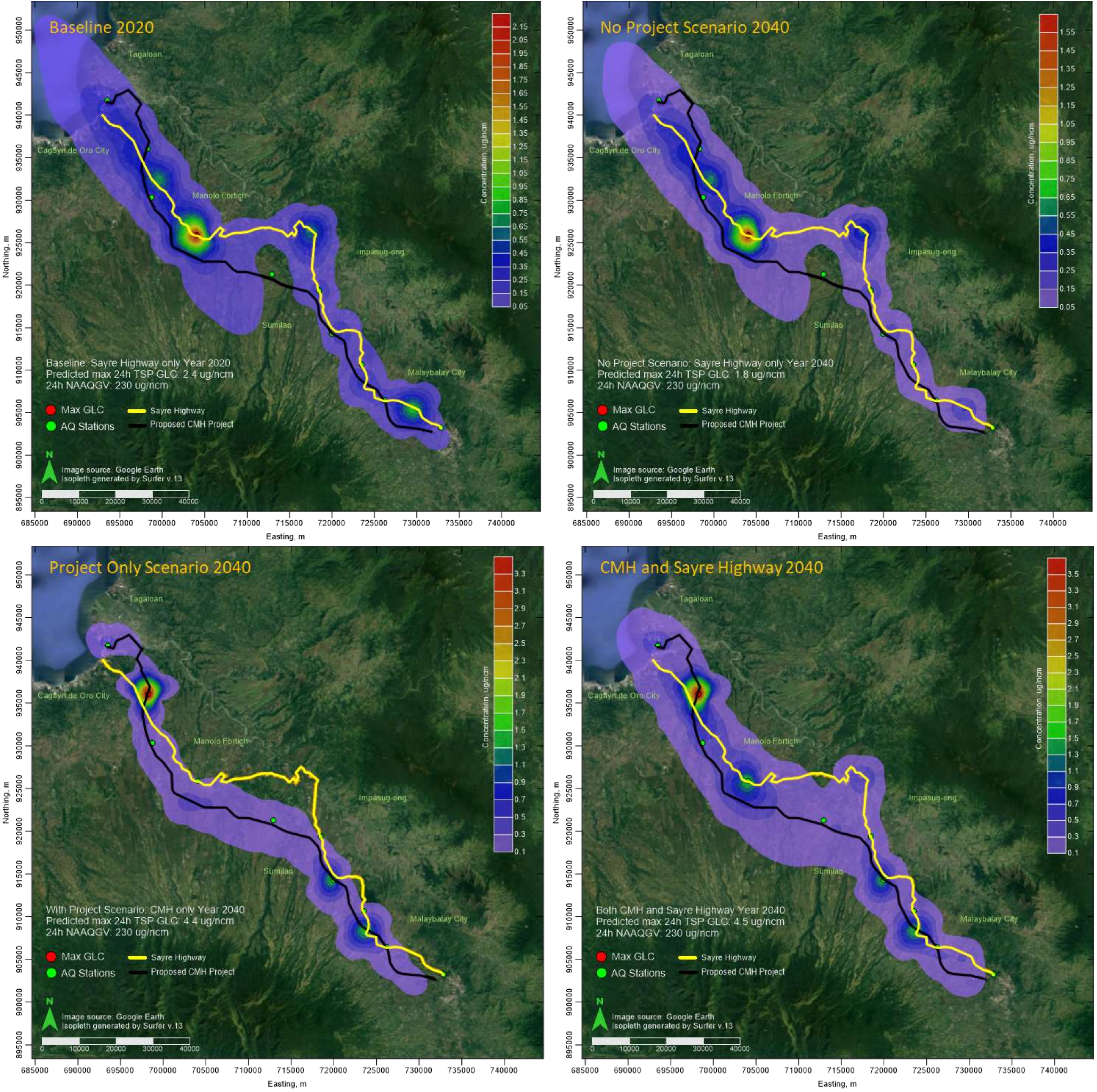


Figure 3-105. Isopleths of 24h TSP GLCs from vehicle emissions



Baseline 2020

Baseline: Sayre Highway only Year 2020
Predicted max 24h TSP GLC: 2.4 ug/ncm
24h NAAQGV: 230 ug/ncm

No Project Scenario 2040

No Project Scenario: Sayre Highway only Year 2040
Predicted max 24h TSP GLC: 1.8 ug/ncm
24h NAAQGV: 230 ug/ncm

Project Only Scenario 2040

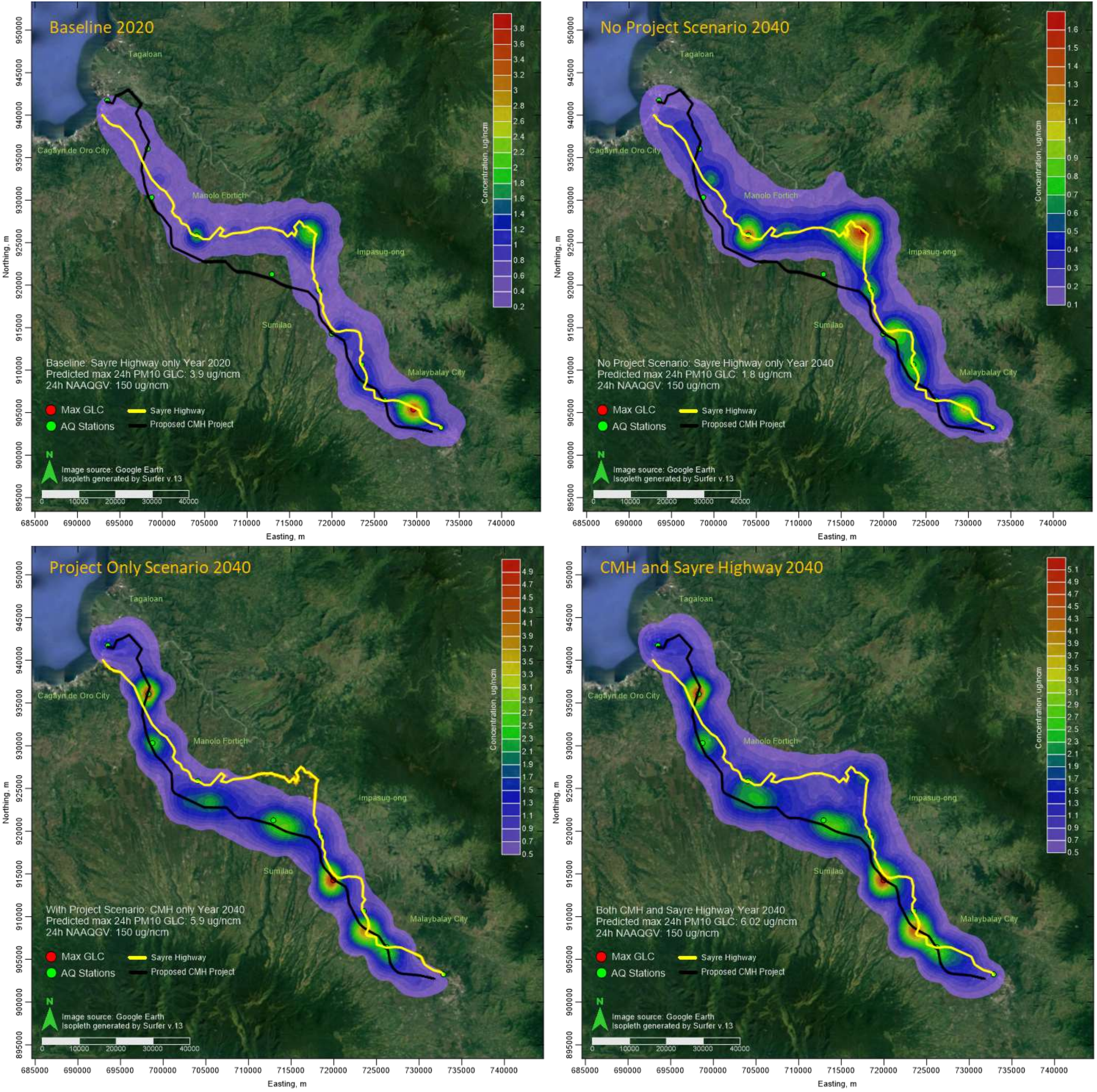
With Project Scenario: CMH only Year 2040
Predicted max 24h TSP GLC: 4.4 ug/ncm
24h NAAQGV: 230 ug/ncm

CMH and Sayre Highway 2040

Both CMH and Sayre Highway Year 2040
Predicted max 24h TSP GLC: 4.5 ug/ncm
24h NAAQGV: 230 ug/ncm

Image source: Google Earth
Isopleth generated by Surfer v.13

Figure 3-106. Isopleths of 24h PM10 GLCs from vehicle emissions



3.3.2.2.2 Noise pollution

Existing sound levels and noise impacts

The salient findings of processing the sound measurements during the low and high rain periods along the CMH alignment are enumerated below. The noise descriptors and existing impacts are shown in **Table 3-111** and **Table 3-112,** respectively. The diurnal sound level trends at the ten stations are shown in **Figure 3-107** to **Figure 3-111.**

a) The major sound sources at the ten stations were motor vehicles, e.g., motorcycles with loud mufflers.

b) The lowest sound levels (*Lmin*) across the stations and rain periods ranged from 24 to 59 decibels.

c) The peak sound levels (*Lmax*) across the stations and rain periods ranged from 44 to 79 decibels.

d) The background sound levels (*L90*) ranged from 34 to 59 decibels.

e) Stations with highest descriptors

   - *Lmin* (59dB) - Station AQN9, evening, low-rain period
   - *L90* (59dB) - Station AQN9, evening; Station AQN10, Morning, Daytime, low- and high-rain periods
   - *Lmax* (79dB) – Station AQN1, daytime, low rain period
   - *Leq* (66dB) – Station AQN1, daytime, low rain period; Station AQN9, evening, high rain period

f) Baseline sound levels in some stations exceeded the Philippine Noise Standards during low rain and/or high rain periods.

g) Baseline sound levels in some stations exceeded Japan and IFC General EHS Guidelines during low rain and/or high rain periods.

Table 3-111. Existing noise descriptors along the Project alignment and vicinities

Station	Location	Category	Timeframe	Low rain period						High rain period					
				Lmin	L90	L50	L10	Lmax	Leq	Lmin	L90	L50	L10	Lmax	Leq
AQN1S	Casinglot, Tagoloan	A	Morning	48	53	59	66	70	62	46	53	59	65	71	62
		A	Daytime	51	54	63	69	79	66	47	52	60	66	70	62
		A	Evening	47	56	61	68	71	64	38	45	54	62	67	58
		A	Night time	36	42	51	61	72	58	34	36	48	61	65	46
AQN2	Mambatangan, Manolo Fortich	A	Morning	35	39	41	46	52	43	24	26	32	34	56	42
		A	Daytime	35	37	40	49	56	45	25	28	40	45	57	43
		A	Evening	25	35	39	43	48	40	32	38	39	45	53	42
		A	Night time	34	34	35	39	44	36	26	29	32	40	47	36
AQN3	Alae, Manolo Fortich	A	Morning	40	42	48	58	61	53	41	41	42	46	69	53
		A	Daytime	35	39	44	54	60	50	38	40	46	60	73	58
		A	Evening	39	39	40	43	47	41	41	41	42	44	46	43
		A	Night time	39	39	40	46	65	50	41	41	41	43	49	42
AQN4	Dicklum, Manolo Fortich	A	Morning	50	52	56	64	71	60	48	50	55	62	70	59
		A	Daytime	47	52	58	64	70	61	45	50	54	62	68	57
		A	Evening	49	50	56	62	71	59	48	48	52	58	65	55
		A	Night time	49	50	52	61	71	58	48	48	49	55	64	53
AQN5	San Roque, Sumilao	AA	Morning	48	49	50	58	60	54	36	38	42	43	51	42
		AA	Daytime	34	35	42	50	58	46	26	38	44	51	73	57
		AA	Evening	57	58	58	58	59	58	38	39	42	45	56	45
		AA	Night time	48	49	53	58	60	54	42	42	42	43	45	42
AQN6i	La Fortuna, Impasug-ong	A	Morning	46	50	57	70	74	65	45	47	50	63	70	60
		A	Daytime	40	50	55	65	74	62	45	47	53	64	74	61
		A	Evening	50	51	53	62	70	59	42	44	55	63	69	60
		A	Night time	47	48	51	59	72	57	38	45	48	62	67	57
AQN7	Poblacion, Impasug-ong	A	Morning	31	37	46	59	68	57	44	45	46	53	63	51
		A	Daytime	38	42	44	54	71	49	25	33	43	52	67	50
		A	Evening	37	37	43	48	56	47	43	44	49	54	62	52
		A	Night time	36	36	38	45	66	43	34	43	45	48	62	48
AQN8	Impalutao, Impasug-ong	A	Morning	46	50	57	70	74	65	33	37	52	60	70	58
		A	Daytime	40	50	55	65	74	62	31	36	50	62	67	57
		A	Evening	50	51	53	62	70	59	33	34	42	55	67	54
		A	Night time	47	48	51	59	72	57	31	32	35	48	58	45
AQN9	Patpat, Malaybalay	A	Morning	56	57	59	63	76	63	49	52	58	65	71	62

Station	Location	Category	Timeframe	Low rain period						High rain period					
				Lmin	L90	L50	L10	Lmax	Leq	Lmin	L90	L50	L10	Lmax	Leq
		A	Daytime	54	56	60	67	77	65	45	53	59	68	73	64
		A	Evening	59	59	61	65	72	63	49	53	59	69	78	66
		A	Night time	54	57	58	62	71	61	48	49	53	62	73	60
AQN10E	Kalasungay, Malaybalay	AA	Morning	58	59	61	63	66	62	34	46	57	61	66	58
		AA	Daytime	55	57	59	62	72	62	55	59	63	67	72	64
		AA	Evening	56	56	61	66	71	63	56	58	63	65	67	63
		AA	Night time	52	58	61	65	68	62	48	55	57	64	67	60

Lmin – lowest sound level; L90 – background sound levels; L50 – median sound level; L10 – sporadic or intermittent sound level; Lmax – peak sound level

Figure 3-107. Diurnal sound level patterns in Stations AQN1 and AQN2

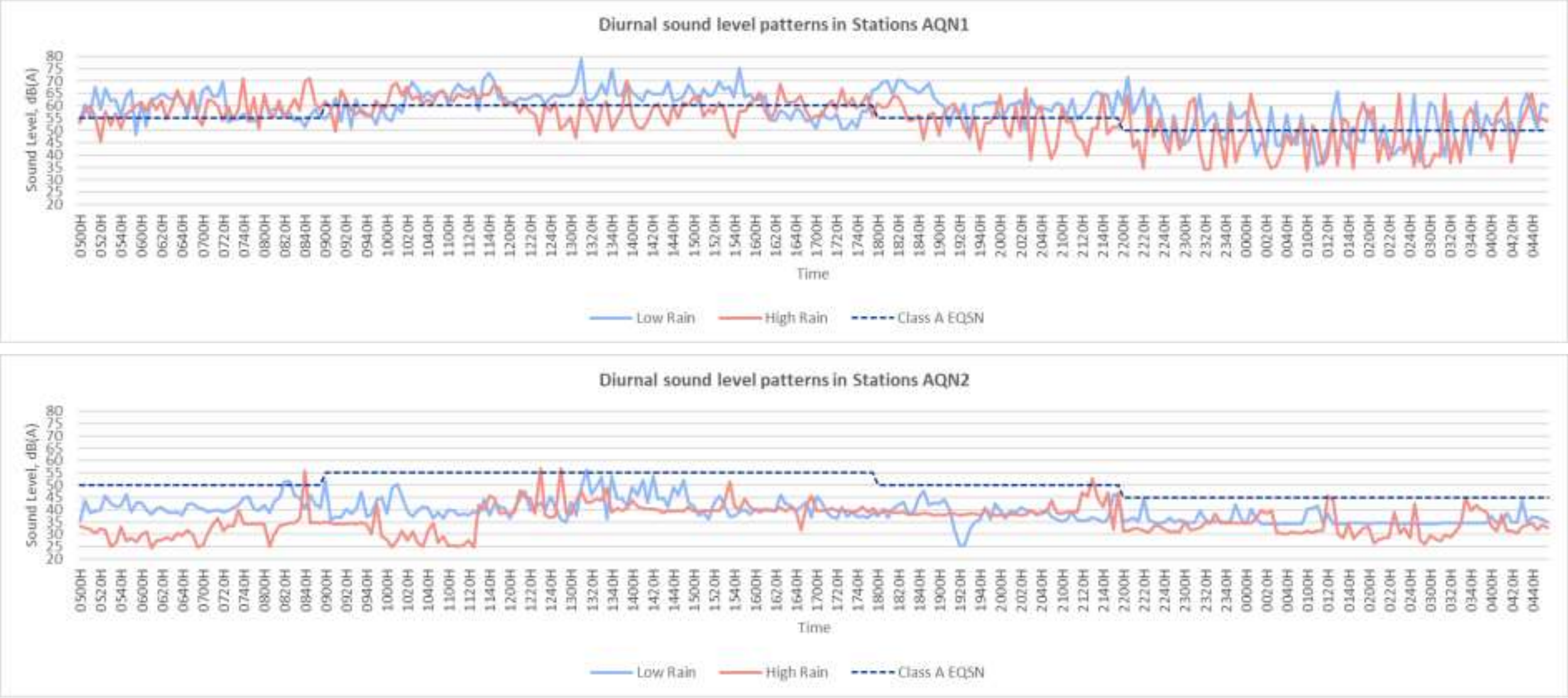


Figure 3-108. Diurnal sound level patterns in Stations AQN3 and AQN4

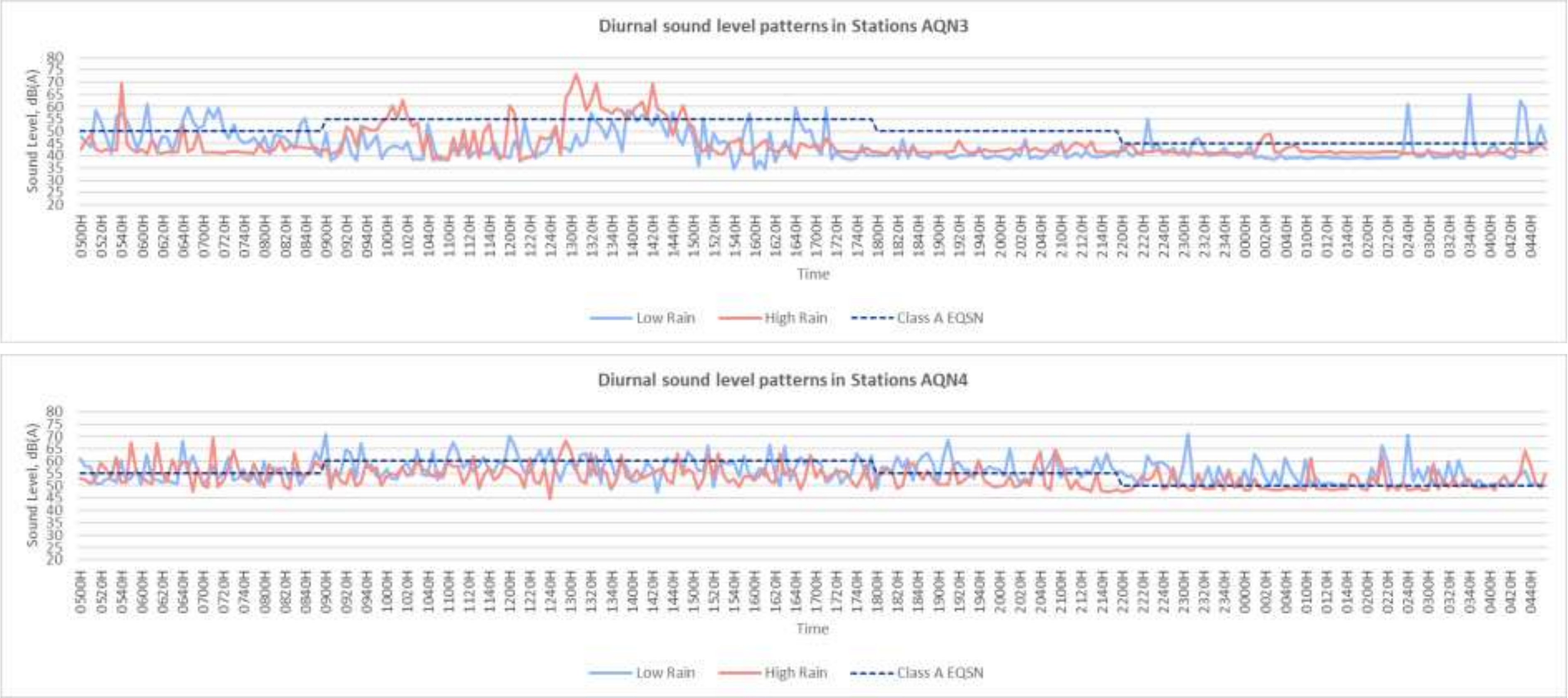


Figure 3-109. Diurnal sound level patterns in Stations AQN5 and AQN6

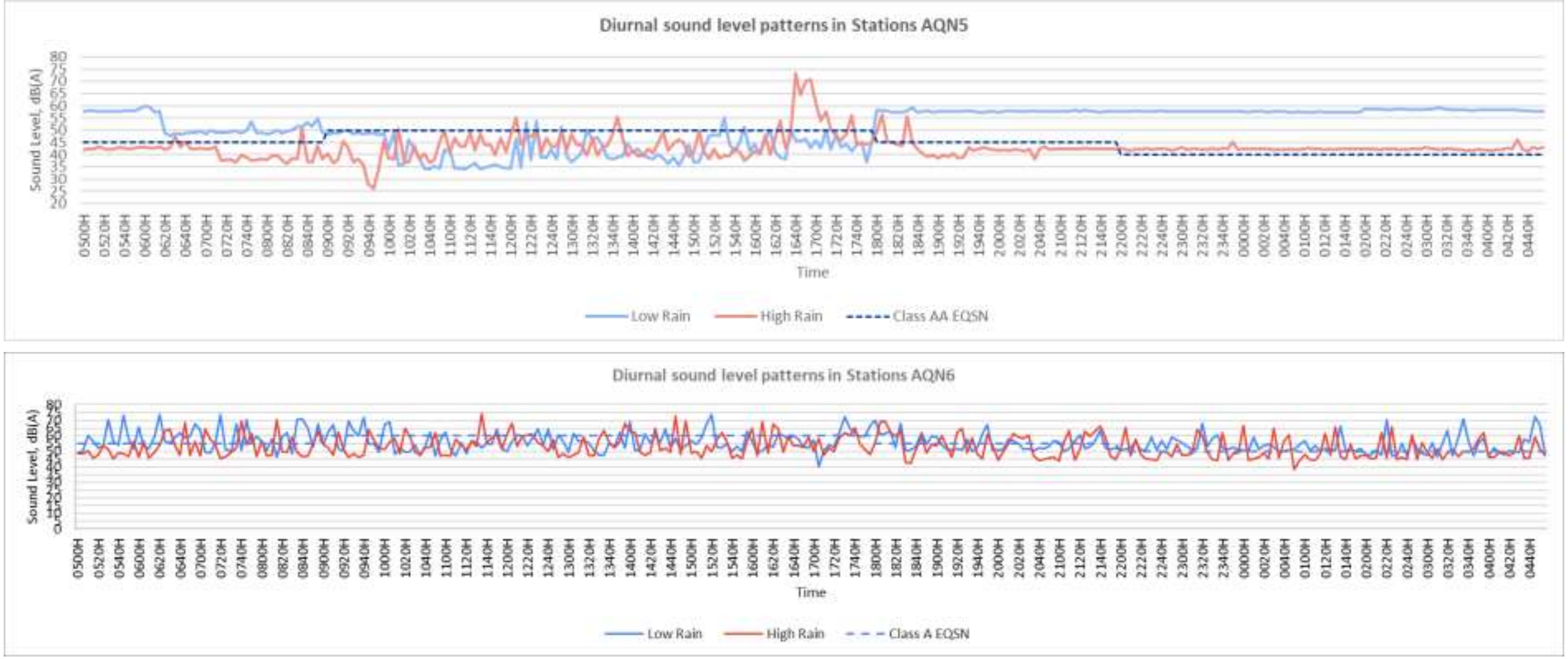


Figure 3-110. Diurnal sound level patterns in Stations AQN7 and AQN8

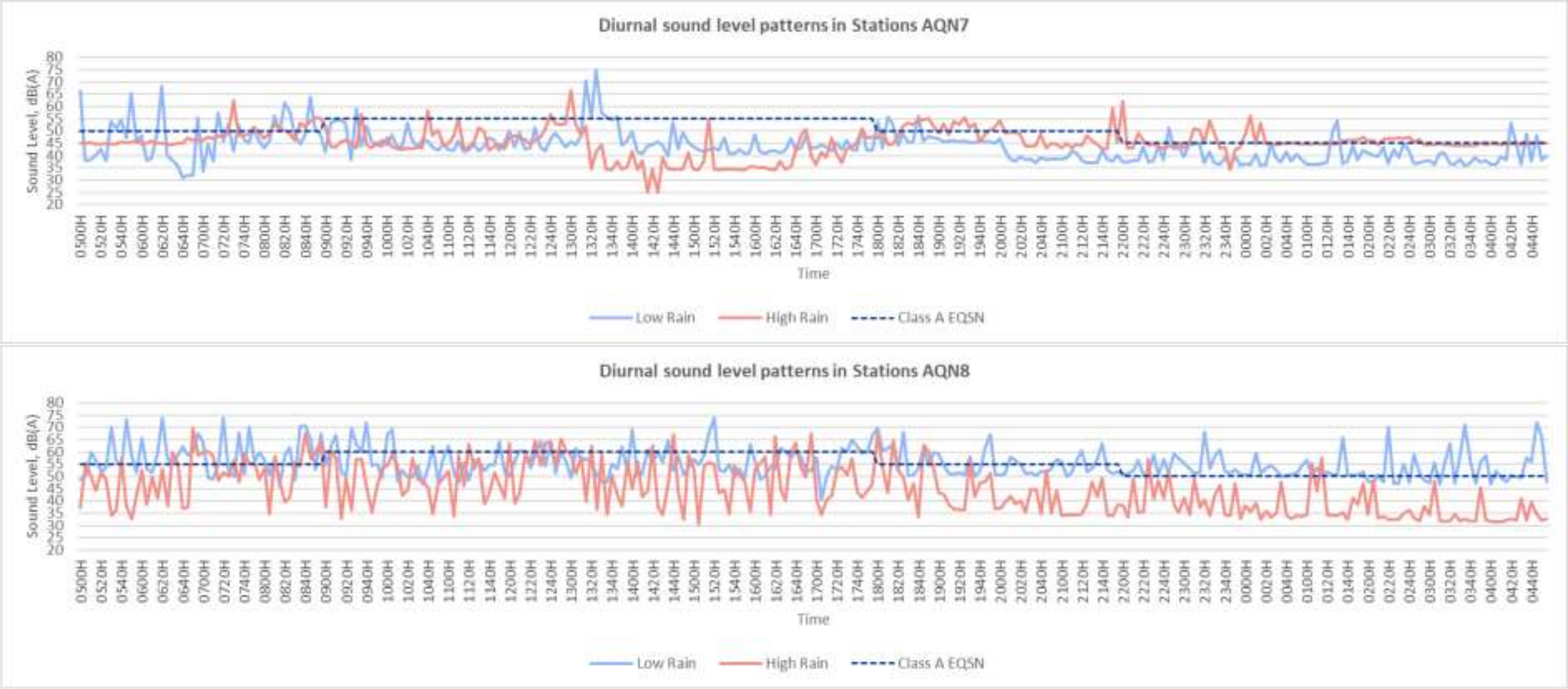


Figure 3-111. Diurnal sound level patterns in Stations AQN9 and AQN10

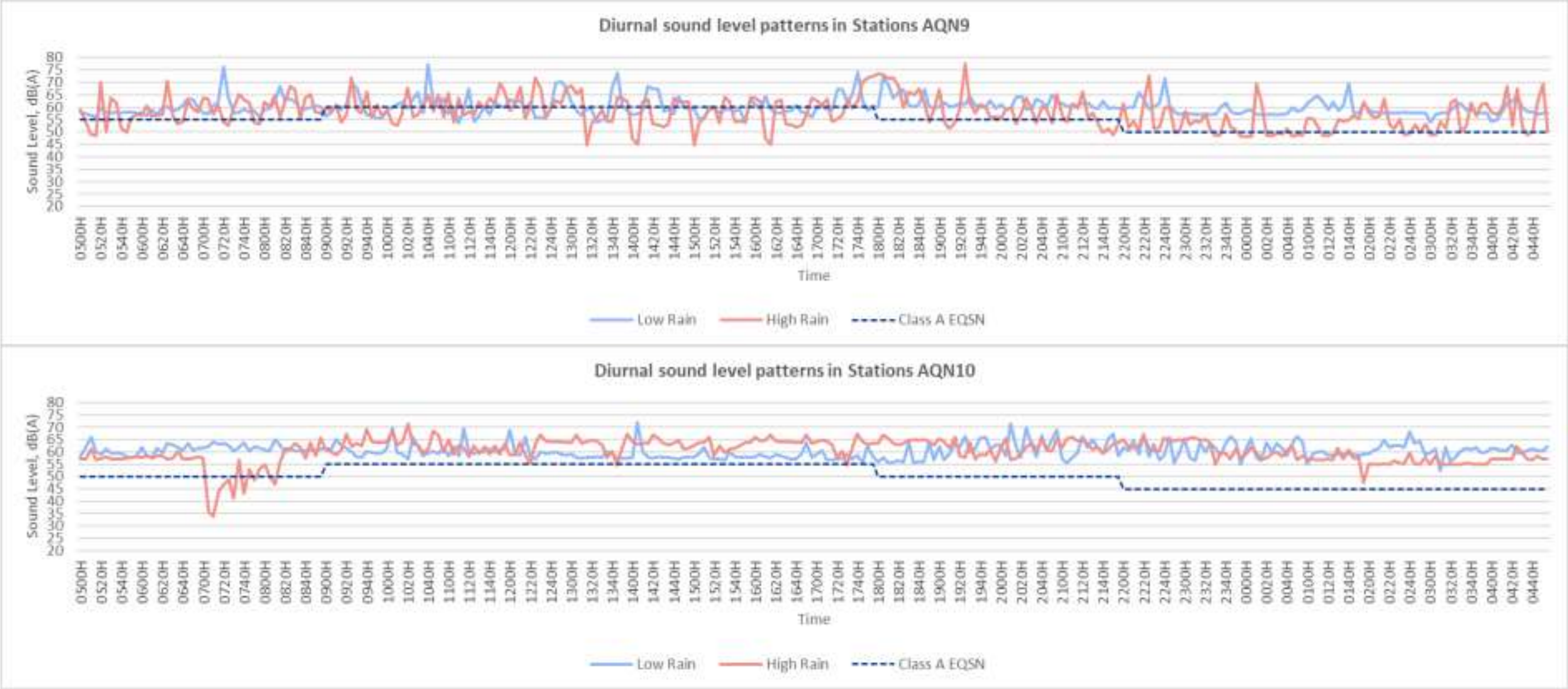


Table 3-112 shows existing noise levels during daytime and nighttime compared to Japan Environmental Quality Standard for Noise (EQSN) and IFC General EHS Guidelines. AQN10E exceeded both daytime and nighttime for both standards. AQN2, AQN3 (daytime), AQN6i (daytime), AQN7 (daytime), AQN8 (daytime) and AQN9 (daytime) are within the standards of both Japan EQSN and IFC General EHS Guidelines.

Table 3-112. Existing Noise Levels compared to Japan EQSN and IFC General EHS Guidelines

Station	Location	Timeframe	Japan (Leq:dB)			IFC (Leq:dB)		
			Low Rain	High Rain	Japan EQSN	Low Rain	High Rain	General EHS Guidelines
AQN1S	Casinglot, Tagoloan	Daytime	65.30	61.92	65	65.08	61.54	55
		Nighttime	59.30	56.16	60	59.91	57.15	45
AQN2	Mambatangan, Manolo Fortich	Daytime	44.36	42.35	55	44.13	42.78	55
		Nighttime	37.88	35.29	45	38.22	34.90	45
AQN3	Alae, Manolo Fortich	Daytime	50.39	56.45	60	49.34	56.16	70
		Nighttime	50.56	50.12	50	51.21	49.81	70
AQN4	Dicklum, Manolo Fortich	Daytime	60.30	57.58	65	60.12	57.23	55
		Nighttime	57.92	54.52	60	58.20	55.40	45
AQN5	San Roque, Sumilao	Daytime	51.74	55.09	55	52.97	54.80	55
		Nighttime	57.98	42.40	45	57.66	42.54	45
AQN6i	La Fortuna, Impasug-ong	Daytime	62.71	60.93	65	61.96	60.72	70
		Nighttime	60.72	56.16	60	61.49	56.90	70
AQN7	Poblacion, Impasug-ong	Daytime	55.95	50.63	60	55.15	50.94	70
		Nighttime	50.18	47.75	50	52.06	47.57	70
AQN8	Impalutao, Impasug-ong	Daytime	62.49	57.61	65	61.72	56.77	70
		Nighttime	60.72	46.09	60	61.49	51.83	70
AQN9	Patpat, Malaybalay	Daytime	63.98	64.24	65	63.89	63.87	70
		Nighttime	60.20	60.07	60	60.18	60.38	70
AQN10E	Kalasungay, Malaybalay	Daytime	61.26	63.04	55	61.89	63.24	55
		Nighttime	61.64	59.89	45	61.61	59.72	45

Note: Japan, Daytime:06:00-22:00, Nightime:22:00—6:00
IFC General EHS Guidelines , Daytime:7:00-22:00, Nighttime:22:00-7:00

Noise impacts during construction phase

Various equipment emits different levels of sound, the degree of disturbance dependent on distance of the source to the receptor, nature of activity, schedule and duration of activity, and type of equipment used. The USEPA defined noise as any undesirable sound that interferes with speech and hearing, and intense enough to damage hearing, or is otherwise annoying. Another definition of noise is airborne sound that is loud, unpleasant, unexpected, or undesired, and may be classified as a more specific group of sounds (California DOT, 2000). The calculated sound levels at 30 meters from different construction equipment in **Table 3-113** using the inverse square law exceeded the Classes 1, 2, 3, and 4 limits by a maximum noise impact magnitude of 7, 12, 22, and 22 decibels respectively (red cells in **Table 3-114**).

Table 3-113. Noise impacts from construction equipment[32]

Classification	Equipment	SPL range dB(A)	Predicted sound levels, dB(A)				
			30m	60m	120m	240m	960m
Earth-moving	Cranes	70-94	64-88	58-82	52-76	46-70	34-58
	Backhoe	74-92	68-86	62-80	56-74	50-68	38-56
	Front loader	77-94	71-88	65-82	59-76	53-70	41-58
	Dozer	70-95	64-89	58-83	52-77	46-71	34-59
	Grader	72-92	66-86	60-80	54-74	48-68	42-62
	Scraper	76-98	70-92	64-86	58-80	52-74	40-62
	Truck	84-93	78-87	72-81	66-75	60-69	48-57

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[32] Measured at 15m; Source: Canter, 1996, American Road Builders Association (1973)

Classification	Equipment	SPL range dB(A)	Predicted sound levels, dB(A)				
			30m	60m	120m	240m	960m
	Compactor	72-74	66-68	60-62	54-56	48-50	36-38
Materials handling	Concrete mixer	75-85	69-79	63-73	57-67	51-61	39-49
	Concrete pump	81-83	74-76	68-70	62-64	56-58	44-46
	Cranes, derrick	88-90	82-84	76-78	70-72	64-66	52-54
	Cranes, movable	75-85	69-79	63-73	57-67	51-61	39-49
Stationary	Pump	69-71	63-65	57-59	51-53	45-47	33-35
	Generator	73-83	67-77	61-71	55-65	49-59	37-47
	Compressor	70-93	64-87	58-81	52-75	46-69	34-57
Impact activities	Jackhammer	82-97	76-91	70-85	64-79	58-73	46-61
	Pile driver	97-105	91-99	85-93	79-87	73-81	61-69

NOTES: *SPL – sound pressure level measured at 15m

As previously presented, construction activities are only allowed from 7am to 7pm (12h) for the construction activity classes in Class A areas. However, most of the areas traversed by the alignment have no residential within 30m of the Project components. The interchanges are the Project components proximate to residential areas.

It is emphasized that the model results were conservative, i.e., overestimates, because it was assumed that all construction equipment were operating simultaneously at steady state. The assumption was made as worst-case scenario and because the actual type, usage factors, and location of construction equipment were unavailable at this time. Noise levels during actual construction are likely to be lower than estimated values.

Table 3-114. Noise impacts from typical construction activities

Construction activity	SPL		Max noise levels*			
	15m	30m	1	2	3	4
Earth-moving	95	89	90	85	75	75
Materials handling	87.1	81	90	85	75	75
Stationary	90	84	90	85	75	75
Impact activities	102	96	90	85	75	75
Concrete batching plant	83	77	90	85	75	75
TOTAL	103	97	90	85	75	75

NOTES: SPL – sound pressure level measured at 15m; *per Construction Activity Class

Noise impacts during operation phase

The results of the simulation for the Project (Sayre Highway and CMH Highway) in 2040 at the sensitive receptors are presented in Table 3-115. At stations 2, 3, 5, and 7, which currently are not facing/near the road, the noise situation will change due to the operation of the new highway. The forecasted results at stations 2, 3, 5, and 7 exceed the IFC standards by within 3 dB from the background level (Base Line level)."
When comparing the forecasted result in daytime and evening time (or nighttime and morning time) at stations 2, 3, 5, and 7 to the daytime standards (6:00-22:00; 70dB(A)) (or nighttime standards (22:00-6:00; 65dB(A)) in Japan for space adjacent to a road carrying arterial traffic, the forecasting result will be satisfied.

Table 3-115. Comparison of noise impacts at sensitive receptor

Station	Location	Timeframe *	Baseline (dB(A)) **	Standard for Baseline (dB(A))	Basis ***	Forecast Result (dB(A))	Standard for Forecast (dB(A))	Basis ***
AQN1S (Class A Area, facing four lane)	Casinglot, Tagoloan	Morning	62	55	2	62	65	3
		Daytime	64	60	2	65	67	3
		Evening	61	55	2	61	64	3
		Night time	52	50	2	61	55	3
AQN2 (Class A Area)	Mambatangan, Manolo Fortich	Morning	43	50	1	63	55	2
		Daytime	44	55	1	66	60	2
		Evening	41	50	1	62	55	2
		Night time	36	45	1	62	50	2
AQN3 (Class A Area)	Alae, Manolo Fortich	Morning	53	50	1	63	56	3
		Daytime	54	55	1	65	55	2
		Evening	42	50	1	61	50	2
		Night time	46	45	1	61	49	3
AQN4 (Class A Area, facing four lane)	Dicklum, Manolo Fortich	Morning	60	55	2	55	63	3
		Daytime	59	60	2	54	60	2
		Evening	57	55	2	52	60	3
		Night time	56	50	2	50	59	3
AQN5 (Class AA Area)	San Roque, Sumilao	Morning	48	45	1	60	51	3
		Daytime	52	50	1	63	55	3
		Evening	52	45	1	59	55	3
		Night time	48	40	1	59	51	3
AQN6i (Class A Areaa, facing four lane)	La Fortuna, Impasug-ong	Morning	63	55	2	60	66	3
		Daytime	62	60	2	62	65	3
		Evening	60	55	2	59	63	3
		Night time	57	50	2	58	60	3
AQN7 (Class A Area)	Poblacion, Impasug-ong	Morning	54	50	1	63	57	3
		Daytime	50	55	1	66	55	2
		Evening	50	50	1	62	53	3
		Night time	46	45	1	61	49	3
AQN8 (Class A Areaa, facing four lane)	Impalutao, Impasug-ong	Morning	62	55	2	56	65	3
		Daytime	60	60	2	54	63	3
		Evening	57	55	2	52	60	3
		Night time	51	50	2	46	54	3
AQN9 (Class A Areaa, facing four lane)	Patpat, Malaybalay	Morning	63	55	2	63	66	3
		Daytime	65	60	2	66	68	3
		Evening	65	55	2	63	68	3
		Night time	61	50	2	62	64	3
AQN10E (Class AA	Kalasungay, Malaybalay	Morning	60	50	1	56	63	3
		Daytime	63	55	1	59	66	3

Station	Location	Timeframe *	Baseline (dB(A)) **	Standard for Baseline (dB(A))	Basis ***	Forecast Result (dB(A))	Standard for Forecast (dB(A))	Basis ***
Areaa, facing four lane)		Evening	63	50	1	58	66	3
		Night time	61	45	1	56	64	3

Note: * NOTE: Morning: 5:00-9:00, Daytime: 9:00-18:00, Evening: 18:00-22:00, Night-time 22:00-5:00
**Baseline is average of low rain season and high wain season.
***Basis – 1: Standard for General Areas, 2: Standard for areas directly facing four-lane roads, 3: IFC Standard EHS Guideline within 3 dB from the background level (Base Line) (dBA) / Red numbers indicate exceeding the criteria.

3.3.2.3 Proposed mitigating measures

Degradation of air quality

Construction phase - Fugitive dust is expected to be the dominant source of air pollution during the construction phase. Sources of these include access roads, staging areas, and active road construction sites. The common dust suppression measures to control particulate emissions and their reduction efficiencies are summarized in **Table 3-116**.

Table 3-116. Particulate reduction from water suppression and speed restriction

Component	% Red	Mitigation
Construction phase	61	Applying water within construction site (3.2-hour interval)
	57	Speed restriction
Unpaved roads	55	2x/day water application
	44	Speed <=40kph

Source: WRAP Fugitive Dust Handbook; %Red – Percent reduction

Air pollution from heavy equipment and motor vehicle emissions are also expected during the construction of the alignment and other components site preparation and structure erection. Other mitigation measures to minimize air pollution during construction are enumerated below.

a) Replacement of vegetation in non-structure areas to minimize wind erosion of topsoil;
b) Compacting of exposed soil surfaces;
c) Provide tarpaulin cover on trucks loaded with construction materials; and
d) Hauling of spoils/excavated earth materials immediately after excavation.
e) Regular maintenance of heavy equipment and motor vehicles; and
f) Use of low-sulfur fuel

Operation phase - Public health concerns have increased due to the rising number of studies linking adverse health effects with exposures to traffic-related pollution near large roadways. Several studies have investigated the use of roadside vegetation because this method is often one of the few short-term options available to reduce near-road air pollution (USEPA). Roadside vegetation can include the preservation of existing trees and bushes as well as planting new ones. This mitigation method can complement existing pollution control programs and regulations as well as provide measures to reduce impacts from sources that are difficult to control such as brake and tire wear and re-entrained road dust (EPA, 2016).

Roadside vegetation also has other potential benefits such as improved aesthetics, increased property values, reduced heat, control surface water runoff, and reduce noise pollution. It can, however, also affect driver sight lines, protrude into clear zones along highway rights-of-way, contribute to debris on roads, present fire hazards, and act as pathways for pests and invasive species. It is important to consider the benefits and unintended consequences of roadside vegetation as a mitigating measure for reducing roadside air pollution. The factors to be considered in designing effective roadside vegetative barriers are shown in **Table 3-117**.

Table 3-117. Factors affecting the effectiveness of vegetation for mitigating roadside air pollution

Characteristic	Recommendation	Description
Physical characteristic		
Height	Five meters or higher or extend one meter above an existing solid barrier	The higher the vegetative barrier the greater the pollutant reduction. A minimum of five meters should be enough to be above typical emission elevations for vehicles on the road. Heights of 10 meters or more however, would likely provide additional pollutant reductions.
Thickness	10 meters or more	The thicker the vegetative barrier, the greater the pollutant reduction. A minimum thickness of 10 meters should provide enough to remove particulate and enhance dispersion. However, gaps in the barrier should be avoided. Multiple rows of different types of vegetation (e.g., bushes, shrubs, trees) should be considered for maximum coverage and pollutant removal.
Porosity	0.5 to 0.9	Porosity should not be too high to allow pollutants to easily pass through the barrier or cause wind stagnation. As the porosity gets lower, the vegetation barrier will perform similarly to a solid barrier, limiting the amount of particulate removal because air is forced up and around the plants.
Length	Minimum of 50 meters	Extending the barrier beyond the area of concern protects against pollutant meandering around edges. Constructing the barrier perpendicular from the road depending on land availability may also be considered.
Vegetation characteristics		
Seasonal effects	Vegetation that is not affected by seasonal changes	Vegetative barrier characteristics must be consistent throughout all season and climatic conditions to ensure effective pollutant reduction.
Leaf surface	Complex waxy and/or hairy surfaces with high surface area	Leaf surfaces with complex and large surface areas will capture and contain more particulate pollutants as air passes through.
Resistance to pollution and stress	Resistant to effects of air pollution and other stressors	Vegetation must be able to survive and maintain its integrity under the high pollution levels and stress that can occur near roads to provide effective pollution reduction from traffic emissions.
Other considerations		
Maintenance	A plan must be in place to properly maintain the vegetative barrier	Proper vegetation maintenance must be provided for the barrier to survive and maintain its integrity.
Drought resistant	Choose species resistant to drought and flooding	The vegetative barrier must maintain its integrity under drought conditions to provide effective pollution reduction.
Native species	Choose native species	Native species will be more robust and resistant to climatic conditions in the area of interest.
Non-invasive	Choose non-invasive species	Non-invasive species will ensure effective pollutant reduction without potential unintended consequences from invasive species adversely effecting nearby areas.
Non-poisonous	Choose non- poisonous species if sensitive populations are nearby	Non-poisonous species are strongly encouraged and should be used if the barrier will be located with sensitive populations, such as schools, parks, and recreation areas.

Characteristic	Recommendation	Description
Roadway safety	Maintains safety for drivers on the road; conforms to local safety and permit requirements	Prior to planting, ensure vegetation plan will meet all safety and other local permit requirements to preserve sight-lines and vegetation compatibility while avoiding potential wildlife/auto accidents.

Source: Roadside Vegetation Design to Improve Local, Near-Road Air Quality, USEPA, 2018.

Noise pollution

Construction phase - An important option in construction noise control strategies is controlling sound at the source. Source control techniques may be approached from two ways: (a) muffler requirements and (b) maintenance and operational requirements.

Most construction noise originates from equipment powered by either gasoline or diesel engines. A large part of the noise emitted is due to the intake and exhaust portions of the engine cycle. One remedy for controlling much of the engine noise is the use of adequate muffler systems. Reductions of 10 dBa or more can be achieved with optimal muffler systems (US Department of Transportation). Muffler requirements can be easily integrated in contract specifications with simple enforcement.

Poor equipment maintenance may also cause high noise levels, e.g., faulty or damaged mufflers, loose engine parts, rattling screws, bolts, or metal plates, as well as careless or improper handling and operation of equipment. Specifications such as regular inspection of equipment in the maintenance area and proper training of equipment operators can be included in the Contractor contract.

Another effective approach in reducing noise impacts is using time and activity constraints. Construction activity noise is disruptive during leisure hours, sleeping hours, and any time where loud continuous noises affect certain special activities. Construction activities can be limited during daytime and avoided at night. Other measures are establishment of barriers and shielding stationary vibrating equipment and provision of buffer zones.

Operation and maintenance phase – Transport noise is conventionally mitigated by either insulation or absorption techniques. Sound insulation prevents the transmission of noise by the introduction of an acoustical shield while sound absorption reduces the amount of energy reflected into the environment through a dissipating mechanism. Examples of these include noise barriers, facade insulation, porous asphalt pavements, and other widely known techniques.

Noise barriers can be constructed from earth, concrete, masonry, wood, metal, and other materials. The material chosen must be rigid and sufficiently dense (at least 20 kilograms/square meter) to effectively reduce sound transmission through the barrier. All noise barrier material types are equally effective, acoustically, if they have this density[33]. Examples of noise barriers are shown in **Figure 3-112**.

Noise barriers are generally seen to be an effective way of attenuating roadway noise. A noise barrier will reduce noise levels by three to seven decibels depending on design and height (Arenas, 2008). Barriers can be constructed with a large range of materials including, wood, steel, aluminum, acrylic sheeting, concrete, masonry block and rubber mats.

Earth berms are the dominant type of noise barrier used in roadways (Bendtsen et al., 2010). An earth berm in general produces 3 dB more attenuation than a wall of the same height (Wilson, 2006).

The Texas Transportation Institute (1997) stated that depressed sections of a roadway provide the greatest reduction in traffic noise in areas near and far from the roadway, especially if the walls of the depression are

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[33] https://www.fhwa.dot.gov/environment/noise/noise_barriers/design_construction/keepdown.cfm

sloped and acoustically treated. They determined that noise is best attenuated in elevated roadways by using solid concrete guardrails. At-grade sections of the CMH alignment produce the highest noise levels and the addition of solid guardrails, median rails, and the use of smooth texture pavements should reduce noise generated.

Vegetation can also be used as a noise barrier. However, their effectiveness in attenuating noise is minimal (e.g., a 10m depth of vegetation results to a 1dB reduction in noise). Their real value however, is in terms of psychoacoustic performance: people cannot see the noise source but see greenery instead it tends to lead to a subjective reduction in annoyance and disturbance (Yang et al., 2011).

To ensure the most effective attenuation is achieved, the following can be considered in the design of the CMH regarding noise attenuation (Mahon, 2013):

a) The barrier must be sufficiently tall to block the line of sight between the source and receiver. The higher the noise barrier, the better the insertion loss, assuming the sound insulation performance of the barrier is adequate;

b) The length of the noise barrier must be sufficient to cover an angle of at least 160 degrees from the receiver. Alternatively, the distance between the receiver and the barrier end should be at least four times the perpendicular distance from the receiver to the barrier;

c) Barriers should be solid and continuous and should overlap if a break is unavoidable. The break sections of the barrier should ideally be finished with sound absorbing material and the overlap should be at least four times the opening width;

d) Barrier placement in relation to the road and receiver is critical. Optimal noise attenuation is obtained if the barrier is as close as possible to either the noise source or the receiver because it maximizes the path length difference;

e) Barriers should have no leaks due to holes, cracks, and gaps because it severely compromises its acoustic effectiveness. For example, a gap occupying just three percent of the surface area of a noise barrier will have an actual transmission loss of 9 dB (Government of Hong Kong,2003).

Figure 3-112. Examples of barriers to reduced road noise

Source: www.skyscrapercity.com

3.3.3 Vibration

3.3.3.1 Methodology

Baseline data collection was made together with noise, ambient air and traffic data collection. The sampling sites, typically spread along the length or primary impact area of the project, cover various features of the landscape, relevant environmental receptors and significant components of the project. The approach used in the baseline study follows the prescription of the British Standard 7385 (1993) standards. The procedure for assessing the vibration impact is illustrated in **Figure 3-113.**

Figure 3-113. Vibration impact assessment methodology

A Vibron Seismograph is used for data collection, each unit is programmed to continuously record ground vibration from triaxial vibration sensors with a natural frequency of 4.5 Hz. Sampling frequency is set at 200 samples per second for the two horizontal and one vertical sensors. The various observable sources of vibration during the monitoring period are also noted and correlated to data during processing.

For each dataset collected, VdB, velocity and acceleration are calculated and graphed to show temporal variability of vibration levels. Percentile statistical values are identified with 24-hour data representation per channel trace per 10-minute time slice to illustrate the likelihood of encountering different vibration levels at specific times of the day. Percentile levels L10, L50 and L90 (24-hour) are utilized to determine vibration levels exceeding 90%, 50% and 10% of each time slice.

The location of the ten sites and schedules for the survey were a-priori defined and are located from Tagoloan to Bukidnon. The sites are predominantly sub-urban areas. The list of the survey sites with its respective geographic coordinates is same as the air quality stations shown in **Table 3-93.** For each site, some notable features can be distinguished indicating in some instances the human activity that causes the background vibration. Vibration data was processed with reference velocity of 1x10^-6 per second.

3.3.3.2 Baseline environmental conditions

The salient findings of processing the sound measurements during the low and high rain periods along the CMH alignment are enumerated below. The vibration descriptors are shown in **Annex 11.** The summary of observed peak values for vibration (VdB), velocity (cm/s), acceleration (cm/s^2) is also shown in **Annex 11** which shows the maximum levels for each of the stations during certain periods of the day.

a) Observations of vibration at the sites indicate that the sites vary in levels of vibration from a low of 41 VdB to a high of 57 VdB. These values are generally lower than active roads and are not considered as annoyance to residential areas.
b) Two types of observation sites can be seen from the data, one in farmlands or forested areas which have very low ambient vibration values ranging from 49 VdB to 52VdB and the sites which are near the roads with values ranging from 53 VdB to 57 VdB.
c) Heavy rainfall can also be observed through the charts as one of the contributors to the changes in vibration levels at certain sites.
d) Observation sites that are situated near pedestrian lanes have the most impact on the background vibration levels at the sites that are closer to the Malabalay City proper.
e) The main sources of vibration that are frequent in most of the sites are generally from large cargo trucks and pedestrians respectively.
f) Temporal patterns indicate that these high vibration levels occur during peak hours in the morning and during daytime.
g) In all sites, the range of vibration levels may reach from 40 VdB which is the typical background vibration and go beyond 50 VdB which is the threshold of human perception of vibration.

The measured background levels of vibration along the alignment of the project indicate that the sites are already affected by vibration from road traffic. Thus, the impact of vibration in these areas will be minimal, since the expected levels of vibration from the project will be of the same or just slightly elevated level as what is existing now. This is particularly true for the areas where the road alignment traverses the areas where roads exist.

In areas where roads are not yet existent and will now be traversed by the road project’s alignment, the impact will be moderate. This will be particularly felt in the residential areas that are beyond the reach of the road networks, and thus in the more distant edges of the villages and in isolated communities. It should be noted that in these areas, the environmental items and human habitation exposed to vibration are few and far apart. Likewise, areas where no road traffic had reached before are mostly agricultural land or otherwise open areas where road vibration may be of least concern.

Furthermore, the expected level of induced vibration from the project shall be very low, since road-traffic vibration tend to dissipate within tens of meters of the ground and is not expected to go beyond 100m from the road. The uniformity of the geological foundation all along the road alignment – being all underlain by volcanic materials of medium to hard soil in consistency – suggest that the attenuation of vibration on the ground will be severe and is not expected to cause amplification nor channeling/focusing of vibration energy into certain sites such as can be observed in alluvial soils. The fact that the road system will also be designed and constructed using concrete structures both in the surface covering and on bridges / elevated roadways further indicate that vibration will be mostly absorbed by the ground and not efficiently transmitted to the surrounding areas.

There are three potential sites where elevated levels of vibration are to be expected: the quarry areas where explosives and rock breaking activities are routine, in sites where the slopes need to be cut, whereby the rocks are removed to clear the alignment, and in the construction of piles or columns for the construction of bridges and elevated roadways. In these areas, the level of vibration shall be disruptive to the people at rest, and to certain facilities where tranquility is essential such as hospitals, churches and schools.

When conducting quarry operations, rock breaking, pile driving, or even heavy equipment operation near or around these vulnerable facilities, it is necessary to implement vibration mitigating measures to reduce the impact on the environment.

The impact of vibration caused by the quarry operations, rock breaking, pile driving, and heavy equipment activities are expected only during the construction phase of the project. After the construction, all the sources of vibration are expected to cease, and the levels shall revert to background levels.

Over the medium and long term, the level of vibration shall increase and be elevated to a slightly higher level along the roadway. The transit of vehicles on the new road, particularly the big trucks and heavy equipment, shall cause this change. However, the vibration is expected to dissipate quickly on the ground and will not exceed beyond 100m away from the road. The right of way clearance along the path of the road shall be mostly sufficient to ensure that no residential areas will have adverse effect of vibration over the medium and long term.

3.3.3.3 Impact analysis and proposed mitigating measures

Most of the areas traversed by the proposed road alignment are on agricultural land use. There are a few built-up areas, mostly as narrow communities along roads that will be traversed by the alignment. In most of these roads and built-up areas, the presence of an existing roadway already elevates the background level of vibration, and the contribution of the Project to the existing vibration level is insignificant.

There were no vibration sensitive areas nor receptors encountered during the surveys, nor were there identified to be vibration sensitive facilities like hospitals, laboratories, and the like within 300m of the proposed road alignment. If during the construction phase a site may complain or is found to be adversely affected by vibration, real time vibration monitoring may be done with the objective of detecting exceedances to levels prescribed as safe in the known vibration standards. The use of heavy equipment and explosives around these areas are then to be allowed only if known not to exceed the prescribed levels.

The most significant effect of vibration during construction are expected around the heavy equipment depot, quarries for aggregates, rock crushing and batching plants and along the truck routes. To avert localized impact of vibration to the existing communities, it is best that these facilities and their temporary access points be located at a distance from residential and developed areas. It is also prudent to avoid unstable areas that may experience ground movement due to vibration, such as steep slopes and those underlain by loose sediments.

3.3.3.4 Proposed mitigation measures

For vibration impact management, the best practice solution is a combination of the following measures:

- Proper choice of sites for operating vibrating machinery such as rock crushers, truck depot, etc.
- Distribution of heavy equipment activity, either by use of more vehicles that are lighter instead of fewer heavy units
- Distribution of heavy equipment activity over time and not clustering movement of many units in a short period
- Locating heavy equipment routes more distant from residential and commercial communities
- Proper maintenance of heavy equipment to ensure optimal condition during operation
- Proper maintenance of road surfaces to avoid bumps and holes that create ground impact from moving vehicles
- Scheduled use of road compactors only during working hours and weekdays
- Use pile-driving work should use the less vibrating methods to prevent intense ground vibration

3.4 THE PEOPLE

3.4.1 Scope

The provisions of the technical scoping checklist defined the scope of the people component. This section presented the key baseline conditions of the LGUs traversed by the alignment in terms of socioeconomic parameters relevant to the impacts specified in the technical scoping checklist.

3.4.2 Methodology

This EIA for the people components employed a concurrent triangulation design where both qualitative and quantitative research were use and both data collected simultaneously in one phase. The design is also defined as the use of multiple observers, interpretive points of views, and levels of forms of empirical materials in the construction of interpretation (Denzin, 1989:270). The purpose of this method is to confirm and cross-validate or corroborate results so that the weakness in one method is overcome with the strength of another (Creswell & Plano, 2011). The qualitative and quantitative data in this case however, were analyzed separately and the findings compared and combined.

The quantitative methods used for the study were the a) socioeconomic survey using a standardized survey and b) key informant interviews (KII) of key barangay officials and multisectoral stakeholders (e.g., NGO, business, religious, women, youth, academe). The survey covered the 30 barangays in six cities/municipalities traversed by the CMH alignment listed below.

a) Barangays Natumolan and Casinglot, Municipality of Tagoloan;
b) Barangays Bugo and Puerto, Cagayan de Oro City;
c) Barangays Alae, Dicklum, Damilag, Tangkulan, Ticala, Sankanan, San Miguel, and Mambatangan, Municipality of Manolo Fortich;
d) Barangays Puntian, Kisolon, Vista Villa, Culasi, San Roque, and Poblacion, Municipality of Sumilao;
e) Barangays Poblacion, Kibenton, Impalutao, La Fortuna, Cawayan, and Capitan Bayong, Municipality of Impasug-ong; and
f) Barangays, Dalwangan, Kalasungay, and Patpat, City of Malaybalay.

The survey sample size of 390 was determined using the 2020 Philippine Statistics Authority (PSA) household population, a confidence level of 95 percent, and used proportional sampling while the KII involved 93 participants. **Table 3-118** shows the distribution of the survey respondents and KII participants. The survey and KIIs were conducted from May 28 to June 4, 2021.

The Statistical Package for the Social Sciences (SPSS) used a standard survey instrument to determine the socio-economic profile of the respondents, their acceptability of the Project, and identify issues and concerns. The instrument was adapted from DAO 2017-15 (Guidelines on Public Participation under the Philippine EIS system) and translated into Cebuano to ensure efficient communication.

SPSS is a software package utilized for logical statistical analysis. It can take data from almost any type of file and use them for generating tabulated reports, charts as well as plots of distributions and trends, descriptive statistics and conduct complex statistical analyses.

The face-to-face survey interviews were conducted with trained data enumerators strictly following the COVID-19 protocols (physical distancing, face masks, face shields, washing of hands) of the Department of Health (DOH).

Table 3-118. Research areas by city/municipality and barangay sampling sites

Province	City/municipality	Barangay	HH Population	Percentage	Sample Size	No. of key informants
Misamis Oriental	Cagayan de Oro	Bugo	7, 021	1.67	60	13
		Balubal	1, 072	0.84	9	
		Puerto	3, 254	0.89	29	
	Tagoloan	Casinglot	2, 207	0.91	20	13
		Natumolan	1, 924	0.88	17	
Bukidnon	Malaybalay	Barangay 10	640	0.94	6	15
		Sumpong	2, 022	0.89	18	
		Dalwangan	1, 523	0.85	13	
		Kalasungay	1, 798	0.88	16	
		Patpat	833	14.28	7	
	Sumilao	Puntian	340	0.88	3	13
		Kisolon	2, 507	0.88	22	
		Kulasi	138	0.72	1	
		Poblacion	1, 023	0.88	9	
		San Roque	275	0.73	2	
		Vista Villa	551	0.91	5	
	Manolo Fortich	Alae	2, 076	0.87	18	24
		Diclum	917	0.87	8	
		Damilag	2, 662	0.90	24	
		Tangkulan	1, 980	0.90	18	
		Ticala	289	1.03	3	
		Sankanan	849	0.94	8	
		San Miguel	1, 106	0.90	10	
		Mambatangan	988	0.91	9	
	Impasug-ong	Poblacion	2, 452	0.86	21	15
		Kibenton	922	0.54	5	
		Impalutao	1, 344	0.82	11	
		La Fortuna	948	0.84	8	
		Cawayan	452	0.88	4	
		Capitan Bayong	679	0.88	6	
		Total	**44,792**	**0.87**	**390**	**93**

NOTE: HH - household

Table 3-119. Number of key informant respondents host LGU

Municipality	Sample Size
Tagoloan	13
Cagayan de Oro	13
Manolo Fortich	24
Sumilao	13
Impasug-ong	15
Malaybalay	15
Total	**93**

The qualitative methods analyzed secondary data and literature study that included the a) Ancestral Domain Sustainable Development Plan (2014), b) Cagayan de Oro City Mayor's Annual Report (2018), and c) CLUPs of Cagayan de Oro City, Tagoloan, Manolo Fortich, Impasug-ong, Sumilao, and Malaybalay City.

3.4.3 Socio-economic perception survey (SPS)

The results of the social perception survey are presented in the succeeding sub-sections. The survey instrument was formulated to determine respondent demographics, household profiles, housing information, aspirations, and perception and attitude towards the Project.

3.4.3.1 Demographic information of the respondents

Sex – Majority (~67 percent) of the respondents were female and remaining male (**Table 3-120**); likely due to husbands at work with wives staying at home.

Table 3-120. Sex of the respondents

LGU	Number			% Distribution	
	Male	Female	Total	Male	Female
CDO	34	64	98	34.7	65.3
Malaybalay	20	40	53	33.3	66.7
Tagoloan	19	18	36	51.4	48.6
Sumilao	11	31	41	26.2	73.8
Manolo Fortich	33	65	98	33.7	66.3
Impasug-ong	12	43	55	21.8	78.2
TOTAL	**129**	**261**	**390**	**33.1**	**66.9**

Socio-economic and Perception Survey

Age distribution – The age distribution of the respondents from 16 to 60 years and above is shown in **Table 3-121**. The minimum age of more than 80 percent of the respondents were 30 years old, showing the maturity level of the respondents. Only 0.8 and 16.7percent of the respondents were between 16-19 and 20 to 29 years old respectively.

Table 3-121. Age of the respondents

Age	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
16 – 19	0	0.00	0	0.00	2	5.60	1	2.40	0	0.00	0	0.00	3	0.80
20 – 29	14	14.60	10	17.50	4	11.10	8	19.50	19	20.00	8	14.50	63	16.60
30 – 39	25	26.00	20	35.10	6	16.70	10	24.40	24	25.30	17	30.90	102	26.80
40 – 49	21	21.90	7	12.30	9	25.00	9	22.00	17	17.90	19	34.50	82	21.60
50 – 59	19	19.80	9	15.80	7	19.40	7	17.10	25	26.30	7	12.70	74	19.50
60 & above	17	17.70	11	19.30	8	22.20	6	14.60	10	10.50	4	7.30	56	14.70
Total	**96**	**100**	**57**	**100**	**36**	**100**	**41**	**100**	**95**	**100**	**55**	**100**	**380**	**100**

Source: Socio-economic and Perception Survey, NOTES: Missing/ No answer=10 (Cagayan de Oro City – 2, Sumilao – 1, Malaybalay – 3, Manolo Fortich – 3, Tagoloan – 1)

Civil status – Majority of the respondents were married (70%) followed by 17 percent single and seven percent with common-law partners (**Table 3-122**). The survey showed that single-parent households were comprised of 6.2 percent widowed and 0.3 percent separated.

Table 3-122. Civil status of the respondents

Civil status	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	N	%	N	%	N	%	N
Single	25	26.00	8	17.40	5	14.70	9	24.30	10	11.20	2	3.70	59	16.60
Married	56	58.30	36	78.30	27	79.40	24	64.90	58	65.20	48	88.90	249	69.90
Widow	7	7.30	2	4.30	1	2.90	2	5.40	8	9.00	2	3.70	22	6.20
CLP	8	8.30	0	0.00	1	2.90	1	2.70	13	14.60	2	3.70	25	7.00
Separated	0	0.00	0	0.00	0	0.00	1	2.70	0	0.00	0	0.00	1	0.30
Total	96	100	46	100	34	100	37	100	89	100	54	100	356	100

Source: Socio-economic and Perception Survey, NOTE: CLP – Common Law Partner; Missing/ No answer= 34 (Cagayan de Oro City – 2, Sumilao – 5, Malaybalay – 14, Manolo Fortich – 9, Tagoloan – 3, Impasug-ong – 1)

Educational attainment – More than three-fourths (76.5%) of the respondents had either elementary (38.7%) or secondary (37.8%) education. Respondents with college education were mostly from Malaybalay City while college graduates from Manolo Fortich (19.3%) and Impasug-ong (19.2%). Respondents with vocational education comprise 3.9 percent of the respondents. **Table 3-123** summarizes the educational attainment distribution of the respondents.

Table 3-123. Educational attainment of the respondents

Educational attainment	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Elementary Level	20	20.80	5	10.40	4	11.40	1	2.40	13	14.80	5	9.60	48	13.30
Elementary Graduate	5	5.20	1	2.10	7	20.00	4	9.80	2	2.30	4	7.70	23	6.40
High School Level	25	26.00	12	25.00	2	5.70	12	29.30	24	27.30	8	15.40	83	23.10
High School Graduate	10	10.40	6	12.50	10	28.60	6	14.60	11	12.50	13	25.00	56	15.60
College Level	14	14.60	21	43.80	6	17.10	10	24.40	18	20.50	9	17.30	78	21.70
College Graduate	17	17.70	2	4.20	5	14.30	7	17.10	17	19.30	10	19.20	58	16.10
Vocational	5	5.20	1	2.10	1	2.90	1	2.40	3	3.40	3	5.80	14	3.90
Total	96	100	48	100	35	100	41	100	88	100	52	100	360	100

Source: Socio-economic and Perception Survey, NOTE: No answer = 30 (Cagayan de Oro City – 2, Sumilao – 1, Malaybalay – 12, Manolo Fortich – 10, Tagoloan – 2, Impasug-ong – 3)

Nature of occupation – In general, the top five occupations comprising about 67 percent of the respondents were entrepreneurs, e.g., *sari-sari* store owners, *carinderia* owners, vendors, (27.7%) followed by the housewives/housekeepers (16.3%), barangay employees (11%), drivers (5.9%), and government employees (5.9%). The rest (33.39%) were engaged in manual or non-manual work. The distribution of the respondents' occupation is shown in **Table 3-124**.

Table 3-124. Occupation distribution of the respondents

Occupation	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Businesspersons	25	25.77	13	24.07	12	34.29	11	30.56	27	27.84	15	28.30	103	27.69
Housewife	17	17.53	6	11.11	0	0.00	9	25.00	18	18.56	10	18.87	60	16.13
Barangay Employees	1	1.03	5	9.26	4	11.43	1	2.78	18	18.56	12	22.64	41	11.02
Driver	6	6.19	2	3.70	6	17.14	0	0.00	5	5.15	3	5.66	22	5.91
Govt. Employee	2	2.06	13	24.07	1	2.86	3	8.33	2	2.06	1	1.89	22	5.91
Retired/ Pensioner	6	6.19	2	3.70	3	8.57	1	2.78	5	5.15	1	1.89	18	4.84
Teacher	5	5.15	0	0.00	3	8.57	3	8.33	2	2.06	3	5.66	16	4.30
Student	2	2.06	0	0.00	1	2.86	2	5.56	4	4.12	0	0.00	9	2.42
Private Employee	0	0.00	6	11.11	0	0.00	2	5.56	0	0.00	0	0.00	8	2.15
Farmer	1	1.03	1	1.85	1	2.86	0	0.00	2	2.06	2	3.77	7	1.88
Labor	3	3.09	2	3.70	0	0.00	1	2.78	0	0.00	1	1.89	7	1.88
Construction worker/Welder	2	2.06	1	1.85	2	5.71	0	0.00	0	0.00	0	0.00	5	1.34
Parttime/ Contractual	1	1.03	0	0.00	0	0.00	0	0.00	3	3.09	1	1.89	5	1.35
Sales Lady	1	1.03	0	0.00	0	0.00	0	0.00	3	3.09	0	0.00	4	1.08
Midwife/ Therapist/ Nurse	1	1.03	1	1.85	0	0.00	0	0.00	1	1.03	4	7.55	7	1.89
Security Guard/ Watch man	2	2.06	0	0.00	1	2.86	0	0.00	0	0.00	0	0.00	3	0.81
Delivery	2	2.06	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	0.54
None/child/old age	1	1.03	0	0.00	0	0.00	0	0.00	1	1.03	0	0.00	2	0.54
Electrician	0	0.00	0	0.00	1	2.86	0	0.00	1	1.03	0	0.00	2	0.54
Pastor	0	0.00	1	1.85	0	0.00	0	0.00	1	1.03	0	0.00	2	0.54
Del Monte Worker	1	1.03	0	0.00	0	0.00	0	0.00	1	1.03	0	0.00	2	0.54
Scrap buyer/seller	2	2.06	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	0.54
Vet Med	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Dentist/Dental Technician	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Mason/ Carpenter	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Overseas Filipino Worker (OFW)	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Nail technician	0	0.00	0	0.00	0	0.00	1	2.78	0	0.00	0	0.00	1	0.27
Engineer	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Child Development Worker	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
SK Chairman	0	0.00	0	0.00	0	0.00	1	2.78	0	0.00	0	0.00	1	0.27

Occupation	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Automotive	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Dress making	0	0.00	0	0.00	0	0.00	1	2.78	0	0.00	0	0.00	1	0.27
Caretaker	0	0.00	1	1.85	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Factory Worker	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Vulcanizer	0	0.00	0	0.00	0	0.00	0	0.00	1	1.03	0	0.00	1	0.27
Repair man	0	0.00	0	0.00	0	0.00	0	0.00	1	1.03	0	0.00	1	0.27
Helper	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Golf Coach	0	0.00	0	0.00	0	0.00	0	0.00	1	1.03	0	0.00	1	0.27
Packer (House)	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Printing Shop Owner	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Aircon Technician	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Butcher	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
On call dishwasher	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Boat Operator	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Parking caretaker	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.27
Total	**97**	**100**	**54**	**100**	**35**	**100**	**36**	**100**	**97**	**100**	**53**	**100**	**372**	**100**

Source: Socio-economic and Perception Survey; NOTE: No answer = 18 (Cagayan de Oro City – 1, Sumilao – 6, Malaybalay – 6, Manolo Fortich – 1, Tagoloan – 2, Impasug-ong – 2)

Years of residency – Majority (63.1%) of the respondents have been residents for six to over 40 years with about 28 percent residents since birth (considered as native in the area) (orange cells in **Table 3-125**). Respondent who has been residents for less than 5 years comprised five percent.

Table 3-125. Residency profile of respondents

Years of stay	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Since birth/ native	12	13.20	22	40.70	13	37.10	12	30.80	18	20.20	22	46.80	99	27.90
Below 5	14	15.40	6	11.10	2	5.70	4	10.30	4	4.50	2	4.30	32	9.00
6 – 10	6	6.60	2	3.70	4	11.40	2	5.10	9	10.10	7	14.90	30	8.50
11 – 15	8	8.80	2	3.70	2	5.70	1	2.60	7	7.90	5	10.60	25	7.00
16 – 20	10	11.00	2	3.70	1	2.90	6	15.40	8	9.00	3	6.40	30	8.50
21 – 25	8	8.80	3	5.60	1	2.90	1	2.60	9	10.10	3	6.40	25	7.00
26 – 30	10	11.00	6	11.10	5	14.30	5	12.80	11	12.40	1	2.10	38	10.70
31 – 35	7	7.70	6	11.10	1	2.90	2	5.10	7	7.90	1	2.10	24	6.80
36 – 40	7	7.70	4	7.40	2	5.70	1	2.60	5	5.60	1	2.10	20	5.60
41 & above	9	9.90	1	1.90	4	11.40	5	12.80	11	12.40	2	4.30	32	9.00
Total	**91**	**100**	**54**	**100**	**35**	**100**	**39**	**100**	**89**	**100**	**47**	**100**	**355**	**100**

Source: Socio-economic and Perception Survey, NOTE: No answer = 35 (Cagayan de Oro City – 7, Sumilao – 3, Malaybalay – 6, Manolo Fortich – 9, Tagoloan – 2, Impasug-ong – 8)

Religious affiliation – The respondents were predominantly Roman Catholic (79.5%) followed by the Baptists (7.8%) and Born-Again Christians (3.4%) (orange cells in **Table 3-126**). The dominance of the Catholics displayed the typical religious affiliation of many Filipinos. There were two Islam respondents in Cagayan de Oro and Impasug-ong with rest either Iglesia ni Cristo, Latter Day Saints, Assembly of God, Jehova Witnesses, Christian and Missionary Alliance Churches of the Philippines, or Christian.

Table 3-126. Religious profile of the respondents

Religion	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Roman Catholic	79	82.29	43	72.88	34	94.44	33	80.49	79	80.61	38	69.09	306	79.48
Baptist	4	4.17	10	16.95	0	0.00	3	7.32	8	8.16	5	9.09	30	7.79
Born Again	6	6.25			0	0.00	0	0.00	2	2.04	5	9.09	13	3.38
SDA	5	5.21	2	3.39	0	0.00	0	0.00	1	1.02	1	1.82	9	2.34
Iglesia Filipinista	0	0.00	1	1.69	0	0.00	2	4.88	2	2.04	2	3.64	7	1.82
Protestant	0	0.00	3	5.08	0	0.00	0	0.00			1	1.82	4	1.04
Mormons	0	0.00	0	0.00	1	2.78	0	0.00	3	3.06	0	0.00	4	1.04
Islam	1	1.04	0	0.00	0	0.00	0	0.00	0	0.00	1	1.82	2	0.52
Others:	1	1.04	0	0.00	1	2.78	3	7.32	3	3.06	2	3.64	10	2.60
Total	96	100	59	100	36	100	41	100	98	100	55	100	385	100

Source: Socio-economic and Perception Survey, NOTE: No answer = 5 (Cagayan de Oro City -2, Tagoloan – 1, Malaybalay – 1, Sumilao – 1); SDA - Seventh Day Adventist

Primary source of income – Salaries (34.4%), business or buy and sell (28.8%), and driving (10.3%) were the top three primary income sources of the respondents (orange cells in **Table 3-127**). Other sources included pensions (4.9%) farming (4.9%) and doing labor (3.3%) with the rest deriving income from dress making, furniture selling, pineapple harvesting, online job, golf coaching, dishwashing, fishing, mechanical working, and watch-making.

Table 3-127. Primary sources of income of the respondents

Primary income source	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Salary/ Honoraria	22	23.66	29	53.70	8	22.22	19	50.00	26	27.08	22	43.14	126	34.24
Business	31	33.33	9	16.67	12	33.33	11	28.95	30	31.25	13	25.49	106	28.80
Driver	11	11.83	4	7.41	6	16.67	3	7.89	11	11.46	3	5.88	38	10.33
Pension	3	3.23	3	5.56	2	5.56	1	2.63	7	7.29	2	3.92	18	4.89
Farming	2	2.15	6	11.11	1	2.78	2	5.26	4	4.17	3	5.88	18	4.89
Labor	6	6.45	0	0.00	1	2.78	0	0.00	0	0.00	5	9.80	12	3.26
H/SC	3	3.23	2	3.70	1	2.78	1	2.63	0	0.00	3	5.88	10	2.72
Construction	2	2.15	0	0.00	1	2.78	0	0.00	2	2.08	0	0.00	5	1.36
Factory Worker	1	1.08	0	0.00	0	0.00	0	0.00	3	3.13	0	0.00	4	1.09
Welding	0	0.00	1	1.85	2	5.56	0	0.00			0	0.00	3	0.82
Allotment	0	0.00	0	0.00	2	5.56	0	0.00	1	1.04	0	0.00	3	0.82
SB/S	3	3.23	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	3	0.82
Bgy. Volunteer	0	0.00	0	0.00	0	0.00	0	0.00	4	4.17	0	0.00	4	1.09
Electrician	1	1.08	0	0.00	0	0.00	0	0.00	1	1.04	0	0.00	2	0.54
OFW	2	2.15	0	0.00	0	0.00	0	0.00			0	0.00	2	0.54
Others	6	6.45	0	0.00			1	2.63	7	7.29	0	0.00	14	3.80
Total	93	100	54	100	36	100	38	100	96	100	51	100	368	100

Source: Socio-economic and Perception Survey; NOTES: No answer = 22 (Cagayan de Oro City – 5, Sumilao – 4, Malaybalay – 6, Manolo Fortich – 2, Tagoloan – 1, Impasug-ong – 4); H/SC - Husband/ Support by Children; SB/S - Scrap Buyer/Seller

Secondary source of income **–** The top three additional income sources of the respondents were business/buy and sell, driving, and farming (orange cells in **Table 3-128**). Driving, identified both for the primary and secondary income sources, signified that transport was an important income source. Other secondary income sources were dress making, working at Del Monte, massage, nail technician, in delivery and construction.

Table 3-128. Respondent secondary sources of income

Secondary income source	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Business	3	15.79	6	66.67	3	33.33	4	40.00	4	16.00	9	42.86	29	31.18
Driver	3	15.79	0	0.00	2	22.22	2	20.00	2	8.00	2	9.52	11	11.83
Farming	0	0.00	0	0.00	0	0.00	2	20.00	3	12.00	3	14.29	8	8.60
Salary	2	10.53	0	0.00	1	11.11	0	0.00	1	4.00	3	14.29	7	7.53
Pension	1	5.26	0	0.00	0	0.00	0	0.00	4	16.00	0	0.00	5	5.38
Honorarium	0	0.00	3	33.33	0	0.00	1	10.00	0	0.00	0	0.00	4	4.30
Barangay worker	0	0.00	0	0.00	0	0.00	0	0.00	4	16.00	0	0.00	4	4.30
BHW	1	5.26	0	0.00	0	0.00	0	0.00	1	4.00	1	4.76	3	3.23
Laborer	1	5.26	0	0.00	1	11.11	0	0.00	0	0.00	1	4.76	3	3.23
None	1	5.26	0	0.00	0	0.00	0	0.00	0	0.00	1	4.76	2	2.15
Pastor			0	0.00	0	0.00	1	10.00	0	0.00	1	4.76	2	2.15
Electrician	1	5.26	0	0.00	0	0.00	0	0.00	1	4.00	0	0.00	2	2.15
Vendor	1	5.26	0	0.00	1	11.11	0	0.00	0	0.00	0	0.00	2	2.15
Wife (abroad)	1	5.26	0	0.00	1	11.11	0	0.00	0	0.00	0	0.00	2	2.15
Barangay Captain	0	0.00	0	0.00	0	0.00	0	0.00	1	4.00	0	0.00	1	1.08
Others	4	21.05	0	0.00	0	0.00	0	0.00	4	16.00	0	0.00	8	8.60
Total	19	100	9	100	9	100	10	100	25	100	21	100	93	100

Source: Socio-economic and Perception Survey

Household monthly income – About 22% of the respondents declared an income range of Php8,001 to P11,000 while a greater number (~43%) had incomes below the poverty line (below PhP5,000 or PhP5,001.00 to P8,000.00). The average monthly poverty threshold for a family of five is Php8,022.00 (Official Gazette, 2014). This amount is sufficient to cover a single family's basic food and non-food needs. **Table 3-129** summarizes the household incomes of the respondents.

Table 3-129. Household monthly income of respondents

Monthly income	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	N	%	N	%	N	%	N
Below Php. 5,000	21	22.30	10	18.50	11	32.40	5	12.50	15	16.00	12	22.60	74	20.10
Php. 5,001–P8,000	11	11.70	13	24.10	5	14.70	8	20.00	25	26.60	12	22.6%	74	20.10
Php. 8,001–P11,000	22	23.40	13	24.10	8	23.50	9	22.50	20	21.30	11	20.80	83	22.50
Php. 11,001–P14,000	14	14.90	3	5.60	4	11.80	3	7.50	7	7.40	4	7.50	35	9.50
Php. 14,001–P17,000	3	3.20	4	7.40	2	5.90	3	7.50	4	4.30	2	3.80	18	4.90
Php. 17,001–P20,000	6	6.40	3	5.60	0	0.00	4	10.00	3	3.20	3	5.70	19	5.10
Php. 20,001 and above	17	18.10	8	14.80	4	11.80	8	20.00	20	21.30	9	17.00	66	17.90
Total	94	100	54	100	34	100	40	100	94	100	53	100	369	100

Source: Socio-economic Survey, NOTES: HH- household, No answer = 21 (Cagayan de Oro City – 4, Sumilao – 2, Malaybalay – 6, Manolo Fortich – 4, Tagoloan -3, Impasug-ong – 2)

Number of household members – Most respondent households had three to four members (43%) followed by 27.2 percent with five to six (orange cells in **Table 3-130**), signifying the typical family size of a Filipino family. It is interesting to note that there were respondents with seven or more household members.

Table 3-130. Household members of respondents

Number	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1-2	19	20.00	6	10.00	9	24.30	6	14.30	14	14.30	2	3.60	56	14.50
3-4	41	43.20	26	43.30	13	35.10	14	33.30	52	53.10	20	36.40	166	42.90
5-6	25	26.30	19	31.70	4	10.80	13	31.00	20	20.40	24	43.60	105	27.10
7-8	10	10.50	7	11.70	7	18.90	6	14.30	9	9.20	8	14.50	47	12.10
9 & above	0	0.00	2	3.30	4	10.80	3	7.10	3	3.10	1	1.80	13	3.40
Total	95	100	60	100	37	100	42	100	98	100	55	100	387	100

Source: Socio-economic Survey, NOTES: HH- household, No answer = 3 (Cagayan de Oro City – 3)

3.4.3.2 Profile of the household members

The succeeding sections presents the profile of the respondent household members in terms of age, sex, education, and civil status.

Household composition – The survey showed that respondent households had extended families where relatives such as in-laws and nieces/nephews and cousins and parents stay together with the married child (**Table 3-131**).

Table 3-131. Household composition (relationship to the respondent)

Relation	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Respondent	98	26.13	59	23.32	36	23.23	42	22.58	98	23.84	55	21.15	388	23.66
Son	71	18.93	5	22.13	25	16.13	40	21.51	87	21.17	73	28.08	352	21.46
Daughter	65	17.33	52	20.55	25	16.13	35	18.82	84	20.44	55	21.15	316	19.27
Husband	38	10.13	28	11.07	10	6.45	21	11.29	38	9.25	32	12.31	167	10.18
Wife	15	4.00	12	4.74	14	9.03	6	3.23	22	5.35	11	4.23	80	4.88
Grandson /daughter	17	4.53	8	3.16	16	10.32	9	4.84	13	3.16	10	3.85	73	4.45
Mother	15	4.00	7	2.77	4	2.58	6	3.23	10	2.43	5	1.92	47	2.87
Brother	14	3.73	8	3.16	4	2.58	8	4.30	9	2.19	3	1.15	46	2.80
Common Law Partner	10	2.67	5	1.98	2	1.29	3	1.61	12	2.92	3	1.15	35	2.13
Nephew/ Niece	14	3.73	2	0.79	3	1.94	2	1.08	10	2.43	2	0.77	33	2.01
Sister	6	1.60	8	3.16	6	3.87	6	3.23	2	0.49	2	0.77	30	1.83
Father	4	1.07	5	1.98	3	1.94	4	2.15	9	2.19	4	1.54	29	1.77
Son/Daughter-in-law	2	0.53	2	0.79	4	2.58	2	1.08	2	0.49	1	0.38	13	0.79
Father/Mother-in-law	2	0.53	0	0.00	1	0.65	1	0.54	4	0.97	2	0.77	10	0.61
Sister / brother-in-law	2	0.53	1	0.40	0	0.00	1	0.54	5	1.22	0	0.00	9	0.55
Relatives (Cousin, Aunt)	1	0.27	0	0.00	2	1.29	0	0.00	1	0.24	2	0.77	6	0.37
Helper	1	0.27	0	0.00	0	0.00	0	0.00	2	0.49	0	0.00	3	0.18
Others (Step Mother, Employer)	0	0.00	0	0.00	0	0.00	0	0.00	3	0.73	0	0.00	3	0.18
Total	375	100	253	100	155	100	186	100	411	100	260	100	1640	100

Source: Socio-economic Survey

Age of household members – The ages of other family members ranged from less than five years to 60 years old and above showing the wide age variation within the respondent households (**Table 3-132**).

Table 3-132. Age of the household members

Age	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Below 5	24	6.42	26	10.12	15	9.32	23	12.04	28	7.04	22	8.30	138	8.38
6 – 10	45	12.03	26	10.12	10	6.21	16	8.38	49	12.31	31	11.70	177	10.75
11 – 15	26	6.95	33	12.84	8	4.97	16	8.38	34	8.54	36	13.58	153	9.30
16 – 19	28	7.49	20	7.78	19	11.80	15	7.85	21	5.28	21	7.92	124	7.53
20 – 29	61	16.31	42	16.34	33	20.50	50	26.18	85	21.36	46	17.36	317	19.26
30 – 39	64	17.11	42	16.34	20	12.42	19	9.95	61	15.33	37	13.96	243	14.76
40 – 49	45	12.03	21	8.17	22	13.66	24	12.57	45	11.31	39	14.72	196	11.91
50 – 59	41	10.96	23	8.95	14	8.70	15	7.85	47	11.81	16	6.04	156	9.48
60. & above	40	10.70	24	9.34	20	12.42	13	6.81	28	7.04	17	6.42	142	8.63
Total	374	100	257	100	161	100	191	100	398	100	265	100	1646	100

Source: Socio-economic Survey

Sex of the household members – The sex distribution within the respondent households were almost equal (49.8% females, 50.2% males) (**Table 3-133**).

Table 3-133. Sex of the household members

Sex	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Female	195	50.78	117	50.43	82	50.62	88	46.56	212	51.33	126	47.37	820	49.82
Male	189	49.22	115	49.57	80	49.38	101	53.44	201	48.67	140	52.63	826	50.18
Total	384	100	232	100	162	100	189	100	413	100	266	100	1646	100

Source: Socio-economic Survey

Civil status of the household members – A little more than half (54.9%) of the household members were single likely composed of the young and unmarried children (**Table 3-134**). About 38.7% were married followed by those with common-law partners (3.6%), widows (2.5%), and separated (0.33%). The survey showed diversity of civil status within the respondent households.

Table 3-134. Civil status of the other household members of respondents

Civil status	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Single	203	55.31	119	59.20	77	51.68	105	60.34	198	51.30	142	54.41	844	54.88
Married	130	35.42	78	38.81	64	42.95	64	36.78	149	38.60	110	42.15	595	38.69
CLP	16	4.36	0	0.00	4	2.68	2	1.15	28	7.25	6	2.30	56	3.64
Widow	17	4.63	4	1.99	2	1.34	2	1.15	10	2.59	3	1.15	38	2.47
Separated	1	0.27	0	0.00	2	1.34	1	0.57	1	0.26	0	0.00	5	0.33
Total	**367**	**100**	**201**	**100**	**149**	**100**	**174**	**100**	**386**	**100**	**261**	**100**	**1538**	**100**

Source: Socio-economic Survey; NOTE: CLP – Common Law Partner

Educational attainment of household members – The survey showed varied levels of educational attainment of the respondent household members from day care/kindergarten to the college levels. Most of them had either elementary level (25.7%) or high school level education (25.9%). Household members with college education (16.2%) were mostly respondents from Malaybalay, Tagoloan, Manolo Fortich and Sumilao. The summary of the educational attainment of household members is shown in **Table 3-135**.

Table 3-135. Highest educational attainment of the household members

Educational attainment	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Day Care/Kinder	3	0.87	0	0.00	3	2.11	2	1.23	9	2.72	3	1.35	20	1.45
Pre-school	1	0.29	0	0.00	0	0.00	1	0.61	0	0.00	3	1.35	5	0.36
Elementary Level	126	36.63	43	25.15	20	14.08	21	12.88	89	26.89	54	24.22	353	25.69
Elementary Graduate	14	4.07	6	3.51	14	9.86	15	9.20	5	1.51	12	5.38	66	0.07
High School Level	83	24.13	51	29.82	29	20.42	54	33.13	84	25.38	56	25.11	357	25.98
High School Graduate	27	7.85	14	8.19	31	21.83	22	13.50	27	8.16	35	15.70	156	11.35
College Level	41	11.92	40	23.39	25	17.61	28	17.18	58	17.52	30	13.45	222	16.16
College Graduate	37	10.76	14	8.19	18	12.68	16	9.82	53	16.01	23	10.31	161	11.72
Vocational	12	3.49	3	1.75	2	1.41	4	2.45	6	1.81	7	3.14	34	2.47
Total	**344**	**100**	**171**	**100**	**142**	**100**	**163**	**100**	**331**	**100**	**223**	**100**	**1374**	**100**

Source: Socio-economic Survey

3.4.3.3 Housing information

Type of dwelling – Majority (86.7%) of the respondents resided in single or bungalow type of dwelling followed by two-storey houses (6%), duplexes (4.8%), and apartments (3.3%) (**Table 3-136**). Some live inside their business office and on huts or "*payag*" (out of wood and boxes).

Table 3-136. Dwelling units of respondents

Dwelling type	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Single (bungalow)	71	74.70	48	87.30	34	97.10	38	92.70	84	87.50	51	94.40	326	86.70
Duplex	8	8.40	1	1.80	1	2.90	2	4.90	5	5.20	1	1.90	18	4.80
Apartment	0	0.00	2	3.60	0	0.00	0	0.00	2	2.10	0	0.00	4	1.10
Two-storey	11	11.60	3	5.50	0	0.00	1	2.40	5	5.20	2	3.70	22	5.90
Inside the Business Office	2	2.10	1	1.80	0	0.00	0	0.00	0	0.00	0	0.00	3	0.80
Payag (huts)	3	3.20	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	3	0.80
Total	95	100	55	100	35	100	41	100	96	100	54	100	376	100

Source: Socio-economic Survey; NOTE: No answer = 14 (Cagayan de Oro City – 3, Sumilao – 1, Malaybalay – 5, Manolo Fortich – 2, Tagoloan – 2, Impasug-ong – 1)

Type of housing materials – The houses of the respondents were mostly made of concrete (41%) followed by both wood and concrete (32.4 %), and wood (22.5%) (**Table 3-137**). A small number of respondents resided on houses made of cogon or bamboo (4.2%).

Table 3-137. Housing materials of respondents

Material	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Concrete	49	50.00	23	41.10	13	36.10	15	36.60	42	43.30	15	27.30	157	41.00
Wood and concrete	23	23.50	21	37.50	8	22.20	18	43.90	30	30.90	24	43.60	124	32.40
Wood	22	22.40	10	17.90	15	41.70	6	14.60	21	21.60	12	21.80	86	22.50
Cogon/ bamboo	4	4.10	2	3.60	0	0.00	2	4.90	4	4.10	4	7.30	16	4.20
Total	98	100	56	100	36	100	41	100	97	100	55	100	383	100

Source: Socio-economic Survey; NOTE: No answer = 7 (Malaybalay – 4, Sumilao – 1, Tagoloan – 1, Manolo Fortich – 1)

House ownership – In terms of dwelling ownership, 59% of the respondents owned both the house and lot while 21% owns the house only and 3.7% were either renting or staying with relatives (**Table 3-138**). The rest stayed in a communal house, works as caretaker in the house they are residing, or have deeds of donation rights only.

Table 3-138. Ownership of respondent dwellings

Housing ownership	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Owns both house and lot	55	56.10	32	57.10	15	41.70	27	65.90	62	64.60	34	61.80	225	58.90
Owns the house only	17	17.30	18	32.10	11	30.60	8	19.50	15	15.60	10	18.20	79	20.70
Renting	14	14.30	3	5.40	7	19.40	4	9.80	9	9.40	5	9.10	42	11.00
Residing w/ relatives	1	1.00	2	3.60	0	0.00	0	0.00	8	8.30	3	5.50	14	3.70
Communal House	2	2.00	0	0.00	0	0.00	2	4.90	1	1.00	0	0.00	5	1.30
House Caretaking	5	5.10	1	1.80	2	5.60	0	0.00	1	1.00	2	3.60	11	2.90

Housing ownership	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Deed of Donation/ Rights	4	4.10	0	0.00	1	2.80	0	0.00	0	0.00	1	1.80	6	1.60
Total	98	100	56	100	36	100	41	100	96	100	55	100	382	100

Source: Socio-economic Survey; NOTES: No answer = 8 (Malaybalay –4, Sumilao – 1, Tagoloan – 1, Manolo Fortich – 2)

Fuel for cooking – The fuel mostly used by respondent households was firewood or charcoal (58.1%) followed by liquefied petroleum gas (31.3%), electric stoves (4.9%) and kerosene (5.7%). **Table 3-139** summarizes the cooking fuel used by respondent households.

Table 3-139. Cooking fuel used by household respondents

Cooking fuel	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	N	%	N	%	N	%	N
Firewood/ charcoal	45	45.90	34	58.60	19	52.80	30	71.40	58	59.20	39	70.90	225	58.10
LPG	42	42.90	16	27.60	13	36.10	8	19.00	28	28.60	14	25.50	121	31.30
Electric stove	5	5.10	3	5.20	3	8.30	1	2.40	5	5.10	2	3.60	19	4.90
Kerosene	6	6.10	5	8.60	1	2.80	3	7.10	7	7.10	0	0.00	22	5.70
Total	98	100	58	100	36	100	42	100	98	100	55	100	387	100

Source: Socio-economic Survey; NOTE: No answer = 3 (*Malaybalay – 2, Tagoloan – 1)*

Household lighting– Almost all of the respondent households used electricity (93.2%) for lighting (**Table 3-140**). However, there were households still using kerosene/gas, candle, solar, or battery for lighting.

Table 3-140. Type of lighting used by respondent households

Lighting	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Electricity	93	94.90	55	94.80	32	91.40	38	92.70	90	93.80	49	89.10	357	93.20
Candle	3	3.10	1	1.70	2	5.70	1	2.40	3	3.10	0	0.00	10	2.60
Kerosene/ gas	2	2.00	1	1.70	0	0.00	1	2.40	2	2.10	2	3.60	8	2.10
Solar/battery	0	0.00	1	1.70	1	2.90	1	2.40	1	1.00	4	7.30	8	2.10
Total	98	100	58	100	35	100	41	100	96	100	55	100	383	100

Source: Socio-economic Survey; NOTE: No answer = 7 (Malaybalay – 2, Sumilao – 1, Tagoloan – 2, Manolo Fortich – 2)

Source of domestic water – The domestic water requirements of respondent households were mostly supplied by the local water district (80.5%) followed by springs (**Table 3-141**). Other households get potable water from the deep well, river, pitcher pump, rainwater and others (communal sources from barangay and Del Monte Corporation).

Table 3-141. Source of domestic water of respondent households

Domestic water	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Water district	78	80.40	49	84.50	23	63.90	30	71.40	87	88.70	43	79.60	310	80.50
Deep/dug well	9	9.20	6	10.30	4	11.1	1	2.40	1	1.00	1	1.90	22	5.7
Pitcher pump	6	6.20	1	1.70	2	5.60	0	0.00	1	1.00	0	0.00	10	2.60
Private pump	0	0.00	0	0.00	2	5.60	1	2.40	1	1.00	1	1.90	5	1.30
Spring	0	0.00	1	1.70	2	5.60	8	19.00	0	0.00	7	13.00	18	4.70
River	0	0.00	1	1.70	3	8.30	1	2.40	0	0.00	0	0.00	5	1.30
Rainwater	0	0.00	0	0.00	0	0.00	1	2.40	0	0.00	0	0.00	1	0.30

Domestic water	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Others:	4	4.10	0	0.00	0	0.00	0	0.00	8	8.20	2	3.70	14	3.60
Total	97	100	58	100	36	100	42	100	98	100	54	100	385	100

Source: Socio-economic Survey; NOTE: No answer = 5 (Cagayan de Oro City – 1, Tagoloan Mis. Occ. – 1, Malaybalay – 2, Impasug-ong – 1)

Method of SW disposal – Majority (89.3%) of the respondent households disposed their solid wastes through the house-to-house collection by the municipality/city (**Table 3-142**). Other households disposed their SW by burning (4.70%), burying (3.90%), dumping to another place (1%) and placing in a hole (1%).

Table 3-142. Solid waste disposal of respondent households

Disposal method	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	N	%	N	%	N	%	N
LGU collection	87	89.70	53	89.80	30	83.30	37	92.50	92	93.90	44	81.50	343	89.30
Burning	8	8.20	2	3.40	1	2.80	1	2.50	1	1.00	5	9.30	18	4.70
Burying	2	2.10	3	5.10	2	5.60	1	2.50	3	3.10	4	7.40	15	3.90
Dumping	0	0.00	1	1.70	1	2.80	1	2.50	0	0.00	1	1.90	4	1.00
Placing in a hole	0	0.00	0	0.00	2	5.60	0	0.00	2	2.00	0	0.00	4	1.00
Total	97	100	59	100	36	100	40	100	98	100	54	100	384	100

Source: Socio-economic Survey; NOTE: No answer = 6, (Cagayan de Oro City – 1, Sumilao – 2, Malaybalay – 1, Impasug-ong – 1, Tagoloan - 1)

Toilet facility – Majority (82.8%) of the respondents mostly coming from Malaybalay, Sumilao and Impasug-ong have water-sealed toilets in their houses followed by the flush-type toilet (**Table 3-143**). The rest used public toilets, Antipolo type commodes, common toilet, or the toilet of relatives.

Table 3-143. Toilet facility used by respondent households

Toilet facility	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Water sealed	59	64.1	51	92.7	29	80.6	34	91.9	83	88.3	48	90.6	304	82.83
Flush type	23	25	3	5.5	6	16.7	3	8.1	10	10.6	3	5.7	48	13.08
Antipolo type	4	4.3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	4	1.09
Public toilet	3	3.3	1	1.8	0	0.00	0	0.00	1	1.1	0	0.00	5	1.36
Toilet of relatives	2	2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	0.54
Common	1	1.1	0	0.00	1	2.8	0	0.00	0	0.00	2	3.8	4	1.09
Total	92	100	55	100	36	100	37	100	94	100	53	100	367	100

Source: Socio-economic Survey; NOTE: No answer = 23 (Cagayan de Oro City – 6, Sumilao – 5, Malaybalay – 5, Manolo Fortich – 4, Tagoloan -1, Impasug-ong – 2)

3.4.3.4 Perceptions towards the Project

Awareness of the proposed Project - Majority of the respondents were aware of the proposed Project (63%) with only 37.4 percent unaware (**Table 3-144**). This showed most of the them knew about the plan to establish the CMH Project in their locality. The respondents in municipalities of Manolo Fortich and Malaybalay have higher awareness (67% and 65.3% respectively) compared with the rest of the host LGUs indicating that the IEC campaign and information dissemination must have been relatively more effective in these areas.

Table 3-144. Awareness of the proposed Project

Awareness	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Yes	62	63.30	40	66.70	24	64.90	25	61.00	64	65.30	28	51.90	243	62.60
No	36	36.70	20	33.30	13	35.10	16	39.00	34	34.70	26	48.10	145	37.40
Total	**98**	**100**	**60**	**100**	**37**	**100**	**41**	**100**	**98**	**100**	**54**	**100**	**388**	**100**

Source: Socio-economic Survey; NOTE: No answer = 2 (Sumilao – 1, Impasug-ong – 1)

Source of project information - The survey showed that Project information came from both formal and informal sources. More than a third (39%) of the respondents knew about the Project from the local government employees. Informal sources such as neighbors, relatives, and friends comprised 23.4 percent of the respondents (**Table 3-145**). Other sources of Project information mentioned by the respondents were DPWH Project employees/City Engineers/JICA (9.4%) and neighbors and LGU combined (8%). The rest mentioned mass media such as the radio and television or from the survey/interviewer, family member and other sources.

Table 3-145. Respondent sources of information regarding the Project

Information Source	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Barangay/Municipal/ City Officials	22	35.48	21	52.50	4	16.67	12	50.00	24	37.50	11	37.93	94	38.68
Neighbors/Relatives/ Friends	16	25.81	6	15.00	8	33.33	9	37.50	15	23.44	3	10.34	57	23.46
DPWH/City Engineers/Project employees	3	4.84	5	12.50	2	8.33	0	0.00	9	14.06	4	13.79	23	9.47
Neighbor and Barangay/Municipal Officials	5	8.06	0	0.00	2	8.33	0	0.00	5	7.81	7	24.14	19	7.82
Radio	6	9.68	0	0.00	4	16.67	0	0.00	0	0.00	1	3.45	11	4.53
Interviewer/Survey	1	1.61	4	10.00	1	4.17	0	0.00	3	4.69	1	3.45	10	4.12
Television	3	4.84	2	5.00	0	0.00	0	0.00	2	3.13	0	0.00	7	2.88
Barangay/Municipal Officials and DPWH Project employees	2	3.23	0	0.00	0	0.00	0	0.00	3	4.69	2	6.90	7	2.88
Family Member	1	1.61	1	2.50	2	8.33	1	4.17	1	1.56	0	0.00	6	2.47
Poster/social media/ Radio & Television	2	3.23	1	2.50	0	0.00	0	0.00	2	3.13	0	0.00	5	2.06
Others (Customer/ Parish Priest)	1	1.61	0	0.00	1	4.17	2	8.33	0	0.00	0	0.00	4	1.65
Total	**62**	**100**	**40**	**100**	**24**	**100**	**24**	**100**	**64**	**100**	**29**	**100**	**243**	**100**

Source: Socio-economic Survey

Initials thoughts about the Project – The respondents' initial reactions and thoughts when hearing about the Project were a) benefits to residents and community (77.1%); none; nothing can be done; not sure; it's enough (15.7%); many problems/complaints against the Project (4.7%); trees will be cut and conversion of private/ agricultural lands (0.6%); houses affected (0.6%); good with big trucks able to pass (0.6%); big help to motorists (0.6%); and loss of livelihood near the highway/roads (0.3%) (**Table 3-146**). These reactions typified a combination of positively- and negatively inclined answers with the predominance of the former with Malaybalay City recognizing the benefits with 91.8 percent. There were those pleased with the Project because big trucks can pass and beneficial to motorists in general. On the other hand, respondents with negative reactions/thoughts need attention with regards to socioeconomic and environmental problems and complaints.

Table 3-146. Initial reactions or thoughts when first heard about the project

Response	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	N	%	N	%	N	%	N
Plenty of benefits to residents and community	72	75.00	45	91.80	18	52.90	31	100	73	76.00	37	71.20	276	77.10
None; nothing can be done/no choice; not sure; It's enough	17	17.70	0	0.00	11	32.40	0	0.00	15	15.60	13	25.00	56	15.7
Many problems/ complaints against the project	6	6.30	4	8.20	2	5.90	0	0.00	4	4.20	1	1.90	17	4.70
Trees will be cut and conversion of private/ agricultural lands	0	0.00	0	0.00	0	0.00	0	0.00	2	2.10	0	0.00	2	0.60
Houses affected	1	1.00	0	0.00	0	0.00	0	0.00	1	1.00	0	0.00	2	0.60
Good with big trucks able to pass	0	0.00	0	0.00	1	2.90	0	0.00	0	0.00	1	1.90	2	0.60
Big help to motorists	0	0.00	0	0.00	2	5.90	0	0.00	0	0.00	0	0.00	2	0.60
Loss of livelihood near the highway/ roads	0	0.00	0	0.00	0	0.00	0	0.00	1	1.00	0	0.00	1	0.30
Total	**96**	**100**	**49**	**100**	**34**	**100**	**31**	**100**	**96**	**100**	**52**	**100**	**358**	**100**

Source: Socio-economic Survey; NOTE: No answer = 32 (Cagayan de Oro City – 2, Sumilao – 11, Malaybalay – 11, Manolo Fortich – 2, Tagoloan -3, Impasug-ong – 3)

Opinion towards the Project – The survey showed that 90.3 percent of the respondents stated that the Project will significantly help the community and local residents (orange cell in **Table 3-147**). About three percent stated that the Project will be either detrimental or will not help the community at all.

Table 3-147. Opinions regarding the proposed Project

Opinion	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Will help the community a lot	92	94.80	52	86.70	27	77.10	38	92.70	85	89.50	50	94.30	344	90.30
Will be able to help but not much	3	3.10	5	8.30	6	17.10	3	7.30	6	6.30	0	0.00	23	6.00
Will be detrimental to the community	1	1.00	3	5.00	1	2.90	0	0.00	2	2.10	2	3.80	9	2.40
Will not help the community	0	0.00	0	0.00	0	0.00	0	0.00	2	2.10	1	1.90	3	0.80
In between	1	1.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.30
Others: Gov't will benefit	0	0.00	0	0.00	1	2.90	0	0.00	0	0.00	0	0.00	1	0.30
Total	**97**	**100**	**60**	**100**	**35**	**100**	**41**	**100**	**95**	**100**	**53**	**100**	**381**	**100**

Source: Socio-economic Survey; Note: No answer = 9 (Cagayan de Oro City – 1, Sumilao – 1, Tagoloan – 2, Manolo Fortich – 3, Impasug-ong – 2

3.4.3.5 Environmental change

The survey revealed several environmental changes perceived by the respondents in the past five years on air, land, water, forest, population, and solid waste management. Respondents who perceived "more changes" conveyed the top three issues as population/migration, traffic congestion, and land conversion into subdivisions (green cells in **Table 3-148**). Respondents who cited "less changes" indicated the top three environmental as solid waste, flooding in lowlands, and forest cover issues (orange cells in **Table 3-148**).

With regards to the changes considered as having the most effect on the community and daily life, the top five responses included impact of COVID-19 pandemic (17.4%), financial crisis/no income/business down/high prices of goods (15.2%), traffic congestion (10.8%), okay/no problem (9.2%), and population growth/migration (9.2%) (orange cells in **Table 3-149**). A close look at the data revealed that while the COVID19 pandemic was not mentioned, it emerged as having the most expected effect with Cagayan de Oro City (23.5%) and Impasug-ong (20.4%). It is worthy to note that during the interviews, Cagayan de Oro City was placed in modified enhanced community quarantine (MECQ). The municipality of Impasug-ong had also a high COVID19 infection rate and strictly observe health protocols amidst the atmosphere of anxiety and fear. The economic slowdown is considered the next change that would affect the community and the household daily affairs with Malaybalay posting the highest at 24.4% and closely followed by Sumilao (20.7%). Population issue resurfaced as the expected change that would affect the constituents. The other responses included air pollution, combination of problems (traffic, flooding, pollution and water problem), solid waste management, flooding, less farm income due to lease of lots to companies, and many more others (denuded forest cover/landslide/ schooling of children affected /no source of electricity).

Perceived beneficial effects of the Project – Respondent opinions on Project effects to their community varied. Beneficial effects were mostly economic such as local employment (35.7%), community projects (20.1%), industrialization of the community (19%), and revenue/income accruing to the locality (13.2%). Some mentioned social related issues such as community solidarity and traffic system. **Table 3-150** summarizes the opinions of the respondents regarding perceived beneficial effects of the Project.

Table 3-148. Changes observed in the community during the past five years

Response	Cagayan de Oro				Malaybalay				Tagoloan				Sumilao				Manolo Fortich				Impasug-ong				Total			
	More		Less		More		Less		More		Less		More		Less		More		Less		More		Less		More		Less	
Factories/ power plants/ industries	13	4.15	27	6.98	4	1.99	28	10.53	16	12.31	4	2.4	4	3.2	14	7.73	31	7.85	23	6.34	9	5.77	24	7.69	77	5.83	120	7.16
Lands converted into subdivision	39	12.46	36	9.3	21	10.45	29	10.9	12	9.23	21	12.57	10	8	23	12.71	69	17.47	21	5.79	11	7.05	35	11.22	162	12.27	165	9.84
Farm harvest	15	4.79	57	14.73	16	7.96	32	12.03	4	3.08	27	16.17	18	14.4	18	9.94	45	11.39	35	9.64	19	12.18	32	10.26	117	8.86	201	11.99
Flooding in low lands	26	8.31	50	12.92	8	3.98	39	14.66	12	9.23	20	11.98	8	6.4	22	12.15	28	7.09	48	13.22	6	3.85	41	13.14	88	6.67	220	13.13
Forest cover	11	3.51	57	14.73	18	8.96	30	11.28	4	3.08	23	13.77	17	13.6	15	8.29	21	5.32	53	14.6	18	11.54	28	8.97	89	6.74	206	12.29
Population/ migration	70	22.36	14	3.62	36	17.91	20	7.52	32	24.62	4	2.4	30	24	9	4.97	77	19.49	10	2.75	36	23.08	17	5.45	281	21.29	74	4.42
Water pollution	23	7.35	50	12.92	21	10.45	26	9.77	9	6.92	19	11.38	8	6.4	21	11.6	27	6.84	47	12.95	16	10.26	32	10.26	104	7.88	195	11.63
Air/noise pollution	38	12.14	37	9.56	25	12.44	19	7.14	17	13.08	13	7.78	12	9.6	18	9.94	35	8.86	39	10.74	19	12.18	29	9.29	146	11.06	155	9.25
Traffic congestion	59	18.85	15	3.88	32	15.92	15	5.64	19	14.62	12	7.19	10	8	19	10.5	43	10.89	32	8.82	16	10.26	33	10.58	179	13.56	126	7.52
Solid wastes	19	6.07	44	11.37	20	9.95	28	10.53	5	3.85	24	14.37	8	6.4	22	12.15	19	4.81	55	15.15	6	3.85	41	13.14	77	5.83	214	12.77
Total	**313**	**100**	**387**	**100**	**201**	**100**	**266**	**100**	**130**	**100**	**167**	**100**	**125**	**100**	**181**	**100**	**395**	**100**	**363**	**100**	**156**	**100**	**312**	**100**	**1320**	**100**	**1676**	**100**

Source: Socio-economic Survey; NOTE; Multiple Responses

Table 3-149. Changes having the most effect on the community and daily life

Changes having the most effect on the community	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Impact of pandemic	19	23.46	5	11.90	3	10.34	5	17.24	13	15.29	10	20.41	55	17.41
Financial crisis; no income; business down; high prices of goods	14	17.28	10	23.81	2	6.90	6	20.69	10	11.76	6	12.24	48	15.19
Traffic congestion	12	14.81	3	7.14	8	27.59	3	10.34	7	8.24	1	2.04	34	10.76
Okay; no problem	5	6.17	0	0.00	1	3.45	0	0.00	7	8.24	16	32.65	29	9.18
More Population/ Migration	3	3.70	5	11.90	1	3.45	0	0.00	17	20.00	3	6.12	29	9.18
Air pollution (e.g., factories)	2	2.47	3	7.14	4	13.79	4	13.79	14	16.47	1	2.04	28	8.86
Combination of problems: traffic, flooding, pollution and water problem	8	9.88	2	4.76	2	6.90	1	3.45	6	7.06	3	6.12	22	6.96
Solid waste management	2	2.47	6	14.29	0	0.00	1	3.45	2	2.35	1	2.04	12	3.80
Flooding	10	12.35	0	0.00	1	3.45	0	0.00	0	0.00	0	0.00	11	3.48
Less farm income due to lease of lots to companies	0	0.00	2	4.76	2	6.90	1	3.45	3	3.53	0	0.00	8	2.53
Others	1	1.23			2	6.90	3	10.34	1	1.18	1	2.03	8	2.53
Destroyed roads	0	0.00	0	0.00	2	6.90	3	10.34	0	0.00	1	2.04	6	1.90
Water Pollution	2	2.47	0	0.00	0	0.00	1	3.45	1	1.18	2	4.08	6	1.90
Problem of water supply	3	3.70	1	2.38	0	0.00	0	0.00	1	1.18	0	0.00	5	1.58
Noise pollution	0	0.00	0	0.00	0	0.00	0	0.00	2	2.35	2	4.08	4	1.27
Farm conversion to subdivision	0	0.00	1	2.38	0	0.00	1	3.45	1	1.18	0	0.00	3	0.95
Drugs and heavy alcohol drinking	0	0.00	2	4.76	0	0.00	0	0.00	0	0.00	1	2.04	3	0.95
Traffic accident, accident prone	0	0.00	1	2.38	1	3.45	0	0.00	0	0.00	0	0.00	2	0.63
Farm to Market Road	0	0.00	1	2.38	0	0.00	0	0.00	0	0.00	1	2.04	2	0.63
Total	**81**	**100**	**42**	**100**	**29**	**100**	**29**	**100**	**85**	**100**	**49**	**100**	**315**	**100**

Source: Socio-economic Survey; NOTE: No answer = 75 **(**Cagayan de Oro City – 17, Sumilao – 13, Malaybalay – 18, Manolo Fortich – 13, Tagoloan. -8, Impasug-ong – 6)

Table 3-150. Perceived positive and beneficial impacts of the Project

Positive Effects/ Impacts	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	N	%	N	%	N	%	N
Employment for some local residents	61	39.35	38	30.89	18	34.62	25	33.78	53	37.59	29	22.31	224	35.73
Assisting community projects/development	30	19.35	26	21.14	7	13.46	16	21.62	25	17.73	22	16.92	126	20.10
Industrialization of the community	19	12.26	28	22.76	8	15.38	17	22.97	23	16.31	24	18.46	119	18.98
Income/revenue to the barangay/municipality/city/province	17	10.97	19	15.45	5	9.62	10	13.51	14	9.93	18	13.85	83	13.24
None/ not sure/ Nothing to narrate	13	8.39	0	0.00	7	13.46	0	0.00	14	9.93	11	8.46	45	7.18
Community solidarity	12	7.74	12	9.76	4	7.69	6	8.11	10	7.09	25	19.23	21	3.35
Help ease out traffic	3	1.94	0	0.00	3	5.77	0	0.00	1	0.71	0	0.00	7	1.12
Others	0	0.00	0	0.00	0	0.00	0	0.00	1	0.71	1	0.77	2	0.32
Total	**155**	**100**	**123**	**100**	**52**	**100**	**74**	**100**	**141**	**100**	**130**	**100**	**627**	**100**

NOTE: Multiple responses; Source: Socio-economic survey

Perceived adverse impacts of the Project – The top five perceived adverse impacts comprising about 57 percent of the responses were traffic congestion, noise pollution, decrease in farm harvest, air pollution, and flooding (orange cells in **Table 3-151**). More than a third (34.6%) had no response and not sure of any adverse impacts (green cell in **Table 3-151**). Other environment-related issues mentioned were decrease in ground water resources, health hazard, peace and order issues, water pollution, affected by road widening and others.

Table 3-151. Perceived adverse impacts of the Project

Impact	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	N	%	N	%	N	%	N
None/ not sure	51	41.46	0	0.00	20	43.48	0	0.00	46	39.66	38	61.29	155	34.60
Traffic congestion	19	15.45	9	14.75	6	13.04	9	22.50	21	18.10	1	1.61	65	14.51
Noise pollution/ disturb residents	13	10.57	10	16.39	8	17.39	8	20.00	17	14.66	7	11.29	63	14.06
Decrease in farm harvest	5	4.07	15	24.59	2	4.35	11	27.50	22	18.97	5	8.06	60	13.39
Air pollution	13	10.57	8	13.11	5	10.87	6	15.00	2	1.72	4	6.45	38	8.48
Flooding	11	8.94	10	16.39	1	2.17	2	5.00	2	1.72	2	3.23	28	6.25
Decrease in ground water resources	1	0.81	4	6.56	1	2.17	1	2.50	4	3.45	1	1.61	12	2.68
Health hazard	2	1.63	1	1.64	3	6.52	0	0.00	1	0.86	2	3.23	9	2.01
Peace and order hazard	1	0.81	3	4.92	0	0.00	2	5.00	1	0.86	1	1.61	8	1.79
Water pollution	3	2.44	1	1.64	0	0.00	1	2.50	0	0.00	1	1.61	6	1.34
Affected by road widening	2	1.63	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	0.45
Others	2	1.62	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	0.44
Total	**123**	**100**	**61**	**100**	**46**	**100**	**40**	**100**	**116**	**100**	**62**	**100**	**448**	**100**

Source: Socio-economic Survey

3.4.3.6 Aspiration

More than three-fourths (79.8%) of the respondents wanted to work for the Project if given the chance while the rest were either were unwilling or not sure (**Table 3-152**). The responses indicated that the residents view the Project as a generator of work or employment and an economic opportunity.

Table 3-152. Opinion on working for the proposed Project

Response	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Yes	77	79.40	53	88.30	27	73.00	37	88.10	74	76.30	41	75.90	309	79.80
No	13	13.40	3	5.00	8	21.60	3	7.10	11	11.30	11	20.40	49	12.70
Not sure	7	7.20	4	6.70	2	5.40	2	4.80	12	12.40	2	3.70	29	7.50
Total	**97**	**100**	**60**	**100**	**37**	**100**	**42**	**100**	**97**	**100**	**54**	**100**	**387**	**100**

Source: Socio-economic Survey; Note: No answer = 3 (Cagayan de Oro City – 1, Manolo Fortich – 1, Impasug-ong – 1)

Table 3-153 summarizes the reasons for the positive response regarding the job opportunities. Most of the reasons were primarily economic where almost half (49%) conveyed the Project as an additional income source. Almost a third (32.3%) recognized employment/work for the residents' children and with the Project providing access. On the other hand, the negative response regarding job opportunity were focused on business (33.3%), have existing work (33.1%), not good senior citizens (11.1%), no one can work; underage children; women (11.1%), allergy to dust and health issues (6.7%), and absence of skill (6.7%). These were the reasons why the respondents were uninterested in working with the Project underscoring presence of work, age and health matters, and absence of skill. In addition, the reasons given for the "*not sure*" responses were COVID19 pandemic, farming as work, and not good as the reasons behind uncertainty.

Table 3-153. Opinion on allowing oneself or a household member to work for the proposed Project

Affirmative reasons	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Additional income source; help financial difficulties; able to buy rice	29	39.73	20	45.45	15	60.00	18	52.94	30	44.78	26	66.67	138	48.94
Employment/work for residents/children/ work accessible to residents	27	36.99	17	38.64	5	20.00	7	20.59	24	35.82	11	28.21	91	32.27
Yes; accept; good	6	8.22	2	4.55	0	0.00	7	20.59	2	2.99	0	0.00	17	6.03
Others: it depends if there is something for us; we are all women	8	10.96	3	6.82	1	4.00	1	2.94	3	4.48	1	2.56	17	6.03
High salary	2	2.74	1	2.27	2	8.00	0	0.00	3	4.48	0	0.00	8	2.84
Progress/development	1	1.37	0	0.00	1	4.00	0	0.00	5	7.46	1	2.56	8	2.84
Others: Business advantage/Support schooling of children	0	0.00	1	2.27	1	4.00	1	2.94	0	0.00	0	0.00	3	1.06
Total	**73**	**100**	**44**	**100**	**25**	**100**	**34**	**100**	**67**	**100**	**39**	**100**	**282**	**100**
Negative reasons	**CDO**		**Malaybalay**		**Tagoloan**		**Sumilao**		**Manolo Fortich**		**Impasug-ong**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Focus on business	7	58.3	0	0.00	1	14.3	2	66.7	2	20	3	27.3	15	33.3
Have work already	0	0.00	0	0.00	1	14.3	1	33.3	5	50	7	63.6	14	31.1
Not good with our old age; senior	3	25	0	0.00	1	14.3	0	0.00	0	0.00	1	9.1	5	11.1
No one can work; underage children; women	0	0.00	2	100	1	14.3	0	0.00	2	20	0	0.00	5	11.1
Allergy to dust; health issue	0	0.00	0	0.00	3	42.9	0	0.00	0	0.00	0	0.00	3	6.7
No skill	2	16.7	0	0.00	0	0.00	0	0.00	1	10	0	0.00	3	6.7
Total	**12**	**100**	**2**	**100**	**7**	**100**	**3**	**100**	**10**	**100**	**11**	**100**	**45**	**100**
Reason for Not Sure response	**CDO**		**Malaybalay**		**Tagoloan**		**Sumilao**		**Manolo Fortich**		**Impasug-ong**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Might have another work/have work	4	57.14	2	50.00	1	50.00	0	0.00	1	8.33	1	50.00	9	30.00
It depends the type of work	1	14.29	1	25.00	1	50.00	0	0.00	3	25.00	0	0.00	6	20.00
Focus on business	1	14.29	0	0.00	0	0.00	2	66.67	2	16.67	0	0.00	5	16.67
Can’t accommodate; child still young and schooling	1	14.29	0	0.00	0	0.00	0	0.00	3	25.00	1	50.00	5	16.67
Partner is elderly	0	0.00	0	0.00	0	0.00	0	0.00	2	16.67	0	0.00	2	6.67
Others: Because of covid pandemic/ engaged in farming	0	0.00	1	25.00	0	0.00	1	33.33	1	8.33	0	0.00	3	10.00
Total	**7**	**100**	**4**	**100**	**2**	**100**	**3**	**100**	**12**	**100**	**2**	**100**	**30**	**100**

3.4.3.7 Attitude towards the Project

Approval on the Project – In general, a high majority (94.6%) of the respondents indicated approval of the Project against the 1.3 percent opposed (**Table 3-154**). About four percent were not sure whether they approve of the Project.

Table 3-154. Approval of the Project

Response	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Yes	94	95.90	56	93.30	34	94.400	42	100.00	92	93.90	50	90.90	368	94.60
No	1	1.00	1	1.70	0	0.00	0	0.00	2	2.00	1	1.80	5	1.30
Not sure	3	3.10	3	5.00	2	5.60	0	0.00	4	4.10	4	7.30	16	4.10
Total	98	100	60	100	36	100	42	100	98	100	55	100	389	100

Source: Socio-economic Survey; Note: No answer = 1 (Tagoloan -1)

The top three reasons of the respondents approving the Project were the expected convenience due to fast travel, road improvement, reduction of traffic congestion (31.7%); progress of the community (28.4%); and less traffic congestion (9.8%). About 3.4 percent mentioned the connection of farm-to-market roads and reduced susceptibility to accidents. The rest of the responses mentioned economic benefits such as work, employment, good roads for investors, and additional income.

Those opposing responded that the Project might affect their living and income source and cutting of trees. Those taking the “not sure stand” stated the Project might affect their house, displace people, and destroy the environment. These issues were underscored during the public consultations.

Approval upon abatement of negative impacts – A large majority (83%) approved the Project if the adverse effects are mitigated, 4.2 percent still gave a negative response, and 13 percent unsure (**Table 3-156**). The top five reasons for the “Yes”, “No” and “Not Sure” responses to Project approval if adverse impacts are mitigated are enumerated below. The summary of the responses is shown in **Table 3-157**.

a) Affirmative response
  - Address the issues/concerns; good process
  - Depends on the contractor
  - Development and big help to the community and people; easy to transport

b) Negative response
  - Develop community; depends on situation; can be control
  - Environment will be affected
  - Others: this is a govt project; no comment

c) Not sure response
  - Don’t know; can’t decide; not certain; it depends; no comment
  - Farmers’ source of water and houses will be affected
  - Others: provided no serious difficulties

Table 3-155. Reasons for approving the establishment of the Project

Affirmative reasons	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Easy travel, access easy and wide/ beautiful roads for vehicles; improved roads with overpass	27	30.70	13	31.70	5	15.60	16	41.00	27	32.90	16	34.80	104	31.70
For progress/improvement; big help; for a change; for the good of the people; for the next generation	24	27.30	14	34.10	10	31.30	11	28.20	21	25.60	13	28.30	93	28.40
Lessen traffic	10	11.40	4	9.80	5	15.60	4	10.30	6	7.30	3	6.50	32	9.80
Agree	11	12.50	5	12.20	3	9.40	2	5.10	6	7.30	1	2.20	28	8.50
It's a government project	3	3.40	2	4.90	5	15.60	3	7.70	11	13.40	2	4.30	26	7.90
Connect farm-to-market roads	1	1.10	1	2.40	0	0.00	2	5.10	4	4.90	3	6.50	11	3.40
Lessen/no accident; no longer prone to accident	4	4.50	0	0.00	0	0.00	0	0.00	4	4.90	3	6.50	11	3.40
Work/employment	4	4.50	1	2.40	3	9.40	0	0.00	0	0.00	0	4.30	10	3.00
Good roads for investors	3	3.40	0	0.00	1	3.10	1	2.60	2	2.40	0	0.00	7	2.10
Additional income	1	1.10	1	2.40	0	0.00	0	0.00	1	1.20	2	4.30	5	1.50
Others: just enough and important	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	2.20	1	0.30
Total	88	100	41	100	32	100	39	100	82	100	46	100	328	100
Negative reasons	**CDO**		**Malaybalay**		**Tagoloan**		**Sumilao**		**Manolo Fortich**		**Impasug-ong**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Might affect our living/-affect income source	0	0.00	1	100.00	0	0.00	0	0.00	1	50.00	1	100.00	3	75.00
Trees cut down	0	0.00	0	0.00	0	0.00	0	0.00	1	50.00	0	0.00	1	25.00
Total	0	0.00	1	100	0	0.00	0	0.00	2	100	1	100	4	100
Reason for Not Sure response	**CDO**		**Malaybalay**		**Tagoloan**		**Sumilao**		**Manolo Fortich**		**Impasug-ong**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Affect houses	2	66.70	1	33.30	0	0.00	0	0.00	0	0.00	2	66.70	5	45.50
Displace people	0	0.00	0	0.00	1	100.00	0	0.00	1	100.00	1	33.30	3	27.30
It depends on the project	1	33.30	1	33.30	0	0.00	0	0.00	0	0.00	0	0.00	2	18.20
Destroy the environment	0	0.00	1	33.30	0	0.00	0	0.00	0	0.00	0	0.00	1	9.10
Total	3	100	3	100	1	100	0	0.00	1	100	3	100	11	100

Source: Socio-economic Survey

Table 3-156. Approval of the Project if the adverse impacts are mitigated

Response	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Yes	75	77.30	54	93.10	31	83.80	35	92.10	80	85.10	38	71.70	313	83.00
No	2	2.10	3	5.20	2	5.40	1	2.60	4	4.30	4	7.50	16	4.20
Not sure	20	20.60	1	1.70	4	10.80	2	5.30	10	10.6	11	20.80	48	12.70
Total	97	100	58	100	37	100	38	100	94	100	53	100	377	100

Source: Socio-economic Survey; NOTE: No answer = 13 (Cagayan de Oro City – 1, Sumilao – 4, Malaybalay – 2, Manolo Fortich – 4, Impasug-ong – 2)

Table 3-157. Reason for the approval/disapproval upon mitigation of adverse impacts

Affirmative reason	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Address the issues/concerns; good process	8	13.1	8	25	10	40	9	32.1	12	20.3	12	34.3	59	24.6
Depends on the contractor	24	39.3	1	3.1	5	20	1	3.6	8	13.6	2	5.7	41	17.1
Development and big help to the community and people; easy to transport	7	11.5	6	18.8	3	12	6	21.4	9	15.3	4	11.4	35	14.6
Safer roads; less accident; safety ensured	7	11.5	4	12.5	2	8	6	21.4	5	8.5	8	22.9	32	13.3
Can't go against the government	2	3.3	6	18.8	2	8	2	7.1	9	15.3	0	0.00	21	8.8
Less traffic	4	6.6	3	9.4	0	0.00	1	3.6	5	8.5	2	5.7	15	6.3
As long as lands and plants affected are paid; settle obligation	2	3.3	1	3.1	0	0.00	0	0.00	5	8.5	2	5.7	10	4.2
Okay if not damaging	3	4.9	0	0.00	1	4	1	3.6	3	5.1			8	3.3
Others: no comment; balance positive and negative; no more muddy roads; way to assist the elderly cross the street	2	3.28	1	3.13	0	0.00	1	3.57	1	1.69	2	5.71	8	3.33
Help each other; unite	2	3.3	1	3.1	2	8	0	0.00	2	3.4	0	0.00	7	2.9
Road accessible to farmers	0	0.00	1	3.1	0	0.00	0	0.00	0	0.00	3	8.6	4	1.7
Total	**61**	**100**	**32**	**100**	**25**	**100**	**28**	**100**	**59**	**100**	**35**	**100**	**240**	**100**
Negative reason	**CDO**		**Malaybalay**		**Tagoloan**		**Sumilao**		**Manolo Fortich**		**Impasug-ong**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Develop community; depends on situation; can be control	0	0.00	0	0.00	1	100	0	0.00	1	33.3	1	33.3	3	30
Environment will be affected	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	66.7	2	20
Others: this is a govt project; no comment	0	0.00	0	0.00	0	0.00	1	100	1	33.3	0	0.00	2	20
Negative reason	**CDO**		**Malaybalay**		**Tagoloan**		**Sumilao**		**Manolo Fortich**		**Impasug-ong**		**Total**	

	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Vulnerable to flooding	0	0.00	0	0.00	0	0.00	0	0.00	1	33.3	0	0.00	1	10
People will be affected	0	0.00	1	100	0	0.00	0	0.00	0	0.00	0	0.00	1	10
There's a positive and negative effect	1	100	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	10
Total	**1**	**100**	**1**	**100**	**1**	**100**	**1**	**100**	**3**	**100**	**3**	**100**	**10**	**100**

Reason for Not Sure response	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Don't know; can't decide; not certain; it depends; no comment	12	85.7	0	0.00	3	100	2	100	3	37.5	4	40	24	64.9
Farmers' source of water and houses will be affected	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	5	50	5	13.5
Others: provided no serious difficulties	0	0.00	0	0.00	0	0.00	0	0.00	2	25	1	10	3	8.1
Neutral; no choice	2	14.3	0	0.00	0	0.00	0	0.00	3	37.5	0	0.00	5	13.5
Total	**14**	**100**	**0**	**0.00**	**3**	**100**	**2**	**100**	**8**	**100**	**10**	**100**	**37**	**100**

Source: Socio-economic Survey

Consultation to the community – A high majority (94.3%) of the respondents indicated the importance of community consultation about the Project with Sumilao and Cagayan de Oro each with 95% affirmation (**Table 3-158**).

Table 3-158. Opinion on consulting the community about the Project

Response	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	N	%	N	%	N	%	N
Yes	93	94.90	58	98.30	33	89.20	38	95.00	90	93.80	50	92.60	362	94.30
No	2	2.00	1	1.70	1	2.70	1	2.50	4	4.20	4	7.40	13	3.40
Not sure	3	3.10	0	0.00	3	8.10	1	2.50	2	2.10	0	0.00	9	2.30
Total	98	100	59	100	37	100	40	100	96	100	54	100	384	100

Source: Socio-economic Survey; Note: No answer = 6 (Malaybalay – 1, Manolo Fortich – 2, Sumilao – 2, Impasug-ong – 1)

The top three reasons behind the need for community consultation were a) augmenting the awareness level (57.1%), b) proper dissemination of information (15%), and c) proper decision making/consent (10.7%). The main reasons of the respondents who answered that community consultation was unnecessary were a) positive effects of the Project (69.23%), b) IEC fatigue, i.e., meetings have been previously conducted (23.1%) and c) no one can go against the Project (7.7%). Respondents with unsure stances gave the following reasons: a) awareness (37.5%), b) Project will depend on the government (37.5%), and c) minimal effect on the poor (25%).

Participation in meetings and consultations – A high majority (83.5%) of the respondents were willing to attend meetings and consultations about the Project with Sumilao having the highest affirmation at 95.2 percent followed by Manolo Fortich and Cagayan de Oro City with 77.68 and 78.6 percent respectively (**Table 3-160**).

The reasons for wanting to attend meetings and concentrated shown in **Table 3-161** were mostly on awareness and knowledge about the Project updates and additional information (29.7%) and knowledge about the process and activities/programs and guidelines (21.5%).

Table 3-159. Reasons for consulting the community about the Project

Affirmative reasons	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Raise awareness; inform the people on project purposes for them to be aware of the good /bad effects	55	62.50	27	58.70	12	40.00	24	70.60	45	56.30	23	47.90	186	57.10
Proper information	8	9.10	7	15.20	10	33.30	2	5.90	14	17.50	8	16.70	49	15.00
Proper decision making; consent by barangay	8	9.10	4	8.70	5	16.70	5	14.70	5	6.30	8	16.70	35	10.70
Gather peoples' perceptions	11	12.50	3	6.50	2	6.70	3	8.80	6	7.50	6	12.50	31	9.50
Explain and coordinate	3	3.40	2	4.30	0	0.00	0	0.00	6	7.50	0	0.00	11	3.40
Follow legal process	0	0.00	2	4.30	1	3.30	0	0.00	2	2.50	0	0.00	5	1.50
Agree to have wide roads	0	0.00	1	2.20	0	0.00	0	0.00	1	1.30	2	4.20	4	1.20
Importance of drainage	2	2.30	0	0.00	0	0.00	0	0.00	1	1.30	0	0.00	3	0.90
Follow rituals of the natives	1	1.10	0	0.00	0	0.00	0	0.00	0	0.00	1	2.10	2	0.60
Total	**88**	**100**	**46**	**100**	**30**	**100**	**34**	**100**	**80**	**100**	**48**	**100**	**326**	**100**
Negative reasons	**CDO**		**Malaybalay**		**Tagoloan**		**Sumilao**		**Manolo Fortich**		**Impasug-ong**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Positive effects of the Project	2	100	0	0.00	1	100.00	1	100	3	75.00	2	50.00	9	69.23
They won't listen/meetings have been conducted before	0	0.00	1	100	0	0.00	0	0.00	1	25.00	1	25.00	3	23.10
Others: No one can go against the government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	25.00	1	7.70
Total	**2**	**100**	**1**	**100**	**1**	**100**	**1**	**100**	**4**	**100**	**4**	**100**	**13**	**100**
Reason for Not Sure response	**CDO**		**Malaybalay**		**Tagoloan**		**Sumilao**		**Manolo Fortich**		**Impasug-ong**		**Total**	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Awareness/for us to know/they will take charge	1	33.30	0	0.00	1	50.00	0	0.00	1	50.00	0	0.00	3	37.50
It depends on the gov't	1	33.30	0	0.00	1	50.00	0	0.00	1	50.00	0	0.00	3	37.50
The poor will not be much affected and people will know	1	33.30	0	0.00	0	0.00	1	100.00	0	0.00	0	0.00	2	25.00
Total	**3**	**100**	**0**	**0.00**	**2**	**100**	**1**	**100**	**2**	**100**	**0**	**0.00**	**8**	**100**

Source: Socio-economic Survey

Table 3-160. Participation in meetings and consultations about the Project

Response	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Yes	77	78.60	52	86.70	32	86.50	40	95.20	76	77.60	48	88.90	325	83.50
No	6	6.10	3	5.00	2	5.40	0	0.00	5	5.10	1	1.90	17	4.40
Not sure	15	15.30	5	8.30	3	8.10	2	4.80	17	17.30	5	9.30	47	12.10
Total	**98**	**100**	**60**	**100**	**37**	**100**	**42**	**100**	**98**	**100**	**54**	**100**	**389**	**100**

Source: Socio-economic Survey; Note: No answer = 1 (Impasug-ong – 1)

Table 3-161. Reason for participation in meetings and consultations

Affirmative reason	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Knowledge/awareness about the Project	26	36.11	11	29.73	9	34.62	11	33.33	18	27.27	8	17.78	83	29.75
Knowledge about the process and activities/programs, processes, guidelines	14	19.44	11	29.73	5	19.23	12	36.36	8	12.12	10	22.22	60	21.51
Might conflict with schedules; busy with business/work; depends on time; if not far; if there is invitation	12	16.67	2	5.41	3	11.54	1	3.03	12	18.18	2	4.44	32	11.47
Provided if available; with time; short period; always attending; willing	5	6.94	2	5.41	4	15.38	4	12.12	5	7.58	8	17.78	28	10.04
Just attend; no problem	5	6.94	5	13.51	2	7.69	2	6.06	8	12.12	6	13.33	28	10.04
Understand the benefits or good effects and improvements of the project/ to gain knowledge what is to be done regarding the project; not to be ignorant	8	11.11	3	8.11	2	7.69	2	6.06	6	9.09	6	13.33	27	9.68
Know if house and lot will be affected	0	0	0	0	1	3.85	0	0	0	0	3	6.67	4	1.43
Others- attend if given money and fare/ to voice out questions not complaints	0	0	1	2.7	0	0	0	0	3	4.55	0	0	4	1.43
Need to get involved and listen; to help; to share the info	2	2.78	2	5.41			1	3.03	6	9.09	2	4.44	13	4.66
Total	**72**	**100**	**37**	**100**	**26**	**100**	**33**	**100**	**66**	**100**	**45**	**100**	**279**	**100**
Negative reason	**CDO**		**Malaybalay**		**Tagoloan**		**Sumilao**		**Manolo Fortich**		**Impasug-ong**		**Total**	

	N	%	N	%	N	%	N	%	N	%	N	%	N	%
busy; no time; working	1	33.3	3	100	1	50	0	0.00	2	50	0	0.00	7	53.8
this is a govt project	0	0.00	0	0.00	0	0.00	0	0.00	1	25	1	100	2	15.4
if given the schedule	2	66.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	15.4
afraid of covid pandemic	0	0.00	0	0.00	1	50	0	0.00	1	25	0	0.00	2	15.4
Total	**3**	**100**	**3**	**100**	**2**	**100**	**0**	**0.00**	**4**	**100**	**1**	**100**	**13**	**100**

Reason for Not Sure response	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
It depends if available; not conflict with schedule; if no work; depends on the situation and time	11	73.33	3	60	2	66.67	2	100	8	50	1	20	27	58.7
Busy; preoccupied with business	1	6.67	2	40	1	33.33	0	0.00	5	31.25	3	60	12	26.09
having high blood pressure; dialysis of husband	0	0.00	0	0.00	0	0.00	0	0.00	3	18.75	0	0.00	3	6.52
There is pandemic	2	13.33	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	4.35
Others: have children to take care	1	6.67	0	0.00	0	0.00	0	0.00	0	0.00	1	20	2	4.35
Total	**15**	**100**	**5**	**100**	**3**	**100**	**2**	**100**	**16**	**100**	**5**	**100**	**46**	**100**

Source: Socio-economic Survey

3.4.4 Key Informant Interviews

The Key Informant Interviews (KII) conducted from May 28 to June 4, 2021 were participated by 93 locals from the six host cities and municipalities. The distribution of the KII respondents is shown in **Table 3-162**.

Table 3-162. Number of key informant respondents host LGU

Municipality	Sample Size
Tagoloan	13
Cagayan de Oro	13
Manolo Fortich	24
Sumilao	13
Impasug-ong	15
Malaybalay	15
Total	**93**

3.4.4.1 Demographic information of the Key Informants

Sex – The overall KII participants on the average comprised of 55.91 percent female and 44.09 percent male (**Table 3-163**). Male respondents dominated the KII in the municipalities of Tagolona and Sumilao.

Table 3-163. Sex of key Informants

Sex	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Male	5	38.46	7	46.67	8	61.54	7	53.85	9	37.50	5	33.33	41	44.09
Female	8	61.54	8	53.33	5	38.46	6	46.15	15	62.50	10	66.67	52	55.91
Total	**13**	**100**	**15**	**100**	**13**	**100**	**13**	**100**	**24**	**100**	**15**	**100**	**93**	**100**

Source: Key Informant Interview

Age distribution – The ages of the key informants ranged from 20 to 60 years old and above where majority (53.76%) were from 40 to 59 years old (orange cells in **Table 3-164**).

Table 3-164. Age of key informants

Age	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
16 – 19	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
20 – 29	0	0.00	0	0.00	3	23.08	1	7.69	0	0.00	2	13.33	6	6.45
30 – 39	5	38.46	5	33.33	2	15.38	2	15.38	2	8.33	4	26.67	20	21.51
40 – 49	1	7.69	3	20.00	1	7.69	7	53.85	10	41.67	3	20.00	25	26.88
50 – 59	5	38.46	5	33.33	3	23.08	1	7.69	7	29.17	4	26.67	25	26.88
60 & above	2	15.38	2	13.33	4	30.77	2	15.38	5	20.83	2	13.33	17	18.28
Total	13	100	15	100	13	100	13	100	24	100	15	100	93	100

Source: Key Informant Interview

Civil status – The total average distribution of the key informant civil status was 72.04 percent married and 18.27 percent single (**Table 3-165**). In addition, more than the majority of the key informants across the host LGUs were married.

Table 3-165. Civil status of key informants

Civil status	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Single	3	23.08	2	13.33	4	30.77	1	7.69	2	8.33	5	33.33	17	18.28
Married	8	61.54	11	73.33	9	69.23	11	84.62	19	79.17	9	60.00	67	72.04
Widow	2	15.38	2	13.33	0	0.00	1	7.69	3	12.50	1	6.67	9	9.68
Total	13	100	15	100	13	100	13	100	24	100	15	100	93	100

Source: Key Informant Interview

Educational attainment – About a third of the key informants were college graduates (38.70%) followed by respondents who had secondary level education (17.20%). The educational attainment profile of the key informants is summarized in **Table 3-166.**

Table 3-166. Educational attainment of key informants

Educational attainment	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Elementary Level	0	0.00	1	6.67	3	23.08	0	0.00	1	4.17	0	0.00	5	5.38
Elementary Graduate	1	7.69	1	6.67	0	0.00	0	0.00	0	0.00	4	26.67	6	6.45
High School Level	4	30.77	2	13.33	2	15.38	2	15.38	4	16.67	2	13.33	16	17.20
High School Graduate	1	7.69	2	13.33	2	15.38	3	23.08	3	12.50	2	13.33	13	13.98
College Level	2	15.38	2	13.33	1	7.69	0	0.00	6	25.00	3	20.00	14	15.05
College Graduate	5	38.46	7	46.67	4	30.77	6	46.15	10	41.67	4	26.67	36	38.71
Vocational	0	0.00	0	0.00	1	7.69	2	15.38	0	0.00	0	0.00	3	3.23
Total	13	100	15	100	13	100	13	100	24	100	15	100	93	100

Source: Key Informant Interview

Occupation – About a fourth (25.8%) of the key informants were barangay officials followed by 14 percent in business and teachers (12.9%). Other occupations of the key informants were farmers, drivers, pastor/priest, government employees and midwives. About two percent of the key informants were housewives and IPs. The occupation distribution of the key informants is shown in **Table 3-167**.

Table 3-167. Occupation of the key informants

Occupation	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Housewife	0	0.00	0	0.00	1	7.70	0	0.00	1	4.00	0	0.00	2	2.20
Barangay Officials	3	23.10	2	14.30	3	23.10	2	25.00	6	24.00	8	40.00	24	25.80
Barangay employee	0	0.00	2	14.30	2	15.40	0	0.00	3	12.00	0	0.00	7	7.50
Barangay Health Worker	1	7.70	3	21.40	0	0.00	1	12.50	1	4.00	2	10.00	8	8.60
Teacher	2	15.40	3	21.40	2	15.40	1	12.50	1	4.00	3	15.00	12	12.90
Farmer	1	7.70	3	21.40	0	0.00	2	25.00	1	4.00	1	5.00	8	8.60
Business	3	23.10	1	7.10	2	15.40	0	0.00	5	20.00	2	10.00	13	14.00
Driver	2	15.40	0	0.00	2	15.40	1	12.50	1	4.00	1	5.00	7	7.50%
Pastor/ priest	1	7.70	0	0.00	0	0.00	1	12.50	1	4.00	0	0.00	3	3.20
Government	0	0.00	0	0.00	1	7.70	0	0.00	2	8.00	3	15.00	6	6.50

Occupation	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
employee														
IPMR	0	0.00	0	0.00	0	0.00	0	0.00	2	8.00	0	0.00	2	2.20
Midwife	0	0.00	0	0.00	0	0.00	0	0.00	1	4.00	0	0.00	1	1.10
Total	13	100	14	100	13	100	8	100	25	100	20	100	93	100

Source: Key Informant Interview

Key Informant sector – The sectors representing the key informants were host LGUs (30.1%), business sector (14%), education (12.9%), health (9.7%), and farmer and transportation (7.5%). Other sectors included religious, IPs, agriculture, CENRO, MPDO, PWD, and Women's group. **Table 3-168** shows the sector distribution of the key informants.

Table 3-168. Sector represented by key informants

Sector	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	5.00	1	1.10
Business	3	23.10	1	7.10	2	15.40	0	0.00	5	20.00	2	10.00	13	14.00
CENRO	0	0.00	0	0.00	0	0.00	0	0.00	1	4.00	0	0.00	1	1.10
Education	2	15.40	3	21.40	2	15.40	1	12.50	1	4.00	3	15.00	12	12.90
Farmer	1	7.70	3	21.40	0	0.00	2	25.00	0	.00	1	5.00	7	7.50
Health	1	7.70	3	21.40	0	0.00	1	12.50	2	8.00	2	10.00	9	9.70
IPs	0	0.00	1	7.10	0	0.00	0	0.00	3	12.00	0	0.00	4	4.30
LGU	3	23.10	2	14.30	5	38.50	2	25.00	7	28.00	9	45.00	28	30.10
Mayor's Office	0	0.00	0	0.00	0	0.00	0	0.00	1	4.00	0	0.00	1	1.10
MPDO-MPDC	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	5.00	1	1.10
PWD and Parents	0	0.00	1	7.10	0	0.00	0	0.00	0	0.00	0	0.00	1	1.10
Religion	1	7.70	0	0.00	1	7.70	1	12.50	2	8.00	0	0.00	5	5.40
Transportation	2	15.40	0	0.00	2	15.40	1	12.50	1	4.00	1	5.00	7	7.50
Women's	0	0.00	0	0.00	1	7.70	0	0.00	2	8.00	0	0.00	3	3.20
Total	13	100	14	100	13	100	8	100	25	100	20	100	93	100

Source: Key Informant Interview; Note: CENRO – City Environment and Natural Office, IPs – Indigenous People, LGU – Local Government Unit, MPDO-MPDC – Municipal Planning and Development Coordinator/Officer, PWD – People with Disabilities

Awareness of local traffic ordinances and safety – More than three-fourths (78.49%) of the participants were unaware of the local traffic ordinances and safety in their areas (**Table 3-169**).

Table 3-169. Awareness of traffic safety ordinances

Response	Frequency	Percent
Yes	20	21.51
No	73	78.49
Total	93	100

Source: Key Informant Interview

Among key informants who were aware, 55 and 18.18 percent said there were local and municipal ordinances respectively (**Table 3-170**). In addition, 18.18 percent said these ordinances pertained to wearing of safety gears, while 9.09 percent said it was slowing down near school premises. Other specific local ordinances related to installing road humps to slow traffic, signage for construction sites, no parking along the highway, banning trucks in the city roads, speed limits and ban on noisy mufflers.

Table 3-170. Local ordinances identified by the key informants pertaining to traffic safety

Local Ordinances	NR	% of total

Yes, there are ordinances	11	55.0
Wearing of safety gears	2	18.18
Municipal Ordinances	2	18.18
City – slow down school premise	1	9.09
Implementing /humps in the barangay/construction signage	1	9.09
No parking along the highway truck ban within the city	1	9.09
Peace and order	1	9.09
Speed limit / noisy muffler	1	9.09
Total	**20**	**100.0**

Source: Key Informant Interview; NOTE: NR – number of responses

Common problems in the community - The common community problems according to the key informants were 1) issues on ancestral land, 2) road/transportation issues, 3) financial problems, 4) lack of social services, 5) peace and security, 6) social issues, 7) COVID-19 pandemic, 8) and informal settler concerns. Issues of IP ancestral lands was the top problems in the communities (**Table 3-171**).

Table 3-171. Common problems observed in the community (Multiple Responses)

Common problems in the community	NR	% of total
IP/ancestral domain issues		
Ancestral domain issues	14	11.29
Ancestral domain, road to hinterland IP community	2	1.61
The ancestral domain is settled but the poor are still suffering	1	0.81
There is land grabbing of IP lands	1	0.81
Poverty among the IPs, ancestral land is not secured	1	0.81
Land conflict for land sold without proper documents	1	0.81
Road/transportation issues		
Road is slippery when it rains, damaged and muddy roads	7	5.65
Traffic, accident prone area, no lane for bicycles	3	2.42
Motorists that are abusive, noisy motorcycles	3	2.42
Traffic congestion, it is not clear where the jeepney stop is	2	1.61
Agriculture, farm to market road, farm inputs (seedlings and fertilizers), sustain their start-up business	1	0.81
Accessibility of buildings, highways, sidewalk	1	0.81
Dust due to construction of roads	1	0.81
Hit and run accidents	1	0.81
Underage children driving without license	1	0.81
Accident prone areas, lack of water supply, COVID-19 cases increasing	1	0.81
Road accidents	1	0.81
Parking space due to crowded area	1	0.81
Need for road construction going to the interior	1	0.81
The road is small even though it is 4 lanes, parking on the shoulder can still cause traffic	1	0.81
The road will not be paved due to military reservation	1	0.81
Difficult to travel due to few numbers of transportation vehicles and fare is very expensive	1	0.81
Miscommunication, wrong information about the road under construction	1	0.81
Financial problems/ issues		
Lack of livelihood projects and issues for farmers in selling their products	4	3.23
Financial issues, family problems	3	2.42
Difficult to bring products to the market and the price is very cheap; very cheap price of corn	2	1.61
Financial issues, unemployed	2	1.61
Financial problem of the organization	1	0.81
Child labor, distance of houses from school / economic status / lack of funding for incoming college students	1	0.81
Food security problem	1	0.81
Social services issues		

Common problems in the community	NR	% of total
Lack of water supply, slow water pressure	5	4.03
Garbage segregation, poverty, crime	2	1.61
Water system, road and drainage system	1	0.81
Dirty canal which causes flooding	1	0.81
Slow internet connection	1	0.81
4Ps selection is biased for those relatives/close people with the officials	1	0.81
Peace and security issues		
Out of school youth loitering, alcoholism among the youth	9	7.26
Crime, theft	4	3.23
Drug abuse or addiction	3	2.42
Peace and order due to high insurgency rates and NPA threats	3	2.42
Peace and security, gang rivalry	3	2.42
Gossiping, lack of discipline	2	1.61
Social issues		
Teenage pregnancy, right now we are educating our youth to decrease the highest problem in our society	7	5.65
Children have different attitudes from the youth before	1	0.81
Children sleep late due to online games / PC games	1	0.81
Illegal gambling such as cockfighting	1	0.81
Delayed pension for the senior citizen	1	0.81
COVID-19 issues		
COVID-19 – fear and anxiety	9	7.26
Not following the health protocols for COVID-19	3	2.42
There are people who do not want to be vaccinated for COVID-19 vaccine	1	0.81
Mental health problems due to stress	1	0.81
Informal settlers		
Proliferation of informal settlers	2	1.61
Migrants coming in and planting potatoes which had an effect on our laborers	1	0.81
Total	125	100

Source: Key Informant Interview; NOTE: NR – number of responses

Skills of the residents - The top three skills mentioned by the key informants shown in **Table 3-172** with an aggregated response of 57.15 percent were driving, cooking, and farming.

Table 3-172. Skills of the community members

Skills	NR	% of total
Driving	21	57.15
Cooking	19	19.39
Farming	16	16.33
Fishing	5	5.1
Food processing, pot making, cooking, facemask making	5	5.1
Handicraft making	5	5.1
Carpentry, labor, mason, electrical, welding, plumbing	5	5.1
Carpentry	4	4.08
Mason, labor	3	3.06
Electrical	2	2.04
Computer literate	2	2.04
Dress making	2	2.04
Creativity in designing, online business	1	1.02
Business	1	1.02
Carpentry, welding, mechanic	1	1.02
Knife making, bag making, mat weaving	1	1.02
Laborer, carpentry, mason	1	1.02
Packaging in Del Monte	1	1.02
Plumber, mason	1	1.02

Skills	NR	% of total
Singing	1	1.02
Welding, plumber, carpenter, mason	1	1.02
Total	98	100

Source: Key Informant Interview; NOTE: NR – number of responses

3.4.4.2 Suggested alternative livelihood

For men and women – The top five alternative livelihood suggested by the key informants for both men and women included handicraft making, farming, business, livestock raising and Technical Education and Skills Development Authority (TESDA) courses as well as Advance Learning System (ALS) courses (orange cells in **Table 3-173**). Other alternative livelihood suggested were establishing a cooperative, construction work, cooking, financial support for farmers, food processing training, food courier/online food selling, rice selling, dressmaking, fish selling, gardening, micro-credit, financial literacy, online selling, and working on tourist attractions.

For men only – The top five alternative livelihood suggested by key informants for men only were farming and training/financial help, carpentry and equipment, skills training on various skills, agricultural projects, and driving (orange cells in **Table 3-174**). Other suggestions were capital for livestock raising, construction work, fishing, handicraft making, and business on hardware supplies, buy and sell business, electrical training, factory worker, financial assistance for small business, food processing, vegetable growing, online business, and TESDA trainings.

Table 3-173. Suggested alternative livelihood for men and women

Alternative Livelihood	NR	% of Total
Handicraft training (rag making, basket weaving, wallets made out of recyclable materials)	14	14.43
Farming	10	11.34
Business, mini market or mini mart, used clothing (ukay-ukay) or repair shop	7	7.22
Livestock raising with provision of feeds	7	7.22
TESDA courses (welding, driving, carpentry)	6	6.19
Advance Learning System (ALS) -skills training, food processing	5	5.15
Financial support, post-harvest facilities, skill training for farmers, farm tractor credit	5	5.15
Cooperative	4	4.12
Construction work	4	4.12
Cooking	4	4.12
Food processing training	4	4.12
Food courier/ food vending/ consignment/online food selling	3	3.09
Gardening	3	3.09
Rice selling	2	2.06
Dress making	2	2.06
Enhanced farming skills, enhanced business skills	2	2.06
Fish selling	2	2.06
Bamboo products, corn-innovate products	1	1.03
Computer literacy and education and trainings	1	1.03
Stove pot making	1	1.03
Employment	1	1.03
Improvement training	1	1.03
Micro-credit	1	1.03
Financial literacy	1	1.03
Motor parts cooperative	1	1.03
Online selling	1	1.03
Seminar on capability building, how to market the products	1	1.03
Small business	1	1.03
Working on tourist attractions	1	1.03
Total	97	100

Source: Key Informant Interview; NOTE: NR – number of responses

Table 3-174. Alternative livelihood for men and women

Alternative Livelihood	NR	% of Total
Farming, training on farming, financial assistance	8	15.09
Carpentry and carpentry equipment	7	13.21
Skills training on black smiting, mechanic, carpentry, welding	7	13.21
Agricultural projects/activities	5	9.43
Driving	4	7.55
Capital for backyard livestock raising	3	5.66
Construction work	3	5.66
Fishing	2	3.77
Handicraft making - wallet making	2	3.77
Business involving hardware	1	1.89
Buy and sell business	1	1.89
Electrical training	1	1.89
Factory worker	1	1.89
Financial assistance for small business	1	1.89
Food processing	1	1.89
Home-grown vegetable	1	1.89
Livelihood	1	1.89
Online business	1	1.89
Plantation employment	1	1.89
TESDA training	1	1.89
Employment	1	1.89
Total	53	100

Source: Key Informant Interview; NOTE: NR – number of responses

For women only – The top five alternative livelihood suggested by key informants for women only were food processing training, TESDA training on various courses/skills, training on cosmetology, cooking viands, and gardening (orange cells in **Table 3-175**). Other suggestions were handicraft making, financial support for small business, online business training, mental health seminars/webinars, baking and pastry training, bamboo cultivation, buy and sell, farming, flower plantation, rice selling, livestock raising and selling used clothing.

Table 3-175. Alternative livelihood for women only

Alternative Livelihood	NR	% of Total
Food processing - cheese making, coffee processing	14	19.18
TESDA training on dress making, face mask, eco-bags, curtains, rag making, soap making, mat weaving	14	19.18
Trainings on cosmetology, massage and spa, housekeeping	9	12.33
Cooking viands	6	8.22
Gardening of vegetables and other plants	5	6.85
Handicraft making - mat weaving, slipper making, bamboo stick making, scrub making	5	6.85
Financial support for small business	4	5.48
On-line business trainings	4	5.48
Mental health seminars/webinars, responsible parenting seminars, women empowerment seminars	3	4.11
Baking and pastry training	2	2.74
Bamboo shoot cultivation and harvesting	1	1.37
Buy and sell	1	1.37
Farming	1	1.37
Flower plantation	1	1.37
Rice selling	1	1.37
Livestock raising	1	1.37
Selling used clothing (ukay-ukay)	1	1.37
Total	**73**	**100**

Source: Key Informant Interview; NOTE: NR – number of responses

For youth (boys and girls) - The top five alternative livelihood suggested by key informants for the youth were sports activities, livelihood programs/trainings, computer literacy trainings, TESDA trainings, and anti-drug campaigns (orange cells in **Table 3-176**). Other suggestions include community service, provision of school supplies, part time job, handicraft making, mental health and spirituality seminars/webinars, multi-purpose projects, values formation seminars, business trainings, teenage pregnancy seminars, faith-based projects, farming, livelihood trainings, and others.

Table 3-176. Suggested projects for youth (boys and girls)

Alternative Livelihood	NR	% of total
Sports – volleyball, cycling, basketball	18	17.82
Livelihood programs, trainings	14	13.86
Computer literacy, digital literacy, vlog making, responsible use of social media	7	6.93
TESDA for out of school youth, technical skills	5	4.95
Anti-drug campaigns, drug awareness seminars	4	3.96
Community service – tree planning, barangay beautification projects	4	3.96
School supplies giving books, life skills training	4	3.96
Part time job	3	2.97
Handicraft making - basket making, rag making,	3	2.97
Mental health, spirituality seminars	3	2.97
Multi-purpose projects	3	2.97
Social responsibilities awareness, values formation	3	2.97
Business, business training, small business	3	2.97
Teenage pregnancy seminars	2	1.98
Faith based projects – Bible study, choir	2	1.98
Farming	2	1.98
Livestock and poultry raising	2	1.98
Livelihood for out of school youth, skills training	2	1.98
Dressmaking training	2	1.98
Scholarship, funding vocational courses	2	1.98
Gardening, bonsai planting	2	1.98
Advocacy to eradicate gadgets	1	0.99
Bonsai planting	1	0.99
Capability building	1	0.99
Clean up drive	1	0.99
Digital library	1	0.99
Environmental awareness webinars/ seminars	1	0.99
Financial management training	1	0.99
Giving gadgets project	1	0.99
Landscaping	1	0.99
Online selling training	1	0.99
Peace and order seminars	1	0.99
Total	**101**	**100**

Source: Key Informant Interview; NOTE: NR – number of responses

Suggested programs and projects for youth - The top five programs and projects suggested by key informants for the youth particularly the boys were sports activities, TESDA skills training, seminars and counselling on HIV, sex education and teenage pregnancy, farming training, and community service (orange cells in **Table 3-177**). For the girls, the topmost five suggestions are training on various handicrafts, cooking, food processing, gardening, and baking and pastry trainings.

Table 3-177. Suggested projects for youth – boys and girls

Suggested programs/projects for youth – boys	NR	% of total
Sports activities – basketball, sports clinic	16	40
TESDA Skills training – carpentry, welding, massage, haircut, barber, electronics, dressmaking	7	17.5
Seminars and counseling on HIV and health literacy, sex education, drug addiction, teenage pregnancy	6	15
Farming training on organic farming	3	7.5
Community service such as tree planting	2	5
Construction work	1	2.5
Government support and financial aid then monitoring for the livelihood	1	2.5
Out school youth program like skills training	1	2.5
Part time job for out of school youth	1	2.5
Training on rescue	1	2.5
Values formation seminars/ trainings	1	2.5
Total	40	100
Suggested programs/projects for the youth – girls	**NR**	**% of total**
Training on basket making, dress making, doormat making, crotchety, bread making	8	19.05
Cooking	5	11.9
Food processing	3	7.14
Gardening	3	7.14
Baking and pastry	3	7.14
Seminar on non-traditional work such as welding and plumbing	3	7.14
Livelihood program	2	4.76
Sports – volleyball, badminton	2	4.76
Art designing	1	2.38
Buy and sell	1	2.38
Cosmetology	1	2.38
Dance contest	1	2.38
Education, team building activities, pageants	1	2.38
Faith-based activities	1	2.38
Mental health seminars	1	2.38
Training on organizing events	1	2.38
Suggested programs/projects for the youth – girls	**NR**	**% of total**
Pasalubong center	1	2.38
Handicraft product from recycled materials	1	2.38
Proper waste management	1	2.38
Selling vegetables	1	2.38
Training on vlogging	1	2.38
Total	**42**	**100**

Source: Key Informant Interview; NOTE: NR – number of responses

3.4.4.3 Attitude towards the Project

Acceptability of the Project - With regards to Project acceptability, 89.24% of the key informants were favorable of the Project with the rest (5.38%) unfavorable and uncertain. **Table 3-178** shows that the top five reasons for favoring the Project were 1) accessibility of transportation (38.55%), 2) farm-to-market roads for products (26.51%), 3) improvement of economic status (13.25%), 4) good road (7.23%), and 5) the children enjoying the benefits (3.61%).

Table 3-178. Reasons for favorable attitude towards the Project

Reasons for favorable attitude	NR	% of total
Accessibility of transportation, ease of traffic/ less traffic, convenience in travelling	32	38.55
Accessibility from farm to market, less expenses for the farmers in transporting products	22	26.51
If this project means to improve our economic status/growth increase employment opportunities, or produce more positive impacts	11	13.25
Good wide road, road is not muddy, high standard highway	6	7.23
Our children will enjoy the benefits	3	3.61
Business near the road will be enhanced	3	3.61
Reduces road accidents	2	2.41
Improve tourism since MF is a gateway	2	2.41
Increases the value of land	1	1.2
Increases the number of cars that can access the roads	1	1.2
Total	**83**	**100**

Source: Key Informant Interview; NOTE: NR – number of responses

Unfavorable attitude towards the Project - On the other hand, **Table 3-179** shows that the reasons why the Project was unfavorable to some key informants were traffic accidents (40.0%), air pollution (20.0%), environment impacts (20.0%), inconvenience during construction (20.0%), and non-or insufficient compensation of affected lands (20.0%).

Table 3-179. Reasons for unfavorable attitude towards the project

Reasons for unfavorable views	NR	% of total
Accidents may happen because of high speed	2	40.00
Air pollution	1	20.00
Might destroy the environment since more forest will be destroyed	1	20.00
Landowners' compensation/payment if not properly negotiated will become a problem	1	20.00
Total	**5**	**100**

Source: Key Informant Interview; NOTE: NR – number of responses

***Uncertain attitudes towards the Project* -** The reasons for uncertain key informants shown in **Table 3-180** were a) affected lands may affect their livelihood (40.0%), b) lack of Project knowledge (20.0%), c) need for more discussion about the Project (20.0%), and d) road accidents and increase the waste generated (20.0%).

Table 3-180. Reasons for uncertain attitude towards the project

Reasons for uncertainty	NR	% of total
Don't want their land and house to be affected; Farmlands might be affected which would impact on their livelihood	2	40.00
No knowledge about the project at present, there is a need to gather more information from the community if they are in favor or not;	1	20.00
There is still a lot of things to be discussed about the project	1	20.00
There might be more road accidents. Increased waste due to the people throwing garbage in the highway	1	20.00
Total	**5**	**100**

Source: Key Informant Interview; NOTE: NR – number of responses

3.4.5 Assessment of key impacts and mitigating measures

Summary of the mitigating measures

The potential impacts of the Project on the people and its corresponding mitigation measures are summarized in Table 3-181.

Table 3-181. Summary of potential impact and mitigation measures

Potential Impact	Proposed mitigation measures
- Displacement of settler/s - Displacement / disturbance of properties - Change/conflict in land ownership - Change/conflict Right of way - Impact on Public Access	- Authority document over RROW - Conduct census of properties and land affected by the staging areas and RROW - Conduct consultations with the stakeholders and formulate mutually agreed schemes - Prepare and implement a Resettlement Action Plan (RAP)
- In-migration - Proliferation of Informal Settlers or "followers"	- Prepare and implement an Informal Settler Monitoring Plan - Monitor arrival of informal dwellers within the Project area - Prioritize local hiring
- Impacts on IPs/Cultures/Lifestyle	- Proper conduct of the FPIC process - Proper orientation of migrant workers on culture oriented on the culture and ways of living in the city/municipality
- Impacts on physical cultural resources	- Conduct survey of physical cultural resources, if necesary
- Threat to public health and safety	- Prepare and proper implement the following: · Formulate Occupational Health and Safety Protocols during construction and operation phases · Establish Grievance Redress Mechanism - Conduct sensitization campaigns both for workers and local communities about illicit behavior and crime - Coordination with local law enforcement
- Enhancement for the Local Benefits of the Project - Generation of Local Employment	- Conduct skills training at the host LGUs - Prepare a local employment plan - Prioritize hiring of qualified residents from the host barangays - Enhance the business opportunities during its constructions through the purchasing of supplies from local sources - Provision of livelihood opportunities if possible - Prompt payment of taxes and other legal fees
- Threat to delivery of basic services and resource competition	- Implement the Informal Settler Monitoring Plan - Coordination of DPWH/contractor with the host LGUs regarding needs of the migrants and residents of the community
- Traffic contribution along impact roads	- Traffic Management Plan that details that will manage the traffic flow must be prepared and properly implemented during the construction phase. - Schedule transport of heavy equipment during period when there are fewer vehicles on the road - Posting of appropriate traffic signage and warnings should also be established. - Predetermined routes of construction materials - Strict implementation of Construction Plan specifications for each Project component

3.4.5.1 Displacement of settlers

Number of households and household size

Cagayan de Oro City, Misamis Oriental

The 2020 household population of Cagayan de Oro City is presented in **Table 3-182**. The city has a population of 728,402. The household population is 723,671 and the number of households is 190,225 with an average size of 3.8.

Meanwhile, Barangay Carmen has the most populated barangay with 77,756 followed by Balulang with 42,205. Kauswagan comes in 3rd with 40,239 followed by Lapasan with 39,234, Bulua with 35,397 and Camaman-an with 35,238. On the other hand, Barangay 39 was the least populated with only 17 individuals. Other least populated barangays were Barangays 16, 6, and 5.

Table 3-182. Household population of Cagayan de Oro City, 2020

Barangay	Population	No of HH
Agusan	19,039	5,010
Baikingon	2,879	758
Bulua	35,397	9,315
Balubal	7,013	1,846
Balulang	42,205	11,107
Barangay 10 (Pob.)	557	147
Barangay 11 (Pob.)	162	43
Barangay 12 (Pob.)	257	68
Barangay 13 (Pob.)	965	254
Barangay 14 (Pob.)	351	92
Barangay 15 (Pob.)	1,847	486
Barangay 16 (Pob.)	25	7
Barangay 17 (Pob.)	2,058	542
Barangay 18 (Pob.)	1,269	334
Barangay 19 (Pob.)	227	60
Barangay 2 (Pob.)	50	13
Barangay 21 (Pob.)	363	96
Barangay 22 (Pob.)	3,324	875
Barangay 23 (Pob.)	936	246
Barangay 24 (Pob.)	607	160
Barangay 26 (Pob.)	1,215	320
Barangay 27 (Pob.)	1,601	421
Barangay 28 (Pob.)	493	130
Barangay 3 (Pob.)	93	24
Barangay 30 (Pob.)	678	178
Barangay 32 (Pob.)	792	208
Barangay 33 (Pob.)	84	22
Barangay 34 (Pob.)	529	139
Barangay 38 (Pob.)	48	13
Barangay 39 (Pob.)	17	4
Barangay 4 (Pob.)	68	18
Barangay 40 (Pob.)	339	89
Barangay 6 (Pob.)	33	9
Barangay 8 (Pob.)	90	24
Barangay 9 (Pob.)	130	34
Barangay 5 (Pob.)	34	9
Bayabas	13,991	3,682
Bayanga	3,402	895
Besigan	1,700	447
Bonbon	10,976	2,888
Bugo	31,229	8,218
Camaman-an	35,238	9,273
Canito-an	34,250	9,013
Carmen	77,756	20,462
Consolacion	9,396	2,473
Cugman	23,468	6,176
Dansolihon	6,206	1,633
F. S. Catanico	2,364	622
Gusa	28,974	7,625
Indahag	17,831	4,692

Barangay	Population	No of HH
Iponan	27,521	7,242
Kauswagan	40,239	10,589
Lapasan	39,234	10,325
Lumbia	31,504	8,291
Macabalan	19,562	5,148
Macasandig	23,235	6,114
Mambuaya	5,963	1,569
Nazareth	6,971	1,834
Pagalungan	2,410	634
Pagatpat	13,007	3,423
Patag	17,941	4,721
Pigsag-an	1,428	376
Puerto	13,174	3,467
Puntod	18,775	4,941
San Simon	1,642	432
Tablon	24,578	6,468
Taglimao	1,391	366
Tagpangi	2,823	743
Tignapoloan	5,621	1,479
Tuburan	1,388	365
Tumpagon	2,305	607
Barangay 1 (Pob.)	168	44
Barangay 7 (Pob.)	544	143
Barangay 20 (Pob.)	80	21
Barangay 25 (Pob.)	661	174
Barangay 29 (Pob.)	476	125
Barangay 31 (Pob.)	575	151
Barangay 35 (Pob.)	2,002	527
Barangay 36 (Pob.)	447	118
Barangay 37 (Pob.)	181	48
Total	**728,402**	**190,225**

Source: Philippine Statistics Authority, 2020

Malaybalay City, Bukidnon

The 2020 census population in Malaybalay City was 190,712 with 4,3834 number of households and a household population of 189,048 (**Table 3-183**). Average number of households is 4.3. Barangay Casiang has the largest population with 29,406 while Barangay 5 (Pob.) is the least with 71.

Table 3-183. Household population of Malaybalay, 2020

Barangay	Population	No of HH
Aglayan	8,215	1910
Bangcud	5,771	1342
Busdi	2,644	615
Cabangahan	3,162	735
Caburacanan	1,130	263
Canayan	6,553	1524
Capitan Angel	1,545	359
Casisang	29,406	6839
Dalwangan	7,785	1810
Imbayao	1,817	423
Indalaza	1,979	460
Kalasungay	9,961	2317
Kabalabag	1,199	279
Kulaman	1,291	300
Laguitas	3,899	907
Patpat (Lapu-lapu)	4,366	1015

Barangay	Population	No of HH
Linabo	7,448	1732
Apo Macote	5,024	1168
Miglamin	2,596	604
Magsaysay	3,176	739
Maligaya	2,413	561
Managok	7,567	1760
Manalog	1,035	241
Mapayag	1,045	243
Mapulo	1,675	390
Barangay 1 (Pob.)	6,442	1498
Barangay 2 (Pob.)	587	137
Barangay 3 (Pob.)	438	102
Barangay 4 (Pob.)	344	80
Barangay 5 (Pob.)	71	17
Barangay 6 (Pob.)	474	110
Barangay 7 (Pob.)	1,891	440
Barangay 8 (Pob.)	579	135
Barangay 9 (Pob.)	9,187	2137
Barangay 10 (Pob.)	3,447	802
Barangay 11 (Pob.)	3,034	706
Saint Peter	2,817	655
San Jose	9,213	2143
San Martin	3,326	773
Santo Niño	1,845	429
Silae	2,681	623
Simaya	4,713	1096
Sinanglanan	3,644	847
Sumpong	9,243	2150
Violeta	2,269	528
Zamboanguita	1,765	410
Total	**190,712**	**43,839**

Philippine Statistics Authority, 2020

Barangay Sta. Cruz is the most populous having 20 percent of the 2020 population of Tagoloan (**Table 3-184**). The second most populated is Barangay Poblacion with 10,326 followed by the Barangay Baluarte with 10,860. The barangay with the least population was the upland barangay of Rosario with 1,130 inhabitants. The total population is 80,319, the household population is 80,051 while the household number is 19,799. The average number per household is 4.0.

Table 3-184. Household population of Tagoloan, 2020

Barangay	Population	No of HH
Baluarte	10,860	2,715
Casinglot	10,207	2,552
Gracia	2,935	734
Mohon	4,349	1,087
Natumolan	10,878	2,720
Poblacion	10,326	2,582
Rosario	1,130	283
Santa Ana	9,010	2,253
Santa Cruz	16,022	4,006
Sugbongcogon	4,602	1,151
Total	**80,319**	**19,799**

Philippine Statistics Authority, 2020

Sumilao, Bukidnon

The municipality of Sumilao composed of 10 barangays has a population of 29,531 with a household population of 29,455 and a household size of 6,849. The 2020 population of the DIB Puntian, Kisolon, Kulasi, Poblacion, Roque and Vista Villa is shown in **Table 3-185**.

Barangay Kisolon, the central business district and the seat of government offices, is the most populated barangay with a population of 12,306 (**Table 3-185**) followed by Barangay Poblacion with a population of 4,927. Barangay Occasion on the other hand had the lowest population of only 617. It has 4.3 average population per household.

Table 3-185. Population and household population of Sumilao (2015)

Barangay	Population	No of HH
Kisolon	12,306	2,862
Culasi	617	143
Licoan	976	227
Lupiagan	978	227
Ocasion	735	171
Puntian	1,642	382
San Roque	1,380	321
San Vicente	3,301	768
Poblacion	4,927	1,146
Vista Villa	2,669	621
Total	**29,531**	6,849

Source: Philippine Statistics Authority, 2020

Manolo Fortich, Bukidnon

Manolo Fortich has a total population of 113,200. The household population is 113,043 while the number of households is 26,196. Manolo Fortich has an average household size of 4.3. The first three with the largest populations among the 11 urban and urbanizing barangays comprising 1/3 of the municipal population are Barangays Damilag (16,303), Alae (11,913) and Agusan Canyon, (9,234). The first two are the locations of Del Monte Philippines Incorporated (DMPI) pineapple plantation while the latter is an urban expansion area. The population increase in Barangay Alae was attributed to the presence of REBISCO, a large biscuit manufacturing company.

Table 3-186. Population of Manolo Fortich

Barangay	Total pop.	No. of HH
Agusan Canyon	9,234	2,147
Alae	11,913	2,770
Dahilayan	1,812	421
Dalirig	5,444	1,266
Damilag	16,303	3,791
Diclum	4,507	1,048
Guilang-guilang	1,459	339
Kalugmanan	4,158	967
Lindaban	2,535	590
Lingion	6,861	1,596
Lunocan	7,879	1,832
Maluko	4,447	1,034
Mambatangan	5,332	1,240
Mampayag	1,498	348
Minsuro	756	176
Mantibugao	3,725	866
Tankulan (Pob.)	8,954	2,082
San Miguel	5,515	1,283
Sankanan	3,776	878

Barangay	Total pop.	No. of HH
Santiago	1,569	365
Santo Niño	4,170	970
Ticala	1,353	315
Total	**113,200**	**26,196**

Source: Philippine Statistics Authority, 2020

Impasug-ong, Bukidnon

The total population of the municipality is 53,863. The urban barangay which is the Poblacion has the higest population of 12,693 followed by the urbanizing barangays of Impalutao (7,081), Kalabugao (5,482), Kibenton (4,977), and La Fortuna (4,812) (**Table 3-187**). The household population of Impasug-ong is 53,272 with 11,843 number of households

Table 3-187. Household population of Impasug-ong (2015)

Barangay	Total pop.	No. of HH
Bontongon	889	207
Bulonay	1,815	422
Capitan Bayong	3,751	872
Cawayan	2,315	538
Dumalaguing	2,991	696
Guihean	2,559	595
Hagpa	2,995	697
Impalutao	7,081	1,647
Kalabugao	5,482	1,275
Kibenton	4,977	1,157
La Fortuna	4,812	1,119
Poblacion	12,693	2,952
Sayawan	1,503	350
Total	**53,863**	**11,843**

3.4.5.1.1 Population density and growth

Northern Mindanao

The results of the 2020 Census of Population and Housing showed that the total population of Northern Mindanao reached 5,022,768 accounting for 4.61 percent of the country's population.

The region's population in 2020 was higher by 333,466 persons than its 2015 population of 4.69 million; 725,445 higher than its population of 4.30 million in 2010; and 1,517,060 higher than its population of 3.51 million in 2000. **Table 3-188** shows the population of Northern Mindanao based on various censuses. Its population increased by 1.46 percent annually from 2015 to 2020. This population growth rate (PGR) was slower than the PGR for the period 2010 to 2015 and even much slower than the PGR for the period 2000 to 2010.

Table 3-188. Total population of Northern Mindanao

Census Year	Total Population	Growth rate
1980	2,226,169	
1990	2,811,646	2.23
2000	3,505,708	2.06
2010	4,297,323	1.68
2015	4,689,302	1.46
2020	5,022,768	1.57

Source: Philippine Statistics Authority, 2020

Region X is composed of two highly urbanized cities (HUCs), seven component cities, 84 municipalities, and 2,022 barangays. By province, Bukidnon had the largest population (1,541,308) followed by Misamis Oriental (956,900), Lanao del Norte (722,902), and Misamis Occidental (617,333). Camiguin had the smallest population with only 92,808 persons. The two highly urbanized cities of Region X, Cagayan de Oro City and Iligan City, posted a population of 728,402 and 363,115, respectively.

Bukidnon was the fastest growing province in the region with an annual population growth rate (PGR) of 1.81 percent from 2015 to 2020 followed by Misamis Oriental (1.57%).

Table 3-189. Total population of Northern Mindanao by selected areas

Province/HUC	Total population			
	2000	2010	2015	2020
Bukidnon	1, 060, 4115	1, 299, 192	1, 415, 226	1, 541, 308
Misamis Oriental	664, 338	813, 856	888, 509	956, 900
Cagayan de Oro city	461, 877	602, 088	675, 950	728, 402

Note: HUC – highly urbanized city; Source: Philippine Statistics Authority, 2020

Among the cities (excluding the City of Cagayan de Oro and the City of Iligan) and municipalities in the region, the City of Malaybalay in Bukidnon had the largest population. Other cities/municipalities that reached the 100 thousand population was Manolo Fortich, Quezon, and Maramag which are all in the province of Bukidnon.

Cagayan de Oro City

The city posted a total population of 728,402 persons as of May 1, 2020 (**Table 3-190**). This represents an increase of 52,452 persons over the total population of 675,950 in 2015. The 2020 figures translated to an annual population growth of 1.58 percent from 2015 to 2020. Last 2015, the growth rate is 1.58% from 2010 to 2015. Mambuaya has the highest annual population growth rate of 12.34%, Barangay 3 has the least population growth rate of -20.16% (**Table 3-191**).

Table 3-190. Historical growth of population in CDO

Census Year	Population	Growth rate
2000	461,877	
2010	602,088	2.69
2015	675,950	2.23
2020	728,402	1.58

Source: Philippine Statistics Authority, 2020

Table 3-191. Annual population growth rate of CDO per barangay

Barangay	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Agusan	19,039	16,261	3.38%
Baikingon	2,879	2,291	4.93%
Balubal	7,013	4,718	8.70%
Balulang	42,205	34,793	4.15%
Barangay 1	168	349	-14.26%
Barangay 10	557	786	-6.99%
Barangay 11	162	204	-4.74%
Barangay 12	257	257	0.00%
Barangay 13	965	1,156	-3.73%
Barangay 14	351	526	-8.16%
Barangay 15	1,847	2,049	-2.16%
Barangay 16	25	36	-7.39%
Barangay 17	2,058	2,280	-2.13%
Barangay 18	1,269	1,561	-4.27%
Barangay 19	227	352	-8.82%

Barangay	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Barangay 2	50	71	-7.12%
Barangay 20	80	69	3.16%
Barangay 21	363	535	-7.84%
Barangay 22	3,324	2,192	9.16%
Barangay 23	936	928	0.18%
Barangay 24	607	795	-5.52%
Barangay 25	661	1,113	-10.39%
Barangay 26	1,215	2,621	-14.94%
Barangay 27	1,601	1,610	-0.12%
Barangay 28	493	536	-1.74%
Barangay 29	476	448	1.28%
Barangay 3	93	271	-20.16%
Barangay 30	678	822	-3.97%
Barangay 31	575	1,170	-13.89%
Barangay 32	792	1,166	-7.82%
Barangay 33	84	67	4.87%
Barangay 34	529	634	-3.74%
Barangay 35	2,002	2,239	-2.33%
Barangay 36	447	679	-8.42%
Barangay 37	181	141	5.40%
Barangay 38	48	67	-6.78%
Barangay 39	17	36	-14.61%
Barangay 4	68	80	-3.36%
Barangay 40	339	791	-16.33%
Barangay 5	34	78	-16.04%
Barangay 6	33	110	-22.39%
Barangay 7	544	511	1.33%
Barangay 8	90	129	-7.30%
Barangay 9	130	315	-17.00%
Bayabas	13,991	13,670	0.49%
Bayanga	3,402	3,289	0.71%
Besigan	1,700	1,673	0.34%
Bonbon	10,976	9,573	2.92%
Bugo	31,229	30,893	0.23%
Bulua	35,397	32,348	1.91%
Camaman-an	35,238	30,927	2.78%
Canito-an	34,250	27,815	4.48%
Carmen	77,756	70,492	2.09%
Consolacion	9,396	10,433	-2.18%
Cugman	23,468	22,383	1.00%
Dansolihon	6,206	5,550	2.38%
F. S. Catanico	2,364	2,502	-1.19%
Gusa	28,974	26,815	1.64%
Indahag	17,831	16,179	2.07%
Iponan	27,521	26,340	0.93%
Kauswagan	40,239	35,069	2.94%
Lapasan	39,234	43,611	-2.20%
Lumbia	31,504	22,429	7.41%
Macabalan	19,562	20,721	-1.20%
Macasandig	23,235	20,738	2.42%
Mambuaya	5,963	3,431	12.34%
Nazareth	6,971	10,395	-8.07%
Pagalungan	2,410	2,290	1.08%
Pagatpat	13,007	8,456	9.49%
Patag	17,941	17,742	0.24%
Pigsag-an	1,428	1,347	1.24%

Barangay	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Puerto	13,174	14,318	-1.74%
Puntod	18,775	18,796	-0.02%
San Simon	1,642	1,391	3.55%
Tablon	24,578	23,004	1.40%
Taglimao	1,391	2,249	-9.62%
Tagpangi	2,823	2,649	1.35%
Tignapoloan	5,621	4,866	3.08%
Tuburan	1,388	1,290	1.55%
Tumpagon	2,305	2,433	-1.13%
Total	**728,402**	**675,950**	1.59%

The recent 2020 population shows that Cagayan de Oro has a population density of 1,765 person per sq. m. This shows a significant change of 7.8% from 2015 population (**Table 3-192**)

Table 3-192. Population density in Cagayan de Oro

Year	Total Pop.	Land Area (sq.m)	PD	% Change in PD
2010	602,088	412.8	1,459	12.3
2015	675,950		1,637	21.0
2020	728,402		1,765	7.8

Source: Philippine Statistics Authority, 2020

Malaybalay, Bukidnon

Table 3-193 shows that the population increased from 174,625 in 2015 to 190,712 in 2020. It shows an increase of 16,087 and an average growth rate of 1.87 from 2015. San Jose shows the highest annual growth rate of 6.42% while Barangay 5 has the least with -18.35%.

Table 3-193. Historical growth rate in Malaybalay city

Census Year	Population	Growth rate
2000	123,672	
2010	153,085	2.16
2015	174,625	2.54
2020	190,712	1.87

Source: Philippine Statistics Authority, 2020

Table 3-194. Annual population growth rate of Malaybalay per barangay

Barangay	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Aglayan	8,215	7,594	1.67%
Apo Macote	5,024	4,903	0.51%
Bangcud	5,771	5,111	2.59%
Barangay 1	6,442	5,293	4.22%
Barangay 10	3,447	2,942	3.39%
Barangay 11	3,034	3,209	-1.17%
Barangay 2	587	969	-10.01%
Barangay 3	438	788	-11.63%
Barangay 4	344	456	-5.76%
Barangay 5	71	186	-18.35%
Barangay 6	474	741	-8.98%
Barangay 7	1,891	2,298	-4.02%
Barangay 8	579	675	-3.18%
Barangay 9	9,187	9,022	0.38%
Busdi	2,644	2,377	2.27%

Barangay	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Cabangahan	3,162	3,015	1.01%
Caburacanan	1,130	1,150	-0.37%
Canayan	6,553	5,870	2.34%
Capitan Angel	1,545	1,160	6.22%
Casisang	29,406	25,696	2.88%
Dalwangan	7,785	7,004	2.25%
Imbayao	1,817	1,833	-0.18%
Indalaza	1,979	1,690	3.38%
Kabalabag	1,199	1,158	0.74%
Kalasungay	9,961	8,272	3.99%
Kulaman	1,291	1,341	-0.80%
Laguitas	3,899	3,233	4.02%
Linabo	7,448	6,933	1.52%
Magsaysay	3,176	3,001	1.20%
Maligaya	2,413	2,113	2.83%
Managok	7,567	7,200	1.05%
Manalog	1,035	969	1.40%
Mapayag	1,045	979	1.38%
Mapulo	1,675	1,260	6.18%
Miglamin	2,596	3,188	-4.23%
Patpat	4,366	3,833	2.78%
Saint Peter	2,817	2,324	4.13%
San Jose	9,213	6,856	6.42%
San Martin	3,326	3,088	1.58%
Santo Niño	1,845	1,675	2.06%
Silae	2,681	2,629	0.41%
Simaya	4,713	4,161	2.66%
Sinanglanan	3,644	3,262	2.36%
Sumpong	9,243	9,302	-0.13%
Violeta	2,269	2,199	0.66%
Zamboanguita	1,765	1,667	1.21%
Total	**190,712**	**174,625**	**1.87%**

The 2015 population density in Malaybalay is 9.2 persons per square meter (**Table 3-195**). It shows a signficant decrease from 24.6 last 2015.

Table 3-195. Population density by area in Malaybalay

Census Year	Total Pop	Land Area (sq.m)	PD	% Change in PD
2010	153,085	969.19	158	14.1
2015	174,625		180	24.6
2020	190,712		197	9.2

Source: Philippine Statistics Authority, 2020

Tagoloan, Misamis Oriental

Table 3-196 shows that the number of households in the municipality increased from 46,649 in 2000 to 80,319 in 2020. The household population rose to 80,319 with a 1.99% growth from 2015. In terms of the population growth per barangay, Natumolan has the highest growth rate of 5.42% while Sugbongcogon has the least with 0.14% (**Table 3-201**).

Table 3-196. Historical growth rate in Tagoloan

Census Year	Population	Growth rate
2000	46,649	
2010	63,850	3.19

2015	73,150	2.62
2020	80,319	1.99

Source: Philippine Statistics Authority, 2020

Table 3-197. Annual population growth rate of Tagoloan per barangay

Barangay	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Baluarte	10,860	9,612	2.60%
Casinglot	10,207	9,711	1.05%
Gracia	2,935	2,574	2.80%
Mohon	4,349	4,037	1.58%
Natumolan	10,878	8,466	5.42%
Poblacion	10,326	10,235	0.19%
Rosario	1,130	1,045	1.66%
Santa Ana	9,010	8,140	2.16%
Santa Cruz	16,022	14,758	1.74%
Sugbongcogon	4,602	4,572	0.14%
Total	**80,319**	**73,150**	**1.99%**

The gross population density posted by the municipality in 2020 including the uncontested area was 682 persons per square kmeter. This shows a 9.8% change from the previous population density last 2015 of 621 person/sq.m.

Table 3-198. Population density of Tagoloan (2015)

Year	Total Pop	Land Area (sq.m)	PD	% Change in PD
2010	63,850	117.73	542	14.6
2015	73,150		621	25.8
2020	80,319		682	9.8

Source: Philippine Statistics Authority, 2020

Sumilao, Bukidnon

The population of the municipality in 2000 was 17,958 with a growth rate of 3.63 percent (**Table 3-199**). The population increased to 29,531 in 2020 despite a lower a growth rate of 1.41 percent. The increase in population could partly be attributed to in-migration of agro-industrial workers brought by multi-national companies and big investors in the municipality. Barangay Lupiagan has the highest annual groath rate of 4.07%, Culasi has the least with -0.60%.

Table 3-199. Historical growth rate of Sumilao (2000 to 2020)

Census Year	Population	Growth rate
2000	17,958	
2010	25,668	3.63
2015	27,660	1.43
2020	29,531	1.39

Source: Philippine Statistics Authority 2020

Table 3-200. Annual population growth rate of Sumilao per barangay

Barangays	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Culasi	617	635	-0.60%
Kisolon	12,306	11,532	1.38%
Licoan	976	858	2.75%
Lupiagan	978	809	4.07%
Ocasion	735	619	3.68%

Barangays	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Poblacion	4,927	4,705	0.98%
Puntian	1,642	1,566	1.00%
San Roque	1,380	1,264	1.87%
San Vicente	3,301	3,139	1.06%
Vista Villa	2,669	2,533	1.11%
Total	**29,531**	**27,660**	**1.39%**

The municipality has a population density of 150 persons per square kilometer (**Table 3-201**). This shows a 6.8% increase from the 2015 population density of 140 person per sq. km.

Table 3-201. Population density of Sumilao

Year	Total Pop	Land Area (sq.km)	PD	% Change in PD
2010	25,668	196.95	130	7.8
2015	27,660		140	15.0
2020	29,531		150	6.8

Source: Philippine Statistics Authority 2020

Manolo Fortich, Bukidnon

The household population of Manolo Fortich increased from 100,210 in 2015 to 113,200 in 2020. This shows a growth rate of 2.60% from 2015 (**Table 3-202**). With the barangays in Manolo Fortich, Minsuro has the least population growth rate of -5.34% while Damilag has the greatest with 7.21% (**Table 3-203**).

Table 3-202. Historical growth rate in Manolo Fortich

Census Year	Population	Growth rate
2000	74,252	
2010	91,026	2.06
2015	100,210	1.85
2020	113,200	2.60

Source: Philippine Statistics Authority 2020

Table 3-203. Annual population growth rate of Manolo Fortich per barangay

Barangays	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Agusan Canyon	9,234	9,985	-1.63%
Alae	11,913	9,135	5.75%
Dahilayan	1,812	1,743	0.82%
Dalirig	5,444	4,844	2.49%
Damilag	16,303	11,713	7.21%
Diclum	4,507	4,033	2.37%
Guilang-guilang	1,459	1,247	3.36%
Kalugmanan	4,158	3,684	2.58%
Lindaban	2,535	2,325	1.84%
Lingion	6,861	6,336	1.69%
Lunocan	7,879	7,346	1.49%
Maluko	4,447	4,125	1.59%
Mambatangan	5,332	4,349	4.38%
Mampayag	1,498	1,334	2.47%
Mantibugao	3,725	3,185	3.35%
Minsuro	756	981	-5.34%
San Miguel	5,515	4,867	2.67%

Barangays	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Sankanan	3,776	3,737	0.22%
Santiago	1,569	1,554	0.20%
Santo Niño	4,170	3,704	2.53%
Tankulan	8,954	8,711	0.58%
Ticala	1,353	1,272	1.31%
Total	**113,200**	**100,210**	**2.60%**

Based on the 2020 population of 113,200, Manolo fortich has a population density of 274 sq.km per person. Based on the previous population density last 2015 242 sq.km/person there iscan increase of 13% (**Table 3-204**).

Table 3-204. Population density of Manolo Fortich

Year	Total Pop	Land Area (sq.km)	PD	% Change in PD
2010	91,026	413.6	220	10.1
2015	100,210		242	24.4
2020	113,200		274	13.0

Source: Philippine Statistics Authority 2020

Impasug-ong, Bukidnon

The number of households in the municipality increased from 31,173 in 2000 to 53,863 in 2020 (**Table 3-207**). Based on the 2020 census, the current population in Impasug-ong shows a growth rate of 2.14% from 2015. In terms of annual population growth rate, Bulonay has the highest with 3.73% while Hagpa has the least (0.98%) (**Table 3-206**)

Table 3-205. Historical growth rate in Impasug-ong

Census Year	Population	Growth rate
2000	31,173	1.80
2010	43,587	2.52
2015	47,859	2.14
2020	53,863	

Source: Philippine Statistics Authority 2020

Table 3-206. Annual population growth rate of Impasug-ong per barangay

Barangays	Population (2020)	Population (2015)	Annual PGR (2015-2020)
Bontongon	889	800	2.25%
Bulonay	1,815	1,525	3.73%
Capitan Bayong	3,751	3,122	3.94%
Cawayan	2,315	2,080	2.28%
Dumalaguing	2,991	2,800	1.40%
Guihean	2,559	2,128	3.96%
Hagpa	2,995	2,859	0.98%
Impalutao	7,081	6,183	2.90%
Kalabugao	5,482	5,084	1.60%
Kibenton	4,977	4,242	3.42%
La Fortuna	4,812	4,360	2.10%
Poblacion	12,693	11,279	2.52%
Sayawan	1,503	1,397	1.55%
Impasugong Total	**53,863**	**47,859**	**2.52%**

The municipality is sparsely populated having a population density of 51 persons per sq. km. (**Table 3-207**). This shows 12.5% increase from 46 persons per sq. m. last 2015

Table 3-207. Population density of Manolo Fortich

Year	Total Pop	Land Area (sq.km)	PD	% Change in PD
2010	43,587	1051.17	41	9.8
2015	47,859		46	23.6
2020	53,863		51	12.5

Source: Philippine Statistics Authority 2020

3.4.5.1.2 Sex and age profile

Cagayan de Oro City

Table 3-208 shows the distribution of ages of the male and female population in CDO. About 30.81% of the city's population belonged to the age group 0-14 years old. Productive population (ages 15-64 years old) comprised 65.86 percent with a small portion (3.33%) above 65 years old.

Over the last three years, the female population was constantly increasing with a very slight increase of female over male with a sex ratio of 99:100 (**Table 3-208**).

Table 3-208. Population by age group and sex in CDO (2015)

Age group	Male	Female	Total	Age group	Male	Female	Total
Under 1	7207	6,616	13823	45-49	17123	16,992	34115
01-Apr	28952	27,008	55960	50-54	14479	15,139	29618
05-Sep	34442	31,832	66274	55-59	11793	12,751	24544
Oct-14	32110	30,533	62643	60-64	9161	9,902	19063
15-19	34120	34,765	68885	65-69	5514	6,093	11607
20-24	35411	36,291	71702	70-74	2692	3,545	6237
25-29	32690	31,529	64219	75-79	1723	2,579	4302
30-34	27120	25,571	52691	80 years and over	1297	2,371	3668
35-39	23882	22,900	46782	**Total**	**339952**	**335,998**	**675950**
40-44	20236	19,581	39817				

Source: CDO Ecological Profile 2019

Malaybalay, Bukidnon

The city has a relatively young populace with about 70% of its population below 30 years old. There appeared to be more males (52%) than the female (48%) population. **Table 3-209** shows the population distribution by age group and sex.

Table 3-209. Population by age group and sex in Malaybalay (2015)

Age group	Male	Female	Total	Age group	Male	Female	Total
Under 1	2049	2006	4055	45-49	4248	3957	8205
01-Apr	8761	8148	16909	50-54	3787	3461	7248
05-Sep	10043	9253	19269	55-59	3012	2793	5805
Oct-14	9924	9006	18930	60-64	2164	2238	4402
15-19	9810	9280	19090	65-69	1341	1345	2686
20-24	8832	8014	16846	70-74	772	852	1624
25-29	7896	6810	14706	75-79	503	666	1169
30-34	6400	5663	12063	80 years and over	380	665	1045
35-39	5807	5206	11013	**Total**	**90754**	**83871**	**174625**

40-44	5025	4508	9533

Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

About 33 percent of its 2015 population were under 15 years of age or 24,377 (**Table 3-210**). Children below five years old comprised 11.81 percent of the household population in the entire municipality. Children aged 5 to 9 years accounted for 11.24 percent of the population, and those aged 10 to 14 years, another 10.28 percent.

In terms of the distribution by age and sex, there were more males than females in age groups 0 to 54 years in 2015, with the male comprising 51.56 percent of these age groups. In the older age group 55 years old and over, there were more females than males. The females in these age groups made up 51.67 percent.

In 2015, children under 15 years old had a sex ratio of 106 males for every 100 females, while for those aged 15 to 64 years; the ratio was 106 males per 100 females. The sex ratio for the age group 65 years old and over was 81 males per 100 females, portraying the higher mortality of females than males in this age group.

Table 3-210. Population by age group and sex in Tagoloan (2015)

Age group	Male	Female	Total	Age group	Male	Female	Total
Under 1	902	754	1,656	45 - 49	1,727	1,715	3,442
1 - 4	3,601	3,379	6,980	50 - 54	1,495	1,465	2,960
5 - 9	4,188	4,032	8,220	55 - 59	1,284	1,231	2,515
10 - 14	3,851	3,670	7,521	60 - 64	920	939	1,859
15 - 19	3,769	3,644	7,413	65 - 69	586	575	1,161
20 - 24	3,776	3,523	7,299	70 - 74	252	320	572
25 - 29	3,419	3,062	6,481	75 - 79	167	247	414
30 - 34	2,891	2,606	5,497	80 years and over	115	242	357
35 - 39	2,452	2,296	4,748	**Total**	**37,497**	**35,653**	**73,150**
40 - 44	2,102	1,953	4,055				

Source: Philippine Statistics Authority, 2015

Sumilao, Bukidnon

The 2007 household population in Sumilao was comprised of 11,250 males and 10,470 females resulting in a sex ratio of 108 males for every 100 females. The municipality has a fairly young household population with ages 14 and below accounting for 40.04 percent of its 2007 population**. Table 3-211** shows the age group and sex distribution in Sumilao.

Table 3-211. Household population by age group and sex in Sumilao (2007)

Age group	Male	Female	Total	Age group	Male	Female	Total
Under 1	366	346	712	50 - 54	398	367	765
1 - 4	1,319	1,228	2,547	55 - 59	279	220	499
5 - 9	1,505	1,424	2,929	60 - 64	139	149	288
10 - 14	1,342	1,326	2,668	65 - 69	117	117	234
15 - 19	1,217	1,081	2,298	70 - 74	72	94	166
20 - 24	1,062	891	1,953	75 - 79	32	45	77
25 - 29	906	856	1,762	80 and over	40	55	95
30 - 34	767	650	1,417	**0 - 17**	**5,277**	**5,065**	**10,292**
35 - 39	678	606	1,284	**18 and over**	**6,023**	**5,405**	**11,428**
40 - 44	549	516	1,065	**Total**	**11,250**	**10,470**	**21,720**
45 - 49	512	449	961				

Source: Sumilao CLUP 2011-2020

Manolo Fortich, Bukidnon

According to the 2015 PSA census, the 5 to 9 years old age group had the highest population in the municipality (**Table 3-212**). Conversely, the age group with the lowest population is 80 and over with only 514 individuals.

Combining age groups of those aged 14 and below make up 33.54% of the municipal population. Those aged 15 to 64, considered the economically active population and actual or potential members of the work force, constitute 62.71 percent. The old dependent population consisting of the senior citizens (aged 65 and over) comprised 3.75 percent.

The age dependency ratios showed that there are 53 youth dependents for every 100 of the working age population in Manolo Fortich; 6 aged/senior citizens for every 100 of the working population; and overall, 59 dependents (young and old-age) for every 100 of the working population.

Table 3-212. Population by age group and sex in Manolo Fortich (2010)

Age group	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Under 1	1,811	4.27	1,722	4.27	3,886	4.27
1-4	3,896	9.19	3,826	9.49	8,494	9.33
5-9	4,732	11.17	4,540	11.26	10,199	11.20
10-14	4,307	10.16	4,035	10.01	9,222	10.13
15-19	4,468	10.54	4,213	10.45	9,549	10.49
20-24	4,328	10.21	4,189	10.39	9,369	10.29
25-29	3,700	8.73	3,409	8.45	7,820	8.59
30-34	3,001	7.08	2,714	6.73	6,287	6.91
35-39	2,353	5.55	2,191	5.43	4,998	5.49
40-44	2,163	5.10	1,986	4.92	4,564	5.01
45-49	2,016	4.76	1,910	4.74	4,319	4.74
50-54	1,901	4.49	1,900	4.71	4,181	4.59
55-59	1,538	3.63	1,436	3.56	3,271	3.59
60-64	913	2.15	827	2.05	1,914	2.10
65-69	510	1.20	552	1.37	1,168	1.28
70-74	363	0.86	454	1.13	899	0.99
75-79	213	0.50	232	0.58	490	0.54
80 and over	168	0.40	192	0.48	396	0.44
Total	**42,381**	**100**	**40328**	**100**	**91,026**	**100**

Source: Manolo Fortich CLUP 2013-2022

Impasug-ong, Bukidnon

The child and youth age group (0 to 14 years old) comprised about 51% of the municipal population while the old age (60 years old and above) only 4.5% (**Table 3-213**). Males also dominate the population with a sex ratio of 110:100.

Table 3-213. Population by age group and sex in Impasug-ong (2015)

Age group	Male	Female	Total	Age group	Male	Female	Total
0-4	3,338	3,238	6,576	40-44	1,334	1,070	2,404
5-9	3,168	2,967	6,135	45-49	1,073	1,003	2,076
10-14	3,004	2,901	5,905	50-54	923	801	1,724
15-19	2,798	2,505	5,303	55-59	653	579	1,232
20-24	2,249	1,960	4,209	60-64	440	389	829
25-29	1,964	1,590	3,554	65 and over	639	678	1,317
30-34	1,724	1,450	3,174	**Total**	**24,852**	**22,412**	**47,264**
35-39	1,545	1,281	2,826				

Source: Impasug-ong CLUP 2019-2028

3.4.5.1.3 Literacy rate and profile of educational attainment

Cagayan de Oro City

Table 3-214 shows that the city has a high level of literacy rate. About 95 percent of its population 10 years old and above are literate. The literacy rate in 2015 was higher among females (99.5 percent) than among males (99.4 percent). The same trend was observed in 2010.

Table 3-214. Literacy rate in Cagayan de Oro city (2010 and 2015)

Census year	Literacy rate %		
	Male	Female	Total
2010	99.0	99.2	99.1
2015	99.4	99.5	99.5

Source: CDO Ecological Profile 2019

Malaybalay, Bukidnon

The 2011 Malaybalay Integrated Survey System (MISS) showed that 97.63% of the city's 118,315 inhabitants 10 years old and older are literate with a higher literacy rate among males (**Table 3-215**).

Table 3-215. Literacy rate in Malaybalay (2011)

Barangay	Population of 10 years old and above	No. of literates	No. of illiterates	% Illiterates	
				Barangay	City
Barangay 1	3,696	3,670	26	0.70%	0.02%
Barangay 2	748	746	2	0.27%	0.00%
Barangay 3	381	380	1	0.26%	0.00%
Barangay 4	324	322	2	0.62%	0.00%
Barangay 5	153	152	1	0.65%	0.00%
Barangay 6	469	468	1	0.21%	0.00%
Barangay 7	1,676	1,667	9	0.54%	0.01%
Barangay 8	578	574	4	0.69%	0.00%
Barangay 9	5,661	5,601	60	1.06%	0.05%
Barangay 10	2,171	2,127	44	2.03%	0.04%
Barangay 11	2,401	2,380	21	0.87%	0.02%
Aglayan	5,478	5,406	72	1.31%	0.06%
Apo Macote	3,590	3,432	158	4.40%	0.13%
Bangcud	4,341	4,209	132	3.04%	0.11%
Busdi	1,587	1,434	153	9.64%	0.12%
Cabangahan	2,168	2,138	30	1.38%	0.02%
Caburacanan	801	746	55	6.87%	0.04%
Can-ayan	4,265	4,103	162	3.80%	0.13%
Capitan Angel	913	873	40	4.38%	0.03%
Casisang	16,220	16,098	122	0.75%	0.10%
Dalwangan	4,389	4,262	127	2.89%	0.10%
Imbayao	1,160	1,120	40	3.45%	0.03%
Indalasa	1,272	1,185	87	6.84%	0.07%
Kalasungay	5,885	5,851	34	0.58%	0.03%
Kibalabag	780	743	37	4.74%	0.03%
Kulaman	866	819	47	5.43%	0.04%
Laguitas	2,250	2,205	45	2.00%	0.04%
Linabo	5,641	5,449	192	3.40%	0.16%
Magsaysay	2,149	2,106	43	2.00%	0.03%
Maligaya	1,705	1,635	70	4.11%	0.06%

Barangay	Population of 10 years old and above	No. of literates	No. of illiterates	% Illiterates	
				Barangay	City
Managok	5,731	5,596	135	2.36%	0.11%
Manalog	635	552	83	13.07%	0.07%
Mapayag	961	926	35	3.64%	0.03%
Mapulo	920	910	10	1.09%	0.01%
Miglamin	2,347	2,217	130	5.54%	0.10%
Patpat	2,002	1,942	60	3.00%	0.05%
San Jose	4,324	4,236	88	2.04%	0.07%
San Martin	2,518	2,458	60	2.38%	0.05%
Sila-e	1,889	1,778	111	5.88%	0.09%
Simaya	3,123	3,090	33	1.06%	0.03%
Sinanglanan	2,659	2,586	73	2.75%	0.06%
St. Peter	1,819	1,712	107	5.88%	0.09%
Sto. Niño	1,261	1,242	19	1.51%	0.02%
Sumpong	6,620	6,548	72	1.09%	0.06%
Violeta	1,971	1,952	19	0.96%	0.02%
Zamboanguita	1,322	1,282	40	3.03%	0.03%
Total	**123,820**	**120,928**	**2,892**	**2.34%**	**2.34%**

Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

The Tagoloan literacy record showed that almost 99 percent of its household population 10 years old and over are literate (**Table 3-216**). Of the remaining one percent that were illiterate, 354 were male and 223 females.

Table 3-216. Household population by literacy of Tagoloan (2015)

Age group	Total Population			Literate			Illiterate		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
10-14	7,520	3,850	3,670	7,424	3,792	3,632	96	58	38
15-19	7,371	3,746	3,625	7,311	3,703	3,608	60	43	17
20-24	7,249	3,743	3,506	7,191	3,701	3,490	58	42	16
25-29	6,453	3,398	3,055	6,406	3,363	3,043	47	35	12
30-34	5,481	2,880	2,601	5,448	2,852	2,596	33	28	5
35-39	4,736	2,440	2,296	4,689	2,408	2,281	47	32	15
40-44	4,050	2,100	1,950	4,024	2,085	1,939	26	15	11
45-49	3,441	1,726	1,715	3,406	1,707	1,699	35	19	16
50-54	2,958	1,494	1,464	2,926	1,476	1,450	32	18	14
55-59	2,515	1,284	1,231	2,494	1,272	1,222	21	12	9
60-64	1,856	918	938	1,829	906	923	27	12	15
65 and over	2,503	1,120	1,383	2,408	1,080	1,328	95	40	55
Total	**56,133**	**28,699**	**27,434**	**55,556**	**28,345**	**27,211**	**577**	**354**	**223**

Source: Philippine Statistics Authority, 2015, Tagoloan CLUP 2017-2027

Among the 64,514 population five years and older, 42.74 percent have reached high school followed by 31.46% who attended elementary education, 1.13% (post-secondary), 11.02% (college undergraduate), 7.58 percent (baccalaureate/college graduate and post baccalaureate) (**Table 3-217**). The remaining 6.07 percent have neither not completed any grade, reached pre-school, nor special education. More males have gone to pre-, elementary education and high school education.

It is important to note however that more males have not completed any grade school education. It has been observed that more females have reached higher levels of education from post-secondary school up to college education.

Table 3-217. Population by highest grade/year completed in Tagoloan (2015)

Highest grade/year completed	Population (5 years old and over)	Male	Female
No grade completed	1,876	1,003	873
Preschool	2,018	1,050	968
Special education	20	9	11
Elementary	20,294	11,158	9,136
1st - 4th grade	10,952	6,129	4,823
5th - 6th grade	3,509	1,967	1,542
Graduate	5,833	3,062	2,771
High school	27,576	13,960	13,616
Undergraduate	11,372	5,690	5,682
Graduate	16,204	8,270	7,934
Postsecondary	727	297	430
Undergraduate	39	19	20
Graduate	688	278	410
College undergraduate	7,111	3,366	3,745
Baccalaureate/college graduate	4,852	2,130	2,722
Post baccalaureate	38	20	18
Not stated	2	1	1
Total	**64,514**	**32,994**	**31,520**

Source: Philippine Statistics Authority, 2015 Census of Population

Sumilao, Bukidnon

The literacy rate in Sumilao is 97.21% where 18,037 of the population 10 years old and over are literate (2010 PSA). On educational attainment for the household population of 5 years old and over, 50.45 percent have attended or completed elementary level, 28.59 percent attended high school, 0.83 percent post-secondary and only 3.31 percent earned an academic degree. 6.48 percent had not attended any grade level.

Manolo Fortich, Bukidnon

Table 3-218 shows there are only three illiterates per 100 literate population for 10 years old and over in the municipality indicating that 97% of the population are literate. The male literacy is slightly greater than the females (49.50% and 47.25% respectively) against the total percentage of persons 10 years old and above.

Table 3-218. Illiteracy rate in Manolo Fortich

Barangay	No. of persons 10 years old and above			Illiterate persons 10 years old and above*					
				Magnitude			Proportion**		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Agusan Canyon	7,850	3,989	3,861	68	30	39	1	1	1
Alae	4,838	2,472	2,366	66	32	34	1	1	1
Dahilayan	970	508	462	140	73	67	16	16	15
Dalirig	2,918	1,528	1,389	151	83	68	6	6	5
Damilag	10,261	5,115	5,146	154	76	78	2	2	2
Dicklum	2,923	1,467	1,455	135	59	76	5	4	5
Guilang-guilang	793	420	373	96	48	47	13	13	13
Kalugmanan	2,171	1,140	1,032	84	45	39	4	4	4
Lingion	3,341	1,748	1,593	69	36	33	2	2	2
Lindaban	1,498	778	721	26	14	12	2	2	2
Lunocan	4,591	2,384	2,208	165	96	69	4	4	3
Maluko	2,632	1,366	1,266	88	37	51	4	3	4
Mambatangan	3,029	1,627	1,403	98	53	45	4	4	3
Mampayag	1,012	504	508	117	54	63	13	12	12

Barangay	No. of persons 10 years old and above			Illiterate persons 10 years old and above*					
				Magnitude			Proportion**		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Mantibugao	1,839	937	902	37	24	13	2	3	1
Minsuro	572	323	249	21	12	9	4	4	4
Sankanan	2,355	1,214	1,141	44	30	14	2	3	1
San Miguel	3,563	1,827	1,736	32	21	11	1	1	1
Santiago	1,044	565	479	29	11	18	3	2	4
Santo Niño	2,814	1,478	1,335	92	44	48	4	3	4
Tankulan (Pob.)	6,127	3,088	3,039	120	63	57	2	2	2
Ticala	996	517	479	57	26	31	6	6	6
Total	**68,137**	**34,995**	**33,141**	**1,889**	**967**	**922**	**3**	**3**	**3**

Source: Manolo Fortich CLUP 2013-2022

Impasug-ong, Bukidnon

Table 3-219 shows that the literacy rate in Impasug-ong of ages 10 years and above is 94.37 percent comprising 32,608 individuals where about 53% are males and 47 % are females.

Table 3-219. Literary population in Impasug-ong (2015)

Age group	Total Population			Literate			Illiterate		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
10-14	5,905	3,004	2,901	5,501	2,763	2,738	404	242	162
15-19	5,303	2,798	2,505	5,150	2,691	2,459	153	107	46
20-24	4,209	2,249	1,960	4,059	2,169	1,890	150	-	150
25-29	3,554	1,964	1,590	3,422	1,872	1,550	132	92	40
30-34	3,174	1,724	1,450	3,078	1,669	1,409	96	55	41
35-39	2,826	1,545	1,281	2,670	1,466	1,204	156	79	77
40-44	2,404	1,334	1,070	2,278	1,271	1,007	126	-	126
45-49	2,076	1,073	1,003	1,931	993	938	145	-	145
50-54	1,724	923	801	1,608	864	744	116	-	116
55-59	1,232	653	579	1,140	602	538	92	-	92
60-64	829	440	389	704	361	343	125	-	125
65 & over	1,317	639	678	1,067	530	537	250	110	140
Total	**34,553**	**18,346**	**16,207**	**32,608**	**17,251**	**15,357**	**1,945**	**685**	**1,260**

Source: Impasug-ong CLUP 2019-2028

3.4.5.1.4 Census of population/property that will be displaced/disturbed

The implementation of RA 7279 (Urban Development and Housing Act) and RA 7160 (Local Government Code) transferred more responsibilities to local government units pertaining to its land use, housing and infrastructure development in their respective localities. As such, the LGUs became the principal implementing bodies with regard to shelter needs to effectively and efficiently respond to the challenge of providing shelter to its homeless and underprivileged constituents.

Cagayan de Oro City

As of 2010, the housing backlog of the city was 39,304 consisting of 4,406 that were doubled-up, 24,813 households located hazardous areas and fire victims, 1,176 affected by infrastructure projects, 5,457 for demolition/eviction, 3,452 with pending threats for demolition, 3,209 for sale to occupants, conflict of ownership (7,955).

Table 3-220. Housing situation in Cagayan de Oro City (2007 and 2010)

Parameter	Year 2007		Year 2010	
	No.	% Change	No.	% change
Households (HH)	116,224	24.27	137,465	

Household Population	553,966	20.47	598,803	
Housing Unit (HU)				
Occupied HU	113,321	24.71	133,366	
Vacant HU				
Ratio of HH to Occupied HU			103:100	

Source: National Statistics Office (NSO)

The ideal standard household to housing unit ratio as of 2000 was 1:1. Ten years later, records showed that there are 133,366 occupied housing units in the city for the 137,465 households resulting to a ratio of 103 households for every 100 occupied housing units. This indicated the existence of doubled-up housing and a shortage of housing units. A total of 4,099 more housing units are needed to achieve the ideal ratio of a housing unit for each household. However, housing units that are made of light materials like cogon, nipa, anahaw, which will not last for five years and makeshift houses make up for the backlog.

Table 3-221. Housing backlog in Cagayan de Oro city (2010)

Backlog	No. of units	Total (%)
Doubled-Up Households	4,406	40.30
Unacceptable Housing Units	5,621	51.40
Makeshift/Salvage/Improvised Housing Units	907	8.3
Total	**10,937**	**100**

Source: National Statistics Office (NSO)

The Tropical Storm Sendong which struck in December 2011 changed the housing scenario in the city. Some places that have long been identified by the DENR as danger areas and not suitable for housing have suddenly been cleared when 4,301 houses were totally washed-out and 14,883 partially damaged. Barangay Macasandig was the hard-hit area with 1,630 structures totally washed-out followed by Balulang with 611 and Barangay 13 with 423 structures.

The declaration of President Benigno Aquino of some areas as "No Build Zone" rendered the once heavily inhabited areas as open and uninhabitable (**Table 3-222**). The former occupants of these areas numbering 2,740 families either temporarily took refuge on the various evacuation centers or stayed with their relatives.

Table 3-222. No build zones in Cagayan de Oro

Barangay	Purok
Macasandig	Sitio Calacala
	Biasong
	Tambo
Consolacion	Isla Baksan
	Isla Bugnaw
Barangay 13	Isla Delta
Barangay 15	Isla De Oro

Source: Cagayan de Oro City CLUP 2013-2022

The 2007 NSO survey showed of the 59 percent of the 116,224 households owned and/or amortized the lot they occupy, 16 percent are renters, 18 percent are occupying the land for free but with owners' consent, and 3 percent occupy the land without the consent of the owners. A survey conducted by the LGU in 2011 also showed 23,893 informal settler families.

Malaybalay City, Bukidnon

The city had a 2000 population of 123,672 with 19,228 households translating to an average household size of 6.43. By 2010, its population has increased to 153,085 resulting to a household population of 32,029 which means a growth rate of 5.24% for the past ten years (**Table 3-223**).

Table 3-223. Occupied housing units and growth rates in Malaybalay City (2000 and 2010)

Census year	Total population	Population growth rate	Total # of HH	HH growth rate	Occupied HU	Occupied HU growth Rate
2000	123,672	**2.16%**	19,228	**5.24%**	23,033	**3.22%**
2010	153,085		32,029		31,611	

Note: HH – household, HU – Housing unit; Source: Malaybalay CLUP 2016-2025

The unequal figures of household population and occupied housing units implied that there are households with double occupancy (one dwelling unit shared by two or more households, aka doubled-up). There were 418 doubled-up households in 2010 using data in **Table 3-223**.

To address the increasing housing needs of the city, private sectors invested in developing subdivision projects to cater most of the average income families. The government, on the other hand, provided decent and affordable housing to qualified beneficiaries based on RA 7279 (Urban Development Housing Act).

Table 3-224 lists the existing subdivision projects within the city as of 2010 consisting of 54 subdivision projects, 28 from the private owner/developer and 26 are government initiated in the form of resettlement, sites, and services, upgrading and employees housing. Three of these sites and services projects are located in rural barangays.

The 2013 MISS records showed 1,535 makeshift houses within Malaybalay City, 290 of it are located in the urban barangay, 321 are in the urbanizing barangays, and the rest in the rural areas. In addition, there were also 12,419 residential structures made of light materials where 2,453 structures are in the urban area, 2,526 in the urbanizing, and 7,440 in the rural areas.

Table 3-224. Housing projects in Malaybalay

No.	Subdivision	Location	Area (ha)	No. of lots/units
Private Housing				
1	Fe	Barangay 1	13.8992	104
2	Bade	Barangay 1	2.7959	88
3	Cudal	Barangay 2	0.4379	23
4	Pabillaran	Barangay 9	10.4418	95
5	Mamawag	Barangay 11	3.4413	46
6	Fortich	Barangay 11	3.5176	28
7	Flores	Sumpong	1.2523	23
8	De la Cerna	Sumpong	1.8880	4
9	Bliss	Casisang	5.3580	50
10	Ocaya	Casisang	4.2500	193
11	Grema I (1994)	Casisang	3.4067	204
12	Villa Azura I (1994)	Casisang	5.0287	306
13	Ma. Lilia Ramos Seelin (1994)	Sumpong	0.9763	25
14	Grema II (1995)	Casisang	3.5796	209
15	Villa Azura II (1996)	Casisang	4.0800	317
16	Carmenville (2003)	Casisang	6.1167	497
17	Manela Inc. (2003)	Barangay 7	2.7744	132
18	P & T Village (2003)	Kalasungay	10.1159	258
19	Green Valley (2005)	Laguitas	11.9437	355
20	Salang Homes (2006)	Natid-asan, Casisang	8.6875	496
21	Asian Village (2006)	San Jose	2.0066	104
22	Suna Village (2006)	Sumpong	2.488	124
23	Sunrise Village (2007)	Can-ayan	3.5791	327
24	CAHAFI Homes (2007)	Casisang	13.6300	859
25	Goldstar Subdivision (2009)	Casisang	2.0000	206

No.	Subdivision	Location	Area (ha)	No. of lots/units
26	Midland Valley Homes (2009)	Kalasungay	4.0000	227
27	Big Apple Homes (2009)	Casisang	3.5161	50
28	Greenfields Subdivision (2010)	Caisang	3.9859	182
29	Villa Monique Subdivision (2010)	Laguitas	3.3112	186
		Subtotal	**142.5084**	**5,718**
Public/government housing				
1	Bukidnon Housing and Site and Service I (1996)	Casisang	6.4049	197 H & L 66 lot only
2	Bukidnon Housing II (1997)	Casisang	2.4056	99
3	Bukidnon Housing IV (2004)	Casisang	3.4963	146
4	Bukidnon Homes (1999)	Casisang	6.4133	176 socialized, 87 economic
5	Panorama Heights (1998)	Kalasungay	1.5961 2.6298 2.304	68 socialized, 48 executives, 49 expansions
6	PGB Subdivision (2000)	Casisang	3.2803	79
7	Bukidnon Resettlement I (1995)	Kubayan, Casisang	5.097	226
8	Bukidnon Resettlement II (1999)	Depot, Casisang	5.387	263
9	Capitol Village I (2001)	Capitol Site	3.1749	134 H & L, 5 lot only
10	Capitol Village II (2001)	Capitol Site	2.125	119
11	Casisang Pagla-um I (2003)	Landing, Casisang	8.7551	339 resettlement, 143 site/services
12	Casisang Pagla-um II (1996)	Landing, Casisang	4.5764	187 lots, 32 Buk Homes
13	Bukidnon Resettlement III	Kimambong, Casisang	1.4775	74
14	Grandstand Village	Sumpong	1.6762	108
15	Kalasungay Village	BFI Area, Kalasungay	4.806	166
16	Bukidnon Housing V	Casisang	5.178	131 socialized
17	Bliss (1999)	Avinca, Casisang	5.345	160
18	GK-Natid-asan (2004)	Casisang	3.0363	169
19	Malaybalay Housing Project I (2005)	Casisang	3.521	147
20	Linabo Site and Services	Linabo	5	236
21	Laguitas Site and Services (2006)	Laguitas	1	63
22	Patpat Site and Services (2006)	Patpat	4	175
23	Natid-asan Resettlement (2006)	Sitio Lemon, Casisang	0.9945	48
24	Melendez Subdivision	Barangay 1	2.073	67
25	Malaybalay Housing Project II	Casisang	3	112
		Subtotal	**98.7532**	**4,119**

Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

The municipality has 16,661 occupied housing unit's majority of which were single houses with 12,953 occupancies (**Table 3-225**).

Table 3-225. Occupied housing units in Tagoloan (2015)

Type of building	Occupied HU	No. of HH*	HH population*	Average HH size	Ratio of HH to occupied HU	Ratio of HH population to occupied HU
Single house	12,953	13,207	58,667	4.44	1.02	4.53
Duplex	2,044	2,103	8,261	3.93	1.03	4.04
Multi-unit residential	1,634	1,659	5,931	3.58	1.02	3.63
Commercial/industrial/ agricultural	21	21	88	4.19	1.00	4.19
Institutional living quarter	2	2	12	6	1.00	6.00
Others	7	7	19	2.71	1.00	2.71
Not Reported	-	-	-	-	-	-
Total	**16,661**	**16,999**	**72,978**	**4.29**	**1.02**	**4.38**

Note: HH – household, HU – housing unit; Source: National Statistics Office, 2015 Census of Population and Housing

There was a housing backlog of 1,782 units in 2015 derived from the sum of the 412 units of housing backlog in **Table 3-226** and the 1,370 informal settlers in **Table 3-224**. The housing backlog was composed of 82.04 percent doubled-up, 1.21 percent unacceptable housing units, 15.78 percent makeshift /salvage/ improvised hut, and 0.97 percent other types.

Table 3-226. Housing backlogs in Tagoloan

Backlog	2007		2015	
	Number	Percent	Number	Percent
Doubled – Up Households	86	34.40	338	82.04
Unacceptable Housing Units	72	28.80	5	1.21
Makeshift / Salvage/ Improvised HU	58	23.20	65	15.78
Others	34	13.60	4	0.97
Total	**250**	**100**	**412**	**100**

Source: Tagoloan CLUP 2017-2027

Sumilao, Bukidnon

The building permits issued from 2007 to 2011 for residential, agricultural, institutional, and commercial structures enumerated below showed annual increases in the construction of buildings in the municipality. Some of the residential building constructions were replacement for old and dilapidated houses. The entry of the Monterey Hog Farm at San Vicente also contributed to the construction of agro-industrial and institutional buildings.

a) 2007 - 108 permits for 76 residential buildings, 25 agricultural, and five for commercial purposes.
b) 2008 - 151 permits for 139 residential, nine commercial, and three agro-industrial buildings.
c) 2009 - 165 permits for 155 residential, five for institutional, one for commercial, and five agro-industrial.
d) 2010 - 190 permits issued for 122 residential, 11 commercial, and six agro-industrial.
e) 2011 – 183 permits issued for 156 residential buildings and 20 agricultural purposes.

Table 3-227 shows that of the 4,179 occupied housing units in 2007, 33.07 percent (1,379 units) have bamboo or sawali walls. followed by 1,212 units with half-concrete and half-wood walls, 889 units with wooden walls, and 633 with concrete walls. Nine units (0.22 percent) of the dwelling units have makeshift or improvised materials.

About 95 percent of the dwelling units in the municipality used G.I. or aluminum sheets for roofing materials. The rest used bamboo roofs and mostly found in the farms.

Table 3-227. Types of houses by construction material in Sumilao

Types of houses	Number
Bamboo/Sawali	1,379
Half-Concrete and Half-wood walls	1,212
Wooden Walls	889
Concrete	633
Makeshift/Improvised Materials	9
Total	**4179**

Source: Sumilao CLUP 2011-2020

The improvement of residential buildings from light materials to concrete and semi-concrete could be attributed to the increased income of most families in the municipality. Most of these are landowners who have leased their agricultural lands to multi-national companies and plantation workers who have labored hard for the welfare of the families. These types of buildings are not only found in the urban barangays but also in the rural areas.

In 2007, the municipality of Sumilao with assistance from the Provincial Government of Bukidnon established the Sumilao Paglaum Village for 55 informal settlers living within the road right-of-way. The LGU had also purchased a one-hectare land at San Vicente and acquired another two areas in Kisolon for socialized housing projects.

Manolo Fortich, Bukidnon

The NSO Census recorded an increase in households in the municipality by 39% in 2010 (19,367) from 13,950 in 2000. The concentration of the households is in Barangay Damilag comprising about 13 percent of the total households in the municipality. Barangay Agusan Canyon ranked second with 1,970 households and followed by Barangay Alae with 1,710. Household size was pegged at an average of five members.

Of the 17,795 households recorded in 2010, 761 were living in makeshift houses. Barangay Lunocan has the highest number of makeshift houses (153) followed by Barangays Agusan Canyon (118) and Mambatangan (85) houses (**Table 3-228**).

Table 3-228. Households living in makeshift housing by barangay in Manolo Fortich (2010)

Barangay	Actual number of HH	Magnitude	Proportion**
Agusan Canyon	2,101	118	6.65
Alae	1,449	64	4.89
Dalirig	746	41	5.5
Dahilayan	278	18	6.47
Damilag	2,502	62	2.48
Diclum	743	12	1.61
Guilang-guilang	176	21	11.93
Kalugmanan	599	6	1
Lingion	893	79	8.85
Lindaban	389	25	6.43
Lunocan	1,218	153	12.56
Maluko	662	12	1.81
Mampayag	282	3	1.06
Mambatangan	818	85	10.39
Minsuro	162	6	3.7
Mantibugao	511	32	6.26
Sankanan	619	74	11.95
Santiago	231	2	0.87
Santo Niño	723	77	10.65
San Miguel	619	34	4.33
Ticala	257	5	1.95
Tankulan (Pob.)	1,651	64	4
Total	**17,795**	**761**	**5%**

Source: Manolo Fortich CLUP 2013-2022

About 63% or 10,868 of the household were owners or owner-like of house and lot and about 39% of the households have no permanent houses (**Table 3-229**).

Table 3-229. Tenure status of houses in Manolo Fortich

Tenure status	Number	Percent
Owner, owner-like possession of house and lot	10868	62.9
Rent house/room including lot	765	4.43
Own house/rent lot	335	1.94
Own house, rent-free lot with consent of owner	2441	14.13

Tenure status	Number	Percent
Own house, rent-free lot without consent of owner	472	2.73
Rent-free house and lot with consent of owner	2055	11.89
Rent-free house and lot without consent of owner	149	0.86
Other tenure status	145	0.84
Total	**17230**	**98.88**

Source: Manolo Fortich CLUP 2013-2022

The type of building for the houses in the municipality reflects its typical rural area. About 48.6 percent of the houses had roofs made of strong materials while 23 percent had roofs made of light materials (**Table 3-230**). A small percentage (2.91%) of the houses had roofs made of mixed but dominantly salvaged materials.

Table 3-230. Roof materials of houses in Manolo Fortich

Construction materials of roof	Frequency	Percent
Strong materials (concrete, brick, stone, wood, galvanized iron)	8397	48.6
Light materials (bamboo, sawali, cogon, nipa)	3972	22.99
Salvaged/makeshift materials	276	1.6
Mixed but predominantly strong materials	2460	14.24
Mixed but predominantly light materials	1639	9.49
Mixed but predominantly salvaged materials	503	2.91
Total	**17247**	**99.83**

Source: Manolo Fortich CLUP 2013-2022

There are about 7,519 houses (43.52%) with walls made of strong materials and 29.14 percent made of light materials (**Table 3-231**). This indicated the economic status of the households in the municipality where poverty incidence is still high.

Table 3-231. House wall materials in Manolo Fortich

Material	Number	Proportion
Strong materials (concrete, brick, stone, wood, galvanized iron)	7519	43.52
Light materials (bamboo, sawali, cogon, nipa)	5035	29.14
Salvaged/makeshift materials	216	1.25
Mixed but predominantly strong materials	2313	13.39
Mixed but predominantly light materials	1700	9.84
Mixed but predominantly salvaged materials	448	2.59
TOTAL	**17795**	**100**

Source: Manolo Fortich CLUP 2013-2022

The number of houses built in Manolo Fortich increased in the last ten years due to population increase. The CBMS records showed that the number of housing units in 2010 was 17,795 compared to NSO data 13, 950 in 2000. Approximately six percent of these were identified as makeshift houses.

In 2011, the Paglaum Village Housing Project, a joint program of the PLGU of Bukidnon and Manolo Fortich was implemented to address the housing needs of 50 families with makeshift houses along the RROW. Out of the 186 sitios scattered in 22 barangays, 18 sitios had 943 makeshift houses where 70 percent are located along the RROW and 30% along riverbanks with slopes susceptible to landslides and floods.

Impasug-ong, Bukidnon

The Sinabualan Village in Purok 6, Poblacion was constructed in the year 1996 and occupied since then by mostly public-school teachers and government employees. On the other hand, the Impasug-ong Village Sites and services (IVSS) in Purok 3 Poblacion was occupied in 2006 (**Table 3-232**).

Table 3-232. Housing projects and subdivisions in Impasug-ong

Housing project	Location	Area covered	Number of units
Sinabualan Subdivision	Purok 6, Poblacion	1.0115	61
Impasug-ong Village Sites & Services (IVSS)	Purok 3, Poblacion	2.5353	114
AITC Housing Project	AITC Site (Purok 7)	2.0000	111
Source: Impasug-ong CLUP 2019-2028	**Total**	**4.5353**	**286**

Most of the families used wood, galvanized iron, and cement or considered semi-concrete residences in building their houses accounting for 63.22 percent of the 9,734 households in 2015 (**Table 3-233**). There were also houses made of light materials, like wood, bamboo, sawali, cogon and nipa followed by those made of cement, bricks, stone and asbestos. In 2000, there were 110 housing units made of improvised and salvage materials also known as barong-barong or makeshift tenement which increased to 156 in 2007 and decreased to 29 in 2015.

Table 3-233. Type of housing construction materials in Impasug-ong (2015)

Construction materials of the outer walls	No. of occupied housing units	Construction materials of the roof					
		Galvanized iron/ aluminum	Tile/ concrete/ clay tile	Half galvanized iron and half concrete	Bamboo/ cogon/ nipa/ anahaw	Makeshift/ salvaged/ improvised materials	Trapal
Concrete/ brick/ stone	2,140	2,130	5	3	1		1
Wood	2,823	2,732	5	2	66	4	14
Half concrete/ brick/stone and half wood	1,319	1,294	4	17	3		1
Galvanized iron/ aluminum	31	31					
Bamboo/sawali/cogon/ nipa	3,221	2,720		7	231	51	212
Asbestos	7	7					
Makeshift/salvaged/ improvised materials	14	10			2		2
Trapal	13	7			1	3	2
No walls	2	2					
Not Reported	164	164					
Others							
Total	**9,734**	**9,097**	**14**	**29**	**304**	**58**	**232**

Source: Impasug-ong CLUP 2019-2028

Almost all of the residents in the municipality are living in their own houses and lots. Some of them may be living with their parents making them with owner-like possession and living in rent-free lots and own the house with the consent of the owner. Another is houses and lots that are free of rent with the consent of the owner (**Table 3-234**).

Table 3-234. Tenure status of housing in Impasug-ong

Tenure status	No. of HH	Type of building				
		Single House	Duplex	Multi-unit residential	Commercial/industrial /agricultural	Not Reported
Own or owner like possession of house and lot	6,925	6,651	200	50	17	7
Rent house/room including lot	412	342	29	40	1	-
Own house rent lot	31	29	2		-	-
Own house rent-free lot with consent of owner	1,483	1,413	48	12	-	7
Own house rent-free lot without	83	75	6	2	-	-

Tenure status	No. of HH	Type of building				
		Single House	Duplex	Multi-unit residential	Commercial/industrial /agricultural	Not Reported
consent of owner						
Rent-free house and lot with consent of owner	910	813	61	29	4	3
Rent-free house and lot without consent of owner	14	13	1	-	-	-
Not Applicable	-	-	-	-	-	-
Not Reported	-	-	-	-	-	-
Total	**9,858**	**9,339**	**347**	**133**	**22**	**17**

Note: HH – household; Source: Impasug-ong CLUP 2019-2028

3.4.5.1.5 Impact assessment on the displacement of settlers

1. PRE-CONSTRUCTION PHASE

Land valuation **-** the CMH project may affect land values for opportunists/businesspersons to flock to the area and lure landowners to dispose and sell their lands and because of economic difficulties, may fall to those with no concern with the welfare of the local residents.

The participants during the public scoping and IEC community consultation raised the issue of how the affected land will be assessed and the payment scheme. This is particularly an issue for owners with no legal documents for their land. The issue of the land rented by the Del Monte corporation was also a concern raised in addition to lands under ancestral domain titles. The IPs in the area were concerned on how the land will be evaluated and assessed.

2. CONSTRUCTION

Relocation of displaced settlers **- i**nformation gathered from the various City/Municipal Planning and Development Offices showed possible displacement of settlers by the Project. The majority of the participants during the public scoping raised concerns on displacement during the detailed engineering design and if there will be a relocation plan for those affected. This concern also came out from the survey and key informant interviews.

Right-of-Way and compensation for land and land improvements **-** Private landowners might disapprove of the Project if their land will be affected. If this is the case, the value of their land must be assessed accordingly with proper compensation. Those owning small land parcels (small lot owner farmers) may no longer have any land to work on for a living. Similarly, those residing near the proposed alignment whose lands will be affected but not benefiting from the Project have to be considered for priority hiring.

The participants during the public scoping stated that the RROW should be settled before the start of Project construction. The participants also asked about the situation with their lands being rented by the Del Monte Another issue to consider is the compensation scheme for those without legal documents for the land they occupy. The IPs also stated their concern for compensation since their land is part of the ancestral domain. These concerns were also raised by the survey respondents and key informants. In addition, the key informants also asked about possible loss of income and livelihood aside from compensation and potential relocation.

Conflict in right of way was a major issue during the pre-construction phase regarding land valuation, compensation for lands affected by the Project, and actual payment.

3.4.5.2 In-migration (proliferation of informal settlers)

Cagayan de Oro City

Informal settlers in the city are located in high-risk areas like rivers and creeks such as at the banks of the Cagayan de Oro River and the riverside of Barangay FS Catanico. The Local Shelter Plan 2012 of the city estimated 46,062 informal settler families occupying both private and public lands. An estimated 34,898 households need to be relocated including located in high-risk areas near rivers, creeks, and landslide prone areas.

Malaybalay City, Bukidnon

The total number of informal settlers in Malaybalay is 667 households composed within its urban area identified by the city LGU in 2014 and also at the road-right-of ways, riverbank buffer zones, and private/government lands comprising about four percent of the total municipal household population. It is expected that more will migrate from rural and from other neighboring cities to urban areas as a result of spill-out of development. Using the average number of persons in households in Malaybalay (4.3 persons per household), the city has an estimated 667 households. **Table 3-236** shows the summary of the informal settlers in Malaybalay City.

Tagoloan, Misamis Oriental

The CBMS 2017 census recorded at least 1,370 households or 9.42 percent of the total municipal households who were informal settlers (**Table 3-235**). The largest number of informal settlers is found in Barangay Sta. Cruz with 367 households followed by Barangay Poblacion with 211, Barangay Mohon with 193, Barangay Sugbongcogon with 184, Barangay Gracia with 116, Barangay Natumolan with 104, Barangay Baluarte with 96, and Barangay Sta. Ana with 73. There were fewer informal settlers in Barangay Casinglot with 20 and Barangay Rosario with six households. Some of these informal settlers build their houses in hazard-prone areas.

Table 3-235. Informal settlers in Tagoloan

Barangay	No. of HH	Informal settlers	
		HH	Percent
Baluarte	2,041	96	4.7
Casinglot	2,263	20	0.88
Gracia	596	116	19.46
Mohon	827	193	23.34
Natumolan	1,721	104	6.04
Poblacion	1,723	211	12.25
Rosario	239	6	2.51
Santa Ana	1,633	73	4.47
Santa Cruz	2,941	367	12.48
Sugbongcogon	552	184	33.33
Total	**14,536**	**1,370**	**9.42**

Note: HH – household; Source: Tagoloan CLUP 2017-2027

Table 3-236. Informal settlers in Malaybalay

No.	Location	Danger Areas*		Court Order		Parks & Playgrounds		Gov't Facilities		Private Properties		For tenurial upgrading		Total		Number of Informal settlers HH
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
	Urban															
1	Barangay 3	8	0.42											8	0.28	2
2	Barangay 4	20	1.04	32	14.95									52	1.81	12
3	Barangay 6	49	2.54											49	1.71	11
4	Barangay 7	116	6.02											116	4.05	27
5	Barangay 9	116	6.02											116	4.05	27
6	Barangay 10			62	28.97			2	0.43					64	2.23	15
7	Barangay 11	14	0.73	69	32.24									83	2.90	19
8	Casisang	17	0.88											17	0.59	4
9	Sumpong	129	6.70					390	82.98					519	18.11	121
	Sub-Total	**469**	**24.35**	**163**	**76.17**	**0**	**0**	**392**	**83.40**	**0**	**0**	**0**	**0**	**1,024**	**35.73**	**238**
	Urbanizing															
1	Aglayan	144	7.48					33	7.02	37	14.45			214	7.47	50
2	Bangcud	42	2.18											42	1.47	10
3	Managok	46	2.39											46	1.61	11
4	San Jose	33	1.71											33	1.15	8
	Sub-Total	**265**	**13.76**	**0**		**0**	**0**	**33**	**7.02**	**37**	**14.45**	**0**	**0**	**335**	**11.69**	**78**
	Rural															
1	Apo Macote	40	2.08											40	1.40	9
2	Busdi	65	3.37											65	2.27	15
3	Cabangahan	93	4.83											93	3.24	22
4	Caburacanan	12	0.62	51	23.83			23	4.89					86	3.00	20
5	Can-ayan	5	0.26											5	0.17	1
7	Dalwangan	27	1.40											27	0.94	6
8	Imbayao	15	0.78											15	0.52	3
9	Indalasa	6	0.31											6	0.21	1
10	Kalasungay	48	2.49							42	16.41			90	3.14	21
12	Kulaman	29	1.51											29	1.01	7
13	Laguitas	57	2.96											57	1.99	13

No.	Location	Danger Areas*		Court Order		Parks & Playgrounds		Gov't Facilities		Private Properties		For tenurial upgrading		Total		Number of Informal settlers HH
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
14	Linabo	11	0.57							82	32.03			93	3.24	22
16	Maligaya	30	1.56					1	0.21					31	1.08	7
18	Mapayag	7	0.36											7	0.24	2
19	Mapulo	3	0.16											3	0.10	1
20	Miglamin	42	2.18											42	1.47	10
21	Patpat		0.00					3	0.64	1	0.39			4	0.14	1
22	San Martin	127	6.59					18	3.83	94	36.72			239	8.34	56
23	Sila-e	54	2.80											54	1.88	13
24	Simaya	172	8.93											172	6.00	40
25	Sinanglanan	155	8.05											155	5.41	36
26	St. Peter	17	0.88											17	0.59	4
27	Sto. Nino	48	2.49											48	1.67	11
28	Violeta	61	3.17											61	2.13	14
29	Zamboanguita	68	3.53											68	2.37	16
	Sub-Total	**1,192**	**61.89**	**51**	**23.83**			**45**	**9.57**	**219**	**85.55**			**1,507**	**52.58**	**350**
	Total	**1,926**	**67.20%**	**214**	**7.47**	**0**	**0**	**470**	**16.40**	**256**	**8.93**			**2,866**		**667**

Note: Danger areas include RROW, riverbanks canal/drainage, coastline, garbage or landfill, and sidewalks/under the bridge; Source: Malaybalay CLUP 2016-20

Sumilao, Bukidnon

Informal settlers in the municipality could not be avoided as these families tend to construct their houses in areas where their livelihood source is located. Most of these families have no other lands, especially those at Barangays Kisolon and San Vicente whose dwelling units were within the road right-of-way. For San Vicente, particularly at Sitio Damay (Zone 7), these houses were not only along the national highway but also within landslide prone areas.

In 2008, the Provincial Government of Bukidnon and Municipal Government of Sumilao established a housing village for the 55 informal settlers living within the National Highway Road right-of-way at Kisolon. However, there are still houses within the road rights-of-way in certain areas in Barangays Kisolon and San Vicente.

Manolo Fortich, Bukidnon

Barangay Damilag (urban barangay) had the highest number of informal settlers (**Table 3-237**). The barangay is very near the Del Monte Plantation where job opportunities for laborers are offered. Some of these laborers, mostly migrants from other parts of Visayas and Mindanao, build makeshift houses in vacant lots without the consent of the owners. Barangays Alae ranked second with the highest number of informal settlers due to a large biscuit company (REBISCO) followed by Barangay Dalirig.

Table 3-237. Informal settlers in Manolo Fortich (2010)

Barangay	Total no. of HHs	Population	Informal settlers against total HHs (%)
Urban			
Alae	1,449	62	0.3484
Damilag	2,502	127	0.7137
Tankulan (Pob.)	1,651	33	0.1854
Sub-total	**5,602**	**222**	**1.2475**
Urbanizing			
Agusan Canyon	2,101	24	0.1349
Diclum	743	25	0.1405
Dalirig	746	40	0.2248
Lunocan	1,218	34	0.1911
Mantibugao	511	39	0.2192
Maluko	662	15	0.0843
Mambatangan	818	48	0.2697
San Miguel	619	19	0.1068
Sub-total	**7,418**	**244**	**1.3712**
Rural			
Dahilayan	278	60	0.3372
Guilangguilang	176	2	0.0112
Kalugmanan	599	53	0.2978
Lingion	893	32	0.1798
Lindaban	389	20	0.1124
Mampayag	282	68	0.3821
Minsuro	162	6	0.0337
Sankanan	619	52	0.2922
Santiago	231	6	0.0337
Santo Niño	723	42	0.236
Ticala	257	7	0.0393
Sub-total	**4,609**	**348**	**1.9556**
Total	**17,795**	**814**	**4.5743**

Source: Manolo Fortich CLUP 2013-2022

Impasug-ong, Bukidnon

Three of the 13 barangays in the municipality are located along the National Highway. Another three barangays are located at the foot of Mt. Kitanglad and seven located across Tagoloan River. Due to this, majority of the barangays are located in forestall areas where the settlement is minimal. Some can be found in Barangays Impalutao, Bontongon, Bulonay, Dumalaguing, Guihean, Sayawan, Hagpa and Kalabuago.

The 2007 local survey showed the existence of homeless residents considered as informal settlers living along road buffers, privately and government owned lands, along creek and riverbanks, and along the road rights of way.

A total of 643 informal settlers were recorded in the 2015 CBMS survey (**Table 3-238**). Barangay Kalabugao had the highest number of about 544 persons followed by Barangays Impalutao with 44, Kibenton 30, Cawayan 29, Kalabugao 28, Dumalaguing 24, Hagpa 23, Guihean 14, La Fortuna 14, Poblacion 13, Bulonay 12, Sayawan 7 and Bontongon 1.

Table 3-238. Informal settlers in Impasug-ong (2015)

Barangay	No. of formal HH		No. of informal settlers HH		Proportion to total no. of HHs
	2011	2015	2011	2015	
Bontongon	162	131	0	1	0.76
Bulonay	276	279	5	3	1.08
Capitan Bayong	530	549	28	7	1.27
Cawayan	412	401	9	2	0.50
Dumalaguing	546	557	11	10	1.80
Guihean	356	381	6	12	3.15
Hagpa	537	621	0	10	1.61
Impalutao	1,145	1,107	28	24	2.17
Kalabugao	1,099	1,215	14	544	44.77
Kibenton	857	482	12	1	0.21
La Fortuna	801	822	9	3	0.37
Poblacion	2,176	2,260	0	10	0.44
Sayawan	265	267	0	16	5.99
Total	**9,162**	**9,072**	**122**	**643**	**7.09**

Source: Impasug-ong CLUP 2019-2028

Table 3-239 shows that 75 hectares of land is potential available for the housing projects of the municipality to cater the need for housing units.

Table 3-239. Inventory of potential lands for housing in Impasug-ong

Owner	Land area (ha)	Location	Suitability/conditions
AITC – LGU	10	Poblacion	Vacant – Residential area
Mr. Fidencio Neri	2	Capitan Bayong	Vacant – Agro-Industrial
CADT	15	Kalabugao	Vacant – Settlement Area
CADT	15	Hagpa	Vacant – Settlement Area
Private Property	10	Bulonay	Vacant – Settlement Area
Mrs. Lagremosa	5	Poblacion	Under Negotiation
Privately Owned	3	Capitan Bayong	Vacant – Settlement Area
Privately Owned	10	Poblacion (Jabines, Padilla)	Vacant – Agro Industrial
CARP	2	Impalutao	Vacant – Settlement Site
Mr. Guingona	2	Sitio Kubayan	Vacant – Settlement Area
Mr. Gaburno	1	Cawayan	Purchased by LGU
Total	**75**	Source: Impasug-ong CLUP 2019-2028	

Impact assessment

In-Migration: labor demand and entry of migrant workers - Contractors during the construction phase might bring in migrant workers increasing the influx of migrants in the area. This may pose a conflict with the issue on local hiring particularly that skilled workers in the barangay/municipality expect to be part of the workforce.

Due to the nature of the project, there might be a need for migrant workers with crucial skills and expertise. The entry of migrant workers will also lead to population increase and create housing demand and possible widening in the differential access to non-farm income and employment opportunities.

The concern for local hiring was raised during the IEC consultation, public scoping, survey and key informant interviews. The participants expect that they will be able to work in the construction project depending on their capabilities and skills. In addition, when the survey respondents were asked if they were given an opportunity to work for the project, majority would take the opportunity and allow their family members to work. However, there were concerns such as age, health matters, and having no skill.

Proliferation of informal settlers or "followers" - Factors such as population growth, lack of affordable housing, weak governance, economic vulnerability, low-paid work, marginalization, and displacement caused by natural disasters and climate change have driven the emergence of informal settlements. Accompanying Project implementation would be an increase in the informal settlers attracted to various economic activities related to construction projects. The presence of migrant workers may also mean the presence of their families in the construction housing provided by the contractor. Some of the migrants might also be those peddling or catering to the needs of the migrant workers in the area such as traders, suppliers, and other service providers (including sex workers). Aside from the proliferation of informal settlers, migration also poses a risk to social cohesion, culture and traditions, and to some extent, to the safety and security of the residents. It can lead to social tension associated with xenophobia and discrimination and to violence in neighborhoods, workplaces or schools.

Increased pressure on accommodations and rents - Accounting for more than 70% of land in most cities, housing determines the city/municipality's form and densities, provides employment, and contributes to growth (UN HABITAT, 2016). One of the biggest challenges cities faces is providing adequate and affordable housing to migrants, which is often in limited supply. A lack of affordable housing has led to people living in slums or squatting. People that live in slums due to poverty and in poor conditions can lead to poor health due to overcrowding and a lack of potable water and proper sanitation. Depending on the project workers' income and form of accommodation provided by the company, there may be increased demand for accommodation, which may lead to price hikes and crowding out of residents.

3.4.5.3 Cultural/Lifestyle change

The succeeding tables in this section present the indigenous peoples as predominantly exemplified in Malaybalay comprising the Manobo, Bukidnon, Talaandig, Higaonon, Tigwahanon, Matigsalug, Umayamnon and other Lumads. Manolo Fortich also mentions the Binukid as a local dialect spoken by 9% of its population signifying the presence of IPs. The Bukidnon and Dumagat also flourish in Impasug-ong.

Malaybalay City

From the city's total population of 162,011 (MISS 2013), the ethnic population of 60,591 comprises more than a third (37.4%) of the total population. The highest number of ethnic populations in the city is Bukidnon which is about 28% of the total ethnic population. Higaonon ranks second embracing 39% of the ethnic population. As shown below, underscored are the ethnic groups within Bukidnon such as the Manobo, Bukidnon, Talaandig, Higaonon, Tigwahanon, Matigsalug, and Umayamnon. Ethnic groups from another locality are included in the "other Lumad" category.

Table 3-240. Population by ethnic origin in Malaybalay

Barangay	Manobo	Bukidnon	Talaandig	Higaonon	Tigwahanon	Matigsalug	Umayamnon	Others	Total
Urban									
Poblacion 1	39	606	119	459	4	5	18	22	1,272
Poblacion 2	12	100	10	68	0	0	0	1	191
Poblacion 3	0	106	25	6	0	0	0	0	137
Poblacion 4	0	76	2	72	0	0	0	0	150
Poblacion 5	0	55	1	8	0	6	0	0	70
Poblacion 6	8	353	10	28	0	0	0	2	401
Poblacion 7	1	133	41	26	0	1	0	1	203
Poblacion 8	10	254	8	38	3	0	1	0	314
Poblacion 9	139	1512	292	814	32	22	64	75	2,950
Poblacion 10	54	398	48	279	16	0	6	16	817
Poblacion 11	9	1185	98	95	13	5	2	6	1,413
Casisang	122	2769	245	798	93	23	24	54	4,128
Sumpong	64	1466	148	2090	10	7	17	5	3,807
Subtotal	**458**	**9,013**	**1,047**	**4,781**	**171**	**69**	**132**	**182**	**15,853**
Urbanizing									
Aglayan	26	961	233	667	11	1	30	4	1,933
Bangcud	174	598	445	869	75	7	37	1	2,206
Managok	73	589	61	207	60	14	301	2	1,307
San Jose	47	532	178	1,127	15	**0**	**9**	5	1,913
Subtotal	**320**	**2,680**	**2,870**	**2,870**	**161**	**22**	**377**	**12**	**7,359**
Rural									
Busdi	1	16	7	1,407	10	0	7	0	1448
Cabangahan	16	720	77	47	1	0	2	3	866
Caburacanan	0	0	0	962	0	0	0	0	962
Can-ayan	39	26	39	4,250	13	0	49	6	4,422
Capt. Angel	0	694	402	23	0	0	0	2	1,121
Dalwangan	31	3,091	207	197	0	1	3	77	3,607
Imbayao	15	447	187	26	0	3	15	0	693
Indalasa	17	106	11	159	0	4	308	0	605
Kalasungay	52	5,447	124	90	3	0	1	6	5,723
Kibalabag	4	1	13	1,039	1	0	2	0	1,060
Kulaman	1	8	0	1,011	2	0	0	0	1,022
Laguitas	15	510	66	707	11	0	25	0	1,334

Barangay	Manobo	Bukidnon	Talaandig	Higaonon	Tigwahanon	Matigsalug	Umayamnon	Others	Total
Linabo	44	1,530	105	794	29	1	18	8	2,529
Macote	26	109	40	134	29	3	192	8	541
Magsaysay	6	922	113	203	7	0	1	14	1,266
Maligaya	16	183	22	227	6	2	2	12	470
Manalog	2	0	0	879	3	0	0	0	884
Mapayag	3	665	14	201	0	0	0	0	883
Mapulo	5	20	3	430	0	4	11	1	474
Miglamin	22	33	19	276	0		298	2	650
Patpat	12	1,566	13	373	1	9	2	8	1,984
San Martin	82	94	78	867	14	0	9	0	1,144
Sila-e	24	11	16	833	1	9	101	0	995
Simaya	29	187	203	97	7	9	6	10	548
Sinanglanan	59	226	109	121	0	3	23	11	552
St. Peter	5	52	264	258	8	0	10	19	616
Sto. Niño	17	114	35	10	1	0	38	3	218
Violeta	7	154	95	100	15	11	12	1	395
Zamboanguita	7	2	23	318	0	0	16	1	367
Subtotal	**557**	**16,934**	**2,285**	**16,039**	**162**	**59**	1,151	**192**	**37,379**
Total	**1,335**	**28,627**	**4,249**	**23,690**	**494**	**150**	1,660	**386**	**60,591**
Lumad population (%)	**2.20%**	**47.25%**	**7.01%**	**39.10%**	**0.82%**	**0.25%**	**2.74%**	**0.64%**	

Source: Malaybalay CLUP 2016-2025

Manolo Fortich

Akin to other areas, the early settlers of Manolo Fortich are a combination of migrants from Visayas and the neighboring areas of Mindanao on top of the existing natives of the place. Several dialects Cebuano/Binisaya, Tagalog, Ilongo, and Binukid are spoken. **Table 3-241** shows the population distribution according to Mother Tongue (Ethnic Origin) by sex in 2010. According to ethnicity, majority of the people in Bukidnon are Cebuano accounting for approximately 41% of the total population. The Bukidnon lumads/IPs (Bukidnon, Higaonon, Manobo, Talaandig, etc.) account for about 24% of the total population of the province. The Maranao form about 8% of the total population followed by the Hiligaynon/Ilonggo and Boholano groups with 12.7% and 7.37%, respectively, of the province's total population.

In Manolo Fortich, 26, 000 are Bukidnon, 10,000 are Higaonon, and 4,000 are Talaandig who are indigenous to the area.

Table 3-241 Population in Manolo Fortich, 2020

IP Group	IP Population
Bukidnon	26, 000
Higaonon	10, 000
Talaandig	4,000
Total	40, 000

Source: Municipal IP Coordinator

Table 3-242 Population by mother tongue and sex in Manolo Fortich (2010)

Mother tongue	Male	Female	Total	% of Total
Cebuano	35,024	33,529	63,049	69.26%
Boholano	4,948	4,664	9,612	10.56%
Tagalog	2,712	1,830	4,542	4.99%
Bikol	1,467	1,375	1,223	1.34%
Ilonggo	821	543	1364	1.50%
Bontok	752	525	1,277	1.40%
Ilocano	1,165	473	1,638	1.80%
Other Local Dialect (Binukid, etc.)	4,654	4,431	8,084	8.88%
Other Foreign Languages	47	44	91	0.10%
Not Stated	291	255	146	0.16%
Total	**49,578**	**46,431**	**91,026**	100.00%

Source: Manolo Fortich CLUP 2013-2022

Impasug-ong, Bukidnon

Based on 2011 CBMS Survey of Impasug-ong, 67.4% are Higaonon and 32.6% are of the tribes from outside Bukidnon (**Table 3-243**). Among the residents of Barangay Capitan Bayong, 63.9% of the residents are Higaonon and 36.1% other tribes while in Barangay Cawayan, 52.6% are from other tribes and only 47.4% are Higaonon. In addition, Impalutao has 68.7% Higaonon and 76.1% of the residents of Kibenton are Higaonon and 71.1% of the dwellers are in La Fortuna.

Bukidnon mother tongue shows dominance comprising 75% of the total population in Impasug-ong.

Table 3-243 Population of Indigenous People in Impasug-ong

Barangay	2007 Population	IP Population	Total (%)	2011 Population	IP Population	Poverty Incidence	No. of HH
Bontongon	837	835	99.76	876	874	82.1	162
Bulonay	1,377	905	5.72	1,515	996	80.4	276
Capitan Bayong	2,172	1,387	63.86	2,560	1,635	47.3	530

Cawayan	1,446	686	47.44	1,918	910	61.2	412
Dumalaguing	2,626	2,592	98.71	2,756	2,720	32.5	543
Guihean	1,590	1,138	71.57	1,880	1,346	57.9	356
Hagpa	2,849	1,251	43.91	1,658	1,167	68.2	537
Impalutao	4,239	2,911	68.67	1,484	3,766	66.3	1,145
Kalabugao	4,974	2,831	56.92	5,412	3,080	64.1	1,099
Kibenton	3,311	2,521	76.14	4,072	3,100	83.3	857
La Fortuna	3,129	2,224	71.08	3,835	2,726	48.1	801
Poblacion	6,502	4,709	72.42	10,061	7,287	61.4	2,180
Sayawan	1,230	471	38.29	1,272	487	69.8	265
Total	**36,282**	**24,461**	**7.42**	**44,299**	**9,866**	**63.28**	**9,162**

Source: Impasug-ong CLUP 2019-2028

Table 3-244. Population by mother tongue and sex in Impasug-ong

Ethnicity	Male		Female		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Bago	10	0.06	14	0.04	4	0.03
Ibanag	5	0.03	9	0.03	4	0.03
Kankanay	5	0.03	6	0.02	1	0
Mangyan	2	0	3	0.01	1	0
Ibaloi	42	0.24	65	0.2	23	0.15
Cuyonen	8	0.05	13	0.04	5	0.03
Subanen	23	0.13	38	0.11	15	0.09
B'laan	27	0.16	41	0.12	14	0.09
Mandaya	13	0.08	34	0.1	21	0.13
Manobo	21	0.12	43	0.13	22	0.14
Teduray	8	0.05	17	0.05	9	0.05
Bukidnon	12,591	72.76	24,461	73.87	11870	75.01
Ati	5	0.029	11	0.03	6	0.038
Itom	10	0.06	20	0.06	10	0.06
Badjao	6	0.034	8	0.02	2	0.012
Tau'tbato	2	0	3	0.01	1	0
Dumagat	4,127	23.85	7,624	23.02	3,497	22.12
T'boli	25	0.14	47	0.14	22	0.14
Other	375	2.17	658	2	283	1.79
Total	**17,305**	**52.26**	**33,115**	**100**	**15,810**	**47.74**

Source: Impasug-ong CLUP 2019-2028

3.4.5.3.1 Existing culture and lifestyle

Malaybalay is home to several indigenous peoples possessing distinct customs and traditionsThere are seven IP groups in the Province of Bukidnon, namely: the Manobo, Higaonon, Bukidnon, Matigsalug, Talaandig, Tigwahanon and Umayamnon tribes. Significant findings of the study show that in the area of religion, they still believe in the existence of spirits that affect their daily activities, albeit exposed to different religious denominations. All the seven tribes continue to engage in rituals which they call "pamuhat" in many activities of their life. The use of herbal medicines to cure certain illnesses remain a tradition despite the presence of the health centers.

Bukidnon

The Bukidnon tribe speak the Binukid dialect. Farming is their main means of livelihood. Among the products they produce are corn, palay vegetables and abaca fiber. The Bukidnons are known for their interest in arts and handicrafts. They have dances for every occasion like planting rice, harvesting or marriage. They also make colorful costume jewelry and accessories made of ornamental materials.

Higaonon
The Higaonon tribe houses are mostly made of wood, are located in the middle of a pineapple plantation. The The main economic activity is slash and burn cultivation of upland rice and corn. The hunting of bats, snakes, field rats, monkey and different kinds of birds is prevalent. Fishing is also one of the major activities. The tribesmen derive their means of living from working in the field as laborers of the pineapple plantation owned by a multinational company.

Manobo
The Manobo‘s possess an ownership system such as communal ownership. Land, called pasak, is the basis of their survival. Land embodies everything vital to support their life and culture. Thus, the Manobo concept of territoriality or land and resource- ownership is not restricted to land itself but it includes those that are physically attached to it.

Manobo’s subsistence pattern is semi-nomadic mainly on shifting agriculture with hunting and gathering as supplementary activities. They have diversified to other economic practices such as entrepreneurship and the provision of physical labor and other services. In general, though, agriculture remains the primary source of employment, followed by forestry, inland fishing, and mining.

Matigsalug
Matigsalug are the original inhabitants of the Salug River (now called the Davao River). Typical dwellings are made of wood with only one room. The life of an animist revolves around a spirit world. They maintain that spirits live in water, land, trees, and rocks. Tragedies like illnesses, drought and death are caused by angry spirits. Events like planting crops and revenge-taking (called “pangayaw”) are preceded by rituals. Life is preoccupied with appeasing the spirits by offering sacrifices.

Tigwahanon
The term Tigwahanon may have been derived from “guwa” (scattered) or from the Tigwa River. They were originally living in the nearby mountains of San Fernando, Bukidnon. The Tigwa river served as the main source of their livelihood. They have no problem as to food as they can always go hunting and gather plants that can be eaten. They are now farm laborers.

Umayamnon
These Indigenous peoples dwell along the watershed of Umayam River in the Mountains of Pantaron. The Umayamnon tribe means of livelihood is farming. Others work as laborers in nearby rice fields. Umayamnon are excellent makers of bead jewelry like necklaces called ginakit and inboy, beautiful, beaded men’s bag called suning and unisex beaded bracelets called binuklad. They are proud and reserved people.

Talaandig
The members of the group are found in barangays and municipalities surrounding the mountain of Kitanglad, the historic domain of the Talaandig people. The Talaandigs are semi-settled agriculturalist in the uplands. The traditional crops of the Talaandig include corn, rice, rootcrops, abaka and banana. These crops are usually produced at consumption levels. Supplements to this subsistence level economy are raising chickens, pigs and other livestock. Pigs and chickens are usually utilized for religious purposes while large animals such as horses and carabaos are used for payment of debt and other financial obligations. The Talaandig technology includes blacksmithing, weaving, embroidery, hunting and food gathering.

3.4.5.3.2 Impacts on the culture and lifestyle

Cultural/lifestyle change on Indigenous Peoples
Government projects like establishment of highway projects that might encroach CADC/CADT will have an affect the security of land tenure that eventually would lead to displacements of the IP inhabitants. Certificate of Non-Overlap has been issued in Misamis Oriental and major parts of the Project in Bukidnon while FPIC is needed for the Barangays in Ticala, Manolo fortich, Culasi, Poblacion, Puntian, Vista Villa and San Roque in

Sumilao of which were identified within the unified claim of IMPUMATRICS (**Appendix 42**). If and when the final design would cover part of IPs ancestral domain, and displacements will occur, this would alter the life style of the people due to the probable loss of their traditional resources. This may affect their lands where they obtain their livelihood and food nutrients, herbal medicines, which they use for curing illness, the loss of the sacred grooves and ritual places and, likewise, desecration of the burial of their ancestors.

This could also lead to changes of their traditional culture and values system, as well as their indigenous knowledge system because such knowledge will be replaced by outsiders' knowledge and finally abandoning their cultural lore. The elders and adult members of the community fear that the youth might be influenced by the pressures of modern ways and that they cannot uphold or continue to live out their culture and traditions. Thus, the disappearance of culture and tradition is a feared possibility. The dreams and aspirations of the IPs are government support to help them uplift their social and economic status

3.4.5.3.3 Impacts on physical cultural resources

Cagayan de Oro City, Misamis Oriental

The City Museum of Cagayan de Oro, formerly known as the Water Tank Tower, is one of the historical places in city that contains old photographs and paintings, artifacts, antiques and an interesting old Ostrich egg, which is believed to be centuries old. The establishment is the oldest public structure in the city, which was built in 1922 and renovated into a museum in 2008.

Museo de Oro exhibits artifacts dug from Huluga Caves and repertoire of Bukidnon and the Maranao cultures; and the La Castilla, a museum dedicated to the conservation and preservation of the historical and cultural heritage found in the personal memorabilia of the founders of the Liceo de Cagayan University.

The most known worship venue in the city, St. Augustine Metropolitan Cathedral, located at the right of the City Museum of Cagayan de Oro. It has a gothic style architecture, adorned with stained glass and beautiful paintings of the four evangelists. The establishment has gone through several changes since it was built in 1624. It was only in 1946 when the cathedral and the convent was rebuilt through Archbishop James Hayes, SJ.

Just beside the St. Augustine Metropolitan Cathedral is the Gaston Park. It was once the main plaza of Cagayan de Misamis during the Spanish colonial period which served as a training ground for local patriots in the course of the Philippine-American War.

Another establishment in the city is Vicente de Lara Park, formerly known as MacArthur Park, where Press Freedom Monument and the Heritage Monument of Misamis Oriental designed by national artist Eduardo Castrillo.

Malaybalay City, Bukidnon

The several cultural/heritage in Malaybalay City are enumerated below:

- **Roxas Monument**

Source: Government of Malaybalay

The memorial site to the late president Manuel Roxas is a tribute to his heroism during the Japanese Regime when his patriotism and refusal to cooperate with the invaders brought him to imprisonment right in the site of the monument.

- **Torre ni David**

Source: Hans Brandeis

An eccentric house gives the visitor a mix awe, fear and curiosity, having been constructed with faces in the posts and in the ground and other sculptures. Although not maintained as before, there are remaining vestiges of the glory that was.

- **Old Acacia Trees**

Source: Bethel Baptist Hospital, Malaybalay City, Fortich St

Although claims of the age of these trees are not substantiated, the trees are interesting for their steady presence in the city and for their fast-dwindling numbers as many of them fall to the unexplained cuttings. The city was once full of them in the national road. One of the remaining is on the road across the plaza and another, in the Bethel Baptist Hospital Compound which in itself is a place for the 40's style complex of building, a vestige of the missionary days of American doctors who started the hospital nearby.

- **Ereccion de Pueblo**

Source: Government of Malaybalay

This newly inaugurated monument depicts the negotiation and agreement between the Spanish colonizers and the native leaders, which took place in Malaybalay on June 15, 1877 in what may be the site traditionally described as the banks of the nearby Sakub spring. The source of this depiction is the Spanish document which is a record of the meeting on that date.

- **OTOP Products** of Malaybalay

Source: Discover Bukidnon

This is made from *"Hinabol"* a native material woven by "Bukidnon-Higaonon" tribe. It is made from abaca fiber and converted to different forms like bags, home decors, ribbons and other uses. Malaybalay Choice Handicrafts, Kamumay, Nida's Handicrafts, Valdez Handicrafts and Zeta Trading offer original and converted Bukidnon products from hinabol.

- Mt. Kitanglad Range National Park (MKRNP)

Source: DENR

The Mount Kitanglad Range Natural Park (MKRNP)- a total land area of 47,270 hectares, is located in northern Mindanao in the province of Bukidnon in Region 10. Mount Kitanglad is one of five peaks in the Kitanglad Mountain Range at 2,899 meters above sea level. MKRNP was declared a Protected Area through Republic Act No. 8978 in 2000. It was also declared as ASEAN Heritage Park in 2009 (DENR 2015).

MKRNP occupies portions of 8 municipalities in Bukidnon and provides various ecosystem services (e.g., water for domestic, agricultural, industrial, and commercial use, source for power generation) to over 100,000 households, and also to nearby provinces and cities like Cagayan de Oro City.

The eight municipalities and cities include Talakag, Baungon, Libona, Manolo Fortich, Impasugong, Lantapan and Malaybalay. The study area for the Central Mindanao High Standard Highway Project traverses the city of Malaybalay and the municipalities of Manolo Fortich, and Impasug-ong. Specifically, Malaybalay is located in the west of Mt. Kitanglad Range National Park (MKRNP). Four barangays of the city namely Dalwangan, Capitan Anghel, Imbayao, and Mapayag are within the buffer zone of the Mount Kitanglad Range Natural Park. The Protected Area Management Board (PAMB) has specified regulations as to the use of resources in the buffer zone. Thus, the city government ensures that communities of these barangays will follow the rules set by the PAMB (Malaybalay CLUP 2016-2025).

In Manolo Fortich, the Mt. Kitanglad Range National Park is located on the south. Two barangays in Manolo Fortich are located along Mt. Kitanglad Range National Park which are Barnagay Dahilayan and Barangay Guilang-guilang (Manolo Fortich CLUP 2013-2022). In Impasug-ong, the highest crest of the municipality is found at Mt. Kitanglad Range National Park located at the southern tip. Mt Saldab is located at the central part within Dumalaguing, Mt. Kimangkil at the northern part within barangay Hagpa, Mt. Kibuwa found at the south-eastern part within barangay Impalutao and Mt. Pangalak-akan, found within the vicinity of the municipal ranch (Impasug-ong CLUP 2019-2028

- **Camp Kasisang**

Source: Government of Malaybalay

A fifty-hectare camp in the heart of Bukidnon plateau, where Brigadier-General Roxas and 6,000 prisoners of war were imprisoned from August to December 1942.Camp Kasisang had been a training ground for the Philippine Constabulary.

Table 3-245 Distance of cultural areas to the Project

Name	Location	Distance (km)	Year Registered	Laws/ Regulations	Supervisory Authority
City Museum of Cagayan de Oro	Brgy. 1, Cagayan de Oro	13.49	2008	Cagayan de Oro Heritage Council	Cagayan de Oro LGU
Museo de Oro	Brgy. 40, Cagayan de Oro	12.94	1967		Liceo de Cagayan University
St. Agustine Metropolitan Cathedral	Brgy. 1, Cagayan de Oro	13.49	1624		Archdiocese of Cagayan de Oro
Gaston Park	Brgy.1, Cagayan de Oro	13.96	1624	National Historical Institute Marker	Cagayan de Oro LGU
Vicente de Lara Park	Brgy. 27, Cagayan de Oro	12.54			Misamis Oriental LGU
Old Acacia Trees	Sumpong, Malaybalay	1.79			
Ereccion de	Brgy. 8, Malaylabay	2.71	2010		Malaybalay LGU

Name	Location	Distance (km)	Year Registered	Laws/ Regulations	Supervisory Authority
Pueblo					
One Town, One Product	Casisang, Malaybalay	4.86			Malaybalay LGU
Roxas Monument	Aglayan, Malaybalay	12.03			Malaybalay LGU
Torre ni David	Cabangahan, Malaybalay	15.56	1962		Valmoria Family
Mt. Kitanglad Range National Park	Dalwangan, Capitan Anghel, Imbayao, and Mapayag, Malaybalay	35-37	2000	Declared as national park by PD No 677 dated December 14, 1990	Protected Area Management Board (PAMB)
	Barnagay Dahilayan and Barangay Guilang-guilang, Manolo Fortich			Declared as Protected Area under Presidential Proclamation 896 dated October 24, 1996	Malaybalay LGU
	Dumalaguing, Hagpa, Impalutao, Impasug-ong			Republic Act 8978 also known as the "Mt. Kitanglad Range Protected Area Act of 2000 on November 9, 2000	Manolo Fortich LGU
				ASEAN Heritage Park in 2009	Impasug-ong LGU
Camp Kasisang	Malaybalay	4.6-7	1948	Level II – Historical Marker	Philippines Historical Committee (PHC)

Focus group discussion has been conducted last April 27-28, 2021, with the IP leaders in order to determine the presence of sacred areas near the Project, their water sources and sources of livelihood. Based on the FGDs, interview with the barangay Indigenous People Mandatory Representatives, and visit to the allowed sacred areas and water sources, no sacred areas (**Table 3-246** and **Figure 3-114**) and water sources (**Table 3-247** and **Figure 3-115**) will be traversed by the alignment. Major sources of livelihood of the IPs are mostly farming and animal husbandry. Some of them are engaged in bead making, abaca weaving and managing resorts**. Annex 12** shows the photos of the sacred areas, water sources and minutes of the meetings.

Table 3-246. List of sacred areas near the Project

No.	Sacred Places	Coordinates		Distance*	Barangay	Municipality
		Longitude	Latitude			
1	Imbado Area	124.807	8.475181	0.55	Mambatangan	Manolo Fortich
2	Mambatangan Creek	124.8136	8.474182	0.55	Mambatangan	
3	Alae Creek	124.816	8.419892	1.6	Alae	
4	Pulog Hill	124.8479	8.417073	2.89	San Miguel	
5	Dicklum Creek	124.8449	8.380175	2.11	San Miguel	
6	Kapuso Creek	124.8598	8.352884	0.8	Tankulan	
7	Tungtungan	124.8436	8.323071	2.84	Sankanan	
8	Maninit creek	124.8594	8.336163	1.06	Sankanan	
9	Kihare creek	124.8607	8.337809	1.06	Sankanan	
10	Banda spring	124.8497	8.29173	5.91	Lindaban	
11	Balete tree	124.869	8.369526	2.97	Tankulan	
12	Mangima river	124.8745	8.364116	2.26	Dalirig	
13	Pagbayuhan stone	124.8804	8.358106	1.63	Dalirig	
14	Sisimon Stone	124.8852	8.346419	0.41	Ticala	
15	Ritual site near Kumaykay	124.8704	8.293948	5.61	Sankanan	
16	Inlapay River	124.8915	8.335826	0.03	Ticala	
17	Basag Falls	124.9111	8.333315	0.17	Vista Villa	Sumilao
18	Basag Cave	124.9111	8.333315	0.17	Vista Villa	
19	Basag river	124.9111	8.333457	0.13	Vista Villa	
20	Inigsinulan	124.9081	8.30672	2.8	Puntian	

No.	Sacred Places	Coordinates		Distance*	Barangay	Municipality
		Longitude	Latitude			
21	Taryaki	124.9359	8.330376	0.77	San Roque	
22	Mt. Kitanglad	124.9253	8.180058	2.23	San Vicente	
23	Danao cave	124.9551	8.215562	2.43	San Roque	
24	Ilihan Cave	124.983	8.330207	2.56	Kisolon	
25	Alalum Falls	124.9804	8.324124	1.57	Kisolon	
26	Pigaralan creek	124.94722	8.305	1.37	Bontongohan	
27	Humuhulyaw creek	124.9333	8.186281	11.49	La Fortuna	Impasug-ong
28	Inkalumad	125.0296	8.290216	4.12	Capitan Bayong	
29	Lirupan	125.0193	8.275075	2.03	Capitan Bayong	
30	Ipoon creek	125.0322	8.226544	1.04	Dalwangan	
31	Mt. Dapitan	124.91	8.06303	20.34	Victory	Lantapan
32	Kulasian Creek	125.12	8.0125	16.4	Cabangahan	Malaybalay
33	Segaba and kabakahan creek	125.0922	8.178351	1.44	Kalasungay	
34	Diguman ritual area	125.1048	8.181569	2.2		
35	Lumayaga and bag-as creek	125.1205	8.169827	1.11	Brgy 10	

NOTE: *distance to the Project, in km

Table 3-247. List of water sources of the IPs near the Project

No.	Water Sources	Coordinates		distance	Barangay	Municipality
		Longitude	Latitude			
1	Cawayanon deep well	124.8321	8.201889	0.86	San Miguel	Manolo Fortich
2	Miranda deep well	124.8213	8.382441	1.77	Damilag	
3	Balanban spring	124.8136	8.31087	5.52	Agusan Canyon	
4	Banda spring	124.8497	8.29173	6.08	Sankanan	
5	Unahon spring	124.8799	8.275198	6.71	Kalugmanan	
6	Basag falls	124.9106	8.275198	0.2	Villa Vista	Sumilao
7	Basag creek	124.9111	8.333457	0.13	Villa Vista	
8	Palaopao spring	124.9628	8.326492	1.79	San Roque	
9	Molokbolok spring	124.9322	8.181093	10.36	Lupiagan	
10	Pigaralan creek	124.94722	8.305	1.37	Bontongohan	
11	Sagumata spring	124.9404	8.186669	9.48		Impasug-ong
12	Inlerop spring	124.952	8.204738	8.48	La Fortuna	
13	Lalawan spring	124.9724	8.194459	6.18	Capitan Angel	
14	Sawaga river	125.0286	8.181093	3.18	Dalwangan	Malaybalay
15	Kulasian Creek	125.12	8.0125	16.4	Cabangahan	
16	Kulasihan Madaluson spring	125.0077	8.100242	10.22	Imbayao	
17	Yumayaban spring	125.0949	8.326492	2.82	Kalasungay	
18	Ibalabag spring	125.1273	8.213165	6.42	Sumpong	
19	Lumayaga and bag-as creek	125.1227	8.344789	1.5	Sumpong	

NOTE: *distance to the Project, in km

Distribution map of sensitive receptors such as education facilities, medical facilities, places of worship, and other public facilities is show in **Table 3-248** and **Figure 3-117**. All facilities are distributed more than 200 meters away from the center of the proposed CMH alignment.

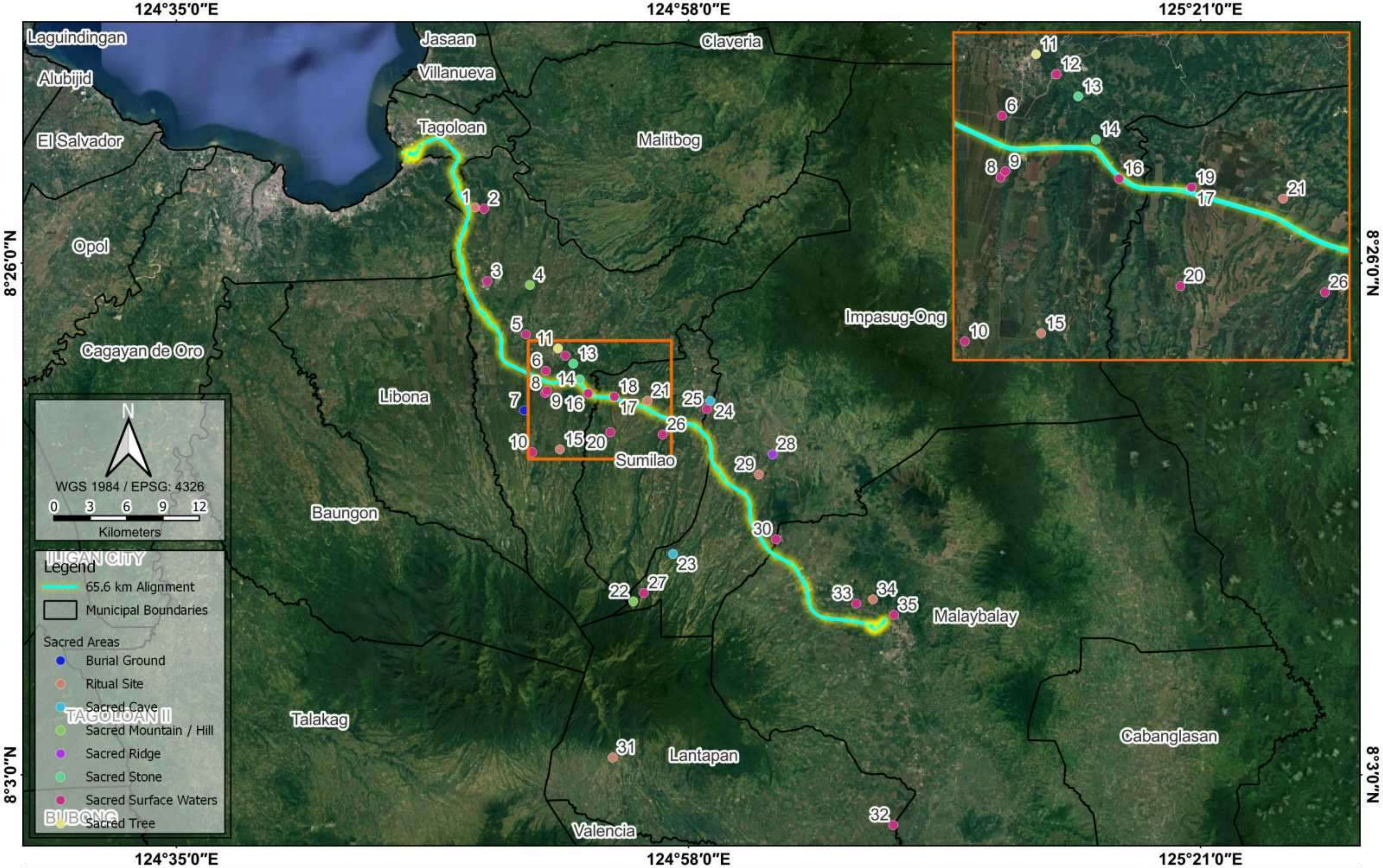
Table 3-248 List of Sensitive Receptors near the Project

No.	Name	Receptor	Distance (m)*	Amenity
1	Prois International Christian School System	Educational Facilities	2,006	school
2	St. Ignatius Technical College	Educational Facilities	1,921	school
3	E-tracc Station	Transportation	859	fuel
4	New Hope Christian School	Educational Facilities	985	school
5	Natumolan Elementary School	Educational Facilities	1,223	school
6	Healtop Eight Pharmacy	Medical Facilities	476	pharmacy
7	Bugo Barangay Hall	Public Facilities	448	townhall
8	PHLPost	Public Facilities	472	post_office
9	R&J Pharmacy	Medical Facilities	665	pharmacy
10	Bright Rock School	Educational Facilities	615	school
11		Public Facilities	785	shelter
12	Philippine Southfield School	Educational Facilities	936	school
13	Suntingon Elementary School	Educational Facilities	1,199	school
14	Bugo National High School	Educational Facilities	1,376	school
15	King of Zion School	Educational Facilities	1,958	school
16	COPCO Police Station 6	Police	1,553	police
17	Rose Pharmacy	Medical Facilities	1,513	pharmacy
18	Mercury Drug	Medical Facilities	1,498	pharmacy
19	Melecia Drug	Medical Facilities	1,479	pharmacy
20	Roan Pharmacy	Medical Facilities	1,486	pharmacy
21	Rika Drugstore	Medical Facilities	1,405	pharmacy
22	Rohon Pharmacy	Medical Facilities	1,391	pharmacy
23	China Bank	bank	1,372	bank
24	Southern Drugstore	Medical Facilities	1,366	pharmacy
25	Pen Bank	bank	1,307	bank
26	BPI	bank	1,262	bank
27	Christian Samaritan School	Educational Facilities	1,233	school
28	Mindanano Consolidated Cooperative Bank	bank	1,193	bank
29	JRS Express	Public Facilities	1,188	post_office
30	First Community Cooperative	bank	1,202	bank
31	BDO	bank	1,176	bank
32	PHINMA-Cagayan de Oro College	Educational Facilities	1,144	college
33	Malitbog Church	Place of Worship	9,643	place_of_worship
34	Aglipay Church	Place of Worship	9,675	place_of_worship
35	Malitbog Police Station	Police	10,012	police
36	Iglesia ni Cristo	Place of Worship	10,300	place_of_worship
37	Patac Primary School	Educational Facilities	19,542	school
38		Public Facilities	4,395	shelter
39	Sto. Nino Parish de Alae	Place of Worship	1,573	place_of_worship
40	San Miguel BHS	Medical Facilities	1,348	clinic
41	Our Mother of Perpetual Help Church	Place of Worship	927	place_of_worship
42	DPWH 3rd District Engineering Office	Public Facilities	2,178	public_building
43	Provincial Industrial Zone	Public Facilities	2,294	public_building
44	PharmaSave	Medical Facilities	2,470	pharmacy
45	Rural Bank of Manolo Fortich	bank	2,436	bank
46	Manolo Fortich Police Station	Police	2,460	police
47	D' Asian Hills Bank	bank	2,549	bank
48	Manolo Fortich Municipal Police Station	Police	2,790	police
49	DPWH Rank & File Cooperative Station	Public Facilities	3,311	community_centre
50	Dalirig Barangay Hall	Public Facilities	3,987	townhall

No.	Name	Receptor	Distance (m)*	Amenity
51	San Lorenzo Ruiz Church	Place of Worship	1,797	place_of_worship
52	San Isidro Old BHS	Medical Facilities	7,513	clinic
53	San Isidro BHS	Medical Facilities	9,080	clinic
54	St. Agustine Church	Place of Worship	7,234	place_of_worship
55	Brgy. Puntian, Sumilao BHS	Medical Facilities	5,897	clinic
56	Kalanganan Elementary School	Educational Facilities	18,736	school
57	DPWH Field Office	Public Facilities	7,056	public_building
58	Sumilao Cooperative Community Center	Public Facilities	4,322	community_centre
59	NFA	Public Facilities	3,130	public_building
60	Petron	Transportation	2,985	fuel
61	Sumilao Bus Terminal	Transportation	2,715	bus_station
62	Phoenix	Transportation	2,640	fuel
63	Shell	Transportation	2,434	fuel
64	Christ The King	Place of Worship	2,124	place_of_worship
65	Pilar High School	Educational Facilities	2,116	school
66	Petron	Transportation	2,068	fuel
67	Sumilao RHU	Medical Facilities	1,622	clinic
68	Impasug-ong Police Station	Police	2,027	police
69	Impasug-ong Central Elementary School	Educational Facilities	2,162	school
70		Transportation	5,854	ferry_terminal
71		Transportation	5,853	ferry_terminal
72	Himlayanan	Public Facilities	4,279	shelter
73	Impalutao Barangay Hall	Public Facilities	1,688	townhall
74	Northern Mindanao Integrated Research Center	Public Facilities	396	public_building
75	Bureau of Soils & Water Management	Public Facilities	377	public_building
76	Bureau of Animal Industry	Public Facilities	416	public_building
77	Bureau of Soils & Water Management	Public Facilities	412	public_building
78	National Artificial Breeding Center	Public Facilities	285	public_building
79	Rojon	Medical Facilities	775	pharmacy
80	Sumpong Chapel	Place of Worship	888	place_of_worship
81	Rodel Pharmacy	Medical Facilities	902	pharmacy
82	Bethel Baptist Christian Academy	Educational Facilities	1,109	school
83	One Network Bank	bank	1,425	bank
84	BDO Network Bank	bank	1,425	bank
85	LBC	Public Facilities	1,448	post_office
86	BukSU University Library	Educational Facilities	1,547	library

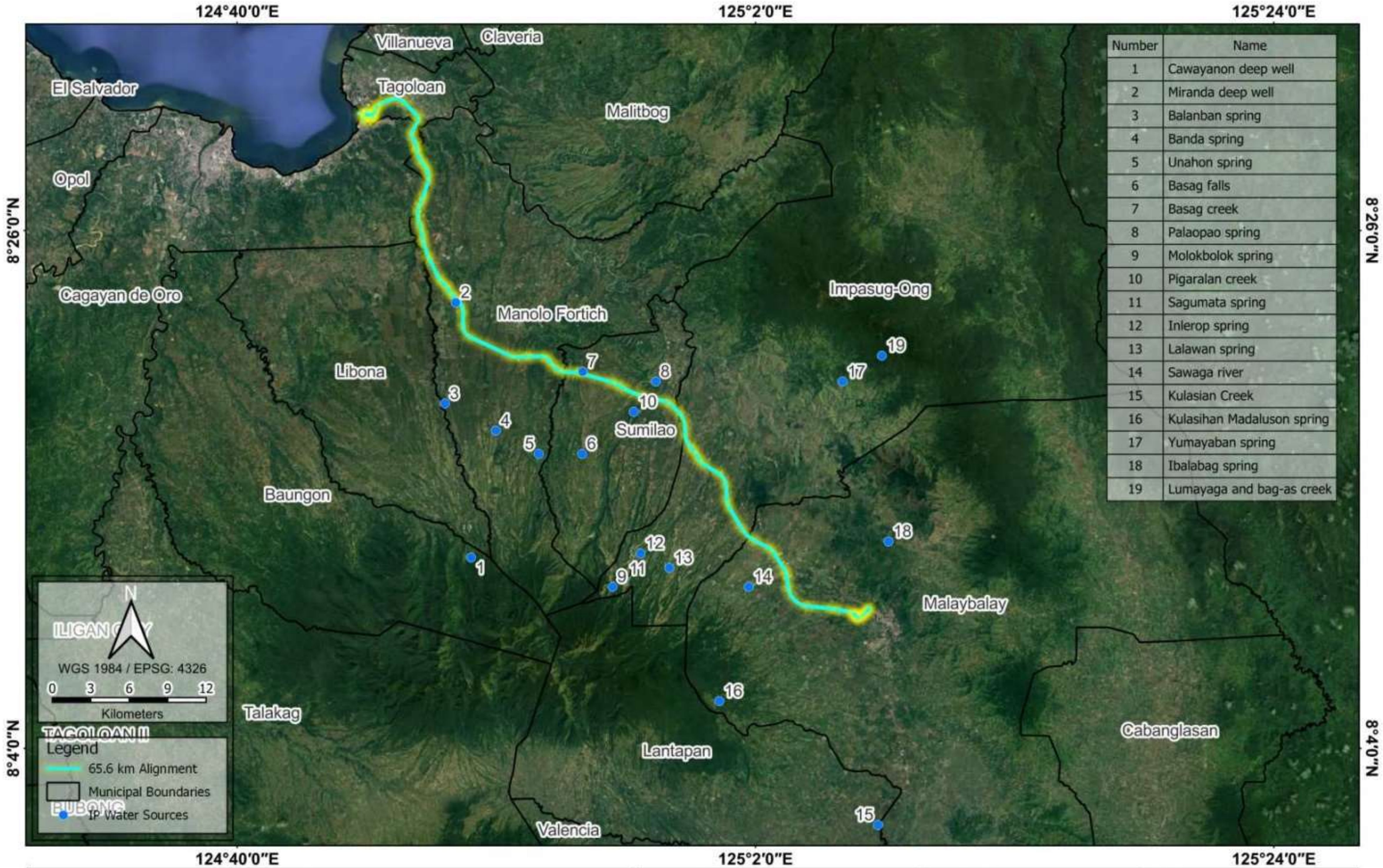
NOTE: *Distance from the center of CMH to facility (m)

Figure 3-114. Sacred areas of the IPs near the alignment



Sacred Areas Map	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Satellite (Basemap) PSA 2016 (Administrative Boundaries)		

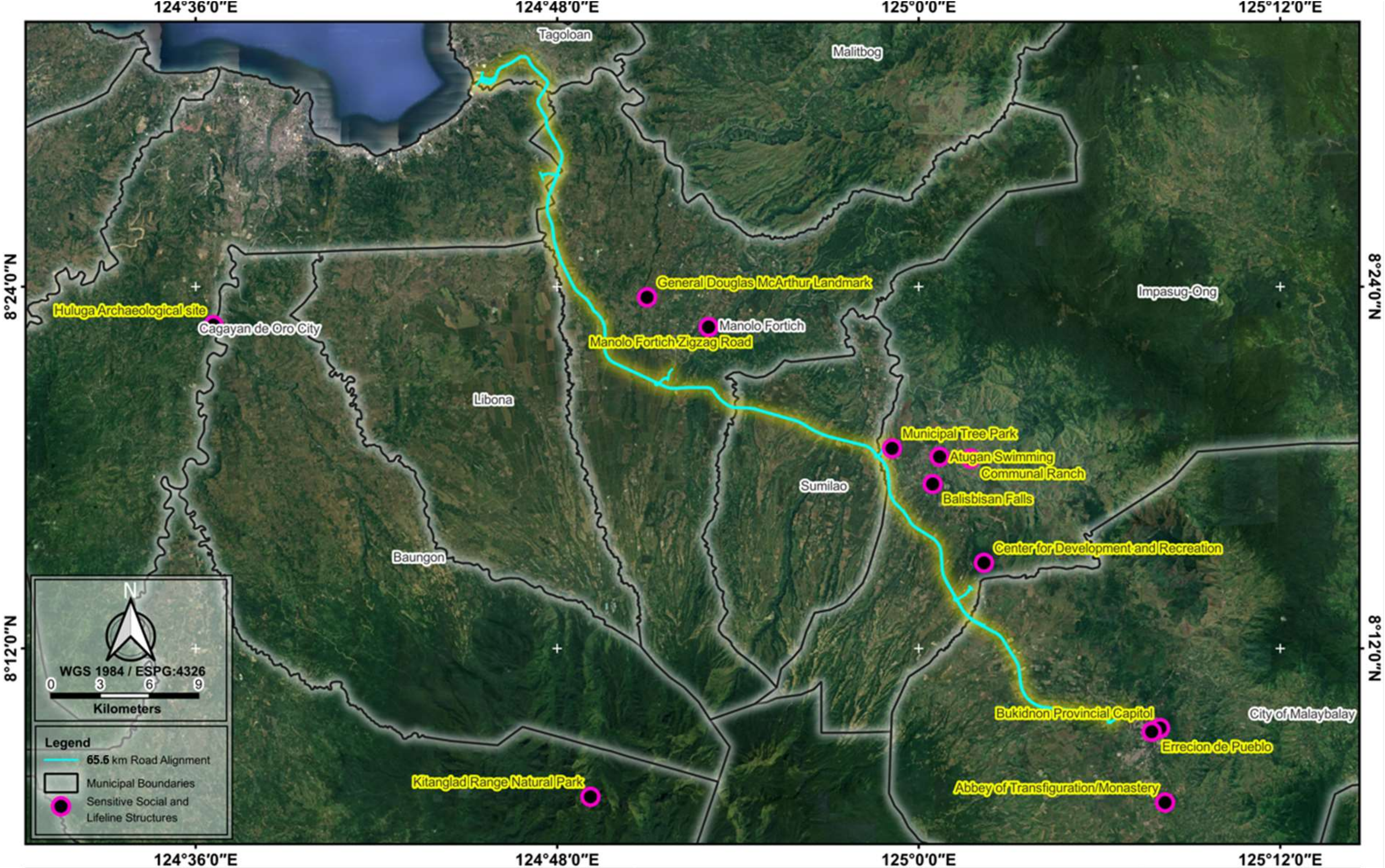
Figure 3-115. Water sources of the IPs



Number	Name
1	Cawayanon deep well
2	Miranda deep well
3	Balanban spring
4	Banda spring
5	Unahon spring
6	Basag falls
7	Basag creek
8	Palaopao spring
9	Molokbolok spring
10	Pigaralan creek
11	Sagumata spring
12	Inlerop spring
13	Lalawan spring
14	Sawaga river
15	Kulasian Creek
16	Kulasihan Madaluson spring
17	Yumayaban spring
18	Ibalabag spring
19	Lumayaga and bag-as creek

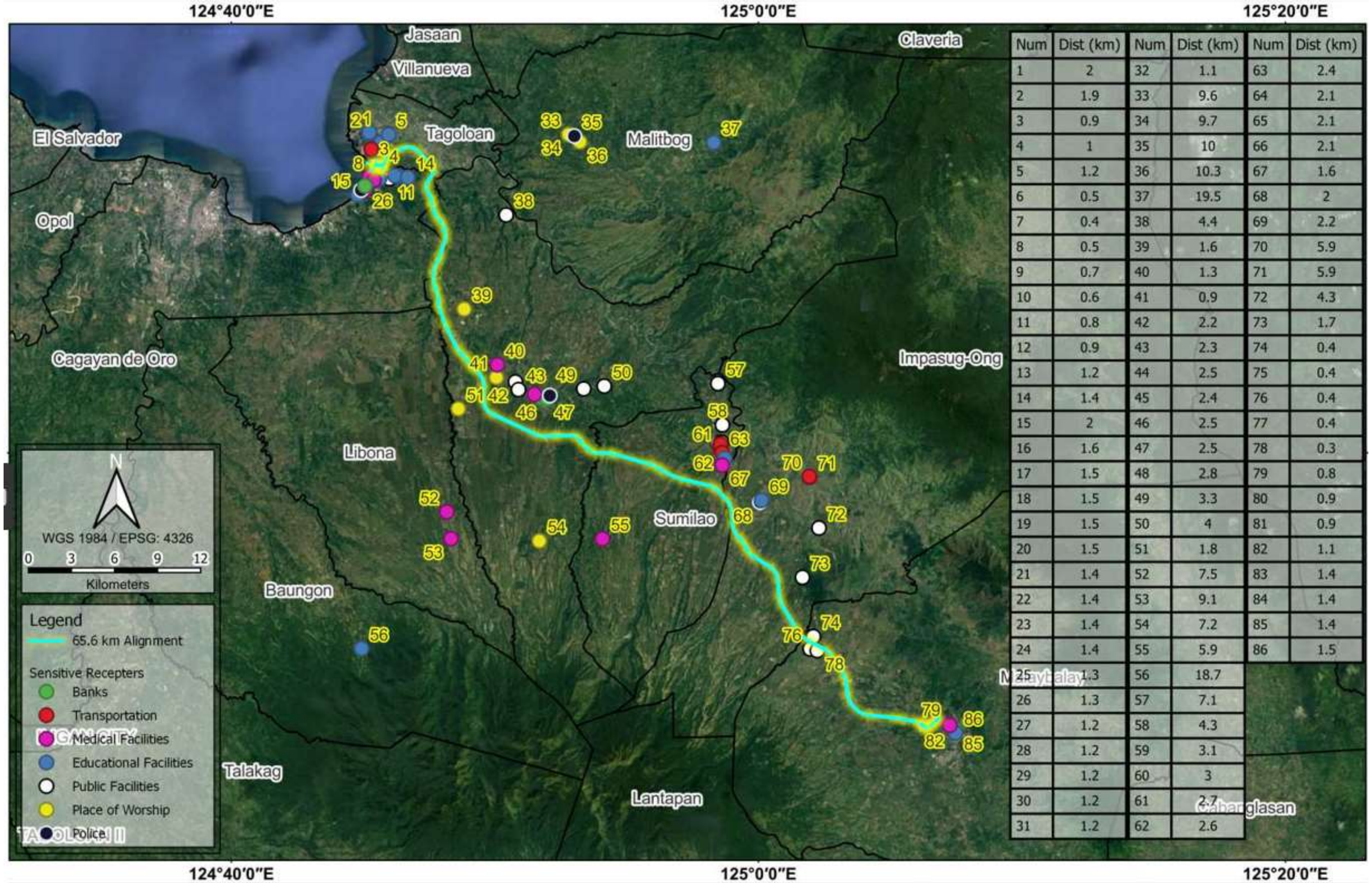
	Project Title	Source(s) of Information	Project Proponent	EIA Preparer
IP Water Sources	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Satellite (Basemap) PSA 2016 (Administrative Boundaries)		AMET ASIA INC.

Figure 3-116. Social and Lifeline structures



	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
Social and Lifeline Structures	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental, Region X	Google Earth Satellite (Basemap) PSA 2016 (Administrative Boundaries)		

Figure 3-117. Sensitive Receptors



Num	Dist (km)	Num	Dist (km)	Num	Dist (km)
1	2	32	1.1	63	2.4
2	1.9	33	9.6	64	2.1
3	0.9	34	9.7	65	2.1
4	1	35	10	66	2.1
5	1.2	36	10.3	67	1.6
6	0.5	37	19.5	68	2
7	0.4	38	4.4	69	2.2
8	0.5	39	1.6	70	5.9
9	0.7	40	1.3	71	5.9
10	0.6	41	0.9	72	4.3
11	0.8	42	2.2	73	1.7
12	0.9	43	2.3	74	0.4
13	1.2	44	2.5	75	0.4
14	1.4	45	2.4	76	0.4
15	2	46	2.5	77	0.4
16	1.6	47	2.5	78	0.3
17	1.5	48	2.8	79	0.8
18	1.5	49	3.3	80	0.9
19	1.5	50	4	81	0.9
20	1.5	51	1.8	82	1.1
21	1.4	52	7.5	83	1.4
22	1.4	53	9.1	84	1.4
23	1.4	54	7.2	85	1.4
24	1.4	55	5.9	86	1.5
25	1.3	56	18.7		
26	1.3	57	7.1		
27	1.2	58	4.3		
28	1.2	59	3.1		
29	1.2	60	3		
30	1.2	61	2.7		
31	1.2	62	2.6		

Sensitive Recepters Map	**Project Title**	**Source(s) of Information**	**Project Proponent**	**EIA Preparer**
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Sensitive Recepters: Open Street Map		

3.4.5.4 Threat to delivery of basic services/resource competition

3.4.5.4.1 Water supply

Cagayan de Oro city, Misamis Oriental

The Cagayan de Oro Water District (COWD), registered in 1973, was the first water district to be established in the country. Its service area covered 64 of the 80 barangays of the Cagayan de Oro City, which include Barangays 1-40 of the Poblacion and 24 non-población barangays. COWD reservoirs, with the following respective location and capacity are shown **Table 3-249**.

Table 3-249 Water service area connection in Cagayan de Oro City (2018)

Location	No. of service connection			Total
	Residential	Commercial	Government	
West Service Area	51,042	2,045	149	53,262
East Service Area	39,356	4,611	391	44,406
Others	74	0	0	74
Total	**79,342**	**5,884**	**540**	**97,668**

Source: Cagayan de Oro City CLUP 2013-2022

Table 3-250 Water reservoir in Cagayan de Oro City (2018)

Description	Location	Capacity (cu.m.)
Concrete	Camaman-an	5,300
Concrete	Carmen	5,300
Steel Tank	Aluba Subd., Macasandig	76
Concrete	Bulua	2,900
Concrete	Tablon	2,100
Concrete	Puerto Heights, Puerto	4,000
Concrete	Youngsville	95
Steel Tank	Paglaum, Camaman-an	60
Steel Tank	Richmond, Camaman-an	189
Steel Tank	Malanang, Opol	385

Source: Cagayan de Oro City CLUP 2013-2022

Majority of connection comprises residential and commercial. The average water consumption in the entire City is about 1,438,068 cubic meters which is consumed by the government. People living in areas not presently covered by COWD rely on point sources such as shallow well, dug well and spring or a combination of these sources for their water needs. Some areas are served by communal faucet system. Other areas rely on ground water sources or rainwater and surface water.

Table 3-251 Water supply in CDO (2018)

Source of water	No. of HH	Percentage of HHs served
Level I	497	0.35
Level II	7,215	5.14
Level III	132,730	94.35
Others	226	0.16
Total	**140,668**	**100**

Source: Cagayan de Oro City CLUP 2013-2022

Malaybalay City, Bukidnon

Malaybalay has available water supply coming from surface waters from the mountain ranges of Mt. Kitanglad, and Mt. Tago. Majority of water sources were surface waters, however, there are also several functional deep wells that draw water from the underground aquifer. Water supply is delivered by a local water district serving 22 Barangays, 11 of which are from the Poblacion while Barangay Bangcud and Linabo are only partially served by the district. The remaining 24 barangays have their own water systems operated by the Barangay Government. All levels of water supply are available to all barangays (Level 1, 2, 3). However, it can be noted that all barangay owned water systems are not equipped with chlorinators or equivalent disinfecting equipment.

Table 3-252. Water district connections by type in Malaybalay

Barangay	Commercial	Residential	Institutional	Total
Barangays 01 to 11	1,127	3,571	1	4,812
Aglayan	163	570	5	738
Bangcud	4	60	1	65
Cabangahan	6	274	3	283
Can-ayan		96	3	99
Casisang	271	3,914	22	4,207
Dalwangan	13	317	4	334
Kalasungay	62	911	8	981
Laguitas	25	298	4	327
Linabo	1	183	1	185
San Jose	48	667	7	722
Sumpong	263	1,337	11	1,611
Total	**2,187**	**11,105**	**192**	**13,484**

Source: Malaybalay CLUP 2016-2025

The local water district relies on 90.21% of its water supply from surface waters. Majority of its water supply comprise 65% of water distributed to its concessionaires produced by the treatment plan owned and run by the local government unit. The Malaybalay City Water Supply System's plant is situated in Sitio Kimambong. The plant has a capacity of producing 120-170 liters per second. The remaining 35% is produced from the combined pumping stations and water processing facilities of the district.

Table 3-253 Inventory of water system facilities in Malaybalay

Water source	Facility	Source capacity	Plant capacity	Ave. actual production
Kibalabag Creek	MCGWSS Plant	250	170	120
Sawaga River	Sumpong Plant	70	40	34
Bag-as, Lumayagan Creeks	Kalasungay Plant	42	30	18
Deep well	BLISS pump station	4	4	4
	Cabangahan pump station	3	3	3
	Dalwangan (BOS) pump station	3	3	3
	Azura pump station	4	4	4
	Total	**376**	**254**	**186**

Source: Malaybalay CLUP 2016-2025; all values in liter per second

The Malaybalay City Water District has expanded its service area to six barangays beginning in the year 2005 identified as Barangay San Jose, Laguitas, Aglayan, Linabo, Cabangahan and Dalwangan. The number of concessionaires rose to13,292 in 2014, in 2010 it was only 10,827 connections. This is equivalent to 23% growth over the last 5 years. The growth can be attributed to the expansion projects implemented jointly by the Local Government of Malaybalay City and of the district. Services have been expanded to include the highway barangays such as Bangcud and Patpat. Barangay Can-ayan has also been recently served.

At present the district has an existing two surface water treatment facility and four pumping stations; all combined has a capability of delivering water discharge of 84 lps. The MCGWSS has a capacity of discharging 170 lps processed water. As mentioned above, total available supply is 186 lps.

Tagoloan, Misamis Oriental

The Municipality of Tagoloan has three water providers namely Tagoloan Waterworks, Cagayan de Oro Water District, and Pilipinas Water Resources, Inc. (private) serving only in eight out of 10 Barangays. It serves Level II & III Water System mostly in the residential areas for their domestic water usage.

Industrial and some commercial establishments avail themselves of water connection from the industrial water of Philippine Veterans Investment Development Corporation (PHIVIDEC) Water System run by electricity (deep well), while others have constructed their own water system (deep well-type). While others are served by the present water provider.

Most residents get their drinking water from the water buying stations in Tagoloan while residents from far barangays avail water by digging shallow well and handpumps provided by the local and barangay government. Recently the Local Government Unit of Tagoloan had started constructing water system (deep well-type using electric motor) in barangay that have no access to the present water providers.

Water providers, namely: Tagoloan Waterworks serve 1,619 household, Pilipinas Water Resources, Inc. serve 1,540 household of level III and 6,185 household served by a communal faucet. Cagayan de Oro Water District and PHIVIDEC water system has no data.

Table 3-254 Water demand in Tagoloan

Year	Population served	ADD
2015 (Censal Year)	73,150	10,823
2018	80,518	11,913
2019	83,135	12,301
2020	85,837	12,701
2021	88,627	13,112

Source: Tagoloan CLUP 2017-2027; ADD - Average Daily Demand in cu.m. per day

Sumilao, Bukidnon

With the abundant source of potable ground water in the municipality, all barangays have their own water systems. However, there is still insufficiency in water supply. This could be attributed to small-sized pipelines and poor management of water system. Limited funds and the long distance of water source to the barangay proper have compelled the local governments to purchase small-sized pipes.

The Municipal Government owned water supply system covers part of Barangay Kisolon and San Vicente. This system was constructed in the early part of 1960s. With the fast increase of population, the system could no longer adequately supply the water needs of the two communities. 75% of households in these communities have less than 12 hours water service. The Barangay Kisolon had also installed water pipes for Purok 6 households which are not covered by the system.

Poblacion water system is managed by the Barangay Water Task Force. Molocboloc Spring supplies the water needs of Poblacion, Sumilao. However, the twelve kilometer water pipeline which started with a 4”Ø was reduced to 2”Ø, hence, restricting the volume of the water supply. At present, water distribution is done through rotation basis. Water service interruption is also experienced when transmission pipeline laid on slope is cut off due to landslide.

The same situation of fewer water supplies is observed in other barangays wherein pipelines started with 2”Ø but reduced to 1½”Ø. Lateral lines are also not installed for lack of funds, thus, depriving other households with water supply. Most of the barangay operated water systems are classified as Level 2. Most of the springs which supply the water systems dry up during long dry months. Most affected sources are those with less vegetation.

Table 3-255 Inventory of water distribution system in Sumilao (2009)

Barangay	HH served		
	Level I	Level II	HH served
Poblacion	37	544	316
Kisolon	60	670	1, 115
Kulasi	15	88	-
Licoan	12	184	-
Lupiagan	23	86	-
Occasion	20	104	-
Puntian	40	231	-
San roque	20	169	-
San Vicente	49	302	-
Vista Villa	14	124	-
Total	**290**	**2502**	**1869**

Note: HH – household; Source: Sumilao CLUP 2011-2020

Manolo Fortich, Bukidnon

Most of the source of water resources in Manolo Fortich are ground water. These are located in Barangay Agusan Canyon, where Del Monte Philippines, Inc. is using deep wells to supply the water requirements of its employees. The list of water resources in Manolo Fortich is presented in **Table 3-256**.

From 8,806 households in 2009, it significantly increased to 15,872 households which are 89.19% of the total number of households with access to safe water. Barangays like Ticala, Kalugmanan and Sankanan has the lowest percentage of households with access to safe water – 45.14%, 57.43% and 58.60%, respectively.

The waterworks system run by the Manolo Fortich Water District (MFWD) supplies the potable water requirements of the 10 barangays, however not all households have availed the level III water system. The 10 barangays are Agusan Canyon, Alae, Damilag, Diclum, Lingi-on, Mambatangan, Mantibugao, San Miguel, Sto. Niño and Tankulan. The municipality has seven water reservoirs that would supply enough water for the whole municipality. Although it has plenty of potential sources of potable water system, it lacks financial resources to construct water system from source to each household.

Table 3-256 Water sources in Manolo Fortich

Sources of water supply	Location	Capacity*
Dicklum Spring Source 3	Dicklum	245.28
Dicklum Spring Source 1	Dicklum	272.64
Dicklum Spring Source 2	Dicklum	299.76
ManupihonLingi-on Spring Source	Lingi-on	136.32
Kisabong Spring Source	Agusan Canyon	872.16
Balamban-1	Agusan Canyon	436.08
Bayabason Spring Source 1	Damilag	817.68
Bayabason Spring Source 2	Damilag	981.072
Tagbalola Spring Source	Mantibugao	625.44
Mangima Spring Source	Tankulan	218.016
Balamban	Agusan Canyon	136.32

Source: Manolo Fortich CLUP 2013-2022; *cu.m. per day

The above water sources are the existing sources developed and used by the Manolo Fortich Water District. However, the present supply of water is not enough for the growing population of the municipality considering the increase of housing subdivisions in barangay Alae. There is a need for the development of more water sources to cope up the present demand of water in residential, industrial and agro-industrial areas. Barangay Ticala, Kalugmanan and Sankanan have the lowest percentage of households with access to safe water – 45.14%, 57.43% and 58.60%, respectively (**Table 3-257**).

The presence of illegal activities within the watershed area has introduced threats to the municipality like forest denudation and degradation and the drying of water source which reduced water charge in the area.

Preventing these activities will reduce the risk of flooding, as well as provide enough water for the watersheds. In the next plans for providing potable water in some areas, new water lines will be strategic and old water lines will be redesigned to avoid contamination of water lines due to the modern threats.

Table 3-257. Households with and without access to safe water in Manolo Fortich

Barangay	No. of HH		
	With access	Without access	Total
Agusan Canyon	2,075	26	2,101
Alae	1,435	14	1,449
Dahilayan	243	35	278
Dalirig	547	199	746
Damilag	2,471	31	2,502
Dicklum	699	44	743
Guilangguilang	173	3	176
Kalugmanan	344	255	599
Lindaban	786	107	893
Lingion	308	81	389
Lunocan	1,168	50	1,218
Maluko	543	119	662
Mambatangan	802	16	818
Mampayag	218	64	282
Mantibugao	506	5	511
Minsuro	143	19	162
San Miguel	515	104	619
Sankanan	460	325	785
Santiago	206	25	231
Sto. Niño	605	118	723
Tankulan	1,509	142	1,651
Ticala	116	141	257
Total	**15,872**	**1,923**	**17,795**

Note: HH – household; Source: Manolo Fortich CLUP 2013-2022

Table 3-258 List of reservoirs in Manolo Fortich

Project	Capacity*	Location	Owner
Calanawan ground reservoir	120	Barangay Poblacion	MFWD
Kihare ground reservoir	120	Barangay Poblacion	MFWD
Lingion reservoir	80	Barangay Poblacion	MFWD
Cristanvilla elevated tank	75	Barangay Dicklum	MFWD
Miranda elevated tank	75	Barangay Dicklum	MFWD
PCH-1 elevated tank	75	Barangay Dicklum	MFWD
PCH-2 steel elevated tank	75	Barangay San Miguel	MFWD
Total	**620**		

Source: Manolo Fortich CLUP 2013-2022; Note: MFWD - Manolo Fortich water district; * cubic meters

Impasug-ong, Bukidnon

Almost all barangays except for Bontongon have Level II type of water system. In terms of number and percentage Poblacion is the highest followed by Impalutao with 1044 and 470 households, respectively which is equivalent to 59 %. Potable water distribution in all barangays and sitios is 85%.

Almost all barangays have the Level II and III water system but there are still residents using the Level I water system, specifically those who live far from the built-up areas. Based on the 2015 CBMS the potable water system in the barangay including sitios, 49% of the household availed the Level III, 39% availed the Level II and 12% still in the Level I water system.

Table 3-259 Inventory of water systems in Impasug-ong (2015)

Barangay	# of HH	Type				Percent of total HH
		Level 1	Level II	Level III	Total	
Bontongon	131	37	68	26	131	1.44%
Bulonay	279	67	149	63	279	3.08%
Capitan Bayong	549	85	143	321	549	6.05%
Cawayan	401	53	156	192	401	4.42%
Dumalaguing	557	30	330	197	557	6.14%
Guihean	381	24	253	104	381	4.20%
Hagpa	621	213	347	61	621	6.85%
Impalutao	1,107	125	438	544	1107	12.20%
Kalabugao	1,215	83	436	696	1215	13.39%
Kibenton	482	22	177	283	482	5.31%
La Fortuna	822	138	373	311	822	9.06%
Poblacion	2,260	160	567	1,533	2260	24.91%
Sayawan	267	28	126	113	267	2.94%
Total	**9,072**	**1,065**	**3,563**	**4,444**	**9,072**	**100.00%**

Source: Impasug-ong CLUP 2019-2028

The biggest average water consumption is the commercial consumers which accounts to 330.7 cubic meter with a total of 10 number of connections located in Barangay La Fortuna followed by Poblacion with 196.92 cubic meter with 13 number of connections (**Table 3-260**). On the other hand, the domestic consumers have 1,533 connections accounting to 24.34 cubic meters average water consumption found in Poblacion. Barangay La Fortuna and Capitan Bayong have an average water consumption of 15 cubic meters. All the rest have an average water consumption of 10 cubic meters.

Table 3-260. Average monthly water consumption by type of consumers in Impasug-ong

Barangay served	Domestic		Commercial		Industrial		Others	
	NOC	AWC	NOC	AWC	NOC	AWC	NOC	AWC
Poblacion	1,533	24.34	13	196.92	0	0	0	0
La Fortuna	311	15.48	10	330.7	0	0	0	0
Capitan Bayong	321	15	1	143	0	0	0	0
Cawayan	192	15	0	0	0	0	0	0
Kibenton	283	10	0	0	0	0	0	0
Impalutao	544	10	0	0	0	0	0	0
Bontongon	26	10	0	0	0	0	0	0
Guihean	104	10	0	0	0	0	0	0
Sayawan	113	10	0	0	0	0	0	0
Dumalaguing	197	10	0	0	0	0	0	0
Kalabugao	696	10	0	0	0	0	0	0
Hagpa	61	10	0	0	0	0	0	0
Bulonay	63	10	0	0	0	0	0	0

Source: Impasug-ong CLUP 2019-2028; NOC – number of connections; AWC – average water consumption

The municipality of Impasug-ong have four water sources namely: Iglirop in Sitio Intavas, La Fortuna; Batingolo, Impalutao; Kagunaw Intake box at Sitio Bontongon, Barangay Hagpa and ground reservoir located at Purok 7, Poblacion (**Table 3-261**). The Iglirop source has a capacity of 30 liters per second, 150 gal/minute in Batingolo and three liters per second in Kagunaw Intake Box. At present, almost all barangays including Sitios have already availed potable water system.

Table 3-261 Sources of water in Impasug-ong

Source	Location	Capacity	HH served	Type of water supply		Funding source
				Pump	Gravity	
Iglirop	Sitio Intavas, Barangay La Fortuna (Operational)	30 li/sec.	1,092		✓	MBUSSP

Source	Location	Capacity	HH served	Type of water supply		Funding source
				Pump	Gravity	
Ground reservoir	Purok 7, Barangay Poblacion (Operational)		792	✓		DMPI
Batingolo	Upper Tulugan, Barangay Impalutao (Operational)	150 gal/min.	173		✓	MRDP & LGU
Kagunaw Intake Box	Sitio Bontongon, Barangay Hagpa (to be constructed)	3li/sec.			✓	Salintubig

Source: Impasug-ong CLUP 2019-2028

3.4.5.4.2 Power supply

Cagayan de Oro City

Cagayan de Oro's power supply is provided by several sources, such as: A) 724 MW hydroelectric power sourced from the powerful Agus and Pulangi rivers provided by TRANSCO'S Mindanao Grid and distributed by CEPALCO, B) CEPALCO's 1 MW grid connected, Photovoltaic Solar Power Plant. The conjunctive operations of the Solar Power Plant and Bubunawan Power Company's (BPC) 7 MW Run-of-River Hydro is the first operational PV-Hydro tandem project in the world. C). 210 MW coal-fired power plant of Germany's STEAG State Power, Inc. at the Phividec Industrial Estate, D). MINERGY's 18.90 MW land-based power generating plant Power distribution is facilitated by the Cagayan Electric Power and Light Company (CEPALCO), and MORESCO. The table below shows the electricity consumed by barangay.

Table 3-262. Electric service in Cagayan de Oro (2018)

Electric Cooperative	Barangay covered		Consumer		Consumption (Kwh)
			Type	Number	
CEPALCO	40 – Poblacion	Gusa	Street Light	150	9,397,995
	26 – Non-Poblacion	Indahag	Residential	107,269	230,424,250
	Agusan	Iponan	Commercial	14,935	224,306,175
	Balubal	Kauswagan	Industrial	258	178,719,189
	Balulang Bayabas	Lapasan	Bulk Power	8	139,396,780
	Bonbon	*Lumbia			
	Bugo	Macabalan			
	Bulua	Macasandig			
	Camaman-an	Nazareth			
	Canitoan	Patag			
	Carmen	Puerto			
	Consolacion				
	Cugman	Puntod			
	F.S. Catanico	Tablon			
Sub-Total				**122,620**	**782,244,389**
MORESCO-1	15 – Non-Poblacion	Pagatpat	Street Light	1,308	839,334.93
	Baikingon	Pigsag-an	Residential	15,445	16,788,995.33
	Bayanga Besigan	San Simon	Commercial	235	2,636,087.81
	*Canitoan	Taglimao	Water System	4	45,499
	Dansolihon	Tagpangi Tuburan	Public	185	678,468.71
	Mambuaya	Tumpagon	Building & Facilities	1	374.92
	Pagalungan	Tignapoloan	Industrial		
			Sub-Total	**17,182**	**20,988,760.7**
			Total	**135,392**	**798,789,447.7**

Source: Cagayan de Oro City CLUP 2013-2022

Malaybalay City, Bukidnon

Bukidnon Electric Cooperative (BUSECO) supplies the energy needs of the city. Due to the increase in the number of consumers, BUSECO has increased its house connections to 25,364 in Malaybalay classified into the following: residential – 22,566, commercial – 1,981, streetlights – 36 accounts, Industrial – 130 that includes high voltage and primary metered and public building – 651.

Table 3-263 Power consumption in Malaybalay

Year	No. of consumers	Consumption (kWh)
2011	26,221	1,682,267.91
2012	28,685	1,818,947.36
2013	31,107	1,959,335.06
2014	33,471	2,102,224.55
2015	35,769	2,246,724.23
2016	37,997	2,392,167.05
2017	40,152	2,538,048.88
2018	42,235	2,683,985.71
2019	44,245	2,829,683.28
2020	53,280	3,548,250.48

Source: Malaybalay CLUP 2016-2025

Residential consumers are the largest in terms of connections and the biggest in terms of consumption. 65,962 consumers were listed in 2011 and out of these, 59,580 or about 90% are residential connections. Also shown in the table below, about 37% or 3,134,153 Kwh of the total 8,440,979 Kwh consumption is residential in nature.

Table 3-264. Power consumption in Malaybalay City (2011)

Consumer	No. of consumers	Average consumption (kWh sales)
Residential	59,580	3,134,153
Low voltage		
Commercial	4,103	1,929,366
Public building	1,649	543,818
Industrial	365	772,879
Street light	236	86,692
Higher voltage	29	1,974,071
Total	**65,962**	**8,440,979**

Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

CEPALCO supplies power to industries, commercial establishments and residential houses in Tagoloan. In 2017, CEPALCO serves a total of 10,182 households, 914 commercial and 30 industrial establishments while 7,940 (43.81%) households are still not served due to its far distance from the distribution lines, and some households cannot afford to have electrical connection, and some households living in the same house.

There are two power substations found in the municipality; these are the NAPOCOR power substations, which is located in upper Natumolan, and CEPALCO substation, which is located in lower Natumolan found along the old national road.

Table 3-265 shows that out of the 4,541 total number of households, only 2,806 have electric connection. It is only 61.79% of the total number of households in the entire municipality. Barangay Kisolon has 27.48% of the total number of households served with electricity. It is followed by the urbanizing barangays of Poblacion and San Vicente with 10.35% and 8.94% respectively. The table further shows that the average consumption per month of some barangays accept the barangays of Kulasi and Lupiagan are high. This is due to the presence of poultry and piggery farms.

Table 3-265 Power consumption in Tagoloan (2015 to 2017)

Consumer	2015		2016		2017	
	NOC	AC	NOC	AC	NOC	AC
Residential	5,710	656,650	9,711	1,233,397	10,182	1,598,574
Commercial	554	277,000	869	459,701	914	512,754
Industrial	81	1,905,863	29	550,491	30	616,230
Institutional	12	7,482.41	13	8,500.50	14	11,331.16
Public Buildings	13	44,860.50	14	50,737.58	14	57,818.16
Streetlights (Public)	13	20,805.58	13	16,923.58	14	16,143.08
Others (Specify)	-	-	-	-	-	-
Total	**6,383**	**2,038,997.57**	**10,649**	**641,161.66**	**11,168**	**721,293.40**

NOTES: NOC - No. of connections; AC – average consumption (kWh/month)

3.4.5.4.3 Communications

Cagayan de Oro City

There are several types of communications systems and service providers within the city, namely: Telecommunication Services, TV Stations, Broadcast Stations, Broadband Networks and Internet Service Provider. Internet has experienced significant growth as the number of service providers have increased.

The city has grown increasingly dense and is characterized by sprawl. This development has led to traffic congestion following the surge in number of private vehicles, as well as limited accessibility to basic services.

Malaybalay City, Bukidnon

There is only one telephone company in the city that serves the urban center which is the Philippine Communications (PhilCom). Cellular phones are widely used in the urban center of the city that compensates the presence of lone telephone company. At least 24 cell towers/cites are located in different places within the city, Globe Telecommunication, Smart Telecommunication, Inc., Sun Cellular and PLDT.

There are six radio stations (2 AM Bands, 4FM) and one cable television network. National daily newspapers circulating the city are the Philippine Daily Inquirer, Philippine Star, and Manila Bulletin, while there are also two local newspapers: Mindanao Gold Star Daily and Bukidnon Newswatch in circulation.
The major mail distribution center of the city is still the Philippine Postal Office, though other private companies like 2GO, LBC Air Cargo, JRS Express, Air 21, Western Union and DHL are now providing messengerial services and other.

The urban center is coping up with the latest technological advancement of telecommunication, but the rural areas are still using the traditional letter sending through vehicle drivers and broadcasting over the public radio stations for their messages. To communicate (especially emergency cases) with the barangay officials in the rural areas, the city government has issued two-way radios to the barangays. These radios also serve as the official channel to relay messages through the Patrol 117.

Table 3-266 Communication services in Malaybalay City

Carrier	Volume per day
FEDEX	3 packages
AIR 21	2 transactions
JRS	50 packages
LBC	50 packages
Cebuana Kuarta Padala	5 transactions
M. Lhuillier	10 transactions
Western Union	5 transactions
Total	**125 transactions**

Source: Malaybalay CLUP 2016-2025

There are five radio stations (2 AM & 3 FM bands) and one cable television network. National daily newspaper circulating the city are the Philippine Daily Inquirer, Philippines Star and Manila Bulletin, while there are also two local newspapers; Mindanao Gold Star Daily and Bukidnon News watch in circulation.

With regards to courier services, there are seven companies that serve the city with a total of 125 transactions a day (**Table 3-266**). Some of these companies also serve as pawnshops. There are seven postal facilities within the city, 82 Mail boxes found in a designated area, one bupost, one manual, one money order machine, one mail distribution center, one stamping machine, one GSIS e-card, two Postal Stations and six mail transport services (**Table 3-267**). Mail transport service is served through the use of motorcycle, bicycle, vans and other means. These postal facility services might increase next year due to increase of population.

Table 3-267. Postal Facilities in Malaybalay city

Postal facility	Number
BUPOST	1
Mail distribution center	1
Mail boxes	82
Money order machine	1 manual for check
Stamping machine (meter)	1 postal metered machine & 1 GSIS-e-card
Postal stations/circuits	2 BSU & Aglayan
Mail transport service	6 motorcycles

Source: Malaybalay city CLUP 2016-2025

Tagoloan, Misamis Oriental

Tagoloan had one telephone company, the Philippine Long-Distance Telecommunication (PLDT) located at barangay Sta. Cruz. PhilPost operates the municipal postal service located at the Municipal Grand Stand building at Poblacion, Tagoloan, with one postmaster and one postman.

In addition, the use of the cellular mobile telecommunication system (CMTS) has become the most common means of communication. This is mainly because of its accessibility and affordability in the area through the presence of six (6) cell sites of the providers like Sun Cellular, Smart and Globe that paved access lines to cell phone holders making communication accessible to all sectors. The municipality has no problems regarding distant communication. Internet Connections are also available with DSL, Smart Bro and Globe Broadband providing 4G data communication but its limited only to urban areas since some rural areas have no signal from these internet providers, as well these areas have no cable for internet connections.

Sumilao, Bukidnon

The most common communication facility in the municipality is the mobile cellular phone. There are four towers installed in the barangays of Kisolon and Poblacion as shown in **Table** 3-268. These stations are owned by Globe, Smart, and Sun Cellular. People in the municipality availed the services though these mobile phone companies. The mobile phones also serve as the tool in building linkages among the ten barangays of Sumilao.

Table 3-268. List of existing cell sites in Sumilao (2010)

Company	Barangay	Number	Date started
Globe	Kisolon	1	November 14, 2003
	Poblacion	1	June 14, 2003
Smart	Kisolon	1	May 15, 2004
Sun Cellular	Poblacion	1	August 18, 2010

Source: Sumilao CLUP 2011-2020

At present, there is one telephone line installed in barangay Kisolon which is owned by SOTELCO. It has several subscribers. Through this, international and domestic calls could be transmitted in this public calling office.

Internet connection is also offered by SOTELCO through DSL connection. Globe, Smart and Sun Cellular through plug and play internet broadband connection also serve as gateway of the municipality to the world wide web. In terms of postal service facility in the municipality, there is one post office based at the municipal hall with only one personnel manning the office. With the presence of other mode of communication, few letters are sent through the post office.

Table 3-269. Volume of postal transactions in Sumilao

Type of service		2007		2008		2009	
		Received	Dispatched	Received	Dispatched	Received	Dispatched
a.	Letter	9,362	1,880	10,500	2,300	9,756	1,180
b.	Packages	3	2	4	4	5	3

Source: Sumilao CLUP 2011-2020

It could be observed that there are more letters received by the post office compared to those that are dispatched. For the packages, most are either sent or received through LBC in Malaybalay City and Cagayan de Oro City. Packages sent to Malaybalay City are delivered to Kisolon by LBC personnel without additional charge. Newspaper of local and national circulations are also delivered in Kisolon. But the most common mode of getting information is through radios and televisions. Dream satellite and Cignal cables are also available that enable subscribers to select TV station programs.

Manolo Fortich, Bukidnon

Smart, Globe and Suncellular Telecommunication are constructing their cellular towers in the six urbanizing barangays in the municipality. SOTELCO is providing landlines while DEARBC is also providing cable services in the urbanizing barangays**.**

Majority of the telecommunication towers are located in the residential areas. There is one tower that is located in a landslide prone area. This tower is vulnerable to geo-hazard such as earthquakes, if this happens, telecommunication services shall be interrupted and would affect the economic activities in the municipality. The emergence of modern information technology and communication interplay in the attainment of the vision of the LGU towards a premiere industrialization.

Table 3-270. Telecommunication companies in Manolo Fortich

Barangay	Smart cell sites tower	Globe cell sites towers	Sun Cellular Cell sites towers	SOTELCO landlines	DEARBC cable network
Agusan Canyon	1	1		1	1
Alae	1	1	1		
Damilag	1	1	1	1	1
Mambatangan	1	1			
San Miguel	1	1			
Tankulan	1	1	1	1	1
Total	**6**	**6**	**3**	**3**	**3**

Source: Manolo Fortich CLUP 2013-2022

Impasug-ong, Bukidnon

Communication system within the Sayre Highway Grid, those barangays near the Sayre Highway namely Poblacion, Capitan Bayong, La Fortuna, Kibenton, Impalutao, and Cawayan use cellular phone technology. The telecommunication companies of Globe and Smart have established towers within the municipality to serve this grid. The Digitel Mobile Philippines, Inc. (Sun cell) had also installed a relay tower in Barangay Guihean but there is still no network connection for Sun Cell in the municipality. Some parts of the municipality have no network connection in all types of telecommunications. They have to be contented with the old system of communication. The municipalities type and location of communication facilities is shown in **Table 3-271.**

In the other areas of the municipality, communication has been through personal contacts, and postal services. In 2008, Postal Communication Service was able to receive 9,783 and dispatch 3,598 letters and packages. In 2018, it is estimated that the Post Office received 50 letters/packages a day. This Office is manned by lone personnel based at the municipal hall. Sometimes letters for far flung barangays are sent through their barangay officials.

Postal Services is present in the premises of the Municipality. Several cellphone companies are also installing their cell site tower to provide the community easy access to communication. These were located in Poblacion, Capitan Bayong, Impalutao and Guihean.

Table 3-271. Communication facilities in Impasug-ong

Facility	Year constructed	Barangay	Ownership
Postal services		Poblacion	Public
Cell sites network			
Globe	2004	Poblacion	Private
Smart	2004	Poblacion	Private
Globe	2005	Capitan Bayong	Private
Globe	2006	Impalutao	Private
Digitel Mobile Philippines, Inc.	2007	Guihean	Private
Digitel Mobile Philippines, Inc.	2010	Poblacion	Private
Domineer Pointe, Inc.	2015	Impalutao	Private
Public calling stations	N/A		
Broadcast and television network (radio, television, cable)	N/A		

Source: Impasug-ong CLUP 2019-2028

The Municipal post office receives a minimum of 50 letters and packages a day and distributes the same immediately. This would sum to 12,000 letters and packages in the whole year.

There are several telecommunication companies who installed cell site towers in the different barangays in the municipality. ABS-CBN and GMA TV Networks also installed tower in Mt. Kitanglad. This is of great help to the community in terms of easy access of communication and information technology.

Table 3-272. Communication companies in Impasug-ong

Cell sites	Location	Date started
Globe	Poblacion	2004
Smart	Poblacion	2004
Globe	Capitan Bayong	2005
Globe	Impalutao	2006
Digitel Mobile Philippines, Inc.	Guihean	2007
Digitel Mobile Philippines, Inc.	Poblacion	2010
Domineer Pointe, Inc.	Impalutao	2015
TOWERS:		
Smart	Guihean	2000
Globe	Guihean	2002
ABS-CBN	Mt. Kitanglad, La Fortuna	1993
GMA	Mt. Kitanglad, La Fortuna	2000
RCPI/Bayan Tel/DOTC	Guihean	1997
DMPI	Mt. Kitanglad	2015

Source: Impasug-ong CLUP 2019-2028

The Post Office of the municipality is still functional, but no one wanted to send letters anymore because it is easier to contact through cellular phones. But official documents are sent through mails such as Bank Notices, Credit Cards, and Court Notices. Packages are also catered by the Post Office specially packages from other countries since it is cheaper than other couriers. Aside from it, there are also internet connections within the municipality.

The Philippine Post Office receives an average of 50 letters/packages a day with a total of 1,000 letters/packages a month and 12,000 a year.

The municipality has no printing statiojn for newspapers, tabloids and magazines but we have access to printouts of tabloids, newspaper and magazines.

3.4.5.4.4 Protective services

Cagayan de Oro City

Peace and order

The peace and order situation of the City of Cagayan is generally stable. The Cagayan de Oro City Police Office (COCPO) has a total strength of 748 uniformed personnel, of which 45 are Police Commissioned Officers and 703 are Police Non-commission Officers, serving a total civilian population of 634,873 (2012 population). It has an approximate police-to population ratio of 1:935 which is within the minimum standard police to population ratio of 1:1000. As of now, there are only 405 policemen assigned in the field to 10 different police stations in the city namely: Divisoria, Cogon, Agora, Carmen, Macabalan, Puerto, Bulua, Lumbia, Macasandig and Cugman. In spite of this, COCPO ably performs its police duties and effectively respond to crime incidence by employing pre-emptive measures through intensified conduct of saturation drives and finding other solution strategies. Such measures greatly deterred criminals and other lawless elements to freely conduct their nefarious activities. In fact, crime rate in the city has decreased from 0.78 in 2010 to 0.61 in 2011.

Also, the presence of BPATS (Tanods, Barangay Police) in each barangay contributes in maintaining peace and order in their respective barangay with a total strength of 1,364 in the entire city. They are the force multipliers of COCPO and the first responder when crime occurs in the barangay sufficient enough to respond immediately to the protective service needs of the residents.

The city's crime volume on index and non-index crimes in 2017 grew by about 90.6% versus the 2016 total crime volume (**Table 3-273**). Despite the rise in crime volume, however, the overall crime solution efficiency grew by 41.1%, which could be attributed to the high number of crimes solved in 2017.

Table 3-273. Cagayan de Oro crime statistics (2016-2017)

Parameter	2016	2017	% Increase
			2016-2017
Total crime volume (Index and Non-Index)	1,878	3,579	90.6%
Crimes solved	717	1,710	138.5%
Crime solving efficiency	38.2%	53.9%	41.1%

Source: City Mayor's Annual Report, 2018

Crime prone barangays are Puerto, Carmen, Macabalan, Macasandig, Cugman, Bugo, Bulua, Nazareth, Puntod, Tablon, Lapasan and Lumbia. Area of Responsibility (AOR) of Police Station 1 and Police Station 2 recorded sporadic and numerous crime incidents and were concentrated in populated barangays. Most were perpetrated in Barangays 5 and 8 of Police Station 1 Area of Responsibility and Barangays 31 and 33 of Police Station 2.

In 2017, among the index crimes reported for the year, theft posted the highest total at 51.0% of the annual total index crimes and also the highest among crimes against property. Meanwhile, deaths resulting from traffic incidents account for 130.0% homicide rates versus the combined cases of murder & homicide. Overall crime solution efficiency for all crimes reported for 2017 by Cagayan de Oro City Police Office (COCPO) was computed at 53.9% (**Table 3-274**).

Table 3-274. Crime statistics in Cagayan de Oro (2017)

Nature of crime	Total	Crimes cleared		Crimes solved	
		Total cleared	Clearance efficiency	Total solved	Solution efficiency
Index crimes	2,587	1,193	46.1%	1,053	40.7%
Against persons	701	480	68.5%	402	57.3%
Murder	35	25	71.4%	17	48.6%
Homicide	15	14	93.3%	9	60.0%
Physical injury	555	372	67.0%	339	61.1%
Rape	96	69	71.9%	37	38.5%
Against property	1,886	713	37.8%	651	34.5%
Robbery	442	118	26.7%	106	24.0%
Theft	1,326	553	41.7%	506	38.2%
Carnapping motor vehicle	11	7	63.6%	7	63.6%
Carnapping motor cycle	106	35	33.0%	32	30.2%
Cattle rustling	1	-	0.0%	-	0.0%
Non-index crimes	992	712	71.8%	657	66.2%
Traffic incidents	2,172	1,335	61.5%	1,025	47.2%
Homicide	65	59	90.8%	54	83.1%
Physical injury	751	471	62.7%	376	50.1%
Damage to property	1,356	805	59.4%	595	43.9%
Special laws	1,773	1,566	88.3%	1,318	74.3%
Total	**7,524**	**4,806**	**63.9%**	**4,053**	**53.9%**

Source: City Mayor's Annual Report, 2018

Fire protection and prevention

The Central Fire Station (CFS) in the city is located in a very congested area which hampers their activities delaying response in time of emergency call for assistance and thus the spread of fire is not easily contained. It has 11 sub-fire stations located in the following barangays: Bugo, Puerto, Tablon, Lapasan, Macabalan, Kauswagan, Bulua, Carmen, Balulang, Macasandig, and Nazareth.

The CFS has only 106 personnel though the ideal fireman to population ratio is 1:2,000 this means there is insufficient number of firefighters. The firefighting facilities are also inadequate; only 3 units rescue trucks exclusively assigned at the Central Fire Station and 12 units pumpers to different fire sub-station (1 pumper in every fire sub-station).

Fire incidents in Cagayan de Oro has reduced by 25% from 56 fire incidents in 2009 to 42 fire incidents in 2010 and in 2011. This achievement is being complemented by the continuous support from the active private/business sectors in the city so with the assistance from trained Barangay Fire Volunteer Brigade.

Reformatory institutions

For the jail management, the BJMP is strategically located at Barangay Lumbia. The City Jails are for both male and female dormitories. It detains almost half of the total population of inmate's region wide. Both the male and female dormitories are now facing congestion problem. Presently, CDOCJ-MD occupies a lot area of 18,632 sq. m. with a floor area of 5,159.05 sq. m. and has only a cell area of 1,226.58 sq. m. with the ideal capacity of 934 inmates from the ideal capacity. However, at present it caters 1,148 inmates or it exceeds about 214 inmates from the ideal capacity or 22.9% congested.

The standard ratio of personnel to inmates is 1:7 or one custodial personnel as to 7 inmates. However, at present this jail has only 74 personnel manning 1,148 inmates or the present ratio is 1:15.5 which means there should be at least 80 additional personnel to meet the required standards set by the United Nations to uplift the living condition of inmates while they are incarcerated.

On the other hand, the female dorm comprises a lot area of 2,184 sq. m. with a floor area of 907.08 sq. m. and has only a cell area of 314.72 sq. m. to cater the ideal capacity of 92 inmates. As of this date, the jail houses 109 inmates which means it exceeds about 17 inmates from its ideal capacity or 18.48% congested.

Malaybalay City, Bukidnon

Peace and order

The Malaybalay Police Station has 76 police force serving 126, 210 population (2005) which translates to a ratio of 1 policeman for every 1, 792 persons. This means it is not an ideal ratio which means the city needs 606 more policemen. There are 9 police community precincts located in Sumpong, Dalwangan, Casisang, Aglayan, Managok, Bangcud, Zamboangita, Can-ayan and Barangay 9 (Public Market). The police force to population ratio is highest in Casisang with 1 policeman for every 13,874 individuals. Lowest ratio is in Sumpong with 1:151. A low ratio indicates that there are more policemen available to serve the population of a given area.

Malaybalay City hosts two military and police camps. One is the Camp Ramon M. Onahon, located at Barangay 7. It is the provincial headquarters of the Philippine National Police. The other one is Camp Osito Bahian, located at Impalambong, Barangay 10. It is the home of the 403rd Infantry Brigade. The Barangay Public Safety Officer (BPSO) also assists in the peace-keeping efforts at the barangay level.

Out of 46 barangays under the area of responsibility (AOR), Barangay Casisang has the highest number of crimes occurrence which recorded 225 crime incidents followed by Barangay 9 with 115 crime incidents, Barangay Sumpong with 104 crime incidents, Barangay 4 with 56 crime incidents and Barangay 5 with 48 crime incidents.

In 2014, a total of 1,660 crime incidents were reported. About 55.42% or 920 cases are index crimes while 740 cases or 44.58% were classified as non-index crime (**Table 3-275**). Among the index crimes, Physical Injuries had the highest frequency with 326 cases followed by Theft with 289 cases, Robbery with 159 cases, Carnapping with 73 cases, Murder with 27 cases, Rape with 22 cases, Homicide with 19 cases and Cattle Rustling with 5 cases. Of the 1660 crime volume, 750 cases were considered solved reflecting a crime solution efficiency (CSE) of 45.57% as compared to last year of which 1011 crime volume with 20.37% crime solution efficiency (CSE).

Table 3-275. Crime statistics in Malaybalay (2014)

Type	No. of cases	Percentage
Index crime	920	55.42%
Non-index crime	740	44.58%
Total	**1,660**	**100%**

Source: Malaybalay CLUP 2016-2025

Women and children protection desk concerns

A total of 456 cases were filed for women and children protection concerns. 287 of these cases involved violence against women and 172 for child abuse and exploitation.

Table 3-276. Cases of violence against women in Malaybalay

Case	Number	Case	Number
Violation of RA 9262	241	Acts of lasciviousness	5

Rape	7	Grave coercion	1
Physical injuries	10	Slander/oral defamation	1
Threats	2	Abandonment	4
Concubinage	2	Sexual harassment	2
Attempted rape	9	Trespassing	1
Malicious mischief	1	**Total**	**287**
Unjust vexation	1		

Source: Malaybalay CLUP 2016-2025

Table 3-277. Cases of child abuse and exploitation in Malaybalay

Case	Number	Case	Number
Rape	20	Grave oral defamation	2
Attempted rape	7	Abandonment	1
Physical injury (Viol of RA 7610)	36	Swindling	1
Violation of RA 7610	88	Frustrated homicide	1
Violation of RA 9262	2	Acts of lasciviousness	5
Abduction	5	Attempted homicide	2
Theft	2	**Total**	**172**

Source: Malaybalay CLUP 2016-2025

In 2014, the Traffic Management Center station recorded 801 traffic accidents in Malaybalay which resulted in the death of 27 victims. 455 of the accidents involve vehicles collision, 151 involve vehicles versus pedestrian, 28 hit and run, 74 single accidents, 16 hit an animal, and 43 hit by fixed objects.

Moreover, 672 of the traffic accidents are caused by reckless driving, 25 caused by driving ‘possible of alcoholic breath”, 15 slippery roads, 12 mechanical defects, 4 tire explosions, and 12 due to roads under construction. Sayre Highway, Fortich St. along city proper and Poblacion Barangays are considered major traffic accident prone areas.

Tagoloan, Misamis Oriental

Peace and order

The Philippine National Police (PNP) station is adjacent to the municipal building. Generally, the peace and order situation in Tagoloan is normal. The peace and order situation and the overall condition are very favorable for development and investment.

Ideally, 500 constituents shall be serviced by one PNP personnel. At present, the actual total number of policemen in Tagoloan is 39, falling short of the standard which must be 74 based on the actual population of 73,150 on the minimum standard police to population ratio of 1:1000. The PNP station needs an additional 35 PNP personnel to conform to the standard. This personnel shortage could not be attributed to the Local Government Unit of Tagoloan since this is inherent to the PNP Organization. The number of PNP personnel assigned to the locality depends on the availability of police uniformed personnel at the provincial level. The limitation is temporarily addressed with the mobilization of the barangay tanods in every barangay and other support groups from civic organizations for the maintenance of peace in and order in the municipality. Despite the shortage of personnel, response time of PNP personnel is satisfactory.

The crime rate in Tagoloan is low with a total of 90 crimes committed in 2017. Most of the crimes committed are violation of special laws, non-index crimes, and for index crimes this involves physical injury and theft. It can be observed that the crime rate decreased from 2013 to 2017 by 16% (**Table 3-278**). The crime rate is 419 per 100, 000 population.

Table 3-278. Crime statistics in Tagoloan (2013-2017)

Type of crime	2013	2014	2015	2016	2017
Index Crimes					
Crimes Against Person					
a. Murder	5	10	1	15	1
b. Homicide	3	2	3	3	1
c. Physical Injury	19	20	26	60	15
d. Rape	7	9	8	6	0
Crimes Against Property					
a. Robbery	47	51	24	31	6
b. Theft	177	257	150	104	14
c. Carnapping	25	23	7	5	2
d. Cattle Rustling	1	3		3	0
Non-index Crimes					
Reckless Imprudence Resulting to	-	-	-	-	
*Homicide			6	9	0
*Physical Injury			59	59	6
*Damage to property			35	33	5
Violation of Special Laws	124	127	110	107	20
Other non-index crimes	189	312	28	114	20
Total	**597**	**814**	**307**	**549**	**90**

Source: Tagoloan CLUP 2017-2027

As shown in **Table 3-279**, Barangay Poblacion has the most numbered cases of CICL for the past three years having a total of 20 cases from 2015 to 2017 followed by Sta. Cruz with 18 cases and Sugbongcogon with 9 CICL cases. Of the 10 barangays of Tagoloan, Mohon and Rosario have no cases of CICL at all for the past 3 years.

Table 3-279. Crime incidence for minors in Tagoloan

Barangay	2015	2016	2017
Poblacion	6	7	7
Baluarte		6	1
Casinglot	1		7
Natumolan		5	3
Gracia	2	3	2
Sugbongcogon	0	0	9
Sta. Cruz	2	6	10
Mohon	-	-	-
Sta. Ana	-	3	-
Rosario	-	-	-

Source: Tagoloan CLUP 2017-2027

Fire Incidence for the Past Five Years

For the past five years, Barangay Gracia has the highest incidents of fire at 10 or 17.86% of the 56 fire incidents recorded. Followed by Barangay Poblacion and Barangay Casinglot, respectively. Based on records, the major causes of fire are the grass fires or rubbish fires, unattended live embers and unattended cooking. Grass Fires and rubbish fires are usually attributed to the hot weather and dry season wherein dry grasses are easily burned and spread.

Table 3-280. Fire incidence records in Tagoloan (2013 to 2017)

Barangay	Type of occupancy	Origin/Cause	Frequency of occurrence				
			2013	2014	2015	2016	2017
Baluarte	Industrial	Unattended live embers	0	1	0	0	0
	Residential	Unattended live embers,	1	0	0	0	1

Barangay	Type of occupancy	Origin/Cause	Frequency of occurrence				
			2013	2014	2015	2016	2017
		electrical short circuit					
Casinglot	Residential	Intentional (arson case), electrical (2)	0	0	0	3	0
	Educational	Electrical short circuit	1	0	0	0	0
	Storage	Rubbish fire	0	0	0	1	0
	Others (grass fire, rubbish fire)	Grass fire, unattended rubbish fire (2)	0	0	0	1	2
Gracia	Industrial	Unattended live embers, flux of welding	1	0	0	1	0
	Others (garbage; electrical transformer)	Unattended cooking, matchstick, grass fire (5)	0	0	2	6	0
Natumolan	Industrial	-	1	0	0	0	0
	Residential	Unattended live embers	0	0	1	0	0
	Others (grass fire)	Grass fire	0	0	0	1	0
Mohon	Industrial	Live embers, unattended rubbish fire	0	0	0	1	1
	Residential	Electrical short circuit	1	0	0	0	0
	Others (rubbish fire 2)	Rubbish fire	0	0	0	1	1
Poblacion	Industrial	-	1	0	0	0	0
	Mercantile	Electrical short circuit,	1	0	0	1	0
	Residential	Kerosene lamp, electrical short circuit, unplugged cellphone, unattended live embers	3	1	0	0	0
	Vehicular	Electrical short circuit	0	0	0	0	1
	Others (grass fire)	Grass fire	0	0	0	1	0
Sugbongcogon	Industrial	Unattended live embers, metal sparks	1	0	0	0	1
	Residential	Unattended live embers	0	0	1	0	0
	Business	Flux of welding machine	0	0	0	1	0
	Others (container van, rubbish)	Exposed to extreme heat weather condition; rubbish fire	0	0	1	1	0
Rosario	-	-	0	0	0	0	0
Sta. Ana	Residential	Unattended live embers, electrical short circuit	0	0	1	0	1
	Others (grass fire, rubbish fire)	Grass fire (3), rubbish fire (2)	0	0	0	4	1
Sta. Cruz	Industrial	LPG tank leakage	1	0	0	0	0
	Residential	Kerosene lamp, unattended live embers, arson	1	0	0	0	2
	Others (grass fire)	Grass fire (1)	0	0	0	1	0
		Total	**13**	**2**	**6**	**24**	**11**

Source: Tagoloan CLUP 2017-2027

Traffic accidents

Statistics shows that the growth in population is the growth of vehicles. as well that gives the increase rate in traffic accidents in this municipality. A wide impounding area intended for vehicles involved in traffic accidents in a must to have in a class A Municipality as it deemed necessary for the full implementation of Traffic Laws for violators.

Tagoloan protective facilities

In terms of police station lot requirements, the present lot area of police station had only 400 square meters comparing the lot requirements for PNP base on standard of a class "A" police station there's a need of 2,500 square meters. So, there is a need of additional lot area of 2,100 square meter.

The Bureau of Fire Protection (BFP) which is mandated to prevent and suppress fires avoiding loss of life and damage to properties. There are twelve firemen personnel assigned in Bureau of Fire Protection situated along the PHIVIDEC area located at Barangay Sta. Cruz and they are complemented with one fire trucks. Based on standard on a ratio of 1:2000 fireman to population and facility of fire truck to population ratio of 1:28,000, compared to the actual, there is a need of additional manpower requirement of 25 firemen and an additional two fire truck based for calendar year 2015.

Table 3-281. Protective services by facilities and equipment in Tagoloan

Type of service	Barangay	Area (sq.m.)	Physical condition of facilities	No. of personnel	Ration	Vehicles	
						No.	Types
Police							
Headquarters	Poblacion	400	Fair (Newly Constructed PNP Building)	39	1:1,600	3	Toyota Hilux, Mahindra Patrol Car and Toyota single cab patrol
						2	Rauser motorcycle and Boxer Patrol Motorcycle
Sub-station	None	N/A	N/A	N/A	N/A	N/A	N/A
Outpost	Poblacion	20	Poor/dilapidated	2	1:1000	1	Mahindra Patrol Car
	Crossing Vicmar	20	Poor/dilapidated	2	1:1000	1	Mahindra Patrol Car
Traffic							
Fire Protection							
Headquarters	Sta Cruz	2,000	Needs repairs (part of roof is leaking, and part of ceiling is destroyed, and tiles of office area needs replacement)	12	1:5000	1	Isuzu Morita Fire Truck (Unserviceable & subject to major repair)
Municipal Jail	Poblacion	153	Some structures need repair	6	1:2	1	MITSUBISHI L300 (Prisoners Van) by September 2018
Coast Guard Station	Sugbongcogon	500	Fair	13	1:4000	2	Rubber boat and Aluminum boat

Source: Tagoloan CLUP 2017-2027: Ratio - Personnel to population ratio

Number of Protective Human power by Type

The protective services and facilities for ensuring public safety and order include the newly constructed type A PNP building and detention cells, Coast Guard station, Fire Station units including firefighting hydrants and Municipal Jail Office. Police protection service is situated just beside the Municipal Office Building along the national highway in Barangay Poblacion with three issued PNP vehicles. In addition, two police outposts are located in Barangay Poblacion and Sugbongcogon. 39 uniformed personnel serving as protectors against all forms of crime, there are Coast Guard station located in Brgy. Sugbongcogon with 13 personnel, in addition to that of the Bureau of Fire Protection situated along the PHIVEDIC area not strategically located from other Government Offices with only one fire truck and a personnel complement of 12 then the Municipal detention cell manned by 6 personnel.

Sumilao, Bukidnon

The present peace and order status of Sumilao is generally peaceful. There are 23 officers assigned in the Sumilao Police Station.

The Sumilao Police Station holds its office in the eastern part of the municipal hall which faces the national highway. Due to its limited space, the women cell was converted into a radio room. Since the municipal hall is not protected with concrete fence, which will serve as perimeter barrier, the station is vulnerable to enemy attack.
To assist the PNP force, the LGU hired traffic aides to assist the flow of traffic at Barangay Kisolon especially during school days when children cross the national highway. There are also 160 Barangay Tanods in the municipality who help in the maintenance of peace and order.

The Police Station has one vehicle in good running condition and the other one needs repair. It has also communication facilities with a radio operator hired by the local government. What the office needs is a women's cell and a generator set in case of power interruption.

The LGU has provided funds for the maintenance and operating expenses of the office. However, this fund is not enough especially for the fuel and repair of vehicle which affect the mobility of the PNP force. Financial support for personnel undergoing training/school and enhancement seminars is also limited. Rice allowance is provided to the PNP by Sumilao.

As shown in **Table 3-282**, Sumilao experienced a high total index crime in 2009 compared to the previous years. The most common crime against person in 2009 is physical injury with 23 cases, murder with 4 incidence and robbery with 2. The non-index crime in 2009 had also slightly increased by four incidences compared to the previous years. The total crime volume for the year 2009 is 77 while 2008 is 56.

Table 3-282. Crime statistics in Sumilao (2006-2009)

Type of crime	2006	2007	2008	2009
Index Crimes				
Murder	1	2	1	4
Homicide	1	1		
Physical injuries	2	15	9	23
Rape	3	3	2	
Total crime against person	7		12	27
Robbery		1	1	2
Bank robbery				
Hijacking/highway robbery				1
Theft	5	4	6	14
Total crime against property	4		6	17
Total Index Crimes	**12**	**26**	**37**	**41**
Average monthly crime rate	2.4	5.5	17.04	18.5
Non-Index Crimes				
Illegal drugs	3	2		2
Illegal gambling	4	8		1
Loose firearms	2	2		1
Kidnapping				
Carnapping		1		2
Illegal fishing				
Illegal logging				
Cattle rustling				1
Estafa				1
Others	27	3	7	12
Other forms of deceits				
Malicious mischief				3
Total non-index crimes	**36**	**16**	**19**	**23**
Total crime volume	**46**	**42**	**56**	**77**

Type of crime	2006	2007	2008	2009
Average monthly crime rate	**9.6**	**8.6**	**2.5**	**3.0**

Source: Sumilao CLUP 2011-2020

The Bureau of Fire Protection Office in the municipality is manned by seven non-commissioned officers. It has one fire truck and a driver hired by the Local Government Unit. The Bureau of Fire has its own office and quarters. The Local Government Unit provides rice allowance to the Bureau of Fire Protection officers. **Table 3-283** shows the fire incidence that occurred for the last 5 years in the municipality. For the last 3 years since 2009, only two fire incidents were recorded and responded. Regular inspections on residential and commercial buildings are conducted by the personnel of the Bureau of Fire Protection.

Table 3-283. Fire incidence in Sumilao

Barangay	Frequency of Occurrence				
	2005	2006	2007	2008	2009
Kisolon	0	0	1	1	0
Total	0	0	1	1	0

Source: Sumilao CLUP 2011-2020

Manolo Fortich, Bukidnon

Peace and order

Crime volume in September 2012-August 2013 was reduced by 42; from 233 in the previous year down to 191. Crime volume is a distinct classification used to get key data on recurring crime. Crimes are sorted into index and non-index categories. Index crimes are those of serious nature that occur with sufficient frequency and regularity. Crimes against person such as murder, homicide, physical injury and rape, and crimes against property such as robbery, theft, car napping/carjacking and cattle rustling make up index crimes. Physical Injury (54) is the most commonly reported crime, followed by robbery 37 comes next and Theft (36) are the top most committed crime in the municipality (**Table 3-284**).

Meanwhile, total volume of non-index crime in 2012 decreased from 68 to 62. Non index crimes, on the other hand, are violations of special laws such as illegal logging or local ordinances (**Table 3-285**).
Table 3-285Crime solution efficiency for the last two years of 20122013 was improved from 48.6% to 53.2%, respectively. Higher crime incidence occurs both in poor rural areas and in urban barangays but relatively high in urban places. **Table 3-286** projected a total number of police manpower using the standard 1:1000 policeman-population ratio for the entire planning period.

The establishment of 24-hour Command Center manned by the Respond Quickly Rescue Team since 2002 and Bantay Zona, both Special Projects of the present administration have also contributed to the peace and order in the area. The Bureau of Fire of Protection-Regional Office 10 has a sub-office in the municipality manned with 7 firemen and equipped with one (1) fire truck, 1 re-filler fire truck and other firefighting facilities. However, the absence of Municipal Disaster Risk Reduction Center may cause us not to fully deliver the protective services to our constituents. particularly those who are vulnerable to disasters.

Table 3-284. Crime volume in Manolo Fortich (2011-2012)

Year	Crime against person				Crime against property				IC	NIC	CV	CSE
	MU	HO	PI	RA	RO	TH	CN	CR				
2011	2	0	8	1	4	3	1	1	20	8	28	35.70%
2011	3	0	6	0	3	4	0	1	17	4	21	33.30%
2011	1	0	8	0		1	0	1	11	7	18	44.40%
2011	1	1	8	0	5	3	0	1	18	12	30	46.60%
2012	0	0	3	1	4	4	0	1	13	8	21	42.80%

Year	Crime against person				Crime against property				IC	NIC	CV	CSE
	MU	HO	PI	RA	RO	TH	CN	CR				
2012	1	1	4	0		6	0	2	14	6	20	50.00%
2012	2	0	7	0	3	2	0	2	16	4	20	45.00%
2012	0	0	2	1	3	7	0	1	14	4	18	55.50%
2012	1	0	5	0	3	1	1	0	11	4	15	66.60%
2012	0	0	1	0	4	1	1	0	7	5	12	33.30%
2012	2	1	0	0	5	2	2	0	12	3	15	66.60%
2012	3	0	2	0	3	2	1	0	11	3	14	64.20%
TOTAL	16	3	54	3	37	36	6	10	165	68	233	48.60%

Source: Manolo Fortich CLUP 2013-2022; NOTES: MU – murder; HO – homicide; PI – physical injuries; RA – rape; RO – robbery; TH – theft; CN – carnapping; CR – cattle rustling; IC- index crime; NIC – non-index crime; CV – crime volume; CSE – crime solution efficiency

Table 3-285. Non-index crime in Manolo Fortich (2013)

Classification	Sept 2011 – Aug 2012	Sept 2012 – Aug 2013	Classification	Sept 2011 – Aug 2012	Sept 2012 – Aug 2013
Grave Threat	4	6	Resistance and Disobedience	6	4
Viol of RA 9262	10	8	Trespass to Dwelling	5	3
Viol of RA 7610	14	11	Viol of RA 9165 (Drugs)	3	4
Malicious Mischief	6	4	Viol of PD 705 (Illegal Logging)	1	5
Oral Defamation	6	5	Acts of Lasciviousness	4	2
Arson		1	Parricide	0	0
Alarm and Scandal	5	4	TOTAL	68	62
Direct Assault	4	5	Source: Manolo Fortich CLUP 2013-2022		

In 2012, average crime rate of 18.2% or 18 number of crimes committed per 1000 population of the municipality has decreased by 3.3% in 2013 with 14.9% crime rate. PNP-Manolo Fortich considers low index crime rate as a measure of successful crime prevention.

Table 3-286. Number of policemen in Manolo Fortich (2010)

Barangay	Population	Barangay	Population
Urban & Urbanizing:	**65,628**	**Rural:**	**25,398**
Tankulan	7,907	Dahilayan	1,527
Agusan Canyon	9,850	Guilang-guilang	1,152
Alae	8,552	Kalugmanan	2,986
Damilag	11,385	Lindaban	2,017
Dalirig	3,541	Lingi-on	5,496
Diclum	3,731	Mampayag	1,312
Lunocan	6,341	Minsuro	870
Mambatangan	3,248	Sankanan	3,287
Mantibugao	2,678	Santiago	2,066
Maluko	3,871	Sto. Nino	3,445
San Miguel	4,524	Ticala	1,240
		Total	**91,026**

Source: Manolo Fortich CLUP 2013-2022

PNP Manolo Fortich thru its Women and Children's Desk Officer is working hand-in-hand with MSWDO concerning crimes committed by delinquent minors and abused women and children. The MSWDO is extending support services to youth offenders through counselling and productive activities that would train them to acquire socially accepted behavior. There were 34 incidences reported regarding victims of R.A 9262 or Anti-Violence Against Women and their Children Act and 19 or 56% of the total reported cases were filed in court.

Manolo Fortich has police manpower to population ratio of 1:2881 (standard1:100), fireman to population ratio of 1:13,400 (standard- 1:2,000), jail guard to inmates' ratio of 1:20 (standard- 1:7) (**Table 3-287**). In entirety, the municipality have not passed the minimum requirement of the national standard at all types of protective services.

Table 3-287. Protective services in Manolo Fortich

Protective service	Location	Existing personnel	Facilities/equipment			
			Fire fighting vehicle	Prisoner van	Rescue truck	Others
PNP						
Headquarters	Poblacion	33	0	0	0	Police cars
Sub- Station/Stations	Alae,Lunocan, Maluko		0	0	0	
Special Training Unit	Damilag					
Police Regional Mobile Group	Alae					
Bureau of Jail Management & Penology	Poblacion	5	0	0	0	
Provincial Detention and Rehabilitation Center	Poblacion	12	0	0	0	
Fire Protection						
Headquarters	Poblacion	7	1	0	0	
Civilian Volunteers	All Barangays	420				
Respond Quickly Rescue Team	All Barangays	10	0	0	1	Ambulance
Military Camps						
52nd Engineering Brigade	Poblacion		0	0	1	
14th Company Bukidnon Citizen Active Auxiliary Detachment- 9th Infantry Batallion (Maramag, Bukidnon)	Guilangguilang		0	0	0	

Source: Manolo Fortich CLUP 2013-2022

Fire incidences

Causes of fire incidences in 2012 is show in **Table 3-288** of which electrical short circuit has the highest cause of 5 incidences followed by spontaneous combustion and playing matches with 1 incidence each.

Table 3-288. Fire incidences in Manolo Fortich (2012)

Causes of fire	Frequency
Electrical short circuit	3
Spontaneous combustion	1
Child playing match	1
Total	**5**

Source: Manolo Fortich CLUP 2013-2022

Impasug-ong, Bukidnon

Table 3-289 shows the unsolved crimes from 2014 until 2018. Among these crimes, the most crimes committed are non–index crime, physical injury and theft. Non-Index Crime includes negligent manslaughter, non-aggravated assault, forgery and counterfeiting, fraud, embezzlement, stolen property, vandalism, weapons, prostitution & common law vice, sex offenses, narcotic laws, gambling, offenses against family & children, driving under the influence of liquor.

Table 3-289. Crime incidence in Impasug-ong (2014 to 2017)

Type of Crime	2014				2015				2016				2017			
	TO	CS	Offender		TO	CS	Offender		TO	CS	Offender		TO	CS	Offender	
			M	F			M	F			M	F			M	F
Index Crimes																
Crimes Against Person																
a. Murder	2	0			7	6	6		5	2	2		3	2	2	
b. Homicide	2	0			1	1	1		2	2	2		0			
c. Physical Injury	8	6	6		73	55	55		42	28	28		79	78	78	
d. Rape	2	2	2		11	11	11		8	8	8		6	6	6	
Crimes Against Property																
a. Robbery	8	0			26	4	4		23	3	3		13	5	5	
b. Theft	12	0			52	21	21		39	17	17		50	8	8	
Non-Index Crimes	11	9	9		136	124	124		174	162	162		144	124	124	

Note: Criminal Suitability (CS) and Technical Offenses (TO):
Source: Impasug-ong CLUP 2019-2028;

Crime Incidence by Barangay for Children Below 18-years Old in Conflict with the Law for the Past Five Years

There is only one crime committed by a child below 18 years old in conflict with the law which was robbery. Robbery is defined as the action of taking property unlawfully from a person or place by force or threat of force and it only happened on year 2014.

Fire Incidence - As presented on the **Table 3-290**, there are two structural fires occurred in barangay Poblacion, one on year 2014 and one last 2016. There were also three fire incidences recorded last 2018 but it was not specified what were burned. There was also one structure burned in Kibenton and one in La Fortuna in 2015. In year 2016, there were two vehicular fire incidents that happened in barangay Dumalaguing. Also, one unspecified fire incident in barangay Impalutao in 2018 that had taken place. There was also 13 grass fire reported in year 2016 during the onset of Dry Spell. The said grass fire occurred in Poblacion, Capitan Bayong, Impalutao and Kibenton. In addition, one unspecified fire incident in year 2018 in barangay Kalabugao. All in all, there are 26 fire incidents reported but in 2017, there are no reported fire incidents.

Table 3-290. Fire incidence in Impasug-ong (2014 to 2018)

Barangay	2014	2015	2016	2017	2018
Poblacion	1-Structural		1-Structural		3
La Fortuna, Kibenton		2- Structural			
Dumalaguing,			2-Vehicular		1
Impalutao					1
Poblacion, Capitan Bayong, Impalutao, Kibenton			13-Grass Fire		1

Barangay	2014	2015	2016	2017	2018
Kalabugao					1
Total	**1**	**2**	**16**		**7**

Source: Impasug-ong CLUP 2019-2028

Number of Protective Manpower by Type - There is only one Police station established in the Municipality manned by 34 Police personnel located in a 2,000 square meter in Barangay Poblacion and in its excellent condition. The Personnel to Population ratio is 1:1,400 and there are 4 Patrol Cars/motorcycles owned by the said Police Station.

One Fire Station can be found in the Municipality manned by 7 Fire Personnel situated in a 120 square meter land beside the Municipal Gymnasium and is considered poor as to its physical condition since it is already dilapidated. There is only 1 fire truck provided for the said station.

Table 3-291. Protective services in Impasug-ong

Type of service	Barangay	Area (sq.m)	Physical condition of facility	No. of personnel	Personnel to population ratio	Vehicle	
						No.	Type
Police							
Headquarters	Poblacion	2,000	Excellent	37	1:1,400	4	Patrol Car/ Motorcycle
Sub-station							
Outpost							
Traffic							
Fire protection							
Headquarters	Poblacion	120	Poor	7	1:2,000	1	Hino, FT
Jail Management							
City/municipal jail							
Total				**44**		**5**	

Source: Impasug-ong CLUP 2019-2028

Number of Protective Manpower by Type - In the Municipal Police Station, there are 32 policemen and 5 policewomen assigned in the station and 3 Non-Uniformed Personnel (NUP) assigned. All the 13 barangays of the municipality have 20 volunteers as force multiplier for Peace and order also known as the BSPJO and a total of 40 Auxiliary Services.

Table 3-292. Impasug-ong Barangay Security Force and volunteers

Type of service	Number of security force/security	Facilities/ equipment	Condition of facilities/equipment
Peace and Order	260	-	-
Disaster	-	-	-
Auxiliary Services	40	-	-
Others	-	-	-

Source: Impasug-ong CLUP 2019-2028

3.4.5.4.5 Educational facilities

Cagayan de Oro City

Elementary and Secondary Education

Cagayan de Oro has 70 public elementary schools and 37 public secondary schools. Complementing the public schools are the 75 private elementary schools, 46 private secondary schools and 90 preschools. With the institutionalization of Kindergarten Education into the Basic Education System R.A. No. 10157 otherwise known as “An Act Institutionalizing the Kindergarten Education into the Basic Education System and

Appropriating Funds Therefor," all public elementary schools in the city are offering kindergarten classes to cater the 5-year-old school children. The different kindergarten programs include Kindergarten Regular Program (KRP), Kindergarten Volunteer Program (KVP) and Kindergarten Summer Program (KSP).

For the school year 2011-2012, there are 12,159 pupils enrolled in kindergarten, 79,368 pupils in elementary and 29,714 students in the public secondary schools. In the private schools, there are 5,992 kindergarten pupils, 12,600 elementary pupils and 11,521 secondary students. Public school enrolment manifested an increase of 3.72% for the elementary and 2.50% in the secondary compared to the previous school year 2010-2011. The private schools also registered an increase of 1.42% for elementary and 6.86% in the secondary. The booming economy of the city and the influx of subdivisions and other socialized housing projects is one major factor on the increase of enrolment in both public and private schools. More families have opted to establish their dwelling in the city with the hope of uplifting their source of income and providing quality education to their children. Cagayan de Oro also serves as the melting pot for Region X. Elementary teacher-pupil ratio is 1:43.83 and1:35.86 in the secondary.

Classroom-pupil ratio is 1:56.49 in the public elementary and 1:60.03 in the public secondary. This signifies that more classrooms are needed and with the institutionalization of kindergarten in basic education, this also means additional classrooms to be constructed with provisions for 5-year-old pupils. The increase of enrolment in every level, the Institutionalization of Kindergarten and the implementation of K to 12 Program collaboratively point to the need to purchase additional textbooks in all levels.

Although the enrolment is continuously increasing, participation rate is decreasing in both elementary and secondary level. This can be attributed to the economic/financial constraint. Some students are forced to work for a living and even others serve as the bread winner of the family.

To address the low participation rate and high dropout rate especially in the secondary, the Division of Cagayan de Oro City implemented the Dynamic Learning Program and the Open High School Program.

The Alternative Learning System of Cagayan de Oro City Division also provided alternative opportunities to our less privileged school children to acquire education. The ALS offered various programs from literacy to livelihood. This is to ensure maximum participation among all learners.

Higher Education - Private school flourished in the city giving parents and students more options in the choice of a school. As of SY 2011-2012 the City of Cagayan de Oro has 16 higher learning schools, 15 are private-owned. Thus, only 17% of college enrollees are in government-operated Mindanao Polytechnic State College (MPSC). In addition, the Bukidnon State University has operated a satellite school located at Misamis Oriental General Comprehensive High School (MOGCHS) which contribute about 1.8 percent of college enrollees in government school. It implies that around 81.2% of the enrolment goes to the private owned colleges/universities.

Malaybalay City, Bukidnon

There are 74 kindergarten schools within the city, 63 of which are public and 11 are private. The number of elementary schools is 78 and 14 of which are private and 64 are public. The secondary schools have also increased, the city now has nine secondary schools plus the five school annexes. There are also two integrated schools, these schools cater to both elementary and high school students (**Table 3-293**).

Table 3-293. Inventory of schools in Malaybalay City (2015)

Classification	Private	Public	SUC	Total
Kindergarten	11	63		**74**
Elementary	14	64		**78**
Secondary	9		1	**9**

Classification	Private	Public	SUC	Total
Main		10		**10**
Annexes		5		**5**
Integrated Schools		2		**2**
Total	**34**	**144**	**1**	**179**

Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

The Municipality of Tagoloan has a total of 81 learning institutions, both public and private. Basic education is being provided by 57 preparatory schools, 15 primary schools, and 6 high schools strategically located in the municipality. Tertiary education is offered by one college (Tagoloan Community College) and two technical/vocational school managed by the Technical Education and Skills Development Authority (TESDA) (**Table 3-294**). Public schools provide majority of the basic education services in the municipality while private schools served mostly Tagoloan secondary and tertiary education levels by the local government unit economic enterprise.

There are also preparatory schools in the municipality. There are 37 Early Childhood Care Development Centers/Day Care Centers (DCCs) located in the 10 barangays in the municipality with a corresponding 37 Child Development Workers who attends the 3-4 years old children, 13 Rural Improvement Club Centers (RICCs), and two run and managed privately.

Table 3-294. Inventory of schools in Tagoloan (2017)

Category	Public school	Private school	Total
Preparatory	50	7	57
Primary	10	5	15
Secondary	3	3	6
Tertiary	1		1
Vocational	1	1	2
Total	**65**	**16**	**81**

Source: Tagoloan CLUP 2017-2027

Manolo Fortich, Bukidnon

Early Childhood Care Development (ECCD) programs in Day Care Centers are strengthened with more than 10 Day Care Centers established in far flung barangays and/or sitios. Taking into account the vast number of public elementary schools scattered in 22 barangays, the Department of Education have clustered the District Level of Manolo Fortich into DepEd District I and DepEd District II. Four primary schools (Abyawan, Impakibel, Gauron & Bagalangit) were converted into elementary schools and more school buildings for elementary level were built and upgraded from semi-concrete to concrete buildings. It is observed that the two central schools namely, MFCES and Alae Central School for DepEd I and DepEd II have the most populated students per classroom; thus, students are already deprived of quality education.

There are four national high schools established in the municipality. Manolo Fortich National High School has the highest number of enrollees. The then extension high school of Manolo Fortich National High School at Barangay Dalirig is now converted as Dalirig National High School. More classroom buildings are needed in order to meet the minimum standard of 1:40 classroom: student ratio. A lower participation rate and higher drop-out rate is generally reported among secondary schools since half of the population for this school-age group are part of the working age population and most of them, for economic reasons, would prefer to work.

NBCC, an LGU-run community college is observed to have a periodic increase per school year of total enrollees, as shown in the table below. More courses were offered since it operationally started in 2005.Throughout its operation, NBCC have been known for molding quality graduates and have been duly recognized by CHED and PRC for its outstanding performance particularly in the field of College of Education. The present administration is granting scholarship program to poor but deserving college students of NBCC.

The Department of Education has implemented Alternative Learning System in 12 Barangays, particularly in the barangays of Tankulan, Lingi-on, Kalugmanan, Sitio Kibolawan of Kalugmanan, Lindaban, Dalirig, Maluko, Alae, Damilag, Agusan Canyon, Mampayag and Manitbugao. Most of the classes are held in the public elementary schools while some classes are being conducted in the barangay halls. ALS is a ladderized, modular non-formal education program for dropouts in elementary and secondary schools, out-of-school youths, non-readers, working Filipinos and even senior citizens.

The former district office of Congressman Paras located at NORMINCO, Tankulan used to be the site for Technical /Vocational Education. There were identified out of school youths and non-working who were given various skills training through short-term courses such as welding, dressmaking, culinary, automotive mechanic, and among others.

Sumilao, Bukidnon

The Department of Education has established complete elementary schools in all barangays of Sumilao. It has 12 complete elementary schools, two public high schools and one private high school. A District Office is established at Kisolon which serves as a center for trainings and other school related activities within the municipality.

In the secondary level, Sumilao National High School at Poblacion and its Annex at Kisolon acquired ICT facilities from different sources which are internet connected serving not only students and teachers but to the community as well. Aside from the public schools in the municipality, there is one private school offering secondary education, the Pilar High School situated in Kisolon.

There is no existing tertiary school/college in the municipality but the people have easy access to higher education considering that the municipality is located between two big cities, Cagayan de Oro City in the North and Malaybalay and Valencia City in the South.
The enrolment of the elementary schools in Sumilao for SY 2007-2008 reached up to 4,344 with 92 teachers. The current teacher-pupil ratio is pegged at 1:47 or one teacher for every 47 pupils. Lupiagan has the highest ratio of 1: 58 and Ocasion has the lowest of 1:30, as shown in the table below.
As to classroom, the same table shows a total of 93 classrooms with an average of one (1) classroom per 47 pupils. This is generally within the standard requirements. However big schools with high enrolment have higher ratio.

For the secondary level, the two public high schools have a combined enrolment of 598 for SY 2007-2008, with 17 teachers and pegged at 1:35 teacher –student ratio. These two schools are in the orange coding which means a ratio of 1:35-39.99. This further means that teachers are fairly distributed. Pilar High School has 429 students with 1:39 ratio.

For student-classroom ratio, Sumilao National High School Main has a ratio of 1:42, Kisolon National High School –Annex at 1:51, while Pilar High School has registered a student-classroom ratio of 1:50 or 50 students in one classroom.

There are 97 school buildings in the elementary schools in this municipality as of 2007-2008. About 25 buildings need repair. Two schools need additional classroom buildings due to increase in enrolment. These are Kisolon Central Elementary School and San Vicente Elementary School.

In the secondary level, Sumilao National High School Main has 14 school buildings, six of these structures need major and minor repairs. Kisolon Annex has 10 school buildings and 2 of which needs repair. Pilar High

School on the other hand has just constructed a two-storey building to cater the classroom needs of their students.

Impasug-ong, Bukidnon

For school year 2017-2018, there are more enrollees in kindergarten and in Senior High School. In June 2017, some Kindergarten teachers are having 70 pupils in a class, especially in big schools.

However, thru the Division of Bukidnon additional teachers were employed and assigned to the district especially those schools in the far distant barangays. Additional IP teachers were assigned in IP schools like in Bundaan Elementary School, Dumalaguing ES, Magawa and Bulonay ES. Integrated schools like Impalutao Integrated School and Kibenton IS were given permanent Secondary School teachers.

In terms of classroom situation, some Kindergarten pupils are housed in makeshifts rooms and Senior High School students are scheduled for shifting classes for them to be accommodated. There are no enough classrooms for the Senior High School students and Integrated Schools. Majority of the elementary schools need additional classrooms.

There are enough chairs in majority of the elementary schools compared to the high schools since the Senior High School students are making use of the Junior High School buildings and classrooms. Majority of the schools have no playgrounds not even enough space for students to play. There is a need of additional comfort rooms, science laboratory rooms, computer laboratory and library.

3.4.5.4.6 Recreational facilities/sports facilities

Cagayan de Oro City

Cagayan de Oro City recreation, entertainment, and sports facilities and their respective locations is shown in **Table 3-295**. Cagayan de Oro has its city–Wide Sports Development Program and it has 11 major events financially subsidized by the city namely; basketball, volleyball, table tennis, sepak takraw, athletic, karatedo, badminton, arnis, chess, taekwondo, boxing and other sports related activities. Under this program, group of competent coaches and trainers called Advance Scientific System Efficiency Training (ASSET) was organized. They have to coach and train young players on sports discipline anchored in the vision and goals of the city sports development program.

This Sports Program had been serving aspirants athletes to excel and explore in different sports competition in national and international level. In fact, it offered not only great opportunity for young people to develop and enhance their skills in sports, but also financial assistance and incentives to those who contributed honors in the name of the city.

The Department of Education Culture and Sports Development Program had organized a school varsity type of athletes in every school. There are seven sports events conducted annually: District Meet, Division Meet, Regional Meet, Palarong Pambansa, COAA Meet, Milo Olympics which are locally funded under the SEF Funds and School Intramurals funded by the school and PTA. In three consecutive school years, the varsity players have been awarded as consistent over-all-champion in the Northern Mindanao Regional Athletic Meet.

Table 3-295 Recreation, entertainment, and sports in Cagayan de Oro (2018)

Faciliy	Location
Movie houses	Limketkai Complex, Barangay 31
Limketkai Cinema I, II, III, IV	Barangay 26
Gaisano Mall Cinema I, II, III, IV	Corrales- C.M. Recto Avenue
SM City Cinema1,2,3,4	1. Yacapin-V. Roa Streets
Centrio Mall, Ayala Cinema 1, 2, 3, 4	2. Barangay 26
Shopping Centers/Malls	3. Hayes-Osmeña Streets

Faciliy	Location
Centrio Mall, Ayala Gaisano Mall/City	4. J.R. Borja-Guillermo Streets
Ororama Supercenter	5. Bulua
Limketkai Center	Carmen
Robinson Super Center	J. R. Borja Street Barangay 31
Savemore	Limketkai Center
Shopwise	1. SM City, Upper Carmen
Puregold	2. Kauswagan Highway
Resorts	3. Agora, Lapasan
Acuña	4. Capistrano-Pacana Streets
Cabula River Resort	Limketkai Center
	Lapasan
	Tablon
	Sitio Cabula, Lumbia
Chali	Cugman
Coco Bay	Baloy
Country Village Hotel	Villarin Street, Carmen
De Oro Saga Resort	Bulua
El Dorado	Bonbon
Harbor Lights Hotel	Gusa
Gardens of Malasag Eco-Tourism Vill	Cugman
Maandig	Bonbon
Macro Hotel	Cugman
Pryce Plaza Hotel	Upper Carmen
Raagas	Bonbon
Ridgeview Chalets	Xavier Estates, Upper Carmen
Victoria	Bayabas
Stargate Dream Vacation	Upper Macasandig
Sonrisa Vista Resort	Bayabas
Sports Facilities	
Bowling Alleys	Upper Balulang
Xavier Estates Sports and Country Club	Gusa
Shuffle Square	
Gymnasium/Coliseum/Auditorium	
Alwana Sports Complex	Cugman
Bulua Gym	Bulua
Capitol University Gym	Corrales Extension
City Central School Gym	A. Velez-Yacapin Streets
Corpus Christi Gym	Macasandig
DMCC Gym	Kauswagan
MUST Gym	Lapasan
Gregorio Pelaez Sports Center	A. Velez Street
Guani Sports Center	Gumamela Street, Carmen
Liceo de Cagayan University Gym	Carmen
Lourdes College Auditorium	Capistrano Street
Lourdes College Gym	Macasandig
Oro Christian Grace School Gym	Macasandig
Pilgrim Christian College Gym	Capistrano-Akut Streets
Sports Zone (Temp. Closed)	Tomas Saco Street, Nazareth
Xavier University Gym	Corrales Avenue
Golf Course	
Camp Evangelista	Patag
Pueblo de Oro	Upper Carmen
Tennis Court	Capitol Compound

Faciliy	Location
Capitol Tennis Court	Gaerlan-Capistrano Streets, B1
Golden Friendship Tennis Court	A Velez Street
Gregorio Pelaez Sports Center	Kauswagan
Liceo de Cagayan University Tennis Court	Nazareth
Nazareth Tennis Court	Macabalan
Phil. Port Authority Tennis Court	
Pryce Plaza Hotel Tennis Court	Carmen Hill Kauswagan
RER Drive Subd. Tennis Court	Upper Balulang
Searsolin Tennis Court	Upper Balulang
Seventh Day Adventist Tennis Court	
Sports and Country Club Tennis Court	Xavier estates
Villa Ernesto Subd. Tennis Court	Gusa
Xavier University Tennis Court	Corrales Avenue
Fitness and SPA	
Ban Sabai Thai Spa	Corrales Street
Body Touch Massage & Spa Duke Spa	Robinson Mall, Limketkai Center
FAI THAI Massage	National Highway, kauswagan
Flora's Beauty Salon & Spa	Pabayo Street
La Cabana Spa	Pabayp Streets (Annex) JR Borja-
Nikki Salon & Spa	Pabayo Streets
Nuat Thai Foot & Body Massage	CM Recto Avenue
Nuat Thai Massage	Marco Hotel, Cugman
Raf-Raf Thai Traditional Massage	Pabayo-Cruztaal Streets
Sentara Nail & Body Spa	Agodo Road, Corner Limketkai
Spa de Marie Beauty Centrum	Florentino Street
Spa de Oro Salon	Tiano-Pacana Street
TA TSU JIN Spa & Body Massage	Limketkai Drive
Thai Boran Massage	Pabayo-Gomez Street
Touch n Heal Facial Body & Foot Massage	Capistrano-Pacana Street
3K Thai Traditional Massage	Abujuela-Burgos Streets Pres.
Vanity Works Salon Day & Spa	Quirino Streets
	Capistrano-Borja Streets
	Rosario Arcade

Source: Cagayan de Oro City Ecological Profile 2019

Malaybalay City, Bukidnon

The City of Malaybalay has several good places that attract tourists the whole year. Some of them are described below.

a. The Monastery of Transfiguration - As a spiritual destination, the monastery sprawls through several hundreds of hectares owned by the Benedictine monks who spend their life in farm work and prayer. Their produce, sold in a souvenir shop consist of the famous Monk's Blend coffee and peanut delicacies. The main church was designed and the last work by national artist Leandro Locsin. This site appeals to the tourist seeking peace quiet, communion with nature and appreciating the pure cool air.

b. Monastery of Carmelite Nuns- The monastery nuns provide an environment of natural attractions with its well-kept grounds as well as spiritual blessings of peace renewal.

c. Jesuit Retreat House - Primarily a retreat center, its well-kept grounds being on the banks of a creek offer the intrepid a climbing experience amidst a mini rainforest ambiance. Owned by the Jesuits, silence and nature harmony is an unforgettable experience.

d. Mt. Kitanglad Agriculture and Ecological Center (MKAEC) – The MKAEC is a Gawad Saka 2006 First Place Winner for showcasing an ecological and agricultural all organic, all-natural lifestyle. This is a site for bird watching, trekking, camping, fishing and eco-walk. Being situated at the foothill of Mt. Kitanglad, a rare flight of the Bukidnon eagle could be in your sights as you walk along misty eco-trails with a cool temperature to equal that of Trinidad valley in Mt. Province. The site of frequent conferences and seminars, the rustic ambiance is one to snare the ecology-oriented tourist at heart.

e. Lapanday Farm - The sweetest pineapples exported fresh are from this Filipino agri-corporation. Its plantations are located in different sites and the headquarters are found not more than a 10-minute drive from the City's commercial section. This is owned by the Lorenzo family, a name long associated with the pineapples and agriculture.

f. NOMIARC and Stock Farm - This area is the site of farm showcases where animals of good stocks (bred) and high value vegetables are seeded and tested for research by government technicians.

g. The Capistrano Mountains - Located in the Basakan area of the city attracts hardy climbers for its high white rock formation where rock climbing, rappelling and exploring of caves in the area will be a great and exciting activity aside from the refreshing view of green rice fields surrounding the mountain.

h. The Bukidnon Tree Park- owned by government unit, the tree park consists of hills and forest that appeal to hikers and bikers. The foremost area known to many tourists is the festival grounds to the Kaamulan Festival. It also has a Kaamulan Open Theater, the scene of many conferences and performances of local and national performing artist.

i. Nature Park and Swimming Pool- this natural attraction features scenic environs the site of a varied flora and fauna, providing varied environmental activities of which bird watching is one. A swimming pool and another for children welcome the daring to try clean, coolest water.

j. Hernandez Ranch- Owned privately by the Hernandez family, the site was developed with horseback riding trails, swimming pools and fishing grounds.

k. Mt. Kitanglad Range Natural Park - The name *"kitanglad"* was derived from a legend that there was once a great flood that submerged the native lands of Bukidnon and only the tip of the mountain, the size of a *"tanglad"* (lemon grass), remained visible (*"kita"* in Cebuano).

l. Mt. Kitanglad Range Natural Park became a full-pledge protected area in 2000 by virtue of Republic Act (RA) 8978 known as the Mt. Kitanglad Range Protected Area Act of 2000. It is considered one of the country's priorities protected areas and a prime spot for nature ventures like trekking and birdwatching. The range is one of the few remaining rainforests in the Philippines and host to most important diverse species of rare and endemic wildlife like the Philippine Eagle. MKRNP covers 47,270 hectares and is the sacred ancestral domain of the Bukidnon, Talaandig and Higaonon tribes. Five of its peaks have very high elevations: Mount Dulang-dulang, the highest at 2,938 meters (the second highest peak in the country following Mt. Apo in Davao City); Mount Kitanglad at 2,899 meters (officially declared the fourth highest peak in the Philippines); Mount Maagnaw at 2,742 meters; Mount Lumuluyaw at 2,612 meters; and Mount Tuminungan at 2,400 meters.

Association of South East Asian Nations (ASEAN) declared Mount Kitanglad Range Natural Park as Heritage Park last May 16, 2010 and joins 27 other heritage parks in the ASEAN region. It is also the third declared ASEAN Heritage Park in the Philippines, after Mt. Apo in Davao, and Mt. Iglit-Baco in Oriental Mindoro.

Accommodation and Food
The Pine Hills Hotel- The City's pearl of food, drinks and accommodations, this elegant setting offers quality food and rest for the travelers with discriminating taste and very particular about comfort.

Haus Malibu, Villa Alemania, Plaza View, 1st Avenue, Green Ridge Apartelle and Pelots Guest House – are six of the hotel/accommodation facilities in the city that offer lodging at reasonable prices and clean facilities.

Rey's Grill, Mindy's, Fiona's, Anton's, Amadeo's, The Garden, & Skyway - are only some of the eating places offering grilled seafood and meat. The tasty concoctions of marinades and sauces are enough to restore one's vitality.

The Bukidnon Brew Café, Mint Leaf Café, Ashley's Tearoom & Gifts, Le' Cafe, Isabella, Café Casanova, Sunflower, Pizzahan sa Plaza and Benedict - affording a refreshing stop from hectic sightseeing, variously located in the center of the city offering snacks and watering holes for the young and coffee aficionados.

Original Delicacies – Pinasitas of Cake Boom, the OO7 Choco Roll of Em's Fastfood and the famous krispylicious Chicken Neck of Centro Food and Folk Haus are original recipes and creations that are truly culinary delights the city is proud of.

Events to Watch or Join
The Kaamulan Festival- a yearly cultural celebration, this festival is unique for being an event that brings together both tribal and lowlanders together in a mutual appreciation of the ethnic custom and mores. Seven hill tribes (the Talaandig, Higaoonon, Umayamnon, Manobo, Tigwahanon, Matigsalug and Bukidnon) come together with ritual prayers, dances and songs in colorful attire to charm the tourist. It is now three decades that the festival has happened, with side shows of horse races, rodeo and other ethnic events.

Horse Racing and Show- the Malaybalay Horseman Association offer equestrian events to watch out for in the course of the year. They have participated as far north as Cebu and as far south as Davao where they garnered awards for their efforts. This group has also overseen the development of horse breeds and their presents specimens prove the success in this endeavor. The Club President is former judge and present Dean of the College of Law Bukidnon State University and a member of the City Tourism Board Vivencio P. Estrada.

Airsoft Club Events- recent placer in the just concluded national competition in Ozamiz City, this Outdoor association of Airsoft aficionados gives great fun even to onlookers, while playing in their very challenging and ruggedly designed game course.

Rodeo, Moto-Cross and Offroad Competition- the action for these is often tied up with the festival Kaamulan. The event is participated in by local and national level competitors.

Mountain Biking-there is a vigorous presence of mountain bikers who regularly get together and hold their events. These are office workers and career men whose idea of recreation and fitness is mountain biking. Their normal place of congregating is right in Fortich Street across the Bukidnon State University.

Easter Sunday- a dawn mass featuring about a hundred 'angels' consisting of children singing quite an event to see every year. It draws together a flood of people usually at the Provincial Capitol grounds having been entrenched in the Church calendar. However, in the 60's it evolved into a feast that brought children to rehearse and perform in the great discipline for the joy of the feast of resurrection and up to now, this has established itself as a regular event for the people of the city.

Malaybalay is positioning itself as an ecotourism and cultural destination. The resources around will definitely answer for that vision.

Sports and Recreation

Sports facilities in the city are mostly basketball courts of which there are 223 courts located all over the city. Most of these are already dilapidated and needs rehabilitation but some are new and housed inside covered courts. Next to basketball, billiards, volleyball and tennis are some of the sports activities the locals enjoyed.

For track and field games, the only venue available is the poorly maintained and dilapidated grandstand at Sumpong. Other outdoor games like football and baseball can be played at the capitol grounds. Recreational activities are usually held in 155 KTV's and 39 internet shops all over the community.

The Sangguniang Kabataan (SK) of the City of Malaybalay conducts various sports activities in the different barangays of the city, which are usually done during the first five months of the year. There were several sports equipment given to select Barangays in support to their sports activities during their celebration of "Fiestas" and "Araw".

Tagoloan, Misamis Oriental

Tagoloan is one of the coastal municipalities in Misamis Oriental and a potential area for eco-tourism. It is approximately 19 kilometers away from the City of Cagayan de Oro by means of public transportation. Presently, the approximately 6.10 kilometers stretch coastline may not be so appealing due to presence of seaside dwellers, underdeveloped offshore/foreshore potentials and occurrence of Industrial/Commercial wharfs. But, by taking a closer assessment, it would reveal more of significant number of attractions.

The A.L. Casiño Park and A.T. Cosin Park is considered as the main tourist attraction in the town. Amenities such as wide-area playing ground with recreational facilities, psychedelic globe-type fountain that catch the attention of pedestrians, especially during night-times, a giant statue of the mother earth and a refreshment canteen brings comfort and relaxation at its best.

The municipality has several outdoor and indoor sports facilities (**Table 3-296**). Majority of outdoor facilities, particularly basketball courts, are provided by the municipality. Except for the Tennis Court which the Parish Church owns, other sports and recreation facilities requiring large investments are provided by the private sector. Majority of these sports and recreation facilities are concentrated in its center of the barangays. But almost all the barangays in the municipality have covered courts which are used for various sports activities and at times serve as venues for assemblies and evacuation centers, cultural activities during fiestas, among others. Public and private schools also have sports facilities like track ovals and courts.

The ten barangays of Tagoloan have basketball courts, with some barangays having two or three basketball courts. There is a public plaza of 23,763 square meters at Poblacion and Sta. Ana, and covered court facilities with a total area of 6,450 square meter distributed to all barangays.

Table 3-296. Sports facilities, parks and playgrounds in Tagoloan

Barangay	Facilities/location	Area (sq. m.)
Baluarte	Covered court - Centro Basketball court – Nabulod, Centro, Sto. Nino Plaza/playground - Sto.niño	540
Casinglot	Covered court - Centro Basketball court – Centro, San Vicente	540
Gracia	Covered court - Centro Basketball court - Centro	540
Mohon	Covered court - Centro Basketball court	540
Natumolan	Covered court - El Mundo Basketball court – Centro, El Mundo	540
Poblacion	Covered court/public gym - Centro Public plaza Tennis court - Parish church Basketball court- Promiseland, Villamanga, & Pulot	1,590 19,387
Rosario	Covered court - Centro Public plaza	540
Sta. Ana	Covered court - Centro Public plaza - Centro Basketball court – Centro, Nasalaban, Bontong, Dike Public plaza - Dike	540 4,376
Sta.Cruz	Covered court- Centro	540
Sugbongcogon	Covered court- Centro	540

Source: Tagoloan CLUP 2017-2027

Manolo Fortich, Bukidnon

Being strategically located near the urban center of Cagayan de Oro City, Manolo Fortich has a lot to offer even to local tourists. Presently, the local tourism industry in Manolo Fortich continues to grow with eco-adventure and nature parks. Among the tourist attraction and are located in areas vulnerable to flood, landslide, strong winds, soil erosion and earthquake and two others are located in areas vulnerable to landslide, strong winds, soil erosion and earthquake.

Tourism has increased by 127.20 hectares from 30.50 in 2005 to 157.70 hectares in 2012. This was attributed to the newly opened recreational tourism sites at Barangay Kalugmanan, Dahilayan and Diclum. **Table 3-297** and **Table 3-298** presents the tourist sites and natural attractions in Manolo Fortich.

Table 3-297. Tourist sites in Manolo Fortich

Name	Location	Facilities
Dahilayan Adventure Park	Dahilayan	Adventure rides such as zip line, drop zone, flying lizard, challenging ropes course and wall climbing. Accredited accommodation and restaurant.
Forest Park	Dahilayan	Assortment of recreational activities, playground, picnic area, café, and accommodation.
Saddle Ridge camp	Dahilayan	Eco-adventure tour, camping area, restaurant and accommodation.
Dahilayan Gardens & Resort	Dahilayan	Fun recreational activities, camp sites, picturesque garden ideal for photoshoots, venue for special occasions and accommodation.
Kampo Juan	Dicklum	Challenging and one-of-a-kind adventure rides, innovative demo farms ideal for educational tours, venue for special occasions
Mangima Canyon Springs & Country Park	Dalirig	Swimming pools, venue for special occasions and gatherings, restaurant and accommodation.
DMPI Golf Course	Cawayanon, San Miguel	18-hole golf course and club house restaurant

Name	Location	Facilities
Del Monte Philippines, Inc. Pineapple Plantation	Located in 12 barangays	Renowned pineapple plantation in the country
Montegelo Farm	San Miguel	Swimming pools, venue for special occasions and gatherings, restaurant and accommodation.
Mountain Pines Farm	Dahilayan	
MENZI Farms and MENZI Orchard Residences	Menzi, Damilag	
Helms Farms	Kalugmanan	
Mac Arthur Landmark	Mapait, Dicklum	
Franciscan Friars of the Immaculate Seminary House and Chapel	Gabok, Lingion	
Bagalangit Ultimate Bivouac	Kalugmanan	Airsoft games, barracks, dining hall, obstacle courses, power van, cottages, archery, tipi huts
Mother of Perpetual Help Church	Cawayanon, San Miguel	

Source: Manolo Fortich CLUP 2013-2022

Table 3-298. Nature attractions in Manolo Fortich

Name	Barangay	Facilities	Description
Mt. Kitanglad Range Natural Park	Dahilayan and Kalugmanan	Rest cabin	The newest mountain destination of the toughest mountain running trail in the country which already hosted two International Rugged Mountain Race participated by local and foreign athletes.
Sumalsag Cave	Dalirig		A place of excitement for the cavers and spelunkers. Sumalsag Cave is the longest cave in Northern Bukidnon with approximately 1,859 meters of underground channel. If you're into an extraordinary adventure, be ready to slide, crawl, swim or even wriggle your body as you move about inside this magnificent Sumalsag Cave.
Mangima Canyon	Dalirig	Cottages	A haven of nature enthusiasts where one can view perfect scenic canyons
Abyawan Ridges	Abyawan, Dalirig		One can have a panoramic vista of the Tagoloan river and the scenic canyons as the river traverse the Dalirig, Lingi-on, Sto. Nino
Tagoloan River	Abyawan & Dalirig		One of the major watersheds of the municipality
Salt Spring	Guilangguilang		Rarely visited spring with natural salty taste of spring water

Source: Manolo Fortich CLUP 2013-2022

Sumilao, Bukidnon

Sumilao is endowed with vast natural and human-made resources which could be developed as tourist destinations. However, the Local Government Unit has no existing local tourism office, nor formulated any tourism development plan that could be used as guide in the development and promotion of the said sector. Although some interesting areas exist, no fees are collected for those who have ventured to visit these places.

The famous landmark of the municipality is the Alalum Falls which is located along the national highway at Barangay Kisolon. Its imposing beauty can easily be seen by motorists. The viewing area had been landscaped and stairs going down to the falls was constructed. Several passers-by stopped to view the grandeur of the falls. The municipality has also other falls that have not been developed.

The Palaopao Hill which stretches along the boundary of the municipalities of Sumilao and Manolo Fortich from the northeast to the southeast and stands 836 feet above sea level is home of several caves. The sides of the hill also contain several rock shelters, limestones overhangs and even contain wooden coffins and artefacts whose designs are traced back during the metal age. These places were used as burial ground in the early part of the nineteenth century. The caves are attracting several spelunkers with Sumalsag cave as the most popular. However, all of these are not protected and developed.

Mount Kitanglad is situated the southern part of the municipality. It is specifically located at barangays Lupiagan and Licoan. Mount Kitanglad ranges imposing majesty and splendor easily catch the attention of the travelers plying the route from Cagayan de Oro City to the southern part of Bukidnon Province. With its strategic location and height of more than 9,000 feet above sea level, anyone can see from the top of the wide splendor of Macajalar Bay and the panorama below and surrounding the mountain. It is also the sanctuary of the wild plants and animals especially the endangered species which is the fast-vanishing monkey-eating eagle. Communication facilities such as relay stations were also established on the top of the mountain and bunkers for their employees were constructed. These bunkers are also used as shelters for the several climbers who have reached the peak of the mountain. Kitanglad Volunteer Guards with honoraria from the Provincial and Municipal Governments have been hired to protect the flora and fauna which are found in the mountain.

The vast fertile land of Sumilao which is also suitable to agriculture is filled with wide plantation of pineapple and banana. These fields present awesome sight to several visitors.

The ½ hectare man-made lake of FARM Coop at Barangay Kisolon has been developed as a resort. The coop has constructed several sheds and bamboo rafts for visitors. This water impounding was purposely constructed as source of drip-irrigation for the banana plantation of DOLE, Philippines and FARM Cooperative Incorporated. It is also utilized as Tilapia production.

A one-hectare man-made lake in a cattle ranch of the Bando Farm at Poblacion, Sumilao has also become the home of wild white ducks. The ranch management had banned the use of air guns in this area to protect these wild ducks.

As for the support facilities, some of the potential tourist spots such as caves and waterfalls could only be reached by foot. Though hotels are not yet available in the locality, lodging houses are available for those who want to pass their night. Fast foods or eateries are also available.

Recreation
All barangays in the municipality have open spaces such as plaza. These plazas serve as an area where families could relax and have funs with their children or friends. Standard- sized basketball courts are constructed within the plaza where boys play their favorite basketball games. These concrete paved courts are also complemented with stage for social and cultural shows which are usually held during celebrations such as fiestas. With the construction of other infrastructure facilities such as barangay hall, health center and other buildings within the plaza, the open space have become limited. Areas for other sports activities such as volleyball are held in vacant lots outside the plaza. In Kisolon, a 2,000-seat gymnasium was constructed by the Municipal Government. Barangays Poblacion and Kisolon have also their own covered courts.
Video-K bars are also present in most barangays. Three barangays had banned the operation of video-k bars as these had caused troubles especially when customers got drank. Some households have their own units for family affairs. The presence of the telephone line in Kisolon had enabled some entrepreneurs to operate internet cafés and video games.

A cockpit arena is established in Kisolon where cockfighting aficionados could spend their weekends. The absence of resorts and swimming pools have forced the local residents to travel to other places. On the general, there are few entertainment venues and activities in the localities where the residents could relax. The table below shows the sports and recreational facilities of the barangays of the municipality.

Table 3-299. Sports and recreational facilities in Sumilao

Type of facility	Barangay	No.
Sports Facilities		
Basketball Court (Outdoor)	Kisolon	4
	Kulasi	1
	Licoan	1
	Lupiagan	1
	Ocasion	1
	Poblacion	1
	Puntian	1
	San Roque	1
	San Vicente	3
	Vista Villa	2
Covered Court	Kisolon	1
	Poblacion	1
Volleyball Court	All barangays	10
Gymnasium	Kisolon	1
Billiard	Kisolon	3
	Licoan	1
	Lupiagan	1
	Occasion	1
	Poblacion	1
	San Vicente	1
	Vista Villa	1
Recreational Facilities		
Cockpit	Kisolon	1
	Vista Villa	1
Children Playground	All Barangays	10
Video-k Bars	Kisolon	15
	Kulasi	1
	San Roque	1
	Licoan	1
	Lupiagan	1
	Poblacion	5
	Puntian	1
	San Vicente	3

Source: Sumilao CLUP 2011-2020

Impasug-ong, Bukidnon

Impasug-ong has a municipal gymnasium utilized as venue for annual basketball tournaments sponsored by the municipal government. The actual recreational area of the urban barangay consisting of Poblacion, Impalutao and Kalabugao in 2015 is 12.4003 square meters while the current area is 12.7094 in 2016 and it increased to 13.3491 in 2017. Presently in this area are constructed in the Municipal Gymnasium, covered court, tennis court and the refurnished Plaza Rizal.

There are 29 basketball courts constructed in 13 barangays. There are also covered courts constructed in all barangays and ongoing construction in 5 sitios. For barangays Kibenton and La Fortuna, considered as urbanizing barangays, the total actual recreational area in the year 2015 is 4.7311 square meters and it has a current aggregate area of 4.8494 in 2016 and 4.9698 in 2017 respectively.

A municipal plaza is located in the Poblacion with a newly constructed Dome. Rest rooms for male and female users are also constructed. The 13 barangays also have their own plazas where residents can stroll and socialize, as well as playgrounds where children can play and enjoy. A cockpit is found at Barangay Impalutao, Impasugong managed by private entity.

The Municipality is conducting an annual summer basketball and volleyball league participated by the 13 barangays. These were divided in five categories for both men and women namely the pasarell division, junior division, senior division, civic division, and women division.

There are at least one covered court in every barangay. These said covered courts are equipped with bleachers, basketball facilities and an outdoor stage. There is also a Gymnasium in the municipality and there is a Dome type covered court in the municipal plaza to cater sports and other activities.

Table 3-300. Sports facilities in Impasug-ong

Name	Location	Facilities/Equipment	Description
Municipal gymnasium	Poblacion	Lights & sounds, fiber glass basketball goal and electronic score board, comfort rooms, fitness equipment	Venue for sports and other activities
Covered court	Poblacion	Bleachers, basketball facilities	Venue for sports and other activities
Covered court	12 barangays	Bleachers, basketball facilities, outdoor stage	Venue for sports and other activities

Source: Impasug-ong CLUP 2019-2028

3.4.5.4.7 Food security

Cagayan de Oro City

Food security is defined by FAO as year-round availability, accessibility and affordability to safe and nutritious food. The Philippine Association of Nutrition (1997) estimates that the poorest sector of the Philippines, which comprises almost 40% of all households, spends about 60 % of its available income on food alone. In a study conducted by Holmer and Dresher (2005) in Cagayan de Oro, on the adult scale, only 29.3 % of the respondents were considered food secure, while 31.3 % were food insecure without hunger and a high 39.4 % were food insecure with hunger (**Table 3-301**).

Table 3-301. Food security of urban poor in Cagayan de Oro City (2006)

Categories	Frequency	Percentage
Food secure	88	29.33
Food secure without hunger	94	31.33
Food insecure with hunger	118	39.33
Total	**300**	**100.00**

Source: Holmer and Drescher (2005)

Malaybalay City, Bukidnon

In Malaybalay, of the city's total land area of 108, 259 hectares, only 2,797 hectares in 2001 and 2,996 hectares in 2012–or an increase of seven percent—were identified under the Network of Protected Areas for Agricultural and Agro-industrial Development (NPAAD) or agricultural protected areas for food production.

In contrast, 2,350 hectares in 2000 and 9,052 hectares in 2012 were actually used for agri-industrial plantations for pineapple, rubber, banana and sugarcane. In those 12 years, land conversion rate rose by 285 percent. This is one of the actions identified by the LGU for ensuring food security in the area.

Malaybalay is mainly an agricultural area, and its products include rice, corn, sugarcane, vegetables, legumes, root crops, high value crops and commercial crops. Commercial crops composed of rubber, coffee, banana and pineapple. Pineapple and banana plantations are now proliferating in the outskirts of the city proper. Their aggressive expansion even to prime agricultural areas could pose a danger to the local food security.

For corn production, the city was able to produce 5,872 MT of corn in 2010, with an average yield per hectare of 2.2MT. In 2015, production rose to 72,032 MT with an average yield per hectare of 4.19MT. Just like rice, the city has become more efficient in producing corn. The city's self-sufficiency level for corn for 2015 is quite high at 1,541.23%, this was only 240% in 2010.

Tagoloan, Misamis Oriental

Pursuant to Republic Act 8435, otherwise known as Agriculture and Fishery Modernization Act, the national government's main thrust is to ensure food security, among others. In line with this, in August 1999, the office of the Municipal Agriculture in Tagoloan submitted the plan and was adopted as per Resolution No. 26, s. 1999 known as the Strategic Agriculture and Fisheries Development Zone (SAFDZ) of the Municipality of Tagoloan, Misamis Oriental.

The major agricultural crops in Tagoloan are corn, cassava, upland rice, banana, papaya, vegetables, mango, and coconut. Of the 1,010.50 hectares planted to various agricultural crops, banana covers 361 hectares or 35.7 percent with an estimated annual production of 1,083 metric tons. Coconut covers 152 hectares with an estimated annual production of 608 metric tons, while vegetables cover 73 hectares with an estimated annual production of 233.6 metric tons. Corn covers 269 hectares with an estimated annual production of 1.34 metric tons. Cassava covers 50 hectares with an estimated production of 0.5 metric tons. Rice covers 31 hectares with an estimated annual production of 248 metric tons. Papaya covers 23.5 hectares with an estimated production of 1,880 metric tons. Mango covers 50.75 hectares with an estimated production of 203 metric tons.

Tagoloan's projected population by the year 2027 is 107,379. Cereals and its by-products are considered as basic food which is very important in the daily nutrition. An area of 300.25 hectares with a total of 1,594 metric ton per year on rice and corn production in two cropping's in a year. The production per year and Average Yield / Ha. / Cropping of 5 tons for corn and 4 tons for rice. By the year 2027, the estimated per capita consumption of the 107,379 population will be 13,315.00 metric ton per year. Also, by 2027 the municipality will need an additional area of 1,760 hectares to meet the demand for rice and corn. By combining the production area for corn and rice, then the municipality can still meet the demands for cereals.

Manolo Fortich, Bukidnon

In order to keep and preserve highly suitable agricultural lands for the long-term food security of the constituents of Manolo Fortich and in line with the food security program of the nation, certain agricultural lands are protected against irreversible conversion such as those for urban uses. These lands belong to the Network of Areas for Agricultural Development (NPAAD). It includes Crop Development Zone and Pasture/livestock development zone.

Manolo Fortich reports food sufficiency and the population from 2017 to 2019 in (**Table 3-302)**. For rice production, there is not enough supply for the population. However, corn production is sufficient for the population. However, Filipinos usually prefer rice to corn for their food.

Table 3-302. Food sufficiency in Manolo Fortich (2017 - 2019)

Crop	2017		2018		2019	
	Population	Food security (%)	Population	Food security (%)	Population	Food security (%)
Rice	104,992	**21.81**	107,154	**22.02**	109,362	**22.21**
Corn	104,992	**3,200.70**	107,154	**3,197.50**	109,362	**3,186.90**

Source: Manolo Fortich CLUP 2013-2022

Sumilao, Bukidnon

The supply and demand of prime food commodities such as supply of rice for human consumption for the municipality is deficit even with the annual projected increase in production of the particular commodity of 0.03 percent. The need to increase the area for irrigated rice cultivation is very evident to attain rice sufficiency to feed the whole population of the municipality.

Poultry meat is still deficit in the municipality since commercial poultry farms are for egg purposes only. Only about 0.5 percent of culled chickens coming from these commercial farms are marketed within the locality, the rest are transported to nearby provinces. Swine production for meat purposes are mostly raised on the backyard level. Pork production is high compared to the demand. For vegetables and fruits, production is still high compared to the demand. The municipality is a supplier of these products outside the local market because of its high production.

Impasug-ong, Bukidnon

The program of the Bureau of Fisheries and Aquatic Resources (BFAR) has helped the municipality answer the needs of fish proteins. Establishment of fishponds by the fish farmers and dispersal of tilapia fingerlings by BFAR have increased agricultural productivity, augmented income, promoted food security and improved the farmers' rural livelihood. The per capita consumption of fish and fish products (along with meat and poultry products) amounted to 54 kilograms per year. Most consumption is of marine fish. But in the municipality of Impasugong, freshwater fish which is tilapia is dominant. Other freshwater fish available through fisherfolk catch are catfish, kasili, pait, haluan, pantat, dalag, Alimango/alimasag, hipon, dalapakan, tambilolo Pigok, shells, tigod and etc. Consumer acceptance of tilapia and other freshwater fish has increased in the past years.

In addition, to increase food security in the municipality, the Department of Agrarian Reform has processed 2,088.2521 hectares of farmlands awarded to deserving beneficiaries and has an area of 158.8111 hectares pending to be covered. The Impalutao-Cawayan Agrarian Reform Community which has 937.2129 hectares is recognized by DAR.

Based on **Table 3-303**, the current production of rice and corn in the municipality exceeds to its consumption. This means that surplus is sold outside the municipality, and some are utilized as feed ingredients.

As to vegetable production, many farmers are investing in high value crop production. The Municipal Agricultures Office (MAO) encourages individual household to venture into "Food Always in the Household" by planting vegetables in their backyards which would also help eliminate malnutrition in the municipality.

As to milk production, MAO aims to utilize the Municipal Communal Ranch to raise hybrid cattle to be used as milking cows to produce fresh milk products. There are many poultry farms located in the municipality, but their egg produced are hatched and delivered to other municipalities which leads the MAO to come up with the strategy to encourage farmers to raise native chickens to produce eggs and meat as well.

Less farmers are into hog fattening due to African swine fever, but the MAO are doing its best to encourage farmers to venture back into hog fattening. The office also encourages people's organizations to participate and avail themselves of livelihood programs offered by National Agencies.

Currently, fruit in the municipality is sparsely produced due to lack of knowledge among farmers in growing fruit trees. This needs orientation among farmers in utilizing riverbanks and lot boundaries as part of the environmental protection program. Its produce will be an additional livelihood for the people and will also help in food security.

Table 3-303. Food production and consumption in Impasug-ong

Food item	Population		Consumers		PLA	AAP	Standard*	Production (M.T.)		Requirement (M.T.)/YR		Surplus/deficit	
	2019	2028	2019	2028				2019	2028	2019	2028	2019	2028
Cereals & cereal products	54,118	65,891	32,470.80	39,534.60	12,151.66		0.124	10,947.15	48,606.64	4,026.38	4,902.29	6,920.77	43,704.35
Rice	54,118	65,891	22,729.56	27,674.22	2,009.88	4.00	0.124	7,555.00	8,039.52	2,818.47	3,431.60	4,736.53	4,607.92
Corn	54,118	65,891	9,741.24	11,860.38	10,141.78	4.00	0.124	3,392.15	40,567.12	1,207.91	1,470.69	2,184.24	39,096.43
White	54,118	65,891	6,818.87	8,302.27	2,061.82	3.50	0.124	1,696.08	7,216.38	845.54	1,029.48	850.54	6,186.90
Yellow	54,118	65,891	2,922.37	3,558.11	8,079.96	4.50	0.124	8,544.73	36,359.80	362.37	441.21	8,182.36	35,918.60
Sugar & syrup	54,118	65,891	21,647.20	26,356.40	400.35	50.00	0.07	31,281.42	20,017.50	1,515.30	1,844.95	29,766.12	18,172.55
Starchy roots & tubers	54,118	65,891	21,647.20	26,356.40	965.00	1.64	0.06	1,520.00	1,582.60	1,298.83	1,581.38	221.17	1.22
Vegetables	54,118	65,891	54,118.00	65,891.00	1,400.00	1.52	0.03	11,638.38	11,638.38	1,623.54	1,976.73	10,014.84	9,661.65
Fruits	54,118	65,891	27,059.00	32,945.50	700.00	1.42	0.028	541.11	994.00	757.65	922.47	(216.54)	71.53
Dried Beans, nuts & seeds	54,118	65,891	5,411.80	6,589.10	859.81	4.55	0.004	0.75	3,912.14	21.65	26.36	(20.90)	3,885.78
Milk & milk products	54,118	65,891	13,529.50	16,472.75	1,676.00	0.50	0.016	200.00	838.00	216.47	263.56	(16.47)	574.44
Eggs	54,118	65,891	27,059.00	2,945.50	1,330.00	0.50	0.004	500.00	665.00	108.24	131.78	391.76	533.22
Fish, meat & poultry	54,118	65,891	27,059.00	49,418.25	665.00	5.00	0.054	113.55	3,325.00	1,461.19	2,668.59	(1,347.64)	656.41

Source: Impasug-ong CLUP 2019-2028; NOTES: *ha/person/year; PLA - Projected Land Area; AAP - Average Annual Production;

3.4.5.4.8 Impact assessment on the threat to delivery of basic services /resource competition

Delivery of basic services /resource competition
Construction and operation- Migration affects the demands on the infrastructure and services in the place of destination. Shifts in demand occur in housing, childcare, power generation, shops, roads, amusement parks, schools, public transport, police, telephones and employment, among others. Inadequacies in the city/municipality's infrastructure and services add to the pressure. The rapid population growth results in migrants having to cope with insufficient infrastructure and cities/municipalities having to manage the lack of planning to meet the needs of all people.

The demand for utilities, such as water, energy and telecommunications, can be put under severe pressure, with those at the lowest income levels suffering disproportionately from a lack of access. The situation gets worse when migrants reside in the same neighborhood as low-income residents already accessing the scarce resources.

Increased demand on water resources
Construction **-** One of the most severe challenges, especially in developing cities/municipalities, is the availability of clean water. The Sustainable Development Goals intend to achieve universal and equitable access to safe and affordable drinking water for all people by 2030. The influx of migrants places an increasing demand on water resources, followed by an associated increase in sewage generation which, in turn, creates demand for waste water treatment facilities. A lack of such facilities results in an increased risk of untreated waste contaminating water, rendering more sources of water unusable and depriving more people of an increasingly scarce resource.

Increased demand on power supply
Construction and operation- **-** Migration also affects energy consumption and CO2 emissions quantitatively. A comprehensive study in 2013 on the effects of internal migration on residential energy consumption and CO2 emissions in Hanoi, Vietnam illustrated that "urban-to-urban migration had no statistically significant effect on per-capita energy consumption and CO2 emissions. Population growth driven by rural-to-urban migration produces lower estimates of energy consumption than natural population growth." Cities are underestimating the impact of rural-to-urban migration such that energy consumption estimates are lower when the population has increased due to this migration than through urban-to-urban migration and natural population growth. These outcomes have imperative implications for the energy policy of cities/municipalities in the context of population growth and energy utilization (Komatsu, Kaneko & Dinh Ha, 2013).

Increased demand on communication technologies
Construction and operation- **-** Advances in communications technology have made it possible to access relevant information. These technologies not only make more and better information accessible to migrants and their families, but also connect relatives, friends and colleagues physically separated by migration. ICT has played a crucial role in reducing the physical divide between migrant family members separated by geographies. Such technology directly influences how people socialize and work in transnational pluralistic societies. However, the speed of transmission may be affected by the volume which is added by the migrants in the areas.

Peace and order/ safety and security
Construction **-** Some developed cities/municipalities regard migration as a security issue and use it as an excuse to instate stringent and restrictive policies. However, some cities/municipalities welcome migrant workers especially if they are integral to the development of the community.

Increased demand for education facilities
Construction **-** Some migrant workers might bring their families along with them, especially if the construction work is long term. Even though the proposed Project will not pose a direct on the accessibility of the students to their schools, soaring immigration directly affects the availability of places in primary schools, and

inevitably pushes schools towards increasing class sizes and adding classrooms. When an influx of children from migration occurs, cities/municipalities need to ramp up resources and capacity to deal with it. Lack of such resources poses big issues for their governments, undermining efforts to keep class sizes down and to provide school places for all children.

Increased use of recreational facilities/sports facilities
Construction **-** The significance of migrants' leisure stems from the role leisure plays in individuals' lives. At the same time, leisure pursuits of migrant bear consequences for the receiving society or the local community. Participation in leisure/recreational activities is important in recuperation from work and building self-esteem aside from building and maintaining a social group. Apart from maintaining individual and group identities, leisure plays a role in migrants' adaptation to the receiving society through opening up opportunities of contacts with the mainstream population and ethnic group members (Stodolska & YiKook 2003; Stodolska & Alexandris 2004; Kim 2012) and facilitates positive inter-ethnic interactions. However, this may also result to conflict in the availability and access to the recreational and sport facilities available in the community.

Increased risk of illicit behavior and crime
Construction **-** The influx of workers and service providers into communities may increase the rate of crimes and/or a perception of insecurity by the local community. Such illicit behavior or crimes can include theft, physical assaults, substance abuse, and prostitution. Local law enforcement may not be sufficiently equipped to deal with the temporary increase in local population.

Food security
Construction **–** Food security is a current reality in the country to include the areas where the highway will be located. Food security is defined by the Food and Agriculture Organization (FAO) "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." Its components include availability, access, utilization and stability (ifsc.aciar.gov.au/food-security-and-why-it-matters.html. Accessed 3 September 2021). This is a current reality in the country to include the areas where the highway will be located.

3.4.5.5 Threat to public health and safety

3.4.5.5.1 Medical facilities

Cagayan de Oro City
There are 53 Barangay Health Centers (BHC) of the city and 13 medical officers are responsible for implementing public health programs. Each medical officer supervises and rotates to at least 3 assigned BHCs or more. There are 37 nurses. Most of them are assigned to one BHC. But there are 8 nurses assigned to two or more BHC with small population coverage. There are 66 midwives. Most of them are assigned to one BHC. Some health centers with larger population have 2 or 3 midwives. There are 6 dentists, 21 sanitary inspectors and 10 medical technologists distributed to four districts of the city, serving several BHCs.

The BHC generally deliver the same package of health services like Maternal and Child Health, Disease- Free Zone Initiatives, Intensified Disease Prevention and Control, Healthy Lifestyle and Health Risk Management, Environmental Sanitation, and Health Advocacy and Promotion. All BHCs are OPB accredited. Though all BHCs are functioning as lying-in clinics and implementing TB sputum examinations through its designated microscopy center, they are still waiting for their Philhealth accreditation on MCP and TB-DOTS.

On the other hand, the City Health Office (CHO) serves as the main headquarter where it houses the medico-legal services, issuance of health permits, animal bite treatment center, social hygiene clinic, and administerial functions. The achievement of various health programs by the CHO depends on the support they receive from their Local Chief Executive (LCE).

The curative health delivery system is provided by the 14 hospitals, 3 of which are government and 11 private hospitals. One government hospital is operating as level 4, Northern Mindanao Medical Center (DOH retained hospital which caters to the constituents of the city and Region X) while the two other government hospitals are operating as level 2, namely JR Borja General Hospital and Camp Evangelista Station Hospital (military hospital which caters mostly to military personnel and their dependents). Of the private hospitals, Maria Reyna Hospital is operating as a level 4 category hospital while 5 of the private hospitals, namely: Madonna and Child Hospital, Polymedic Medical Plaza, Capitol University Medical City, Polymedic General Hospital and Cagayan de Oro Medical Center are operating as level 3 hospitals. Puerto Community Hospital and Sabal Hospital Inc. are level 2 private hospitals while Del Monte – Bugo operates as a level 1 private hospital.

In Cagayan de Oro, there are four districts attending the health care delivery system. In the West, there are four hospitals namely; JR. Borja General Hospital, Madonna and Child Hospital, Camp Evangelista Station Hospital and Polymedic Medical Plaza. In the East, there are also four hospitals namely Ma Reyna Hospital, Capitol University Medical City, Del Monte Hospital – Bugo, and Puerto Community Hospital. Lastly, there are six hospitals comprising the central district namely, Northern Mindanao Medical Center, Polymedic General Hospital, Sabal Hospital Inc., Cagayan de Oro Medical Center, CDO Maternity Children’s Hospital and Puericulture Center. The fourth district is High Land District which doesn’t have any hospital.

In 2011, all government and private hospitals in the various districts of Cagayan de Oro City were able to meet the minimum licensing requirements of the Department of Health and all are also accredited with PhilHealth.

From the 14 Hospitals of the four Districts excluding NMMC (DOH retained hospital) and Camp Evangelista Station Hospital (Military Hospital), there are a total number of 1,805 beds.

Table 3-304. Hospitals by category, bed capacity, and personnel in Cagayan de Oro City (2018)

Hospital	Category	# of beds	# of rooms	Physician	Nurse	Midwife	Dentist
CDO Polymedic Medical Plaza	Tertiary	150	128	392	221	0	0
CDO Polymedic Medical General hospital	Tertiary	105	24	3	97	0	2
Capitol University Medical City	Tertiary	181	148	36	254	14	5
Cagayan de Oro Maternity Children’s Hospital & Puericulture	Level 1	70	26	26	24	6	0
Cagayan de Oro Medical Center	Tertiary	112	98	6	132	34	1
Camp Evangelista Station Hospital	Secondary	100	20	5	17	13	1
Doctor’s Sabal Hospital	Primary	55	70	4	37	2	0
J.R. Borja General Hospital	Secondary	100	36	56	233	19	2
Northern Mindanao Medical Center	Tertiary	600	61	194	548	59	3
Madonna and Child Hospital	Tertiary	105	-	6	113	9	1
Maria Reyna Hospital	Tertiary	130	108	15	181	6	3
Puerto Community Hospital	Secondary	35	19	3	23	1	1
	Total	**1,708**	**738**	**360**	**1,880**	**163**	**19**

Malaybalay City, Bukidnon

The Malaybalay City Health Office serves as the main rural health unit facility of the city and is staffed with doctors, dentists, nurses, medical technologists, midwives, pharmacists, nutritionists, sanitary inspectors and non-technical personnel. The CHO has 140 employees, of whom only 52 or 37% are regular. It is located in Barangay 4 this city (**Table 3-305**). It provides all basic health services such as medical and dental check-ups, consultations, laboratory tests, nutrition services and other health related services for communicable and noncommunicable diseases. With these available services and various department of health programs implemented, the City Health Office facility has inadequate and limited space to cater all its daily clients.

The City Health Office usually caters to the needs of nearby urban barangays, while the other barangays are served by Barangay Health Centers (BHC). Of the 46 barangays of the city, only Poblacion Barangays 2, 4, 5, 6, 7 and 8 have no health centers because these barangays lack site where they could construct the health centers. The BHCs are manned by midwives, Barangay health workers, barangay nutrition scholars and trained hilots. Based on standard ratio of population per Barangay Health Station which is 1:5000, Malaybalay City has 1:3,886ratio. However, the deployment of Barangay Midwives is based on per barangay, regardless of its population.

A lying-in clinic in Barangay Mapulo serves residents of 8 Upper Pulangui Barangays.There are four existing private hospitals and one Bukidnon Provincial Medical Center (BPMC) in the city. All are situated within the población area. Out of the four private hospitals, three are secondary level and one is primary.

Table 3-305. Health demographic information of Malaybalay

Total Population (2015)	170,635
Number of Barangays	46
Number of BHS	52
No. of Households (2015)	41,343
Botika ng Barangay	28
Sentrong Sigla BHS	12
Nutrition Posts	98

Health workers	Number	Health workers	Number
Doctors	4	Dentist	2
Nurses	18	Midwives	47
Medical technologist	4	Sanitary Inspectors	3
Laboratory aides	4	Malaria worker	1
Non-Technical/Medical	93	Radiologic technologist	1
Pharmacist	1	Total CHO employees	183
Nutritionist	1	Active BHWs	467
Dental Aide	3	BNS	72
Physical Therapist	1	Trained Birth Attendants	61

Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

Table 3-306 shows the Tagoloan medical health facilities and personnel. Tagoloan has one Municipal Health Center, 10 Barangay Health Stations, one BEMONC Facility with one Newborn Screening Facility, one Public-Private Mix DOTS Unit, and one Laboratory.

The Municipal Health Office has 1 Municipal Health Officer, 1 Public Health Nurse, 2 Sanitary Inspectors, 1 Medical Technologist, 1 Dentist, 14 Midwives, 1 (DTTB) Doctors to the Barrio, 16 Nurses under Nurse Deployment Project 1 (FHA) Family Health Associates, 1 (PHA) Philippine Health Agenda, 1 (UHCI) and 5 Rural Health Midwifes Placement Program of Department of Health.

There are two hospitals in the municipality. St. Paul Hospital run by the local government unit of Tagoloan, with 28 beds capacity and 5 doctors, 34 Nurses, 2 Midwifes, and 2 MedTech. While the other is Tagoloan Polymedic General Hospital, a private hospital, with 50 beds capacity and 17 doctors, 28 Nurses, 1 Midwife, and 2 other personnel.

In providing health services to the locality, the ratio on health care personnel must be parallel to the localities' total population. The Municipality of Tagoloan has a total population of the following per year: 2015-74,755, 2016-76,759, and 2017-77,241. The increasing population of Tagoloan implies the need of the following health personnel: Doctor-2, Nurse (to be assigned at Rural Health Unit)-4, Midwife (to be assigned at Rural Health Unit)-4, and Rural Sanitary Inspector-3.

Table 3-306. Health facilities and personnel in Tagoloan (2017)

Health facility	Barangay	Ownership	# of beds	Personnel						Physical condition
				D	N	M	SI	Other	Total	
Hospital										
Tagoloan Polymedic General Hospital	Sta. Cruz	Private	50	17	28	1	0	2	48	Operational
St. Paul Hospital	Poblacion	Public	28	5	34	2	0	2	43	Operational
Main/Municipal Health Center										
MHO	Poblacion	Public	5	1	1	4	2	2	10	Operational
BHS	Poblacion	Public	0	0	0	1	0	14	15	Operational
BHS	Sta. Cruz	Public	0	0	0	1	0	17	18	Operational
BHS	Natumolan	Public	0	0	0	1	0	18	19	Operational
BHS	Sta. Ana	Public	0	0	0	1	0	20	21	Operational
BHS	Baluarte	Public	0	0	0	1	0	15	16	Needs repair
BHS	Casinglot	Public	0	0	0	1	0	11	12	Operational
BHS	Mohon	Public	0	0	0	1	0	8	9	Operational
BHS	Sugbongcogon	Public	0	0	0	1	0	8	9	Operational
BHS	Gracia	Public	0	0	0	1	0	5	6	Operational
BHS	Rosario	Public	0	0	0	1	0	8	10	Need Repair

Source: Tagoloan CLUP 2017-2027; NOTES: D – doctor, N – nurse, M – midwife, SI – Sanitary inspector; MHO - Municipal Health Office; BHS - Barangay Health Station

Manolo Fortich, Bukidnon

There is one public hospital existing in the municipality (Bukidnon Provincial Hospital) located at Barangay San Miguel and private hospital situated within the premise of Del Monte Philippines Inc. in Camp Philipps, Agusan Canyon that is run by Tagoloan Polymedic Hospital. All barangays have Barangay Health Stations and the Municipal Health Center, a certified Sentrong Sigla with Birthing Facility that is Philhealth Accredited. It is situated within the vicinity of the New Municipal Government Center at Tankulan. The main health center is open 24 hours and manned by 2 doctors, 1 dentist, 1 medical technologist, 3 nurses, 7 nurses under contract thru DOH RN HEALS, 1 dental aide, 1 rural sanitary inspector (J.O.), 24 midwives and 235 active BHWs.

Sumilao, Bukidnon

A Municipal Health Center is established in Barangay Kisolon which serves as referral station for patients and clients coming from the different barangays of Sumilao. This center is manned by a Municipal Health Officer, a public health nurse, a medical technologist, a midwife and a sanitary inspector. An ambulance driver and a utility worker are also assigned in this office. **Table 3-307** shows the medical health facilities and personnel of the municipality in 2009.

Table 3-307. Health facilities and personnel in Sumilao (2009)

Barangay	Facility			Personnel					
	Type	# of beds	Condition	D	N	M	SI	Others	Total
Kisolon	MHO	0	Dilapidated		1	1	1	1	5
San Vicente	Barangay health station								
Puntian									
Culasi									
San Roque									
Ocasion									
Lupiagan									
Licoan									
Vista Villa									
Poblacion									

Barangay	Facility			Personnel					
	Type	# of beds	Condition	D	N	M	SI	Others	Total
Kisolon	Provincial health station	0	Well maintained		1	1	0	3	6
Kisolon	Emergency hospital	10			4	3	0	2	10

Source: Sumilao CLUP 2011-2020; NOTES: D – doctor, N – nurse, M – midwife, SI – Sanitary inspector

Other barangays have their own Health Stations which are manned by midwives and assisted by Barangay Health Workers. Since there are only six midwives in the municipality, four of them are assigned to serve two barangays. Barangay Kisolon has also its own Barangay Health Station but is only manned by a Barangay Health Worker.

There are 54 Barangay Health Workers, 10 trained hilots, 20 Barangay Nutrition Scholars and 29 Barangay Service Point Officers who assist in the delivery of health services in the municipality. Except for the trained hilots, these barangay volunteers received regular honoraria from the Provincial, Municipal and Barangay Governments.

The Provincial Government of Bukidnon had also established the Provincial Health Station which is located near the Municipal Health Center. It is manned by a doctor, a nurse, a midwife, a medical technologist, a clerk and an ambulance driver/utility worker. This PhilHealth Accredited Station caters to the beneficiaries of the Indigency Program of the Provincial Government.

In addition to these health facilities, there are also one private hospital and a clinic in Kisolon and another community clinic at San Vicente. The ten-bed hospital is manned by two doctors, 4 nurses, 3 midwives and 1 medical technologist. They have also a clerk and aides.

The Sumilao Cooperative Community Clinic at Barangay San Vicente caters to all patients of Sumilao with referrals from the municipal paid midwives. This clinic which is managed by San Miguel Corporation dispenses medicines and consultation free of charge. However, the medicines are limited and are more on first aid cases.

There are also eight Botika ng Barangay in the municipality with initial capital in the form of medicines from the Department of Health. These stores sell generic medicines which are cheap and affordable. Only barangays Kisolon and Vista Villa have not availed this assistance. However, there are three pharmacy stores in Kisolon.

For patients who need adequate medical care, they are referred to other hospitals at Malaybalay City and Cagayan de Oro City. The Local Government Unit has three units' ambulance for the transportation of these patients. The Provincial Health Station has also its own ambulance and so with the private hospital.

Impasug-ong, Bukidnon

All health facilities are owned by the LGU and are distributed as follows: one Rural Health Unit (RHU) located in Barangay Poblacion, and one Barangay Health Station (BHS) in the rest of the barangays totaling to 12 BHS (**Table 3-308**). There is no existing BHS located in Barangay Poblacion, all health services are provided by the RHU. There is no existing hospital facility in the municipality. For patients requiring hospitalization they would have to travel to Malaybalay City where the nearest hospitals are Bukidnon Provincial Medical Center in Malaybalay City is the referral hospital of the Rural Health Unit.

Currently the MHO has only one physician, one dentist, one nurse, one medical technologist, one sanitary inspector and 14 midwives. Based on the population of the municipality, it would require at least two doctors, two dentists, four nurses, three sanitary inspectors and 16 midwives to serve the community with 2 RHM in 3 Barangays namely Poblacion, Kalabugao and Impalutao. Since the rural health unit provide birthing services, more midwives are required for the functionality of the birthing facility.

All the 12 Barangay Health Stations in the Municipality provides Maternal and Child Health services, Child Care services, services for communicable and non-communicable diseases, Expanded Program on Immunization, family planning services, consultation, sputum smearing and environmental sanitation services. The Rural Health Unit, on the other hand, provides all the services given by the BHS with the addition of dental services, laboratory services and birthing services.

Table 3-308. Health facilities and personnel in Impasug-ong

Health facility	Barangay	Ownership	Personnel					
			D	N	M	SI	Others	Total
Main/district/city health center								
RHU	Poblacion	LGU	1	1	1	1	2 RHM	6
Barangay health station								
BHS	Bontongon	LGU	0	0	0	0	1 RHM	1
BHS	Bulonay	LGU	0	0	0	0	1 RHM	1
BHS	Capitan Bayong	LGU	0	0	0	0	1 RHM	1
BHS	Cawayan	LGU	0	0	0	0	1 RHM	1
BHS	Dumalaguing	LGU	0	0	0	0	1 RHM	1
BHS	Guihean	LGU	0	0	0	0	1 RHM	1
BHS	Hagpa	LGU	0	0	0	0	1 RHM	1
BHS	Impalutao	LGU	0	0	0	0	1 RHM	1
BHS	Kalabugao	LGU	0	0	0	0	1 RHM	1
BHS	Kibenton	LGU	0	0	0	0	1 RHM	1
BHS	La Fortuna	LGU	0	0	0	0	1 RHM	1
BHS	Sayawan	LGU	0	0	0	0	1 RHM	1

Source: Impasug-ong CLUP 2019-2028; NOTES: D - Doctor, N - nurse, M-Medical technologist, SI-Sanitary Inspector; RHU- Rural Health Unit; BHS – Barangay Health Station

3.4.5.5.2 Leading causes of morbidity and mortality and nutritional status of children

Cagayan de Oro City

Live births in the city in 2011 numbered 14,485 or a crude birth rate of 23.4%. This translated to 1207 babies born each month, 40 babies born per day, or almost 2 births per hour. There was a very slight decrease in the rate from previous year, which was 24.5%. There were 5,149 or 8.33% people die this year in the city. This indicates to 429 persons died per month or 14 persons died per day.

High Maternal Mortality. Cagayan de Oro City's maternal mortality was persistently and steadily increasing from 90/100,000LB in 2002 to 170/100,000LB in 2010. However, there is a drop to 110/100,000LB in 2011. This is due to active monitoring of traditional birth attendants and, at the same time, ensuring that all the health centers are functioning as lying-in clinics. The improvement in data recording and reporting lead to abrupt rise in maternal deaths starting 2006. This reflected a more realistic picture of the magnitude of maternal deaths. Several factors were probed for the high maternal mortality, such as; the low coverage of quality prenatal and postpartum care, home deliveries attended by TBAs, low coverage of iron supplementation, delays in referral of emergency cases and low contraceptive prevalence rate. In addition, the referral hospitals are located in the city, thus the increase in death. All these factors will be further illustrated in the next discussions below. Very striking in the review of maternal deaths is the fact that most deaths (uterine atony, uterine rupture and uterine inversion) are due to incompetence of the person that conducted the delivery. Most of these deliveries occurred at home assisted by TBA. There were also considerable numbers of teenage maternal deaths. In fact, in 2011, 30% of maternal deaths are teen-age mothers.

In 2011, most common causes of maternal deaths were eclampsia, preeclampsia, followed by uterine atony, and then amniotic fluid embolism on 3rd. Sepsis and congenital heart disease shared on 4th rank. All of these were preventable causes of maternal deaths if only early and adequate interventions were in place. More so, strict adherence to safe motherhood policy, that includes regulating birthing homes and traditional birth attendants, should be imposed.

Data also showed that maternal deaths are occurring in densely populated areas while no deaths occurred in the rural or highland areas. This clearly implies that despite the availability and accessibility of health facilities where a pregnant mother could travel less than 15 minutes to the nearest health facility for care, most of them prefer to deliver at home assisted by TBA. Several factors can be hypothesized such as, social exclusion of people belonging to marginalized sectors, level of education of pregnant mothers, poor seeking behaviors of pregnant mothers, affordability of health services, unregulated functions of TBA and weak support and referral system.

Percentage of facility-based deliveries was gradually increasing above the NOH target for the past years. Notably, in 2011 facility-based deliveries rose to 84%. However, despite improvement in the rate of facility-based deliveries, it did not reduce the number of maternal deaths in the city. This is because most deaths either occur at home or happened due to delays in referral when emergency arises. Factors involved were already discussed above. To date, there are already BEmONC Teams trained, although their health centers need to be upgraded to become BEmONC areas.

High Infant Mortality. For six years, the trend of infant deaths was maintained steadily in significant numbers. Although the city achieved the MDG target for 2015, which is less than 19 per 1,000 live births, city's IMR doubled in 2011 from 2001 data (**Table 3-309**).

The consistent high number of infant deaths in the city is due to the following: late or delay referrals of non-CDO infants to end-referral centers in this city, neonatal deaths from home deliveries assisted by TBA, poor childcare at home, and poverty. The data may also show the need of strengthening its safe motherhood policy as more than two-thirds of infant deaths were neonates. Most of these neonates died either related to home delivery assisted by unskilled birth attendants or inadequate newborn care.

More infant deaths occurred in the urban areas compared to rural areas. The reasons of high maternal deaths in urban areas as mentioned above may hold true also for infant deaths. However, the low registry of infant deaths in rural areas is possible since some families prefer to bury them immediately rather register their infant deaths.

Sepsis and Respiratory Distress Syndrome/ Prematurity top the leading causes of infant death in 2011. This is followed by pneumonia. In the past, pneumonia has always been the number one cause of infant deaths. However, since there was an increase in prematurity, RDS and sepsis ranked number 1. Poor antenatal care is one of the factors that contribute to poor pregnancy outcome. Sepsis was mostly observed among children delivered at home. Pneumonia is the 3rd leading cause of infant death. It was showed also that incidence of pneumonia deaths was lowered. Factors affecting the outcome of pneumonia include nutrition, immunization coverage, micronutrient supplementation and early referral of complicated cases.

Table 3-309. Leading cases of infant death in Cagayan de Oro (2011)

Leading causes	Number	Rate
Sepsis	39	2.69
Respiratory Distress Syndrome	39	2.69
Pneumonia	32	2.21
Asphyxia	20	1.38
Congenital Heart Disease	19	1.31
Age	17	1.17
Meningitis	11	0.76
Multiple Congenital Anomalies	11	0.76
Aspiration	6	0.41

NOTE: per 1000 live birth, Source: Cagayan de Oro City CLUP 2013-2022

Double burden from communicable diseases and lifestyle-related diseases. Pneumonia remains on top as the leading cause of mortality from the top 10 diseases over the last 3 years as shown in **Table 3-310**. Chronic kidney disease, dengue and sepsis show an equal number of cases for the last 2018 period.

Table 3-310. Leading causes of mortality in Cagayan de Oro City (2016 - 2018)

Causes	Number of cases		
	2016	2017	2018
Pneumonia	545	739	126
CAD/MI	'-	-	115
Cancer	638	712	108
CVD/CVA	411	462	76
HCVD	464	372	63
DM	312	324	55
Vehicular accidents	202	246	40
Sepsis	-	-	15
Dengue	-	-	15
Chronic Kidney Dis.	-	-	15

Source: Cagayan de Oro City CLUP 2013-2022

Malaybalay City, Bukidnon

In 2015, there were 3,577 live births with a birth rate of 20.7%. Based on the survey, there were about 86.4% babies born attended by medical practitioners like doctors (45%); midwives (41%), and nurses (0.3%). Of the total deliveries, only about 444 or 12.4% deliveries were assisted by trained hilots and 41 or 1.1% attended by hilots not officially trained.

Leading Causes of Morbidity - The top five causes of morbidity include intestinal infections like cholera, amoebiasis, and the like. The second top cause is disease of esophagus, stomach and duodenum. This is the major cause of morbidity of patients under 1 year old. Third is influenza and pneumonia. Fourth is other diseases of the urinary tract system and fifth is chronic lower respiratory diseases.

Intestinal infectious diseases or gastroenteritis is the number one cause of morbidity of Malaybalay City. The pattern of the occurrence of the disease decreases as the age increases. Mainly it affects the ages below 19 years and most cases involve the male patients. Viruses, bacteria, parasites, or other pathogens can cause infections in the stomach and small and large intestines, which often lead to gastroenteritis.

The second top cause of morbidity is the diseases of esophagus, stomach and duodenum in Malaybalay City. Alarmingly 74% of the affected age is under 1 year old, however, it is decreasing as the age increases. Further, 87% of the affected sex is the male group.

The third top cause for morbidity is influenza and pneumonia. For influenza and pneumonia, it can be observed that individuals at greatest risk for being hospitalized were infants younger than 19 years and adults 60 years of age or older regardless of the sex. Further, pneumonia is the second top cause of morbidity in the Province of Bukidnon. A record of 14,029 cases has been reported by the Provincial Health Office on its 2012 annual report.

The top three leading causes of infant mortality were Pneumonia (3,146; 14.3%); Bacterial sepsis of newborn (2,731; 12.4%); and Respiratory distress of newborn (2,347; 10.7%). The listed top ten leading causes of infant mortality in 2013 were the same with what was recorded in 2012 which only differ in ranks.

Another cause of morbidity in Malaybalay city is the diseases of the urinary system. Infants under 1 are the most affected, thus the number of cases decreases as the age increases. It can also be observed that the females are the most susceptible to the disease.

Chronic lower respiratory diseases completed the top five causes of morbidity in Malaybalay City. It can be deduced that below 19 years old are the most affected age thus, declining as the age rises. Chronic Lower Respiratory Disease (CLRD) actually comprises three major diseases: chronic bronchitis, emphysema, and asthma, that are all characterized by shortness of breath caused by airway obstruction. The obstruction is irreversible in chronic bronchitis and emphysema, reversible in asthma.

Leading Causes of Mortality - In 2015, the top five leading causes of mortality are cardiac arrest, myocardial infarction, pneumonia unspecified, hypertensive heart disease and abdominal aortic aneurysm (**Table 3-311**). More males suffered from the top five causes of mortality, while there is more female who suffered from hypertension and status asthmaticus. There are also more males who suffered from motor vehicular and cerebrovascular accidents.

Table 3-311. Leading causes of mortality in Malaybalay (2011)

No.	Causes	Number of cases			
		Male	Female	Total	Rate
1	Cardiac arrest	41	30	71	4.20
2	Myocardial infarction	43	25	68	4.02
3	Pneumonia unspecified	41	21	62	3.66
4	Hypertensive heart disease	17	13	30	1.77
5	Abdominal aortic aneurysm	17	11	28	1.65
6	Non-Insuline dépendent diabetes mellitus	16	11	27	1.59
7	Hypertension	11	15	26	1.53
	Cerebrovascular disease unspecified	14	12	26	1.53
8	Motor vehicular accidents	22	3	25	1.47
9	Cerebrovascular accident	11	10	21	1.24
10	Status asthmaticus	8	11	19	1.12
	Total	**537**	**331**	**868**	**5.13**

NOTE: per 10,000 Population; Source: Malaybalay CLUP 2016-2025

Other Causes of Mortality - In 2015, there were 35 infant deaths recorded, 4 maternal deaths, 16 perinatal deaths, 7 neonatal, and 12 fetal deaths (**Table 3-312**). The top three cause of death among infants were prematurity with 25.7%, congenital heart disease and birth asphyxia with 11%. Maternal deaths are caused by uterine atony, ruptured ectopic pregnancy, severe pre-eclampsia, and post-partum dilated cardiomyopathy.

Causes of fetal deaths are fetal distress/ asphyxia, fetus affected by cord complications, and meconium aspiration syndrome. Perinatal deaths are caused by fetal distress/asphyxia, meconium aspiration syndrome, congenital heart disease, congestive heart failure, meconium stained, and cord complications.

Table 3-312. Other causes of mortality in Malaybalay

Causes	No. of cases	Rate
Under five children mortality	42	13.97
Infant mortality	35	9.78
Maternal death	3	1.11
Fetal deaths	12	3.35
Perinatal deaths	16	4.45
Neonatal deaths	7	1.95

Source: Malaybalay CLUP 2016-2025

Nutritional Status of Children -In 2015, there 3,577 live births with a birth rate of 20.7%. There were about 86.4% babies born attended by medical practitioners like doctors (45%); midwives (41%), and nurses (0.3%).

Of the total deliveries, only about 444 or 12.4% deliveries were assisted by trained hilots and 41 or 1.1% attended by hilots not officially trained.

Tagoloan, Misamis Oriental

Leading Causes of Morbidity - With respect to morbidity, from 2016-2017, acute upper respiratory tract Infection ranked as number one cause of illness in the municipality from a rate of 62.3% per 1,000 population for a total number of 5,448 cases present as compared to 70.5% of a total number of 4,660 for the year 2017. Other diseases are animal bite, hypertension, wound (all forms), urinary tract infection, diabetes mellitus, tuberculosis (all forms), diarrhea, pneumonia, dengue fever (**Table 3-313**).

Table 3-313. Leading causes of morbidity in Tagoloan (2015 – 2017)

No.	Causes of morbidity	2015	2016	2017
1	Acute upper respiratory tract infection	4,660	5,845	5,448
2	Animal bite	921	1,036	461
3	Hypertension	696	242	195
4	Wound (All Forms)	395	92	375
5	Urinary tract infection	250	769	392
6	Diabetes mellitus	239	76	7
7	Tuberculosis (All Forms)	233	214	240
8	Diarrhea	213	76	86
9	Pneumonia	109	24	20
10	Dengue fever	107	135	0
	Total	**7,823**	**8,509**	**7,224**

Source: Tagoloan CLUP 2017-2027 (Rate per 1,000 Population)

Leading causes of mortality- The state of health in the Municipality in 2015 appears to be fluctuating as reflected by the decrease in the total crude death rate, in which 2.53 in 2015, 2.66 in 2016 and 2.51 in 2017 per 1,000 populations (**Table 3-314**).

There was no maternal death reported from 2015-2017 since effective, quality and continuous care delivery of personnel and proper supervision of Rural Health Midwives and Integrated Volunteers, (BHW's & BNS) and knowledge gained from trainings were applied.

Table 3-314. Leading causes of mortality in Tagoloan (2015 - 2017)

No.	Causes	2015	2016	2017	Total
1	Chronic Hypertensive Vascular	40	43	55	138
2	Cancer All Forms	27	22	24	73
3	Pneumonia	22	28	17	67
4	Cardio Respiratory Arrest	21	29	41	91
5	Bronchial Asthma	18	11	6	35
6	Diabetes Mellitus	17	20	28	65
7	Myocardial Infarction	17	9	4	30
8	Injuries All Forms	9	22	18	49
9	Sepsis/Septicemia	7		3	10
10	Chronic Renal Failure	7	17		24
	Total	**185**	**201**	**196**	**582**

Source: Tagoloan CLUP 2017-2027 (Rate per 1,000 Population)

Nutritional status of children - Tagoloan registered an increasing malnutrition in the degree of underweight, severely underweight and overweight of children 0–71 months for the year 2015 to 2017. While children 0–15 years consolidated school nutritional status records a decreasing number of wasted, severely wasted increase in 2017, overweight and obese records annually increasing.

Table 3-315. Nutritional status of children in Tagoloan

Degree of malnutrition	2015		2016		2017	
	Number	Percent	Number	Percent	Number	Percent
Total children (0-71 months) weight for age status						
Underweight	307	3.20	237	2.5	452	5.10
Severely underweight	70	0.75	51	0.54	128	1.40
Overweight	81	0.86	55	0.58	130	1.50
Total children (0-15 Years)						
Wasted	1,159	10	970	9	746	6.7
Severely wasted	312	3	269	3	322	2.9
Overweight	192	2	204	2	243	2.1
Obese	37	0.30	40	0.36	69	0.6

Source: Tagoloan CLUP 2017-2027

Manolo Fortich, Bukidnon

Vital Health Statistics for the last three years (2010-2012) such as crude birth rate, crude death rate and infant mortality rate were at its highest rates in 2011 (**Table 3-316**). The topmost leading causes of morbidity are often upper respiratory tract infection, urinary tract infection and hypertension (**Table 3-317**). While the top three causes of mortality are commonly related to poor lifestyle and improper food intake such as hypertensive vascular disease, hypostatic pneumonia/ senility and all forms of cancer (**Table 3-318**). Vital Heath Programs for children generally showed good performance as far as annual accomplishment report is concerned due to the trained and functional 230 BHWs designated in 22 barangays.

Table 3-316. Vital health statistics in Manolo Fortich (2010 – 2012)

No.	Vital health statistics	2010		2011		2012	
		No.	Rate	No.	Rate	No.	Rate
1	Crude Birth Rate	2,481	29.01	3,381	38.39	2,317	25.83
2	Crude Death Rate	297	3.47	337	3.83	318	3.54
3	Infant Mortality Rate	3	1.21	9	2.66	4	1.72
4	Maternal Mortality Rate	2	0.81	1	0.3	1	0.43
5	Fetal Mortality Rate	4	1.61	8	2.37	10	4.31

Source: Manolo Fortich CLUP 2013-2022; Note: Rate per 1,000 population

Table 3-317. Leading causes of morbidity in Manolo Fortich (2010 - 2012)

No.	Causes of morbidity	2010		Causes of morbidity	2011		Causes of morbidity	2012	
		No.	Rate		No.	Rate		No.	Rate
1	URTI	1,247	145.83	URTI	1,468	167	URTI	3,733	416.29
2	Hypertension	678	79.29	UTI	975	111	Hypertension	1,192	132.92
3	Diarrhea	159	18.59	Hypertension	888	101	Peptic acidosis	335	37.35
4	Dengue	139	16.25	Peptic Acidosis	492	55.9	Diarrhea	309	34.45
5	UTI	84	9.82	Arthritis	447	50.8	Amoeba	95	10.59
6	Skin Disease	67	7.84	Diarrhea	366	47.5	UTI	86	9.59
7	Influenza	34	3.98	Skin Disease	357	40.5	Asthma	72	8.02
8	Pneumonia	26	3.04	Influenza	298	33.8	TB, Pulmonary	36	4.01
9	Bronchitis	25	2.92	Bronchitis	204	23.2	Pneumonia	21	2.34
10	Amoebiasis	10	1.17	Gastroenteritis	173	19.6	Chicken Pox	16	1.78

Source: Manolo Fortich CLUP 2013-2022; Note: URTI – upper respiratory tract infection, UTI – Urinary tract infection

Table 3-318. Leading causes of mortality in Manolo Fortich (2010 - 2012)

No.	Causes of morbidity	2010		2011		2012	
		No.	Rate	No.	Rate	No.	Rate
1	Hypertensive Vascular Disease	109	12.74	113	12.83	98	10.92
2	Hypostatic Pneumonia, Senility	48	5.61	75	8.52	62	6.91
3	Accidents (all forms)	33	3.86	48	5.45	48	5.35
4	Cancer (all forms)	33	3.86	26	2.95	23	2.56
5	Chronic Renal Failure	14	1.64	11	1.25	18	2
6	6. Diabetes Mellitus	13	1.52	11	1.25	14	1.56
7	Chronic Obstructive Pulmonary Disease	11	1.29	5	0.57	8	0.89
8	Alcoholic Liver Cirrhosis	7	0.82	9	1.02	6	0.66
9	Status Asthmaticus	6	0.70	5	0.57	9	1
10	Peptic Ulcer Disease	2	0.23	7	0.79	2	0.22

Source: Manolo Fortich CLUP 2013-2022(Rate per 1,000 Population)

Impasug-ong, Bukidnon

The general health situation of Impasugong based on the past five years (2012-2016) is fluctuating. For the crude birth rate, it has the sharpest increase on 2014 at 19.3%. For the general morbidity, indicators were also fluctuating with the sharpest increase on 2016 at 11.95% (**Table 3-319**). This may be attributed to an increase in health seeking behavior of the constituents or an improved access to health services. It is important to note that the indicators on morbidity are only based on the data from the Rural Health Unit (RHU), and as to consultation from private sectors or clinics outside the municipality, it cannot be consolidated by the RHU.

For the indicators under mortality, the general trend was also fluctuating except for the Infant Mortality Rate (IMR) where it has been decreasing. The fluctuating health indicators signify that the municipality should focus on programs to control or decrease the trends, especially on Maternal Mortality and Young Child Mortality Rate. The general health situation of the municipality is summarized on the table below.

Table 3-319. General health situation in Impasug-ong (2014 to 2018)

Health indicator	2014		2015		2016		2017		2018	
	No.	%	No.	%	No.	%	No.	%	No.	%
Fertility										
Crude birth rate (CBR)	959	19.3	1004	19.59	1,061	20.08	1,349	25.53	1,347	25.49
Morbidity										
General medical	2,125	4.29	2,725	5.3	6,313	11.95			8,425	16.92
Consultative rate	2,125	4.29	2,725	5.3	6,313	11.95			8,425	16.92
Mortality										
Crude death rate (CDR)	94	1.89	102	1.99	118	2.23			101	0.203
Infant mortality rate (IMR)	9	9.38	2	1.99	2	1.19	5		4	0.30
Young child mortality rate (YCMR)	12	0.13	10	0.19	3	2.83	5		4	
Maternal mortality rate (MMR)	8	8.34	1	0.99	1	0.94	0	0	0	0

Source: Impasug-ong CLUP 2019-2028

***Leading causes of morbidity* -** The leading morbidity in the municipality of Impasugong for the past five years is predominantly communicable in nature. In 2012 and 2013, cough and colds were the leading cases of morbidity, while on the years 2015 and 2016 it was fever of undescribed origin (**Table 3-321**). This is consistent with many studies showing high communicable disease morbidities among low- and middle-

income communities. Factors affecting this include geographic consideration, demographic profile and socio-economic factors.
Leading causes of mortality - As summarized on **Table 3-322**, the leading cause of death was senility while on the succeeding years it was cardiac arrest of undescribed cause. However, looking into the rest of the 10 causes of mortality for the past five years it is evident that the municipality is facing the double burden of communicable and non-communicable disease as causes of mortality. It is important to note that in 2014 there was a high incidence of strangulation secondary to suicide indicating an increased in suicide rate. Also, in the past two years there is an emergence of poisoning and trauma as leading causes of death.
Nutritional status of children

Nutritional status of children - Impasugong have been consistently in the bottom five among the municipalities in the Province of Bukidnon. **Table 3-323** shows that there was an increased malnutrition rate from 5.15% in 2012 to 10.6% in 2016. Further dissection of the data reveals that GIDA barangays are the biggest contributor to the overall malnutrition rate. Other contributing factors are socio-economic profile of the families the children belong to.

Common illness at the respondent households – The common illnesses that commonly affected the household members from May 28 ito June 2021 were coughs (35.5%), colds (33.1%) and fever (13.9%). These illnesses were mostly weather- and lifestyle-related illnesses.

Table 3-320 shows the common illnesses experience by household members.

Table 3-320. Common illnesses experienced by respondent households

Illness	CDO		Malaybalay		Tagoloan		Sumilao		Manolo Fortich		Impasug-ong		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Cough	28	37.84	17	41.46	15	33.33	14	32.56	25	35.21	19	32.76	118	35.54
Colds	28	37.84	11	26.83	15	33.33	12	27.91	26	36.62	18	31.03	110	33.13
Fever	7	9.46	9	21.95	4	8.89	10	23.26	7	9.86	9	15.52	46	13.86
Fever Relapse	1	1.35	0	0.00	0	0.00	0	0.00	8	11.27	6	10.34	15	4.52
Headache	2	2.70	0	0.00	3	6.67	2	4.65	0	0.00	1	1.72	8	2.41
Arthritis	1	1.35	0	0.00	3	6.67	2	4.65	0	0.00	0	0.00	6	1.81
Diabetes	3	4.05	1	2.44	0	0.00	0	0.00	0	0.00	2	3.45	6	1.81
High blood	0	0.00	1	2.44	2	4.44	1	2.33	0	0.00	1	1.72	5	1.51
Flatulence/Colic	0	0.00	0	0.00	1	2.22	0	0.00	2	2.82	0	0.00	3	0.90
Tooth ache	0	0.00	0	0.00	1	2.22	1	2.33	0	0.00	1	1.72	3	0.90
Allergies	0	0.00	0	0.00	0	0.00	0	0.00	1	1.41	1	1.72	2	0.60
Chicken fox	0	0.00	1	2.44	0	0.00	0	0.00	0	0.00	0	0.00	1	0.30
Covid-19	0	0.00	0	0.00	0	0.00	0	0.00	1	1.41	0	0.00	1	0.30
Diarrhea	0	0.00	1	2.44	0	0.00	0	0.00	0	0.00	0	0.00	1	0.30
Heart disease	0	0.00	0	0.00	0	0.00	1	2.33	0	0.00	0	0.00	1	0.30
Boils	1	1.35	0	0.00	0	0.00	0	0.00	1	1.41	0	0.00	2	0.60
Pneumonia	1	1.35	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.30
Tonsilitis	1	1.35	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.30
Tuberculosis	1	1.35	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.30
UTI	0	0.00	0	0.00	1	2.22	0	0.00	0	0.00	0	0.00	1	0.30
Total	**74**	**100**	**41**	**100**	**45**	**100**	**43**	**100**	**71**	**100**	**58**	**100**	**332**	**100**

Source: Socio-Ecconomic Survey conducted from May 28 to June 4, 2021.

Table 3-321. Leading causes of morbidity in Impasug-ong (2012 - 2016)

No.	2012		2013		2014		2015		2016	
	Causes	Total	Causes	Total	Causes	Total	Causes	Total	Causes	Total
1	Cough and colds	1506	Cough and colds	1642	Headache	1128	Fever	802	Fever	802
2	URTI	583	URTI	621	Cough and colds	305	URTI	613	URTI	613
3	Fever	252	Pneumonia	295	URTI	223	Influenza	347	Influenza	347
4	Diarrhea	231	Essential Hypertension	179	Diarrhea	57	Pneumonia	175	Dermatitis	202
5	Pneumonia	158	Hypertension stage 1	164	Infected wound	47	Acute gastroenteritis	168	Pneumonia	173
6	Abdominal Pain	129	Tension Headache	162	UTI	26	Hypertension	141	Acute gastroenteritis	168
7	Infected wound	126	UTI	113	Pneumonia	25	UTI	85	Hypertension	141
8	Acute Gastroenteritis	114	Boil	112			Acute bloody diarrhea	30	UTI	85
9	UTI	103	Toothache	98			Otitis	27	Acute bloody diarrhea	30
10	Skin disease	100	Functional diarrhea	0					Otitis media	27
	Total	**3,302**	**Total**	**3,386**	**Total**	**1,811**	**Total**	**2,388**	**Total**	**2,588**

Note: URTI – Upper respiratory tract infection, UTI – urinary tract infection; Source: Impasug-ong CLUP 2019-2028

Table 3-322. Leading causes of mortality in Impasug-ong (2012 - 2016)

No.	2012					2013					2014					2015					2016				
	Causes	%	Total	M	F	Causes	%	Total	M	F	Causes	%	Total	M	F	Causes	%	Total	M	F	Causes	%	Total	M	F
1	Old Age	31	17	12	5	Senility	19%	8	2	6	Senility	37	23	15	8	CP arrest	34	18	7	11	Cardiac arrest	28	17	10	7
2	Severe pneumonia	16	9	3	6	Pneumonia	12%	5	0	5	CPA	21	13	8	5	Pneumonia	17	9	4	5	CVA	25	15	6	9
3	CPA	13	7	5	2	HT Stage 2	12%	5	3	2	Strangulation	10	6	4	2	Cardiac Arrest	13	7	5	2	Trauma	15	9	6	3
4	Cancer, all forms	11	6	5	1	CVA	12	5	4	1	Cardiac Arrest	6	4	3	1	CVA	11	6	4	2	Senility	7	4	1	3
5	ARF	9	5	3	2	HT Stage 1	10	4	2	2	ARF	6	4	3	1	Typhoid	9	5	5	0	Respiratory failure	7	4	2	2
6	Hypertension	5	3	2	1	MI	10	4	3	1	Cancer	5	3	1	2	SOB	6	3	2	1	CPA	5	3	2	1
7	Edema	5	3	1	2	CHF	7	3	1	2	Asthma	5	3	2	1	Poisoning	4	2	2	0	Breast cancer	5	3	0	3
8	CRF	4	2	1	1	Asthma	7	3	0	3	CHD	5	3	2	1	AP	2	1	1	0	Cholelithiasis	2	1	1	0
9	CVA	4	2	2	0	Head injury	7	3	2	1	Severe dehydration	3	2	1	1	Acute hepatitis	2	1	0	1	Liver cirrhosis	3	2	1	1
10	Hemoptysis	2	1	1	0	Cancer	5	2	0	2	Pneumonia	3	2	1	1	Gastroenteritis	2	1	0	1	Severe dehydration	3	2	1	1
	TOTAL	**100**	**55**	**35**	**20**		**100**	**42**	**17**	**25**		**100**	**63**	**40**	**23**		**100**	**53**	**30**	**23**		**100**	**60**	**30**	**30**

Source: Impasug-ong CLUP 2019-2028; ARF – acute respiratory failure; CRF - chronic respiratory failure; MI - Myocardial Infarction; HT – Hypertension; CHF - Congestive Heart Failure; CP – cardio-pulmonary arrest; CHD - congenital heart disease; SOB - shortness of breath; AP - acute pancreatitis;

Table 3-323. Nutritional status of children in Impasug-ong (2012 – 2016)

Degree of malnutrition	2012		2013		2014		2015		2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Underweight	306	4.37	337	5.16	183	2.28	845	5.84	603	8.2
Severely Underweight	55	0.78	64	0.98	59	0.73	142	1.71	177	2.41
Total	**361**	**5.15**	**401**	**6.54**	**620**	**7.7**	**363**	**7.55**	**780**	**10.6**
Overweight	18	0.26	26	0.4	6	0.07	67	0.81	123	1.67
Total no. of children (0-15 years old)	7,010	100	7,748	100	6,240	100	6,227	100	7,351	100

Source: Impasug-ong CLUP 2019-2028

3.4.5.5.3 Environmental health and sanitation profile

Cagayan de Oro City

Sanitation - Cagayan de Oro had some households without sanitary toilets. In 2019 there were 4, 279 or 3.04% of households with unsanitary toilets and 3, 729 or 2.87% without toilets. **Table 3-324** shows the data of status of toilet in 2019.

Table 3-324. Toilet facilities in Cagayan de Oro City (2019)

Type of toilet	HH Number	Percentage of HH
Household with sanitary toilets	132,660	94.08
Household with unsanitary toilets	4,279	3.04
Household without toilets	3,729	2.87

Note: HH – household; Source: Cagayan de Oro City CLUP 2013-2022

Inventory of cemeteries and memorial parks- Cagayan de Oro City Memorial Park is located at Bolonsori, Camaman-an, with an area of 19.6716 hectares or 196,716 sq.m. As reflected in **Table 3-325**, the number of burials in the said memorial park totaled to 51,979 in 2011. The present the city memorial park is congested, some plots are located in critical areas and flood prone areas along the bank of the creek. Records show an estimated average of five burials a day.

Complementing the city memorial park are four private memorial parks namely: Cagayan de Oro Golden Memorial Park, Divine Shepherd Memorial Park, Green Hills Memorial Park, and Golden Haven Memorial Park. These memorial parks have enough plots to accommodate more burials.

Table 3-325. Cemeteries and memorial parks in Cagayan de Oro City

Cemeteries and memorial parks	Barangay	Ownership	Area (ha)	Capacity	Remarks
Cagayan de Oro Golden Memorial Garden Phase I & II	Lumbia	Private	15	39,094	
Divine Shepherd Memorial Garden	Bulua	Private	7.4	7,865	
Green Hills Memorial Park	Bulua	Private		5,290	
Bolonsori - CDO Memorial Park	Camamanan	Public	19.6716	51,979	Congested flooded Located in critical areas
Bulua Cemetery	Bulua	Public	0.750	72	Congested
IFI Cemetery	Bulua	Private	14,970	74	
Iponan Cemetery	Iponan	Public	1.2248		Fully occupied
Canitoan Cemetery	Canitoan	Public	1.9	487	Congested
Gusa Cemetery	Gusa	Public	0.5912		Fully occupied
Golden Haven Memorial Park	Bulua	Private	10.0202	197/22,068	
Tablon Barangay Cemetery	Tablon	Public	3.000		Fully occupied
Baikingon Barangay Cemetery	Baikingon	Public	1.0		
Balubal Barangay Old Cemetery	Balubal	Public	1.0		
Bayanga Barangay Cemetery	Bayanga	Public	1.0		
Besigan Barangay Cemetery	Besigan	Public	-		
Canitoan Barangay Cemetery	Canitoan	Public	1.9	487	Congested
Dansolihon Barangay Cemetery	Dansolihon	Public	0.75		
Roman Catholic Church	Agusan	Private	0.2		Fully occupied
Bugo Memorial Home	Bugo	Public	2.4	91	
Taglimao Cemetery	Taglimao	Public	-	-	
Tignapoloan Cemetery	Tignapoloan	Public	2.5	-	
Tuburan Cemetery	Tuburan	Public	-	-	
Tumpagon Cemetery	Tumpagon	Public	1.0	-	

Souce: Cagayan de Oro City Ecological Profile 2019

Solid waste management - To address the increasing solid waste generation of the city, the City Council legislated an Ordinance No 6444-98 creating the City Public Services Office (CPSO). The office oversees street cleaning, park maintenance, garbage collection, dumpsite operation and maintenance. The Solid Waste and Management program has been turned over to City Local Environment and Natural resources Office (CLENRO).

A total of 267,714.31 kilograms per day are disposed at the sanitary landfill. Biodegradable waste material has the highest disposal quantity at 174,037.81 kilogram per day with public market and commercial sources have contributed significantly **Table 3-326**. Noticeably, the institutional sector disposed 45 percent of recyclable waste to sanitary landfill.

With the total waste generated, 53% of biodegradable and 72% of recyclable wastes were diverted from the total waste generation within the collection service area. For 2017, Cagayan De Oro City has 48 % waste diversion rate with 248,648.69 kilograms per day.

Table 3-326. Solid waste generation in Cagayan de Oro City (2017)

Sector	Biodegradable		Recyclable		Residual		Special waste	
	kg/day	%	kg/day	%	kg/day	%	kg/day	%
Residential	46,117.70	34	4,792.19	15	17,165.04	100	1,970.44	100
Commercial	21,453.85	50	2,895.28	15	16,182.51	100	2,134.64	100
Public Market	87,272.58	75	474.55	10	10,624.58	100	383.14	100
Institutional	17,420.50	45	6.009.68	45	7,728.30	100	437.88	100
Industrial	1,773.19	10	854.45	10	21,476.47	100	574.34478	100
Total	**174,0327.81**		**15,026.15**		**73,176.90**		**5,473.445**	

Source: Cagayan de Oro City CLUP 2013-2022

The 25-hectares City Sanitary Landfill was opened in 2017 in barangay Pagalungan, which is about 12 kilometers from the city proper, with the first-ever disposal of solid waste generated in the city made on 18 April 2017.

Efforts at the new landfill in 2017 included the establishment of 1-hectare operation cell with leachate pond and drainage system. In compliance with conditions set in the Environmental Compliance Certificate (ECC), three water quality monitoring were conducted with all results within the standards set by the government.

Meanwhile, the decommissioned 17hectare controlled dumpsite of the city government located in Upper Dagong, Barangay Carmen was the nominated project for funding under the 2018 General Appropriations Act (GAA) – Local Government Support Fund (LGSF) which allocated PHP 35 million for the city government. When completed, the proposed ecopark will feature facilities for a wider range of publics, from children to senior citizens. Located about 3 kilometers from the city proper, the ecopark will offer a breather for city residents and visitors alike to engage in leisure and wellness activities. In 2017, eight hectares of the decommissioned dumpsite was rehabilitated through the planting of various tree species.

Among the institutional efforts supportive of solid waste management included the endorsement by the City Ecological Solid Waste Management Board to the City Council of the proposed Integrated Solid Waste Management Ordinance for the latter's legislation of the proposal into law.
The Oro Kalimpyo Awards was also launched in 2017 in search of outstanding barangays on ecological solid waste management.

Revenues generated through enforcement of environmental laws resulted to the collection of PhP 13.946 million in 2017, while during the first quarter of 2018 about PHP 40.635 million has been generated.

Malaybalay City, Bukidnon

Sanitation - In 2011, 28,176 or ninety percent (90%) of the households have access to safe water. Household with sanitary toilet is 86% or 27,237 of the total 32,201 households of the city. Eight-eight percent (88%) of the total numbers of households have garbage disposal system and basic sanitation facilities. Food handlers with health certificate and the food establishments with sanitary permits have increased in number as compared in the previous years.

Inventory of cemetery- The city has a public cemetery with 21.30 hectares. The city is planning to add 1.91 hectares in Barangay Sumpong.

Solid waste management - Prior to the creation of the City Environment and Natural Resources Office (City ENRO), the City General Services Office (CGSO) served as the lead office in the management of solid waste in the City of Malaybalay. However, when the City ENRO was created and started its operation in 2009, it took charge of the entire solid waste management of the city, including the management of all equipment and facilities used in the garbage collection, transport and disposal; the operation and maintenance of the final disposal facility; and the supervision of all personnel who are involved in the management of the solid wastes, like the street sweepers, garbage collectors, compactor/dump truck drivers and dumpsite maintenance personnel.

In 2011, Solid Waste Management Ordinances of the city was fully enforced to the 14 barangays originally served by the garbage collection with the imposition of fines and penalties for those who violated the ordinances. The Clean and Green Program is actually a competition among the 46 barangays of the city, to determine the performance of the barangay in implementing programs and policies relating to ecological solid waste management, pollution control, and other environmental considerations. The outstanding barangay is given due recognition and cash prizes.

By 2015, from the original 14 barangays (11 urban barangays: Poblacion 1 to 11 and 3 urbanizing barangays: Sumpong, Casisang, Kalasungay), as the only beneficiaries of the garbage collection, the City ENRO expanded its collection services to the additional 22 barangays, making the total number of barangays served by waste collection into 35. These include barangays Dalwangan, Patpat, San Jose, Laguitas, Aglayan, Cabangahan, Bangcud, Linabo, Violeta, Managok and Maligaya. Solid Waste collected in the 14 barangays were both the biodegradable and the non-biodegradable, while only residual wastes were collected in the added barangays considering that these 14 barangays are within the urban area wherein the establishment of a composting facility is difficult compared to that of the rural barangays. To address the problem, the City Government provided composting facilities to cater the biodegradable of the 14 clustered barangays.

The total waste generation of the city is estimated to be at 151.98 tons/day but only 18.54 tons/day reaches the disposal site (**Table 3-327**). This means that only 12.20% of the total wastes generated per day reached the final disposal facility at present. In other words, 139.78 tons/day does not reach the final disposal facility. This could have been diverted through composting and recycling or some are retained at home. MISS data also revealed that there are residents in the city whose disposal systems are either through pit-holes, open-dumping, and open-burning which are actually prohibited in the city.

Table 3-327. Waste generation in Malaybalay City

Year	Population	Waste generation source unit	Volume of waste generation
2011	157,167	0.500	78,583.5
2012	160,625	0.500	80,312.5
2013	164,159	0.500	82,079.5
2014	167,770	0.500	83,885.0
2015	171,461	0.500	85,730.5
2016	175,233	0.500	87,616.5

Year	Population	Waste generation source unit	Volume of waste generation
2017	179,088	0.500	89,544.0
2018	183,028	0.500	91,514.0
2019	187,055	0.500	93,527.5
2020	191,170	0.500	95,585.0
2021	195,376	0.500	97,688.0

Source: Malaybalay CLUP 2016-2025

The city government still uses the controlled disposal facility at Barangay Can-ayan, which is around 5 kilometers from the urban center as its final disposal of the collected waste. Biodegradable wastes were processed as organic fertilizer through the Bioreactor Composting Facility and Vermi Composting Facility, the Bioreactor has a capacity of 1,000 kilograms per day. While the non-biodegradable wastes are disposed into the City Material Recovery Facility for further segregation and sorting, the residual wastes are finally dumped into the final disposal area. The collection of garbage fees is incorporated in the license permit payment as part of the miscellaneous fees collected from the establishment. Generally, the small establishments are collected Php80.00, while the large establishment including the restaurant are collected PhP400.00 per year.

Tagoloan, Misamis Oriental

Sanitation - Tagoloan is a fast-developing town due to the presence of several industries in the area. Influx of migrants is expected, thus the growing number of households and rapid growth of population each year. **Table 3-328** shows the type of toilet facilities in the occupied housing units in Tagoloan by barangay.

Table 3-328. Toilet facilities in Sumilao

Barangay	Type of toilet facility					
	Sanitary			Unsanitary		
	2015	2016	2017	2015	2016	2017
1. Sta. Cruz	2,092	2,416	2,416	464	24	24
2. Poblacion	2,004	2,510	2,500	292	30	40
3. Casinglot	1,685	1,907	1,905	149	161	163
4. Sta. Ana	1,299	2,047	2,047	479	77	77
5. Baluarte	1,208	1,832	1,820	392	187	199
6. Mohon	1,050	925	932	31	7	0
7. Natumolan	1,027	1,848	1,868	324	20	0
8. Sugbongcogon	751	817	817	35	0	0
9. Gracia	381	481	481	29	0	0
10. Rosario	192	203	221	25	18	0
Total	**11,689**	**14,986**	**15,007**	**2,220**	**524**	**503**

Source: Tagoloan CLUP 2017-2027

Inventory of cemeteries and memorial parks - The Catholic cemetery in Poblacion, Tagoloan Misamis Oriental has existed since time in memorial. Way back then, the area was isolated from the residential and commercial areas at the time it came to be.

Tagoloan has now grown from a sleeping town to an urbanizing community in an industrialized and highly commercialized area. The cemetery in between the main access road to Barangay Natumolan and the National Highway has become a question in its location but then again it has existed in the area longer than any other resident and commercial establishment.

Poblacion cemetery is located behind Paula's hotel in which congestion and flooding incidence occur during heavy rains. The Iglesia Filipiniana Independiente Cemetery in Sta Ana has also existed longer than the residents living in the area. The old Catholic Cemetery in Sta. Ana is no longer accepting new burials since there is no more available lots, the new location of the public cemetery at an elevated location in Sta. Ana is now being utilized by all religious sectors. The adjoining properties have become an avenue for burial spilling and expansion of cemetery. The rest of the cemeteries are newly operated. **Table 3-329** presents the cemeteries and memorial parks in Tagoloan.

Table 3-329. Cemeteries and memorial parks in Tagoloan

Cemetery/memorial park	Barangay	Ownership	Area (ha)	Remarks
Iglesia Filipina Cemetery	Sta. Ana	Private	0.1480	Congested
Sta. Ana Catholic Cemetery (Old)	Sta. Ana	Private	0.1692	Congested
Tagoloan Roman Catholic Cemetery	Poblacion	Private	3.3000	Congested
Rosario Cemetery	Rosario	Public	1.0000	
Sta. Ana Catholic Cemetery (New)	Sta. Ana	Private	1.2500	
Royal Garden	Sta. Ana	Private	1.4998	
Sta. Ana Public Cemetery	Sta. Ana	Public	0.5000	

Source: Tagoloan CLUP 2017-2027

Solid waste management - The municipality's solid waste management program is being run by the Municipal Environment & Natural Resource Office (MENRO) with a designate Solid Waste Focal Person. It is municipal departments which handles the collection system, oversees the operation of the eco-waste center, enforce the provisions under R.A 9003, the SWM Ordinance in coordination with other offices, conducts information and education campaign in barangays as well as supervises progress of SWM implementation in the barangays. Municipal Environment and Natural Resources Office findings are reported during the MSWM Board meetings. Starting from a controlled dumpsite, the municipality has put it into closure and converted it into an eco-waste facility wherein it became a central Material Recovery Facility (MRF) of the municipality. It has a Residual Containment Area (RCA) while an ongoing processing for the establishment of Sanitary Landfill.

Industrial establishments have provided their own water treatment facilities while others using septic tank and concrete line canals before it drains to street canals and creeks and rivers. The size and capacity of wastewater treatment systems are determined by the estimated volume of sewage generated from residences, businesses, and industries connected to sewer systems as well as the anticipated inflows and infiltration, but the LGU has no wastewater treatment systems yet. The toilet facilities commonly used by the household in buildings and houses are water-sealed, sewer/Septic Tank, closed pit and others. The predominant method of wastewater disposal in municipality is discharged into a body of surface water. Suburban and rural areas rely more on subsurface disposal. The Industrial waste created, the DENR evaluate the degree of pollution problem created. In either case, wastewater must be purified or treated to some degree in order to protect both public health and water quality.

The degree to which wastewater must be treated varies, depending on local environmental conditions and governmental standards. Effluent standards, on the other hand, pertain directly to the quality of the treated wastewater discharged from a sewage treatment plant. The factors controlled under these standards usually include biochemical oxygen demand (BOD), suspended solids, acidity, and coliforms.

The waste of the municipality of Tagoloan totals to 9,029.21 kilograms per day (9.02 tons). The composition per source is shown in **Table 3-330**. Disposed waste composition came from different types of sectors such as residential, commercial, Institutional, market, Industry, and RHU and hospital. It is indicated that the highest volume of wastes collected coming from the biodegradable of 3,883.48 kgs/day or 43%, followed by Residual of 2,936.23 kgs/day or 32.52%, Recyclable of 1,734.12 kgs/day or 19.21%, and Special of 475.39 kgs/day or 5.27%. The waste collected and transported to the temporary residual containment area.

Table 3-330. Waste generation and composition in Tagoloan

Sector	Biodegrables (kg/day)	Recyclable (kg/day)	Residual (kg/day)	Special (kg/day)	Total wastes (kg/day)
Residential	2,122.18	1,245.38	1,944.02	222.28	5,533.86
Commercial	269.77	32.02	45.21	9.00	355.99
Institution	14.90	17.23	12.97	0.93	46.03
Market	1,369.97	193.59	857.91	28.43	2,449.91
Industry	104.97	243.07	70.82	214.33	633.18
RHU and hospital	1.69	2.83	5.30	0.42	10.24
Total	**3,883.48**	**1,734.12**	**2,936.23**	**475.39**	**9,029.21**
% composition	**43.00%**	**19.21%**	**32.52%**	**5.27%**	**100%**

Source: Tagoloan CLUP 2017-2027

Manolo Fortich, Bukidnon

Manolo Fortich has some households without sanitary toilets. There were 1,419 or 7.12% of households without toilets. **Table 3-331** shows the data of status of toilet in the municipality.

Table 3-331. Number of households without toilets in Manolo Fortich

Barangay	No. of HH	WT	Barangay	No. of HH	WT
Agusan Canyon	1,839	25	Minsuro	242	53
Alae	1,949	4	Mantibugao	570	41
Damilag	2,797	8	Mampayag	248	54
Dahilayan	371	71	Mambatangan	830	173
Dalirig	746	74	Santiago	263	16
Diclum	865	16	Sto. Niño	875	138
Guilang-Guilang	208	6	San Miguel	886	29
Kalugmanan	462	200	Sankanan	843	129
Lingion	1,193	81	Tankulan	1,792	24
Lindaban	459	128	Ticala	270	143
Lunocan	1,343	1	**Total**	**19, 903**	**1, 419**
Maluko	852	5			

Note: HH – household; Source: Manolo Fortich CLUP 2013-2022; WT - without toilet

Inventory of cemeteries and memorial parks - There are eight barangays who have not yet apportioned their respective cemetery areas, namely; Dicklum, Lingi-on, Kalugmanan, San Miguel, Sto. Nino, Ticala and Mambatangan. Pryce Garden is located in Barangay Mambatangan but it is limited only to those who can afford to pay. Some barangays such as Dicklum is near to Tankulan Cemetery or Kalugmanan is near to Sankanan but having their own public cemetery areas shall not only offer convenience to their constituents but could also prevent a fast overcrowding of burials in the said existing cemeteries.

Solid waste management - The Municipality has two garbage trucks with personnel who are responsible in collecting non-biodegradable waste from the households of the seven urbanizing barangays. Bio- degradable wastes are not collected by the garbage crew, it will remain in the households.

Waste characterization survey conducted in the last quarter of 2011 showed that there is about 0.50 kg per day of waste generated per capita and about 890,171 kg of residual waste that are final disposed to the CDF. **Table 3-332** shows the solid waste generation of the municipality per year 2010-2021. Manolo Fortich is operating and establishing a Controlled dumping Facility at barangay Alae. It has been used by the LGU in year 2002. It is about 6 hectares.

Table 3-332. Solid waste generation in Manolo Fortich (2010 - 2021)

Year	Population	Waste generation	Year	Population	Waste generation
2010	91,026	16,566,732	2016	102,872	18,722,704
2011	92,901	16,907,982	2017	104,992	19,108,544
2012	94,815	17,256,330	2018	107,154	19,502,028
2013	96,768	17,611,776	2019	109,362	19,903,884
2014	98,762	17,974,684	2020	111,615	20,313,930
2015	100,796	18,344,872	2021	113,914	20,732,348

Source: Manolo Fortich CLUP 2013-2022; NOTEs: kg/year; 0.5kg/daysx7days/week x 52weeks/year

The municipal government is currently operating a five hectare - Controlled Dumping Facility at Barangay Alae. Barangays are encouraging to implement their own Material Recovery Facilities (MRFs) but only about 60% are actively operating their respective MRFs. Major industries shall be enforced to operate their own landfill and thereby manage their own waste disposal site considering that the would-be conversion of LGU-owned CDF into Sanitary Landfill shall only be enough to household wastes to be generated.

Sumilao, Bukidnon
Inventory of cemeteries and memorial parks **-** All ten barangays of Sumilao have their own public cemeteries. These cemeteries occupy 13.1285 hectares or 0.063% of the Sumilao's land area. Population growth is very suggestive to increase area for cemeteries. With these, an additional 3.9217 hectares is proposed, accounting a total cemetery area of 17.0502 for the next ten years.

Solid waste and wastewater management - With the implementation of the Republic Act 9003 otherwise known as the Ecological Solid Waste Management Act, the Local Government Unit of Sumilao created a team to spearhead in the information dissemination and education campaign in all ten (10) barangays of the municipality regarding RA 9003. In spite of it, collection of garbage is concentrated only in the urban barangay of Kisolon, particularly in the barangay proper. Kisolon, where the seat of government is located, has the highest number of households and is the business center of the municipality, thus, large volume of garbage is generated from this locality. Solid wastes in other nine barangays are still manageable and are taken care of by the households.

Solid waste management in the urban area is handled by the Ecological Solid Waste Management Coordinator. Households and commercial establishments practice segregation of solid waste at source. The segregated garbage is hauled and temporarily disposed at barangay San Vicente which is approximately five kilometers away from the barangay proper of Kisolon. The existing dumping facility which is one hectare is a temporary site until such time that the local government unit has identified and acquired an area for Final Disposal Facility (FDF).

Collection of garbage is undertaken regularly. Garbage collectors spent eight hours a day from Monday to Friday using the three-cubic meter capacity garbage compactor and oftentimes, the mini-dump truck is used to haul solid waste from the source to the disposal facility. The road leading to the dumpsite is maintained with the use of a grader.

Garbage from the households is deposited in receptacles or sacks. The garbage collectors load the solid waste in the truck. Since most households take care of their own garbage, only four trips are needed for the garbage compactor to collect the garbage in a day.

Although segregation of solid waste is practiced in most households, some wastes dumped at the disposal site are still mixed with other materials. This is the reason why the local government employed a total of six waste segregators. They are stationed in the dumpsite to further segregate the hauled garbage and place separately the recyclable materials in the Material Recovery Facility (MRF) which is constructed within the dumpsite.

Waste reduction is unconsciously done in every household in the municipality. Bottles, scrap iron, metals and tin cans are separated and sold to junk shops that are present in the locality. There are about ten or more transient / ambulant buyers coming from Cagayan de Oro City and Valencia City who buy recyclable and reusable materials.

In some public places like the market, municipal buildings, plaza, school buildings and waiting sheds, receptacles are strategically installed wherein transients deposit their solid waste. Their receptacles are either metal or plastic drums.

The compostable wastes are more than half or eighty percent of the total wastes (**Table 3-333**). It is composed of food, kitchen, yard and garden wastes and rotten vegetables from the flea market. The recyclable that includes plastics, metals, bottles, glasses, ceramics, boxes, cartons and empty sacks makes up for the twenty percent.

Biodegradable materials are separated from non-biodegradable materials. The non-biodegradable materials are stored in the MRF and later, sold to buyers. At present, there are no buyers for cellophanes and broken glasses/bottles. With this, the local government unit planned to purchase processing facilities such as shredding machines and plastic densifiers.

Table 3-333. Average waste generated in Sumilao (2009)

Type of waste	Volume*	Total (%)
Biodegradable	4.0	80
Non-Biodegradable	1.0	20
Total	**5.0**	**100**

Source: Sumilao CLUP 2011-2020; NOTE: *cu.m./day

Impasug-ong, Bukidnon

Sanitation - About 1,032 have unsanitary toilets and around 1,594 without toilets.
Solid waste generation - **Table 3-334** shows the waste composition and source of the municipality. Waste generated in all sources showed that biodegradable waste has the biggest volume followed by recyclable waste. Based on the data gathered by the LGU, the bulk of the types of waste generated from the total sampling, are biodegradable wastes which is equivalent to 79.46%. This implies that if properly managed, more than one half will be recovered as compost fertilizer which can be used for household backyard gardening. This will enable every household to produce food for consumption and for additional income. If properly implemented, this becomes a livelihood project for income generation. The remaining 20.54% of the total wastes sampling are non-biodegradable, it is in this waste that the council should identify specific strategies in order that proper segregation, recycling and recovery will be applied. Eventually, there will be reductions of waste volume dumped at the landfill.

Toxic/hazardous waste, which implies proper handling and management, are generated mostly by multinational corporations like DOLE Philippines and Inc. Del Monte Philippines, Inc. due to the use of chemical pesticides in their banana/pineapple plantations. These wastes need regular crop management. Nevertheless, the company’s Environment and Safety Division are controlling such practices for public health and the general welfare of the community. This has been created a Multi-Tripartite Committee to monitor the environmental compliance of these companies.

Table 3-334. Waste composition and source in Impasug-ong

Source	Biodegradable	Recyclable	Special waste	Residual	Total	% of total
Household	35.08	5.58	0.03	15.23	56.55	22.48
High Income	1.28	1.17	-	0.83	3.28	1.3
Middle Income	17.4	2.08	0.03	8.33	27.84	11.07
Low Income	16.4	2.33	-	6.07	25.43	10.11
Commercial	7.65	4.24	-	-	11.69	4.65
Industrial	-	-	-	-	-	-
Institutional	151.5	23.5	-	-	175	69.57
Others	5.66	3.25	-	-	8.31	3.3
Total	**199.89**	**36.57**	**0.03**	**15.86**	**251.55**	**100**

Source: Impasug-ong CLUP 2019-2028; All values in kg/day

There is only one method of Solid Waste Disposal or treatment used in the municipality which is the Controlled Dump Site. The facility is located in Capitan Bayong, Impasugong with a total land area of two hectares and is managed by the Local Government Unit.

Wastewater generation by source and treatment/ disposal methods - The Municipality has several industries but most are using dry processing which require less water and thus emits almost no waste water. Some of these are the San Miguel Feed Mill, ABERDI and Impasugong Furniture Shop and Sawmill. The San Miguel Purefoods Hatchery is generating wastewater but they constructed a wastewater treatment facility for the purpose. The wastewater from the Public Market is treated in the treatment facility constructed by the LGUImpact assessment on the threat to public health and safety

Construction phase

<u>*Threat to public health and safety*</u>

Increased risk of communicable diseases and burden on local health services. Health is considerably linked to the conditions and environment in which people are born, live and work. Migration, social structures and economic policies are other social determinants of health. The presence of infectious diseases in migrants causes concern for cities/municipalities, which in some cases have opted to screen for them, leading to debates on the human rights of migrants. While the “healthy migrant effect” may be applicable in cases where migrants are generally healthier than the population, migrants with pre-existing health conditions can strain cities’/ municipalities’ healthcare systems. Due to the current pandemic with COVID-19, more stringent healthcare protocols are required for migrants.

In addition, the influx of people may bring communicable diseases to the area, including sexually transmitted diseases (STDs), or the incoming workers may be exposed to diseases to which they have low resistance. This can result in an additional burden on local health resources. Workers with health concerns relating to substance abuse, mental issues or STDs may not wish to visit the project’s medical facility and instead go anonymously to local medical providers, thereby placing further stress on local resources. Local health and rescue facilities may also be overwhelmed and/or ill-equipped to address the industrial accidents that can occur in a large construction site.

Weather-sensitive diseases and impact aggravation as a result of climate change as projected by PAGASA. One of the most vital sectors that is severely affected by climate change is the human health. Increases in temperatures and rain could trigger a number of adverse impacts; in particular, the outbreak and spread of water-based and vector-borne diseases leading to higher morbidity and mortality; increased incidence of pulmonary illnesses among young children and cardiovascular diseases among the elderly. In addition, there could also be increased health risk from poor air quality especially in urbanized areas.

Vector-borne diseases which include malaria, diarrhea, and infections associated with undernutrition – are most serious in children living in poverty. Due to fluctuations in the weather, the food supply will be affected which may cause the increase in malnutrition.

Floods, droughts and contaminated water raise disease risk. Higher temperatures are hastening rates of evaporation of surface waters and melting the glaciers that provide fresh water for many populations. Lack of fresh water compromises hygiene, thus increasing rates of diarrheal disease.

Extreme air temperatures and air pollution are hazardous to health. Heatwaves are a direct contributor to deaths from cardiovascular and respiratory diseases, particularly among elderly people. High temperatures can also raise the levels of ozone and other air pollutants that exacerbate cardiovascular and respiratory diseases, as well as pollen and other aeroallergens that trigger asthma (WHO, 2009).

Environmental Health and Sanitation. The link between drinking water and sanitation is critical because human waste is a major source of water contamination. Migration can greatly exacerbate the challenges of managing sewage in a city/municipality given the growth of the population, but the city/municipality cannot always meet the demand due to insufficient capacity. This aggravates health problems associated with spreading communicable diseases, which can further worsen with the lack of sanitation facilities.

3.4.5.6 Generation of local benefits from the project

3.4.5.6.1 Local economy

Cagayan de Oro City
The economy of Cagayan de Oro is largely based on industry, commerce, trade, service and tourism. The city's development has led to a rising demand for safe and affordable housing for its growing population. New investments in 2017 reported by the City Finance Department grew at 136.7% with total capitalization at PHP 3.906 billion, consisting of more than 4,000 businesses that are either registered with the Department of Trade and Industry (DTI) or Securities and Exchange Commission (SEC) and those without trade name. Meanwhile, despite growth of renewed business licensees in 2017, their Gross Sales posted negative growth at -8.2%.
Meanwhile, construction boom in the city surged to new heights in 2017 driven mainly by construction of hotels, condominium, housing units and commercial and hospital buildings. However, the single largest investment reported was the Bulk Water Project of Metro Pacific Investments at PHP 2.8 billion.

Based on the report on investments registered with and/or monitored by the Department of Trade and Industry (DTI) provincial office in 2017 posted an overall growth of 2.14% against the 2016 recorded investments. Major investments in 2017 was recorded at PHP 4.468 billion under the Infrastructure and Services Sector category and at PHP 2.267 billion under Real Property/Real Estate/Real Estate Development Sector, as categorized by DTI.

In 2017, the annual revenue receipts reported by the Treasurer's Office posted an increase of 15% over 2016 receipts. By source, local tax (e.g., Real Property Tax, Business Tax) and nontax (e.g., Permits, Licenses, etc.) receipts grew by 9% versus the 2016 receipts while receipts from external sources, which includes the Internal Revenue Allotment (IRA) of the city, posts a growth of 20% compared to the external receipts reported for 2016 (**Table 3-335**). Meanwhile, receipts from the city's economic enterprises decline by -24.7%, based on the City Accounting Office report for 2017.

Table 3-335. Annual revenue of Cagayan de Oro City (2016 - 2017)

Sources	2016	2017	% Change
Local sources	1,604,215	1,748,644	9%
Tax revenue	1,197,270	1,450,461	21%
Real property tax	280,558	542,425	93%

Sources	2016	2017	% Change
Business tax	843,046	820,253	(3%)
Other taxes	73,666	87,783	19%
Non-tax revenue	406,945	298,183	(27%)
Permits and licenses	88,867	107,520	21%
Service income	80,518	91,968	14%
Economic enterprise	236,735	97,605	(59%)
Other receipts	825	1,090	32%
External sources	1,605,022	1,926,483	20%
Internal revenue allotment	1,223,554	1,408,088	15%
Other shares from National Tax Collection	72,008	127,606	77%
Extraordinary receipts, grants, donations, aid	309,460	390,789	26%
Total	**3,209,237**	**3,675,127**	**15%**

Note: In thousand pesos; Source: City Mayor's Annual Report, 2018

In terms of the city's annual share out of the proceeds from national internal revenue taxes for 2017, the city received a total share of PHP 1.408 billion in IRA, which constitutes 46.6% of the city's total income in 2017. The 2017 IRA is 15.1% higher than the 2016 IRA.

Meanwhile, analysis of the report by the Bureau of Local Government Finance (BLGF) of the Department of Finance (DOF), as posted in its website, shows that the IRA dependency of the city for the period 2013 to 2016 grows at an average of 0.6% annually.

Malaybalay City, Bukidnon

Malaybalay City is mainly an agricultural area, and its products include rice, corn, sugarcane, vegetables, legumes, root crops and commercial crops such as rubber, coffee, banana and pineapple. During the past years, corn used to be the pre-dominant crop in the city, but corn areas gave way to sugarcane, agri-farms (poultry, hog), and residential areas. Sugarcane (306,600 metric tons) and rice (30,318 MT) came out now as the predominant crops in terms of production volume. These products are usually sold in the local market, or in nearby municipalities of the province. There are also farmers producing larger volume of corn and rice who sell their products in Cagayan de Oro.

Agri-based industries primarily poultry and piggery, now flourish in the Malaybalay. These farms are assisted by big corporations such as San Miguel, Purefoods, Monterey and Swift. Other agri-based industries in the city include Asian Hybrid Philippines (feeds processing), Rubber Tex (rubber shoes manufacturing), and Monastery Farms (peanuts and other preserved foods). Also notable are the 12 cattle ranches that produce an average of 470 heads yearly.

The employment per sector showed that 70% of employment is in the farming/ crop production sector followed by government agencies and commercial/private establishments. Agri industries and service sectors registered only about 1.63% and 5.99% respectively. The lowest is the manufacturing/processing sector at only 0.36 %

Given Malaybalay's scenic natural areas, so far only three spring resorts, five plazas/nature parks have been developed. Other beautiful sites such as natural growth forest, industrial tree plantation sites, mountains, falls, rivers and caves are still to be developed for eco-tourism which can be additional sources of employment/livelihood.

In 2014, the City Agriculture Office generated the total income of Php115, 450.00 coming from the different agriculture-based projects. The amount collected contributed the revenue generation activity of the city.
High dependency rate on the Internal Revenue Allotment (IRA) is one of the major fiscal problems that confront the Local Government Units, and Malaybalay is not an exemption. This observation is based on the actual income of Malaybalay for calendar year 2012 - 2015. The City Government realized an average income

of 847.3 million in the past four years, of which 750 million or 88% comes from IRA and the remaining 12% or 97.2 million are locally sourced.

In line with the efforts of the City Government to boost local income, the local taxes received from local taxpayers in 2015 was P116.5 million, it was only 83.3 million in 2012.The Internal Revenue Allotment (IRA) also soared at 888.9 million for calendar year 2015.As shown in the table below, the gross income of the city reached 1 billion pesos by end of 2015. It appears that the local taxes have grown bigger that IRA over the past 4 years. The average growth rate of local taxes, while IRA has 115 growths.

One of the sources of local income comes from Business Tax collection. For the year 2012, the amount collected was P27, 045,157.27 and by year 2015 it rose to 36,304,496.45 (refer to Table 32 below). In the span of four years the business taxes registered an average annual growth rate of 11%. This is the rate uses to project the income from business taxes from 2016 until 2020 (**Table 3-336**).

Table 3-336. Annual revenue of Malaybalay City (2012 - 2015)

Revenue source	2012	2013	2014	2015	% Change
Business taxes					
Tax on business	21,989,339.92	20,169,101.33	28,440,371	29,121,094	12%
Other taxes	-		5,205,385	7,183,403	38%
Other permit & licenses	5,055,817.35	6,519,255.92	-	-	-36%
Printing & publication	-		-	-	-
Sub-Total	**27,045,157.27**	**26,688,357.25**	**33,645,756.00**	**36,304,496.45**	**11%**
Fees and charges					
other taxes	2,911,606.14	4,151,424.85	-	-	-19%
Fees & charges	3,270,095.50	3,438,074.71	8,202,015	8,281,589	48%
Service/user charges	1,299,717.90	746,486.91	3,037,737	3,842,730	97%
Other receipts	2,220,966.27	3,418,973.65	242,043	872,286	74%
Share from lotto	1,631,631.32	1,737,215.56	980,634	1,877,367	18%
Interest income	-	-	4,485,540	4,833,241	8%
Miscellaneous sale	-	-	-	-	-
Sub-Total	**11,334,017.13**	**13,492,175.68**	**16,947,969.00**	**19,707,214.22**	**20%**
Economic enterprise					
Income from Cemetery	246,000.00	225,100.00	356,990	422,700.00	23%
Market Operations	9,179,561.90	9,720,121.46	9,554,599	9,425,683.26	1%
S/H Operations	758,785.39	782,246.63	760,799	740,186.47	-1%
Toll & Terminal Fees	2,624,470.00	2,740,915.00	2,678,956	-	-33%
Water Works	8,017,549.43	9,268,820.40	9,791,972	10,939,627.91	11%
Other Economic Enterprises	-	-	-	3,075,329.50	-
Sub-Total	**20,826,366.72**	**22,737,203.49**	**23,143,316.00**	**24,603,527.14**	**6%**
Real property tax collection					
Current Year	18,607,139.42	19,235,771.78	21,303,421	27,070,936.19	14%
Prior Year	3,719,631.88	4,668,310.74	3,802,078	6,558,019.92	26%
Penalties for CY & PY	1,789,774.90	1,818,414.80	1,885,823	2,277,343.04	9%
Sub-Total	24,116,546.20	25,722,497.32	26,991,322	35,906,299.15	15%
Local income	83,322,087.32	88,640,233.74	100,728,363	116,521,536.96	12%
IRA	644,147,712.00	689,529,984.00	777,687,180	888,964,728.00	11%
Total income	**727,469,799.32**	**778,170,217.74**	**878,415,543**	**1,005,486,264.96**	**11%**

Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

Although the municipal economy is inclining towards urbanization, some barangays are quite rural with its economy still the agriculture sector. Commerce and trade are the highest generator of employment in the municipality. The strategic location of the town encourages some merchants and businessmen from other towns to sell their products. The Industrialization is an economic activity that is advantage for Tagoloan

The Tagoloan Public Market at Poblacion with an area of 5,000 square meters and the immediate commercial areas around it serve as the Central Business District (CBD). There are also strings of commercial establishments such as grocery/convenient stores, fast food chains, pawnshops, pharmacies, lending financial institutions, hardware stores, gasoline refilling stations, water refilling stations, and real estate renting hotel and restaurants. The municipality has its own slaughterhouse which is located at Barangay Sta. Cruz. The municipality's population is engaged in various cottage industries like, furniture making, sand and gravel and hollow blocks making and other concrete products.

Local revenue sources include the Php 229,927,613.97 actual income for the General Fund in 2017 which is 17% higher than the Php 196,503,323.77 generated revenues for 2016. The increase is attributable to the growing industrialization which entails high collection rate of local business tax. Similarly, a consistent growth rate is acclaimed on tertiary school operation under the local economic enterprise which largely contributed to local revenues (**Table 3-337**).

Table 3-337. Annual revenue of Tagoloan

Income by source	2017	Growth rate 2017	2016	2015	Growth rate 2016
Income - general fund					
Tax revenue	67,254,551.84	23%	54,574,286.05	47,453,984.60	15%
Non-tax revenue			17,177,422.38		
Service & bus. income	15,231,515.13	(11%)	0.00	18,695,392.16	8%
Gains	1,000,000.00	100%	206,736.00	0.00	
Other income	0.00	(100%)		1,473,276.12	(86%)
IRA	146,441,547.00	18%	124,544,879.00	113,012,470.00	10%
Total revenue (GF)	**229,927,613.97**	17%	**196,503,323.77**	**180,635,122.88**	8%
Less: expenditures					
1. Personnel services	82,930,742.42	(11%)	93,372,067.70	76,767,686.20	22%
2. MOOE	92,132,007.69	34%	68,436,547.48	84,716,794.78	(19%)
3. Non-cash expenses	7,223,364.11	(15%)	8,514,861.27	0.00	100%
4. Financial expenses	3,808,181.14	4%	2,010,325.36	0.00	100%
Total current operating	**186,094,295.36**	20%	**172,333,801.81**	**167,974,125.98**	(7%)
Surplus/deficit from Current operation	**43,833,318.69**	17%	**24,169,521.96**	**0.00**	
5. ADD/subsidy from	1,699,500.00	20%	0.00	0.00	
6. Subsidy to other Fund	7,336,755.60	111%	6,070,700.24	6,489,645.00	6%
Surplus/deficit	**38,196,063.01**		**18,098,821.72**	**12,660,996.90**	42%
Income-economic enterprise					
Market/slaughterhouse					
Market-Service and bus. income	3,115,724.12	21%	2,572,176.89	2,085,143.64	23%
Slaughterhouse income	600,899.00	7%	562,594.00	462,015.00	21%
Total revenue	**3,716,623.12**	19%	**3,134,770.89**	**2,547,158.64**	23%
Less: expenses		12%	1,094,287.79	1,045,608.92	5%
1. Personnel services	1,229,596.20	24%	1,569,289.48	2,962,453.70	(47%)
2. MOOE	1,948,808.70	25%	10,309.38	1,439.32	62%
3. Non-cash	12,879.73	100%	0.00	70.34	(100%)
4. Financial Expenses	345.81	19%	**2,673,886.65**	**4,009,572.28**	(33%)
Total expenses	**3,191,630.44**	14%	**460,884.24**	**(1,462,413.64)**	132%
Net Income	**524,992.68**				
Add: Subsidy from GF	0.00	(81%)	0.00	1,682,000.45	(100%)
Less: Subsidy to National	24,000.00	48%	124,000.00	24,000.00	72%
Surplus/Deficit	**500,992.68**		**336,884.24**	**195,586.81**	42%
Tagoloan Comm. College					
Actual Income	**58,408,935.33**	6%	**54,658,926.13**	**54,043,597.02**	1%

Income by source	2017	Growth rate 2017	2016	2015	Growth rate 2016
Less: Expenditures				0.00	
P.S.	17,256,134.62	9%	15,785,913.68	18,322,803.81	(13%)
MOOE	30,964,927.19	(13%)	35,692,399.85	18,373,402.85	94%
Financial Expenses	19,533.28	(25%)	254,962.19	1,859,642.66	(86%)
Non-cash	21,023,485.32	18%	1,094,194.53	8,186,543.68	(87%)
Total Expenses	**49,264,080.42**	(6%)	**52,827,470.25**	**46,742,393.00**	13%
Surplus	**9,144,854.91**	399%	**1,831,455.88**	**7,301,204.02**	(75%)
Less: subsidy	888,000.00	5%	884,000.00	7,344,790.00	(88%)
Net Income	**8,256,854.91**	771%	**947,455.88**	**(43,585.98)**	23%
St. Paul Hospital (first yr)					
Service & Business Income					
Less: Expenditures	**6,819,672.00**				
P.S.	8,738,525.43				
MOOE	5,173,322.17				
Non-cash expenses	244,580.00				
Total Expenses	**14,156,427.60**				
Net Income/deficit	**(7,336,755.60)**				
SEF					
Personnel Services	0.00	(100%)	2,142,410.34	2,716,371.07	(21%)
MOOE	4,178,808.62	23%	3,380,521.07	6,459.740.11	(47%)
Non-cash Expenses	102,297.70	(84%)	679,444.36	0.00	100%
Total expenses	**4,281,106.32**	(30%)	**6,202,375.77**	**9,176,111.18**	(32%)
Surplus	**3,760,539.08**	(105%)	**1,832,953.83**	**107,554.72**	604%

Source: Tagoloan CLUP, 2017-2027

Manolo Fortich, Bukidnon

Being an agricultural municipality, farmers and/or farm laborers particularly in corn plantation is the predominant type of employment. The topmost major crops in Manolo Fortich are corn, pineapple and cassava. Vast areas for pineapple plantation are owned mainly by DMPI and only small portions of areas in certain barangays are planted with pineapple by local farmers.

Major firms operating in Manolo Fortich are into production or processing of agricultural products such as pineapple, corn, cut flowers, coffee, rice and livestock. The major investment of REBISCO, a biscuit factory is also instrumental towards the thrust to generate employment in the municipality. Farming is the main income source of 50% of the households while those employed account for 38% only. Those engaged in business is 8% and about 4% depend on retirement or remittances.

As far as revenue generation is concerned, cost to collect revenues have declined from 29% down to 10.77%. Local revenue collection efforts are seen in the figure below wherein the municipality have decreasing IRA dependency rates (or its dependency from external sources) have dropped dramatically from 70.97% in 2010, 69% in 2011 and 65% in 2012. There is an increasing trend for local- sourced revenue per capita which significantly describes locally- sourced revenue per person.

Personal expenditure ratio has not exceeded the ceiling mandated by the Local Government Code of 1991. In a per capita basis, the municipal government have not met the desired/ exceptional ratings for total expenditure per capita, wherein Manolo Fortich only spent P1556.39 per person in 2010, P1,618.00 per person in 2011 and P1,409 per person in 2012. The proportion of actual debt service costs against total regular income was always in accordance to LG Code of 1991 since it has not exceeded the debt servicing limitation which is 20% of its total regular income.

Table 3-338 show the 4-year comparative income and expenses of the LGU. A consistent increase from 2009 to 2011 of 6% and 8%. However, in 2012, the IRA was reduced by about 3% over that of 2011. In 2011, the LGU has a total revenue of P176,275,318.94, wherein P121,327,560.00 or 69% came from the IRA. Only 31%

of the total revenue represents the locally sourced income. This means that the IRA dependency of the LGU is 69%.

In 2012, the LGU has a total local income of P57, 507,429.50 under the General Fund. While in 2011, the total local income is P54, 947,758.94. There is an increase of P2, 559,670.56 or 5% of local income from 2011 to 2012. On the other hand, expenditures for Personal Services and Maintenance and Other Operating Expenses are also increasing from 2009 to 2012. This was attributed to the increase of the salaries of the employees under the Salary Standardization Law and also increased in the cost of supplies and materials and services.

Table 3-338. Manolo Fortich revenues (2006 - 2012)

Income	2009	2010	2011	2012
Local Taxes	17,046,782.98	19,464,966.58	22,176,686.43	19,249,226.06
Permits and Licenses	2,856,973.07	2,764,988.37	2,887,749.83	4,261,533.51
Services Income	2,001,070.96	2,039,077.07	2,290,460.12	2,505,042.62
Business Income	19,782,916.01	25,195,448.64	25,352,263.46	28,431,312.01
Other Income	26,314,811.88	1,047,727.53	2,240,599.10	3,060,315
IRA	105,651,788.20	112,134,547.20	121,327,560.00	117,857,304.00
Total Income	173,654,343.10	162,646,755.39	176,275,318.94	175,364,733.50
Less: EXPENSES				
Personal Services	54,054,054.78	57,773,580.34	74,033,502.34	78,269,652.25
MOOE	62,188,847.14	66,675,735.75	71,886,075.38	55,313,024.57
Financial Expenses	5,300,422.26	4,879,257.84	3,541,356.04	2,756,717.33
Total Expenses	121,543,324.18	129,328,573.93	149,460,933.76	133,582,676.82
Net Operating Income	52,111,018.92	33,318,181.46	26,814,385.18	39,025,339.35
Add: Subsidies	0	0	0	0
Subsidies to Other LGUs/GOCC	13,487,833.01	12,096,257.80	18,254,779.47	9,169,755.31
Net Income before extraordinary Items	38,374,395.85	21,221,923.66	8,559,605.71	29,855.584.04
Net income	38,374,395.85	21,221,923.66	8,559,605.71	29,855,584.04

Source: Manolo Fortich CLUP 2013-2022

Sumilao, Bukidnon

Sumilao is strategically situated between two cities of Cagayan de Oro and Malaybalay. The growth of commerce and trade is slowly transformed into a society of business organization, although mostly micro. Sumilao is an agricultural and industrial developing municipality. More than 85% of its population is dependent on agriculture while the rest are on commercial activities.

Sumilao is basically an agriculture-based community where most of the populace are dependent on agriculture as its main economic activity and as source of main income. Ordinary farmers are planting rice, corn and vegetables both traditional and high value crops while the large corporations, the DOLE Philippines-Skyland Division and the De Monte Philippines, Inc. are engaged in planting commercial crops of sweet lakatan banana and pineapple. There is also an influx of agro-industrial establishment in the area, the piggery and breeder farms but required a minimal employment only. The municipality boost of its natural and man-made attractions which when developed can be a source of income for the populace. Small cottage industries like broom making made of guiyong, ceramics and pot made of clay and hollow blocks making are gaining headway in the area.

Impasug-ong, Bukidnon

The economy of Impasug-ong is intensified through the development of its natural resources. Hydro-electric power projects are present such as the Panoon Mini-Hydro Power Project managed by the Urbiztondo-

Pelonio Associates Company (UPAC). The National Greening Program of the Department of the Environment and Natural Resources (DENR) is also a significant component in the economic growth of Impasug-ong. 19 partner organizations were funded for the rehabilitation and protection of forests/watershed and for the development of marginal lands to production areas. This is to provide the upland and lowland households with low income to have an alternative livelihood, thus alleviating poverty.

There are also manufacturing, and processing plants established in the municipality. Skilled workers and laborers are hired locally by these companies. These companies include the Feed Mill at Barangay Impalutao; Veneer/Plywood at Poblacion; Oil Palm Mill at Poblacion; DOLE Organic Fertilizer Plant and Banana Plantations; and, the Pineapple Plantations of Del Monte Philippines, Incorporated.

Agriculture has become the economic backbone of the Municipality. Most of its farmers are into the production of corn, rice, coffee, abaca, rubber, oil palm, high value commercial crops and livestock serving as their sources of income.

The Municipality is also a tourist destination with its natural endowments. Although tourism in Impasugong is not yet full-blown to generate income, however, this is being developed by the LGU.

For 2017, there is a significant decrease in the non-office expenditures classified under Special Purpose Appropriations per COA Circular no. 2015-009, the implementation of Philippine Public Sector Accounting System (PPAS) of which appropriations in the budget shall reconcile with COA for uniformity of implementation.

The local government is highly dependent on Internal Revenue Allotment (IRA) Share by 90.28%. Below is a table showing an actual 6-year comparative income and expenses of the LGU. The table below shows that Internal Revenue Allotment is the major source of income of the LGU.

Table 3-339. Resources utilization of Impasug-ong (2014 - 2019)

Source	2014	2015	2016	2017	2018	2019
Revenue						
Local income					-	-
Local taxes	8,253,610.61	8,960,585.96	9,689,885.07	9,500,000.00	10,450,000.00	11,495,000.00
Permit fees and licenses	691,859.90	-	-	-	-	-
Service income	946,087.11	3,481,226.99	1,833,796.50	1,660,000.00	1,826,000.00	2,008,600.00
Business income	7,934,983.10	6,740,038.10	6,506,522.75	6,040,000.00	6,644,000.00	7,308,400.00
Other income	2,452,144.10	1,338,315.78	1,145,468.08	400,000.00	440,000.00	484,000.00
Total local income	20,278,684.82	20,520,166.83	19,175,672.40	17,600,000.00	19,360,000.00	21,296,000.00
IRA	166,491,105.00	190,203,433.00	209,527,081.00	238,801,634.00	262,681,797.40	288,949,977.14
Total revenues	**186,769,789.82**	**210,723,599.83**	**228,702,753.40**	**256,401,634.00**	**282,041,797.40**	**310,245,977.14**
Allocation						
PS	47,910,522.18	48,171,466.56	53,638,363.95	81,098,851.00	89,208,736.10	98,129,609.71
MOOE	12,209,874.59	15,703,190.36	15,287,065.26	104,098,686.00	114,508,554.60	125,959,410.06
CO	550,640.00	1,528,140.00	504,500.00	4,710,688.00	5,181,756.80	5,699,932.48
20%DF	8,164,656.10	9,613,333.50	7,993,163.69	47,760,327.00	52,536,359.70	57,789,995.67
5% LDRRMF	1,924,214.59	4,581,909.50	7,160,244.50	12,820,082.00	14,102,090.20	15,512,299.22
Aid to barangay		13,000.00		13,000.00	13,000.00	13,000.00
Non office	71,804,053.98	74,642,938.79	78,483,225.93			
Infrastructure	2,983,009.21	6,218,456.24	350,575.00	5,900,000.00	6,490,000.00	7,139,000.00
Total (a)	**145,546,970.65**	**160,472,434.9**	**163,417,138.3**	**256,401,634.00**	**282,040,497.40**	**310,243,247.1**

Source	2014	2015	2016	2017	2018	2019
		5	**3**			**4**

Source: Impasug-ong CLUP 2019-2028; (a) allocation

3.4.5.6.2 Employment rate/ profile

Cagayan de Oro City

The average labor force participation rate for both sexes comprised 69.8 percent (81.7 male and 57.7 female) as of 2010 for ages 15 years old and up; lower than that of 2007 which is 70.9 percent (based on NSO Regional Survey) (**Table 3-340**). The decreasing number of labor force indicates that there are more members of the household who are not in the labor force.

Table 3-340. Labor force population of Cagayan de Oro City (2010)

Age group	Both Sexes	Percent age	Male	Percent age	Female	Percent age
15-19	70,220	18.14	34,982	9.03	35,239	9.1
20-24	62,407	16.12	31,089	8.03	31,318	8.09
25-29	54,197	14	26,999	6.97	27,198	7.02
30-34	44,243	11.43	22,041	5.69	22,203	5.73
35-39	39,690	10.25	19,772	5.11	19,918	5.14
40-44	33,795	8.73	16,836	4.35	16,959	4.38
45-49	29,968	7.74	14,929	3.86	15,039	3.88
50-54	24,863	6.42	12,386	3.2	12,477	3.22
55-59	17,517	4.52	8,726	2.25	8,791	2.27
60-64	10,280	2.65	5,121	1.32	5,159	1.33
Total	**387,180**	**100**	**192,882**	**49.82**	**194,299**	**50.18**

Source: Cagayan de Oro City CLUP 2013-2022

Malaybalay City, Bukidnon

The employment rate of the city is quite high at 95%. As to nature of employment, based on the 2013 MISS results, about 33% of those employed have permanent status, 46% are seasonal or temporarily employed, and 22% are employed on demand basis (daily, weekly, or monthly). As to type of employment, 53% are wage and salary earners; 32% are self-employed and about 15% have their own farms (**Table 3-341**).

Table 3-341. Nature and type of employment in Malaybalay City

Total Population of labor force	99,984	
Population of 15-64 years old in the Labor Force	58,281	58.30% (to total 15-64 years old population)
Employed Population (15-64 years old)	55,442	95% (To total Employed Population)
Nature & type of employment	**Population**	**Percentage to employed population**
Nature of Employment		
Permanent	18,069	32.6%
Seasonal/Temporary	25,305	45.6%
Daily/Weekly	12,068	21.8%
Type of Employment		
Salary/Wage Earners	9,643	17.4%
Self-employed (small enterprises)	8,032	14.5%
Farmers	9,394	16.9%

Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

Household population in Tagoloan was estimated at 73,150 in 2015. Overall, 63.03 percent of the total population in 2015 were in their economically productive years (15 to 64 years old). The age-dependency ratio in 2015 was estimated at 58 per hundred working persons. This implies that 100 working individuals would have to support 58 more persons aside from themselves. The dependency burden falls on the working group and the dependents comprising almost 37 percent of the total population.

Table 3-342. Household population composition by work force dependent in Tagoloan (2015)

Classification	Total	Male		Female		Ratio
		Number	Percent	Number	Percent	
Working-age (15-64)	46,110	23,729	51.46	22,381	48.54	106
Labor force (15 & over)	48,613	24,849	51.12	23,764	48.88	105
Dependent (0-14 and 65 & over)	26,868	13,654	50.82	13,214	49.18	103
Young dependent (0-14)	24,365	12,534	51.44	11,831	48.56	106
Old dependent (65 and over)	2,503	1,120	44.75	1,383	55.25	81

Source: Tagoloan CLUP 2017-2027

Manolo Fortich, Bukidnon

Table 3-343 shows that 48% of the total household population belonged to working-age population (15 to 64 years). Young dependents (0 to 14 years) and old dependents (65 years and over) posted a share of 52%. Manolo Fortich had an overall dependency ratio of 52 in 2010. This means that there were 52 dependents for every 100 working-age population.

From this total of 40,277, 68% are in the labor force. It is estimated that 91.22% are economically active and 8.78 % are unemployed, thus; disclosing a ratio of 9 unemployed persons for every 100 employed persons. Using the 2.06% annual growth rate of population, labor force population increased by 10.17%.

Table 3-343. Labor force population of Manolo Fortich

Year	Population (15 years old and above)			In the labor force						Not in the labor force		
				Employed			Unemployed					
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
2010	59,270	30,512	28,758	37,026	19,061	17,965	3,251	1,674	1,577	31,756	16,348	15,408
2011	60,491	31,141	29,350	37,789	19,454	18,335	3,318	1,708	1,610	32,410	16,685	15,725
2012	61,737	31,782	29,955	38,567	19,854	18,713	3,386	1,743	1,643	33,078	17,029	16,049
2013	64,307	33,105	31,202	40,173	20,681	19,492	3,527	1,816	1,711	32,461	16,711	15,750
2014	64,307	33,105	31,202	40,173	20,681	19,492	3,527	1,816	1,711	34,455	17,737	16,718
2015	65,631	33,787	31,844	41,000	21,107	19,893	3,600	1,853	1,747	35,165	18,103	17,062
2016	66,983	34,483	32,500	41,844	21,542	20,303	3,674	1,891	1,783	35,889	18,476	17,413
2017	68,364	35,194	33,170	42,707	21,985	20,721	3,750	1,930	1,819	36,628	18,856	17,772
2018	69,771	35,918	33,853	43,586	22,438	21,148	3,827	1,970	1,857	37,383	19,245	18,138

Source: Manolo Fortich CLUP 2013-2022

Sumilao, Bukidnon

Based on the 2009 Community-Based Monitoring (CBMS) survey, there are 13,453 people in the locality and 3,654 people belong to the productive age. About 98% percent of the total number of employable age is employed mostly in agriculture. However, most of them have inadequate income.

Impasug-ong, Bukidnon

The labor force population as presented in **Table 3-344**, shows that males ages 15 years old and above consist of 15,342 with 10,828 or 37.80% who are employed while 13,306 females of the same age group is 3,759 or 13.12% are employed.

Table 3-344. Labor force population of Impasug-ong (2015)

Sex	Population 15 years old and over	Employed	Percent	Unemployed	Percent
Male	15,342	10,828	37.80	4,514	15.76
Female	13,306	3,759	13.12	9,547	33.33

Sex	Population 15 years old and over	Employed	Percent	Unemployed	Percent
Total	**28,648**	**14,587**	**50.92**	**14,061**	**49.08**

Source: Impasug-ong CLUP 2019-2028

The productive population or the working age group which is within the 15-64 years old comprises 53.83% of the total count. With the total population as illustrated in the table below, the child and youth age group (0-14 years old) comprise about 18,616 equivalents to 68.11% while the older population (65 years old and above) comprises 4.82% of the population with a total of 46.20%. This composes the total age dependency ratio (**Table 3-345**).

Table 3-345. Work force dependent population in Impasug-ong (2015)

Classification	Total	Male		Female		Ratio
		Number	Percent	Number	Percent	
School going population (4-21)	**19,143**	**9,927**	**51.86**	**9,216**	**48.14**	**109**
Pre-school (5)	1,247	646	51.80	601	48.20	107
Primary (6-11)	7,288	3,742	51.34	3,546	48.66	106
High School (12-17)	6,801	3,515	51.68	3,286	48.32	107
Tertiary (18-21)	3,807	2,024	53.17	1,783	46.83	114
Working-age (15-64)	27,331	14,703	53.80	12,628	46.20	116
Labor Force (15 and over)	28,648	15,342	53.55	13,306	46.45	115
Dependent (0-14 and 65 & over)	**19,933**	**10,149**	**50.92**	**9,784**	**49.08**	**104**
Young Dependent (0-14)	18,616	9,510	51.09	9,106	48.91	104
Old Dependent (65 and over)	1,317	639	48.52	678	51.48	94

Source: Impasug-ong CLUP 2019-2028

3.4.5.6.3 Poverty incidence

Misamis Oriental and Bukidnon

In the Philippines in 2018, the monthly poverty threshold for a family of five is an average income of P10, 481 per month. This amount is enough to cover a single family's basic food and non-food needs. Poverty threshold refers to the minimum income a family or individual must earn in order to be considered “not poor”. Food threshold in 2018 means that a family of five needed no less than P 7,337, on average, to meet the family’s basic food needs for a month.

The 2018 Family Income and Expenditures Survey (FIES), the PSA is able to generate reliable estimates down to Highly Urbanized City. In Cagayan de Oro the poverty level is 6.2% among the total population. In terms of food threshold, 1.1% of the total population belong to such category. Misamis Oriental without Cagayan de Oro City has a subsistence of 2.3% of the total families and a poverty incidence of 11.4% among the population. This includes Tagoloan, Misamis Oriental. Bukidnon registered 5.6% subsistence incidence among families and 22.2% poverty incidence in Malaybalay, Sumilao, Manolo Fortich and Impasug-ong (**Table 3-346**)

Table 3-346. Subsistence and poverty incidence in Misamis Oriental and Bukidnon (2018)

Province/city	Subsistence incidence among families (%)		Poverty incidence among population (%)	
	2015	2018	2015	2018
Cagayan de Oro city		1.1	41.9	31.5
Misamis Oriental (without Cagayan de Oro city)	5.1	2.3	16.5	11.4
Bukidnon	27.0	5.6	47.6	22.3

Source: Philippine Statistics Authority, 2020

Poverty is chronic and endemic in Bukidnon. The incidence of poverty is high because Bukidnon is largely dependent on traditional forms of agriculture where incomes are substantially low. In fact, labor leaders in a 2002 dialogue with government officials estimated that the average farm laborer in Bukidnon was only paid

70 to 80 pesos a day—about US$1.4 at the 2002 average exchange rate of 51.6 pesos per dollar (Mordeno 2002). In addition, the seasonal nature of most of Bukidnon's farm work leaves much of the labor force without secure employment for a substantial part of the year.

Cagayan de Oro City, Misamis Oriental

Based on 2009 NSO Regional survey on family income and expenditures, the average regional family income for 2009 increased to P165, 000 from P142, 000 in 2006. The total number of families was recorded at 839,000 in 2009 and 789,000 in 2006. This 50,000-rising number of families from 2009 to 2006 indicates the increasing number of populations in this time span.

Based on 2003 Small Area Poverty Estimates of the National Statistical Coordination Board (NSCB), Cagayan de Oro City posted the least in poverty incidence in Northern Mindanao. The city had a poverty incidence of 15.50% which implies that 15.50 % of the City's population has an income below the poverty line for 2003. In 2018, PSA Family Income and Expenditures Survey (FIES) showed that Cagayan de Oro's poverty incidence decreased from 41.9% to 31.5%. The subsistence incidence among families in Cagayan de Oro is recorded at 1.1% in 2018.

Malaybalay City, Bukidnon

Based on the 2013 Malaybalay Integrated Survey System (MISS) results, with 35,055 households surveyed, there are 17,413 households or 50% which have income below food threshold and 22,019 households or 63% which have income below the poverty threshold.

Also shown in **Table 3-347** the magnitude of subsistence and poor families in the city using the 2011 MISS survey results and using the 2009 food and poverty thresholds of PhP 11,365 and PhP 16,297 respectively. Comparing the 2011 and 2013 figures, it appears that the magnitude of subsistence households has increased by 1,074. However, the percentage to total number of households decreased by 1% (from 51% to 50%). The magnitude of poor households has increased by 1,603, but its percentage to total remained the same at 63%. The Province of Bukidnon is considered among the top ten in the country with high incidence of poverty, and its 2012 poverty incidence is 41.5%, which is lower than the city (63%).

Table 3-347. Comparative magnitude of poverty in Malaybalay

Indicators	2011 MISS survey	2013 MISS survey
Provincial Food Threshold (2009, 2012)	11,365	14,062
Provincial Poverty Threshold (2009, 2012)	16,297	20,115
Surveyed Households	32,193	35,055
Magnitude of Subsistence Households	16,339	17,413
Percentage of Subsistence Households	51%	50%
Magnitude of Poor Households	20,416	22,019
Percentage of Poor Households	63%	63%
Magnitude of Poor Households above Subsistence	4,077	4,606
Percentage of Poor Households above Subsistence	13%	13%

NOTE: MISS - Malaybalay Integrated Survey System; Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

Among the population in Tagoloan, 41.9% of all the households or 27,019 population live below the poverty line. The highest proportion of households who fall below the poverty line is noted in barangay Rosario (80.1%) which the source of income is farming and furthest barangay to the urban center, followed by Baluarte (51.3%) which some household income relies on fishing. The barangays with more than forty percent of its households falling below the poverty line are Sugbongcogon (40.3%), Sta. Cruz (41.7%), Casinglot (42.4%), Sta. Ana (42.6%), and Natumolan (45.8%) (**Table 3-348**).

Table 3-348. Households in Tagoloan with income below the poverty threshold (2016)

Barangay	No. of HHs	HHs with income below poverty threshold	
		Magnitude	Proportion
Baluarte	1,646	844	51.3
Casinglot	1,987	843	42.4
Gracia	418	155	37.1
Mohon	987	323	32.7
Natumolan	1,443	661	45.8
Poblacion	1,697	522	30.8
Santa Ana	1,615	688	42.6
Santa Cruz	2,544	1,060	41.7
Sugbongcogon	658	265	40.3
Rosario	216	173	80.1
Total	**13,211**	**5,534**	**41.9**

Note: HHs – households; Source: CBMS Census 2012, Tagoloan CLUP 2017-2027

Manolo Fortich, Bukidnon

The poverty incidence in Manolo Fortich in 2015 is 49.93%. This means that 19, 903 households are living below the poverty line. Of this, 9, 938 households are living below the food threshold.

Poverty incidence in Manolo Fortich is at its highest in barangays Santiago, Guilang-guilang and Minsuro which are also exposed to higher risk for landslide, flood and earthquake along with Maluko, Agusan Canyon and Dalirig.

Sumilao, Bukidnon

The poverty incidence in Sumilao in 2005 is 43% and a poverty gap of 13%. The severity of the poverty in the municipality is at 5%. Sumilao is basically an agriculture-based community where most of the people are dependent on agriculture as its main economic activity and as source of main income. Ordinary farmers are planting rice, corn and vegetables both traditional and high value crops while the large corporations, the DOLE Philippines-Skyland Division and the De Monte Philippines, Inc. are engaged in planting commercial crops of sweet lakatan variety banana and pineapple. There is also an influx of agro-industrial establishment in the area, the piggery and breeder farms but required a minimal employment only. The municipality boasts of its natural and man-made attractions which when developed can be a source of income for the populace. Small cottage industries like broom making made of guiyong, ceramics and pot made of clay and hollow blocks making are gaining headway in the area.

Impasug-ong, Bukidnon

The poverty incidence in Impasug-ong in 2015 is 54.31% with a poverty gap of 17.56%. The severity of the poverty in the municipality is 1.75%. Impasug-ong is home to 67.42% Higaonon. They are distributed in the various barangays of the municipality. The table below shows the IP population and their poverty incidence and the number of households in poverty.

It can be seen that the total poverty incidence of the IP community in Impasug-ong is 63.28% which is higher than the municipality's poverty incidence of 54.31%. The barangay with the highest poverty incidence is Kibenton with 83.3% and 857 households living in poverty.

Table 3-349. IP population and poverty incidence in Impasug-ong

Barangay	Population 2007	IP population	% of Total	Population 2011	IP population	Poverty incidence	No. of HH
Bontongon	837.00	835.00	99.76	876	874	82.1	162
Bulonay	1,377.00	905.00	5.72	1,515	996	80.4	276
Capitan Bayong	2,172.00	1,387.00	63.86	2,560	1,635	47.3	530

Cawayan	1,446.00	686.00	47.44	1,918	910	61.2	412
Dumalaguing	2,626.00	2,592.00	98.71	2,756	2,720	32.5	543
Guihean	1,590.00	1,138.00	71.57	1,880	1,346	57.9	356
Hagpa	2,849.00	1,251.00	43.91	1,658	1,167	68.2	537
Impalutao	4,239.00	2,911.00	68.67	1,484	3,766	66.3	1,145
Kalabugao	4,974.00	2,831.00	56.92	5,412	3,080	64.1	1,099
Kibenton	3,311.00	2,521.00	76.14	4,072	3,100	83.3	857
La Fortuna	3,129.00	2,224.00	71.08	3,835	2,726	48.1	801
Poblacion	6,502.00	4,709.00	72.42	10,061	7,287	61.4	2,180
Sayawan	1,230.00	471.00	38.29	1,272	487	69.8	265
Total	**36,282.00**	**24,461.00**	**7.42**	**44,299**	**9,866**	**63.28**	**9,162**

Note: HH – House hold, IP – Indigenouse people; Source: Impasug-ong CLUP 2019-2028

3.4.5.6.4 Sources of livelihood

Cagayan de Oro City

Residents and those working in the city mostly work in the industrial, agri-industrial and commercial sectors. Cagayan de Oro is mainly industrial with manufacturing, processing, bottling, fabrication, and assembling categories. This also includes small-scale industries like repair shops, food processing and handicraft factories. Mostly, these activities are concentrated along the National Highway. The existing industrial area of the city is 175.58 hectares. The increasing number of industries is attributed to the expansion of the industrial area.

Agricultural areas are located mostly in the rural areas. These areas are located in Barangays Lumbia, Canitoan, Iponan, Bayabas, Bulua and Pagatpat. Existing agro-industrial areas in the city are situated along the strip of Sayre Highway in Upper Puerto and include feed mills, post-harvest and warehousing facilities. This area, abutting the province of Bukidnon caters to its large volume of agricultural production.

Commercial establishments include offices, services, supermarkets, and shopping centers. Regional offices and financial establishments concentrated in the Poblacion (CBD) create pressure in the area. Large-scale shopping centers (such as the Limketkai Mall, Gaisano, Ororama, and Centrio) are also within the CBD. Small-scale operations (like hardware, store and services) are located in all parts of urban area, as well as in dominantly residential areas.

Malaybalay City, Bukidnon

Most of the residents and working population in Malaybalay are mainly employed in farming/ crop production sector followed by government agencies and commercial/private establishments. Agri industries and service sectors registered only about 1.63% and 5.99%, respectively. The lowest is the manufacturing/processing sector at only 0.36 %

For the agricultural sector, its products include rice, corn, sugarcane, vegetables, legumes, root crops, high value crops and commercial crops. Commercial crops are composed of rubber, coffee, banana and pineapple. There are 70 commercial poultry and piggery farms operating in the city. In addition, commercial establishments have proliferated in the past several years.

However, pineapple and banana plantations are now increasing in the outskirts of the city proper. This aggressive expansion even to prime agricultural areas could pose a danger to the local food security. The industrial activities of these companies may pose a problem to the community in the form of flooding and landslides.

Tagoloan, Misamis Oriental

Tagoloan has industrial and agricultural establishments were most of its resident's work. PHIVIDEC industrial economic zone provides employment to residents in Tagoloan. There are also 38 establishments of registered (Phividec-Industrial Estate Misamis Oriental-Special Economic Zone PIEMO-SEZ) manufacturing/processing firms. These industries are distributed in the eight barangays of Tagoloan. Aside from service-oriented firms, there are also fuel and chemical depots in the municipality.

The commercial sector has also increased in the municipality. There are 315 establishments under the wholesale and retail trade/repair of motor vehicles, motorcycles, personal and household goods as well as hotels and restaurants.

Agriculture plays a major role in Tagoloan's economy, especially towards supporting agri-industrialization. The major agricultural crops in the area are corn, cassava, upland rice, banana, papaya, vegetables, mango, and coconut.
Tagoloan household heads occupation by barangay records show that most head of household come from hired labor where barangay Sta. Cruz has the top most number of household heads as hired laborer, followed by Employed in Private where barangay Casinglot, Poblacion Sta. Cruz, and Natumolan have almost equal number of household head occupation, self-employed/business where barangay Sta. Cruz have the highest household head occupation followed by barangay Baluarte and the rest barangays, then employed in government and private agency followed by farming, Employed in government, fishing, overseas contract worker and lastly the practice on law and medicine and dentistry.

Sumilao, Bukidnon

Most of the people in Sumilao are working in the agriculture sector. Sumilao is an agriculture-based municipality endowed with vast agricultural resources and typical climate for crop and livestock production. More than 85% of its population is dependent on agriculture while the rest are on commercial activities.

There are also multi-national corporations dealing with plantation crops and livestock production. Other residents also work in financial, commercial and small-scale business along Sayre Highway.

Manolo Fortich, Bukidnon

Manolo Fortich is primarily an agricultural area. Farming and working in corn plantations are the predominant type of employment. Some major firms are also located in the municipality which are into processing agricultural products such as pineapple, corn, cut flowers, coffee, rice and livestock. REBISCO, a biscuit factory is also a source of livelihood in the municipality.

Farming is the main income source of 50% of the households while those employed account for 38% only. Others are engaged in business with 8% and 4% depend on retirement or remittances. Other residents are employed by the LGU.

Impasug-ong, Bukidnon

Impasug-ong is an agriculture – based municipality. Ninety percent of the total populace are actual farm tillers, 50% are agricultural farm workers and laborers who are either employed in the multi-national corporations or on poultry farms or breeder farms. For 50 years, the total area utilized for agricultural production has increased to more or less to 20%.

For all the business transactions within the municipality, it generated a total revenue of 7,275,093.75. The whole sale trade and retail contributes the largest in revenue.
Impasug-ong relies heavily in the agriculture sector for livelihood of its residents. In addition, there are manufacturing and processing plants in the municipality. These industries play a vital role in the economy of the municipality, hiring local workers in their companies. Impasug-ong also looks into its tourism sector to generate livelihood for the residents.

3.4.5.6.5 Commercial establishments and activities

Cagayan de Oro City, Misamis Oriental

The presence of all types of commercial establishments in the city is a clear indication that trade and commerce is the prime mover of the city's economy. In 2012, there are five malls in the city, at least nine major Central Business Districts, six public markets, nine neighborhood centers, several commercial complexes and commercial strips rationally distributed all over the city. To these, a total of 18,144 registered businesses as of 2010 make up the bustling city of Cagayan de Oro.

Wholesale and retail trade dominate the businesses in the city reaching a 5-digit number in 2010 or 10,227 permits from 8,521 in 2009 and as compared to other applied categories. The community, social and personal service is second in the most applied at 3,274 in 2010, followed by financing, insurance, real estate and business services at 2,376 on same year. On the summary, there is an increasing trend of investors permitted to venture in the city in the last five years (2006-2010) arriving at 18,144 (**Table 3-350**).

Table 3-350. Business permits issued by type in Cagayan de Oro City

Major industry division	2006	2007	2008	2009	2010
Agriculture, fishery and forestry	-	-	156	13	14
Mining and quarrying	1	4	6	4	11
Manufacturing	671	732	345	209	279
Construction	121	130	272	282	266
Wholesale and retail trade	8,771	8,577	8,431	8,521	10,227
Transportation, storage and communication	260	270	300	340	358
Financing, insurance, real estate and business services	1,776	1,890	2,192	2,303	2,376
Community, social and personal services	3,141	3,238	3,068	2,969	3,274
Others N.E.C.	891	951	1,109	1,245	1,339
Total	**15,632**	**15,792**	**15,879**	**15,886**	**18,144**

Source: Cagayan de Oro City CLUP 2013-2022

Malaybalay City, Bukidnon

The economic activities in Malaybalay City have flourished in the last five years. As shown in **Table 3-351**, almost all types of business establishments have increased in numbers from 2006 to 2010. Wholesale/retail is still the highest in terms of numbers although it decreases from 3,144 to 1,748.

Data from the License Department of the City showed that a majority or 95.87% of the establishments in the city belong to the service sector. Looking at the breakdown, sari-sari stores (37%) make up majority of the establishments in this sector, followed by trade/wholesale/retails (21%) and other, social and personal services (14%). Industry sector and agriculture sector only make up only 2.27% and 1.9%, respectively of all establishments.

Table 3-351. Commercial establishments in Malaybalay city

Economic activities	2010	2011	2012	2013	2014
Agri-based	352	396	497	815	768
Food establishments	369	398	346	543	527
Services	532	591	656	923	888
Wholesale/Retail	1,748	2,115	2,067	4,832	4,462
Manufacturing	6	7	7	32	30
Sports and recreation	33	42	44	147	112
Other services	49	55	59	70	64
Communications	76	89	98	114	102
Banking and finance	64	79	68	130	133
Insurance	13	13	19	21	22
Real estate	171	181	208	278	313
Mining and quarrying	4	5	5	6	6
Processing	3	4	4	2	6

Economic activities	2010	2011	2012	2013	2014
Others				125	135
Total	**3,420**	**3,975**	**4,078**	**8,038**	**7,568**

Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

Tagoloan is 19 kilometers from Center of Cagayan de Oro City and it is traversed by a national road connecting the southern towns of the province of Misamis Oriental, the creation and implementation of PHIVIDEC Industrial Authority (PIA) specifically the emergence of several industries. The strategic location of the town encourages some merchants and businessmen from other towns to sell their products. Industrialization is an economic activity that is an advantage for Tagoloan.

The Tagoloan Public Market at Poblacion with an area of 5,000 square meters and the immediate commercial areas around it serve as the Central Business District (CBD). There are also strings of commercial establishments such as Grocery/Convenient stores, fast food chains, pawnshops, pharmacies, lending financial institutions, hardware stores, gasoline refilling stations, water refilling stations, and real estate renting hotel and restaurants. The municipality has its own slaughterhouse which is located at Barangay Sta. Cruz. The municipality's population is engaged in various cottage industries like, Furniture Making, Sand and Gravel and Hollow Blocks Making and other concrete products.

In 2017, Municipality of Tagoloan has 315 establishments under the wholesale and retail trade/repair of motor vehicles, motorcycles, personal and household goods (**Table 3-352**). The nine establishments for hotels and restaurants are located in the business center of the municipality Barangay Poblacion. The 92 establishments comprise transport, storage and communication in Barangays of Casinglot, Sugbongcogon, Natumolan, Baluarte Gracia, Sta. Cruz and Mohon. The 38 financial intermediation business establishments are situated Barangay Poblacion.

The real estate renting & business activities are also concentrated in Barangay Poblacion which is the commercial center in the Municipality, Casinglot, where the International Container Port is located and Baluarte where the only tertiary school in the municipality, the Tagoloan Community College is located. The public administration and defense/compulsory social security are situated within various locations comprising mostly of security agencies. While the education business composed of five private schools are located in different Barangays like Poblacion, Natumolan and Sta. Cruz. Health, the 16 health and social work business mostly comprises the pharmacies and clinics and the 93 business establishments comprising other community, social & personal service activities are located around Tagoloan. All business activities except transport, storage and communication cater market outside the municipality.

Table 3-352. Commercial establishment in Tagoloan (2017)

Type of commercial areas	No. of establishments
Wholesale and retail trade/repair of motor vehicles motorcycles personal and household goods	315
Hotels/restaurants	9
Transport, storage and communication	92
Financial intermediation	38
Real estate renting and business activities	28
Public administration and defense/compulsory social security	7
Education	5
Health & social work	16
Other community, social and personal service activities	93

Source: Tagoloan CLUP 2017-2027

The public market is subsidized by the local government unit since the income derived from the stalls and other fees & charges is not enough to sustain its operation. The LGU through its market administrator is currently looking for ways and means to augment the market income, improve the structural conditions that would be complementary to the imposed stall rentals and eventually eliminate the subsidiary provided by the local government unit.

The municipality economic enterprise comprises the following: public cemetery located in the Barangay Sta. Ana with an approximate land area of 2 hectares, Tagoloan Community College (TCC) located in barangay Baluarte where the only tertiary school and the St. Paul hospital at Poblacion.

Manolo Fortich, Bukidnon

Major firms operating in Manolo Fortich are into production or processing of agricultural products such as pineapple, corn, cut flowers, coffee, rice and livestock. The major investment of REBISCO, a biscuit factory and Del Monte pineapple plantation also generate employment in the municipality. The bulk of investments by sector are paced by infrastructure & services –related from the initiatives of the local government ranging from livelihood programs, schools, electric power, water system and farm-to-market –roads. Canned and fresh fruit pineapple, cut flowers and ornamentals and high valued crops/vegetables are the exported commodities.

Farming is the main income source of 50% of the households while those employed account for 38% only. About 8% are engaged in business while 4% depend on retirement or remittances. Registered and non-registered enterprises classified were mostly micro and cottage enterprises accounting for 94.07% while small enterprises comprised 5.05%.

Based on **Table 3-353**, trading and servicing accounts to 80.99% of the total business activities in Manolo Fortich while 19.01% are into value-adding activities. Retail is the highest type of business, followed by eateries and restaurants.

Table 3-353. Business activities in Manolo Fortich (2012)

Type	Number	Percentage
Trading	25	19.23
Servicing	80	61.53
Manufacturing	6	3.07
Production	19	14.62
Total	**130**	**100.00**

Source: Manolo Fortich CLUP 2013-2022

Sumilao, Bukidnon

Located between two cities of Cagayan de Oro and Malaybalay, Sumilao slowly transformed its economy through mostly micro enterprises. Sumilao is an agricultural and industrial developing municipality. More than 85% of its population is dependent on agriculture while the rest are on commercial activities.

The entry of multi-national corporations dealing with plantation crops and livestock production contributed to rapid increase in population of the place. The existence of financial institutions, commercial establishments and its strategic location being along the Sayre National Highway and as the set of government has categorized barangay Kisolon as the center of trade and industry. Its accessibility and favorable feasibility for more investments would help fare its way towards a well-developed commercial center of the municipality. **Table 3-354** shows the total number of commercial establishments by type present in the municipality.

Table 3-354. Commercial establishments in Sumilao (2009)

Barangay	Type of establishment	Number
Kisolon	Sari-sari store	38
	Tailoring	2
	Meat and Fish Retail	14

Barangay	Type of establishment	Number
	Construction Materials/hardware	5
	Eatery/Carenderia	12
	Gasoline Station	3
	Dry Goods	5
	Motorcycle Spare parts Dealers	4
	Hospital	1
	Agricultural products	4
	Rice and Corn Mill	3
	General Merchandise	4
	Bakery	3
	Billiard Hall	2
	Vulcanizing shop	5
	Drugstore/Pharmacy	3
	Funeral Parlor	2
	Rural Bank	1
	Water Refilling	1
	Photo Center	1
	Cockpit Arena	1
Kulasi	Sari-sari Store	3
Licoan	Sari-sari Store	4
Lupiagan	Sari-sari Store	3
Ocasion	Sari-sari Store	3
Poblacion	Sari-sari Store	24
	General Merchandise	2
	Corn Mill	2
Puntian	Sari-sari Store	5
San Roque	Sari-sari Store	3
San Vicente	Sari-sari Store	8
	Eatery	1
	Agri-business	1
Vista Villa	Sari-sari Store	10
	Rice Mill	2
	Corn Mill	1

Source: Sumilao CLUP 2011-2020

Impasug-ong, Bukidnon

In the urban/urbanizing barangays, there are commercial areas allocated for commercial activities. In Barangay Poblacion, there is a total of 280,000 sq. m. commercial areas. This includes the Public Market, terminal, boarding houses, wholesalers, gasoline stations and funeral parlors, meat shops, bakeries, eateries and many others. In barangay Capitan Bayong, the 20,000 sq. m. allocated for commercial use cater gasoline stations, eatery and other commercial activities.

For the fast five years, there are 6 manufacturers located in the different barangays within the municipality. There are also 2 gasoline stations operating in the municipality, one is located in Purok 9, and the other in Crossing Mt. Kitanglad, both in Poblacion.

In 2018, 148 applied and were granted with business permits for the wholesaler and retailer trade/repair of motor vehicles and household goods. In 2017, there were 11 hotels and restaurants granted with business permit. In 2016, there is only 1 financial intermediator, but it increased to 2 the following year. There are several mining and quarrying in the municipality but in 2017 there were only 2 who possess the business permit and increased to 3 in 2018.

The Municipality has four existing dining facilities namely The Rodeo Drive Grill, Sakuro, Bhog's Restaurant and Catering Services, and Seven Sis Catering Services all located in Barangay Poblacion which caters the needs of the residents of the municipality in terms of dining activities.

There are also two tourist accommodating facilities in the municipality namely the Municipal Tree Park and Communal Ranch which have Cottages & Training Center that could cater Trainings and Seminars.

There are six industrial establishments in the Municipality of Impasugong – the A Brown Energy Resources and Development Inc. (ABERDI), the Impasugong Furniture Shop and Mini Sawmill at Poblacion, the San Miguel Foods, Inc. Impalutao and San Miguel Purefoods Hatchery located at Capitan Bayong. The Del Monte Philippines Inc. and the DOLE-Stanfilco are the manufacturer and wholesaler. Raw materials required by these industrial establishments are provided by the areas in all barangays of the municipality and other areas within Mindanao.

3.4.5.6.6 Banking and financial institutions

Cagayan de Oro city, Misamis Oriental

The banking sector registered a modest average rate of increase of 5.2% on a year-on-year basis, although it posted a negative growth from 2007 to 2008 with the economy not being exempt from the effects brought about by the economic slump during that year. The banking sector, however, immediately recovered on the following year of 2009 posting the biggest increase at 14%. This sector sustained substantial increases onwards between 4% - 5% to 2011 and accounts for about 4.3% to the total financing institutions (**Table 3-355**).

Table 3-355. Banking institution in Cagayan de Oro City (2007 - 2011)

Year	Number	Increase /(Decrease)	Growth rate
2007	88		
2008	86	-2	-2%
2009	98	12	14%
2010	102	4	4%
2011	107	5	5%

Source: Cagayan de Oro City CLUP 2013-2022

Malaybalay City, Bukidnon

The Malaybalay banking sector increased by 108% in the last five years from 2010 to 2014. There were 64 new banking establishments in 2010 which increased to 133 new banking establishments in 2014. This means that the banking institutions in Malaybalay increased by 23% from 2010 to 2011 but it also decreased by 13% from 2011 to 2012. The highest growth of the financial institutions in Malaybalay was in 2013 with 91% increase (**Table 3-356**).

Table 3-356. Banking institutions in Malaybalay City (2010 - 2014)

Year	Number	Increase / (Decrease)	Growth rate
2010	64		
2011	79	15	23%
2012	68	-11	-13 %
2013	130	62	91%
2014	133	3	2%

Source: Malaybalay CLUP 2016-2025

Tagoloan, Misamis Oriental

Tagoloan had 38 banking establishments in 2017 which are all located in Barangay Poblacion. This was an increase of 5.33% from 2013 to 2017. The banking sector in Tagoloan showed a growth from 3.33% increase from 2013 to 2014. There was a high growth from 2014 to 2015 at 9.67% (**Table 3-357**).

Table 3-357. Banking institution in Tagoloan (2013 - 2017)

Year	Number	Increase / (Decrease)	Growth rate

Year	Number	Increase / (Decrease)	Growth rate
2013	30	-	
2014	31	1	3.33%
2015	34	3	9.67%
2016	35	1	2.94%
2017	38	3	8.57%

Source: Tagoloan CLUP 2017-2027

Manolo Fortich, Bukidnon

The banking establishment of Manolo Fortich is booming with four banks. There are also several cooperative banks and financial companies in the municipality. **Table 3-358** shows that there are five banking companies, 13 cooperatives, and two financial companies.

Table 3-358. Banking and financial institutions in Manolo Fortich

Type	Name
Bank	Landbank of the Philippines
	BPI Direct BanKo Inc.
	Asian Hills Bank
	Rural Bank of Manolo Fortich
	Post Bank
Cooperative Bank	Bukidnon Cooperative Bank
	Bukidnon Community Cooperative
	Lunocan Agrarian Reform Beneficiary Primary Multipurpose Cooperative
	Bukidnon Vegetables Producers Multipurpose Cooperative Bank
	Central Manolo Single Motorist Multipurpose Cooperative
	Mindanao Consolidated Cooperative Bank
	DMPI Employees Agrarian Reform Beneficiaries Cooperative
	Mantibugao Small Farmers Multipurpose Cooperative
	Immaculate Conception Equity Development Multipurpose Cooperative
	Kisolon Multipurpose Dairy Cooperative
	Oro Integrated Cooperative
	First Community Cooperative
	North-South Alliance Multipurpose Cooperative
Financial Companies	Gleh Financial Solution
	Macondry Finance Corporation

Sumilao, Bukidnon

There are only three banks in Sumilao such as D' Asian Hills Bank, Western Union, and Rural Bank of Manolo Fortich. In addition, there are several cooperative banks in Sumilao and other financial institutions. Listed in the table below are the financial institutions in Sumilao. There are also 11 cooperative banks and two financial companies that offer loans (**Table 3-359**).

Table 3-359. Banking and financial institutions in Sumilao

Type	Name
Bank	D' Asian Hills Bank
	Western Union
	Rural Bank of Manolo Fortich
Cooperative Bank	Poblacion Sumilao Multipurpose Cooperative Bank
	Kamuty Farmers Multipurpose Cooperative Bank
	Kibenton Farmers Multipurpose Cooperative Bank
	Radiant Sumilao Agro-Industrial-Multipurpose Cooperative Bank
	First Agrarian Reform Multipurpose Cooperative Bank
	Bukidnon Community Cooperative Bank
	Sumilao Sons and Daughters of Veterans Credit Cooperative Bank

Type	Name
	Lunocan Agrarian Reform Beneficiary Primary Multipurpose Bank
	Bukidnon Vegetables Producers Multipurpose Cooperative Bank
	Ilignan Multipurpose Cooperative Bank
	Oro Integrated Cooperative Bank
Financial Companies	Hills Finance Corporation
	Macondry Finance Corporation

Impasug-ong, Bukidnon

Impasug-ong had two new banking establishments in 2018. This was an increase of 20% from 2014 to 2018 (**Table 3-360**). The banking sector in Impasug-ong showed a slow growth for the banking sector.

Table 3-360. Banking institution in Impasug-ong (2013 – 2017)

Year	Number	Increase/(Decrease)
2014	1	-
2015	1	1
2016	1	1
2017	2	2
2018	2	2

Source: Impasug-ong CLUP 2019-2028

3.4.5.6.7 Impact assessment on the generation of local benefits from the Project

Generation of local benefits from the project. The proposed Cagayan de Oro-Malaybalay Standard Highway Project (CMHP) is envisioned to enhance transportation needs and hasten the development of Northern Mindanao in general. The LGU needs additional highways and road considering the trend of urban growth and increasing population and new revenue sources to improve the delivery of basic services and infrastructures.

Enhancement of employment and livelihood opportunities. A new highway infrastructure could reallocate economic activity. It may attract economic activity resulting in gross positive economic effects to the geographic area where the new infrastructure is built. Studies have shown that public sector investments in transportation infrastructure result in long-term economic benefits, including increased output, productivity, and income (Bhatta and Drennan, 2003). The highway project can increase employment opportunities, such that the construction and post-maintenance of roads need to hire local residents, thus creating more employment opportunities.

Labor intensive construction and the use of local labor during the construction will increase benefits to the local community residents who are skilled and semi-skilled such as laborers, truck drivers, cleaning and food catering and the like. Indirectly, other sources of income in each project area will also increase like leasing of office spaces, houses, spaces for temporary facilities; operation of stores, food stalls, laundry shops and others.

Increased business opportunities and associated economic activities. A highway is an important infrastructure which can solve the problem of “difficult travel” and promote economic growth. The direct impact of the highway project is to drive the development of related industries such as the increase in the demand for local raw materials, machinery and other related industries in the process of road construction. In addition, the construction of a highway can accelerate the local industrial layout of the city/municipality to change around the development of roads and transportation. It increases the attractiveness of investment such as promoting the development of restaurants along highways and other service industries such as car repair and car washing, promoting tourism and farmhouses and other tourism industries, and driving slower development areas.

Increased revenue of LGUs. The people within the project area will directly benefit from the project in the following ways: reliable and fast travel leading to greater mobility of people and goods; improved access to markets for the farmers; and better access to wholesalers for the stores. The LGUs within the project area will experience increased population as more lands will be converted for residential development. The increase in business and associated economic activities as well as increased employment and livelihood opportunities will also result in increase in the revenue collection of the LGUs within the project area.

Child labor and school drop-out. Increased opportunities for the host community to sell goods and services to the incoming workers can lead to child labor to produce and deliver these goods and services, which in turn can lead to enhanced school dropout.

Local inflation of prices. Due to labor influx, the demand for goods and services may lead to local price hikes and/or crowding out of community consumers.

3.4.5.7 Traffic congestion

3.4.5.7.1 Methodology

Identification of critical movements

Critical movement is the lane that requires the most time to service its queue. Stations were established in residential areas, where six stations are situated in the national highway and the other four stations are located in barangay roads. The 10 identified critical movements are located in barangays as listed in **Table 3-361** and shown in **Figure 3-118.**

Table 3-361. Traffic count stations

Stn.	Location	Coordinates		Description	Date	Time
		Latitude	Longitude			
1	Brgy. Casinglot, Tagoloan	8°30'55.65"N	124°45'28.77"E	4-way lane, asphalt	April 23, 2021	10:30-22:30
2	Brgy. Mambatangan, Manolo Fortich	8°27'49.98"N	124°48'3.60"E	2-way lane, dirt road, junction	April 24, 2021	14:30-2:30
3	Brgy. Alae, Manolo Fortich	8°24'38.34"N	124°48'16.41"E	2-way lane, dirt road, junction	April 27, 2021	15:30-3:30
4	Brgy. Dicklum, Manolo Fortich	8°22'18.07"N	124°51'11.50"E	4-way lane asphalt, dirt road, concrete road, intersection	April 26, 2021	13:00 – 11:00
5	Brgy. San Roque, Sumilao	8°19'47.64"N	124°56'0.10"E	2-way lane, dirt road	April 30, 2021	10:30-22:30
6	Brgy. Poblacion, Impasug-ong	8°18'45.61"N	124°59'0.77"E	4-way lane, asphalt and concrete	April 28, 2021	6:00-18:00
7	Brgy. La Fortuna, Impasug-ong	8°15'57.05"N	124°59'48.38"E	2-way lane, dirt road	May 1, 2021	13:45-11:45
8	Brgy. Impalutao, Impasug-ong	8°13'59.97"N	125° 1'44.41"E	2-way lane, asphalt	May 3, 2021	9:20 – 21:20
9	Brgy. Patpat, Malaybalay	8°11'42.45"N	125° 3'12.10"E	2-way lane, asphalt	May 4, 2021	10:35 – 22:35
10	Brgy. Kalasungay, Malaybalay	8° 9'57.12"N	125° 6'48.86"E	2-way lane, asphalt, junction	May 5, 2021	13:30-11:30

Data Collection

Traffic data were gathered using 24-hour traffic survey in the ten stations located in the three municipalities of Bukidnon and one municipality of Misamis Oriental. All vehicles that passed by in different bounds were counted according to ten (10) classifications, namely, a) motorcycle/bicycle, b) tricycle, c) car/SUV, d) van, e) jeepneys, f) bus, g) truck, h) over-dimensioned truck, i) government vehicles, and j) others which more likely consists of L300, multi-cabs and heavy equipment. The volume of traffic in each bound were enlisted in the traffic monitoring sheets by the traffic enumerators.

Trip Generation

Trip generation can predict the number of trips originating in or destined for a particular traffic analysis zone. Traffic flow focuses on both the number of vehicles and human factor or a general trip of people for traffic involves people and trips of vehicle. Passenger Car Equivalent (PCE) is used as a factor to express the number of cars needed to theoretically replace a non-passenger vehicle to simulate the same effect on a road or intersection. Assumed PCE is shown in **Table 3-362**. A trip is a one-way directional travel movement, which is composed of starting and ending points within the study area. Local Trip Generation Rates in person trips is located in **Table 3-363.**

Table 3-362. Assumed passenger car equivalent

Vehicle type	PCEF
Private cars/ van / SUV	1.2
Government vehicle	1.2
Delivery/elf trucks	1.5
Over-dimensioned trucks	2.0
Tricycle/motorcycle/bicycle	0.5
Municipal/provincial buses	2.2
Others	1.5

Source: ITE, 2001; Passenger Car Equivalent Factor

Table 3-363. Local trip generation rates (in person trips)

Land use	Trip production	Trip attraction	Units
Office	0.0027	0.0176	Trips/m2 of GFA
Commercial	0.0576	0.0735	Trips/m2 of GFA
Hotel	2.00	2.55	Trips/hotel room
Residential	2.42	1.52	Trips/dwelling unit
Mixed Use	0.0172	0.0243	Trips/m2 of GFA

Source: Asiaworld Transportation Planning Study, 1997

Trip rates show the number of traffic/people movements in and out of a development for a given trip rate parameter factor. Gross Leasable Area (GLA) and Gross Floor Area (GFA) are the factors used for computing the trip rates. Trip rates vary based on the type of development shown in **Table 3-364**.

Table 3-364. Trip rates for different development types

Category	Weekend	Weekday	Unit
Fine Dining Restaurant	0.1165	0.0447	Trips/ m^2 GFA
Office	0.0044	0.0164	Trips/ m^2 GFA
Shopping Center	0.0535	0.0257	Trips/ m^2 GFA
Fast Food	0.5872	0.3768	Trips/ m^2 GFA
Supermarket	0.1319	0.0794	Trips/ m^2 GFA

Source: ITE, 2001

Figure 3-118. Identified critical movement and traffic study station map

Traffic Stations	Project Title	Source(s)of Information	Project Proponent	EIA Preparer
	Central Mindanao High Standard Highway Construction Project (CDO-Malaybalay Section) Misamis Oriental and Bukidnon, Region X	Google Earth Satellite (Basemap) PSA 2016 (Administrative Boundaries)		

3.4.5.7.2 Baseline traffic

Baseline traffic observation

Peak hour may vary from place to place, from time to time, and seasonally. Based on the observation, most of the study site doesn't have establishments, such as malls, supermarket, and school zone, that could attract travelers. Peak hour was identified by the greatest number of vehicles recorded in a period of time, most of the identified peak hour in the study stations doesn't create a congestion since the demand-supply of traffic network in the area is enough to sustain the volume of vehicle encompasses the study site.

Existing traffic current volumes

The current traffic conditions per stations were discussed in the following section. The summary of the existing and future traffic conditions is shown in **Table 3-365** and illustrated in **Appendix 43.**

Station 1 - Brgy. Casinglot, Tagoloan, Misamis Oriental

Station 1 is located in a residential area, 1.9 km away from the existing Sayre Highway, which is located at Brgy. Puerto, Cagayan De Oro, Misamis Oriental. The national highway is a 4-way lane asphalt road, 2 lanes each bound (West bound and East bound).

West Bound - The total number of vehicles during the 24-hr sampling at the west bound of Station 1 was 14,608 units. Out of this, the identified peak hour was during 16:30-17:30, which consisted of 1,197 units. At this time, a high volume of trucks passing by compared to other time interval. In the said peak hour, 32.16% of which is composed of trucks. It is followed by motorcycle / bicycle with 17.13%, tricycle with 16.71%, and car/SUV with 10.44%. Motorcycle/bicycle had the highest number recorded in the entire sampling period with a total of 3,966 units. Trucks followed it with 2,935 units, car/van with 2,813 units, and tricycle with 2,229 units, and the rest were recorded less than a thousand units (**Appendix 43**)

East Bound - As shown in **Appendix 43**, the total traffic count recorded was 19,806 units. Its peak hour was the same at the west bound, which was 16:30-17:30 PM. During peak hour, the volume of vehicles recorded was 1,483 units. Out of the total traffic count during the 24hr sampling, motorcycle/bicycle had the highest count with total units of 6,376. At said peak hour, motorcycle/bicycle were recorded 33.78 % out of the total, it is followed by car/SUV with 5,059 units (26.77%) and tricycle with 2,455 units (10.52%). Trucks, jeepneys, and over-dimensioned trucks were recorded over thousand units and the rest were recorded less than a thousand.

Station 2 - Brgy. Mambatangan, Manolo Fortich, Bukidnon

Only a few vehicles were recorded at Station 2 because it is a barangay road located 2.1 km away from the existing Sayre Highway. This area is a mix agricultural and residential zones in which no commercial establishments are present. The road condition in this station is a dirt road with single lane in each way bound. **Appendix 43** shows the existing traffic volume in Station 2.

North bound - The total recorded vehicles in the north bound of Station 2 was 221 units. In this station only motorcycles/bicycles, tricycles, cars/SUVs, vans, and trucks were observed during the whole sampling period. Out of the total, motorcycles/bicycles were the highest count with 204 units. The identified peak hour was during 11:30-12:30 where 24 units were recorded. At this time, motorcycle/bicycle consisted of the 91.67% of the total count during the peak hour. Tricycles and cars/SUVs consisted of the 4.17 %.

South bound -The total vehicles counted for south bound was 159 units with only 4 vehicle types recorded. Out of this, 153 units were recorded as motorcycle/bicycle and the other 3 vehicles were recorded with 2 units each. The identified peak hour in this way bound was 9:30-10:30 with 21 units. Most of the vehicles passing by during the peak hour was motorcycle/bicycle with 20 (95.24%) units.

East bound - The total number of vehicles recorded at the east bound of Station 2 was 223 units. The most numbered vehicle was motorcycle/bicycle with 211 units. The identified peak hour in this way bound was 18:30 to 19:30 with a total of 22 units. At this time, only 2 types of vehicles were recorded, 21 units (95.45%) of motorcycle and 1 unit (4.55%) of tricycle. The volume of motorcycle counted in this time was highest compared to the other time intervals.

West bound - Only three vehicle types were observed at the west bound of Station 2. Out of 31 units in total, 27 of which was motorcycle/bicycle. The identified peak hour in this way bound was 11:30 to 12:30 with a total of 5 (100%) units of vehicle passing by. In this way bound only few vehicles were recorded because it is heading to a privately owned farm.

Station 3 - Brgy. Alae, Manolo Fortich, Bukidnon

Station 3 is located 0.74 km away from Camp Philips Road. The road is a single lane dirt road located in a residential and agricultural area.

North bound - A total of 294 units were recorded at the north bound of Station 3. Out of the total count, 285 units of which were motorcycle/bicycle (**Appendix 43**). The identified peak hour was 6:30-7:30 with a total of 90 (100%) units. A high number of motorcycle/bicycles was recorded during peak hour because most of the people living in the area were off to work.

South bound - At the south bound, a total of 180 vehicles were recorded. Peak hour was identified at 17:30-18:30 with a total of 22 units. Motorcycles with 167 (92.78%) units, tricycles with 3 (1.67%) units, cars/SUVs with 1 (0.56%) unit, van with 1 (0.56%) unit, and trucks with 8 (4.44%) units were observed in this way bound with motorcycle/bicycle giving the highest number of units (**Appendix 43**).

West Bound –West bound had the same peak hour (17:30-18:30) with south bound but the number of vehicles at the west bound was higher with a total of 40 units. A total of 284 units were recorded at this way bound with motorcycle/bicycle giving the highest contribution in the traffic count with 265 (93.31%) units (**Appendix 43**).

Station 4 - Brgy. Dicklum, Manolo Fortich, Bukidnon

Station 4 is located in Sayre Highway around a residential area with intersection going to a farm and barangay proper. It is a 4-way asphalt road going to north and south bounds, while going to east (barangay proper) is concrete road, and in west bound (going to farm) is a dirt road. **Appendix 43** shows the current traffic volume in Station 4.

North Bound - A total of 8,879 units were recorded at the north bound of the 4th station. It was mostly consisting of motorcycles/bicycles with a total count of 4,028 (45.37%) units, followed by cars/SUVs with a total of 2,408 (27.12%) units. Peak hour was identified during 13:00-14:00 with a total of 756 units. At this time, motorcycles/bicycles were recorded the highest count with 394 (52.12%) units, followed by cars/SUVs with 190 (25.13%) units. The unit of motorcycle recorded within this time period was relatively higher compared to other time period.

South Bound - South Bound of Station 4 had fewer units of 7,299 vehicles than north bound. The number of motorcycles/bicycles that passed by this way bound was 2,717 (37.16%), the highest number compared to the other vehicle types. It is followed by cars/SUVs with a total of 2,144 (29.37%) units and trucks with 1,486 (20.36%) units. The identified peak hour was 13:00-14:00 PM with 637 recorded units. During this time period the volume of vehicle like tricycle, van, jeepney, bus, government vehicles, and over-dimensioned trucks were relatively higher compared to other time.

West Bound - The total number of vehicles recorded at the west bound of Station 4 was 300 units. Units were fewer at this way bound because it is heading to a farm. Most of the vehicles recorded at this way bound were motorcycles/bicycles with a total of 259 (86.33%) units. The identified peak hour in this way bound was 10:00-11:00 with a total unit of 51. In this time, most of farm workers are heading to the farm.

East Bound - A total of 368 units were recorded at east bound of Station 4. Out of this, 318 (86.41%) units were motorcycles/bicycles. East bound is going towards the barangay thus, fewer vehicles were observed compared to north and south bounds of national highway. The identified peak hour at the east bound was 17:00-18:00 with 62 units in total. Most of the workers at this time are heading towards the barangay proper where they live

Station 5 - Brgy. San Roque, Sumilao, Bukidnon

Station 5 is located in a distant community which is approximately 8.61 km away from the existing Sayre Highway. This community is surrounded by vast pineapple plantation far from civilization. The road condition on the said study area is a single lane dirt road in each way bound.

North bound - At the north bound of Station 5, only seven (7) types of vehicles were recorded. Out of the 262 total units recorded in the sampling duration, 233 (89.27%) units of which were motorcycle/bicycle units. It is followed by trucks with 18 (6.90%) units, cars/SUVs with 7 (2.68%) units, and 1 (0.38%) unit to each of the rest vehicle type observed. The identified peak hour was 17:30-18:30 with 24 units recorded. In the said peak hour, 22 (91.67%) units of which is motorcycle/bicycle, and 2 (8.33%) units were truck. Most of the farmers were observed to be going back to the community during this time (**Appendix 43**).

East bound - A total of 169 units of vehicles were recorded at the east bound of Station 5. Only three (3) types of vehicles were observed at this way bound namely motorcycle/bicycle, car/SUV, and truck. Out of this, 153 (90.53%) units were motorcycle/bicycle units. There were 9 (5.33%) units of trucks and 7 (4.14%) units of cars/SUVs that passed by. The peak hour was 16:30-17:30 with a total of 23 units. During this time most of the workers are going back to their houses after working in the farm (**Appendix 43**).

West bound - A total of 397 units were recorded at the west bound of Station 5 with seven (7) different types of vehicles observed. Motorcycle had the highest number recorded with a total of 355 units. In this way bound, the volume of vehicles recorded is higher compared to the other two way bound, because it's the road going to the nearest civilization in the area. The identified peak hour was 8:30-9:30 which a total of 48 units were recorded. Out of which, 41 (85.42%) units is motorcycle/bicycle and 7 (14.58%) units of trucks. During this time workers are heading to farm (**Appendix 43**).

Station 6 - Brgy. Poblacion, Impasug-ong, Bukidnon

Station 5 is located in Sayre Highway along a tree park and agricultural zone with patches of residential areas. The road condition is a four-lane asphalt, 2 lanes in each way bound.

North Bound –Out of the total vehicle count (5,990 units), motorcycle/bicycle had the highest number of 1,800 (30.05%) units recorded in the whole observation period. It is followed by car/SUV with 1,500 (25.04%) units and truck with 1,170 (19.53%) units. The identified peak hour at this way bound is 14:00-15:00 with 636 units. In the said peak hour, 175 (27.52%) of which is motorcycle/bicycle, followed by car/SUV with 165 (25.94%) units, and truck with 118 (18.55%) units (**Appendix 43**). Peak hour varies in this area since the area where it is located is a park and agricultural zone.

South Bound - At the south bound of Station 6, a total of 5,772 units were recorded in the whole sampling period. Out of this, 1,555 (27.18%) units of motorcycle/bicycle was recorded the highest, followed by car/SUV with 1,517 (26.51%) units. The other types of vehicles were recorded less than a thousand units. The identified peak hour at this way bound was 14:00-15:00 PM. A total of 118 (27.63%) units of car/SUV and about 113 (26.46%) unit of motorcycle/bicycle were recorded during this time (**Appendix 43**).

Station 7 - Brgy. La Fortuna, Impasug-ong, Bukidnon

Station 7 is an agricultural area located at the foot of the mountain and is 0.72 km away from existing Sayre Highway. There is also a residential area at the side of the area. The road condition is a single lane dirt road in both directions.

North bound - The total number of vehicles recorded at the north bound of Station 7 was 318 units with six (6) vehicle types. Out of this, motorcycle recorded the highest number of 284 (89.31%) units and the other are less than a hundred. The identified peak hour at this way bound was 12:45-13:45 with a total unit of 38. At this time, a total of 35 (92.11%) units of motorcycle/bicycle and 3 (7.89%) units of car/SUV (**Appendix 43**). Most of locals living in the area were going down to the mountain at this time of observation.

South bound - Out of the 10 identified vehicle types, only five (5) were seen at the south bound of Station 7 with a total count of 302 units. Motorcycle/bicycle had the highest number of units recorded with a total of 279 (92.38%) units, other vehicle types had 9 (2.98%) units, truck with 6 (1.99%) units, tricycle with 5 (1.66%) units, and car/SUV with 3 (0.99%) units. The identified peak hour was 7:45-8:45 with 34 units. During this time, 33 (97.06%) of which is motorcycle/bicycle and 1 (2.94%) unit of truck (**Appendix 43**).

Station 8 - Brgy. Impalutao, Impasug-ong, Bukidnon

Station 8 is located along the Sayre Highway. It is situated in an agriculture and patches of residential area that are said to be informal settlers. The road condition in the area is a 2-way asphalt lane, 1 lane for each direction.

North bound - The total vehicle count recorded at the north bound of Station 8 was 6,014 which consisted of all the type of vehicle identified. Motorcycle/bicycle had the highest volume of vehicle recorded during the whole sampling period with 1,866 (31.03%) units. It is followed by car/SUV with 1,526 (25.37%) units recorded and truck with 1,043 (17.34%) units. The other vehicle types recorded were less than a thousand. The identified peak hour was 9:20-10:20 with a total unit of 733. Out of which, 256 (34.92%) units of motorcycle were recorded during this time. It is followed by car/SUV with 173 (23.60%) units, and the other were less than a hundred. The peak hour in this area may also vary since is located in an agricultural area (**Appendix 43**).

South bound - A total of 7,513 units were recorded at the south bound of Station 8 which was higher than north bound. Out of this, 2,320 (30.88%) motorcycle/bicycle units were recorded which the highest number of vehicles was. It is followed by car/SUV with 1,921 (25.57%) units recorded. The peak hour at this way bound was 15:20-16:20 with 771 units (**Appendix 43**). This peak hour may vary because it is located in a national highway in an agricultural zone.

Station 9 - Brgy. Patpat, Malaybalay, Bukidnon

Station 9 is located along the Sayre Highway in an agricultural and residential area. This area is located 1.19 km away from barangay proper. The road condition is a four-way asphalt lane, 2 lanes each direction.

North bound - The volume of vehicles recorded at the north bound of Station 9 was 5,539 units. A total of 2,031 (336.67%) units of motorcycle/bicycle was recorded which was the highest. It is followed by car/SUV with 1,434 (25.89%) units. The peak hour identified at this way bound was 10:35-11:35 with 594 units. It is composed of 107 (18.01%) units of motorcycle/bicycle, 4 (0.67%) units of tricycle, 95 (15.99%) units of car/SUV, 35 (5.89%) of van, 42 (7.07%) units of jeepney, 27 (4.55%) units of bus, 143 (24.07%) units of truck, 13 (2.19%) units of over-dimensioned truck, 12 (2.02%) units of government vehicle, and 116 (19.53%) units of other vehicles. Peak hour in the area may vary since is it located in an agricultural zone which 1.19 km away from commercial establishments (**Appendix 43**).

South bound –Out of the 5,716 total units of vehicle recorded at the south bound of Station 9, 2,174 (38.03%) units were motorcycle/bicycle, the highest recorded during the whole sampling period. It was followed with car/SUV with 1,453 (25.42%) units recorded. The peak hour identified at this way bound was 16:35-17:35 with 456 units recorded (**Appendix 43**). Peak hour may also vary since the area is located in an agricultural area.

Station 10 - Brgy. Kalasungay, Malaybalay, Bukidnon

Station 10 is located in a residential area, 1 km away from Malaybalay town proper. The road condition in the area is single lane asphalt in each way bound.

North bound - A total of 8,828 units of vehicle was recorded at the north bound of Station 10 which consist of all types of vehicles. Motorcycle/bicycle had the highest volume of vehicles recorded during the whole sampling period with a total of 3,464 (39.24%) units. It is followed by car/SUV with a total of 1,959 (22.19%) units recorded. The peak hour identified at this way bound was 16:30-17:30 with 719 units recorded. During this hour, most of workers in town proper were going out. Out of this, a total of 343 (47.71%) units of motorcycle/bicycle were record, followed by 135 (18.78%) units of car/SUV, and 102 (14.19%) units of jeepneys (**Appendix 43**). The rest were less than a hundred units.

South bound - The volume of vehicle recorded in the south bound of station 10 was 8,730 units in total. The greatest number of vehicles recorded was motorcycle/bicycle with 3,665 (41.98%) units. It is followed by car/SUV with 1,823 (20.88%) units. The peak hour identified at this way bound was 16:30-17:30 with 677 units. During this time, workers are going out form their offices. A total of 308 (45.49%) units of motorcycle/bicycle were recorded, followed by 152 (22.45%) units of car/SUV.

West Bound- Out of the total 70 vehicles recorded, motorcycle/bicycle was the highest with 56 (80%) units during the whole sampling period. It is followed by truck with 10 (14.29%) units and jeepneys with 3 (4.29%) units. The identified peak hour in this way bound is 16:30-17:30 PM with 14 units consist of the 4 identified types of vehicles (**Appendix 43**). During this time, workers are going back from work.

3.4.5.7.3 Estimation of future traffic

Future traffic without the Project

Using the data from the traffic count, the traffic projection starting 2022 to 2040 was estimated in this section. As the number of occupants of the project increases, the projected traffic is further forecasted annually for the analysis of traffic. Person trips are converted to vehicle trips to determine the number of vehicle trips that will mix with the volume of vehicles computed without the Central Mindanao High Standard Highway. Computations of forecasted volume of vehicles were up to year 2040. The future traffic situation without and without the Project is shown in **Table 3-365** and **Appendix 43.**

Future traffic with the Project

The volume of traffic in Sayre Highway was assumed to decrease by 30% of its total traffic volume in the years of operation phase (2026) of the CMH project. The project is a high standard highway, which will be used as a connecting road from Tagoloan, Misamis Oriental to Malaybalay, Bukidnon. The alignment for this high standard highway is much safer and shorter compared to the existing Sayre Highway. **Table 3-365** and **Appendix 43** shows the traffic projection with the Project.

Table 3-365. Existing and future traffic projections at the traffic survey stations

Way bound	Total vehicle volume	Existing	Projections

		2021	2025	2030	2035	2040
Stn. 1 - Casinglot, Tagoloan						
Westbound	without the Project	14608	16200	18437	20982	23878
	with the Project		5531	6294	7163	7163
East bound	without the Project	19806	21965	24997	28448	32375
	with the Project		7499	8534	9712	9712
Stn. 2 - Mambatangan, Manolo Fortich						
North bound	without the Project	221	238	261	286	313
	with the Project		78	86	94	94
South bound	without the Project	159	171	188	206	225
	with the Project		56	62	68	68
Westbound	without the Project	31	33	37	40	44
	with the Project		11	12	13	13
East bound	without the Project	223	240	263	288	316
	with the Project			79	86	95
Stn. 3 - Alae, Manolo Fortich						
North bound	without the Project	294	316	347	380	416
	with the Project			104	114	125
Westbound	without the Project	284	306	335	367	402
	with the Project			100	110	121
South bound	without the Project	180	194	212	233	255
	with the Project			64	70	76
Stn. 4 - Dicklum, Manolo Fortich						
North bound	without the Project	8879	9555	10472	11477	12578
	with the Project			3141	3443	3774
South bound	without the Project	7299	9555	10472	11477	12578
	with the Project			3141	3443	3774
Westbound	without the Project	300	323	354	388	425
	with the Project			106	116	127
East bound	without the Project	368	396	434	476	521
	with the Project			130	143	156
Stn. 5 - San Roque, Sumilao						
North bound	without the Project	262	277	298	320	343
	with the Project			89	96	103
East bound	without the Project	169	179	192	206	221
	with the Project			58	62	66
Westbound	without the Project	397	420	451	484	520
	with the Project			135	145	156
Stn. 6 - Poblacion, Impasug-ong						
North bound	without the Project	5990	6433	7033	7689	8407
	with the Project			2110	2307	2522
South bound	without the Project	5722	6145	6719	7345	8031
	with the Project			2016	2204	2409
Stn. 7 - La Fortuna, Impasug-ong						
North bound	without the Project	318	342	373	408	446
	with the Project			112	122	134
South bound	without the Project	302	324	355	388	424
	with the Project			106	116	127
Stn. 8 - Impalutao, Impasug-ong						
North bound	without the Project	6014	6459	7061	7720	8441
	with the Project			2118	2316	2532
South bound	without the Project	7513	8069	8822	9645	10544
	with the Project			2646	2893	3163
Stn. 9 - Patpat, Malaybalay						
North bound	without the Project	5539	6124	6942	7869	8921
	with the Project			2083	2361	2676
South bound	without the Project	5716	6319	7164	8121	9206
	with the Project			2149	2436	2762
Stn. 9 - Kalasungay, Malaybalay						

Way bound	Total vehicle volume	Existing	Projections			
		2021	2025	2030	2035	2040
North bound	without the Project	8828	9760	11064	12542	14218
	with the Project			3319	3763	4265
South bound	without the Project	8730	9651	10941	12403	14060
	with the Project			3282	3721	4218
East bound	without the Project	70	77	88	99	113
	with the Project			26	30	34

3.4.5.7.4 Traffic analysis

Guidelines and standard requirements in Traffic Impact Assessment are provided in TIA Handbook by National Center for Transportation Studies (NCTS). TIA is conducted in order to address the traffic congestion. Parking space requirements must also be met according to standards administered by National Building Code. Should the project cause a decline in the level of service (LOS) or affect safety concerns, the developer is responsible for the funding of necessary countermeasures.

Road Capacity Analysis

Level of Service (LOS) is a mechanism used to distinguish how well a transportation facility are. Typically, six levels of service are defined and each is assigned a letter designation from A to F, with LOS A representing the best operating conditions, and LOS F the worst (**Table 3-366**).

The Level of Service of peak hour in the following study stations were presented in **Appendix 44.** Most of the identified critical movements in the study stations were classified as Class A to C Level of Service meaning the level of traffic condition is ranging from very light traffic to moderately light traffic. This indicates a free low traffic with low densities where drivers can maintain their desired speed with little or no delay and are unaffected by other vehicles (Class A&B). In Class C, speed remains near free flow speeds, but freedom to maneuver noticeably restricted. This classification was projected in stations 2, 3, 5, 6, 7, 8, 9, & 10 from 2021 to 2040. Class D to F would be projected level of service for Station 1 and Station 4 (north and south bounds). This class is ranging from moderately heavy to very heavy traffic in which speed begins to decline with increasing volume. Freedom to maneuver is further reduced and traffic stream has little space to absorb disruptions, also saturation traffic volumes, stop and go situations.

Table 3-366. Level of Service (LOS) criteria

VCR, V/C	Description	Traffic condition	LOS Rating
0 – 0.20	Free flow, Low Volume and Densities; Drivers can maintain their can maintain their desired speeds with little or no delay and are unaffected by other vehicles.	Very Light	A
0.21 – 0.50	Reasonably free flow, operating speeds beginning to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speeds.	Light	B
0.51 – 0.70	Speeds remain near free flow speeds, but freedom to maneuver noticeably restricted.	Moderate	C
0.71 – 0.85	Speeds begin to decline with increasing volume. Freedom to maneuver is further reduced and traffic stream has little space to absorb disruptions.	Moderately Heavy	D
0.86 – 1.00	Unstable flow, with volume at or near capacity. Freedom to maneuver is extremely limited and level of comfort afforded the driver is poor. Heavy Traffic	Heavy	E
> 1.00	Saturation traffic volumes, stop and go situations	Very Heavy	F

NOTE: VCR – Volume to Capacity Ratio, VC – Volume to Capacity

3.4.5.7.5 Impact of traffic congestion

Construction - Activities such as clearing operation could create a slight traffic congestion in the areas where heavy equipment will be transported. Transport of construction materials to the Project site and travel to/from project site by construction workers and other personnel will generate additional traffic load on the existing road network near and within the Project site. During construction, in the worst-case scenario, where it is assumed that excavation trucks, concrete mixers, trucks for materials will be arriving, vehicles will operate at the same time, but impacts are expected to be minimal and still under control.

Operation – The Project will positively affect the existing Sayre highway during operational phase by decreasing the possible travelers that will be using the Sayre highway. CMH provides move safe and fast travel from Tagoloan, Misamis Oriental to Malaybalay, Bukidnon and to the municipalities/cities between these two locations.

3.4.6 Mitigating measures

3.4.6.1 Displacement of settler/s

Land Valuation

Pre-construction phase **-** As a mitigating measure, the driver and farmer organizations and local officials must be vigilant to ensure that land sales within the service area are restricted to drive away or discourage the speculators and opportunists.

Relocation of displaced settlers

Pre-construction phase - There is a need to formulate a resettlement plan framework and implementation or action plan for the affected families (Afs) through a participatory process, especially that they belong to a vulnerable sector as poor people. The absence of formal legal title to land should not be a bar to due compensation. The scheme relocation of Afs must foremost gain the full information and tacit approval of the Afs concerned and must be preceded by a social preparation to build their capacity to deal with the situation. The compensation scheme must be mutually acceptable to the Afs and DPWH. Foremost, the provisions of the Philippine Constitution, RA 7279 or 1992 Urban Development and Housing Act (UDHA), Japan International Cooperation Agency (JICA) guidelines for environmental and social consideration the Asian Development Bank (ADB) involuntary resettlement policy must be implemented. The resettlement plan to be formulated must be guided by the following 3 elements:

- compensation for lost assets and loss of livelihood and income
- assistance for relocation including provision of relocation sites with appropriate families and services;
- assistance for rehabilitation to achieve at least the same level of well-being with the project as without it

In addition, according to Lohani, et al. (1997), there is a need to incorporate the following: basic information on the impact of land acquisition and losses to potentially affected families and clear definition of eligibility and entitlement considerations, description of resettlement site development and income restoration programs, institutional and capacity building and training, a realistic budget for land acquisition and resettlement costs and funding allocation sources; and monitoring and evaluation system. It is also important that in the organizational framework of the resettlement plan, the following are included: a grievance/redress committee, cooperating agencies and institutions (GA, LGU, NGO, PO, and Business), livelihood association, and community action group. The latter must have such committees as demolition/relocation/transfer, grievance/complaint, monitoring, environmental protection unit, and monitoring and evaluation (ADB Policy, 1998).

The Japan International Cooperation Agency (JICA) has established comprehensive guidelines addressing environmental and social considerations related to the displacement of settlers for highway projects. These guidelines aim to ensure that such projects are conducted with utmost sensitivity and responsibility towards affected communities. The key aspects of these guidelines generally cover:

- Community Engagement: Encouraging meaningful consultation and participation of affected communities throughout the project lifecycle. This involves informing them about the project, listening to their concerns, and involving them in decision-making processes.

- Social Impact Assessment (SIA): Conducting thorough assessments to identify potential impacts on affected communities, including the displacement of settlers. This involves evaluating social, economic, and cultural factors to mitigate negative consequences.

- Resettlement Planning: Developing comprehensive plans for resettling affected settlers, ensuring adequate compensation, livelihood restoration, and access to essential services such as education, healthcare, and infrastructure.

- Environmental Protection: Implementing measures to minimize environmental impact, preserve natural resources, and prevent any adverse effects on ecosystems caused by the project.

- Capacity Building and Empowerment: Supporting affected communities by enhancing their skills, providing training opportunities, and facilitating their active participation in the project’s planning and execution.

- Monitoring and Evaluation: Establishing mechanisms to monitor the project's impact on displaced settlers and the environment, ensuring compliance with guidelines and making necessary adjustments as required.

JICA's guidelines emphasize a holistic approach that considers not only the physical displacement of settlers, but also their socio-economic well-being and the preservation of the environment. These guidelines aim to mitigate potential negative effects on affected communities while fostering sustainable development in the regions where the highway projects are implemented.

Moreover, the Afs may choose to receive actual cash for the family and to decide where to build their residence or to live in the site to be offered by the company. The resettlement area provided by the project holder must have complete provisions for light and water, and health center equipped with medicines and medical staff. The location must also be in proximity to the local schools.

For farmers and other stakeholders whose lands and plants/trees are affected by the highway construction, the principle of equity must be invoked. This means all lands, plants; house and other improvements must be valued and credited as equity. Compensation must be based on mutually agreed or acceptable packages. Equity may also be based on value of labor and materials used.

Some of the areas affected by the project have identified sites for resettlement. For Cagayan de Oro City, there are five resettlement sites identified in relation to Typhoon Sendong victims. These are located in Barangay Canitoan, Camamanan and Indahag. The LGU has already prepared the sites for relocation of the Typhoon Sendong victims and currently there are 500 units turned over to the qualified Sendong victims.

These relocation sites can also be used for Cagayan de Oro relocates of the Central Mindanao High Standard Highway Project.

In Tagoloan, the resettlement areas of PHIVIDEC based on the report declared a total of 82.7 hectares and have developed a total of 28.7 hectares. These resettlement areas are as follows: Sta. Ana Village with declared area of 60 hectares but only 6 hectares developed at sta. Ana, Mohon Relocation with 2.0 hectares declared and developed, Sta. Cruz Re-location with 3.0 hectares declared and developed, Sto. Niño, Baluarte Relocation with 12.0 hectares declared and developed, Gracia Relocation with 1.8 hectares declared and developed, and Villa San Juan, Casinglot Relocation with 3.9 hectares declared and developed. According to the reports there are 2,733 lots awarded to the relocates. In line with this, the Afs of Central Mindanao High Standard Highway Project may look at the resettlement sites identified by PHIVIDEC in coordination with the Tagoloan LGU.

Impasug-ong has also identified Purok 3, Poblacion called the Impasug-ong Village Sites and Services (IVSS) intended for the resettlement of the households living in hazardous areas like river easements and the like. It has 118 units in a 2.5353 hectare-lot purchased for resettlement by the Provincial Government. At present 108 units are being occupied.

<u>Right-of-Way and compensation for land and land improvements</u>

Pre-construction phase - To minimize conflict, a series of genuine consultations must be conducted to ensure participation of all the stakeholders and eventually formulate and establish a mutually agreed just scheme. Resettlement Action Plan is currently on-going of which the land and property owners that will be affected by the Project were informed and consulted. The Journal of Assessment Transactions on Market and Assessed Land Values from the municipal assessor's office must be reviewed by a competent technical committee to ensure that the land value is fair enough and secure RROW prior to construction.

In the case of Del Monte and the ancestral domain lands, this must be resolved by creating a Task Force for this matter to include IP leaders/representatives. There is a need to ensure that all issues and concerns of the landowners and Del Monte will be resolved through negotiation.

3.4.6.2 In-migration (proliferation of informal settlers)

<u>In-migration: labor demand and entry of migrant workers</u>

Construction phase - Local hiring should be prioritized and should be adopted as a policy provided the applicant residents are qualified for the position. Should there be highly technical staff required for certain positions, this should be spelled out in the guidelines for hiring. Job opportunities should be advertised through local media to discourage project "followers" from loitering and/or settling around the project site in hope of job opportunities. Coordination with the local Public Employment Service Office (PESO) is also important to recruit local residents with the right skills. Skills enhancement should be provided to local skilled labor when necessary to ensure their being taken in. Migrant workers, meanwhile, must be oriented on the culture and ways of living in the city/municipality to ensure harmonious relationships between them and local labor.

<u>Proliferation of informal settlers or "followers".</u>

Pre-construction phase - Countering the negative aspects of informal settlements requires the local government, DPWH and the contracting company to recognize the challenges faced by the residents and actively engage them in consultations. Those already formed informal settlements in the cities and municipalities need to be regulated. Key drivers for action by the LGU and concerned government agencies include: recognition of informal settlement and human rights; government leadership in implementing appropriate policies for infrastructure development; systemic and city/municipality wide/at scale approaches that work best with the location; integration of people and systems; provision of affordable and adequate housing; and developing a participatory, standardized and computerized data collection system for informal settlers.

It is necessary to prepare and implement an Informal Settler Monitoring Plan (ISMP), monitor arrival of informal dwellers within the Project area as well as to prioritize local hiring in order to mitigate the in-migration and proliferation of informal settlers.

<u>Increased pressure on accommodation and rents.</u>

Construction phase - To deal with the challenge of affordable housing, cities and municipalities can explore avenues to repurpose vacant space, apartments or underutilized buildings in the city/municipality for temporary or long-term use for housing migrants or informal settlers. Coordination with NGOs involved in housing programs can also be done for help in deploying a solution. In addition, the LGU can look upon housing as a human right and explore the housing challenge from that perspective. The city or municipality's administrative capacity to manage its housing stock and the services that accompany effective housing developments requires support from multiple stakeholders in the community. The company can also establish a workers' camp with facilities and support staff sufficient for the needs of the workers and subcontractors. This should be included in the contract of funding for the establishment of the worker's camp.

3.4.6.3 Cultural/Lifestyle change

Pre-Construction phase - If inevitably the IPs are affected persons with their lands, plants/trees and houses process should be applied for proper documentation in close coordination with NCIP and their authentic tribal leaders. In the process, a MOA will be coached in a language that they understand and duly agreed upon outlining payment and other forms of compensation for the affected lands, plants/trees, houses and the like. Finally, the Certification Precondition (CP) will be issued after the finalization of Resolution of Consent.

Documentation of customary laws helps preserve their traditions and indigenous knowledge system. This can be done in a participatory method together with the trained and capable locals. This can be carried out with pertinent government agencies and academic institutions. Proper orientation of migrant workers on culture oriented on the culture and ways of living in the city/municipality must also needed to be conducted.

Creation of opportunities for the IPs of various barangay/municipalities to address their most basic assets that will encourage and enhance growth and development within their ancestral domains in order to address their most basic needs. This necessitates capability enhancement training and most importantly alternative livelihood projects that are culture and gender sensitive. Provision of scholarships for youth is also important.

3.4.6.4 Impacts on physical cultural resources.

Pre-construction phase - The identified cultural/historical resources in both Cagayan de Oro and Malaybalay City are not located within the covered project site. Thus, there is no significant impact.

3.4.6.5 Threat to delivery of basic services /resource competition

<u>Threat to delivery of basic services /resource competition</u>

Construction phase - Migration affects the demands on the infrastructure and services in the place of destination. Shifts in demand occur in housing, childcare, power generation, shops, roads, amusement parks, schools, public transport, police, telephones and employment, among others. Inadequacies in the city/municipality's infrastructure and services add to the pressure. The rapid population growth results in migrants having to cope with insufficient infrastructure and cities/municipalities having to manage the lack of planning to meet the needs of all people.

The demand for utilities, such as water, energy and telecommunications, can be put under severe pressure, with those at the lowest income levels suffering disproportionately from a lack of access. The situation gets worse when migrants reside in the same neighborhood as low-income residents already accessing the scarce resources.

With regards to this, it is necessary to provide and implement an Informal Settler Monitoring Plan and conduct a proper coordination between DPWH/contractor with the host LGUs regarding needs of the migrants and residents of the community.

Increased demand on water resources

Construction phase - The affected cities and municipalities have identified various water sources that can be developed to provide for the water supply needs of the community. Coordination with the contractor and the LGU is necessary to increase the water supply to cater to the needs of the migrants and the residents of the community. The contractor can consider recycling of water and the use of rainwater where it is feasible. Proper water management is also essential to ensure sustainability of the water sources of the communities affected by the project. In addition, the LGUs and the contractor can create awareness among residents about saving water (which could reduce the overall cost of water to residents, including migrant workers and the contractor).

Increased demand on power supply

Construction phase - Energy policies of cities and municipalities affected by the project should include assessment of the power supply needs of the potential migrant workers and their families, as well as the construction power supply needs based on the duration of the project. Alternative sources could be provision of solar powered equipment and diesel generators.

Increased demand on Communication Technologies

Construction phase - The country is suffering from slow internet connection which is being addressed by new telecommunication companies. This slow internet connection poses a problem for the workers, students and professionals who use ICT. Thus, there is a proliferation of internet cafes and *piso*-net in the locality. Additionally, the LGUs and the contractor can provide assistance through telecommunications technologies, including through access to the internet (e.g., Wi-Fi hotspots, charging facilities for electronic devices and navigation systems across the city or municipality) for the tech-savvy population.

Peace and order/ safety and security

Construction phase - Some measures that can be integrated in the community includes training and knowledge of precautionary measures to be implemented based on the type of threat. This can be included in the orientation of workers, students, parents and the community at large. It is important to create awareness among residents to help counteract and adequately respond to safety and security.

Increased demand for education facilities

Construction phase - Some cities/municipalities can have specific plans that focus on education to integrate migrants. Other affected cities/municipalities can adapt their strategies to respond to migrants' educational needs. Cities/municipalities and the contractor can coordinate between different stakeholders (e.g., independent training institutions, government agencies, private schools, universities), which interact at the local level but often do not cooperate sufficiently if city/municipal administrations are not involved. Partnerships with national/local and private sector to identify the most appropriate investments in building infrastructure, including academic institutions, innovation centers, industrial parks, and cultural and healthcare institutions; this would include exploring innovative or unconventional methods of providing education to migrants, residents and their children, who otherwise have no access to education.

Increased use of recreational facilities/sports facilities

Construction phase - The contractors may provide recreational and sports facilities near the housing settlements for their migrant workers in order to prevent conflict in the use of the facilities in the city/municipality. However, the affected cities and municipalities have numerous natural and human-made tourist attractions that can cater to a number of visitors.

Food security.

Construction phase - The need to produce more food and to distribute it better is a means to address malnutrition mindful of various social, religious, and cultural functions of food. To address food insecurity in terms of available food supply, sustainable productive farming systems and well managed natural resources should be in place. Improving access requires better market access or better transport for the poor and lowly to generate more income from cash crops, livestock products and other productive enterprises. At the core of food security is access to healthy food and optimal nutrition for all.

3.4.6.6 Threat to public health and safety

Increased risk of communicable diseases and burden on local health services

Construction phase - To mitigate the risks, there is a need to develop tools and solutions that help assess the equity of healthcare in the city/municipality, ensure adequate health planning and help policymakers establish health services that cater equally to the migrant population. In addition, planning is needed on how to make universal healthcare truly inclusive and effective, so that all city's/municipality's residents, including migrants, have access to financial coverage for a wide and adequate range of healthcare services. Proper coordination with local law enforcement must also be conducted.

In regard to communicable diseases, the contractor can vaccinate its workers against common and locally preventable disease, as well as COVID-19 vaccination. Information campaigns about HIV/AIDS and STDs among workers and local residents can also be conducted. The contractor can also establish a health center at the camp and construction sites with free testing facilities for COVID-19 and other communicable diseases. The health center should also provide free condoms and other contraceptives.

Additionally, the contractor can recruit an environmental, health, and safety manager (EHSM) to address health concerns in the work sites and liaise/work with the nearby communities and formulate occupational Health and Safety Protocols and Grievance Redress Mechanisms during construction and operation phases. Workers should also be equipped with personal protection equipment, such as safety boots, helmets, gloves, protective clothing, goggles, and ear protection; provision of clean drinking water to all workers; and adequate protection to the general public, including safety barriers and marking of hazardous areas.

Weather-sensitive diseases and impact aggravation as a result of climate change as projected by PAGASA

Construction phase - Strengthening of public health services needs to be a central component of adaptation to climate change. An effective response will require actions from across society: from individuals, the health sector, and community and political leaders. A fair and effective response will require a sharing of responsibilities between the populations that make the greatest contribution to climate change and those that are most vulnerable to its effects, in order to safeguard and enhance public health security.

Carefully planned climate change mitigation policies bring direct health benefits (WHO, 2009). For example, well-designed transport systems can reduce greenhouse gas emissions, while simultaneously reducing the major health impacts of air pollution and physical inactivity, which kill millions each year. Housing with efficient insulation can cut energy consumption and associated greenhouse gas emissions and reduce deaths from heat.

The contractor can also provide adequate drainage throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form; and septic tank and garbage box will be set up in construction site, which will be periodically cleared by the contractors to prevent outbreak of diseases.

Environmental Health and Sanitation.

Construction phase - To mitigate the pollution generated by the growing population, LGUs and the contractor can develop sanitation systems to handle waste generated from all forms of settlements, including slums and camps. In addition, the LGUs and the contractor can source solutions from the private sector, innovators and other external stakeholders to create awareness of safe waste disposal and better hygiene.

3.4.6.7 Generation of local benefits from the project

Generation of Local Benefits from the project

Operation phase - The proposed Project is envisioned to enhance transportation needs and hasten the development of Northern Mindanao in general. The LGU needs additional highways and road considering the trend of urban growth and increasing population and new revenue sources to improve the delivery of basic services and infrastructures.

Enhancement of employment and livelihood opportunities

Pre-construction, Construction and Operation phase - To enhance the employment and livelihood opportunities in the cities and municipalities where the project is located, there must be policies and resources to address the challenges. Since most of the economies show that agriculture continues to be the biggest source of employment in Bukidnon, there is a risk because of the lack of financial instruments like insurance to weather the shocks. Whether for livelihood or subsistence, most families are forced to supplement their farming income with other sources. Women can also try to expand into non-farm and off-farm opportunities to augment their household income. But they need information and guidance on setting up business and how to get or use credit. Even with a steady growth in formal sources of credit like through microfinance and networks, people typically do not have easy access to mentors who can guide them to use the credit effectively.

The Central Mindanao High Standard Highway Project may allow some of the residents to work in the construction to grow their incomes. This can be done through the conduct skills training at the host LGUs and prepare a local employment plan and prioritize hiring of qualified residents from the host barangays.

- Conduct skills training at the host LGUs
- Prepare a Local Employment Plan (LEP)
- Prioritize hiring of qualified residents from the host barangays
- Enhance the opportunity for new businesses and innovation
- Implement the Local Employment Plan
- Purchase supplies from local sources
- Provide livelihood opportunities if possible
- Prompt payment of taxes and other legal fees

Increased business opportunities and associated economic activities.

Construction and Operation phase - The construction of the Central Mindanao High Standard Highway Project can fuel entrepreneurship and innovation for economic growth. New businesses can create jobs, strengthen market competition, and increase productivity. Thus, the LGU can enhance the opportunity for new businesses and innovation by offering policies that nurture the growth of business. This may include stronger open trade policies that encourage growth and transform the market; make it easier to obtain permits; and reduced approval costs. Reduction in trade-related administrative costs helps strengthen business environment and reduce the costs of doing business in the city/municipality. The Project will enhance the business opportunities during its constructions through the purchasing of supplies from local sources. Support from government and private financial agencies can also be tapped for 'start-up' businesses.

Although new road alignment has many long-term benefits to a community, they can pose serious challenges especially on the business owner and employee, who operate the business along the existing road. The new road can disrupt patrons' accessibility to businesses, and produce negative impacts on sales revenues especially if the main customers of existing roadside business are travelers or drivers. However, there is no significant negative impact on the business establishments along Sayre Highway since it was assumed that their customers are also within their vicinity or municipality as most of them are traveled by foot or motorcycle. The usual destination of the respondents when using Sayre is within the municipality also indicating that most of their destination is within their vicinity.

Increased revenue of LGUs

Operation phase - Local government units (LGUs) derive their revenues from local and external sources. Local sources include tax revenues from the real property tax and the business tax, and non-tax revenues from fees and charges, receipts from government business operations and proceeds from sale of assets. With the increase in the number of business and other associated economic activities created by the new highway construction project, the LGUs need a better revenue-generation capability. LGUs can boost their revenue-generation capabilities by adopting new digital tools and bolstering institutional development and policy support for property valuation. These tools are important for accurate and transparent reporting and updating of property valuation assessments and tax maps.

Child labor and school drop-out

Construction phase **-** The contractor and LGUs should ensure that children and minors are not employed directly or indirectly in the project. The LGUs through the local PESO and the contractor should clarify the hiring criteria such as minimum age and the applicable laws with regards to child labor.

Local inflation of prices

Operation phase - To mitigate for inflation of prices, an appropriate mix of locally and non-locally procured goods that will allow the local market to benefit while reducing the risk of crowding out and price hikes for local consumers could be done. The LGUs can also monitor the local prices and the security of supply in the market.

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CHAPTER 4 - ENVIRONMENTAL MANAGEMENT PLAN

The **Environmental Management Plan** (EMP) is an environmental management tool to ensure that undue or reasonably avoidable adverse impacts of the pre-construction, construction, operation, and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced [1]. It is also described as how an action might impact the natural environment where it occurs and set out clear commitments from the person taking the action on how those impacts will be avoided, minimized, and managed so that they are environmentally acceptable [2].

The EMP provides a general guide for managing adverse and enhancing beneficial impacts. It includes options for mitigation or enhancement, implementer, costs, and arrangement to guarantee implementation for the potential impacts during the pre-construction, construction, operation, and abandonment phases of the Project.

The Impact Management Plan template in **Annex 2-17 of the DAO 2003-30 Revised Procedural Manual** was used to craft the EMP of the Project during the pre-construction, construction, operation, and abandonment phases. The indicative costs were assumed to be part of the Project costs in Section 1.9 of the Project Description because it is difficult to assign accurate costs for specific activities at this time.

Although the potential impacts during the Pre-Construction stage are not expected because site development activities have not started, formulating the recommended plans and guidelines in Table 4-1 is due diligence on the part of DPWH and the Contractor(s) to address the anticipated adverse impacts during the Construction and Operation phases. Crafting these during when the construction and operation phases have started is already late because the adverse impacts are already occurring and there will not be time to review and fine-tune the plans and guidelines.

The Construction Plan was also included in the mitigation measures because adverse impacts are likely to be minimized by its strict implementation. A Construction Plan is a set of documents that defines the activities, resources, schedule, and budget during the construction phase. It is a result of the construction planning process and includes the following:

a) A written document that defines the methodologies and approach
b) Blueprints, computer aided designs, photographs, and other images that illustrate the design
c) A work breakdown structure that identifies all the activities that make up the project
d) A construction project schedule that organizes all the project activities on a timeline
e) The construction project participants and stakeholders such as contractors, sponsors, crews, etc.

The strict implementation of the Construction Plan will have a significant contribution in reducing impact intensity and magnitude in addition to specific measures because it defines the Project construction requirements mentioned earlier and considered the results and recommendations the additional site studies conducted.

Abandonment of the Project, i.e., closing of the CMH to public traffic, dismantling of structures, etc., is not expected. In the remote event of abandonment, however, the chapter on decommissioning/abandonment

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[1] Lochner, P. 2005. Guideline for Environmental Management Plans. CSIR Report No ENV-S-C 2005-053 H. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town

[2] Environmental Management Plan Guidelines, Commonwealth of Australia, 2014.

will guide the DPWH to address the impacts associated with closing the CMH. It is recommended that the DPWH submits a detailed Abandonment Plan to EMB Central Office one year before the actual abandonment of the CMH.

Table 4-1. Impact Management Plan[1]

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
Pre-Construction: Preparation of sub-studies, architectural and engineering design, procurement of permits and clearances, consultations, etc., and clearing of RROW					
LAND					
1	Land use and classification	Compatibility with existing land use	- Confirm classification of the Project area to the zoning regulation of host cities and municipalities	DPWH	Consultancy fees: 250,000
2		Compatibility with classification as an Environmentally Critical Area (ECA)	- Include susceptibility of the Project area to natural hazards in the Detailed Engineering Design (DED)	Design contractor, DPWH	Consultancy fees: 250,000
3		Existing land tenure issue/s	- Conduct parcellary survey - Secure documents showing authority to develop the Project RROW	DPWH	Part of RAP costs
5		Devaluation of land value because of improper solid waste management and other related impacts	- Identify the final disposal site for solid waste, excavated soil, and hazard waste at each LGU	DPWH	Design & consultancy fees: 300,000
6	Geology	Change in sub-surface geology/underground conditions	- Conduct of factual Geological mapping with focus on the following: geology, geomorphology, geohazards, areas that may be prone to settlement or subsidence. - The outcome of the map are the following Site specific semi-detailed to detailed interpretative factual geological maps with presentation of the base filed information focusing on the following: a. rock type/s variation, the types and density of rock fracturing and geological structures such as faults, joints, etc.; the degree and extent of weathering, morphology and slopes.	Design Contractor, DPWH	Part of design costs-Php 1,000,000

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[1] Potential Impact column denotes ADVERSE impact unless specified.

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
			b. Identified geohazards to be reflected / included in the interpretative factual geological map.		
7		Inducement of subsidence, liquefaction, landslides, mud / debris flow, etc.	- Conduct of Engineering Geological and Geohazard Assessment (EGGA) and factual geological mapping focusing on geology, geomorphology, and geohazards. EGGA - Through the conduct of an EGGA, areas that are prone / susceptible to geological hazards such as seismic related hazards (earthquake-induced landslide, ground acceleration, subsidence, etc.) and hydrometeorological hazards (rain-induced landslide, rock fall	Design Contractor, DPWH	Part of design costs-Php 500,000
8		Effects of geohazards to the Project	- Conduct of EGGA	Design Contractor, DPWH	Part of design cost including above
9	Pedology	Soil erosion / Loss of topsoil/overburden	- Formulate a Soil Erosion Management Plan (SEMP) that includes among others minimized cut and fill operations to minimize the modified area to prevent soil erosion of new surface soil due to cut and filling - Ensure the slope protection after cut and filling as soon as possible - to establish the adequate drainage in the construction area	Design Contractor, DPWH	Part of design costs
10		Change in soil quality/fertility	- Identify staging areas. Staging areas is the designated area where supplies and construction equipment are positioned for access to a construction site. - Include a buffer zone during construction and operations. Buffer zones - identified zones are areas outside the boundaries of and immediately adjacent to designated protected areas	Design Contractor, DPWH	Part of design costs
11	Terrestrial ecology	Impacts on terrestrial flora and fauna	- To study the design for minimizing of removing existing vegetation - Validate or conduct a updated flora - Consider the locations of significant flora and fauna during	Design Contractor, DPWH	Part of pre-construction costs - 600,000

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
			Project design. If possible, avoid removal of trees along the RROW and include them in the visual design. If not possible, trees will be balled and planted in areas that will not be affected by the project;		
PEOPLE					
12	Displacement	- Displacement of settler/s - Displacement / disturbance of properties - Change/conflict in land ownership	- Authority document over RROW - Conduct census of properties and land affected by the staging areas and RROW - Undergo the FPIC process as prescribed under RA 8371.	DPWH coordinate with NCIP	Part of RAP costs
13	Public Access	- Change/conflict Right of way - Impact on Public Access	- Conduct consultations with the stakeholders and formulate mutually agreed schemes - Review Journal of Assessment Transactions on Market and Assessed Land Values to ensure fair compensation	Community Relations Officer of DPWH	Part of RAP costs
14	Public Involvement	- Informed/empower the public to participate in the decision making process - Threat to public health and safety	- Informed/empower the public to participate in the decision making process -Prepare the following: ・Operation Waste Management Plan (OWMP) (P) : ・Regular maintenance of highway to reduce visual impact due to expected wear and tear. ・Implementation of best housekeeping practices and continue the regularly disposed through LGU garbage collectors.	DPWH	Conduct of IEC and public consultations: 600,000
Construction: Site preparation, installation of structures, temporary ancillary elements					
LAND					
1	Land use and classification	Change/Disturbance in land use pattern due to road construction & ancillary facilities	- Scheduling heavy construction works during the daytime - Construction activities that necessitate utilizing portion of the road/street should be undertaken upon permission by the LGU Traffic management team and outside of traffic rush hours;	DPWH, Contractor, Traffic Management	Part of construction costs

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
			- Construction activities should not be a hindrance to the operations in neighboring area.	Unit of the LGUs	
2		Impairment of visual aesthetics	- To mitigate the changes in visual aesthetics, it is imperative to implement plans such as the establishment of vegetation buffer zones within the Right-of-Way (ROW) vacant areas. - Maintain the construction site/ yards tidy and clean and rehabilitate after construction.	DPWH, Contractor	Part of construction costs
3		Devaluation of land value as a result of improper solid waste management	- Maintain the construction site/ yards tidy and clean and rehabilitate after construction. - Temporary stockpiles of excavated materials from foundation works must be properly covered and regularly hauled to DENR approved disposal sites. - Litters and other types of domestic garbage from construction sites and camps must be properly kept in trash bins and regularly disposed through LGU garbage collectors	DPWH, Contractor	Part of construction costs
4	Geology	Change in surface landform/ topography/ terrain/ slope	- Employ appropriate erosion control and slope protection measures. - Designate a spoils storage area and optimize re-use of spoils. - Increase vegetation and construction drainage canals at the break-of-slope (between the gentle to moderate slopes). - Slope re-contouring, benching or lowering the slope gradient - Drainage system includes drain construction and anchored structures.	DPWH , Contractor	Part of construction costs
5		Change in sub-surface/ underground geomorphology	- Field inspection in active construction sites especially after heavy and prolonged rains and after earthquakes (if it occurs). - Regular inspection of identified areas prone to subsidence particularly those underlain by the limestone. - Follow recommendations of the geotechnical / civil engineer / geologist to address any adverse geological and	DPWH, Contractor, MMT	Part of construction costs

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
			geomorphological conditions.		
6		Inducement of subsidence, liquefaction, landslides, mud/debris flow	- Apply retaining walls and other engineered structures along steep walls - Increase vegetation cover particularly at the vicinity of the break-of-slope - Surface drainage control works – construction of drainage canal at the break-of-slope (between the gentle to moderate slopes) - Slope re-contouring, benching or lowering the slope gradient - Good drainage system including under drain constructions and anchored structures.	DPWH, Contractor	Part of construction costs
7		- Effects of geo- and hydrological hazards	- Install sufficient protection measures such as soil improvements during excavation activities and implement appropriate materials handling program or a site protection and rehabilitation program. - Proper inspection of all installed and constructed / ongoing construction structures and facilities. - Coordinate with the Philippine Institute of Volcanology and Seismology (PHIVOLCS) during earthquake and volcanic events to adjust construction schedule. Conduct earthquake drills for workers	DPWH, Contractor	Part of construction costs
8	Pedology	Soil erosion or loss of topsoil	- Implementation the recommendations of geotechnical engineer and EGGA Report in areas of steep slopes and traversed by surface water channels - Immediate removal of excavated soil stockpiles - Optimize re-use of spoils - Surface drainage control works – construction of drainage canal at the break-of-slope (between the gentle to moderate slopes). - Construct perimeter sediment barriers; - Divert upstream drainage away from the stockpiles	DPWH, Contractor	Part of construction costs

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
			- Install drainage canals and settling pond.		
9		Change in soil quality/fertility	- Proper inspection and maintenance of machines and equipment to avoid unexpected leakage of oil due to malfunctions - Strictly implement solid waste management plan and proper disposal by contractor in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969. - Conduct soil quality monitoring in case of any possible contamination events occur.	DPWH, Contractor	Part of construction costs
10	Terrestrial ecology	Vegetation removal and loss of habitat	- Proper implementation of Tree Cutting Permit conditions by the DENR and DPWH (DAO 2018-16 and DAO 2020-06). Removed trees should be geotagged and recorded prior the extraction. Coordination with CENR office in removal and relocating of trees. - Limit the development activities within the planned structure or component footprint. - Establish on site nurseries in accessible locations - Transplant saplings to affected areas especially riparian zones	DPWH, Contractor	Part of construction costs
11		- Threat to existence of important local species - Threat to abundance, frequency and distribution of important species	- Proper implementation of Tree Cutting Permit conditions by the DENR and DPWH (DAO 2018-16 and DAO 2020-06). Removed trees should be geotagged and recorded prior the extraction. Coordination with CENR office in removal and relocating of trees. - Strict implementation of a "*No Hunting and No Collecting*" policy - Collect saplings of endangered, vulnerable and other threatened species and harden in nurseries for eventual transplanting to target areas, particularly riparian zones - Adoption of lower noise and vibration construction method and machines - Incorporating green infrastructure into road and highway design as roadside vegetation can act as wildlife corridors	DPWH and Contractor	Part of construction costs

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
			- Establishment of underpasses or box culverts - Reduction of light intrusion by modifying the height of streetlamps, lighting intensity, spectral composition.		
WATER					
12	Hydrology/ Hydrogeology	- Change in drainage morphology - Inducement of flooding - Reduction in stream volumetric flow	- Installation of silt fences - Establishment of no intrusion areas during road construction - Rapid re-vegetation of side slopes with anti-erosion cover, and the use of appropriate anti-erosion technologies. - All earthworks for site preparation and trench excavation implemented during the low rainfall period if possible - Reuse excavated earth material for backfilling whenever feasible - Backfilling and leveling of the borrow pits to prevent water ponding - Provide adequate drainage systems to minimize the impact downstream of active construction sites - Limit the area of project activities within the RROW - Regular checking of temporary drainage canals to ensure adequate storm water flow.	DPWH, Contractor	Part of construction costs
13		Change in stream depth	- Installation of erosion control measures - Minimizes disturbance to river sediments - Disposal of unused or excess fill material during construction will comply with the DPWH standard specifications	DPWH, Contractor	Part of construction costs
14		Water resource use and competition	- Use of any open water body or natural water source that are being used by the general populace must not be permitted - Construction of wells as source of potable water shall not be allowed	DPWH, Contractor	Part of construction costs
15	Water quality	Degradation of surface water	- Best housekeeping practices	DPWH,	Part of

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
		quality	- Provide onsite sanitary facilities - Adequate drainage leading to siltation ponds	Contractor	construction costs
16	Freshwater ecology	- Water pollution, Soil Contamination and impact on bottom sediment - Threat to existence and/or loss species of important local and habitat - Threat to abundance, frequency and distribution of species	- Bunded area for tanked fuels, lubricants, etc., at the staging areas with drainage leading to oil-water separator. - Provide onsite sanitation facilities - Contain runoff from construction areas with silt traps or curtains	DPWH, Contractor	Part of construction costs
AIR					
17	Air quality	Fugitive dust pollution	-Replacement of vegetation in non-structure areas to minimize wind erosion of topsoil - Apply dust suppression measures, e.g., water application, in active construction areas; - Compact exposed soil surfaces; - Provide tarpaulin cover on trucks loaded with construction materials; - Haul spoils/excavated earth materials immediately after excavation;	DPWH, Contractor	Part of construction costs
18		Increase in SO_2, NO_2, PM and CO ambient levels	- To avoid unexpected emissions due to malfunctions, regular maintenance of construction equipment and machineries, and vehicles - Use of low-sulfur gasoline	DPWH, Contractor	Part of construction costs
19	Noise	Increase in noise levels	- Provision of Noise barriers and shielding stationary vibrating equipment; and - Scheduling of noisy activities during daytime.	DPWH, Contractor	Part of construction costs

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
			- Install noise control devices such as mufflers and noise suppressors on all construction equipment and machinery. Use of electric instead of diesel-powered equipment, hydraulic tools instead of pneumatic tools. - To avoid unexpected noise due to malfunctions, Daily routine check-up of construction vehicles, equipment, and machineries must be strictly complied with		
PEOPLE					
20	In-migration	Proliferation of informal settlers	- Implement the Informal Settler Monitoring Plan: ・Plan and implement construction schedule to shorten time between the preconstruction and construction as much as possible ・Install fencing and guarding of the proposed project to restrict the public from entering the ROW. - Prioritize local hiring	DPWH, Contractor in coordination with the host LGUs	Part of construction costs
21	Culture/ Lifestyle	Cultural/Lifestyle change (especially on IPs, if any)	- Proper orientation of migrant workers on culture oriented on the culture and ways of living in the city/municipality	DPWH and Contractor in coordination with the host LGUs	Part of construction costs
22	Delivery of basic services /resource	- Land Use Competition: Staging areas may compete with existing land uses, potentially affecting nearby residential, agricultural, or commercial areas. - Noise and Traffic Disruption: Increased construction-related activities in staging areas can lead to noise pollution and	- Coordination of DPWH/contractor with the host LGUs regarding needs of the migrants and residents of the community	DPWH, Contractor in coordination with the host LGUs	Construction costs: 600,000

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
		disruptions in local traffic patterns, impacting daily life for nearby residents. - Construction activities can lead to increased traffic congestion, affecting the flow of vehicles on existing roads and impacting local transportation systems. - Resource Competition: The construction process may require significant resources such as water, energy, and raw materials. Competition for these resources with local communities or other industries can occur. - Construction activities may require excavation near existing utility lines, posing a risk of damage and disruption to essential services like water, electricity, and telecommunications.			
23	Public health and safety	Threat to public health and safety	- Conduct sensitization campaigns both for workers and local communities about illicit behavior and crime. - Coordination with local law enforcement - Implement the Construction Waste Management Plan ・Temporary stockpiles of excavated materials from foundation works must be properly covered and regularly hauled to DENR approved disposal sites.	DPWH, Contractor in coordination with the host LGUs	Part of construction costs

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
			・Litter and other types of domestic garbage from construction sites and camps must be properly kept in trash bins and regularly disposed through LGU garbage collectors.		
24	Local benefits	Generation of local benefits from the Project (BENEFICIAL IMPACT)	- Enhance the opportunity for new businesses and innovation - Purchase supplies from local sources - Provide livelihood opportunities if possible - Prompt payment of taxes and other legal fees	DPWH, Contractor in coordination with the host LGUs	Part of construction costs
25	Traffic	Traffic congestion	- Prepare and implement the Traffic Management Plan including, traffic guide, sign board for construction information, detour route plan and schedule of transportation of construction material smoothly	DPWH, Contractor in coordination with the host LGUs	Part of construction costs
Operation: Project presence, infrastructure maintenance					
LAND					
1	Land use and classification	Impairment of visual aesthetics	- Regular maintenance of the highway	DPWH, O&M Concessionaires	Part of operating cost
2		Devaluation of land value as a result of improper solid waste management and other related impacts	- Regular maintenance of the highway - Best housekeeping practices	DPWH, O&M Concessionaires	Part of operating cost
3	Terrestrial ecology	- Threat to existence of important indigenous species - Threat to Abundance, Frequency, and Distribution of Important Species - Hindrance to Wildlife Access	- Regular maintenance of vegetation planted in the project area - Establishment of underpasses or box culverts may be considered a critical mitigating measure to protect wildlife and promote ecological connectivity	DPWH, O&M Concessionaires	Part of operating cost
WATER					
4	Hydrology/Hydrogeology	Change in drainage morphology/ Inducement of flooding/	- Regular maintenance of drainage canals, pipe culvert, cross drains.	DPWH, O&M Concessionaires	Part of operating cost

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
		Reduction in stream volumetric flow			
5		Change in stream depth	Restoration and maintenance of natural drainage traversed by the alignment.	DPWH, O&M Concessionaires	Part of operating cost
6	Water quality	Degradation of surface water quality	- Best housekeeping practices - Provision of sanitation facilities - Maintain drainage system leading to siltation ponds	DPWH, O&M Concessionaires	Quarterly monitoring: 500,000
7	Freshwater ecology	- Threat to existence and/or loss species of important local and habitat - Threat to abundance, frequency and distribution of species	- Bunded area for tanked fuels, lubricants, etc., with drainage leading to oil-water separator. - Provide onsite sanitation facilities - No wastewater discharges into rivers or streams	DPWH, O&M Concessionaires	Quarterly monitoring: 450,000
- AIR					
8	Meteorology	Contribution in terms of greenhouse gas emissions (or GHG mitigation potential).	- Prohibit idling in parking areas and emergency curb - Establishment of traffic signs to impose speed restrictions	DPWH, O&M Concessionaires, Highway Police	Part of operating cost
9	Air quality	Air pollution from motor vehicles	- Proper installation, and maintenance of selected option, e.g., vegetation barrier. - Establishment of traffic signs to impose speed restrictions	DPWH, O&M Concessionaires, Highway Police	Part of operating cost
10	Noise	Noise pollution from motor vehicles	- Proper design installation and maintenance of selected sound attenuation barriers option, e.g., vegetation barrier. - Establishment of traffic signs to impose speed restrictions - Periodical road surface maintenance	DPWH, O&M Concessionaires	Part of operating cost
PEOPLE					
11	Public health and safety	Threat to public health and safety	- Maintain sanitary facilities - Maintenance of traffic signs for safety	DPWH, O&M Concessionaires	Part of operating cost

No.	Environmental component likely affected	Estimated potential impacts	Proposed mitigation plans	Responsible organization	Cost (php)
12	Local benefits	Generation of local benefits from the Project (BENEFICIAL IMPACT)	- Prioritize hiring of qualified residents from host LGUs - Purchase supplies from local sources - Provide livelihood opportunities if available - Prompt payment of fees and taxes	DPWH, Tollway operator	Part of operating cost
Abandonment: Project closure, decommissioning					
1	Land use and classification	Impact in terms of compatibility with existing land use	- Restore RROW to its state prior to Project implementation if possible or the current land use/zoning of the LGU where a road section is located.	DPWH	To be determined
2		Impairment of visual aesthetics	- Proper demolition of the road, structures, and other ancillaries - Proper disposal of demolition wastes	DPWH, O&M Concessionaires	To be determined
3		Devaluation of land value as a result of improper SW management	- Proper disposal of demolition and solid wastes - Best housekeeping practices	DPWH, O&M Concessionaires	To be determined
4	Geology	Change in surface landform	- Check RROW with destabilized slopes and implement slope stabilization measures	DPWH, O&M Concessionaires	To be determined
5	Pedology	Soil erosion	- Check RROW for soil erosion and implement measures	DPWH, O&M Concessionaires	To be determined
6	Soil quality	Change in soil quality	- Conduct Levels 1 and 2 ESA (ASTM)	DPWH, O&M Concessionaires	To be determined
7	Terrestrial ecology	Impact to terrestrial ecology	- Revegetate areas occupied by the demolished road sections, structures, and other ancillaries.	DPWH, O&M Concessionaires	To be determined

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CHAPTER 5 - ENVIRONMENTAL RISK ASSESSMENT (ERA) & EMERGENCY RESPONSE POLICY AND GUIDELINES

5.1 ENVIRONMENTAL RISK ASSESSMENT

The Environmental Risk Assessment (ERA) in the context of Philippine EIS System (PD 1586) is concerned with human safety where risks are characterized by probabilities, consequences, accidental nature, and acute effects.

On the other hand, geological risks are covered by the Engineering Geological and Geohazard Report (EGGAR) requirement of the Mines and Geosciences Bureau (MGB) and health risks characterized by exposures and chronic human health effects are assessed in the Environmental Health Impact Assessment (EHIA) under the DOH mandate. The EGGAR and EHIA have their own procedural processes that are not covered by the EIA System and not required by the ECC application.

Annex 2-7e of the Revised Procedural Manual (RPM) of the Department Administrative Order No. 30 Series of 2003 (DAO 03-2003) or Implementing Rules and Regulations of PD1586 defines how the ERA should be done in the context of the Philippine EIS System.

In general, an ERA is required if a proposed Project will use, handle, transport, store substances that are explosive, flammable, oxidizing, or toxic. The following list shows the projects in the RPM where the ERA is required:

a) Facilities for the production or processing of organic or inorganic chemicals using:
    - Alkylation, Amination by ammonolysis, Carbonylation, Condensation, Dehydrogenation, Esterification
    - Halogenation and manufacture of halogens, hydrogenation, hydrolysis, oxidation, polymerization
    - Sulphonation, desulphurization, manufacture and transformation of sulphur-containing compounds
    - Nitration and manufacture of nitrogen-containing compounds
    - Manufacture of phosphorus-containing compounds
    - Formulation of pesticides and of pharmaceutical products.
    - Distillation, Extraction, or Solvation
b) Installations for distillation, refining, or processing of petroleum products.
c) Installations for the total or partial disposal of solid or liquid substances by incineration or chemical decomposition.
d) Installations for the production or processing of energy gases, for example, LPG, LNG, SNG.
e) Installations for the dry distillation of coal or lignite.
f) Installations for the production of metals or non-metals by a wet process or by means of electrical energy.
g) Installations for the loading/unloading of hazardous materials as defined by RA 6969 (or DAO 29).

Since the proposed CMH Project does not fall in any category listed above, it is opined that an ERA not needed for the ECC application.

5.2 EMERGENCY RESPONSE POLICY AND GUIDELINES

The Proponent will formulate an Emergency Response Policy and corresponding protocols to address the safety concerns of the Project during the construction and maintenance (operation) phases because it is in the interest of the Proponent to ensure that Project implementation is hazard-free as possible and the factors leading to an accident are minimized if not eliminated. To attain this, the proponent will formulate and implement protocols to address accidents at the workplace, road accidents, and the those resulting from natural hazards.

In general, contingency and emergency planning are necessary to address accidents during the Project implementation. The main components of contingency planning include (a) measures to prevent accidents, (b) methods for response and clean up, and (c) organizing and training of personnel to implement the plan. Among the measures to be instituted, these will include at the minimum:

1. Medical assistance during accidents - Staff shall be trained in first-aid techniques to provide medicines and treat minor wounds and ailments during the plant's operation. A first aid kit shall be placed in a conspicuous place in the staging area, offices, and other structures.

2. Communications - Public address (PA) systems and other means of communication will be installed or provided. These will be used to issue forecasts, alarms, warnings and other information in case of accidents. Hand-held radios will also be issued to selected personnel to coordinate personnel movement during emergencies.

3. Emergency response teams - An emergency response team will be organized, trained, and deployed to implement the necessary remedial measures during accidents.

4. Fire hazards - Fire extinguishers, hoses and other firefighting materials prescribed by the Fire Code of the Philippines must be strategically located at the staging area, offices, and other structures. Fire alarms can also be installed in case of fire or explosions. Fire drills should also be conducted regularly to maintain the alertness of the personnel.

Chapter 6 - SOCIAL DEVELOPMENT PLAN (SDP) AND IEC FRAMEWORK AND PUBLIC PARTICIPATION

The Project itself can be considered as a component of the regional social development program because it will enhance transportation needs and hasten the development of Northern Mindanao in general. With increasing population and movement of people and business growth future developments in this region may be affected if this project will not be implemented.

The preliminary SDP and IEC framework are presented in the succeeding sections. It is worthy to note that some elements of the SDP and the IEC Framework were derived from the KI interviews, community consultations, and EIA Perception Survey. And Public Participation in the EIA Process, Public Scoping and Public Hearing were conducted.

Within the environmental situation of the proposed project area, the future scenarios without the project are as follows:

1. Northern Mindanao constituents will not avail of the opportunity to have a standard highway to meet the potential need of additional modern highway, improve access to easy and safe highway, and eventually contribute to economic development of the locality. Thus, the future of the two cities and four municipalities of Cagayan de Oro and Malaybalay may partly anchor on the implementation of this highway development project.

2. There will be less internally generated funds for the LGUs of Cagayan de Oro and Malaybalay for improved delivery of services and local development projects. The same can be stated for the local IP and non-IP residents.

3. No displacement/disturbance of houses and communities will occur.

4. In terms of socioeconomic improvement, it is likely to be the same if the host communities will not be receptive to the project. The LGU needs additional highways and road considering the trend of urban growth and increasing population and new revenue sources to improve the delivery of basic services and infrastructures. In terms of population and migration, the present trend of migration is anticipated to continue in search of new livelihood opportunities.

6.1 SOCIAL DEVELOPMENT PLAN (SDP) FRAMEWORK

The SDP framework seeks to address the issues and concerns identified during public hearings and the impact assessment. The final SDP will be formulated and finalized through a participatory workshop by the implementing agency, DPWH, after the issuance of the Environmental Compliance Certificate (ECC). Participants include representatives of the LGUs of the affected cities and municipalities, and other stakeholders.

In this context, participatory planning, implementation and monitoring/evaluation of programs must be built-in the program components. Gender sensitivity must ensure balance between the role of men and women in community activities. Moreover, the process must also involve multi-sectoral networking. This means forging links with LGUs, POs, NGOs, government line agencies (e.g., DPWH, NCIP, PENRO, DA/BFAR, DOH, DepED, DSWD), partner funding institutions, and other community development partners. This also entails bolstering efforts and linking together of services, and agencies/institutions so as to coordinate and mobilize resources.

Community development projects must be need-driven, participatory/consultative in nature, and aligned with the declared thrust of the locality or group. DPWH must come up with a workable social development program and implement guidelines to make itself visible to the community with a specific focal person or division to ensure carrying out of planned projects and activities. Thus, environmental management and planning in development projects take cognizance of the participatory approach, gender concerns, disaster preparedness, and institutional development. These must also propagate capability, responsibility and accountability.

The Environmental Management Plan is embodied in the Social Development Program that plays a crucial role in implementing the project effectively and efficiently. This translates various mitigation and enhancement measures into concrete plans of action for the constituents who will be directly benefited by the project, as well as those who will not directly gain access to the highway or transport services/facilities.

The SDP for the CMH project, comprised of the IP Development Framework, Socioeconomic Program, Alternative Livelihood Development Program, and the Capability Building Program (CBP), are presented in the succeeding sections.

6.2 IP Development Framework (IPDF)

The IPDF is presented to protect and promote the rights of indigenous peoples (IP) in accordance with the Indigenous Peoples' Rights Act of 1997 (Republic Act 8371). The IPRA concretizes the constitutional mandate to recognize, protect and promote the rights of indigenous peoples within the context of national unity and development, especially their rights to their ancestral lands and domain, to the preservation and development of their cultures, traditions and institutions, and to their human rights and freedoms as mandated in the 1987 Philippine Constitution.

The IPDF in cooperation with the NCIP seeks to address the issues of IPs. It is seen to facilitate the planning and implementation of programs in coordination with the LGUs. In coordination with the local government, the DPWH will to provide economic opportunities to uplift majority of them from poverty. These are the 18 ethno-linguistic indigenous peoples who have lived on Mindanao for generations. Notwithstanding the procurement of the Certificate of Precondition after the Free and Prior Informed Consent (FPIC) process under RA 8371, the indicative social development plan for the IP groups is shown in **Table 6-1** which indicated the Lumads or the Mindanao's indigenous people. These are the 18 ethno-linguistic indigenous peoples who have lived on Mindanao for generations.

Table 6-1. Proposed SDP for Indigenous Peoples

Concern	RCM/B	GA/ NGAS	Proponent	Indicative Timeline	Source of fund
Employment Program	Lumad, Talandig, and Bukidnon-Tagolanon leaders in the locality	DPWH , NCIP, LGU	DPWH	2022-2025	DPWH Operational Funds
Alternative Livelihood Development Program	Lumad, Talandig, and Bukidnon-Tagolanon leaders in the locality	DPWH , NCIP, LGU	DPWH	2022-2025	DPWH-SDP Funds
Capability Building Program (CBP) (to include assistance in the enhancement/finalization of the ADSDPP)	Lumad, Talandig, and Bukidnon-Tagolanon leaders in the locality	DPWH , NCIP, LGU	DPWH	2022-2025	DPWH-SDP Funds

NOTES: RCM/B - Responsible Community Member/Beneficiary; GA/NGAS - Government Agency / Non- Government Agency and Services ; Lumads - Mindanao's indigenous people

6.2.1 Socioeconomic Program (SEP)

The SEP aims to ensure provision for local employment and alternative livelihood development program for the IPs, other local residents, especially those in the direct impact area. Except for highly sensitive and technical positions, guidelines for hiring of local residents especially those residing in the direct impact barangays must consider the following:

a) Hiring priority of displaced residents (of their farmlots and land) and those in the direct impact area; and
b) Hiring based on skills or capability and extent of active participation in activities of the community.

6.2.2 Alternative Livelihood Development Program (ALDP)

The ALDP aims to enhance economic activities of local constituents by providing alternative livelihood in coordination with the LGU and Tribal Council. Conducting training, whenever needed as identified, also constitutes as alternative livelihood. The KII with the constituents of the locality revealed various skills possessed by the key informants which included driving, cooking, farming and fishing, food processing, handicraft making, carpentry and related works, computer skills, knife making, among others.

For men and women – The top five alternative livelihood for both men and women included handicraft making, farming, business, livestock raising and TESDA courses as well as ALS courses (orange cells in **Table 6-2**). Other alternative livelihood suggested were establishing a cooperative, construction work, cooking, financial support for farmers, food processing training, food courier/online food selling, rice selling, dressmaking, fish selling, gardening, micro-credit, financial literacy, online selling, and working on tourist attractions.

Table 6-2. Suggested alternative livelihood for men and women

Alternative livelihood	NR	Percent
Handicraft training (rag making, basket weaving, wallets made out of recyclable materials)	14	14.43
Farming	10	11.34
Business, mini market or mini mart, used clothing (*ukay-ukay*) or repair shop	7	7.22
Livestock raising with provision of feeds	7	7.22
TESDA courses (welding, driving, carpentry)	6	6.19
ALS-skills training, food processing	5	5.15
Financial support, post-harvest facilities, skill training for farmers, farm tractor credit	5	5.15
Cooperative	4	4.12
Construction work	4	4.12
Cooking	4	4.12
Food processing training	4	4.12
Food courier/ food vending/ consignment/online food selling	3	3.09
Gardening	3	3.09
Rice selling	2	2.06
Dress making	2	2.06
Enhanced farming skills, enhanced business skills	2	2.06
Fish selling	2	2.06
Bamboo products, corn-innovate products	1	1.03
Computer literacy and education and trainings	1	1.03
Stove pot making	1	1.03
Employment	1	1.03
Improvement training	1	1.03
Micro-credit	1	1.03

Alternative livelihood	NR	Percent
Financial literacy	1	1.03
Motor parts cooperative	1	1.03
Online selling	1	1.03
Seminar on capability building, how to market the products	1	1.03
Small business	1	1.03
Working on tourist attractions	1	1.03
Total	**97**	**100**

Source: Key Informant Interview; NOTE: NR – number of responses

For men only – The top five alternative livelihood for men only were farming and training/financial help, carpentry and equipment, skills training on various skills, agricultural projects, and driving (orange cells in **Table 6-3**). Other suggestions were capital for livestock raising, construction work, fishing, handicraft making, and business on hardware supplies, buy and sell business, electrical training, factory worker, financial assistance for small business, food processing, vegetable growing, online business, and TESDA trainings.

Table 6-3. Alternative livelihood for men only

Alternative Livelihood	NR	Percent
Farming, training on farming, financial assistance	8	15.09
Carpentry and carpentry equipment	7	13.21
Skills training on black smiting, mechanic, carpentry, welding	7	13.21
Agricultural projects/activities	5	9.43
Driving	4	7.55
Capital for backyard livestock raising	3	5.66
Construction work	3	5.66
Fishing	2	3.77
Handicraft making - wallet making	2	3.77
Business involving hardware	1	1.89
Buy and sell business	1	1.89
Electrical training	1	1.89
Factory worker	1	1.89
Financial assistance for small business	1	1.89
Food processing	1	1.89
Home-grown vegetable	1	1.89
Livelihood	1	1.89
Online business	1	1.89
Plantation employment	1	1.89
TESDA training	1	1.89
Employment	1	1.89
Total	53	100

Source: Key Informant Interview; NOTE: NR – number of responses

For women only – The top five alternative livelihood for women only were food processing training, TESDA training on various courses/skills, training on cosmetology, cooking viands, and gardening (orange cells in **Table** 6-4). Other suggestions were handicraft making, financial support for small business, online business training, mental health seminars/webinars, baking and pastry training, bamboo cultivation, buy and sell, farming, flower plantation, rice selling, livestock raising and selling used clothing.

Table 6-4. Alternative livelihood for women only

Alternative Livelihood	NR	Percent
Food processing - cheese making, coffee processing	14	19.18
TESDA training on dress making, face mask, eco-bags, curtains, rag making, soap making, mat weaving	14	19.18
Trainings on cosmetology, massage and spa, housekeeping	9	12.33
Cooking viands	6	8.22
Gardening of vegetables and other plants	5	6.85
Handicraft making - mat weaving, slipper making, bamboo stick making, scrub making	5	6.85
Financial support for small business	4	5.48
On-line business trainings	4	5.48
Mental health seminars/webinars, responsible parenting seminars, women empowerment seminars	3	4.11
Baking and pastry training	2	2.74
Bamboo shoot cultivation and harvesting	1	1.37
Buy and sell	1	1.37
Farming	1	1.37
Flower plantation	1	1.37
Rice selling	1	1.37
Livestock raising	1	1.37
Selling used clothing (ukay-ukay)	1	1.37
Total	73	100

Source: Key Informant Interview; NOTE: NR – number of responses

For youth (boys and girls)- The top five alternative livelihood for the youth were sports activities, livelihood programs/trainings, computer literacy trainings, TESDA trainings, and anti-drug campaigns (orange cells in **Table 6-5**). Other suggestions include community service, provision of school supplies, part time job, handicraft making, mental health and spirituality seminars/webinars, multi-purpose projects, values formation seminars, business trainings, teenage pregnancy seminars, faith-based projects, farming, livelihood trainings, and others.

Table 6-5. Suggested projects for youth (boys and girls)

Alternative Livelihood	Frequency	Percent
Sports – volleyball, cycling, basketball	18	17.82
Livelihood programs, trainings	14	13.86
Computer literacy, digital literacy, vlog making, responsible use of social media	7	6.93
TESDA for out of school youth, technical skills	5	4.95
Anti-drug campaigns, drug awareness seminars	4	3.96
Community service – tree planning, barangay beautification projects	4	3.96
School supplies giving books, life skills training	4	3.96
Part time job	3	2.97
Handicraft making - basket making, rag making,	3	2.97
Mental health, spirituality seminars	3	2.97
Multi-purpose projects	3	2.97
Social responsibilities awareness, values formation	3	2.97
Business, business training, small business	3	2.97
Teenage pregnancy seminars	2	1.98
Faith based projects – Bible study, choir	2	1.98
Farming	2	1.98
Livestock and poultry raising	2	1.98

Alternative Livelihood	Frequency	Percent
Livelihood for out of school youth, skills training	2	1.98
Dressmaking training	2	1.98
Scholarship, funding vocational courses	2	1.98
Gardening, bonsai planting	2	1.98
Advocacy to eradicate gadgets	1	0.99
Bonsai planting	1	0.99
Capability building	1	0.99
Clean up drive	1	0.99
Digital library	1	0.99
Environmental awareness webinars/ seminars	1	0.99
Financial management training	1	0.99
Giving gadgets project	1	0.99
Landscaping	1	0.99
Online selling training	1	0.99
Peace and order seminars	1	0.99
Total	101	100

Source: Key Informant Interview; Note: Multiple responses

6.2.3 Capacity Building Program (CBP)

The CBP aims to increase awareness on the importance of the Project, environmental management, and sustained capacities of Ips and other stakeholders through capability building.

Continuing education and training is important for local residents to acquire and upgrade their skills and knowledge. Training topics suggested are highway and environmental management, alternative livelihood, gender sensitivity training, community disaster preparedness, value formation, conflict mediation, organizational development, and the like. It is worthy to not that these topics are part of the IEC advocacy.

A Training Needs Assessment (TNA) via survey equally represented by men and women may be conducted to determine the potentials and interests of the locals. In the case of alternative livelihood, skills training may be done in any of the areas previously mentioned. In addition, alternative livelihood development programs must be done in coordination with LGU, DPWH, TESDA, Tribal Council/NCIP to enable the residents, especially the affected families and IPs to avail themselves of the alternative livelihood projects.

Continuing education is also important for the IPs and other local residents in acquiring and upgrading their skills and knowledge and training on innovations on the previously mentioned topics. Networking among various sectors to mobilize resources and coordinate activities must also be done. Some of the topics for capability building are incorporated under IEC programs.

6.3 INFORMATION, EDUCATION AND COMMUNICATIONS (IEC)

6.3.1 Pre-Screening IEC Activities

The pre-scoping IEC was conducted from March 22 to 24, 2021 at the six host LGUs at the barangay, municipal, and city levels. Basic project information and the ECC application process were presented to the stakeholders. Issues and concerns about the Project were also solicited and responded to. The summary of the IEC conducted, and participants are shown in **Table 6-6.**

Table 6-6. Outline of Pre-Screening IEC for the CMH Project

Province	LGU/ Barangay	Date and Time/ Venue	Number of Attendances	Stakeholders invited
Misamis Oriental	Municipality of Tagaloan ● *Natumolan* ● *Casinglo*	March 24, 2021 2:00 pm/ Tagoloan Central Elementary School, Tagoloan	Total 27 (Male 15, Female12)	Barangay level ● *Barangay officials/ Barangay Council* ● *Senior Citizen Organizations* ● *Youth Organizations* ● *Farmer Associations* ● *PWD Organizations* ● *religious organizations* ● *Indigenous People's organization* ● *Women's Organizations* ● *Transportation Organizations* Municipal level ● *Mayor* ● *Municipal Councilors* ● *Municipal Environmental and Natural Resources Officer/representative* ● *Municipal Health Officer/representative* ● *Municipal Planning and Development Officer/representative* ● *Municipal Engineering Officer/representative* ● *Senior Citizen Organizations* ● *Youth Organizations* ● *Farmer Associations* ● *PWD Organizations* ● *religious organizations* ● *Indigenous People's organization* ● *Women's Organizations* ● *Transportation Organizations*
	Cagayan De Oro City ● *Bugo* ● *Purto* ● *Balubal*	March 24, 2021 10:00 am/ Puerto Barangay Hall, Cagayan De Oro	Total43 (Male 21, Female 22)	Barangay level ● *Barangay officials/ Barangay Council* ● *Senior Citizen Organizations* ● *Youth Organizations* ● *Farmer Associations* ● *PWD Organizations* ● *Religious organizations* ● *Indigenous People's organization* ● *Women's Organizations* ● *Transportation Organizations* City level ● *Mayor* ● *City Councilors* ● *City Environmental and Natural Resources Officer/representative* ● *City Health Officer/representative* ● *City Planning and Development Officer/representative* ● *City Engineering Officer/representative*

Province	LGU/ Barangay	Date and Time/ Venue	Number of Attendances	Stakeholders invited
Bukidnon	Municipality of Manolo Fortich ● *Alae* ● *San Miguel* ● *Damilag* ● *Dicklum* ● *Sankana* ● *Tankulan* ● *Ticala* ● *Mambatangan*	March 22, 2021 2:00 pm/ BRCI Bldg., Diclum, Manolo Fortich	Total 65 (Male 40, Female 25)	*Barangay level* ● *Barangay officials/ Barangay Council* ● *Senior Citizen Organizations* ● *Youth Organizations* ● *Farmer Associations* ● *PWD Organizations* ● *Religious organizations* ● *Indigenous People's organization* ● *Women's Organizations* ● *Transportation Organizations* Municipal level ● *Mayor* ● *Municipal Councilors* ● *Municipal Environmental and Natural Resources Officer/representative* ● *Municipal Health Officer/representative* ● *Municipal Planning and Development Officer/representative* ● *Municipal Engineering Officer/representative*
	Municipality of Sumilao ● *Puntian* ● *Vista Villa* ● *Culasi* ● *Poblacion* ● *Kisolon* ● *San Roque*	March 24, 2021 10:00 am/ Conference Hall, 2nd Floor, New Building, Sumilao	Total 36 (Male 22, Female 14)	*Barangay level* ● *Barangay officials/ Barangay Council* ● *Senior Citizen Organizations* ● *Youth Organizations* ● *Farmer Associations* ● *PWD Organizations* ● *religious organizations* ● *Indigenous People's organization* ● *Women's Organizations* ● *Transportation Organizations* Municipal level ● *Mayor* ● *Municipal Councilors* ● *Municipal Environmental and Natural Resources Officer/representative* ● *Municipal Health Officer/representative* ● *Municipal Planning and Development Officer/representative* ● *Municipal Engineering Officer/representative*
	Municipality of Impasug-ong ● *Poblacion* ● *La Fortuna* ● *Cawayan* ● *Capitan Bayong* ● *Impalutao*	March 23, 2021 2:00 pm/ Conference Hall, Municipal Hall, Impasug-ong	Total 50 (Male 28, Female 22)	*Barangay level* ● *Barangay officials/ Barangay Council* ● *Senior Citizen Organizations* ● *Youth Organizations* ● *Farmer Associations* ● *PWD Organizations* ● *Religious organizations* ● *Indigenous People's organization* ● *Women's Organizations*

Province	LGU/ Barangay	Date and Time/ Venue	Number of Attendances	Stakeholders invited
	• *Kibenton*			• *Transportation Organizations* <u>Municipal level</u> • *Mayor* • *Municipal Councilors* • *Municipal Environmental and Natural Resources Officer/representative* • *Municipal Health Officer/representative* • *Municipal Planning and Development Officer/representative* • *Municipal Engineering Officer/representative*
	City of Malaybalay • *Patpat* • *Kalasungay* • *Sumpong* • *Dalwangan* • *Brg.10*	*March 23, 2021* *10:00 am/* Casisang Covered Court, Malaybalay City	Total 44 (Male 28, Female 14)	<u>*Barangay level*</u> • *Barangay officials/ Barangay Council* • *Senior Citizen Organizations* • *Youth Organizations* • *Farmer Associations* • *PWD Organizations* • *Religious organizations* • *Indigenous People's organization* • *Women's Organizations* • *Transportation Organizations* <u>City level</u> • *Mayor* • *City Councilors* • *City Environmental and Natural Resources Officer/representative* • *City Health Officer/representative* • *City Planning and Development Officer/representative.* • *City Engineering Officer/representative*

6.3.2 Stakeholder issues and concerns

The common issues raised during the IEC were compensation of affected properties and IP concerns on consent and intrusion to sacred lands (Table 6-7). The reader is referred to **Annex 14** for the details of the issues and responses.

Table 6-7. Summary of major issues and concerns during the IEC

Host LGU	Major issues and concerns
Municipality of Tagoloan	- Project design (whether or not the road is elevated) - Presence of informal settlers - Necessity of the Project - Project timeline - Resettlement - Presence of IP sacred places - Compensation of the affected properties and untitled lands - Safety - Formulation of the MMT and source of the EGF

Cagayan de Oro City	- Compensation of affected properties - Duration of compensation payment - Compensation for environmental damages
Municipality of Manolo Fortich	- Difference between the proposed highway and the 'Build, Build, Build' project of the government - Conflicts in boundary and right of way - Managing opposition to the Project - Compensation of affected properties - FPIC application - Political change of administration - Existing government projects that might be affected (e.g. irrigation) - Construction waste
Municipality of Sumilao	- Rationale of the Project in the presence of the existing road from Cagayan de Oro to Malaybalay - Toll fee - Environmental considerations in the design (e.g. landslide prone areas in San Vicente in Maluko) - IP consent - Public participation in the project - Compensation of affected landowners
Malaybalay City	- Source of Project funding - Issue of eminent domain - Property demolition and payment - Informing affected property owners - Compliance to FPIC - Coordination between Regional and District DPWH - Coordination with LGU - Affected trees - Secure LGU endorsement

6.3.3 The IEC framework

The IEC framework in this context is a tool to provide the correct and appropriate Project information through different media and materials to the stakeholders at the same time solicit feedback to the proponent on the stakeholders' understanding of the issues and concerns about the Project.

It is also a strategy or approach aimed at changing or reinforcing a set of behaviors in a target population involving a specific issue. The activity is vital in establishing support, linkages, and participation of the stakeholders to generate awareness, informed opinions and views, and suggestions to eventually stimulate support in the implementation of development activities. The IEC activities need to have an appropriate context mindful of the influence of underlying social, cultural, economic, and environmental conditions and producing IEC materials in the local dialect. The strategies that may be adopted are enumerated below.

a) **Use of billboards and signages** posted on public or conspicuous places to display the important features of the highway project to generate enhanced public awareness about the project.
b) **Printed communications and mass media.** The former may take the form of brochures, leaflets, posters, wall calendars, desktops, flip charts, or giveaways. Mass media may include television, radio and audio-visual presentations and other forms of electronic communication, i.e., use of DVDs/VCDs containing taped productions about DPWH and the highway project. The following may be incorporated in IEC and advocacy efforts:

    - Highway development

- DPWH corporate social responsibility and social development programs
- Environmental conservation and management
  - Sustainable farming and indigenous knowledge management
  - Solid waste management
  - Climate change and global warming
  - Disaster preparedness, risk reduction and management
- Others: Alternative livelihood, Conflict transformation, Gender sensitivity training, etc.

Public consultations are needed to generate views, opinions, interest, and suggestions/approaches. IEC will primarily consist of information dissemination and advocacy to enlighten the stakeholders about the nature and design of the highway project and environmental consciousness. The variations of IEC may use print or visual, television, or radio as forms of mass media with the following as strategies:

a. Distribution of pamphlets, fact sheets, flyers, and brochures both in English and in Cebuano local dialect
b. Maintaining community billboards in strategic places
c. Barangay assembly meetings and presentations
d. Conduct of workshops and focus group discussions
e. Media: tv, radio programs and internet
f. Publication of a regular newsletter for the IEC or project publications thru CD
g. Text brigade of messages on environmental conservation

As part of the EIA study, the responses on the concerns of the stakeholders that were made during the IEC were answered, continuous IEC activities with stakeholders throughout all the stages of the project will be conducted. The DPWH will closely coordinate with the host LGUs to maintain transparency during the activity.

The proposed IEC for IPs and non-IPs local residents and LGU/GAs are shown in Table 6-8 and Table 6-9 respectively. The initial cost of the IEC during the pre-construction and construction is estimated to be between PhP 3 to PhP 5 million. In the operational phase, a minimum annual budget of PhP500,00.00 may be allocated for the purpose.

Table 6-8. Proposed IEC for IPs

Target sector identified as needing project IEC	***Major topic of concern in relation to project***	***IEC scheme/strategy/ methods***	***Information Medium***	***Indicative timelines and frequency***	***Indicative cost***
Tribal men/women leaders (Datu/Bae) Members of IP Org.	· CMH development · · CMH corporate social responsibility and social development programs	· Printed information about the proposed project · Oral presentation (meetings/forum) · Radio program ·	· Pamphlets, fact sheets, flyers, brochures in local dialect · Assembly meetings · Radio · Billboards/ · Tarpaulin	2024-2025	PhP 1 million
Tribal men/women leaders (Datu/Bae) Members of IP	· Environmental conservation and management To cover · Alternative livelihood · Sustainable farming	· Oral presentation · Handouts ·	· Assembly meetings · Workshops and · Discussions ·	2024-2025	PhP 1 million

Orgs.	and indigenous knowledge management · Conflict Management · Climate change and global warming · Disaster preparedness, risk reduction and management · Others: Solid waste management, Gender Sensitivity, etc ·				

Table 6-9. Proposed IEC for non-IP local residents and LGU/GAs

Target sector identified as needing project IEC	*Major topic of concern in relation to project*	*IEC scheme/strategy/ methods*	*Information medium*	*Indicative timelines and frequency*	*Indicative cost*
Local residents, LGU and govrnment agencies in the DIB	· Highway development and CMH · CMH corporate social responsibility and social development programs	· Printed information about the Project · Oral presentation (meetings/forum) · Radio program	· Pamphlets, fact sheets, flyers, brochures in local dialect · Assembly meetings · Radio · Billboards/Tarpaulin	2024-2025	PhP 1 million
· Local residents in project areas and IIA · LGU and government agencies in the direct impact cities and municipalities	Environmental conservation and management to cover: · Sustainable farming and indigenous knowledge management · Climate change and global warming · Disaster preparedness, risk reduction and management · Conflict transformation · Gender sensitivity training · Others: Solid waste management, sex education, etc	· Oral presentation · Handouts	· Assembly meetings · Workshops and · Discussions ·	2024-2025	PhP 1million

6.4 Public Participation

6.4.1 Public Scoping Meeting

Scoping is another activity where the public can participate in the Philippine EIA process. The Public Scoping was conducted following the EMB Memorandum Circular No. 2020-30 "Interim Guidelines on Public Participation in the Implementation of the Philippine Environmental Impact Statement System (PD 1586) During the State of National Public Health Emergency". Participants of face-to-face meetings were limited according to local ordinances and the Inter-Agency Task Force (IATF) directives. In consideration of this, virtual meeting rooms via Zoom TM were provided to accommodate stakeholders where internet connections are available. Regarding this, locations with adequate ventilation have been put into place to comply with the laws enforced by the government. The public scoping was conducted in combination of English, Filipino and local language (Cebuano) for stakeholder's understanding during the presentation and open forum. According to the protocol, and the laws enforced by the government, ensured that necessary hygiene measures, such as masks and alcohol sanitizer, were in place and keeping distance between seats was maintained for participants in face-to-face sessions. The venue was selected in well-ventilated areas, such as outdoor basketball courts.

Table 6-10 Summary of the Scoping Meeting

Province	City/Municipality	Date and Time	Number of Attendances Total (Male , Female)
Misamis Oriental	Tagoloan, Misamis Oriental	May 28, 2021 10:00-12:00	46 (18, 28)
	Cagayan de Oro City, Misamis Oriental	May 31, 2021 10:00-12:00	37 (25, 12)
Bukidnon	Manolo Fortich, Bukidnon	June 1, 2021 10:00-12:00	67 (41, 26)
	Sumilao, Bukidnon	June 2, 2021 10:00-12:00	35 (18, 17)
	Malaybalay City, Bukidnon	June 3, 2021 10:00-12:00	56 (24, 32)
	Impasug-ong, Bukidnon	June 4, 2021 10:00-12:00	53 (34, 19)

The series of Public Scoping meetings were attended by representatives of the stakeholders from the host LGUs initially identified during the pre-scoping IEC. A total 338 participants (onsite: 176 and online: 162) from different social groups such as NGO, youth, LGBT, and women's associations, and representatives of Central/Regional/Local Government officers joined the meeting.

The open forum provided the avenue for the participant stakeholders to express their opinions and comments or ask questions and clarifications about the project and its potential impacts. The salient issues and concerns raised by city and municipality are summarized below.

<u>Issues raised in Tagoloan, Misamis Oriental</u>

a) Road alignment traversing the water reservoir that the community uses as a water source.
b) Water reservoir should be avoided and not be damaged during construction.
c) Compensation for affected lands and houses
d) Aggravation of flooding along the national highway in Barangay Casinglot
e) In Casinglot, our water reservoir will be affected. What will happen to our water reservoir?
f) Projects or programs for women

Issues raised in Cagayan de Oro City

a) Compensation of affected landowners
b) Compensation for the affected animals
c) Road amenities and local permits
d) Flooding due to overflowing of the canal on the hillside part of Bugo
e) Measures during construction to prevent debris to lower portions
f) Measures for rain induced landslide.

Issues raised in Manolo Fortich, Bukidnon

a) Compensation for affected residential areas and trees
b) Abiding with IP process during the detailed design
c) Mitigation for affected flora and fauna in forested areas
d) Assessment of cultural impacts

Issues raised in Sumilao, Bukidnon

a) Livelihood opportunities
b) Compensation for affected farms
c) Compliance with Free and Prior Informed Consent requirements
d) Relocation

Issues raised in Malaybalay, Bukidnon

a) Compensation of affected lands
b) Compliance with FPIC requirements
c) Identification of the affected roads
d) Classification of the High Standard Highway
e) Toll fee

Issues raised in Impasug-ong, Bukidnon

a) Noise impacts on poultry farms especially from Manolo to Malaybalay
b) Possible access hindrance along the Atugan river
c) Compensation and relocation for affected households Possible re-alignment to avoid infrastructure
d) Impact of the alignment to two irrigation canal structures in San Juan and La Fortuna proper
e) Impact on banana and pineapple plantations
f) Mitigation of impact on the main water line and reservoir
g) Compensation for affected agricultural land
h) Conduct of IP rituals prior to any Project activity

Questions were raised during the open forums regarding the Project description and impacts on the environment. Some barangays raised the same concern while majority of the concerns were focused on resettlement and compensation. The issues and concerns were responded by representatives from the DPWH as the proponent, JICA Study Team, and DENR-EMB. The issues and concerns are enumerated below:

Table 6-11. Summary of the Scoping Meeting

Comment, Questions and Suggestions	Answers
Project Description - *Presence of policy/ordinances for the construction of highway and hierach of arterial and the inclusion of lightning facilities, warning signs and requirements included in the budget.*	- *Information will be obtained on the detailed engineering design and will coordinate with the LGU* - *Proper coordination with LGU will be conducted*

- *Identification of affected roads if there will be barangay road*	
Land - *What measures should be done so that the debris will not go to the lower portion during construction.* - *Identification of disposa site in the plan prior to construction*	- *Geohazard assessment will be conducted and mitigation measures will be done* - *This will be included in the plan and how the wastes will be disposed will be strictly monitored*
Water - *A common concern among the barangays is flooding once the project construction and operation starts.*	- *Flood prone areas will be studied and road alignment will be designed to mitigate flooding*
People - Presence of projects and programs for livelihood for women were asked. - Hoping for the issues and concerns of the IPs in terms of cultural impacts are included in the report - Compensation issues for untitled lands and no legal documents	- *Livelihood project for the women sector will be considered alongside with other sectors in line with GAD* - *The culture sensitivity will be included in the report. Interview will be conducted to determine the lifestyle and practices of the cultural communities*

6.4.2 Public Hearing

The Public Hearing conducted in the affected City of Cagayan de Oro, Municipalities of Tagoloan, Manolo Fortich, Sumilao, and Impasug-ong, and City of Malaybalay achieved the following objectives: presentation of the results of the environmental impact assessment done by sector: Land, Water, Air, and People; and documentation of issues and concerns of the stakeholders on the results of the studies conducted on the proposed project. The aspects that were identified and suggested by the stakeholders during the meeting were documented.

The series of Public Hearing meetings were attended by representatives of the stakeholders from the host LGUs initially identified during the Public Scoping. A total of 178 representatives participated in the meeting.

On September 22, 2023, the Notice of Public Hearing and the copy of the Environmental Impact Assessment (EIA) and Executive Summary for Public (ESP) in two (2) languages, Filipino and English were posted on the EMB website. The notice indicated October 11 to 13, 2023 at 9 o'clock in the morning as the date and time of the hearing to be conducted onsite and online via Zoom. It also included a brief description of the project and information on where to get a copy of the project's EIS which was made available at the EMB website.

Table 6-12 shows the summary of the public hearing meetings.

A copy of the Notice of Public Hearing is provided in **Annex17**. In addition to the website posting, the notice of hearing was published in the national newspaper Daily Tribune on September 25 and October 2, 2023. This was done in accordance with DAO 2017-05, Guidelines on Public Participation under the Philippine Environmental Impact Statement (EIS) System. Copy of the Affidavit of Publication from Daily Tribune is provided in **Annex 17**.

Letters of invitation were also sent to the following offices/groups/organizations:
- Municipal and City Local Government Units and concerned departments
- Affected barangay LGUs
- Non-Government Organizations
- Local Groups/Organizations

Table 6-12. Outline of Public Hearing

Province	City/Municipality	Venue	Date and TIme	No. of Attendances
Misamis Oriental	Tagoloan and Cagayan De Oro City	Congressional office - Balay Ninotchka Tagoloan, Misamis Oriental	October 11, 2023 9:00 am to 5:00 pm	Total 61 (40 males and 21 females)
Bukidnon	Sumilao and Malaybalay City	2nd Flr., New Bldg., Sumilao Municipal Hall	October 12, 2023 9:00 am to 5:00 pm	Total 66 (46 males & 20 females)
Bukidnon	Impasug-ong and Manolo Fortich	Kaamulan Folk Arts Theatre Kaamulan	October 13, 2023 9:00 am to 5:00 pm	Total 51 (29 males & 22 females)

Issues and Concerns Issues raised in Cagayan De Oro and Tagoloan, Misamis Oriental

Participated in by a total of 61 stakeholders (40 males & 21 females) from pertinent government agencies, local government units, civil society organizations in the locality, the following are the general issues and concerns raised during the forum:

a) Road alignment impact to the traffic congestion in Tagoloan, Misamis Oriental
b) Aggravation of flooding and landslides along Brgy. Bugo, Cagayan De Oro
c) Measures for identifying the properties and families to be affected by flooding and landslide
d) Multipartite Monitoring Team (MMT) purpose and function
e) Necessary documents and papers to be prepared for land negotiation for those to be affected
f) Measures to consider for planning of drainage system: climate projection, history and amount of rainfall volume and the sea level rise.
g) Measures on monitoring of the sand/gravel quarrying by the provincial government to safeguard the river in compliance with the standards set by MGB and EMB.
h) Suggestion to include planting strips for green spaces in highway design considering that Cagayan De Oro is one of the green cities in the country.
i) Inquiry on whether the feasibility study includes specific designated places for the electrical posts and drainage.
j) Highway structures caused also accidents since there are roads that have too many curves or zigzags
k) Incorporation of the 4 lanes to avoid posts and plants that remain as observed in the past with road widening.
l) Inquiry if this project will affect the Metro Rail Project for Mindanao
m) Other Matters: These need to be brought to the attention of the DPWH District Office.
  - There are other existing JICA projects that have caused environmental damage such as the perennial flooding problem in Bugo, CDO.
  - In Bugo National High School, there is an existing pipe from which mud flows thereby filling the ground floor of the school.

Issues raised in Sumilao and Malaybalay City, Bukidnon

Participated by a total of 66 stakeholders (46 males & 20 females) coming from government agencies, local government units, civil society organizations in the locality, the following are the general issues and concerns raised during the forum:

a) Road alignment traversing the specific barangays and schools
b) Compensation on affected of untitled lands and landowners
c) Issue of genuine claimant of real property
d) Request of tax declaration documents

e) IPs' lump-sum payments should be different for several barangays and holding of rituals are believed to be protection for untoward incidents
f) Toll fee
g) Safety features of a high standard highway with 80 kilometers per hour - emergency safety area
h) Other Matters
  - Mt Kitanglad circumferential road: Observed to have environmental damage and should be monitoring of TSS in the rivers.
  - Another project near the Atugan River regarding the New Sayre highway project where private properties were included: no consultations and corresponding payments to owners have not been done

Issues raised in Manolo Fortich and Impasug-ong Bukidnon Cluster

Participated in by a total of 51 stakeholders (29 males & 22 females) coming from government agencies, local government units, civil society organizations in the locality, the following are the general issues and concerns raised during the forum:

a) Road alignment traversing the specific barangays and houses
b) Conduct of IP rituals prior to any Project activity
c) Compensation to affected land and crops of IPs
d) Design for relocation and specific area for the relocation site of affected people
e) Clarification on the role of the DPWH District
f) Request for the file of the proposed road alignment for planning purposes of LGU
g) Basis and standard payment for land and crops.
h) Land ownership status and documents of the affected lands
i) Other Matters
  - Issue of unpaid affected lands until the present citing the case of a bridge whose landowner is demanding for a toll fee

Questions were raised during the open forums regarding the Project description and impacts on the environment. Some barangays raised the same concern while majority of the concerns were focused on resettlement and compensation. The issues and concerns were responded by representatives from the DPWH as the proponent, JICA Study Team, and DENR-EMB. The issues and concerns are enumerated below:

Table 6-13. Summary of comments, questions and suggestion during Public Hearing

No.	Comment, Questions and Suggestions	Answers
1	***Project Alignment*** - *Impact to traffic congestion* - *Request for the file of the proposed road alignment for planning purposes of LGU* - *Suggestion to include planting strips for green spaces in highway design*	- *This alignment was chosen as this is the most economical and to relieve traffic.* - *The file of the TIS thatw as submitted for applying for ECC will be not issued until the ECC is issued* - *The suggestion is noted and will be evaluated if it can be added to the current design.*
2	***Water and Land*** - Aggravation of flooding and landslides in some areas - Measures for identifying the properties and families to be affected by flooding and landslide	- *Will be addressed during the detailed engineering design. As part of this study, natural drainage systems will be studied* - *There will be MMT and there will be representatives coming from barangays. So in during monitoring, concern such as flooding particularly on Brgy. Bugo will be addressed and mitigated*

3	***Water*** - Measures to consider for planning of drainage system, climate projection, history and amount of rainfall volume and the sea level rise	- *This will be considered in the detailed engineering design and a hydrologist will be available and will coordinate with LGUs because of the need of secondary data aside from the primary data from other agencies*
4	***People*** - Holding rituals are believed to be protection for untoward incidents - Compensation for the affected of untitled lands and landowners. Necessary documents and papers to be prepared for land negotiation for those to be affected	- *This is noted. Conduct of the holding of rituals and conduct it per barangay so that no accident will happen and is also protection for those who will do the construction.* - *The construction will not start until the land acquisition is not finished or the land owner received the payment.* - *Guided by Republic Act 10752, also known as the Right-of-Way Acquisition Act. There is a commissioned third-party appraiser authorized by the Bangko Sentral ng Pilipinas to be neutral so, there will be a fair and just assessment and evaluation of the property that will be affected*
5	**Others** - Multipartite Monitoring Team (MMT) purpose and fu	- MMT comes from the different stakeholders. from the government to represent. Usually, the monitoring is quarterly. Unless there is a really special team meeting as to where to complain, the MMT can also accept complaints, and the MMT will take care of them.

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Chapter 7 – Grievance Redress Mechanism

7.1 Objectives of the Grievance Redress Mechanism

The Grievance Redress Mechanism (GRM) is an effective tool for early identification, assessment, and resolution of complaints on projects. GRM will serve as a venue for receiving aggrieved stakeholders' concerns and acting on the concerns, but it does not hinder them from their right to judicial action if the decision is unacceptable. The DPWH will establish a GRM with these objectives:

- Receive and facilitate the resolution of the stakeholders' concerns and grievances about environment-related project impacts, which cannot be settled during public consultations, paying particular attention to the impacts on vulnerable groups;
- Measure to the risks and adverse impacts of the project; and
- Address project stakeholders' concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the country's judicial or administrative remedies.

7.2 Information Dissemination

GRM will be established during the DED Stage. The Unified Project Management Office (UPMO) will consult the affected people through their representative and make necessary revision in this GRM to make this more effective. This will ensure the stakeholders are aware of the existence of this GRM. The consultation includes providing the contact information of the UPMO (hotlines, email, etc.)

7.3 Levels of Grievance Redress Mechanism

The GRM is composed of four (4) levels (Table 7-1). The Grievance officer of DPWH-UPMO will be the contact point for receiving the grievances/complaints from the stakeholders.

Table 7-1. Levels Of Grievance Redress Mechanism

Level	Environment Issue	Health and Safety Issue	Timeline
Contact Point	Grievance Officer of DPWH-UPMO		Same day
1st Level	HSEO of UPMO		3 working days
2nd Level	HSEC		7 working days
3rd Level	MMT	DPWH	15 working days
4th Level	DENR EMB	Court of Justice	

Note: HSEO – Health, Safety and Environment Officer, HSEC - Health, Safety and Environment Committee, MMT – Multipartite Monitoring Team

As part of the basic policies for the GRM, a grievance will be resolved in a timely manner at the lowest level possible. However, (a) if not settled at the lowest level, (b) if the aggrieved stakeholders are not satisfied with the action taken, or (c) the case is not acted upon after 15 days, the issue or concern will be taken to the next level.

The DENR and the Court of Justice will be the final decision maker for the complaint and grievance. All cases elevated to the 4th level will be outside the jurisdiction and control of this GRM.

7.4 Roles and Responsibilities

7.4.1 The Grievance Officer of DPWH-UPMO

The Grievance Officer will be appointed as a complaint contact point of DPWH-UPMO to receive all project-related complaints. The Grievance Officers will be provided with sufficient training prior to deployment.

The following are the roles and responsibilities of the Grievance Officer of the DPWH-UPMO:

- Screening of complaint if it is project-related or not. If the complaint is project-related (health, safety, and environment issue), the complaint will be forwarded to the HSEO, HSEC or MMT. If the complaint to the appropriate agency or LGUs who will act on the complaint.
- Receiving the written, verbal or electronically forwarded complaint from the aggrieved stakeholder and explaining the grievance redress process. Acknowledge receipt (and entering it into the records) of the complaint and provide a copy of the complaint including the contact details where the complaint will be forwarded and who will act on it within the day of receipt.
- Constant communication with the with the aggrieved stakeholder.
- Following up with the HSEO, HSEC, and/or MMT on their action on the complaint.
- Providing feedback to the UPMO on the status of the complaint and corresponding action/decision of the HSEO, HSEC, and/or MMT.
- Maintaing records of the complaints and corresponding actions and decisions. Prepare reports on Grievance Redress.

7.4.2 1st Level: Health, Safety and Environment Officer (HSEO)

The HSEO will be responsible for receiving, assessing, evaluating, and providing findings and recommendations on the complaints forwarded by the Grievance Officer. In addition, the HSEO will:

- Act and decide within three (3) working days on the complaint forwarded by the Grievance Officer.
- Provide feedback to the aggrieved stakeholder on the status and/or decision of the complaint through the Grievance Officer.

7.4.3 2nd Level: Health, Safety and Environment Committee (HSEC)

The HSEC, composed of HSEO, General Contractor, and Contractor, will be responsible to receive all complaints forwarded by the Grievance Officer. In addition, the HSEC will:

- Discuss forwarded grievances on regular meetings.
- Act and decide within 10 working days on the complaint forwarded by the Grievance Officer.
- Provide feedback to the aggrieved stakeholder on the status and/or decision of the complaint through the Grievance Officer.

7.4.4 3rd Level: MMT / DPWH

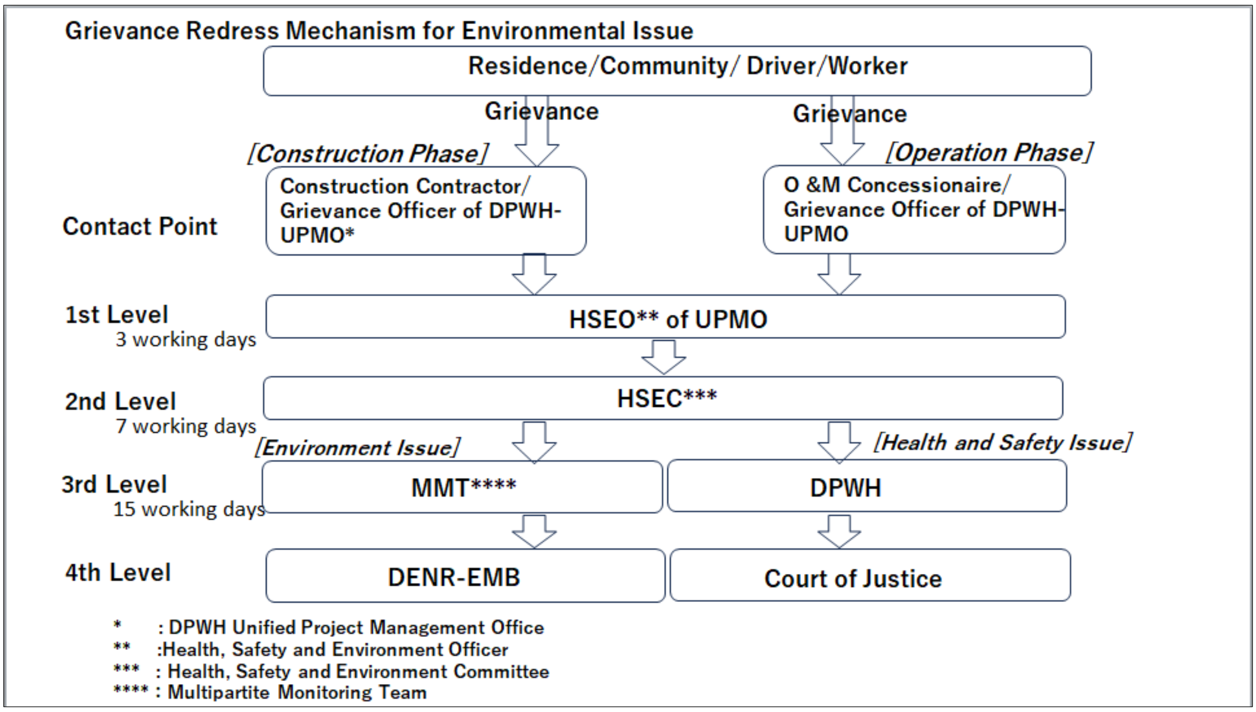
The UPMO will initiate the formation of the MMT in accordance with DAO 2017-15. Part of the responsibilities of the MMT is to handle environmental issues while health and safety issues will be handled by the DPWH. In addition, the two bodies will:

- Convene immediately once a complaint forwarded by the Grievance Officer has not been resolved in the 1st and 2nd level.
- Act and decide within 15 working days on the complaint filed by aggrieved stakeholder who is not satisfied with the action or decision of HSEC.
- Provide feedback to the aggrieved stakeholder on the status and/or decision of the complaint through the Grievance Officer.

7.4.5 4th Level: DENR

Issues related to the environment not addressed in the third level will be elevated to DENR-EMB.

Figure 7-1. Diagram flow for handling complaints regarding environmental aspects during construction and operation stage.



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Chapter 8 ENVIRONMENTAL COMPLIANCE MONITORING

The Environmental Compliance Monitoring (ECM) system ensures compliance to environmental laws which in turn minimizes the adverse effects of a Project to its immediate surroundings and protects health of the affected public. The ECM system specified by MC 2010-14 is composed of three components: a) Self-Monitoring Plan, b) multi-sectoral monitoring framework (for ECPs and EIS-based non-ECPs as deemed necessary by EMB Regional Office), and c) the Environmental Guarantee and Monitoring Fund Commitment (for ECPs and EIS-based non-ECPs as deemed necessary by EMB Regional Office).

Screening of the project using Annex A of the EMB Memorandum Circular 005 July 2014 classifies the proposed CMH as Category A: ECP project (*3.4.1 Roads, new construction*). The required document for the ECC application is the Environmental Impact Statement (EIS) submitted to the EMB-Central Office for review and subsequent issuance of the ECC.

8.1 SELF-MONITORING PLAN (SMP)

The proposed SM Plans during the pre-construction, operation, and abandonment phases formulated using the recommended format in Annex 2-20 of RPM DAO 2003-30 are shown in **Table 8-1**, **Table 8-2**, and **Table 8-3**. A qualitative SMP for environmental aspects with no standard is also included (**Table 8-4**).

The final SMP shall be formulated once the ECC has been issued. The more detailed SMP will establish the final Environmental Quality Performance Levels (EQPL) for monitoring, budget, accountability, stakeholder participation, complaints management, communication and reporting, environmental impact event/action response plan, audit program and schedule for baseline monitoring and preparation of the environmental management audit manual. Initially, the SMP will shall have the following objectives:

a. Ensure that all emissions and effluents as a result of the Project are according to DENR Rules and Regulations which include but not be limited to RA 8749 (Clean Air Act) and PD 984 (Pollution Control Law), PD 1586, RA 6969;
b. Validate the changes in the various environmental media (impact monitoring) as discussed in the impact assessment.
c. Provide early warning information of unacceptable environmental conditions; and
d. Encourage stakeholder participation.

The initial conditions to calculate the EQPL Alert, Action, and Limit values are enumerated below.

a) ALERT - 85% of the LIMIT
b) ACTION – 90% of the LIMIT
c) LIMIT – 90% of the threshold (CAA, WQG, Dutch Soil standards)

Table 8-1. Quantitative Self-Monitoring Plan during construction

Key environmental aspects per project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Estimated annual cost (Philippine Peso)	EQPL MANAGEMENT SCHEME					
			Method	Frequency	Location			EQPL range (a)			Management measure		
								ALERT	ACTION	LIMIT	ALERT	ACTION	LIMIT
Preparation of staging areas, Site preparation, Road construction, Construction of major components, Dismantling of staging areas	(LC) Soil contamination	Arsenic	(c)	Quarterly	Staging areas	(i)	Quarterly monitoring cost: 300,000	42.075	44.55	49.5	(n)	(o)	(p)
	(LC) Soil contamination	BTEX - Benzene	(b)	Quarterly	Staging areas	(i)		0.8415	0.891	0.99	(n)	(o)	(p)
	(LC) Soil contamination	BTEX - Ethylbenzene	(b)	Quarterly	Staging areas	(i)		244.8	259.2	288	(n)	(o)	(p)
	(LC) Soil contamination	BTEX - Toluene	(b)	Quarterly	Staging areas	(i)		84.15	89.1	99	(n)	(o)	(p)
	(LC) Soil contamination	BTEX - Xylenes	(b)	Quarterly	Staging areas	(i)		13.005	13.77	15.3	(n)	(o)	(p)
	(LC) Soil contamination	Cadmium	(c)	Quarterly	Staging areas	(i)		9.18	9.72	10.8	(n)	(o)	(p)
	(LC) Soil contamination	Chromium	(c)	Quarterly	Staging areas	(i)		290.7	307.8	342	(n)	(o)	(p)
	(LC) Soil contamination	Lead	(c)	Quarterly	Staging areas	(i)		405.45	429.3	477	(n)	(o)	(p)
	(LC) Soil contamination	Mercury	(c)	Quarterly	Staging areas	(i)		7.65	8.1	9	(n)	(o)	(p)
Preparation of staging areas, Site preparation, Road construction, Construction of major components, Dismantling of staging areas	(AC) Ambient air pollution	24h TSP	(d)	Quarterly	(q)	(i)	Quarterly monitoring cost: 500,000	175.95	186.3	207	(n)	(o)	(p)
	(AC) Ambient air pollution	24h PM10	(d)	Quarterly	(q)	(i)		114.75	121.5	135	(n)	(o)	(p)
	(AC) Ambient air pollution	24h SO_2	(e)	Quarterly	(q)	(i)		137.7	145.8	162	(n)	(o)	(p)
	(AC) Ambient air pollution	24h NO_2	(f)	Quarterly	(q)	(i)		114.75	121.5	135	(n)	(o)	(p)
	(AC) Noise pollution	Sound levels	(k)	Quarterly	(q)	(i)		1dB (l)	2dB (l)	2dB (m)	(n)	(o)	(p)
Preparation of staging areas, Site preparation, Road construction, Construction of major components,	(WC) Stream pollution	Arsenic	(g)	Quarterly	(h)	(i)	Quarterly monitoring cost: 300,000	0.0153	0.0162	0.018	(n)	(o)	(p)
	(WC) Stream	BOD	(g)	Quarterly	(h)	(i)		5.355	5.67	6.3	(n)	(o)	(p)

Key environmental aspects per project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Estimated annual cost (Philippine Peso)	EQPL MANAGEMENT SCHEME					
			Method	Frequency	Location			EQPL range (a)			Management measure		
								ALERT	ACTION	LIMIT	ALERT	ACTION	LIMIT
Dismantling of staging areas	pollution												
	(WC) Stream pollution	Cadmium	(g)	Quarterly	(h)	(i)		0.003825	0.00405	0.0045	(n)	(o)	(p)
	(WC) Stream pollution	COD	n/a	n/a	n/a	n/a		No WQG value			n/a	n/a	n/a
	(WC) Stream pollution	Color	(g)	Quarterly	(h)	(i)		57.375	60.75	67.5	(n)	(o)	(p)
	(WC) Stream pollution	Cyanide as Free CN-	(g)	Quarterly	(h)	(i)		0.0765	0.081	0.09	(n)	(o)	(p)
	(WC) Stream pollution	DO	(g)	Quarterly	(h)	(i)		3.825	4.05	4.5	(n)	(o)	(p)
	(WC) Stream pollution	Fecal Coliform	(g)	Quarterly	(h)	(i)		153	162	180	(n)	(o)	(p)
	(WC) Stream pollution	Hex Chromium (Cr^{6+})	(g)	Quarterly	(h)	(i)		0.00765	0.0081	0.009	(n)	(o)	(p)
	(WC) Stream pollution	Lead	(g)	Quarterly	(h)	(i)		0.03825	0.0405	0.045	(n)	(o)	(p)
	(WC) Stream pollution	Mercury	(g)	Quarterly	(h)	(i)		0.00153	0.00162	0.0018	(n)	(o)	(p)
	(WC) Stream pollution	Nitrate (NO$_3$-N)	(g)	Quarterly	(h)	(i)		5.355	5.67	6.3	(n)	(o)	(p)
	(WC) Stream pollution	Oil and Grease	(g)	Quarterly	(h)	(i)		1.53	1.62	1.8	(n)	(o)	(p)
	(WC) Stream pollution	pH	(g)	Quarterly	(h)	(i)		4.7 - 5.3	5.36 - 7.3	5.8 - 8.1	(n)	(o)	(p)
	(WC) Stream pollution	Phosphate	(g)	Quarterly	(h)	(i)		0.3825	0.405	0.45	(n)	(o)	(p)
	(WC) Stream pollution	Chloride	(g)	Quarterly	(h)	(i)		267.75	283.5	315	(n)	(o)	(p)
	(WC) Stream pollution	Sulfate	(g)	Quarterly	(h)	(i)		210.375	222.75	247.5	(n)	(o)	(p)
	(WC) Stream	Surfactants	(g)	Quarterly	(h)	(i)		1.1475	1.215	1.35	(n)	(o)	(p)

Key environmental aspects per project phase	**Potential impacts per environmental sector**	**Parameter to be monitored**	**Sampling & Measurement Plan**			**Lead person**	**Estimated annual cost (Philippine Peso)**	**EQPL MANAGEMENT SCHEME**					
			Method	Frequency	Location			EQPL range (a)			Management measure		
								ALERT	ACTION	LIMIT	ALERT	ACTION	LIMIT
	pollution	(MBAS)											
	(WC) Stream pollution	Temperature	(g)	Quarterly	(h)	(i)		24.8	25.11	27.9	(n)	(o)	(p)
	(WC) Stream pollution	TSS	(g)	Quarterly	(h)	(i)		61.2	64.8	72	(n)	(o)	(p)

NOTES: LC – Land Component; AC – Air Component; WC – Water Component; TDB – to be determined prior to start of construction. In the vicinity of staging areas and active construction sites

(a) EQPL values: Limit = 90% of the standard; Alert ✇85% of Limit; Action ✇90% of Limit; Final values for limits, action, and alert levels will be determined from monitoring data; Units: ug/ncm for ambient air, mg/li for water quality parameters, decibel for sound
(b) USEPA Method 8260B Btex
(c) EPA Method 3050B metals in soil
(d) Sampling method: 24h High Volume Sampler; Analytical method: Gravimetric USEPA 40 CFR, Part 50, Appendix B
(e) Sampling method: 24-hr Gas Bubbler; Analytical method: Pararosaniline Method
(f) Sampling method: 24-hr Gas Bubbler; Analytical method: Griess-Saltzman or Chemiluminescence Method
(g) EMB Approved Methods of Analysis for Water and Wastewater (EMB Memorandum Circular #012 Series of 2016)
(h) Location and coordinates of surface water monitors

Station ID	River	Latitude	Longitude
WQ1	Tagoloan River	8.52971N	124.78861E
WQ2	Dicklum River	8.35425N	124.84182E
WQ3	Kumaykay Stream	8.34422N	124.87815E
WQ4	Puntian River	8.29619N	124.91088E
WQ5	Tagalongon River	8.29878N	124.92311E
WQ6	Mapolo River	8.31123N	124.96838E
WQ7	Ipoon River	8.21708N	125.02844E
WQ8	Komotal River	8.21528N	125.03030E
WQ9	Sawaga River	8.17999N	125.05012E
WQ10	Sawaga River	8.16246N	125.11364E

(i) Contractor
(j) Monitoring included in total construction cost
(k) Noise meter with data logger @ 5-min intervals
(l) above the Limit
(m) less than DENR EQSN for a particular time and category
(n) ID pollutant source (construction activity or equipment)
(o) Implement appropriate corrective action at identified pollutant source

(p) Temporary stoppage or replacement of identified construction activity or equipment

(q) Location and coordinates of ambient AQ and sound monitors

Station ID	**Barangay**	**Latitude**	**Longitude**
AQ1	Zone 2B, Casinglot	124.757942	8.515825
AQ2	Purok 7, Mambatangan	124.800872	8.463833
AQ3	Zone 4, Alae	124.804962	8.412193
AQ4	Zone 1, Diclum	124.852996	8.371687
AQ5	Purok 4, San Roque	124.933255	8.329792
AQ6	San Antonio	124.983626	8.312317
AQ7	Purok 7, La Fortuna	124.996892	8.266137
AQ8	Zone 3, Impalutao	125.028944	8.232600
AQ9	Zone 9, Patpat	125.053188	8.195157
AQ10	Casanova St. Kalasungay	125.113440	8.165801

Table 8-2. Quantitative Self-Monitoring Plan during operation

Key environmental aspects per project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Estimated annual cost	EQPL MANAGEMENT SCHEME					
			Method	Frequency	Location			EQPL range (a)			Management measure		
								ALERT	ACTION	LIMIT	ALERT	ACTION	LIMIT
Opening of the CMH to traffic Regular maintenance road, bridges, interchanges, underpass, overpass, and other components	(AC) Ambient air pollution	24h TSP	(d)	Quarterly	(q)	(i)	Quarterly monitoring cost: 500,000	175.95	186.3	207	(n)	(o)	(p)
	(AC) Ambient air pollution	24h PM10	(d)	Quarterly	(q)	(i)		114.75	121.5	135	(n)	(o)	(p)
	(AC) Ambient air pollution	24h SO_2	(e)	Quarterly	(q)	(i)		137.7	145.8	162	(n)	(o)	(p)
	(AC) Ambient air pollution	24h NO_2	(f)	Quarterly	(q)	(i)		114.75	121.5	135	(n)	(o)	(p)
	(AC) Noise pollution	Sound levels	(k)	Quarterly	(q)	(i)		1dB (l)	2dB (l)	2dB (m)	(n)	(o)	(p)
Opening of the CMH to traffic Regular maintenance road, bridges, interchanges, underpass, overpass, and other components	(WC) Stream pollution	Arsenic	(g)	Quarterly	(h)	(i)	Quarterly monitoring cost: 300,000	0.0153	0.0162	0.018	(n)	(o)	(p)
	(WC) Stream pollution	BOD	(g)	Quarterly	(h)	(i)		5.355	5.67	6.3	(n)	(o)	(p)
	(WC) Stream pollution	Cadmium	(g)	Quarterly	(h)	(i)		0.003825	0.00405	0.0045	(n)	(o)	(p)
	(WC) Stream pollution	COD	n/a	n/a	n/a	n/a		No WQG value			n/a	n/a	n/a
	(WC) Stream pollution	Color	(g)	Quarterly	(h)	(i)		57.375	60.75	67.5	(n)	(o)	(p)
	(WC) Stream pollution	Cyanide as Free CN-	(g)	Quarterly	(h)	(i)		0.0765	0.081	0.09	(n)	(o)	(p)
	(WC) Stream pollution	DO	(g)	Quarterly	(h)	(i)		3.825	4.05	4.5	(n)	(o)	(p)
	(WC) Stream pollution	Fecal Coliform	(g)	Quarterly	(h)	(i)		153	162	180	(n)	(o)	(p)
	(WC) Stream pollution	Hex Chromium (Cr^{6+})	(g)	Quarterly	(h)	(i)		0.00765	0.0081	0.009	(n)	(o)	(p)
	(WC) Stream pollution	Lead	(g)	Quarterly	(h)	(i)		0.03825	0.0405	0.045	(n)	(o)	(p)
	(WC) Stream pollution	Mercury	(g)	Quarterly	(h)	(i)		0.00153	0.00162	0.0018	(n)	(o)	(p)
	(WC) Stream pollution	Nitrate (NO_3-N)	(g)	Quarterly	(h)	(i)		5.355	5.67	6.3	(n)	(o)	(p)
	(WC) Stream pollution	Oil and Grease	(g)	Quarterly	(h)	(i)		1.53	1.62	1.8	(n)	(o)	(p)
	(WC) Stream pollution	pH	(g)	Quarterly	(h)	(i)		4.7 - 5.3	5.36 - 7.3	5.8 - 8.1	(n)	(o)	(p)
	(WC) Stream pollution	Phosphate	(g)	Quarterly	(h)	(i)		0.3825	0.405	0.45	(n)	(o)	(p)
	(WC) Stream pollution	Chloride	(g)	Quarterly	(h)	(i)		267.75	283.5	315	(n)	(o)	(p)
	(WC) Stream pollution	Sulfate	(g)	Quarterly	(h)	(i)		210.375	222.75	247.5	(n)	(o)	(p)
	(WC) Stream pollution	Surfactants (MBAS)	(g)	Quarterly	(h)	(i)		1.1475	1.215	1.35	(n)	(o)	(p)
	(WC) Stream pollution	Temperature	(g)	Quarterly	(h)	(i)		24.8	25.11	27.9	(n)	(o)	(p)
	(WC) Stream pollution	TSS	(g)	Quarterly	(h)	(i)		61.2	64.8	72	(n)	(o)	(p)

NOTES: LC – Land Component; AC – Air Component; WC – Water Component; TDB – to be determined prior to start of construction. In the vicinity of staging areas and active construction sites

(a) EQPL values: Limit = 90% of the standard; Alert ✇85% of Limit; Action ✇90% of Limit; Final values for limits, action, and alert levels will be determined from monitoring data; Units: ug/ncm for ambient air, mg/li for water quality parameters, decibel for sound

(b) USEPA Method 8260B Btex

(c) EPA Method 3050B metals in soil

(d) Sampling method: 24h High Volume Sampler; Analytical method: Gravimetric USEPA 40 CFR, Part 50, Appendix B

(e) Sampling method: 24-hr Gas Bubbler; Analytical method: Pararosaniline Method

(f) Sampling method: 24-hr Gas Bubbler; Analytical method: Griess-Saltzman or Chemiluminescence Method

(g) EMB Approved Methods of Analysis for Water and Wastewater (EMB Memorandum Circular #012 Series of 2016)

(h) Location and coordinates of surface water monitors

Station ID	River	Latitude	Longitude
WQ1	Tagoloan River	8.52971N	124.78861E
WQ2	Dicklum River	8.35425N	124.84182E
WQ3	Kumaykay Stream	8.34422N	124.87815E
WQ4	Puntian River	8.29619N	124.91088E
WQ5	Tagalongon River	8.29878N	124.92311E
WQ6	Mapolo River	8.31123N	124.96838E
WQ7	Ipoon River	8.21708N	125.02844E
WQ8	Komotal River	8.21528N	125.03030E
WQ9	Sawaga River	8.17999N	125.05012E
WQ10	Sawaga River	8.16246N	125.11364E

(i) DPWH/O&M Concessionaires

(j) Monitoring included in total construction cost

(k) Noise meter with data logger @ 5-min intervals

(l) above the Limit

(m) less than DENR EQSN for a particular time and category

(n) ID pollutant source (construction activity or equipment)

(o) Implement appropriate corrective action at identified pollutant source

(p) Temporary stoppage or replacement of identified construction activity or equipment

(q) Location and coordinates of ambient AQ and sound monitors

Station ID	**Barangay**	**Latitude**	**Longitude**
AQ1	Zone 2B, Casinglot	124.757942	8.515825
AQ2	Purok 7, Mambatangan	124.800872	8.463833
AQ3	Zone 4, Alae	124.804962	8.412193
AQ4	Zone 1, Diclum	124.852996	8.371687
AQ5	Purok 4, San Roque	124.933255	8.329792
AQ6	San Antonio	124.983626	8.312317
AQ7	Purok 7, La Fortuna	124.996892	8.266137
AQ8	Zone 3, Impalutao	125.028944	8.232600
AQ9	Zone 9, Patpat	125.053188	8.195157
AQ10	Casanova St. Kalasungay	125.113440	8.165801

Table 8-3. Quantitative Self-Monitoring Plan during abandonment[1]

Key environmental aspects per project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Estimated annual cost	EQPL MANAGEMENT SCHEME					
			Method	Frequency	Location			EQPL range (a)			Management measure		
								ALERT	ACTION	LIMIT	ALERT	ACTION	LIMIT
Demolition of road, structures, ancillaries Disposal of demolition and solid wastes	(LC) Soil contamination	Arsenic	(c)	Quarterly	(r)	(i)	Quarterly monitoring cost: 300,000	42.075	44.55	49.5	(n)	(o)	(p)
	(LC) Soil contamination	BTEX - Benzene	(b)	Quarterly	(r)	(i)		0.8415	0.891	0.99	(n)	(o)	(p)
	(LC) Soil contamination	BTEX - Ethylbenzene	(b)	Quarterly	(r)	(i)		244.8	259.2	288	(n)	(o)	(p)
	(LC) Soil contamination	BTEX - Toluene	(b)	Quarterly	(r)	(i)		84.15	89.1	99	(n)	(o)	(p)
	(LC) Soil contamination	BTEX - Xylenes	(b)	Quarterly	(r)	(i)		13.005	13.77	15.3	(n)	(o)	(p)
	(LC) Soil contamination	Cadmium	(c)	Quarterly	(r)	(i)		9.18	9.72	10.8	(n)	(o)	(p)
	(LC) Soil contamination	Chromium	(c)	Quarterly	(r)	(i)		290.7	307.8	342	(n)	(o)	(p)
	(LC) Soil contamination	Lead	(c)	Quarterly	(r)	(i)		405.45	429.3	477	(n)	(o)	(p)
	(LC) Soil contamination	Mercury	(c)	Quarterly	(r)	(i)		7.65	8.1	9	(n)	(o)	(p)
Demolition of road, structures, ancillaries Disposal of demolition and solid wastes	(AC) Ambient air pollution	24h TSP	(d)	Quarterly	(q)	(i)	Quarterly monitoring cost: 500,000	175.95	186.3	207	(n)	(o)	(p)
	(AC) Ambient air pollution	24h PM10	(d)	Quarterly	(q)	(i)		114.75	121.5	135	(n)	(o)	(p)
	(AC) Ambient air pollution	24h SO_2	(e)	Quarterly	(q)	(i)		137.7	145.8	162	(n)	(o)	(p)
	(AC) Ambient air pollution	24h NO_2	(f)	Quarterly	(q)	(i)		114.75	121.5	135	(n)	(o)	(p)
	(AC) Noise pollution	Sound levels	(k)	Quarterly	(q)	(i)		1dB (l)	2dB (l)	2dB (m)	(n)	(o)	(p)
Demolition of road, structures, ancillaries Disposal of demolition and solid wastes	(WC) Stream pollution	Arsenic	(g)	Quarterly	(h)	(i)	Quarterly monitoring cost: 300,000	0.0153	0.0162	0.018	(n)	(o)	(p)
	(WC) Stream pollution	BOD	(g)	Quarterly	(h)	(i)		5.355	5.67	6.3	(n)	(o)	(p)
	(WC) Stream pollution	Cadmium	(g)	Quarterly	(h)	(i)		0.003825	0.00405	0.0045	(n)	(o)	(p)
	(WC) Stream pollution	COD	n/a	n/a	n/a	n/a		No WQG value			n/a	n/a	n/a
	(WC) Stream pollution	Color	(g)	Quarterly	(h)	(i)		57.375	60.75	67.5	(n)	(o)	(p)
	(WC) Stream pollution	Cyanide as Free CN-	(g)	Quarterly	(h)	(i)		0.0765	0.081	0.09	(n)	(o)	(p)
	(WC) Stream pollution	DO	(g)	Quarterly	(h)	(i)		3.825	4.05	4.5	(n)	(o)	(p)
	(WC) Stream pollution	Fecal Coliform	(g)	Quarterly	(h)	(i)		153	162	180	(n)	(o)	(p)
	(WC) Stream pollution	Hex Chromium (Cr^{6+})	(g)	Quarterly	(h)	(i)		0.00765	0.0081	0.009	(n)	(o)	(p)
	(WC) Stream pollution	Lead	(g)	Quarterly	(h)	(i)		0.03825	0.0405	0.045	(n)	(o)	(p)
	(WC) Stream pollution	Mercury	(g)	Quarterly	(h)	(i)		0.00153	0.00162	0.0018	(n)	(o)	(p)

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[1] Monitoring stations will depend on the phasing and location of demolition

Key environmental aspects per project phase	**Potential impacts per environmental sector**	**Parameter to be monitored**	**Sampling & Measurement Plan**			**Lead person**	**Estimated annual cost**	**EQPL MANAGEMENT SCHEME**					
			Method	Frequency	Location			EQPL range (a)			Management measure		
								ALERT	ACTION	LIMIT	ALERT	ACTION	LIMIT
	(WC) Stream pollution	Nitrate (NO_3-N)	(g)	Quarterly	(h)	(i)		5.355	5.67	6.3	(n)	(o)	(p)
	(WC) Stream pollution	Oil and Grease	(g)	Quarterly	(h)	(i)		1.53	1.62	1.8	(n)	(o)	(p)
	(WC) Stream pollution	pH	(g)	Quarterly	(h)	(i)		4.7 - 5.3	5.36 - 7.3	5.8 - 8.1	(n)	(o)	(p)
	(WC) Stream pollution	Phosphate	(g)	Quarterly	(h)	(i)		0.3825	0.405	0.45	(n)	(o)	(p)
	(WC) Stream pollution	Chloride	(g)	Quarterly	(h)	(i)		267.75	283.5	315	(n)	(o)	(p)
	(WC) Stream pollution	Sulfate	(g)	Quarterly	(h)	(i)		210.375	222.75	247.5	(n)	(o)	(p)
	(WC) Stream pollution	Surfactants (MBAS)	(g)	Quarterly	(h)	(i)		1.1475	1.215	1.35	(n)	(o)	(p)
	(WC) Stream pollution	Temperature	(g)	Quarterly	(h)	(i)		24.8	25.11	27.9	(n)	(o)	(p)
	(WC) Stream pollution	TSS	(g)	Quarterly	(h)	(i)		61.2	64.8	72	(n)	(o)	(p)

NOTES: LC – Land Component; AC – Air Component; WC – Water Component; TDB – to be determined prior to start of construction. In the vicinity of staging areas and active construction sites

(a) EQPL values: Limit = 90% of the standard; Alert ✇85% of Limit; Action ✇90% of Limit; Final values for limits, action, and alert levels will be determined from monitoring data; Units: ug/ncm for ambient air, mg/li for water quality parameters, decibel for sound

(b) USEPA Method 8260B Btex

(c) EPA Method 3050B metals in soil

(d) Sampling method: 24h High Volume Sampler; Analytical method: Gravimetric USEPA 40 CFR, Part 50, Appendix B

(e) Sampling method: 24-hr Gas Bubbler; Analytical method: Pararosaniline Method

(f) Sampling method: 24-hr Gas Bubbler; Analytical method: Griess-Saltzman or Chemiluminescence Method

(g) EMB Approved Methods of Analysis for Water and Wastewater (EMB Memorandum Circular #012 Series of 2016)

(h) Location and coordinates of surface water monitors

Station ID	River	Latitude	Longitude
WQ1	Tagoloan River	8.52971N	124.78861E
WQ2	Dicklum River	8.35425N	124.84182E
WQ3	Kumaykay Stream	8.34422N	124.87815E
WQ4	Puntian River	8.29619N	124.91088E
WQ5	Tagalongon River	8.29878N	124.92311E
WQ6	Mapolo River	8.31123N	124.96838E
WQ7	Ipoon River	8.21708N	125.02844E
WQ8	Komotal River	8.21528N	125.03030E
WQ9	Sawaga River	8.17999N	125.05012E
WQ10	Sawaga River	8.16246N	125.11364E

(i) DPWH/O&M Concessionaires, Contractor

(j) Monitoring included in total construction cost

Quarterly cost that is for the whole monitoring for 10 stations
(k) Noise meter with data logger @ 5-min intervals
(l) above the Limit
(m) less than DENR EQSN for a particular time and category
(n) ID pollutant source (construction activity or equipment)
(o) Implement appropriate corrective action at identified pollutant source
(p) Temporary stoppage or replacement of identified construction activity or equipment
(q) Location and coordinates of ambient AQ and sound monitors

Station ID	Barangay	Latitude	Longitude
AQ1	Zone 2B, Casinglot	124.757942	8.515825
AQ2	Purok 7, Mambatangan	124.800872	8.463833
AQ3	Zone 4, Alae	124.804962	8.412193
AQ4	Zone 1, Diclum	124.852996	8.371687
AQ5	Purok 4, San Roque	124.933255	8.329792
AQ6	San Antonio	124.983626	8.312317
AQ7	Purok 7, La Fortuna	124.996892	8.266137
AQ8	Zone 3, Impalutao	125.028944	8.232600
AQ9	Zone 9, Patpat	125.053188	8.195157
AQ10	Casanova St. Kalasungay	125.113440	8.165801

(r) Location and coordinates of soil quality monitoring stations

Station ID	Latitude	Longitude	Location
S1	8.509855	124.791145	Bugo, CDO
S2	8.313177	124.965641	Kisolon, Sumilao
S3	8.165251	125.113072	Kalasungay, Malaybalay

Table 8-4. Qualitative Self-Monitoring Plan

Project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Cost[2] *Php- Philippine Peso	EQPL MANAGEMENT SCHEME			
								EQPL range		Management measure	
			Method	Frequency	Location			ALERT	ACTION	ALERT	ACTION
PRE-CONSTRUCTION PHASE											
RROW acquisition	Inadequate land valuation	Affected land and compensation	- Ocular inspection - Photo documentation - Meetings - Minutes of meetings and attendance sheets - Unstructured interviews - Review of assessed market value	As necessary until agreement and just compensation given	Affected areas in the host LGUs	Community Relations Officer of DPWH	Included in the RAP	Criteria to be determined by stakeholders (e.g., authentic landowners, LGU, tribal leaders) in consensus		Post ECC Agreement between DPWH and DENR	
	(LAND) Vegetation removal and loss of habitat	- Number and species of trees removed - Number and species of saplings collected, hardened - Number and species transplanted Number of species of fauna affected	- Census/Inventory - Establishment of on-site nurseries - Collection of saplings - Hardening of saplings in nurseries - Transplanting of saplings to target reforestation areas - Sampling collection of endangered, vulnerable and	Prior to and during site development activities	Initially all identified riparian zones during the EIA; Transects 1, 2, 3, 7, 9 in during the EIA	Third Party	Php 1,000,000	- Inadequate sapling collection of important species Low survival rate of samplings in target reforestation areas		Institute measures to a) increase number of saplings collected, and b) survival rate of transplanted saplings	

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[2] Indicative annual cost. May change during implementation.

Project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Cost[2] *Php- Philippine Peso	EQPL MANAGEMENT SCHEME			
			Method	Frequency	Location			EQPL range		Management measure	
								ALERT	ACTION	ALERT	ACTION
			other threatened species such as necessary to implement a *"no hunting, no collection"* policy on wildlife during the construction.								
CONSTRUCTION PHASE[3]											
	(LAND) Changes in surface landforms / geomorphology / topography / terrain / slope	Surface land form	Field mapping, observations	- Semi-annually to annually - After inclement weather conditions	Areas with moderate to steep slopes identified during the EIA	Contractor	20,000	Observe landslide zone areas traversed by the alignment	Observed landslides in areas traversed by the alignment	- Report any changes on the surface landforms - Prepare incident report highlighting observed changes - Recommend remedial measures.	- Execute remedial measures such retaining walls and other engineered structures - Increase vegetation cover.
	(LAND) Soil erosion	Soil erosion	Field mapping, observations	Semi-annually	Areas identified with rill and gully erosion.	Geologist under DPWH	10,000	Potential rill or gully erosion adjacent to the road alignment.	Actual occurrence of rill or gully erosion adjacent to the road alignment.	- Report areas susceptible to rill and gully erosion. - Prepare incident report highlighting accelerated soil erosion. Provide	- Surface drainage control works. - Implement erosion control measures

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[3] Preparation of staging areas, Preparation of segment construction site, Road construction, Construction of components (underpass, overpass, interchanges, toll booths, offices, bridges)

Project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Cost[2] *Php- Philippine Peso	EQPL MANAGEMENT SCHEME			
			Method	Frequency	Location			EQPL range		Management measure	
								ALERT	ACTION	ALERT	ACTION
										recommendation if necessary	
	(LAND) Susceptibility to earthquake-induced and hydrological hazards	Susceptibility to earthquake-induced and hydrological hazards	Field mapping, observations	Semi-annually to annually or after increment weather conditions	Areas identified during the EIA with moderate to steep slopes and prone to flooding	Geologist under DPWH	20,000	Observe landslide zone areas traversed by the alignment	Observed landslides in areas traversed by the alignment	- Report areas affected by earthquake and hydrogeological hazards. - Prepare incident report and provide recommendation as necessary	- Implement recommended measures. - Conduct IEC
	(LAND) Soil contamination	Municipal solid and hazardous wastes, Fuel spillages, Oil contamination	Ocular	Daily	Staging areas and active construction sites	Contractor	Part of construction cost	Report slight presence of MSW and oil spillage	Report massive presence of MSW and oil spillage	- Prepare Incident Report - Determine cause or source - Implement corrective actions	- Determine cause or source - Implement corrective actions. - Conduct training
	(LAND) Vegetation removal and loss of habitat	- Number and species of trees removed - Number and species of saplings collected, hardened - Number and species	- Census/Inventory - Establishment of on-site nurseries - Collection of saplings - Hardening of saplings in nurseries - Transplanting of saplings to target reforestation	Prior to and during site development activities	Initially all identified riparian zones during the EIA; Transects 1, 2, 3, 7, 9 in during the EIA	Third Party under DPWH	1,000,000	- Inadequate sapling collection of important species - Low survival rate of samplings in target reforestation areas		Institute measures to a) increase number of saplings collected, and b) survival rate of transplanted saplings	

Project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Cost^2 *Php- Philippine Peso	EQPL MANAGEMENT SCHEME			
			Method	Frequency	Location			EQPL range		Management measure	
								ALERT	ACTION	ALERT	ACTION
		transplanted - Number of species of fauna affected	areas - Sampling collection of endangered, vulnerable and other threatened species such as necessary to implement a *"no hunting, no collection"* policy on wildlife during the construction.								
	(WATER-Hydrology) River siltation	Complaints and visible turbidity or discoloration of water bodies	- Ocular inspection and visual observation - Complaints lodged	During rainy days	Streams near active construction sites	Contractor	Part of construction cost	Significant visual water discoloration.	Severe visual water discoloration.	Conduct immediate investigation on the possible source of discoloration	Temporary suspension of earthmoving works and check soil erosion control measures.
	(WATER-Aquatic ecology) Displacement of species	Phytoplankton diversity and abundance	20-µm plankton sieve	Once for low and high rainfall period	All stations except A1	Contractor	100,000	Determine the significant degree of diversity and abundance change. Use this to determine the Alert and Action levels		Determine causes of significant change	Corrective action on cause of significant change
	(WATER-Aquatic ecology) Displacement of species	Zooplankton diversity and abundance	90-µm plankton sieve	Once for low and high rainfall period	All stations except A1	Contractor	100,000	Determine the significant degree of diversity and abundance change. Use this to determine the Alert and Action levels		Determine causes of significant change	Corrective action on cause of significant change
	(WATER-Aquatic ecology)	Diversity and abundance of fishes and	Dip net sampling	Once for low and high rainfall period	All stations except A1	Contractor	100,000	Determine the significant degree of diversity and abundance change. Use this		Determine causes of significant	Corrective action on cause of

Project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Cost[2] *Php- Philippine Peso	EQPL MANAGEMENT SCHEME			
			Method	Frequency	Location			EQPL range		Management measure	
								ALERT	ACTION	ALERT	ACTION
	Displacement of species	macrobenthic fauna						to determine the Alert and Action levels		change	significant change
	(WATER-Aquatic ecology) Displacement of pollution-sensitive species	Diversity and abundance of aquatic insects	Dip net sampling	Low and high rainfall period	All stations except A1	Contractor	100,000	Determine the significant degree of diversity and abundance change. Use this to determine the Alert and Action levels		Determine causes of significant change	Corrective action on cause of significant change
	Proliferation & entry of migrant workers or "followers"	Number of migrants	- Photo documentation - Consultation, dialogues - Minutes of meetings and attendance sheets - Written guidelines regarding entry of workers	Monthly meeting	Affected areas in host LGUs	Contractor	included in the Construction Cost	Alert, action, limit criteria to be determined by multi-stakeholders in consensus w/LGU, tribal leaders, DPWH and contracting agency		Post ECC Agreement between DPWH and DENR	
	Traffic congestion	Traffic	24-hour traffic survey	As needed	Existing roads affected by the Project	Contractor	TBD	Determine the significant degree of diversity and abundance change. Use this to determine the Alert and Action levels		Determine causes of significant change	Corrective action on cause of significant change
OPERATION PHASE											
	(LAND) Changes in surface landforms / geomorphology / topography / terrain / slope	Surface land form	Field mapping, observations	- Semi-annually to annually After inclement weather conditions	Areas with moderate to steep slopes identified during the EIA	DPWH	20,000	Observe landslide zone areas traversed by the alignment	Observed landslides in areas traversed by the alignment	- Report any changes on the surface landforms - Prepare incident report highlighting	- Execute remedial measures such retaining walls and other

Project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Cost[2] *Php- Philippine Peso	EQPL MANAGEMENT SCHEME			
								EQPL range		Management measure	
			Method	Frequency	Location			ALERT	ACTION	ALERT	ACTION
										observed changes - Recommend remedial measures.	engineered structures - Increase vegetation cover.
	(LAND) Soil erosion	Soil erosion	Field mapping, observations	Semi-annually	Areas identified with rill and gully erosion.	Geologist	10,000	Potential rill or gully erosion adjacent to the road alignment.	Actual occurrence of rill or gully erosion adjacent to the road alignment.	- Report areas susceptible to rill and gully erosion. - Prepare incident report highlighting accelerated soil erosion. Provide recommendation if necessary	- Surface drainage control works. - Implement erosion control measures
	(LAND) Susceptibility to earthquake-induced and hydrological hazards	Susceptibility to earthquake-induced and hydrological hazards	Field mapping, observations	Semi-annually to annually or after increment weather conditions	Areas identified during the EIA with moderate to steep slopes and prone to flooding	Geologist	20,000	Observe landslide zone areas traversed by the alignment	Observed landslides in areas traversed by the alignment	- Report areas affected by earthquake and hydrogeological hazards. - Prepare incident report and provide recommendation as necessary	- Implement recommended measures. - Conduct IEC
	(LAND) Vegetation removal and loss of habitat	Tree density	Census/Mapping	Biannual	- Entire stretch of the road alignment - All 13	Third Party	300, 000	Five percent decrease from previous census	10 percent decrease from previous census	Determine cause of decrease	Corrective measures on cause of decrease

Project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Cost[2] *Php- Philippine Peso	EQPL MANAGEMENT SCHEME			
								EQPL range		Management measure	
			Method	Frequency	Location			ALERT	ACTION	ALERT	ACTION
					Wildlife (riparian) sampling stations						
	Threat to abundance, frequency and distribution of important species	Diversity and abundance of birds, bats, frogs	Wildlife Surveys	Annual	All 13 Wildlife (riparian) sampling stations	Third Party	300,000	Five percent decrease from previous census	10 percent decrease from previous census	Determine cause of decrease	Corrective measures on cause of decrease
	(WATER-Hydrology) Flooding	Water level	Water level logger	Daily	Near main Tagoloan River	DPWH/O&M Concessionaires	420,000	Within the annual maximum flood level	One meter above annual maximum water flood level	Conduct more frequent monitoring	Corrective action on cause of water level rise
	(WATER-Aquatic ecology) Displacement of species	Phytoplankton diversity and abundance	20-µm plankton sieve	Once for low and high rainfall period	All stations except A1	DPWH/O&M Concessionaires	100,000	Determine the significant degree of diversity and abundance change. Use this to determine the Alert and Action levels		Determine causes of significant change	Corrective action on cause of significant change
	(WATER-Aquatic ecology) Displacement of species	Zooplankton diversity and abundance	90-µm plankton sieve	Once for low and high rainfall period	All stations except A1	DPWH/O&M Concessionaires	100,000	Determine the significant degree of diversity and abundance change. Use this to determine the Alert and Action levels		Determine causes of significant change	Corrective action on cause of significant change
	(WATER-Aquatic ecology) Displacement of species	Diversity and abundance of fishes and macrobenthic fauna	Dip net sampling	Once for low and high rainfall period	All stations except A1	DPWH/O&M Concessionaires	100,000	Determine the significant degree of diversity and abundance change. Use this to determine the Alert and Action levels		Determine causes of significant change	Corrective action on cause of significant change
	(WATER-Aquatic ecology)	Diversity and abundance of aquatic	Dip net sampling	Low and high rainfall period	All stations except A1	DPWH/O&M Concessionaires	100,000	Determine the significant degree of diversity and abundance change. Use this		Determine causes of significant	Corrective action on cause of

Project phase	Potential impacts per environmental sector	Parameter to be monitored	Sampling & Measurement Plan			Lead person	Cost[2] *Php- Philippine Peso	EQPL MANAGEMENT SCHEME			
								EQPL range		Management measure	
			Method	Frequency	Location			ALERT	ACTION	ALERT	ACTION
	Displacement of pollution-sensitive species	insects						to determine the Alert and Action levels		change	significant change

8.2 MULTI-SECTORAL MONITORING FRAMEWORK (MMF)

The MMF guides the proponent in creating the Multi-partite Monitoring Team (MMT). Section 16.1 of the DENR AO 2017-15 stipulates that a Multi-partite Monitoring Team (MMT) is required for projects classified as an ECP. The MMT, a recommendatory body to EMB, is organized to encourage public participation, to promote greater stakeholder vigilance and to provide appropriate check and balance mechanisms in the monitoring of project implementation[4]. The MMT has the primary responsibility of validating the Proponent's environmental performance.

One salient revision in the DENR AO 2017-15 was that project proponents and EMB are no longer members. The EMB is now tasked to provide oversight guidance to the MMT and consider its reports and recommendations in the evaluation of impacts and compliance. The composition of the reconstituted MMT stipulated in DENR AO 2017-15 are enumerated below.

1. Host LGUs (one representative each)
    - Municipal Environment and Natural Resources Officer (or representative)
    - Municipal Planning and Development Officer (if there is no MENRO)
    - Rural Health Unit (RHU) Chief
    - Barangay Captains

2. Representatives from two (2) non-government organizations (NGO) accredited by the host LGUs
    - One (1) representative from local recognized community leaders representing vulnerable sectors, e.g., women and senior citizens.
    - One (1) representative from the academe
    - Representative from the IP groups

The MMT functions are enumerated below.

1. Quarterly site visit to validate the proponent's compliance with the ECC conditions, EMP, SMP, and compliance reporting. The MMT may also observe sampling activities conducted by the DPWH;
2. Prepare and submit semi-annual reports to EMB Central Office and EMB Regional Office using prescribed formats; and
3. Institute an environmental emergency and complaints mechanism.

The proposed MMT members are expected to exceed the 10-member limit because the proposed CMH traverses two provinces (Bukidnon and Misamis Oriental), four municipalities, and two cities in Region X. In addition it is proposed that two MM Teams will be organized for each province with jurisdiction of the CMH alignment. The project proponent (DPWH) will provide funds for the MMT activities based on the Annual Work and Financial Plan approved by EMB.

Table 8-5. Proposed MMT for the CMH section in Misamis Oriental

Local government unit	Agency/Department/Organization	MMT Position
Province of Misamis Oriental	Representative, PG-ENRO	Chairman
Cagayan de Oro City	Representative, City ENRO	Member
Municipality of Tagoloan	Representative, Municipal ENRO	Member
Cagayan de Oro City	Representative, Rural Health Unit	Member
Municipality of Tagoloan	Representative, Rural Health Unit	Member
Cagayan de Oro City	Chairman, Barangay Bugo	Member
Cagayan de Oro City	Chairman, Barangay Puerto	Member
Cagayan de Oro City	Chairman, Barangay Balubal	Member
Municipality of Tagoloan	Chairman, Barangay Casinglot	Member

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[4] Revise Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (DAO 03-30)

Local government unit	Agency/Department/Organization	MMT Position
Municipality of Tagoloan	Chairman, Barangay Natumolan	Member
Province of Misamis Oriental	Representative, accredited NGOs	Member
Province of Misamis Oriental	Representative, IP Groups	Member
Province of Misamis Oriental	Representative, Farmer associations	Member
Province of Misamis Oriental	Representative, PWD organizations	Member
Province of Misamis Oriental	Representative, Women's Organizations	Member
Province of Misamis Oriental	Representative, Transportation Organizations	Member
Province of Misamis Oriental	Representative, DA Region X	Member
Province of Misamis Oriental	Representative, NCIP Region X	Member
Province of Misamis Oriental	Representative, PENRO Misamis Oriental -DENR Region X	Member

Table 8-6. Proposed MMT for the CMH section in Bukidnon

Local government unit	Agency/Department/Organization	MMT Position
Province of Bukidnon	Representative, PG-ENRO	Chairman
Municipality of Manolo Fortich	Representative, Municipal ENRO	Member
Municipality of Sumilao	Representative, Municipal ENRO	Member
Municipality of Impasug-ong	Representative, Municipal ENRO	Member
City of Malaybalay	Representative, City ENRO	Member
Municipality of Manolo Fortich	Representative, Rural Health Unit	Member
Municipality of Sumilao	Representative, Rural Health Unit	Member
Municipality of Impasug-ong	Representative, Rural Health Unit	Member
City of Malaybalay	Representative, Rural Health Unit	Member
Municipality of Manolo Fortich	Chairman, Barangay Alae	Member
Municipality of Manolo Fortich	Chairman, Barangay San Miguel	Member
Municipality of Manolo Fortich	Chairman, Barangay Damilag	Member
Municipality of Manolo Fortich	Chairman, Barangay Dicklum	Member
Municipality of Manolo Fortich	Chairman, Barangay Sankanan	Member
Municipality of Manolo Fortich	Chairman, Barangay Tankulan	Member
Municipality of Manolo Fortich	Chairman, Barangay Ticala	Member
Municipality of Manolo Fortich	Chairman, Barangay Mambatangan	Member
Municipality of Sumilao	Chairman, Barangay Puntian	Member
Municipality of Sumilao	Chairman, Barangay Vista Villa	Member
Municipality of Sumilao	Chairman, Barangay Culasi	Member
Municipality of Sumilao	Chairman, Barangay Poblacion	Member
Municipality of Sumilao	Chairman, Barangay Kisolon	Member
Municipality of Sumilao	Chairman, Barangay San Roque	Member
Municipality of Impasug-ong	Chairman, Barangay Poblacion	Member
Municipality of Impasug-ong	Chairman, Barangay La Fortuna	Member
Municipality of Impasug-ong	Chairman, Barangay Cawayan	Member
Municipality of Impasug-ong	Chairman, Barangay Capitan Bayong	Member
Municipality of Impasug-ong	Chairman, Barangay Impalutao	Member
City of Malaybalay	Chairman, Barangay Dalwangan	Member
City of Malaybalay	Chairman, Barangay Patpat	Member
City of Malaybalay	Chairman, Barangay Kalasungay	Member
Province of Bukidnon	Representative, accredited NGOs	Member
Province of Bukidnon	Representative, IP Groups	Member
Province of Bukidnon	Representative, Farmer associations	Member
Province of Bukidnon	Representative, PWD organizations	Member
Province of Bukidnon	Representative, Women's Organizations	Member
Province of Bukidnon	Representative, Transportation Organizations	Member
Province of Bukidnon	Representative, DA Region X	Member
Province of Bukidnon	Representative, NCIP Region X	Member
Province of Bukidnon	Representative, PENRO Bukidnon - DENR Region X	Member

8.3 ENVIRONMENTAL GUARANTEE AND MONITORING FUND COMMITMENTS

8.3.1 Environmental Guarantee Fund (EGF)

DENR Administrative Order No. 2003-3 states that an EGF shall be established for all co-located or single projects that have been determined by DENR to pose a significant public risk or where the project requires rehabilitation or restoration. An EGF Committee shall be formed to manage the fund. It shall be composed of representatives from the EMB Central Office, EMB Regional Office, affected communities, concerned LGU's, and relevant government agencies identified by EMB. An integrated MOA on the MMT-EMF-EGF shall be entered into among the EMB Central Office, EMB Regional Office, the proponent, and representatives of concerned stakeholders.

DENR Administrative order NO.2003-3 states also the objective of establishing the EGF as follows. The EGF is a fund that proponents commit when an ECC is issued for projects or undertakings determined by EMB to pose significant damage risk to life, property, and the environment. The fund is established and used for the following risk-management related purposes[5]:

a) immediate rehabilitation of areas affected by damage to the environment and the resulting deterioration of environmental quality as a direct consequence of project construction, operation, and abandonment;
b) the just compensation of parties and communities affected by the negative impacts of the project;
c) the conduct of scientific or research studies that will aid in the prevention or rehabilitation of accidents and/or risk-related environmental damages; or
d) contingency clean-up activities, environmental enhancement measures, damage prevention program including the necessary IEC and capability building activities to significantly minimize or buffer environmental risk- related impacts.

The two major components of the EGF are described below:

a) The **Trust Fund** is a form of a guarantee instrument used to compensate aggrieved parties for any damages to life or property, undertake community-based environmental programs, and conduct environmental research aimed at strengthening measures to prevent environmental damage, and finance restoration and rehabilitation of environmental quality damages caused by the project. This could be in the form of insurance, letters of credit, trust funds, other financial instruments and other similar guarantee instruments. Unless extreme circumstances warrant, surety or performance bonds are not acceptable forms of EGF trust fund.

b) The **Environmental Guarantee Cash Fund** is allotted for immediate rehabilitation and compensation of affected communities in case of damage or accidents and to cover the administrative costs of managing the fund by an MMT-authorized fund manager. The part of the fund for emergency response may be placed in a government bank guarantee, withdrawable within a 24-hour or other short-term notice by the proponent or the MMT. The rest of the Cash Fund may be placed in an interest-bearing account with the interest accruing to the Cash Fund. The fund is required to be replenished when it reaches a certain level agreed upon by the MMT but not be lower than 50%.

Because of the absence of explicit provisions under DAO 2003-30 in determining the amount of the EGF, experiences of projects with similar nature with EGF funds can be used to initially determine the amount and adjusted through discussions between the proponent and EMB considering the following factors:

a) EIS committed programs
b) Degree of environmental risk involved (based on number and extent of potential damage)
c) Valuation of resources that would most likely to be affected; and
d) Proponent’s ability to provide funds for the EGF

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[5] Annex 3-6 of the RPM of DAO2003-30

A Contractor's All Risk Insurance (CARI) required by the DPWH covers cases of untoward incidents during the construction stage. The CARI as the EGF is initially set at Php7 billion (assuming 10 percent[6] of the indicative project cost of Php70 billion in *Section 1.9* of the PD). The CARI will be used as the EGF during the construction phase and as such will follow the purpose, administration, and management of the EGF.

8.3.2 Environmental Monitoring Fund (EMF)

The EMF (required for MMTs) is a fund that a Proponent commits to establish to support the activities of the MMT for the compliance monitoring. The initial determination of the EMF is included as part of the Environmental Management and Monitoring Plan and as established in the ECC for a particular project or undertaking. The actual amount however is determined by the Annual Work and Financial Plan (AWFP) agreed upon with the MMT and derived from the Proponent's Environmental Monitoring Plan (EMoP). The final amount is specified in the MOA between EMB and the Proponent with conformity of the MMT members.

Initially, the basis for determining the EMF is the cost of monitoring activities and mitigating measures proposed by the Proponent in the Environmental Management Plan. The rates or amounts for the preparation of the Work and Financial Plan will be according to the limits set prescribed in pertinent government guidelines.

The EMF will be exclusively used for all costs related to the operation of the MMT, the activities of which are detailed in the MMT Manual of Operations (MOO). The following activities/costs are covered by the EMF:

a) Cost of transportation, board and lodging;
b) MMT meetings;
c) Equipment rental;
d) Documentation (photos, video, etc.);
e) Sampling, shipment or transport of samples including laboratory analysis;
f) Hiring external experts or subcontracting of a monitoring work to a neutral party;
g) MMT training;
h) Preparation of monitoring reports and distribution; and
i) Public information campaign/dissemination

An initial amount of PhP500,000.00 per year will be allotted for the Environmental Monitoring Fund to be finalized upon the creation of the MMT.

8.4 PEMAPS QUESTIONNAIRE

Project Name	:	Central Mindanao High Standard Highway Project
Project Location	:	Cagayan de Oro City, Malaybalay City, Municipalities of Tagoloan, Manolo Fortich, Sumilao, Impasug-ong
DPWH	:	Department of Public Works and Highway – Central Office
Pollution Control Officer	:	To be appointed
Tel. No./Fax No./Email	:	
Project Type	:	Category A:ECP (3.4.1 Roads, new construction, NATIONAL ROAD: ≥20.0 km (length with no critical slope) OR ≥10.0 km (length with critical slope))

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[6] 10 percent of the Total Contract Cost, Bidding Documents for Infrastructure, Annex II-1.1: DPWH Standard, Volume II – Infrastructure, Department of Public Works and Highways Procurement Manual, 27 September 2016.

Project Status : Proposed

I. PROJECT CONSIDERATIONS

Size and Type:

- Length: 65.5 km
- Area: 3,936,000m^2 (393.6ha)
- Type: Road Project

Size based on number of employees
Project Type
ECP: X
Non-ECP but in ECA:
Non-ECP and Non-ECA
Specify number of employees: Construction: 50,000

Waste Generation and Management

Category	Waste	Type		Quantity
		Hazardous	Non-Hazardous	
Air	Fugitive dust		x	TBD
	Vehicle emissions		x	TBD
Liquid	Domestic wastewater		x	TBD
Solid	Municipal wastes		x	TBD
	Hazardous wastes	x		TBD

TBD - To be determined

Pollution Control System (PCS)

Category	PCS/Waste Management Method Used	Remarks
CONSTRUCTION PHASE		
Air/Noise	- Air / Noise: Scheduled or appropriate maintenance or repair of machinery/ equipment especially those that have high noise levels; - Noise: Placement of appropriate covers or barriers on machinery/equipment - Fugitive Dust: Dust suppression measures	- Activity: use of heavy equipment during construction. - Part of Environmental Management Plan (EMP). - To be enforced by the proponent thru the PCO. - To be monitored for compliance.
Liquid	- Surface Run-Off: Erosion control measures - Domestic wastewater: Onsite sanitary facilities - Hazardous wastes, e.g., used oil: Construction Waste Management Plan	- Activity: Earthmoving activities during rainy days - Part of Environmental Management Plan (EMP). - To be put in place prior to construction activities. - To be enforced by the DPWH thru the PCO. - To be monitored for compliance.
Solid	Construction solid wastes: Construction Waste Management Plan for Municipal Solid Wastes and Hazardous Wastes	- Activity: During entire construction period. - Part of Environmental Management Plan (EMP). - To be enforced by the proponent thru the PCO. - To be monitored for compliance.
OPERATION PHASE		

Category	PCS/Waste Management Method Used	Remarks
Liquid	- Water conservation plan - Treatment of process wastewater - Sludge: Hauling by DENR Accredited hauler	- Part of Environmental Management Plan (EMP).
Solid	Municipal and hazardous wastes: Waste Management Plan	- Part of Environmental Management Plan (EMP). - To be enforced by the proponent thru the PCO. - To be monitored for compliance.

II. PATHWAYS

Prevailing wind towards barrio or city? Yes X No ____
Rainfall (impacts surface & groundwater pathways)
Average annual net rainfall: 2,136.6 mm[7]
Maximum 24-hour rainfall: 284.5mm

Terrain (select one and mark) Flat Rolling X Steep X
Is the facility located in a flood-prone area? Yes X (some portions) No __

Ground Water
Depth of groundwater table (meter)
0 to less than 3 ____
3 to 10 X
Greater than 10 X

III. RECEIVING MEDIA/RECEPTORS

Air (Distance to nearest community)
0 to less than 0.5 km X
0.5 to 1 km X
Greater than 1 km X

Receiving Surface Water Body
Distance to receiving surface water:
0 to less than 0.5 km X
0.5 to 1 m ____
Greater than 1 km ____
Size of population using receiving surface water: indeterminate

Fresh Water
Classification of fresh water
AA ____
A ____
B ____
C X
D ____

Size of fresh water body: 949,000 hectares
Economic value of water use
Drinking X

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[7] Average of normal data at the Lumbia Airport and Malaybalay PAGASA stations (1981-2010)

Domestic X
Recreational X
Fishery (marginal) X
Industrial X
Agricultural X
Others: recipient of surface runoff X
Recipient of domestic discharges X

Salt water (not applicable)

Ground Water
Distance to nearest recharge area
0 to less than 0.5 km ____
0.5 to 1 km ____
Greater than 1 km X
Distance to nearest well used
0 to less than 0.5 km ____
0.5 to 1 km X
Greater than 1 km ____

Groundwater use within the nearest well
Drinking X
Industrial X
Agricultural X

Land
Indicate current/actual land uses within 0.5 km radius:
Residential X
Commercial/Institutional X
Industrial X
Agricultural/Recreational X
Protected Area ____

Potential/proposed land uses within 0.5 km
Residential X
Commercial/Institutional X
Industrial X
Agricultural/Recreational X
Protected Area ____

Number of affected Environmentally Critical Areas within 1 km: 3 (natural calamities, water bodies, agricultural area)

Distance to nearest ECA
0 to less than 0.5km X
0.5 to 1 km ____
Greater than 1 km ____

IV. ENVIRONMENTAL PERFORMANCE

Compliance (will be double-checked with PCD files)

Law	Violation	Type (specify number of times committed)				Type of Admin Violation	Additional Remarks/ Status of Compliance
		STANDARD					
		Emission/ Effluent/ Discharge	Ambient	Human Impact	Admin/ ECC		
RA 8749	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RA 9275	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RA 6969	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PD 1586	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RA 9003	n/a	n/a	n/a	n/a	n/a	n/a	n/a

n/a – not applicable

Number of Valid Complaints
Citizen and NGOs: n/a
Others (other Govt. Agencies, Private Institutions): n/a

(To be filled up by EMB Personnel)
RECOMMENDATION/S:

Noted By: Assessed By:

ACCOUNTABILITY STATEMENT OF PROJECT PROPONENT

This is to certify that all information in the submitted Project Environmental Monitoring and Audit Prioritization Scheme (PEMAPS) Questionnaire of the CENTRAL MINDANAO HIGH STANDARD HIGHWAY PROJECT of the DEPARTMENT OF PUBLIC WORKS AND HIGHWAY – CENTRAL OFFICE located in the provinces of Misamis Oriental and Bukidnon is true, accurate and complete. Should we learn of any information, which makes this inaccurate, we shall bring said information to the Environmental Management Bureau Central Office.

In witness whereof, I hereby set out my hands this _____ day of __________ at ________________.

CONSTANTE A. LLANES, JR.
Acting Undersecretary for Planning Service
DPWH – Central Office

SUBSCRIBED AND SWORN to before me this ___ day of ________ at ______________ Affiant exhibiting to me his _______________________ issued on _____________ at ______________________.

Doc. No. ______________
Page No. ______________
Book No. ______________
Series ______________

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CHAPTER 9 – DECOMMISSIONING/ ABANDONMENT/ REHABILITATION POLICY

Abandonment in this context means dismantling of the staging areas (barracks, equipment, support facilities) during construction of the alignment segments. To comply and support the requirements of the Philippine EIS System on abandonment, decommissioning, and rehabilitation, e.g., RPM of DAO 2003-30, MC 2010-14, it will be the policy of DPWH to ensure that abandonment of staging areas, decommissioning of equipment, and rehabilitation will have the least environmental impact and comply with existing laws. The Proponent (DPWH, Contractor) will formulate an Environmental, Health, and Safety policy during the dismantling of staging areas for each road segment.

The detailed Staging Area Abandonment and Decommissioning Plan (ADP) will be formulated during the pre-construction phase and submitted to the EMB-Central Office.

The ADP will include a) land or soil restoration, decontamination, and remediation, and b) strategies and methods for rehabilitating the staging areas. The proposed activities and components of the ADP are enumerated below.

a) Procedures for the decommissioning of equipment
b) Transport/disposal of equipment and other materials used during construction;
c) Remediation of contaminated soil and water resources due to spills and leakage of chemicals and other materials used; and
d) Procedures for rehabilitating of the staging area close to its original condition

The wastes expected in the event of dismantling the staging areas are:

1. Demolition wastes - waste building materials, packaging, and rubble resulting from renovation, repair.
2. Bulky wastes - Oversized wastes which, because of large size, preclude or complicates their handling by normal solid waste collection, processing, or disposal methods.
3. Special Wastes - Wastes that may have particular health, safety, and environmental concerns. These include materials with lead-based paint coatings, lighting wastes (e.g., mercury containing lamps, PCB containing ballast's), electrical components (e.g., oil containing switches and transformers), and other equipment.
4. Unused fuels and lubricants

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Chapter 10 - INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

The Institutional Plan ensures the proper implementation of the requirements in Chapters 3, 5, and 6 (EMP, SMP, MMT, SDP, IEC) during the pre-construction, construction, and operation (maintenance) of the CMH Project. The Institutional Plan will ensure:

a) Compliance with ECC conditions;
b) Effectiveness of environmental measures for adverse impacts and enhancing beneficial ones; and
c) Continued updating of the EMP, SMP, MMT, SDP, and IEC for sustained responsiveness to Project implementation and impacts.

10.1 The Environmental Unit

The Proponent (DPWH) has an Environmental Unit (EU) to implement the environmental compliance requirements and conduct regular coordination with EMB Region 10. The DPWH EU will also be responsible for ensuring compliance with other environmental rules and regulations that the EMB may impose.

The Environmental Unit (EU) shall have the following responsibilities:
a) Monitor actual project impacts the predicted impacts and management measures in the EIS;
b) Recommend revisions to the EMoP, whenever necessary subject to the approval of the EMB-CO;
c) Ensure that data gathered during monitoring activities are properly documented, assessed, evaluated, and reported in accordance with the standard formats; and d. Ensure that monitoring and submission of reports to EMB-CO are carried out as required.

10.2 Compliance Reporting

Regular compliance reporting to EMB-R10 indicated in the EMP will be undertaken by the EU. The Proponent after the issuance of the ECC will ensure that the contractors and toll operator during the construction and operation phases will implement the EMP and SMP in addition to compliance to the same during the operation phase. The Proponent will also ensure that the quarterly Self-Monitoring Reports (SMR) and bi-annual Compliance Monitoring Reports (CMR) are submitted on the regular and timely basis.

10.3 Organizational Structure

The DPWH as the Proponent has the Environmental and Social Safeguards Division (ESSD) under the Office of the Undersecretary for Planning as an organic structure tasked to ensure the integration and implementation of environment and social safeguards for its projects. The ESSD is mainly responsible for monitoring the overall operation and effectiveness of the Impact Management Plan (IMP) during the construction and operational phases. See the Table 10-1-for the Roles of the Relevant Agencies on EIA of this project ,Table 10-2 for Environmental Management and Monitoring Implementation Organization. Also in the Figure 10-5 Environmental Management and Monitoring Implementation Organization indicated the flow of the submissions of the reports.

The role of the ESSD shall cover project planning, preparation, design, implementation, monitoring and post implementation evaluation. The ESSD shall coordinate closely with the other concerned offices of the DPWH to enable it to provide assistance during various stages of project planning and implementation. The functions of the ESSD are as follows:
a) Conduct assessments for environmental, social impact and land acquisition.
b) Prepare relevant reports such as Initial Environmental Examinations (IEE), Environmental Impact Statements (EIS), Environmental Management Plans (EMP), Resettlement Action Plans (RAP), Gender Development Plan (GAD) and other necessary documents.

c) Facilitate consultation and information dissemination to project affected persons and other relevant stakeholders.
d) Conduct environmental monitoring;
e) Monitor RAP implementation and conduct post implementation evaluation. Provide guidance to regional and district level DPWH staff and local authorities in carrying out the above studies, preparation of documents and RAP implementation.
f) Provide training at regional, district and local level for consultation/participation, RAP implementation, environmental management planning, environmental monitoring, EIA tools and other new techniques.
g) Maintain and update the existing data bank and Geographical Information System (GIS).
h) Coordinate environmental concerns with other DPWH offices, Government Agencies, Local Government Units and Non-Governmental Organizations.
i) The roles of ESSD have been extended beyond EIA compliance to include the design and implementation of Resettlement Action Plans (RAPs), public consultation and information dissemination, and providing guidance and training to all DPWH offices

The ESSD is divided into three (3) units, namely: a) Environmental Safeguards Section (ESS), b) Social Safeguards and Right-of-Way Section (SSROW); and c) National Sewerage and Septage Management Program Section (NSSMP).

Environment Safety and Health (ESH) Officer - shall be assigned by the main Contractor during the construction phase. In coordination with the Senior Environmental Specialist of Construction Supervision Consultant, the ESH Officer is responsible for implementing the Impacts Management Plan (IMP) and the Self-monitoring Plan (SMP). The main duties of the ESH Officer are enumerated below.

a) Ensure that all concerned supervisors and staff understand and properly undertake their responsibilities;
b) Ensure proper and timely conduct of environmental monitoring activities;
c) Implement an effective preventive and corrective control system, particularly in terms of environmental emergency preparedness and response procedures;
d) Conduct or initiate training of contractors (and sub-contractors, if any) on environmental awareness; and
e) Collate performance data and prepare reports which include performance assessment in comparison with the Impacts Management Plan (IMP) objectives and targets for submission to the Construction Supervision Consultant's Senior Environmental Specialist.
f) To ensure effectiveness of the IEC, act as a liaison between DPWH- Unified Project Management Office (UPMO) and the primary stakeholders, particularly the host LGUs, affected barangays, and other government agencies.

Safety Officer - The main Contractor will engage a Safety Officer to review and recommend amendments and updates to the DPWH and authorized company circulars and bulletins pertaining to environmental safety, with special attention to the protection of human lives and properties against fire, and natural disasters such as typhoons, earthquake, and other calamities. The Safety Officer in coordination with the ESH Officer shall also take charge of posting environmental information and internal/external communications regarding environmental quality and safety.

Aside from these two key staff, each Sub-Contractor is required to assign Environmental Coordinators to undertake site supervision and inspection during the implementation of the Environmental Monitoring Plan as well as in maintaining cleanliness and aesthetic appeal at the staging areas and active construction areas. The Environmental Coordinators are also responsible for liaising with other government agencies with regards to licensing and securing permits, as required.

Pollution Control Officer (PCO) - The duties and responsibilities stipulated in DENR AO 21 of the accredited Pollution Control Officer are enumerated below.

a) Attend to the environmental compliance requirements of the EMB and LGU prior to the construction or installation of pollution control facilities;
b) Monitor activities during the installation or construction of pollution source and control facilities to ensure compliance with the air, noise and water quality standards;
c) Supervise the proper operation and maintenance of pollution source and control facilities;
d) Report to the immediate supervisor within reasonable time if any pollution control facility breaks down including the estimated and actual date of completion/repair;
e) Promptly submit validated/certified periodic reports;
f) Be updated and familiar with the requirements of the DENR-EMB and the latest available technology on the pollution prevention, control, and abatement;
g) Maintain liaison with the host LGU pollution control or environmental officers;
h) Attend meetings for PCOs called by the DENR-EMB;
i) Facilitate compliance to DENR-EMB requirements during Project implementation;
j) Recommend the installation and operation of additional equipment for the pollution control; and
k) Handle other environmental matters as required.

The structures that include the EU of the DPWH and other actors of the overall Implementation Plan during the construction and operation phases are shown in **Figure 10-1** –**Figure 10-4** respectively. Also **Table 10-1**-for the Roles of the Relevant Agencies on EIA of this project and **Table 10-2** for Environmental Management and Monitoring Implementation Organization

The DPWH-UPMO is responsible for ensuring compliance to the ECC provisions, EMP, and SMP during Project implementation. The ESSD and its Environmental Unit is directly in-charge to handle the management and technical works necessary to comply with the environmental requirements of the Project. The Unit will also coordinate and provide the necessary information and assistance to other parties, e.g., EMB, host LGUs, other government agencies, people's organization and the stakeholders. The ESSD is responsible for implementing the RAP as a member of the Resettlement Implementation Committee.

The main Project contractor will have its own environmental unit and PCO during the construction stage to ensure compliance to the Construction Environmental Management Plan. The sub-contractors will have at least an Environmental Coordinator to monitor activities and environmental performance.

A Project Management Team or Project Management Office (PMO) will be established on-site to directly manage the construction activities, including environmental compliance monitoring.

The DPWH Regional Office may be designated by the DPWH-UPMO during the operation stage of the project (because it is long term) to monitor and comply with the environmental requirements. The regional office will constitute an Environmental Unit/PCO solely dedicated to the CMH Project.
The description of the roles of other key actors in the institutional arrangement are described below.

1. **EMB** - Primarily responsible for the over-all evaluation/audit of the Proponent's monitoring activities.

2. **Other Parties/Stakeholders** - Other parties such as the host LGUs (city, municipality, barangay), national and other government agencies, and community/people's organization have their respective roles and responsibilities in monitoring project implementation and the environmental performance of the proponent.
   a) Mayors of host LGUs or representatives – Mayors of Tagoloan, Cagayan De Oro, Sumilao, Malaybalay, Manolo Fortich and Impasug-ong
   b) UPMO/Field Offices

c) Host LGU government officers - Tagoloan, Cagayan De Oro, Sumilao, Malaybalay, Manolo Fortich and
Impasug-ong
    - Brgy Bugo, Puerto, Balubal Cagayan De Oro Misamis Oriental
    - Brgy.Casinglot, Natumolan Tagoloan, Misamis Oriental
    - Brgy. Alae, Brgy. San Miguel, Brgy. Damilag, Brgy. Dicklum, Brgy.Sankanan, Brgy. Tankulan, Brgy. Ticala, Mambatangan Manolo Fortich Bukidnon
    - Brgy. Puntian, Brgy. Vista Villa, Brgy. Culasi, Brgy. Poblacion, Brgy. Kisolon, Brgy. San Roque, Brgy. Kisolon Sumilao Bukidnon
    - Brgy. Poblacion, Brgy. La Fortuna, Brgy. Capitan Bayong, Brgy. Cawayan, Brgy. Impalutao Impasug-ong Bukidnon
    - Brgy. Patpat, Brgy. Kalasungay, Brgy. Dalwangan, Barangay 10 Malaybalay Bukidnon

d) Representative of PAPs of the host barangaysBrgy Bugo, Puerto, Balubal Cagayan De Oro Misamis Oriental
    - Brgy.Casinglot, Natumolan Tagoloan, Misamis Oriental
    - Brgy. Alae, Brgy. San Miguel, Brgy. Damilag, Brgy. Dicklum, Brgy.Sankanan, Brgy. Tankulan, Brgy. Ticala, Mambatangan Manolo Fortich Bukidnon
    - Brgy. Puntian, Brgy. Vista Villa, Brgy. Culasi, Brgy. Poblacion, Brgy. Kisolon, Brgy. San Roque, Brgy. Kisolon Sumilao Bukidnon
    - Brgy. Poblacion, Brgy. La Fortuna, Brgy. Capitan Bayong, Brgy. Cawayan, Brgy. Impalutao Impasug-ong Bukidnon
    - Brgy. Patpat, Brgy. Kalasungay, Brgy. Dalwangan, Barangay 10 Malaybalay Bukidnon
    - Representative of NGOs within the jurisdiction of the host LGUs

e) Representatives of assisting regional government offices such as NHA, Department of Labor and Employment (DOLE), Technical Education and Skills Development Authority (TESDA), Department of Social Welfare and Development (DSWD), Department of Trade and Industry (DTI) and others if necessary

3. **Resettlement Implementation Committee (RIC)** - The RIC is a local coordinating and consultative body for implementing the RAP. It is set-up by the DPWH UPMO by a MOA with concerned parties prior to the commencement of the detailed engineering design. The composition and functions of the RIC are presented below.

Members

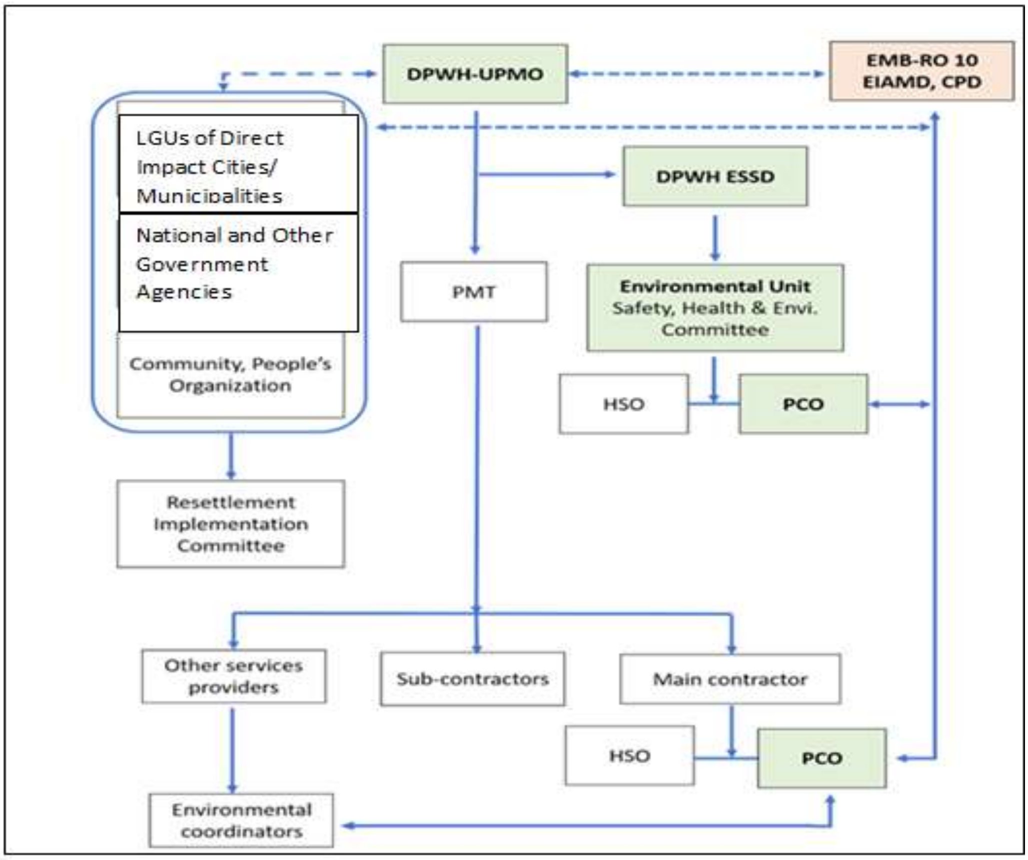
a) Mayors of host LGUs or representatives
b) UPMO/Field Offices
c) Host LGU government officers
d) Barangay Chairpersons of the host barangays
e) Representative of PAPs of the host barangays
f) Representative of NGOs within the jurisdiction of the host LGUs
g) Representatives of assisting regional government offices such as NHA, Department of Labor and Employment (DOLE), Technical Education and Skills Development Authority (TESDA), Department of Social Welfare and Development (DSWD), Department of Trade and Industry (DTI) and others if necessary.

Functions

a) Assist UPMO in preparing and validating the list of PAFs and affected assets;
b) Assist UPMO and ESSD during consultation meetings and information dissemination of PAPs and other relevant stakeholders during Reprocess;
c) Assist UPMO and ESSD in monitoring the implementation of RAP during the process;

d) Assist the host LGUs in coordination with concerned government agencies regarding enforcement of laws and ordinances regarding encroachment to the Project RROW;
e) Receive complaints and grievances of PAPs and other stakeholders and act accordingly; and
f) Maintain records of all public meetings, complaints, and actions taken

Figure 10-1. Institutional arrangement scheme during construction



NOTES: DPWH UPMO - DPWH Unified Project Management Office, DPWH ESSD – DPWH Environmental and Social Safeguards Division, PMT – Project Management Team, HSO – Health and safety Officer, PCO – Pollution Control Office

NOTES : Solid Arrow - direction or reporting
Dotted arrow –coordination

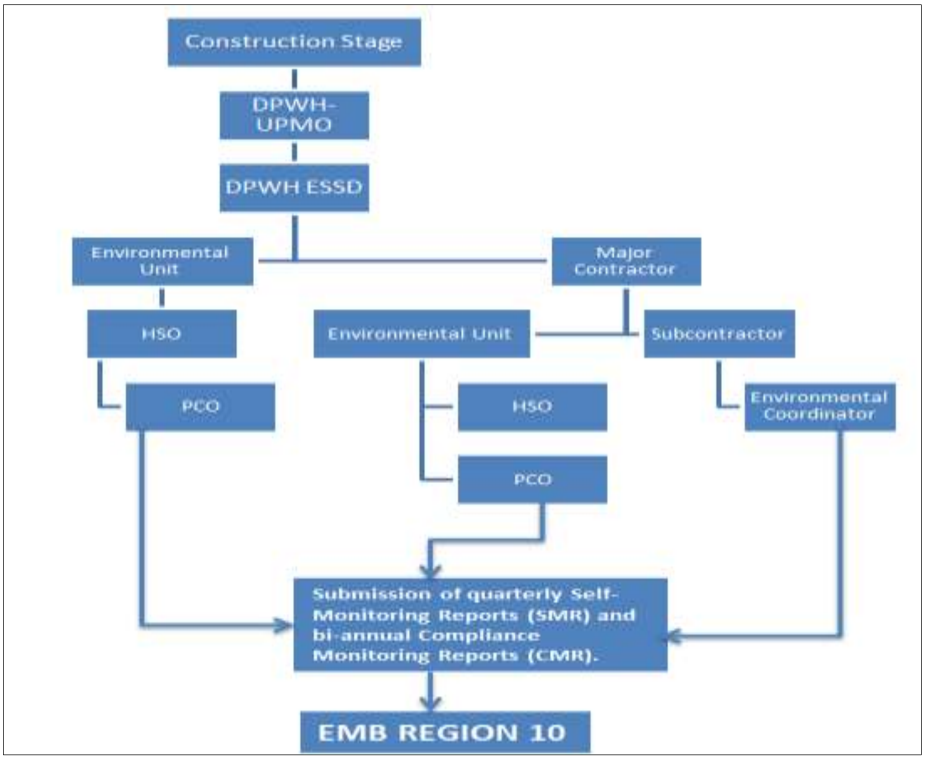
Legend:

🟧 Orange- Institution primarily responsible for the over-all evaluation/audit of the Proponent's monitoring and the MMT validation.

🟩 Green- Proponent/Key Institutions and roles

⬜ White – Proponent Driven but outside of EIA Process as requirements are under the mandate of other entities

Figure 10-2. Flowchart of submission of monitoring reports to EMB R10



NOTES: DPWH UPMO - DPWH Unified Project Management Office, DPWH ESSD – DPWH Environmental and Social Safeguards Division, PMT – Project Management Team, HSO – Health and safety Officer, PCO – Pollution Control Officer
PCO – Pollution Control Officer

Figure 10-3. Institutional arrangement scheme during operation

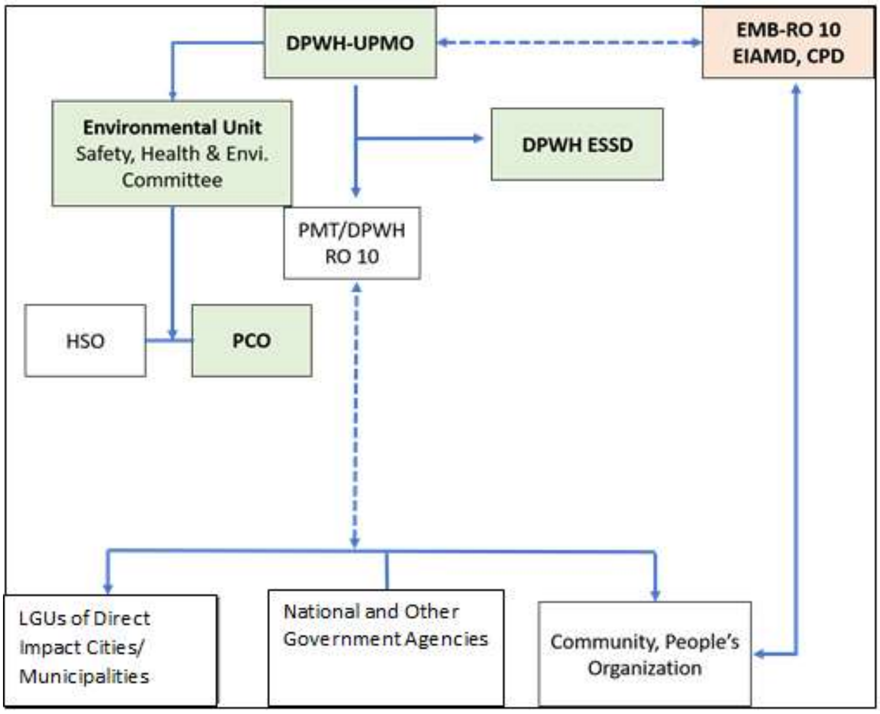


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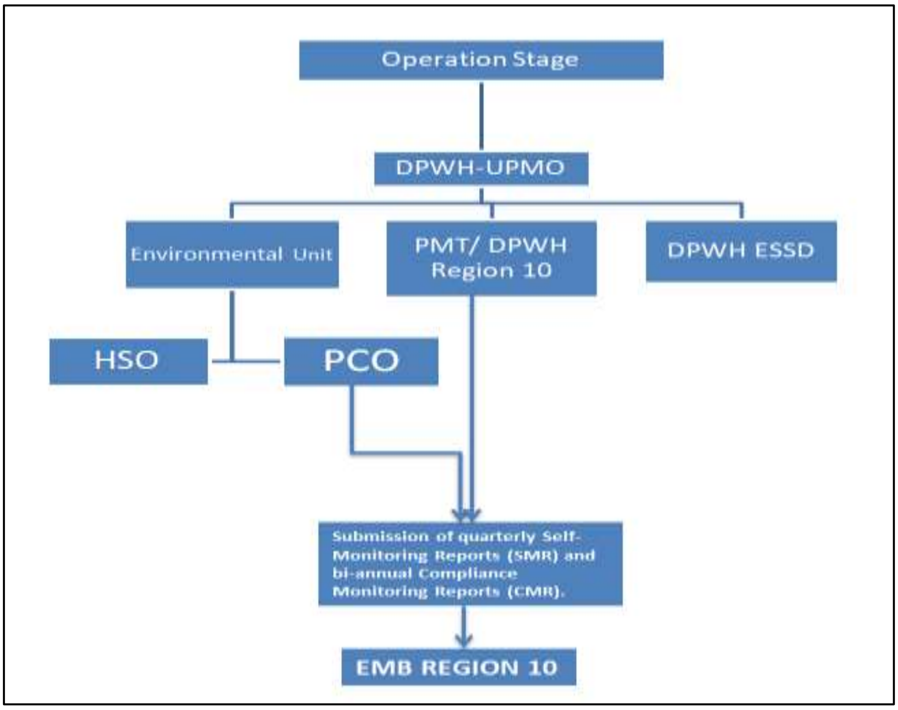
Figure 10-4. Flowchart of submission of monitoring reports to EMB R10



NOTES: DPWH UPMO - DPWH Unified Project Management Office, DPWH ESSD - DPWH Environmental and Social Safeguards Division, PMT – Project Management Team, HSO – Health and safety Officer, PCO – Pollution Control Officer

Table 10-1 Roles of the Relevant Agencies on EIA of this project

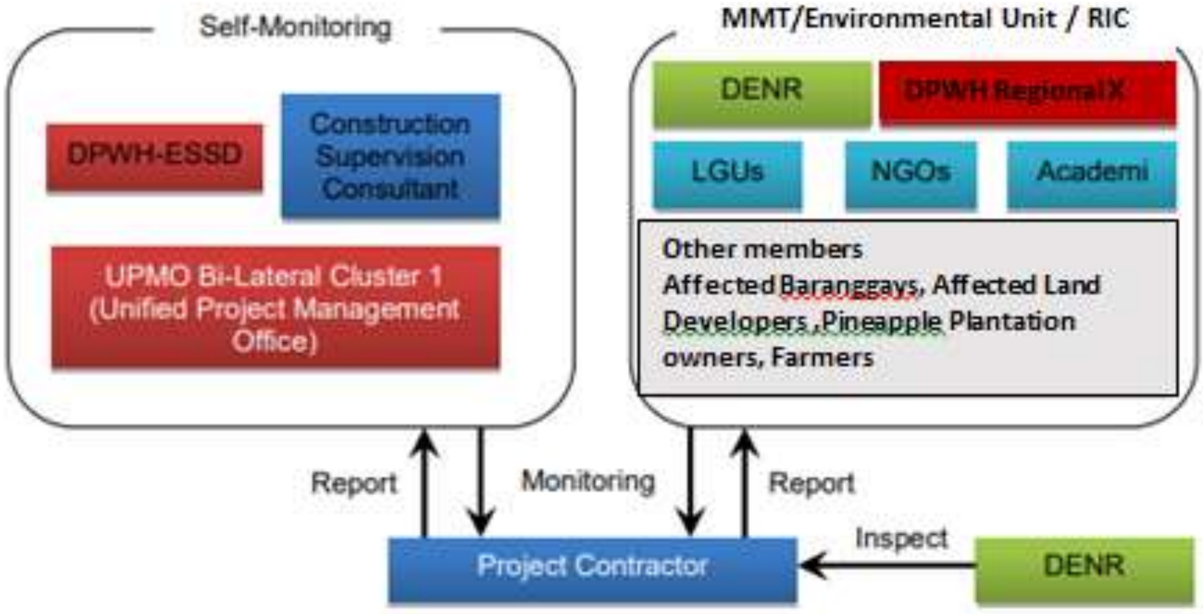
Relevant Agency		Roles
Department of Public Works and Highways (DPWH)		To proceed with the project of EIA procedure as the project proponent Detailed roles are show below; · Holding of a meeting for Information, Education and Communication (IEC) · Holding a meeting for Public Scoping for EIA · Preparation & submission of project description for scoping (PDS) and Environmental Impact Statement (EIS) · Payment of EIA review support fund · Making the necessary logistical arrangements for public consultation · Submission of final EIS and Environmental Performance Report and Management Plan (EPRMP)
Department of Environment and Natural Resources (DENR)	CO EMB	Responding to the application from the proponents, management of EIA review committee (EIARC) and the Director of EMB will issue the environmental compliance certificates (ECCs) for the port project Detailed roles are shown below; · Facilitating of EIA Review Committee (EIARC) (scoping stage and substantive review stage) · Scoping · Procedural screening of EIS · Conduct of public consultation · Preparation of decision document · Approval of ECCs from EMB Director / DENR Secretary
	RO EMB	Supporting of EIA process in the project area; · Participation of public scoping facilitated by proponent of the project · Making the necessary arrangements for EIARC site validation and public consultation

Table 10-2. Environmental Management and Monitoring Implementation Organization

Stage	Name of Organization	Role and Responsibility
Pre-Construction and Construction Phases	DPWH-Environment and Social Safeguards Division (ESSD)	· Assist the UPMO Bi-Lateral Cluster 1 and the Contractor in the setting up of the Multi-Partite Monitoring Team (MMT); · Overseeing the implementation of the EMP by the Contractor/s; · Overseeing the updating of the Resettlement Action Plan (RAP) after the DED; · Assisting in the conduct of IEC Meetings as enumerated in the IEC Framework of this EIS; · Monitoring actual payments of compensation to affected landowners, structure owners, and crops/trees owners; · In coordination with the Misamis Oriental and Bukidnon City District Engineering Office prepare periodic supervision and monitoring reports on RAP implementation; and · Other necessary roles upon finalization of the RAP during the DED stage
	The Construction Supervision Consultant	· Inspection of mitigation measures and environmental monitoring conducted by the contractor based on the approved EIS · Report the monitoring result to DPWH and donor (JICA) on monthly report

Stage	Name of Organization	Role and Responsibility
	DPWH UPMO Bi-Lateral Cluster 1	· Ensure that compliance to all conditions stipulated in the ECC are included as provisions in the Bid Documents to be issued to prospective Contractors; · Ensure that all engineering interventions in the approved EMP, RAP, and ECC issued are included in the Terms of Reference (TOR) of the Detailed Engineering Design; · Execution of MOA with DENR-EMB Region X, Misamis Oriental and Cagayan De Oro LGUs regarding formation and operationalization of the Multi-Partite Monitoring Team (MMT) for implementing the EMoP; and · Other necessary roles upon finalization of the RAP during the DED stage
	Multi-Partite Monitoring Team (MMT)/ EU/RIC Shall be composed of representatives of DPWH, DENR-EMB-FMB, LGUs, NGOs, academia, representative of affected persons and organizations and associations.	· Validate project compliance with the conditions stipulated in the ECC and the EMP; · Validate DPWH's conduct of self-monitoring; · Receive complaints, gather relevant information to facilitate determination of validity of complaints or concerns about the project and timely transmit to the Proponent and EMB recommended measures to address the complaint; · Prepare, integrate and disseminate simplified validation reports to community stakeholders; and · Make regular and timely submission of MMT Reports based on the EMB-prescribed format · Observe/participate as applicable during conduct of monitoring activities; · Coordinate with the Pollution Control Officer (PCO) of Contractors assigned to the Project, to ensure that conditions stipulated in the ECCs are properly complied with, including the gathering of baseline data on air and water quality, and subsequent monitoring of such; · Notify DPWH ESSD about any act or activity by the Contractors that are deemed as violations to the stipulations in the ECCs and amendments issued, and recommend immediate courses of action to avoid or mitigate any violation to said stipulations; and · Compile monitoring data gathered by the Contractors and supervise preparation of semi-annual monitoring reports to be submitted to the DENR
	POs and NGOs (Pineapple Plantation Owners, , and Farmers' Associations)	· Actively participate in ALL activities of the MMT; · Receive complaints from Barangay Homeowners' Associations, women's organizations, and other concerned sectors; · Gather relevant information to facilitate determination of validity of complaints or concerns about the project; · Promptly transmit to the MMT recommended measures to address the complaint; and · Prepare, integrate and disseminate simplified validation reports and feedback to community stakeholders
	The Contractor	· Ensuring that all engineering interventions in the approved EMP, RAP, and ECC issued are included in the Terms of Reference (TOR) of the Detailed Engineering Design; · Implementation of mitigation measures and monitoring based on the approved EMP on EIS and RAP

Figure 10-5. Environmental Monitoring Implementation and Reporting Flow



NOTES: DPWH UPMO - DPWH Unified Project Management Office, DPWH ESSD - DPWH Environmental and Social Safeguards Division, PMT – Project Management Team, HSO – Health and safety Officer, PCO – Pollution Control Officer

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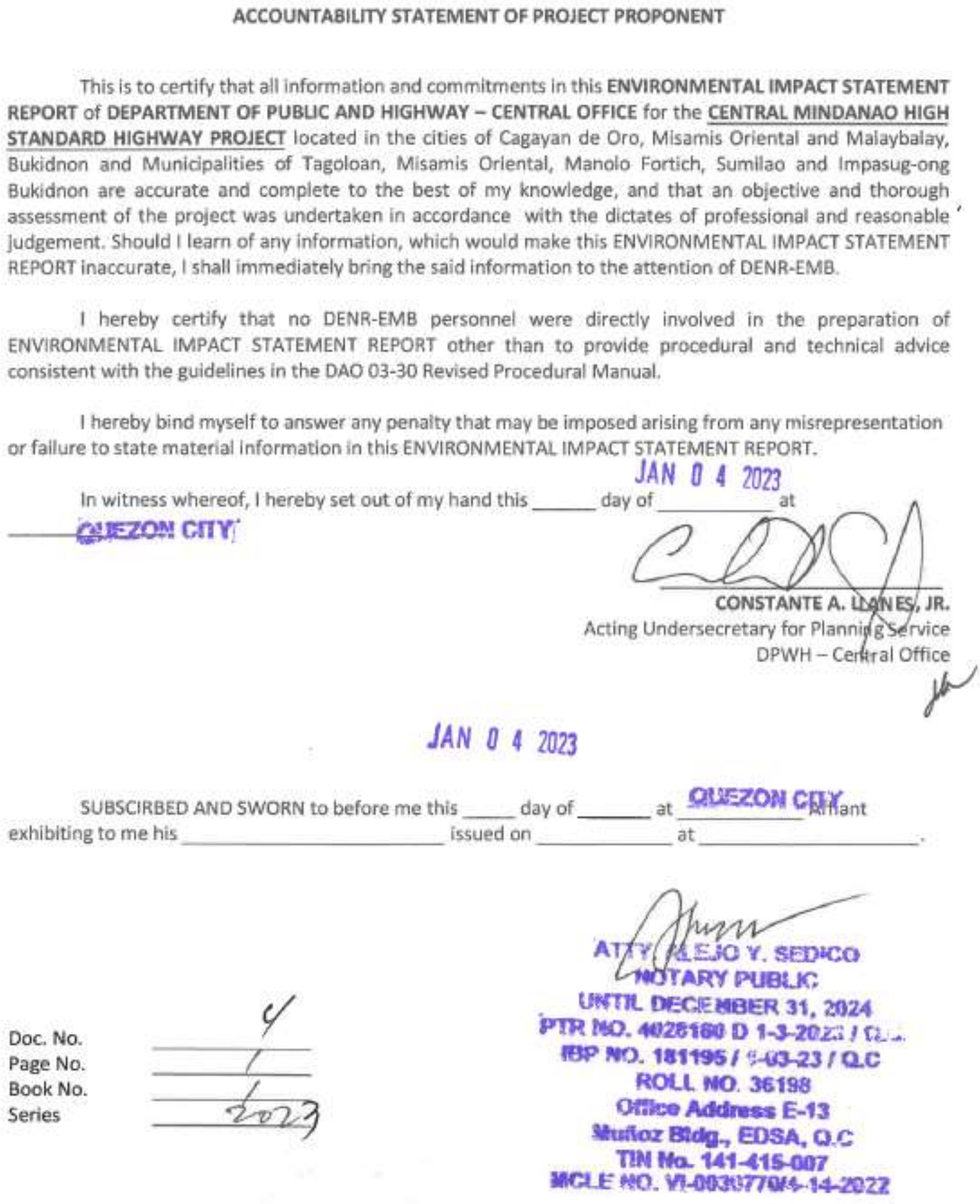
APPENDICES

APPENDICES

Appendix 1. Accountability statement of the proponent



ACCOUNTABILITY STATEMENT OF PROJECT PROPONENT

This is to certify that all information and commitments in this **ENVIRONMENTAL IMPACT STATEMENT REPORT** of **DEPARTMENT OF PUBLIC AND HIGHWAY – CENTRAL OFFICE** for the **CENTRAL MINDANAO HIGH STANDARD HIGHWAY PROJECT** located in the cities of Cagayan de Oro, Misamis Oriental and Malaybalay, Bukidnon and Municipalities of Tagoloan, Misamis Oriental, Manolo Fortich, Sumilao and Impasug-ong Bukidnon are accurate and complete to the best of my knowledge, and that an objective and thorough assessment of the project was undertaken in accordance with the dictates of professional and reasonable judgement. Should I learn of any information, which would make this ENVIRONMENTAL IMPACT STATEMENT REPORT inaccurate, I shall immediately bring the said information to the attention of DENR-EMB.

I hereby certify that no DENR-EMB personnel were directly involved in the preparation of ENVIRONMENTAL IMPACT STATEMENT REPORT other than to provide procedural and technical advice consistent with the guidelines in the DAO 03-30 Revised Procedural Manual.

I hereby bind myself to answer any penalty that may be imposed arising from any misrepresentation or failure to state material information in this ENVIRONMENTAL IMPACT STATEMENT REPORT.

In witness whereof, I hereby set out of my hand this ______ day of JAN 04 2023 at QUEZON CITY

CONSTANTE A. LLANES, JR.
Acting Undersecretary for Planning Service
DPWH – Central Office

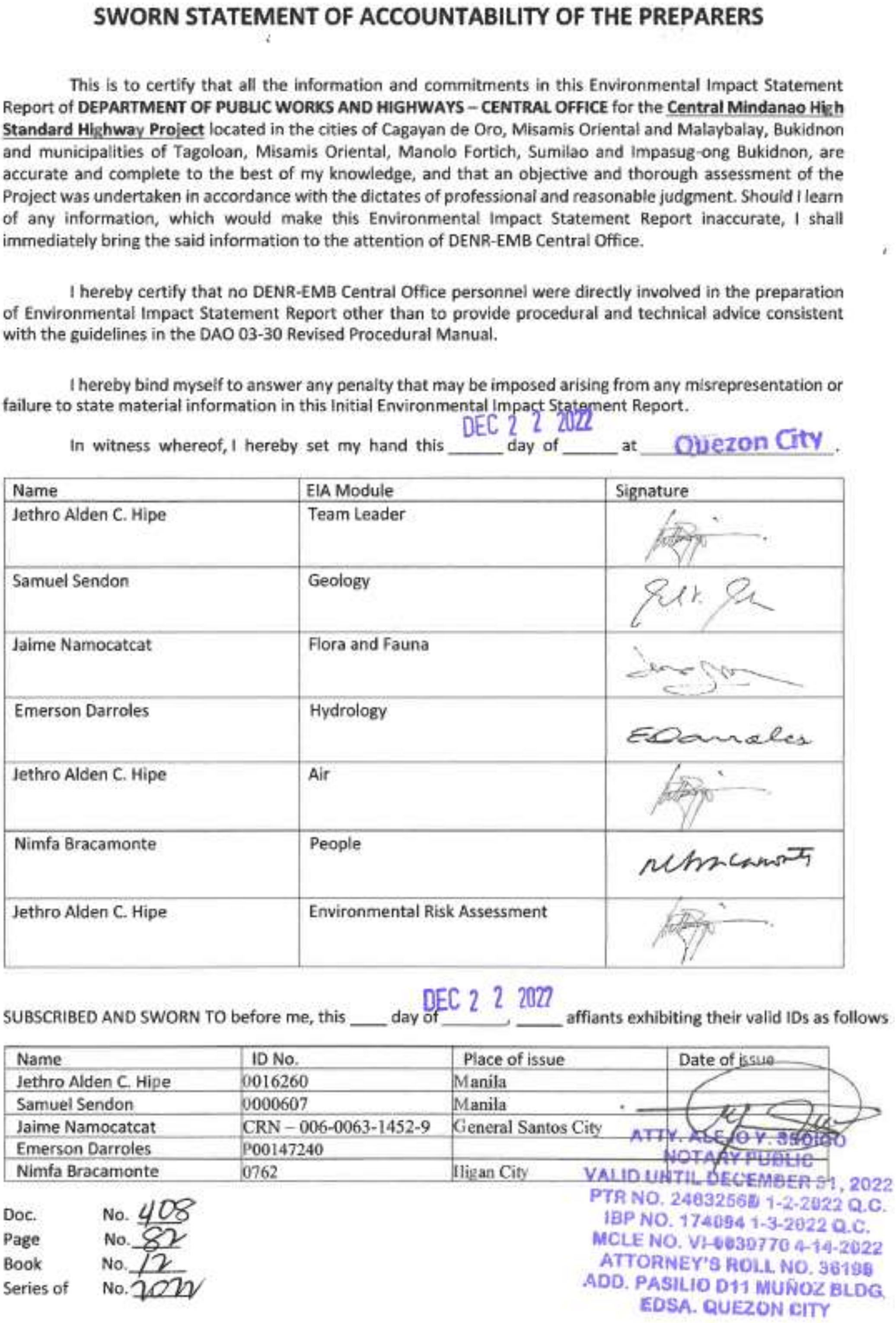
JAN 04 2023

SUBSCRIBED AND SWORN to before me this _____ day of _______ at QUEZON CITY Affiant exhibiting to me his ________________________ issued on _____________ at ____________________.

ATTY. ALEJO Y. SEDICO
NOTARY PUBLIC
UNTIL DECEMBER 31, 2024
PTR NO. 4026160 D 1-3-2023 / Q.C
IBP NO. 181195 / 1-03-23 / Q.C
ROLL NO. 36198
Office Address E-13
Muñoz Bldg., EDSA, Q.C
TIN No. 141-415-007
MCLE NO. VI-0030770/4-14-2022

Doc. No. 4
Page No. 1
Book No. 1
Series 2023

Appendix 2. Accountability statement of the preparer



SWORN STATEMENT OF ACCOUNTABILITY OF THE PREPARERS

This is to certify that all the information and commitments in this Environmental Impact Statement Report of **DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS – CENTRAL OFFICE** for the **Central Mindanao High Standard Highway Project** located in the cities of Cagayan de Oro, Misamis Oriental and Malaybalay, Bukidnon and municipalities of Tagoloan, Misamis Oriental, Manolo Fortich, Sumilao and Impasug-ong Bukidnon, are accurate and complete to the best of my knowledge, and that an objective and thorough assessment of the Project was undertaken in accordance with the dictates of professional and reasonable judgment. Should I learn of any information, which would make this Environmental Impact Statement Report inaccurate, I shall immediately bring the said information to the attention of DENR-EMB Central Office.

I hereby certify that no DENR-EMB Central Office personnel were directly involved in the preparation of Environmental Impact Statement Report other than to provide procedural and technical advice consistent with the guidelines in the DAO 03-30 Revised Procedural Manual.

I hereby bind myself to answer any penalty that may be imposed arising from any misrepresentation or failure to state material information in this Initial Environmental Impact Statement Report.

In witness whereof, I hereby set my hand this DEC 2 2 2022 day of ______ at Quezon City.

Name	EIA Module	Signature
Jethro Alden C. Hipe	Team Leader	
Samuel Sendon	Geology	
Jaime Namocatcat	Flora and Fauna	
Emerson Darroles	Hydrology	EDarroles
Jethro Alden C. Hipe	Air	
Nimfa Bracamonte	People	
Jethro Alden C. Hipe	Environmental Risk Assessment	

SUBSCRIBED AND SWORN TO before me, this ____ day of DEC 2 2 2022, ____ affiants exhibiting their valid IDs as follows

Name	ID No.	Place of issue	Date of issue
Jethro Alden C. Hipe	0016260	Manila	
Samuel Sendon	0000607	Manila	
Jaime Namocatcat	CRN – 006-0063-1452-9	General Santos City	
Emerson Darroles	P00147240		
Nimfa Bracamonte	0762	Iligan City	

ATTY. ALEJO V. SSOIGO
NOTARY PUBLIC
VALID UNTIL DECEMBER 31, 2022
PTR NO. 24832568 1-2-2022 Q.C.
IBP NO. 174094 1-3-2022 Q.C.
MCLE NO. VI-0030770 4-14-2022
ATTORNEY'S ROLL NO. 36198
ADD. PASILIO D11 MUÑOZ BLDG.
EDSA. QUEZON CITY

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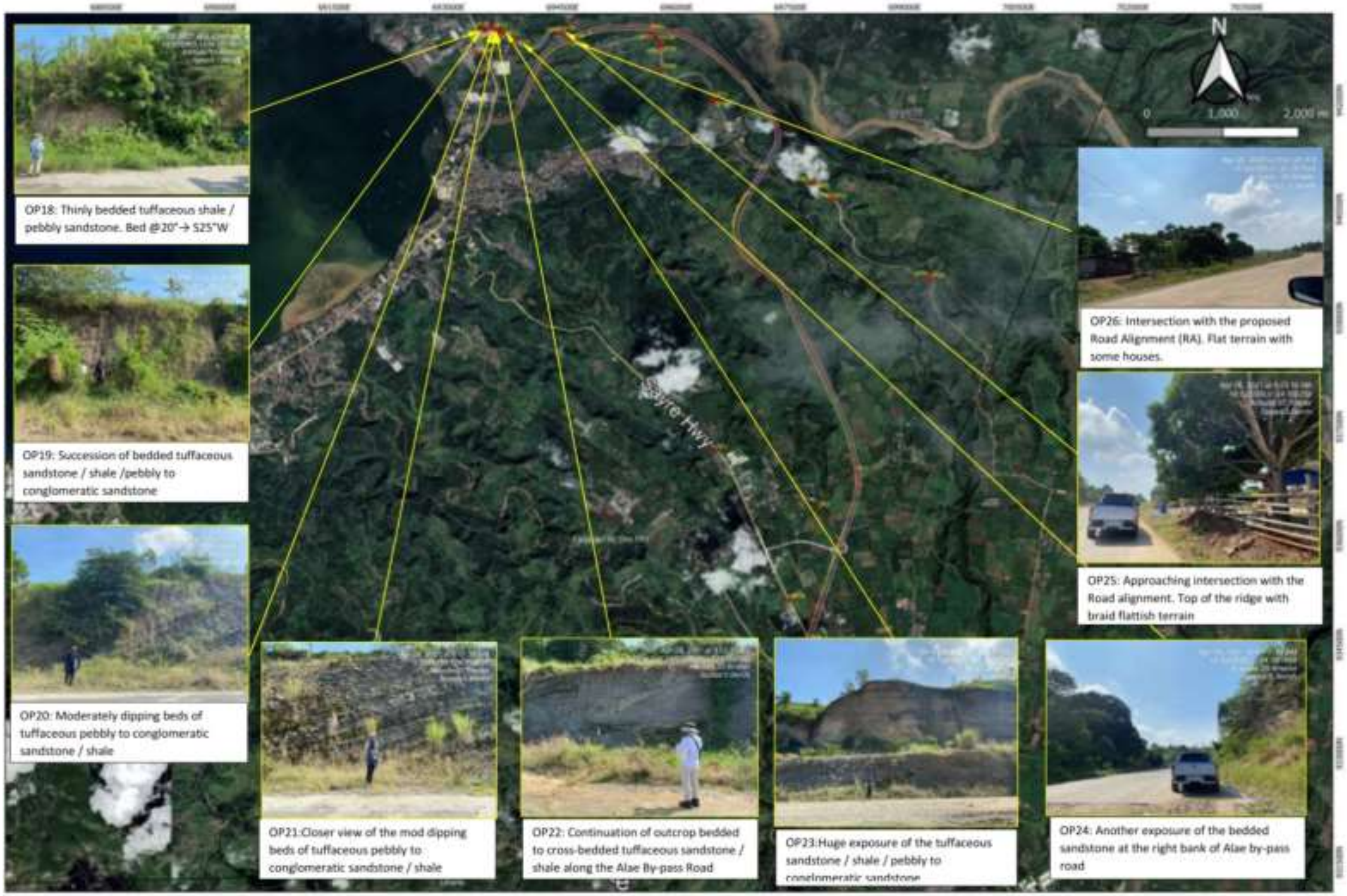
Page No. 82
Book No. 12
Series of No. 2022

Appendix 3. Photographs of the geological conditions at the observation points



OP18: Thinly bedded tuffaceous shale / pebbly sandstone. Bed @20°→ S25°W

OP19: Succession of bedded tuffaceous sandstone / shale /pebbly to conglomeratic sandstone

OP20: Moderately dipping beds of tuffaceous pebbly to conglomeratic sandstone / shale

OP21:Closer view of the mod dipping beds of tuffaceous pebbly to conglomeratic sandstone / shale

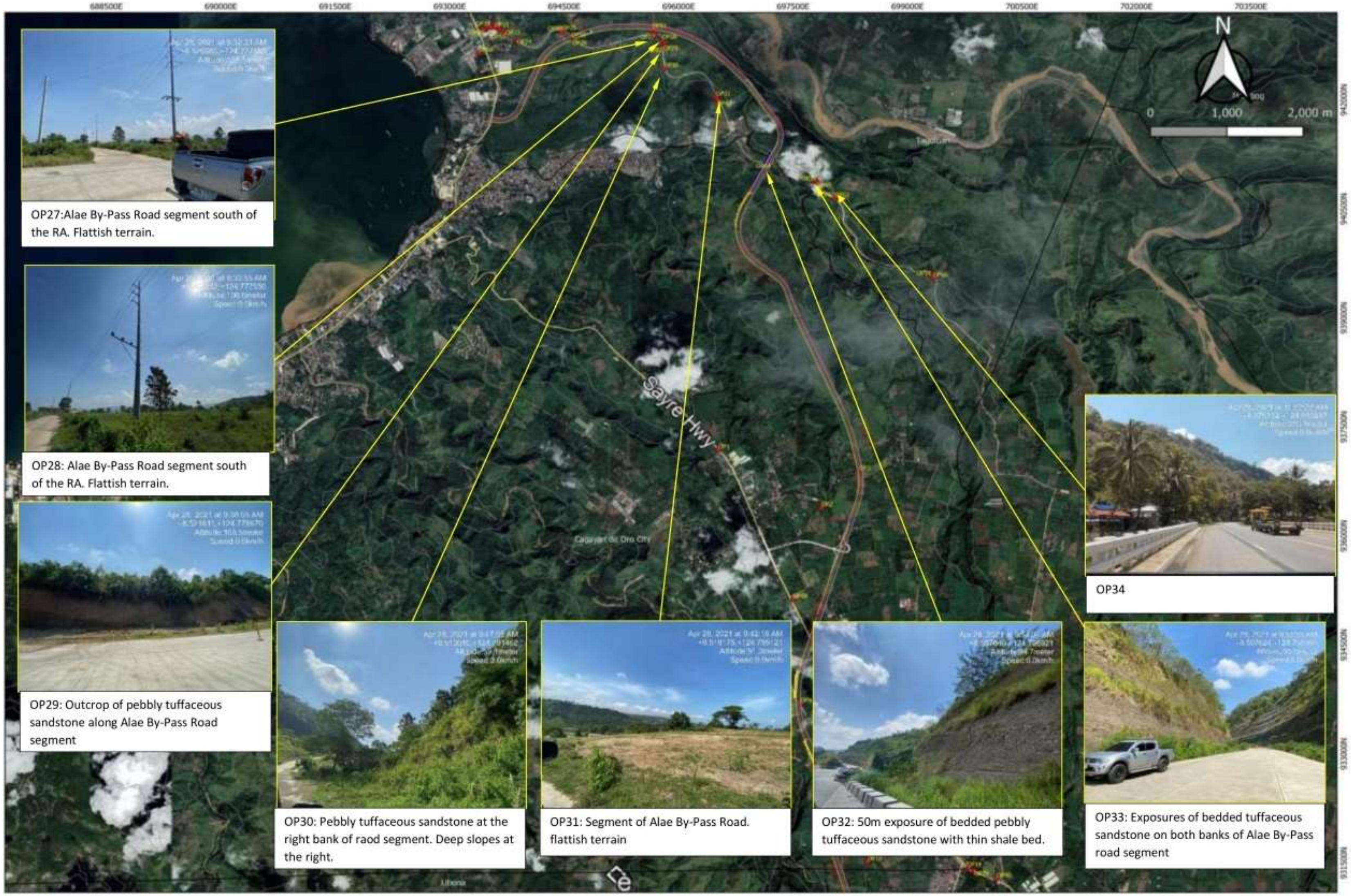
OP22: Continuation of outcrop bedded to cross-bedded tuffaceous sandstone / shale along the Alae By-pass Road

OP23:Huge exposure of the tuffaceous sandstone / shale / pebbly to conglomeratic sandstone

OP24: Another exposure of the bedded sandstone at the right bank of Alae by-pass road

OP25: Approaching intersection with the Road alignment. Top of the ridge with braid flattish terrain

OP26: Intersection with the proposed Road Alignment (RA). Flat terrain with some houses.



OP27:Alae By-Pass Road segment south of the RA. Flattish terrain.

OP28: Alae By-Pass Road segment south of the RA. Flattish terrain.

OP29: Outcrop of pebbly tuffaceous sandstone along Alae By-Pass Road segment

OP30: Pebbly tuffaceous sandstone at the right bank of raod segment. Deep slopes at the right.

OP31: Segment of Alae By-Pass Road. flattish terrain

OP32: 50m exposure of bedded pebbly tuffaceous sandstone with thin shale bed.

OP33: Exposures of bedded tuffaceous sandstone on both banks of Alae By-Pass road segment

OP34


700500E
702000E
703500E
705000E
706500E
708000E
709500E
711000E
712500E
714000E
715500E
717000E
931500N
930000N
928500N
927000N
925500N
924000N
922500N
921000N
N
0
1,000
2,000 m
OP91: End of ocp, Zno, Sayre Highway
OP101: Localized ocp of calcareous ss, mod wthrd, rbnk Sayre Highway,
OP102: Localized sch ocp rbnk, Sayre Highway
OP103: End of sch ocp rbnk, Sayre Highway
OP104: Ocp sch rbnk, steep slope lbnk, Landslide zone, sch rbnak, Sayre Highway, mod wthrd, crenulated folds,
OP92: Zgzag, start of ocp lbank, steep slope at the right side, Sayre Highway
OP105: sch ocp both banks, landslide zone, Sayre Highway
OP93: Schist L.bnk, continuous ocp along Zgzg road
094: Schist ocp at the R.bnk, stp slope at L.bnk, Sayre Highway
OP95: After Mangima Bridge, ocp both banks, slight to mod wthrd
OP99: Sch along rbnk. Rockfall and Slide, steep lbank
Sayre Hi

OP108: Vesicular basalt at the R. bnk

OP107: End of ocp rbnk, mod wthrd ss, Sayre Highway

OP106: Start of bedded ss ocp at the lbnk

OP109: Bdd cg after basalt, landslide zone along the zgzg at the R.side, Forested before the bridge, steep slope after bridge, ocp at the lbnk

OP110: Start of ocp rbnk, steep slopes, landslide area. Kulaman Brdge

OP111: Landslide zone sch rbnk, rckfall

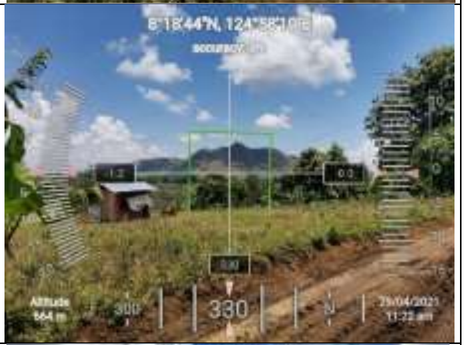
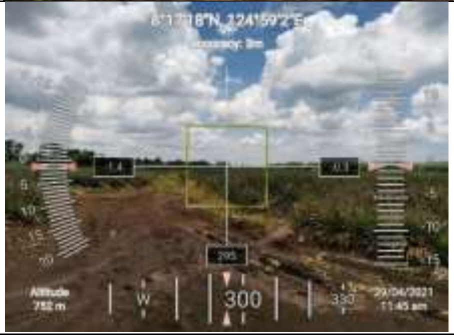
OP112: End of bdd ss /cg rightbnk, steep slope lbnk

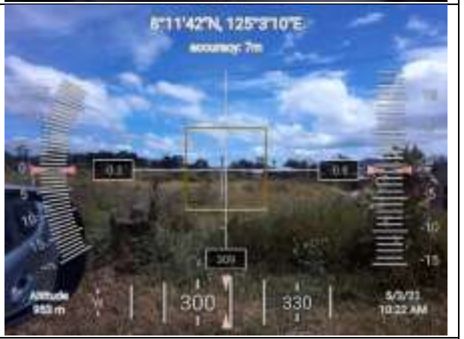
Appendix 4. Field logs summary for road alignments

Location and Date	Observation Points	N. Latitude	E. Longitude	Elev. in meter	Description	Photo Documentation
Brgy. Puerto, CDO	1.	8°26’33”	124°47’41”	432	Road Alignment 5: Steep slope, localized road slip, potential landslide.	
Brgy. Sugbongcogon, Tagoloan, Alae Bypass Road North end	2.	8°31'31.55"	124°46'4.87"	100	Road Alignment 1: Broadly undulating terrain	
Brgy. Natulmolan, Tagoloan, Alae Bypass Road	3.	8°31'34.07"	124°46'39.36"	105	Immediately south of Road Alignment 2: Broadly undulating to flattish terrain	

Location and Date	Observation Points	N. Latitude	E. Longitude	Elev. in meter	Description	Photo Documentation
Brgy. Natulmolan, Tagoloan, Alae Bypass Road	4.	8°31'36.67"	124°46'31.01"	107	Road Alignment 3: Alae By-pass Road. Flat to broadly undulating terrain, No outcrop observed.	
Brgy. Natulmolan, Tagoloan, Alae Bypass Road	5.	8°30'36.19"	124°47'29.26"	46	Road Alignment 4: Slightly weathered bedded tuffaceous shale / pebbly sandstone in both road banks.	
Brgy. Villa Vista, Manolo Fortich	6.	8°19'59.23"	124°54'39.85"	609	Road Alignment 7: Adjacent to creek.	

Location and Date	Observation Points	N. Latitude	E. Longitude	Elev. in meter	Description	Photo Documentation
Brgy. Villa Vista, Manolo Fortich	7.	8°19'47.88"	124°55'35.51"	630	Road Alignment 8: Broadly undulating terrain, pineapple palnatation. Limestone cliffs at the background	
Brgy. San Roque Manolo Fortich	8.	8°19'31.10"	124°56'2.47"E	600	Road Alignment 9: Steep slope at the road bank	
Brgy. San Roque Manolo Fortich	9.	8°19'19.35"	124°56'22.78"	626	Road Alignment 10: Broadly undulating terrain, pineapple plantation, clayey reddish-brown soil.	

Location and Date	Observation Points	N. Latitude	E. Longitude	Elev. in meter	Description	Photo Documentation
Brgy. San Roque Manolo Fortich	10.	8°19'15.36"	124°56'30.19"	623	Road Alignment 11: Broadly undulating terrain, pineapple plantation, clayey reddish-brown soil.	
Brgy. Kisolon, Sumilao Adjacent to Road Alignment	11.	8°18’44”	124°58’10”	664	Road Alignment 12: Broad undulating terrain with localized steep gullies. Farm lots. Pineapple plantation.	
Brgy. Poblacion, Sumilao	12.	8°17’18”	124°59’2”	752	Road Alignment 13: Broadly undulating terrain, pineapple plantation	

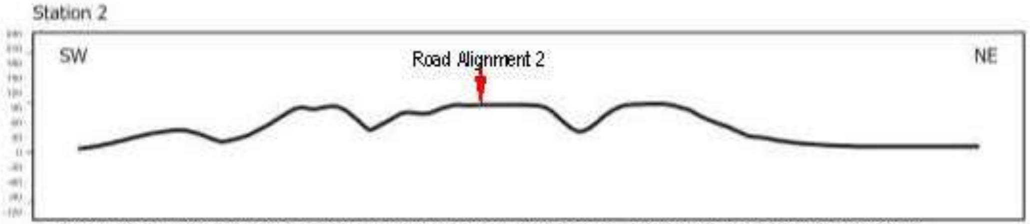
Location and Date	Observation Points	N. Latitude	E. Longitude	Elev. in meter	Description	Photo Documentation
Brgy. 11, Malaybalay	13.	8°9'34"	125°6'17"	757	Road Alignment 14: broad undulating to flattish terrain	
Brgy. Dalwangan, Malaybalay	14.	8°11'42"	125°3'10"	953	Road Alignment 18: Intersection with Sayre Highway, flat to very gently sloping.	
Brgy. Dalwangan, Malaybalay	15.	8°12'51.73"	125° 1'59.12"	888	Road Alignment 15: Valley lft side, flt ride, wtrhd rock ocp, thin 1m brown soil exposed locally	
Brgy. Dalwangan, Sayre Highway intersection with RA, Malaybalay	16.	8°11'48.86"	125° 2'58.09"	884	Road Alignment 16: Lbnk. Loclzed highly wthrd ocp 50m	
May 3 Sayre Highway, Brgy. Dalwangan, Malaybalay	17.	8°12'51.73"	125° 1'59.12"	888	Road Alignment 19: valley at the left side, flattish Terain, wtrhd rock ocp, thin 1m brown soil exposed locally	
Malaybalay Diversion	18.	8°10'20.89"	125° 3'36.54"	852	Road alignment 17:	

Location and Date	Observation Points	N. Latitude	E. Longitude	Elev. in meter	Description	Photo Documentation
Road, Brgy. Lapu-lapu					1.5m thick soil 59m wide. Heavily weathered on both both sides.	
Malaybalay Diversion Road, Brgy. Kalasungay	19.	8°10'3.93"	125° 4'3.22"	839	Road alignment 20: 3m thick, moderately weathered, brown to yellowish brown soil, broadly undulating to gentle sloping terrain.	
Malaybalay Diversion Road	20.	8°9’56”	125°6’50”	733	Adjacent to Road Alignment: Fresh to slightly weathered, andesite outcrop along access road, localized rockfall.	

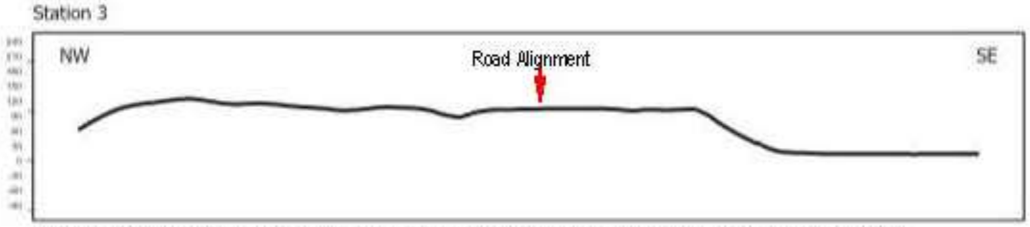
Appendix 5. Road Alignment Profiles

Profiles at road alignment 1 to 5

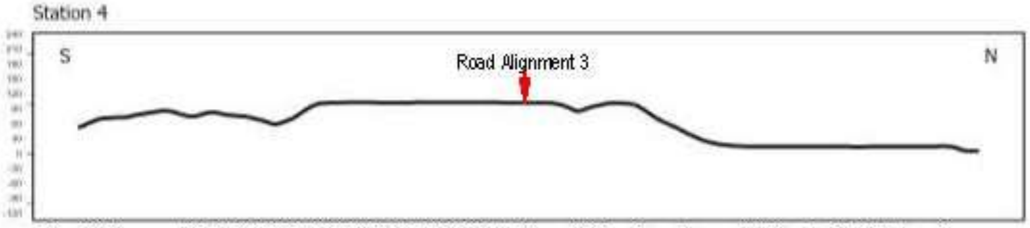
Road Alignment 5: 8°26’33”N / 124°47’41”E. Elev. 432m. Steep slope, localized road slip, potential landslide. Brgy. Natulmolan, Tagoloan, Alae Bypass Road



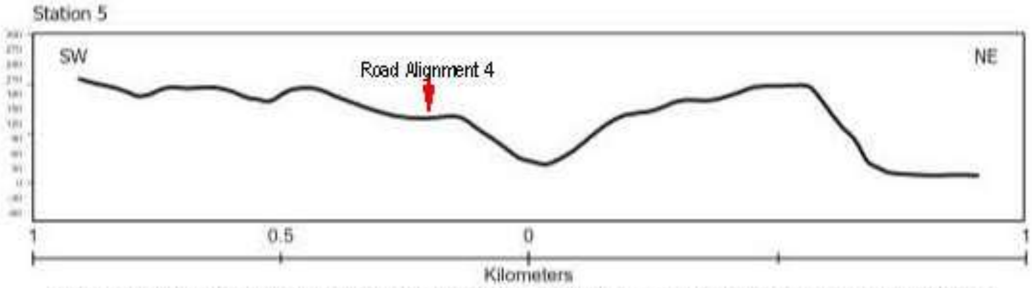
Road Alignment 1: 8°31'31.55"N / 124°46'4.87E. Elev.100m. Broadly undulating terrain. Brgy. Sugbongcogon, Tagoloan, Alae Bypass Road North end



Immediately south of Road Alignment 2: 8°31'34.07"N / 124°46'39.36"E. Elev. 105m. Broadly undulating to flattish terrain. Brgy. Natulmolan, Tagoloan, Alae Bypass Road



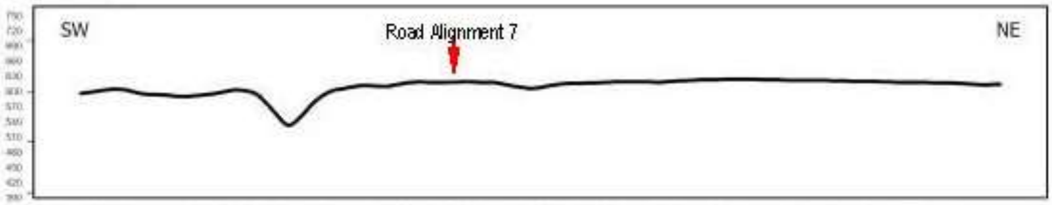
Road Alignment 3: 8°31'36.67"N / 124°46'31.01"E. Elev. 107m. Broadly undulating to flattish terrain. Brgy. Natulmolan, Tagoloan, Alae Bypass Road



Road Alignment 4: 8°30'36.19"N / 124°47'29.26"E. Elev. 46m. Slightly weathered bedded tuffaceous shale / pebbly sandstone in both road banks. Brgy. Natulmolan, Tagoloan, Alae Bypass Road.

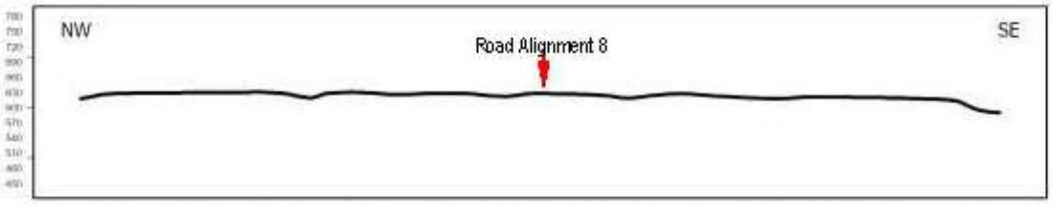
Profiles at road alignment 6 to 10

Station 6



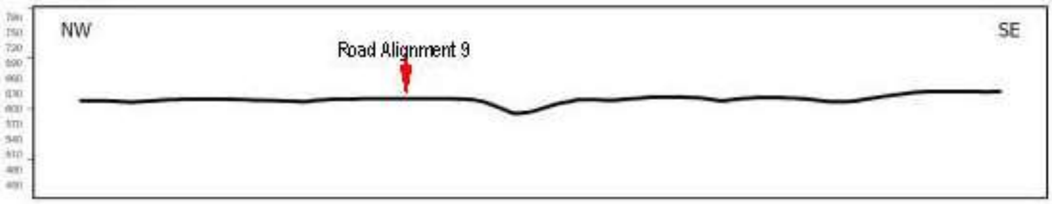
Road Alignment 7: 8°19'59.23"N / 124°54'39.85"E. Elev. 609m. Adjacent to creek. Brgy. Villa Vista, Manolo Fortich

Station 7



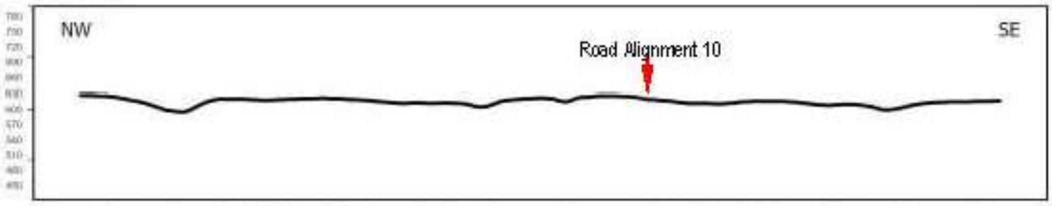
Road Alignment 8: 8°19'47.88"N / 124°55'35.51"E. Elev. 630m. Broadly undulating to flattish terrain. Brgy. Villa Vista, Manolo Fortich.

Station 8



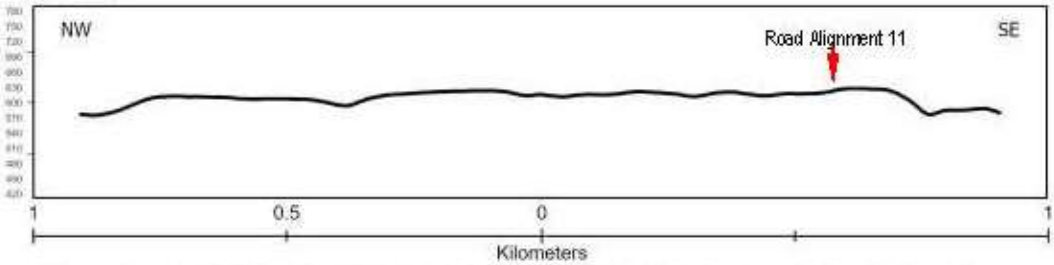
Road Alignment 9: 8°19'31.10"N / 124°56'2.47""E. Elev. 630m. Steep slope at the road bank. Brgy. San Roque Manolo Fortich

Station 9



Road Alignment 10: 8°19'19.35"N / 124°56'22.78"E. Elev.626m. Broadly undulating terrain, pineapple plantation, clayey reddish brown soil. Brgy. San Roque Manolo Fortich

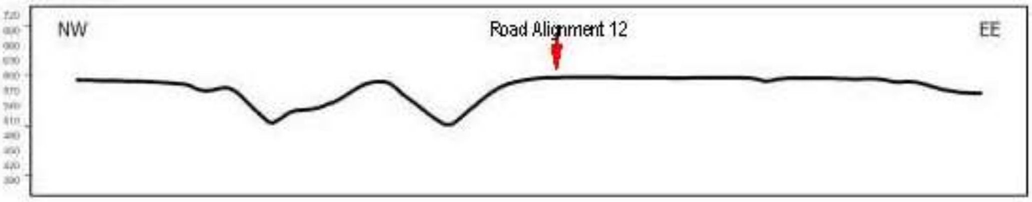
Station 10



Road Alignment 11: 8°31'36.67"N / 124°46'31.01"E. Elev.623m. Broadly undulating terrain, pineapple plantation, clayey reddish brown soil. Brgy. San Roque Manolo Fortich

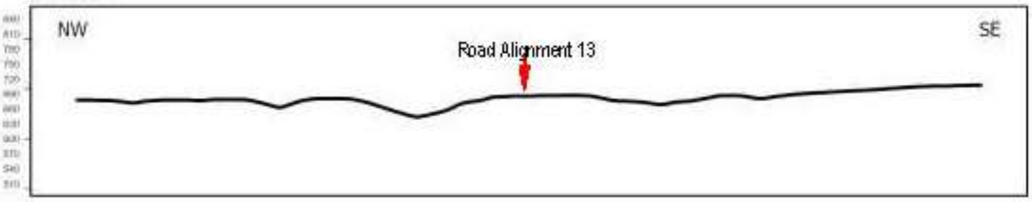
Profiles at road alignment 11 to 15/17

Station 11



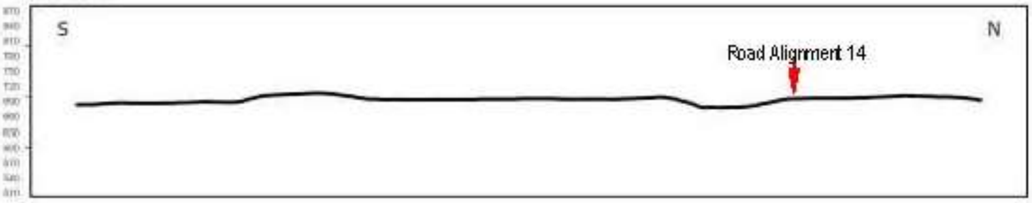
Road Alignment 12: 8°18'44"N / 124°58'10'"E. Elev. 664m. Broad undulating terrain with localized steep gullies. Farm lots. Pineapple plantation. Brgy. Kisolon, Sumilao.Adjacent to Road Alignment

Station 12



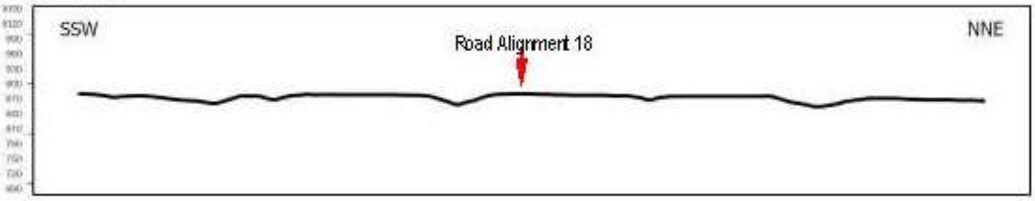
Road Alignment 13: 8°17'18"N / 124°59'2"E. Elev. 752m. Broadly undulating terrain, pineapple plantation

Station 13



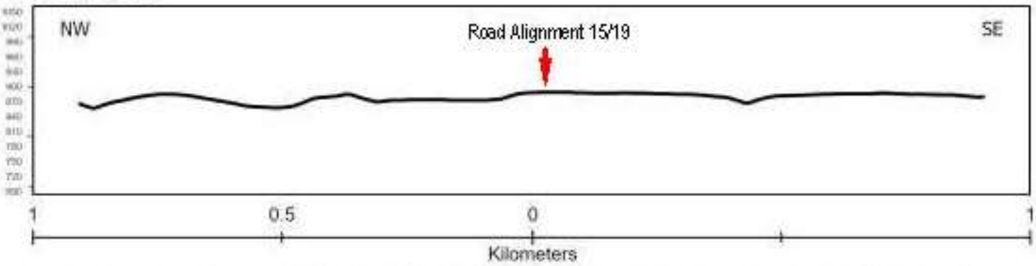
Road Alignment 14: 8°9'34"N / 124°6'17"E. Elev. 757m. Broadly undulating to flattish terrain. Brgy. 11, Malaybalay

Station 14



Road Alignment 18: 8°311'42"N / 124°3'10E. Elev. 953m. Intersection with Sayre Highway, flat to very gently sloping. Brgy. Dalwangan, Malaybalay

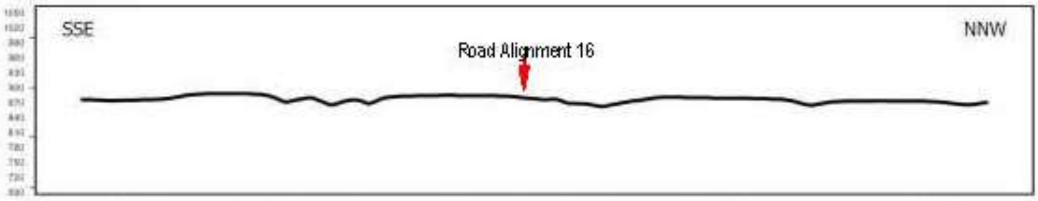
Station 15 & 17



Road Alignment 15/19: 8°12'51.73"N / 125° 1'59.12"E. Elev. 888m Valley at the west side. Weathered rock with thin 1m brown soil exposed locally. Brgy. Dalwangan, Malaybalay

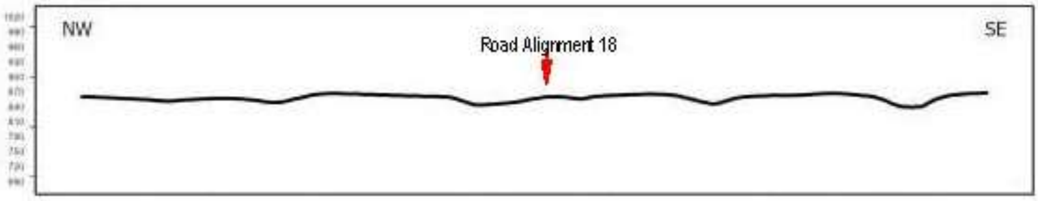
Profiles at road alignment 16 to 20

Station 16



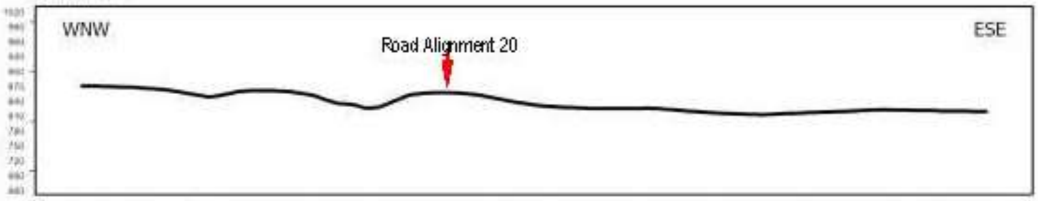
Road Alignment 16: 8°11'48.86"N / 125° 2'58.09""E. Elev. 884m. Localized highly weathered outcrop of andesitic volcaniclastics. Brgy. Dalwangan, Sayre Highway intersection with RA, Malaybalay

Station 18



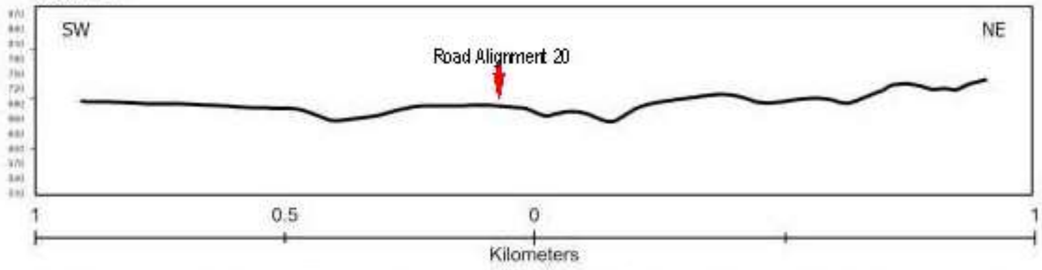
Road Alignment 17: 18°10'20.89"N / 125° 3'36.54"E. Elev. 852m 1.5m thick soil, 59m wide. Heavily weathered on both both sides. Malaybalay Diversion Road, Brgy. Lapu-lapu

Station 19



Road Alignment 20: 8°10'3.93"N / 125° 4'3.22"E. Elev. 839m. 3m thick, moderately weathered, brown to yellowish brown soil, broadly undulating to gentle sloping terrain. Malaybalay Diversion Road, Brgy. Kalasungay

Station 20



Road Alignment 1: 8°9'56"N / 125°6'50"E. Elev. 733m. Adjacent to Road Alignment. Fresh to slightly weathered, andesite outcrop along access road, localized rockfall. Malaybalay Diversion Road

Appendix 6. Photographs of the soil quality sampling stations

Appendix 7. Photographs of the sediment sampling stations

Top row, left to right: Sed1 (Tagoloan River, Natumolan, Tagoloan), Sed2 (Dicklum River, Dicklum, Manolo Fortich), Sed3 (Kumayakay River, Ticala, Manolo Fortich); *Second row, left to right:* Sed4 (Puntian River, Puntian/Vista Villa, Sumilao), Sed5 (Tagolongon River, Vista Villa/Culasi, Sumilao), Sed6 (Mapolo River, Kisolon/Poblacion, Sumilao); *Third row, left to right:* Sed7 (Ipoon River, Impalutao, Impasug-ong/Dalwangan, Malaybalay), Sed8 (Komotal River, Dalwangan, Malaybalay), Sed9 (Sawaga River, Patpat, Malaybalay); *Last row:* Sed10 (Sawaga River, Kalasungay, Malaybalay)

Appendix 8. Tree inventory data

Species (98)	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	Grand Total	RA (%)
Acacia mangium Willd.					16												1	2		3	22	0.20
Albizia saman (Jacq.) F.Muell	17	3																			20	0.18
Albizia saponaria (Lour.) Blume ex Miq									1												1	0.01
Alstonia scholaris (L.) R.Br.				1																	1	0.01
Anacardium occidentale L.	1						1														2	0.02
Annona muricata L.	1		2	1					1												5	0.05
Annona squamosa L.	1																				1	0.01
Antidesma ghaesembilla Gaertn.	3		7																		10	0.09
Araucaria heterophylla																4					4	0.04
Artocarpus blancoi (Elmer) Merr.	47	18	17	30	19	3	4	7	10	4			3					1		1	164	1.50
Artocarpus heterophyllus Lam.	2	1	5	2	5		1	4			1		1			5	5	5		7	44	0.40
Artocarpus odoratissimus Merr.	17			1	2	1	1		2	2	3	12	3		3	4	1	4	1	5	62	0.57
Astronia sp.																			1		1	0.01
Azadirachta excelsa (Jack) Jacobs	2												1								3	0.03
Azadirachta indica A.Juss.	1																				1	0.01
Barringtonia reticulata Miq.	2																				2	0.02
Caesalpinia pulcherrima (L.) Sw.																				5	5	0.05
Canarium ovatum	2																				2	0.02
Casia fistula L.			1		2	1															4	0.04
Ceiba pentandra (L.) Gaertn	12	3	1	3					3	3			1							1	27	0.25
Chrysophyllum cainito L.	2		3										1							1	7	0.06
Cinnamomum mercadoi S. Vidal							1														1	0.01
Cocos nucifera L.	71						2														73	0.67
Cratoxylum sumatranum (Jack) Blume								3	3	1							1				8	0.07
Dendrocalamus asper (Schult.f.) Backer ex Heyne			40			94		465		77	110		135		35			10	38	274	1,278	11.69
Dendrocnide sp.						1															1	0.01
Diplodiscus paniculatus Turcz.													3								3	0.03
Duabanga sp.	1																				1	0.01
Durio zibethinus L.															5	422		2		26	455	4.16
Elaeocarpus sp.								4	1												5	0.05
Erythrina variegata L. in Stickm.					1								3								4	0.04

Species (98)	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	Grand Total	RA (%)
Eucalyptus camaldulensis Dehnh.															7						7	0.06
Eucalyptus deglupta Blume			1														2				3	0.03
Falcataria moluccana (Miq.) Barneby & J.W.Grimes			700	1	3					16		1		2		5	3		400		1,131	10.35
Ficus ampelas Burm.f.													1								1	0.01
Ficus balete Merr.	1			2																	3	0.03
Ficus fiskei Elmer										1											1	0.01
Ficus magnoliifolia Blume	12		1																		13	0.12
Ficus minahassae (Teijsm. & Vriese) Miq.					2	1	1		1	6	2		2			1	11			1	28	0.26
Ficus nota (Blanco) Merr.					1	1	1			6	4		1			2			1		17	0.16
Ficus pseudopalma Blanco	7									1	2										10	0.09
Ficus ruficaulis Merr.	6	4	12			1															23	0.21
Ficus septica Burm.f.	1					1			1												3	0.03
Ficus sp.					1		2	1	1		1								1	2	9	0.08
Ficus sp. 2																3			1		4	0.04
Ficus sp. 3	1															1		1			3	0.03
Ficus sp. 4																		1			1	0.01
Garcinia mangostana L.																1				1	2	0.02
Gmelina arborea Roxb. ex Sm.	59	23	31	33	2		10	5	2	7	5	2	4		14	32	2	32		29	292	2.67
Greeniopsis sp.										2	1								1		4	0.04
Hevea brasiliensis (Willd. ex A.Juss.) Müll.Arg.												1,700			175			962	1,250	816	4,903	44.86
Hydroanthus chrysotrichus (Mart. Ex DC) Mattos			5							1										4	10	0.09
Kleinhovia hospita L.	1																				1	0.01
Lansium domesticum Correa				1	1			6	16							157		27		119	327	2.99
Leucaena leucocephala (Lam.) de Wit	31			3	35	1			1	2	1			1	1		2	3	1		82	0.75
Litsea cordata (Jack) Hook.f.																			1		1	0.01
Litsea philippinensis Merr.			1		2	1	2	9	9		1		1		3		2	3	1	1	36	0.33
Macaranga bicolor Mull.Arg.	2							6		1			1			1	2		2		15	0.14
Macaranga hispida (Blume) Mull.Arg. in DC	14	1	13	3		3							1						1		36	0.33
Macaranga sp.									1				1								2	0.02
Macaranga tanarius (L.) Mull.Arg. in DC	22	3	2		1	1	6	3	4		3		8								53	0.48
Mallotus sp.	12																		1		13	0.12
Mangifera indica L.	40	2	80	137											5	5	1	1		1	272	2.49

Species (98)	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	Grand Total	RA (%)
Melanolepis multiglandulosa (Reinw. ex Blume) Rchb. & Zoll.	27	2	4	27	8	2	1	2	2	2										2	79	0.72
Melicope triphylla (Lam.) Merr.								1											1		2	0.02
Morinda citrifolia L.							2														2	0.02
Neonauclea sp	1									1											2	0.02
Nephelium lappaceum L.			1	1												491					493	4.51
Omalanthus populneus (Geiseler) Pax								2	1								1				4	0.04
Osmoxylon sp.					1	1	1			1	1		1								6	0.05
Palaquium sp.	1																				1	0.01
Pangium edule Reinw. ex Blume							4														4	0.04
Persea americana Mill.	1			2			2								2	2					9	0.08
Pinus kesiya Royle ex Gordon					45							1			11	3		1			61	0.56
Pithecellobium dulce (Roxb.) Benth. in Hook	3						1		1	2	1										8	0.07
Polyalthia longifolia Benth. & Hook.f. ex Hook.f			7																		7	0.06
Polyscias nodosa (Blume) Seem	2	1	1		4	2	2	2	2		1				2	1		1			21	0.19
Pometia pinnata J.R. Forst. & G.Forst.	9						3			1			1								14	0.13
Psidium guajava L.	2		1						1							1					5	0.05
Pterocarpus indicus Willd.	5			3			2			2		3			5	1	1	6		5	33	0.30
Rhamnus philippinensis C.B.Rob																			1		1	0.01
Rhus taitensis Guill.								2	5												7	0.06
Sandoricum koetjape (Burm.f.) Merr.	3		2	2	6				1				2			5		1		2	24	0.22
Saurauia sp.								1									2				3	0.03
Schizolobium parahyba (Vell.) S.F.Blake	6		12					3	3	6								21		26	77	0.70
Semecarpus sp.	1					1		1													3	0.03
Shorea contorta S.Vidal															1						1	0.01
Spathodea campanulata P.Beauv.	1		1	47	44	2	3	5	2	2		1	4	1	4	63	5	16	2	13	216	1.98
Spiraeopsis sp.						1															1	0.01
Sterculia rubiginosa Vent.	2						1		1												4	0.04
Streblus asper Lour.	1																				1	0.01
Swietenia macrophylla King	1	24	38	12	45	1	1	4	1			16	2		4	1				82	232	2.12
Syzygium aqueum (Burm.f.) Alston																1					1	0.01
Syzygium cumini (L.) Skeels	2																				2	0.02
Terminalia catappa L.	3				1											1					5	0.05
Trema orientalis (L.) Blume	34	1	27		5				1				1			2		1			72	0.66

Species (98)	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	Grand Total	RA (%)
Vitex parviflora Juss.	2	2																			4	0.04
Ziziphus jujuba Mill.		1																			1	0.01
Grand Total	**498**	**89**	**1,016**	**312**	**252**	**120**	**55**	**536**	**78**	**147**	**137**	**1,736**	**182**	**4**	**277**	**1,215**	**42**	**1,101**	**1,705**	**1,427**	**10,929**	

Appendix 9. Importance values of trees recorded across the stations

Species Name	Abundance	Frequency	Density/ ha	RA (%)	RF (%)	RD (%)	IV
Hevea brasiliensis (Willd. ex A.Juss.) Müll.Arg.	4,903	0.25	296.46	44.86	1.18	45.91	91.95
Dendrocalamus asper (Schult.f.) Backer ex Heyne	1,278	0.5	76.19	11.69	2.36	11.80	25.85
Falcataria moluccana (Miq.) Barneby & J.W.Grimes	1,131	0.45	46.49	10.35	2.12	7.20	19.67
Nephelium lappaceum L.	493	0.15	40.24	4.51	0.71	6.23	11.45
Durio zibethinus L.	455	0.2	36.20	4.16	0.94	5.61	10.71
Gmelina arborea Roxb. ex Sm.	292	0.85	18.41	2.67	4.01	2.85	9.53
Spathodea campanulata P.Beauv.	216	0.9	12.54	1.98	4.25	1.94	8.16
Lansium domesticum Correa	327	0.35	20.66	2.99	1.65	3.20	7.84
Swietenia macrophylla King	232	0.7	9.43	2.12	3.30	1.46	6.88
Mangifera indica L.	272	0.45	13.43	2.49	2.12	2.08	6.69
Artocarpus blancoi (Elmer) Merr.	164	0.65	8.35	1.50	3.07	1.29	5.86
Artocarpus odoratissimus Merr.	62	0.8	4.12	0.57	3.77	0.64	4.98
Leucaena leucocephala (Lam.) de Wit	82	0.55	4.19	0.75	2.59	0.65	3.99
Melanolepis multiglandulosa (Reinw. ex Blume) Rchb. & Zoll.	79	0.55	4.16	0.72	2.59	0.64	3.96
Litsea philippinensis Merr.	36	0.7	1.99	0.33	3.30	0.31	3.94
Artocarpus heterophyllus Lam.	44	0.65	2.56	0.40	3.07	0.40	3.87
Macaranga tanarius (L.) Mull.Arg. in DC	53	0.5	3.20	0.48	2.36	0.50	3.34
Polyscias nodosa (Blume) Seem	21	0.6	1.13	0.19	2.83	0.18	3.20
Trema orientalis (L.) Blume	72	0.4	3.88	0.66	1.89	0.60	3.15
Schizolobium parahyba (Vell.) S.F.Blake	77	0.35	4.43	0.70	1.65	0.69	3.04
Pterocarpus indicus Willd.	33	0.5	2.30	0.30	2.36	0.36	3.02
Ficus minahassae (Teijsm. & Vriese) Miq.	28	0.5	1.94	0.26	2.36	0.30	2.92
Sandoricum koetjape (Burm.f.) Merr.	24	0.45	1.27	0.22	2.12	0.20	2.54
Macaranga bicolor Mull.Arg.	15	0.45	0.99	0.14	2.12	0.15	2.41
Ceiba pentandra (L.) Gaertn	27	0.4	1.60	0.25	1.89	0.25	2.38
Ficus nota (Blanco) Merr.	17	0.4	1.27	0.16	1.89	0.20	2.24

Species Name	Abundance	Frequency	Density/ ha	RA (%)	RF (%)	RD (%)	IV
Pinus kesiya Royle ex Gordon	61	0.25	2.71	0.56	1.18	0.42	2.16
Macaranga hispida (Blume) Mull.Arg. in DC	36	0.3	1.85	0.33	1.42	0.29	2.03
Cocos nucifera L.	73	0.1	5.08	0.67	0.47	0.79	1.93
Ficus sp. 1	9	0.35	0.42	0.08	1.65	0.07	1.80
Osmoxylon sp.	6	0.3	0.35	0.05	1.42	0.05	1.52
Persea americana Mill.	9	0.25	0.61	0.08	1.18	0.09	1.36
Ficus ruficaulis Merr.	23	0.2	1.08	0.21	0.94	0.17	1.32
Acacia mangium Willd.	22	0.2	0.79	0.20	0.94	0.12	1.27
Pometia pinnata J.R. Forst. & G.Forst.	14	0.2	0.89	0.13	0.94	0.14	1.21
Pithecellobium dulce (Roxb.) Benth. in Hook	8	0.2	0.54	0.07	0.94	0.08	1.10
Cratoxylum sumatranum (Jack) Blume	8	0.2	0.42	0.07	0.94	0.07	1.08
Chrysophyllum cainito L.	7	0.2	0.35	0.06	0.94	0.05	1.06
Psidium guajava L.	5	0.2	0.29	0.05	0.94	0.04	1.03
Annona muricata L.	5	0.2	0.22	0.05	0.94	0.03	1.02
Casia fistula L.	4	0.2	0.12	0.04	0.94	0.02	1.00
Ficus pseudopalma Blanco	10	0.15	0.78	0.09	0.71	0.12	0.92
Albizia saman (Jacq.) F.Muell	20	0.1	1.35	0.18	0.47	0.21	0.86
Hydroanthus chrysotrichus (Mart. Ex DC) Mattos	10	0.15	0.41	0.09	0.71	0.06	0.86
Terminalia catappa L.	5	0.15	0.32	0.05	0.71	0.05	0.80
Greeniopsis sp.	4	0.15	0.31	0.04	0.71	0.05	0.79
Sterculia rubiginosa Vent.	4	0.15	0.21	0.04	0.71	0.03	0.78
Ficus sp. 3	3	0.15	0.24	0.03	0.71	0.04	0.77
Semecarpus sp.	3	0.15	0.16	0.03	0.71	0.03	0.76
Ficus septica Burm.f.	3	0.15	0.13	0.03	0.71	0.02	0.76
Mallotus sp.	13	0.1	0.89	0.12	0.47	0.14	0.73
Ficus magnoliifolia Blume	13	0.1	0.88	0.12	0.47	0.14	0.73
Antidesma ghaesembilla Gaertn.	10	0.1	0.46	0.09	0.47	0.07	0.63
Rhus taitensis Guill.	7	0.1	0.26	0.06	0.47	0.04	0.58

Species Name	Abundance	Frequency	Density/ ha	RA (%)	RF (%)	RD (%)	IV
Elaeocarpus sp.	5	0.1	0.27	0.05	0.47	0.04	0.56
Ficus sp. 2	4	0.1	0.29	0.04	0.47	0.05	0.55
Vitex parviflora Juss.	4	0.1	0.24	0.04	0.47	0.04	0.55
Omalanthus populneus (Geiseler) Pax	4	0.1	0.23	0.04	0.47	0.04	0.54
Erythrina variegata L. in Stickm.	4	0.1	0.22	0.04	0.47	0.03	0.54
Saurauia sp.	3	0.1	0.22	0.03	0.47	0.03	0.53
Azadirachta excelsa (Jack) Jacobs	3	0.1	0.21	0.03	0.47	0.03	0.53
Eucalyptus deglupta Blume	3	0.1	0.19	0.03	0.47	0.03	0.53
Ficus balete Merr.	3	0.1	0.17	0.03	0.47	0.03	0.52
Neonauclea sp	2	0.1	0.15	0.02	0.47	0.02	0.51
Garcinia mangostana L.	2	0.1	0.12	0.02	0.47	0.02	0.51
Melicope triphylla (Lam.) Merr.	2	0.1	0.11	0.02	0.47	0.02	0.51
Anacardium occidentale L.	2	0.1	0.11	0.02	0.47	0.02	0.51
Macaranga sp.	2	0.1	0.09	0.02	0.47	0.01	0.50
Eucalyptus camaldulensis Dehnh.	7	0.05	0.72	0.06	0.24	0.11	0.41
Polyalthia longifolia Benth. & Hook.f. ex Hook.f	7	0.05	0.25	0.06	0.24	0.04	0.34
Araucaria heterophylla	4	0.05	0.33	0.04	0.24	0.05	0.32
Caesalpinia pulcherrima (L.) Sw.	5	0.05	0.19	0.05	0.24	0.03	0.31
Pangium edule Reinw. ex Blume	4	0.05	0.15	0.04	0.24	0.02	0.30
Diplodiscus paniculatus Turcz.	3	0.05	0.20	0.03	0.24	0.03	0.29
Barringtonia reticulata Miq.	2	0.05	0.14	0.02	0.24	0.02	0.28
Canarium ovatum	2	0.05	0.14	0.02	0.24	0.02	0.28
Syzygium cumini (L.) Skeels	2	0.05	0.14	0.02	0.24	0.02	0.28
Morinda citrifolia L.	2	0.05	0.08	0.02	0.24	0.01	0.27
Shorea contorta S.Vidal	1	0.05	0.10	0.01	0.24	0.02	0.26
Ficus sp. 4	1	0.05	0.09	0.01	0.24	0.01	0.26
Syzygium aqueum (Burm.f.) Alston	1	0.05	0.08	0.01	0.24	0.01	0.26
Ficus fiskei Elmer	1	0.05	0.08	0.01	0.24	0.01	0.26

Species Name	Abundance	Frequency	Density/ ha	RA (%)	RF (%)	RD (%)	IV
Annona squamosa L.	1	0.05	0.07	0.01	0.24	0.01	0.26
Azadirachta indica A.Juss.	1	0.05	0.07	0.01	0.24	0.01	0.26
Duabanga sp.	1	0.05	0.07	0.01	0.24	0.01	0.26
Kleinhovia hospita L.	1	0.05	0.07	0.01	0.24	0.01	0.26
Palaquium sp.	1	0.05	0.07	0.01	0.24	0.01	0.26
Streblus asper Lour.	1	0.05	0.07	0.01	0.24	0.01	0.26
Ficus ampelas Burm.f.	1	0.05	0.07	0.01	0.24	0.01	0.26
Ziziphus jujuba Mill.	1	0.05	0.05	0.01	0.24	0.01	0.25
Astronia sp.	1	0.05	0.05	0.01	0.24	0.01	0.25
Litsea cordata (Jack) Hook.f.	1	0.05	0.05	0.01	0.24	0.01	0.25
Rhamnus philippinensis C.B.Rob	1	0.05	0.05	0.01	0.24	0.01	0.25
Alstonia scholaris (L.) R.Br.	1	0.05	0.05	0.01	0.24	0.01	0.25
Cinnamomum mercadoi S. Vidal	1	0.05	0.04	0.01	0.24	0.01	0.25
Dendrocnide sp.	1	0.05	0.03	0.01	0.24	0.00	0.25
Spiraeopsis sp.	1	0.05	0.03	0.01	0.24	0.00	0.25
Albizia saponaria (Lour.) Blume ex Miq	1	0.05	0.03	0.01	0.24	0.00	0.25
Total	**10,929**	**21.2**	**645.73**	**100**	**100**	**100**	**300**

Appendix 10. Species and conservation status of trees documented across stations

Family	Species	Conservation status	Distribution	Family	Species	Conservation status	Distribution
Achariaceae	1. *Pangium edule* Reinw. ex Blume	Least concern		Lamiaceae	34. *Gmelina arborea* Roxb. ex Sm.	Least concern	Invasive
Actinidiaceae	2. *Saurauia* sp.	Least concern		Lauraceae	35. *Litsea cordata* (Jack) Hook.f.	Least concern	
Adoxaceae	3. *Sambucus javanica* Reinw. Ex Blume	Least concern			36. *Litsea philippinensis* Merr.	Least concern	Endemic
Anacardiaceae	4. *Anacardium occidentale* L.	Least concern	Introduced		37. *Persea americana* Mill.	Least concern	
	5. *Mangifera indica* L.	Least concern		Lithocarpaceae	38. *Lithocarpus* sp.	Least concern	
	6. *Semecarpus* sp.	Least concern		Melastomataceae	39. *Astronia* sp.	Least concern	Endemic
Araliaceae	7. *Osmoxylon* sp.	Least concern		Meliaceae	40. *Dysoxylum* sp.	Least concern	
	8. *Polyscias nodosa* (Blume) Seem	Least concern			41. *Lansium domesticum* Jack	Least concern	
Bignoniaceae	9. *Spathodea campanulata* P.Beauv.	Least concern			42. *Sandoricum koetjape* (Burm.f.) Merr.	Least concern	
	10. *Tabebuia chrysotricha* (Mart. ex DC.) Standl.	Least concern			43. *Swietenia macrophylla* King	Least concern	
	11. *Spathodea campanulata* P.Beauv.	Least concern		Moraceae	44. *Artocarpus blancoi* (Elmer) Merr.	Least concern	Endemic
Bombacacee	12. *Ceiba pentandra* (L.) Gaertn	Least concern			45. *Artocarpus heterophyllus* Lam.	Least concern	
Brownlowiaceae	13. *Diplodiscus paniculatus* Turcz.	Least concern	Endemic		46. *Artocarpus odoratissimus* Merr.	Least concern	Naturalized
Cannabaceae	14. *Trema orientalis* (L.) Blume	Least concern			47. *Ficus ampelas* Burm.f.	Least concern	
Cunoniacee	15. *Caldcluvia* sp.	Least concern			48. *Ficus fiskei* Elmer	Least concern	Endemic
Elaeocarpaceae	16. *Elaeocarpus* sp.	Least concern		Moraceae	49. *Ficus minahassae* (Teijsm. & Vriese) Miq.	Least concern	
Euphorbiaceae	17. *Macaranga bicolor* Mull.Arg.	Least concern	Endemic		50. *Ficus nota* (Blanco) Merr.	Least concern	
	18. *Macaranga hispida* (Blume) Mull.Arg. in DC	Least concern			51. *Ficus pseudopalma* Blanco	Least concern	Endemic
	19. *Macaranga* sp.	Least concern			52. *Ficus septica* Burm.f.	Least concern	
	20. *Macaranga tanarius* (L.) Mull.Arg. in DC	Least concern			53. *Ficus ruficaulis*Merr.	Least concern	
	21. *Mallotus* sp.	Least concern			54. Ficus sp. 1	Least concern	
	22. *Melanolepis multiglandulosa* (Reinw. ex Blume) Rchb. & Zoll.	Least concern			55. *Ficus sp. 2*	Least concern	
	23. *Omalanthus macradenius* Pax & Hoffm.	Least concern	Endemic		56. *Ficus sp. 3*	Least concern	
Fabaceae	24. *Acacia mangium* Willd.	Least concern		Myrtaceae	57. *Eucalyptus camaldulensis* Dehnh.	Least concern	Invasive
	25. *Casia fistula* L.	Least concern	Introduced		58. *Eucalyptus deglupta* Blume	Least concern	
	26. *Erythrina variegata* L.	Least concern			59. *Psidium guajava* L.	Least concern	Invasive
	27. *Falcataria moluccana* (Miq.) Barneby & J.W. Grimes	Least concern	Introduced and naturalized in the Philippines	Rubiaceae	60. *Greeniopsis* sp.	Least concern	
	28. *Leucaena leucocephala* (Lam.) de Wit	Least concern	Invasive species		61. *Neonauclea* sp.	Least concern	
	29. *Pithecellobium dulce* (Roxb.) Benth. in Hook	Least concern			62. *Wendlandia luzoniensis* DC	Least concern	
	30. *Pterocarpus indicus* Willd.	Vulnerable		Rutaceae	63. *Melicope triphylla* (Lam.) Merr.		
	31. *Schizolobium parahyba* (Vell.) S.F.Blake	Least concern		Sapindaceae	64. *Pometia pinnata* J.R. Forst. & G. Forst.	Least concern	
Hypericaceae	32. *Cratoxylum sumatranum* (Jack) Blume	Least concern		Sterculiaceae	65. *Sterculia rubiginosa* Vent.	Least concern	
Juglandaceae	33. *Engelhardia spicata* Lechen. ex Blume	Least concern		Urticaceae	66. *Dendrocnide* sp.	Least concern	

Appendix 11. Photographs of tree representatives recorded across the stations

Artocarpus heterophyllus

Schizolobium parahyba

Dendrocalamus asper

Polyscias nodusa

Cassia fistula

Ficus nota

Pterocarpus indicus Wild.a

Vitex parviflora

Azadirachta excelsa

Canarium ovatum

Cinnamomum mercadoi

Appendix 12. List of Flora Species indicated in IUCN Red List

<table>
<tr><th>Scientific Name: <i>Pterocarpus indicus</i> Wild.</th><th>Common Name: Smooth Narra</th><th>IUCN Red List: Endangered
DAO 2017-11: Vulnerable</th></tr>
<tr><td>Population</td><td colspan="2">There is little precise population information available for <i>P. indicus.</i> Although the species is found across Indonesia the subpopulation is scattered and the species is described as uncommon (Barstow, 2018).</td></tr>
<tr><td>Geographic Range</td><td colspan="2">This species is native to much of south and Southeast Asia. The species was previously more widespread but the subpopulation within Vietnam is now considered extinct and upon the last survey of Sri Lanka the species could not be found. The species occurs at a wide range of altitude from 600 to 1,300 m above sea level (Barstow, 2018).

<i>Source: IUCN Red List of Threatened Species</i></td></tr>
<tr><td>Habitat</td><td colspan="2">This large tree species can grow up to 40 m in height. It grows within lowland rainforests as an emergent, canopy or subcanopy tree. It can occur in both primary and less commonly in secondary forests. The tree can grow on all soils types and is most frequent along tidal creeks, rocky shore and some coastal sites (Barstow, 2018).</td></tr>
<tr><td>Local Information</td><td colspan="2"><i>Pterocarpus indicus</i> flowers annually and the species is insect pollinated. The species is a pioneer as it grows best in open forest however seedlings are slow growing (Barstow, 2018).</td></tr>
<tr><td>Situation of site during the site survey</td><td colspan="2">The species was present within stations T1, T4, T7, T10, T12, T15, T16, T17, T18, and T20. These established stations situated both in agricultural plantation and riparian forest. The majority of the species exist in secondary forests, which are areas where land has been cleared of its original vegetation and woody vegetation has begun to regenerate. Furthermore, riparian forests are among the most diverse and complex habitats, serving as</td></tr>
</table>

	corridors and improving connectivity by connecting forest patches.
Record of existing survey	At a country level, in China, the subpopulation is scattered and the species is considered uncommon. Although the species is found across Indonesia the subpopulation is scattered and the species is described as uncommon. A similar description is given for the subpopulations in Malaysia, Myanmar, Thailand and Viet Nam. The species is experiencing decline in all of these countries, and consequently it will be becoming more scattered and even less common (Barstow, 2018).
Photos	 *Source: https://www.gbif.org/*

<table>
<tr><th>Scientific Name:
<i>Vitex parviflora</i></th><th>Common Name:
Molave</th><th>IUCN Red List: Least Concern
DAO 2017-11: Endangered</th></tr>
<tr><td>Population</td><td colspan="2">In the Philippines all major mature populations have now been logged. There is no further information about the population size and trends of this species (de Kok, 2020).</td></tr>
<tr><td>Geographic Range</td><td colspan="2">This tree species is native to the Philippines and Indonesia (Moluccas and Lesser Sunda Islands) and East Timor. Introduced as a timber tree on many tropical countries (de Kok, 2020).


<i>Source: IUCN Red List of Threatened Species</i></td></tr>
<tr><td>Habitat (inhabitation feeding area, breeding area, and nesting area)</td><td colspan="2">This species is a tree between 4–15 (– 30) m high. It grows in secondary or mixed primary forest, often along streams, between 30–400 (– 650) m altitude (de Kok 2009).</td></tr>
<tr><td>Local Information</td><td colspan="2">Reported to be one of the dominant trees in the Philippine monsoon forest (de Kok 2009).</td></tr>
<tr><td>Situation of site during the site survey</td><td colspan="2">The species were found along the transects 1 and 2. Transect 1 was located in a secondary forest patch where underlying vegetation (grasses and saplings) and intermediate vegetation were also found. Two (2) trees were found in transect 2, which was situated in a riparian forest.</td></tr>
<tr><td>Record of existing survey</td><td colspan="2">It has a relatively large extent of occurrence (EOO of 1,367,808 km², but most of this is sea) and area of occupancy (AOO of 48 km²). It is known not known from a protected area, but it is very likely that it does occur in protected areas in the Philippines.</td></tr>
</table>

Photos	 *Source: https://www.gbif.org/*

Scientific Name: Shorea contorta	**Common Name: White Lauan**	**IUCN Red List: Least Concern DAO 2017-11: Endangered**
Population	There is no overall population information. The species is considered very common in every area it inhabits (EDC, 2020).	
Geographic Range	*Shoreacontorta* is endemic to the Philippines and naturally occurs in lowland forest where it remains throughout the country. Distribution data has not been mapped for this species (EDC, 2020).	
Habitat (inhabitation feeding area, breeding area, and nesting area)	*Shoreacontorta* is a large tree, found in lowland seasonal semi-evergreen dipterocarp forest. This species is likely to be positively affected by future climate (EDC, 2020).	
Local Information/	The species is recorded from Babuyan islands (Calayan), Luzon (in most provinces), Polillo, Mindoro, Sibuyan, Marinduque, Masbate, Negros, Leyte, Samar, Mindanao and Basilan (EDC, 2020). It is recorded to be flowering in the months of March (Laguna, Palawan), April (Laguna), May (Quezon) (EDC, 2020).	
Situation of Site During the Site Survey	The species were identified in transect 15 where pineapple plantation and cornfields were located. There were open areas observed during the survey.  Transect 15 (Impasug-ong, Bukidnon)	
Record of existing survey	Approximately more than 10,000 mature individuals are recorded during the BINHI-EDC explorations (EDC, 2020)	

Photos	 *Source: https://binhi.ph/tree/white-lauan/*

<table>
<tr><th>Scientific Name:
<i>Azadirachta excelsa</i></th><th>Common Name:
Philippine Neem Tree</th><th>IUCN Red List: Least Concern
DAO 2017-11: Vulnerable</th></tr>
<tr><td>Population</td><td colspan="2">There is limited population information for this species. As the extent of decline from country to country varies so widely and the overall popuation size or density across the range is not known, it is not possible to calculate an accurate population decline for this species (Barstow, 2018).</td></tr>
<tr><td>Geographic Range</td><td colspan="2">This species is widespread in southeast Asia. Where it is found from Viet Nam south to Papua New Guinea, occurring on Borneo and most islands of Indonesia and Philippines in between. The species is cultivated within Singapore (Barstow, 2018).


<i>Source: IUCN Red List of Threatened Species</i></td></tr>
<tr><td>Habitat (inhabitation feeding area, breeding area, and nesting area)</td><td colspan="2"><i>Azadirachtaexcelsa</i> is a large tree species up to 50 m in height. It grows in lowland, monsoon rainforests. The species can be evergreen or deciduous depending on the local climate. The species habitat is currently in decline as lowland rain forests are targeted for logging and conversion to plantations within southeast Asia (Barstow, 2018). The species is sensitive to shade, poor soil nutrition and drought but in ideal growth conditions it has been found to grow quickly (Barstow, 2018).</td></tr>
<tr><td>Local Information</td><td colspan="2">It is fast becoming a favorite plantation species as an alternate source of logs or timber. The species is found growing naturally in Palawan. It can be harvested in 3 to 15 years depending on the planting requirements or planned end-use (ERDB, 2001).</td></tr>
<tr><td>Situation of Site During the Site Survey</td><td colspan="2">There were 2 individuals found in transect 1 near the residential area and along the conducted bypass road. Only 1 individual found in transect 13, where plantations of pineapple, sugarcane and corn were located.</td></tr>
<tr><td>Record of existing survey</td><td colspan="2">The species is confirmed to be common within southeast Viet Nam. Within Borneo there has been an estimated loss of forest cover of 30% since the 1970's, with extent loss from each country varying from 8.8% in Brunei Darussalam up to
39.5% in Sarawak. While in Papua New Guinea 15% of forest loss is estimated tohave been cleared between 1972 and 2002 and in Indonesia rate of forest loss is between 0.76 and 0.98% per year (Barstow, 2018).</td></tr>
</table>

Photos	 *Source: www.nparks.gov.sg*

Scientific Name: *Canarium ovatum*	**Common Name: Pili**	**IUCN Red List: Least Concern DAO 2017-11: Other Threatened Species**
Population	*Canarium ovatum* was found to have a considerably large extent of occurrence of 278,000 km^2 it was expected that it has a relatively large total population number. However, due to the continuous decline of the forest resources of its type locations and the provinces where it can be found there is an expected future population decline to its total population in the non-distant future indicating a 126,000 hectares of tree cover loss from 2001 to 2018 (EDC, 2020).	
Geographic Range	*Canarium ovatum* is an endemic species in the Philippines which was found native in Luzon region, where it was found to be occurring in the provinces of Quezon, Laguna, Camarines Sur, Bohol, Albay, Sorsogon, Catanduanes, Masbate, Leyte, Samar and Antique. It also occurs in Mindanao, particularly in the provinces of Bukidnon, Surigao, Agusan del Norte, and Davao del Sur (EDC, 2020).Distribution data has not been mapped for this species.	
Habitat	*Canarium ovatum* is a tree and is found mostly in lowland forests with warm temperatures and well distributed rainfalls. This species of *Canarium* typically grows up to 20 m tall in light and heavy soils. The phenology of this species is between March and June. Seeds are dispersed by some wildlife (i.e. hornbills, wild pigs, wild deer, rodents, etc.) consuming the pulp and leaving the nuts (EDC, 2020).	
Local Information	*Canarium ovatum* (known locally as pili and pilaui) is the most important nut-producing species in the Philippines. Although one of the more typhoon-resistant species, severe typhoons have led to significant destruction of pili trees. The most severe threat is posed by humans who have felled pili trees to sell as lumber or fuelwood in periods of food insecurity following a major typhoon (Coronel, 1996).	
Situation of site during the site survey	Found along the Transect 1. Transect 1 is near residential areas with coconut and mango plantation areas, open grassland, and residual secondary forest patches at the ravines.	

Record of existing survey	It has a relatively large extent of occurrence (EOO) of around 300,000 km2 where its prominent geographic distribution indicates its well-adaptability in the country's various provinces. It also considered to have a large total population given its wide distribution (EDC, 2020).
Photos	 *Source: http://regenerag.org/*

Scientific Name: *Cinnamomum mercadoi*	**Common Name: Kalingag**	**IUCN Red List: Least Concern DAO 2017-11: Other Threatened Species**
Population	Currently, the population size of the species remains uncertain due to lack of research which can be addressed by further inventory and documentation. Its minimum area of occupancy is 252 km² (EDC, 2020). (EDC, 2020).	
Geographic Range	*Cinnamomum mercadoi* is an endemic tree species in the Philippines. The number of locations were estimated at 50. Distribution data has not been mapped for this species.	
Habitat (inhabitation feeding area, breeding area, and nesting area)	*Cinnamomum mercadoi* is a small tree species with height ranging from five to 15 meters and can usually be found in lowland to high-elevated primary forests at 150 to 985 m asl. Other herbarium records indicate its suitability in forest ridges, dipterocarp forests, logged-over secondary forests, as well as in extreme ultrabasic areas. It is also abundant in lower montane to upper montane forests at 2,050 to 2,300 m asl. e.g. Mt Kitanglad Mountain Range. Its complete flowering and fruiting cycle has yet to be determined but flowering has been observed during from January to May, while fruits were observed from March to November (EDC, 2020).	
Local Information/	*Cinnamomum mercadoi* is an endemic tree species in the Philippines which naturally thrives in low to high-elevated primary forests in various provinces and localities in Luzon to Mindanao islands. It has a calculated extent of occurrence (EOO) of 667,408 km² and a minimum area of occupancy (AOO) of 252 km² which account for 50 estimated locations (EDC, 2020).	
Situation of site during the site survey	It is found along Transect 7. The transect is along Mangima river. It is a mix agroforest area on both sides of the ravine with cornfields near the river and pineapple plantation at the top of the plateau  Transect 7(Manolo Fortich, Bukidnon)	

Record of existing survey	It has a calculated extent of occurrence (EOO) of 667,408 km² and a minimum area of occupancy (AOO) of 252 km² which account for 50 estimated locations based on currently available species' information. Given its large distribution throughout the country and its very common habitat requirements, it is expected that it is abundantly occurring within its known localities (EDC, 2020).
Photos	 *Source: http://phytoimages.siu.edu/*

Appendix 13. Importance values of grassland and understory vegetation recorded across the stations

Species Name (64)	Density	Frequency	Cover	RD (%)	RF (%)	RC (%)	SIV
Asytasia gangetica subsp. Micrantha	441.47	9.70	4.66	28.37	17.00	28.69	74.06
Axonopus compressus	350.83	6.18	3.38	22.54	10.82	20.82	54.18
Rottboella cochinchinensis	66.33	4.15	1.11	4.26	7.27	6.84	18.37
Sphagneticola trilobata	110.10	1.03	0.72	7.07	1.81	4.43	13.32
Oplimenus hirtellu	76.96	2.10	0.62	4.95	3.68	3.85	12.48
Drynaria cordata	53.51	1.11	0.43	3.44	1.95	2.63	8.01
Ageratum conyzoides	23.33	2.65	0.26	1.50	4.64	1.62	7.75
Mimosa pudica	16.42	2.56	0.33	1.06	4.50	2.02	7.57
Arachis hypogea	59.65	0.57	0.42	3.83	1.00	2.57	7.40
Eleusine indica	17.81	2.21	0.39	1.14	3.86	2.38	7.39
Chromolaena odorata	24.22	2.12	0.28	1.56	3.71	1.72	6.99
Centrosa pubescens	14.41	1.48	0.31	0.93	2.60	1.92	5.44
Borreria laevis	24.89	1.30	0.13	1.60	2.28	0.79	4.67
Calopogonium mucunoides	7.74	1.35	0.23	0.50	2.36	1.42	4.28
Kylinga nemoralis	28.90	0.81	0.12	1.86	1.42	0.72	3.99
Euphorbia hirta	18.36	1.18	0.11	1.18	2.07	0.67	3.92
Stachytarpheta jamaicensis	7.42	1.18	0.21	0.48	2.07	1.32	3.86
Commelina diffusa	24.06	0.77	0.13	1.55	1.35	0.79	3.69
Sida rhombifolia	6.89	0.94	0.18	0.44	1.65	1.11	3.20
Crotalaria pallida	4.56	1.07	0.11	0.29	1.87	0.67	2.84
Synedrella nodiflora	10.71	0.88	0.10	0.69	1.54	0.60	2.83
Mimosa diploticha	7.75	0.41	0.24	0.50	0.71	1.46	2.67
Euphorbia heterophylla	12.21	0.57	0.13	0.78	1.00	0.78	2.56
Solanum torvum	2.95	1.09	0.07	0.19	1.90	0.45	2.55
Crassocephalum crepidiodes	4.28	0.91	0.08	0.28	1.60	0.48	2.35
Chamaecrista nictitans	9.25	0.60	0.11	0.59	1.06	0.66	2.31
Spilanthes paniculata	5.89	0.71	0.09	0.38	1.24	0.54	2.16
Digitaria ciliaris	14.85	0.30	0.07	0.95	0.53	0.42	1.90
Richardia grandiflora	7.23	0.55	0.07	0.46	0.96	0.43	1.86
Acmella paniculata	4.05	0.68	0.06	0.26	1.18	0.35	1.80
Tradescantia fluminensis	11.85	0.20	0.11	0.76	0.35	0.65	1.76
Oldenlandia corymbosa	13.79	0.11	0.10	0.89	0.18	0.63	1.70
Christella normalis	2.86	0.59	0.05	0.18	1.04	0.34	1.56
Euphorbia prostata	14.21	0.16	0.05	0.91	0.28	0.29	1.48
Nephrolepis bisserata	3.84	0.39	0.08	0.25	0.69	0.47	1.41
Amaranthus spinosus	1.65	0.45	0.07	0.11	0.79	0.42	1.32
Erigeron canadensis	1.54	0.57	0.03	0.10	1.01	0.19	1.29
Cloeme rutidosperma	3.27	0.47	0.03	0.21	0.82	0.16	1.19
Ipomea batatas	1.43	0.28	0.09	0.09	0.48	0.54	1.12
Eclipta prostata	1.65	0.25	0.05	0.11	0.44	0.30	0.84
Peperomia pellucida	7.19	0.08	0.03	0.46	0.13	0.19	0.79
Echinocloa colona	5.14	0.08	0.05	0.33	0.14	0.31	0.78
Colocasia esculenta	0.94	0.31	0.03	0.06	0.54	0.17	0.77
Melothria pendula	2.06	0.23	0.03	0.13	0.40	0.21	0.75
Lantana camara	1.45	0.25	0.02	0.09	0.44	0.11	0.64
Borreria ocymoides	2.78	0.20	0.02	0.18	0.35	0.10	0.63
Cornus sericea	0.83	0.18	0.04	0.05	0.31	0.27	0.63
Ruella tuberosa	3.23	0.13	0.03	0.21	0.22	0.18	0.61
Grona trifloral	5.92	0.03	0.02	0.38	0.05	0.12	0.55

Species Name (64)	Density	Frequency	Cover	RD (%)	RF (%)	RC (%)	SIV
Eragotis amabilis	1.85	0.05	0.03	0.12	0.09	0.18	0.39
Amaranthus viridis	1.70	0.12	0.01	0.11	0.22	0.05	0.37
*Coffea arabica** seedlings	3.24	0.03	0.02	0.21	0.05	0.11	0.37
Swietenia sapling	0.45	0.15	0.01	0.03	0.26	0.06	0.36
Ananas comosus	0.30	0.05	0.04	0.02	0.09	0.22	0.33
Odontonema cuspidatum	1.10	0.05	0.03	0.07	0.09	0.16	0.32
Phaulopsis imbritica	0.20	0.15	0.00	0.01	0.26	0.01	0.28
Cyathillium cinereum	1.76	0.03	0.01	0.11	0.06	0.09	0.26
Tridax procumbens	1.52	0.03	0.01	0.10	0.06	0.08	0.24
Manihot esculenta	0.10	0.10	0.01	0.01	0.18	0.03	0.22
Polygonum tomentosum	0.74	0.05	0.01	0.05	0.09	0.05	0.19
Corchorus olitorus	0.10	0.05	0.01	0.01	0.09	0.06	0.15
Piper sarmentosum	0.20	0.05	0.01	0.01	0.09	0.04	0.14
Alocasia cucullate	0.05	0.05	0.00	0.00	0.09	0.00	0.09
Melonchia corchorifolia	0.33	0.03	0.00	0.02	0.04	0.02	0.09
Total	**1556.25**	**57.06**	**16.23**	**100**	**100**	**100**	**300**

Appendix 14. Abundance and distribution of birds across stations

Low rainfall period

Family	Species	Transect																				Total	RA (%)
		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20		
Accipitridae	Brahminy kite (Haliastur indus)							1		1	2											4	0.5
Accipitridae	Philippine serpent-eagle (Spilornis cheela)									1												1	0.12
Alcedinidae	Collared Kingfisher (Todiramphus chloris)	3		1	1		3	5		1	5		1			2			3		8	33	4.08
Alcedinidae	Southern silvery kingfisher (Ceyx argentatus)								1													1	0.12
Alcedinidae	White-throated kingfisher (Halcyon gularis)	1					2	2						1					3			9	1.11
Anatidae	Philippine Duck (Anas luzonica)															1						1	0.12
Apodidae	Glossy swiftlet (Collocalia esculenta)	20	2	10				15	1	5	7					8	3	6	9		3	89	11.01
Ardeidae	Cattle egret (Bubulcus ibis)															14						14	1.73
Artamidae	White breasted wood swallow (Artamus leucoryn)	1	2			1		1			6			3		1			1		1	17	2.1
Campephagidae	Pied triller (Lalage nigra)	1										1										2	0.25
Columbidae	Grey-capped emerald dove (Chalcophaps indica)								1	1				1								3	0.37
Columbidae	Philippine Cuckoo Dove (Macropygia tenuirostris)		1																			1	0.12
Columbidae	White-eared brown dove (Phapitreron leucotis)	2				1	2	4	3	5	3	2		1		7			1			31	3.84
Columbidae	Zebra dove (Geopelia striata)	3			1		1	1	1		1							2	13	4	30	57	7.05
Corvidae	Large-billed crow (Corvus macrorhynchos)													1		1					3	5	0.62
Cuculidae	Black-faced coucal (Centropus melanops)									1									1		1	3	0.37
Cuculidae	Philippine coucal (Centropus viridis)	1												1								2	0.25

Family	Species	Transect																				Total	RA (%)
		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20		
Dicaeidae	Fire-breasted flowerpecker (Dicaeum ignipectus)								1		1											2	0.25
Dicaeidae	Red keeled flowerpecker (Dicaeum austral)							3			2			1		1			4			11	1.36
Estrildidae	Chestnut munia (Lonchura atricapilla)							1													4	5	0.62
Falconidae	Philippine falconet (Microhierax erythrogenys)								1		1											2	0.25
Laniidae	Long-tailed shrike (Lanius schach)										1								2		1	4	0.5
Locustellidae	Striated grassbird (Megalurus palustris)	1						1	1		2	1				2						8	0.99
Locustellidae	Tawny grassbird (Megalurus timoriensis)											1										1	0.12
Megalaimidae	Coppersmith barbet (Psilopogon haemacephalus)				1			2			1					2						6	0.74
Meropidae	Blue-throated bee-eater (Merops viridis)	3					2	4								1						10	1.24
Motacillidae	Eastern Yellow Wagtail (Motacilla flava)											1										1	0.12
Muscicapidae	Blue-and-white flycatcher (Cyanoptila cyanomelana)						1	1			1			1								4	0.5
Muscicapidae	Oriental magpie-robin (Copsychus saularis)						1		1	1	1								1			5	0.62
Muscicapidae	Pied Buschat (Saxicola caprata)									1												1	0.12
Nectariniidae	Brown-throated sunbird (Anthreptes malacensis)																				11	11	1.36
Nectariniidae	Lina's sunbird (Aethopyga linaraborae)	1						3														4	0.5
Nectariniidae	Olive-backed sunbird (Cinnyris jugularis)		2		1		3	2	2	7	1	1	1	1		2			8		7	38	4.7
Pachycephalidae	White-vented whistler																		3			3	0.37

Family	**Species**	**Transect**																				**Total**	**RA (%)**
		T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**T16**	**T17**	**T18**	**T19**	**T20**		
	(Pachycephala homeyeri)																						
Passeridae	Eurasian tree sparrow (Passer montanus)	7	4	2			1	3	1	4	20	1	1	5	12	34	2	6	49	20	67	239	29.58
Psittacidae	Philippine hanging parrot (Loriculus philippensis)							2														2	0.25
Pycnonotidae	Philippine bulbul (Hypsipetes philippinus)							4		1	2	2				2						11	1.36
Pycnonotidae	Yellow-vented bulbul (Pycnonotus goiavier)	10	4		1		2	3		4	4			1	3	15	2		20	14	19	102	12.62
Rallidae	Barred rail (Hypotaenidia torquata)		1					1		2						1						5	0.62
Rhipiduridae	Black-and-cinnamon fantail (Rhipidura nigrocinnamomea)																				2	2	0.25
Rhipiduridae	Philippine pied fantail (Rhipidura nigritorquis)	2			1			1		2						1			4			11	1.36
Sturnidae	Asian glossy starling (Aplonis panayensis)	4						2		1	17					9			2			35	4.33
Sturnidae	Coleto (Sarcops calvus)		1								1											2	0.25
Timaliidae	Brown tit-babbler (Macronus striaticeps)							1								2						3	0.37
Turdidae	Island thrush (Turdus poliocephalus)															1						1	0.12
Turnicidae	Barred Button quail (Turnix suscitator)															1						1	0.12
Tytonidae	Eastern Grass-owl (Tyto longimembris)															2						2	0.25
Zosteropidae	Mountain white-eye (Zosterops japonicus)									1	1	1										3	0.37
	Total	**60**	**17**	**13**	**6**	**2**	**18**	**63**	**14**	**39**	**80**	**11**	**3**	**17**	**15**	**110**	**7**	**14**	**124**	**38**	**157**	**808**	

High rainfall period

Family	Species	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	Total	RA %
Accipitridae	Black-shouldered kite (*Elanus axillaris*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**2**	**0.27%**
Accipitridae	Brahminy kite (*Haliastur indus*)	0	0	1	0	1	0	3	1	0	0	0	1	0	0	1	2	1	0	1	1	**13**	**1.73%**
Alcedinidae	Collared Kingfisher (*Todiramphus chloris*)	7	0	2	3	1	1	1	0	0	0	0	0	1	0	1	2		1	1	2	**23**	**3.07%**
Alcedinidae	White-throated kingfisher (*Halcyon gularis*)	3	1	0	2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**9**	**1.20%**
Apodidae	Fork-tailed swift (*Apus pacificus*)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**2**	**0.27%**
Apodidae	Glossy swiftlet (*Collocalia esculenta*)	68	1	11	15	3	1	0	1	0	1	17	0	0	0	2	4		8	1	25	**158**	**21.07%**
Apodidae	House swift (*Apus nipalensis*)	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**3**	**0.40%**
Ardeidae	Cattle egret (*Bubulcus ibis*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	**2**	**0.27%**
Artamidae	White breasted wood swallow (*Artamus leucoryn*)	0	4	6	0	0	0	1	0	0	0	0	0	0	1	2	0	1	0	1	32	**48**	**6.40%**
Bucerotidae	Mindanao hornbill (*Penelopides affinis*)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0.13%**
Columbidae	Grey-capped emerald dove (*Chalcophaps indica*)	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**4**	**0.53%**
Columbidae	Philippine Cuckoo Dove (*Macropygia tenuirostris*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**	**0.13%**
Columbidae	Pied imperial pigeon (*Ducula bicolor*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**	**0.13%**
Columbidae	Red collared dove (*Streptopelia tranquebarica*)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	**2**	**0.27%**
Columbidae	White-eared brown dove (*Phapitreron leucotis*)	0	0	1	0	1	0	0	0	2	0	0	0	1	0	1	0	0	1	0	2	**9**	**1.20%**
Columbidae	Zebra dove (*Geopelia striata*)	13	1	2	8	4	0	1	1	1	0	0	0	1	0	1	1	1	0	1	5	**41**	**5.47%**
Corvidae	Large-billed crow (*Corvus macrorhynchos*)	3	0	3	0	0	0	0	0	1	0	1	1	4	0	2	1	0	1		6	**23**	**3.07%**
Cuculidae	Black-faced coucal (*Centropus melanops*)	2	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	5	**10**	**1.33%**
Cuculidae	Philippine coucal (*Centropus viridis*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**	**0.13%**
Dicaeidae	Fire-breasted flowerpecker	1	0	0	0	1	1	1	0	1	1	0	0	1	0	1	0	0	1	0	2	**11**	**1.47%**

Family	Species	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	Total	RA %
	(*Dicaeum ignipectus*)																						
Dicaeidae	Red keeled flowerpecker (*Dicaeum austral*)	7	1	1	4	0	0	0	0	0	1	0	0	1	0	1	1	0	5	1	1	**24**	**3.20%**
Estrildidae	Chestnut munia (*Lonchura atricapilla*)	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	1	1	1	0	5	**12**	**1.60%**
Estrildidae	White-bellied Munia (*White-bellied Munia*)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**2**	**0.27%**
Hirundinidae	Barn swallow (*Hirundo rustica*)	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**7**	**0.93%**
Laniidae	Long-tailed shrike (*Lanius schach*)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	1	**4**	**0.53%**
Locustellidae	Striated grassbird (*Megalurus palustris*)	3	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	**8**	**1.07%**
Locustellidae	Tawny grassbird (*Megalurus timoriensis*)	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	1	**6**	**0.80%**
Megalaimidae	Coppersmith barbet (*Psilopogon haemacephalus*)	0	0	0	0	2	0	1	0	3	0	0	0	0	0	0	0	0	1	0	0	**7**	**0.93%**
Meropidae	Blue-throated bee-eater (*Merops viridis*)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**1**	**0.13%**
Monarchidae	Black-naped monarch (*Hypothymis azurea*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**	**0.13%**
Muscicapidae	Oriental magpie-robin (*Copsychus saularis*)	2	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	**7**	**0.93%**
Muscicapidae	Pied Buschat (*Saxicola caprata*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**	**0.13%**
Nectariniidae	Lina's sunbird (*Aethopyga linaraborae*)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0.13%**
Nectariniidae	Olive-backed sunbird (*Cinnyris jugularis*)	9	1	4	1	1	0	1	0	0	1	1	0	1	0	0	1	0	4	1	2	**28**	**3.73%**
Oriolidae	Black-naped oriole (*Oriolus chinensis*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**	**0.13%**
Passeridae	Eurasian tree sparrow (*Passer montanus*)	45	8	17	42	2	1	6	1	0	0	1	1	1	1		4	1	3	3	8	**145**	**19.33%**
Psittacidae	Philippine hanging parrot (*Loriculus philippensis*)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**1**	**0.13%**
Psittaculidae	Guaiabero (*Bolbopsittacus lunulatus*)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0.13%**

Family	Species	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	Total	RA %
Pycnonotidae	Philippine bulbul (*Hypsipetes philippinus*)	3	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	**7**	**0.93%**
Pycnonotidae	Yellow-vented bulbul (*Pycnonotus goiavier*)	32	3	5	4	5	3	2	1	0	1	1	0	1	1	0	2	1	8	1	2	**73**	**9.73%**
Rallidae	Barred rail (*Hypotaenidia torquata*)	2	1	0	0	1	0	0	1	0	0	1	0	0	0	1		1	1	1		**10**	**1.33%**
Rhipiduridae	Philippine pied fantail (*Rhipidura nigritorquis*)	1	0	1	1	2	0	0	0	0	1	0	0	0	0	1	1	1	1	1	5	**16**	**2.13%**
Sturnidae	Asian glossy starling (*Aplonis panayensis*)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	**3**	**0.40%**
Turnicidae	Barred Button quail (*Turnix suscitator*)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1		1	0	0		**3**	**0.40%**
Tytonidae	Eastern Grass-owl (*Tyto longimembris*)	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	1	**1**	**0.13%**
Zosteropidae	Mountain white-eye (*Zosterops japonicus*)	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	**16**	**2.13%**
	Total	**204**	**25**	**62**	**85**	**29**	**10**	**20**	**11**	**10**	**6**	**23**	**3**	**30**	**3**	**20**	**27**	**12**	**40**	**14**	**116**	**750**	**100.00%**

Appendix 15. Photographs of the captured bird at the survey stations

White-collared kingfisher
(*Todiramphus chloris*)

Coppersmith barbet
(*Psilopogon haemacephalus*)

Glossy swiftlet
(*Collocallia esculenta*)

White-eared brown fruit dove
(*Phapitreron leucotis*)

Southern silvery kingfisher
(*Ceyx argentatus)*

Philippine Duck
***(Anas luzonica*)**

Mindanao Tarictic Hornbill
(*Penelopides affinis)*

Lina's sunbird
(*Aethopyga linaraborae*)

Appendix 16. List of Important Avifaunal Species indicated in IUCN Red List

<table>
<tr><th>Scientific Name:
<i>Ceyx argentatus</i></th><th>Common Name:
Southern silvery kingfisher</th><th>IUCN Red List: Near Threatened
DAO 2019-09: Vulnerable</th></tr>
<tr><td>Population</td><td colspan="2">The population is estimated to number 2,500-9,999 individuals (BirdLife, 2017).</td></tr>
<tr><td>Geographic Range</td><td colspan="2"><i>Ceyxargentatus</i> is endemic to the Philippines, where it occurs on Dinagat, Siargao, Mindanao and Basilan. Since 1980, documented observations are confined to east Mindanao, although there are also recent sightings from the Zamboanga Peninsula, particularly within the Lituban-Quipit Watershed IBA (BirdLife, 2017).

<i>Source: IUCN Red List of Threatened Species</i></td></tr>
<tr><td>Habitat (inhabitation feeding area, breeding area, and nesting area)</td><td colspan="2">It appears to be reliant upon forested streams and ponds. It occurs below 1,000 m (with one record from 1,120-1,350 m), and will tolerate secondary and selectively logged forest and even streamside vegetation within coconut plantations, close to forest edge, but terminalia and sago are the principal forest types where the highest densities were recorded during mist-netting in 2002-2003. It breeds in riverside banks and is apparently sedentary (BirdLife, 2017).</td></tr>
<tr><td>Local Information/ The situation at the time of the discovery during field survey</td><td colspan="2">Since 1980, documentedobservations are confined to east Mindanao, although there are also recent sightings from the

Zamboanga Peninsula, particularly within the Lituban-Quipit Watershed IBA. It is shy and inconspicuousand very likely under-recorded(BirdLife, 2017).

It is found during the low rainfall period.</td></tr>
</table>

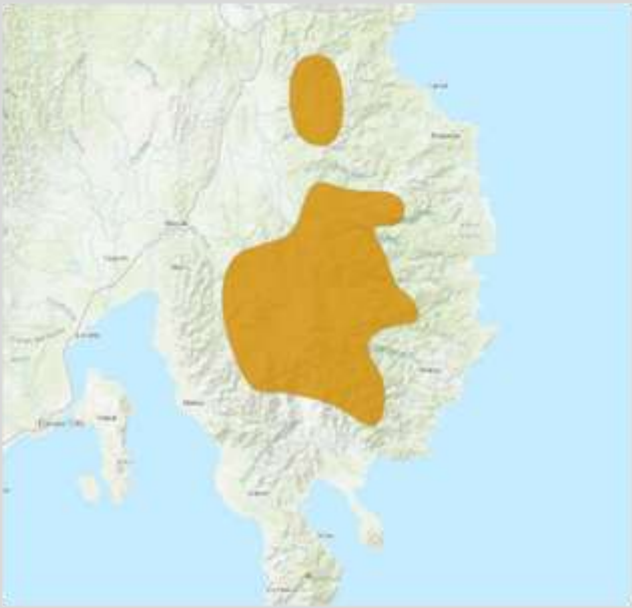
Situation of Site (Photo, how many locations) during the site survey	Found along W8. Cornfields and pineapple plantations at the top of the ravines with thick agroforest patches near and along the river.  W8 (Impasug-ong, Bukidnon)
Record of existing survey	Formerly widespread and locally common, a comparison of pre- 1970 and more recent records indicate a decline throughout its range. Since 1980, documented observations are confined to east Mindanao, although there are also recent sightings from the Zamboanga Peninsula, particularly within the Lituban-Quipit Watershed IBA (BirdLife, 2017).
Photos	 *Source: ebird.org*

Scientific Name: ***Anas luzonica***	**Common Name:** **Philippine Duck**	**IUCN Red List: Vulnerable** **DAO 2019-09: Vulnerable**
Population	A total of 4,632 individuals were counted in the Asian Waterbird Census in 2004, and 4,428 in 2005. The total population is likely to fall between 5,000-10,000 individuals, roughly equating to 3,300-6,700 mature individuals (BirdLife, 2016).	
Geographic Range	*Anas luzonica* is endemic to the Philippines, being recorded from all the major islands and eight smaller islands. Records are mostly from Luzon and Mindanao (BirdLife, 2016).  *Source: IUCN Red List of Threatened Species*	
Habitat (inhabitation feeding area, breeding area, and nesting area)	It frequents most freshwater and saltwater habitats, including mangroves, open sea and watercourses inside forest. It appears to be sedentary although some seasonal aggregation occurs. It feeds on fish, shrimps, insects, rice and young vegetation (BirdLife, 2016).	
Local Information/ The situation at the time of the discovery during field survey	*Anas luzonicais* endemic to the **Philippines**, being recorded from all the major islands and eight smallerislands. Records are mostly from Luzon and Mindanao. Records from Siquijor and the Sulus remainunsubstantiated. A steep population decline was evident by the mid-1970s, with high numbers recordedat only a few sites in the following decade. It was found during the low rainfall period.	

Situation of Site (Photo, how many locations) during the site survey	*A. luzonica* is found along W10. The station is a pineapple and cornfields with minimal vegetation and open grasslands.  W10 (Impasug-ong, Bukidnon)
Record of existing survey	Steep population decline was evident by the mid-1970s, with high numbers recorded at only a few sites in the following decade, e.g. Candaba Marsh (Luzon) which probably supported many thousands in the early 1980s, though in 2012 only 390 individuals were recorded. Important current areas include Malasi Lake (7000 individuals in 2013), Brgy. Perlas (3252 in 2013, San Roque Multipurpose Project (3500 individuals in 2013), Biong&Pandan. Cabusao Wetland Area (3000 individuals in 2011, though only 2 in 2013), Subic Bay (600 seen in 1997, 400 in 2003), Magat dam (2,000 were seen in 2001, 495 in 2013) and Malasi lakes (1,320 were recorded in 2002 and 7,000 in 2013). Other recent records come from Mangatarem, Pangasinan (east of Zambales Mountains IBA) where 70 individuals were counted on the Barabac River inside the Manleluag Spring National Park, Cantilan mangroves in Surigao del Sur and from a mangrove fishpond in Bicol Region, Southern Luzon (BirdLife, 2016).
Photos	 *Source: ebird.org*

Scientific Name: ***Penelopides affinis***	**Common Name:** **Mindanao Tarictic Hornbill**	**IUCN Red List: Least Concern** **DAO 2019-09: Vulnerable**
Population	The global population size has not been directly quantified, but the species is reported to be common in primary forest and the population is believed to be well over 10,000 birds (BirdLife, 2020a).	
Geographic Range	*This species is found on the island of Mindanao and adjacent smaller islands in the Philippines. Only 6,307 km2 of its habitat is considered to be optimal (BirdLife, 2020a).*  *Source: IUCN Red List of Threatened Species*	
Habitat (inhabitation feeding area, breeding area, and nesting area)	The species is found in both primary and secondary rainforests and forest edges, up to elevations of 900m. It moves below the canopy and is seen in pairs or small groups of up to 12 individuals. It appears to be both sedentary and territorial. It feeds on both fruits, seeds and prey such as lizards and beetles. The pair breeds between April and May. The incubation period lasts 25 days and a nesting period of 47- 54 days was observed in captivity when 3 eggs were laid (BirdLife, 2020a).	
Local Information/ The situation at the time of the discovery during field survey	This species is found on the island of Mindanao and adjacent smaller islands in the Philippines. Only 6,307 km^2 of its habitat is considered to be optimal. The population is suspected to be in decline locally owing to ongoing habitat destruction and hunting forfood *P. affinis* has been observed during the high rainfall period	
Situation of Site (Photo, how many locations) during the site survey	The species is found in W4. The station is along Mangima river. It is a mix agroforest area on both sides of the ravine with cornfields near the river and pineapple plantation at the top of the plateau.  Station W4 (Manolo Fortich, Bukidnon)	

Record of existing survey	This species is found on the island of Mindanao and adjacent smaller islands in the Philippines. Only 6,307 km^2 of its habitat is considered to be optimal (BirdLife, 2020a).
Photos	 *Source:* *ebird.org*

Scientific Name: ***Aethopyga linaraborae***	**Common Name:** **Lina's sunbird**	**IUCN Red List: Near Threathened** **DAO 2019-09: Vulnerable**
Population	The global population size has not been quantified, but the species is described as fairly common within its very small total range (BirdLife, 2020b).	
Geographic Range	Aethopyga linaraborae is endemic to Mindanao, Philippines, It is relatively common in suitable habitat within its altitudinal range; assuming that it generally occurs in all available remaining habitat above 1,000 m, its total range likely comprises c. 1,200 km^2(BirdLife, 2020b).  *Source: IUCN Red List of Threatened Species*	

Habitat (inhabitation feeding area, breeding area, and nesting area)	It occupies montane mossy forest from 970-2,000 m and above. Breeding appears to take place in May, but may happen at other times of year (BirdLife, 2020b).
Local Information/ The situation at the time of the discovery during field survey	*Aethopyga linaraboraeis* currently known from Mts Mayo, PutingBato (Tagub) and Pasian in the eastern provinces of Davao del Norte and Davao Oriental. However, it has also been recorded in the lower montane forest of Mt. Hamiguitan at an elevation of 1,000-1,100 m (Mohagan et al. 2015).Habitat degradation due to mining may affect the population in some parts of its range(BirdLife, 2020b). Found along the Transect 1 and Station W4 during the low rainfall while it is observed in Station W3 during the high rainfall
Situation of Site (Photo, how many locations) during the site survey	Found in T1, W3 and W4. Transect 1 is near residential areas with coconut and mango plantation areas, open grassland, and residual secondary forest patches at the ravine. Station W3 is composed of agroforest near the river surrounded by pineapple plantation and along a recently constructed bypass road. W4 is along Mangima river. It is a mix agroforest area on both sides of the ravine with cornfields near the river and pineapple plantation at the top of the plateau T1 (Tagoloan, Msi. Or.) (for insert)  Station W3 (Manolo Fortich, Bukidnon)

	 Station W4 (Manolo Fortich, Bukidnon)
Record of existing survey	it is currently known from MtsMayo, PutingBato (Tagub) and Pasian in the eastern provinces of Davao del Norte and Davao Oriental.However, it has also been recorded in the lower montane forest of Mt. Hamiguitan at an elevation of1,000-1,100 m (BirdLife, 2020b).

Photos	 *ource: ebird.org*

Appendix 17. Total bat captures across stations in the Project Site

Low rainfall period

Family	Species Name	Abundance	Frequency	RA (%)	RF (%)
Pteropodidae	*Ptenochirus jagori*	50	0.82	70.42	42.86
Pteropodidae	*Cynopterus brachyotis*	14	0.455	19.72	23.81
Pteropodidae	*Macroglossus minimus*	2	0.18	2.82	9.52
Pteropodidae	*Rousettus amplexicaudatus*	3	0.27	4.23	14.29
Pteropodidae	*Haplonycteris fischeri*	1	0.09	1.41	4.76
Hipposideridae	*Hipposideros diadema*	1	0.09	1.41	4.76
	Total	71	1.905	100	100

NOTE: RA – relative abundance; RF – relative frequency

High rainfall period

Family	Species	Abundance	Frequency	RA (%)	RF (%)
Pteropodidae	*Ptenochirus jagori*	80	1.00	55.56	32.47
Pteropodidae	*Cynopterus brachyotis*	30	0.917	20.83	29.76
Pteropodidae	*Ptenochirus minor*	18	0.50	12.50	16.23
Pteropodidae	*Macroglossus minimus*	9	0.42	6.25	13.53
Pteropodidae	*Rousettus amplexicaudatus*	7	0.25	4.86	8.12
	Total	144	3.087	100.00	100.00

NOTE: RA – relative abundance; RF – relative frequency

Appendix 18. Individual morphometrics of bats captured per site

Low rainfall period

Station	Species Name	Sex	Age	Forearm (mm)	Hind foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Total Length (mm)	Weight (g)
1	*Ptenochirus jagori*	♀	Adult	51	8	65	145	8	10	75	87
	Ptenochirus jagori	♂	Juvenile	34	8	51	130	8	7	58	31
	Cynopterus brachyotis	♂	Adult	12	7	39	111	6	7	46	21
	Ptenochirus jagori	♂	Adult	52	9	74	122	9	9	83	83
	Ptenochirus jagori	♂	Juvenile	35	8	48	125	8	8	56	40
	Ptenochirus jagori	♀	Adult w/pup	53	10	72	130	9	10	82	94
2	*Haplonycteris fischeri*	♂	Adult	55	10	60	150	11	15	75	90
	Hipposideros diadema	♂	Adult	32	8	46	111	8	12	58	21
3	*Ptenochirus jagori*	♂	Juvenile	37	8	48	125	9	9	57	32
	Ptenochirus jagori	♀	Juvenile	25	9	50	125	8	8	58	48
	Cynopterus brachyotis	♂	Juvenile	29	9	45	127	9	7	52	28
	Ptenochirus jagori	♀	Juvenile	57	9	60	130	9	9	69	108
4	No Captures										
5	*Ptenochirus jagori*	♂	Adult	48	9	45	160	9	8	53	53
	Ptenochirus jagori	♀	Adult/with pup	45	9	65	130	9	8	73	70
	Rousettus amplexicaudatus	♀	Adult	25	9	48	143	9	15	63	68
	Ptenochirus jagori	♀	Adult	60	9	62	145	9	9	71	55
	Ptenochirus jagori	♀	Adult	55	9	70	165	9	15	85	78
	Macroglossus minimus	♀	Juvenile	10	8	35	80	8	Absent	80	16
6	*Ptenochirus jagori*	♂	Adult w/pup	53	8	71	170	8	10	81	88
	Ptenochirus jagori	♀	Juvenile	15	5	20	75	4	5	25	22
	Cynopterus brachyotis	♀	Juvenile	25	6	35	111	5	6	41	24
	Ptenochirus jagori	♂	Juvenile	25	8	44	130	8	8	52	35
	Rousettus amplexicaudatus	♀	Adult	55	11	57	131	10	15	72	88
	Ptenochirus jagori	♂	Adult	55	11	55	180	10	11	66	100
	Cynopterus brachyotis	♀	Juvenile	22	5	35	128	4	4	39	24
	Ptenochirus jagori	♀	Adult	57	11	17	150	10	10	27	89

Station	Species Name	Sex	Age	Forearm (mm)	Hind foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Total Length (mm)	Weight (g)
	Cynopterus brachyotis	♀	Juvenile	15	7	30	116	7	5	35	17
	Cynopterus brachyotis	♂	Juvenile	25	7	25	112	7	8	33	25
	Cynopterus brachyotis	♂	Juvenile	20	8	26	121	8	1	27	19
	Ptenochirus jagori	♀	Adult	33	7	42	130	7	7	49	38
7	*Ptenochirus jagori*	♂	Adult w/pup	53	8	71	170	8	10	81	88
	Ptenochirus jagori	♀	Juvenile	15	5	20	75	4	5	25	22
	Cynopterus brachyotis	♀	Juvenile	25	6	35	111	5	6	41	24
	Ptenochirus jagori	♂	Juvenile	25	8	44	130	8	8	52	35
	Rousettus amplexicaudatus	♀	Adult	55	11	57	131	10	15	72	88
	Ptenochirus jagori	♂	Adult	55	11	55	180	10	11	66	100
	Cynopterus brachyotis	♀	Juvenile	22	5	35	128	4	4	39	24
	Ptenochirus jagori	♀	Adult	57	11	17	150	10	10	27	89
	Cynopterus brachyotis	♀	Juvenile	15	7	30	116	7	5	35	17
	Cynopterus brachyotis	♂	Juvenile	25	7	25	112	7	8	33	25
	Cynopterus brachyotis	♂	Juvenile	20	8	26	121	8	1	27	19
	Ptenochirus jagori	♀	Adult	33	7	42	130	7	7	49	38
8	*Ptenochirus jagori*	♀	Juvenile	25	8	36	130	8	9	45	46
	Ptenochirus jagori	♂	Adult	45	8	72	165	8	7	79	78
	Ptenochirus jagori	♂	Adult	51	9	70	153	9	8	78	74
	Ptenochirus jagori	♀	Juvenile	57	9	60	130	8	9	69	76
	Ptenochirus jagori	♂	Adult	32	9	37	125	8	8	45	33
	Ptenochirus jagori	♂	Adult	53	9	62	160	8	10	72	75
	Ptenochirus jagori	♂	Juvenile	25	8	36	118	8	8	44	35
	Ptenochirus jagori	♂	Adult	35	8	37	125	8	8	45	31
9	*Ptenochirus jagori*	♂	Adult	60	10	85	165	11	10	95	89
	Ptenochirus jagori	♂	Adult	55	8	71	140	9	8	79	73
	Ptenochirus jagori	♂	Juvenile	32	8	65	130	8	7	72	52
10	*Ptenochirus jagori*	♀	Adult	55	9	82	150	9	9	91	89
	Ptenochirus jagori	♂	Juvenile	39	8	45	130	8	7	52	35
	Ptenochirus jagori	♀	Juvenile	35	7	47	127	8	7	54	34

Station	Species Name	Sex	Age	Forearm (mm)	Hind foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Total Length (mm)	Weight (g)
11	*Ptenochirus jagori*	♂	Juvenile	33	6	122	123	5	5	127	30
	Cynopterus brachyotis	♀	Adult	62	6	70	132	5	8	78	80
	Ptenochirus jagori	♂	Adult	54	9	71	170	8	5	76	86
	Ptenochirus jagori	♂	Juvenile	32	8	43	130	8	7	50	35
	Ptenochirus jagori	♀	Adult	56	18	81	139	8	7	88	110
	Ptenochirus jagori	♂	Juvenile	30	8	71	130	8	8	79	36
	Ptenochirus jagori	♀	Adult	55	9	72	175	15	12	84	118
	Ptenochirus jagori	♀	Juvenile	31	10	85	167	9	6	91	86
	Ptenochirus jagori	♀	Juvenile	35	9	46	125	8	9	55	33
	Ptenochirus jagori	♀	Adult	45	9	80	145	10	8	88	68
	Ptenochirus jagori	♂	Adult	43	9	80	145	10	8	88	84
	Ptenochirus jagori	♀	Juvenile	25	9	36	125	8	7	43	65
	Ptenochirus jagori	♀	Juvenile	32	7	53	121	8	8	61	32
	Macroglossus minimus	♂	Juvenile	11	8	27	101	8	Absent	101	13
	Cynopterus brachyotis	♂	Adult	31	7	50	125	8	8	58	60

High rainfall period

ID	Species	Sex	Age	Forearm (mm)	Hind Foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Weight (g)
1	*Rousettus amplexicaudatus*	♀	Adult	85	16	91	215	19	11	101
	Cynopterus brachyotis	♀	Juvenile	56	10	72	165	13	6	27
	Ptenochirus jagori	♀	Adult	76	14	108	221	14	8	82
	Ptenochirus jagori	♀	Adult	84	14	103	253	13	15	88
	Ptenochirus jagori	♂	Adult	81	16	115	215	13	15	76
	Cynopterus brachyotis	♀	Adult	63	10	82	169	12	9	29
	Ptenochirus minor	♂	Adult	64	9	87	181	11	9	34
2	*no sampling.*									
3	*Rousettus amplexicaudatus*	♀	Adult	85	17	75	213	16	20	75
	Cynopterus brachyotis	♀	Adult	61	12	66	185	13	7	27
	Ptenochirus jagori	♂	Adult	83	13	119	243	17	5	75
	Ptenochirus jagori	♀	Juvenile	63	11	85	163	12	7	37
	Ptenochirus jagori	♀	Adult	82	11	90	243	13	6	97
	Macroglossus minimus	♀	Adult	43	10	62	133	11	-	25
	Ptenochirus jagori	♂	Adult	83	14	100	238	15	7	90
	Ptenochirus jagori	♂	Juvenile	65	12	80	185	14	6	15
	Ptenochirus jagori	♂	Juvenile	64	12	82	191	15	9	35
	Macroglossus minimus	♂	Adult	41	7	64	138	11	-	23
	Cynopterus brachyotis	♂	Adult	59	11	81	178	11	6	27
	Ptenochirus jagori	♀	Adult	64	11	88	188	11	10	50
	Ptenochirus jagori	♀	Juvenile	57	11	66	170	12	9	30
	Ptenochirus jagori	♀	Adult	80	15	117	246	19	9	87
	Macroglossus minimus	♂	Adult	44	9	57	130	13	-	25
	Macroglossus minimus	♂	Juvenile	39	9	52	132	9	-	27
	Cynopterus brachyotis	♀	Adult	59	12	92	179	13	8	50

ID	Species	Sex	Age	Forearm (mm)	Hind Foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Weight (g)
	Macroglossus minimus	♂	Juvenile	39	10	56	117	10	-	15
	Ptenochirus jagori	♀	Adult	86	15	95	248	12	9	85
	Ptenochirus jagori	♀	Adult	83	14	93	244	11	13	87
	Ptenochirus jagori	♀	Juvenile	56	11	74	184	16	8	26
	Macroglossus minimus	♂	Juvenile	40	7	55	119	11	-	26
	Macroglossus minimus	♀	Adult	42	9	60	134	12	-	25
4	*Ptenochirus jagori*	♀	Adult	84	14	86	245	15	10	89
	Cynopterus brachyotis	♂	Adult	64	13	80	172	8	9	36
	Rousettus amplexicaudatus	♂	Adult	69	13	73	196	12	13	53
	Rousettus amplexicaudatus	♂	Adult	70	18	73	198	14	16	45
	Ptenochirus jagori	♂	Adult	85	12	114	230	12	13	86
	Ptenochirus jagori	♂	Adult	83	16	119	248	15	14	88
	Ptenochirus jagori	♂	Adult	82	13	104	257	12	14	94
	Cynopterus brachyotis	♂	Adult	58	8	80	178	13	7	27
	Cynopterus brachyotis	♂	Juvenile	57	11	57	176	14	6	24
	Cynopterus brachyotis	♂	Adult	59	12	78	167	13	9	27
	Ptenochirus minor	♀	Adult	76	17	95	227	16	12	66
	Ptenochirus jagori	♂	Adult	85	16	120	240	16	11	98
	Ptenochirus jagori	♀	Adult	86	13	115	234	16	14	95
	Ptenochirus jagori	♀	Adult	84	13	103	233	14	11	81
	Cynopterus brachyotis	♂	Adult	61	9	79	186	14	7	30
	Cynopterus brachyotis	♀	Adult	58	11	68	155	13	8	22
	Rousettus amplexicaudatus	♂	Adult	74	15	87	203	18	11	32
	Ptenochirus minor	♂	Juvenile	51	8	69	140	8	6	19
5	*Ptenochirus jagori*	♀	Adult	80	15	112	234	12	10	100
	Ptenochirus minor	♀	Juvenile	60	11	72	174	12	7	30

ID	Species	Sex	Age	Forearm (mm)	Hind Foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Weight (g)
	Ptenochirus minor	♀	Adult	62	10	81	183	12	10	55
	Ptenochirus minor	♀	Adult	75	12	85	211	10	11	70
	Ptenochirus jagori	♀	Adult	81	16	115	236	12	9	106
	Ptenochirus minor	♀	Adult	73	12	104	193	14	12	59
	Ptenochirus minor	♂	Adult	76	14	82	225	17	7	60
	Ptenochirus minor	♀	Adult	73	11	89	205	12	12	74
6	*Ptenochirus jagori*	♂	Juvenile	61	10	78	183	13	7	33
	Ptenochirus jagori	♂	Adult	76	12	79	220	13	10	65
	Ptenochirus jagori	♂	Juvenile	56	8	68	155	9	9	17
	Ptenochirus jagori	♀	Adult	77	14	88	205	12	15	62
	Cynopterus brachyotis	♂	Juvenile	60	10	68	175	12	11	40
	Ptenochirus jagori	♀	Adult	81	17	109	248	14	10	95
	Ptenochirus jagori	♀	Juvenile	55	13	66	176	11	7	29
	Ptenochirus minor	♂	Adult	72	13	85	206	12	9	46
	Cynopterus brachyotis	♂	Adult	60	9	82	183	12	10	31
	Ptenochirus jagori	♂	Juvenile	58	9	79	175	13	8	24
	Ptenochirus jagori	♂	Adult	87	12	101	228	15	15	93
	Ptenochirus minor	♂	Adult	75	14	93	232	18	12	84
	Ptenochirus jagori	♂	Adult	80	14	110	222	15	15	80
	Ptenochirus jagori	♂	Juvenile	79	15	101	234	14	14	59
	Macroglossus minimus	♀	Adult	41	7	52	124	10	0	17
	Cynopterus brachyotis	♀	Adult	68	11	85	191	10	10	-
	Ptenochirus minor	♂	Adult	74	14	87	228	17	12	52
	Ptenochirus jagori	♂	Adult	80	15	110	239	13	12	90
	Ptenochirus jagori	♂	Juvenile	65	13	75	153	10	7	25
7	*Cynopterus brachyotis*	♂	Juvenile	62	9	73	158	11	8	21

ID	Species	Sex	Age	Forearm (mm)	Hind Foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Weight (g)
	Ptenochirus jagori	♂	Juvenile	60	11	81	177	12	7	32
	Ptenochirus jagori	♂	Adult	80	15	94	216	13	10	58
	Cynopterus brachyotis	♂	Juvenile	63	10	78	183	12	9	30
	Ptenochirus minor	♂	Adult	73	14	73	194	15	13	42
	Cynopterus brachyotis	♀	Adult	63	12	75	187	11	7	-
	Ptenochirus jagori	♀	Adult	83	13	106	212	16	13	96
	Ptenochirus jagori	♀	Juvenile	65	12	90	186	17	10	45
	Ptenochirus jagori	♂	Adult	85	17	107	248	14	14	90
	Ptenochirus minor	♂	Adult	73	11	75	194	15	10	53
	Ptenochirus minor	♀	Adult	78	11	85	237	14	10	59
	Ptenochirus minor	♀	Adult	77	16	97	196	14	13	-
	Ptenochirus jagori	♂	Adult	83	15	101	240	15	10	-
	Ptenochirus jagori	♂	Adult	84	17	82	231	19	11	85
	Ptenochirus jagori	♂	Juvenile	62	13	83	188	12	8	52
8	*Ptenochirus jagori*	♀	Adult	85	14	115	263	13	9	98
	Cynopterus brachyotis	♀	Adult	58	11	73	184	15	9	48
	Ptenochirus jagori	♂	Adult	81	12	84	209	12	12	75
	Ptenochirus jagori	♂	Adult	83	13	117	217	16	9	74
	Cynopterus brachyotis	♀	Adult	64	9	88	186	10	11	-
9	*Ptenochirus jagori*	♀	Adult	76	12	76	231	12	10	76
	Cynopterus brachyotis	♀	Adult	60	11	80	205	10	7	44
	Ptenochirus jagori	♀	Adult	86	11	123	246	15	13	120
	Ptenochirus jagori	♀	Adult	80	11	92	230	13	12	56
	Ptenochirus minor	♂	Adult	75	15	82	225	12	12	60
	Ptenochirus minor	♀	Adult	75	11	98	200	16	12	75
	Ptenochirus jagori	♀	Juvenile	65	13	58	185	10	10	44

ID	Species	Sex	Age	Forearm (mm)	Hind Foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Weight (g)
	Ptenochirus jagori	♀	Adult	76	16	80	220	15	13	55
10	*Ptenochirus jagori*	♀	Adult	87	14	114	243	15	11	-
	Ptenochirus jagori	♀	Adult	83	19	96	245	18	11	-
	Ptenochirus jagori	♂	Adult	79	17	100	236	11	13	-
	Cynopterus brachyotis	♀	Adult	62	14	89	192	16	9	-
11	*Ptenochirus jagori*	♂	Adult	80	15	106	242	12	7	-
	Ptenochirus jagori	♀	Adult	82	14	118	237	15	8	-
	Rousettus amplexicaudatus	♀	Adult	80	18	92	228	16	15	-
	Cynopterus brachyotis	♀	Adult	60	12	83	183	12	3	-
	Cynopterus brachyotis	♀	Juvenile	55	12	70	172	12	7	-
12	*Cynopterus brachyotis*	♂	Adult	61	12	86	153	13	6	-
	Cynopterus brachyotis	♂	Adult	60	12	78	156	15	4	-
	Ptenochirus jagori	♀	Adult	84	18	120	240	15	12	-
	Cynopterus brachyotis	♂	Adult	59	13	81	181	13	5	-
	Ptenochirus jagori	♀	Adult	83	19	124	249	13	5	-
	Ptenochirus jagori	♀	Adult	87	16	120	249	15	10	-
	Ptenochirus jagori	♂	Adult	71	16	89	225	13	7	-
	Cynopterus brachyotis	♂	Adult	62	13	92	193	17	4	-
	Cynopterus brachyotis	♀	Adult	63	12	77	169	15	8	-
	Ptenochirus jagori	♂	Adult	82	18	87	234	15	15	-
	Ptenochirus jagori	♂	Adult	78	15	108	227	14	10	-
	Ptenochirus jagori	♀	Adult	77	16	98	229	16	5	-
	Ptenochirus jagori	♀	Adult	79	17	97	210	14	7	-
	Macroglossus minimus	♀	Adult	41	9	47	122	12	-	-
	Rousettus amplexicaudatus	♂	Juvenile	73	13	70	211	7	10	-
	Ptenochirus jagori	♂	Juvenile	73	13	70	211	7	10	-

ID	Species	Sex	Age	Forearm (mm)	Hind Foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Weight (g)
	Ptenochirus jagori	♂	Juvenile	70	14	87	232	17	8	-
	Ptenochirus jagori	♀	Adult	80	16	91	237	18	8	-
	Ptenochirus jagori	♂	Adult	78	17	99	244	15	14	-
	Ptenochirus jagori	♀	Adult	77	12	107	222	15	14	-
	Ptenochirus jagori	♀	Adult	77	19	113	238	19	8	-
13	*Cynopterus brachyotis*	♂	Adult	61	12	99	196	15	12	-
	Cynopterus brachyotis	♂	Adult	62	12	78	201	13	4	-
	Ptenochirus jagori	♂	Adult	85	14	106	246	16	7	-
	Ptenochirus jagori	♀	Adult	90	17	118	271	14	5	-
	Ptenochirus jagori	♀	Adult	84	20	122	228	15	13	-
	Ptenochirus jagori	♂	Adult	80	16	107	238	15	7	-
	Ptenochirus jagori	♀	Adult	83	17	108	262	15	12	-
	Ptenochirus jagori	♀	Adult	86	17	93	246	16	8	-
	Ptenochirus jagori	♀	Adult	87	15	122	250	20	9	-
	Ptenochirus jagori	♀	Adult	83	16	124	249	14	10	-
	Ptenochirus jagori	♀	Adult	87	17	112	228	16	7	-

Average Morphometrics of bats captured across the faunal station

Low rainfall period

Species	Sex	Age	Forearm (mm)	Hind foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Total Length (mm)	Weight (g)
Ptenochirus jagori	♀=2; ♂=26	A=28; J=22	60 ± 15	18 ± 5	122 ± 17	180 ± 75	15 ± 4	15 ± 5	127 ± 25	118 ± 22
Cynopterus brachyotis	♀=7; ♂=7	A=3; J=11	31 ± 12	9 ± 7	50 ± 25	127 ± 111	9 ± 6	8 ± 1	58 ± 27	60 ± 19
Rousettus amplexicaudatus	♀=3; ♂=0	A=3; J=0	55 ± 25	11 ± 9	57 ± 48	143 ± 131	10 ± 9	15	72 ± 63	88 ± 68
Macroglossus minimus	♀=1; ♂=1	A=0; J=2	11 ± 10	8	35 ± 27	101 ± 80	8	Absent	101 ± 80	16 ± 13
Haplonycteris fischeri	♀=0; ♂=1	A=1; J=0	55	10	60	150	11	15	75	90
Hipposideros diadema	♀=0; ♂=1	A=1; J=0	32	8	46	111	8	12	58	21

high rainfall period

Species	Sex	Age	Forearm (mm)	Hind foot (mm)	Body Length (mm)	Wing Span (mm)	Ear (mm)	Tail (mm)	Total Length (mm)	Weight (g)
Ptenochirus jagori	♀=44; ♂=36	A=63; J=17	90 ± 55	20 ± 8	124 ± 58	271 ± 153	20 ± 7	15 ± 5	139 ± 63	118 ± 22
Cynopterus brachyotis	♀=14; ♂=16	A= 24; J=6	68 ± 55	14 ± 8	99 ± 57	205 ± 153	17 ± 8	12 ± 3	111 ± 30	60 ± 19
Ptenochirus minor	♀= 9; ♂= 9	A=16; J=3	78 ± 51	17 ± 8	104 ± 69	237 ± 140	18 ± 8	13 ± 6	117 ± 75	88 ± 68
Macroglossus minimus	♀=4; ♂=5	A=6; J=3	44 ± 39	10 ± 7	64 ± 47	138 ± 117	13 ± 9	Absent	64 ± 47	16 ± 13
Rousettus amplexicaudatus	♀=3; ♂=4	A=6; J=1	85 ± 69	18 ± 13	92 ± 70	228 ± 196	19 ± 7	16 ± 10	108 ± 77	101 ± 32

Appendix 19. Photographs of bat representatives captured across stations

Harpy fruit bat
(*Haplonycteris fischeri*)

Lesser short-nosed fruit bat
(*Cynopterus brachyotis*)

Geoffrey's Rousette
(*Rousettus amplexicaudatus*)

Lesser longue-tongued fruit bat
(*Macroglossus minimus*)

Round-leafed bat
(*Hipposiderus diadema*)

Musky fruit bat
(*Ptenochirus jagori*)

Appendix 20. Abundance of murid species collected across the stations

Low rainfall period

Species name	Station											Total
	1	2	3	4	5	6	7	8	9	10	11	
Muridae												
Rattus tanezumi	-	-	-	1	-	-	-	-	-	-	-	1
Total	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

NOTE: RA – relative abundance

High rainfall period

Scientific name	Station													Total	RA (%)
	1	2	3	4	5	6	7	8	9	10	11	12	13		
Muridae															
Rattus norvegicus		1					1							2	50
Rattus tanezumi			1											1	25
Rattus rattus						1								1	25
Total		**1**	**1**			**1**	**1**							**4**	

NOTE: RA – relative abundance

Appendix 21. Photos of non-volant mammals captured across stations

Rattus rattus

Rattus norvegicus

Rattus tanezumi

Appendix 22. Relative abundance of herpetofauna captured

FROGS

Low rainfall

Species Name	Station													Total	RA (%)
	1*	**2**	**3**	**4**	**5**	**6***	**7**	**8**	**9**	**10**	**11**	**12**	**13**		
Microhyalidae															
Kaloula pulchra		1										1		1	2.94
Dicroglossidae															
Limnonectes magnus		2	13					9						24	70.59
Bufonidae															
Rhinela marina		2				2			1	1	2	1		9	26.47
Grand Total	**5**	**13**			**2**		**9**	**1**	**1**	**2**	**2**			**34**	100.00

NOTE: RA – relative abundance

High rainfall

Species Name	Station													Total	RA (%)
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**		
Bufonidae															
Rhinela marina	2		8											10	33.33
Ceratobatrachidae															
Platymantis sp. 1							1							1	3.33
Dicroglossidae															
Limnonectes magnus	1			2					2	8	2	1		16	53.33
Megophrydae															
Megophrys stejnegeri						1								1	3.33
Microhyalidae															
Kaloula picta							1							1	3.33
Kaloula pulchra								1						1	3.33
Total	**3**			**2**		**1**	**2**	**1**	**2**	**8**	**2**	**1**		**30**	

NOTE: RA – relative abundance

Snakes and lizards

High rainfall only

Species Name	Station													Total	RA (%)
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**		
Colubridae															
Coelognathus sp.								1			1		1	3	75.00
Varanidae															
Varanus cumingi				1										1	25.00
Grand Total				**1**				**1**			**1**		**1**	**4**	

NOTE: RA – relative abundance

Appendix 23. Photographs herpetofauna representatives captured across stations during low rainfall

Frogs


Rhinela marina


Platymantis sp. 1


Limnonectes magnus


Megophrys stejnegeri


Kaloula picta


Kaloula pulchra

Snakes and lizards


Coelognathus sp.


Varanus cumingi

Appendix 24. List of Herpetofauna species indicated in the IUCN Red List

Scientific Name: ***Limnonectes magnus***	**Common Name:** **Giant Philippine Frog**	**IUCN Red List: Near Threatened** **DAO 2019-09: Other Threatened Species**
Population	Generalized surveys are still recording the species within the last five years, however fewer large individuals are being observed (IUCN SSC Amphibian Specialist Group, 2020)	
Geographic Range	This species complex is found on Mindanao, Basilan, Bohol, Camiguin, Samar and Leyte Islands in the Philippines, from 0-1,800 masl. (IUCN SSC Amphibian Specialist Group, 2020)  Source: IUCN Red List of Threatened Species	
Habitat (inhabitation feeding area, breeding area, and nesting area)	It inhabits undisturbed and disturbed streams and rivers in lower montane and lowland forests. It breeds and deposits egg clutches in quiet side pools of forested riverine habitats(IUCN SSC Amphibian Specialist Group, 2020)	
Local Information	The species is frequently observed in its natural habitat, but some subpopulations are experiencing a decline due to excessive exploitation. Despite this, recent surveys have detected the species within the past five years, but there are fewer sightings of larger individuals. This information was reported by the IUCN SSC Amphibian Specialist Group in 2020.	
Situation of Site (Photo, how many locations) during the site survey	*L. magnus* has been observed on the stations A2, A3, A8 during the low rainfall period while on the stations A1, A4, A9, A10, A11, A12 during the high rainfall period. All the stations are located along the streams and rivers (IUCN SSC Amphibian Specialist Group, 2020).	

Record of existing survey	In the Philippines, threats include habitat loss due to agriculture and logging, and pollution of streamsand rivers from agricultural pesticides, herbicides, and mine-tailings. On Mindanao, the major threat isthe destruction and conversion of both lowland and montane rainforest habitat due to small-scale agricultural activities, large-scale oil palm plantations, wood collection for charcoal production, andexpanding human settlements (IUCN SSC Amphibian Specialist Group, 2020)
Photos	 *Source: Photo during the survey*

Appendix 25. Terrestrial insect distribution and abundance at the sampling sites

Low rainfall

Family	Species Name	Station											
		A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**Total**
Coleoptera	Metallic flea beetle (*Alticini sp.*)	1				1	1		2	2			7
Coleoptera	Jewel beetle (Buprestidae)				1								1
Coleoptera	Tortoise beetle (Cassidinae)			1				1					2
Coleoptera	Leaf beetle (Chrysomelidae)	2					1	2	1				6
Coleoptera	Long nose weevil (*Rhinotia sp.)*			11					1				12
Coleoptera	Asian lady beetle (*Harmonia sp.*)	1		1				1				1	4
Coleoptera	Firefly (Lampyridae)			1		1			1		1		4
Coleoptera	Broad nose weevil (Curculionidae)	1		4	2	2	1	3	5	1	3	8	30
Coleoptera	Long horn beetle (*Oberea nigriventis*)	1								1			2
Coleoptera	Weevil (*Pseudapocyrtus sp.*)	1									3		4
Diptera	Mosquito hawk (Tipulidae)						1						1
Hemiptera	Red cotton stainer (*Dysdercus cingulatus*)			1				1				1	3
Hymenoptera	Carpenter ant (Camponotus)						1						1
Hymenoptera	Yellow spotted mason wasp *(Odynerus bicinctus)*								2				2
Lepidoptera	Common grass yellow *(Eurema hecabe)*											1	1
Lepidoptera	Blue moon butterfly *(Hypolimas bolina philippinensis)*							2				1	3
Odonata	Dancer Damselfly *(Argia sp.)*											1	1
Odonata	Ebony jewel wing (*Calopteryx maculata*)				2					2			4
Odonata	Blue ground Skimmer (*Diplacodes trivialis*)											1	1
Odonata	Red parasol dragonfly (*Neurothermis terminata*)				1		1						2
Odonata	Slender skimmer (*Orthetrum sabina sabina*)											1	1
Odonata	Black bambootail damselfly (*Prodasineura verticalis*)								2				2
Odonata	Jewel damselfly (*Rhinocypha colorata*)						4			1		1	6
Odonata	Red-veinted darter dragonfly (*Sympetrum fonscolombii*)									3			3
Odonata	Pigmy skimmer dragonfly (*Tetrathemis platyptera*)							1					1
Orthoptera	Grasshopper (Caelifera)				4								4
	Total	**7**	**0**	**19**	**10**	**4**	**10**	**11**	**14**	**10**	**7**	**16**	**108**

High rainfall

Family	**Species Name**	**Stations**											
		A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**Total**
Blattodea	Roach								1				**1**
Coleoptera	Asian lady beetle (*Harmonia sp.*)						1	3			2	2	**8**
Coleoptera	Broad nose weevil (Curculionidae)		2	7	3	4		8	3		1	6	**34**
Coleoptera	Firefly (Lampyridae)		1					1			1		**3**
Coleoptera	Leaf beetle (Chrysomelidae)						3	1				2	**6**
Coleoptera	Long horn beetle (Cerambycidae)								1		1		**2**
Coleoptera	Metallic flea beetle (*Alticini sp.*)		2				1			2	1	2	**8**
Coleoptera	Tiger beetle (*Neocollyris sp.*)							1					**1**
Coleoptera	Tiger beetles (Cicindelinae)				3								**3**
Coleoptera	Weevil (*Pseudapocyrtus sp.*)		1		6				3	1	3		**14**
Hemiptera	Assasin bug (*Rhynocoris iracundus*)								1				**1**
Hemiptera	Kissing bug (Triatominae)									1			**1**
Hemiptera	Red cotton stainer (*Dysdercus cingulatus*)		2										**2**
Hymenoptera	Velvet ant (Mutillidae)										1		**1**
Lepidoptera	Common Mormon (*Papilio polytes alphenor*)		2										**2**
Lepidoptera	Metalmark moths (Choreutidae)				1								**1**
Lepidoptera	Scarlet Mormon (*Papilio rumanzovia*)											1	**1**
Odonata	Blue ground Skimmer (*Diplacodes trivialis*)		1						1				**2**
Odonata	Crimson marsh glider (*Trithemis aurora*)									3			**3**
Odonata	Green skimmer (*Orthetrum serapia*)								1	1			**2**
Odonata	Jewel damselfly (*Rhinocypha colorata*)											1	**1**
Odonata	Slender skimmer (*Orthetrum sabina sabina*)						1						**1**
Orthoptera	Grasshopper (Caelifera)					1							**1**
Phasmatodea	Stick insect						1						**1**
	Grand Total	**0**	**11**	**7**	**13**	**5**	**7**	**14**	**11**	**8**	**10**	**14**	**100**

Appendix 26. Photographs of representative insect species captured across stations

Asian lady beetle (*Harmonia sp.*)

Broad-nose weevil (Curculionidae)

Firefly (Lampyridae)

Leaf beetle (Chrysomelidae)

Long-horn beetle (Cerambycidae)

Metallic flea beetle (*Alticini sp.*)

Tiger beetle (*Neocollyris sp.*)

Tiger beetle (Cicindelinae)

Weevil (*Pseudapocyrtus sp.*)

Weevil (Curculionidae)

Assasin bug (*Rhynocoris iracundus*)

Kissing bug (Triatominae)

Red cotton stainer (*Dysdercus cingulatus*)

Velvet ant (Mutillidae)

Appendix 27. Photographs of the hydrology survey

LOW RAINFALL

Hydrology survey Stations H1 to H4

Top row, left to right: H1 (Tagoloan River, Natumolan, Tagoloan), H2 (Dicklum River Tributary, Dicklum, Manolo Fortich); *Bottom row, left to right*: H3 (Kumaykay River, Ticala, Manolo Fortich), H4 (Mangima River Tributary, Vista Villa-Puntian Boundary, Puntian, Sumilao)

Hydrology survey Stations H5 to H8

Top row, left to right: H5 (Kulaman River Tributary, Poblacion-Kisolon Boundary, Sumilao), H6 (Kulaman River Tributary, Culasi-Poblacion Boundary, Sumilao, Bukidnon); *Bottom row, left to right*: H7 (Ipoon River, Dalwangan, Malaybalay), H8 (Komotal River, Dalwangan, Malaybalay)

Hydrology survey stations H9 to H10

Left: H9 (Sawaga River, Patpat, Malaybalay); *Right*: H10 (Sawaga River, Sumpong, Malaybalay)

HIGH RAINFALL

Top row, left to right: H1 (Tagoloan River, Natumolan, Tagoloan), H2 (Dicklum River, Dicklum, Manolo Fortich), H3 (Kumayakay River, Ticala, Manolo Fortich); *Second row, left to right:* H4 (Puntian River, Puntian/Vista Villa, Sumilao), H5 (Tagolongon River, Vista Villa/Culasi, Sumilao), H6 (Kulaman River, Poblacion, Sumilao); *Third row, left to right:* H7 (Ipoon River, Impalutao, Impasug-ong/Dalwangan, Malaybalay), H8 (Komotal River, Dalwangan, Malaybalay), H9 (Sawaga River, Patpat, Malaybalay); *Last row:* H10 (Sawaga River, Kalasungay, Malaybalay)

Appendix 28. Estimated monthly discharges of the Tagoloan River Basin

Estimated monthly discharges (in LPS) based on the generated monthly runoffs over the 177,300.16-Ha area of
the Tagoloan River Basin (Simulation Year 1985-2020)

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	13,133.34	4,446.18	2,394.10	1,162.85	4,377.78	4,309.38	9,576.40	60,126.09	76,611.18	72,164.99	42,136.15	86,461.19
1986	101,236.20	46,582.33	24,009.40	12,791.33	8,823.97	10,602.44	10,534.04	17,579.53	35,227.46	57,321.58	27,839.95	14,638.21
1987	6,908.69	5,335.42	2,052.09	752.43	4,104.17	6,840.28	6,977.09	28,866.00	11,354.87	6,498.27	6,224.66	3,351.74
1988	684.03	820.83	1,162.85	1,710.07	3,420.14	5,814.24	8,618.76	4,514.59	66,077.14	53,080.60	58,347.62	38,100.38
1989	19,905.23	11,628.48	7,113.90	3,214.93	34,338.22	117,105.66	89,812.93	71,686.17	85,298.34	79,620.90	39,400.03	20,726.06
1990	9,986.81	4,514.59	2,599.31	1,231.25	8,960.77	6,703.48	27,292.73	13,954.18	83,246.25	49,386.85	202,198.79	93,506.68
1991	47,745.18	23,188.56	14,090.98	8,139.94	5,130.21	7,319.10	47,197.96	21,683.70	12,586.12	35,911.49	27,908.36	12,038.90
1992	5,951.05	2,941.32	1,710.07	752.43	2,736.11	7,661.12	16,348.28	20,247.24	32,012.53	50,070.88	22,025.71	13,201.75
1993	6,498.27	8,071.53	2,394.10	1,504.86	1,436.46	2,736.11	8,413.55	6,908.69	106,845.23	102,672.66	54,995.88	83,109.45
1994	38,442.39	21,204.88	11,765.29	9,165.98	6,224.66	102,399.05	66,213.95	84,477.50	62,930.61	32,286.14	14,911.82	10,055.22
1995	6,019.45	2,736.11	2,941.32	1,162.85	3,078.13	7,045.49	14,159.39	69,976.10	89,334.11	62,451.79	42,888.58	78,936.87
1996	38,373.99	38,647.60	17,989.95	16,348.28	11,149.66	36,048.30	21,546.89	14,159.39	32,764.96	46,240.32	80,988.96	37,758.37
1997	22,641.34	10,055.22	7,866.33	2,257.29	5,745.84	6,840.28	25,103.84	11,081.26	63,341.03	73,054.23	34,269.82	17,921.54
1998	8,687.16	4,172.57	2,120.49	1,026.04	2,257.29	4,377.78	6,635.08	9,302.79	17,169.11	9,234.38	80,920.56	37,416.35
1999	26,266.69	70,660.13	38,168.78	37,758.37	34,201.42	17,442.72	89,539.31	65,324.71	37,621.56	42,546.57	54,722.27	93,643.48
2000	44,188.23	25,309.05	13,817.37	14,775.01	7,866.33	83,451.46	65,871.93	82,083.41	40,494.48	104,040.72	79,757.71	38,989.62
2001	19,015.99	12,038.90	8,755.56	3,214.93	8,892.37	5,951.05	63,341.03	70,112.91	79,484.10	43,435.80	93,233.07	57,868.80
2002	29,002.80	16,827.10	8,892.37	4,104.17	6,156.26	52,396.57	33,106.97	36,937.53	106,366.41	65,871.93	32,149.33	16,143.07
2003	8,755.56	4,240.98	1,983.68	957.64	4,788.20	8,960.77	34,269.82	54,927.48	106,366.41	66,282.35	33,243.78	117,926.49
2004	53,422.62	29,550.03	14,706.61	7,387.51	7,319.10	7,729.52	6,019.45	4,514.59	4,309.38	4,925.00	684.03	2,804.52
2005	1,026.04	342.01	2,325.70	136.81	6,361.46	6,977.09	9,507.99	45,829.90	83,793.48	58,552.83	27,566.34	18,673.97
2006	9,097.58	6,293.06	3,078.13	2,052.09	2,530.90	8,892.37	21,957.31	16,485.08	29,550.03	50,686.50	23,188.56	12,380.91
2007	8,345.15	4,309.38	1,436.46	1,504.86	4,993.41	8,618.76	10,328.83	44,188.23	44,051.43	56,363.94	49,181.64	25,240.65
2008	41,725.73	20,794.46	11,696.89	13,748.97	23,325.37	50,891.71	66,897.98	59,168.45	88,923.69	93,848.69	46,103.51	37,074.34
2009	146,382.07	107,324.05	50,139.28	29,755.23	20,520.85	29,139.61	79,962.92	40,631.29	52,259.77	26,129.88	91,044.18	41,110.11
2010	25,172.24	9,986.81	5,814.24	3,078.13	6,498.27	5,951.05	32,217.74	43,914.62	72,507.01	93,575.08	44,119.83	25,514.26
2011	32,286.14	41,110.11	27,224.33	12,586.12	9,713.20	11,970.50	24,419.81	48,224.00	63,683.04	64,503.88	33,859.40	98,773.70
2012	44,530.25	26,061.48	13,201.75	8,003.13	7,934.73	6,293.06	23,188.56	25,445.86	42,614.97	45,829.90	21,204.88	26,471.90
2013	51,233.73	25,103.84	13,064.94	8,550.35	9,644.80	59,168.45	78,184.44	69,155.27	49,113.24	51,165.32	38,921.21	30,370.86
2014	112,591.07	58,484.43	54,790.67	34,680.24	61,972.97	115,942.81	84,340.70	114,985.17	93,233.07	77,021.60	68,266.03	40,768.09
2015	32,628.15	16,758.70	10,055.22	8,345.15	7,182.30	35,022.25	67,513.60	59,168.45	51,986.16	43,230.59	75,790.34	55,064.28
2016	27,908.36	16,621.89	6,908.69	7,250.70	16,348.28	113,275.10	77,842.43	67,103.18	94,874.74	96,721.61	120,594.20	111,975.45
2017	194,058.85	136,532.06	193,306.42	135,164.01	235,374.16	221,693.60	196,589.76	169,707.44	165,261.26	144,672.00	185,303.29	240,435.97
2018	236,195.00	229,012.70	149,049.78	160,131.04	197,136.98	138,926.16	68,608.05	37,484.76	21,888.91	74,011.87	141,525.47	134,069.56

2019	121,346.63	57,526.79	34,133.02	37,005.94	27,839.95	133,317.13	112,249.06	56,090.33	38,716.01	56,021.92	42,067.75	37,826.77
2020	17,442.72	9,234.38	5,609.03	3,214.93	7,866.33	8,823.97	51,849.35	75,516.73	74,148.68	87,008.41	48,702.82	74,832.70
Mean	***44,689.85***	***30,790.78***	***21,343.59***	***16,517.39***	***22,673.64***	***40,462.18***	***46,006.61***	***47,821.18***	***61,556.85***	***60,456.71***	***57,952.40***	***52,366.17***
Max	***236,195.00***	***229,012.70***	***193,306.42***	***160,131.04***	***235,374.16***	***221,693.60***	***196,589.76***	***169,707.44***	***165,261.26***	***144,672.00***	***202,198.79***	***240,435.97***
Min	***684.03***	***342.01***	***1,162.85***	***136.81***	***1,436.46***	***2,736.11***	***6,019.45***	***4,514.59***	***4,309.38***	***4,925.00***	***684.03***	***2,804.52***
Std Dev	***53,845.76***	***44,548.86***	***38,991.32***	***33,547.27***	***48,631.03***	***52,281.78***	***39,479.36***	***33,713.74***	***33,555.84***	***28,501.41***	***44,406.27***	***47,259.95***

Estimated monthly discharges (in LPS) based on the generated monthly runoffs over the 177,300.16-Ha area of
the Tagoloan River Basin (Simulation Year 2050 Projection)

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	13,201.75	4,446.18	2,325.70	1,162.85	3,693.75	4,104.17	9,097.58	33,038.57	58,484.43	58,142.41	30,576.07	78,321.25
1986	94,737.93	43,299.00	22,230.92	11,696.89	7,866.33	9,986.81	7,934.73	5,882.64	6,635.08	31,875.72	15,117.03	8,276.74
1987	3,762.16	3,762.16	1,162.85	410.42	3,214.93	6,429.87	6,566.67	8,071.53	1,162.85	1,436.46	3,693.75	2,120.49
1988	68.40	547.22	820.83	1,299.65	2,804.52	5,472.23	8,208.34	4,240.98	33,722.60	31,875.72	43,299.00	27,361.14
1989	14,501.40	9,029.17	5,267.02	2,325.70	9,507.99	76,953.19	59,305.26	46,308.72	67,650.41	65,803.53	32,422.95	17,305.92
1990	8,276.74	3,625.35	2,052.09	957.64	7,319.10	6,293.06	7,387.51	3,967.36	44,461.84	24,967.04	185,371.69	85,161.53
1991	43,641.01	21,068.07	12,517.72	7,182.30	4,446.18	6,908.69	16,074.67	6,224.66	4,993.41	14,159.39	12,517.72	4,377.78
1992	2,052.09	1,026.04	684.03	273.61	2,120.49	7,182.30	8,618.76	5,403.82	6,087.85	31,670.51	12,791.33	8,687.16
1993	4,240.98	6,977.09	1,641.67	1,094.45	1,094.45	2,530.90	7,934.73	6,498.27	77,295.21	82,972.64	41,110.11	72,985.83
1994	33,380.58	18,742.38	10,055.22	7,729.52	5,198.62	65,598.32	38,168.78	59,168.45	45,487.89	23,598.98	10,534.04	7,934.73
1995	4,925.00	2,188.89	2,257.29	889.24	2,462.50	6,635.08	8,481.95	35,501.07	67,376.80	46,513.93	30,370.86	70,249.71
1996	33,996.21	30,234.05	13,543.76	11,970.50	6,977.09	8,139.94	5,198.62	4,582.99	6,566.67	17,921.54	62,246.58	28,455.58
1997	18,058.35	7,797.92	6,087.85	1,641.67	4,651.39	6,429.87	9,439.59	3,351.74	33,654.20	53,149.00	24,351.41	12,996.54
1998	6,156.26	2,941.32	1,436.46	684.03	1,778.47	4,104.17	6,224.66	8,755.56	5,745.84	3,556.95	54,790.67	24,351.41
1999	16,143.07	59,510.47	28,866.00	17,305.92	11,012.86	6,224.66	52,328.17	37,142.74	19,905.23	27,497.94	42,683.37	85,161.53
2000	39,947.26	23,188.56	12,107.30	9,029.17	4,856.60	41,110.11	34,543.43	55,269.49	27,361.14	87,282.02	66,761.17	32,559.75
2001	15,801.06	10,465.63	7,182.30	2,599.31	7,319.10	5,609.03	12,791.33	33,927.81	56,432.34	28,455.58	79,552.50	47,745.18
2002	24,009.40	14,364.60	7,182.30	3,351.74	5,061.81	24,967.04	11,560.08	14,501.40	90,154.94	52,670.19	25,514.26	12,859.73
2003	7,113.90	3,420.14	1,573.27	752.43	3,967.36	8,413.55	9,713.20	31,807.32	89,881.33	53,012.20	26,608.70	108,418.50
2004	48,566.01	27,155.93	13,133.34	6,635.08	6,293.06	7,250.70	5,677.44	4,240.98	4,240.98	4,925.00	684.03	2,872.92
2005	1,026.04	342.01	1,915.28	68.40	5,267.02	6,635.08	7,045.49	7,797.92	48,702.82	35,843.09	16,211.47	13,133.34
2006	6,293.06	4,925.00	2,120.49	1,504.86	1,983.68	8,345.15	7,250.70	4,651.39	5,814.24	28,660.79	12,175.71	6,908.69
2007	5,677.44	3,009.72	752.43	1,026.04	3,967.36	8,139.94	6,908.69	10,260.43	22,025.71	40,289.27	36,663.92	19,015.99
2008	31,944.13	15,937.86	8,755.56	7,866.33	6,361.46	8,208.34	32,696.56	32,354.54	70,591.73	79,757.71	39,058.02	25,651.06
2009	139,268.18	100,894.19	46,855.94	27,292.73	18,263.56	12,038.90	32,012.53	15,527.44	26,061.48	13,064.94	74,764.30	33,038.57
2010	21,204.88	7,934.73	4,651.39	2,462.50	5,335.42	5,540.63	11,696.89	16,143.07	53,559.42	78,868.47	36,800.73	21,888.91
2011	18,810.78	31,465.31	16,485.08	7,387.51	6,498.27	9,097.58	6,703.48	8,550.35	38,647.60	46,855.94	23,804.19	87,829.24
2012	38,921.21	23,325.37	11,423.27	6,840.28	6,703.48	5,882.64	9,439.59	5,951.05	7,319.10	22,983.35	9,781.61	12,928.14
2013	41,452.12	20,247.24	10,260.43	6,771.88	7,797.92	12,654.52	43,435.80	41,452.12	30,097.25	36,595.52	27,087.52	20,999.67
2014	106,229.61	51,712.55	32,764.96	17,989.95	18,879.18	80,099.72	54,995.88	86,734.80	73,601.45	61,494.15	55,406.30	30,918.08
2015	24,009.40	12,449.32	7,319.10	6,361.46	5,677.44	9,029.17	24,419.81	26,471.90	30,028.85	26,540.30	62,041.37	44,530.25

2016	22,641.34	14,090.98	5,472.23	5,882.64	9,507.99	61,836.17	41,520.52	37,005.94	74,217.08	80,646.95	107,460.86	102,330.65
2017	187,834.19	130,444.21	153,564.37	93,780.29	168,202.58	174,222.03	158,968.19	137,352.90	143,509.15	128,392.13	172,101.54	232,501.25
2018	230,380.76	224,292.90	125,382.40	118,405.31	138,926.16	98,978.91	48,702.82	27,292.73	16,895.50	43,435.80	121,141.43	121,004.62
2019	111,633.43	52,601.78	30,576.07	18,605.57	11,560.08	77,432.01	72,507.01	36,185.10	21,410.09	33,996.21	25,993.08	26,266.69
2020	11,628.48	6,361.46	3,830.56	2,257.29	6,293.06	8,208.34	9,439.59	38,784.41	50,618.10	69,839.30	35,090.66	65,119.50
Mean	***39,764.85***	***27,606.25***	***17,062.71***	***11,485.98***	***14,524.20***	***24,908.13***	***24,805.53***	***26,122.28***	***40,566.68***	***43,576.41***	***46,016.11***	***44,507.45***
Max	***230,380.76***	***224,292.90***	***153,564.37***	***118,405.31***	***168,202.58***	***174,222.03***	***158,968.19***	***137,352.90***	***143,509.15***	***128,392.13***	***185,371.69***	***232,501.25***
Min	***68.40***	***342.01***	***684.03***	***68.40***	***1,094.45***	***2,530.90***	***5,198.62***	***3,351.74***	***1,162.85***	***1,436.46***	***684.03***	***2,120.49***
Std Dev	***52,717.31***	***43,197.75***	***31,630.99***	***23,937.61***	***34,114.84***	***36,565.58***	***29,272.01***	***26,972.32***	***31,589.33***	***27,236.79***	***41,834.88***	***45,910.24***

Appendix 29. Photograph of the surface water quality sampling stations

Low rainfall

First row, left to right: WQ1 (Tagoloan River, Natumolan), WQ2 (Diclum River, Diclum, Manolo Fortich), WQ3 (Kumaykay River, Ticala, Manolo Fortich); *Second row, left to right*: WQ4 (Puntian River, Puntian, Sumilao), WQ5 (Mapolo River, Poblacion/Kisolon, SUmilao), WQ6 (Tagolongon River, Vista Villa/Culasi, Sumilao); *Third row, left to right*: WQ7 (Agutan River Tributary/Ipoon River, Poblacion/Kisolon, Sumilao), WQ8 (Komotal/Kubatan River, La Fortuna, Impasug-ong), WQ9 (Sawaga River, Patpat, Malaybalay); *Last row*: WQ10 (Sawaga River, Kalasungay, Malaybalay)

<u>High rainfall</u>

Top row, left to right: WQ1 (Tagoloan River, Natumolan, Tagoloan), WQ2 (Dicklum River, Dicklum, Manolo Fortich), WQ3 (Kumayakay River, Ticala, Manolo Fortich); *Second row, left to right:* WQ4 (Puntian River, Puntian/Vista Villa, Sumilao), WQ5 (Tagolongon River, Vista Villa/Culasi, Sumilao), WQ6 (Mapolo River, Kisolon/Poblacion, Sumilao); *Third row, left to right:* WQ7 (Ipoon River, Impalutao, Impasug-ong/Dalwangan, Malaybalay), WQ8 (Komotal River, Dalwangan, Malaybalay), WQ9 (Sawaga River, Patpat, Malaybalay); *Last row:* WQ10 (Sawaga River, Kalasungay, Malaybalay)

Appendix 30. Photographs of the groundwater quality sampling stations

Top row, left to right: GW1 (Purok 6 Tubod Casinglot Reservoir, Casinglot Tagoloan), GW2 (Purok A1 Spring, San Miguel, Manolo Fortich), GW3 (Enlapay Spring, Ticala, Manolo Fortich); *Second row, left to right:* GW4 (Lumok Spring, Puntian, Sumilao), GW5 (Briana Spring, Poblacion, Sumilao), GW6 (Kisolon Reservoir, Kisolon Sumilao); *Third row, left to right:* GW7 (Kalahi Seeds Reservoir, Capitan Bayong, Impasug-ong), GW8 (Bureau of Soils Reservoir, Dalwangan, Malaybalay), GW9 (Patpat Waterbrake, Patpat, Malaybalay); *Last row:* GW10 (Kalasungay Spring, Malaybalay)

Appendix 31. Photographs of the aquatic ecology sampling stations during

Low rainfall

Top row, left to right: **AS1** (Tagoloan River, Natumolan, Tagoloan Misamis Oriental), **AS2** (Diclum River, Diclum, Manolo Fortich, Bukidnon, **AS3** (Tankulan, Manolo Fortich, Bukidnon); *Middle row, left to right*: **AS4** (Ticala, Manolo Fortich, Bukidnon), **AS5** (San Roque, Sumilao, Bukidnon), Aquatic Station 6 (La Fortuna, Impasug-ong, Bukidnon); *Bottom row, left to right*: **AS7** (Dalwangan, Malaybalay City), **AS8** (Dalwangan, Malaybalay City), **AS9** (Patpat, Malaybalay City)

Top row, left to right: AS10 (Brgy. 10 Poblacion, Malaybalay City), New WQ4 (Puntian, Sumilao), New WQ5 (Vista Villa and Culasi, Sumilao); *Middle row, left to right*: In-situ measurement of physico-chemical parameters in AS8, Collection of water samples for plankton community assessment in AS4, Collection and sorting of aquatic insects and freshwater fishes in AS5; *Bottom*: Cleaning debris, sorting aquatic insects and fishes, and sample preservation in AQS9

High rainfall

Top row, left to right: A1 (Tagoloan River, Natumolan/Sta. Ana, Tagoloan), A2 (Natumolan, Tagoloan/Bugo, CDO), A3 (Alae/Damilag, Manolo Fortich); *Second row, left to right:* A4 (Dicklum River, Damilag/Dicklum, Manolo Fortich), A5 (Ticala River, Sankanan/Ticala, Manolo Fortich), A6 (Puntian River, Puntian/Vista Villa, Sumilao); *Third row, left to right:* A7 (Tagolongon River, Vista Villa/Culasi, Sumilao), A8 (Kulaman River, Culasi/Poblacion, Sumilao), A9 (Poblacion/Kisolon, Sumilao); *Last row:* A10 (Kisolon, Sumilao/Poblacion, Impasug-ong)

Top row, left to right: A11 (Atugan River, La Fortuna/Capitan Bayong, Impasug-ong), A12 (Ipoon River, Impalutao/Dalwangan, Malaybalay City) A13 (Komotal River, Dalwangan, Malaybalay City); *Second row, left to right:* A14 (Sawaga River, Patpat, Malaybalay City), A15 (Sawaga River Patpat, Malaybalay City), A16 (Kalasungay – Brgy. 10 Poblacion, Malaybalay City); *Third row, left to right:* A17 (Sawaga River, Kalasungay – Brgy. 10 Poblacion, Malaybalay City)

Appendix 32. Phytoplankton abundance and distribution at the sampling sites during

Low rainfall

Group/Taxa	Station														Total	Relative abundance (%)
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	NWQ10	NWQ4	NWQ5	NWQ9		
Bacillariophyta	**228**	**26**	**97**	**65**	**292**	**560**	**138**	**336**	**1,611**	**63**	**98**	**443**	**139**	**559**	**4,654**	**18.7**
Actinocyclus	2								40						42	0.17
Amphora sp. 1	4			13	5	8		9		6	8	3	4	12	70	0.28
Amphora sp. 2								3							3	0.01
Asterionella			6			5		13						13	36	0.15
Caloneis	14		3	15	8	73	4	99	33		2		1	7	257	1.03
Coscinodiscus						3		5	36				3	3	49	0.2
Diadesmis	2				5		4	8	5					4	28	0.11
Diploneis			2												2	0.01
Fragilaria	106	3	14	20	13	63	33	31	217	7	13	98	12	56	683	2.74
Gomphonema					250	20	2		42	2		8	1	6	331	1.33
Gyrosigma		3	2			10	4			4	4	4	20		51	0.2
Haematococcus		3				3		2							7	0.03
Melosira	2		50			193		2	328	11	15	53	8	275	936	3.76
Navicula	33	16	2	18	10	140	67	149	247	15	38	40	43	115	932	3.74
Nitzschia	13		2			40		7	7		6	4	13	4	95	0.38
Pinnularia		2				3	11	4		2		21	8		49	0.2
Stephanodiscus						3									3	0.01
Synedra	2								233	5	2	81	2	11	334	1.34
Tabellaria	51		16		3		13	6	424	12	10	133	26	54	748	3.01
Chlorophyta	**36**	**58**	**163**	**78**	**6,039**	**35**	**21**	**101**	**70**	**31**	**69**	**164**	**80**	**148**	**7,092**	**28.5**
Actinastrum											18				18	0.07
Ankistrodesmus	15	23	3	3	10	5	19	22	2		13	4	18	8	143	0.58
Chlorella	2	14		35	5,996	3	2	12	4	3	2			48	6,121	24.6
Cladophora				33											33	0.13
Closterium	2							6			2	36	8	2	55	0.22
Coelastrum			138					38							175	0.7
Cosmarium				5	3	10		4	2			43	11	7	84	0.34
Kirchneriella					9										9	0.04

Group/Taxa	Station														Total	Relative abundance (%)
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	NWQ10	NWQ4	NWQ5	NWQ9		
Monoraphidium	18	13			8	5			4	17	31	46	10	32	183	0.74
Oedogonium									53			13		15	80	0.32
Pleurotaenium			7			8		6				1			22	0.09
Scenedesmus					10						2				12	0.05
Selenastrum				3				2		5		18	23		51	0.2
Tetraedron			4		2	5		11	4			1	2		30	0.12
Treubaria		8	12		3					6		3	9	37	77	0.31
Chrysophyta														**2**	**2**	**0.01**
Mallomonas														2	2	0.01
Cyanophyta	**77**	**181**	**238**	**75**	**6,947**	**2,528**	**375**	**319**	**286**	**66**	**68**	**319**	**1,478**	**150**	**13,105**	**52.66**
Anabaena								40							40	0.16
Chroococcus		4			1,225			10						10	1,248	5.02
Cryptomonas						3									3	0.01
Cylindrospermopsis								2		63					65	0.26
Gleocapsa					5,375									20	5,395	21.68
Leptolyngbya		25		50	3	10		142							229	0.92
Lyngbya			40				2	3	11	3			43	18	120	0.48
Merismopedia												40			40	0.16
Microcystis			188			2,500									2,688	10.8
Nostoc					44								8		51	0.21
Oscillatoria	75	150			100		313	109	188		66	275	1,394		2,669	10.72
Romeria							38								38	0.15
Spirulina	2							8	88				30	82	209	0.84
Stigonema			9	25	190	15	19							19	276	1.11
Trachelomonas		2	2		11		4	6			2	4	3	2	36	0.14
Dinophyta			**3**						**2**			**10**	**7**	**2**	**23**	**0.09**
Ceratium			3						2			9	3		17	0.07
Peridinium												1	4	2	7	0.03
Euglenophyta				**3**		**3**	**2**					**1**			**8**	**0.03**
Euglenoid				3											3	0.01
Phacus						3	2					1			6	0.02
Others																28.23

Group/Taxa	Station														Total	Relative abundance (%)
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	NWQ10	NWQ4	NWQ5	NWQ9		
Grand Total	**341**	**264**	**500**	**220**	**13,277**	**3,125**	**537**	**756**	**1,970**	**160**	**234**	**936**	**1,704**	**860**	**24,884**	**100**

High rainfall

Group/Taxa	Station																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	R.A. %
Bacillariophyta	366	94	2	26	366	214	311	996	248	311	388	231	270	154	41	126	56	67.46
Amphora	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	2	2	0.12
Ankistrodesmus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0.06
Aulacoseira	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0.03
Caloneis	2	2	0	0	0	0	0	0	6	6	8	0	6	17	0	0	2	0.75
Coscinodiscus	0	0	0	0	2	0	0	4	2	0	0	4	2	0	0	0	0	0.21
Cymbella	2	0	0	4	2	0	0	23	13	26	11	2	4	6	4	23	4	1.96
Diadesmis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.03
Diploneis	0	0	0	0	0	0	0	0	8	0	0	0	2	0	0	0	0	0.15
Fragilaria	139	34	0	8	204	49	137	234	13	71	66	58	43	6	23	6	4	17.57
Gomphonema	0	0	0	0	0	4	2	2	4	0	0	0	4	2	0	2	0	0.3
Gyrosigma	0	2	0	0	0	2	8	2	26	11	0	0	6	4	0	6	8	1.18
Hyalodiscus	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0.09
Melosira	99	0	0	2	13	38	0	566	4	8	88	15	6	17	4	0	0	13.8
Navicula	26	17	2	4	30	30	51	62	113	92	39	28	99	62	8	36	11	11.39
Nitzschia	8	6	0	0	34	11	26	34	19	6	21	4	8	8	2	13	13	3.37
Pinnularia	0	0	0	2	4	6	0	8	11	0	0	2	2	9	0	0	0	0.69
Stephanodiscus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0.12
Surirella	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0.03
Synedra	90	34	0	8	77	69	88	62	28	88	156	118	88	24	2	28	11	15.61
Chlorophyta	2	11	0	64	21	2	4	2	26	148	28	62	79	54	11	6	34	8.89
Ankistrodesmus	0	6	0	17	6		2	0	2	0	2	0	0	4	0	2	0	0.63
Chlorella	0	0	0	4	0	0	0	0	0	4	6	47	2	0	0	0	0	0.99
Closterium	2	4	0	0	0	0	0	0	0	4	0	2	4	0	0	4	4	0.36

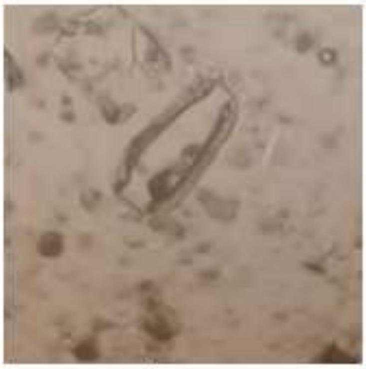
Group/Taxa	Station																	
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**	**A14**	**A15**	**A16**	**A17**	**R.A. %**
Coelastrum	0	0	0	0	0	0	0	0	0	2	0	9	0	0	0	0	0	0.18
Cosmarium	0	2	0	0	8	2	2	2	11	8	13	4	2	9	0	0	2	1.02
Crucigenia	0	0	0	0	0	0	0	0	0	45	0	0	0	0	0	0	23	1.08
Golenkia	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03
Haematococcus	0	0	0	0	0	0	0	0	2	2	0	0	0	2	0	0	0	0.09
Monoraphidium	0	0	0	41	4	0	0	0	9	2	0	0	4	8	8	0	4	1.27
Oedogenium	0	0	0	0	4	0	0	0	0	2	0	0	53	21	0	0	0	1.27
Pleurotaenium	0	0	0	0	0	0	0	0	2	6	4	0	2	11	4	0	2	0.48
Scenedesmus	0	0	0	0	0	0	0	0	0	0	4	0	11	0	0	0	0	0.24
Spyrogyra	0	0	0	0	0	0	0	0	0	75	0	0	0	0	0	0	0	1.21
Tetraedron	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0.03
Cyanophyta	19	131	0	38	94	19	0	240	0	75	0	19	188	77		516	21	23.05
Aphanizomenon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94	0	1.51
Chroococcus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.03
Oscillatoria	0	56	0	38	94	19	0	53	0	0	0	0	131	56	0	234		10.94
Spirulina	0	75	0	0	0	0	0	0	0	0	0	19		19	0	188	19	5.12
Stigonema	19	0	0	0	0	0	0	188	0	75	0	0	56	2	0	0	0	5.45
Dinophyta	2	0	0	6	6	0	0	0	2	8	2	0	2	0	0	0	0	0.42
Ceratium	2	0	0	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0.15
Peridinium		0	0	4		0	0	0	2	8	2	0	2	0	0	0	0	0.27
Euglenophyta	6	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	0	0.18
Euglena	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0.06
Trachelomonas	4	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0.12
Grand Total	**394**	**236**	**2**	**133**	**486**	**234**	**315**	**1,238**	**276**	**544**	**420**	**311**	**538**	**285**	**53**	**649**	**111**	**100**

Appendix 33. Photographs of recorded phytoplankton species at the sampling stations

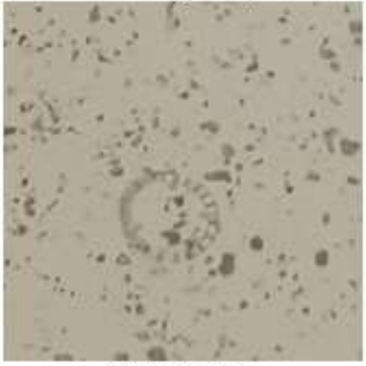
Low rainfall


Actinastrum sp.


Actinocyclus sp.


Amphora sp. 1


Amphora sp. 2


Anabaena sp.


Ankistrodesmus sp.


Asterionella sp.


Caloneis sp.

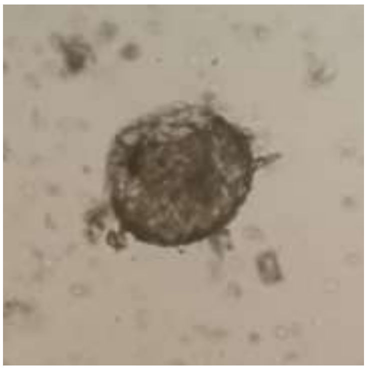

Ceratium sp.


Chlorella sp.


Chlorella vulgaris


Chroococcus sp.

Arcella sp.

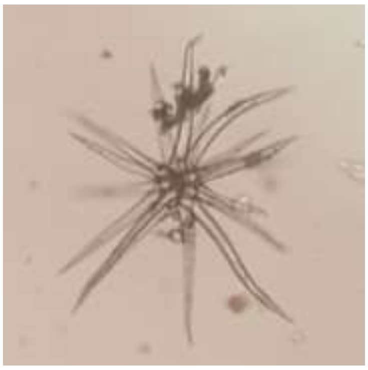


Centropyxis sp.

Cyclops sp.

Cyclops sp. (nauplius)

Filinia sp.

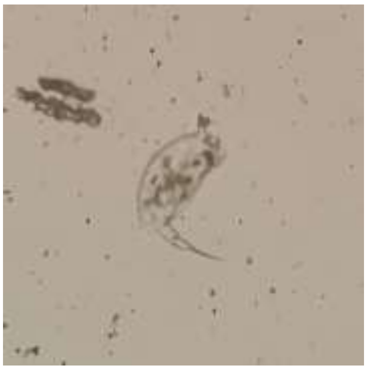


Hydrozoa sp. 1

Hydrozoa sp. 2

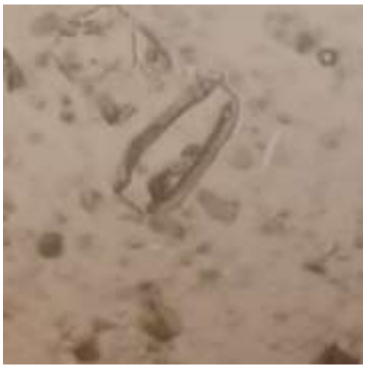
Hydrozoa sp. 3

Nematode



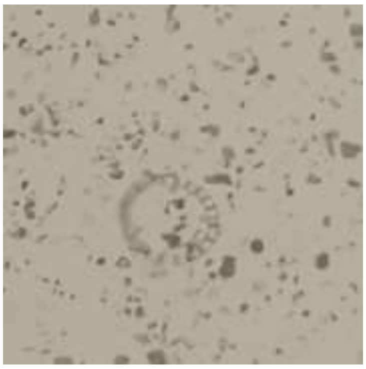
Actinastrum sp.

Actinocyclus sp.



Amphora sp. 1

Amphora sp. 2



Anabaena sp.

Ankistrodesmus sp.

Asterionella sp.

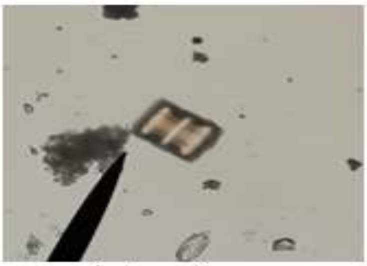
Caloneis sp.

Ceratium sp.

<u>High rainfall</u>

Bacillariophyta


Amphora sp.

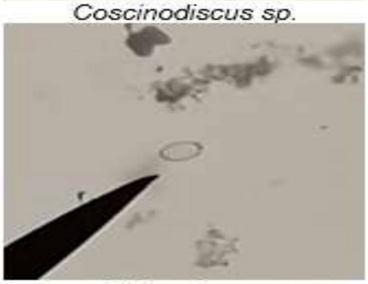

Aulacoseira sp.

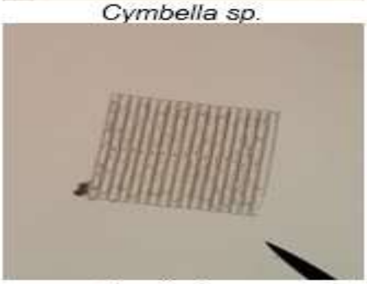

Caloneis sp.


Coscinodiscus sp.


Cymbella sp.


Diadesmis sp.


Diploneis sp.


Fragilaria sp.


Gomphonema sp.


Gyrosigma sp.

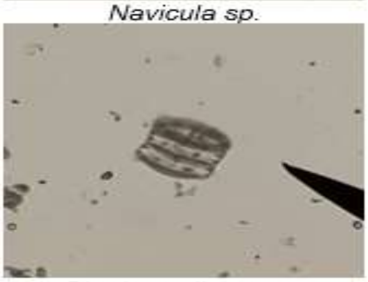

Hyalodiscus sp.


Melosira sp.


Navicula sp.


Nitzschia sp.


Pinnularia sp.


Stephanodiscus sp.

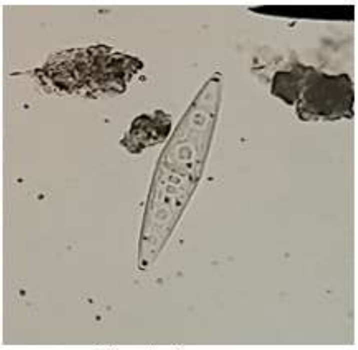

Surirella sp.


Synedra sp.

Chlorophyta

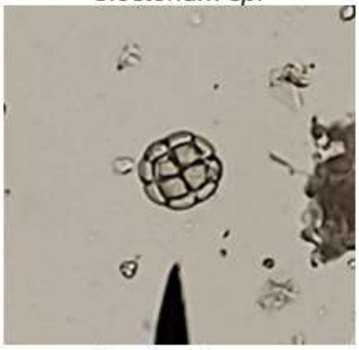

Ankistrodesmus sp.

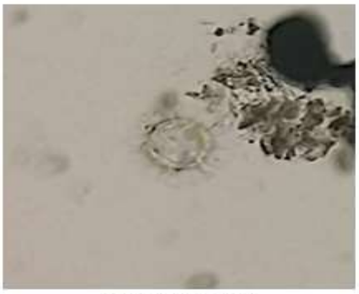

Chlorella sp.

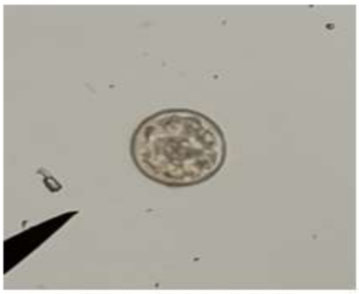

Closterium sp.


Coelastrum sp.

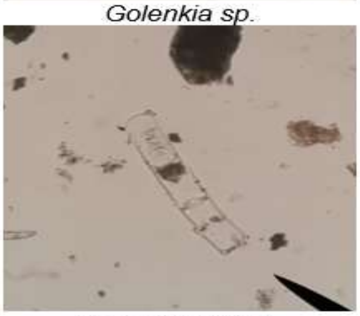

Cosmarium sp.


Crucigenia sp.


Golenkia sp.

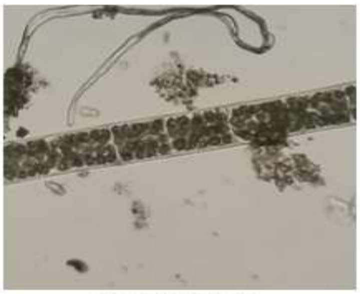

Haematococcus sp.

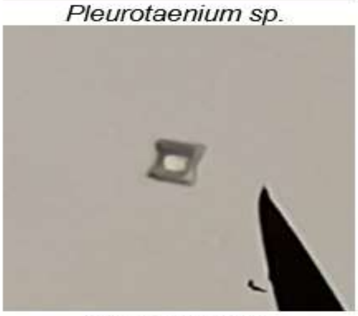

Monoraphidium sp.


Oedogenium sp.

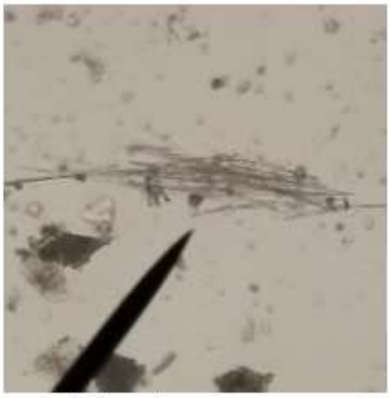

Pleurotaenium sp.


Scenedesmus sp.


Spyrogyra sp.


Tetraedron sp.

Cyanophyta



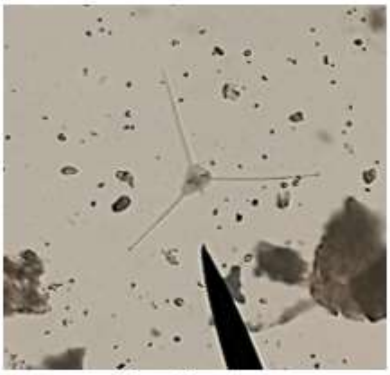
Aphanizomenon sp.

Chroococcus sp.

Oscillatoria sp.

Spirulina sp.

Stigonema sp.



Ceratium sp.

Peridinium sp.

Euglenophyta

Euglena sp.

Trachelomonas sp.

Appendix 34. Zooplankton diversity, abundance, and distribution at the sampling stations

Low rainfall

Group/Taxa	STATION														Total	Relative abundance (%)
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**	**A14**		
Amoebozoa	9						2		2		1	3		1	17	32.45
Arcella sp.	5										1	3		0	9	16.62
Centropyxis sp.	5						2		2					1	8	15.84
Arthropoda					2										2	3.52
Diaptomus sp.					2										2	3.52
Cnidaria	2	1	7	2	2	3	1		2	2	1		1		22	41.94
Hydrozoa (?) sp. 1	2	1	6	2	2		1		2	2	1		1		19	34.90
Hydrozoa (?) sp. 2			1												1	1.17
Hydrozoa (?) sp. 3						3									3	5.87
Nematoda					1	1	3				1		1		6	11.24
Nematode					1	1	3				1		1		6	11.24
Rotifera				2			1		1		3				6	10.85
Filinia sp.				2			1				1				4	6.74
Lecane sp. 1											1				1	1.56
Lecane sp. 2											1				1	1.56
Trichotria sp.									1						1	0.98
Grand Total	**11**	**1**	**7**	**3**	**5**	**4**	**6**		**4**	**2**	**6**	**3**	**2**	**1**	**53**	**100.00**

NOTE: All values are in individuals/L

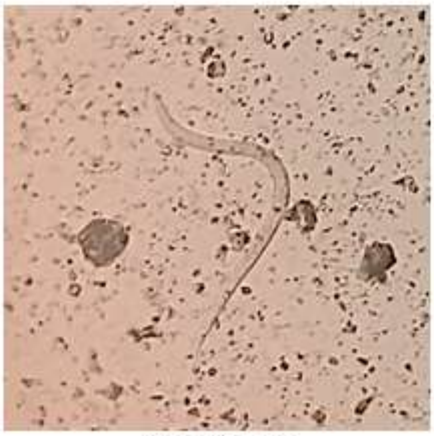
High rainfall

Group/Taxa	Station																	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	R.A. %
Amoebozoa	0	0	0	1	0	0	0	0	0	7	1	2	0	0	0	1	1	52.99
Arcella sp.	0	0	0	1	0	0	0	0	0	7	1	2	0	0	0	0	0	44.84
Centropyxis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	8.15
Nematoda	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	12.23
Nematode	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	12.23
Rotifera	0	0	0	1	0	1	0	0	0	1	1	3	0	0	0	1	0	32.61
Asplanchna sp.	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	12.23
Lecane sp.	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	1	0	20.38
Grand Total	0	0	0	2	2	1	0	0	0	8	2	5	0	0	0	2	2	100.00

NOTE: All values are in individuals/L

Appendix 35. Photographs of recorded zooplanktons at the sampling stations

Nematoda



Nematode

Protozoa

Arcella sp.

Centropyxis sp.

Rotifera

Asplanchna sp.

Lecane sp.

Appendix 36. Abundance and distribution of fishes and macrobenthic fauna at the sampling stations

Low rainfall

Species Name	Station													Total	RA (%)
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13		
Fishes															
Poeciliidae															
Gambusia affinis		3	4	1	5	2	17	11	1	10	1		15	70	57.85
Gobiidae															
Glossogobius giuris	5									1				6	4.96
Glossogobius celebius	4													4	3.31
Cyprinidae															
Barbodes sp.	1													1	0.83
Barbodes binotatus							1			1		1		3	2.48
Cichlidae															
Oreochromis niloticus	36									1				37	30.58
Total	**46**	**3**	**4**	**1**	**5**	**2**	**18**	**11**	**1**	**13**	**1**	**1**	**15**	**121**	**100.00**
Macrobenthic fauna															
Shellfishes															
Thiaridae															
Thiara scabra								3						3	18.18
Melanoides tuberculata								3						3	15.15
Melanoides turriculus			2					1						3	18.18
Lymnaeidae															
Lymnaea perega								1						1	6.06
Lymnaea natalensis								3						3	18.18
Viviparidae															
Vivipara angularis								3						3	18.18
Planorbidae															
Planorbis planorbis								1						1	6.06
Total			**2**					**15**						**17**	**100.00**
Crustaceans															
Paleamonidae															
Macrobrachium rosenbergii	20												25	45	88.24
Gecarcinidae															

Species Name	**Station**													**Total**	**RA (%)**
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**		
Tuerkayana hertipes			5					1						6	11.76
Total	**20**		**5**					**1**					**25**	**51**	**100.00**

High rainfall

Species	**STATION**																	**Total**	**RA (%)**
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**	**A14**	**A15**	**A16**	**A17**		
Fishes																			
Poeciliidae																			
Gambusia affinis						1								1			1	3	10
Poecilia reticulata			1													4	1	5	16.67
Gobiidae																			
Glossogobius giuris		1													2			3	10
Cyprinidae																			
Barbodes binotatus			1		6	1	1		3						2			14	46.67
Cichlidae																			
Sarotherodon sp.															2		3	5	16.67
Total	**0**	**1**	**2**	**0**	**6**	**2**	**1**		**3**	**0**	**0**	**0**	**0**	**1**	**6**	**4**	**5**	**30**	
Macrobenthic Fauna																			
Shellfishes																			
Thiaridae																			
Melanoides tuberculata			1															1	25
Melanoides turriculus											1		1					2	50
Viviparidae																			
Vivipara punctata													1					1	25
Total	**0**	**0**	**1**	**0**	**0**	**0**	**0**		**0**	**0**	**1**	**0**	**2**	**0**	**0**	**0**	**0**	**4**	
Crustaceans																			
Paleamonidae																			
Macrobrachium rosenbergii	4																19	23	85.19
Gecarcinidae																			
Tuerkayana hertipes												2			2			4	14.81
Total	**4**			**0**	**0**	**0**	**0**		**0**	**0**	**0**	**2**	**0**	**0**	**2**		**19**	**27**	

Appendix 37. Photographs of recorded fishes and macrobenthos across sampling stations

Low rainfall

Family: Cyprinidae

Barbodes binotatus

Family: Cyprinidae

Barbodes sp.

Family: Cichlidae

Oreochromis niloticus

Family: Gobiidae

Glossogobius giuris

Family: Gobiidae

Glossogobius celebius

Family: Poeciliidae

Gambusia affinis

Family: Thiaridae

Family: Thiaridae

Family: Thiaridae

High rainfall

Family: Poeciliidae
Poecilia reticulata

Family: Poeciliidae
Gambusia affinis

Family: Cichlidae
Sarotherodon sp.

Family: Cyprinidae
Barbodes binotatus|

Family: Gobiidae
Glossogobius giuris

Family: Thiaridae
Melanoides turriculus

Family: Thiaridae
Melanoides tuberculata

Family: Viviparidae
Vivipara punctata

Family: Paleamonidae
Macrobrachium rosenbergii

Appendix 38. Diversity, abundance, and distribution of aquatic insects at the sampling stations

Low rainfall

Species Name	**Station**													**Total**	**Relative abundance (%)**
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**		
Ephemeroptera															
Mayfly nymph		2		1			1	1	6			1		12	11.11
Hemiptera															
Common backswimmer (*Enithares sp.*)								1						1	0.92
Riffle Bugs (*Rhagovelia sp.)*			3	4	8		1			5				21	19.45
Water strider (Gerridae)			1	1	2			1				3		8	7.4
Whirligig beetle (*Dineutus sp.*)			1	2										3	2.80
Aphelocheirus sp.			1		1		4	2						8	7.4
Odonata															
Damselfly nymph		9	8	2	1		8	8	1	1		1		39	36.11
Dragonfly nymph			1	2			4	4	1	1				13	12.03
Plecoptera															
Stonefly nymph										2				2	1.86
Trichoptera															
Caddisfly nymph					1									1	0.92
Total	**0**	**11**	**15**	**12**	**13**	**0**	**18**	**17**	**8**	**9**	**0**	**5**	**0**	**108**	

High rainfall

Species Name	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	Grand Total
Coleoptera																		
False water pennies (Psephenidae)													2	1				**3**
Water beetle (Dytiscidae)									1				2		2			**5**
Water beetle (Noteridae)						1						1						**2**
Whirligig beetle (Gyrinidae)					1													**1**
Ephemoptera																		
Mayfly nymph (Baetidae)								3	3	5		2	1	2	3	1		**19**
Mayfly nymph (Ephemerellidae)				1				1	4	3	2	1	3	3	1			**19**
Hemiptera																		
Broad-shouldered Water strider (Veliidae)					1			2					1			4		**8**
Saucer bugs (Naucoridae)					2	3							2					**7**
Water scorpion (Nepidae)		1																**1**
Water strider (Gerridae)					1			1					1		1	4		**8**
Odonata																		
Dragonfly nymph (Aeshnidae)														1				**1**
Dragonfly nymph (Libellulidae)					1							1		1				**3**
Dragonfly nymph (Macromiidae)									1									**1**
Trichoptera																		
Caddisfly nymph (Rhyacophilidae)				2					3	1			2	3	4			**14**
Grand Total	**-**	**1**	**-**	**3**	**6**	**4**	**-**	**7**	**12**	**9**	**2**	**5**	**13**	**10**	**11**	**9**	**-**	**91**

Appendix 39. Photographs of recorded aquatic insects at the sampling stations in low rainfall

Low rainfall

Aphelocheirus sp.

Caddisfly nymph

Caddisfly nymph

Enithares sp.

Damselfly nymph

Dineutus sp.

Dragonfly nymph

Mayfly nymph

Stonefly nymph

Appendix 40. Photographs of recorded aquatic insects at the sampling stations in high rainfall

High rainfall

Coleoptera

False water pennies
(Psephenidae)

Water beetle (Dytiscidae)

Water beetle (Noteridae)

Whirligig beetle (Gyrinidae)

Ephemoptera

Mayfly nymph (Baetidae)

Mayfly nymph
(Ephemerellidae)

Hemiptera


Broad-shouldered Water strider (Veliidae)


Creeping water bugs (Naucoridae)


Saucer bugs (Naucoridae)


Water scorpion (Nepidae)


Water strider (Gerridae)

Odonata


Dragonfly nymph (Aeshnidae)


Dragonfly nymph (Libellulidae)


Dragonfly nymph (Macromiidae)

Trichoptera


Caddisfly nymph (Rhyacophilidae)

Appendix 41. Photographs of ambient air quality and noise sampling stations along the CMH alignment

Top row, left to right: AQ1 (Zone 2B, Casinglot, Tagoloan), AQ2 (Purok 7, Mambatangan, Manolo Fortich), AQ3 (Zone 4, Alae, Manolo Fortich); *Bottom row, left to right*: AQ4 (Zone 1, Dicklum, Manolo Fortich), AQ5 (Purok 4, San Roque, Sumilao), AQ6 (Poblacion, Impasug-ong)

Top row, left to right: AQ7 (Purok 7, La Fortuna, Impasug-ong), AQ8 (Zone 3, Impalutao, Impasug-ong); *Bottom row, left to right*: AQ9 (Zone 9, Patpat, Malaybalay), AQ10 (Casanova St., Kalasungay, Malaybalay)

Appendix 42. Photographs of the traffics survey stations

Traffic Station 1

Traffic Station 2

Traffic Station 3

Traffic Station 4

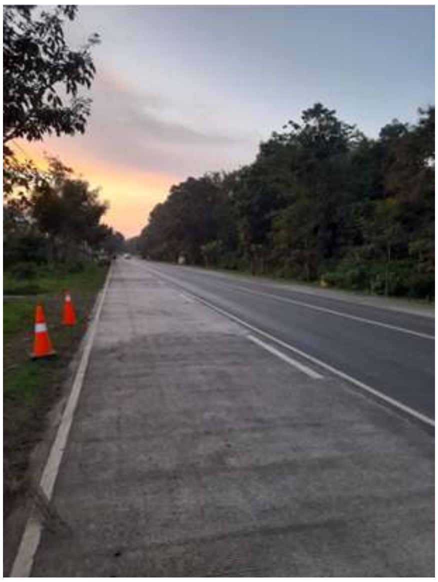
Traffic Station 5

Traffic Station 6


Traffic Station 7


Traffic Station 8


Traffic Station 9

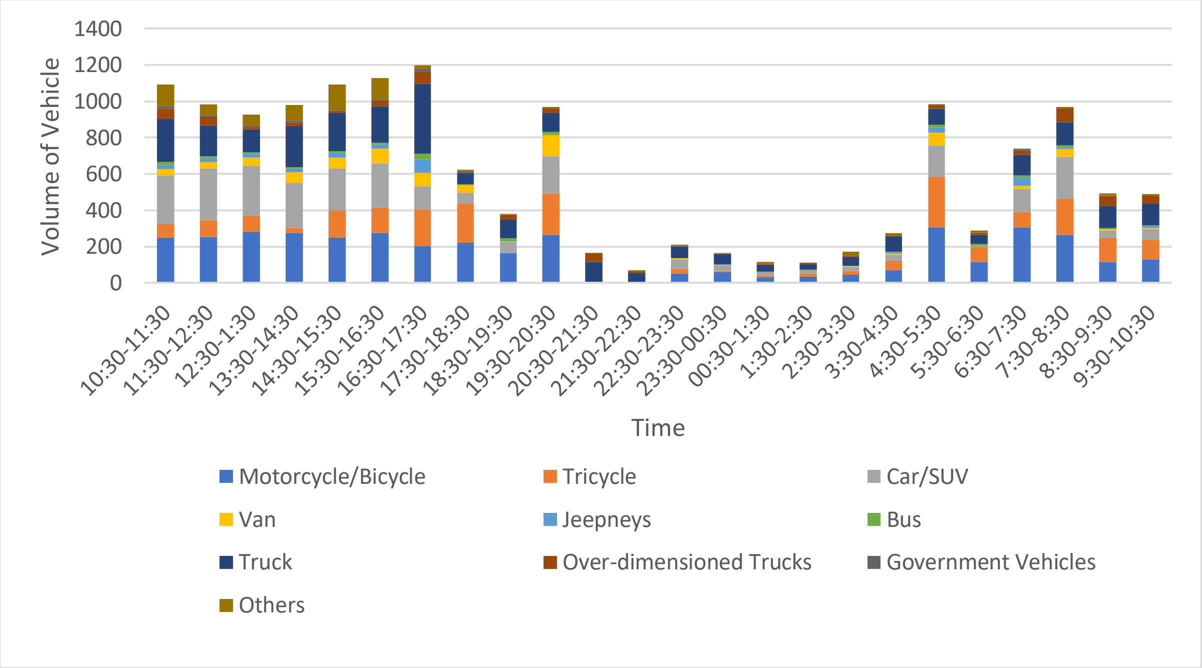


Traffic Station 10

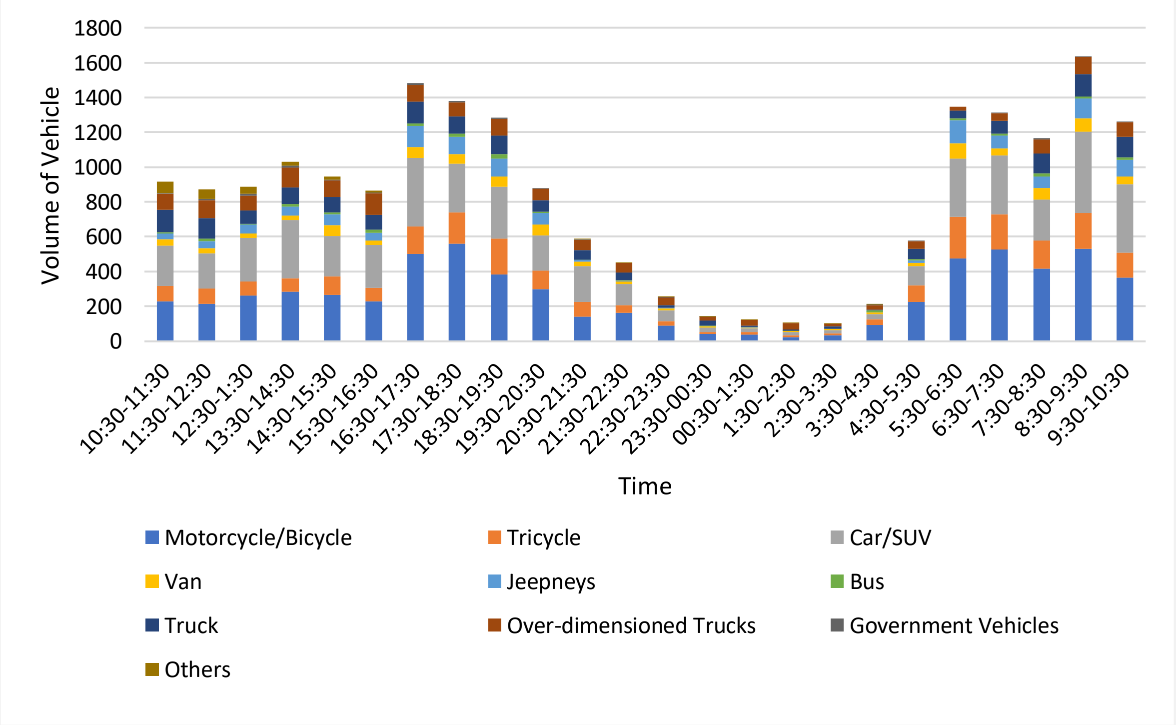
Appendix 43. Baseline traffic and estimation of future traffic section

Baseline Traffic Current Volumes

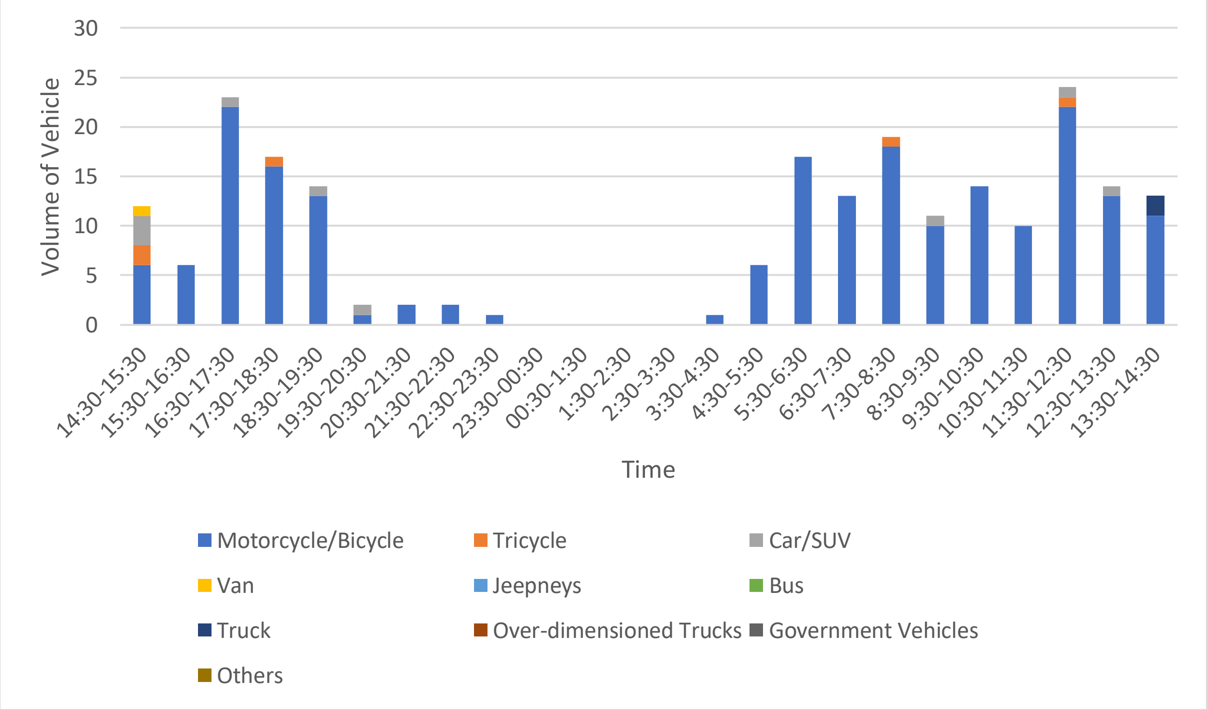
Traffic Count at Station 1 (West bound)



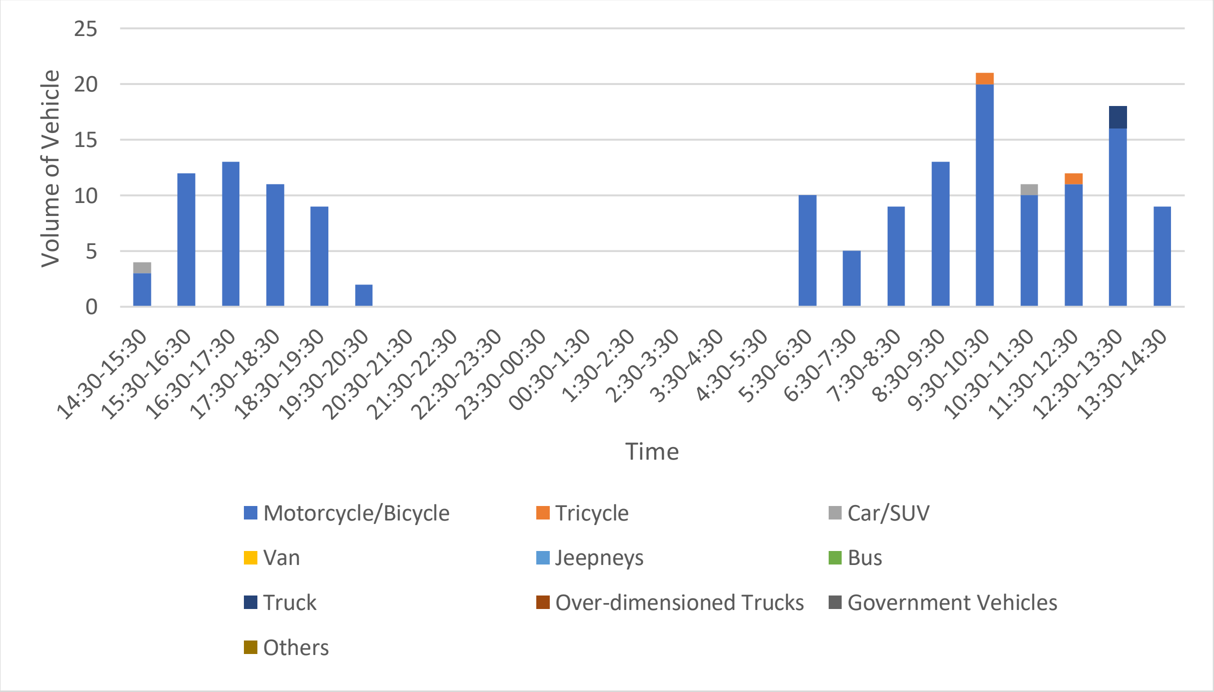
Traffic Count at Station 1 (East bound)



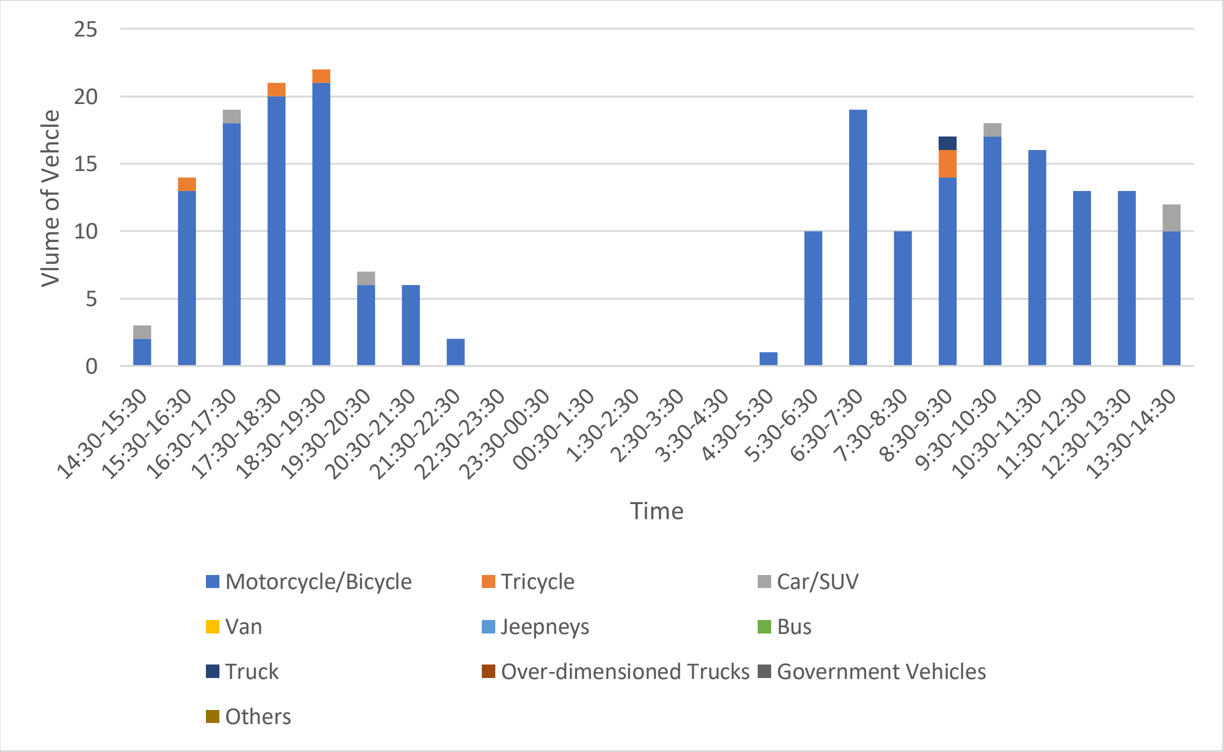
Traffic Count at Station 2 (North bound)



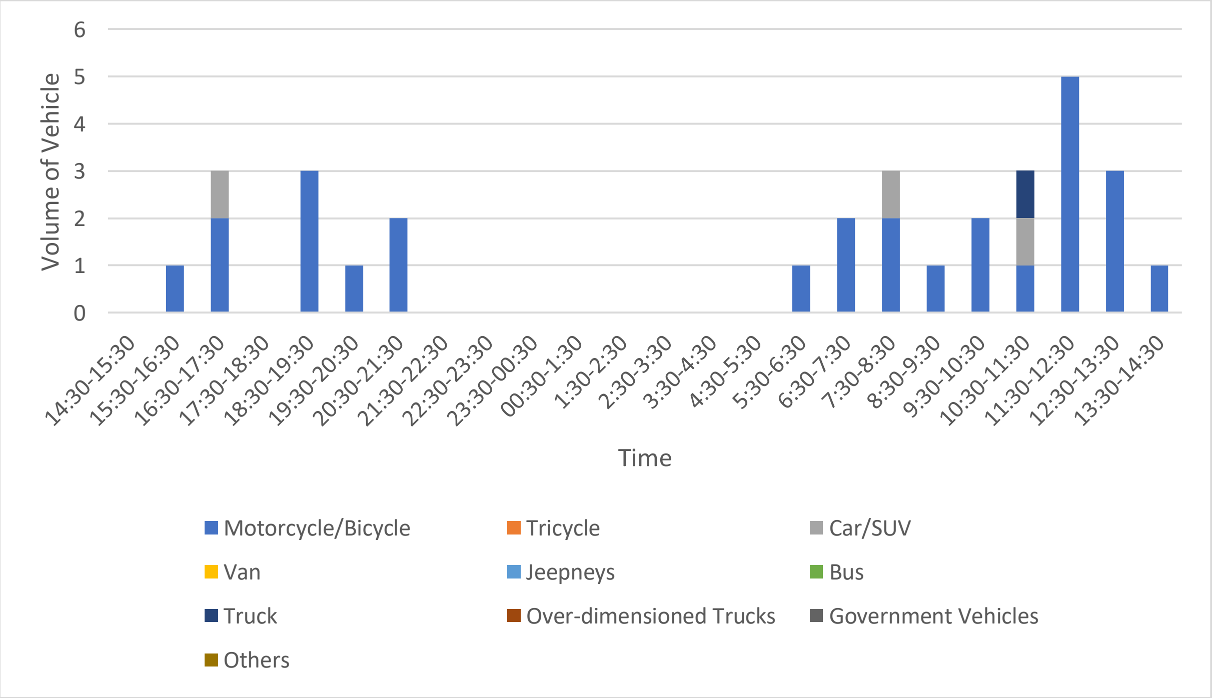
Traffic Count at Station 2 (South bound)



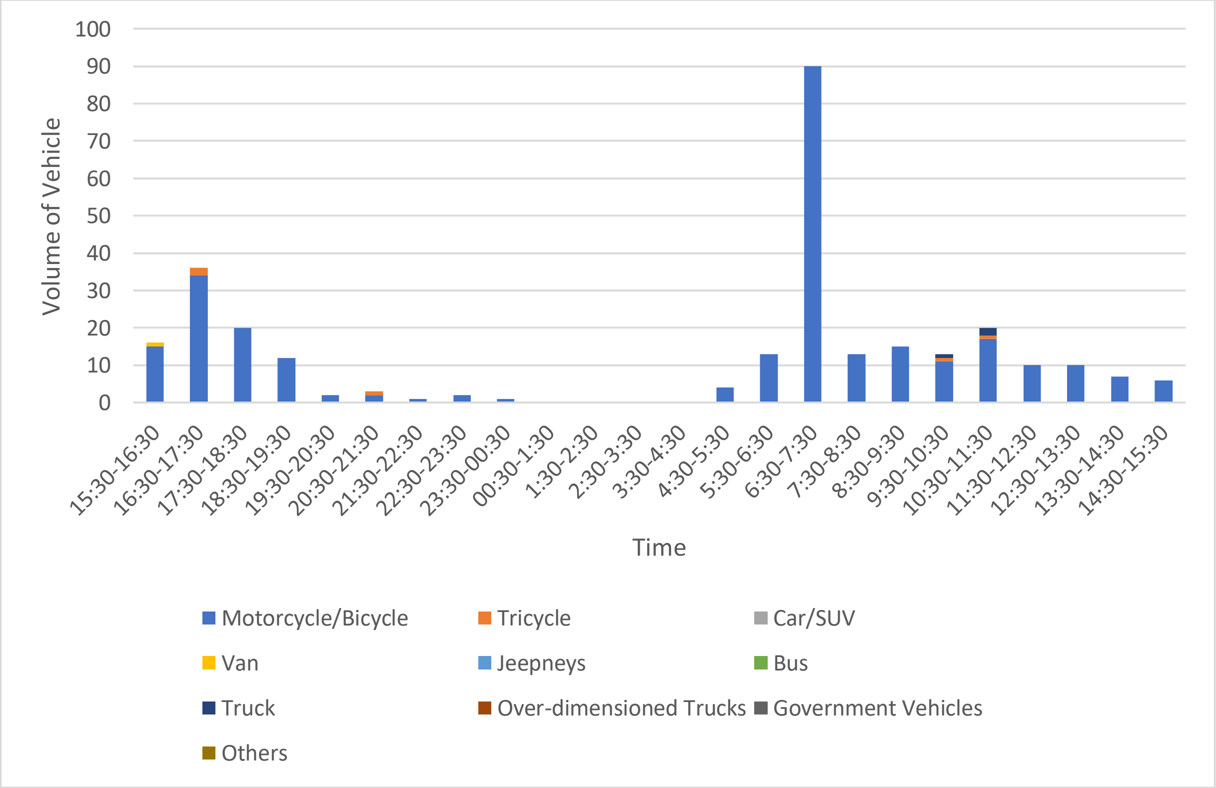
Traffic Count at Station 2 (East bound)



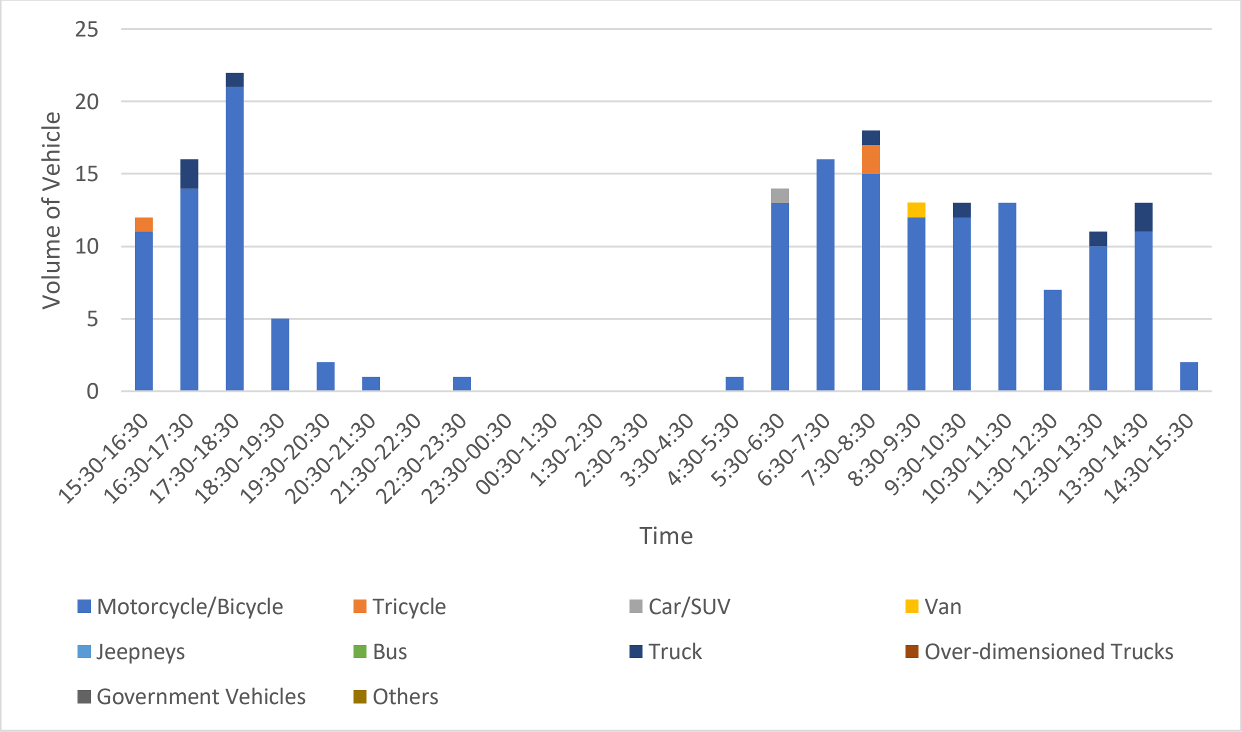
Traffic Count at Station 2 (West bound)



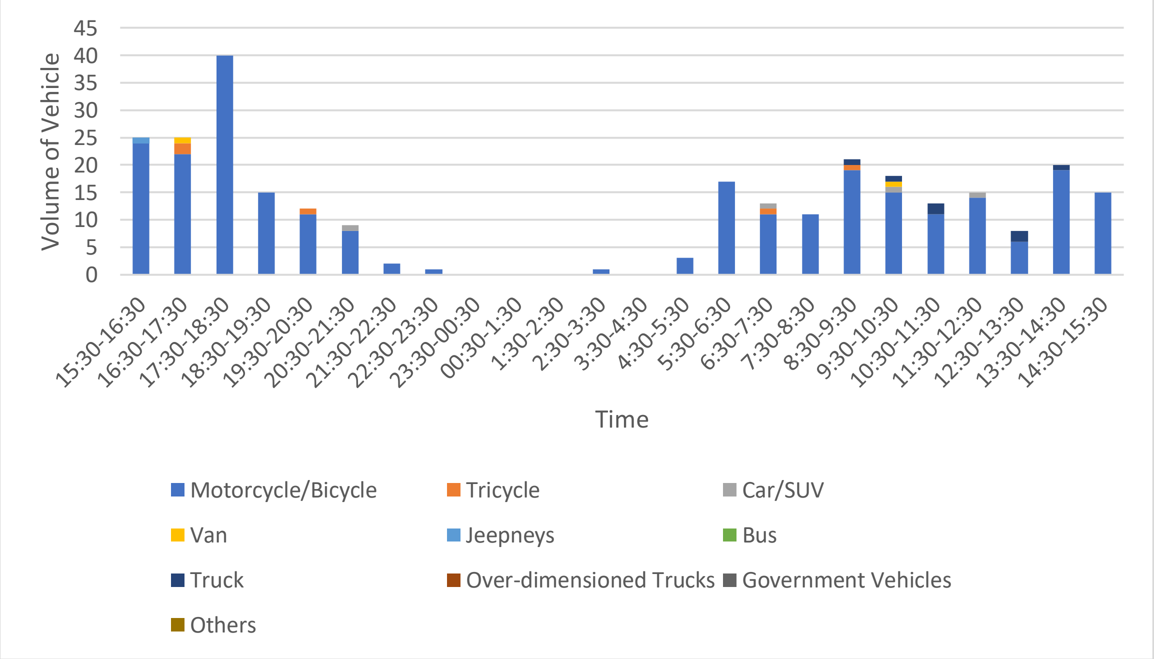
Traffic Count at Station 3 (North bound)



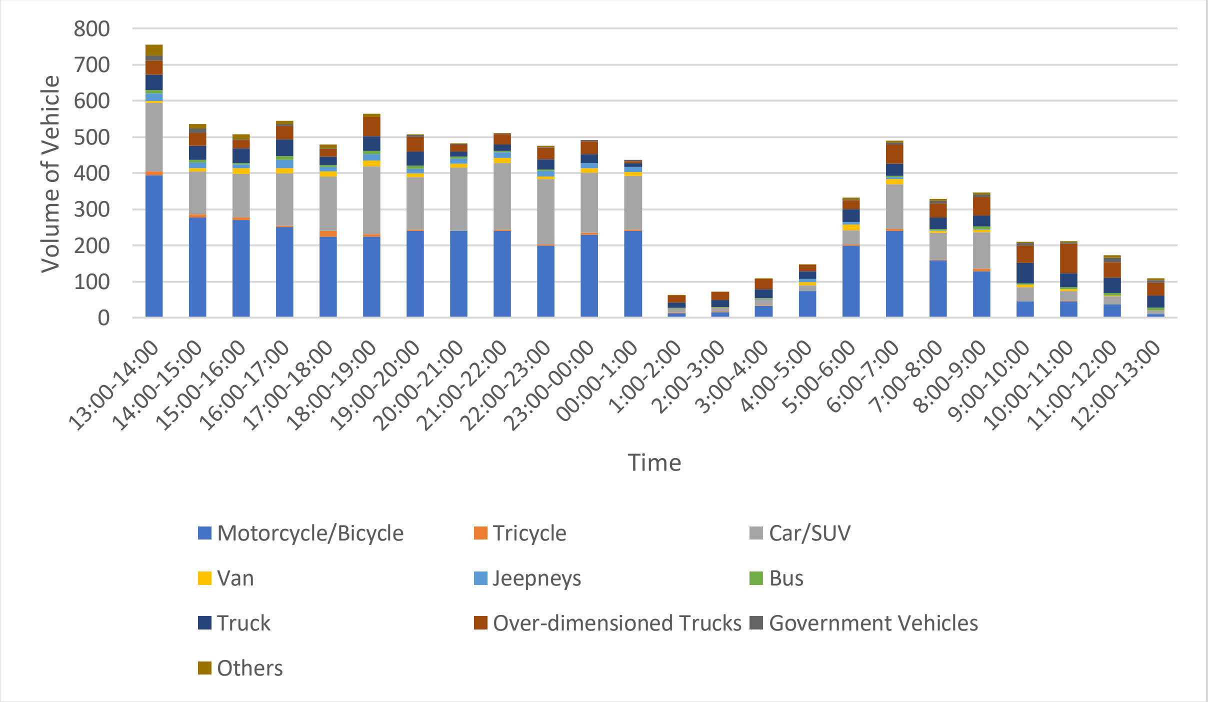
Traffic Count at Station 3 (South bound)



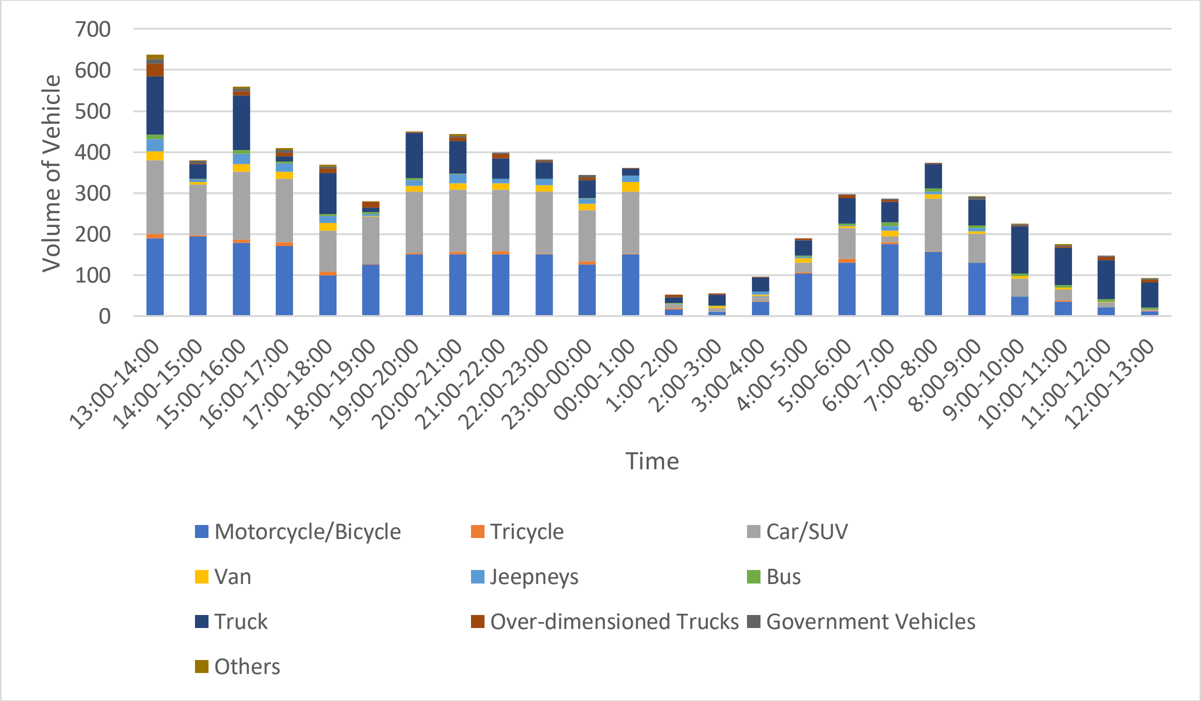
Traffic Count at Station 3 (West bound)



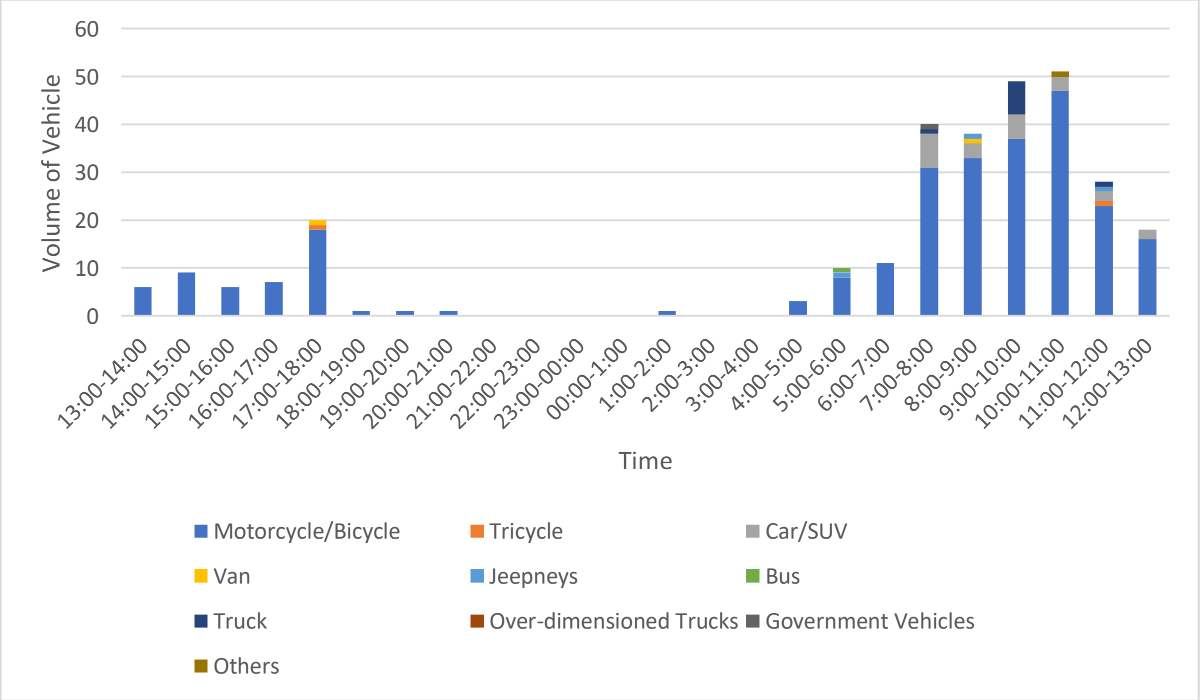
Traffic Count at Station 4 (North bound)



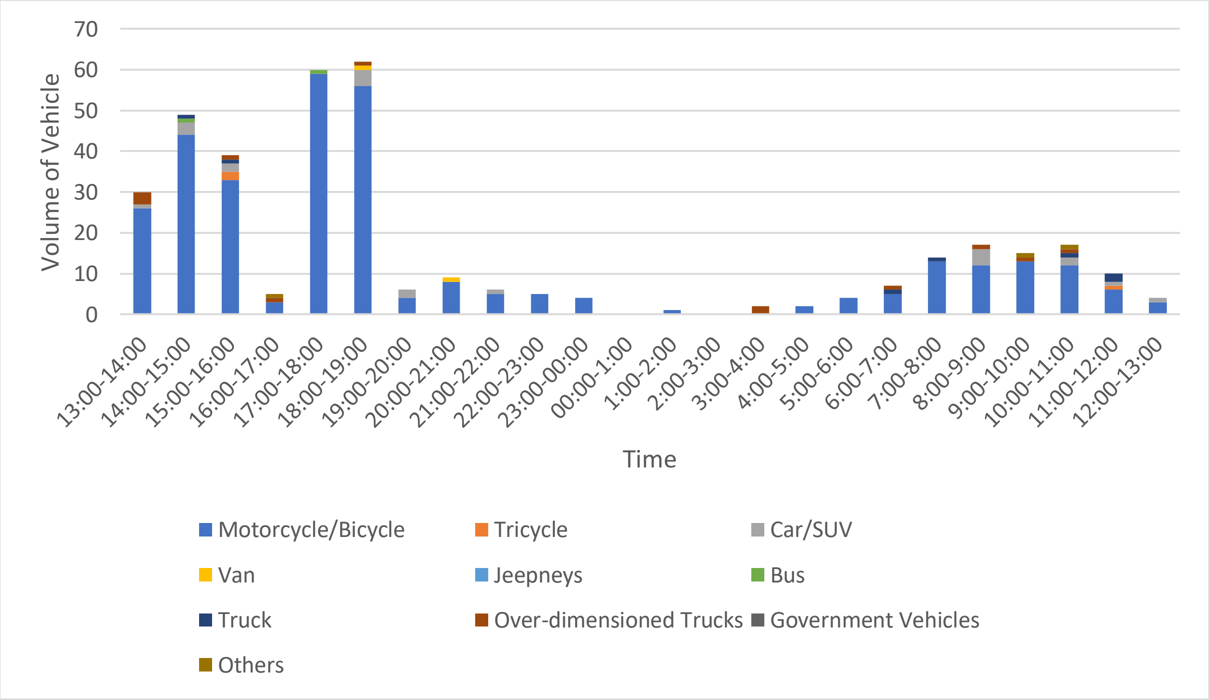
Traffic Count at Station 4 (South bound)



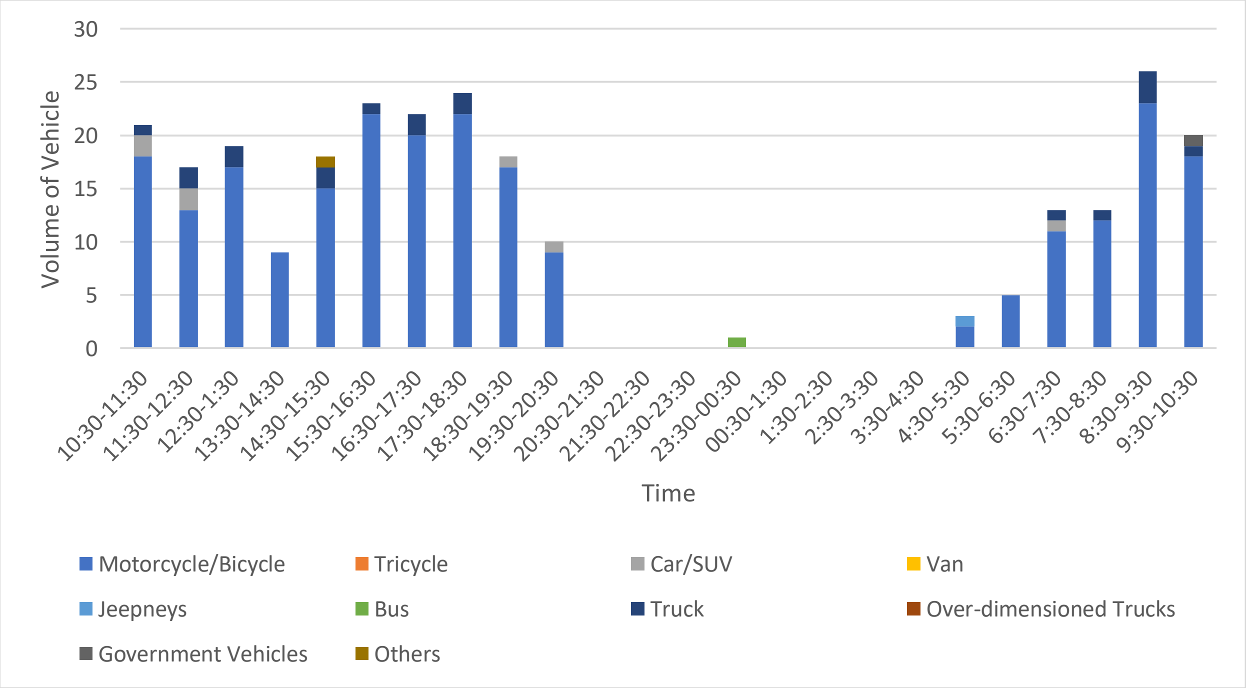
Traffic Count at Station 4 (West bound)



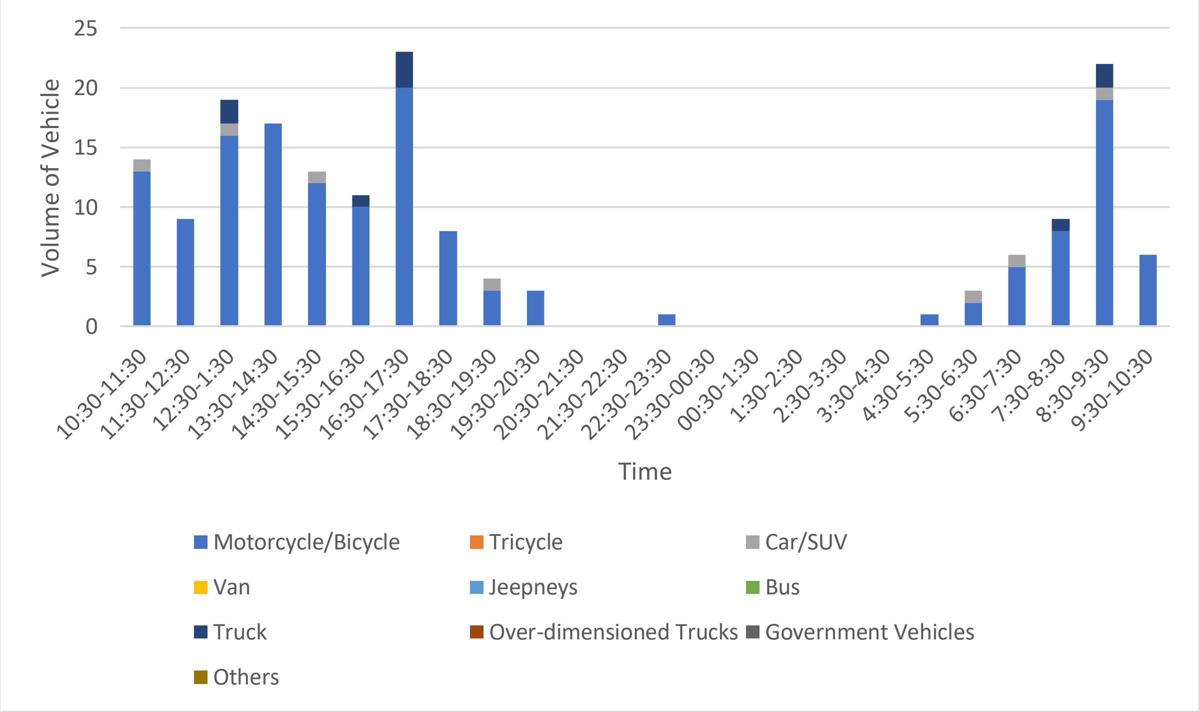
Traffic Count at Station 4 (East bound)



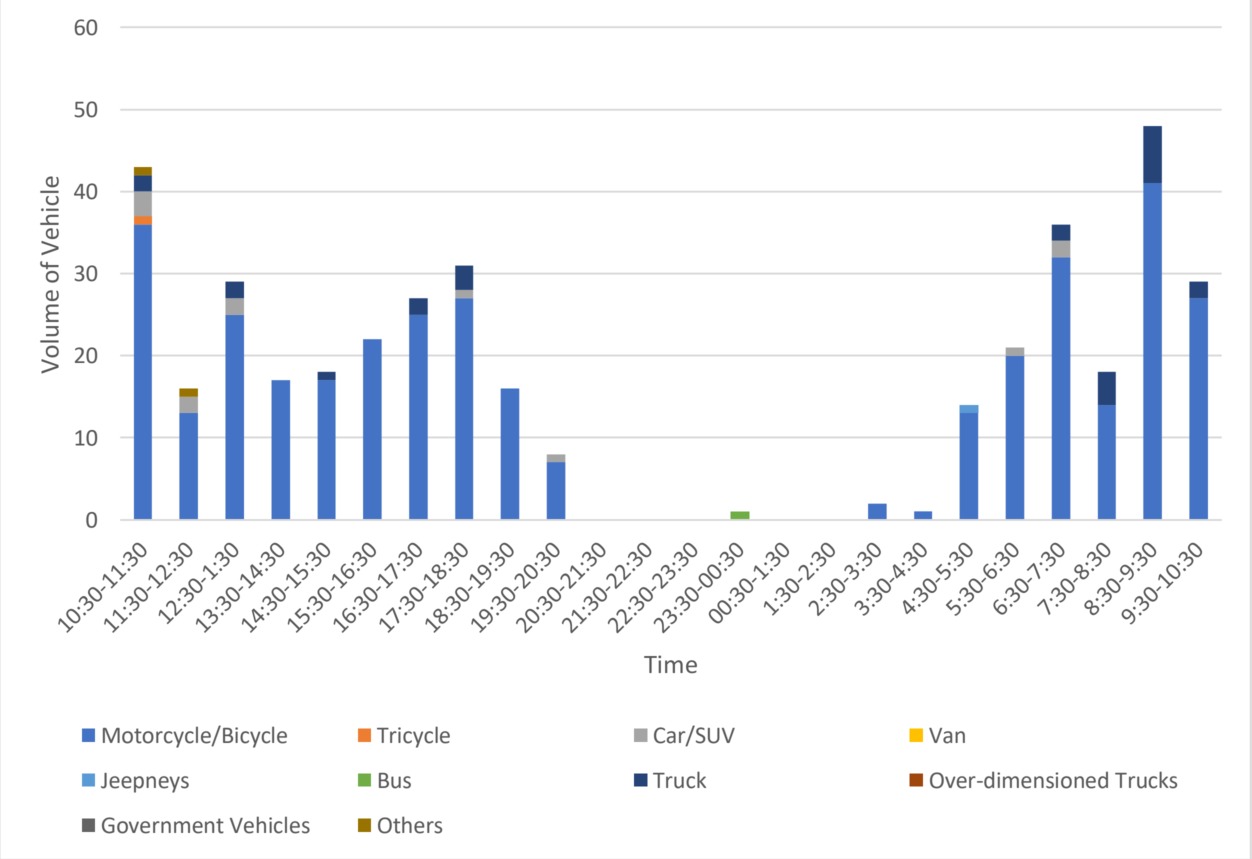
Traffic Count at Station 5 (North bound)



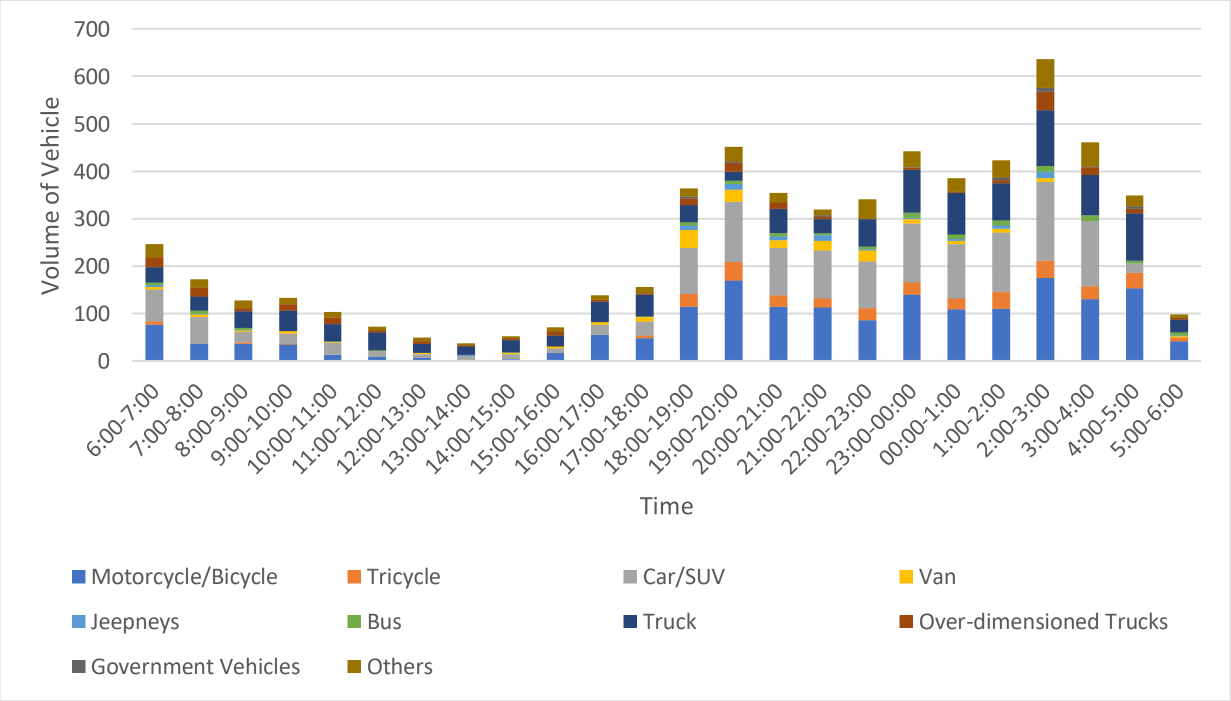
Traffic Count at Station 5 (East bound)



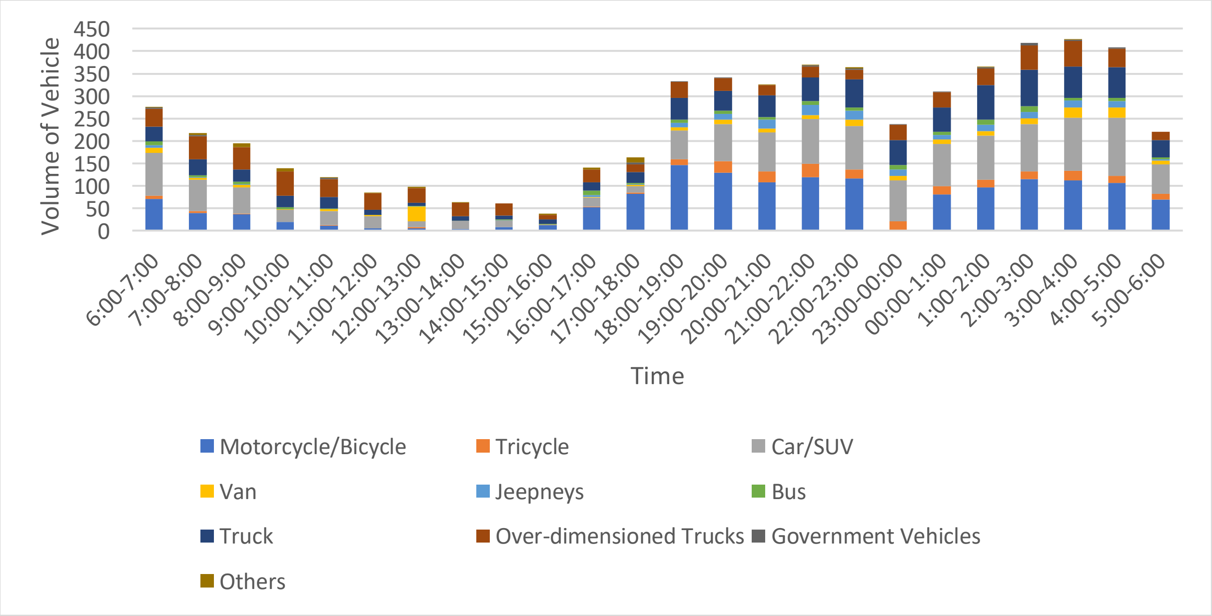
Traffic Count at Station 5 (West bound)



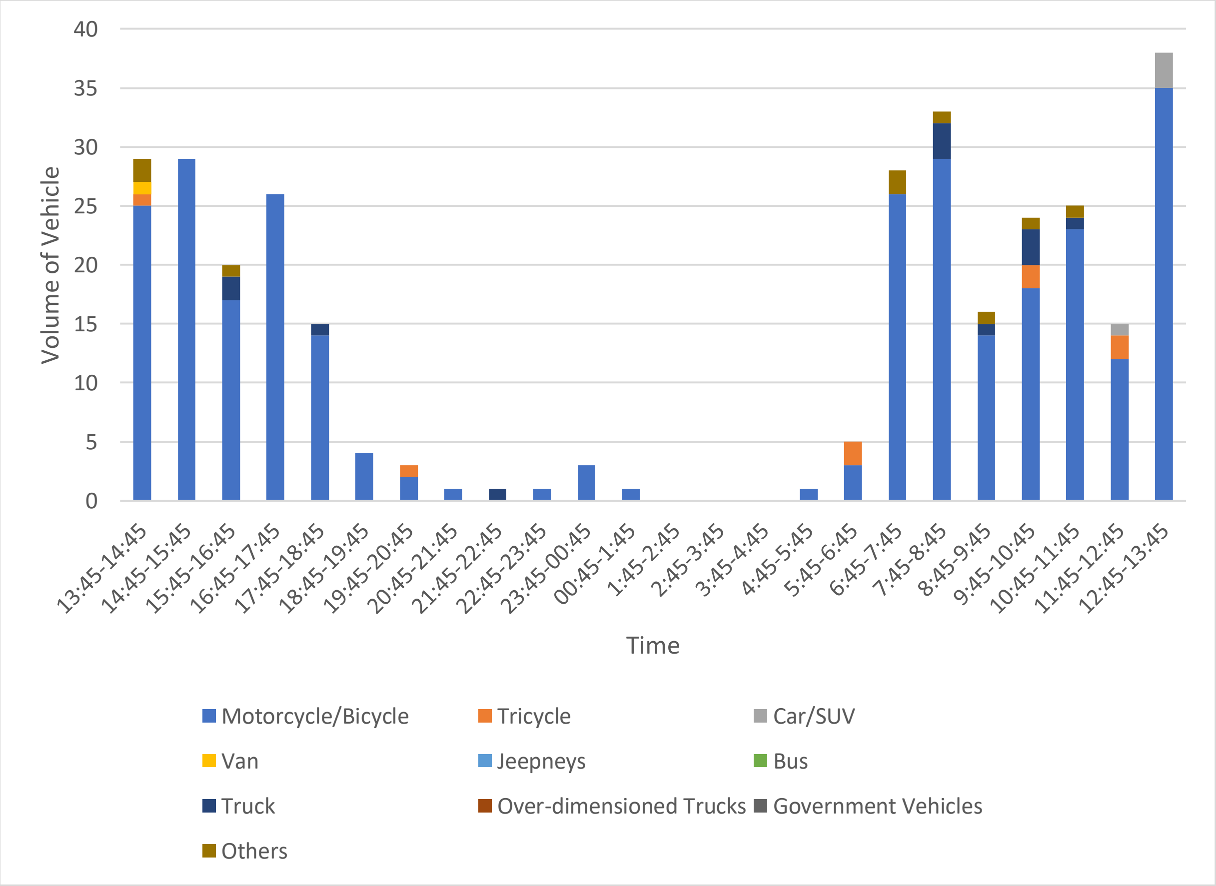
Traffic Count at Station 6 (North bound)



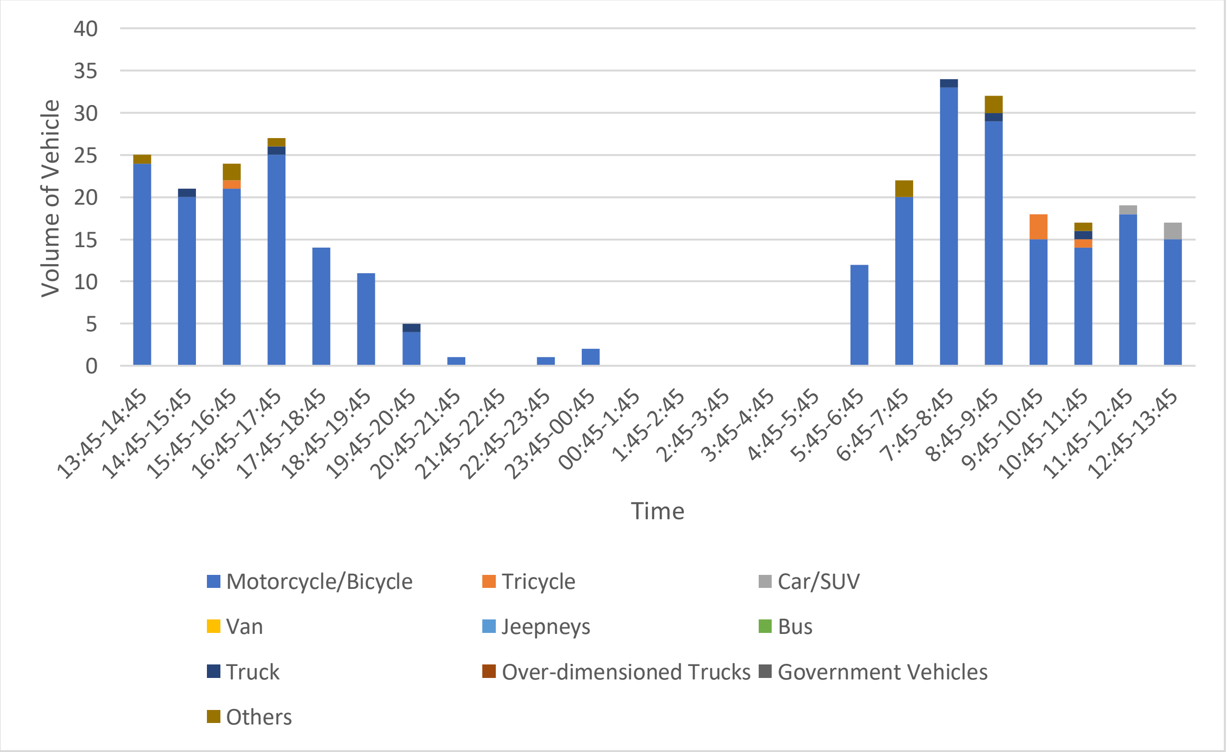
Traffic Count at Station 6 (South bound)



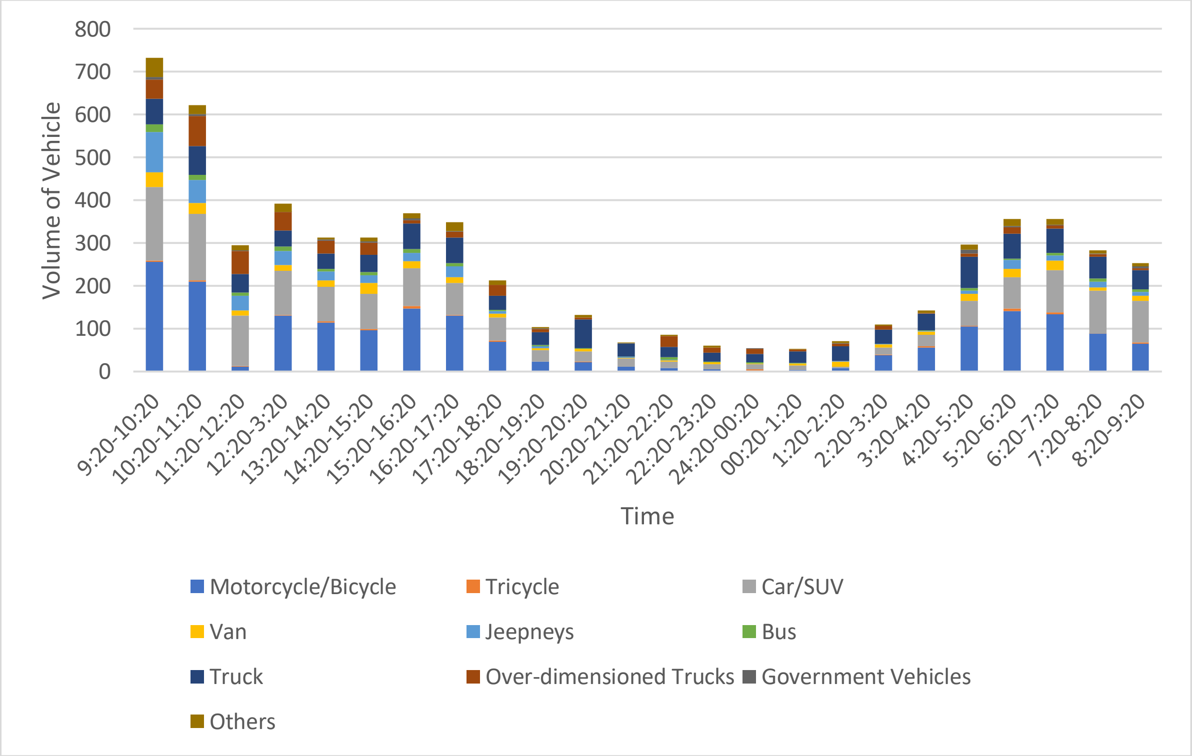
Traffic Count at Station 7 (North bound)



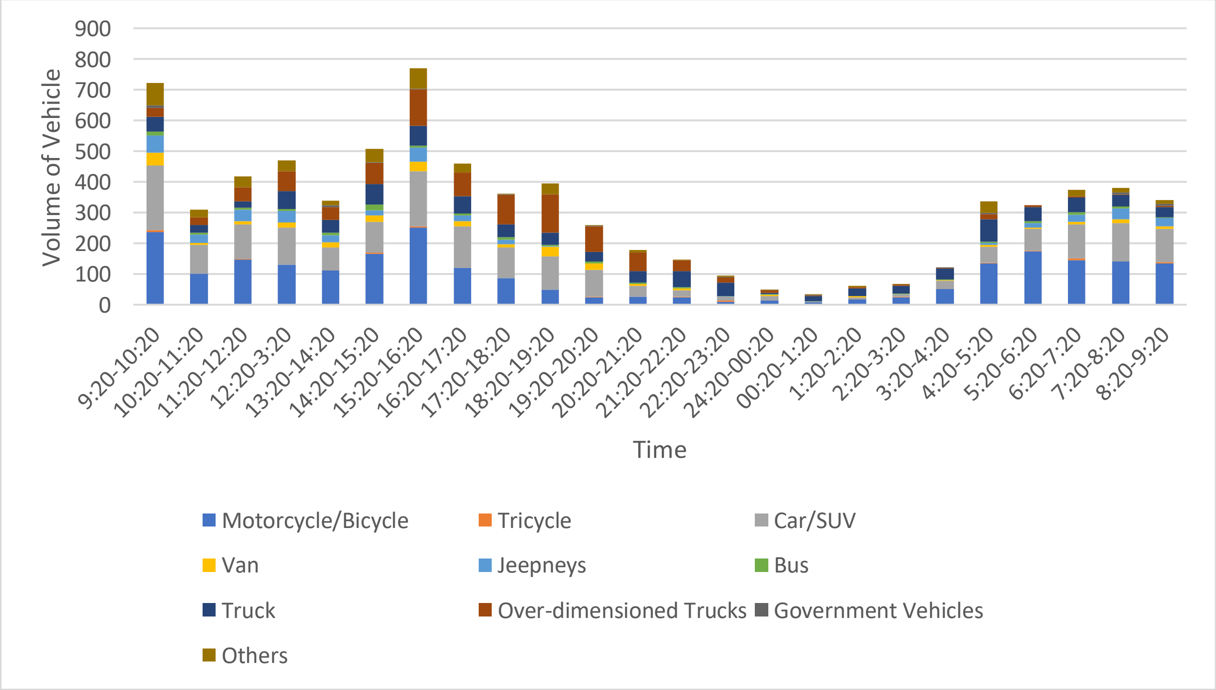
Traffic Count at Station 7 (South bound)



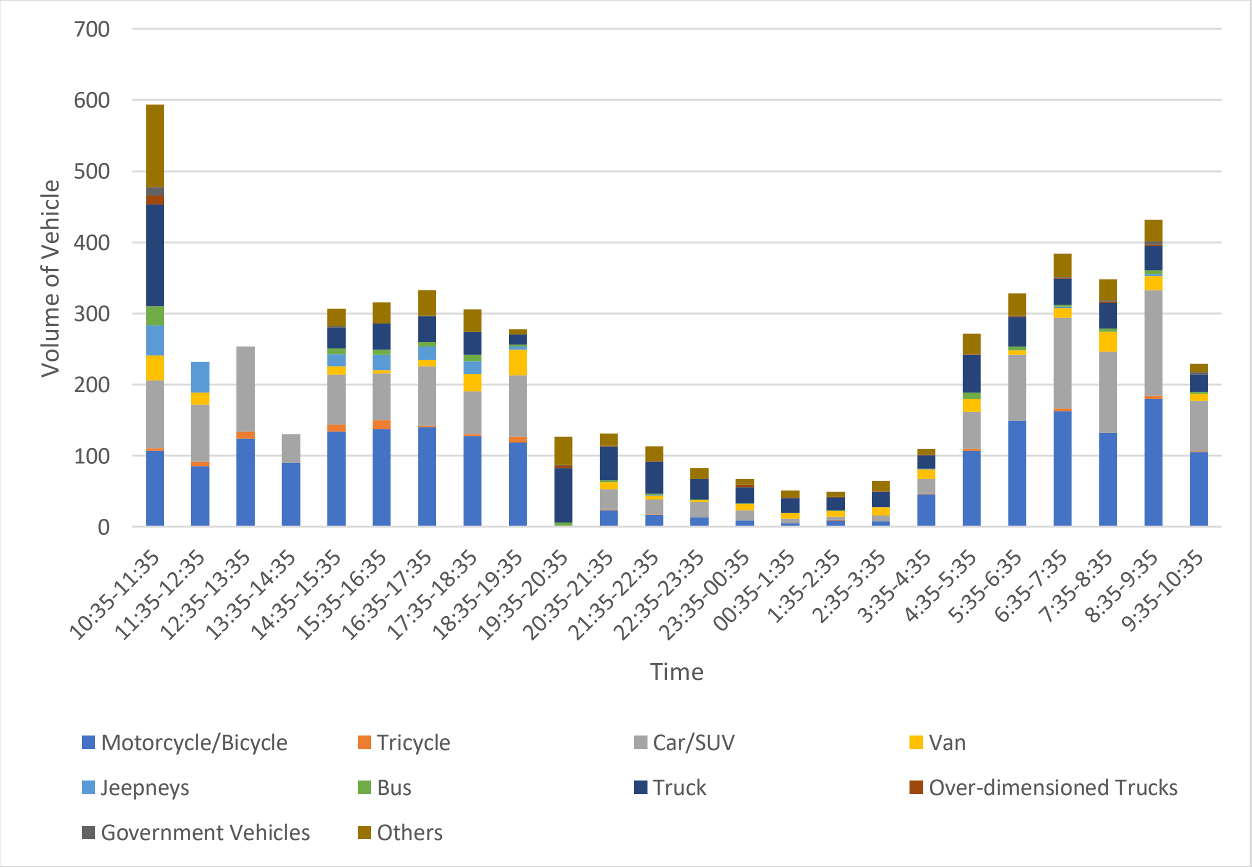
Traffic Count at Station 8 (North bound)



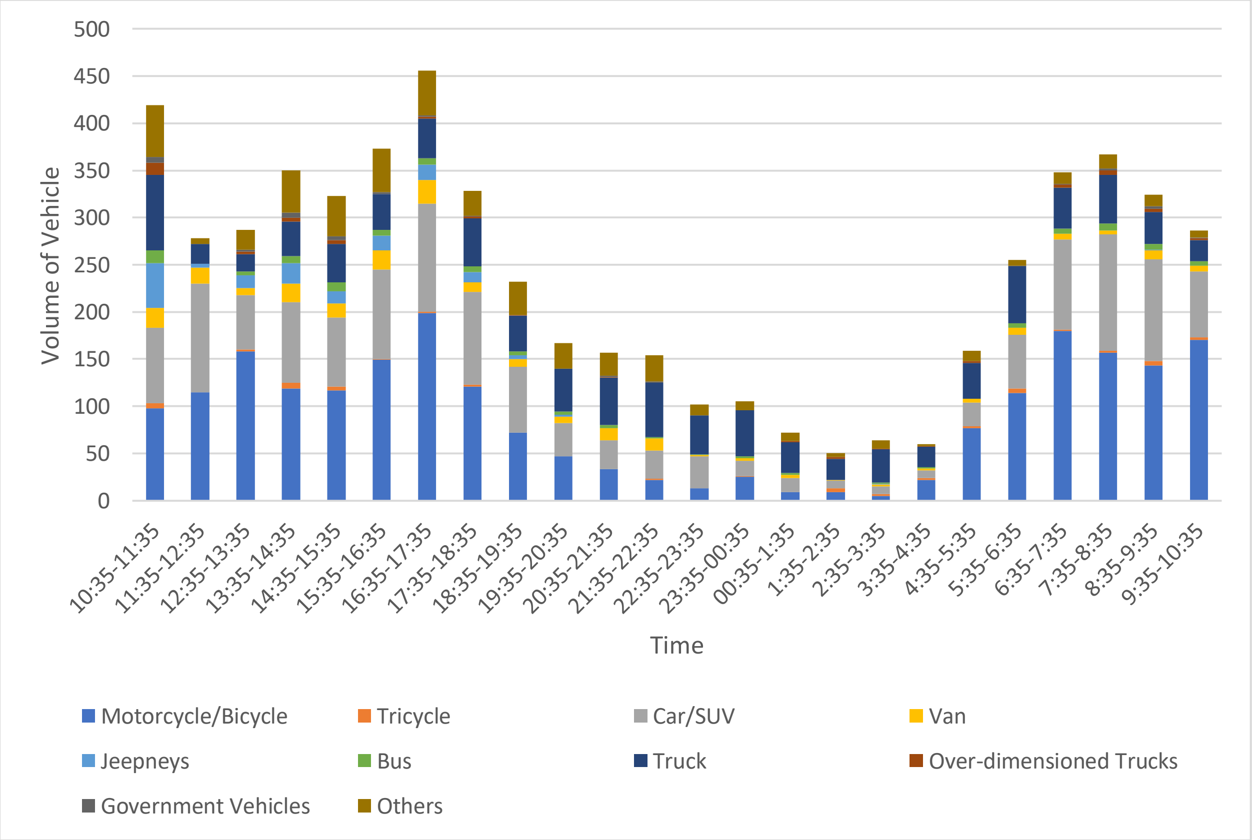
Traffic Count at Station 8 (South bound)



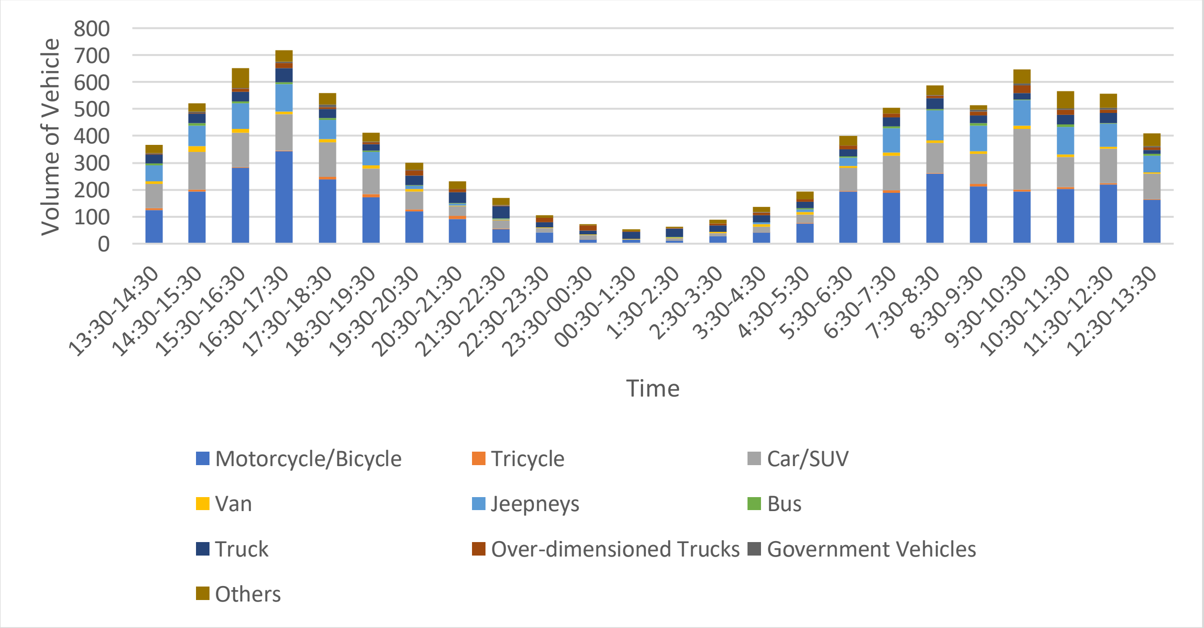
Traffic Count at Station 9 (North bound)



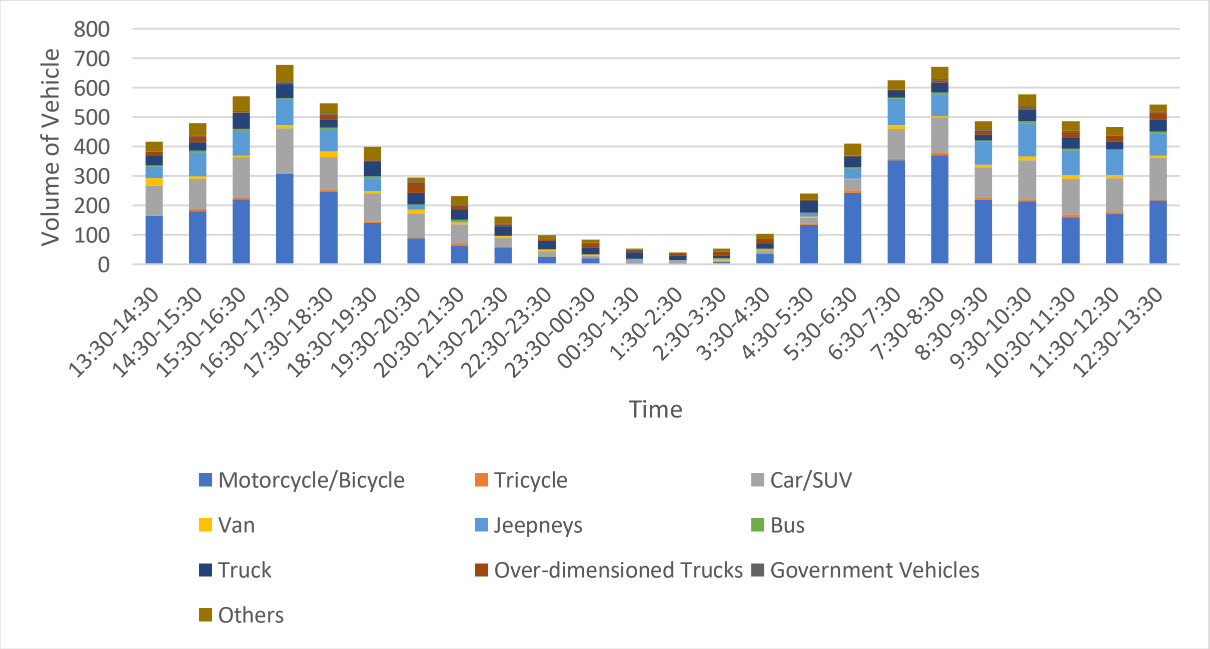
Traffic Count at Station 9 (South bound)



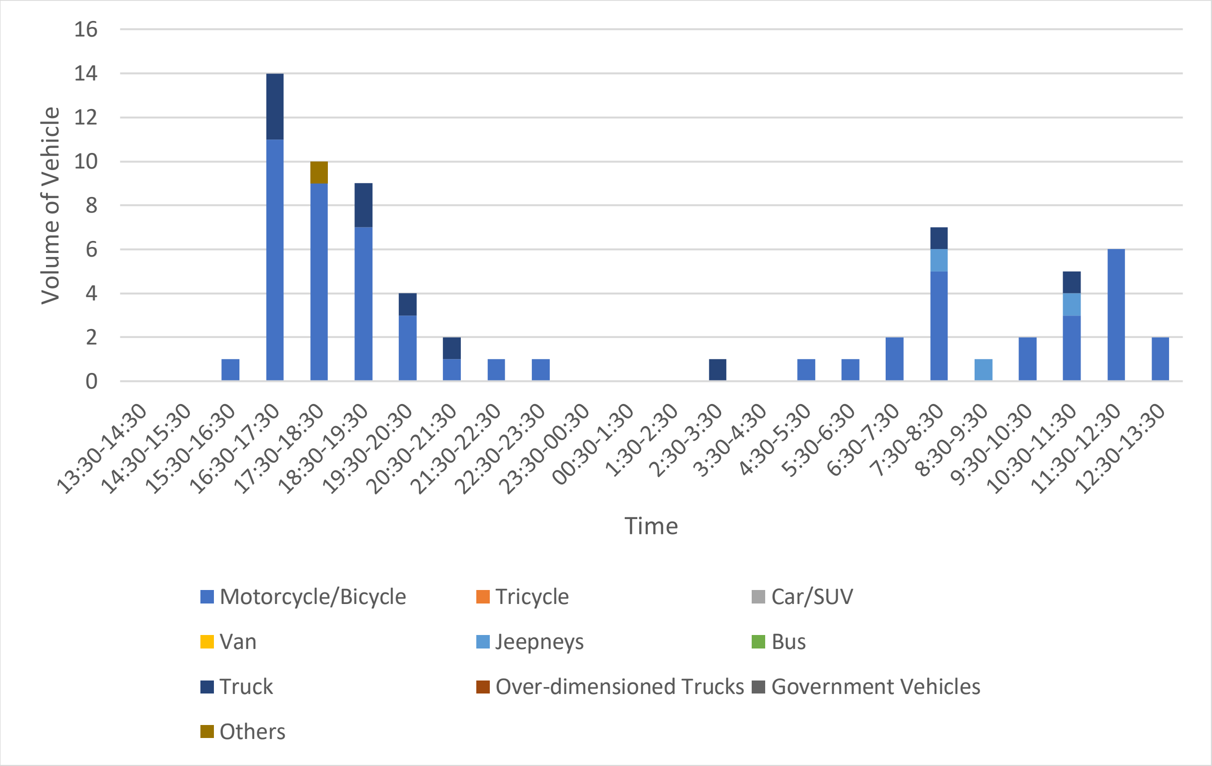
Traffic Count at Station 10 (North bound)



Traffic Count at Station 10 (South bound)

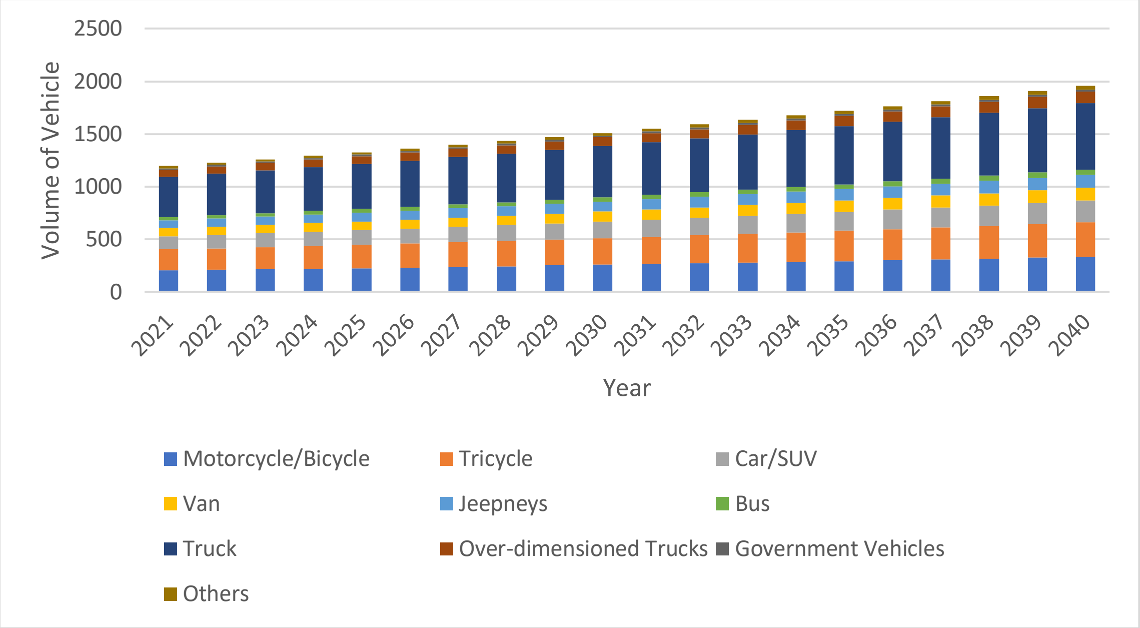


Traffic Count at Station 10 (West bound)

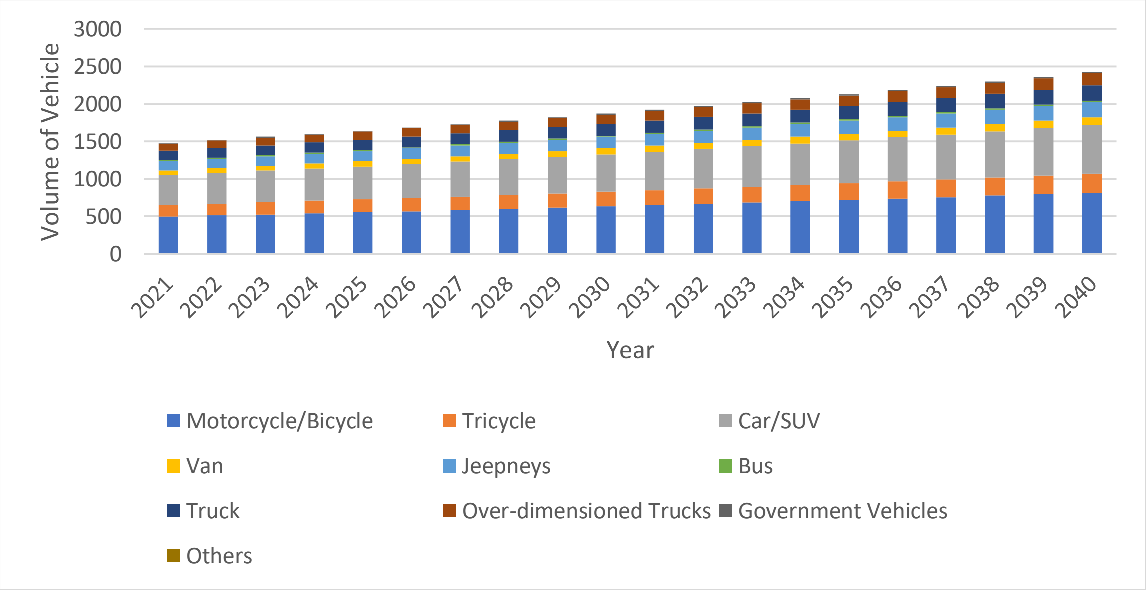


Future Traffic without Development (Existing Sayre)

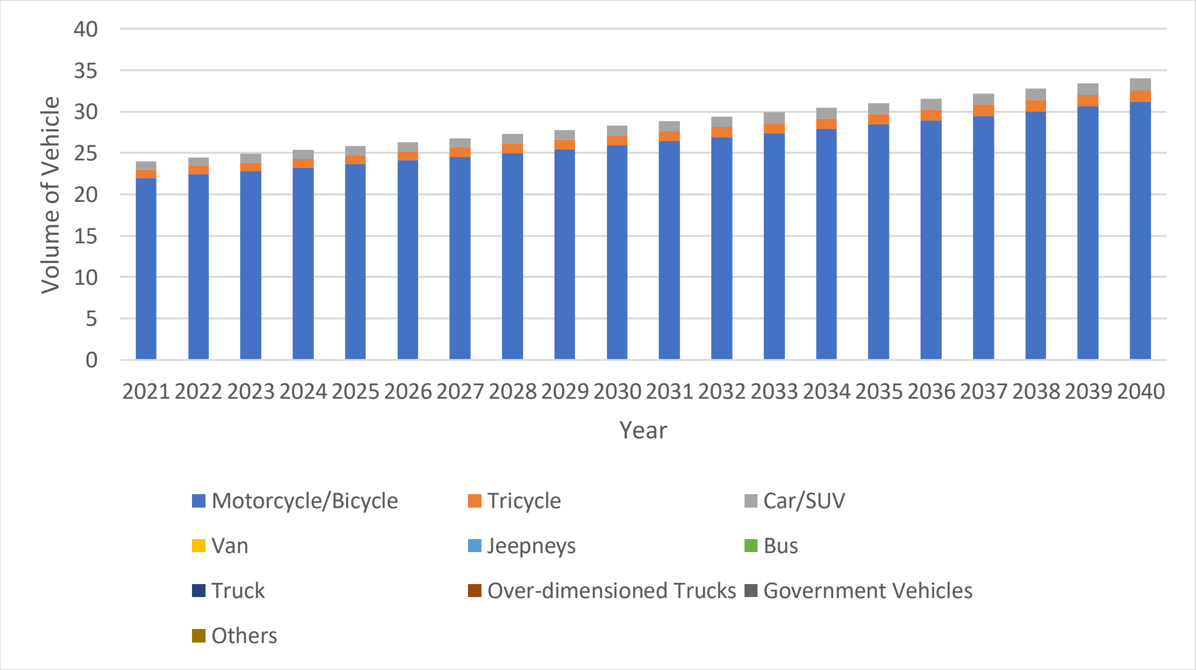
Peak hour traffic volume projection in west bound of Station 1 (without the Project)



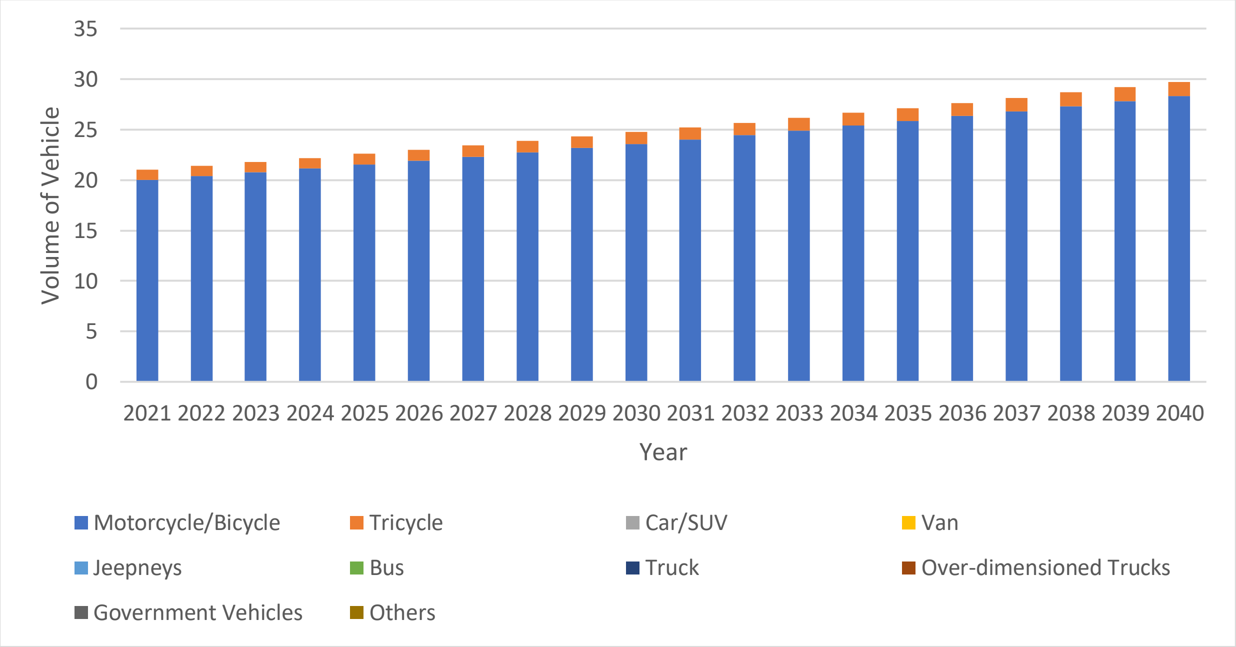
Peak hour traffic volume projection in west bound of Station 1 (without the Project)



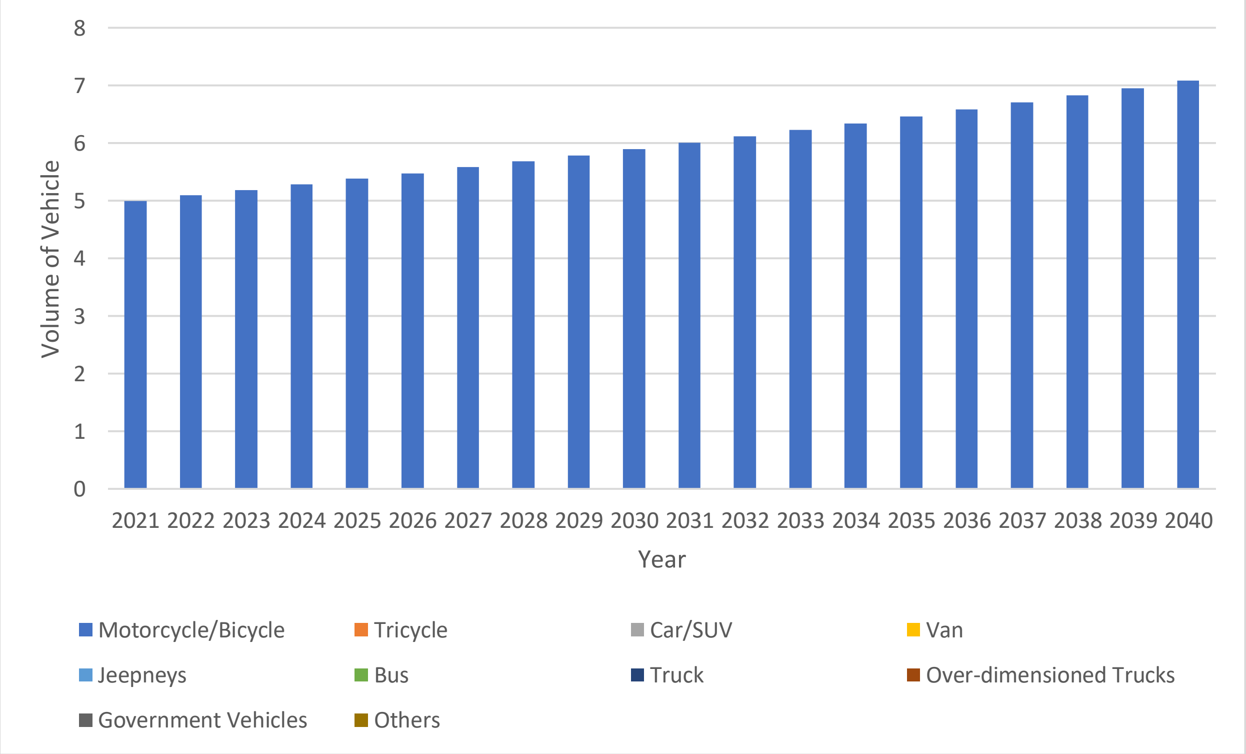
Peak hour traffic volume projection in north bound of Station 2 (without the Project)



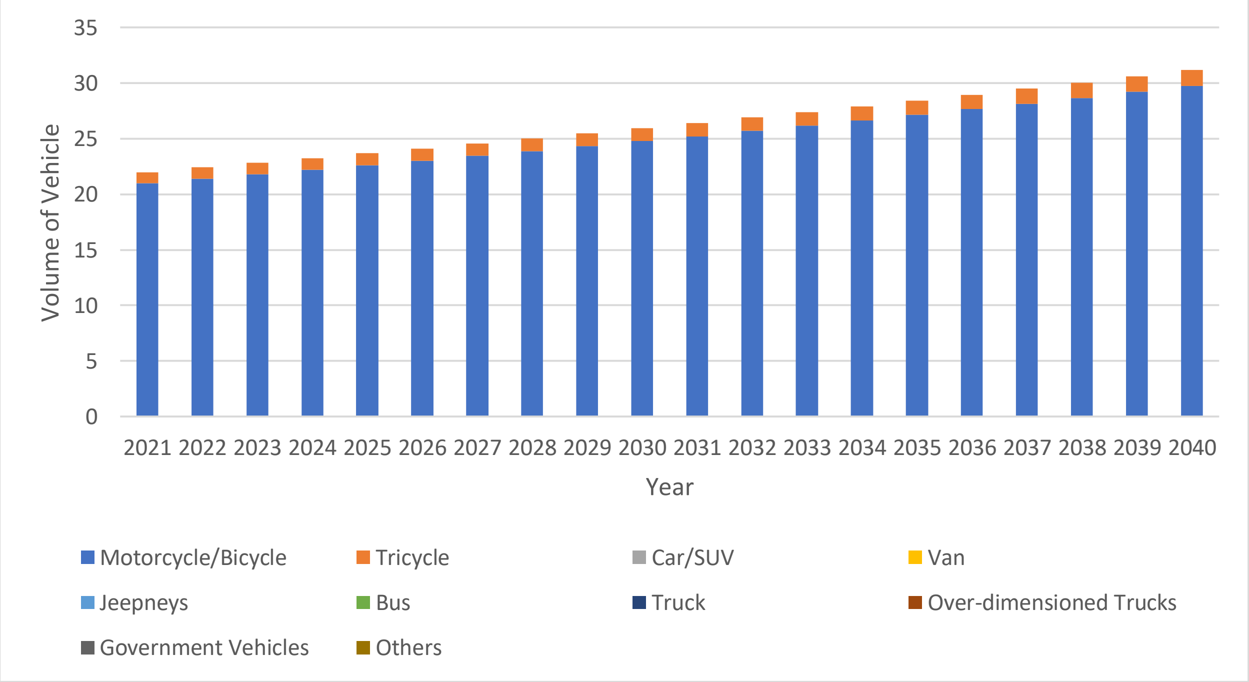
Peak hour traffic volume projection in south bound of Station 2 (without the Project)



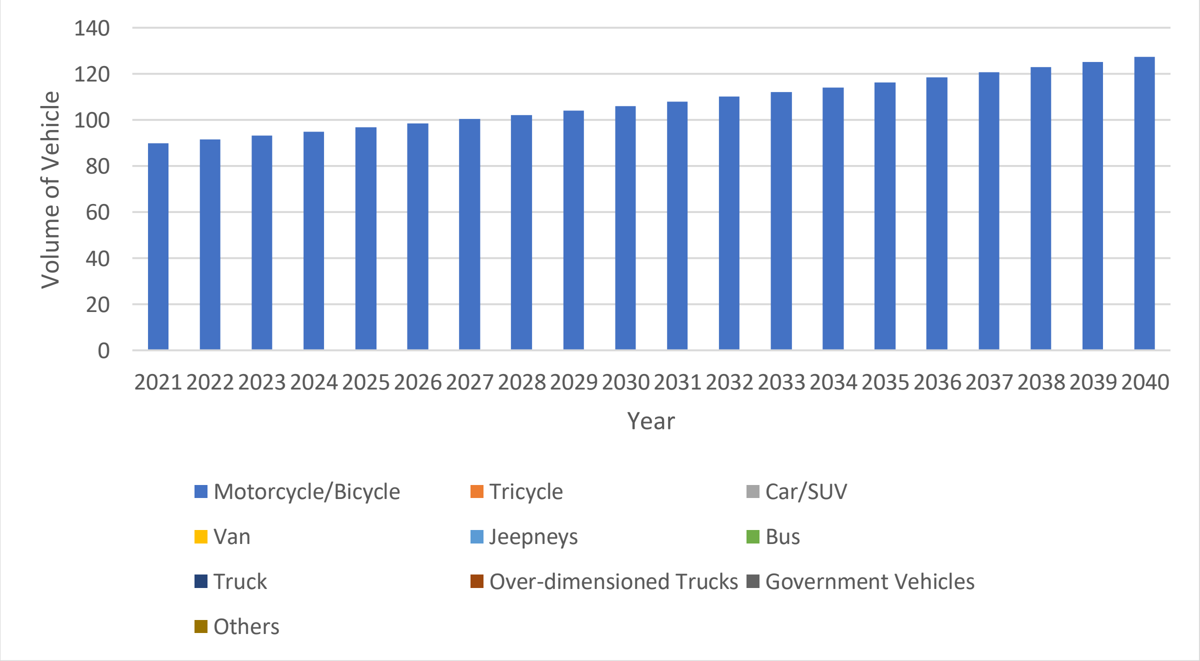
Peak hour traffic volume projection in west bound of Station 2 (without the Project)



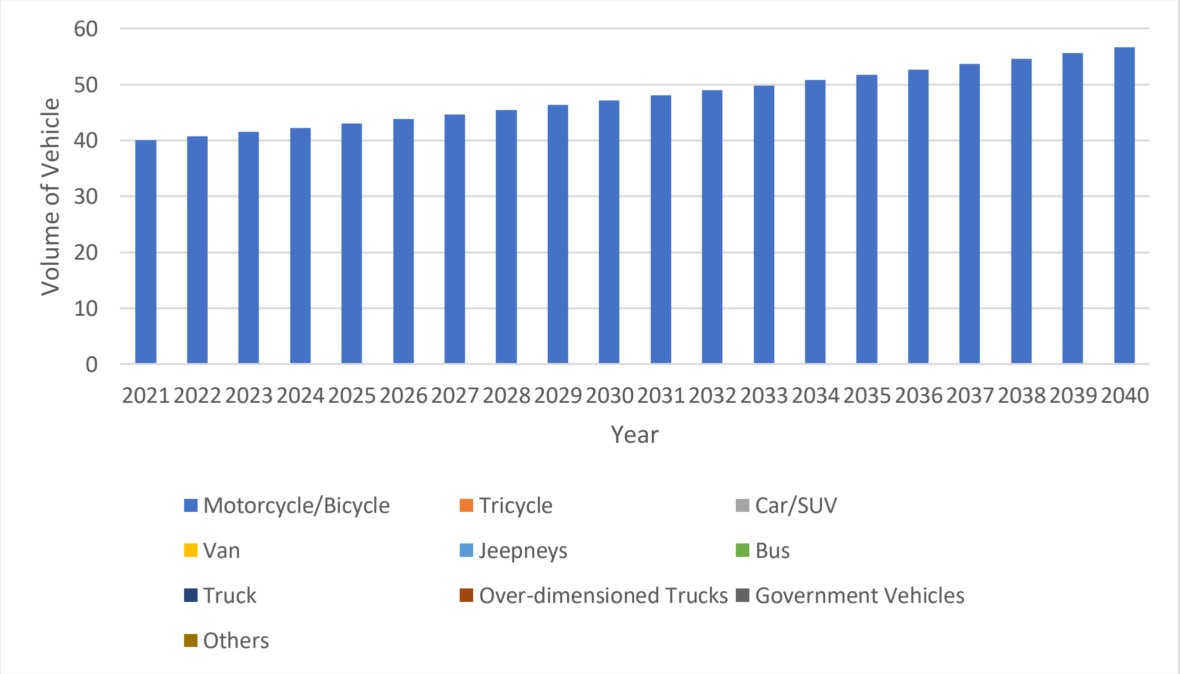
Peak hour traffic volume projection in east bound of Station 2 (without the Project)



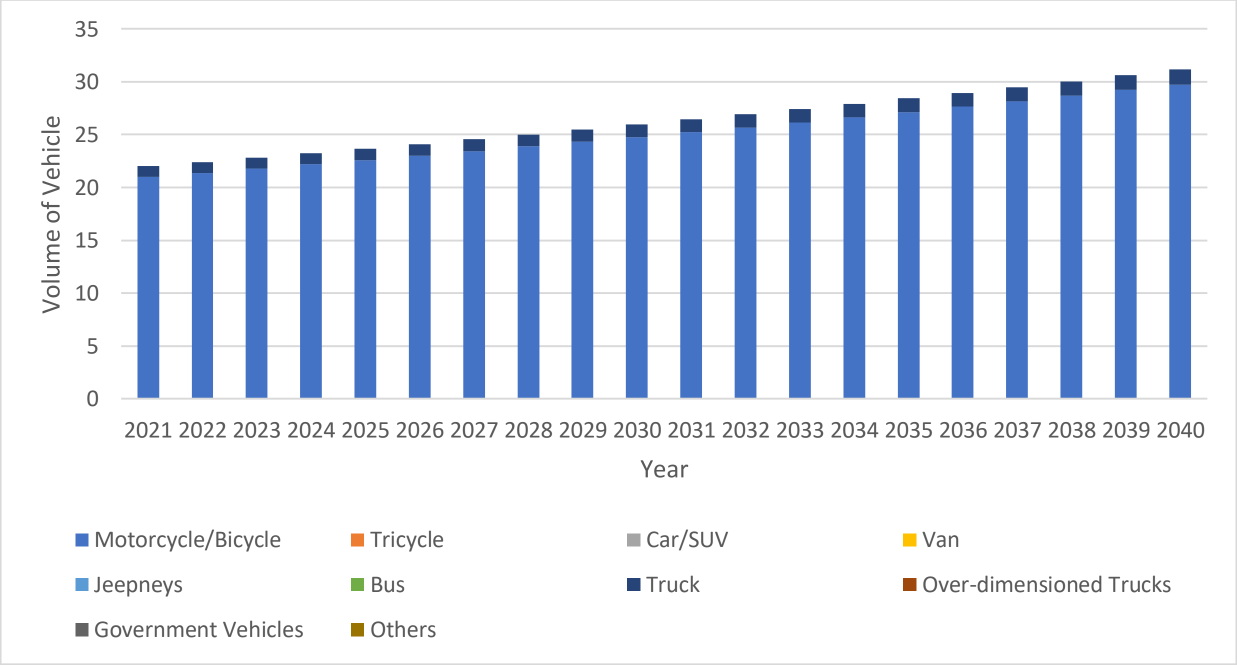
Peak hour traffic volume projection in north bound of Station 3 (without the Project)



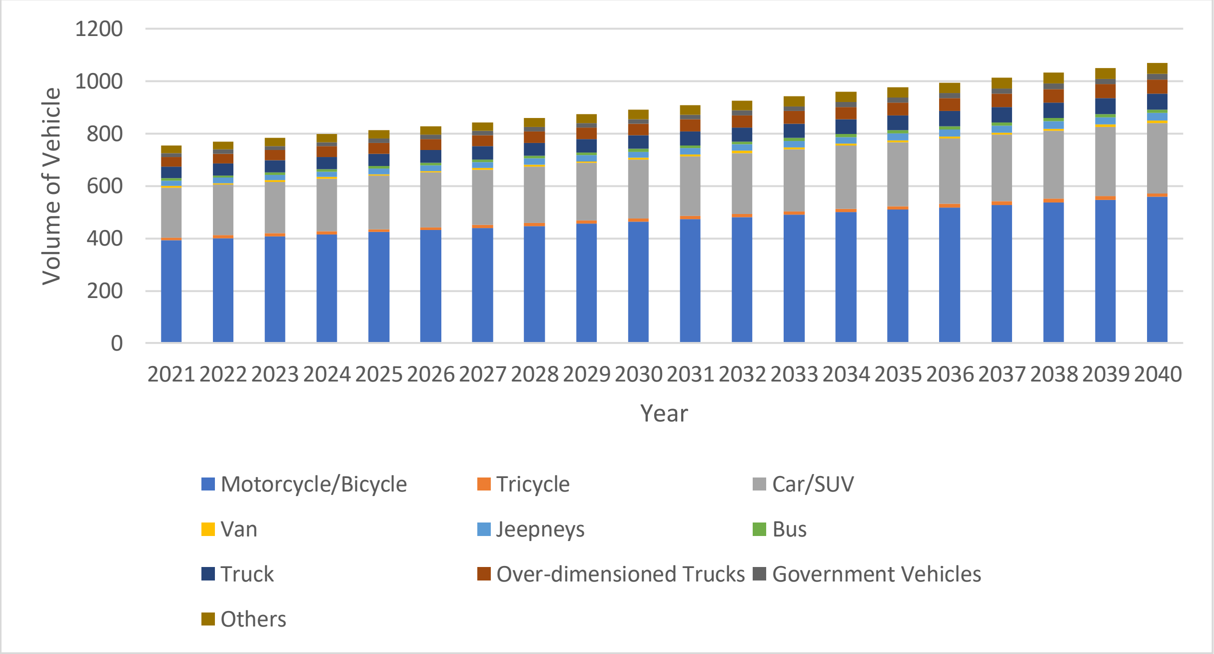
Peak hour traffic volume projection in west bound of Station 3 (without the Project)



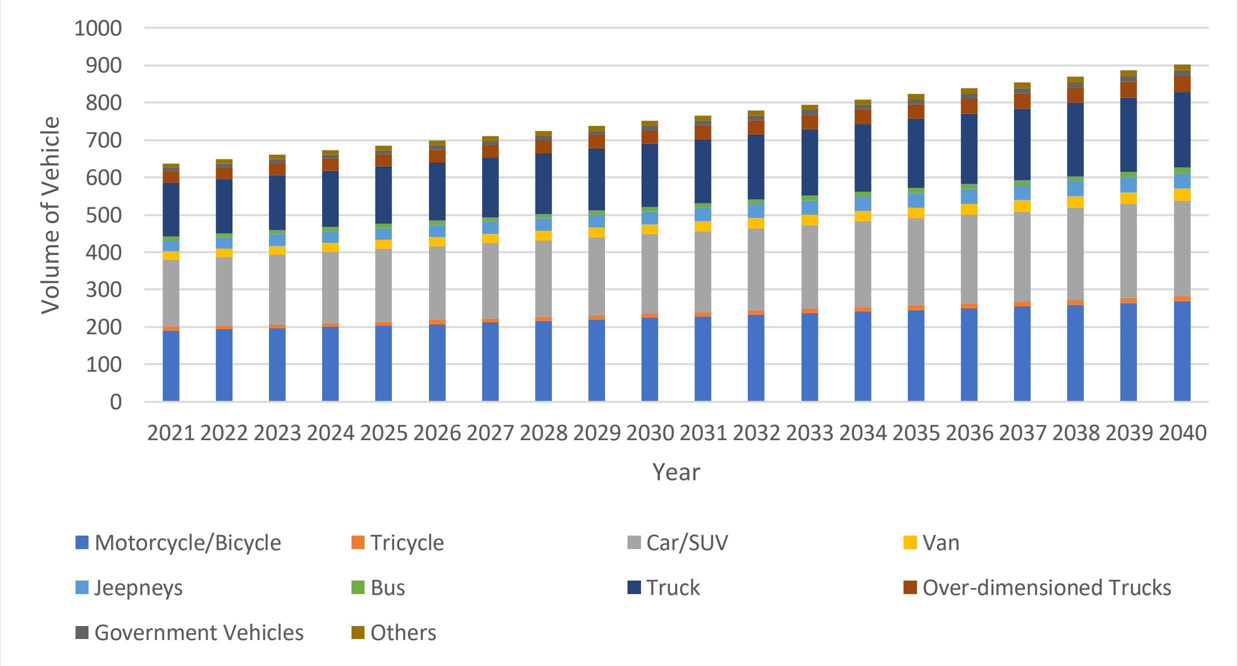
Peak hour traffic volume projection in south bound of Station 3 (without the Project)



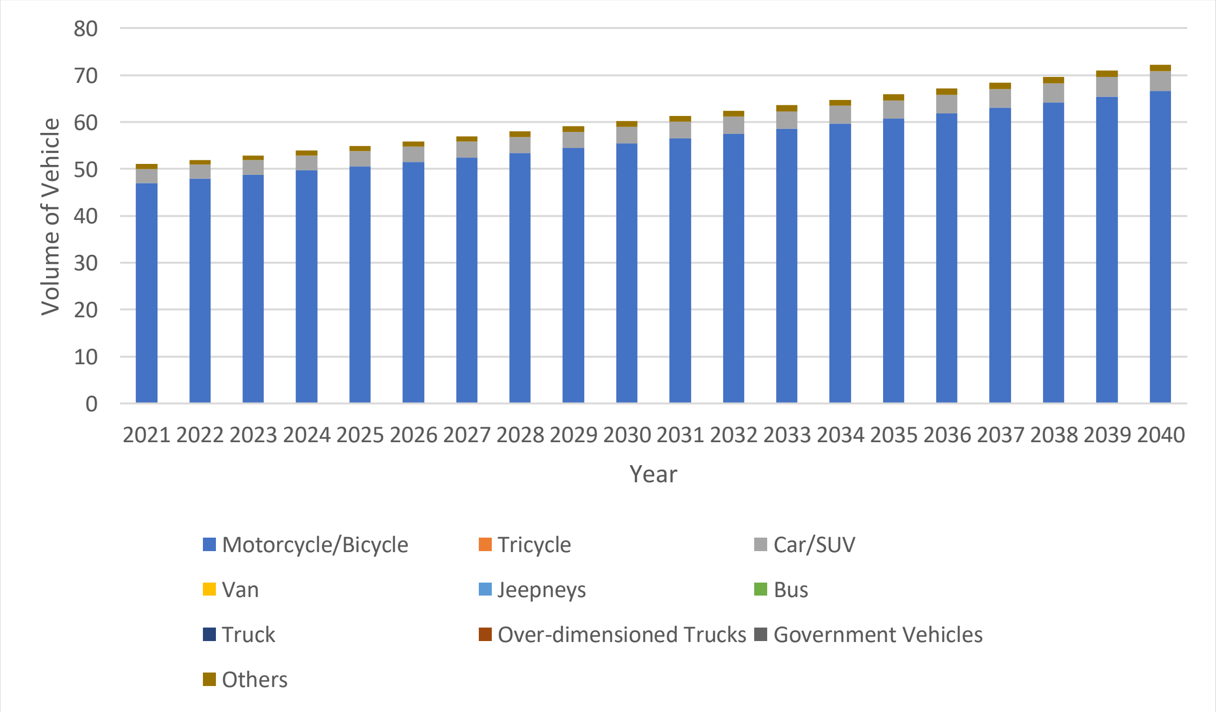
Peak hour traffic volume projection in north bound of Station 4 (without the Project)



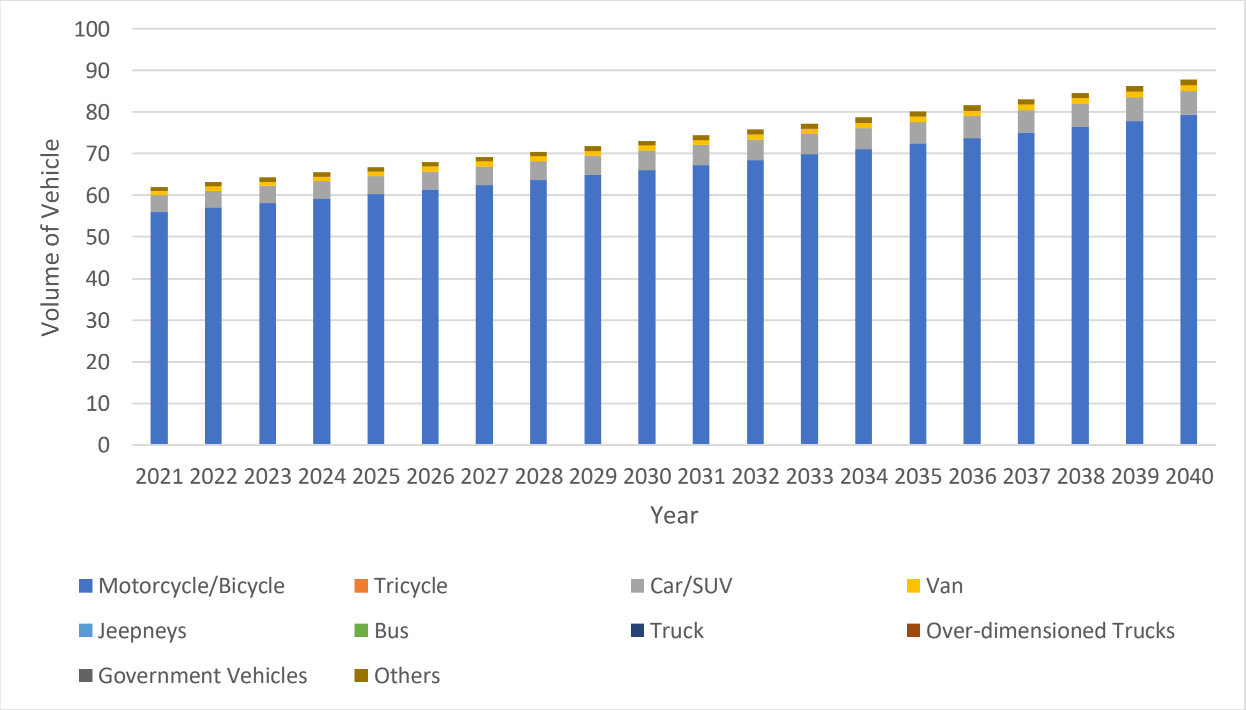
Peak hour traffic volume projection in south bound of Station 4 (without the Project)



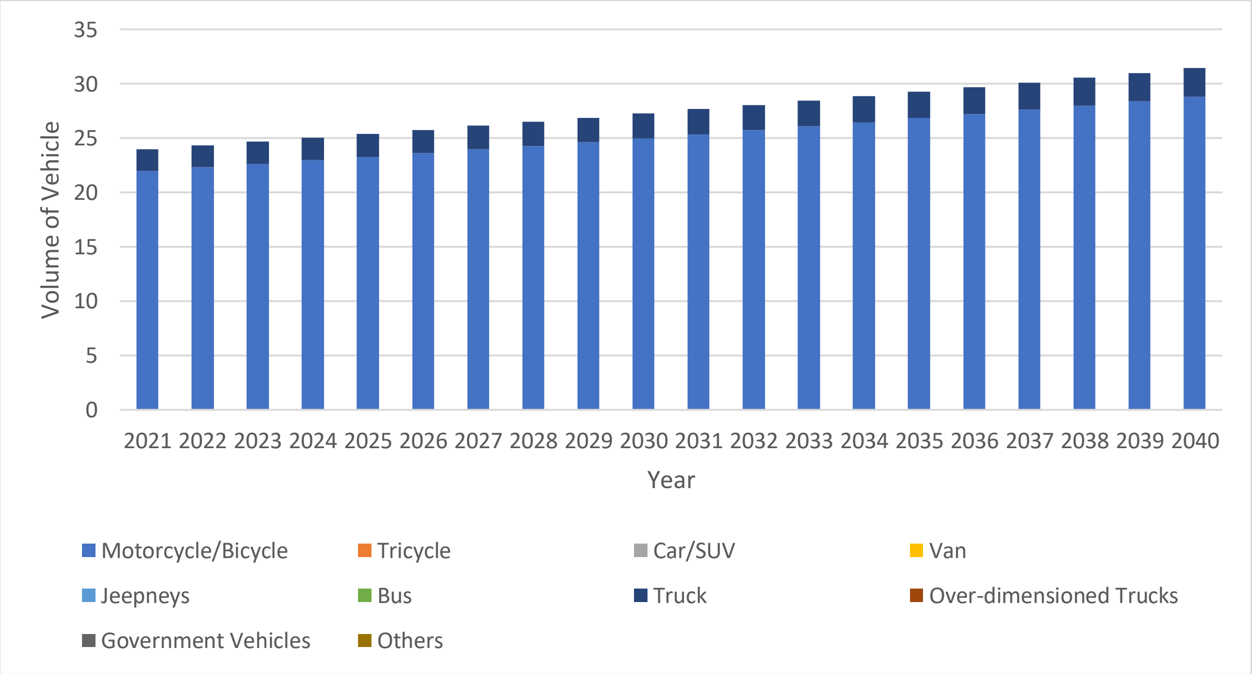
Peak hour traffic volume projection in west bound of Station 4 (without the Project)



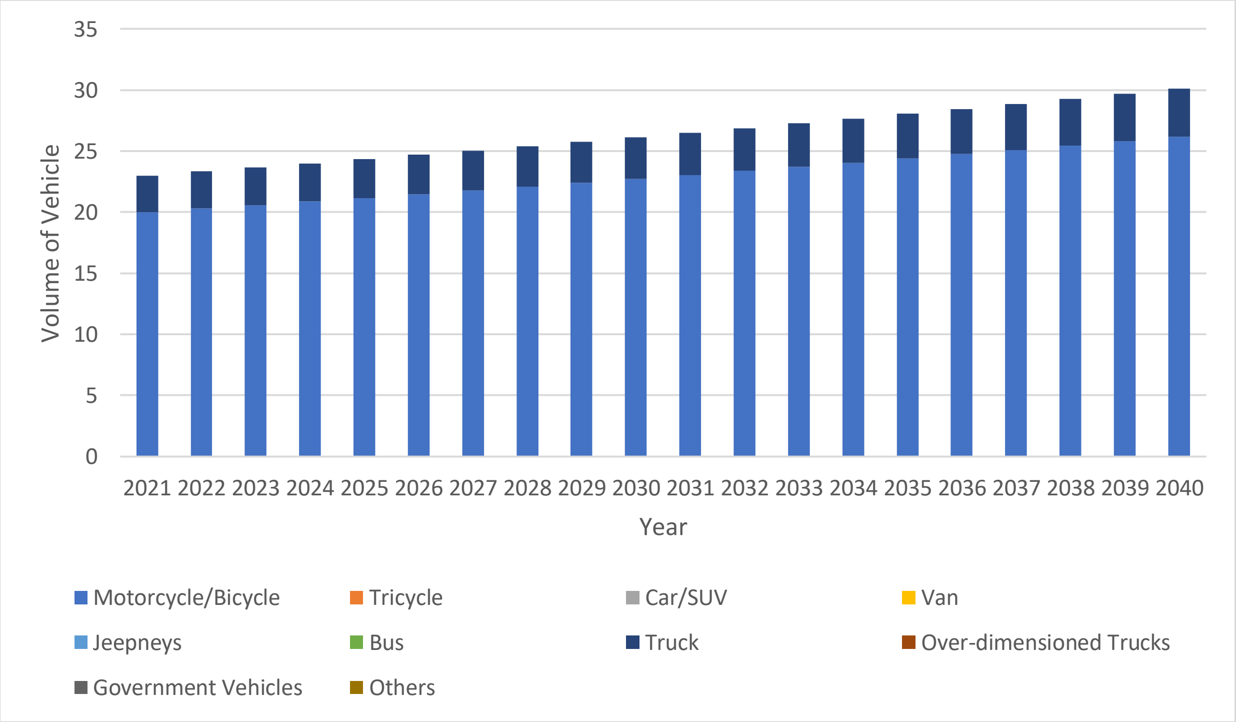
Peak hour traffic volume projection in west bound of Station 4 (without the Project)



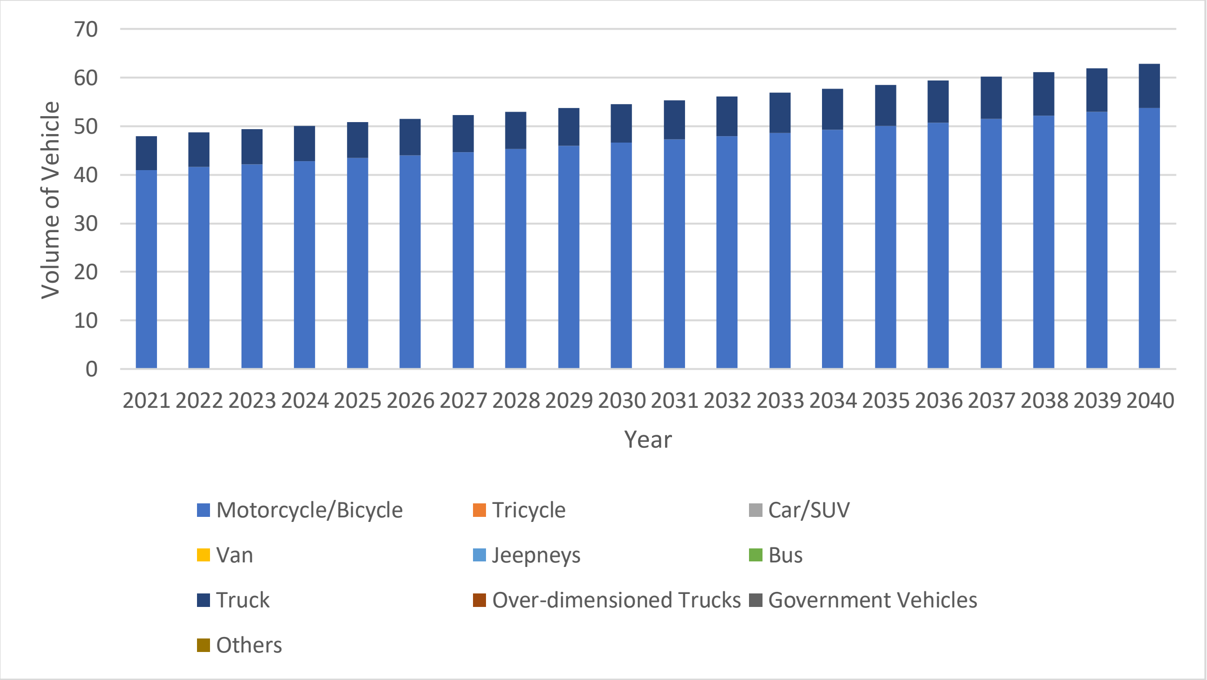
Peak hour traffic volume projection in west bound of Station 5 (without the Project)



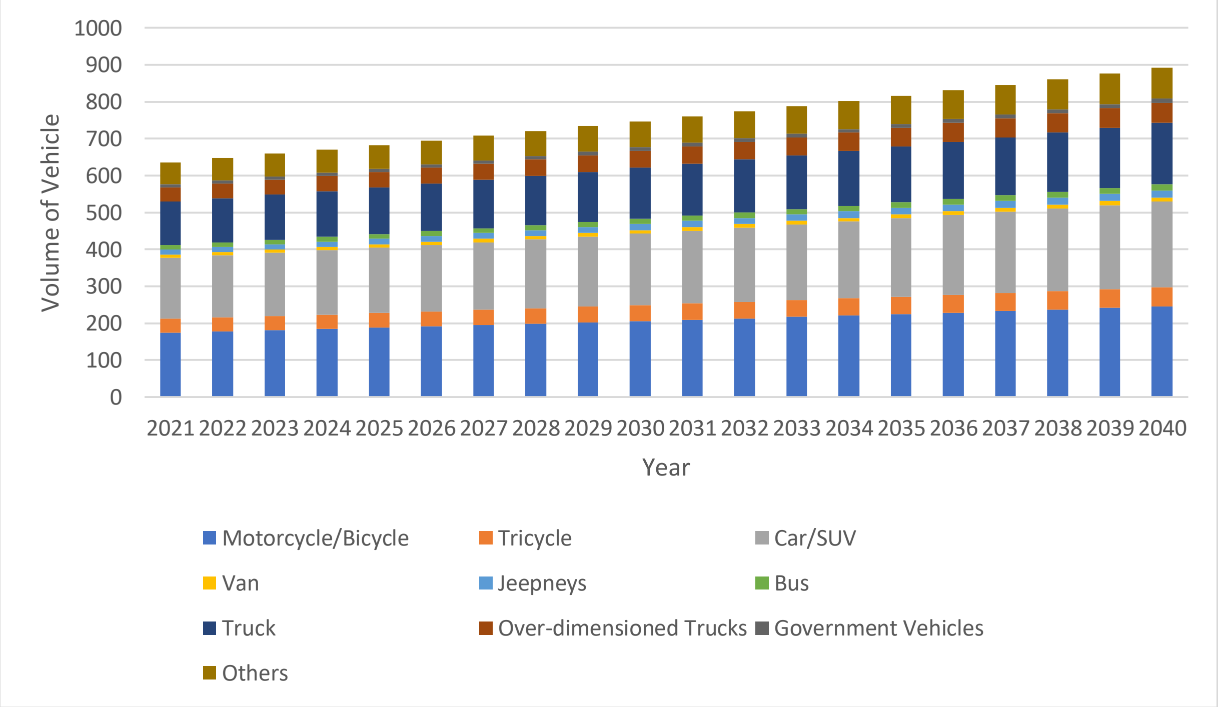
Peak hour traffic volume projection in east bound of Station 5 (without the Project)



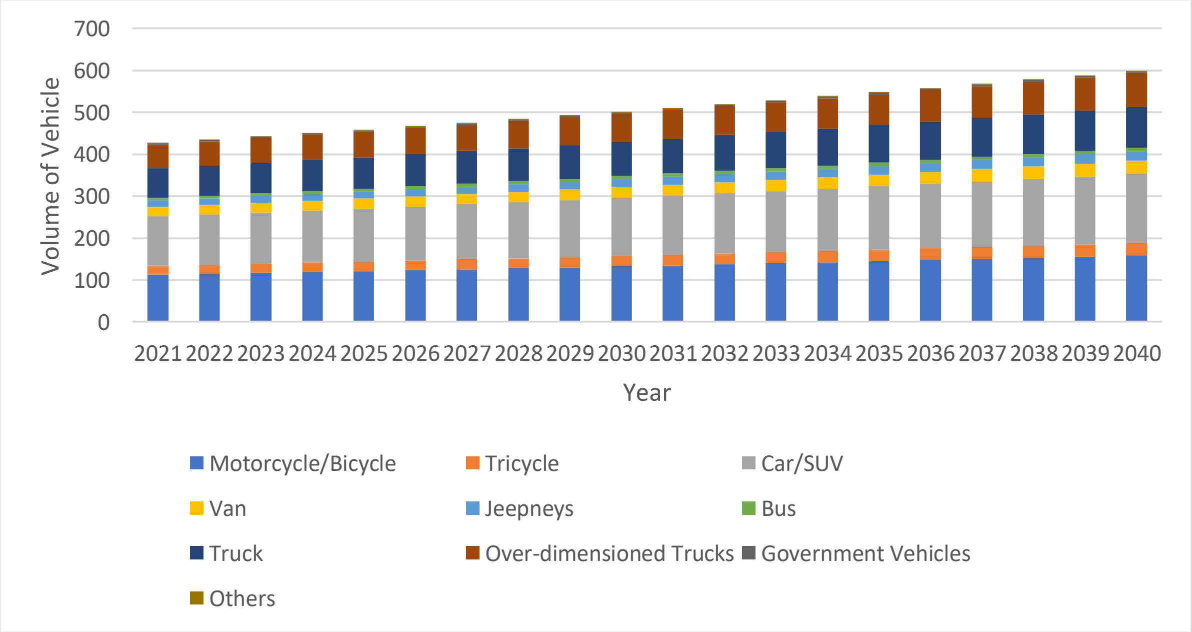
Peak hour traffic volume projection in west bound of Station 5 (without the Project)



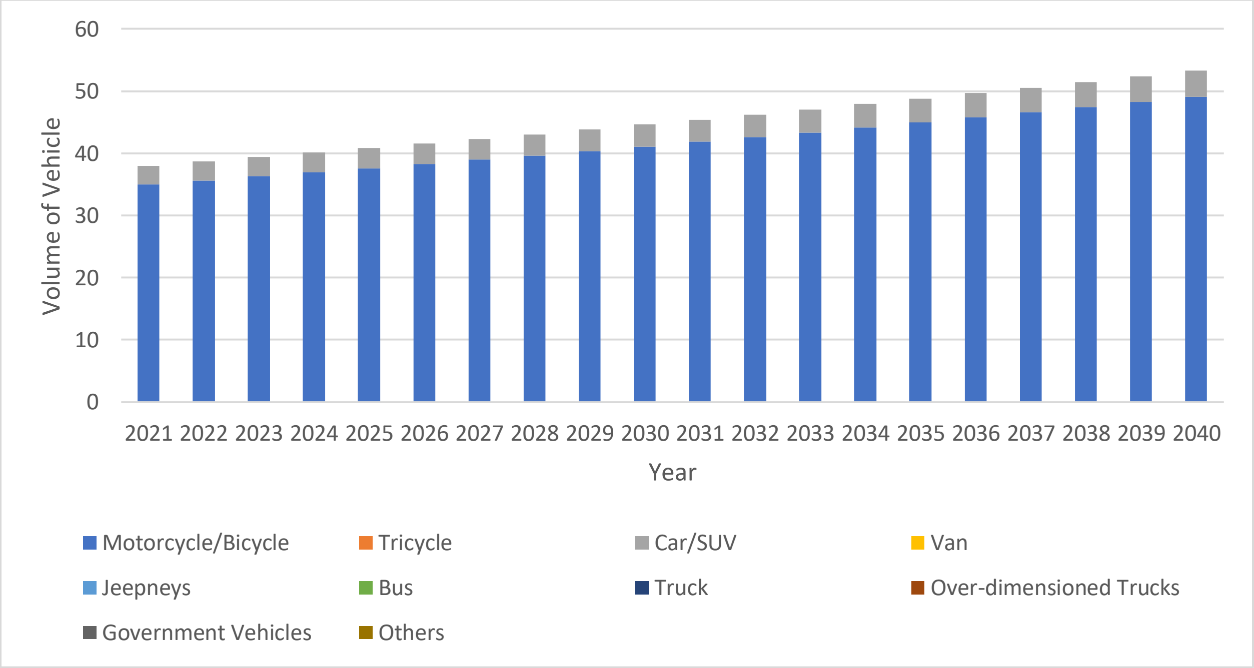
Peak hour traffic volume projection in north bound of Station 6 (without the Project)



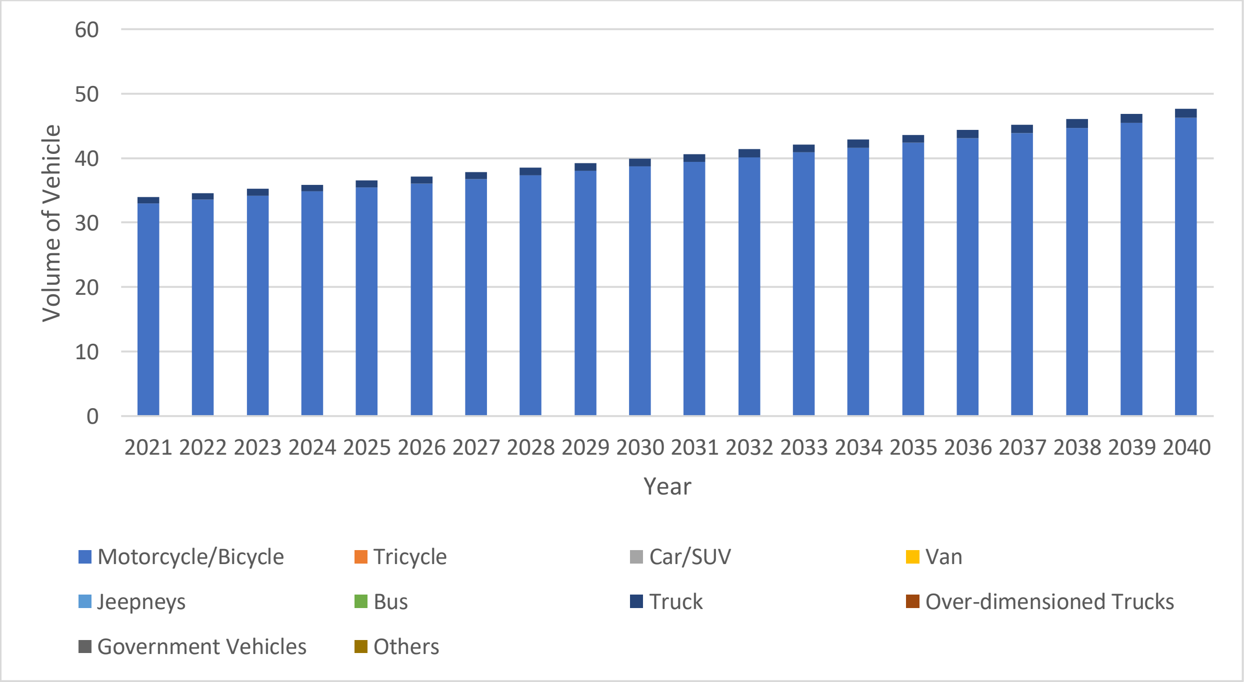
Peak hour traffic volume projection in south bound of Station 6 (without the Project)



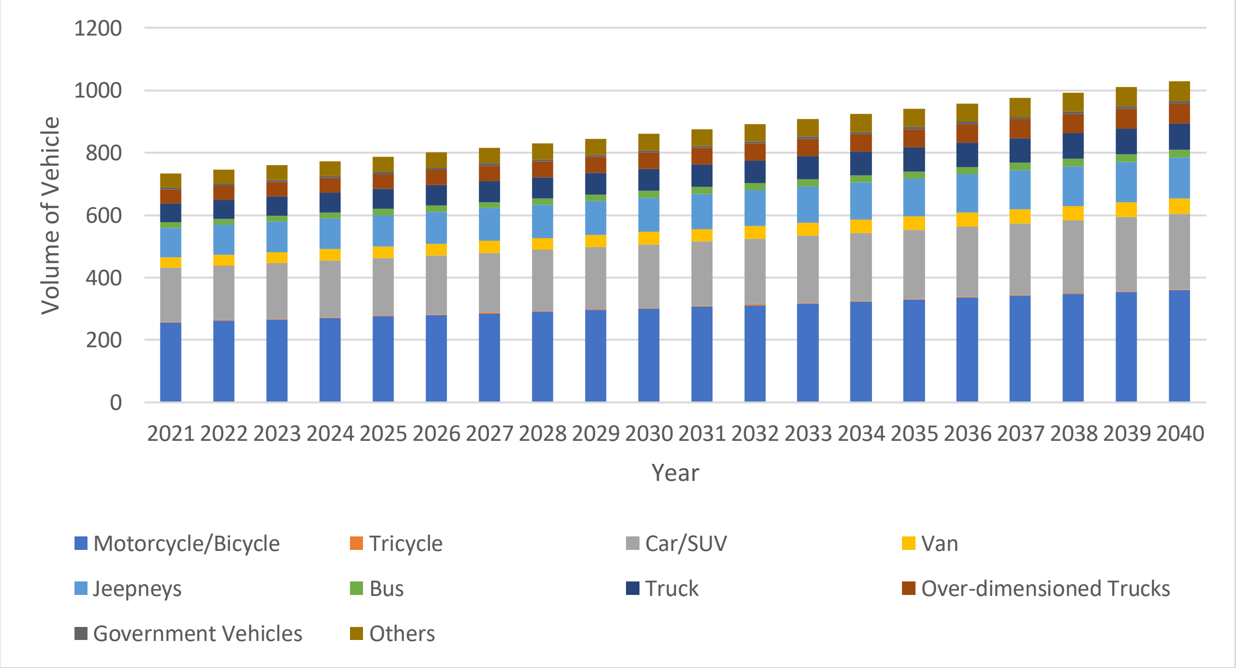
Peak hour traffic volume projection in north bound of Station 7 (without the Project)



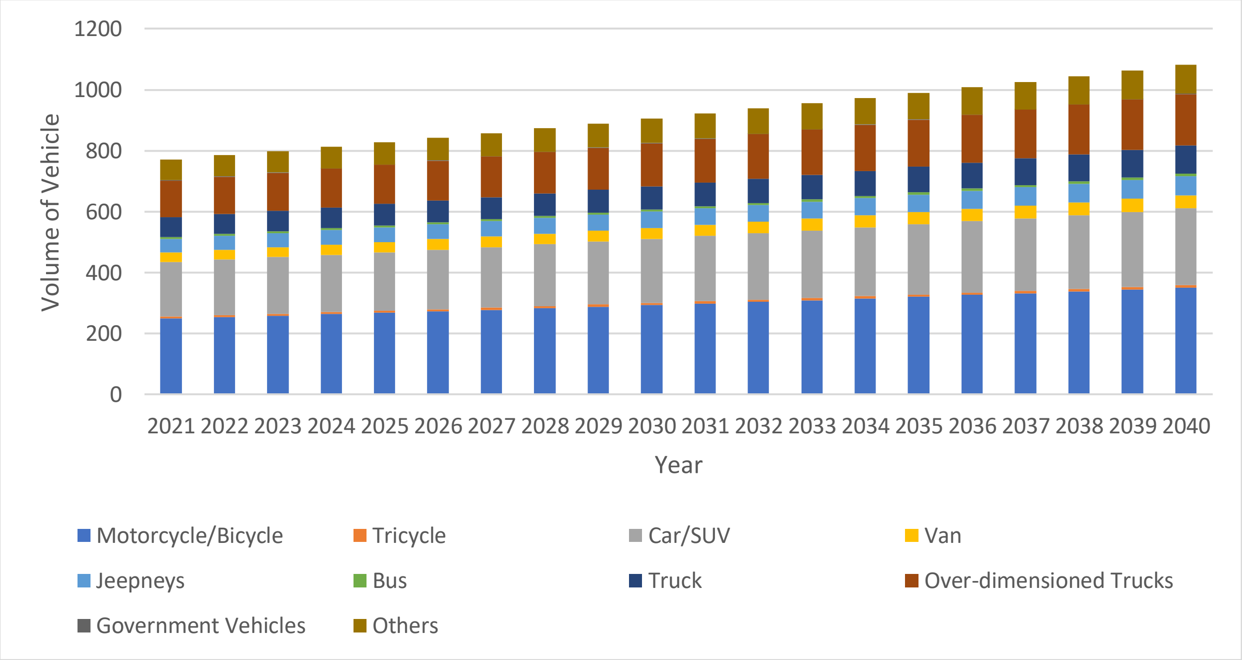
Peak hour traffic volume projection in south bound of Station 7 (without the Project)



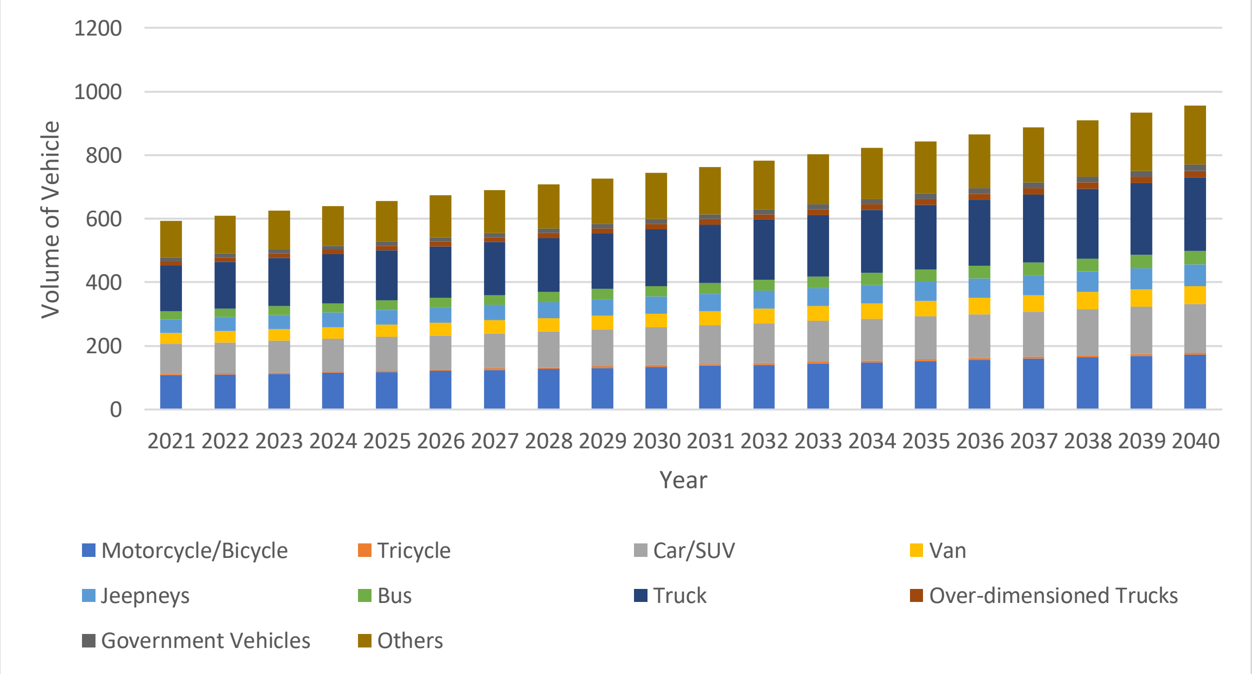
Peak hour traffic volume projection in north bound of Station 8 (without the Project)



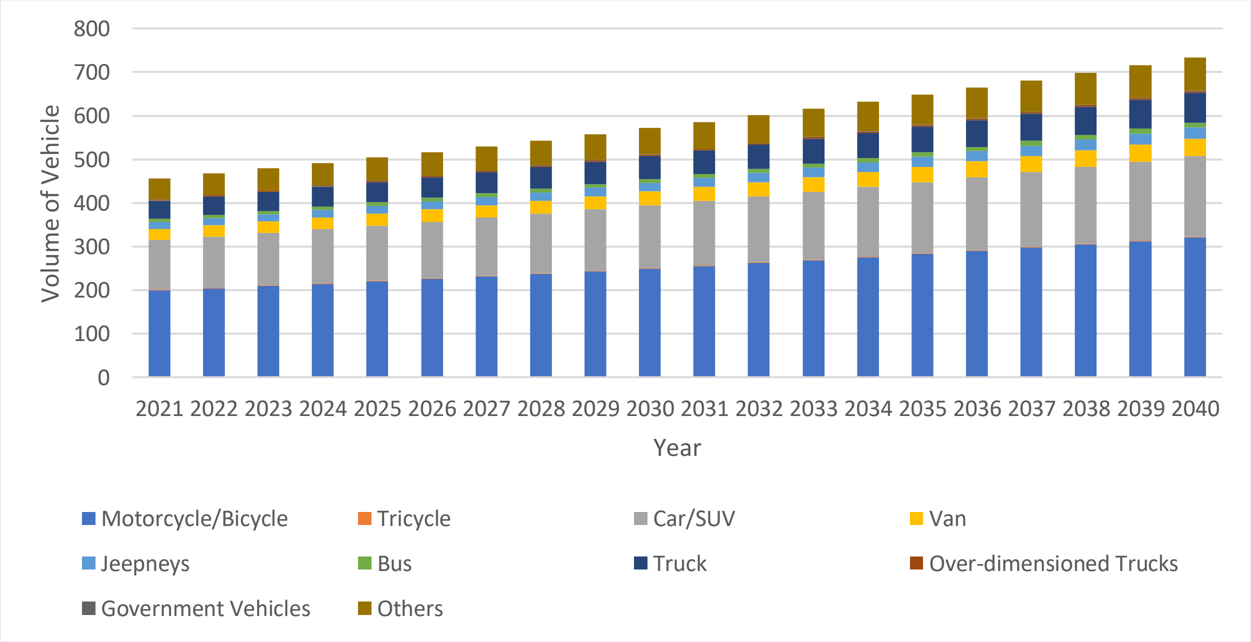
Peak hour traffic volume projection in south bound of Station 8 (without the Project)



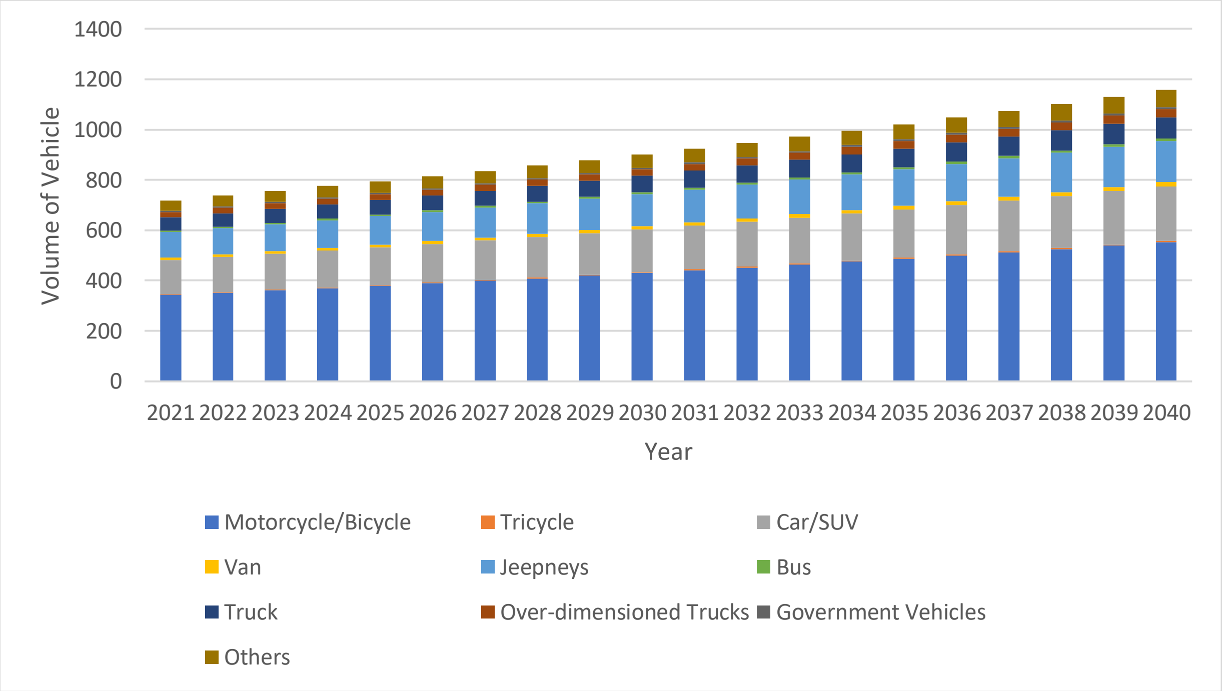
Peak hour traffic volume projection in north bound of Station 9 (without the Project)



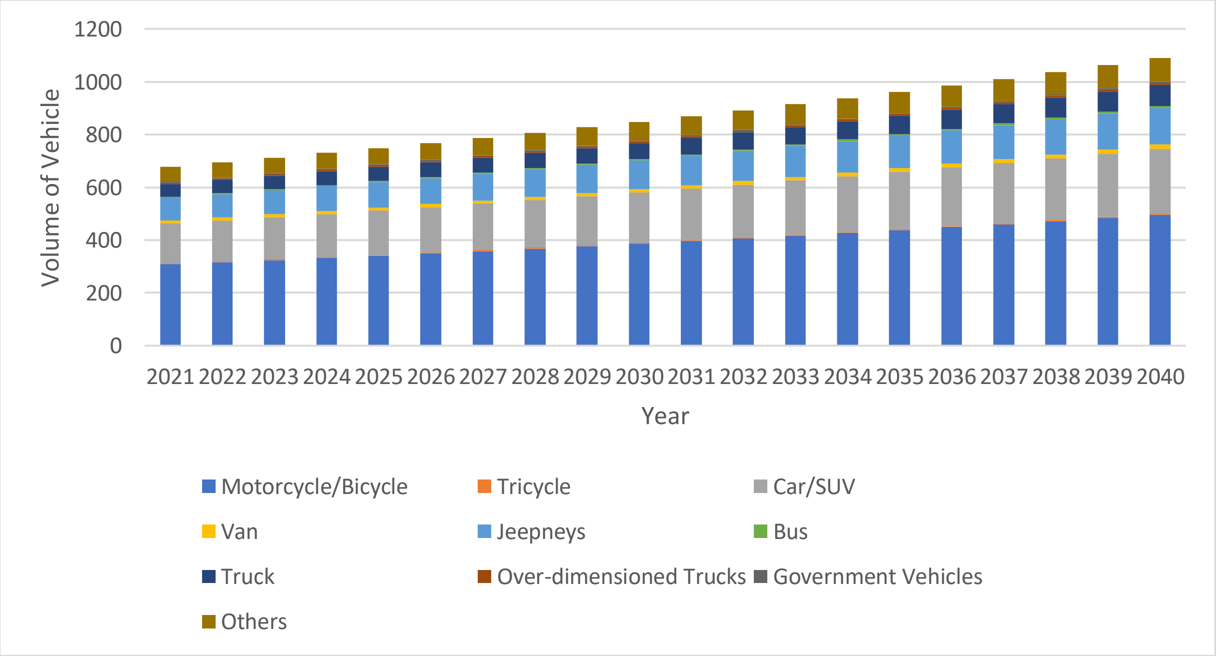
Peak hour traffic volume projection in south bound of Station 9 (without the Project)



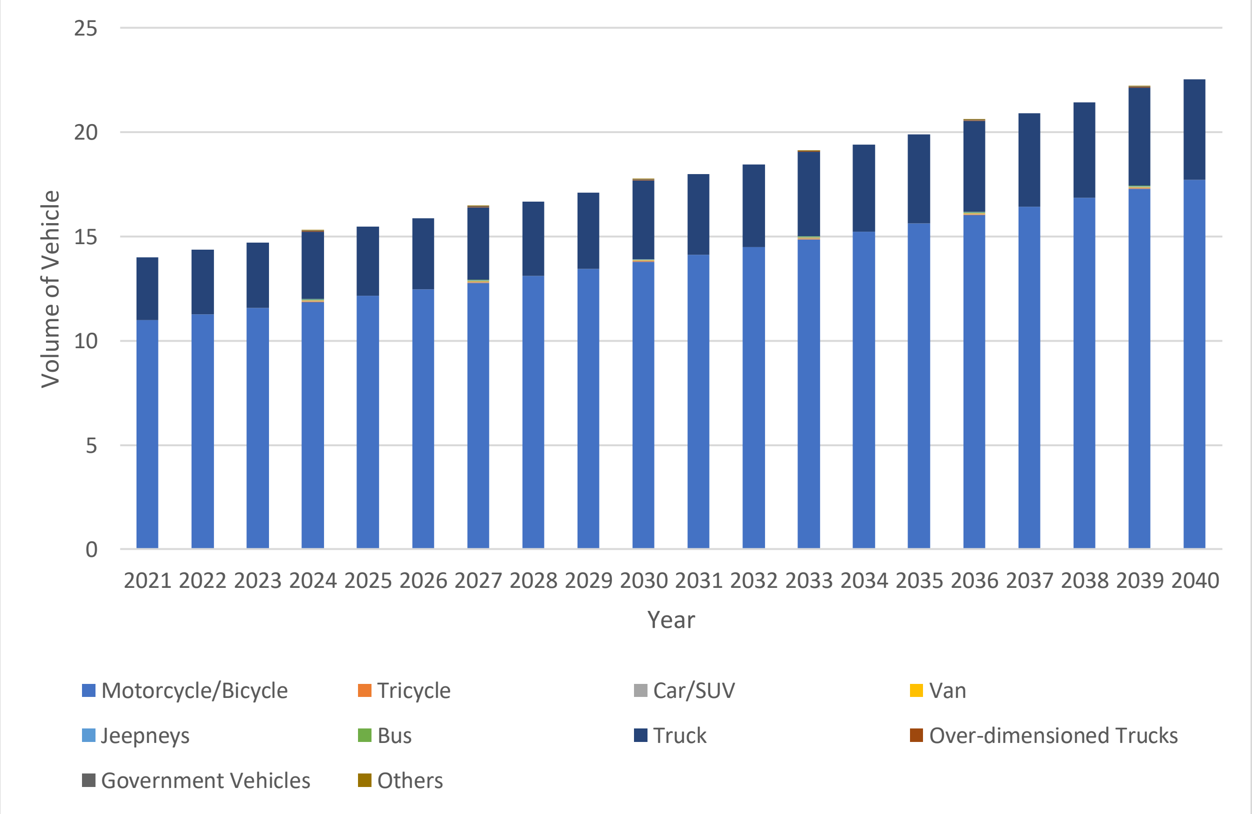
Peak hour traffic volume projection in north bound of Station 10 (without the Project)



Peak hour traffic volume projection in south bound of Station 10 (without the Project)

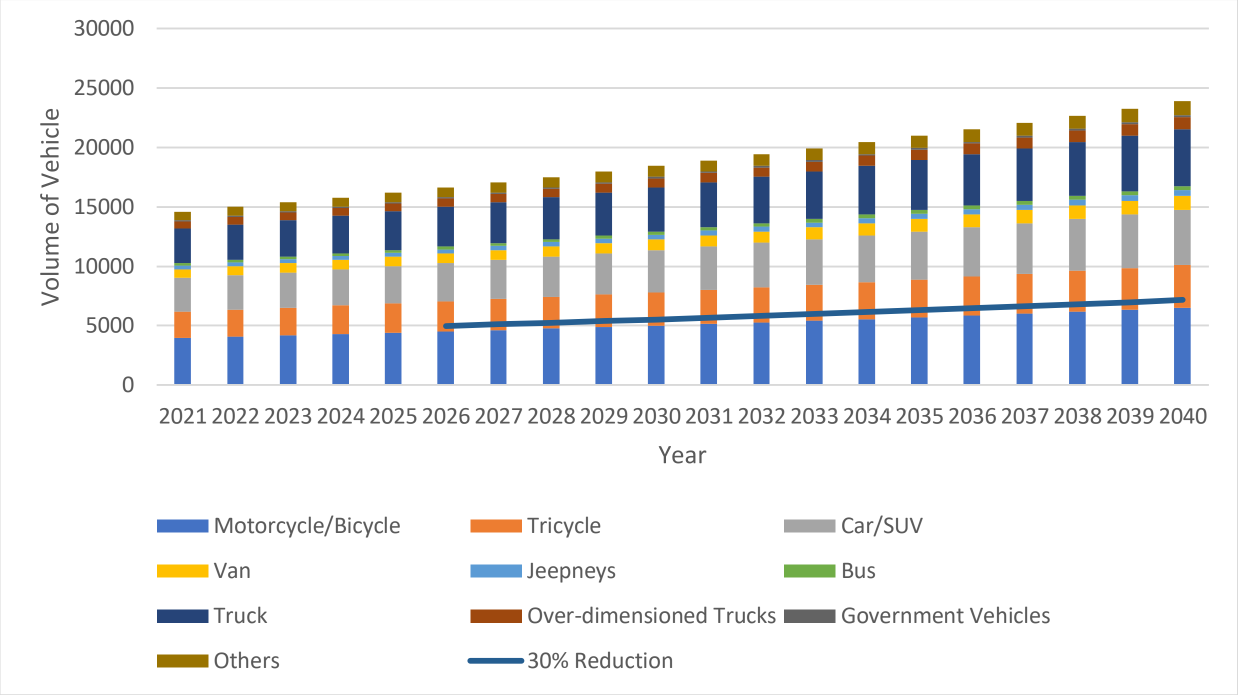


Peak hour traffic volume projection in west bound of Station 10 (without the Project)

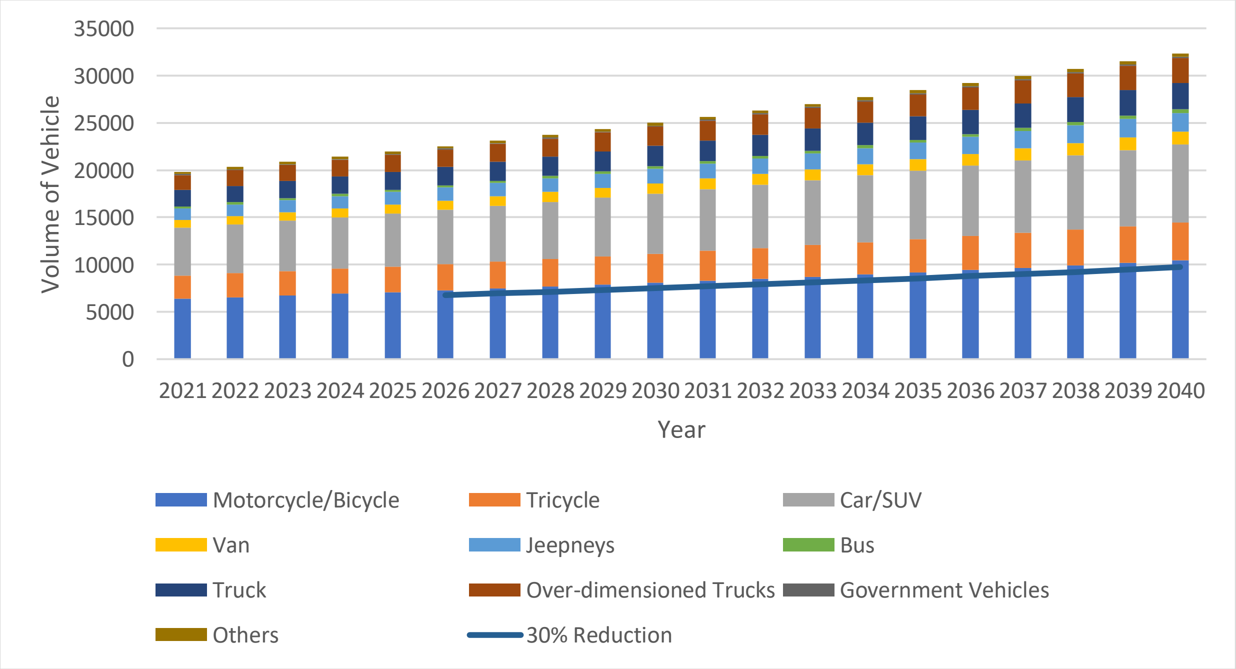


Future Traffic with Development (Central Mindanao High Standard Highway)

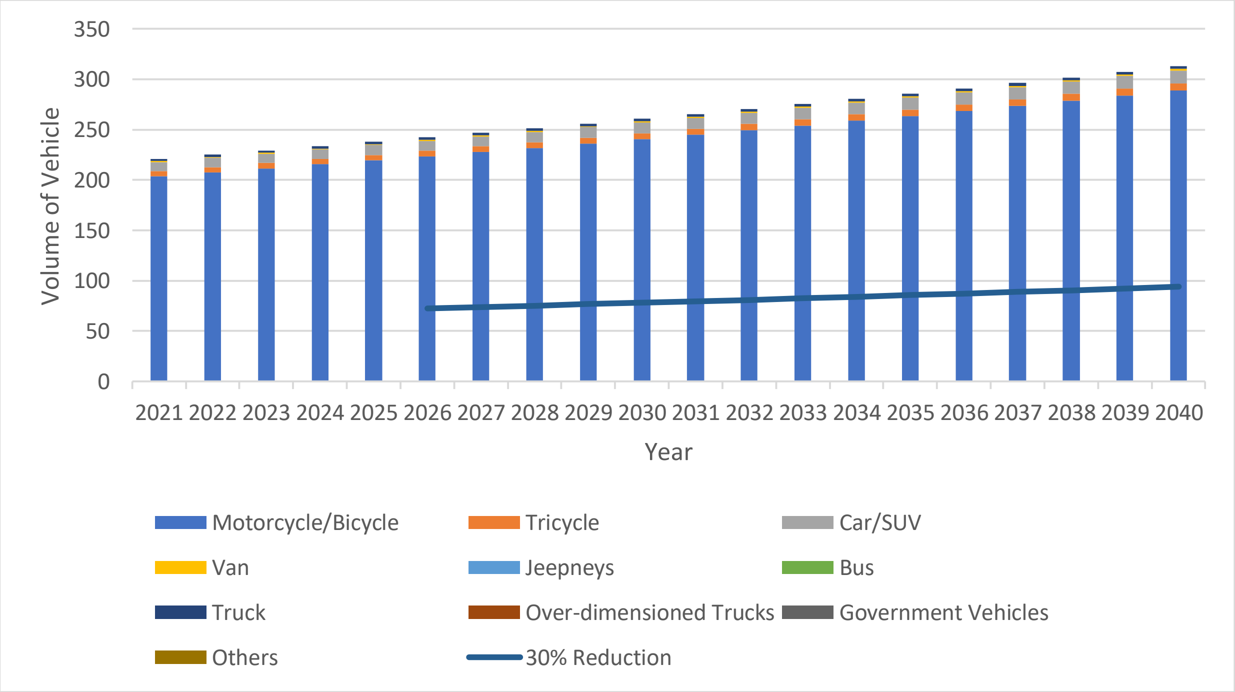
Peak hour traffic volume projection in east bound of Station 1 (with the Project)



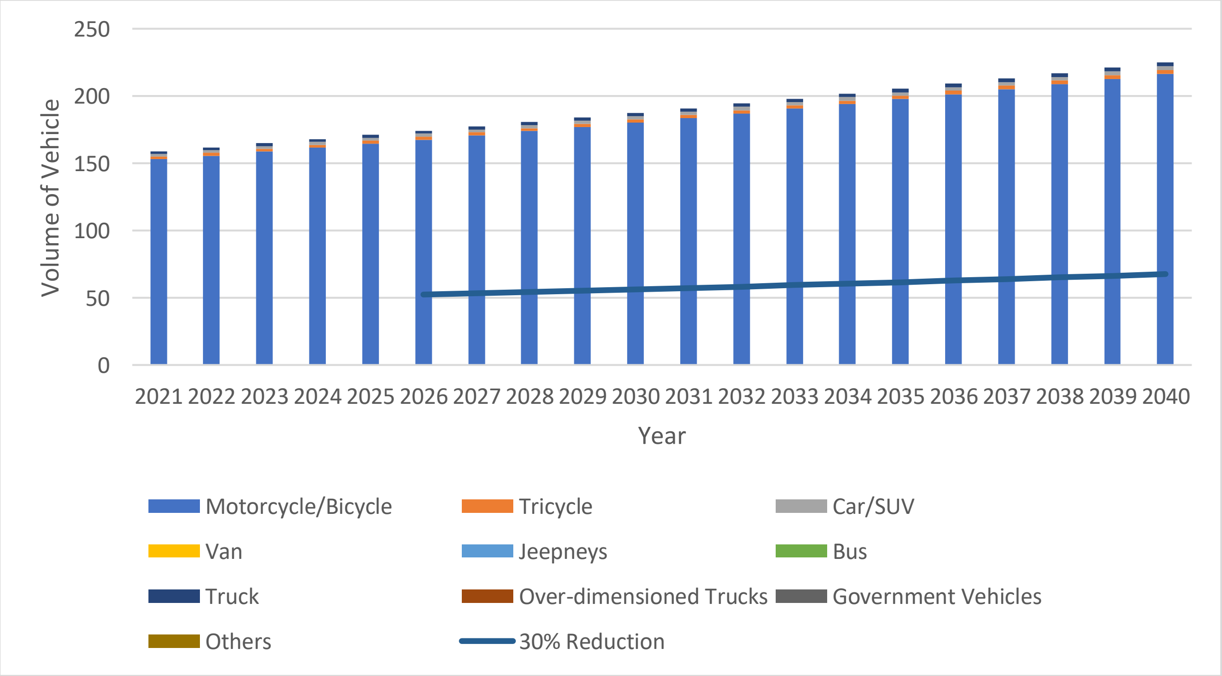
Peak hour traffic volume projection in east bound of Station 1 (with the Project)



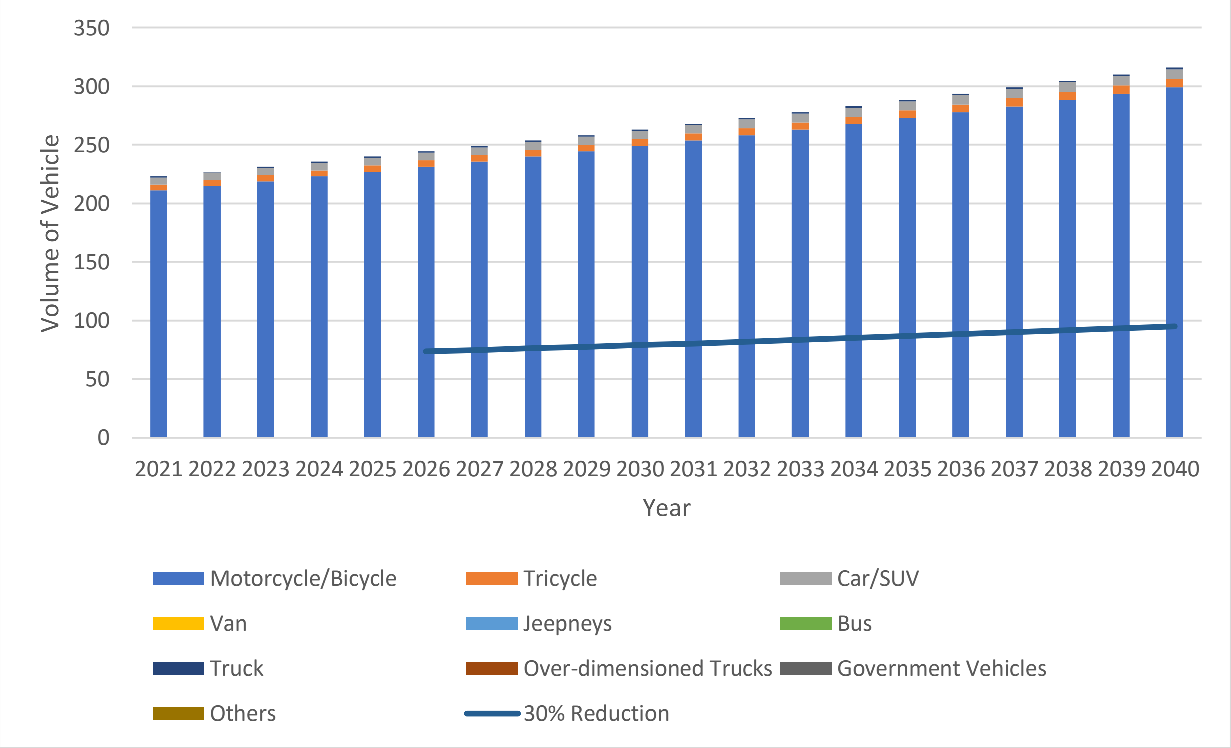
Peak hour traffic volume projection in north bound of Station 2 (with the Project)



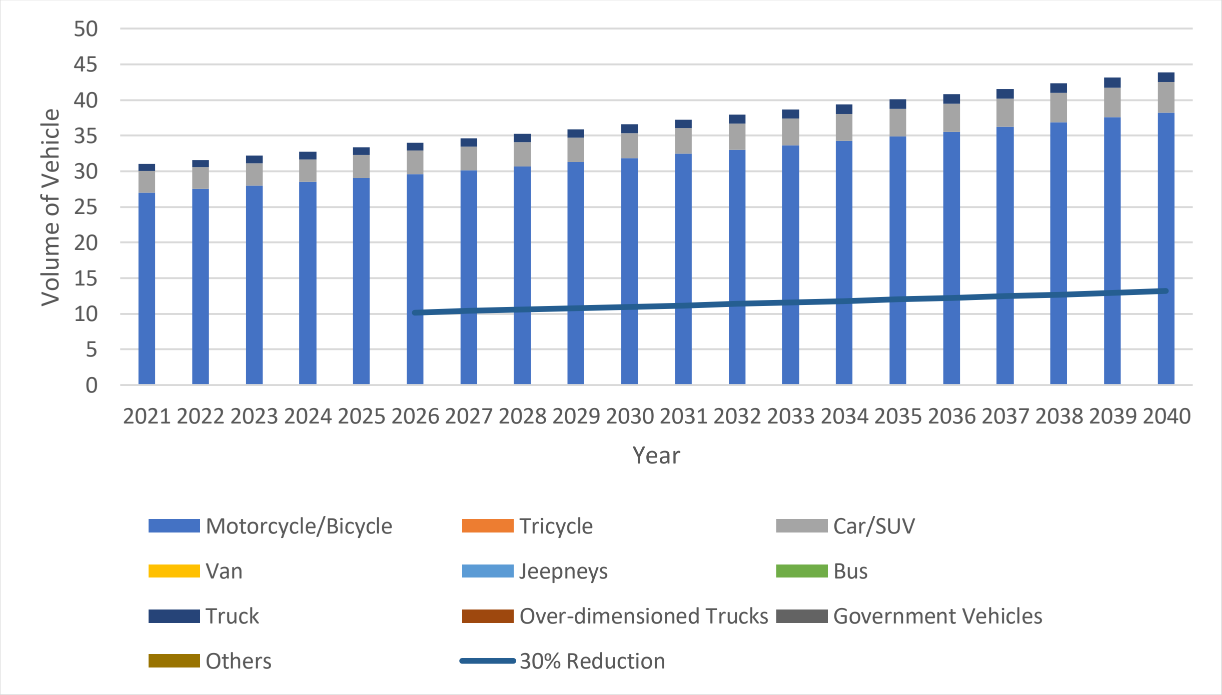
Peak hour traffic volume projection in south bound of Station 2 (with the Project)



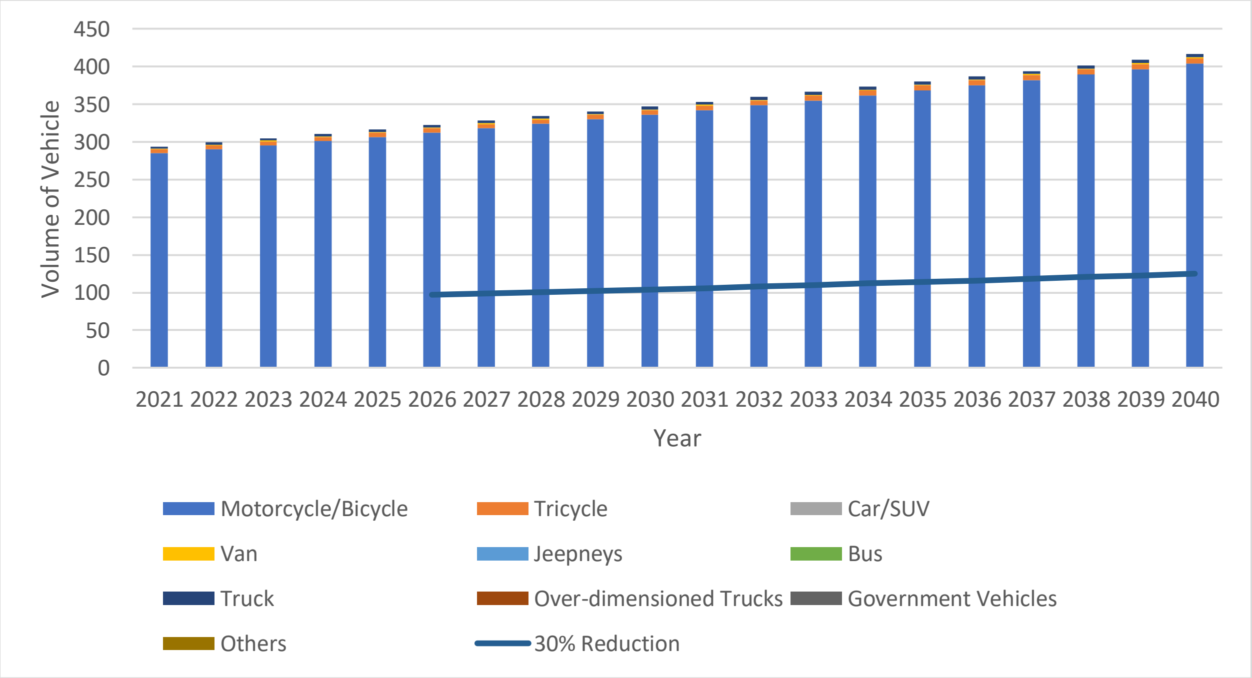
Peak hour traffic volume projection in east bound of Station 2 (with the Project)



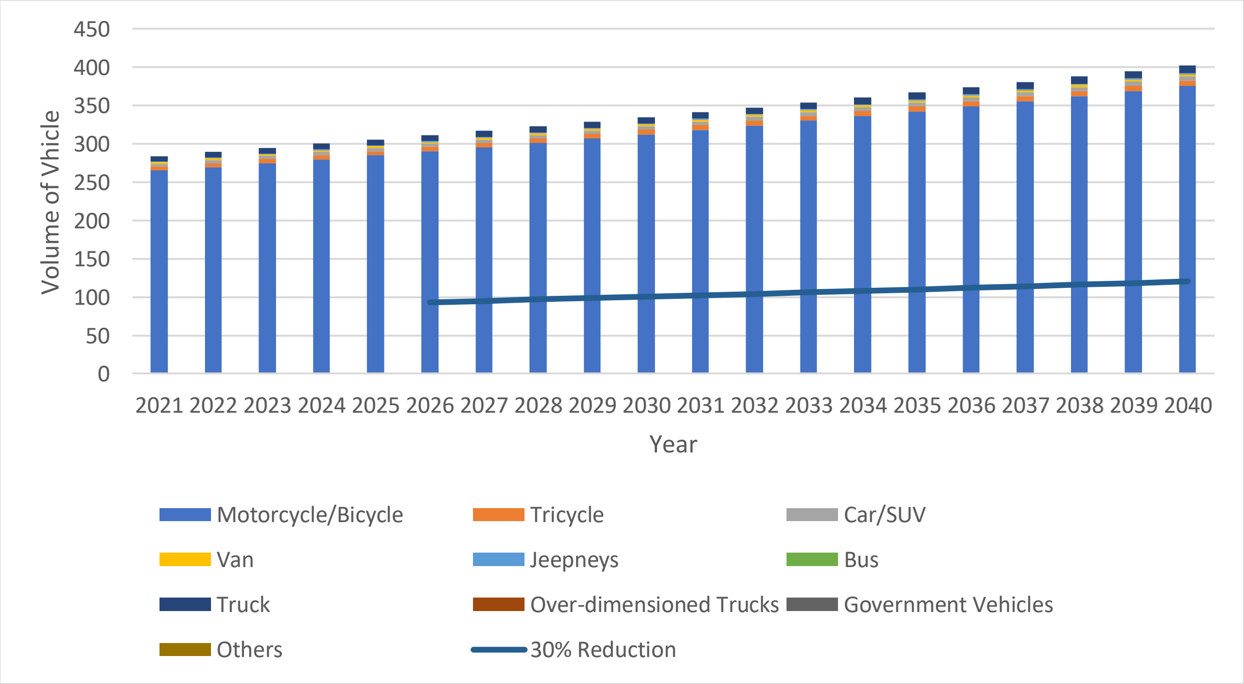
Peak hour traffic volume projection in west bound of Station 2 (with the Project)



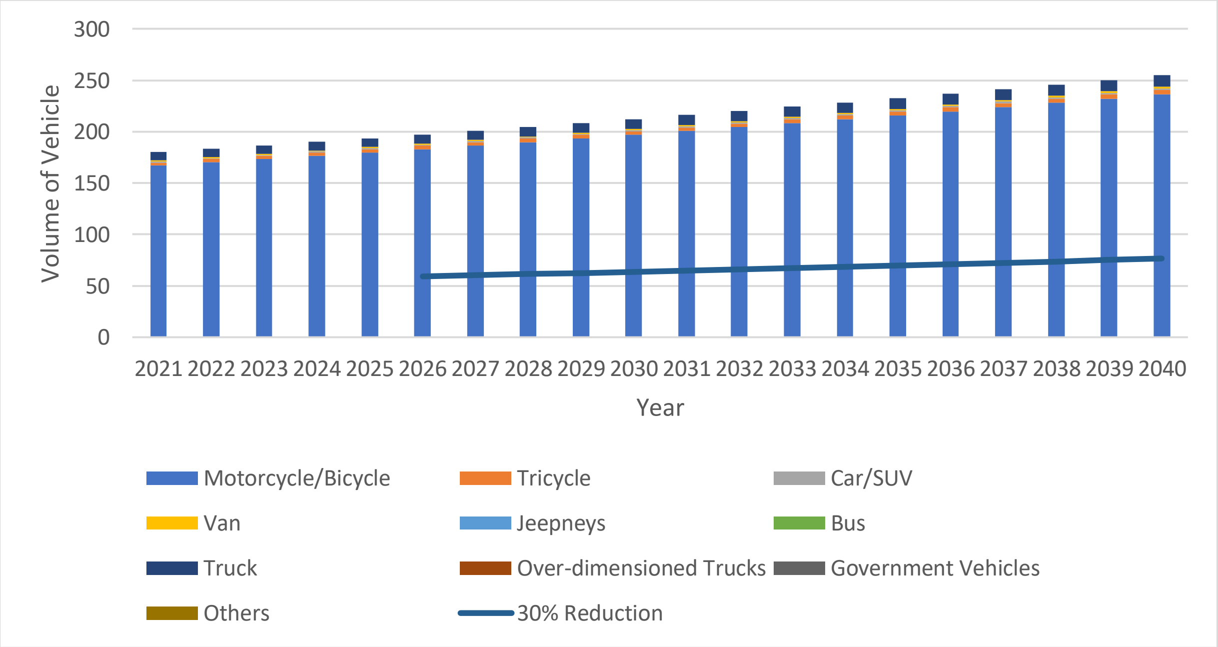
Peak hour traffic volume projection in north bound of Station 3 (with the Project)



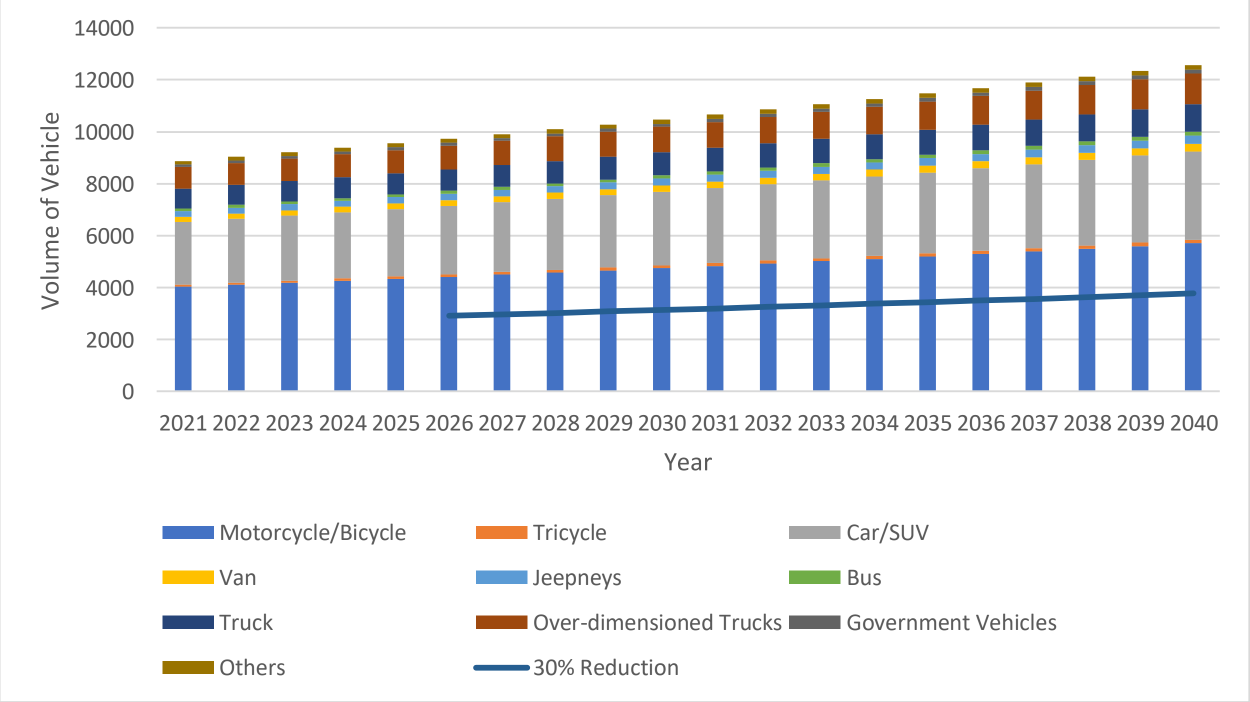
Peak hour traffic volume projection in south bound of Station 3 (with the Project)



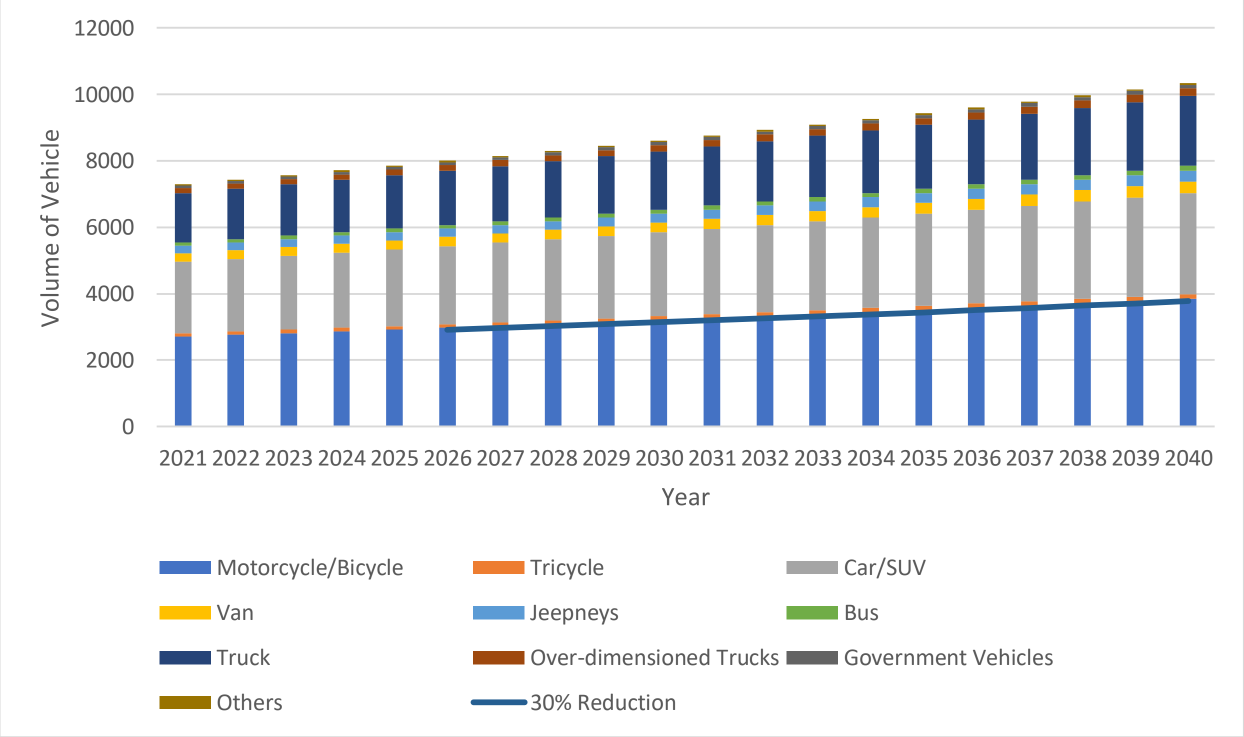
Peak hour traffic volume projection in east bound of Station 3 (with the Project)



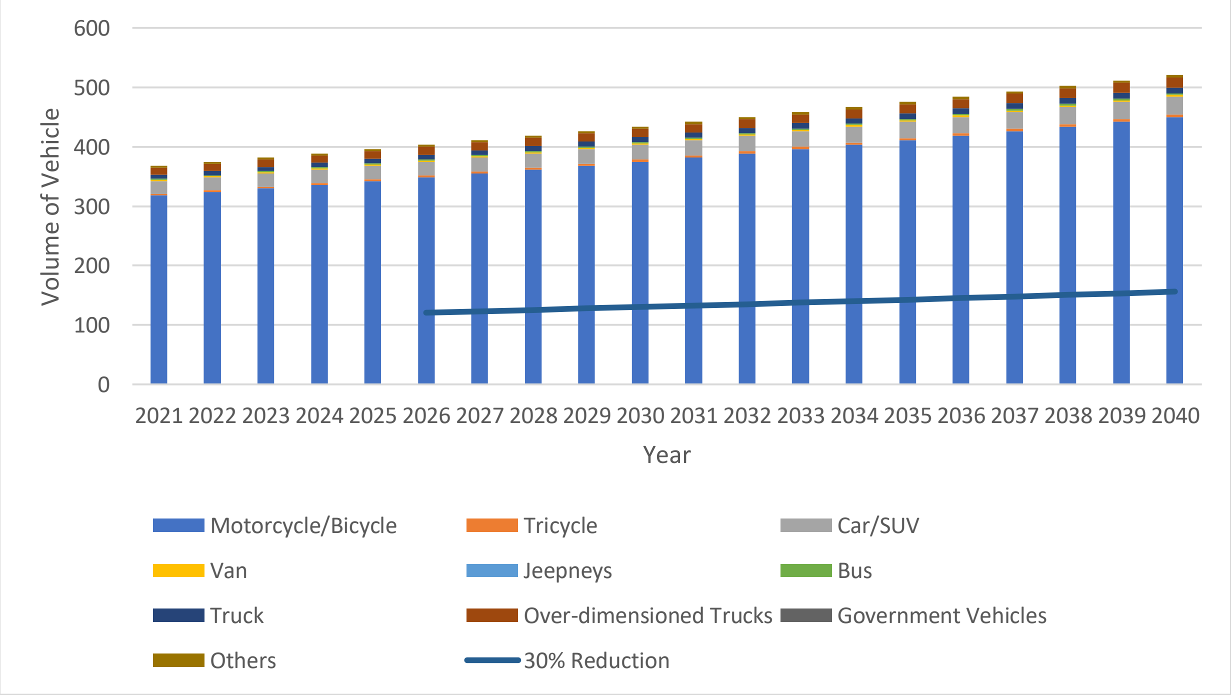
Peak hour traffic volume projection in north bound of Station 4 (with the Project)



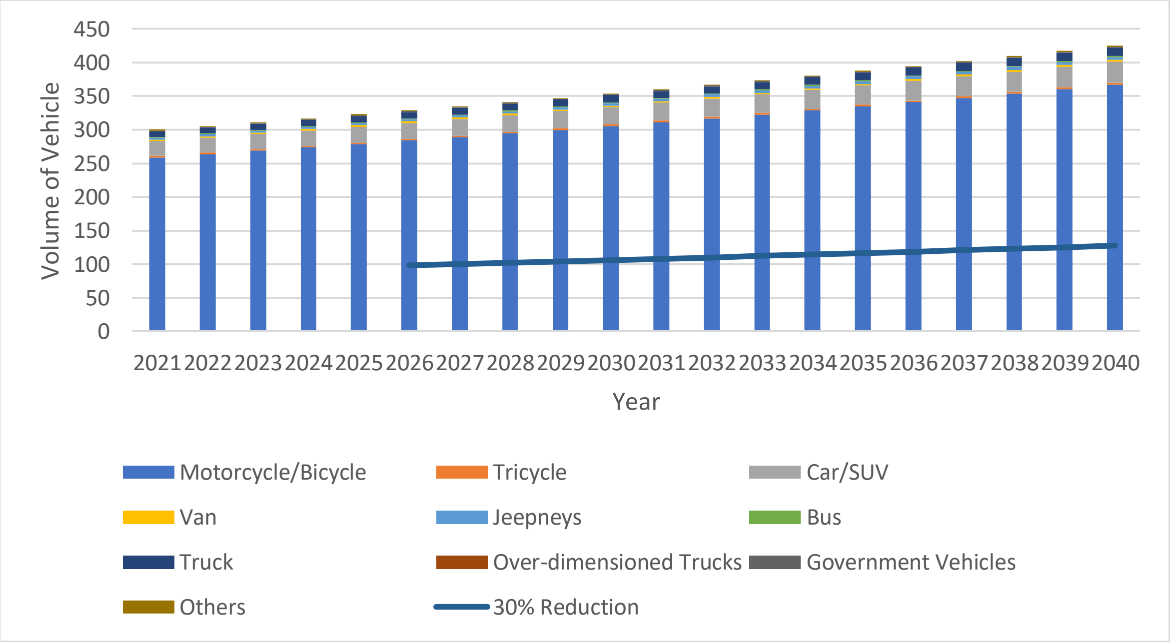
Peak hour traffic volume projection in south bound of Station 4 (with the Project)



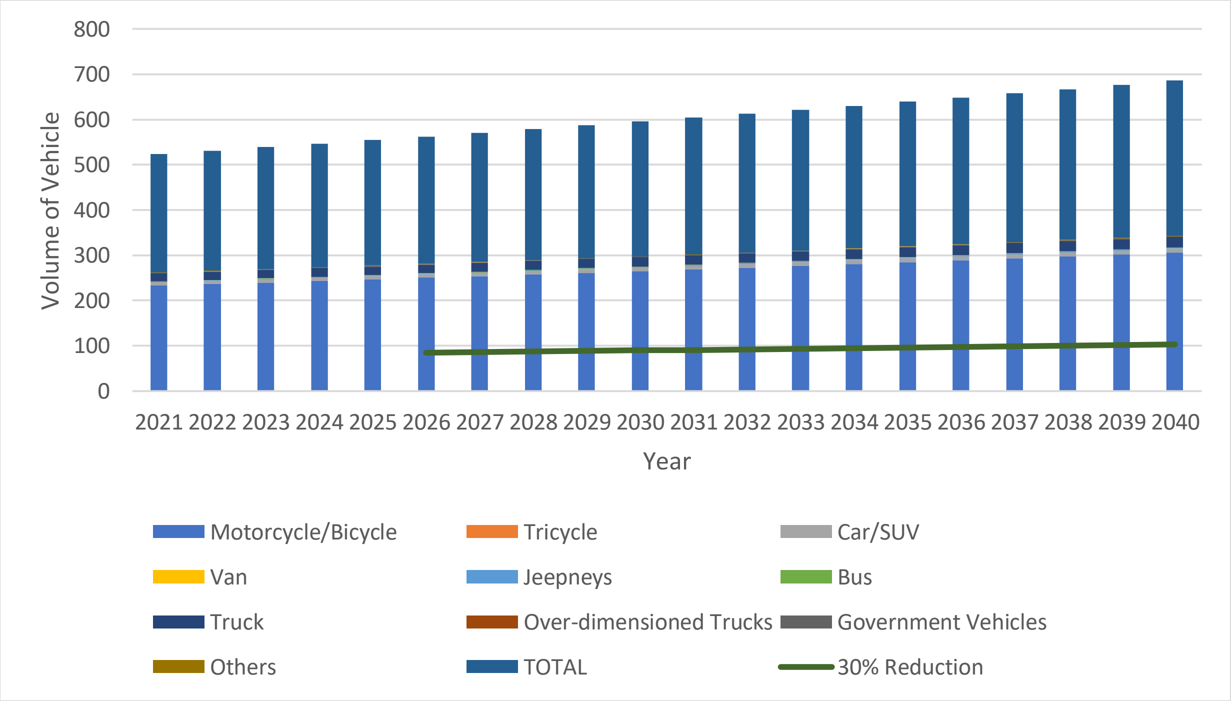
Peak hour traffic volume projection in east bound of Station 4 (with the Project)



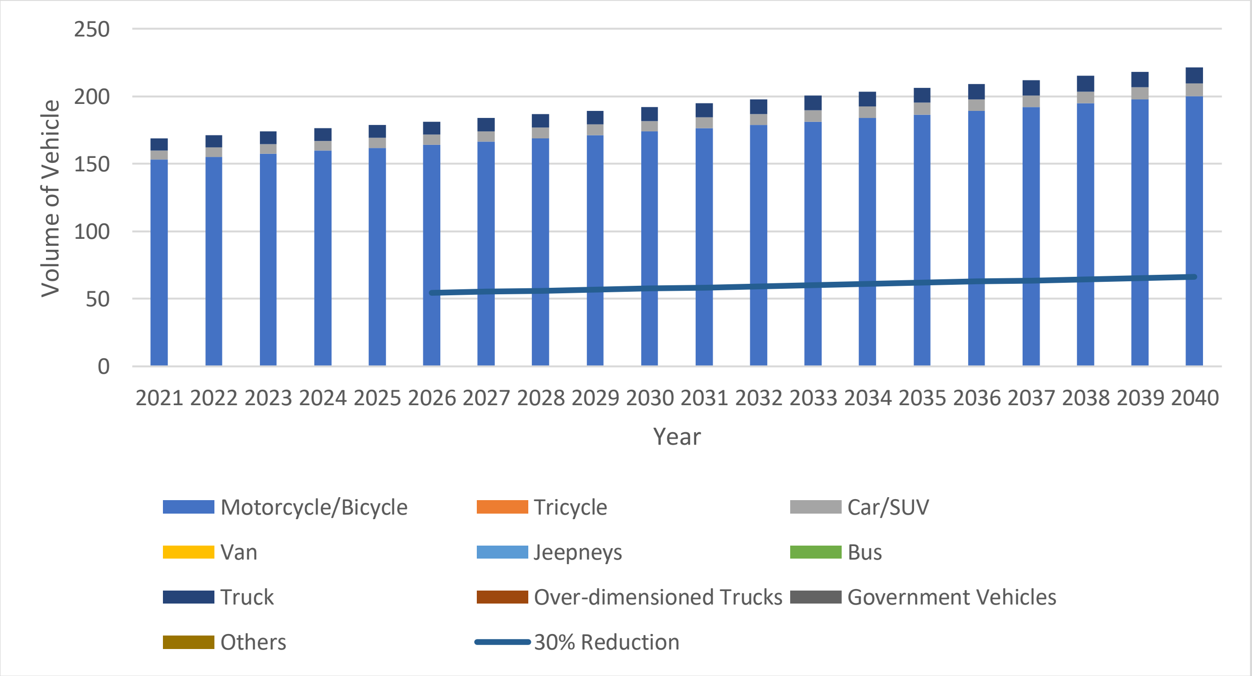
Peak hour traffic volume projection in west bound of Station 4 (with the Project)



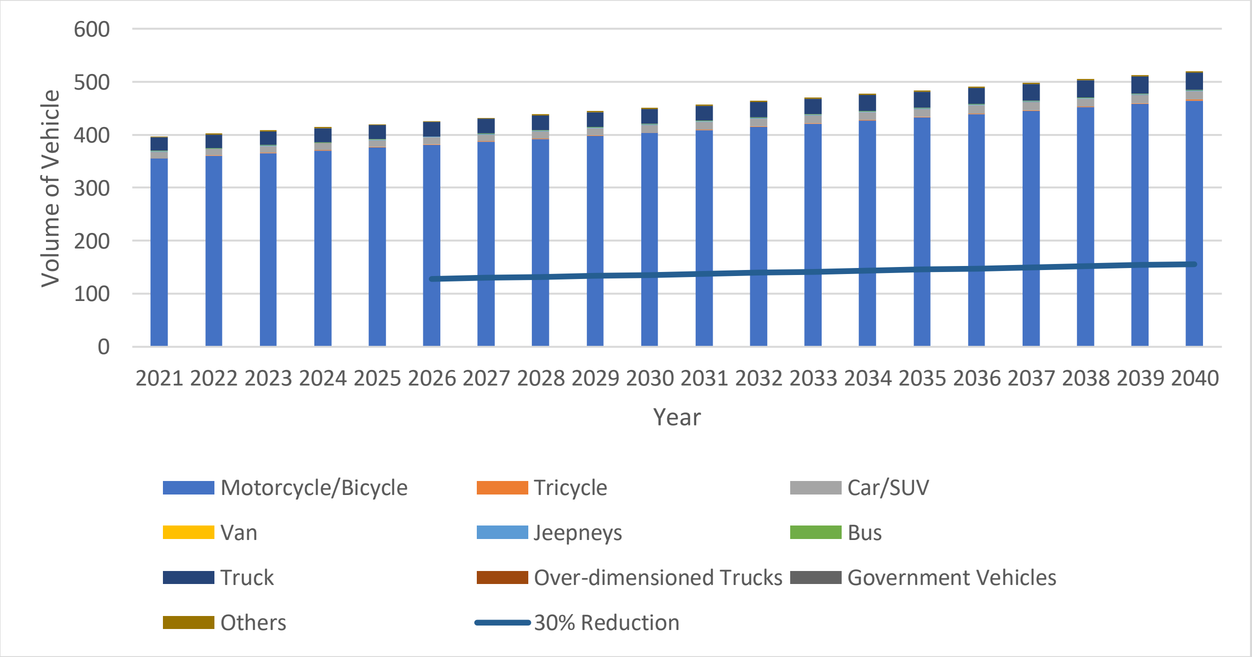
Peak hour traffic volume projection in north bound of Station 5 (with the Project)



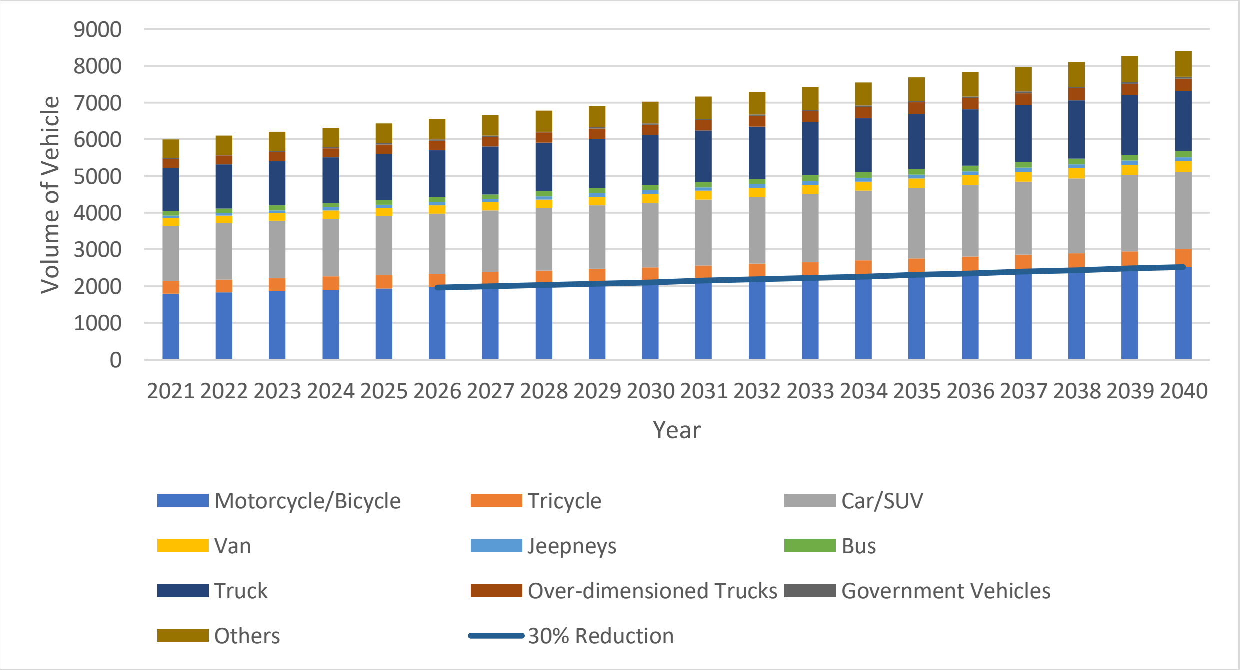
Peak hour traffic volume projection in east bound of Station 5 (with the Project)



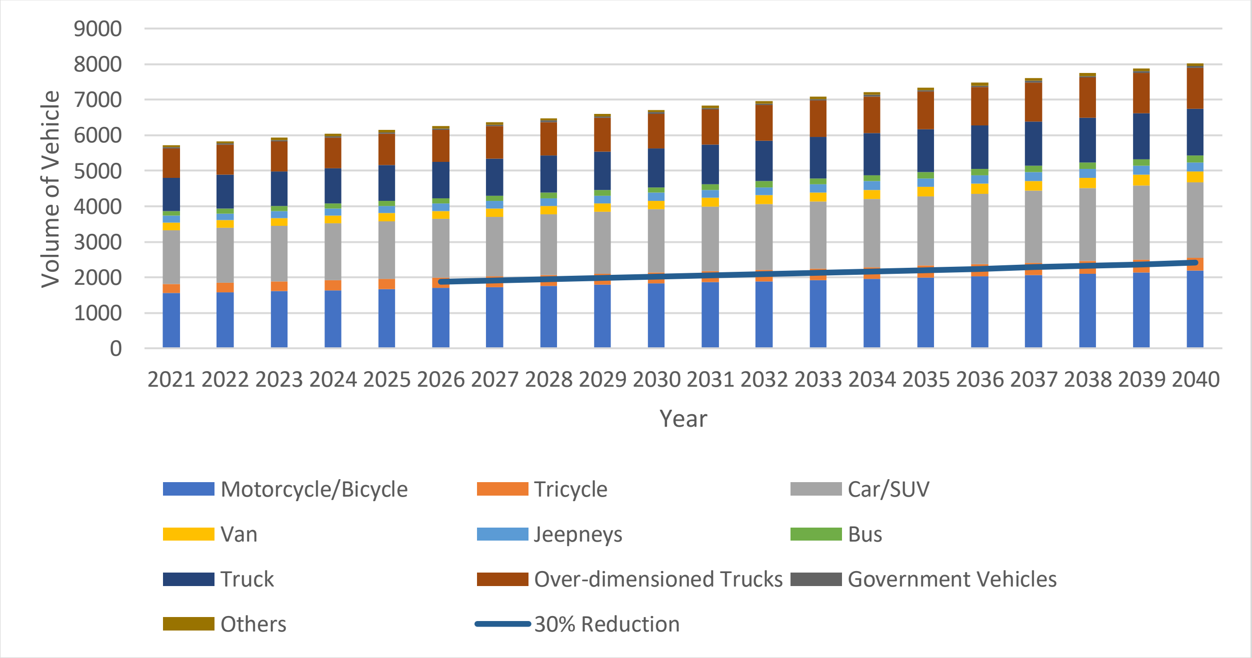
Peak hour traffic volume projection in west bound of Station 5 (with the Project)



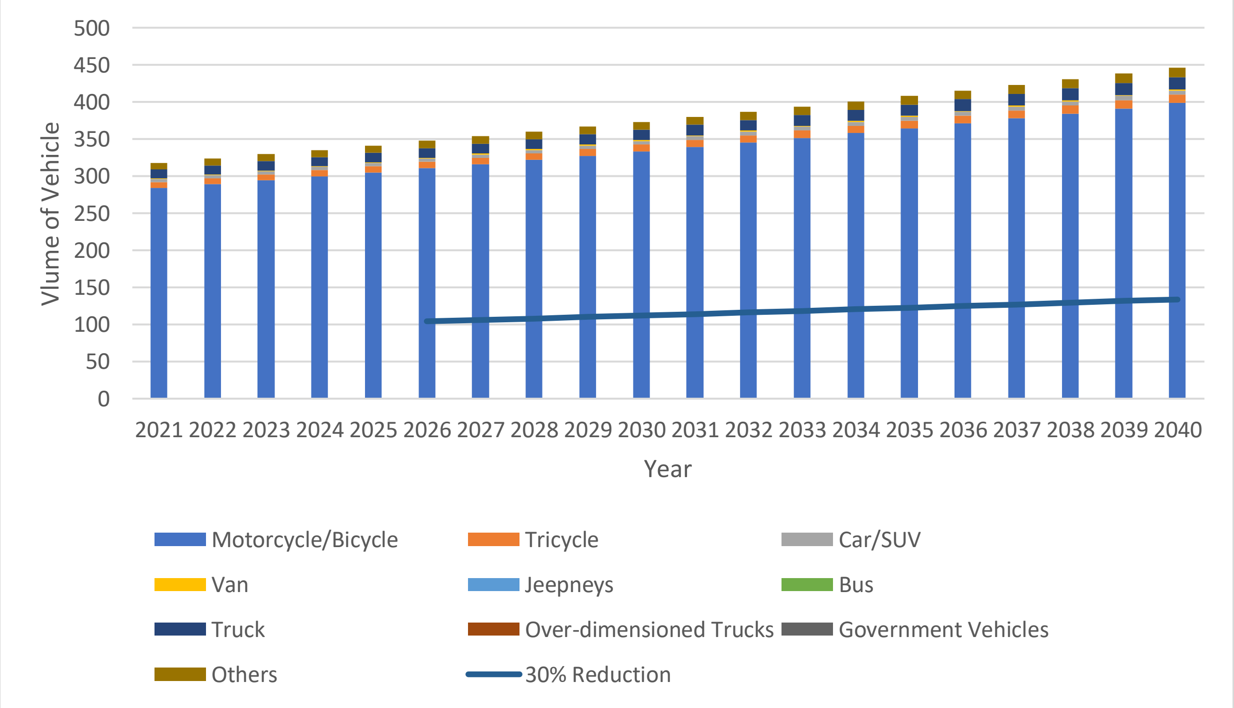
Peak hour traffic volume projection in nortg bound of Station 6 (with the Project)



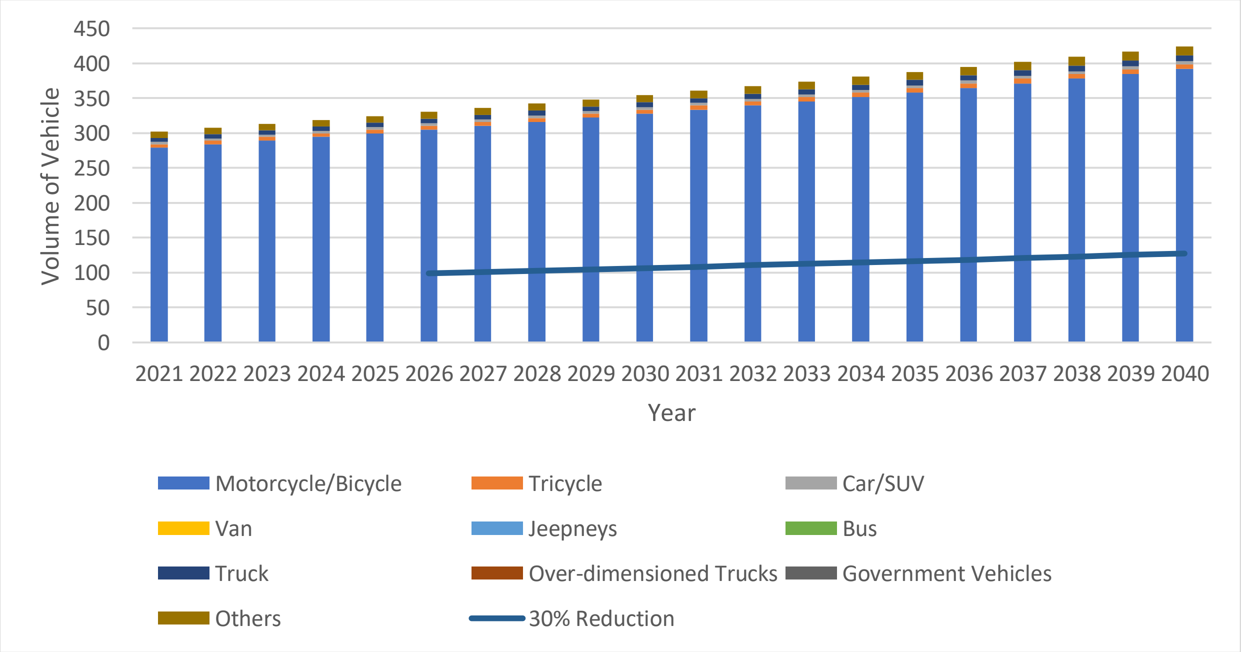
Peak hour traffic volume projection in south bound of Station 6 (with the Project)



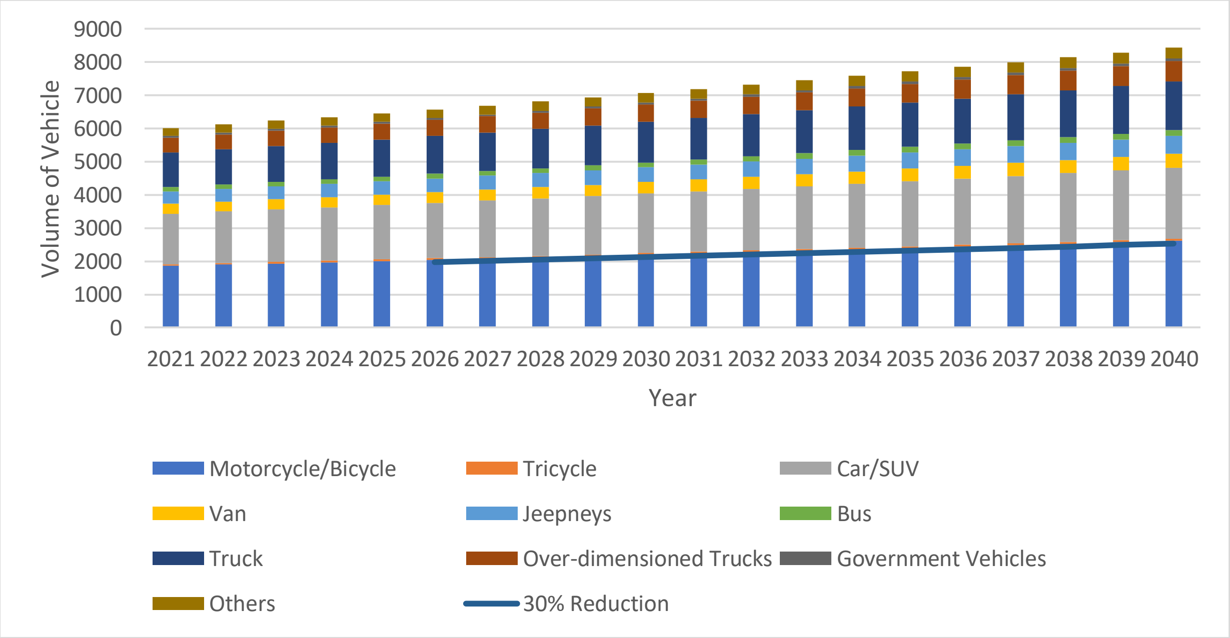
Peak hour traffic volume projection in north bound of Station 7 (with the Project)



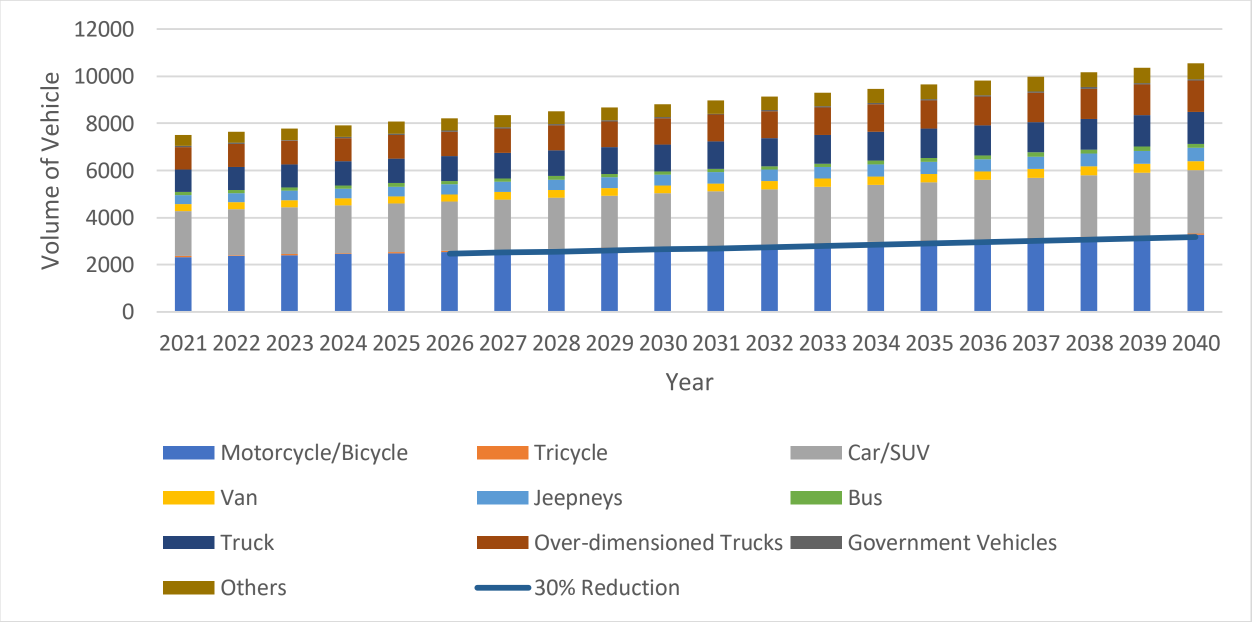
Peak hour traffic volume projection in south bound of Station 7 (with the Project)



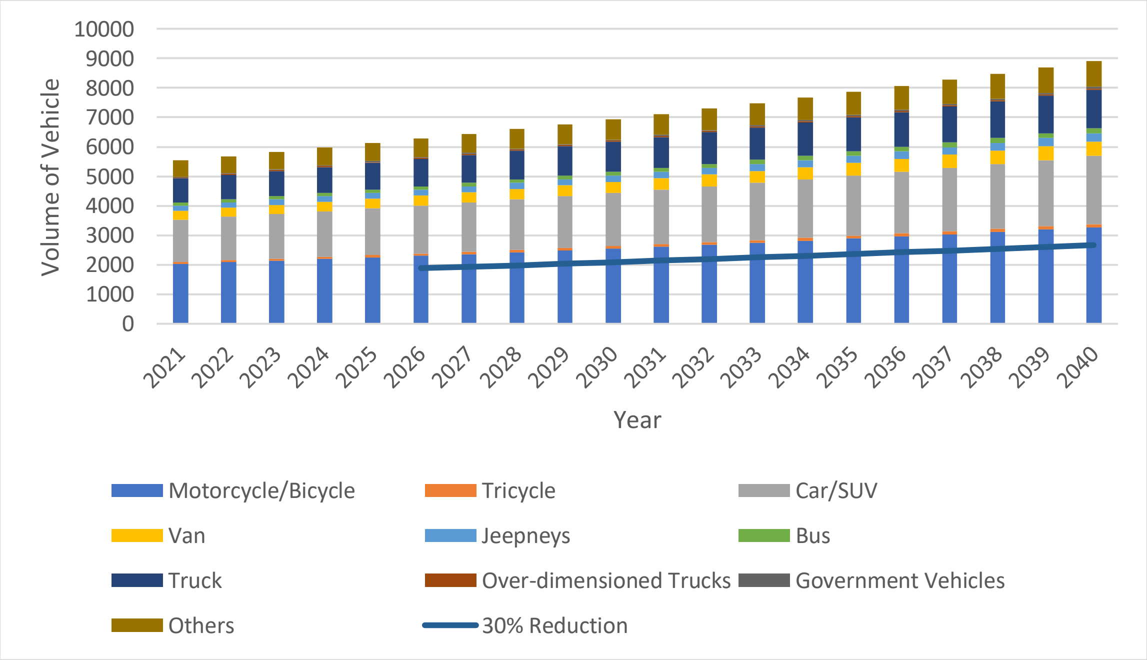
Peak hour traffic volume projection in north bound of Station 8 (with the Project)



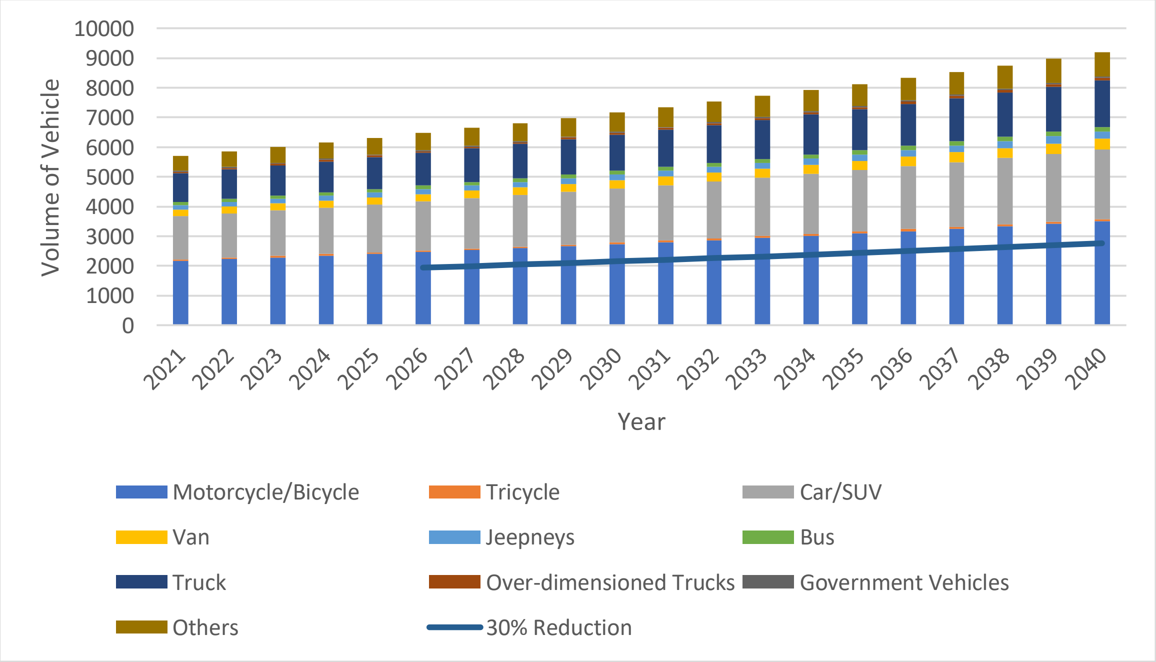
Peak hour traffic volume projection in south bound of Station 8 (with the Project)



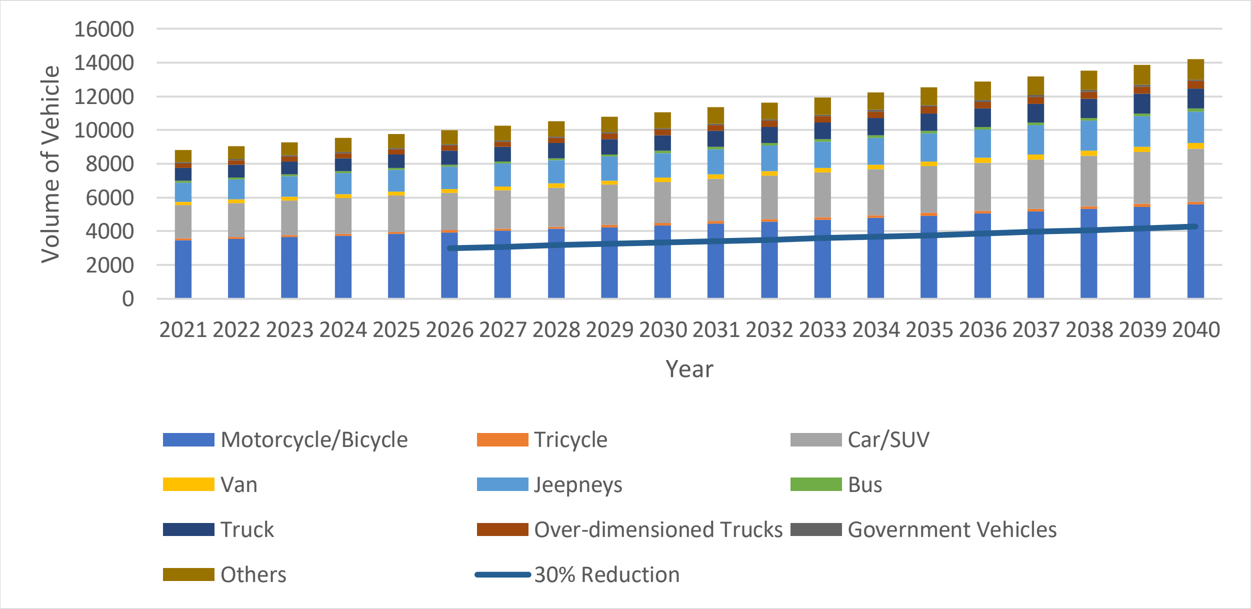
Peak hour traffic volume projection in north bound of Station 9 (with the Project)



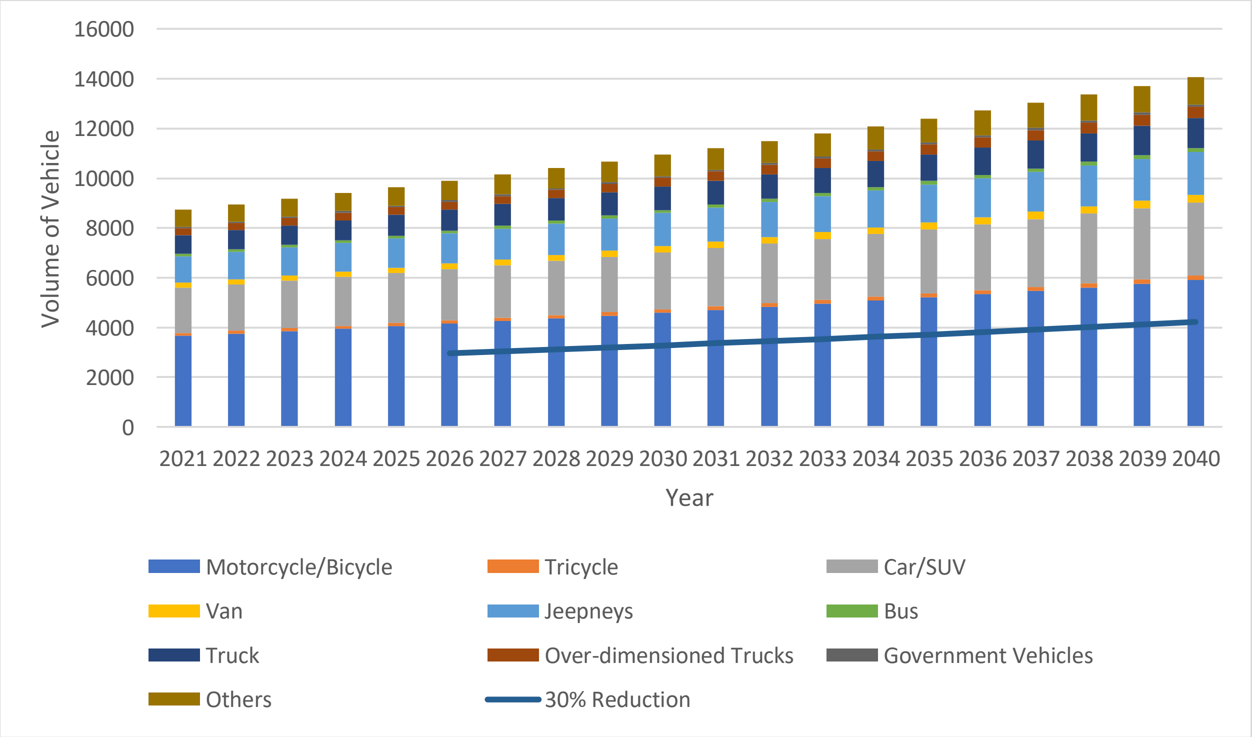
Peak hour traffic volume projection in south bound of Station 9 (with the Project)



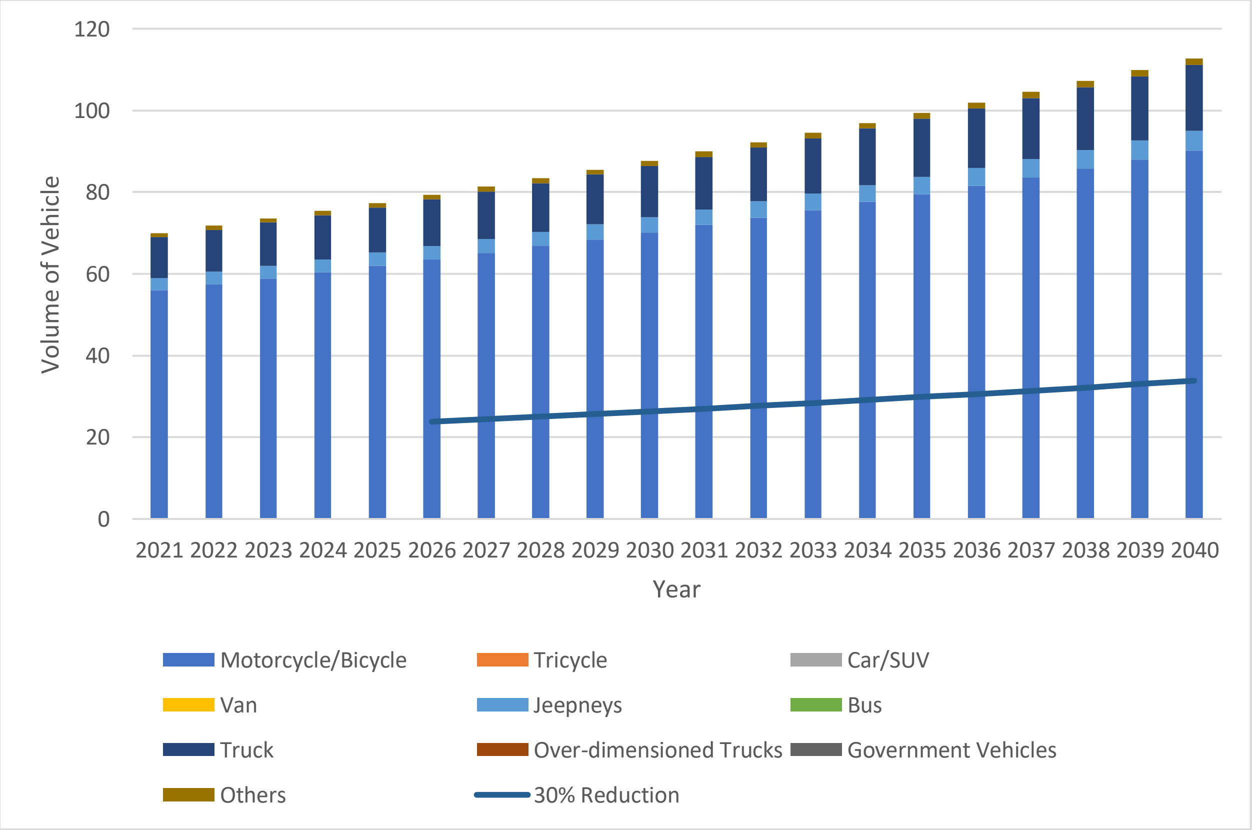
Peak hour traffic volume projection in north bound of Station 10 (with the Project)



Peak hour traffic volume projection in south bound of Station 10 (with the Project)



Peak hour traffic volume projection in west bound of Station 10 (with the Project)



Appendix 44. Level of Service of the peak hour

Level of service of the peak hour in the West Bound of Station 1

Peak hour (16:30-17:30)	Volume	Capacity	V/C	LOS
2021	1197	1800	0.67	C
2022	1228	1800	0.68	C
2023	1260	1800	0.70	C
2024	1293	1800	0.72	D
2025	1326	1800	0.74	D
2026	1361	1800	0.76	D
2027	1396	1800	0.78	D
2028	1433	1800	0.80	D
2029	1470	1800	0.82	D
2030	1508	1800	0.84	D
2031	1547	1800	0.86	E
2032	1588	1800	0.88	E
2033	1629	1800	0.90	E
2034	1671	1800	0.93	E
2035	1715	1800	0.95	E
2036	1759	1800	0.98	E
2037	1805	1800	1.00	F
2038	1852	1800	1.00	F
2039	1900	1800	1.00	F
2040	1949	1800	1.00	F

Level of Service of the peak hour in the East Bound of Station 1.

Peak hour (16:30-17:30)	Volume	Capacity	V/C	LOS
2021	1483	1800	0.82	D
2022	1522	1800	0.85	D
2023	1561	1800	0.87	E
2024	1602	1800	0.89	E
2025	1643	1800	0.91	E
2026	1686	1800	0.94	E
2027	1730	1800	0.96	E
2028	1775	1800	0.99	E
2029	1821	1800	1.00	F
2030	1868	1800	1.00	F
2031	1917	1800	1.00	F
2032	1967	1800	1.00	F
2033	2018	1800	1.00	F
2034	2070	1800	1.00	F
2035	2124	1800	1.00	F
2036	2179	1800	1.00	F
2037	2236	1800	1.00	F
2038	2294	1800	1.00	F
2039	2354	1800	1.00	F
2040	2415	1800	1.00	F

Level of Service of the peak hour in the North Bound of Station 2.

Peak hour (11:30-12:30)	Volume	Capacity	V/C	LOS
2021	24	900	0.03	A
2022	25	900	0.03	A
2023	25	900	0.03	A
2024	26	900	0.03	A
2025	27	900	0.03	A
2026	27	900	0.03	A
2027	28	900	0.03	A
2028	29	900	0.03	A
2029	29	900	0.03	A
2030	30	900	0.03	A
2031	31	900	0.03	A
2032	32	900	0.04	A
2033	33	900	0.04	A
2034	34	900	0.04	A
2035	34	900	0.04	A
2036	35	900	0.04	A
2037	36	900	0.04	A
2038	37	900	0.04	A
2039	38	900	0.04	A
2040	39	900	0.04	A

Level of Service of the peak hour in the South Bound of Station 2

Peak hour (16:30-17:30)	Volume	Capacity	V/C	LOS
2021	21	900	0.02	A
2022	22	900	0.02	A
2023	22	900	0.02	A
2024	23	900	0.03	A
2025	23	900	0.03	A
2026	24	900	0.03	A
2027	24	900	0.03	A
2028	25	900	0.03	A
2029	26	900	0.03	A
2030	26	900	0.03	A
2031	27	900	0.03	A
2032	28	900	0.03	A
2033	29	900	0.03	A
2034	29	900	0.03	A
2035	30	900	0.03	A
2036	31	900	0.03	A
2037	32	900	0.04	A
2038	32	900	0.04	A
2039	33	900	0.04	A
2040	34	900	0.04	A

Level of service of the peak hour in the West Bound of Station 2.

Peak hour (16:30-17:30)	Volume	Capacity	V/C	LOS
2021	5	900	0.01	A
2022	5	900	0.01	A
2023	5	900	0.01	A
2024	5	900	0.01	A
2025	6	900	0.01	A
2026	6	900	0.01	A
2027	6	900	0.01	A
2028	6	900	0.01	A
2029	6	900	0.01	A
2030	6	900	0.01	A
2031	6	900	0.01	A
2032	7	900	0.01	A
2033	7	900	0.01	A
2034	7	900	0.01	A
2035	7	900	0.01	A
2036	7	900	0.01	A
2037	8	900	0.01	A
2038	8	900	0.01	A
2039	8	900	0.01	A
2040	8	900	0.01	A

Level of service of the peak hour in the East Bound of Station 2

Peak hour (16:30-17:30)	Volume	Capacity	V/C	LOS
2021	22	900	0.02	A
2022	23	900	0.03	A
2023	23	900	0.03	A
2024	24	900	0.03	A
2025	24	900	0.03	A
2026	25	900	0.03	A
2027	26	900	0.03	A
2028	26	900	0.03	A
2029	27	900	0.03	A
2030	28	900	0.03	A
2031	28	900	0.03	A
2032	29	900	0.03	A
2033	30	900	0.03	A
2034	31	900	0.03	A
2035	32	900	0.04	A
2036	32	900	0.04	A
2037	33	900	0.04	A
2038	34	900	0.04	A
2039	35	900	0.04	A
2040	36	900	0.04	A

Level of Service of the peak hour in the North Bound of Station 3

Peak hour (6:30-7:30)	Volume	Capacity	V/C	LOS
2021	90	900	0.10	A
2022	92	900	0.10	A
2023	93	900	0.10	A
2024	95	900	0.11	A
2025	97	900	0.11	A
2026	99	900	0.11	A
2027	100	900	0.11	A
2028	102	900	0.11	A
2029	104	900	0.12	A
2030	106	900	0.12	A
2031	108	900	0.12	A
2032	110	900	0.12	A
2033	112	900	0.12	A
2034	114	900	0.13	A
2035	116	900	0.13	A
2036	118	900	0.13	A
2037	121	900	0.13	A
2038	123	900	0.14	A
2039	125	900	0.14	A
2040	127	900	0.14	A

Level of service of the peak hour in the West Bound of Station 3.

Peak hour (17:30-18:30)	Volume	Capacity	V/C	LOS
2021	40	900	0.04	A
2022	41	900	0.05	A
2023	41	900	0.05	A
2024	42	900	0.05	A
2025	43	900	0.05	A
2026	44	900	0.05	A
2027	45	900	0.05	A
2028	45	900	0.05	A
2029	46	900	0.05	A
2030	47	900	0.05	A
2031	48	900	0.05	A
2032	49	900	0.05	A
2033	50	900	0.06	A
2034	51	900	0.06	A
2035	52	900	0.06	A
2036	53	900	0.06	A
2037	54	900	0.06	A
2038	55	900	0.06	A
2039	56	900	0.06	A
2040	57	900	0.06	A

Level of Service of the peak hour in the South Bound of Station 3.

Peak hour (17:30-18:30)	Volume	Capacity	V/C	LOS
2021	22	900	0.02	A
2022	22	900	0.02	A
2023	23	900	0.03	A
2024	23	900	0.03	A
2025	24	900	0.03	A
2026	24	900	0.03	A
2027	25	900	0.03	A
2028	25	900	0.03	A
2029	25	900	0.03	A
2030	26	900	0.03	A
2031	26	900	0.03	A
2032	27	900	0.03	A
2033	27	900	0.03	A
2034	28	900	0.03	A
2035	28	900	0.03	A
2036	29	900	0.03	A
2037	29	900	0.03	A
2038	30	900	0.03	A
2039	31	900	0.03	A
2040	31	900	0.03	A

Level of Service of the peak hour in the North Bound of Station 4.

Peak hour (13:00-14:00)	Volume	Capacity	V/C	LOS
2021	756	900	0.84	D
2022	770	900	0.86	E
2023	784	900	0.87	E
2024	799	900	0.89	E
2025	814	900	0.90	E
2026	829	900	0.92	E
2027	844	900	0.94	E
2028	860	900	0.96	E
2029	875	900	0.97	E
2030	892	900	0.99	E
2031	908	900	1.00	F
2032	925	900	1.00	F
2033	942	900	1.00	F
2034	959	900	1.00	F
2035	977	900	1.00	F
2036	995	900	1.00	F
2037	1014	900	1.00	F
2038	1032	900	1.00	F
2039	1052	900	1.00	F
2040	1071	900	1.00	F

Level of Service of the peak hour in the South Bound of Station 4

Peak hour (13:00-14:00)	**Volume**	**Capacity**	**V/C**	**LOS**
2021	637	900	0.71	D
2022	649	900	0.72	D
2023	661	900	0.73	D
2024	673	900	0.75	D
2025	685	900	0.76	D
2026	698	900	0.78	D
2027	711	900	0.79	D
2028	724	900	0.80	D
2029	738	900	0.82	D
2030	751	900	0.83	D
2031	765	900	0.85	D
2032	779	900	0.87	E
2033	794	900	0.88	E
2034	808	900	0.90	E
2035	823	900	0.91	E
2036	839	900	0.93	E
2037	854	900	0.95	E
2038	870	900	0.97	E
2039	886	900	0.98	E
2040	902	900	1.00	E

Level of Service of the peak hour in the West Bound of Station 4

Peak hour (6:30-7:30)	**Volume**	**Capacity**	**V/C**	**LOS**
2021	51	900	0.06	A
2022	52	900	0.06	A
2023	53	900	0.06	A
2024	54	900	0.06	A
2025	55	900	0.06	A
2026	56	900	0.06	A
2027	57	900	0.06	A
2028	58	900	0.06	A
2029	59	900	0.07	A
2030	60	900	0.07	A
2031	61	900	0.07	A
2032	62	900	0.07	A
2033	64	900	0.07	A
2034	65	900	0.07	A
2035	66	900	0.07	A
2036	67	900	0.07	A
2037	68	900	0.08	A
2038	70	900	0.08	A
2039	71	900	0.08	A
2040	72	900	0.08	A

Level of Service of the peak hour in the East Bound of Station 4.

Peak hour (6:30-7:30)	Volume	Capacity	V/C	LOS
2021	62	900	0.07	A
2022	63	900	0.07	A
2023	64	900	0.07	A
2024	66	900	0.07	A
2025	67	900	0.07	A
2026	68	900	0.08	A
2027	69	900	0.08	A
2028	70	900	0.08	A
2029	72	900	0.08	A
2030	73	900	0.08	A
2031	74	900	0.08	A
2032	76	900	0.08	A
2033	77	900	0.09	A
2034	79	900	0.09	A
2035	80	900	0.09	A
2036	82	900	0.09	A
2037	83	900	0.09	A
2038	85	900	0.09	A
2039	86	900	0.10	A
2040	88	900	0.10	A

Level of Service of the peak hour in the North Bound of Station 5

Peak hour (17:30-18:30)	Volume	Capacity	V/C	LOS
2021	24	900	0.03	A
2022	24	900	0.03	A
2023	25	900	0.03	A
2024	25	900	0.03	A
2025	25	900	0.03	A
2026	26	900	0.03	A
2027	26	900	0.03	A
2028	27	900	0.03	A
2029	27	900	0.03	A
2030	27	900	0.03	A
2031	28	900	0.03	A
2032	28	900	0.03	A
2033	28	900	0.03	A
2034	29	900	0.03	A
2035	29	900	0.03	A
2036	30	900	0.03	A
2037	30	900	0.03	A
2038	31	900	0.03	A
2039	31	900	0.03	A
2040	31	900	0.03	A

Level of Service of the peak hour in the East Bound of Station 5

Peak hour (16:30-17:30)	Volume	Capacity	V/C	LOS
2021	23	900	0.03	A

2022	23	900	0.03	A
2023	24	900	0.03	A
2024	24	900	0.03	A
2025	24	900	0.03	A
2026	25	900	0.03	A
2027	25	900	0.03	A
2028	25	900	0.03	A
2029	26	900	0.03	A
2030	26	900	0.03	A
2031	27	900	0.03	A
2032	27	900	0.03	A
2033	27	900	0.03	A
2034	28	900	0.03	A
2035	28	900	0.03	A
2036	28	900	0.03	A
2037	29	900	0.03	A
2038	29	900	0.03	A
2039	30	900	0.03	A
2040	30	900	0.03	A

Level of Service of the peak hour in the West Bound of Station 5

Peak hour (8:30-9:30)	**Volume**	**Capacity**	**V/C**	**LOS**
2021	48	900	0.05	A
2022	49	900	0.05	A
2023	49	900	0.05	A
2024	50	900	0.06	A
2025	51	900	0.06	A
2026	52	900	0.06	A
2027	52	900	0.06	A
2028	53	900	0.06	A
2029	54	900	0.06	A
2030	55	900	0.06	A
2031	55	900	0.06	A
2032	56	900	0.06	A
2033	57	900	0.06	A
2034	58	900	0.06	A
2035	59	900	0.07	A
2036	59	900	0.07	A
2037	60	900	0.07	A
2038	61	900	0.07	A
2039	62	900	0.07	A
2040	63	900	0.07	A

Level of Service of the peak hour in the North Bound of Station 6

Peak hour (17:30-18:30)	**Volume**	**Capacity**	**V/C**	**LOS**
2021	636	1800	0.35	B
2022	647	1800	0.36	B
2023	659	1800	0.37	B

2024	671	1800	0.37	B
2025	683	1800	0.38	B
2026	695	1800	0.39	B
2027	708	1800	0.39	B
2028	721	1800	0.40	B
2029	734	1800	0.41	B
2030	747	1800	0.41	B
2031	760	1800	0.42	B
2032	774	1800	0.43	B
2033	788	1800	0.44	B
2034	802	1800	0.45	B
2035	816	1800	0.45	B
2036	831	1800	0.46	B
2037	846	1800	0.47	B
2038	861	1800	0.48	B
2039	877	1800	0.49	B
2040	893	1800	0.50	B

Level of Service of the peak hour in the South Bound of Station 6.

Peak hour (16:30-17:30)	**Volume**	**Capacity**	**V/C**	**LOS**
2021	427	1800	0.24	B
2022	435	1800	0.24	B
2023	443	1800	0.25	B
2024	450	1800	0.25	B
2025	459	1800	0.25	B
2026	467	1800	0.26	B
2027	475	1800	0.26	B
2028	484	1800	0.27	B
2029	493	1800	0.27	B
2030	501	1800	0.28	B
2031	510	1800	0.28	B
2032	520	1800	0.29	B
2033	529	1800	0.29	B
2034	538	1800	0.30	B
2035	548	1800	0.30	B
2036	558	1800	0.31	B
2037	568	1800	0.32	B
2038	578	1800	0.32	B
2039	589	1800	0.33	B
2040	599	1800	0.33	B

Level of Service of the peak hour in the North Bound of Station 7

Peak hour (12:45-13:45)	**Volume**	**Capacity**	**V/C**	**LOS**
2021	38	1800	0.02	A
2022	39	1800	0.02	A
2023	39	1800	0.02	A

2024	40	1800	0.02	A
2025	41	1800	0.02	A
2026	42	1800	0.02	A
2027	42	1800	0.02	A
2028	43	1800	0.02	A
2029	44	1800	0.02	A
2030	45	1800	0.02	A
2031	45	1800	0.03	A
2032	46	1800	0.03	A
2033	47	1800	0.03	A
2034	48	1800	0.03	A
2035	49	1800	0.03	A
2036	50	1800	0.03	A
2037	51	1800	0.03	A
2038	51	1800	0.03	A
2039	52	1800	0.03	A
2040	53	1800	0.03	A

Level of Service of the peak hour in the South Bound of Station 7.

Peak hour (7:45-8:45)	Volume	Capacity	V/C	LOS
2021	34	1800	0.02	A
2022	35	1800	0.02	A
2023	35	1800	0.02	A
2024	36	1800	0.02	A
2025	37	1800	0.02	A
2026	37	1800	0.02	A
2027	38	1800	0.02	A
2028	39	1800	0.02	A
2029	39	1800	0.02	A
2030	40	1800	0.02	A
2031	41	1800	0.02	A
2032	41	1800	0.02	A
2033	42	1800	0.02	A
2034	43	1800	0.02	A
2035	44	1800	0.02	A
2036	44	1800	0.02	A
2037	45	1800	0.03	A
2038	46	1800	0.03	A
2039	47	1800	0.03	A
2040	48	1800	0.03	A

Level of Service of the peak hour in the North Bound of Station 8

Peak hour (12:45-13:45)	Volume	Capacity	V/C	LOS
2021	733	1800	0.41	B
2022	746	1800	0.41	B
2023	760	1800	0.42	B
2024	773	1800	0.43	B
2025	787	1800	0.44	B

2026	801	1800	0.45	B
2027	816	1800	0.45	B
2028	830	1800	0.46	B
2029	845	1800	0.47	B
2030	861	1800	0.48	B
2031	876	1800	0.49	B
2032	892	1800	0.50	B
2033	908	1800	0.50	B
2034	924	1800	0.51	C
2035	941	1800	0.52	C
2036	958	1800	0.53	C
2037	975	1800	0.54	C
2038	993	1800	0.55	C
2039	1011	1800	0.56	C
2040	1029	1800	0.57	C

Level of Service of the peak hour in the South Bound of Station 8.

Peak hour (7:45-8:45)	**Volume**	**Capacity**	**V/C**	**LOS**
2021	771	1800	0.43	B
2022	785	1800	0.44	B
2023	799	1800	0.44	B
2024	813	1800	0.45	B
2025	828	1800	0.46	B
2026	843	1800	0.47	B
2027	858	1800	0.48	B
2028	874	1800	0.49	B
2029	889	1800	0.49	B
2030	905	1800	0.50	B
2031	922	1800	0.51	C
2032	938	1800	0.52	C
2033	955	1800	0.53	C
2034	972	1800	0.54	C
2035	990	1800	0.55	C
2036	1008	1800	0.56	C
2037	1026	1800	0.57	C
2038	1044	1800	0.58	C
2039	1063	1800	0.59	C
2040	1082	1800	0.60	C

Level of Service of the peak hour in the North Bound of Station 9

Peak hour (10:35-11:35)	**Volume**	**Capacity**	**V/C**	**LOS**
2021	594	1800	0.33	B
2022	609	1800	0.34	B
2023	625	1800	0.35	B
2024	640	1800	0.36	B
2025	657	1800	0.36	B
2026	673	1800	0.37	B

2027	690	1800	0.38	B
2028	708	1800	0.39	B
2029	726	1800	0.40	B
2030	744	1800	0.41	B
2031	763	1800	0.42	B
2032	783	1800	0.43	B
2033	803	1800	0.45	B
2034	823	1800	0.46	B
2035	844	1800	0.47	B
2036	865	1800	0.48	B
2037	887	1800	0.49	B
2038	910	1800	0.51	C
2039	933	1800	0.52	C
2040	957	1800	0.53	C

Level of Service of the peak hour in the South Bound of Station 9

Peak hour (16:35-17:35)	Volume	Capacity	V/C	LOS
2021	456	1800	0.25	B
2022	468	1800	0.26	B
2023	479	1800	0.27	B
2024	492	1800	0.27	B
2025	504	1800	0.28	B
2026	517	1800	0.29	B
2027	530	1800	0.29	B
2028	544	1800	0.30	B
2029	557	1800	0.31	B
2030	571	1800	0.32	B
2031	586	1800	0.33	B
2032	601	1800	0.33	B
2033	616	1800	0.34	B
2034	632	1800	0.35	B
2035	648	1800	0.36	B
2036	664	1800	0.37	B
2037	681	1800	0.38	B
2038	698	1800	0.39	B
2039	716	1800	0.40	B
2040	734	1800	0.41	B

Level of Service of the peak hour in the South Bound of Station 10.

Peak hour (10:35-11:35)	Volume	Capacity	V/C	LOS
2021	677	1800	0.38	B
2022	694	1800	0.39	B
2023	712	1800	0.40	B
2024	730	1800	0.41	B
2025	748	1800	0.42	B
2026	767	1800	0.43	B

2027	787	1800	0.44	B
2028	807	1800	0.45	B
2029	827	1800	0.46	B
2030	848	1800	0.47	B
2031	870	1800	0.48	B
2032	892	1800	0.50	B
2033	915	1800	0.51	C
2034	938	1800	0.52	C
2035	962	1800	0.53	C
2036	986	1800	0.55	C
2037	1011	1800	0.56	C
2038	1037	1800	0.58	C
2039	1063	1800	0.59	C
2040	1090	1800	0.61	C

Level of Service of the peak hour in the North Bound of Station 10

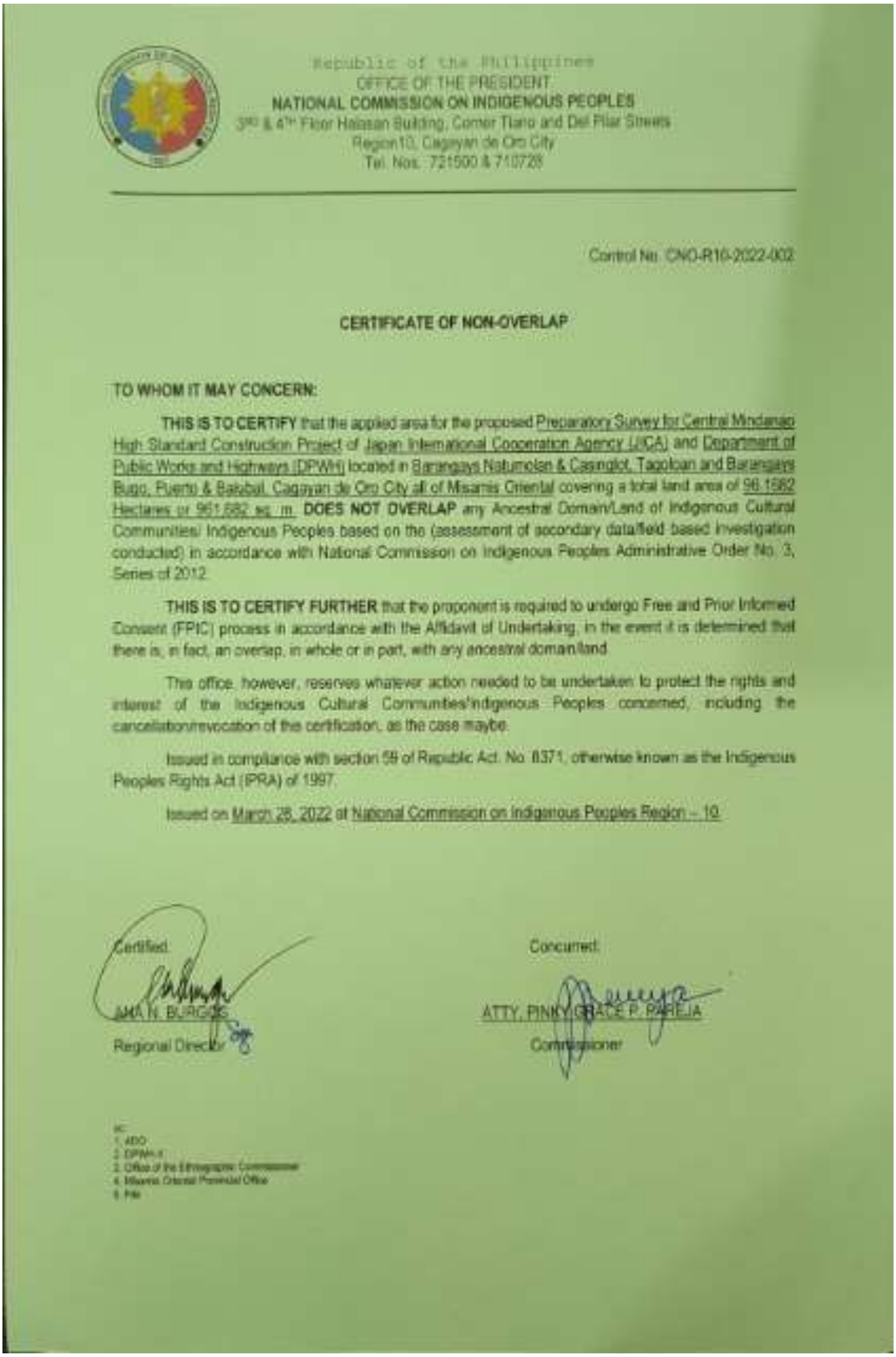
Peak hour (16:35-17:35)	Volume	Capacity	V/C	LOS
2021	719	1800	0.40	B
2022	737	1800	0.41	B
2023	756	1800	0.42	B
2024	775	1800	0.43	B
2025	795	1800	0.44	B
2026	815	1800	0.45	B
2027	836	1800	0.46	B
2028	857	1800	0.48	B
2029	879	1800	0.49	B
2030	901	1800	0.50	B
2031	924	1800	0.51	C
2032	947	1800	0.53	C
2033	972	1800	0.54	C
2034	996	1800	0.55	C
2035	1021	1800	0.57	C
2036	1047	1800	0.58	C
2037	1074	1800	0.60	C
2038	1101	1800	0.61	C
2039	1129	1800	0.63	C
2040	1158	1800	0.64	C

Level of Service of the peak hour in the West Bound of Station 10

Peak hour (16:35-17:35)	Volume	Capacity	V/C	LOS
2021	14	1800	0.01	A
2022	14	1800	0.01	A
2023	15	1800	0.01	A
2024	15	1800	0.01	A
2025	15	1800	0.01	A
2026	16	1800	0.01	A
2027	16	1800	0.01	A
2028	17	1800	0.01	A

2029	17	1800	0.01	A
2030	18	1800	0.01	A
2031	18	1800	0.01	A
2032	18	1800	0.01	A
2033	19	1800	0.01	A
2034	19	1800	0.01	A
2035	20	1800	0.01	A
2036	20	1800	0.01	A
2037	21	1800	0.01	A
2038	21	1800	0.01	A
2039	22	1800	0.01	A
2040	23	1800	0.01	A

Appendix 45. Certificate of No Overlap and Work Order for FPIC



Republic of the Philippines
OFFICE OF THE PRESIDENT
NATIONAL COMMISSION ON INDIGENOUS PEOPLES
3RD & 4TH Floor Halasan Building, Corner Tiano and Del Pilar Streets
Region10, Cagayan de Oro City
Tel. Nos. 721500 & 710728

Control No. CNO-R10-2022-002

CERTIFICATE OF NON-OVERLAP

TO WHOM IT MAY CONCERN:

THIS IS TO CERTIFY that the applied area for the proposed Preparatory Survey for Central Mindanao High Standard Construction Project of Japan International Cooperation Agency (JICA) and Department of Public Works and Highways (DPWH) located in Barangays Natumolan & Casinglot, Tagoloan and Barangays Bugo, Puerto & Balubal, Cagayan de Oro City all of Misamis Oriental covering a total land area of 96.1582 Hectares or 961,582 sq. m. **DOES NOT OVERLAP** any Ancestral Domain/Land of Indigenous Cultural Communities/ Indigenous Peoples based on the (assessment of secondary data/field based investigation conducted) in accordance with National Commission on Indigenous Peoples Administrative Order No. 3, Series of 2012.

THIS IS TO CERTIFY FURTHER that the proponent is required to undergo Free and Prior Informed Consent (FPIC) process in accordance with the Affidavit of Undertaking, in the event it is determined that there is, in fact, an overlap, in whole or in part, with any ancestral domain/land.

This office, however, reserves whatever action needed to be undertaken to protect the rights and interest of the Indigenous Cultural Communities/Indigenous Peoples concerned, including the cancellation/revocation of this certification, as the case maybe.

Issued in compliance with section 59 of Republic Act. No. 8371, otherwise known as the Indigenous Peoples Rights Act (IPRA) of 1997.

Issued on March 28, 2022 at National Commission on Indigenous Peoples Region – 10.

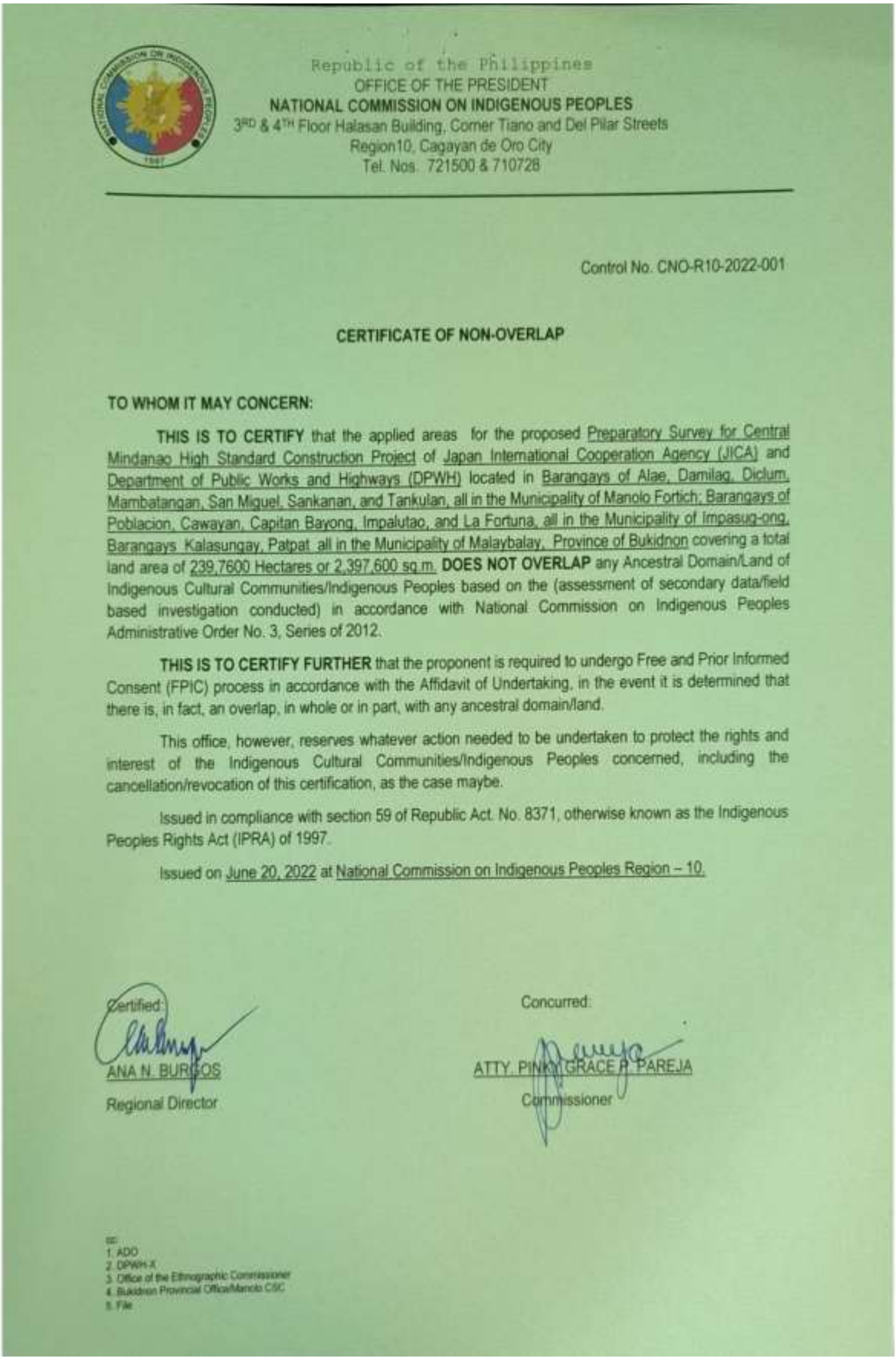
Certified:

AMA N. BURGOS
Regional Director

Concurred:

ATTY. PINKY GRACE P. PAREJA
Commissioner

cc:
1. ADO
2. DPWH-X
3. Office of the Ethnographic Commissioner
4. Misamis Oriental Provincial Office
5. File



Republic of the Philippines
OFFICE OF THE PRESIDENT
NATIONAL COMMISSION ON INDIGENOUS PEOPLES
3RD & 4TH Floor Halasan Building, Corner Tiano and Del Pilar Streets
Region10, Cagayan de Oro City
Tel. Nos. 721500 & 710728

Control No. CNO-R10-2022-001

CERTIFICATE OF NON-OVERLAP

TO WHOM IT MAY CONCERN:

THIS IS TO CERTIFY that the applied areas for the proposed Preparatory Survey for Central Mindanao High Standard Construction Project of Japan International Cooperation Agency (JICA) and Department of Public Works and Highways (DPWH) located in Barangays of Alae, Damilag, Diclum, Mambatangan, San Miguel, Sankanan, and Tankulan, all in the Municipality of Manolo Fortich; Barangays of Poblacion, Cawayan, Capitan Bayong, Impalutao, and La Fortuna, all in the Municipality of Impasug-ong, Barangays Kalasungay, Patpat all in the Municipality of Malaybalay, Province of Bukidnon covering a total land area of 239.7600 Hectares or 2,397,600 sq.m. **DOES NOT OVERLAP** any Ancestral Domain/Land of Indigenous Cultural Communities/Indigenous Peoples based on the (assessment of secondary data/field based investigation conducted) in accordance with National Commission on Indigenous Peoples Administrative Order No. 3, Series of 2012.

THIS IS TO CERTIFY FURTHER that the proponent is required to undergo Free and Prior Informed Consent (FPIC) process in accordance with the Affidavit of Undertaking, in the event it is determined that there is, in fact, an overlap, in whole or in part, with any ancestral domain/land.

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Issued in compliance with section 59 of Republic Act. No. 8371, otherwise known as the Indigenous Peoples Rights Act (IPRA) of 1997.

Issued on June 20, 2022 at National Commission on Indigenous Peoples Region – 10.

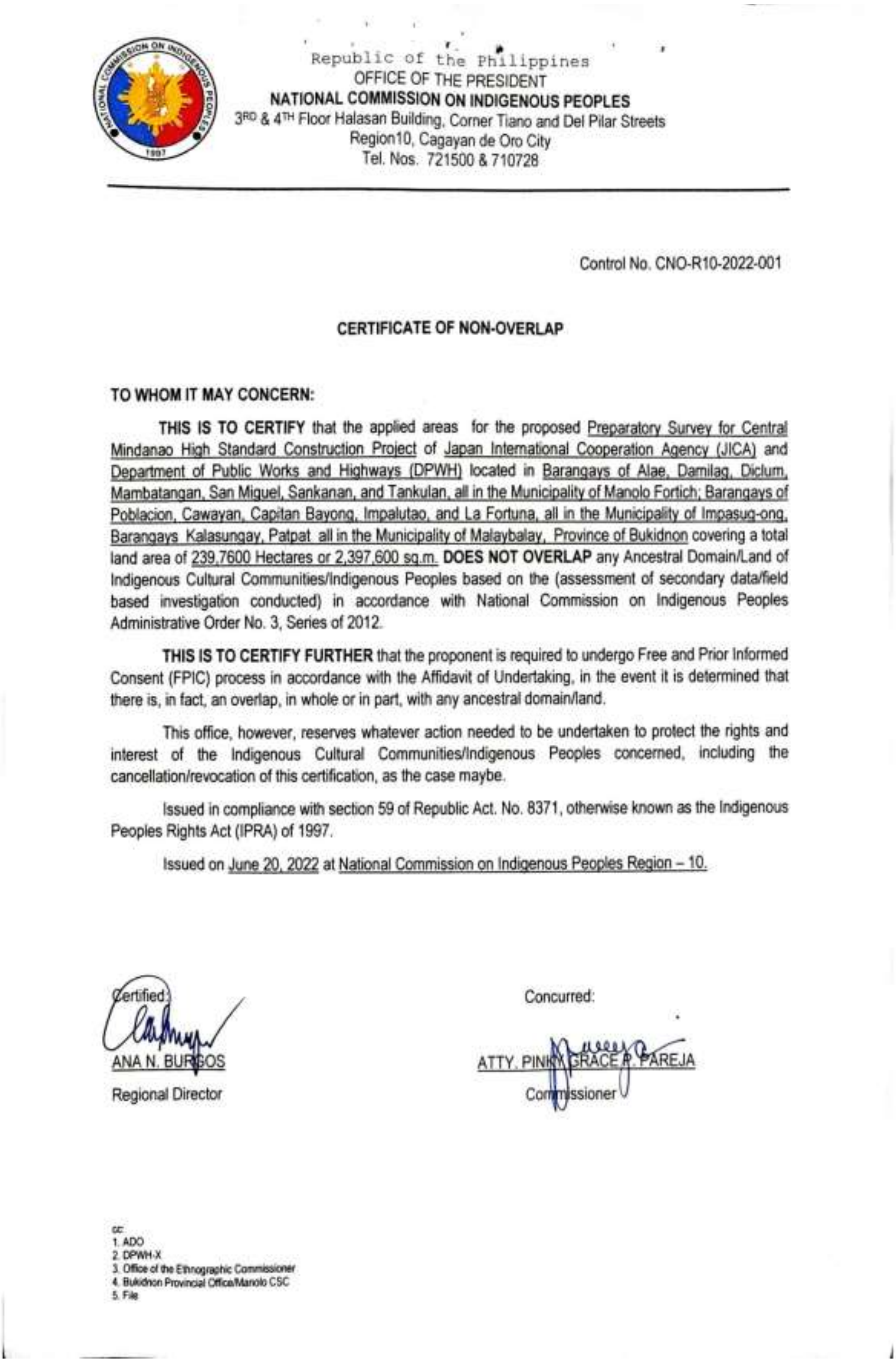
Certified:

ANA N. BURGOS
Regional Director

Concurred:

ATTY. PINKY GRACE P. PAREJA
Commissioner

cc:
1. ADO
2. DPWH-X
3. Office of the Ethnographic Commissioner
4. Bukidnon Provincial Office/Manolo CSC
5. File



Republic of the Philippines
OFFICE OF THE PRESIDENT
NATIONAL COMMISSION ON INDIGENOUS PEOPLES
3RD & 4TH Floor Halasan Building, Corner Tiano and Del Pilar Streets
Region10, Cagayan de Oro City
Tel. Nos. 721500 & 710728

Control No. CNO-R10-2022-001

CERTIFICATE OF NON-OVERLAP

TO WHOM IT MAY CONCERN:

THIS IS TO CERTIFY that the applied areas for the proposed Preparatory Survey for Central Mindanao High Standard Construction Project of Japan International Cooperation Agency (JICA) and Department of Public Works and Highways (DPWH) located in Barangays of Alae, Damilag, Diclum, Mambatangan, San Miguel, Sankanan, and Tankulan, all in the Municipality of Manolo Fortich; Barangays of Poblacion, Cawayan, Capitan Bayong, Impalutao, and La Fortuna, all in the Municipality of Impasug-ong, Barangays Kalasungay, Patpat all in the Municipality of Malaybalay, Province of Bukidnon covering a total land area of 239.7600 Hectares or 2,397,600 sq.m. **DOES NOT OVERLAP** any Ancestral Domain/Land of Indigenous Cultural Communities/Indigenous Peoples based on the (assessment of secondary data/field based investigation conducted) in accordance with National Commission on Indigenous Peoples Administrative Order No. 3, Series of 2012.

THIS IS TO CERTIFY FURTHER that the proponent is required to undergo Free and Prior Informed Consent (FPIC) process in accordance with the Affidavit of Undertaking, in the event it is determined that there is, in fact, an overlap, in whole or in part, with any ancestral domain/land.

This office, however, reserves whatever action needed to be undertaken to protect the rights and interest of the Indigenous Cultural Communities/Indigenous Peoples concerned, including the cancellation/revocation of this certification, as the case maybe.

Issued in compliance with section 59 of Republic Act. No. 8371, otherwise known as the Indigenous Peoples Rights Act (IPRA) of 1997.

Issued on June 20, 2022 at National Commission on Indigenous Peoples Region – 10.

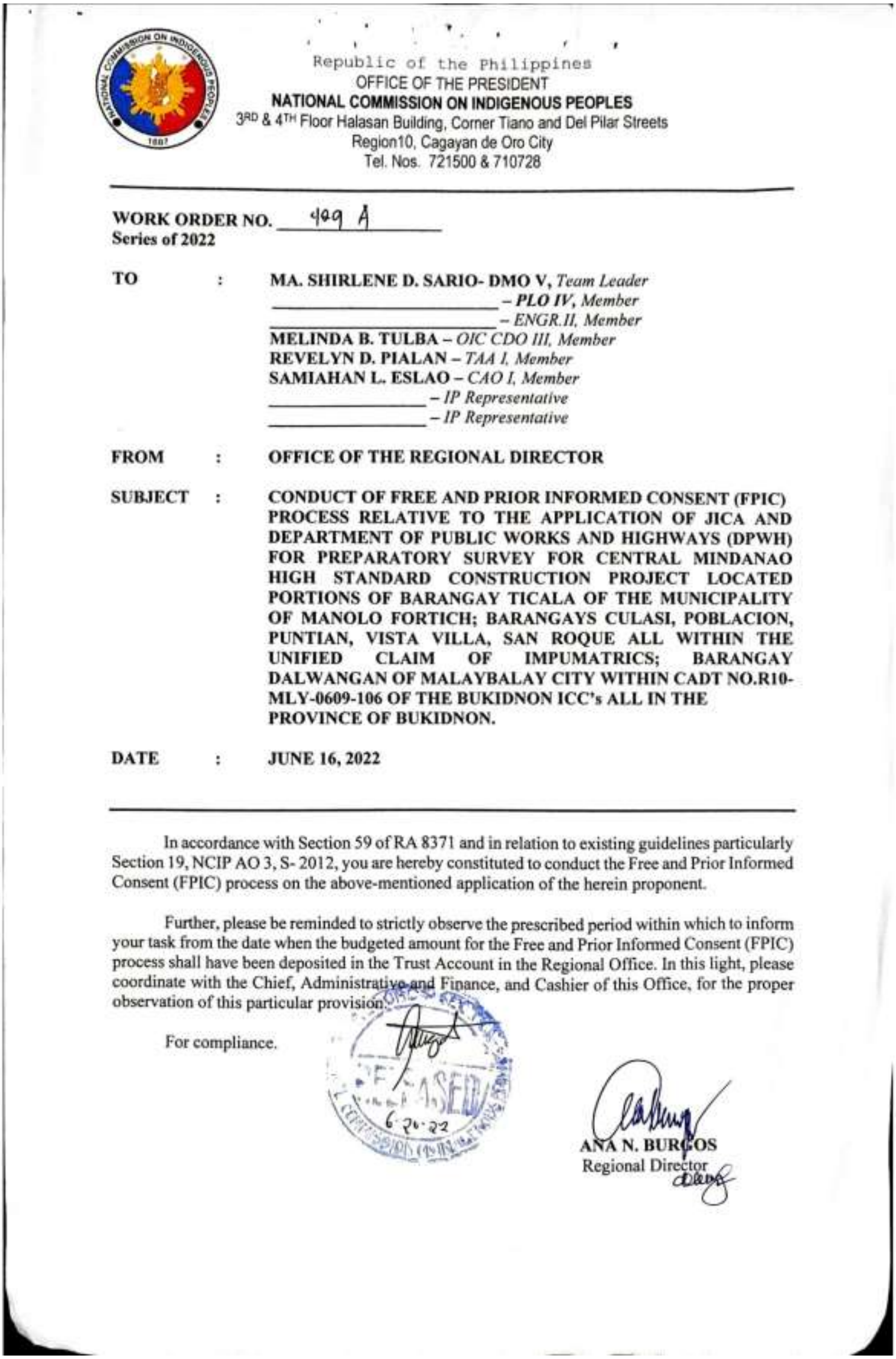
Certified:

ANA N. BURGOS
Regional Director

Concurred:

ATTY. PINKY GRACE P. PAREJA
Commissioner

cc:
1. ADO
2. DPWH-X
3. Office of the Ethnographic Commissioner
4. Bukidnon Provincial Office/Manolo CSC
5. File



Republic of the Philippines
OFFICE OF THE PRESIDENT
NATIONAL COMMISSION ON INDIGENOUS PEOPLES
3RD & 4TH Floor Halasan Building, Corner Tiano and Del Pilar Streets
Region10, Cagayan de Oro City
Tel. Nos. 721500 & 710728

WORK ORDER NO. 409 A
Series of 2022

TO : **MA. SHIRLENE D. SARIO- DMO V,** *Team Leader*
______________________ – ***PLO IV**, Member*
______________________ – *ENGR.II, Member*
MELINDA B. TULBA – *OIC CDO III, Member*
REVELYN D. PIALAN – *TAA I, Member*
SAMIAHAN L. ESLAO – *CAO I, Member*
________________ – *IP Representative*
________________ – *IP Representative*

FROM : **OFFICE OF THE REGIONAL DIRECTOR**

SUBJECT : **CONDUCT OF FREE AND PRIOR INFORMED CONSENT (FPIC) PROCESS RELATIVE TO THE APPLICATION OF JICA AND DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS (DPWH) FOR PREPARATORY SURVEY FOR CENTRAL MINDANAO HIGH STANDARD CONSTRUCTION PROJECT LOCATED PORTIONS OF BARANGAY TICALA OF THE MUNICIPALITY OF MANOLO FORTICH; BARANGAYS CULASI, POBLACION, PUNTIAN, VISTA VILLA, SAN ROQUE ALL WITHIN THE UNIFIED CLAIM OF IMPUMATRICS; BARANGAY DALWANGAN OF MALAYBALAY CITY WITHIN CADT NO.R10-MLY-0609-106 OF THE BUKIDNON ICC's ALL IN THE PROVINCE OF BUKIDNON.**

DATE : **JUNE 16, 2022**

In accordance with Section 59 of RA 8371 and in relation to existing guidelines particularly Section 19, NCIP AO 3, S- 2012, you are hereby constituted to conduct the Free and Prior Informed Consent (FPIC) process on the above-mentioned application of the herein proponent.

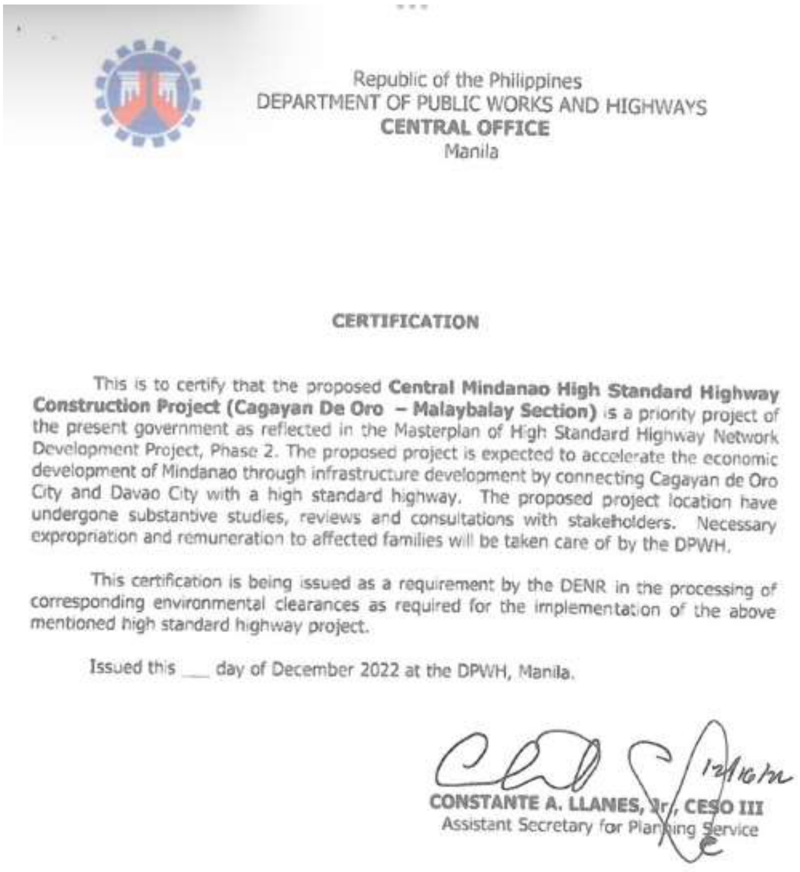
Further, please be reminded to strictly observe the prescribed period within which to inform your task from the date when the budgeted amount for the Free and Prior Informed Consent (FPIC) process shall have been deposited in the Trust Account in the Regional Office. In this light, please coordinate with the Chief, Administrative and Finance, and Cashier of this Office, for the proper observation of this particular provision.

For compliance.

RELEASED
6-20-22

ANA N. BURGOS
Regional Director

Appendix 46. CMH Certification as Masterplan of High Standard Highway Development Project Phase 2



Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

CERTIFICATION

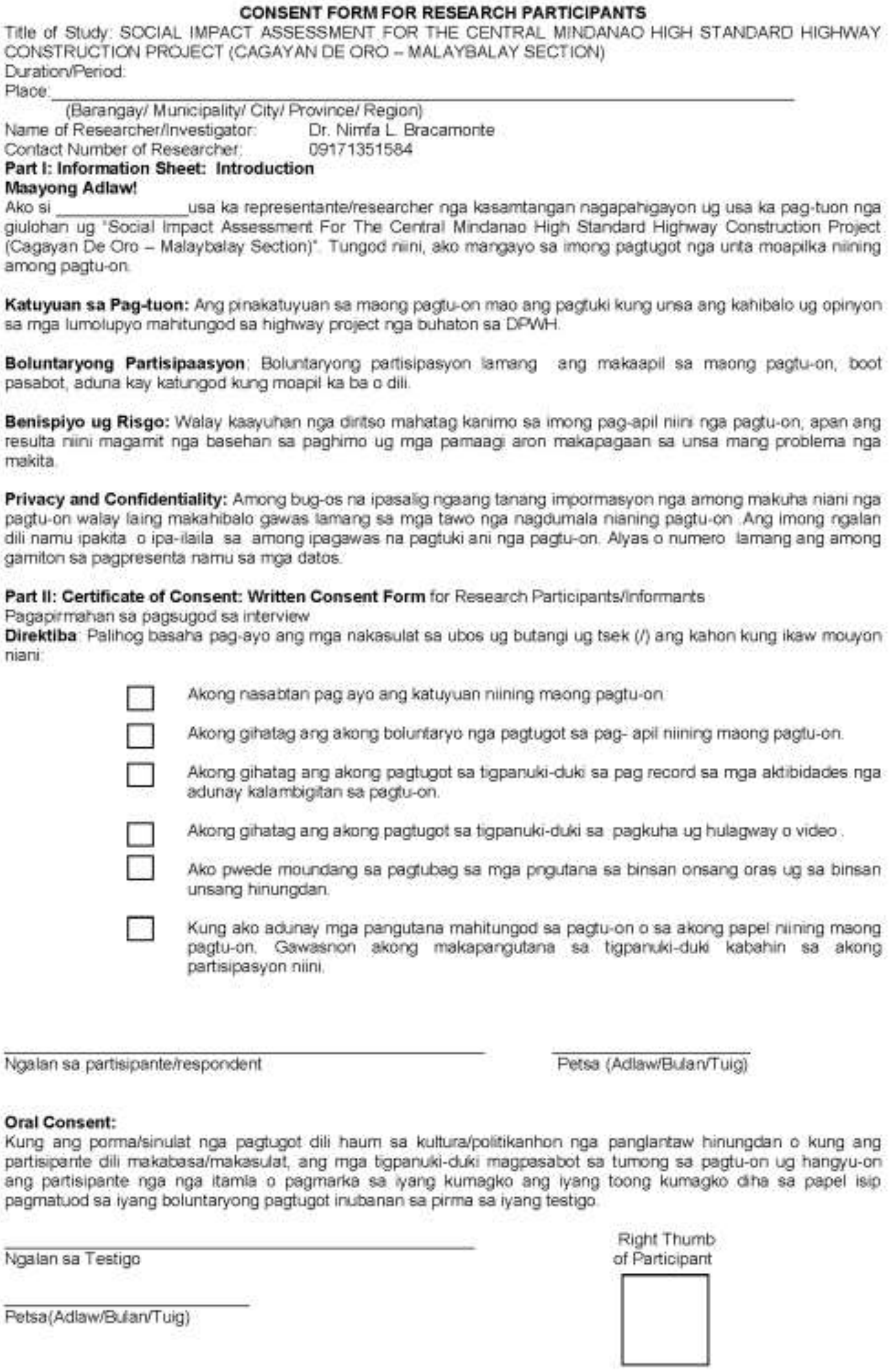
This is to certify that the proposed **Central Mindanao High Standard Highway Construction Project (Cagayan De Oro – Malaybalay Section)** is a priority project of the present government as reflected in the Masterplan of High Standard Highway Network Development Project, Phase 2. The proposed project is expected to accelerate the economic development of Mindanao through infrastructure development by connecting Cagayan de Oro City and Davao City with a high standard highway. The proposed project location have undergone substantive studies, reviews and consultations with stakeholders. Necessary expropriation and remuneration to affected families will be taken care of by the DPWH.

This certification is being issued as a requirement by the DENR in the processing of corresponding environmental clearances as required for the implementation of the above mentioned high standard highway project.

Issued this ___ day of December 2022 at the DPWH, Manila.

12/16/22
CONSTANTE A. LLANES, Jr., CESO III
Assistant Secretary for Planning Service

Appendix 47. Perception survey form sample



CONSENT FORM FOR RESEARCH PARTICIPANTS

Title of Study: SOCIAL IMPACT ASSESSMENT FOR THE CENTRAL MINDANAO HIGH STANDARD HIGHWAY CONSTRUCTION PROJECT (CAGAYAN DE ORO – MALAYBALAY SECTION)
Duration/Period:
Place:____
(Barangay/ Municipality/ City/ Province/ Region)
Name of Researcher/Investigator: Dr. Nimfa L. Bracamonte
Contact Number of Researcher: 09171351584

Part I: Information Sheet: Introduction

Maayong Adlaw!

Ako si ______________usa ka representante/researcher nga kasamtangan nagapahigayon ug usa ka pag-tuon nga giulohan ug "Social Impact Assessment For The Central Mindanao High Standard Highway Construction Project (Cagayan De Oro – Malaybalay Section)". Tungod niini, ako mangayo sa imong pagtugot nga unta moapilka niining among pagtu-on.

Katuyuan sa Pag-tuon: Ang pinakatuyuan sa maong pagtu-on mao ang pagtuki kung unsa ang kahibalo ug opinyon sa mga lumolupyo mahitungod sa highway project nga buhaton sa DPWH.

Boluntaryong Partisipaasyon: Boluntaryong partisipasyon lamang ang makaapil sa maong pagtu-on, boot pasabot, aduna kay katungod kung moapil ka ba o dili.

Benispiyo ug Risgo: Walay kaayuhan nga diritso mahatag kanimo sa imong pag-apil niini nga pagtu-on, apan ang resulta niini magamit nga basehan sa paghimo ug mga pamaagi aron makapagaan sa unsa mang problema nga makita.

Privacy and Confidentiality: Among bug-os na ipasalig ngaang tanang impormasyon nga among makuha niani nga pagtu-on walay laing makahibalo gawas lamang sa mga tawo nga nagdumala nianing pagtu-on. Ang imong ngalan dili namu ipakita o ipa-ilaila sa among ipagawas na pagtuki ani nga pagtu-on. Alyas o numero lamang ang among gamiton sa pagpresenta namu sa mga datos.

Part II: Certificate of Consent: Written Consent Form for Research Participants/Informants
Pagapirmahan sa pagsugod sa interview
Direktiba: Palihog basaha pag-ayo ang mga nakasulat sa ubos ug butangi ug tsek (/) ang kahon kung ikaw mouyon niani:

☐ Akong nasabtan pag ayo ang katuyuan niining maong pagtu-on.

☐ Akong gihatag ang akong boluntaryo nga pagtugot sa pag- apil niining maong pagtu-on.

☐ Akong gihatag ang akong pagtugot sa tigpanuki-duki sa pag record sa mga aktibidades nga adunay kalambigitan sa pagtu-on.

☐ Akong gihatag ang akong pagtugot sa tigpanuki-duki sa pagkuha ug hulagway o video .

☐ Ako pwede moundang sa pagtubag sa mga pngutana sa binsan onsang oras ug sa binsan unsang hinungdan.

☐ Kung ako adunay mga pangutana mahitungod sa pagtu-on o sa akong papel niining maong pagtu-on. Gawasnon akong makapangutana sa tigpanuki-duki kabahin sa akong partisipasyon niini.

____
Ngalan sa partisipante/respondent

____
Petsa (Adlaw/Bulan/Tuig)

Oral Consent:

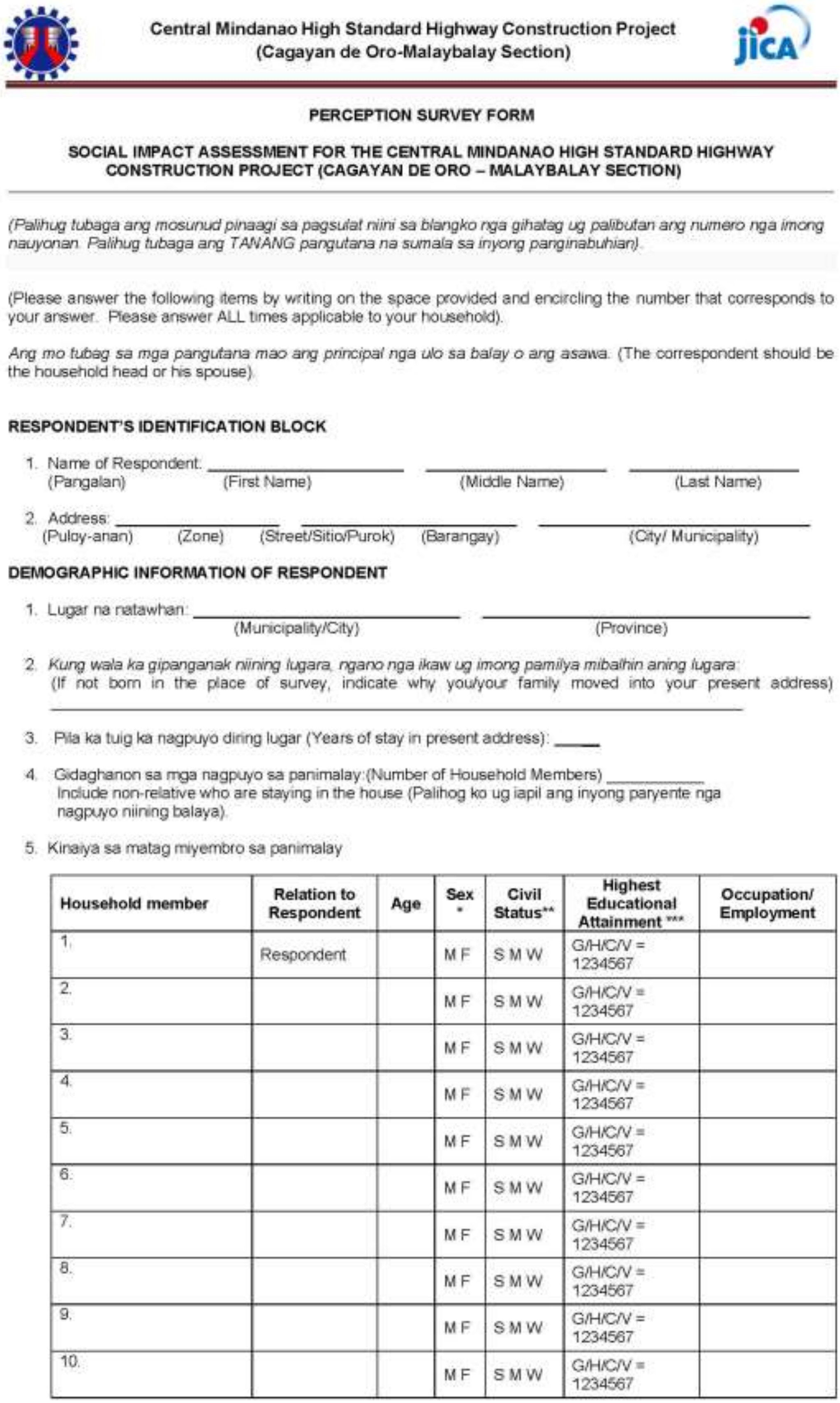
Kung ang porma/sinulat nga pagtugot dili haum sa kultura/politikanhon nga panglantaw hinungdan o kung ang partisipante dili makabasa/makasulat, ang mga tigpanuki-duki magpasabot sa tumong sa pagtu-on ug hangyu-on ang partisipante nga nga itamla o pagmarka sa iyang kumagko ang iyang toong kumagko diha sa papel isip pagmatuod sa iyang boluntaryong pagtugot inubanan sa pirma sa iyang testigo.

____
Ngalan sa Testigo

____
Petsa(Adlaw/Bulan/Tuig)

Right Thumb
of Participant

☐



Central Mindanao High Standard Highway Construction Project
(Cagayan de Oro-Malaybalay Section)

PERCEPTION SURVEY FORM

SOCIAL IMPACT ASSESSMENT FOR THE CENTRAL MINDANAO HIGH STANDARD HIGHWAY CONSTRUCTION PROJECT (CAGAYAN DE ORO – MALAYBALAY SECTION)

(Palihug tubaga ang mosunud pinaagi sa pagsulat niini sa blangko nga gihatag ug palibutan ang numero nga imong nauyonan. Palihug tubaga ang TANANG pangutana na sumala sa inyong panginabuhian).

(Please answer the following items by writing on the space provided and encircling the number that corresponds to your answer. Please answer ALL times applicable to your household).

Ang mo tubag sa mga pangutana mao ang principal nga ulo sa balay o ang asawa. (The correspondent should be the household head or his spouse).

RESPONDENT'S IDENTIFICATION BLOCK

1. Name of Respondent: ____________ ____________ ____________
(Pangalan) (First Name) (Middle Name) (Last Name)

2. Address: ____________ ____________ ____________
(Puloy-anan) (Zone) (Street/Sitio/Purok) (Barangay) (City/ Municipality)

DEMOGRAPHIC INFORMATION OF RESPONDENT

1. Lugar na natawhan: ____________ ____________
(Municipality/City) (Province)

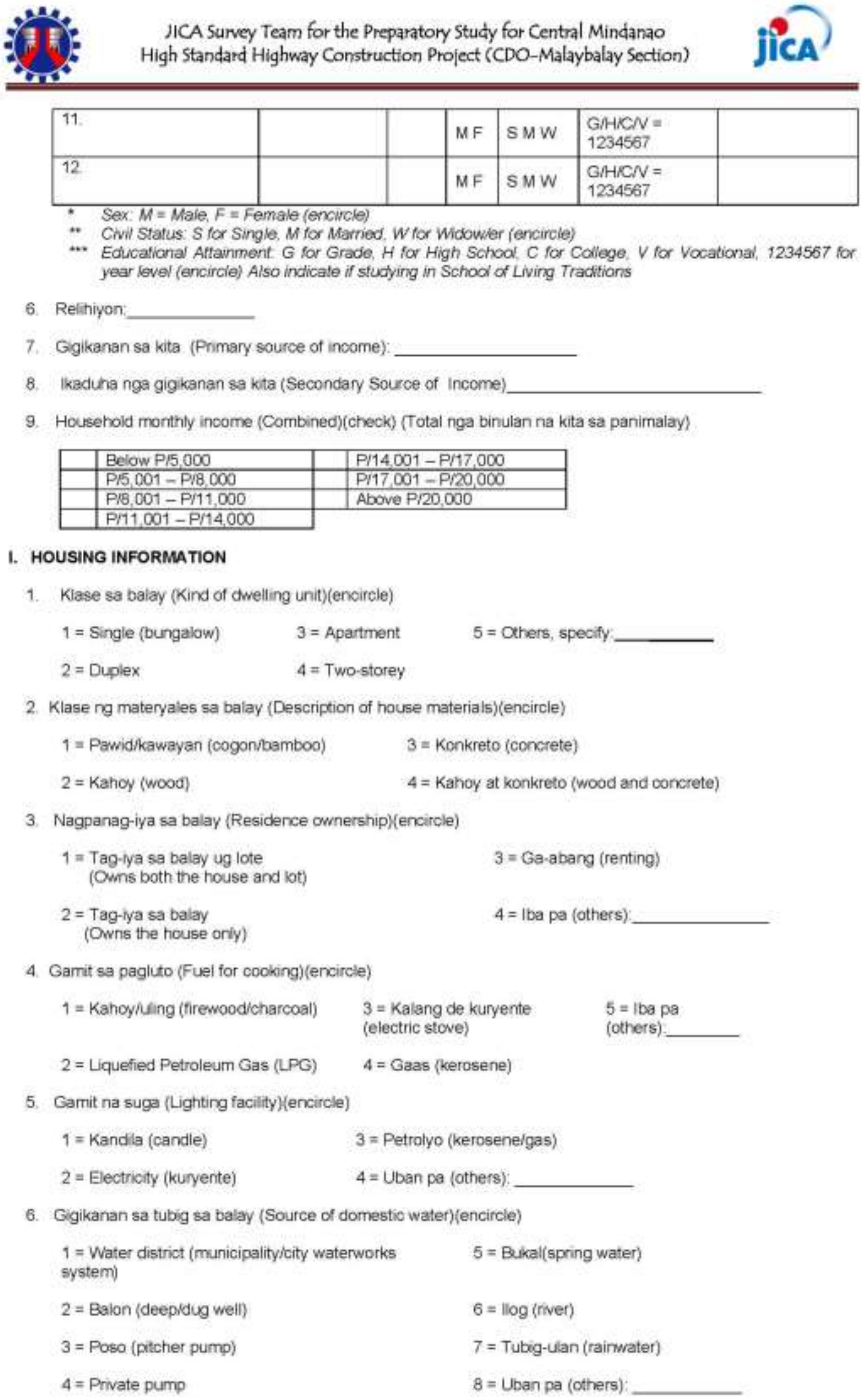
2. *Kung wala ka gipanganak niining lugara, ngano nga ikaw ug imong pamilya mibalhin aning lugara:* (If not born in the place of survey, indicate why you/your family moved into your present address)
____

3. Pila ka tuig ka nagpuyo diring lugar (Years of stay in present address): _____

4. Gidaghanon sa mga nagpuyo sa panimalay:(Number of Household Members) ___________
Include non-relative who are staying in the house (Palihog ko ug iapil ang inyong paryente nga nagpuyo niining balaya).

5. Kinaiya sa matag miyembro sa panimalay

Household member	Relation to Respondent	Age	Sex *	Civil Status**	Highest Educational Attainment ***	Occupation/ Employment
1.	Respondent		M F	S M W	G/H/C/V = 1234567	
2.			M F	S M W	G/H/C/V = 1234567	
3.			M F	S M W	G/H/C/V = 1234567	
4.			M F	S M W	G/H/C/V = 1234567	
5.			M F	S M W	G/H/C/V = 1234567	
6.			M F	S M W	G/H/C/V = 1234567	
7.			M F	S M W	G/H/C/V = 1234567	
8.			M F	S M W	G/H/C/V = 1234567	
9.			M F	S M W	G/H/C/V = 1234567	
10.			M F	S M W	G/H/C/V = 1234567	



JICA Survey Team for the Preparatory Study for Central Mindanao
High Standard Highway Construction Project (CDO-Malaybalay Section)

11.			M F	S M W	G/H/C/V = 1234567	
12.			M F	S M W	G/H/C/V = 1234567	

* Sex: M = Male, F = Female (encircle)
** Civil Status: S for Single, M for Married, W for Widow/er (encircle)
*** Educational Attainment: G for Grade, H for High School, C for College, V for Vocational, 1234567 for year level (encircle) Also indicate if studying in School of Living Traditions

6. Relihiyon:______________

7. Gigikanan sa kita (Primary source of income): ____________________

8. Ikaduha nga gigikanan sa kita (Secondary Source of Income)___________________________

9. Household monthly income (Combined)(check) (Total nga binulan na kita sa panimalay)

☐	Below P/5,000	☐	P/14,001 – P/17,000
☐	P/5,001 – P/8,000	☐	P/17,001 – P/20,000
☐	P/8,001 – P/11,000	☐	Above P/20,000
☐	P/11,001 – P/14,000		

I. HOUSING INFORMATION

1. Klase sa balay (Kind of dwelling unit)(encircle)

1 = Single (bungalow)
2 = Duplex
3 = Apartment
4 = Two-storey
5 = Others, specify:__________

2. Klase ng materyales sa balay (Description of house materials)(encircle)

1 = Pawid/kawayan (cogon/bamboo)
2 = Kahoy (wood)
3 = Konkreto (concrete)
4 = Kahoy at konkreto (wood and concrete)

3. Nagpanag-iya sa balay (Residence ownership)(encircle)

1 = Tag-iya sa balay ug lote (Owns both the house and lot)
2 = Tag-iya sa balay (Owns the house only)
3 = Ga-abang (renting)
4 = Iba pa (others):_______________

4. Gamit sa pagluto (Fuel for cooking)(encircle)

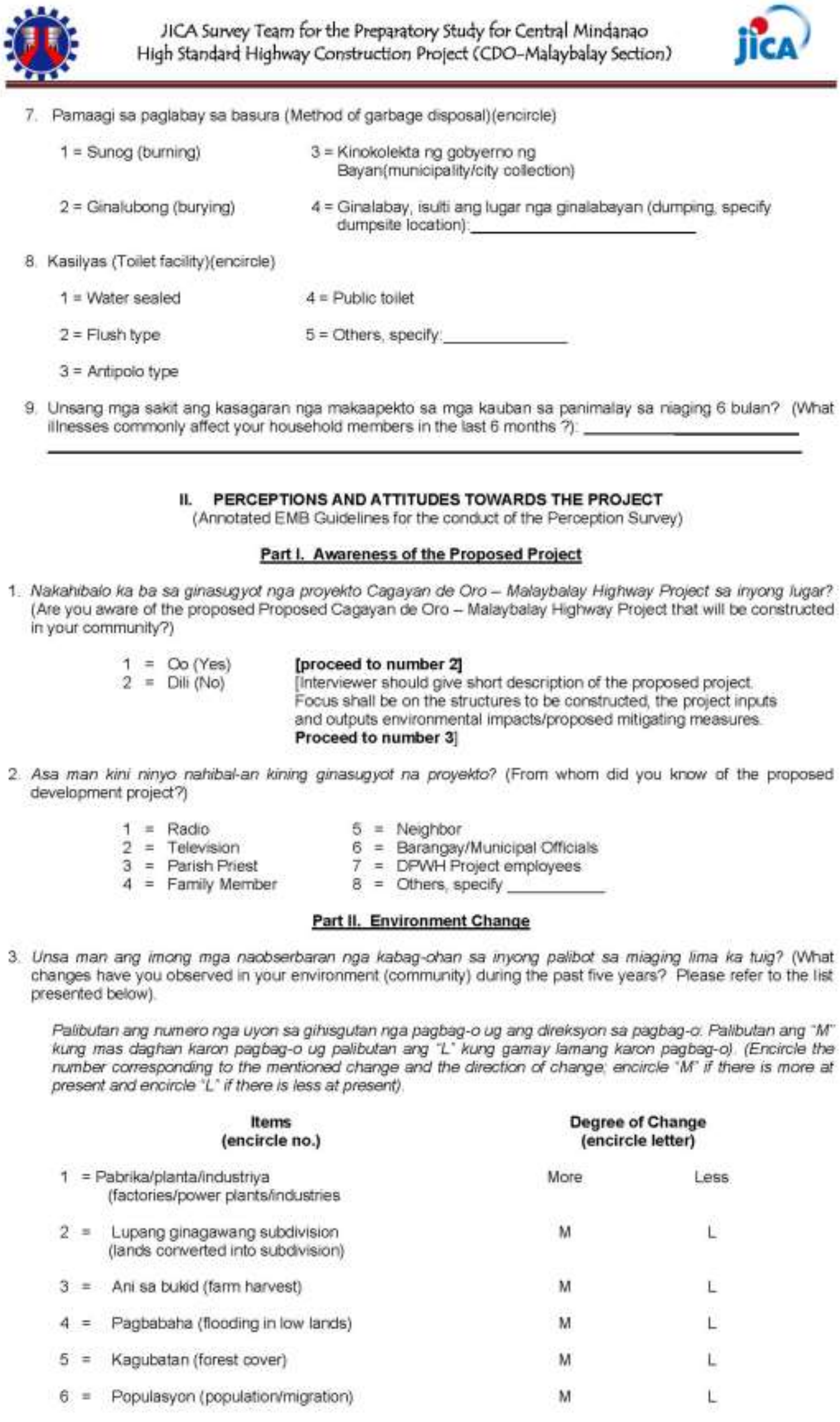
1 = Kahoy/uling (firewood/charcoal)
2 = Liquefied Petroleum Gas (LPG)
3 = Kalang de kuryente (electric stove)
4 = Gaas (kerosene)
5 = Iba pa (others):________

5. Gamit na suga (Lighting facility)(encircle)

1 = Kandila (candle)
2 = Electricity (kuryente)
3 = Petrolyo (kerosene/gas)
4 = Uban pa (others): _____________

6. Gigikanan sa tubig sa balay (Source of domestic water)(encircle)

1 = Water district (municipality/city waterworks system)
2 = Balon (deep/dug well)
3 = Poso (pitcher pump)
4 = Private pump
5 = Bukal(spring water)
6 = Ilog (river)
7 = Tubig-ulan (rainwater)
8 = Uban pa (others): ____________



JICA Survey Team for the Preparatory Study for Central Mindanao
High Standard Highway Construction Project (CDO-Malaybalay Section)

7. Pamaagi sa paglabay sa basura (Method of garbage disposal)(encircle)

1 = Sunog (burning)	3 = Kinokolekta ng gobyerno ng Bayan(municipality/city collection)
2 = Ginalubong (burying)	4 = Ginalabay, isulti ang lugar nga ginalabayan (dumping, specify dumpsite location):______________________

8. Kasilyas (Toilet facility)(encircle)

1 = Water sealed	4 = Public toilet
2 = Flush type	5 = Others, specify:____________
3 = Antipolo type	

9. Unsang mga sakit ang kasagaran nga makaapekto sa mga kauban sa panimalay sa niaging 6 bulan? (What illnesses commonly affect your household members in the last 6 months ?): ____________________

____

II. PERCEPTIONS AND ATTITUDES TOWARDS THE PROJECT

(Annotated EMB Guidelines for the conduct of the Perception Survey)

Part I. Awareness of the Proposed Project

1. *Nakahibalo ka ba sa ginasugyot nga proyekto Cagayan de Oro – Malaybalay Highway Project sa inyong lugar?* (Are you aware of the proposed Proposed Cagayan de Oro – Malaybalay Highway Project that will be constructed in your community?)

1 = Oo (Yes)	**[proceed to number 2]**
2 = Dili (No)	[Interviewer should give short description of the proposed project. Focus shall be on the structures to be constructed, the project inputs and outputs environmental impacts/proposed mitigating measures. **Proceed to number 3**]

2. *Asa man kini ninyo nahibal-an kining ginasugyot na proyekto?* (From whom did you know of the proposed development project?)

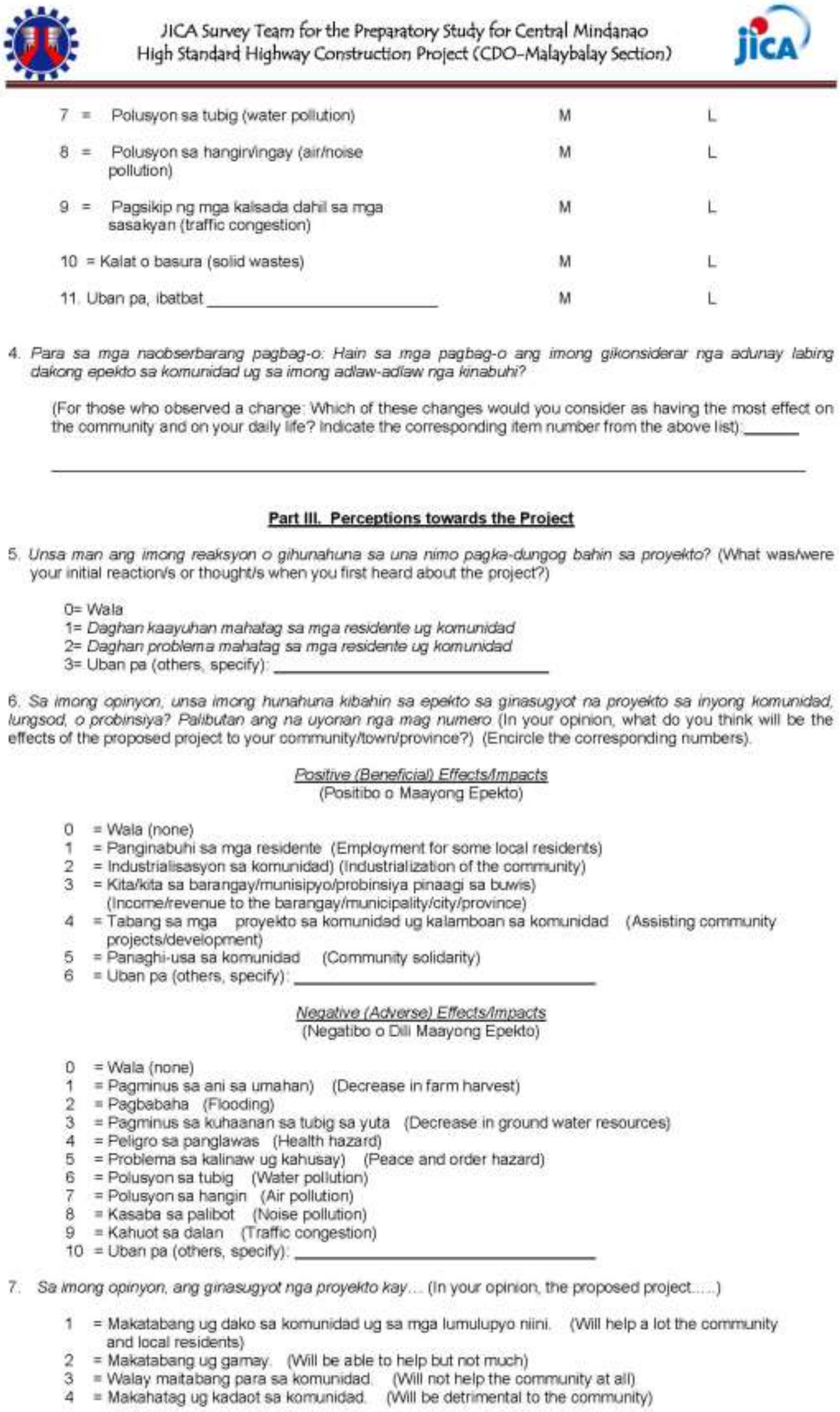
1 = Radio	5 = Neighbor
2 = Television	6 = Barangay/Municipal Officials
3 = Parish Priest	7 = DPWH Project employees
4 = Family Member	8 = Others, specify __________

Part II. Environment Change

3. *Unsa man ang imong mga naobserbaran nga kabag-ohan sa inyong palibot sa miaging lima ka tuig?* (What changes have you observed in your environment (community) during the past five years? Please refer to the list presented below).

Palibutan ang numero nga uyon sa gihisgutan nga pagbag-o ug ang direksyon sa pagbag-o. Palibutan ang "M" kung mas daghan karon pagbag-o ug palibutan ang "L" kung gamay lamang karon pagbag-o). (Encircle the number corresponding to the mentioned change and the direction of change; encircle "M" if there is more at present and encircle "L" if there is less at present).

Items (encircle no.)	**Degree of Change (encircle letter)**	
1 = Pabrika/planta/industriya (factories/power plants/industries	More	Less
2 = Lupang ginagawang subdivision (lands converted into subdivision)	M	L
3 = Ani sa bukid (farm harvest)	M	L
4 = Pagbabaha (flooding in low lands)	M	L
5 = Kagubatan (forest cover)	M	L
6 = Populasyon (population/migration)	M	L



JICA Survey Team for the Preparatory Study for Central Mindanao
High Standard Highway Construction Project (CDO-Malaybalay Section)

7 = Polusyon sa tubig (water pollution)	M	L
8 = Polusyon sa hangin/ingay (air/noise pollution)	M	L
9 = Pagsikip ng mga kalsada dahil sa mga sasakyan (traffic congestion)	M	L
10 = Kalat o basura (solid wastes)	M	L
11. Uban pa, ibatbat ________________________	M	L

4. *Para sa mga naobserbarang pagbag-o: Hain sa mga pagbag-o ang imong gikonsiderar nga adunay labing dakong epekto sa komunidad ug sa imong adlaw-adlaw nga kinabuhi?*

   (For those who observed a change: Which of these changes would you consider as having the most effect on the community and on your daily life? Indicate the corresponding item number from the above list):______

   ____

Part III. Perceptions towards the Project

5. *Unsa man ang imong reaksyon o gihunahuna sa una nimo pagka-dungog bahin sa proyekto?* (What was/were your initial reaction/s or thought/s when you first heard about the project?)

   0= Wala
   1= *Daghan kaayuhan mahatag sa mga residente ug komunidad*
   2= *Daghan problema mahatag sa mga residente ug komunidad*
   3= Uban pa (others, specify): ______________________________

6. *Sa imong opinyon, unsa imong hunahuna kibahin sa epekto sa ginasugyot na proyekto sa inyong komunidad, lungsod, o probinsiya? Palibutan ang na uyonan nga mag numero* (In your opinion, what do you think will be the effects of the proposed project to your community/town/province?) (Encircle the corresponding numbers).

Positive (Beneficial) Effects/Impacts
(Positibo o Maayong Epekto)

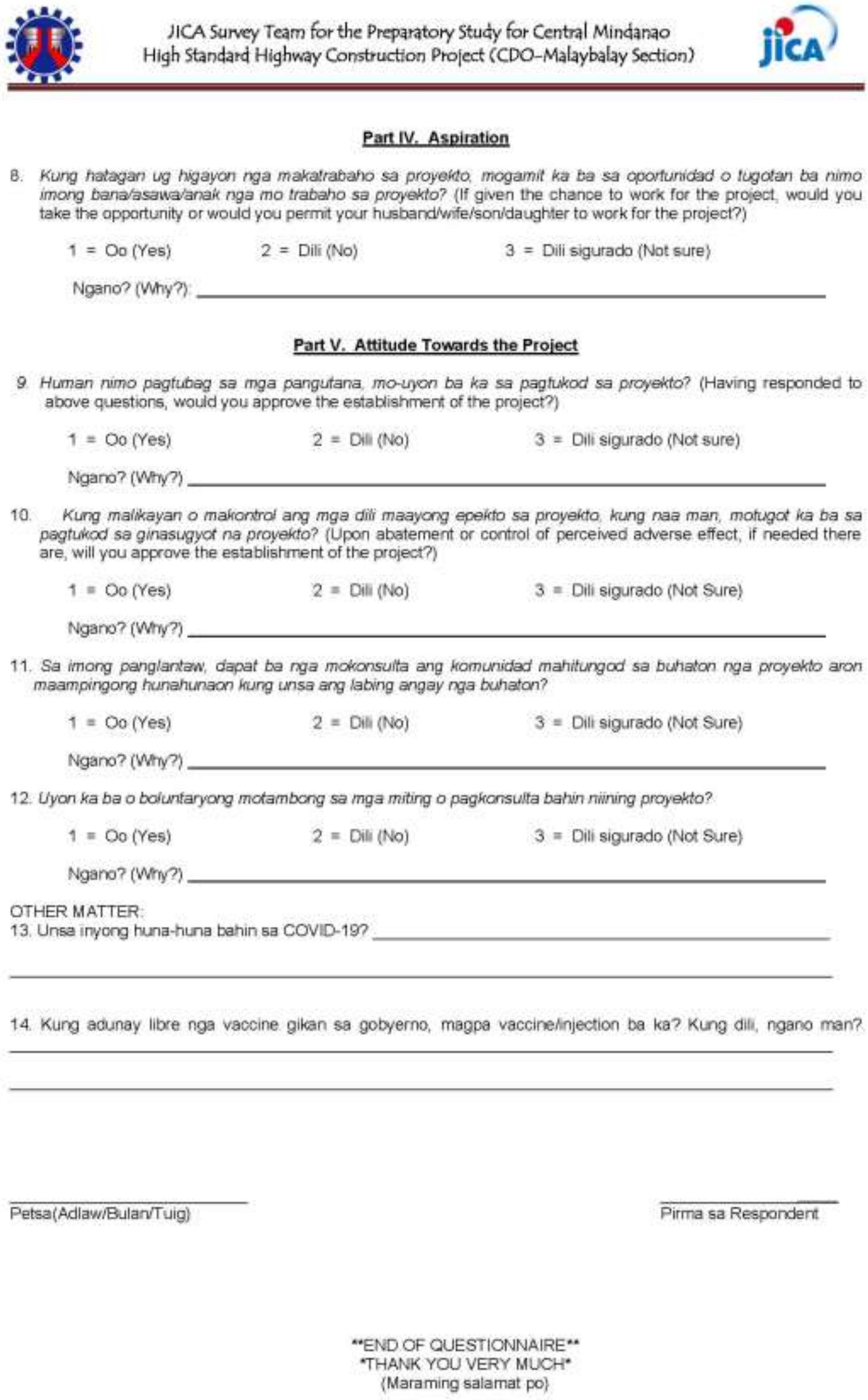
0 = Wala (none)
1 = Panginabuhi sa mga residente (Employment for some local residents)
2 = Industrialisasyon sa komunidad) (Industrialization of the community)
3 = Kita/kita sa barangay/munisipyo/probinsiya pinaagi sa buwis) (Income/revenue to the barangay/municipality/city/province)
4 = Tabang sa mga proyekto sa komunidad ug kalamboan sa komunidad (Assisting community projects/development)
5 = Panaghi-usa sa komunidad (Community solidarity)
6 = Uban pa (others, specify): ________________________________

Negative (Adverse) Effects/Impacts
(Negatibo o Dili Maayong Epekto)

0 = Wala (none)
1 = Pagminus sa ani sa umahan) (Decrease in farm harvest)
2 = Pagbabaha (Flooding)
3 = Pagminus sa kuhaanan sa tubig sa yuta (Decrease in ground water resources)
4 = Peligro sa panglawas (Health hazard)
5 = Problema sa kalinaw ug kahusay) (Peace and order hazard)
6 = Polusyon sa tubig (Water pollution)
7 = Polusyon sa hangin (Air pollution)
8 = Kasaba sa palibot (Noise pollution)
9 = Kahuot sa dalan (Traffic congestion)
10 = Uban pa (others, specify): ________________________________

7. *Sa imong opinyon, ang ginasugyot nga proyekto kay*... (In your opinion, the proposed project.....)

   1 = Makatabang ug dako sa komunidad ug sa mga lumulupyo niini. (Will help a lot the community and local residents)
   2 = Makatabang ug gamay. (Will be able to help but not much)
   3 = Walay maitabang para sa komunidad. (Will not help the community at all)
   4 = Makahatag ug kadaot sa komunidad. (Will be detrimental to the community)



JICA Survey Team for the Preparatory Study for Central Mindanao
High Standard Highway Construction Project (CDO-Malaybalay Section)

Part IV. Aspiration

8. *Kung hatagan ug higayon nga makatrabaho sa proyekto, mogamit ka ba sa oportunidad o tugotan ba nimo imong bana/asawa/anak nga mo trabaho sa proyekto?* (If given the chance to work for the project, would you take the opportunity or would you permit your husband/wife/son/daughter to work for the project?)

1 = Oo (Yes)   2 = Dili (No)   3 = Dili sigurado (Not sure)

Ngano? (Why?): ____________________

Part V. Attitude Towards the Project

9. *Human nimo pagtubag sa mga pangutana, mo-uyon ba ka sa pagtukod sa proyekto?* (Having responded to above questions, would you approve the establishment of the project?)

1 = Oo (Yes)   2 = Dili (No)   3 = Dili sigurado (Not sure)

Ngano? (Why?) ____________________

10. *Kung malikayan o makontrol ang mga dili maayong epekto sa proyekto, kung naa man, motugot ka ba sa pagtukod sa ginasugyot na proyekto?* (Upon abatement or control of perceived adverse effect, if needed there are, will you approve the establishment of the project?)

1 = Oo (Yes)   2 = Dili (No)   3 = Dili sigurado (Not Sure)

Ngano? (Why?) ____________________

11. *Sa imong panglantaw, dapat ba nga mokonsulta ang komunidad mahitungod sa buhaton nga proyekto aron maampingong hunahunaon kung unsa ang labing angay nga buhaton?*

1 = Oo (Yes)   2 = Dili (No)   3 = Dili sigurado (Not Sure)

Ngano? (Why?) ____________________

12. *Uyon ka ba o boluntaryong motambong sa mga miting o pagkonsulta bahin niining proyekto?*

1 = Oo (Yes)   2 = Dili (No)   3 = Dili sigurado (Not Sure)

Ngano? (Why?) ____________________

OTHER MATTER:
13. Unsa inyong huna-huna bahin sa COVID-19? ____________________

____

14. Kung adunay libre nga vaccine gikan sa gobyerno, magpa vaccine/injection ba ka? Kung dili, ngano man?

____

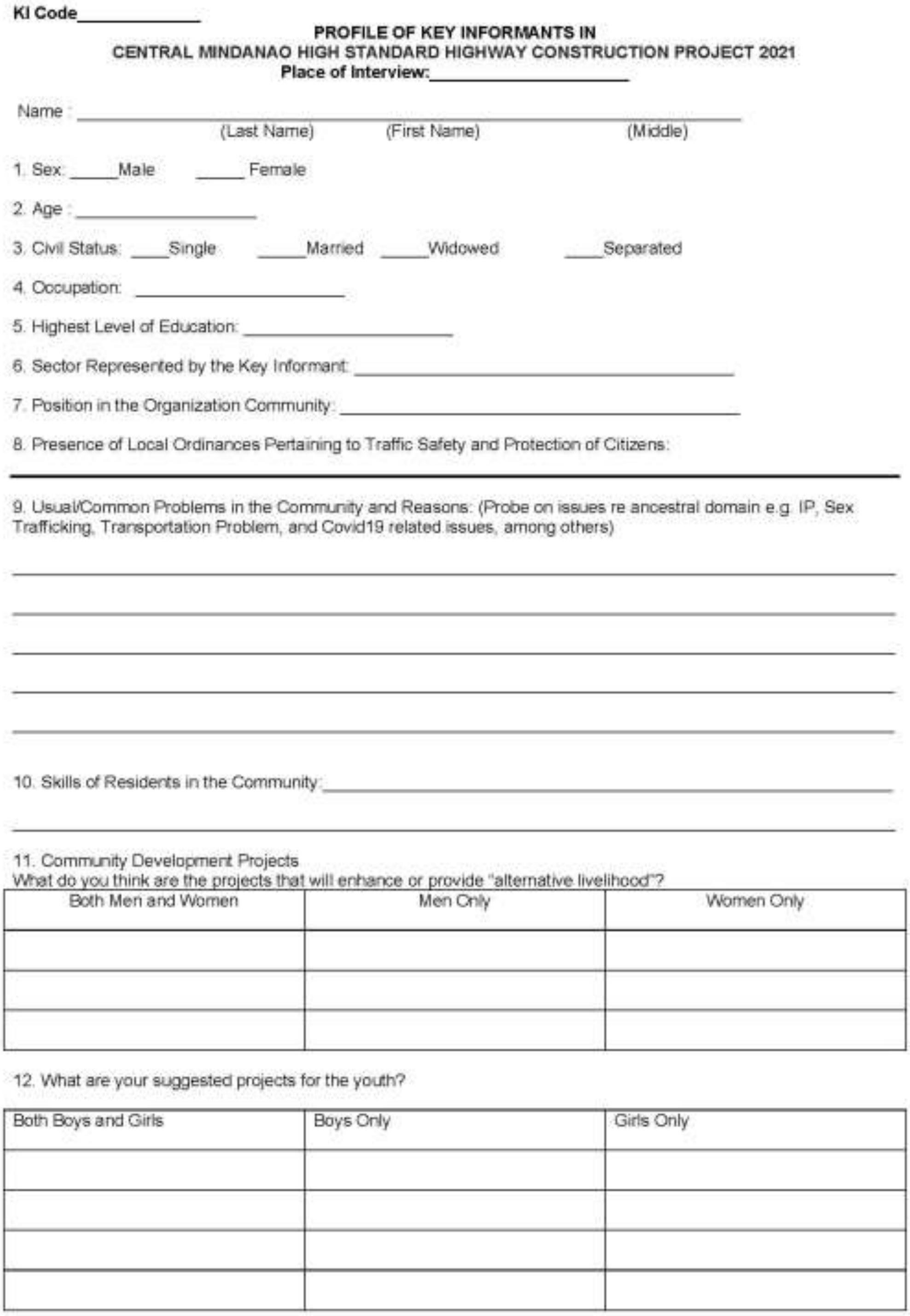
____

Petsa(Adlaw/Bulan/Tuig)

Pirma sa Respondent

END OF QUESTIONNAIRE
THANK YOU VERY MUCH
(Maraming salamat po)

Appendix 48. Key informant interview guide questions



KI Code____________

PROFILE OF KEY INFORMANTS IN
CENTRAL MINDANAO HIGH STANDARD HIGHWAY CONSTRUCTION PROJECT 2021
Place of Interview:____________________

Name : ____
(Last Name) (First Name) (Middle)

1. Sex: _____Male _____ Female

2. Age : __________________

3. Civil Status: ____Single _____Married _____Widowed ____Separated

4. Occupation: _____________________

5. Highest Level of Education: _____________________

6. Sector Represented by the Key Informant: _____________________________________

7. Position in the Organization Community: ______________________________________

8. Presence of Local Ordinances Pertaining to Traffic Safety and Protection of Citizens:

9. Usual/Common Problems in the Community and Reasons: (Probe on issues re ancestral domain e.g. IP, Sex Trafficking, Transportation Problem, and Covid19 related issues, among others)

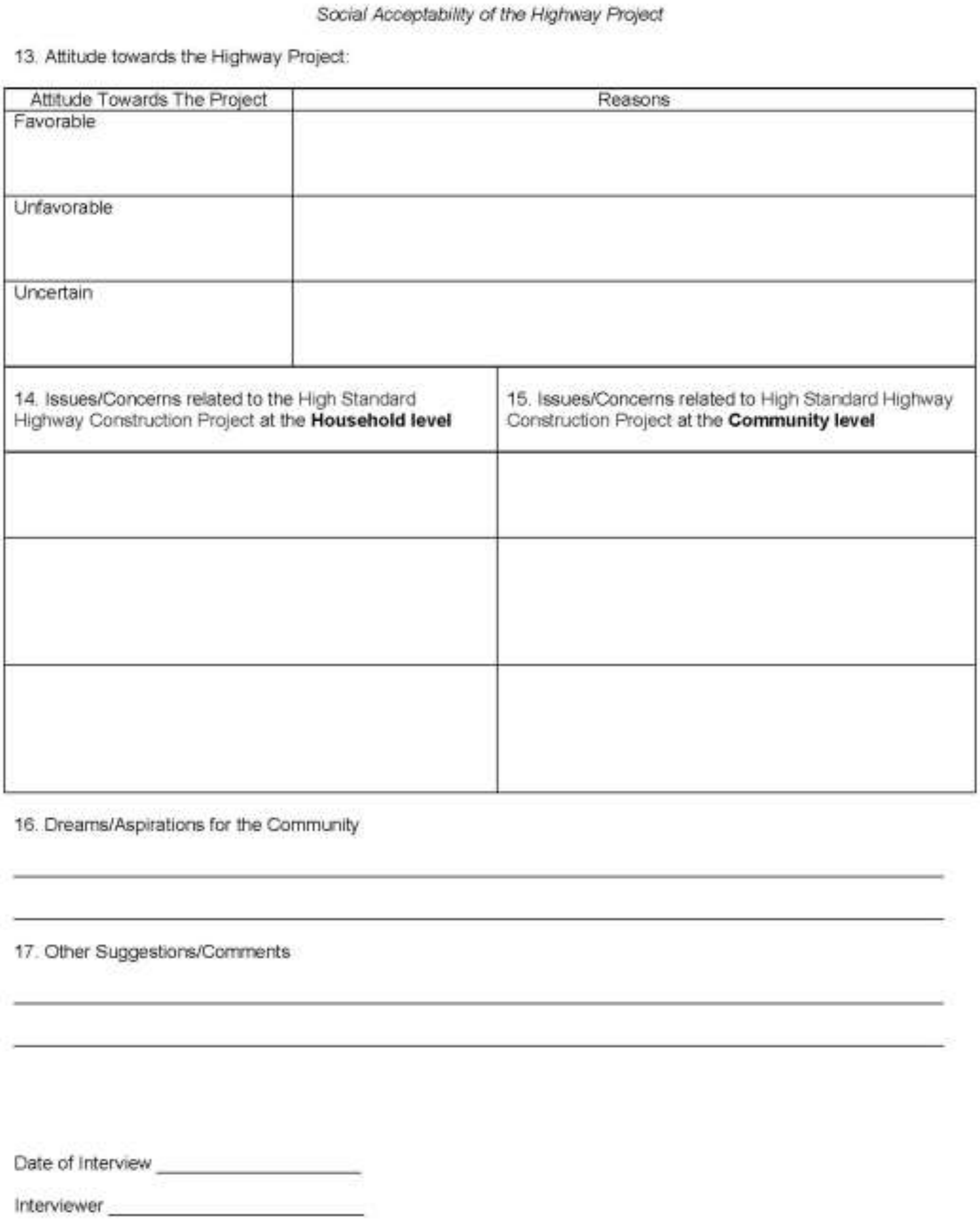
10. Skills of Residents in the Community:____

11. Community Development Projects
What do you think are the projects that will enhance or provide "alternative livelihood"?

Both Men and Women	Men Only	Women Only

12. What are your suggested projects for the youth?

Both Boys and Girls	Boys Only	Girls Only



Social Acceptability of the Highway Project

13. Attitude towards the Highway Project:

Attitude Towards The Project	Reasons
Favorable	
Unfavorable	
Uncertain	

14. Issues/Concerns related to the High Standard Highway Construction Project at the **Household level**	15. Issues/Concerns related to High Standard Highway Construction Project at the **Community level**

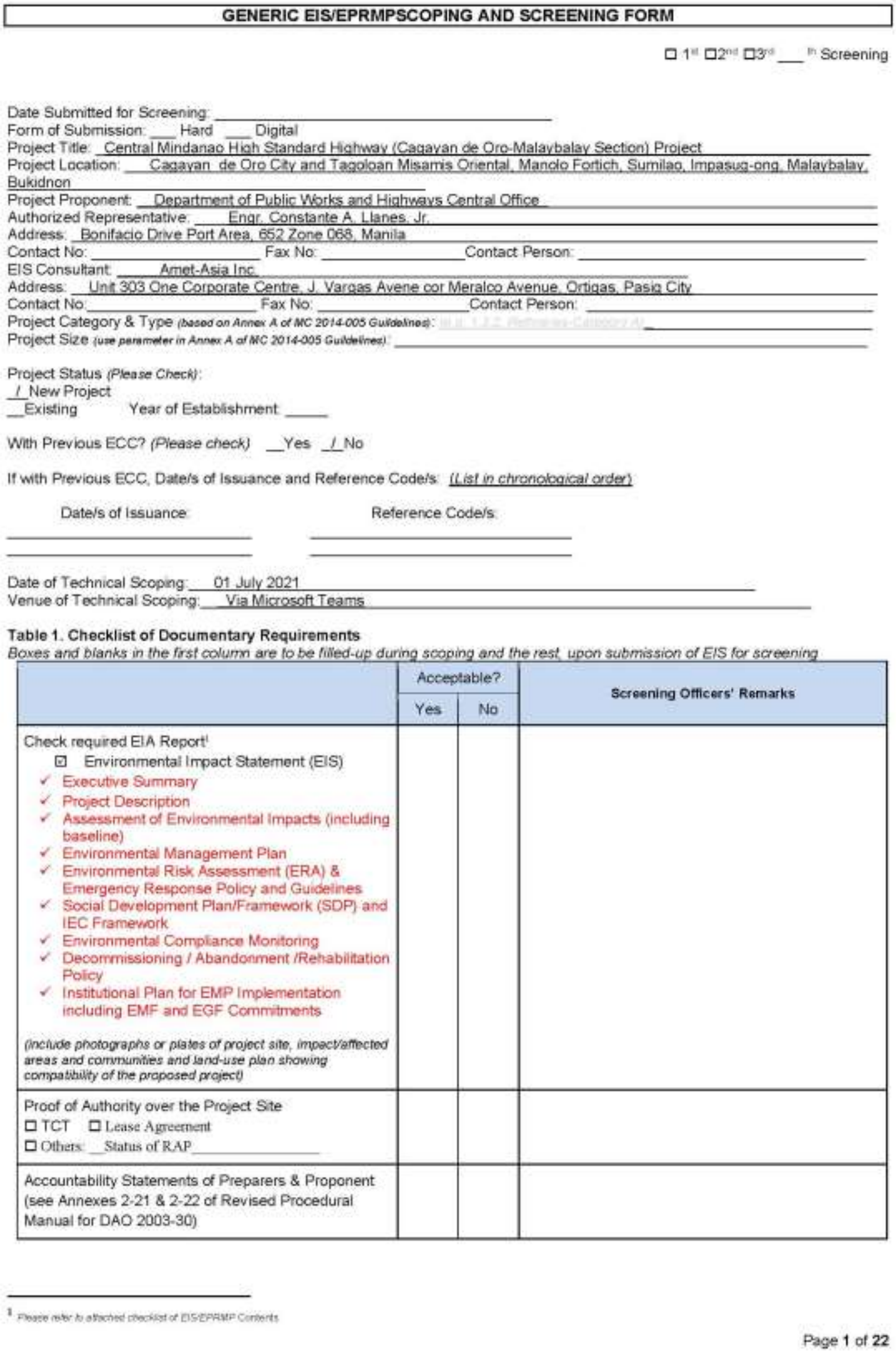
16. Dreams/Aspirations for the Community

17. Other Suggestions/Comments

Date of Interview ____________________

Interviewer ________________________

Appendix 49. EIA Technical Screening and Scoping Checklist



GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

☐ 1st ☐2nd ☐3rd ___th Screening

Date Submitted for Screening: __________________________________
Form of Submission: ___ Hard ___ Digital
Project Title: Central Mindanao High Standard Highway (Cagayan de Oro-Malaybalay Section) Project
Project Location: Cagayan de Oro City and Tagoloan Misamis Oriental, Manolo Fortich, Sumilao, Impasug-ong, Malaybalay, Bukidnon
Project Proponent: Department of Public Works and Highways Central Office
Authorized Representative: Engr. Constante A. Llanes, Jr.
Address: Bonifacio Drive Port Area, 652 Zone 068, Manila
Contact No: ________________ Fax No: ________________ Contact Person: ________________________
EIS Consultant: Amet-Asia Inc.
Address: Unit 303 One Corporate Centre, J. Vargas Avene cor Meralco Avenue, Ortigas, Pasig City
Contact No: ________________ Fax No: ________________ Contact Person: ________________________
Project Category & Type *(based on Annex A of MC 2014-005 Guidelines)*: [illegible]
Project Size *(use parameter in Annex A of MC 2014-005 Guidelines)*: ________________________

Project Status *(Please Check)*:
_/_ New Project
__Existing Year of Establishment: _____

With Previous ECC? *(Please check)* __Yes _/_ No

If with Previous ECC, Date/s of Issuance and Reference Code/s: *(List in chronological order)*

Date/s of Issuance:	Reference Code/s:

Date of Technical Scoping: 01 July 2021
Venue of Technical Scoping: Via Microsoft Teams

Table 1. Checklist of Documentary Requirements
Boxes and blanks in the first column are to be filled-up during scoping and the rest, upon submission of EIS for screening

	Acceptable?		**Screening Officers' Remarks**
	Yes	No	
Check required EIA Report[1] ☒ Environmental Impact Statement (EIS) ✓ Executive Summary ✓ Project Description ✓ Assessment of Environmental Impacts (including baseline) ✓ Environmental Management Plan ✓ Environmental Risk Assessment (ERA) & Emergency Response Policy and Guidelines ✓ Social Development Plan/Framework (SDP) and IEC Framework ✓ Environmental Compliance Monitoring ✓ Decommissioning / Abandonment /Rehabilitation Policy ✓ Institutional Plan for EMP Implementation including EMF and EGF Commitments *(include photographs or plates of project site, impact/affected areas and communities and land-use plan showing compatibility of the proposed project)*			
Proof of Authority over the Project Site ☐ TCT ☐ Lease Agreement ☐ Others: __Status of RAP____________			
Accountability Statements of Preparers & Proponent (see Annexes 2-21 & 2-22 of Revised Procedural Manual for DAO 2003-30)			

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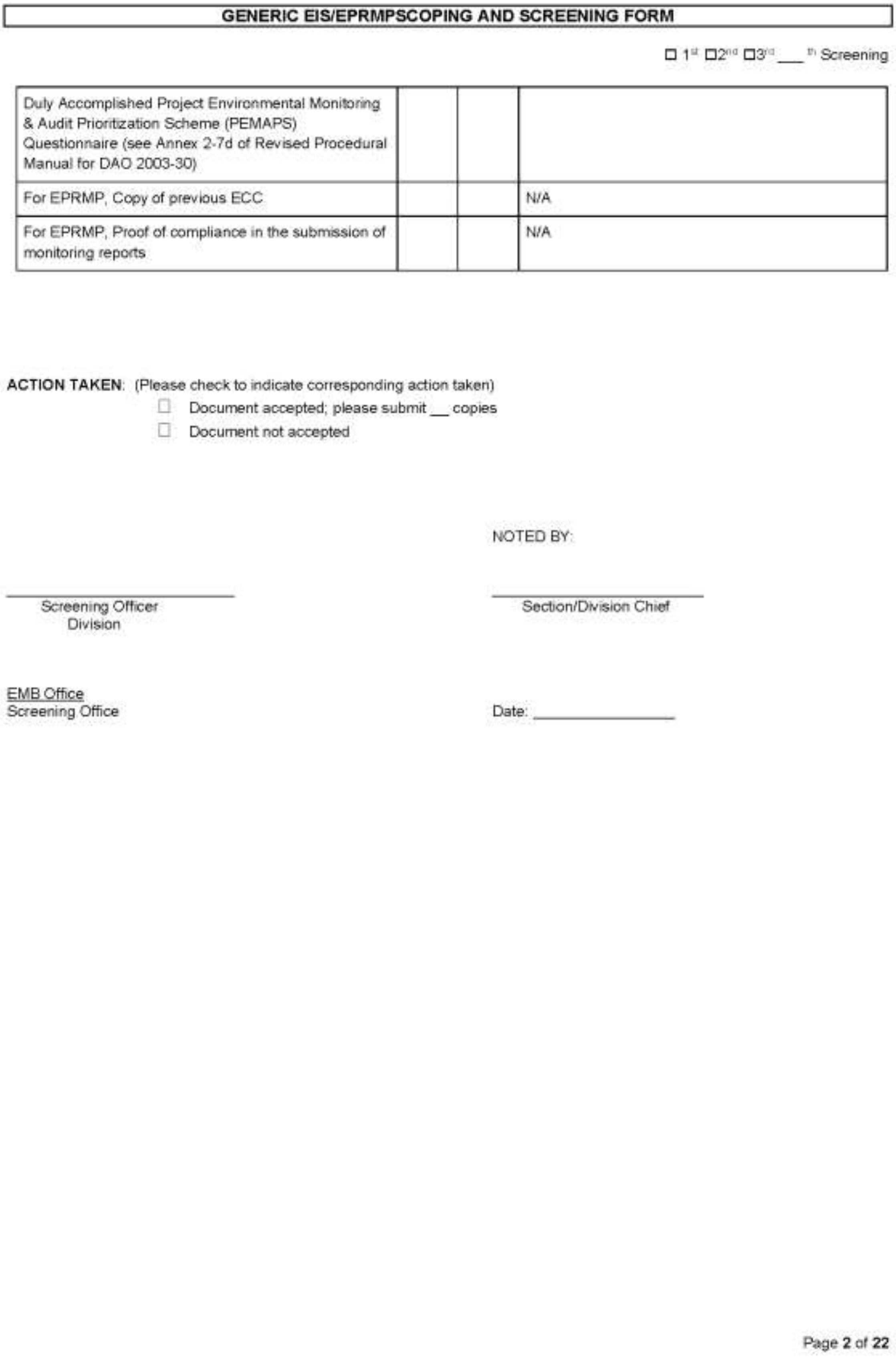
[1] *Please refer to attached checklist of EIS/EPRMP Contents*

Page **1** of **22**



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☐ 1st ☐2nd ☐3rd ___ th Screening

Duly Accomplished Project Environmental Monitoring & Audit Prioritization Scheme (PEMAPS) Questionnaire (see Annex 2-7d of Revised Procedural Manual for DAO 2003-30)			
For EPRMP, Copy of previous ECC			N/A
For EPRMP, Proof of compliance in the submission of monitoring reports			N/A

ACTION TAKEN: (Please check to indicate corresponding action taken)
☐ Document accepted; please submit __ copies
☐ Document not accepted

NOTED BY:

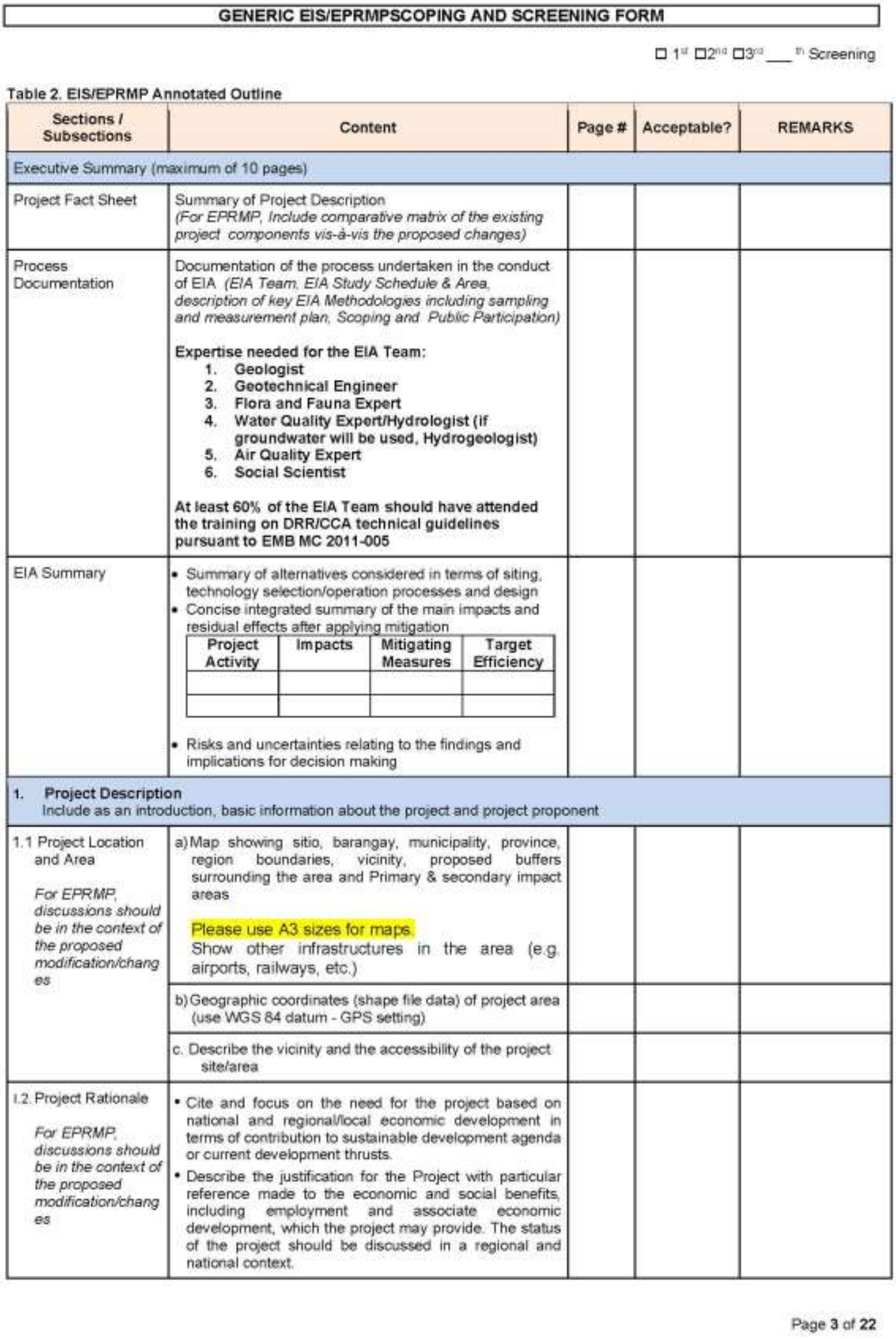
____
Screening Officer
Division

____
Section/Division Chief

EMB Office
Screening Office

Date: ________________

Page 2 of 22



GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

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Table 2. EIS/EPRMP Annotated Outline

<table>
<tr><th>Sections / Subsections</th><th>Content</th><th>Page #</th><th>Acceptable?</th><th>REMARKS</th></tr>
<tr><td colspan="5">Executive Summary (maximum of 10 pages)</td></tr>
<tr><td>Project Fact Sheet</td><td>Summary of Project Description
(For EPRMP, Include comparative matrix of the existing project components vis-à-vis the proposed changes)</td><td></td><td></td><td></td></tr>
<tr><td>Process Documentation</td><td>Documentation of the process undertaken in the conduct of EIA *(EIA Team, EIA Study Schedule & Area, description of key EIA Methodologies including sampling and measurement plan, Scoping and Public Participation)*

Expertise needed for the EIA Team:
1. Geologist
2. Geotechnical Engineer
3. Flora and Fauna Expert
4. Water Quality Expert/Hydrologist (if groundwater will be used, Hydrogeologist)
5. Air Quality Expert
6. Social Scientist

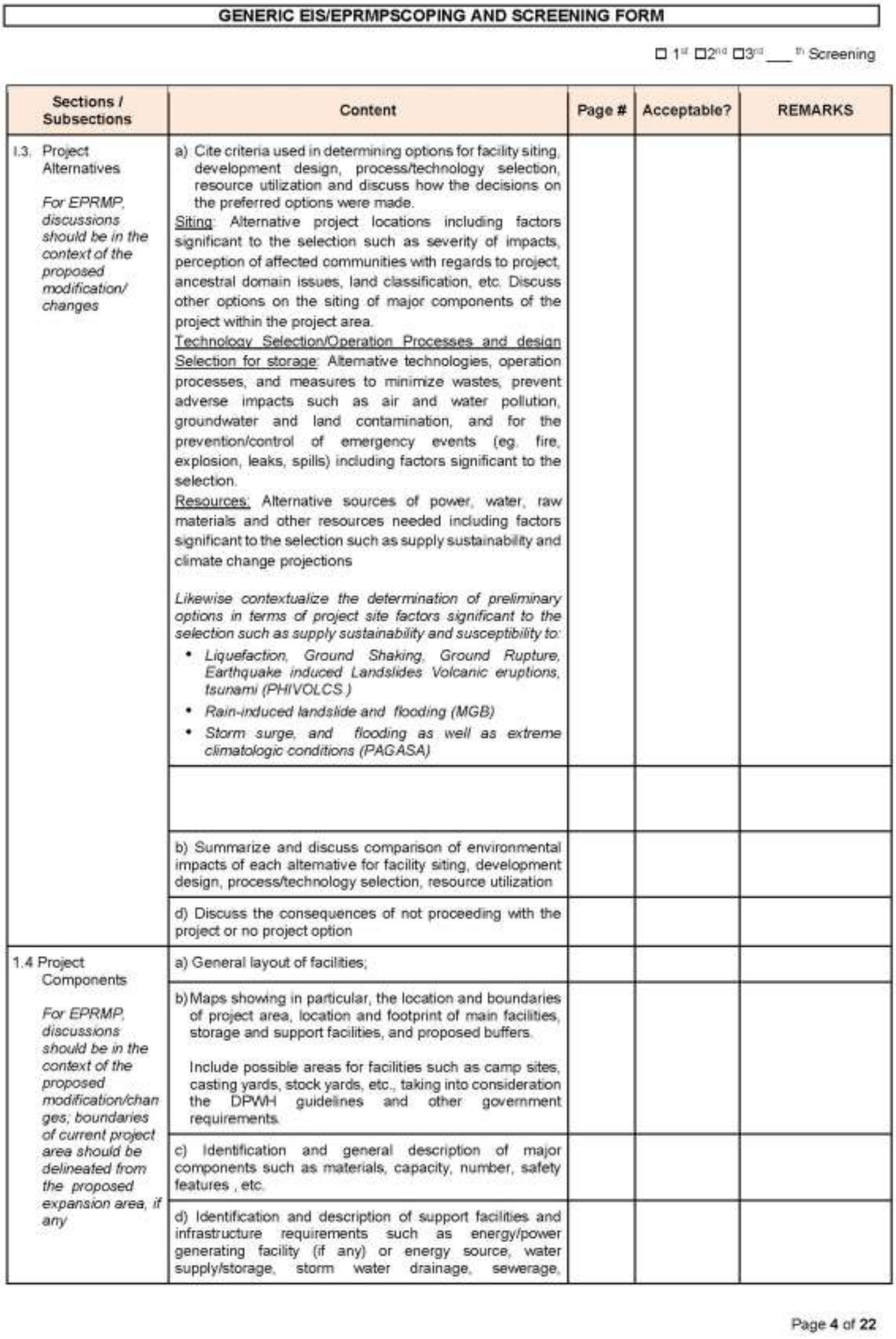
At least 60% of the EIA Team should have attended the training on DRR/CCA technical guidelines pursuant to EMB MC 2011-005</td><td></td><td></td><td></td></tr>
<tr><td>EIA Summary</td><td>• Summary of alternatives considered in terms of siting, technology selection/operation processes and design
• Concise integrated summary of the main impacts and residual effects after applying mitigation
<table>
<tr><th>Project Activity</th><th>Impacts</th><th>Mitigating Measures</th><th>Target Efficiency</th></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>
• Risks and uncertainties relating to the findings and implications for decision making</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">**1. Project Description**
Include as an introduction, basic information about the project and project proponent</td></tr>
<tr><td>1.1 Project Location and Area

For EPRMP, discussions should be in the context of the proposed modification/changes</td><td>a) Map showing sitio, barangay, municipality, province, region boundaries, vicinity, proposed buffers surrounding the area and Primary & secondary impact areas

Please use A3 sizes for maps.
Show other infrastructures in the area (e.g. airports, railways, etc.)</td><td></td><td></td><td></td></tr>
<tr><td></td><td>b) Geographic coordinates (shape file data) of project area (use WGS 84 datum - GPS setting)</td><td></td><td></td><td></td></tr>
<tr><td></td><td>c. Describe the vicinity and the accessibility of the project site/area</td><td></td><td></td><td></td></tr>
<tr><td>I.2. Project Rationale

For EPRMP, discussions should be in the context of the proposed modification/changes</td><td>• Cite and focus on the need for the project based on national and regional/local economic development in terms of contribution to sustainable development agenda or current development thrusts.
• Describe the justification for the Project with particular reference made to the economic and social benefits, including employment and associate economic development, which the project may provide. The status of the project should be discussed in a regional and national context.</td><td></td><td></td><td></td></tr>
</table>

Page 3 of 22



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Sections / Subsections	Content	Page #	Acceptable?	REMARKS
I.3. Project Alternatives *For EPRMP, discussions should be in the context of the proposed modification/ changes*	a) Cite criteria used in determining options for facility siting, development design, process/technology selection, resource utilization and discuss how the decisions on the preferred options were made. Siting: Alternative project locations including factors significant to the selection such as severity of impacts, perception of affected communities with regards to project, ancestral domain issues, land classification, etc. Discuss other options on the siting of major components of the project within the project area. Technology Selection/Operation Processes and design Selection for storage: Alternative technologies, operation processes, and measures to minimize wastes, prevent adverse impacts such as air and water pollution, groundwater and land contamination, and for the prevention/control of emergency events (eg. fire, explosion, leaks, spills) including factors significant to the selection. Resources: Alternative sources of power, water, raw materials and other resources needed including factors significant to the selection such as supply sustainability and climate change projections *Likewise contextualize the determination of preliminary options in terms of project site factors significant to the selection such as supply sustainability and susceptibility to:* • *Liquefaction, Ground Shaking, Ground Rupture, Earthquake induced Landslides Volcanic eruptions, tsunami (PHIVOLCS.)* • *Rain-induced landslide and flooding (MGB)* • *Storm surge, and flooding as well as extreme climatologic conditions (PAGASA)*			
	b) Summarize and discuss comparison of environmental impacts of each alternative for facility siting, development design, process/technology selection, resource utilization			
	d) Discuss the consequences of not proceeding with the project or no project option			
1.4 Project Components *For EPRMP, discussions should be in the context of the proposed modification/changes; boundaries of current project area should be delineated from the proposed expansion area, if any*	a) General layout of facilities;			
	b) Maps showing in particular, the location and boundaries of project area, location and footprint of main facilities, storage and support facilities, and proposed buffers. Include possible areas for facilities such as camp sites, casting yards, stock yards, etc., taking into consideration the DPWH guidelines and other government requirements			
	c) Identification and general description of major components such as materials, capacity, number, safety features , etc.			
	d) Identification and description of support facilities and infrastructure requirements such as energy/power generating facility (if any) or energy source, water supply/storage, storm water drainage, sewerage,			

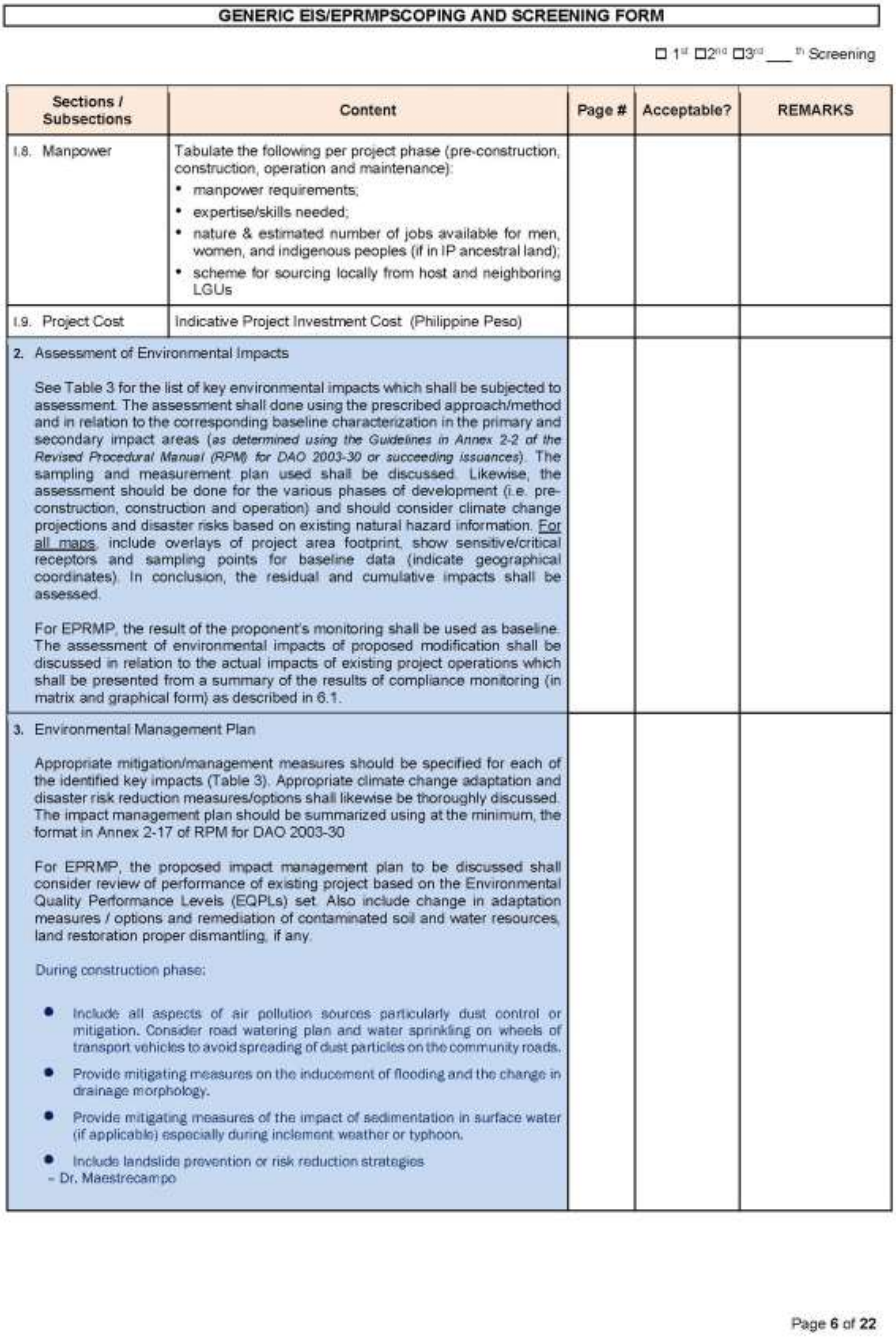
Page 4 of 22

GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

☐ 1st ☐2nd ☐3rd ___ th Screening

Sections / Subsections	Content	Page #	Acceptable?	REMARKS
	telecommunications, safety devices/emergency facilities, accommodation and similar facilities Include wastewater and solid waste management system during construction phase – Dr. Maestrecampo			
	e)Identification and description of pollution control devices and waste management system for the waste materials: wastewater, air emissions, domestic wastes, sewage and septage, toxic and hazardous wastes, non toxic and non hazardous wastes, etc.			
I.5. Process/ Technology *For EPRMP, include discussion/comparison of existing and proposed modifications or expansion*	a) ~~Description of the Processing/Manufacturing technology~~ ~~o process flow sheet showing material, and water (and energy, if applicable) balance including inputs and similar data on products, recycling and waste streams~~ ~~o materials/product handling and transport including storage protocols~~			
	c) ~~Description of the pollution control devices and waste management system~~			
	d) Description of the operations and maintenance of facility			
I.6. Project Size *For EPRMP, include discussion/comparison of existing and proposed modifications or expansion*	a) ~~Total capacity / stock population/dimension (whichever is applicable based on screening parameter in the Guidelines for Coverage Screening per MC 2014-005)~~			
	b)Total Project Length in km.			
I.7. Development Plan, Description of Project Phases and Corresponding Timeframes For EPRMP, *discussions should be in the context of the proposed modification/changes*	Phases to be described in terms identifying specific activities (w/ special attention on those with significant environmental impacts as well as DRR/climate change adaptation options relevant to the project and project activities) and corresponding projected implementation timeframes: • ***Pre-construction*** (e.g. planning, acquisition of rights to use land, etc.) • ***Construction*** (e.g. land/site clearing, temporary housing, transport of materials, health and other services for the workforce, discussion of temporary facilities including the progress of works/milestones and the number workers required per milestones) • ***Operation*** (projected period of start-up/commissioning/full operation of various project components) include discussion on the operation of various components (as identified above) in terms of raw materials, fuel requirements, waste management and infrastructure requirements • ***Decommissioning/Abandonment/Rehabilitation*** - projected life of the project and alternatives for the future use of the project area which should be consistent with long term zoning and land use development plan of the municipality; - Abandonment Plan (general) to include management plan for the projected cumulative/long term project impacts such as remediation of contaminated soil and water resources, land restoration, proper dismantling/abandonment of facilities/ equipment and other necessary activities			

Page 5 of 22

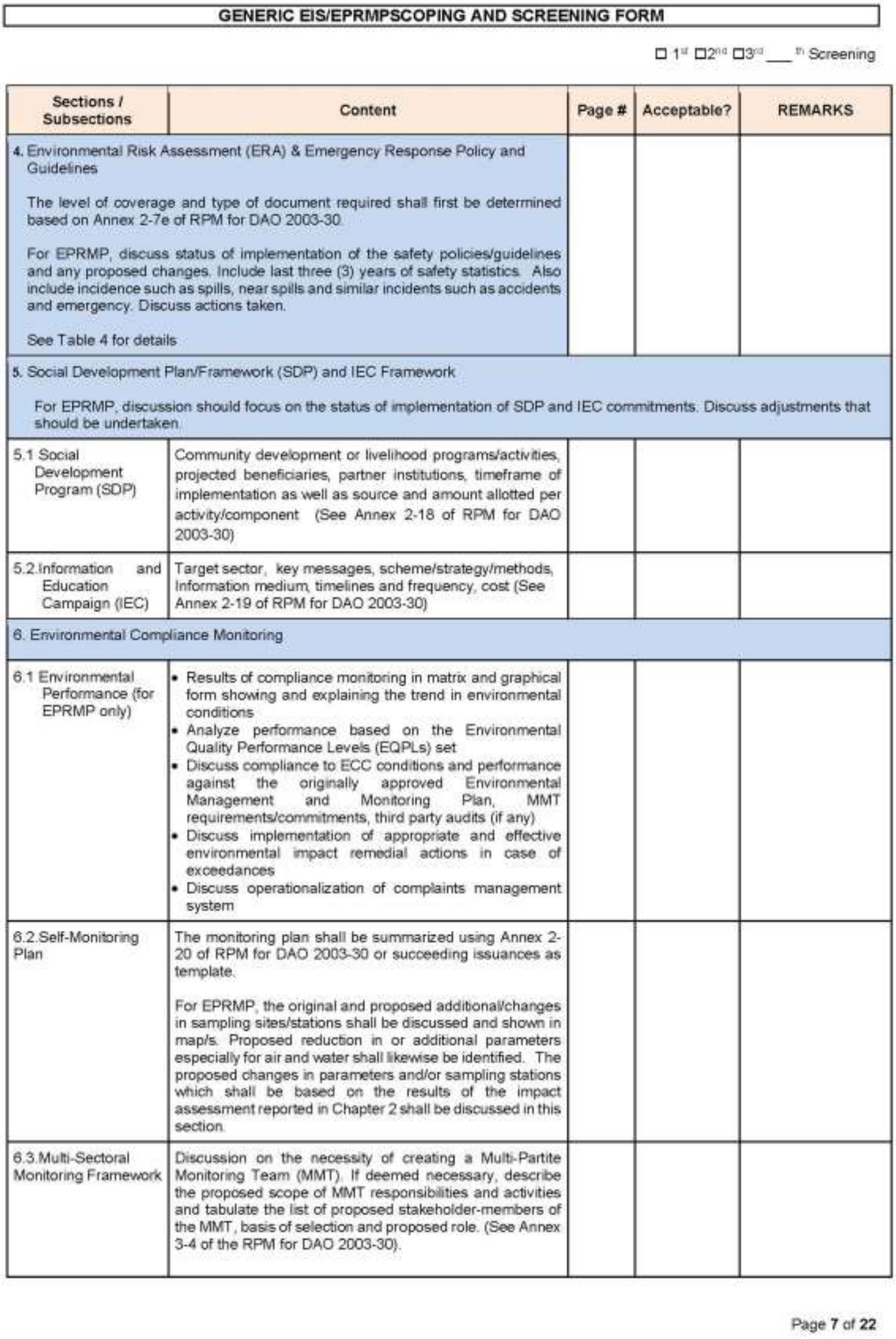


GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

☐ 1st ☐2nd ☐3rd ___ th Screening

Sections / Subsections	Content	Page #	Acceptable?	REMARKS
I.8. Manpower	Tabulate the following per project phase (pre-construction, construction, operation and maintenance): • manpower requirements; • expertise/skills needed; • nature & estimated number of jobs available for men, women, and indigenous peoples (if in IP ancestral land); • scheme for sourcing locally from host and neighboring LGUs			
I.9. Project Cost	Indicative Project Investment Cost (Philippine Peso)			
2. Assessment of Environmental Impacts See Table 3 for the list of key environmental impacts which shall be subjected to assessment. The assessment shall done using the prescribed approach/method and in relation to the corresponding baseline characterization in the primary and secondary impact areas (*as determined using the Guidelines in Annex 2-2 of the Revised Procedural Manual (RPM) for DAO 2003-30 or succeeding issuances*). The sampling and measurement plan used shall be discussed. Likewise, the assessment should be done for the various phases of development (i.e. pre-construction, construction and operation) and should consider climate change projections and disaster risks based on existing natural hazard information. For all maps, include overlays of project area footprint, show sensitive/critical receptors and sampling points for baseline data (indicate geographical coordinates). In conclusion, the residual and cumulative impacts shall be assessed. For EPRMP, the result of the proponent's monitoring shall be used as baseline. The assessment of environmental impacts of proposed modification shall be discussed in relation to the actual impacts of existing project operations which shall be presented from a summary of the results of compliance monitoring (in matrix and graphical form) as described in 6.1.				
3. Environmental Management Plan Appropriate mitigation/management measures should be specified for each of the identified key impacts (Table 3). Appropriate climate change adaptation and disaster risk reduction measures/options shall likewise be thoroughly discussed. The impact management plan should be summarized using at the minimum, the format in Annex 2-17 of RPM for DAO 2003-30 For EPRMP, the proposed impact management plan to be discussed shall consider review of performance of existing project based on the Environmental Quality Performance Levels (EQPLs) set. Also include change in adaptation measures / options and remediation of contaminated soil and water resources, land restoration proper dismantling, if any. During construction phase: ● Include all aspects of air pollution sources particularly dust control or mitigation. Consider road watering plan and water sprinkling on wheels of transport vehicles to avoid spreading of dust particles on the community roads. ● Provide mitigating measures on the inducement of flooding and the change in drainage morphology. ● Provide mitigating measures of the impact of sedimentation in surface water (if applicable) especially during inclement weather or typhoon. ● Include landslide prevention or risk reduction strategies - Dr. Maestrecampo				

Page 6 of 22

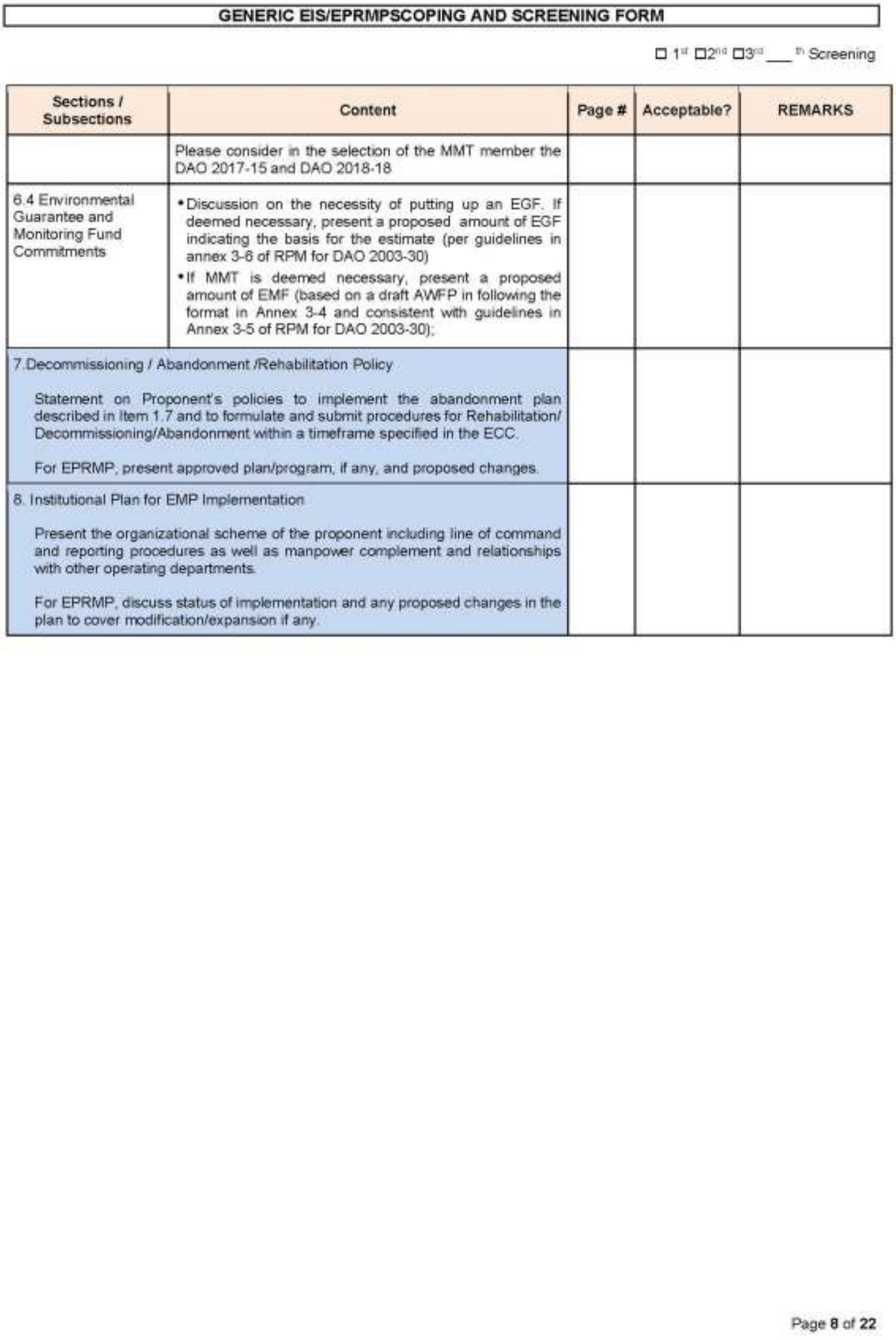


GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

☐ 1st ☐2nd ☐3rd ___ th Screening

Sections / Subsections	Content	Page #	Acceptable?	REMARKS
4. Environmental Risk Assessment (ERA) & Emergency Response Policy and Guidelines The level of coverage and type of document required shall first be determined based on Annex 2-7e of RPM for DAO 2003-30. For EPRMP, discuss status of implementation of the safety policies/guidelines and any proposed changes. Include last three (3) years of safety statistics. Also include incidence such as spills, near spills and similar incidents such as accidents and emergency. Discuss actions taken. See Table 4 for details				
5. Social Development Plan/Framework (SDP) and IEC Framework For EPRMP, discussion should focus on the status of implementation of SDP and IEC commitments. Discuss adjustments that should be undertaken				
5.1 Social Development Program (SDP)	Community development or livelihood programs/activities, projected beneficiaries, partner institutions, timeframe of implementation as well as source and amount allotted per activity/component (See Annex 2-18 of RPM for DAO 2003-30)			
5.2.Information and Education Campaign (IEC)	Target sector, key messages, scheme/strategy/methods, Information medium, timelines and frequency, cost (See Annex 2-19 of RPM for DAO 2003-30)			
6. Environmental Compliance Monitoring				
6.1 Environmental Performance (for EPRMP only)	• Results of compliance monitoring in matrix and graphical form showing and explaining the trend in environmental conditions • Analyze performance based on the Environmental Quality Performance Levels (EQPLs) set • Discuss compliance to ECC conditions and performance against the originally approved Environmental Management and Monitoring Plan, MMT requirements/commitments, third party audits (if any) • Discuss implementation of appropriate and effective environmental impact remedial actions in case of exceedances • Discuss operationalization of complaints management system			
6.2.Self-Monitoring Plan	The monitoring plan shall be summarized using Annex 2-20 of RPM for DAO 2003-30 or succeeding issuances as template. For EPRMP, the original and proposed additional/changes in sampling sites/stations shall be discussed and shown in map/s. Proposed reduction in or additional parameters especially for air and water shall likewise be identified. The proposed changes in parameters and/or sampling stations which shall be based on the results of the impact assessment reported in Chapter 2 shall be discussed in this section.			
6.3.Multi-Sectoral Monitoring Framework	Discussion on the necessity of creating a Multi-Partite Monitoring Team (MMT). If deemed necessary, describe the proposed scope of MMT responsibilities and activities and tabulate the list of proposed stakeholder-members of the MMT, basis of selection and proposed role. (See Annex 3-4 of the RPM for DAO 2003-30).			

Page 7 of 22

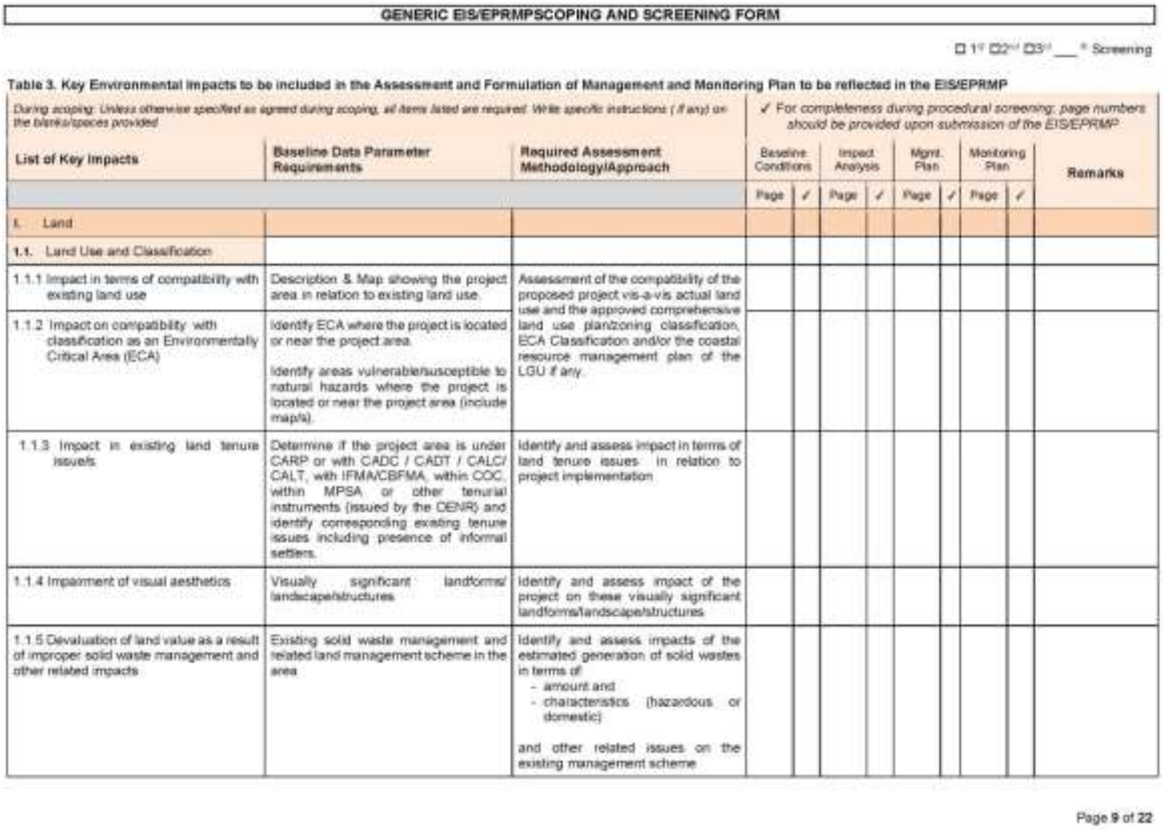


GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

☐ 1st ☐2nd ☐3rd ___ th Screening

Sections / Subsections	Content	Page #	Acceptable?	REMARKS
	Please consider in the selection of the MMT member the DAO 2017-15 and DAO 2018-18			
6.4 Environmental Guarantee and Monitoring Fund Commitments	• Discussion on the necessity of putting up an EGF. If deemed necessary, present a proposed amount of EGF indicating the basis for the estimate (per guidelines in annex 3-6 of RPM for DAO 2003-30) • If MMT is deemed necessary, present a proposed amount of EMF (based on a draft AWFP in following the format in Annex 3-4 and consistent with guidelines in Annex 3-5 of RPM for DAO 2003-30);			
7.Decommissioning / Abandonment /Rehabilitation Policy Statement on Proponent's policies to implement the abandonment plan described in Item 1.7 and to formulate and submit procedures for Rehabilitation/ Decommissioning/Abandonment within a timeframe specified in the ECC. For EPRMP, present approved plan/program, if any, and proposed changes.				
8. Institutional Plan for EMP Implementation Present the organizational scheme of the proponent including line of command and reporting procedures as well as manpower complement and relationships with other operating departments. For EPRMP, discuss status of implementation and any proposed changes in the plan to cover modification/expansion if any.				

Page 8 of 22



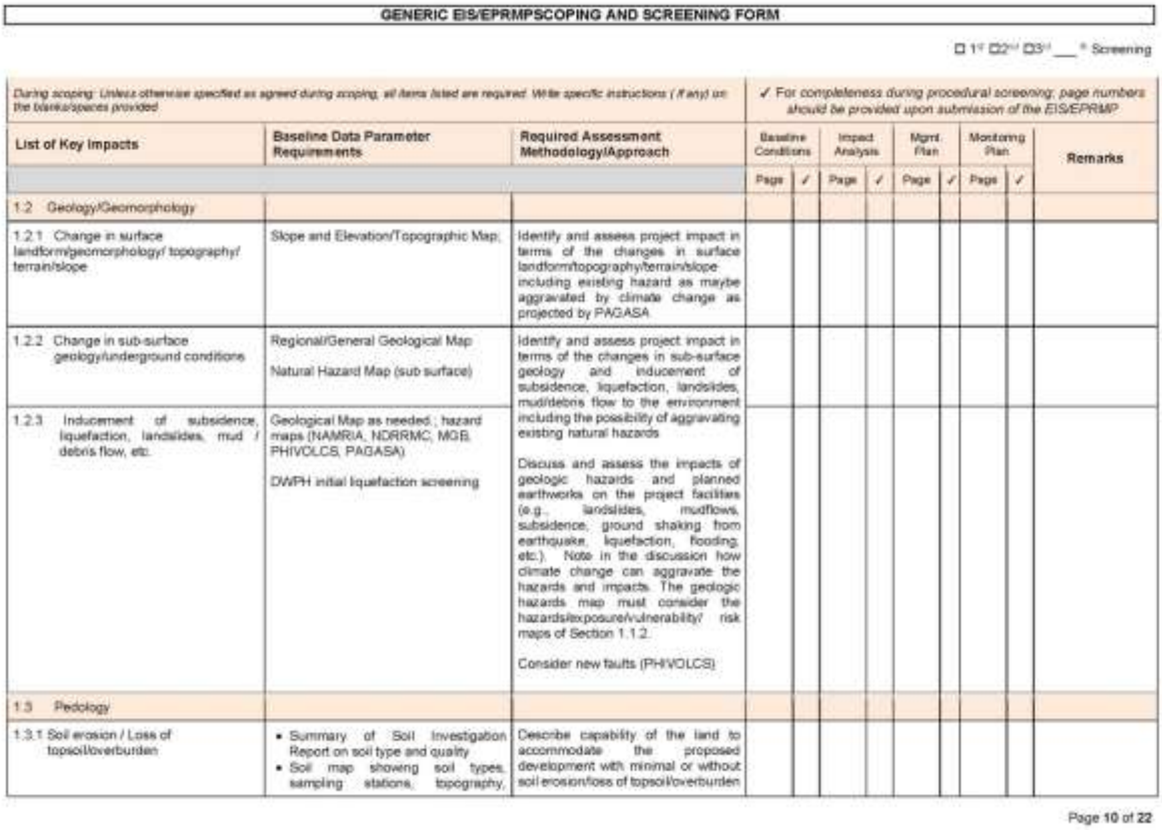
GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

☐ 1st ☐2nd ☐3rd ___th Screening

Table 3. Key Environmental Impacts to be included in the Assessment and Formulation of Management and Monitoring Plan to be reflected in the EIS/EPRMP

During scoping: Unless otherwise specified as agreed during scoping, all items listed are required. Write specific instructions (if any) on the blanks/spaces provided			*✓ For completeness during procedural screening; page numbers should be provided upon submission of the EIS/EPRMP*								
List of Key Impacts	**Baseline Data Parameter Requirements**	**Required Assessment Methodology/Approach**	Baseline Conditions		Impact Analysis		Mgmt. Plan		Monitoring Plan		**Remarks**
			Page	✓	Page	✓	Page	✓	Page	✓	
I. Land											
1.1. Land Use and Classification											
1.1.1 Impact in terms of compatibility with existing land use	Description & Map showing the project area in relation to existing land use.	Assessment of the compatibility of the proposed project vis-a-vis actual land use and the approved comprehensive land use plan/zoning classification, ECA Classification and/or the coastal resource management plan of the LGU if any.									
1.1.2 Impact on compatibility with classification as an Environmentally Critical Area (ECA)	Identify ECA where the project is located or near the project area. Identify areas vulnerable/susceptible to natural hazards where the project is located or near the project area (include map/s).										
1.1.3 Impact in existing land tenure issue/s	Determine if the project area is under CARP or with CADC / CADT / CALC/ CALT, with IFMA/CBFMA, within COC, within MPSA or other tenurial instruments (issued by the DENR) and identify corresponding existing tenure issues including presence of informal settlers.	Identify and assess impact in terms of land tenure issues in relation to project implementation									
1.1.4 Impairment of visual aesthetics	Visually significant landforms/ landscape/structures	Identify and assess impact of the project on these visually significant landforms/landscape/structures									
1.1.5 Devaluation of land value as a result of improper solid waste management and other related impacts	Existing solid waste management and related land management scheme in the area	Identify and assess impacts of the estimated generation of solid wastes in terms of - amount and - characteristics (hazardous or domestic) and other related issues on the existing management scheme									

Page 9 of 22



GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

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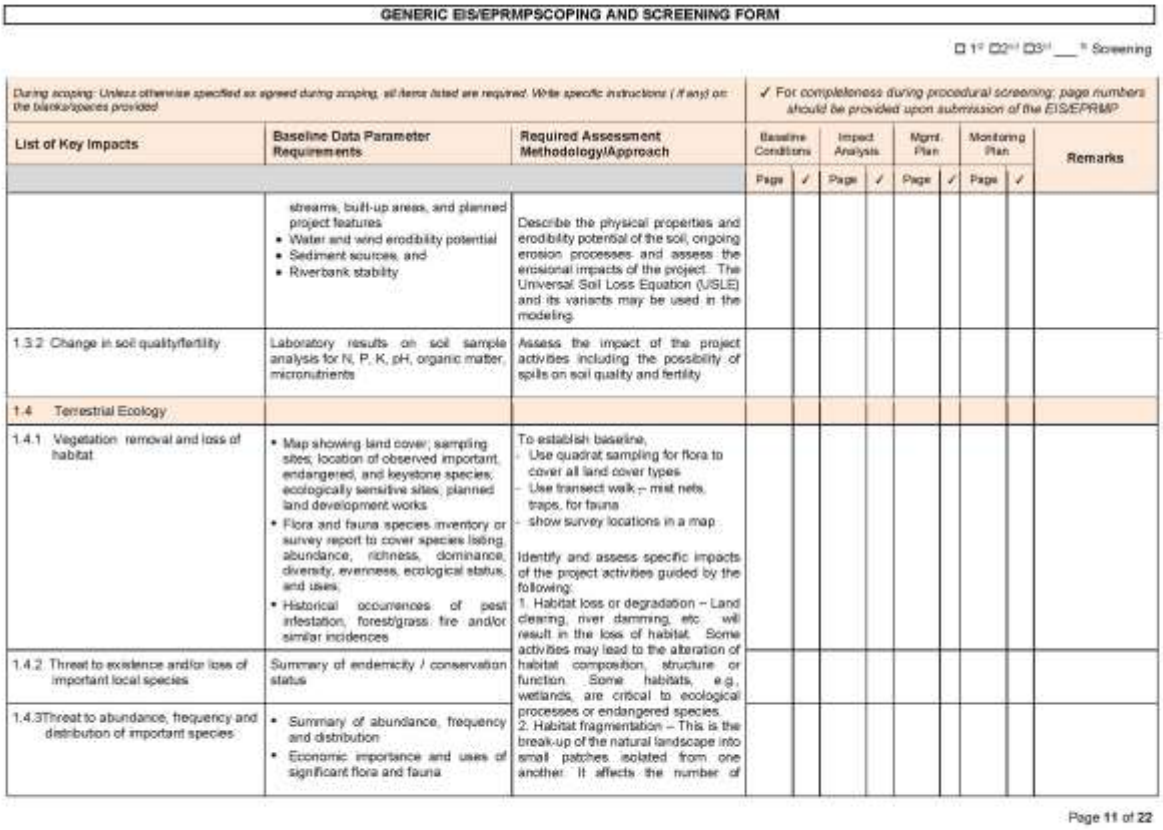
			Page	✓	Page	✓	Page	✓	Page	✓	
1.2 Geology/Geomorphology											
1.2.1 Change in surface landform/geomorphology/ topography/ terrain/slope	Slope and Elevation/Topographic Map;	Identify and assess project impact in terms of the changes in surface landform/topography/terrain/slope including existing hazard as maybe aggravated by climate change as projected by PAGASA									
1.2.2 Change in sub-surface geology/underground conditions	Regional/General Geological Map Natural Hazard Map (sub surface)	Identify and assess project impact in terms of the changes in sub-surface geology and inducement of subsidence, liquefaction, landslides, mud/debris flow to the environment including the possibility of aggravating existing natural hazards Discuss and assess the impacts of geologic hazards and planned earthworks on the project facilities (e.g., landslides, mudflows, subsidence, ground shaking from earthquake, liquefaction, flooding, etc.). Note in the discussion how climate change can aggravate the hazards and impacts. The geologic hazards map must consider the hazards/exposure/vulnerability/ risk maps of Section 1.1.2. Consider new faults (PHIVOLCS)									
1.2.3 Inducement of subsidence, liquefaction, landslides, mud / debris flow, etc.	Geological Map as needed.; hazard maps (NAMRIA, NDRRMC, MGB, PHIVOLCS, PAGASA) DWPH initial liquefaction screening										
1.3 Pedology											
1.3.1 Soil erosion / Loss of topsoil/overburden	• Summary of Soil Investigation Report on soil type and quality • Soil map showeng soil types, sampling stations, topography,	Describe capability of the land to accommodate the proposed development with minimal or without soil erosion/loss of topsoil/overburden									

Page 10 of 22



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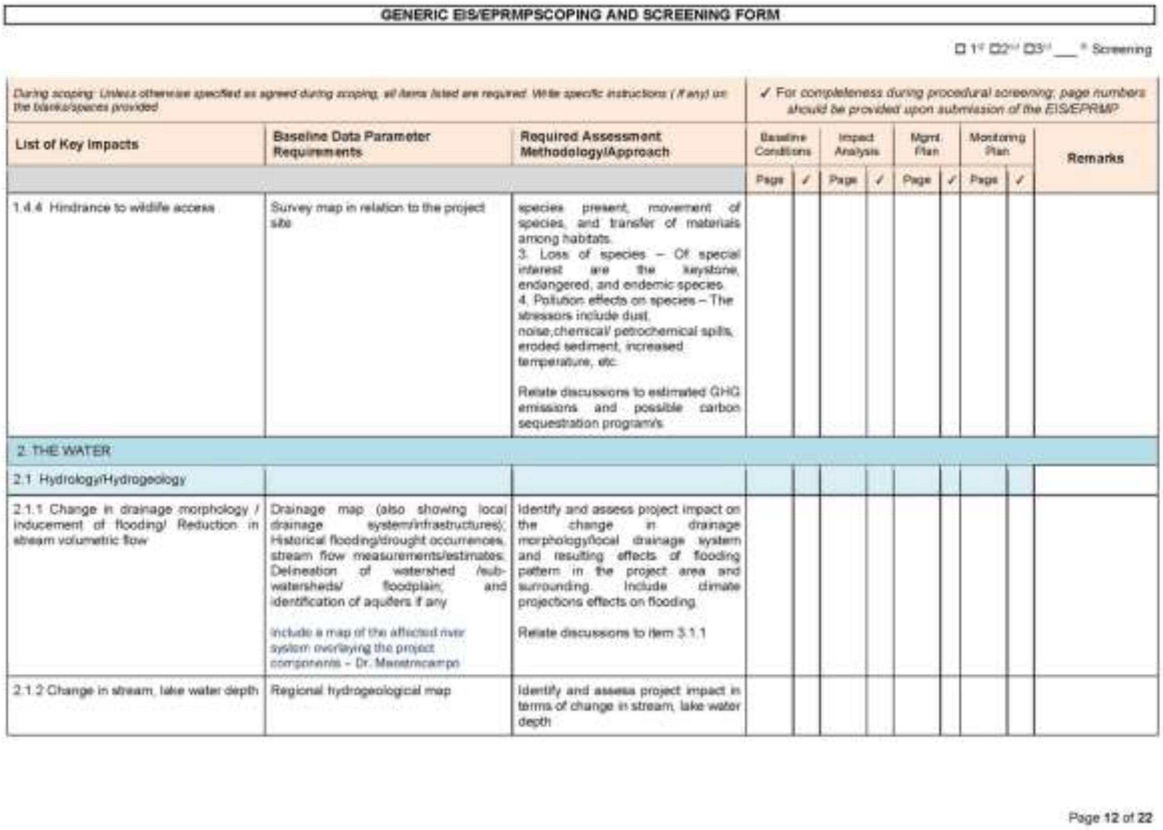
			Page	✓	Page	✓	Page	✓	Page	✓	
	streams, built-up areas, and planned project features • Water and wind erodibility potential • Sediment sources, and • Riverbank stability	Describe the physical properties and erodibility potential of the soil, ongoing erosion processes and assess the erosional impacts of the project. The Universal Soil Loss Equation (USLE) and its variants may be used in the modeling.									
1.3.2 Change in soil quality/fertility	Laboratory results on soil sample analysis for N, P, K, pH, organic matter, micronutrients	Assess the impact of the project activities including the possibility of spills on soil quality and fertility									
1.4 Terrestrial Ecology											
1.4.1 Vegetation removal and loss of habitat	• Map showing land cover; sampling sites; location of observed important, endangered, and keystone species; ecologically sensitive sites; planned land development works • Flora and fauna species inventory or survey report to cover species listing, abundance, richness, dominance, diversity, evenness, ecological status, and uses; • Historical occurrences of pest infestation, forest/grass fire and/or similar incidences	To establish baseline, - Use quadrat sampling for flora to cover all land cover types - Use transect walk – mist nets, traps, for fauna - show survey locations in a map Identify and assess specific impacts of the project activities guided by the following: 1. Habitat loss or degradation – Land clearing, river damming, etc. will result in the loss of habitat. Some activities may lead to the alteration of habitat composition, structure or function. Some habitats, e.g., wetlands, are critical to ecological processes or endangered species. 2. Habitat fragmentation – This is the break-up of the natural landscape into small patches isolated from one another. It affects the number of									
1.4.2 Threat to existence and/or loss of important local species	Summary of endemicity / conservation status										
1.4.3Threat to abundance, frequency and distribution of important species	• Summary of abundance, frequency and distribution • Economic importance and uses of significant flora and fauna										

Page 11 of 22



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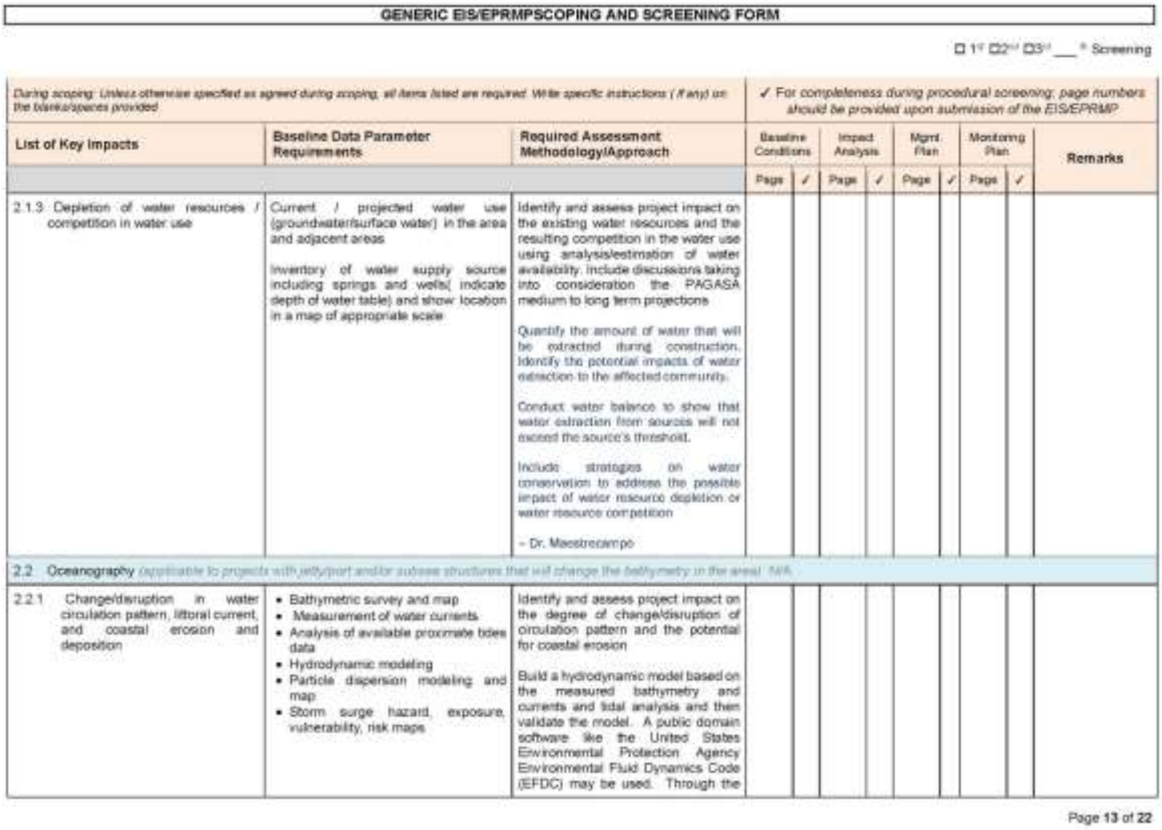
			Page	✓	Page	✓	Page	✓	Page	✓	
1.4.4 Hindrance to wildlife access	Survey map in relation to the project site	species present, movement of species, and transfer of materials among habitats. 3. Loss of species – Of special interest are the keystone, endangered, and endemic species. 4. Pollution effects on species – The stressors include dust, noise,chemical/ petrochemical spills, eroded sediment, increased temperature, etc. Relate discussions to estimated GHG emissions and possible carbon sequestration program/s									
2. THE WATER											
2.1 Hydrology/Hydrogeology											
2.1.1 Change in drainage morphology / inducement of flooding/ Reduction in stream volumetric flow	Drainage map (also showing local drainage system/infrastructures); Historical flooding/drought occurrences, stream flow measurements/estimates. Delineation of watershed /sub-watersheds/ floodplain; and identification of aquifers if any Include a map of the affected river system overlaying the project components – Dr. Mazatmacampo	Identify and assess project impact on the change in drainage morphology/local drainage system and resulting effects of flooding pattern in the project area and surrounding. Include climate projections effects on flooding. Relate discussions to item 3.1.1									
2.1.2 Change in stream, lake water depth	Regional hydrogeological map	Identify and assess project impact in terms of change in stream, lake water depth									

Page 12 of 22



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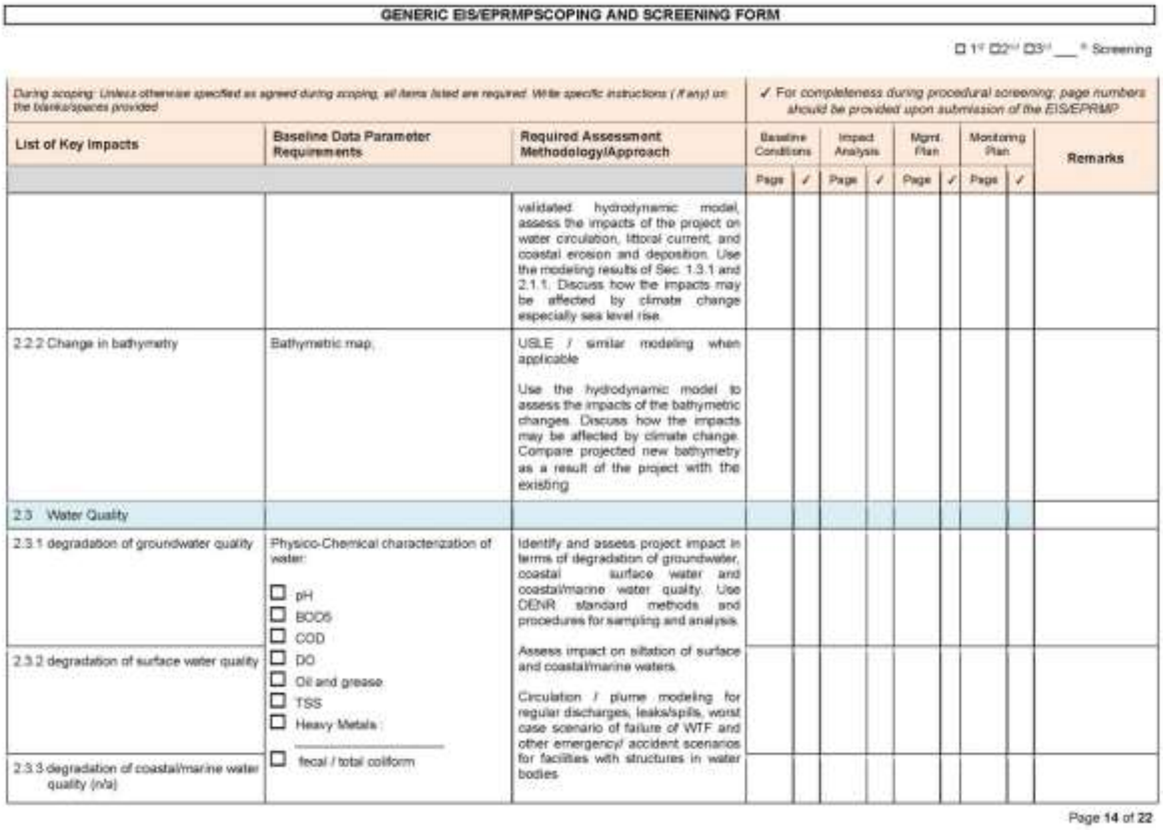
			Page	✓	Page	✓	Page	✓	Page	✓	
2.1.3 Depletion of water resources / competition in water use	Current / projected water use (groundwater/surface water) in the area and adjacent areas Inventory of water supply source including springs and wells(indicate depth of water table) and show location in a map of appropriate scale	Identify and assess project impact on the existing water resources and the resulting competition in the water use using analysis/estimation of water availability. Include discussions taking into consideration the PAGASA medium to long term projections Quantify the amount of water that will be extracted during construction. Identify the potential impacts of water extraction to the affected community. Conduct water balance to show that water extraction from sources will not exceed the source's threshold. Include strategies on water conservation to address the possible impact of water resource depletion or water resource competition - Dr. Maestrecampo									
2.2 Oceanography *(applicable to projects with jetty/port and/or subsea structures that will change the bathymetry in the area) N/A*											
2.2.1 Change/disruption in water circulation pattern, littoral current, and coastal erosion and deposition	• Bathymetric survey and map • Measurement of water currents • Analysis of available proximate tides data • Hydrodynamic modeling • Particle dispersion modeling and map • Storm surge hazard, exposure, vulnerability, risk maps	Identify and assess project impact on the degree of change/disruption of circulation pattern and the potential for coastal erosion Build a hydrodynamic model based on the measured bathymetry and currents and tidal analysis and then validate the model. A public domain software like the United States Environmental Protection Agency Environmental Fluid Dynamics Code (EFDC) may be used. Through the									

Page **13** of **22**



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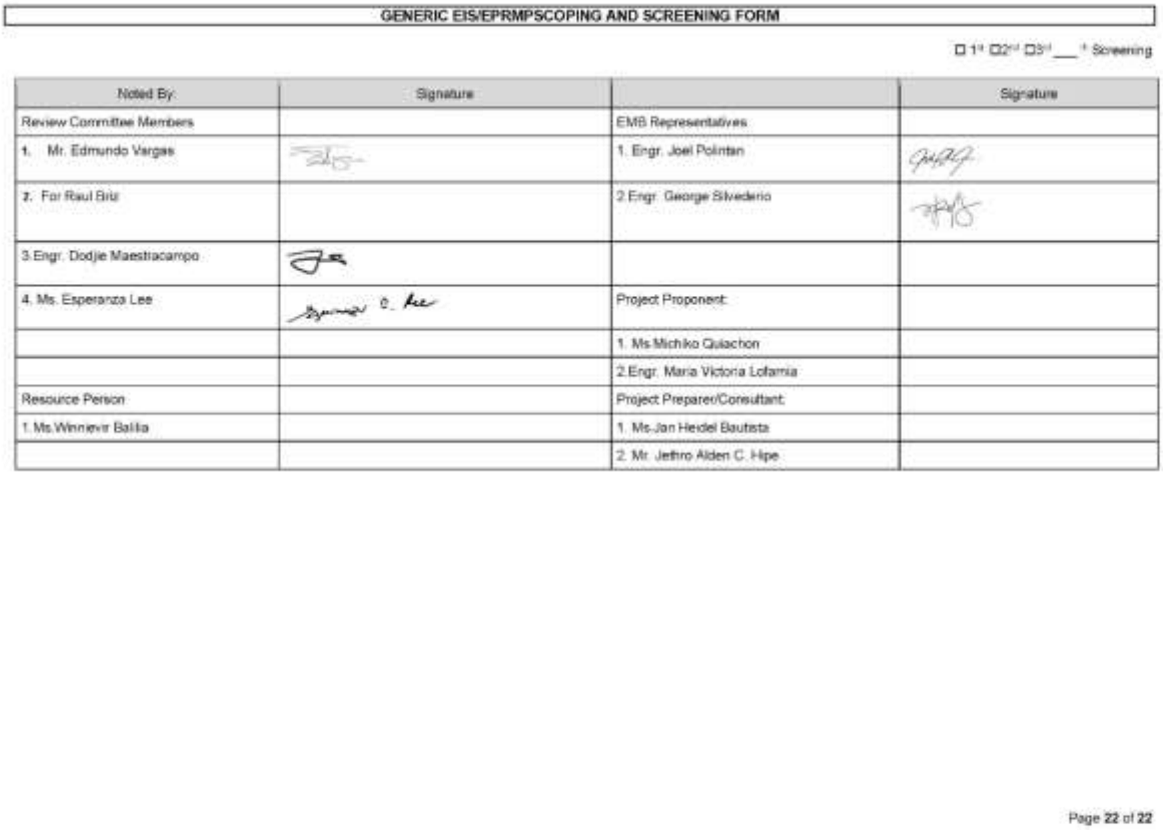
			Page	✓	Page	✓	Page	✓	Page	✓	
		validated hydrodynamic model, assess the impacts of the project on water circulation, littoral current, and coastal erosion and deposition. Use the modeling results of Sec. 1.3.1 and 2.1.1. Discuss how the impacts may be affected by climate change especially sea level rise.									
2.2.2 Change in bathymetry	Bathymetric map;	USLE / similar modeling when applicable Use the hydrodynamic model to assess the impacts of the bathymetric changes. Discuss how the impacts may be affected by climate change. Compare projected new bathymetry as a result of the project with the existing									
2.3 Water Quality											
2.3.1 degradation of groundwater quality	Physico-Chemical characterization of water: ☐ pH ☐ BOD5 ☐ COD ☐ DO ☐ Oil and grease ☐ TSS ☐ Heavy Metals : ____________ ☐ fecal / total coliform	Identify and assess project impact in terms of degradation of groundwater, coastal surface water and coastal/marine water quality. Use DENR standard methods and procedures for sampling and analysis. Assess impact on siltation of surface and coastal/marine waters. Circulation / plume modeling for regular discharges, leaks/spills, worst case scenario of failure of WTF and other emergency/ accident scenarios for facilities with structures in water bodies									
2.3.2 degradation of surface water quality											
2.3.3 degradation of coastal/marine water quality (n/a)											

Page **14** of **22**



GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

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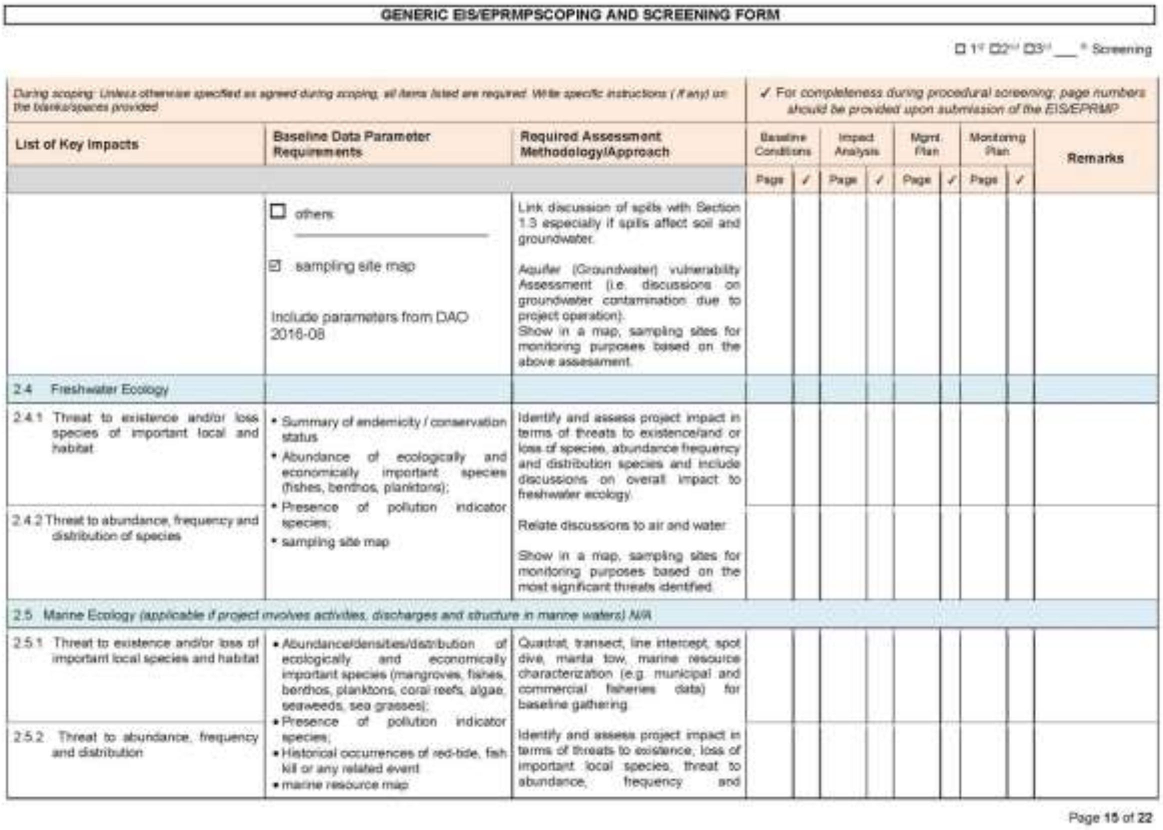
Noted By:	Signature		Signature
Review Committee Members		EMB Representatives	
1. Mr. Edmundo Vargas		1. Engr. Joel Polintan	
2. For Raul Briz		2.Engr. George Silvederio	
3.Engr. Dodjie Maestracampo			
4. Ms. Esperanza Lee		Project Proponent:	
		1. Ms.Michiko Quiachon	
		2.Engr. Maria Victoria Lofamia	
Resource Person		Project Preparer/Consultant:	
1.Ms.Winnievir Balila		1. Ms.Jan Heidel Bautista	
		2. Mr. Jethro Alden C. Hipe	

Page **22** of **22**



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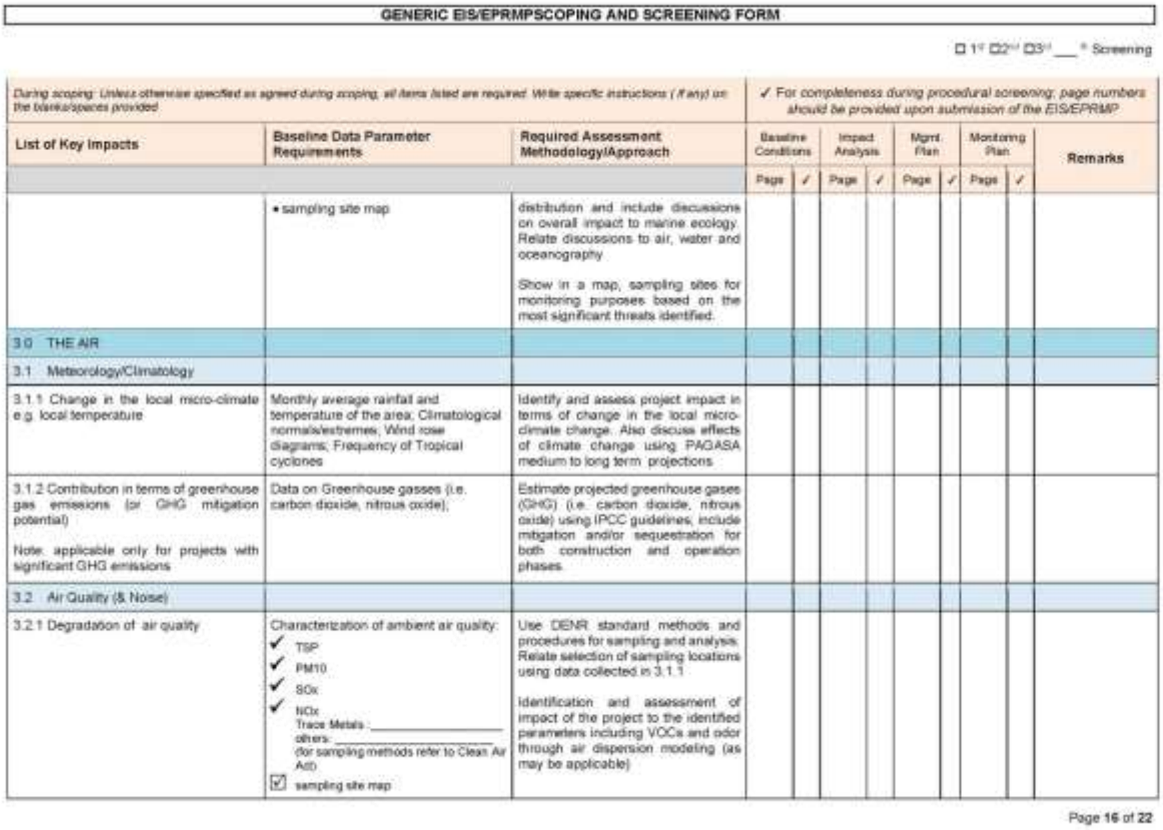
			Page	✓	Page	✓	Page	✓	Page	✓	
	☐ others ________ ☑ sampling site map Include parameters from DAO 2016-08	Link discussion of spills with Section 1.3 especially if spills affect soil and groundwater. Aquifer (Groundwater) vulnerability Assessment (i.e. discussions on groundwater contamination due to project operation). Show in a map, sampling sites for monitoring purposes based on the above assessment.									
2.4 Freshwater Ecology											
2.4.1 Threat to existence and/or loss species of important local and habitat	• Summary of endemicity / conservation status • Abundance of ecologically and economically important species (fishes, benthos, planktons); • Presence of pollution indicator species; • sampling site map	Identify and assess project impact in terms of threats to existence/and or loss of species, abundance frequency and distribution species and include discussions on overall impact to freshwater ecology.									
2.4.2 Threat to abundance, frequency and distribution of species		Relate discussions to air and water. Show in a map, sampling sites for monitoring purposes based on the most significant threats identified.									
2.5 Marine Ecology *(applicable if project involves activities, discharges and structure in marine waters) N/A*											
2.5.1 Threat to existence and/or loss of important local species and habitat	• Abundance/densities/distribution of ecologically and economically important species (mangroves, fishes, benthos, planktons, coral reefs, algae, seaweeds, sea grasses); • Presence of pollution indicator species; • Historical occurrences of red-tide, fish kill or any related event • marine resource map	Quadrat, transect, line intercept, spot dive, manta tow, marine resource characterization (e.g. municipal and commercial fisheries data) for baseline gathering.									
2.5.2 Threat to abundance, frequency and distribution		Identify and assess project impact in terms of threats to existence, loss of important local species, threat to abundance, frequency and									

Page **15** of **22**



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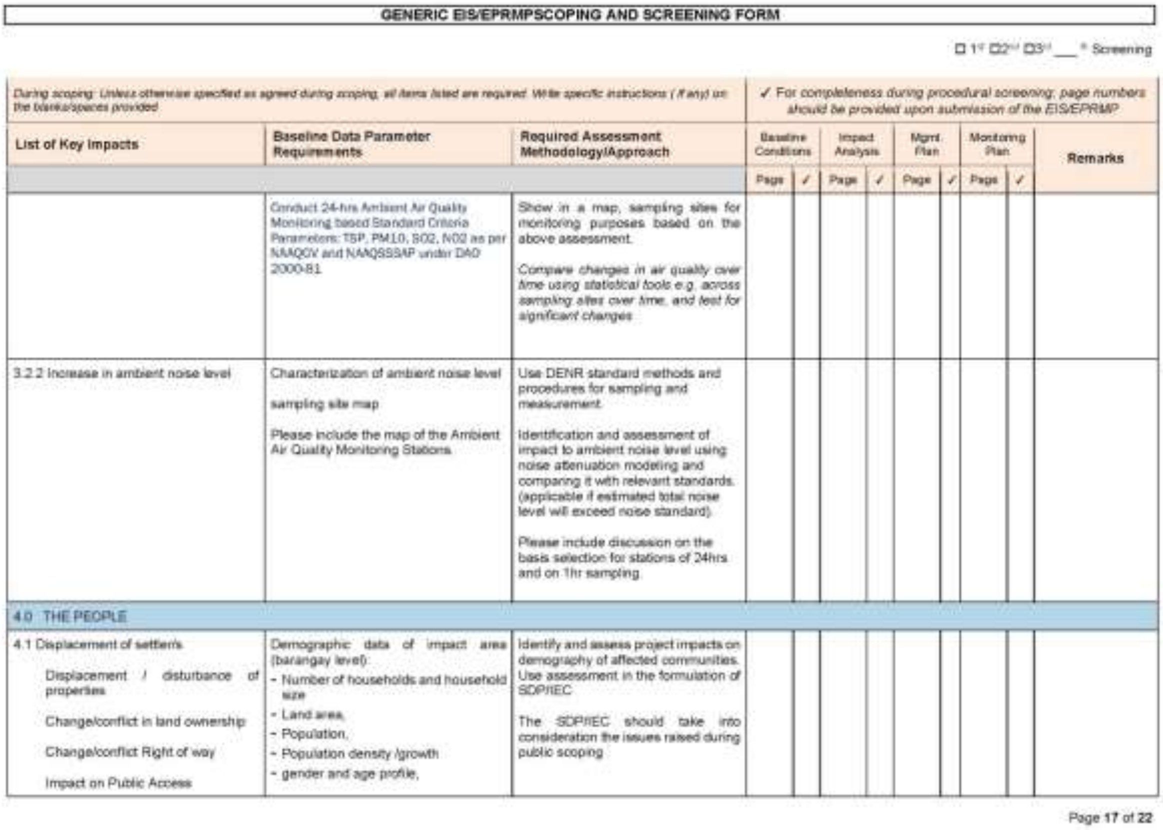
			Page	✓	Page	✓	Page	✓	Page	✓	
	• sampling site map	distribution and include discussions on overall impact to marine ecology. Relate discussions to air, water and oceanography Show in a map, sampling sites for monitoring purposes based on the most significant threats identified.									
3.0 THE AIR											
3.1 Meteorology/Climatology											
3.1.1 Change in the local micro-climate e.g. local temperature	Monthly average rainfall and temperature of the area; Climatological normals/extremes; Wind rose diagrams; Frequency of Tropical cyclones	Identify and assess project impact in terms of change in the local micro-climate change. Also discuss effects of climate change using PAGASA medium to long term projections									
3.1.2 Contribution in terms of greenhouse gas emissions (or GHG mitigation potential) Note: applicable only for projects with significant GHG emissions	Data on Greenhouse gasses (i.e. carbon dioxide, nitrous oxide);	Estimate projected greenhouse gases (GHG) (i.e. carbon dioxide, nitrous oxide) using IPCC guidelines; include mitigation and/or sequestration for both construction and operation phases.									
3.2 Air Quality (& Noise)											
3.2.1 Degradation of air quality	Characterization of ambient air quality: ✓ TSP ✓ PM10 ✓ SOx ✓ NOx Trace Metals : ________________ others: ________________ (for sampling methods refer to Clean Air Act) ☑ sampling site map	Use DENR standard methods and procedures for sampling and analysis; Relate selection of sampling locations using data collected in 3.1.1 Identification and assessment of impact of the project to the identified parameters including VOCs and odor through air dispersion modeling (as may be applicable)									

Page **16** of **22**



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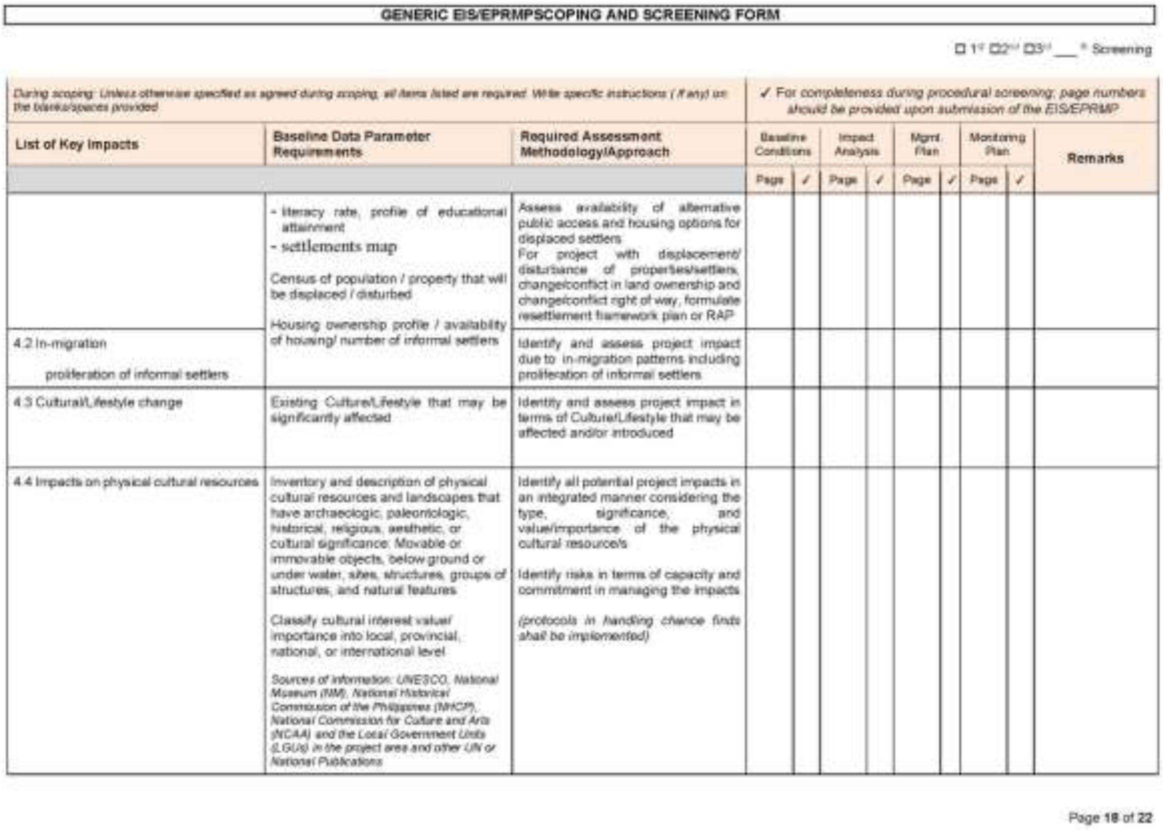
	Conduct 24-hrs Ambient Air Quality Monitoring based Standard Criteria Parameters: TSP, PM10, SO2, NO2 as per NAAQGV and NAAQSSSAP under DAO 2000-81	Show in a map, sampling sites for monitoring purposes based on the above assessment. *Compare changes in air quality over time using statistical tools e.g. across sampling sites over time, and test for significant changes*									
3.2.2 Increase in ambient noise level	Characterization of ambient noise level sampling site map Please include the map of the Ambient Air Quality Monitoring Stations.	Use DENR standard methods and procedures for sampling and measurement. Identification and assessment of impact to ambient noise level using noise attenuation modeling and comparing it with relevant standards. (applicable if estimated total noise level will exceed noise standard). Please include discussion on the basis selection for stations of 24hrs and on 1hr sampling.									
4.0 THE PEOPLE											
4.1 Displacement of settler/s Displacement / disturbance of properties Change/conflict in land ownership Change/conflict Right of way Impact on Public Access	Demographic data of impact area (barangay level): - Number of households and household size - Land area, - Population, - Population density /growth - gender and age profile,	Identify and assess project impacts on demography of affected communities. Use assessment in the formulation of SDP/IEC The SDP/IEC should take into consideration the issues raised during public scoping									

Page **17** of **22**



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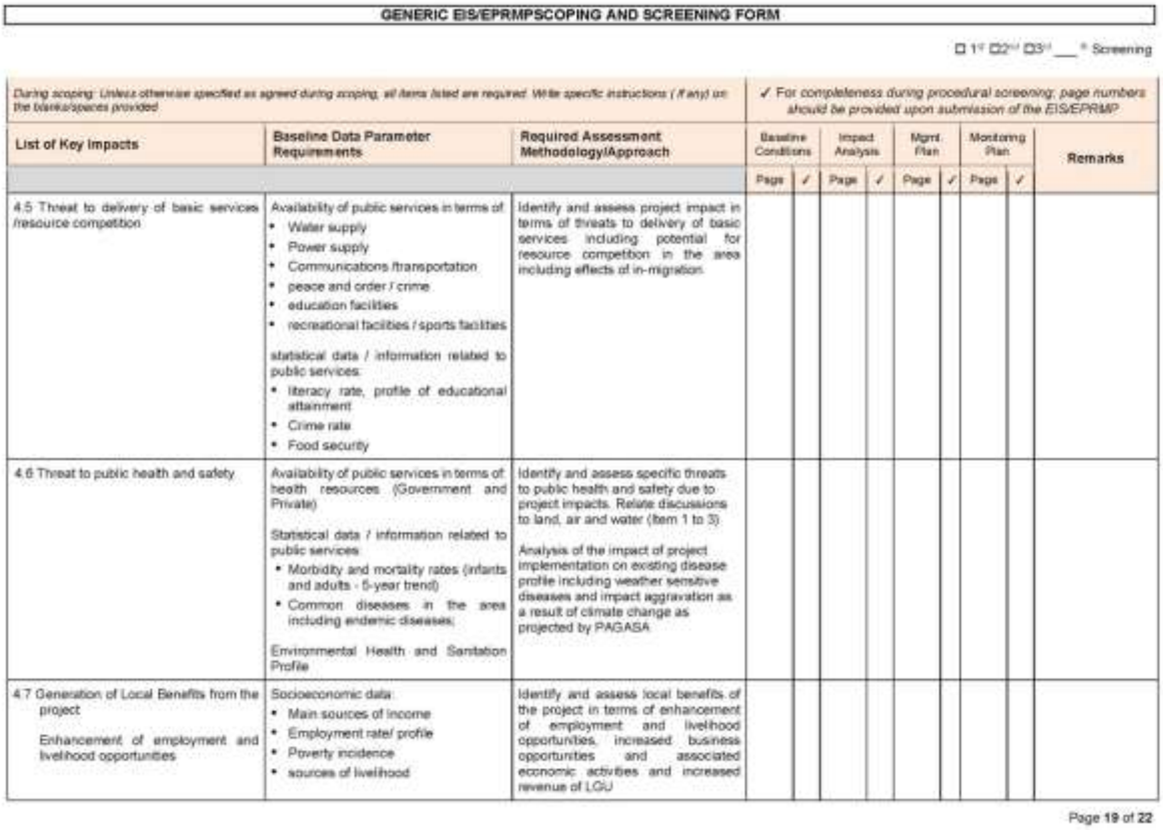
			Page	✓	Page	✓	Page	✓	Page	✓	
	- literacy rate, profile of educational attainment - settlements map Census of population / property that will be displaced / disturbed Housing ownership profile / availability of housing/ number of informal settlers	Assess availability of alternative public access and housing options for displaced settlers For project with displacement/ disturbance of properties/settlers, change/conflict in land ownership and change/conflict right of way, formulate resettlement framework plan or RAP									
4.2 In-migration proliferation of informal settlers		Identify and assess project impact due to in-migration patterns including proliferation of informal settlers									
4.3 Cultural/Lifestyle change	Existing Culture/Lifestyle that may be significantly affected	Identify and assess project impact in terms of Culture/Lifestyle that may be affected and/or introduced									
4.4 Impacts on physical cultural resources	Inventory and description of physical cultural resources and landscapes that have archaeologic, paleontologic, historical, religious, aesthetic, or cultural significance: Movable or immovable objects, below ground or under water, sites, structures, groups of structures, and natural features Classify cultural interest value/ importance into local, provincial, national, or international level *Sources of information: UNESCO, National Museum (NM), National Historical Commission of the Philippines (NHCP), National Commission for Culture and Arts (NCAA) and the Local Government Units (LGUs) in the project area and other UN or National Publications*	Identify all potential project impacts in an integrated manner considering the type, significance, and value/importance of the physical cultural resource/s Identify risks in terms of capacity and commitment in managing the impacts *(protocols in handling chance finds shall be implemented)*									

Page 18 of 22



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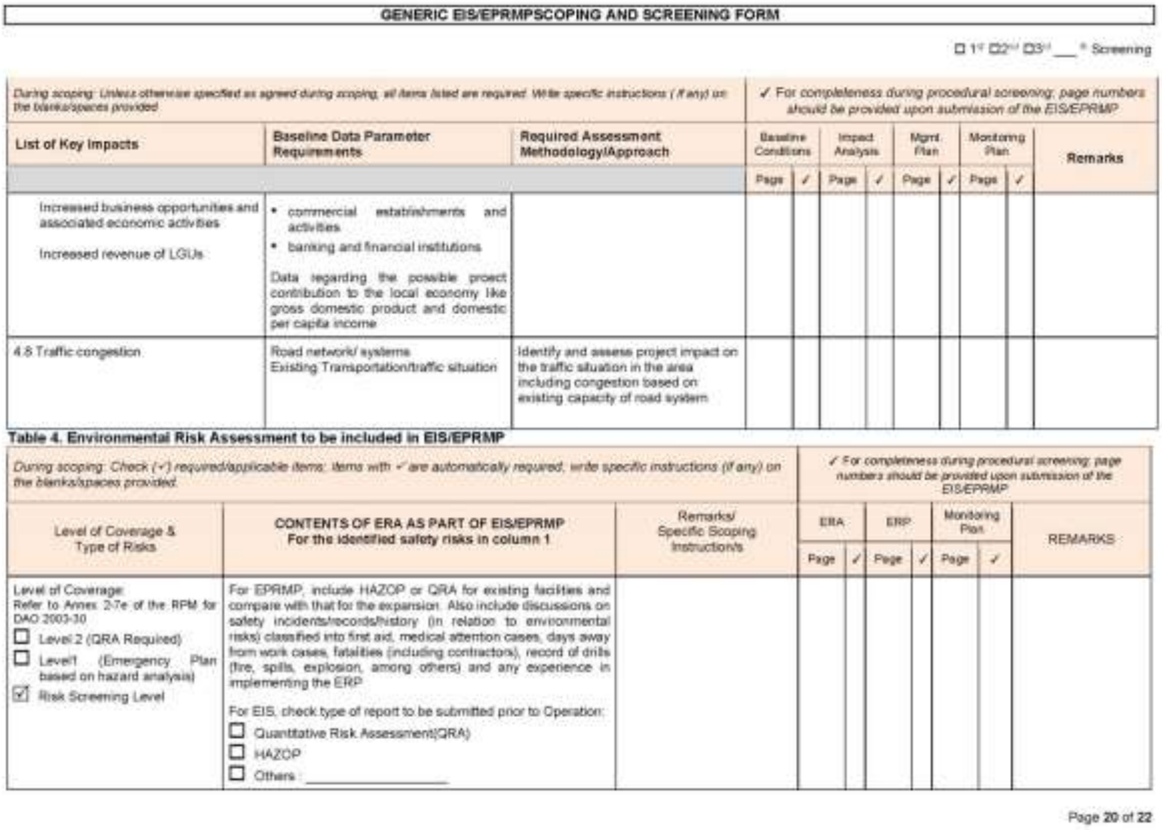
			Page	✓	Page	✓	Page	✓	Page	✓	
4.5 Threat to delivery of basic services /resource competition	Availability of public services in terms of: • Water supply • Power supply • Communications /transportation • peace and order / crime • education facilities • recreational facilities / sports facilities statistical data / information related to public services: • literacy rate, profile of educational attainment • Crime rate • Food security	Identify and assess project impact in terms of threats to delivery of basic services including potential for resource competition in the area including effects of in-migration									
4.6 Threat to public health and safety	Availability of public services in terms of: health resources (Government and Private) Statistical data / information related to public services: • Morbidity and mortality rates (infants and adults - 5-year trend) • Common diseases in the area including endemic diseases; Environmental Health and Sanitation Profile	Identify and assess specific threats to public health and safety due to project impacts. Relate discussions to land, air and water (Item 1 to 3) Analysis of the impact of project implementation on existing disease profile including weather sensitive diseases and impact aggravation as a result of climate change as projected by PAGASA									
4.7 Generation of Local Benefits from the project Enhancement of employment and livelihood opportunities	Socioeconomic data: • Main sources of income • Employment rate/ profile • Poverty incidence • sources of livelihood	Identify and assess local benefits of the project in terms of enhancement of employment and livelihood opportunities, increased business opportunities and associated economic activities and increased revenue of LGU									

Page 19 of 22



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			Page	✓	Page	✓	Page	✓	Page	✓	
Increased business opportunities and associated economic activities Increased revenue of LGUs	• commercial establishments and activities • banking and financial institutions Data regarding the possible project contribution to the local economy like gross domestic product and domestic per capita income										
4.8 Traffic congestion	Road network/ systems Existing Transportation/traffic situation	Identify and assess project impact on the traffic situation in the area including congestion based on existing capacity of road system									

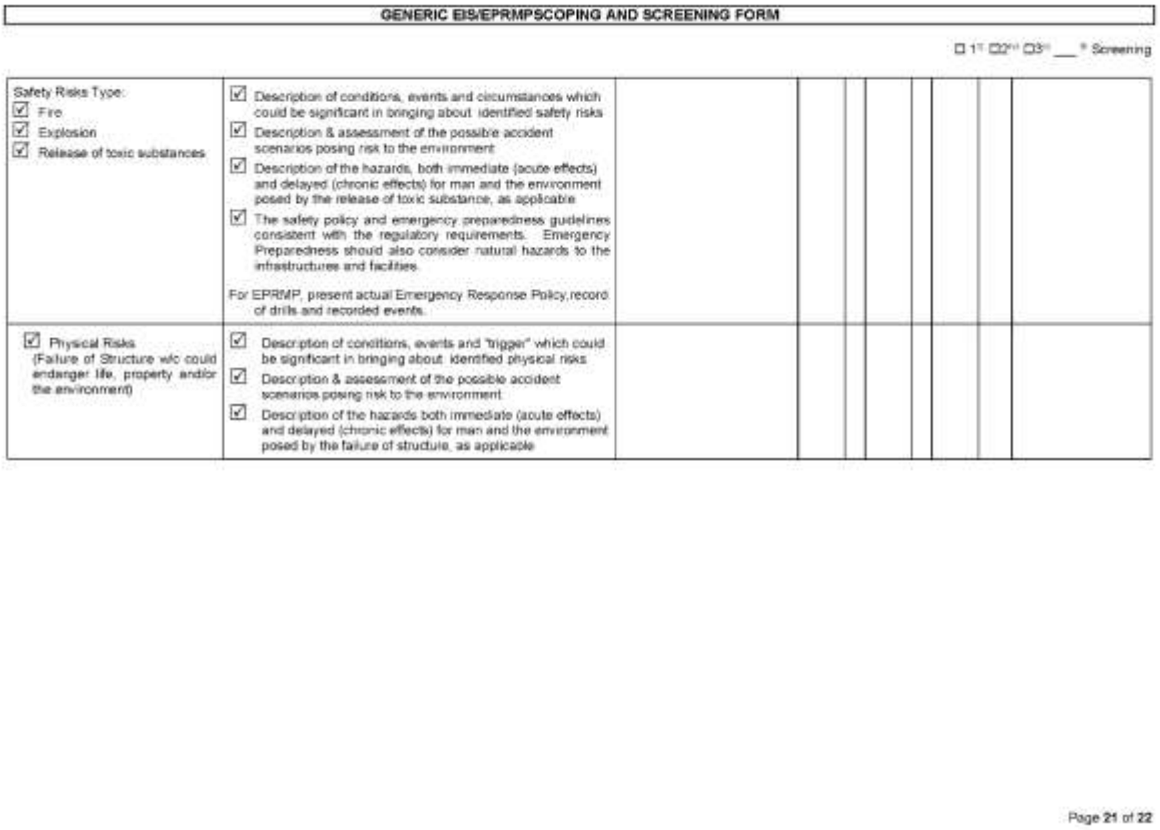
Table 4. Environmental Risk Assessment to be included in EIS/EPRMP

During scoping: Check (✓) required/applicable items; items with ✓ are automatically required; write specific instructions (if any) on the blanks/spaces provided.

✓ For completeness during procedural screening: page numbers should be provided upon submission of the EIS/EPRMP

Level of Coverage & Type of Risks	CONTENTS OF ERA AS PART OF EIS/EPRMP For the identified safety risks in column 1	Remarks/ Specific Scoping Instruction/s	ERA		ERP		Monitoring Plan		REMARKS
			Page	✓	Page	✓	Page	✓	
Level of Coverage: Refer to Annex 2-7e of the RPM for DAO 2003-30 ☐ Level 2 (QRA Required) ☐ Level1 (Emergency Plan based on hazard analysis) ☑ Risk Screening Level	For EPRMP, include HAZOP or QRA for existing facilities and compare with that for the expansion. Also include discussions on safety incidents/records/history (in relation to environmental risks) classified into first aid, medical attention cases, days away from work cases, fatalities (including contractors), record of drills (fire, spills, explosion, among others) and any experience in implementing the ERP For EIS, check type of report to be submitted prior to Operation: ☐ Quantitative Risk Assessment(QRA) ☐ HAZOP ☐ Others : _______________								

Page 20 of 22

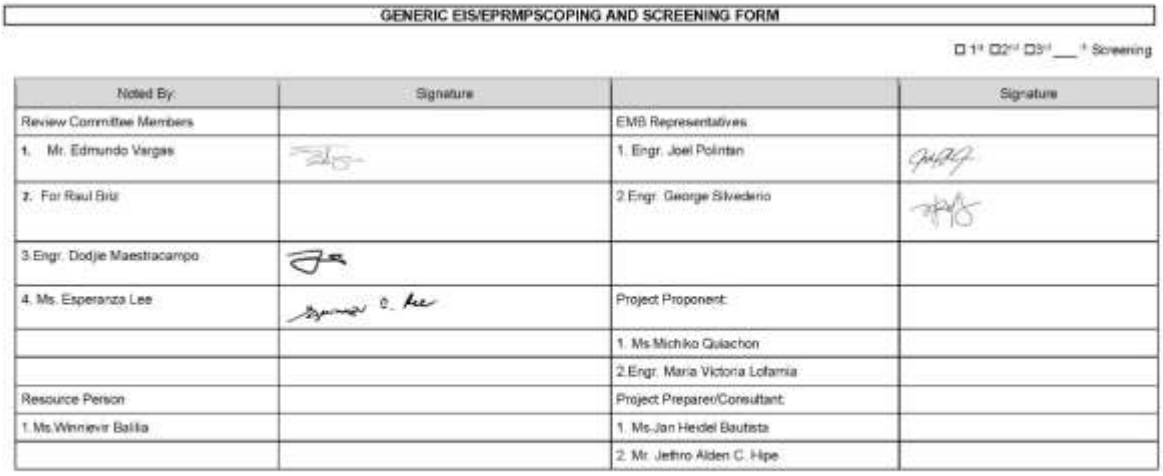


GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

☐ 1st ☐2nd ☐3rd ___ th Screening

Safety Risks Type: ☑ Fire ☑ Explosion ☑ Release of toxic substances	☑ Description of conditions, events and circumstances which could be significant in bringing about identified safety risks ☑ Description & assessment of the possible accident scenarios posing risk to the environment ☑ Description of the hazards, both immediate (acute effects) and delayed (chronic effects) for man and the environment posed by the release of toxic substance, as applicable ☑ The safety policy and emergency preparedness guidelines consistent with the regulatory requirements. Emergency Preparedness should also consider natural hazards to the infrastructures and facilities. For EPRMP, present actual Emergency Response Policy,record of drills and recorded events.								
☑ Physical Risks (Failure of Structure w/c could endanger life, property and/or the environment)	☑ Description of conditions, events and "trigger" which could be significant in bringing about identified physical risks ☑ Description & assessment of the possible accident scenarios posing risk to the environment ☑ Description of the hazards both immediate (acute effects) and delayed (chronic effects) for man and the environment posed by the failure of structure, as applicable								

Page 21 of 22



GENERIC EIS/EPRMPSCOPING AND SCREENING FORM

☐ 1st ☐2nd ☐3rd ___th Screening

Noted By:	Signature		Signature
Review Committee Members		EMB Representatives	
1. Mr. Edmundo Vargas		1. Engr. Joel Polintan	
2. For Raul Briz		2.Engr. George Silvederio	
3.Engr. Dodjie Maestracampo			
4. Ms. Esperanza Lee		Project Proponent:	
		1. Ms.Michiko Quiachon	
		2.Engr. Maria Victoria Lofamia	
Resource Person		Project Preparer/Consultant:	
1.Ms.Winnievir Balila		1. Ms.Jan Heidel Bautista	
		2. Mr. Jethro Alden C. Hipe	

Page 22 of 22